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EVALUATING THE COST OF SAVING NATIVE HAWAIIAN BIRDS

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Abstract. Approximately $94 million has been spent on avian research and management in Hawai'i over the past decade. This figure represents a large investment in refuges and reserves as well as research across five state and federal agencies and The Nature Conservancy. This level of funding has made a substantial contribution to local economies, far outweighing even any contribution that local hunters make. Yet only one firm success story exists, the Nēnē (*Branta sandvicensis*), which has been brought back from the edge of extinction to more than 300 birds on two islands today. This paper examines the accomplishments gained by this level of funding, and the problems that still remain to be examined. Niche dimensions, territory sizes, impact of introduced birds, diet preferences, plant associations, invertebrate hosts, disease avoidance mechanisms, behavioral barriers all await study in rare species. Complex models of interaction must be built to better define the decline process. Avian genetics and the consequences of hybridization, important for future recovery efforts, are poorly studied and will likely become future focal points for research. It is recognized that a need exists to integrate future restoration efforts with tourism, the primary income generator for the Hawaiian Islands. One way to do this is through ecotourism and attraction of the birding community. Continued public support is necessary to maintain current and future funding levels or research and management of birds, and the need to develop outreach and education programs for the public is recognized as well. Hawai'i and the research community should seize the opportunity to integrate economic needs of the state and resource management needs that can then serve as a model for other states and countries.

Key Words: avian biology and research; economics; ecotourism; endangered species; Hawaiian Islands.

We are all familiar with the cost of saving endangered species. This cost is not strictly related to restoration. It includes, in any final analysis, costs of saving habitats, and conducting research into the biology, genetics, and other useful facts about the species of concern. Hawai'i, with its many endangered bird species, is a case in point. It turns out, as shown below, that currently about $9,451,664 is spent each year on providing, saving, and managing bird habitat. This includes research concerning all aspects of avian biology and ecology. But this figure may be important to providing other benefits as well, a fact which needs to be pointed out and discussed in open forum to identify and verify exactly what those benefits are. And it should not be overlooked that these species play important roles in the Hawaiian environment in terms of pollination, seed dispersal, and insect predation.

The rate of spending has not declined over the years; yet the Nēnē (*Branta sandvicensis*) program is the only telling success story concerning increase in a Hawaiian bird to date though not without its own setbacks and problems (Banko 1992, Black and Banko 1994, Black et al. 1997, Banko et al. *this volume*; see also Scott and Banko 2000). In fact, the increase of this species has not allowed its removal from the endangered species list, and is due as much to the length of the recovery program (40 years) as dollars spent. This belies the fact that investments in avian conservation often take long periods of time to yield returns since habitats often require considerable restoration (P. Banko, pers. comm.). Banko et al. (*this volume*) show that densities of many of the endangered species under study for the last half century have either remained steady or have declined. In a few cases, investigation of what was thought to be just a few remaining individuals of some rare species uncovered larger and/or additional populations than originally thought to exist (Scott et al. 1986), but this occurred only after intensive field studies. This type of success is due to improved field observation and technique and so it is not accurate to attribute these increases to restoration efforts. Finding additional individuals or populations of a species may serve to establish the extent of extant populations, population subdivision, and more accurate estimation of remaining numbers, thus allowing rank ordering of need for restoration under a regime of limited resource dollars.

In this paper I address the actual cost of research and management in Hawai'i over the past decade and raise two related questions: what have we accomplished with this expenditure? And where do we need to go from here? These questions are important if there is a need for directional change or a program refocus, or if particular points need to be reexamined. There may also be a need to determine if current funding allocations are adequate to get the job done.

The amount spent in Hawai'i with regard to saving the declining native avian resource can be broken into several categories. The first concerns what was spent directly on the resource for research and management, including studies of avian biology and conservation and purchase

of lands for refuges and reserves. The second concerns what was spent that indirectly impacted birds and other related resource components. It includes, for example, dollars spent on avian disease characterization or for study of predator biology. A third category, that in which dollars spent on the avian resource indirectly benefited other endangered (e.g., plant) resources will not be considered here but is worthy of some future examination since it gives a measure of "fallout" effect from dollars spent to protect trust species in general. It is important to note that one very good reason an assessment is needed is to better focus limited restoration and recovery dollars on species that have a good chance of benefiting from the attention.

