



Integrated Conservation Strategy for Hawaiian Forest Birds

Author(s): Leonard A. Freed, Rebecca L. Cann, J. M. Scott, C. B. Kepler, C. van Riper III, C. Stone, S. I. Fefer

Source: *BioScience*, Vol. 39, No. 7, Renaissance of the Phenotype (Jul. - Aug., 1989), pp. 475-479

Published by: American Institute of Biological Sciences

Stable URL: <http://www.jstor.org/stable/1311141>

Accessed: 14/11/2008 17:08

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at <http://www.jstor.org/page/info/about/policies/terms.jsp>. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at <http://www.jstor.org/action/showPublisher?publisherCode=aibs>.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is a not-for-profit organization founded in 1995 to build trusted digital archives for scholarship. We work with the scholarly community to preserve their work and the materials they rely upon, and to build a common research platform that promotes the discovery and use of these resources. For more information about JSTOR, please contact support@jstor.org.



American Institute of Biological Sciences is collaborating with JSTOR to digitize, preserve and extend access to *BioScience*.

<http://www.jstor.org>

Integrated conservation strategy for Hawaiian forest birds

We compliment Scott et al. (*BioScience* 38: 238–253) on their statement of the problems associated with the conservation of Hawaiian birds. As they point out, few places have lost so large a proportion of their avifauna. The Hawaiian loss is especially significant because the forest passerines manifest a spectacular adaptive radiation involving divergence of beaks, foraging behavior, plumage coloration, and breeding biology (Grant 1986, Freed et al. 1987). We agree that the magnitude and diversity of problems with forest birds requires a variety of approaches for conservation. We are concerned, however, that Scott and his colleagues underestimate the full range of conservation efforts required for all these approaches, and they are incorrect in asserting that current knowledge of Hawaiian forest birds is adequate for the task of conserving them. Detailed biological knowledge has been important for conserving such notable birds as whooping cranes, Kirtland's warblers, Puerto Rican parrots, and red-cockaded woodpeckers (Temple 1977), but this information is not yet available for Hawaiian birds. All we know with certainty is that many Hawaiian birds have declined or become extinct even in apparently pristine forests (Munro 1944, Scott et al. 1986).

Scott and his colleagues focus on ecosystem management, equating the legal protection and preservation of ecosystems with the systems approach to conservation. This systems approach emphasizes large evolutionary units in the hope that common species will persist and rare species will recover. They do not single out any one species for managerial action,

an approach they call the "clinical approach" to conservation.

We agree that ecosystem management is essential as a first step, because most Hawaiian forest birds have greatly reduced distributions and are now limited to forested habitat at upper elevations. It is thus imperative that ecosystems at these elevations be legally protected and preserved to ensure that sufficient critical habitat exists to maintain viable bird populations. Moreover, knowledge is adequate for at least legal aspects of ecosystem protection. The comprehensive Hawaii Forest Bird Survey (Scott et al. 1986), which is indeed a "classic in conservation biology" (Pimm 1988), identified habitats and areas where native forest birds still exist in greatest abundance. This study thus sets an agenda for the acquisition of space to be set aside and managed as preserves, and for state, federal, and private agencies it clearly identifies habitats and species as conservation hot spots.

We feel, however, that Scott et al. (1988) have misrepresented a true systems approach to conservation. Such an approach, by first principles, must deal with all four levels of biological organization associated with biodiversity: genetic, population, community, and ecosystem levels. Conservation management is charged with preventing extinctions and preserving genetic diversity (Frankel and Soulé 1981). Therefore, conservation of any plant or animal ultimately involves management of populations and their associated gene pools.

Populations can be managed indirectly through preservation or enlargement of ecosystems or through preservation of communities by removing invasive alien species. Populations may also require direct control of the multitude of demographic and genetic factors that can cause small populations to decline or further lose

genetic variability and that can limit recovery. Such management may involve translocating individuals among populations in nature to maintain adequate size or genetic variability or to disperse genetic lineages discovered to have evolved resistance or tolerance to disease. Scott et al. (1988) make no mention of these actions. Captive breeding, which they do mention, is only the final application of genetic and population management to save species from imminent extinction.

