

The 1998 Hawai'i Conservation Conference

July 30-31, 1998
Honolulu, Hawai'i

Sponsored by the Secretariat for Conservation Biology

The annual Hawai'i Conservation Conference is the largest gathering of people actively involved in the protection and management of Hawaii's native species and ecosystems. The purpose of the conference is to facilitate interaction among resource managers, educators and the scientific community. It is an opportunity to discuss and obtain up-to-date information on a variety of conservation activities in Hawai'i. It is also a time to see old friends, meet new colleagues and form new partnerships.

Please join us in welcoming the Honorable Governor Cayetano, who can be proud of the dedication and accomplishments of Hawaii's conservation community in protecting and managing a truly unique part of the United States and the world. Our keynote speaker, Hal Salwasser, will help us shape a vision of Hawaii's future that embraces a dynamic world and serves the needs of people and nature.

Presentations at this year's conference highlight the enhanced understanding and progress towards ecosystem restoration, native species recovery, alien species control, ecological economics and successful public awareness campaigns. This improved knowledge will provide us with the necessary tools for preventing the future endangerment of additional species and ecosystems. We also bring you a multitude of poster presentations in the 'Iolani Suites and encourage you to visit the poster exhibit room during the entire conference.

Following the lead of previous year's conferences, concurrent panels are offered to discuss four distinct conservation issues: community participation and volunteerism in resource management; dry forest recovery efforts; conservation benefits of certifying sustainable forestry; and a strategic approach to native invertebrate conservation. These issues were selected from a wide variety that you submitted in response to our request for ideas. A plenary speaker will introduce each issue, prior to dividing into the four separate panels.

Current initiatives and accomplishments in conservation by organization are presented in the conference booklet to provide you with up-to-date information on conservation activities in Hawai'i. To help plan future conferences, there is an evaluation form in the conference booklet for participants to fill out. Please do so and turn it in before you leave.

Mahalo for your support and participation.

Conference Organizing Committee:

Tonnie Casey, Kamehameha Schools Bishop Estate

Luisa Castro, Secretariat for Conservation Biology

Athline Clark, State Department of Land and Natural Resources

Curtis Ewing, Ecology, Evolution and Conservation Biology Program, University of Hawai'i

Nancy Glover, Secretariat for Conservation Biology

Roy Kam, The Nature Conservancy of Hawai'i

Steve Miller, US Fish and Wildlife Service

Cliff Morden, University of Hawai'i, Center for Conservation Research and Training

Carol Terry, State Department of Land and Natural Resources, Division of Forestry and Wildlife

Francis Villablanca, University of Hawai'i, Center for Conservation Research and Training

Bethany Woodworth, US Geological Survey, Biological Resources Division

TAPA CONFERENCE CENTER

Plenary Sessions ~ Tapa Ballrooms 2/3

Concurrent Panels ~ Honolulu Suites

Lunch ~ Tapa Ballroom 1

Poster Session ~ 'Iolani Suites

Evening Photographic Presentation ~ Tapa Ballrooms 2/3

Restrooms ~ Across 'Iolani Suite 3

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PLENARY PANELS

The Research/Management Interface: Bringing Basic Research into the Applied Arena

The panel is composed of individuals who represent various points along a continuum from the conduct of basic research to the implementation of hands-on management programs. Each panelist will outline his thoughts on: 1) how researchers can contribute more directly and efficiently to the design and implementation of management actions, 2) how managers can communicate their research needs to researchers and keep up-to-date on recent relevant research, and 3) how research results can be quickly and effectively integrated into management actions. Discussion with and questions from the audience is encouraged.

Moderator:

Sheila Conant, Department of Zoology, University of Hawai‘i at Mānoa

Panelists:

Randy Bartlett, Maui Pineapple Company

David Duffy, Cooperative Parks Studies Unit, Department of Botany, University of Hawai‘i at Mānoa

Bob Hobdy, State Department of Land and Natural Resources, Division of Forestry and Wildlife

Larry Katahira, Hawai‘i Volcanoes National Park, Resource Management Division

Bob Kinzie, Department of Zoology, University of Hawai‘i at Mānoa

Lloyd Loope, USGS Biological Resources Division, Pacific Islands Ecosystem Research Center

How Recovery Plans Can Be More Relevant and Useful to Managers

The panel is composed of US Fish and Wildlife staff, who are responsible for developing recovery plans, and land managers, who are often responsible for implementing plans. Unfortunately, while many recovery plans have been used by various individuals and agencies, a general consensus is that most plans sit on shelves. For this reason, the recovery handbook is currently under revision and US Fish and Wildlife staff are seeking ideas on how to improve plans or possible alternatives to recovery plans. Panelists will give an overview of the requirements and value that recovery plans have for funding, how plans are currently used, and how they may be improved and developed to be more useful for conservation efforts. Discussion with and questions from the audience is encouraged.

Moderator:

Scott Johnston, US Fish and Wildlife Service, Division of Endangered Species, Washington DC

Panelists:

Vicki Finn, US Fish and Wildlife Service, Ecological Services, Portland Regional Office

Karen Rosa, US Fish and Wildlife Service, Ecological Services, Pacific Islands Ecoregion

Carol Terry, State Department of Land and Natural Resources, Division of Forestry and Wildlife

Keith Unger, McCandless Land and Cattle Company

Mark White, The Nature Conservancy of Hawai‘i

PROGRAM

Thursday, July 30, 1998

- 8:00 a.m. Welcome: *Nancy Glover, Secretariat for Conservation Biology*
- 8:10 a.m. *Opening Address: **The Honorable Governor Cayetano***
- 8:20 a.m. *Keynote Address: Coming Face-to-Face With Sustainability*
Hal Salwasser, USDA Forest Service, Pacific Southwest Research Station
- 9:00 a.m. Natural Resources Management: Islands as Microcosms
Katherine C. Ewel, USDA Forest Service, Institute of Pacific Islands Forestry
- 9:30 a.m. Environmental Valuation and The Hawaiian Economy Initiative
Jim Roumasset, Department of Economics, University of Hawai'i at Mānoa
- 10:00 a.m. BREAK
- 10:30 a.m. The Northwest Forest Plan: Lessons in Adaptive Management and Interagency Collaboration
Michael W. Collopy, USGS BRD Forest and Rangeland Ecosystem Science Center
- 11:00 a.m. *Panel: The Research/Management Interface: Bringing Basic Research into the Applied Arena*
- 12:15 p.m. LUNCH
- 1:30 p.m. *Panel: How Recovery Plans Can Be More Relevant and Useful to Managers*
- 3:00 p.m. BREAK

Ecosystem Planning and Restoration

Moderator: Sam Gon III, The Nature Conservancy of Hawai'i

- 3:40 p.m. Conservation of Hawaii's Biota in the 21st Century: How Can We Get There From Here?
James D. Jacobi, US Geological Survey, Biological Resources Division
- 4:00 p.m. Restoration of a Closed Faya Tree Stand: A Collaboration Between Management and Research with Unexpected Results
Rhonda Loh, Hawai'i Volcanoes National Park, Resources Management Division
- 4:20 p.m. Protecting Native Hawaiian Forest Through a Unique Partnership
Peter MacDonald, Kulani Correctional Facility
- 4:40 p.m. Conservation Management in Hanawī Natural Area Reserve: A 25-Year Perspective and Future Directions
Betsy H. Gagne, State DLNR Division of Forestry and Wildlife
- 5:30 p.m. Poster Session: Authors will attend their posters. No-host bar and pupus available.
- 8:00 p.m. *Hawaii's Endangered Species: Don't Say Good-Bye*
A photographic excursion through the world of endangered species in Hawai'i by
David Liittschwager and **Susan Middleton**, North American Endangered Species Project

Friday, July 31, 1998

7:00 a.m. Wildlife Society Annual Meeting: Honolulu Suite #3, Tapa Tower.

Public Awareness

Moderator: Aulani Wilhelm, State Department of Land and Natural Resources

8:00 a.m. The Silent Invasion: A Partnership Approach to Successful Public Awareness
Grady Timmons, The Nature Conservancy of Hawai'i

8:20 a.m. Non-Traditional Approaches to Public Awareness: The Maui Forest Bird Education Project
Maile Sakamoto, State DLNR Division of Forestry and Wildlife

Invertebrates

Moderator: Curtis Ewing, UH Ecology, Evolution and Conservation Biology Graduate Program

8:40 a.m. Parasitism of Endemic *Cydia* Caterpillars (Lepidoptera: Tortricidae) Found in Māmane Seedpods (*Sophora chrysophylla*) on Mauna Kea, Hawai'i
Peter T. Oboyski, US Geological Survey, Biological Resources Division

9:00 a.m. A Genetic Approach to Invertebrate Conservation: Two Case Studies-Onychophora and Mollusca
Dianne Gleeson, Manaaki Whenua Landcare Research New Zealand Ltd.

CONCURRENT PANELS

9:20 a.m. Introduction to Concurrent Panels (refer to panel descriptions on page 8 & 9)

Invertebrate Conservation in Hawai'i: Developing a Strategy
Greg Brenner, US Geological Survey, Biological Resources Division

Community Participation and Volunteerism in Resource Management
Athline Clark, State Department of Land and Natural Resources

Dry Forest Recovery Efforts
Marie Bruegmann, US Fish and Wildlife Service

Certifying Sustainable Forestry: Benefits to Conservation
Michael Buck, DLNR Division of Forestry and Wildlife

9:40 a.m. BREAK

10:00 a.m. Concurrent Panels

12:00 p.m. LUNCH
Presentation of the Secretariat for Conservation Biology's Distinguished Service Awards

Alien Species Impacts and Control

Moderator: Alan Holt, The Nature Conservancy of Hawai'i

- 1:30 p.m. Population Structure and Movement Patterns of Black (*Rattus rattus*) and Polynesian (*Rattus exulans*) Rats in a Hawaiian Wet Forest
Gerald D. Lindsey, US Geological Survey, Biological Resources Division
- 1:50 p.m. Response of Forest Bird Populations to Predator Control in a Hawaiian Rainforest
Bethany L. Woodworth, US Geological Survey, Biological Resources Division
- 2:10 p.m. Alien Pest Plant Control: Lessons from New Zealand
Pat Bily, The Nature Conservancy of Hawai'i
- 2:30 p.m. Utilizing Tree Farming Techniques to Increase Efficiency and Effectiveness in Managing Lands for Conservation Values
Peter D. Simmons, Kamehameha Schools Bishop Estate
- 2:50 p.m. BREAK

Alien Species Impacts and Control (cont.)

Moderator: Bill Steiner, US Geological Survey, Biological Resources Division

- 3:30 p.m. An Overview of Recent Advances in Brown Tree Snake (*Boiga irregularis*) Research
Earl Wm. Campbell, USDA APHIS National Wildlife Research Center
- 3:50 p.m. Feral Ungulate Movement and Home Ranges, Pōhakuloa Training Area, Island of Hawai'i
Jeremy Gooding, Hawai'i Volcanoes National Park, Resources Management Division
- 4:10 p.m. New Frog Introductions to Hawai'i: Current Status, Likely Impacts, and Prospects for Control
Fred Kraus, DLNR Division of Forestry and Wildlife
- 4:30 p.m. CLOSING

CONCURRENT PANELS

Invertebrate Conservation in Hawai‘i: Developing a Strategy

Location: Honolulu Suite # 1

Panelists will discuss the various approaches (species, habitat and ecological) to invertebrate conservation, as well as priority setting criteria for each approach. Recommendations will be made towards developing a comprehensive native invertebrate conservation plan for Hawai‘i, including methodologies for measuring success.

Moderator:

Greg Brenner, USGS Biological Resources Division, Pacific Islands Ecosystem Research Center

Panelists:

Adam Asquith, US Fish and Wildlife Service

David Foote, USGS Biological Resources Division, Pacific Islands Ecosystem Research Center

Rosemary Gillespie, Center for Conservation Research and Training, University of Hawai‘i at Mānoa

Dianne Gleeson, Manaaki Whenua - Landcare Research New Zealand Ltd.

Frank Howarth, Bishop Museum

Community Participation and Volunteerism in Resource Management

Location: Honolulu Suite # 3

Panelists will discuss the pros and cons of working with volunteers, and explore some of the innovative ways volunteer programs have been developed. Each panelist will review some of their most noteworthy volunteer projects, and discuss their greatest challenges in working with volunteers. Panelists will also discuss how they recruit volunteers, why people are interested in volunteering, and how to keep volunteers motivated.

Moderator:

Athline Clark, State Department of Land and Natural Resources

Panelists:

Curt Cotrell, State Department of Land and Natural Resources, Division of Forestry and Wildlife

Eric Enos, Cultural Learning Center at Ka‘ala

Reese Liggett, Sierra Club Hawai‘i Chapter

Kate Reinard, Koke‘e Natural History Museum

Dry Forest Recovery Efforts

Location: Honolulu Suite # 2

The moderator will review the former and current distribution of Hawaii's dry forests, discuss historic and current threats, and examine the need to recover diverse and functional dry forest ecosystems. Individual panelists will follow with an overview of their dry forest recovery project, which will also be distributed as a one-page summary. Projects to be discussed include: Kaupulehu (Big Island), Keālia (O'ahu), Kaho'olawe, Auwahi (Big Island), and Kanaio (Maui). The panel will then be opened for a question/answer session with the audience.

Moderator:

Marie Bruegmann, US Fish and Wildlife Service

Panelists:

Bob Cabin, USDA Forest Service, Institute of Pacific Islands Forestry
Bill Garnett, State Department of Land and Natural Resources, Division of Forestry and Wildlife
Paul Higashino, Kaho'olawe Island Reserve Commission
Art Medeiros, USGS Biological Resources Division, Pacific Islands Ecosystem Research Center
Trae Menard, Hawai'i Army National Guard

Certifying Sustainable Forestry: Benefits to Conservation

Location: Tapa Ballroom 2/3

Panelists will discuss the latest trends in forest certification and its relationship to sustainable forest management. Applications for Hawai'i will be discussed with a specific analysis presented of upland koa forest fragmentation, and the potential to restore forest bird habitat on the island of Hawai'i. The current status of the MacArthur grant received to develop a forest certification process for Hawai'i will be described.

Moderator:

Michael Buck, State Department of Land and Natural Resource, Division of Forestry and Wildlife

Panelists:

Alan Holt, The Nature Conservancy of Hawai'i
Catherine Mater, Mater Engineering Ltd.
Jim Quinn, CEO Collins Pine
Peter Simmons, Kamehameha Schools Bishop Estate

POSTER SESSION

Posters are located in the 'Iolani suites (one through seven) and are grouped into one of the following categories:

- I. Management Approaches
- II. Partnerships and Public Participation
- III. Alien Invasion
- IV. Native Species and Ecosystems
- V. Economic Valuation
- VI. Maps and Models

In the following list, posters are listed by title within each category. They are presented in alphabetical order by primary author. The number before each title refers to the location of the poster in the 'Iolani suites – refer to the map following this list.

I. MANAGEMENT APPROACHES

- 3** Evaluating Relations among Physical, Chemical, and Biological Characteristics of Streams on O'ahu.
Anne M. Brasher and Stephen S. Anthony, US Geological Survey, Water Resources Division.
- 4** Hāhā (*Cyanea superba*), An Example of Army Endangered Species Management.
Mathew Burt, Alvin Char, Vince Costello, Jordan Jokiel, Kapua Kawelo, Steven Kim and Joby Rohrer, US Army Garrison Hawai'i, Environmental Division.
- 5** Preservation and Restoration of a Native Hawaiian Dry Forest.
Robert J. Cabin, USDA Forest Service, Lisa Hadway, University of Hawai'i at Mānoa, David Lorence, National Tropical Botanical Garden, and Stephen Weller, University of California, Irvine.
- 6** A Review of Wildlife Damage Management Techniques Developed for Use in Agriculture that could be Used for Endangered Species Conservation.
Earl Campbell, Mike Fall, Bob Sugihara, Ann Koehler, USDA APHIS National Wildlife Research Center.
- 7** Recovery Efforts for the Endangered Po'ouli (*Melamprosops phaeosoma*).
Mark Collins, Fern Duvall, Jim Kowalsky, Jamie Bruch, Peter Dunlevy, Sharon Reilly, Valerie Stein and Jennifer Turner, State Department of Land and Natural Resources, Division of Forestry and Wildlife.
- 8** Ground Based Predator Control Efforts to Protect the Po'ouli (*Melamprosops phaeosoma*) and Other Endangered Forest Birds in the Hanawī Natural Area Reserve.
Peter Dunlevy, Mark Collins, Jim Kowalsky, Jamie Bruch, Valerie Stein, and Jennifer Turner, State Department of Land and Natural Resources, Division of Forestry and Wildlife.
- 9** Developing Techniques for Restoring Palila (*Loxioides balleui*).
Elizabeth Gray, Paul Banko, Steven Dougill, Daniel Goltz, Luanne Johnson, Peter Oboyski, John Semones, and Michael Wiley, USGS Biological Resources Division, Pacific Islands Ecosystem Research Center.
- 10** Ecosystems Management of the Pōhakuloa Plain, Island of Hawai'i.
Scott Henderson, Steve Evans, Lena Schnell, Kathleen Sherry, and Laila Tamimi, US Army Garrison Hawai'i, Environmental Office, Pōhakuloa Training Area.
- 11** Success of *Miconia Calvescens* Control on the Island of Hawai'i.
Nelson Ho and Kim Tavares, State Department of Agriculture, Big Island Melastome Action Committee, Operation Miconia.