THE ACCUMULATED AND AVERAGE COSTS OF SAVING HAWAIIAN AVIFAUNA

For over a decade, the U.S. Department of Interior, the state of Hawai'i, and various other agencies have, sometimes under legislated mandate or under court order, invested considerable sums to save the endangered bird species of Hawai'i. A rough summation demonstrates this figure to lie somewhere around $37,765,530 for research and $56,751,110 for habitat acquisition and management over the past decade, totaling $94,516,640 (Table 1). These estimates are limited to the dollars spent during the past decade because this has been a critical period in determining the extent of the avian population decline in Hawai'i. Since 1994, this figure includes $5,804,000 of base funding which the Biological Resources Division of the U.S. Geological Survey (National Biological Service prior to 1996) has invested in understanding the biology and other factors influencing survival of Hawai'i's shrinking avian resource. The annual amount for the BRD figure previously would have been found in the U.S. Fish and Wildlife Service (USFWS) budget.

The figure of $94.5 million is astonishing. It has increased over the 1980s in part because of environmental action and lawsuits associated with the Endangered Species Act. These legal actions demonstrated that the Endangered Species Act would have to be taken seriously and put the onus on land management agencies to establish baseline data concerning avian species population densities. But a large portion of the increase is also due to USFWS land acquisition initiatives and increased funding for management costs associated with the Natural Area Reserve System and Natural Area Partnership funding by the state. The figure does not include some costs due to restoration efforts currently underway in Hawai'i and related to the Peregrine Fund's own effort to rear and release endangered birds, nor does it include the cost of Department of Defense efforts on military lands (this information was unavailable at the time of writing this paper; see Drigot *this volume* for an example of what is being done on military

TABLE 1. MINIMUM ESTIMATES OF AGENCY EXPENDITURES FOR AVIAN RESEARCH AND MANAGEMENT IN HAWAI'I, 1987–1997

Source	Estimated annual dollars	
	Research	Management
State of Hawai'i[a]	$ 764,560	$ 1,575,111
U.S. Fish and Wildlife Service[b]	$ 849,993	$ 500,000
U.S. National Park Service[c]	$ 12,000	$ 600,000
U.S. Geological Survey Biological Resources Division[d]	$ 1,451,000	-0-
U.S. Department of Defense (1996–1997 based on Palila)	$ 99,000	not known
The Nature Conservancy[e]	$ 600,000	$ 3,000,000
Average annual expenditure for avian research, 1987–1997	$ 3,776,553	$ 5,675,111
Total spent/year, last ten years	$ 9,451,664	

Note: This table does not include federally funded research to university scientists or visiting scientists whose work may comprise major sources of information prior to or during this period. In some cases figures may be only an approximation of annual expenditures.

[a] Information provided by Paul Conry, Hawaii Dept. of Land and Natural Resources. The estimate includes 50% of the cost of the Natural Areas Reserve program since the reserves provide habitat for endangered birds among other species. Section 6 dollars are included in the research component.

[b] Includes dollars spent on rearing facilities and management of refuges. Estimate for research is based on a seminar by Adam Asquith (USFWS) March 1996 and covers the period from 1992 to 1995. Based on contracts to the BRD-PIERC, this figure probably holds for post-1995 years as well. Management estimate includes dollars provided to The Peregrine Fund rate bird rearing facility by the USFWS for construction, rearing, and management.

[c] This estimate includes prorated dollars spent for rodent and special ecological area research through the NRPP program, and dollars spent for management of feral pigs, Nēnē, and Dark-rumped Petrel (*Pterodroma phaeopygia*). Information provided by Drs. Lloyd Loope and David Foote of BRD.

[d] Between 1991 and 1995, the U.S. Geological Survey Biological Resources Division did not exist and NBS was in formation. Spending on avian research during this period averaged $995,467 annually. This was 47.4% of the budget of the NBS center at its formation in October of 1994. By 1997 this had grown to 54.1% of the annual budget for the center and has been declining since.

[e] Estimates provided by Dan Orodenker and Alan Holt for The Nature Conservancy includes land acquisitions, which eventually formed the basis for many of the refuges that now exist in the Hawaiian Islands. The refuges harbor endemic avian species in protected habitats.

lands). Thus the estimate is likely low. The figure does, however, include efforts by the state of Hawai'i in the early 1990s to rear endangered species, such as the Hawaiian Crow, hereafter referred to as the 'Alalā (*Corvus hawaiiensis*), at the old rearing facility on Maui.