A systems approach in Hawaii must take into account that most of the 22 species and subspecies of endangered forest birds exhibit small population size and fragmented distribution (Scott et al. 1986). Numerous conservation biologists have stressed the importance of genetic and population management in nature for species with these characteristics (Frankel and Soulé 1981, Lande 1988, Schonewald-Cox et al. 1983, Shaffer 1981, Soulé 1986, 1987). At the very least, intensive genetic management serves as a stop-gap measure to deal with inbreeding depression and loss of genetic variability, whereas intensive population management addresses population decline in relation to stochastic demographic and environmental fluctuations (Lande 1988).

Such "clinical" management also characterizes a research plan that identifies and attempts to solve the specific ecological problems causing the initial decline, which are not necessarily the same for each species. The claim by Scott et al. (1988) that a systems approach limited to ecosystem management is the only way to save Hawaiian birds for future generations is an underestimate of the biological problems related to the management of small populations. They assume that endangered species with small populations and fragmented

by Leonard A. Freed
and Rebecca L. Cann

distributions will automatically respond to habitat management.

Existing biological knowledge of Hawaiian forest birds is grossly inadequate to deal with small and fragmented populations and with ecological causes of decline. Scott et al. (1988, Table 3) list 31 species of native terrestrial birds. Integrated breeding and life-history studies with banded birds have been conducted with only three of these (Conant 1977, van Riper 1980, 1987), and there are at least six species (not counting subspecies on different islands) whose nests have never been discovered. No studies of genetic population structure exist.

In the absence of sufficiently detailed studies, the specific ecological and genetic links to population decline remain poorly understood in a few cases and completely unknown in most. Indeed, Scott et al. (1986) documented distributional anomalies, defined as unexpectedly low abundance or absence of a species in areas of seemingly appropriate habitat, for 21 species. For 14 of these species, the anomalies even exist at high elevations above the putative disease belt.

Hawaiian forest birds represent perhaps the greatest challenge to US conservation biology. Nowhere else in the United States are there so many endangered species, so little knowledge of basic biology, and so many potential causes of endangerment (Scott et al. 1986). The fact that many birds exhibit distributional anomalies or have declined or become extinct even in apparently pristine forests is *prima facie* evidence that ecosystem-level management is necessary but not sufficient. An integrated conservation strategy is required to save most species of forest birds.

These birds possess too much significance for biology to let conservationists be little more than passive observers of extinctions on protected land. Complementary genetic and population management, as part of a true systems approach to conservation in Hawaii, will require considerable funding for field stations, laboratories, and personnel to work in cold and wet Hawaiian rainforests. Great strides have been made in establishing a database related to needed ecosystem management as Scott et al. have stressed. We hope that comparable

efforts in a second generation of studies will enable biologists to manage small populations and assist in their recovery.

References cited

- Conant, S. 1977. The breeding biology of the Oahu elepaio. *Wilson Bull.* 89: 193–210.
- Frankel, O. H., and M. E. Soulé. 1981. *Conservation and Evolution*. Cambridge University Press, Cambridge, UK.
- Freed, L. A., S. Conant, and R. C. Fleischer. 1987. Evolutionary ecology and radiation of Hawaiian passerine birds. *Trends Ecol. & Evol.* 2: 196–203.
- Grant, P. R. 1986. *Ecology and Evolution of Darwin's Finches*. Princeton University Press, Princeton, NJ.
- Lande, R. 1988. Genetics and demography in biological conservation. *Science* 241: 1455–1460.
- Munro, G. C. 1944. *Birds of Hawaii*. Tongg, Honolulu, HI.
- Pimm, S. A. 1988. Review of *Forest Bird Communities of the Hawaiian Islands: Their Dynamics, Ecology, and Conservation* by J. M. Scott et al. (1986). *Auk* 105: 400–402.
- Schonewald-Cox, C., B. MacBryde, and L. Thomas, eds. 1983. *Genetics and Conservation*. Benjamin Cummings, Inc., Menlo Park, CA.
- Scott, J. M., C. B. Kepler, C. van Riper III, and S. I. Fefer. 1988. Conservation of Hawaii's vanishing avifauna. *BioScience* 38: 238–253.
- Scott, J. M., S. Mountainspring, F. L. Ramsey, and C. B. Kepler. 1986. *Forest Bird Communities of the Hawaiian Islands: Their Dynamics, Ecology, and Conservation*. *Studies in Avian Biology* No. 9.
- Shaffer, M. L. 1981. Minimum population sizes for species conservation. *BioScience* 31: 131–134.
- Soulé, M. E., ed. 1986. *Conservation Biology*. Sinauer Associates, Sunderland, MA.
- Soulé, M. E., ed. 1987. *Viable Populations for Conservation*. Cambridge University Press, Cambridge, UK.
- Temple, S. A., ed. 1977. *Endangered Birds*. University of Wisconsin Press, Madison.
- van Riper, C., III. 1980. Observations on the breeding of the palila *Psittirostra bailleui* of Hawaii. *Ibis* 122: 462–475.
- _____. 1987. Breeding ecology of the Hawaii common amakihi. *Condor* 89: 85–102.

