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LONGEVITY OF PACIFIC SEABIRDS

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Between 1937 and 1951 George C. Munro and others banded large numbers of seabirds in the Hawaiian Island Chain, the Phoenix Islands, the "Equatorial" Islands (a term Mr. Munro used for the Line Islands plus Howland and Baker Islands), and the Wake Island group. Recovery data from the banding project are still being received by the Hawaii Audubon Society through the Bird Banding Laboratory of the U.S. Fish & Wildlife Service. The data are kept on index cards housed at the Pacific Science Institute of the Bernice P. Bishop Museum. While entering recovery data on the cards I became interested in the longevity of seabirds. This report is a compilation of the recovery data through 1973, and is based on a longer report I prepared as a class project for Professor Andrew J. Berger at the University of Hawaii. A copy of the longer report is filed with the banding records at the Bishop Museum.

Studying seabird longevity presents a number of special problems. The most efficient way to band, and subsequently to recover, large numbers of seabirds is to capture them at their breeding sites. Since breeding colonies are scattered over vast distances in the Pacific, travel between the colonies to band birds and recover previously banded birds is both time-consuming and expensive. Since time and money for such work are usually limited, banding projects in the Pacific have often been short term and narrow in scope. The additional problems generated by the Second World War gravely disrupted the study of seabirds throughout the Pacific for many years. Despite these difficulties, Mr. Munro and his co-workers banded a remarkable number of birds during the fifteen-year period covered by this report.

Another obstacle to getting recovery data from seabirds is loss of bands. Seawater has a corrosive effect on the aluminum bands used to tag the birds. When combined with the abrasive effects of digging a nesting cavity, as in some shearwaters and petrels, band losses can be very high. The lack of returns among the burrow-nesting species for any period greater than three years after banding can probably be attributed to this corrosion/abrasion effect.

If banders return to breeding colonies and replace worn bands, as Dr. Harvey I. Fisher has been doing on Midway, less data are lost. Some of the Laysan Albatrosses on Midway are wearing their third band as old bands have been replaced. Offsetting the difficulties involved in banding Pacific seabirds, is the advantage of numbers. The density of seabirds in nesting colonies is phenomenal. Hundreds of birds can be banded at one time, which greatly increases the chances of getting recovery data.

The species summaries below are based on band numbers for which there is a banding date and a species designation. The records are not always complete for a number of reasons, including record and band losses during WW II, and the partial destruction of the Bird Banding Laboratory files by fire.

Because birds of different ages were banded the listed age is a minimum one. For example, an adult booby banded in May, 1939, and recovered in August, 1950, is listed as being at least eleven years old. In fact, such an individual is probably at least thirteen years old because boobies reach maturity at between two and three years of age.

A recovery represents only a single point in the life of a banded bird, but from many individual recoveries we can learn a great deal about the potential life span of a

bird species. Most individuals, however, don't even approach the maximum potential age for their species. Some die between hatching and fledging, others between fledging and maturity, and the rest during their adult years.

A large number of recoveries over a long period of time have been recorded for the two albatrosses and the Red-footed Booby. From this data a rough mortality curve (a statistical representation of the probability a given individual will survive a given number of years) can be constructed for these three species. The "adjusted return" figure reflects the number of individuals known to be alive each successive year after banding, whether or not the bird was recovered in any given year.

Here, then, is a summary of each species banded with some comments on longevity and mortality.

Albatrosses: Black-footed Albatross (Diomedea nigripes)--1742 individuals were banded on Sand and Eastern Islands at Midway; there have been 273 recoveries. Ten percent of the birds are known to have survived one year after being banded. At least 53 birds survived for ten years; the record is currently held by bird #40-721648 which was recovered 27 years after being banded. Plotting the adjusted returns gives an exponential curve: an albatross of this species has a very low chance of surviving as a young bird, but once it has managed to live for ten years its chances of surviving each additional year are fairly high.

Laysan Albatross (Diomedea immutabilis)--1712 birds were banded on Sand and Eastern Islands at Midway; there have been 491 recoveries. Twenty-one percent of the birds are known to have survived one year after being banded. At least 158 birds survived for ten years; the record is currently held by birds #40-721857 and #40-721864 which were both recovered 27 years after being banded. Plotting the adjusted returns gives an exponential curve, but the curve is shifted further to the right, indicating that this species may live about five years longer on the average than its relative, the Black-footed Albatross. There are several objections to this hypothesis which can only be resolved by future returns.

Shearwaters & Petrels: Wedge-tailed Shearwater (Puffinus pacificus)--6200 individuals were banded at Ulupau Head, Popoia, Kaohikaipu, Mokulii, Manana, Mokulua, and Kapapa in the main Hawaiian Islands, on Sand and Eastern Islands at Midway, and on Jarvis Island in the "Equatorial" Islands. There have been 959 recoveries, all of them within three years after the banding date.

Audubon's Shearwater (Puffinus lherminieri)--74 individuals were banded on Enderbury in the Phoenix Islands; there have been no recoveries.

Christmas Island Shearwater (Puffinus nativitatus)--50 birds were banded on Moku Manu in the main Hawaiian Islands and on Eastern Island at Midway; there have been four recoveries, all of them within one year after the banding date.

Bonin Petrel (Pterodroma hypoleuca)--887 individuals were banded on Sand and Eastern Islands at Midway; there have been no recoveries.

Phoenix Petrel (Pterodroma alba)--27 birds were banded on Enderbury in the Phoenix Islands; there have been no recoveries.

Bulwer's Petrel (Bulweria bulwerii)--227 individuals were banded at Popoia, Kaohikaipu, Manana, Mokulua, and Kapapa in the main Hawaiian Islands, and on Eastern and Sand Islands at Midway. There have been nine recoveries; the record is currently held by bird #40-131001 which was recovered twelve years after being banded.