- 12 Use of Salt Water to Control Non-Native Plants in a Coastal Strand Community.
Janelle Ishida, Kalaupapa National Historic Park.
- 13 ‘Alalā (*Corvus hawaiiensis*) Restoration Through Captive Propagation.
Paul Oesterle, Peter Harrity, Tracey Powers, Joop Kuhn, Marla Kuhn, The Peregrine Fund, Donna Ball, John Klavitter, and Ken Clarkson, US Fish and Wildlife Service.
- 14 Kahanahāiki Gulch Ecosystem Management.
Joby Rohrer, Matthew Burt, Alvin Char, Vince Costello, Jordan Jokiell, Kapua Kawelo, and Steven Kim, US Army Garrison Hawai‘i, Environmental Division.
- 15 Controlling Mosquitoes (*Culex quinquefasciatus*) in Remote Forest Habitats: A Management Study.
Nicholas Shema, Carter Atkinson, Julie Lease and Beth Drake, USGS Biological Resources Division, Pacific Islands Ecosystem Research Center.
- 16 Hawaii’s Wetlands Management Policy – Challenges and Strategies.
Sarah Young, June Harrigan, and Glen Fukunaga, State Department of Health, Environmental Planning Office.

II. PARTNERSHIPS AND PUBLIC PARTICIPATION

- 17 Kaua‘i Montane Bog Protection and Public Education.
Marie M. Brugemann, Christine Willis, Dave Hopper, Mick Castillo and Lorena Wada, US Fish and Wildlife Service.
- 2 The Secretariat for Conservation Biology: Mission, Goals and Activities.
Luisa F. Castro and Nancy Glover, Secretariat for Conservation Biology, University of Hawai‘i at Mānoa.
- 18 Project Stewardship: Promoting Community Participation in Conservation.
Jennifer Crummer and Pauline Sato, The Nature Conservancy of Hawai‘i.
- 19 Incorporation of Current Conservation Research and Personnel into Camp Erdman’s Outdoor Environmental Education Programs.
Justin Culley, YMCA Camp Erdman.
- 1 US Fish and Wildlife Service: Partnering in the Pacific.
Ann B. Hudgins, US Fish and Wildlife Service.
- 20 Farm Bill Programs: Synergy of Agriculture and Conservation in Hawai‘i.
Terrell Kelly and Shirley Nakamura, USDA Natural Resources Conservation Service.
- 21 Native Hawaiian Plant Society, Cooperating to Maintain Native Species and Habitats.
Lisa Raymond, Native Hawaiian Plant Society.
- 22 Presenting a Master Plan for the Maui Botanical Gardens.
Lisa Raymond, Maui Nui Botanical Gardens, Inc.
- 23 The Role of Citizen Enforcement of the Endangered Species Act in Hawai‘i: A 25-year Perspective.
Marjorie Ziegler, Earthjustice Legal Defense Fund.

III. ALIEN INVASION

- 24 Recent Replacement of Native Pili Grass (*Heteropogon contortus*) by Invasive African Grasses in the Hawaiian Islands.
Debbie Carino and Curtis Daehler, Department of Botany, University of Hawai'i at Mānoa.
- 25 Comparative Reproductive Biology of a Native Grass and its Alien Competitor in Hawai'i.
Erin Goergen and Curtis Daehler, Department of Botany, University of Hawai'i at Mānoa.
- 26 How far Can You Fly?: Mosquito (*Culex quinquefasciatus*) Dispersal in Closed-Canopy Forest.
Dennis La Pointe, Carter Atkinson, Julie Lease, and Nicholas Shema, USGS Biological Resources Division, Pacific Islands Ecosystem Research Center.
- 27 Avian Disease and Potential Transmission at Two Sites in Hakalau Forest Wildlife Refuge.
Julie K. Lease, Carter T. Atkinson, Dennis La Pointe and Nicholas Shema, USGS Biological Resources Division, Pacific Islands Ecosystem Research Center.
- 28 Unseen Infestation: The Seed Bank of Miconia (*Miconia calvescens*).
Earlene L. Wilson, University of Hawai'i at Hilo, Hawaiian Internship Program and USDA Forest Service, Institute of Pacific Islands Forestry.

IV. NATIVE SPECIES AND ECOSYSTEMS

- 29 Investigations of Koa (*Acacia koa*) Decline in Hawaiian Forests.
Robert Anderson, Cooperative Parks Study Unit, Department of Botany, University of Hawai'i at Mānoa, and Donald Gardner, USGS Biological Resources Division, Pacific Island Ecosystems Research Center.
- 30 Assessment of a Crayfish (*Procambarius clarkii*) Kill Concerning in Mānoa Stream, O'ahu, Hawai'i
Hedy Elaine Hager, Marine Option Program, University of Hawai'i at Mānoa
- 31 Morphological and Molecular Systematics of the Hawaiian Damselfly Genus *Megalagrion*: Implications for Conservation.
Steve Jordan, Jennifer Morris, Chris Simon, University of Connecticut, and Dan Polhemus, National Museum of Natural History, Smithsonian Institution.
- 32 Habitat Use by the Endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) on the Island of Hawai'i.
Theresa Menard, Department of Zoology, University of Hawai'i at Mānoa.
- 33 Natural History and Conservation Observation of a Hawaiian Spinner Dolphin (*Stenella longirostris*) Resting Site on the Wai'anae Coast of O'ahu.
Suchi Psakaros and Ken Marten, Earthtrust.
- 34 Seed Rain in Abandoned Sakau (*Piper methysticum*) Plots and Closed-Canopy Rainforest on Phonpei, Federated States of Micronesia.
Lisa Winthrop and Nora Devoe, New Zealand School of Forestry, University of Canterbury.
- 35 Practical Medium-Term Storage of Native Plant Seeds.
Alvin Yoshinaga, Center for Conservation and Research Training, University of Hawai'i at Mānoa.

V. ECONOMIC VALUATION

- 36 Contingent Value of Kailua Bay Water Quality.
Richard L. Bowen and Carol A. Ferguson, Department of Agriculture and Resource Economics, University of Hawai'i at Mānoa.
- 37 Land Use Allocation and Non-Market Benefits: O'ahu, Hawai'i.
Gary Vieth and Linda Cox, Department of Agriculture and Resource Economics, University of Hawai'i at Mānoa.

VI. MAPS AND MODELS

- 38 A Model of Land Use Preference: Open Space in Hawai'i.
Linda Cox, Gary Vieth, and Carol Ferguson, Department of Agriculture and Resource Economics, University of Hawai'i at Mānoa.
- 39 Water Balance of a Montane Cloud Forest Treeline During a Rainless Period.
Trae Menard, Hawai'i Army National Guard, Environmental Section, and Tom Giambelluca, Department of Geography, University of Hawai'i at Mānoa.
- 40 The Hawaiian High Islands Ecosystem.
Dan Dorfman, Dwight Matsuwaki, and Sam Gon, The Nature Conservancy of Hawai'i.

POSTER SESSION ~ 'IOLANI SUITES

ABSTRACTS

(alphabetical order)

Robert C. Anderson¹ and Donald E. Gardner²

¹Cooperative Park Studies Unit, Department of Botany, University of Hawai'i at Mānoa, 3190 Maile Way, Honolulu, HI 96822

²US Geological Survey, Biological Resources Division, Pacific Islands Ecosystem Research Center, 3190 Maile Way, Honolulu, HI 96822

INVESTIGATIONS OF KOA (*Acacia koa*) DECLINE IN HAWAIIAN FORESTS. Koa (*Acacia koa*) is an endemic Hawaiian tree that serves as a keystone species in upland forests. It is second only to 'ōhi'a-lehua (*Metrosideros polymorpha*) in overall abundance of native overstory trees. Koa stands provide habitat for endemic understory plants, as well as many endemic insects and birds. An unexplained decline resulting in death of koa trees of all age and size classes has been observed over the past several years in both natural forests and agroforestry settings. The decline is often evident in patches, suggesting centers of decline, in which otherwise vigorous trees begin to wilt, develop chlorotic leaves, and die soon after the onset of symptoms. Previous study of the problem indicated that a seedborne vascular wilt fungus (*Fusarium oxysporum* f. sp. *koa*), pathogenic to koa seedlings, was associated with seed collected from healthy trees, and may be related to the current decline. In further studies, this fungus has been isolated from roots of dying koa and from healthy trees. Root samples (1-2 cm diameter) were collected from both dying and apparently healthy trees in the Mauna Loa strip areas of Hawai'i Volcanoes National Park. Roots were surface sterilized using standard methods, sectioned, and plated in petri dishes on 2% water agar. Following a short incubation of 3 to 5 days, *F. oxysporum* f. sp. *koa* was consistently isolated from the vascular tissue of dying and healthy roots. Greenhouse inoculations of koa seedlings confirmed pathogenicity and virulence of these isolates. The results suggest a close association between koa and this fungus, and a role of the pathogen in shaping koa stand dynamics under environmental and edaphic conditions favorable for disease development.

Pat Bily

The Nature Conservancy of Hawai'i, Maui Preserves, PO Box 1716, Makawao, HI 96768

ALIEN PEST PLANT CONTROL: LESSONS FROM NEW ZEALAND. New Zealand's progress in addressing 'environmental weeds' offers Hawai'i the advantage to project that same focus towards protection of our threatened natural areas. Hawai'i is somewhat a microcosm of New Zealand, not only similar in its' vulnerable endemic species, but in many of the invasive plants as well. Although the scale of management of these pests is much larger in New Zealand, it is virtually the same battle being waged. However encouraging it is to realize that Hawaii's weed managers share much in common with New Zealand, there are profound differences that should be examined: the enactment of the Biosecurity Act, including the responsible development of an enforcement means; and the relative pride many Kiwis have for their 'native bush'. Compared to Hawaii's people, I found that in my interactions with lay people, many in New Zealand knew their native plants and attached an intrinsic value to their native forests. Therefore, when a case is presented as threatening to the native bush (e.g. possums, wild ginger), the populace is more easily convinced that control of these pests is justified. Generally, New Zealand has a tradition of taking pride in natural areas, fostered by a comparatively insular society. In contrast, Hawaii's values reflect a population of transplants, appearing as a bridge between eastern and western cultures. Values for native bush are often replaced by a perspective that 'gaps' in Hawaiian biota (snakes, parrots, mammals, showy tropical plants) should be filled. This homogenization value is an ongoing hurdle for environmental educators in Hawai'i to overcome. While Hawai'i is making progress involving landowner participation in weed management, there is a lack of clarity in the list of target species, as well as which agency is responsible for controlling them. Through the Biosecurity Act, New Zealand's National Surveillance List (for invasive plants) provides a framework from which the Regional Councils operate to administer compliance of the Act. Hawaii's only acting authority being a severely understaffed Department of Agriculture leaves us without a regulating body, even if we had a mandate like Biosecurity Act. Regulation and enforcement are key to basing any realistic strategies and actions. Improvements are being made to border control issues to stop new introductions, but many of the incipient and established environmental weeds are being dealt with at the 'border' of our natural areas. Groups like the Maui Invasive Species Committee are attempting to involve diverse participation from landowners, business, and government to address prevention and early containment issues. Although New Zealand is still in the early stages of developing and implementing a National Weed Control Strategy, they have laid the groundwork for others interested in following a comprehensive program that considers invasive plants on such a grand scale.

Richard L. Bowen and Carol A. Ferguson

Department of Agricultural and Resource Economics, University of Hawai'i at Mānoa, 3050 Maile Way, Honolulu, HI 96822

CONTINGENT VALUE OF KAILUA BAY WATER QUALITY. Beaches are an importance source of recreation for residents and tourists. When the quality of water near beaches is degraded by sewage spills or sediments and nutrients from upland sources, the quality of life for residents and the attractiveness of the islands as a tourist destination declines. A contingent valuation survey of water quality problems at Kailua Beach was conducted in 1993 to estimate the magnitude of economic damages that can result from pollution of our recreational waters. A little less than half of those surveyed lived in the Kailua area. The rest were mostly from other parts of O'ahu or from the mainland US. Kailua residents were well aware of water quality problems at Kailua Beach which occur after heavy rains. A greenish scum occasionally observed is an algae bloom due to greater nutrients in the water. Some beach users attribute skin diseases, ear-aches, and streptococcus infections to coastal water pollution. Our survey asked people how much their household would be willing to pay to keep the water at Kailua Beach clean all the time. For those who accepted the theoretical payment scheme, O'ahu residents were willing to pay an average of \$1.67 per beach trip for clean water, while visitors were willing to pay an average of \$1.33 per trip. The total value of keeping Kailua Beach water clean is estimated to be \$340,000 per year. The survey revealed deep skepticism that government can or will solve the problems. This supports the case for more community involvement in monitoring, public education, and environmental remediation activities.

Anne M. Brasher and Stephen S. Anthony

US Geological Survey, Water Resources Division, 677 Ala Moana Boulevard Suite 415, Honolulu, HI 96813

EVALUATING RELATIONS AMONG PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS OF STREAMS ON THE ISLAND OF O'AHU. To address the need for consistent and scientifically sound information for managing the nation's water resources, the US Geological Survey began the National Water Quality Assessment (NAWQA) Program in 1991. This program is unique when compared with other national water quality assessment studies in that it integrates the monitoring of the quality surface and ground waters with the study of aquatic ecosystems. The island of O'ahu is the setting for one of 13 NAWQA studies that began in Federal fiscal year 1997. At sites on Mānoa, Waiakeakua (tributary to Mānoa), Waikele, Kipapa (tributary to Waikele) and Kahana streams, selected physical, chemical and biological characteristics will be monitored over a three-year period. Water column studies will describe physical and chemical characteristics, including suspended sediment, major ions, nutrients, organic carbon, and dissolved pesticides, and their relation to hydrologic conditions, sources, and transport. Bed sediment and tissue analysis studies will assess the occurrence and distribution of trace elements and hydrophobic organic contaminants. A spatially hierarchical framework will be used to characterize stream habitat at basin, segment, reach, and microhabitat scales. Qualitative and quantitative surveys of the spatial and temporal distribution of native and introduced algae, invertebrates, and fish will characterize community structure and biological integrity at the sampling sites. The integrated assessment of water quality using physical, chemical, and biological characteristics will provide nationally consistent, as well as locally relevant, information that can be used in the management of stream systems.

Marie M. Bruegmann, Christine Willis, Dave Hopper, Mick Castillo, and Lorena Wada

US Fish and Wildlife Service, 300 Ala Moana Boulevard, Room 3-122, Honolulu, HI 96850

KAUA'I MONTANE BOG PROTECTION AND PUBLIC EDUCATION. In July of 1996, the US Fish and Wildlife Service (Service) and the State Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) entered into a cooperative agreement to fence nine bogs in the Alaka'i Wilderness Area on the island of Kaua'i. The purpose of these fences is to protect the bog communities of Kaua'i and four rare plants species that are restricted to bogs. All of these bogs had varying degrees of pig damage at the time of fencing. As part of this cooperative agreement, the recovery of the bog vegetation and the status of seven rare plant species: pa'iniu (*Astelia waialealae*), na'ena'e (*Dubautia waialealae*), nohoanu (*Geranium kauaiense*), kāmakahala (*Labordia pumila*), *Lagenifera helenae*, lehua maka noe (*Lysimachia daphnoides*) and fringed orchid (*Platanthera holochila*) is being monitored. One of the most important aspects of conservation in Hawai'i is the involvement and awareness of the public in the need for management actions. While there are few hunters on the island of Kaua'i who use the remote areas where the bog fencing is occurring, the Service and DOFAW want to ensure that the hunting public would not

be negatively impacted by this work. Therefore, two hunters who use the area were taken to the bogs and asked to participate in determining the alignment of some of the fences and the locations of gates in the fences. In addition, the Service and DOFAW funded the preparation of a video for presentation on local cable access to explain to the public the uniqueness of Kauai's bogs, the threats to those bogs, and the actions that are being taken to protect them.

Mathew Burt, Alvin Char, Vince Costello, Jordan Jokiel, Kapua Kawelo, Steven Kim, and Joby Rohrer

US Army Garrison Hawai'i, Environmental Division, Directorate of Public Works, Schofield Brks, HI 96857-5000

HĀHĀ (*Cyanea superba*), AN EXAMPLE OF ARMY ENDANGERED SPECIES MANAGEMENT. *Cyanea superba* subsp. *superba* is a palm-like plant, about 4-6 m tall. This lobeliad is extremely rare; the last five known wild individuals are located in Mākua Valley. While monitoring these individuals during fruiting season, environmental personnel discovered one of the five plants had immature fruit. We began intensive management to protect the fruit from rat predation and to ensure fruit collection. The plants were monitored weekly for six weeks, and then biweekly when the fruit began to ripen. This management strategy was very successful. We collected all of the fruit that were produced, planted several, and gave many away to other propagation facilities. Fruit was taken to Bill Garnett (Pahole Mid-elevation facility), Terence Nagauchi (DOFAW Makiki Nursery), David Orr and Keith Woolliams (Waimea Botanical Garden), Nellie Sugii (Lyon Arboretum tissue culture lab), and the National Tropical Botanical Garden. We have been enormously successful in germinating these seeds, with hundreds of young plants emerging. In addition, we have outplanted older *Cyanea superba* individuals from Bill Garnett's stock into our Kahanahāiki gulch enclosure. These are the first endangered plants outplanted on Army land on O'ahu, with many to follow.