Leonard A. Freed is an associate professor in the Department of Zoology, and Rebecca L. Cann is an assistant professor in the Department of Genetics, University of Hawaii, Honolulu, 96822. © 1989 American Institute of Biological Sciences.

To facilitate meaningful discussion of the articles appearing in *BioScience*, a new department—**BioFeedback**—presents extended comments and responses.

J. M. Scott, C. B. Kepler,
C. van Riper III, C. Stone,
and S. I. Fefer reply:

Freed and Cann have raised a major issue in conservation biology as well as specific points pertinent to Hawaii. We welcome the opportunity to readdress, in the Hawaiian context, a central challenge facing conservation biology today: how do we set priorities for research and management needs so as to allocate limited resources in the face of overwhelming stresses to nature's ecosystems? How much information do we *require* to effectively manage species, and what is the proper mix between research and management?

Pitelka (1981), Scott et al. (1987, 1988a), Stone (1989), and others have argued that continued species-by-species management will result in much more loss than with a systems approach that manages, *whenever possible*, for the survival of intact, self-sustaining native ecosystems. This seemingly self-evident perspective apparently suffers from lack of exposure and understanding. The differences of opinion between Scott et al. (1988b) and Freed and Cann on Hawaiian conservation can be reduced to a single question: do we currently know enough to begin to manage effectively the valuable natural resources of Hawaii? We believe we have the information to deal with many management problems with confidence.

Freed and Cann state that "all we know with certainty is that many Hawaiian birds have declined or become extinct even in apparently pristine forests." We agree that not everything is known regarding the life histories of Hawaii's native birds. However, the limited list of references that Freed and Cann provide to support their argument ignored many important papers. They stated that life histories of only three species have been studied using banded birds (Conant 1977, van Riper 1978, 1984). There are others. We found eight additional studies not cited by Freed and Cann involving ten species. Some of these studies lasted five years and used thousands of banded birds (Baldwin 1953, Banko and Manuwai 1982, Eddinger 1970, Griffin 1985,

Ralph in press, Sakai et al. 1986, Simons 1985).¹

In addition, there are many published papers documenting factors that limit the distribution and abundance of Hawaii's birds. These factors include habitat degradation by introduced ungulates (Scott et al. 1986, Spatz and Mueller-Dombois 1973, Stone 1985, Stone and Scott 1985), avian malaria in forest bird populations (van Riper and van Riper 1985, van Riper et al. 1986, Warner 1968), predation by feral cats (Munro 1944), predation by rats (Atkinson 1977) and mongooses (Banko and Manuwal 1982, Simons 1985), and competition with introduced species of birds (Mountainspring and Scott 1985).

Habitat loss as the direct result of man's activities (logging, conversion to agricultural or urban uses, and grazing by domestic cattle) has also had major impacts that have been quantified (Mueller-Dombois et al. 1981, Warshauer and Jacobi 1982).

With the exception of disease, many of these limiting factors can be controlled at least in some areas. We believe that the lack of native forest birds in the "apparently pristine forests" found at low elevation (Scott et al. 1986, van Riper et al. 1986, Warner 1968) is explained by the presence of avian malaria and pox. We therefore argue strongly for managing intact native ecosystems above the putative disease belt and restoring upland pastures to their former status of closed-canopy forests. The benefits to be derived from restoring upland forests—a 4- to 20-fold increase in bird density (Scott et al. 1986)—could include a doubling of several endangered forest bird populations, to say nothing of benefits to hundreds of endemic plants and invertebrates. Moreover, continued preservation of extant native forests in the lower elevations should provide habitat for native species if they develop immunogenic resistance to diseases presently in the islands.