Tropicbird: Red-tailed Tropicbird (Phaethon rubricauda)--2505 individuals were banded on Sand and Eastern Islands at Midway, on Canton and Enderbury in the Phoenix Islands, and on Howland and Jarvis in the "Equatorial" Islands. There have been 93 recoveries, all of them within one year after banding except for bird #40-503953 which was recovered eight years after being banded.

Boobies: Brown Booby (Sula leucogaster)--759 birds were banded on Enderbury in the Phoenix Islands, and on Howland and Jarvis in the "Equatorial" Islands. There have been seven recoveries; the record is currently held by bird #40-720101 which was recovered 24 years after being banded.

Masked Booby (Sula dactylatra)--1223 individuals were banded on Enderbury in the Phoenix Islands, and on Howland and Jarvis in the "Equatorial" Islands. There have been five recoveries, most of them within two years after being banded. The record is currently held by bird #41-720687 which was recovered 25 years after being banded.

Red-footed Booby (Sula sula)--2341 birds were banded at Ulupau Head and Moku Manu in

the main Hawaiian Islands, on Eastern Island at Midway, on Enderbury in the Phoenix Islands, and on Howland, Jarvis, and Palmyra in the "Equatorial" Islands. There have been 89 recoveries. Three percent are known to have survived one year after being banded, and at least seven birds lived for ten years. The record is currently held by birds #40-735589 and #44-725171 which were recovered 20 years after being banded. Plotting the adjusted returns gives an exponential curve similar to those for the albatrosses.

Frigatebird: Great Frigatebird (Fregata minor)--1012 individuals were banded on Enderbury in the Phoenix Islands, and on Howland and Jarvis in the "Equatorial" Islands. There have been three recoveries; the record is currently held by bird #39-722380 which was recovered 28 years after being banded.

Terns: Common Noddy (Anous stolidus)--2338 birds were banded on Moku Manu and Manana in the main Hawaiian Islands, on Enderbury in the Phoenix Islands, on Eastern Island at Midway, and on Jarvis in the "Equatorial" Islands. There have been 16 recoveries; the record is currently held by bird #42-330840 which was recovered 24 years after being banded.

Sooty Tern (Sterna fuscata)--6582 individuals were banded on Manana in the main Hawaiian Islands, on Peale Island at Wake, on Enderbury in the Phoenix Islands, on Sand and Eastern Islands at Midway, and on Howland, Jarvis, and Palmyra in the "Equatorial" Islands. There have been 22 recoveries; at least 19 birds survived for more than ten years. The record is currently held by bird #38-312038 which was recovered 28 years after being banded. This individual had not been recovered in any of the preceding years!

Gray-backed Tern (Sterna lunata)--452 birds were banded on Eastern Island at Midway, on Enderbury in the Phoenix Islands, and on Howland in the "Equatorial" Islands. There have been no recoveries. At least two individuals which Mr. Munro originally listed as juvenile terns of this species were subsequently recovered and identified as adult Sooty Terns.

Blue-gray Noddy (Procelsterna cerulea)--One individual was banded on Enderbury in the Phoenix Islands; it has not been recovered.

White Tern (Gygis alba)--157 birds were banded on Sand Island at Midway, on Canton, Enderbury, and Fanning in the Phoenix Islands, and on Palmyra in the "Equatorial" Islands. There have been no recoveries.

I give my thanks to Professor Andrew J. Berger, Mr. Edwin J. Bryan, Jr., and Ms. George-Ann Davis for their help and encouragement.

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Comments on 26 October 1973 Draft Environmental Statement on the NATURAL RESOURCES MANAGEMENT PLAN, Hawaii Volcanoes National Park to G. Bryan Harry, Superintendent, Hawaii Volcanoes National Park, from President Wayne C. Gagne, 18 February 1974:

The Society has examined the Plan and it was found to be generally satisfactory. ...The proposed alternatives are untenable.

There seems to be some confusion regarding one of the plant species listed in Table 3, page 6. Gouania hawaiiensis is almost certainly an extinct species. (see St.John, Pacific Science 27(3): 269-73, 1973) Members of this genus are not known to have had Hawaiian names. The mao usually refers to Hawaiian cotton, Gossypium sandwicensis, an endemic species, or to Abutilon molle, an exotic species in the same plant family(Malvaceae).

Special mention should be made on the status of the 'o'u discussed on page 7. We consider this species to be in the most critical situation of the native birds on the Island of Hawaii, certainly more so than either the 'akepa or the 'akiapola'au. No sighting has been reported in the last few years in spite of active searching by resident ornithologists there.

We are of the opinion that no population level of exotic mammals will be found to have "minimal" impact on the endemic island biota. The present practices would seem to run counter to the recommendations in the "Leopold Report" to the National Park Service. We would prefer wording to the effect that goats and pigs will be totally removed from the park and that there will be a continuing effort to exclude peripheral populations of these animals from reentering the Park. We would prefer also that research be initiated towards the eventual elimination of the mongoose and the rodents. Following the same logic, there seems to be no ecological grounds to tolerate the presence of exotic birds. It could be argued that the exotic gallinaceous species, for example, are possibly direct food competitors with the nene as well as having potential roles as vectors of diseases and parasites. Research needs to be initiated to better define the damage exotic birds are doing to native ecosystems and at population control measures.