In a sense, the annual expenditure flowing into and/or within Hawai'i has become a force to be reckoned with at social, cultural, and economic levels, as well as biological. This expenditure is easily ten times the economic value, for example, of hunting in Hawai'i, assuming that about 900 hunters in the state spend an average of $1,000 each to exercise the privilege. The hunting expenditures are offset by earmarked dollars that come to Hawai'i via the Pittman-Robertson bill, which supports research and management of nongame species. Still, hunting expenditures are an important consideration because wild pigs, feral goats and cattle, mouflon sheep, and deer lie at the root of claims to any cultural right of hunting. All of these introduced mammals impact avian habitats and have contributed substantially to the observed and continuing decline in endemic avifauna as well as plants and invertebrates. It is a consideration that the average taxpayer should be seriously concerned with, for their dollars help finance the battle to save Hawai'i's birds.

ACCOMPLISHMENTS OF AVIAN RESEARCH AND MANAGEMENT IN HAWAI'I

Despite the understanding gained about endemic Hawaiian bird biology and establishing the beginnings of restoration for the Nēnē, it is difficult to assess how successfully research results have been applied to avian conservation in Hawai'i. In a sense, we are in the "investment phase" of conservation program building in Hawai'i (T. K. Pratt, pers. comm.), because many of the accomplishments deal with placing lands under protection; starting recovery projects for specific species of birds; and building and maintaining the infrastructure of captive propagation facilities, field stations, reserves, and refuges (including building of roads and fences). T. K. Pratt (pers. comm.) rightly points out that the present generation of conservation managers, workers, and scientists have inherited a very bad situation and has had to start from scratch to build conservation programs and do land acquisition and capital improvements. We need to invest in species and ecosystem management now or biological losses will be greater in the future. T. K. Pratt (pers. comm.) raises a very important question: is it realistic to expect turnaround in population trends in the short-term? And, if not, what time frame should we use? Expenditures must accompany whatever the length the time frame will be.

There is no question the past decade of research has dramatically increased our understanding of avian biology in Hawai'i, and that this increase of knowledge has been driven in part by the threat of losing so many endangered species. We now have better understanding of avian behavior, demography, and life cycles, and their population fluctuations, diet, and disease distribution and transmission; we have even begun research via observation into the effects of climate change on various bird species (Table 2). These important studies provide baseline information at a critical time.

But nonbird advantages have also accrued, giving a larger 'bang-for-the-buck" as it were. These accomplishments secured by funding avian research and management include:

- Established habitat protection for many listed species of plants.
- Established habitat protection and refuge for undescribed and unstudied arthropod species endemic to the Hawaiian Islands, including insects, snails, and "happy-face" spiders, many of which are dependent on endangered plants and so must in turn be endangered themselves.
- Saved the last remaining native rain forests on several islands from destruction and development.
- Created refuges for culturally important plants and animals for the remaining Polynesian society, thus ensuring continuation of cultural diversity.
- Contributed toward ecological and thus economic stability of the islands by saving the concept of "original paradise."
- Contributed toward saving coral reefs just offshore by stabilizing ecology on steep volcanic slopes such that erosion, as a marine polluting process, is reduced.
- Saved the original watersheds that provide abundant and wholesome water to the human populace of the islands by preventing increased run-off due to erosion.

For example, establishing bird habitats has also served to save or provide sanctuary for many of the endangered plant species and natural communities remaining in Hawai'i, in addition to an unknown number of rare arthropods, some of which may be crucial to avian diets. Refuges and reserves have saved some of the last pristine native semitropical rain forest left in Hawai'i from development. It is probably impossible to tease apart those funds which have actually served to stop bird declines from those which have effectively prevented decline of remaining