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PRESERVATION AND RESTORATION OF A NATIVE HAWAIIAN DRY FOREST. Like many other tropical dry forest ecosystems throughout the world, Hawaii's remaining dry forests have been severely fragmented and degraded by such forces as deforestation and land development, fire, grazing by non-native ungulates, and invasions by alien species. On the island of Hawai'i, the understory of most of the remnant patches of native dry forests today are infested by a dominant, fire-promoting alien bunch grass, fountain grass (*Pennisetum setaceum*), and several species of alien seed-eating rodents. Our previous research within a 2.3 hectare dry forest preserve found that there had been virtually no regeneration of native canopy trees despite over 40 years of protection from human and ungulate disturbances. To promote "natural" native plant regeneration, in 1995 we began an aggressive campaign to control the fountain grass and rodent populations within this preserve. We found that while this technique may greatly enhance the regeneration of some native species, it may also facilitate the colonization and invasion of new alien plant species. At present we are utilizing direct-seeding experiments to reestablish viable populations of key native species while assessing the importance of supplemental weeding and supplemental watering techniques. Research results will be summarized broader implications for other arid land restoration projects will be discussed.

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AN OVERVIEW OF RECENT ADVANCES IN BROWN TREE SNAKE (*Boiga irregularis*) RESEARCH. The brown tree snake, an introduced pest, has caused ecological, economic, and human health problems on the island of Guam. There is concern that the introduction of this pest to other Pacific Islands could cause this tragedy to be repeated elsewhere. Due to the high risk posed by the accidental spread of the brown tree snake from Guam to other islands in the Pacific and continuing problems caused by the snake on Guam, significant efforts have been made by managers and researchers to control this pest species. Researchers developing techniques to control brown tree snakes have not met in an organized forum since 1993. There have been substantial advances in the understanding of brown tree snake biology and the development of control techniques for this pest species since 1993. For three days preceding the 1998 Hawai'i Conservation Conference, the 1998 Brown Tree Snake Research Symposium was held in Honolulu to discuss this progress. This presentation will be an overview of progress made by researchers working to develop techniques for brown tree snake control. Subject matter reviewed during this presentation will be progress

made in the following research areas: basic brown tree snake biology; trapping strategies and snake movements; attractants; extra-limital dispersal events; population biology; barriers; snake detector dogs; large scale control; and unmet research needs for operational control.

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A REVIEW OF WILDLIFE DAMAGE MANAGEMENT TECHNIQUES DEVELOPED FOR USE IN AGRICULTURE THAT COULD BE USED FOR ENDANGERED SPECIES CONSERVATION. The reduction of wildlife depredation on agriculture has been an issue through recorded history. Due to this fact, numerous techniques have been developed, and continue to be developed, with the intention of addressing this issue. A broad range of techniques designed to reduce wildlife depredation on agricultural crops could be applied to reduce the impact of predators on endangered flora and fauna. Much attention has been paid to the successful control of introduced rodents in insular areas /isolated sites worldwide through the careful application of rodenticides. In Hawai'i, efforts have been made by staff of several state and federal agencies, non-governmental organizations, and university-based researchers to aid in the registration of rodenticides for use in conservation areas in the state. Rodenticides are only one of several wildlife damage management techniques developed for agricultural use that could be used for endangered species conservation. Concerted efforts are presently being undertaken to identify and develop non-lethal or non-chemical alternative management methods for specific wildlife problems. The goal of this presentation is to review the breadth of techniques developed for wildlife damage management in agriculture that could be used for the preservation of endangered flora and fauna. These techniques include the use of repellents and attractants. Techniques currently being developed by researchers involved in wildlife damage management such as immunocontraception for feral ungulates, predators and rodents will also be reviewed.

Debbie A. Carino and Curtis C. Daehler

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RECENT REPLACEMENT OF NATIVE PILI GRASS (*Heteropogon contortus*) BY INVASIVE AFRICAN GRASSES IN THE HAWAIIAN ISLANDS. Pili grass (*Heteropogon contortus*) is a native perennial bunchgrass that has long dominated leeward coastal grasslands of the Hawaiian Islands. We recently surveyed 41 sites on O'ahu that were dominated by pili grass in the late 1960s. We report a significant decline in pili grass abundance. Pili grass was absent from 35% of the sites and had declined in abundance in most of the remaining sites, relative to the 1960s. With the exception of one population at Koko Head, all pili grass-dominated communities we surveyed were under 500 m², clearly only small remnants of their former extent. At most sites, pili grass has been replaced by one of three African grasses: buffel grass (*Cenchrus ciliaris*), Guinea grass (*Panicum maximum*), or fountain grass (*Pennisetum setaceum*). These African grass-dominated communities were significantly less diverse than pili grass-dominated communities, in terms of number of plant species. The dense growth of the African grasses, relative to pili grass, not only crowds out most other species but also poses a greater fire risk. Ongoing research will assess how various environmental factors influence competitive interactions between pili grass and invasive African grasses, and whether specific fire regimes might be used to maintain pili grasslands in the Hawaiian Islands.

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RECOVERY EFFORTS FOR THE ENDANGERED PO'OULI (*Melamprosops phaeosoma*). The Maui Forest Bird Recovery Project is a multi-disciplinary approach to the conservation of Hawaiian forest birds and their habitat. Current efforts are focused on the po'ouli, which is on the verge of extinction with only three known individuals left in the world. The three birds live in disjunct home ranges in the Hanawī Natural Area Reserve on the island of Maui. Management efforts directed toward the recovery of the species will be presented including efforts to determine the

sex of each individual using molecular genetic techniques from feathers collected during banding operations. The effect of ground-based predator control efforts on forest bird prey base will also be presented.

Michael W. Collopy

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THE NORTHWEST FOREST PLAN: LESSONS IN ADAPTIVE MANAGEMENT AND INTERAGENCY COORDINATION. Following many years of controversy and litigation, President Clinton announced his proposed "Forest Plan for a Sustainable Economy and a Sustainable Environment" on July 1, 1993. After a period of substantial public comment on this and a companion draft EIS, the Secretaries of Agriculture and Interior issued a Record of Decision on April 13, that put in place what is now referred to as the Northwest Forest Plan (NFP). The NFP provides guidelines for managing natural resources on federal lands within the range of the northern spotted owl. In doing so, it mandates a network of land allocations designed to protect and enhance habitat for species associated with late-successional and old-growth forest; protect the integrity of riparian and aquatic habitats; support research on alternative management techniques; and support timber production and other resources. The Record of Decision establishes a series of Standards and Guidelines to direct management activities in each type of land allocation. Determining how to achieve the goals of ecosystem management and follow the requirements of the Northwest Forest Plan has required considerable innovation. Ecosystem processes transcend political and ownership boundaries; therefore, successful ecosystem management has required uncommon levels of cooperation and collaboration among local, state, federal and tribal governments, non-governmental research and educational institutions, and private landowners. This presentation will summarize the various accomplishments and lessons learned from this extraordinary effort to meet the legal and scientific needs of forest management in the Pacific Northwest.

Linda J. Cox, Gary R. Vieth, and Carol A. Ferguson

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A MODEL OF LAND USE PREFERENCE: OPEN SPACE IN HAWAI'I. Viewer preferences for alternative open space land use need to be understood to formulate land use policy. Two lines of thought exist on the nature of the relationship between land uses and preferences. One argues that differences can be explained by landscape attributes, while the other contends that the differences are a result of differences in viewers. A conceptual model of the preference formulation process including both landscape attributes and viewer characteristics is proposed in this paper and the contribution of each model component is empirically tested. Duncan's multiple range grouping indicated that a one-to-one correspondence between land use and preference does not adequately model landscape preferences, and a more complex model is needed. Two-way contingency analysis results demonstrated that landscape attributes and preferences have significant, usually nonlinear, relationships. Principal components analysis is used to reduce an unmanageable list of viewer characteristics to a manageable number of profiles. Higher significance levels for the nonlinear association between attributes and preferences are obtained using three-way contingency analysis than for two-way contingency analysis. The research results in this paper support the hypothesis that preference formulation is a complex process. The empirical analysis suggests that both land use attributes and viewer characteristics should be included in land use preference models.

Jennifer Crummer and Pauline Sato

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PROJECT STEWARDSHIP: PROMOTING COMMUNITY PARTICIPATION IN CONSERVATION. Project Stewardship involves high school students in an interactive partnership with natural resources managers to promote environmental stewardship. Through in-class and outdoor activities, students learn skills in botany, ecology, horticulture, cartography, resource management, and team work. Over the course of the 1997-98 school year, we involved nearly 100 students and their teachers from four high schools (Campbell, Waipahu, Wai'anae, and Kailua) in Project Stewardship. These participants joined volunteers and staff of The Nature Conservancy of Hawai'i (TNCH) to actively care for a designated restoration site in Honouliuli Preserve. The areas surrounding Honouliuli Preserve have traditionally been used for agriculture (sugar cane and pineapple). New housing and business developments have begun to reach the borders of the preserve as sugar production declines, increasing the potential threats to the preserve such as the spread of new weed species, release of pets that could become feral, accidental fire, over-harvesting of

native plants, and overuse by people seeking undeveloped, open space. Through Project Stewardship, teachers and students from the communities that surround Honouliuli Preserve immerse themselves in the practical application of conservation theory and activities that will help them conserve natural areas in their backyard as well as build a sense of shared community pride. Project Stewardship also exposes students to a variety of conservation careers. Traditional career opportunities are in science and resource management. Support of conservation efforts also demands the expertise of other career fields: business; marketing; non-profit management; philanthropic fundraising; teaching; art; and writing.

Justin Culley

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INCORPORATION OF CURRENT CONSERVATION RESEARCH AND PERSONNEL INTO CAMP ERDMAN'S OUTDOOR ENVIRONMENTAL EDUCATION PROGRAMS. Camp Erdman has been providing quality outdoor environmental science education experiences to the children of Hawai'i for over 30 years. In the last four seasons, the curriculum has improved drastically in both quality of content and quantity of classes offered. We believe the next step is to involve Hawaii's scientific and conservation communities in the further development of our programs. First, we feel that a format should be found for incorporating information on current research initiatives in Hawai'i that involve native flora and fauna. Second, we would like to involve people from a variety of state and private agencies/organizations to visit our programs as guest speakers/staff trainer specialists, etc. Camp Erdman is able to provide an audience of roughly 9,000 elementary and intermediate-aged students. Through contacts in the schools, we can keep students and teachers up-to-date on current projects and research, as well as involve them in the conservation issues facing our state today. Education is the key, if the work being done today is to have a lasting impact tomorrow. Camp Erdman can provide that crucial link between the scientific/management community and the general populous.

Dan Dorfman, Dwight Matsuwaki, and Sam Gon

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THE HAWAIIAN HIGH ISLANDS ECOSYSTEM. This presentation displays a set of maps which has been developed to provide a baseline set of data on the condition of natural resources within the Hawaiian High Islands Ecosystem. It displays the current extent of native dominated landscape (about 46% of the total land area). The maps also show the observed locations of rare, threatened, and endangered species and natural communities recorded in the Hawai'i Natural Heritage Program's Biological Conservation Database. A second set of maps indicates the lands which are currently protected for conservation purposes and highlights the areas which receive active management for biodiversity protection. This poster display highlights the results of the Ecosystem Data Group. The Ecosystem Data Group is a joint venture of The Nature Conservancy, the US Fish and Wildlife Service, the USGS Biological Resource Division, and the University of Hawai'i Center for Conservation Research and Training. This project has established a draft of ecoregional conservation targets to guide ecosystem conservation efforts in Hawai'i.

Peter Dunlevy, Mark S. Collins, Jim Kowalsky, Jamie Bruch, Valerie Stein, and Jennifer Turner

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GROUND BASED PREDATOR CONTROL EFFORTS TO PROTECT THE PO'OULI (*Melamprosops phaeosoma*) AND OTHER ENDANGERED FOREST BIRDS IN THE HANAWI NATURAL AREA RESERVE. The Maui Forest Bird Recovery Project is a multi-disciplinary approach to the conservation of Hawaiian forest birds and their habitat. A component of this effort is the maintenance of two predator control grids designed to protect the home ranges of two of the last known po'ouli. Recent research into the comparative abundance of rodents in the treatment area and control indicate that our ground based methods; snap traps and diphacinone bait boxes, are effective in controlling numbers of black rats (*Rattus rattus*) and house mice (*Mus musculus*), but not Polynesian rats (*Rattus exulans*). Results from sampling are, as outside of the treatment area suggest, that Polynesian rats may be significantly more abundant in the Hanawī Natural Area Reserve than in previous years.

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NATURAL RESOURCES MANAGEMENT: ISLANDS AS MICROCOSMS. Islands often serve as microcosms for studying interactions between natural resources and economic development. On the island of Kosrae, Federated States of Micronesia, research is underway to determine how mangrove forests function and how they respond to human impacts such as harvesting and changes in water and sediment delivery. Harvesting trees can increase porewater salinity and decrease soil redox potential, creating more stressful growing conditions, but these changes are not likely to affect species composition if gaps are small (1-3 contiguous trees). Interior mangrove stands in Kosrae appear to depend on freshwater flows, in many cases from upstream freshwater wetlands, to maintain their growth rates. Small-scale harvesting, primarily for firewood, appears to be sustainable, but impacts of associated changes in habitat on mangrove crabs, which are collected for food, may be significant. Crabs, in fact, provide a greater economic return to Kosraeans than firewood. Although people understand the ecological and economic value of mangrove forests, increases in human population and reductions in per capita income may endanger these wetlands and the ecosystem services they provide because of subsequent increased rates of harvesting. Kosraeans participate in this project by working in the field with research scientists, collaborating with natural resource economists and demographers on surveys, and taking part in discussions of research results at local workshops and community meetings. Determining what policies are successful in this small society may be valuable for developing a strategy for larger islands and even continents.

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CONSERVATION MANAGEMENT IN HANAWĪ NATURAL AREA RESERVE: A 25-YEAR PERSPECTIVE AND FUTURE DIRECTIONS. Twenty-five years ago, a group of University of Hawai'i students spent the summer on the northeast slopes of Haleakalā on a National Science Foundation student-originated studies program. The principal study area was the Hana Forest Reserve. Subsequent forays into neighboring Ko'olau Forest Reserve yielded, among other things, discovery of a new species of native forest bird, with a seemingly restricted range. Much interest was generated in the area, including forest bird surveys and rat studies. A decade later the area became designated as Hanawī Natural Area Reserve. Soon thereafter, active management of the area began in earnest with fencing and feral ungulate removal. Today, pig-free reserve units are showing increased re-growth of understory plants, which provide an important forage source for many native forest birds. Hanawī will continue to be a success story as long as habitat management is actively pursued on all fronts. Endangered species recovery efforts are limited without habitat management. This presentation will discuss the effectiveness and the future direction of the habitat management component of the Maui Forest Bird Recovery Project.

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A GENETIC APPROACH TO INVERTEBRATE CONSERVATION: TWO CASE STUDIES; ONYCHOPHORA AND MOLLUSCA. Invertebrates have only recently become the focus of conservation efforts despite their obvious importance in sustaining most natural ecosystems. The difficulty in promoting invertebrate conservation has been the fact that their public profile is not of the same standing as birds or mammals. Due to the diversity of the invertebrates, habitat protection and restoration is the ultimate approach to ensure their long-term conservation. However, a 'species approach' can also be utilized in creating both public awareness and sympathy. We have focused on two high profile groups in New Zealand with varying conservation requirements: the velvetworms (Phylum: Onychophora) and the landsnails (Phylum: Mollusca). In both groups we have utilized molecular methods in determining species diversity, phylogenetic relationships, and evolutionary significant units. This approach has also enabled a greater understanding of areas of invertebrate endemism and bio-geographic relationships within New Zealand. We present these results along with a summary of how this work has impacted on conservation priority setting for these groups.

Erin Goergen and Curtis C. Daehler

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COMPARATIVE REPRODUCTIVE BIOLOGY OF A NATIVE GRASS AND ITS ALIEN COMPETITOR IN HAWAI'I. Pili grass (*Heteropogon contortus*), a native perennial bunchgrass, has been replaced in many leeward grassland communities by alien grasses, one of which is fountain grass (*Pennisetum setaceum*), also a perennial bunchgrass. This study compares the reproductive biology of pili grass and fountain grass, with the goal of gaining insights as to why fountain grass appears to be so successful at the expense of pili grass. It was found that fountain grass produced more inflorescence than comparably sized pili grass. Furthermore, fountain grass averaged 18 viable seeds per inflorescence while pili grass averaged only two. Additionally, fountain grass seeds germinated within two to five days of exposure to moist soil. In contrast, pili grass exhibited a dormancy mechanism whereby most viable seeds did not germinate even after several weeks in moist soil. Further, under common greenhouse growing conditions, fountain grass seedlings were larger than pili grass seedlings of the same age. These results suggest that alien fountain grass has reproductive advantages over native pili grass in terms of seeds per plant, seedling germination, and seedling growth. Percent of ovules that form viable seeds was generally low for both species, suggesting that both species have the potential to produce many more seeds under appropriate conditions. Future work will identify factors that may affect seed set rates in pili grass, with the goal of promoting maintenance and expansion of remaining pili grass populations in Hawai'i.