Regarding CONTROL OF EXOTIC PLANTS (page 15), is Table 4a that on page 16? We regard the cut and individually poisening technique to be preferable in all cases. Fountain grass needs to be uprooted, removed from the site where found, then burned. Biological control is less preferable because this adds additional exotic species to the park on a probably permanent basis. In certain instances these also attack native plants. A blackberry moth also attacks 'akala. This was probably predictable on hindsight. More importantly, however, species introduced for biological control have the genetic potential of evolving the unexpected. For example, a lantana bug on Oahu attacks the entirely unrelated endemic naio as do the adults of the lantana leaf beetle on olopua in South Kona, Island of Hawaii. The function of biological control should be one wherein the pest is beyond the bounds of cultural control and the biological agent(s) would likely bring the pest population down to a level where cultural techniques could proceed toward the elimination of both the pest and its alien natural enemies.

With regard to DESCRIPTION OF THE ENVIRONMENT, page 23, paragraph 2, it should be noted that the Smithsonian Institution under the direction of Dr. Raymond Fosberg are compiling a list of the "endangered" plants in the Hawaiian Islands. The Hibiscadelphus species have been entered into the "Red Data Book" of the International Union for the Conservation of Nature and Natural Resources as endangered species.

In light of recent monographs, sightings and/or collections the distribution maps of the plants and birds need revision in some cases. The 'awikiwiki and 'ohai also occur at South Point. The 'aiea, Nothocestrum longifolium is now known from the Puu Makaala area. The holei is now known as Ochrosia compta and it is also known from Oahu. The meu, Cibotium hawaiiense is known from the Kohala Mountains (Richard Becker, personal communication). Mr. Win Banko of the U.S. Bureau of Sport Fisheries and Wildlife should be consulted regarding recent sightings of the 'akiapola'au and 'akepa. Recent reports indicate sporadic occurence in additional areas. The Hawaiian bat, another endangered species, should also be added to these distribution maps and Dr. F. Quentin Tomich of Honokaa should be consulted regarding its status with respect to this draft proposal.

Also in light of recent discoveries as to the presence and extent of a most remarkable biota in the lava tubes of Hawaii Volcanoes National Park and elsewhere in the State, a new section needs to be added under DESCRIPTION OF THE ENVIRONMENT. Mr. Francis Howarth of the Entomology Department of the Bishop Museum who made the initial discovery of this biota and who is continuing research on it under the International Biological Program... suggested the following wording:

Lava Tube Ecosystem--A remarkable and significant ecosystem within the Park boundary is the lava tube ecosystem. More than 30 species of arthropods are endemic to caves on the Island of Hawaii. Most of these animals are found in Hawaii Volcanoes National Park and are worthy of protection. Many, such as the blind big-eyed hunting spider, the cave tree cricket and the blind terrestrial water treader are among the most bizarre cave animals known anywhere. The main energy source in Hawaiian caves is tree roots, mostly of 'ohi'a.

The proposed park plan to preserve the above-ground ecosystems will not conflict with the integrity of the cave ecosystem. However, changes in the vegetation cover or the direct use of caves by visitors or for park facilities may jeopardize this ecosystem.

Lava Flow Ecosystem--Recent lava flows, far from being biologically barren, harbor a unique assemblage of endemic arthropods which appear to scavenge on plant and animal detritus blown onto the flow. A newly discovered cricket, related to the Hawaiian cave cricket, lives on Mauna Ulu. The Hawaiian bat also forages over new flows.

We have consulted Dr. D. Mueller-Dombois, Botany Department, University of Hawaii, regarding the proposed re-establishment of endemic Hawaiian plant species into former range in Hawaii Volcanoes National Park. We generally concur with the remarks he has submitted to your office. ...

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From Mae E. Mull, Big Island Representative, 18 February 1974:

The Society is in full agreement with the two broad goals of the Natural Resources Management Plan to (1) Re-establish endemic Hawaiian species into former range and to (2) Protect remnant Hawaiian ecosystems from exotics introduced by man. ...

The following comments and questions relate to research, techniques and actions in effective pursuit of these goals: (1) Re-establishing endemic plants in areas freed of destructive exotic mammals. The Plan should give assurance that particular species

selected for planting in specific vegetation zones are the same that occurred in that zone before disturbance by modern man--or that match as closely as can be known.

After feral goats have been removed from some large areas, restoration efforts will be starting from scratch with only scant vegetative remnants of the native ecosystem present. The species components of the pre-goat ecosystem may be largely unknown. Restoration, in effect, could become just guessing what major species were there before and then planting on a large scale seeds of a few likely available candidates. What is needed before further planting proceeds is intensive research and planning in terms of the balanced diversity of species and their interaction in the whole ecosystem that is to be restored. To insure that planting most closely approximate the endemic species make-up of the area, park records and scientific literature must be thoroughly researched and coordinated and several knowledgeable botanists and ecologists consulted on a continuing basis.

When the species components of an ecosystem are known, or carefully selected as the most likely components, the seeds or seedlings from immediately adjacent areas, or that most nearly match, should be used for planting. As much as possible, restoration managers must avoid creating new and different ecosystems from the wholesale planting of seeds taken from a single source in a divergent zone. When it is possible to approximate or replicate the native ecosystem that previously existed by judicious planting of species components in a balanced proportion, this must be done.

Hawaiian varieties tend to grade into different varieties even as the species itself extends in a continuous belt through one zone into another. Because some plant species vary considerably over short distances depending on climate, elevation and soil changes, the seed source should be as close as possible to the planted area.

It is essential that the park protect the genetic integrity of its endemic plants. To this end, the management Plan should recognize that the distinctive gene pool of a species, subspecies or variety is worth preserving. To avoid mixing gene pools, even of the same subspecies or variety, seeds from different vegetation zones and elevations should not be mixed together. Allied with this is the related recommendation that conscious effort be made to preserve the natural genetic diversity of a plant species in one ecosystem. This can be done by using many different parent trees in one area as the source for seeds or seedlings to be planted. In short, care must be taken not to mix two separate gene pools, but still to sustain the natural diversity within one specific gene pool. The Plan should acknowledge both the dangers of artificial hybridization and inbreeding in altering the composition of endemic species, and it should outline procedures to protect the natural genetic make-up of species to be re-established. (The writer is no more than a concerned layperson, but, undoubtedly, competent scholars will discuss this issue in precise scientific terms and provide relevant examples.)