TABLE 2. SPECIFIC ACCOMPLISHMENTS RELATED TO AVIAN RESEARCH IN HAWAI'I

Accomplishment	Author(s)
Summarized the known biology, habitat associations, density, and distribution of endemic surviving bird species	Scott et al. 1986, Conant et al. 1998
Determined sex and age in native Hawaiian birds	Fancy et al. 1993a, 1994; Jeffrey et al. 1993; Pratt et al. 1994
Determined nesting behavior and reproductive biology in several native birds	Banko and Williams 1993, Fleischer et al. 1994; Ralph and Fancy 1994a,b,c; Kepler et al. 1996
Determined insectivorous behavior of forest birds on alien plants versus native plants	Waring et al. 1993
Demonstrated demography, change over time, movement, diet, life history, survival, and recognition of specific Hawaiian birds	Engilis and Pratt 1993; Fancy et al. 1993a,b; Ralph and Fancy 1994a,b,c; Snetsinger et al. 1994, Lindsey et al. 1995a, Ralph and Fancy 1995, Engilis et al. 1996, Jacobi et al. 1996, Ralph and Fancy 1996, Fancy et al. 1997
Led to understanding pathogenecity and avian disease and distribution in Hawai'i	Atkinson et al. 1993a,b; Atkinson et al. 1995, Herrmann and Snetsinger 1997
Proved that introduced mammals were predators of native birds	Snetsinger et al. 1994
Demonstrated a link between climate changes and native forest bird population change	Lindsey et al. 1997
Demonstrated the potential for translocation of existing bird populations to serve as a conservation tool to build population density and replenish a native species in the archipelago	Fancy et al. 1997

biological ecosystems and communities. And most crucial, and completely unstudied, is the value this may have for developing and promoting ecotourism, currently considered an economically important income "wave of the future" in Hawai'i.

Technical contributions also exist. A very useful statistical procedure, analyzing bird densities from variable circular-plot counts (Reynolds et al. 1980, Fancy 1997), has proven valuable for inventorying and monitoring island bird species. Hughes' celluloid leg bands in various color combinations have been used to identify individual birds carrying them. However, Lindsey et al. (1995b) found that under Hawaiian conditions the bands may undergo color changes, rendering them questionable for long-term use in the field. Additionally, taking blood samples from small birds is always difficult, so finding that Hawaiian honeycreepers were not affected by blood sampling was encouraging (Pratt et al. 1994).

Clearly, there are gaps in our knowledge of Hawaiian birds and how to conserve them. There is a need to develop genetic profiles *before* a species' decline becomes threatening, yet there is still no comprehensive gene data bank for native Hawaiian birds. Genetic profiling might prove extremely valuable as Hawaiian avian research moves into a restoration phase. Information on the nature of genetic differences between apparently the same species or even subspecies across islands would be useful in assessing probability for bird survival and determining management approaches. An example can be found in 'Elepaio (*Chasiempis sandwichensis*), which is now being considered for listing by the USFWS because of its declining status on O'ahu. Subpopulations of this species exist on Hawai'i and might serve as transplant donor populations if no reproductive barriers exist. The importance of this can be seen in two recent studies. Although Franklin and Frankham (1998) maintain that an effective population size of 500 to 1,000 individuals is enough to maintain genetic variation for evolutionary change under mutation and random genetic drift load, Lynch and Lande (1998) question this figure, saying that it should be revised upward by at least fivefold because selection plays a defining role in quantity and quality of genetic variation. At the very least, the 'Elepaio subpopulations could act to increase genetic variance via hybridization when and if the two populations are brought together. Knowledge about what portion of genetic variation is lost during a population decline could give clues to a species ability to adapt to new conditions. As we gain understanding of gene structure and function, this knowledge could also provide insight as to why declines are occurring.

There also appears to be no information on compatibility of crosses (hybridization) of subspecies from different islands. This information would prove valuable if decline of a species on one island forces drastic measures to be taken which demand forsaking genetic purity of the subspecies. Unanswered questions here concern

survival of hybrids, fertility, genetic compatibility, disruption of behavior, etc., all of which can effect any transition period before a new species stability is reached. If success does result (e.g., an endangered subspecies is successfully propagated as a hybrid to save some portion of its gene pool), information on how the hybrid fits into the old ecosystem and survives threats posed by that ecosystem, especially the threats that led to the decline of the original subspecies, is desirable. This type of research might teach us new ways of looking at the interaction of a species with its environment. Needless to say, any approach using hybridization to save a portion of a gene pool must be carefully weighed against other approaches, such as whether to concentrate limited human and cash resources on saving ecosystems or saving avian species that have not yet reached some critical stage of decline.

Even more critical work is necessary to better understand the interactions of each of Hawai'i's avian species with macro and micro components of its ecosystem. Niche dimensions, territory sizes, impact of introduced birds, diet preferences, plant associations, invertebrate hosts, disease avoidance mechanisms, and behavioral barriers all await study in rare species. Complex models of interaction must be built to better define the decline process. We have learned a lot in the past decade, but we still do not know enough.

WHAT DOES THE FUTURE HOLD?

The meeting and research results summarized in this volume led to a roundtable discussion and a list of the following action items:

What Can We Do To Stop Native Bird Declines?