Jeremy Gooding, Keali'i Bio, Lance Tominaga, and Larry Katahira

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FERAL UNGULATE MOVEMENT AND HOME RANGES, PŌHAKULOLOA TRAINING AREA, ISLAND OF HAWAI'I. Feral ungulates, including sheep (*Ovis aries*), goats (*Capra hircus*), mouflon sheep (*Ovis musimon*), and mouflon hybrids (*O. aries* x *O. musimon*) are widespread throughout Pōhakuoloa Training Area (PTA) and adjacent lands. These animals have been shown to cause damage to native flora and fauna. In response to public questions regarding seasonal animal movements, the U.S. Army contracted Hawai'i Volcanoes National Park (HAVO) to document feral ungulate movement, home ranges and behavior at PTA. Ten animals were selected for study and fitted with radio-telemetry transmitters; including five feral sheep, four goats, and one mouflon hybrid ram. Subject animals were monitored for one calendar year using ground-based observation and helicopter aided telemetry. Animals occupied finite home ranges with no evidence of migration or nomadism. Estimated home range polygons ranging from 250 hectares to 950 hectares have been plotted with notable differences in the size and shape of areas that different species of ungulates use. Differences were also noted between movement patterns and habitat preferences of sheep, goats and hybrids. Diurnal activity for ungulates in PTA follows a predictable and generally regular pattern. Herd associations were found to be loose but stable for all radio-equipped animals. Feral sheep generally have fluid associations where individuals move freely among a number of small groups. Goat herds tend to be large groups in excess of 50 individuals that spread-out during the day and bed together at night. Mouflon hybrid sheep associate with smaller discreet herds.

Elizabeth Gray, Paul Banko, Steven Dougill, Daniel Goltz, Luanne Johnson, Peter Oboyski, John Semones, and Michael Wiley

US Geological Survey, Biological Resources Division, Pacific Island Ecosystems Research Center, Kilauea Field Station, PO Box 44, Hawai'i National Park, HI 96718

DEVELOPING TECHNIQUES FOR RESTORING PALILA (*Loxioides balleui*). The palila (*Loxioides balleui*) population has not increased, despite improved habitat conditions, and has become concentrated on the west slope of Mauna Kea. Therefore, it is necessary to develop additional techniques for recovery. We evaluated the potential for palila restoration at three sites on Mauna Kea and one site in the saddle between Mauna Loa and Mauna Kea. We characterized habitat quality by measuring māmane tree density and recruitment, evaluated food availability by estimating māmane productivity and phenology, and identified threats to insect foods. We also evaluated fire risks, extent and distribution of suitable habitat, and potential for human disturbance. The Pu'u Mali area on the north slope of Mauna Kea was selected as the most suitable site for trial reintroduction of palila. We translocated more than 40 palila to the north site in 1997 and 1998 and discovered that most birds older than six months returned to the source area on the west slope. Following predation of several palila, we began predator control and studies of radio-tagged rats to determine their threat to birds. Annual nesting effort on the west slope varied greatly: 125 nests in 1996, less than 60 nests in 1997. Few birds have nested this year because of dry conditions. In 1996 our cooperator, The Peregrine Fund, hatched 21 of 22 viable eggs collected from wild nests and fledged 11 young for use as captive breeding stock. In 1999, we hope to compare translocation of wild birds and release of captive stock to determine the most effective method of reintroduction.

Hedy Elaine Hager

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ASSESSMENT OF A CRAYFISH (*Procambarius clarkii*) KILL CONCERNING IN MĀNOA STREAM, O'AHU, HAWAI'I. The introduced freshwater crayfish species, *Procambarus clarkii*, experienced a significant decline throughout much of Mānoa Stream during November 1-5, 1997. This crayfish kill was assessed by a field survey. Methodologies entailed recording observed dead crayfish remains (body parts) and live individuals. Results indicate that *P. clarkii* survived in only one upstream region of the surveyed areas. Live crayfishes were also located in a lo'i (taro pond) fed by diverted Mānoa Stream water. Analysis of data indicates that one or more pollutants is suspected as the probable cause of the crayfish kill. The reasonable source of entry for the pollutant(s) is a stormwater outlet pipe located approximately 25 meters below the *P. clarkii* live population in Reach 10 (located underneath the intersection of Pawaina and Pinao streets). The likely cause of the crayfish kill is subterranean pesticide runoff. Alternatively, heavy metals such as cadmium or chromium that are present in Mānoa Stream may have adversely influenced thermal tolerance (measured as the Critical Thermal Maximum) of *P. clarkii*, producing lethal effects. The presence of a crustacean species like *P. clarkii* in Mānoa Stream and its susceptibility to contaminants makes it an appropriate indicator species; one that could potentially yield information pertaining to land-based pollutants.

Scott Henderson, Steve Evans, Lena Schnell, Kathleen Sherry, and Laila Tamimi

US Army Garrison Hawai'i, Environmental Office, Pōhakuloa Training Area, HI; APO AP 96556-5703

ECOSYSTEMS MANAGEMENT OF THE PŌHAKULOA PLAIN, ISLAND OF HAWAI'I.

The US Army has just completed the fourth year of an Ecosystems Management Program designed to provide effective management and stewardship of natural and cultural resources on the 109,000 acre Pōhakuloa Training Area on the island of Hawai'i. Several new projects have started over the last few months. A 2,000 square-foot clear plastic-glazed greenhouse has been erected and a 6,500 square-foot plant adaptation compound is being fenced. Those facilities will support propagation of rare and common native plants which will be used in outplanting and revegetation efforts at Pōhakuloa. Russian thistle (*Salsola kali*), a fire-prone and invasive weed that recently established a foothold at Pōhakuloa, was successfully controlled by an aggressive herbicide program directed at 25 acres of affected areas. New plans for control of a variety of weeds are being formulated for areas surrounding rare plant populations within ungulate exclusion fences. Aerial censuses and radio tracking of goats and sheep have provided valuable information on the abundance, habits and ecosystem effects of those grazing animals.

Nelson Ho and Kim Tavares

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SUCCESS OF MICONIA (*Miconia calvescens*) CONTROL ON THE ISLAND OF HAWAI'I. Miconia has the potential to invade Hawaiian ecosystems from sea level to 2,000 meters (6,000 feet) elevation. Forestry and agricultural operations within this range are at risk of increased weed control costs and becoming vectors for this noxious weed tree. The island of Hawai'i contains the largest and most widespread infestation in the state. Miconia has a potential range of 121,500 hectares (around 300,000 acres), however only an estimated 8,100 hectares (20,000 acres) currently needs surveying and control work. Control efforts are building momentum with an initial goal to contain the spread of miconia and a long-range goal of eradication. The Big Island Melastome Action Committee (BIMAC) a multi-agency task force, oversees Operation Miconia. A field crew of five has killed over 50,000 trees on about 1,215 hectares (3,000 acres) since 1996. Most outlying miconia populations in high and low elevation Puna, South Hilo, North Hilo and Kona Districts have been identified and controlled or eliminated. The large task remains to contain the dense core populations at Onomea and Pana'ewa, where difficult terrain and fragmented land ownership hampers control efforts. Public involvement has been crucial in the success to date, and volunteer work is a key component of future eradication. Miconia control is an ambitious undertaking that will need years of well-organized effort and funding.

Ann B. Hudgins

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US FISH AND WILDLIFE SERVICE: PARTNERING IN THE PACIFIC. Hawai'i and the Pacific Islands are home to 16 of the nation's diverse National Wildlife Refuges, from Hakalau Forest National Wildlife Refuge on the Big

Island to Guam National Wildlife Refuge. Intensive management of these refuges involves partnering with community volunteers and business leaders to provide native species habitat and public education. The poster will describe the refuges and their diversity of wildlife and plants, and how citizens help participate in their management.

Janelle Ishida

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USE OF SALT WATER TO CONTROL NON-NATIVE PLANTS IN A COSTAL STRAND COMMUNITY. The purpose of this experiment was to evaluate the effectiveness of using salt water to control non-native plant species within the northeast coastal spray zone of Kalaupapa National Historical Park. The study area contained the following native Hawaiian plants: sedge (*Fimbristylis cymosa* var. *pynocephala*), 'ilima (*Sida fallax*), 'ākia (*wistroemia uva-ursi*), and *Tetramolopium rockii* var. *rockii*. The two primary non-native species competing with the native plants were Henry's crabgrass (*Digitaria ciliaris adscendens*), and a legume (*Desmodium triflorum*). Five treatment groups were established to receive the following treatments once a week using a 4 gal. plastic backpack sprayer: 4 gal. of salt water/m², 2 gal. of salt water/m², 4 gal. tap water/m², 2 gal. of tap water/m², and no treatment for the control group. Data was collected on a weekly basis using a modified Braun-Blanquet Cover Abundance Scale, and by conducting a point intercept test before and after the experiment. Soil tests were conducted at the beginning, middle, and end of the experiment through the University of Hawai'i Extension Service, and the ocean water was tested weekly with a calibrated refractometer. Photographs were also taken at the beginning, middle, and end of the experiment to document visual changes in the plots. At the end of the 18-week study period, the plots that received the salt water treatment showed a definite decrease in the percent cover of the non-native plants and an increase in the coverage of the native sedge.

James D. Jacobi

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CONSERVATION OF HAWAII'S BIOTA IN THE TWENTY-FIRST CENTURY--HOW CAN WE GET THERE FROM HERE? Major advances have been made during the past 50 years studying the diversity, evolution, distribution, and status of Hawaii's unique species of plants and animals and the ecosystems they depend upon. However, the continued introduction and expansion of alien organisms into Hawai'i, coupled with landscape alteration, have accelerated the decline to extinction of many of our endemic species and, in some cases, the seemingly irreversible collapse of native ecosystems. It will become even more difficult to preserve Hawaii's native plants and animals over the next 50 years as more invasive aliens become established in the islands and additional demands are placed on modifying the landscape to meet housing, agricultural, ranching, forestry, and recreation needs of our increasing population. Using the island of Hawai'i as an example, conservation options are explored in this presentation with the aid of ArcView GIS (geographical information system). Models of species and plant community distribution based on data collected over the past 25 years are used to examine management scenarios that focus on a combination of species and ecosystem recovery efforts. Conclusions from this study include recognition of the need for linking current management efforts to an island-wide perspective, merging conservation efforts on private and public lands, increasing protection and restoration of ecosystems in addition to rare species recovery, expanding public awareness of the native biota and increasing public input into the development of management strategies, and doing a better job of integrating conservation with island-wide and state-wide planning.

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MORPHOLOGICAL AND MOLECULAR SYSTEMATICS OF THE HAWAIIAN DAMSELFLY GENUS *Megalagrion*: IMPLICATIONS FOR CONSERVATION. The Hawaiian damselfly genus *Megalagrion* contains 22 species that occupy a broad array of habitats. Some of these species are widespread while others are single island endemics. Six species are currently candidates for listing as threatened or endangered and one species, *M. williamsoni*, may be extinct. We have used 23 morphological characters and roughly 650 base pairs of the mitochondrial cytochrome oxidase II (COII) gene to explore the phylogeny of 16 *Megalagrion* species. Maximum parsimony and maximum likelihood models were used to analyze the molecular data. Initial results indicate that some well supported clades are recovered in both the morphological and molecular analyses, including the sister groupings

of *M. xanthomelas* and *M. pacificum*; *M. nigrohamatum* and *M. orobates*; and *M. calliphya* and *M. oresitrophum*, and the monophyletic grouping of *M. oceanicum*, *M. heterogamias*, and *M. blackburni*. However, some morphologically based clades are not found in the molecular analysis. For example, *M. eudytum* and *M. vagabundum* are sister taxa in all molecular analyses, but are well separated in the morphological analysis. In addition to these results, exploratory studies of a 339 base pair region of the COII gene suggest that populations of *M. xanthomelas* from Moloka'i and the Tripler Army Medical Center on O'ahu differ by less than 1%, but are separated by up to 5% from Big Island populations. Individuals of *M. koelense* from Moloka'i and Big Island differ by 2.5% in the complete COII gene. This type of population genetic data could guide future restoration and translocation efforts.

Terrell Kelley and Shirley Nakamura

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FARM BILL PROGRAMS: SYNERGY OF AGRICULTURE AND CONSERVATION IN HAWAI'I. Almost 62% of the land in Hawai'i is privately owned; most of that (80%) is considered agricultural land. Conservation activities on these lands have great potential to positively affect the future of Hawaii's natural resources and wildlife. The 1996 Farm Bill authorized the US Department of Agriculture (USDA) to offer cost-share assistance and incentives to private landowners and lease holders to apply and install conservation practices that reduce soil erosion, improve water quality, and enhance forests, wetlands, riparian areas, grazing lands, and wildlife habitat. Nationally, Farm Bill programs are funded at \$2.5 billion per year. Each program has a strengthened environmental emphasis and has been developed to address specific resource areas and concerns. Resource concerns are identified and proposed locally by conservation stakeholders, including resource managers, Soil and Water Conservation Districts, and farmers and ranchers. In Hawai'i, we have landowner participation and interest in five of the programs: the Conservation Reserve Program, Environmental Quality Incentives Program, Forestry Incentives Program, Wetlands Reserve Program, and Wildlife Habitat Incentives Program. NRCS will explain their programs, describe the increased interaction between agricultural entities and conservation partnerships, show examples of on-the-ground conservation practices implemented by private landowners, and discuss the anticipated benefits.

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NEW FROG INTRODUCTIONS TO HAWAI'I: CURRENT STATUS, LIKELY IMPACTS, AND PROSPECTS FOR CONTROL. Three species of Caribbean frogs (*Eleutherodactylus coqui*, *E. martinicensis*, and *E. planirostris*) have appeared in Hawai'i in the past five years and represent the first unintentional introductions of reptiles or amphibians to the islands. Two of the species are currently known from a total of ten sites on Maui and two species are known from six sites on Hawai'i. Most reported incidences of the frogs are in residential, resort, or nursery settings, and introduction to and spread within the state appears due to transport of eggs or adults in live horticultural material. Population growth is rapid and densities can be high. The frogs pose a direct threat to native invertebrates and an indirect threat to native forest birds. The loud calls of two of the species already pose a nuisance to many residents on Maui and will only worsen as frog densities and range increase. Because calling males are conspicuous, bold, and easily targeted, control or eradication of most populations is feasible at relatively low densities and will be discussed. Control of populations in forested habitat remains problematic because of difficulty of movement in such terrain at night.

Dennis A. LaPointe, Carter Atkinson, Julie Lease and Nick Shema

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HOW FAR CAN YOU FLY?: MOSQUITO (*Culex quinquefasciatus*) DISPERSAL IN CLOSED-CANOPY FOREST. The southern house mosquito (*Culex quinquefasciatus*) is the vector of avian disease (malaria and pox) in the Hawaiian Islands. Both these introduced diseases are thought to have a major limiting effect on native Hawaiian forest bird populations. Paradoxically, avian disease has been reported from refuge areas where breeding populations of mosquitoes have not been

encountered. It has been suggested that mosquitoes fly, or are wind-blown, into areas where they do not occur as larvae. In an attempt to determine the dispersal abilities of *Culex quinquefasciatus* we made two releases of marked mosquitoes in a closed-canopy forest and recaptured mosquitoes within a radius of three kilometers. We recaptured approximately 0.5% (N=6,300) and 1.7% (N=4,717) of marked female mosquitoes from releases made on October 11, 1997 (OCT) and November 2, 1997 (NOV) respectively. The mean dispersal distances for the two releases were 313.23 meters (SD 468.9) and 269.25 meters (SD 357.29). During both releases a few individuals were captured at two kilometers. Sixty-one percent (OCT) and 74% (NOV) of all recaptures were made within 100 meters of the release site. More mosquitoes were captured along forest transects than along forestry road transects. The majority of mosquitoes, including the furthest dispersers, were captured downwind of the prevailing winds. Implications of these results for disease control management will be presented.

Julie K. Lease, Carter T. Atkinson, Dennis A. LaPointe, and Nicholas P. Shema

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AVIAN DISEASE AND POTENTIAL TRANSMISSION AT TWO SITES IN HAKALAU FOREST WILDLIFE REFUGE. The greatest density of endangered forest birds at Hakalau Forest National Wildlife Refuge is found in high elevation habitat at Pua Akala Tract. The number of endangered birds drops considerably at similar elevations in the northern Maulua Tract. Previous disease research in Hakalau cannot fully account for the large differences in population densities. We hypothesize that malaria transmission in mid-elevation areas of the refuge may be severely impacting the forest bird population by creating a "sink" that exposes dispersing juvenile birds to disease at lower elevations. We conducted field studies in Pua Akala and Maulua Tracts at 4,200 feet forests during March and April 1998 to collect and compare information on disease prevalence, vector abundance, and mosquito larval habitats. We assessed the prevalence of malaria by capturing, banding and bleeding forest birds. Blood samples from both sites were screened by microscopy. Oviposition traps were operated to collect adult mosquitoes and belt transects were surveyed for tree fern density and pig damage. All standing waters were examined for larval mosquitoes and subsamples of all sites were sampled for other aquatic organisms as well as physical and chemical parameters. Results of this ongoing study will be presented.