Two additional points are raised in this section on planting endemic species in their former range. Kipuka Puaulu is listed in Table 2 as the seed source for many rare plants. It appears from other park records that some of these parent plants themselves were planted in that kipuka in the past, having been derived from sources far removed from that location both inside and outside the park. The question is whether such planted stock is a valid seed source for all species in restoration planting in a "former range," especially if a search can reveal stock growing naturally close to the restoration area.

Specific understory and groundcover plants should be recognized in the Plan as integral components of ecosystems in areas where only trees are presently scheduled to be re-established. Whenever possible, all of the plant components of the ecosystem should be identified, and, as frequently as possible, the understory and groundcover species should be planted to speed recovery of an area. Other native flora and fauna of the system, including ferns, mosses, insects and birds, are likely to reoccupy their niches at a faster rate when mid-level plants and some ground cover are planted along with trees.

(2) Maps and records of species planted. For later workers to distinguish planted stock from growth and regeneration that occurs naturally, it is extremely important that permanent, accurate records be kept of the planted species. Such records are essential for productive evaluation of the degrees of success or failure of the restoration program. Some technique of recording on scaled maps with a grid system, with corresponding grid staking in the field where extensive planting occurs, will provide future managers with necessary and valuable data. If they exist, the record systems of the U.S. Forest Service

in planting diversified native forest on the mainland may suggest a useful guide. If time and labor are expended in planting young trees, it would be a small additional cost to attach permanent metal tags with abbreviated data, as well as properly noting the plantings in the written record.

(3) The question of whether the park should propagate and maintain a stock of endangered Hawaiian plant species not known to have occurred previously in the park must be faced, although its resolution is difficult. This question is suggested from points raised in the Statement (pp. 3-6, 43, 52, 59, 60, 67).

Priority certainly must be given to restoring those native plants into the ecosystems it is known they occupied in pre-goat and pre-pig times. Second priority should be given to establishing those endemic plants that the most informed plant ecologists judge to have been likely residents of the park in the past. That leaves a third category of endangered endemic species of the Island of Hawaii that probably never occupied a park habitat. A convincing rationale and excellent arguments can be presented for the park not assuming the burden of saving these endemics.

The Society's position is that the foremost responsibility of the National Parks is the maintenance of park native ecosystems in their living process of natural selection and succession, with man manipulating the system only to remove exotics and to restore the destroyed native biota to their former park habitat. Thus the question of what the park should do, if anything, about non-resident, but endangered, endemic species on this island is troublesome.

Because of the lack of interest or concern by relevant State agencies, a number of additional unique Hawaiian plants are in imminent danger of extinction through habitat destruction. Their survival as living species may be assured only if the park propagates them. With the choice reduced to certain extinction or park propagation, we must opt for the latter. However, if this is a feasible park operation, such species maintenance must be kept separate, with lower priority, and be removed from the planting program. Such threatened Big Island species could be sustained in an arboretum environment until the time they could be returned to their former habitat.

An arboretum operation to save such plants can be justified on the basis of their unique value as distinctive Hawaiian species. The diversity of endemic Hawaiian biota has been reduced already by the extinction of hundreds of species, so it makes sense to save those that totter on the brink. They enrich the natural heritage of the nation as well as Hawaii. Another consideration is that the natural range of these endemics may at some later time fall within the expanded boundaries of the park, or within a Natural Area Reserve or a Wilderness Preserve yet to be set aside.

Nevertheless, the Society finds instructive the development of park policy as written by David K. Morris, Park Ranger, The History of Native Plant Propagation and Re-introduction in Hawaii Volcanoes National Park, 1967. We are in accord with the policy as stated by Morris (pp. 13-14): "...that propagating rare plant forms not originally found in the park is not consistent with the Service policy," and suggest an arboretum for those threatened plants with no planting directly onto open park lands.

(4) A park-appointed Scientific Council on Restoration of Native Ecosystems could provide park managers with useful biological information in depth and constructive counsel on aspects of natural resources management. These scientists, acting in a voluntary community service capacity, could supplement the present dedicated and overburdened staff in offering skills in the specialized fields of botany, plant and animal ecology, plant and animal pathology, entomology, ornithology and vertebrate zoology. In choosing such advisers from among the scientific community in Hawaii, the most productive service may be given by those who have detailed knowledge of a segment of Hawaiian biota, an appreciation of Hawaii's insular ecosystems, who support the purposes of the National Park Service, and who would not be limited by a conflict of interest.

(5) Re-establishing endemic birds into former range. The operation to restore a breeding population of Nene in the lower elevations of the park would have a better chance of success if park managers could draw upon the 23 years experience of the Division of Fish and Game at Pohakuloa. It was necessary to try out many experimental techniques over several years with a full-time staff of workers before a successful breeding program was established. Since the first objective is to establish productive breeding pairs, the long experience of Ah Fat Lee and David Woodside at Pohakuloa would be invaluable in reaching this goal.

Habitat restoration and a natural food source apparently are not enough to engender successful reproduction when working with just a few penned pairs that may not be well matched to begin with. The low reproduction observed in the hundreds of pen-reared Nene released at higher elevations in Hawaii and Maui suggests that the park's program will need a lot of help for some time. At a minimum, the park should start with Nene of sturdy stock that have already established records as successful breeders. Artificial feeding may be necessary if some reproduction is an early goal. To expect a fair breeding rate and self-sufficiency in food may be asking too much at once in a habitat new to these transplanted Nene.