Funding

1. The percentage of the total budget devoted to conservation by the state of Hawai'i, about 1%, is inadequate; work to get the state to commit more funding and encourage the state to put more funding into supporting the Department of Forestry and Wildlife and hiring more biologists for management of its lands.
2. Coordinate efforts between federal agencies so that joint funding initiatives can be developed for congressional action taking advantage of the great rate of loss and listing of endangered and threatened species in Hawai'i.

Education

3. Encourage agencies to develop and conduct outreach and public education programs. Children 9 to 14 years of age should be targeted in education programs. Outreach efforts need to reach into schools on a regular basis (don't wait for the invitation).
4. In support of outreach, encourage USFWS to reprioritize their funding programs to place education programs near the top.
5. Make an attempt (by survey?) to find out what is relevant to the public and encourage education programs that address this relevancy and use this as a wedge to make the public more environmentally aware. In this regard, develop programs that take advantage of modern marketing techniques to create the *need* for the public to know.
6. Get on a first-name basis with as many news reporters and writers as possible, and actively promote newsworthy projects and problems.
7. Work toward establishing some Hawaiian "flagship" successes in species recovery, habitat recovery, etc., to create a "positive" mood in the public and a "can do" attitude in the research and management agencies.
8. Accept the mixed (alien and native) biology we are stuck with and use established alien species to educate the public while working to conserve the natives that remain.

Ecotourism

9. Encourage the city, country, and state governments to support, expand, and promote Hawaiian zoos, aviaries, botanical gardens, and aquariums that feature Hawaiian organisms and tell their stories to the tourist trade.
10. Promote ecotourism that is nonharmful to the sensitive Hawaiian environment; to this end, encourage the state of Hawai'i to build roads, trails, boardwalks, etc., that can bring tour groups in more immediate touch with natural Hawai'i and its biota.
11. Encourage development of adequate marketing programs in ecotourism.
12. Encourage the cities and counties to include information brochures on endangered species at tourist information kiosks.
13. Work to include the Secretariat of Conservation as a member of the Hawaii Visitors Bureau.

How Can We Bridge The Gap Between Researchers And Management?

14. Work to coordinate research and management strategies better.
15. Examine the way we develop strategies to address conservation problems.
16. Publish research reports and technical reports in a more timely manner to make them available to the management agencies.

WHAT BENEFITS HAVE ACCRUED TO HAWAIIAN CONSERVATION EFFORTS BEYOND THOSE WHICH HAVE BEEN SPENT STUDYING AND MANAGING ENDANGERED BIRD SPECIES?

17. Conduct monitoring surveys to determine how endangered plant species are doing in critical bird habitat. Do the same for endangered invertebrates.
18. Link findings from the above surveys to outreach programs targeting groups in Native Hawaiian cultural programs (such as kumu hulu halaus who use native plants in their ceremonies) in order to demonstrate relevance of biodiversity and broader impact of specific management and research programs for cultural needs and practices.
19. Determine contribution at the landscape level to ecosystem sustainability.
20. Determine contribution to decision support systems to support management functions.

To some extent, the action items are responses to embedded questions, which remain unanswered today and require serious efforts to resolve in the future. For example, action item 1 under funding addresses the implicit question "is support of avian conservation adequate by the state of Hawai'i?" Discussion at the meeting implied that support is not adequate. Action items related to what can we do to stop native bird declines are most telling in terms of what we have not done or have not done well. Here, effort must be expanded in the areas of funding, education, and ecotourism. The state of Hawai'i has spent some $23,396,715 in the past decade, mostly on providing management of reserves for saving critical bird habitat. Yet the figure for state-sponsored research is declining; it is thought to represent less than ½ of one percent of the total state budget in the current (1998) economy. Part of this decline is due to a lack of understanding and appreciation of the problem by the public and state legislatures. Part of it is due to harsh economic times; tourism is the state's main income generator and declines in the Far East economy and the Japanese tourist base in 1998 has resulted in hotel occupancy rates that have fallen 15% or more in recent months.

For management purposes, funding is needed to control predators; prevent fires, especially in El Niño years; and provide protection from ungulates and introduced and feral grazing animals. Federal management funds for which the state could compete if it had matching dollars go begging or go elsewhere. Although the state has recently provided funding to hire more law enforcement officers for management and oversight of marine fisheries resources, similar efforts are needed to protect natural ecosystems and endangered terrestrial species. Instead, the Hawaii Department of Land and Natural Resources has undergone budget cuts. These cuts come at a critical time for mounting unified efforts to understand and halt avian declines.