Gerald D. Lindsey, Stephan Mosher, Steve Fancy, and Ty Smucker

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POPULATION STRUCTURE AND MOVEMENT PATTERNS OF BLACK (*Rattus rattus*) AND POLYNESIAN (*Rattus exulans*) RATS IN A HAWAIIAN WET FOREST. We used live traps, kill traps, tracking tunnels, and radio telemetry to determine population structure, reproductive patterns, activity in tree canopies, and movement patterns of black and Polynesian rats in an 'ōhi'a (*Metrosideros polymorpha*)-koa (*Acacia koa*) wet forest in the Hakalau Forest National Wildlife Refuge, on the island of Hawai'i. Species composition from 1,264 rats live captured over 41 months was 60.8% black rats, 38.1% Polynesian rats, and 1.0% Norway rats. Juvenile rats made up 26.2% and 31.7% of black and Polynesian rats captured, respectively. Both species reproduced year around with the peak reproductive period from May to October. Mean seasonal rat activity in tree canopies was 43%. Rats visited koa and 'ōhi'a trees with similar frequency; 39% of tunnels in 'ōhi'a trees were visited versus 48% of tunnels in koa trees. Of 44 individual rats captured in canopies of trees, 43 were black rats and one was a Polynesian rat. Most black rats nested in cavities in tree canopies and all Polynesian rats nested underground. Mean distances traveled between the first and last live capture was 98.3 meters for male black rats, 55.6 meters for female black rats, 42.9 meters for male Polynesian rats and 10.9 meters for female Polynesian rats. Mean minimum convex polygon home ranges were 3.6 hectares for four black rats and 3.0 hectares for three Polynesian rats.

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RESTORATION OF A CLOSED FAYA (*Myrica faya*) TREE STAND: A COLLABORATION BETWEEN MANAGEMENT AND RESEARCH WITH UNEXPECTED RESULTS. Faya is an introduced tree threatening native ecosystems in Hawai'i Volcanoes National Park. Creation of closed faya stands in former 'ōhi'a (*Metrosideros polymorpha*) dominated forests result in the near total loss of understory vegetation. Studies have shown that invasion by this nitrogen-fixing tree leads to elevated nitrogen soil levels which can ultimately alter community composition

and successional pathways in favor of a broader range of invasive species. In 1989, experimental plots were established to follow succession after removal of faya from closed stands. Alien herbs and shrubs rapidly invaded gaps created by logging faya trees. Girdling standing trees resulted in the gradual thinning of the canopy and facilitated the establishment of native tree fern (*Cibotium glaucum*), māmakī (*Pipturus albidus*) and pilo (*Coprosma rhynchocarpa*). Very little regeneration of faya or 'ōhi'a occurred. The unexpected results of this study demonstrate the need for a cautious, scientific approach to ecological management to ensure desirable treatment results.

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PROTECTING NATIVE HAWAIIAN FOREST THROUGH A UNIQUE PARTNERSHIP. The 'Ola'a- Kilauea Project is a cooperative land management effort for 32,000 acres on the Big Island. The project area includes State Department of Public Safety Kulani Correctional Facility, State Department of Land and Natural Resources Pu'u Maka'ala Natural Area Reserve, 'Ola'a tract of Hawai'i Volcanoes National Park, and Kilauea Forest Reserve owned by Kamehameha Schools Bishop Estate. Managers of these project lands and representatives from US Fish and Wildlife Service, US Geological Survey Biological Resources Division, and US Forest Service meet regularly to make decisions about the project direction. The project area contains one of the best remaining native forest ecosystems in Hawai'i with a high degree of diversity and general lack of invasive weed species. The project area supports four species of endangered forest birds: the Hawaiian hawk (*Buteo solitarius*), nēnē (*Branta sandvicensis*), Hawaiian hoary bat (*Lasiurus cinereus semotus*) and 22 rare or endangered plant species. Overall project goals include enhancing the long-term survival of native ecosystems and managing a large contiguous area across ownership boundaries. Management actions are critical for the stabilization and recovery of rare species and will also keep other more common native species from declining. Management and research are currently focused on removing or reducing impacts from feral animals, alien plants and non-native predators, documenting the response of native and alien species to management, restoring native habitat and rare species, and providing work training and education to Kulani inmates. All partners are providing funding and/or in-kind support to contribute to project success.

Theresa Menard

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HABITAT USE BY THE ENDANGERED HAWAIIAN HOARY BAT (*Lasiurus cinereus semotus*) ON THE ISLAND OF HAWAI'I. The Hawaiian hoary bat (*Lasiurus cinereus semotus*) is the only extant bat in the Hawaiian Islands. I investigated habitat use by this endangered bat on the island of Hawai'i, which presumably supports the largest population of bats in the state. We know the bat can be found over a wide elevational range (from sea level to 7,500 feet), but we do not know the degree to which the bat is associated with different elevation sites at different times of year. From February 1996 to March 1998, I monitored bat activity at low (sea level to 2,500 feet), mid (2,500 to 5,000 feet), and high (5,000 to 7,500 feet) elevation sites throughout the year to determine if there were seasonal shifts in activity. Bats were active at low, mid, and high elevation sites throughout the year. However, habitat use in a given elevational zone was seasonal. I found that bat activity was reduced at some elevations during some winter and summer months. This seasonal shift in bat activity with elevation supports the hypothesis of altitudinal migration. To assess whether bat activity in an area is stable or declining, activity should be compared during the same season over several years. The Hawaiian hoary bat should be down-listed or de-listed only if activity is determined to be stable (or increasing) in all elevational zones for a number of years.

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WATER BALANCE OF A MONTANE CLOUD FOREST TREELINE DURING A RAINLESS PERIOD. The upper-elevation limit of montane cloud forests, or the treeline, in Hawai'i coincides with a rapid decline in rainfall with elevation above the tradewind inversion layer. Data from pollen cores extracted from high elevation bogs on Haleakalā, Maui suggest that the past elevation of this treeline fluctuated with glacial and inter-glacial periods. We examined the role that periodic water deficits may play in the elevational migration of the high elevation treeline on

the windward slope of Haleakalā. Our objectives were to determine if the soil water availability and the internal water status of 'ōhi'a (*Metrosideros polymorpha*) differ between the grassland, treeline, and forest ecosystems near the upper-elevation forest limit during an extended rainless period. To determine the frequency and intensity of rainless periods, we developed a site-specific available soil moisture model by combining measured rainfall, modeled Penman-Monteith evapotranspiration, and measured soil available water capacity. The modeled available soil moisture values were compared to field measurements of soil moisture and pre-dawn water potential of 'ōhi'a in the forest, treeline, and grassland. After 13 rainless days, both modeled and measured soil moisture and pre-dawn water potential measurements on 'ōhi'a decreased to permanent wilting point. The grassland soils retained more moisture than the forest soils thereby allowing isolated 'ōhi'a in the grassland to maintain less negative water potentials than the forest 'ōhi'a. Although this study demonstrated that rainless periods may significantly affect 'ōhi'a at high elevations, our results indicated that physiological constraints to water limitation may not be the sole cause of the treeline.

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PARASITISM OF ENDEMIC *Cydia* CATERPILLARS (LEPIDOPTERA: TORTRICIDE) FOUND IN MĀMANE SEEDPODS (*Sophora chrysophylla*) ON MAUNA KEA, HAWAI'I. Endemic Hawaiian moths in the genus *Cydia* form a complex of at least 14 species. Seven species have been reared from māmane seedpods collected from 1,800 to 2,700 meters elevations on Mauna Kea, on the island of Hawai'i. Analysis of feces collected from palila (*Loxioides bailleui*: Fringillidae), an endangered Hawaiian honeycreeper, revealed that *Cydia* caterpillars are the most important insect prey of the bird, and may be especially important to nestlings. To estimate the availability of *Cydia* we dissected māmane seedpods collected monthly at five sites along an elevational gradient, from April 1996 to April 1997. Additional seedpods were collected and monitored for the emergence of adult moths, parasitic wasps, and other insects. Four parasitic wasp species (*Pristomerus hawaiiensis*, *Diadegma blackburni*, *Calliephialtes grapholithae* [Ichneumonidae] and *Euderus metallicus* [Eulophidae]), all adventive or purposely introduced biocontrol agents, were reared from *Cydia* caterpillars. Parasitism ranged from 21% at 2,700 meters to 94% at 1,800 meters, and was negatively correlated with *Cydia* abundance.

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'ALALĀ (*Corvus hawaiiensis*) RESTORATION THROUGH CAPTIVE PROPAGATION. The 'alalā or Hawaiian crow is a critically endangered species with a wild population of 16 individuals in the South Kona District on the island of Hawai'i, and a captive population of 18 individuals. A program to restore the wild population has been developed and implemented through a cooperative partnership consisting of The Peregrine Fund, US Fish and Wildlife Service, the Division of Forestry and Wildlife of Hawai'i, McCandless Ranch, Keālia Ranch, Kai Malino Ranch and Kamehameha Schools Bishop Estate. The captive flock, managed by The Peregrine Fund, has seven potential breeding pairs. Eggs from both the captive and the wild flocks are incubated and hatched at the Keahou Bird Conservation Center. The chicks are puppet fed until approximately 70 days old, and transported to a release aviary on McCandless Ranch at 90-100 days. The 'alalā are "soft released" at 110-180 days with a gradual reduction in supplemental food over a period of eight weeks. They are monitored for an additional two weeks using radio-telemetry. Since 1993 The Peregrine Fund has raised 27 'alalā and released 24 on McCandless Ranch. Of the 24 birds released, 23 have survived the ten-week process to independence.

Suchi Psarakos and Ken Marten

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NATURAL HISTORY AND CONSERVATION OBSERVATIONS OF A HAWAIIAN SPINNER DOLPHIN (*Stenella longirostris*) RESTING SITE ON THE WAI'ANAEO COAST OF O'AHU. Wild Hawaiian spinner dolphins (*Stenella longirostris*) have been studied since the 1970's, primarily focusing on presence and activity around the island of Hawai'i. This study, initiated in 1995, reports the initial results of a long-term natural history and conservation study of a spinner dolphin resting site on west O'ahu. The study's primary goal is to identify the dolphins and study their behavior, accomplished through analysis of underwater slide photography and video.

Comparison of current ID slides with a set taken in 1978 show that at least two known male individuals, and possibly four, have been visiting the area for 20 years. The study's secondary goal is to provide the information for developing a management plan for the area, if and when the dolphins need it. Increasing numbers of people are seeking to observe and swim with wild dolphins. In 1997, three commercial dolphin-watching boats began running daily trips to the dolphin resting site, marking the beginning of a potentially critical surge in the numbers and type of visitor exposed to the area. Data taken in the summers of 1995, 1996, and 1997 tracked items such as number/location of swimmers and dolphins, dolphin dive times, and aerial behavior. Analysis of the 1995 data suggests that as the number of swimmers in the area increased, the dive times of spinner dolphins decreased. Preliminary comparison indicates the most common dolphin group size shifted from 51 to 75 animals in 1995 and 1996, to 1 to 25 animals in 1997, and that the dolphins stayed at the resting site for shorter cumulative times throughout a given morning in 1997: most frequently staying for less than an hour, as compared to three or more hours in 1995 and 1996.

Lisa Raymond

Maui Nui Botanical Gardens, Inc., PO Box 6040, Kahului, HI 96723

PRESENTING A MASTER PLAN FOR THE MAUI BOTANICAL GARDENS. The Maui Botanical Gardens comprises of 7.5 acres located on Kanaloa Avenue in the coastal area of Kahului, on the island of Maui. The existing garden is under the authority of Maui county's Parks and Recreation Department. A master plan is being developed to improve and expand the garden and will include a xeriscape demonstration garden, propagation nursery, ethnobotanical collections, amphitheater, resource library, and educational buildings. The focus of the collection will be the conservation of coastal and dry forest species of Maui Nui, (Maui, Moloka'i, Lāna'i, and Kaho'olawe). The non-profit organization, Maui Nui Botanical Gardens, Inc., is proposing a partnership between the organization and the Parks and Recreation Department and that the organization manage and develop the garden.

Lisa Raymond

Native Hawaiian Plant Society, PO Box 5021, Kahului, HI 96723

NATIVE HAWAIIAN PLANT SOCIETY, COOPERATING TO MAINTAIN NATIVE SPECIES AND HABITATS. The mission of the Native Hawaiian Plant Society (NHPS) is to support the rescue and preservation of native Hawaiian plants; increase public awareness of native Hawaiian plants by working on projects cooperatively with governmental agencies, public and private groups and individuals and; to use the Maui Botanical Gardens and other resources for public education. To accomplish this, NHPS has formed partnerships with landowners and other conservation organizations to established a number of conservation sites and exclosures. Currently there are 11 exclosures and three natural areas maintained by NHPS which total approximately 65 acres.

Joby Rohrer, Mathew Burt, Alvin Char, Vince Costello, Jordan Jokiel, Kapua Kawelo, and Steven Kim

US Army Garrison Hawai'i, Environmental Division, Directorate of Public Works, Schofield Brks, HI 96857-5000

KAHANAHĀIKI GULCH ECOSYSTEM MANAGEMENT. Kahanahāiki gulch is located in the northeastern corner of Makua Valley, O'ahu. The gulch shares a common boundary with Pahole Natural Area Reserve, as well as many of the same species and management problems. The native forest patches within the gulch are characterized as mesic and are very diverse with more than a dozen canopy species. There are also seven endangered plants, one endangered animal, and one candidate animal species within the gulch. Kahanahāiki has been a center of our management efforts since the beginning of our program and continues to be. We completed a 3K ungulate perimeter fence in December 1996 and have maintained the gulch as a pig-free environment. We have been intensively monitoring the endangered plants within the gulch and have collected propagules from many of these species. Extensive weed control has been performed and continues with the help of many volunteer organizations. We have begun outplanting common native species and have plans to begin re-introducing endangered plant taxa. We are also working to conserve the rare and endangered animal resources. O'ahu NARS has selected to erect an *Euglandina rosea* and rat exclosure around concentrations of *Achatinella mustelina*. During 'elepaio nesting season we conduct predator control in hopes of increasing fledging success. We are also working to address specific threats within the gulch including rats on the ecosystem level, and black twig borer to mēhamehame (*Flueggea neowawraea*). All of these efforts have been designed and directed with the help and guidance of many people involved in conservation both on the management as well as the academic level.

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ENVIRONMENTAL VALUATION AND THE HAWAIIAN ECONOMY (EVHE) INITIATIVE. From the top of Mauna Kea to the depths of marlin territory, Hawai'i is blessed with abundant, unique natural resources and the ecosystems that support them. These ecosystems provide direct and indirect services to the Hawaiian economy and its people in a myriad of ways. Forested watersheds replenish our water supplies with clean water. Forests, beaches, underwater reefs, and fisheries provide scenic vistas and tourist attractions for beach relaxers and ecotourists alike. The streams, ocean, forests and farms feed our mouths and our cultural heritage with taro, fruits, flowers, koa canoes, fishes, and many other goods and services. We cannot go into a store and ask for clean water, healthy forests, or wide beaches the way we can grab a cup of coffee or even purchase home insurance. Hawaii's native, threatened or endangered species are just one of many natural resources which are not directly valued in the marketplace. Because these types of natural capital are not traded in marketplaces, they tend to get overlooked, taken for granted, and undervalued when decisions are made concerning their use. Conventional measures of economic performance focus solely on market activities. This has led to a fragmented approach to public policy, with economic policies intended to boost the size of the market economy and separate policies intended to safeguard the environment. The contradictory policy regime results in both lower economic performance and unnecessary environmental degradation. The Environmental Valuation and the Hawaiian Economy (EVHE) project is completing a report that proposes a more integrated approach to public policy and reporting on the status and performance of the full economy in a way that recognizes the interdependence of the market economy, natural resources, and human welfare. The report also documents the nature of specific interdependencies and provides prima facie valuations of selected resource systems.

Maile Sakamoto and Sharon Reilly

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NON-TRADITIONAL APPROACHES TO PUBLIC AWARENESS: THE MAUI FOREST BIRD EDUCATION PROJECT. More than 150 types of endemic forest birds once lived in Hawai'i, and now only 39 of these species remain. Habitat destruction, disease, and alien species invasions have wreaked havoc with the populations of native birds. Yet few people in Hawai'i have seen these birds or even know they exist, so support for their conservation and recovery has dwindled. In recent history, information about these birds has been largely kept in the realm of the natural sciences. To gain support and awareness of Hawaiian birds, new approaches must be taken that will appeal to a larger sector of the public. By using such creative techniques as children's theater, cartoons, photography, and music, the public can learn about the birds and related issues in a positive and attractive manner. This presentation will demonstrate some of the techniques that will be used in the Maui Forest Bird Education campaign.