For many years the State has been receiving an annual federal grant of $20,000 to support its Nene program. This is in addition to separate project funding under the Pittman-Robertson Act. Would it be possible, or desirable, for the park to coordinate its Nene program with the Division of Fish and Game to share the federal grant in restoring the State's official bird to its historic lowlands nesting grounds?

With the rapid decline in populations of Hawaiian birds on the U.S. List of Endangered Species, field studies of the park's endemic birds are desperately needed. With more knowledge of their feeding and breeding biology and knowledge of the impact of exotic birds, introduced diseases, and rats on endemic birds, sound habitat management would be enhanced. There are a number of mature graduate students in ornithology in Hawaii now with the time, enthusiasm and skills to undertake a project on endangered endemic birds. There are several private foundations in Hawaii and on the mainland that have been responsive recently to applications for grants in field research in Hawaii on native birds. If the park would sponsor such studies and provide housing, the opportunity does exist for foundation assistance to qualified researchers already resident in the State.

Table 5a. Status of land birds native to the Big Island of Hawaii (p. 25) could be upgraded to provide the reader with more precise and accurate information. Scientific names should be given for all species. Hawaiian names should be added for the Hawaiian hawk ('Io) and Hawaiian short-eared owl (Pueo). Greater 'Amakihi is the present name in standard use for the species formerly called "Green solitaire." 'Oma'o, the subspecies of thrush endemic to the Island of Hawaii (Phacornis obscurus obscurus), is properly called the Hawaii thrush. Kauai should be omitted from the Distribution column since the thrush resident on that island is a different subspecies and is on the Endangered List while the Hawaii thrush is not. The subspecies of 'Akialoa endemic to this island is properly called the Hawaii 'akialoa (Hemignathus obscurus obscurus). Since different subspecies are endemic to Oahu and Lanai, those islands should be omitted from the Distribution column. It would be confusing not to make this change since there is a species of 'Akialoa on Kauai that is considered "endangered." The correct spelling of the Hawaiian name for Ciridops anna is 'Ula-'ai-hawane. It can be confusing if the scientific name is not given since the Hawaiian name is the same for two different species in several cases. For example, in Table 5a. Kioea (Chaetoptila angustipluma) refers to the extinct forest bird endemic to the Island of Hawaii. The Hawaiian name for the Bristle-thighed curlew (Numenius tahitiensis) is also Kioea. The subspecies of 'Elepaio endemic to the Big Island is properly called the Hawaii 'elepaio (Chasiempis sandwichensis sandwichensis). The subspecies of 'Amakihi endemic to the Big Island is properly called Hawaii 'amakihi (Loxops virens virens).

Not treated in the Plan as natural resources are several categories of fauna that are native to the park and are distinctive and valuable assets. These include the seabirds that are not endangered that regularly visit park lands, the migratory shore birds resident in the park for 8-9 months of the year, and the amazing array of endemic insects with highly adapted forms that are a notable wonder in the scientific world.

(6) Protect remnant Hawaiian ecosystems from exotics introduced by man. The emphatic position of the Society on the urgency of permanent and speedy removal of feral goats from park lands has been expressed previously to park managers and is strongly reiterated here! The most important and constructive action the park is taking today in natural resources management is the building of boundary, drift and exclosure fences to exclude the destructive goat. The Society is most grateful to the park administration for its commitment to this costly project. Fencing and the removal of goats by a variety of additional techniques will reap great rewards in a few years in the significant restoration of native ecosystems. Although chemical sterilants did not appear promising when the statement was written, this means of population control should be closely followed and

investigated for a break-through in the near future. As much as possible, park rangers should be encouraged regularly to carry rifles for direct reduction of both goats and pigs. One useful incentive with the high meat prices, would be cooking demonstrations on how to prepare delectable goat and pig in a variety of ways. That incentive has one potential drawback for administrators. The satisfactions of such good "free" meat may lead to reduced and selective shooting to maintain a sustained-yield! The Society would not be in favor of the alternatives of private operators conducting goat drives or goat shooting from helicopters because of the overriding negative consequences of such actions that outweigh the goat reduction--particularly when other suitable techniques are working effectively.

The Society gives its wholehearted support to operations for the removal of feral pigs from the park. We urge the park to investigate pig reduction through poison and chemo-sterilants. Trapping of pigs is not mentioned in the Plan but it would appear to be a promising control measure. We recommend that the park experiment with pig trapping in heavily infested areas.

In addition to the extensive damage done to native trees and other vegetation, rats are significant predators on both ground-nesting birds and on the nests of forest birds high in the canopy. We strongly support research on rat and mongoose damage and vigorous control of these pests.

The Society approves of the control measures proposed for agressive exotic plants--uprooting, herbicides and biological control. The latter method requires careful testing of possible control insects against a broad spectrum of native plants to be sure that the insect agent is host-specific to the exotic plant. The State tests promising control insects against agricultural crops of economic importance and far less frequently against native plant species that have no economic value.

There are additional exotic trees and plants which should be removed from the park eventually. The stand of eucalyptus trees in Namakani Paio campground is a special eyesore to those Hawaii residents who know of the thousands of acres of prime native forests that were destroyed for the purpose of planting eucalyptus plantations. That lumber could be well used in fireplaces at the campgrounds.

At some time the exotic plantings at Volcano House and around park residences should be replaced with native ornamentals. The exotic fuschia along the park road to Thurston Lava Tube should be removed before it naturalizes further, as well as the exotic passion fruit vines in Kipuka Ki. The Jerusalem cherry is as unpleasing to the visitor's eye as it is to the goat's taste, but the exotic plants listed in Table 4 certainly have immediate priority in control efforts.