We did not intend to detail the entire spectrum of necessary conservation efforts: this has been done elsewhere (Kepler et al. 1984, Scott et al. 1986, 1988a, Sincock et al. 1984).

Our objective was to select the major problems and management actions identified in the large amount of information compiled by research efforts of the last 20 years (Mueller-Dombois et al. 1981, Scott et al. 1986, Stone and Scott 1985).

The enormous biological stresses facing Hawaii's small populations of native birds and the staggering financial burden necessary to control them (well over \$15,000,000 has already been spent) requires at this juncture that scarce resources be applied in a manner that maximizes potential benefits, not only to birds but to entire ecosystems. In addition to the forest birds, there are hundreds of species of endemic gastropods, insects, and plants that all require immediate attention, and they are unlikely to benefit now from anything other than a systems approach.

Formally listing these species as endangered, let alone studying them all, will require several hundred years at current rates. Simply "acquiring and protecting" land to become "passive observers," as Freed and Cann suggest, is not what we advocate. In fact, we have specifically cautioned others against such a conservation strategy (Kepler and Scott 1985). Rather than restricting recommendations to legal protection of forest bird habitat, we have identified specific actions that could be taken to increase the numbers of forest birds now and in the future (Giffin et al. 1987, Kepler et al. 1984, Scott et al. 1984, Scott et al. 1983).

The restoration of upland forests will require an aggressive control program for alien ungulates, invertebrates, and plants, as well as the elimination of domestic stock from many of these areas (Scott et al. 1988b). The ambitious program we outline will require millions of additional dollars, increased public awareness and political will, and decades of hard work. If this is not accomplished, habitat losses will continue and "clinical management," which we and others discuss in great detail elsewhere (Carson 1989, Giffin 1989, Kepler et al. 1984, Scott et al. 1983, Scott et al. 1986, Temple 1977), and single-species research will no longer be an option for most species. However, we did stress the need for clinical management of

shearwaters and waterfowl in Hawaii, a practice that requires protected, managed habitat.

Freed and Cann noticed our lack of attention to translocation and genetic studies as management tools. We have addressed these problems in other works (Kepler et al. 1984, Scott et al. 1983, Scott et al. 1984, Scott et al. 1986, van Riper and Quinn 1988), identifying no fewer than 17 translocation possibilities (Scott et al. 1986). We must caution against optimism, however, because for 9 of the 14 species identified, the numbers available for translocation (Griffith et al. in press) are well below those needed, on average, for success. In several instances, the areas available to receive the birds are not optimal habitat, further reducing the chance of success.

We believe that successful translocations can only be accomplished if the first step, ecosystem preservation and management, is accomplished. However, if radiotagged birds are used in release programs that are treated as experiments, it might be possible to further knowledge of limiting factors, especially if releases are conducted in areas of known distributional anomalies (e.g., Hawaiian thrush translocated to Kohala Mountain on the island of Hawaii).

Detailed genetic studies of single species are not a viable option for perhaps 13 (61%) of Hawaii's 21 endangered forest birds, including olomao (*Myadestes lanaiensis*), nukupuu (*Hemignathus lucidus*), ou (*Psittirostra psittacea*), akialoa (*Hemignathus procerus*), Molokai creeper (*Paroreomyza flammea*), Oahu creeper (*Paraoreomyza maculata*), and pooouli (*Melamprosops phaeosoma*). Populations of these species are so low that it would be virtually impossible to study them. Yet these species could still benefit from ecosystem management.

We thus return to our major point. Because of the complex situation in Hawaii and the severe stresses placed on its native plants and animals, management must proceed now on the basis of facts already discovered about major stresses currently operating. Management is possible and capable of greatly improving numbers and survival chances of native species. Without this management, population

¹H. F. Sakai and C. J. Ralph, 1989, manuscript in preparation. US Forest Service, Arcata, CA.

studies will be lost as an option as populations of endangered species become vanishingly small, and as nonendangered populations become endangered. We do not have the time to undertake across-the-board clinical studies on the more than 1000 species of plants and animals in Hawaii currently stressed by long-term neglect at the ecosystem level. With limited dollars, emphasis on attractive and understandable clinical research is likely to exclude funds critical for more complex management actions. We must choose a course of action that will secure the greatest number of benefits for the species in the long run. Any other approach, if exclusive, will doom countless species to oblivion.