Hal Salwasser

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COMING FACE-TO-FACE WITH SUSTAINABILITY. Sustainability is quite a trendy term these days. It sounds good. It feels good. Hardly any one is likely to be against it. The various councils of the United Nations, following UNCED in 1992, have wholeheartedly embraced it in principles, conventions, criteria and indicators. But what, exactly, does sustainability mean in a changing world; especially one changing as fast as Hawai'i and as vulnerable to change as Micronesia?

Global change now plays its hand in extreme weather (ENSO events); potential sea level rise; invasions of alien plant, animal and disease species; accelerated trade, transportation and communications; economic shifts; and not least of all, population growth and its attendant resource demands and need for waste disposal sites. It plays this hand with vigor on islands. On continents, these forces create problems. On islands they create disasters. Water supplies, agriculture, fisheries, cultural cohesion, and economic viability are all at risk. How do we draw sufficient attention to the plight of islands that we can get adequate resources from places with far more electoral college votes to tackle the challenges?

For starters we have to market the unique values of islands. Islands, in general, and those in the Pacific in particular have special attributes not possessed by continents. Their biological and cultural diversity and evolutionary histories are not matched on mainlands. These create a great tourist attraction, one that has the potential to damage the very assets that attract the tourists in the first place. Pacific Island peoples can be the stewards of the world's pelagic fisheries if they so choose. The islands themselves are the world's front-line barometers of global change. And the

cultures could, perhaps, show others how to get on the path to sustainability. By performing on these opportunities islanders can show a greater return on investment for global sustainability than is possible in other places.

To capitalize on these assets and use them to draw the resources needed to stem the tide of resource degradation, we will all have to work together even better than has occurred to date. The Secretariat for Conservation Biology is a great start on inter-institutional collaboration. Now, we need to develop common messages as opposed to agency-specific programs. We need to adopt risk assessment protocols so we spend our resources in places where they will do the most good regardless of who "owns" the places. We will have to learn to conserve species and biological diversity through a form of ecosystem management that simultaneously helps sustain cultural diversity and local ownership of problem solving. We will have to focus ecosystem stewardship on whole watersheds because, as author Norman MacLean wrote, "eventually everything merges into one, and a river runs through it." I might add, this river runs right down into the coral reef, estuary, or mangrove swamp and carries everything it picks up from the watershed right into the ocean. Nowhere, as on islands, is the link between land and sea so obvious. We will also have to craft interdependencies between scientists, educators, managers, businesses, and constituencies so that each plays its legitimate role without usurping the unique roles of each other.

All this can be done. But it can't be done using only the methods of the past. And it can't be done if we allow polarized special interests to divide and conquer. Crafting a vision for sustainability that embraces a dynamic world and serve the needs of people and nature is the great conservation challenge of our time. Fortunately we have learned a few lessons here and elsewhere that will prove useful. Let's talk.

Nicholas Shema, Carter Atkinson, Julie Lease, and Beth Drake

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CONTROLLING MOSQUITOES (*Culex quinquefasciatus*) IN REMOTE FOREST HABITATS: A MANAGEMENT STUDY. The effects of avian malaria on Hawaiian native forest birds and the role of the mosquito in the transmission of malaria has been well documented, but little work has been done on methods to control these mosquitoes in Hawai'i. Studies have shown that cavities in hāpu'u (*Cibotium* spp.) caused by feral pigs provide major breeding habitat for mosquitoes. We evaluated habitat reduction as a technique for controlling mosquito populations over an 807 hectare area by physically draining these hāpu'u cavities. A team of four to five people with machetes spent 310.25 person days draining a total of 11,990 hāpu'u. A random sampling of 60, 0.25 hectare plots following treatment showed that 36% of the hāpu'u cavities were missed. Populations of adult mosquitoes were sampled over a continuous three month period in treatment and adjacent control areas in 1996 and again in 1997 after hāpu'u had been drained. No significant drop in numbers of mosquitoes within the treatment area was detected. Failure to eliminate 36% of available breeding cavities and ingress of mosquitoes from outside the treatment area may account for failure to reduce numbers of adult mosquitoes. Physical drainage of hāpu'u cavities will not be effective in reducing disease transmission, unless coverage is high and treatment areas can be made large enough to exceed the flight range of *Culex*.

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UTILIZING TREE FARMING TECHNIQUES TO INCREASE EFFICIENCY AND EFFECTIVENESS IN MANAGING LANDS FOR CONSERVATION VALUES. PruTimber leases about 20,000 acres from Kamehameha Schools Bishop Estate in the districts of Hamakua, North Hilo, South Hilo and Ka'u on the island of Hawai'i. These lands were used to cultivate sugar cane (*Saccharum officinarum*) for over 100 years. The abandoned fields were overgrown with weeds, including ratoon cane, ironwood (*Casuarina equisetifolia*), California grass (*Panicum purpurascens*), and *Desmodium intortum*. The fallow biomass on these fields, occasionally, exceeded 100 tons per hectare that presented a significant management problem to the new tree farmers. A typical prescription for a particularly difficult field might include, aerial spraying of herbicides, burning, ripping with a deep shank ripper, cutting the thatch with a coulter, and eliminating the ironwoods. It was soon discovered upon initial land clearing that the traditional heavy tools and large land management methods that were practiced in Hawai'i would not be efficient in preparing the fields. New tools and methods were needed. The tools and methods that are being refined in the development of tree farms, and already sparking interest for use in natural areas, include using: the herbicide Fusillade DX to help control fountain grass (*Pennisetum setaceum*) in remnant dry forests; a helicopter and newly

designed spray rig to deliver the herbicide; a serrated dozer blade to remove large trees; a coulter to slice through thick cane or grass; and improved seed drilling for large scale production of nursery plants. Encouraging managers of conservation lands to avail themselves to agricultural and silvicultural innovative developments will yield increased efficacy and effectiveness in their areas of responsibility.

Grady Timmons

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THE SILENT INVASION: A PARTNERSHIP APPROACH TO SUCCESSFUL PUBLIC AWARENESS. In October of 1996, 14 state, federal and private agencies known collectively as the Coordinating Group on Alien Pest Species (CGAPS) launched a major public awareness campaign to inform the public of the critical issues surrounding the invasion of Hawai'i by alien pests. Entitled "The Silent Invasion," this campaign succeeded in significantly raising public awareness and garnering political support for this issue. A number of factors contributed to the success of the campaign, and to its low cost, but the most important of these was the use of a partnership approach. Such an approach took advantage of the different skills, knowledge and contacts of the people involved, distributed the workload, lowered costs and helped generate much broader exposure. Other factors critical to the campaign's success included the following:

- A strong case statement that served as the foundation for almost every other aspect of the campaign.
- Strong, consistent visual identity among the different media elements of the campaign.
- Two effective campaign "poster children": the brown tree snake and *Miconia*.
- A decision to frame the alien pest problem not just as an environmental issue but as an economic, health and lifestyle issue that affects everyone in Hawai'i.
- A subject, alien species, that generated its own news stories, increasing public awareness at no cost to CGAPS.
- High level political support, including a press conference launch that brought together the Governor, Hawaii's entire Congressional delegation and the US Deputy Secretary of Agriculture.

Gary Vieth and Linda Cox

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LAND USE ALLOCATION AND NONMARKET BENEFITS: O'AHU, HAWAI'I. The market values of agriculture and urban land in Hawai'i are estimated at \$2,075.89 and \$443,980.20 per acre, respectively. Theoretically the marginal value of land in agriculture and urban land uses as represented by the respective market prices should be equal for optimum land allocation between the two uses. Since the marginal value decreases as the amount of land in a given use, it might be concluded that too much of O'ahu's land is being allocated for agriculture. However, the marginal open-space values of agriculture land use in Hawai'i are estimated at \$16,449.00 and \$143,129.30 per acre for residents and tourists, respectively. The social value of agricultural land use is, therefore, \$161,651.19 per acre. The equivalent value for urban land use is \$443,980.20. The difference in the social value in the two uses may be due to data deficiencies rather than a misallocation of land. A more comprehensive study of Hawai'i land use with emphasis on visitors' open-space values is needed.

Earlene L. Wilson

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UNSEEN INFESTATION: THE SEED BANK OF MICONIA (*Miconia calvescens*).

On the island of Hawai'i, attempts are being made to develop effective means for containment of the highly invasive woody weed, miconia (*Miconia calvescens*). Management agencies and concerned community members focus on locating and eradicating the "seen" infestation – adult fruiting trees, juveniles and seedlings – using mechanical, chemical, and biological methods. However, little is known about the remaining "unseen" miconia population – those individuals in the soil seed bank. I used seedling emergence in the shadehouse from field-collected soil to estimate the number of viable miconia seeds in the soil. Soil samples were taken from plots beneath miconia canopies and in randomly selected open areas within an abandoned sugarcane field near Kurtistown. After six months of germination, I estimated that the density of miconia seeds in the soil ranged from 150 to over 16,000 seeds m². Density of miconia seeds in the soil was significantly higher below canopies of adult miconia trees than in open areas of the field (5004 ± 2871 (SE) seeds m² and 903 ± 646 seeds m², respectively). Germination from the seed bank continued for over one

year making these estimates conservative. Although soil seed densities were higher below miconia canopies, seeds disperse abundantly to other areas where they form a substantial seed reserve. A key to effective management of miconia infestations is a better understanding of the spatial and temporal dynamics of its “unseen” seed bank.

Lisa Winthrop and Nora Devoe

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SEED RAIN IN ABANDONED SAKAU (*Piper methysticum*) PLOTS AND CLOSED-CANOPY RAINFOREST ON POHNPEI, FEDERATED STATES OF MICRONESIA. Rainforest on Pohnpei, Federated States of Micronesia declined from 45% of land area in 1975 to 15% in 1995, primarily due to increased cultivation of sakau, elsewhere called kava (*Piper methysticum*). An earlier study showed that regeneration in abandoned sakau plots is dominated by early successional and introduced weedy species, while intact forest regeneration is richer in late successional trees. We compared seed rain (aerial input of seeds and fruits) in abandoned sakau plots with that at paired closed-canopy forest sites to determine whether differential recruitment reflected differential propagule supply under the two conditions. Five hundred and twenty seed traps (each with a horizontal trapping surface of 0.1 m²) were randomly placed in 13 forest sites and 13 abandoned sakau plots. Contents were collected twice following 30-day trapping periods. Significantly more seeds were trapped in cultivator-induced gaps than forest sites. However, seeds of late-successional species were twice as numerous and seed mass was over four times greater at forest sites than gap sites. Forest traps were more than twice as likely to receive at least one seed than gap traps. These results suggest that a reduced propagule supply contributes to the arrested succession observed in abandoned sakau plots. Reduced opening sizes, manipulation of gap vegetation, and direct seeding of mid- to late-successional species after native pioneers are well established are recommended to overcome propagule supply limitations.

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RESPONSE OF FOREST BIRD POPULATIONS TO PREDATOR CONTROL IN A HAWAIIAN RAINFOREST. Introduced mammalian predators occur at high densities in Hawaiian rainforests and are known to prey on the eggs, chicks, and adults of native birds, as well as on native plants and insects. Studies in New Zealand have documented recovery of bird populations following predator control operations, but few data are available in Hawai‘i on the costs and benefits of ground-based predator control for recovery of native forest birds. We conducted a five-year adaptive management study at two 48-hectare sites (managed and unmanaged) in the Hakalau Forest National Wildlife Refuge to compare rat abundance and productivity of bird populations before and after predator control. Black rat (*Rattus rattus*) numbers at the managed site were reduced by more than 95% using diphacinone poison within 2-3 weeks of the beginning of poisoning operations each year. Polynesian rats (*Rattus exulans*) were removed primarily by snap-trapping as most individuals would not consume the peanut butter and molasses flavored bait. Bird populations were monitored by quarterly density estimates and by relative numbers and age ratios of more than 2,537 banded birds captured on 8,545 occasions. Preliminary findings show increased productivity of at least three native species, indicating that ground-based predator control may be an effective tool for recovery of native forest birds in key areas.

Alvin Yoshinaga

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PRACTICAL MEDIUM-TERM STORAGE OF NATIVE PLANT SEEDS. Research on storage life of native plant seeds shows that many native plant seeds lose viability rapidly when stored at room temperatures and humidities prevailing in Hawai‘i. Rain forest species are especially likely to be short lived. By using proper storage techniques, storage life of some seeds can be extended to a year or more. Two simple methods that work for many species, dry storage over silica gel in an airtight container and refrigeration in an ordinary refrigerator, will be presented. Basic principles of seed storage will be discussed and recommendations will be given for processing and storing seeds. Specific advice will be given for some species. If seed life is as short in the field as in the laboratory, it implies that most native rain forest plants do not form persistent banks of dormant seeds in the soil.

Sarah X.H. Young, June Harrigan, and Glen Fukunaga

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HAWAII'S WETLANDS MANAGEMENT POLICY- CHALLENGES AND STRATEGIES.

Wetlands are an integral part of Hawaii's landscape and play an important role in maintaining and improving the State's water quality and biological resources. Three endemic, endangered waterbirds; Hawaiian stilt (*Himantopus mexicanus knudseni*), coot (*Fulica americana alai*) and gallinule (*Gallinula chloropus sandvicensis*), the endangered Hawaiian Duck (*Anas wyvilliana*), and various migratory shorebirds (e.g., Pacific golden plover (*Pluvialis fulva*)); frequent wetlands for foraging and breeding purposes. Wetlands account for approximately 110,000 acres, spreading across the island in low-lying coastal areas, elevated lands and forested mountains. Over the past two centuries, about one-third of the coastal wetlands has been lost to development activities. Conservationists, resource managers, government agencies and business communities have long supported development of a comprehensive management policy to preserve these vulnerable and valuable resources. Nevertheless, overlaps in agency jurisdictions over wetlands, and lack of agreement on how to manage wetlands and administer the Clean Water Act Sections 404 and 401 programs have hampered the state in developing a coherent wetlands policy. Consequently, decisions have often been made in a piece meal and argumentative mode. The Environmental Protection Agency recognizes a need for a comprehensive statewide policy and has provided funding for developing a coherent and consensus-based statewide policy. The State Department of Health, Environmental Planning Office has formed a Wetlands Management Policy Workgroup to develop such a policy. This poster discusses the challenges faced and preliminary strategies developed by the workgroup. This poster will increase public awareness of wetlands functions and values, inform the public about the workgroup's efforts and will enable the public to contribute to the policy-making process.

Marjorie Ziegler

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THE ROLE OF CITIZEN ENFORCEMENT OF THE ENDANGERED SPECIES ACT IN HAWAII: A 25-YEAR PERSPECTIVE. The federal Endangered Species Act (ESA) was enacted in 1973 to conserve "the ecosystems upon which endangered species and threatened species depend." Approximately 34% of the country's listed birds and 42% of the listed plants are unique to the Hawaiian Islands. In addition, 90% of the native dry forest and 50% of the native rain forest in Hawai'i have been lost. The ESA generally provides for citizen enforcement of the law, as well as citizen petitions to list and de-list species, and to designate, modify, or remove critical habitat for listed species. Beginning with the endangered palila (*Loxioides bailleui*) and its critical habitat on Mauna Kea, citizens have employed the ESA to protect and enhance ongoing recovery efforts for dozens of imperiled Hawaiian plants and animals. I discuss citizen involvement in implementing the ESA in Hawai'i, the role of citizen enforcement, and the need for habitat protection requirements directed at state and county government. Hawaiian case studies are used to illustrate discussion points.

CURRENT INITIATIVES AND ACCOMPLISHMENTS IN CONSERVATION

Secretariat for Conservation Biology

Nancy Glover, Program Officer

<http://www2.hawaii.edu/scb/>

The Secretariat for Conservation Biology (SCB) promotes effective, long-term management of Hawaii's native ecosystems through collaborative research, training and outreach among resource managers, scientists, educators and the general public. It is an innovative partnership guided and funded by 10 organizations involved in resource management, research and education in Hawai'i. The SCB staff is based with the University of Hawai'i Center for Conservation Research and Training, while an advisory group representing the partner organizations meet quarterly to design and guide the SCB agenda and activities.

SCB partner organizations and advisory group members:

- University of Hawai'i, Center for Conservation Research and Training *Ken Kaneshiro*
- The Nature Conservancy of Hawai'i *Alan Holt*
- State Division of Forestry and Wildlife *Michael Buck*
- US Fish and Wildlife Service *Robert Smith*
- US Forest Service *Kathy Ewel*
- USGS Biological Resources Division *Bill Steiner*
- US National Park Service *Bryan Harry*
- Bishop Museum *Allen Allison*
- The Peregrine Fund *Alan Lieberman*
- The East West Center, Program on Environment *Jeff Fox*

Specifically, the SCB operates to:

- Maintain a prioritized agenda of research topics focused on problems faced by managers.
- Increase and sustain support for high-priority management-oriented conservation research in Hawai'i.
- Communicate the results of conservation science to natural resource managers.
- Increase public awareness as to the importance of conserving and managing Hawaii's biological diversity.
- Facilitate and coordinate collaborative projects and sharing of resources that support the SCB mission.