The control of exotic bird populations is not discussed in the Plan, but this problem warrants serious consideration in the management of resources. Introduced game birds have no place in the park's environment and should be shot or trapped whenever possible. The Society does not favor the retention of exotic bird populations in any park habitats. The control of exotic plants and the spread of native vegetation may also have the positive effect of reducing populations of some exotic bird species such as the Ricebird (Lonchura punctulata), House Finch (Carpodacus mexicanus frontalis), and House Sparrow (Passer domesticus). The aggressive White-eye (Zosterops palpebrosus japonicus), which exhibits flocking tendencies, is suspected of being a serious competitor with endemic honeycreepers for food and territory. The White-eye, a hardy survivor from Asia, may also be a factor in the potential transmittal of introduced disease and parasites to endemic birds.

The presence of stray cattle and feral sheep in park habitats, as indicated in Table 4b, must not be tolerated one day longer than is necessary to remove them. Feral sheep should be shot on sight. The park should adopt stricter measures in demanding the immediate removal of stray cattle on park lands by their owners from adjacent grazing lands. Fence maintenance and repair is an important preventive measure. When feral cats and dogs can be dispatched quickly by poison or trapping, it should be done. ...

Oral presentation by Mae E. Mull at the public meeting, Hilo, Hawaii, 19 February 1974.

Land Acquisition. The Society supports the inclusion of the Ola'a Forest Tract within the park boundaries, and approves of action by Congress to accomplish that.

The acquisition of Tract 22 on the east side of the park, which is a significant rain forest habitat and buffer, is fully supported.

The acquisition of small parcels in the Kalapana Extension and in the western Great

Crack region is supported.

The Society strongly supports the inclusion of offshore lands at the southern boundary of the park for the protection and interpretation of those tidal and marine ecosystems.

The position on the park acquisition of the summit of Hualalai Volcano and upper slopes of Mauna Loa will be presented by the Society president in Honolulu.

The Society recommends more intensive consideration of the acquisition of the Kilauea Forest Reserve than is offered in Alternative E of the Environmental Statement. Most of this rich and mature rain forest is in near prime condition. Several rare and endangered endemic bird species are residents, and the endemic plant communities are unique assets of the natural heritage of Hawaii and the nation. They deserve the permanent protection by public ownership.

In amending the importance of Alternative E, several corrections in fact can be made on pages 41 and 87. The Kilauea Forest Reserve /KFR/, totaling 5,070 acres (not 9,000), is privately owned by the Bernice P. Bishop Estate, and is in the Conservation District land use category. Commercial use of this forest is regulated by the State Board of Land and Natural Resources. The State itself is not harvesting koa and 'ohi'a in this area. Private hapu'u harvesting in the lower part of the forest is currently permitted under the State Land Use Regulation. Koa, and some 'ohi'a, harvesting has been underway for a long time in the adjacent Keauhou Ranch, also owned by the Bishop Estate, which is in the Agricultural District land use category. However, the Bishop Estate has shown considerable interest in harvesting koa in the Kilauea Forest Reserve and this lumbering activity would have significant negative effects of the native ecosystems of the forest. Map (p.87) places the KFR too far north. Omitted from the map is the location of the Ola'a Section which borders the KFR for a distance, ½ mile, at the 3900' elevation. Would it be feasible to have an access road connect the park with the attached portion of the Ola'a Tract which fall within Tract 20 already authorized for acquisition? Only enough of the tract for a roadway and parking area would be acquired.

The Society supports the RESEARCH AND RESOURCE MANAGEMENT proposals listed on pp.4-5. The Society is in full agreement with the two broad goals of natural resources management to: (1) Re-establish endemic Hawaiian species into former range. (2) Protect remnant Hawaiian ecosystems from exotics introduced by man.

Detailed comments of the restoration of plant communities and populations of endemic birds are presented separately in the Society's review of the Natural Resources Management Plan. That review also contains recommendations on the removal of feral mammals from park lands, and on the control of exotic plants and exotic bird populations presently occupying park habitats.

We recommend that boundary, drift and exclosure fencing be given the highest priority in any allocation of construction funds. Road alignments and improvements, visitor facilities, back country shelters and other construction should be postponed so that concentrated effort and necessary funds be channeled into the fencing projects. The estimates of current goat populations may be optimistically low, since the figures on page 30 do not appear to take into account the annual natural increase.

Page 42: The Nene release sites on the slopes of Mauna Loa are not "sanctuaries" in the common sense of the word. The State has 30-day revocable agreement with the Damon and Bishop Estate to use these upper ranch lands for release and observation of Nene that were reared at Pohakuloa. Use of the word sanctuaries implies some permanent protection and habitat maintenance on these lands which does not actually exist.

Since effective feral mammal control is not likely to happen on lands under State control, and with other uncontrolled exotic elements reducing the quality of Nene habitats, the program to establish breeding populations on Nene on National park lands is of urgent importance.

Question: What is the almost 10,000 acres of privately owned land within the park boundaries? Page 47.

Not spoken at the hearing: The sea birds referred to on page 30 are not usually called "migrant", particularly since the White-tailed Tropicbird and the Hawaiian (Black) Noddy Tern are considered resident in Hawaiian waters the year round. On the other hand, the Pacific Golden Plover, Ruddy Turnstone, Wandering Tattler are usually called migratory shore birds, spending 8-9 months of the year in Hawaiian habitats.

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Statement for the Public Hearing on Proposed WILDERNESS AREAS of the HAWAII VOLCANOES

NATIONAL PARK, Hawaii to Director, Western Region, National Park Service from Mae E. Mull, Big Island Representative, 20 February 1974.