This same problem exists on national and international levels. Worldwide, anything less than a systems approach will almost certainly doom large numbers of species. Human disregard has proceeded so rapidly during the last two decades that we are now forced in many cases to protect ecosystems, rather than single species, if we are to save the greatest number of species for future generations. We are in need of an "endangered ecosystem act" to augment the guidance of the Endangered Species Act.

We agree completely with Freed and Cann that "These birds possess too much significance for biology to let conservationists be little more than passive observers of extinctions on protected land," and we add that it would be a shame if researchers failed to recognize that a number of the major limiting factors for Hawaii's native birds have been identified. Now we need to act on this information. We will always need more information and well-planned research, but we need to act now on the biologically and statistically defensible research results already obtained.

We think it would be a pity if those professing an interest in saving Hawaii's unique and fragile biota continued to delay management actions while they seek additional funding for research efforts, which in many cases amount to simply fine-tuning factors that are not among the main driving forces behind the continuing loss of species in Hawaii. We need instead to increase the management activities initiated by The Nature Conservancy,

other private conservation groups, and state and federal land owners, while we pursue those research efforts that will provide the information needed to better manage Hawaii's endemic species and communities.

References cited

- Atkinson, I. A. E. 1977. A reassessment of factors, particularly *Rattus rattus* L., that influenced the decline of endemic forest birds in the Hawaiian Islands. *Pacific Sci.* 31: 109-133.
- Baldwin, P. H. 1953. Annual cycle, environment, and evolution in the Hawaiian honeycreepers (Aves: Drepaniidae). *Univ. Calif. Publ. Zool.* 52: 285-398.
- Banko, P. C., and D. A. Manuwal. 1982. Life history, ecology, and management of Nene (*Branta sandvicensis*) in Hawaii Volcanoes and Haleakala national parks. Technical Report 82-3, Cooperative Park Study Unit. University of Washington, Seattle.
- Carson, H. L. 1989. Gene pool conservation. Pages 118-124 in C. P. Stone and D. B. Stone, eds. *Conservation Biology in Hawaii*. University of Hawaii Press, Honolulu, Hawaii.
- Conant, S. 1977. The breeding biology of the Oahu elepaio. *Wilson Bull.* 89: 193-210.
- Eddinger, C. R. 1970. A study of the breeding behavior of four species of Hawaiian honeycreeper (Drepaniidae). Ph.D. dissertation, University of Hawaii, Honolulu.
- Giffin, J. G. 1989. Captive propagation of birds. Pages 103-108 in C. P. Stone and D. B. Stone, eds. *Conservation Biology in Hawaii*. University of Hawaii Press, Honolulu, Hawaii.
- Giffin, J. G., J. M. Scott, and S. Mountainspring. 1987. Habitat selection and management of the Hawaiian crow. *J. Wildl. Manage.* 51: 485-494.
- Griffin, C. R. 1985. *Hawaiian Hawk Recovery Plan*. US Fish and Wildlife Service, Portland, OR.
- Griffith, B., J. M. Scott, J. W. Carpenter, and C. Reed. Translocations as a species conservation tool: status and strategy. *Science*, in press.
- Kepler, C. B., T. Burr, C. B. Cooper, D. Durnatchik, J. Medeiros, J. M. Scott, M. Ueoka, and W. Wong. 1984. *Maui-Molokai Forest Bird Recovery Plan*. US Fish and Wildlife Service, Portland, OR.
- Kepler, C. B., and J. M. Scott. 1985. Conservation of island ecosystems. Pages 255-271 in P. J. Moors, ed. *Conservation of Island Birds: Case Studies for the Management of Threatened Island Species*. ICBP Technical Publication no. 3. Plaston Press, Norwich, UK.