To accomplish the above, the SCB conducts the following activities:

The *Hawai'i Conservation Conference* is the largest gathering of people actively involved in the protection and management of Hawaii's native species and ecosystem. The purpose of the conference is to facilitate interaction among resource managers, educators and the scientific community. It is an opportunity to discuss and obtain up-to-date information on a variety of conservation activities in Hawai'i. The conference is held annually in July.

The *Hawai'i Conservation Forum* brings together more than 50 organizational representatives to discuss issues of mutual concern, identify gaps in knowledge, and collectively initiate collaborative projects. The purpose of the forum is to facilitate communication among managers and researchers to ensure that research addresses the problems faced by managers. The forum is held annually in February.

The *New Zealand-Hawai'i Conservation Exchange Program* encourages technical cooperation between Hawai'i and New Zealand through annual exchange visits. It is funded and administered in collaboration with Manaaki Whenua - Landcare Research New Zealand Ltd. Resource managers, researchers and educators can apply for financial support to participate in the exchange program by submitting a proposal at anytime of the year.

The *Research Grants Program* supports research that will result in improved management strategies and practices essential to conserving Hawaii's native ecosystems. Grants are awarded for projects that actively involve resource managers and include a component to communicate research finding to managers. A catalogue of high-priority research topics identified for specific protected native ecosystems by their respective managers is available to help focus research efforts.

The *Support Services Program for Natural Resource Managers* produces practical management guides, conducts training workshops and maintains a clearinghouse of conservation science information on the Internet. The purpose of the program is to ensure that relevant research results are accessible and understandable to resource managers. Management guides and training workshops address issues such as monitoring protocols, alien pest control, native plant propagation, and ecosystem restoration techniques.

The *Environmental Economics and the Hawaiian Economy Initiative* is a joint effort with the University of Hawaii's Department of Economics for the purpose of developing sound, objective economic analysis for improved natural resource decision making. The impetus for this initiative is the fact that the State of Hawai'i devotes less than one percent of its annual budget to manage all of its terrestrial and marine resources, despite the actuality that these natural resources provide inputs to the production of goods and services, act as sinks for waste and pollution and support all human activity.

The *Public Information and Awareness Program* seeks to establish a multi-agency partnership to develop and implement a statewide public awareness campaign focused on the greatest conservation challenges facing Hawai'i.

Current Initiatives and Accomplishments:

- In July 1997, the SCB received a generous Packard Foundation grant to expand and strengthen its ability to accomplish its mission and goals.
- We welcomed the East West Center's Program on the Environment, directed by Jeff Fox, as a partner in the SCB in November 1997. The EWC is contributing office space for the SCB staff, and collaborative projects are being discussed with the other partner organizations.
- An educational specialist, Luisa Castro, was hired to implement our new support services program for natural resource managers. A feral ungulate monitoring workshop was held in May 1998, and was attended by 70 resource managers throughout the state. A vegetation and rare plant monitoring workshop is currently being planned, to be held in February 1998. A practical management guide on weed control in natural areas has been drafted and will be published later this year. The SCB conservation science website was created.
- Nine research grants were awarded totaling \$100,000 that will lead to improved management practices at various protected natural areas. Research will focus on optimal rates for broadcasting rodenticide; impacts and control of feral ungulates and yellowjacket wasps; restoration techniques for native snails; native plant seed storage methods; eradication of alien pest invertebrates; monitoring impacts of biological control agents; and impacts of rodent control on bird nesting success.
- A natural resources economics working group was convened, consisting of economists and natural resource managers, that produced an action plan outlining activities necessary to develop sound, objective economic analysis for improved natural resource decision making. A team of economists was hired to begin the implementation of the action plan, which will provide the information for a public awareness campaign and lay the foundation for more comprehensive environmental economic analyses.
- The Conservation Forum was held in February 1998 and collaborative projects were initiated to address native invertebrate conservation, dry forest recovery, training needs and wetlands protection and restoration.
- The first Secretariat Advisory Group retreat was held in June 1998 to revisit the SCB goals and activities, and to make revisions as necessary to ensure that it is optimally aligned to fulfill its mission over the next few years. This included a special focus on the organizational structure, as well as the financial and human resources needed to promote the group's productivity and strengthen its ability to team up on shared problems.
- Pat Bily from The Nature Conservancy of Hawai'i was a recipient of the Hawai'i-New Zealand Exchange Program in 1997. His exchange focused on alien pest plant control strategies and methods. Graham Nugent from Landcare Research New Zealand visited Hawai'i as part of the exchange program, focusing on feral ungulate management and monitoring.
- The SCB is collaborating with the UH Hawaiian Internship Program in Natural Resource Management, coordinated by Sharon Ziegler. Brooks Pai, supported by the SCB, is an intern with The Peregrine Fund this summer.

The Birds of North America

Marie Morin, HI Coordinator, and Sheila Conant, HI Chair

<http://www.birdsofna.org>

The Birds of North America (BNA) project began as a joint venture of the American Ornithologists' Union (AOU) and the Academy of Natural Sciences of Philadelphia. Founded in 1883, AOU is North America's foremost organization devoted to the scientific study of birds. It has a membership of 5,000 professional and amateur ornithologists, including many of the BNA authors. In 1987, AOU began planning a new comprehensive publication series, The Birds of North America, to parallel the Mammalian Species profiles published by the American Society of Mammalogists, and to update the famous Bent's bird Life Histories. The 700+ species of birds that breed in North America or in the AOU checklist region are the subjects of these BNA publications. Authors are generally experts on their species, and each species account provides an up-to-date and comprehensive summary of standard topics, including current and past distribution, taxonomy, population status, limiting factors, and recommended future management and research.

Over half of the nationwide accounts are published or in final proofs, and thus far these endemic Hawaiian species accounts are finished: 'Akeke'e (#295), 'Akepa (#294), 'Amakihi (#360), 'Anianiau (#312), 'Apapane (#296), Duck, Laysan (#242), 'Elepaio (#344), 'I'iwi (#327), Millerbird, Laysan and Nihoa (#302), Owl, Short-eared (Pueo) (#62), Parrotbill, Maui (#311), 'O'ū and Lāna'i Hookbill (#335-336), Petrel, Dark-rumped (#345), Po'ouli (#272), and Shearwater, Townsend's and Newell's (#297). An additional nine "Hawaiian" accounts are in final draft or proof stage.

The following indigenous species' accounts are finished: Albatross, Black-footed (#65), Albatross, Laysan (#66), Booby, Masked (#73), Booby, Red-footed (#241), Golden-Plover, American and Pacific (#201-202), Night-Heron, Black-crowned (#74), Noddy, Brown (#220), Petrel, Bulwer's (#281), Pintail, Northern (#163), Shearwater, Wedge-tailed (#305), Shoveler, Northern (#217), and Tropicbird, Red-tailed (#43).

The following introduced species' accounts are also finished, although many of these accounts emphasize information from mainland populations: Chukar (#258), Dove, Rock (#13), Egret, Cattle (#113), Lark, Sky (#286), Leiotoxix, Red-billed (#359), Mockingbird, Northern (#7), Owl, Barn (#1), Quail, Gambel's (#321), Sparrow, House (#12), Sparrow, Java (#304), and Turkey, Wild (#22).

Many Hawaiian biologists have been involved in this project, as authors or reviewers, or both. Approximately 17 other Hawai'i-related accounts remain to be re-assigned or completed, with the nationwide project expected to be finished by the year 2000. Species accounts may be purchased individually or as a complete set.

Bishop Museum

Allen Allison, Vice President of Research

<http://www.bishop.Hawaii.org/bishop/HBS/>

The Hawai'i Biological Survey, a program of the Bishop Museum, continues to focus on the development of information products and services based on specimen collections and associated research efforts that advance the understanding and management of biological diversity, including ecosystem and endangered species management. A wealth of useful information on Hawaiian biodiversity is available on the Museum's World Wide Web server:

- Species checklists for 14,767 species of the 22,462 known from Hawai'i in searchable interfaces. This number is an accurate assessment of the fauna and includes deletion of unsubstantiated records, misidentifications, and species now considered junior synonyms.
- Lists and images of endangered species, threatened species, extinct species, and species of special concern.
- Select alien species specimens contained in the Museum's collections are being added through funding from the MacArthur foundation.
- Current US Fish and Wildlife Service status for all threatened and endangered species, as well as candidate species (including what used to be called "C2" species).
- Taxonomic information, specimen data, full bibliographies, images of adults and immatures, and distribution maps all linked for damselfly genus *Megalagrion* (also published as an HBS Handbook).
- Specimen data and full bibliographies linked for over 200 species of insects.
- Images, mostly color photographs of living organisms, available for many Hawaiian insects, fishes, birds, and plants. A diverse array of organisms are being added.

Current Initiatives and Accomplishments:

- Commenced work on a three-year grant from the MacArthur Foundation to produce comprehensive databases on alien invertebrate and plant species.
- Submitted on behalf of a consortium of federal, state and private organizations a \$998,000 proposal to the National Science Foundation to develop a Geographic Information Decision Support System on behalf of Ecosystem Management in Hawai'i.
- Produced Records of the Hawai'i Biological Survey for 1997. This latest 3-volume set included 34 articles for a total of 191 pages.
- Increased to 18% (160,000 records) specimen label databasing for Bishop Museum's Hawaiian of ca. 850,000 lots representing some 4 million specimens. Many of which are already available on the Internet.
- Continued work on a National Science Foundation funded project in partnership with San Diego Supercomputer Center, and the National Center for Ecological Analysis and Synthesis to develop WWW tools for display and analysis of ecological data, especially 3 dimensional visualization and analysis.
- Joined a consortium led by the University of Kansas under the aegis of the US Organization for Biodiversity Information and funded by the National Science Foundation to extend Z39.5 database technology to support standards based access to biological specimens and species authority records in support of Internet discovery of institutional specimen holdings, collections cataloging, taxonomic research, and various management and educational applications of biodiversity data.

Center for Plant Conservation Vickie Caraway, Coordinator

The Center for Plant Conservation (CPC), established in 1984, is the only national organization in the United States dedicated exclusively to the conservation of native US plants. Headquartered at the Missouri Botanical Garden in St. Louis, CPC is a network of 28 of the United State's leading botanical gardens and arboreta actively committed to plant conservation. These gardens collect, grow, and maintain the National Collection of Endangered Plants, a living collection of more than 500 of the nation's rarest plant species. With support from the MacArthur Foundation, the CPC-Hawai'i office was created as part of a national program for off-site plant conservation. The CPC-Hawai'i program provides long-term protection for 76 rare native Hawaiian plants in a network of five botanical institutions: Amy B. H. Greenwell Ethnobotanical Garden, Harold L. Lyon Arboretum of the University of Hawai'i, Honolulu Botanical Garden of the City and County of Honolulu, National Tropical Botanical Garden, and Waimea Arboretum. CPC-Hawai'i performs a unique role in integrating garden activities with conservation programs of the many land management agencies throughout the state. The CPC-Hawai'i center has established the following goals for the 1998-2000 period: 1) expand the off-site plant conservation capability; 2) enhance statewide institutional cooperation in plant conservation; 3) advance public awareness and citizen action in conserving rare plants; and 4) develop a collaborative and accessible database tracking rare Hawaiian plants.

Current Initiatives and Accomplishments:

- Developed the Genetic Safety Net initiative, an extension of CPC's 1994 Action Plan that focuses on Hawaii's most critically endangered plants.
- Maintained a comprehensive database of rare Hawaiian plant occurrences and status.
- Organized and chaired meetings of the Hawai'i Rare Plant Restoration Group (HRPRG), a coalition of 16 community groups, botanical gardens, and land management organizations coordinating off-site conservation programs in Hawai'i.
- Received funding to establish rare plant monitoring and sampling corps on O'ahu.

Earthjustice Legal Defense Fund, Paul H. Achitoff, Managing Attorney

Earthjustice Legal Defense Fund (previously Sierra Club Legal Defense Fund) is a 501(c)(3) non-profit, public interest environmental law firm with nine offices around the country. The Mid-Pacific office opened in Honolulu, Hawai'i in August 1988 under a generous grant from the MacArthur Foundation. Support comes primarily from individual contributions and foundation grants. Utilizing the Endangered Species Act, National Environmental Policy Act, Clean Water Act, State Water Code, and other laws, the Mid-Pacific office has represented over 70 environmental, community, and native Hawaiian organizations in litigation and administrative proceedings focused on endangered species/habitat, stream restoration, water pollution, and open government. Clients include Sierra Club, Conservation Council for Hawai'i, Hawai'i/National Audubon Society, Hawaiian Botanical Society, Hawaii's Thousand Friends, Environment Hawai'i, Common Cause, Ka Lāhui Hawai'i, Waiāhole-Waikāne Community Association, Greenpeace, Pele Defense Fund, Life of the Land, Earth Island Institute, PASH, Protect Mā'ālaea Coalition, 1000 Friends of Kaua'i, Lāna'ians for Sensible Growth, and others. Three attorneys, a resource analyst, and support staff are assigned to the Mid-Pacific office.

Current Initiatives and Accomplishments:

- Enforcement of the Endangered Species Act and a recent ruling that the US Fish and Wildlife Service must re-evaluate its across-the-board decision not to designate critical habitat for 245 threatened/endangered Hawaiian plant taxa as required by law. A time frame is currently being considered by the court.
- Enforcement of Hawaii's Sunshine Law and a recent ruling resulting in increased public notice, disclosure, and participation in proceedings and decision-making by the Hawai'i Board of Land and Natural Resources.
- Enforcement of two previous court orders involving the endangered palila bird and its critical habitat on Mauna Kea. As a result of recent discussions with the state Attorney General's Office, the Hawai'i Division of Forestry and Wildlife has repaired miles of fences and increased ungulate control (sheep and mouflon).
- Precedent-setting stream restoration at Waiāhole, Windward O'ahu after prolonged administrative contested case hearing. The Commission on Water Resource Management's restoration/water allocation decision is currently on appeal before the Hawai'i Supreme Court.
- Petition to the Commission on Water Resource Management to restore streams in Waipi'o Valley on the Big Island and on complaints on the dumping of unused water by the Lower Hāmākua Ditch and Lālākea Ditch on the island of Hawai'i.
- Ongoing litigation under the Clean Water Act involving unpermitted land development, erosion, stream crossing, and sedimentation of coastal waters at 'Aha'ino, Moloka'i.
- Enforcement of a previous settlement with the Army involving the Multi-Purpose Range Complex in the Pōhakuloa Training Area on Hawai'i. The issues are: an incomplete environmental impact statement, dry forest/site restoration, and conservation measures to mitigate the improper construction of the range.
- Appeal of the Hawai'i County Appeal Board's decision to issue a Use Permit to a commercial helicopter tour operation adjacent to Hawai'i Volcanoes National Park.

Hawai'i Audubon Society

Linda Paul, President

The Hawai'i Audubon Society (HAS), with a current membership of over 2,000, was established in 1939 and is the oldest continuously operating non-governmental organization devoted to environmental education and protection in Hawai'i and throughout the Pacific. HAS became a chapter of the National Audubon Society in 1978, but it is independent of that organization in matters of policy, financial control, and programs. The mission of HAS is to foster community values that result in protection and restoration of native ecosystems and conservation of natural resources through education and advocacy in Hawai'i and the Pacific.

Membership meetings, featuring presentations by both local and visiting lecturers, are held on a bimonthly basis at the Bishop Museum Pākī Conference Room. In addition, HAS conducts a monthly field trip/service trip which in recent months has included excursions to Kanepu'u Preserve on Lāna'i, the Waikalualoko Fish Pond in Kāne'ohe (service trip), and the Kahuku Point Sand Dunes (migratory bird hike). HAS also maintains a list of birders interested in setting up their own informal birding trips with other members.

HAS emphasizes educational activities, including the Paradise Pursuits Environmental Quiz Program, HAS's high school environmental education effort, which completed its seventh year in 1998. In addition, a teacher-training workshop funded by an Environmental Protection Agency grant was co-sponsored by the State Department of Education and HAS. Education Committee members also judged and presented HAS's annual awards to the best junior and senior division entries for outstanding research on natural history at the Hawai'i State Science and Engineering Fair.

Grants and scholarships offered by HAS include the George C. Munro Environmental Law Award, and tuition scholarships for the 1997-98 school year provided in the memory of Rose Schuster Taylor for use in the University of Hawai'i system. HAS also supports a small grants program, with recent awardees including a project that examines the diversity of crab spiders in Hawaiian dry forests; an investigation of the parent-offspring conflict on adult provisioning strategies of the wedge tailed shearwater; an examination of the role of *myccorrhizae*, a fungus, in Hawaiian dry forest restoration; and a study of blood samples from birds in American Samoa for hemoparasites.

HAS annually hires a Legislative Analyst who, along with other members, monitors environmental issues at the State Legislature, preparing and presenting testimony on behalf of HAS. In addition, HAS and the Kawai Nui Heritage Foundation last year joined forces to successfully lobby for state matching funds to provide a 3:1 match to a federal grant to restore 60 acres of waterbird habitat in Kawai Nui Marsh where HAS is currently seeking funding for an environmental and cultural education center.