The Hawaii Audubon Society has reviewed the Draft Environmental Statement and the Wilderness Study and gives full support to the findings that: "Significant portions of the volcanic features, rain forest, and Pacific Ocean shoreline in Hawaii Volcanoes National Park on the Island of Hawaii have been found suitable for preservation as wilderness, and are proposed for inclusion in the National Wilderness Preservation System."

The following comments and recommendations relate to management of the wilderness areas and provisions of the wilderness proposal to be submitted to the Congress:

From our knowledge of the areas involved, and from study of the Service's "Guidelines for Wilderness Proposals," we conclude that all four of the special provisions for management should be specifically written out in the legislation that designates wilderness status. It is necessary to include these provisions because of the singular character of this park's wilderness. Without these provisions in the statute, park management that is based on them could be denied at a later time or simply not carried out.

(1) Without the provision for unobstrusive catchment of rain water on the coastal wilderness, even light visitor use would be unduly restricted.

(2) The geological and volcanic research by the U.S. Geological Survey is of such importance to Hawaii and the nation, that the minimum tools, instruments and vehicular access in Unit 2 should be specially allowed. While maintaining the jeep road on the north side of Mauna Loa to the summit may be a necessary facility for weather observatory personnel, strong arguments for this exception are not presented. If such road use is allowed, there must be effective safeguards to insure that such travel is not abused. It must not become a route for recreation use by vehicles.

(3) Including provisions now for the later wilderness status of the two parcels to be acquired by the park will quicken the process, avoid duplication of labor, reduce costs, and relieve the park and public of unnecessary paperwork. The 5,800 acre tract in Unit 3 would be a particularly valuable wilderness addition because of the dynamic natural forces at work here. With near-continuous volcanic activity causing rapid alteration of biotic communities, this is a unique area for long-term research in the processes of regeneration, natural selection, succession, and genetic change in species in a native forest ecosystem.

(4) The special provision for minimum tools and fences to stop feral animals from entering the park wilderness is absolutely essential to wilderness designation. If this provision is not written into the legislation, eventually there could be no Hawaiian wilderness left to preserve in the park. The provision should not only permit fences within the wilderness areas, but must constrain the park to maintain the fenced boundaries in perpetuity. The proposal to Congress should be so written that wilderness status and the special provision for tools and fences are inextricably tied together.

Since there are inevitable changes in park policy and managers, the fencing provision should be a mandatory directive to the park and not a discretionary action. The park should not only have the authority to construct and maintain fences in this wilderness, but it must be directed to do so.

If wilderness status and boundary fencing are not tied together in one package, and if wilderness designation is granted alone, the consequences could be disasterous for the wilderness itself. Future policy and funds could be directed to other projects such as visitor facilities and road construction and the fences neglected or construction halted. Volcanic eruptions could quickly alter and divert management programs and actions now aimed at restoration of endangered plant and animal communities. Considering such future possibilities as these, the present emphasis on the enhancement of native Hawaiian ecosystems, through the control of exotic populations of plants and animals, could soon decline.

Both fence construction and the internal program of feral mammal control are vital to wilderness preservation. Without both programs the present populations of goats and pigs could quickly double or triple in number. Without permanent boundary fencing, the animals have continuous open entry to wilderness lands from adjacent non-park lands. Since internal control of exotic animals is subject to the fluctuations of policies and managers, at least one control measure should be permanent and unchanging. That is the special provision in the wilderness legislation that directs the park to construct and maintain boundary and exclosure fences for the preservation of wilderness values.

With that mandatory provision in the wilderness legislation itself, there will be a permanent basis for the necessary funds to maintain the fencing project.

It is assumed that other control programs will continue, such as goat drives and direct reduction of animals by park personnel and deputized citizens. There is no mention of how goats rounded-up in drives will be removed from wilderness areas when four-wheeled vehicles will be excluded from those areas. ...

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FOR JUNIOR MEMBERS: The name of the beautiful orange moth described last month on page 120 is Anua indiscriminata. The following is from the Hawaii Cooperative Economic Insect Report titled, "Summary of Insect Conditions in Hawaii - 1974" on pages 2 and 3: A noctuid moth, Anua indiscriminata (Hampson): Five adults were collected during the period June to August 1974. The first moth was collected from Hickam Air Force Base, Oahu, and subsequent specimens were collected at Manoa and Nuuanu, Oahu. The moth was identified by E.L. Todd of the U.S. National Museum. Host range includes Eucalyptus, Carea, and other Myrtaceae (Catalogue of Lepidoptera Phalaenae in the British Museum, Vol. XII). Subsequent surveillance of these hosts resulted in discovery of the larvae on strawberry guava, Psidium cattleianum, at Kahala, Oahu, and on guava, Psidium guajava at Manoa, Oahu.

To date, adult specimens have been collected from most areas of Oahu. No specimens have been collected from other Hawaiian islands. Larvae have only been collected from strawberry guava and guava, although one larva was found near the base of a paper bark tree (no guava hosts closeby). Adult specimens were first caught in light traps on Oahu during the first week in September 1974; this was approximately three months after initial discovery of the moth on Oahu.

Information on the biology of A. indiscriminata in Hawaii is sparse. Only guava and strawberry guava have been shown to be hosts. Other genera of Myrtaceae are likely hosts. Larvae were generally found stretched out on the bark or branches and twigs. Larvae seem to prefer young, succulent leaves for feeding. No feeding during daylight hours were observed in the field, but larvae did feed during the day under laboratory conditions. Although the damage to guava has been widespread in Manoa, Oahu, few larvae have been collected during surveys of the area.