- Mountainspring, S., and J. M. Scott. 1985. Interspecific competition among Hawaiian forest birds. *Ecol. Monogr.* 55: 219-239.
- Mueller-Dombois, D., K. W. Bridges, and H. L. Carson, eds. 1981. *Island Ecosystems: Biological Organization in Selected Hawaiian Communities*. Hutchinson Ross, Stroudsburg, PA.
- Munro, G. C. 1944. *Birds of Hawaii*. Tongg, Honolulu, HI.
- Pitelka, F. A. 1981. The condor cases: an uphill struggle in a downhill crush. *Auk* 98: 634-635.
- Ralph, C. J. *Foraging Ecology and Population Dynamics of Some Hawaiian Forest Birds*. Western Foundation for Vertebrate Zoology, Los Angeles, CA. In press.
- Sakai, H. F., C. J. Ralph, and C. D. Jenkins. 1986. Foraging ecology of the Hawaiian crow, an endangered specialist. *Condor* 88: 211-219.
- Scott, J. M., J. K. Baker, A. J. Berger, E. Kosaka, L. Landgraf, C. J. Ralph, D. Woodside, R. Bachman, and T. Burr. 1983. *Hawaii Forest Bird Recovery Plan*. US Fish and Wildlife Service, Portland, OR.
- Scott, J. M., B. Csuti, J. D. Jacobi, and J. E. Estes. 1987. Species richness: a geographic approach to protecting future biological diversity. *BioScience* 37: 782-788.
- Scott, J. M., B. Csuti, K. Smith, J. E. Estes, and S. Caicco. 1988a. Beyond endangered species: an integrated conservation strategy for the preservation of biological diversity. *Endangered Species Update* 5: 43-48.
- Scott, J. M., C. B. Kepler, C. van Riper III, and S. I. Fefer. 1988b. Conservation of Hawaii's vanishing avifauna. *BioScience* 38: 238-253.
- Scott, J. M., S. Mountainspring, F. L. Ramsey, and C. B. Kepler. 1986. *Forest Bird Communities of the Hawaiian Islands: Their Dynamics, Ecology, and Conservation*. Studies in Avian Biology no. 9.
- Scott, J. M., S. Mountainspring, C. van Riper III, C. B. Kepler, J. D. Jacobi, T. A. Burr, and J. G. Griffin. 1984. Annual variation in the distribution, abundance, and habitat of the Palila (*Loxioides bailleui*). *Auk* 101: 647-664.
- Simons, T. R. 1985. Biology and behavior of the endangered Hawaiian dark-rumped petrel. *Condor* 87: 227-245.
- Sincock, J. L., R. E. Daehler, T. Telfer, and D. H. Woodside. 1984. *Kauai forest bird recovery plan*. US Fish and Wildlife Service, Portland, OR.
- Spatz, G., and D. Mueller-Dombois. 1973. The influences of feral goats on koa tree reproduction in Hawaii Volcanoes National Park. *Ecology* 54: 870-876.
- Stone, C. P. 1985. Alien animals in Hawaii's native ecosystems: towards controlling the adverse effects of introduced vertebrates. Pages 251-297 in C. P. Stone and J. M. Scott, eds. *Hawaii's Terrestrial Ecosystems: Preservation and Management*. University of Hawaii Press, Honolulu.
- Stone, C. P. 1989. Native birds. Pages 96-102 in C. P. Stone and D. B. Stone, eds. *Conservation Biology in Hawaii*. University of Hawaii Press, Honolulu.
- Stone, C. P., and J. M. Scott, eds. 1985. *Protection and Management of Terrestrial Hawaiian Ecosystems*. University of Hawaii Press, Honolulu.
- Temple, S. A., ed. 1977. *Endangered Birds: Management Techniques for Preserving Threatened Species*. University of Wisconsin Press, Madison.
- van Riper, C. III. 1978. The breeding ecology of the amakihi (*Loxops virens*) and palila (*Psittirostra bailleui*) on Mauna Kea, Hawaii. Ph.D. dissertation, University of Hawaii, Honolulu.
- _____. 1984. The influence of nectar re-

sources on nesting success and movement patterns of the common amakihi (*Jemignathus virens*). *Auk* 101: 38-46.

van Riper, C. III, and J. F. Quinn. 1988. Alternative views of reserve design for wildlife managers. *Transactions of the Western Section of the Wildlife Society* 24: 12-17.

van Riper, C. III, S. G. van Riper, M. L. Goff, and M. Laird. 1986. The epizootiology and ecological significance of malaria in Hawaiian landbirds. *Ecol. Monogr.* 56: 327-344.