There is a great need to educate the public about Hawai'i's conservation problems. Excellent programs now exist in some of the elementary schools in the state. These programs should be identified, singled out for reward, and used as examples for other schools. Although education starts with the children, it should not end there because it will take the children at least a decade to reach voting age, when they make a difference by going to the polls. The remaining Hawaiian avifauna might very well go extinct in the waiting period. For this reason, effective adult education programs, perhaps led by state community colleges, and enhancement of existing conservation biology programs in local universities should be considered. An example is seen in *Miconia calvescens,* a highly competitive, invasive, South American plant (with the ability to replace native rain forest) that occurs on Maui. An education program on this island has mobilized the public to help eradicate the plant. The success of this program demonstrates how effective public education can be.

Much could be gained by recognizing and establishing the economic value of having rare bird species within relatively easy accessibility. This is an economic component that resource managers are either unaware of or have no way to assess. More than $50 million dollars was poured into promoting tourism in the state of Hawai'i in 1998. Little, if any, was used to promote the beautiful avifauna, although some was used to promote whale-watching. The Maui "Whalefest" is an example. Held in March, this event not only promotes whale-watching to tourists, but sponsors the "Lahaina Whalefest Essay" competition in which local high school students win opportunities to attend advanced courses on whales at Costeau Catalina Island Camp in California. Where the humpbacked whale (*Megaptera novaeangliae*) is making a comeback, the endemic avifauna is not with the exception of the Nēnē. Yet the Nēnē can be most easily seen, even occurring on golf courses in the state! Reports suggesting that birders and their organizations contribute hundreds of millions of dollars to local community economies with their birding visits need to be brought to the attention of local resource managers, tourism boards, and the Hawai'i Visitors Bureau. Figures published by the USFWS and others suggest that over $29.2 billion was spent as an industry output for watching wildlife in 1996, and the ripple

effect in America was over $85 billion. Already individual bird-watching guides take small parties into the mountains to see Hawai'i's rare avifauna and the state's Na Ala Hele Trail and Access program is planning on opening nearly 40 trails on four islands to limited commercial hiking tours. The Hawai'i Ecotourism Association is preparing a manual for use by ecotour hikers. The McCandless Ranch on the island of Hawai'i offers tours to see the rare 'Alalā and other native plants and birds, such as the Hawaiian 'Io (*Buteo solitarius*), the endemic subspecies of the Short-eared Owl (*Asio flammeus sandwichensis*), the 'I'iwi (*Vestiaria Coccinea*) and 'Elepaio. Studies need to be done to determine just how many tourists take time to bird in Hawai'i. Integration of economic need with the natural resource need could prove highly successful.

Effective management is not purely a textbook enterprise; it relies on and must integrate good science and the research that derives from it. Studies are needed on the population biology of alien birds and how they affect competition for food and nest sites, as well as disease transmission. We do not know if we need to control alien birds or not, yet these may have as large an impact as predatory rats, feral cats, and mongoose. If alien bird species undergo declines in frequency, it may be that these can serve as a harbinger of problems to come for native birds. Habitat protection on a larger geographical scale, assessment of current management practices, and population ecology of low-elevation populations deserve research attention.

The considerations mentioned herein suggest that an annual average research expenditure of $3.7–$3.8 million (Table 1) should continue if not increase. Given the educational component mentioned above, this figure needs to be expanded so that the role and nature of the educational component can be developed as well as studied. Unlike nongovernmental organizations like The Nature Conservancy, design of federal and state conservation programs, after recognizing an existing or potential problem, has rarely taken into consideration the need for public education. Yet the success of such programs are inherently related to the willingness of the public to support them and pay for them. P. Banko (pers. comm.) has pointed out that ". . . the amount spent . . . might seem astonishingly high . . . until the costs of other activities undertaken by society are considered. For example, $50 million was spent in one year to promote tourism in Hawai'i . . ." This provides a benchmark against which to compare amounts spent on research and education.

I suggested that given the need for avian restoration and the need for research, Hawai'i, with its defined island boundaries, high number of endemic endangered bird species that occur across a wide variety of ecosystems and habitats, and upscale tourist industry, presents a unique opportunity to build an integrated model of conservation and economics. Without such a model, the current expenditures on research may eventually become as extinct as the birds they are intended to save, as the public fails to grasp the moral, ethical, and economic importance of why their dollars need to be spent on understanding avian biology and on restoration of native birds.

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