If you know anything about this moth, please write to Kojima, 725-A 8th Ave,Hon.,HI 96816.

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Are you watching the plover? On 23 April, I saw one at University and Dole with complete breeding plumage; a handsome bird. MAHALO for being there. Please share your observations.

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Field Notes from Nicholas Mitchell, received 14 April 1975: 'Io, Hawaiian Hawk

I came upon an unusual observance the other day, and I thought maybe some members... might be interested. A cowboy on the Kukaiau Ranch, located in upper Hamakua on the Big Island, was riding through the forest when he heard the squealing of pig in distress. He headed to the scene and upon approaching noticed an 'Io circling overhead. Suddenly the hawk came swooping down and clutched a very small piglet by its back and proceeded to lift it completely off the ground. The pig was just a bit too heavy, however, and the hawk soon let go of its prey, from a height of a few feet. The pig landed unharmed and started running for all it was worth. The hawk being aggressive; however, did not give up so easily, and it came down again and again trying to take away the pig for dinner. After four or five times it finally decided the pig was more than it could handle, so it flew away amidst the squealings of a very frightened little pig, who had a rather unusual day.

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Field Trip by Erika Wilson: The monthly field trip was held March 9, 1975, with thirteen people walking the Waahila Ridge above St. Louis Heights. Good weather made the walk quite pleasant. We saw a few 'Amakihi, both males and females, in koa trees within the State Recreational Area. The lower end of the trail has primarily introduced vegetation which provides habitat for Spotted Doves, Shama Thrushes, Japanese White-eyes, House Finches, and Cardinals. At higher elevations the vegetation is primarily native species and it was in this area that an 'Apapane was seen. 'Amakihi were quite common as there were blooming koa trees; we heard a number of males singing. Equally vocal were the many Japanese White-eyes that have moved into most habitats on Oahu. Another songster we heard was the Japanese Bush Warbler. This species is quite good at concealing itself; in fact, we were unable to locate any of the singers. We had Dr. Howarth in our group; he pointed out a number of native plant species, and an interesting native insect which lives on one

of the ferns, causing a gall-like growth.

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Reprint edition of Wilson & Evans' AVES HAWAIIENSES now available: Scott B. Wilson and A.H. Evans, AVES HAWAIIENSES: THE BIRDS OF THE SANDWICH ISLANDS, London, published by R.H. Porter, 1890-99. Reprint edition 1974 by Arno Press, Inc. (A New York Times Company), New York, N.Y., list price $20.00. Reprinted from a copy in The American Museum of Natural History Library. The illustrations in this book have been reproduced in black and white, and the pages have been reduced by 31%. AVES HAWAIIENSES is one volume in an extensive list of classic works reprinted by the Arno Press in the series: Natural Sciences in America.

Mae E. Mull says, "I obtained the reprint from Buteo Books (PO Box 481, Vermillion, South Dakota 57069) with delivery taking 7 weeks after the order was placed...."

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Donations: MAHALO! Life member Thelma Hensley has not only shared her numerous bird books with the other members but also generously donated $10.00 with the note, "to be used as you wish." Mr. & Mrs. Ray H. Greenfield have again generously donated $4.00 to enable us to be aware of the wonders around us and to live harmoniously within our unique ecosystem.MAHALO!

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ALOHA to new members: Junior--Derek Fujimoto, PO Box 8378, Honolulu, HI 96815
Regular--Catherine Ramsey Craine, 175 Pauahilani St, Kailua, Oahu 96734
Mr. & Mrs. Howard C. Culbreth, 755 N. Kainalu Drive, Kailua, Oahu 96734
Susan L. Frank, 41760 Ala Koa St, Waimanalo, Oahu 96795
Dorothy M. Hart, 925 Azalea Drive, Burlingame, California 94010
Mrs. Fred W. Koch, 3107 Alika Ave, Honolulu, HI 96817
Mark Merlin, Dept of Gen Science, Univ of Hawaii, Dean Hall, Honolulu, HI 96822 /
Grant N. Stemmermann, 46-458 Haiku Plantation Dr, Kaneohe, Ohau 96744
Holy Family School Library, 830 Main St, Honolulu, HI 96818

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The annual and five-year indexes will be mailed to the members only upon request. If you are interested in receiving either one or both copies of the indexes, please send in your request indicating (1) annual, (2) five-year, or (3) both, before June to Kojima, 725-A 8th Avenue, Honolulu, Hawaii 96816.

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The poster "We Care About Hawaiian Wildlife Habitat" is available for a suggested donation of $1.50 or more. Despite our frugal existence we are unable to give away this valuable educational poster to the general public. I hope very soon, we'll care enough and live harmoniously within our ecosystem that even Hawaii Audubon, a very small organization with limited funds, can afford to distribute these educational printed matters to the general public with the only payment of better living for all of the people. For information please call Steve Montgomery, 941-4974. MAHALO.

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HAWAII'S BIRDS, a field guide, is out of print. As soon as the new edition is out, we'll let you know. We'll do our best to keep the price as it is now, but no guaranty.

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MAY ACTIVITIES: PLEASE NOTE DATES

11 May - WEATHER PERMITTING: Boat trip to Manana to study seabirds. Boat fee $3.00 per person. Bring lunch and water. Participants should be prepared to get soaked in landing and should be able to swim. Advance reservations required. For meeting time and place call Dr. Robert Shallenberger, telephone 261-3741 (evenings).

12 May - General meeting with the ~~Hawaii~~ Hawaiian Botanical Society at the Kaimuki Library Auditorium at 7:30 p.m. Program: Hawaiian Invertebrate: A Pictorial Essay and Commentary by William P. Mull (color slides)

19 May - Board meeting at McCully-Moiliili Library, 6:45 p.m. Members welcome.

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