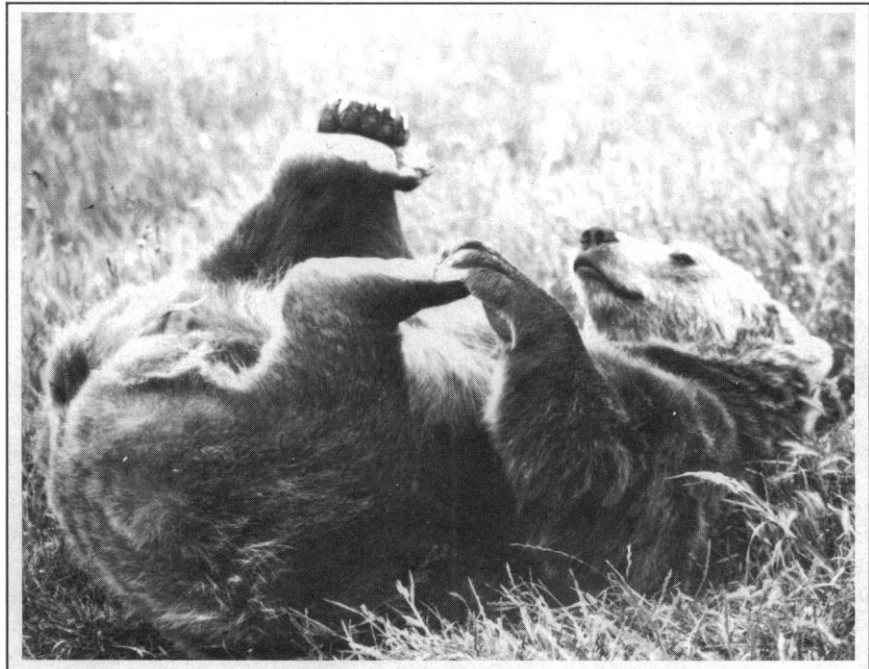
van Riper, S. G., and C. van Riper III. 1985. A summary of known parasites and diseases recorded from the avifauna of the Hawaiian islands. Pages 298-371 in C. P. Stone and J. M. Scott, eds. *Hawaii's Terrestrial Ecosystems Preservation and Management*. University of Hawaii Press, Honolulu.

Warner, R. E. 1968. The role of introduced diseases in the extinction of the endemic Hawaiian avifauna. *Condor* 70: 101-120.

Warshauer, F. R., and J. D. Jacobi. 1982. The distribution and status of *Vicia menziesii* spreng (Leguminosae): Hawaii's first officially listed endangered plant species. *Biol. Conserv.* 23: 111-126.

J. M. Scott, a US Fish and Wildlife Service employee, is the unit leader of the Idaho Cooperative Fish and Wildlife Research Unit, College of Forestry, University of Idaho, Moscow, 83843. C. B. Kepler is a research biologist with the Southeast Field Station of Patuxent Wildlife Research Center, US Fish and Wildlife Service, School of Forest Resources, University of Georgia, Athens, 30602. C. van Riper III is a research ecologist with the Cooperative National Parks Studies Unit and the Department of Wildlife and Fisheries Biology, University of California, Davis, 95616. C. Stone is a research scientist at the US National Park Service, Hawaii Volcanoes National Park, Hawaii National Park, 96718. S. I. Fefer is the refuge complex manager of the Hawaiian Islands and Wetlands Complex of National Wildlife Refuges, Pacific Islands Office, US Fish and Wildlife Service, Honolulu, 96850.

No Wild, No Wildlife.



Erwin and Peggy Bauer

Life in the wild can be pretty tough these days. Without the necessary habitat to live in, some species like the Grizzly Bears that inhabit Yellowstone National Park are severely threatened.

Over 80% of the national forest lands that border Yellowstone and are not specifically put out-of-reach for oil development, have been leased: habitat that the Grizzlies rely on, as do elk, moose and deer.

If their refuges are replaced with roads, oil rigs and gas pipelines, they

too will become victims of senseless and thoughtless development. The Sierra Club's work to protect public lands from development also helps preserve the habitat of these Grizzlies, saving the wilderness they need in order to survive.

To learn more about our work protecting endangered species such as the Grizzly Bear in Yellowstone or to take part in it through membership, please write us at: Sierra Club, 730 Polk Street, San Francisco, CA 94109, (415) 776-2211.

**SIERRA
CLUB**