HAS provides volunteer observers for the Laysan Albatross Re-colonization Project on O'ahu in conjunction with the US Fish and Wildlife Service, Department of Land and Natural Resources, and the National Audubon Society. In addition, members represent HAS on several public committees and task forces, including the Alien Aquatic Organisms Task Force and the Permit Process Task Force (Linda Paul), the 'Alalā Recovery Team (Reggie David), and the Western Pacific Regional Fisheries Management Council Community Development Program Ad-hoc Committee (Linda Paul). Linda also represented HAS on a panel at the Fifth Annual Hawai'i Conservation Conference and at the annual State Sustainability Conference.

Current Initiatives and Accomplishments:

- In September, HAS held its annual awards dinner at the Pākī Hale in Kapi'olani Park with a presentation by Susan Scott, author of All Stings Considered. The President's Award went to Bill Devick, Administrator of the Division of Aquatic Resources, for his courageous watershed restoration advocacy; the Conservation Award went to Betsy Gagne, Executive Director for the Natural Areas Reserves System Commission, for her tenacious alien species eradication advocacy; and the Government Partnership Award went to Gary Gill, Director of the Office of Environmental Quality Control, for making the environmental evaluation process more accessible to the public.
- In October, Linda Paul conducted an advocacy training session for science teachers in preparation for the 1998 legislative session.
- In November, the second annual "Birding for Beginners" Workshop was coordinated by Lynnea Overholt. Also in November HAS's Board of Directors took a service trip to the Hakalau Forest National Wildlife Refuge.
- In December, Christmas Bird Counts, coordinated by Arlene Buchholz, were held on O'ahu, Kaua'i, Moloka'i, Maui, and the Big Island.
- HAS publishes 'Elepaio, our journal that includes peer-reviewed articles on research and management of Hawai'i and Pacific natural resources. Individual copies are available for \$3.00. Hawaii's Birds was also reprinted in 1997 with minor revisions by Publications Committee Chair Reggie David, and continues to sell well at \$9.95 along with its companion cassette tape set Voices of Hawaii's Birds at \$24.95.
- In October HAS received a grant from the Trust for Public Land and the David and Lucile Packard Foundation to develop a handbook on conservation options and land protection tools for communities and landowners in Hawai'i. The proposal was drafted and the work is being done by John and Maile Bay as independent contractors.
- Looking towards the future, HAS has drafted a grant proposal seeking funds for a Hawai'i Aquatics Resources Secretariat and an Aquatics Resources Management Conference to be held in 1998, the Global Year of the Oceans. There is currently no Hawai'i conservation organization that has taken the protection of our aquatic resources under its wing and, given the interaction of seabirds, shorebirds, and wetlands birds with aquatic ecosystems, as well as the experience of several board members in this area. It is a good direction to expand HAS' conservation efforts. The Hawai'i Aquatics Resources Secretariat, if funded, would ideally be merged with

the Secretariat for Conservation Biology to provide research and management facilitation from a complete island ecosystem perspective.

Hawai'i Environmental Education Association

Tom Alexander, President

<http://maui.net/~heea>

Since 1989, the Hawai'i Environmental Education Association (HEEA) has been the catalyst for bringing together environmental educators from all the diverse backgrounds and interests represented in our community. We are the only state organization devoted to serving environmental educators. HEEA has accepted the leadership role for the implantation of a strategic plan, *Our Environmental Future: A Strategic Plan for Educating the People of Hawai'i*, and is committed to updating the plan annually. This plan was developed through a consensus process involving educators and representatives from government, business, and community organizations. The primary 1998 goal of HEEA is implementation of the strategic plan.

Hawai'i Forest Industry Association

Andrea T.G. Beck, Executive Director

The Hawai'i Forest Industry Association (HFIA) is a non-profit trade organization incorporated in 1989. HFIA was founded by and for people interested in maintaining healthy, sustainable and productive forests. HFIA promotes a balance of forest land uses ranging from the protection of native forest ecosystems to managing commercial forests for economic purposes.

A statewide organization, HFIA's diverse membership encompasses forestry professionals, woodworkers, landowners, educators, mill operators, wood product manufacturers, retailers, environmentalists, ecotourism operators, agroforesters, nursery managers, and private citizens who are interested in healthy and productive forests. The membership, currently over 270, also includes individuals and companies on the mainland and in foreign countries.

According to a study completed by the Governor's Agriculture Coordinating Committee and published in 1993, forestry is among the top ten diversified agricultural enterprises in the state, with a total production value of \$29 million and over 800 workers. Much of the value of the industry comes from adding value to commodity wood by skillfully crafting it into furniture, turned bowls, boxes and other items.

HFIA manages a variety of projects, many under contract to organizations such as the Hawai'i Forestry and Communities Initiative, the Industry Network Corporation, the US Fish and Wildlife Service, the Department of Land and Natural Resources, the Department of Business, Economic Development, and Tourism, the County of Hawai'i, and the Rural Community Assistance Corporation. Some of the projects are:

- **Dryland Forest Restoration.** HFIA coordinates a working group consisting of landowners, federal and state agencies, environmental organizations and concerned individuals who are developing management techniques for the large-scale restoration of native dry forests. Working in Ka'upulehu, Kona, with a five-acre fenced parcel owned by Kamehameha Schools Bishop Estate (KSBE) and leased to the National Tropical Botanical Garden, the effectiveness of various herbicides and manual weed-whacking for fountain grass control was compared. Evidence of rodent damage on seeds and seedlings also prompted efforts to reduce the rat population. To protect the site from brushfires, a fire break is being maintained. Limited outplanting, initially with irrigation, was also completed. Presently, focusing on a 70-acre parcel owned by KSBE and leased to PIA Kona Partnership, the working group is exploring cost-effective ways of controlling fountain grass over extremely rough terrain. Rodent censuses are also being initiated to guide the group in the best management methods. Some outplanting of species raised from seeds collected in the area, with limited irrigation, is also continuing, but the group hopes to develop methods of encouraging natural regeneration or economically seeding native species over significant acreage, which will be more practical than hand-planting for large landholders.
- **Public Information.** HFIA has sponsored or participated in special informative forums on, for instance, dryland forest issues. In addition, a quarterly newsletter, WOODS is published, with a current readership exceeding 1,200 individuals. Approximately every year, HFIA also sponsors a public symposium. The 1996 session was entitled, "Koa: A Decade of Growth", and the 1998 conference was "Harvest to Market: Adding Value to Hawaii's

Woods”. Proceedings are published to make the information presented at the symposia available to everyone. A valuable forestry reference, *Common Forest Trees of Hawai‘i*, has been reprinted for public information.

- **Wood Product Market Development.** Research into consumer attitudes and preferences regarding crafted wood products was the basis for the development of a statewide branding program, which HFIA will be implementing in the coming year. In addition, HFIA is investigating appropriate markets for larger-volume commodity woods which were planted decades ago on commercial forest lands.
- **Woodworking Exhibition.** For six years, HFIA’s Wood Show has been a premier event highlighting the finest furniture and woodworking in the state, with an emphasis on the use of conservative woodworking techniques and alternative tropical hardwoods. A major purpose of the show is to develop a demand for unique tropical woods which can be grown sustainably in Hawai‘i.
- **Training and Business Assistance.** Through special workshops aimed at improving the skills of professional woodworkers and the delivery of one-on-one assistance to forest-related businesses, HFIA is working to improve the productivity and competitiveness of forest enterprises in Hawai‘i. Other seminars have included kiln drying and forest economics.
- **Education.** Working with the Department of Education and the University of Hawai‘i, HFIA has brought woodworkers into high school wood shops, nursery professionals to high school agriculture programs, and forestry curricula onto college campuses, preparing a new generation for jobs in forestry.

The Hawai‘i Nature Center

Diana King, Education Director

The Hawai‘i Nature Center (HNC) is a 501(c)(3) private non-profit organization incorporated in 1981. Its purpose is to foster awareness, appreciation and understanding of the environment by and for the people of Hawai‘i and to encourage wise stewardship of the islands in the future. This is accomplished through hands-on, heart-touching environmental education field experiences for elementary school children, families and the public.

Since our modest beginnings, over 500,000 children and families have participated in environmental education programs at the HNC. HNC programs have won the national honors: the “take Pride in America” award in education from the Department of Interior; the Nancy Hanks Memorial Award for Professional Excellence granted by the American Association of Museums; and the United Nations Environmental Leadership award bestowed by the US Department of Education’s Eisenhower Regional Consortia as a Promising Practice in math and science education, one of only two programs in Hawai‘i to be so honored.

On O‘ahu, HNC now has three field sites: the original Makiki Valley field site, the Pu‘u ‘Ualaka‘a State Park and the Honouliuli National Wildlife Refuge. The program has grown from serving 2,000 school children in 1981, to more than 22,000 in 1997. These programs now include a different conceptual focus and unique ecosystems for each grade level. We are continuing to grow by adding new programs, increasing field sites and securing additional funding sources.

In addition to serving schools, HNC provides outdoor programs for families and community groups on weekends. These include guided interpretive hikes, nature adventures, earth care projects, and more. In 1997, our community programs served more than 25,000 island families on O‘ahu and Maui.

In 1992 we opened the doors of our first neighbor island facility on Maui in ‘Iao Valley. This facility, as well as a field site at Keālia Pond, now serves more than 60% of Maui County’s elementary school students each year. In addition, the recently renovated ‘Iao Valley facility was acquired in perpetuity for environmental education.

A ten-year strategic plan, developed in 1990 and being implemented now, is directed at insuring all elementary school children statewide will have access to high quality environmental education opportunities.

Current Initiatives and Accomplishments:

- An Interactive Science Arcade with more than 30 hands-on exhibits emphasizing the natural history of the Hawaiian islands was opened at our Maui site in 1997. Hawaii’s first hands-on science center is a unique new attraction where visitors and residents – adults and children • can experience interactive displays such as rain forest explorations, dispersal arcade games, live insect and stream animal exhibits and a dragonfly’s view of the world.

- Development of a conceptual plan for Diamond Head interpretation.
- Hands-on, field based workshops for teachers.
- Collaborative efforts addressing the pollution problems at the Ala Wai Canal.
- Development of a Nature Plant Trail used for teaching.
- Publication of a native plant guide for Manoa Cliff Trail.

Hawai'i State Department of Agriculture, Plant Pest Control Branch

Myron Isherwood, Agriculture Pest Control Manager

<http://www.hawaii.gov/icsd/doa/doa.html>

The Hawai'i State Department of Agriculture, Plant Pest Control Branch, supports biodiversity conservation by eradicating or controlling designated plant pests that become established by using chemical, mechanical, biological, and integrated control measures. Insects, mites, snails, slugs, noxious weeds, plant diseases, and other destructive organisms not only pose a threat to agriculture and the public but also impact native ecosystems. Many control efforts against agricultural pests also result in the conservation of native flora and fauna.

Current Initiatives and Accomplishments:

- USDA APHIS permit was received to apply the fungus *Colletotrichum gloeosporioides f.sp. miconiae* to control miconia (*Miconia calvescens*) on East Maui and at Onomea, Hawai'i. With the return of wet weather, the fungus has become established at Onomea and is beginning to spread. Confirmation of establishment at East Maui is pending.
- *Melittia oedipus*, a borer used to control ivy gourd (*Coccinia grandis*), is well-established at wet release sites on O'ahu. Release of two beetles, *Acythopeus sp. 1* and *Acythopeus sp. 2*, to control ivy gourd was recently approved by the Board of Agriculture. Approval by USDA APHIS is expected to take six months.
- Chemical control of the ivy gourd infestation at Anahola, Kaua'i is continuing with about an 80% control rate achieved to date.
- The DOA's request to release gorse rust (*Uromyces pisi f.sp. europaei*) is still being evaluated by USDA APHIS.
- The biocontrol fungus, *Septoria myricae*, has been released but is not yet established on firetree (*Myrica faya*) at the Hawai'i Volcanoes National Park.

Hawai'i State Department of Agriculture, Plant Quarantine Branch

Larry Nakahara, Plant Quarantine Manager

<http://www.hawaii.gov/icsd/doa/doa.html>

The Hawai'i State Department of Agriculture, Plant Quarantine Branch, supports biodiversity conservation by preventing pests and diseases from entering the state that could impact our agriculture, environment, or the health and welfare of the public. Pest prevention is achieved through risk analyses of organisms before they are allowed to enter the state, inspection of agricultural goods at air and sea ports of entry, monitoring of restricted organisms after their entry into the state by permit, investigation of violations, and an ongoing public education program.

Current Initiatives and Accomplishments:

- Helped initiate a statewide public awareness alien pest species campaign involving numerous print and video media coverage under the multi-agency Coordinating Group on Alien Pest Species (CGAPS) with support of The Nature Conservancy.
- Revising Hawai'i Administrative Rules on importation of plants, animals, and microorganisms; on intrastate movement of plants and animals; and on export of plants to facilitate movement without compromising Hawai'i's laws on pest prevention.
- Developing a computerized system to keep track of allowed, restricted, and prohibited organisms; permits and conditions that are issued; and status of restricted organisms undergoing risk analyses.

- Established procedures with the University of Hawaii's Institutional Biosafety Committee to facilitate importation of microorganisms for the university's research community.
- Established a Memorandum of Agreement and procedures with the State Department of Health to facilitate site inspections and importation of restricted microorganisms for use in diagnostic testing by health laboratories and clinics.
- Established a Brown Tree Snake Technical Committee with several other agencies under CGAPS to resolve brown tree snake prevention, control, and training issues; trained both military and civilian airport and harbor personnel on the brown tree snake; and received numerous print and video media coverage on the snake and detector dogs.
- Developed an interisland inspection program with the help of the USDA to facilitate inspections of plants carried by passengers traveling between islands.
- Coordinated import requests with Aquaculture Development Program to facilitate reviews of proposals to import and develop aquaculture programs in Hawai'i.
- Initiated federal reviews of State of Hawai'i requests to release biocontrol agents in Hawai'i to facilitate the federal review process.
- Continued a public education program on alien pest prevention for the eighth consecutive year (several times per week) with no special funding.
- Facilitated the export of cut flowers and plants to domestic and foreign markets, including Japan.

Hawai'i State Department of Land and Natural Resources, Division of Forestry and Wildlife

Michael Buck, Administrator

<http://www.hawaii.gov/dlnr/dfw/dfw.html>

The Division of Forestry and Wildlife (DOFAW or the Division), one of ten operating divisions within the State Department of Land and Natural Resources, is responsible for endangered species protection statewide, directly administers 580,000 acres of forest reserve, 109,000 acres of Natural Area Reserves, 10,000 acres of wilderness reserves, 50 plant enclosures, nearly 60,000 acres of wildlife sanctuaries, and has regulatory control over an additional 1 million acres of conservation lands.

DOFAW's professional staff includes foresters, wildlife biologists, botanists, aviculturists and natural area specialists. DOFAW does not conduct its own formal research but instead depends on cooperative projects with partners to obtain research needs. DOFAW has cooperative research and management agreements with many other government and private organizations including the US Forest Service, the University of Hawai'i, the US Fish and Wildlife Service, the National Park Service, USGS Biological Resources Division, The Nature Conservancy, the YMCA, and a number of local Hawaiian organizations. The Division also is providing 2:1 matching funding for natural resource management activities on over 25,000 acres of private land under the Natural Area Partnership Program and 1:1 matching funding for 13,250 acres under the Forest Stewardship program.

The Division has five core programs:

- Watershed Protection and Management
- Native Resource Protection and Enhancement Program
- Outdoor Recreation Resource and Development Program
- Forest Products Resource and Development Program
- Volunteer and Information Program

Hawaiian Islands Humpback Whale National Marine Sanctuary

Naomi McIntosh, O'ahu Sanctuary Liason

<http://wave.nos.noaa.gov/ocrm/nmsp/nmshawaiiislands.html>

The Hawaiian Islands Humpback Whale National Marine Sanctuary (Hawai'i Sanctuary) was designated by Congress in 1992. The mission of the Hawai'i Sanctuary is to provide protection for the humpback whale and its Hawaiian

marine habitat by promoting comprehensive and coordinated management, research, education, long-term monitoring, and interpretive enforcement programs. The Hawai'i Sanctuary helps to support the work of marine researchers, develops community outreach educational programs, publishes brochures and other informational materials to educate and enhance the public's awareness about Hawaii's unique marine environment, provides presentations and conducts resource protection workshops. Additionally, the Hawai'i Sanctuary works cooperatively with other government agencies, local organizations, and individuals in the community to accomplish its goals.

The Hawai'i Sanctuary is the nation's newest and one of only 12 national marine sanctuaries located around the country and American Samoa. The Hawai'i Sanctuary encompasses approximately 1,370 statute miles and includes waters around the islands of Kaua'i, O'ahu, Maui, Moloka'i, Lāna'i and Hawai'i.

Current Initiatives and Accomplishments:

- February 16, 1998 Dedication Ceremony of the Hawaiian Islands Humpback Whale National Marine Sanctuary to celebrate the 1998 International Year of the Ocean and a new federal and state partnership to ensure a legacy of protection for Hawaii's humpback whale. On June 6, 1997, Governor Benjamin Cayetano signed an agreement to enter into a five-year partnership with the National Oceanic and Atmospheric Administration (NOAA) to protect the endangered humpback whales and their Hawai'i habitat.
- The Hawai'i Sanctuary volunteer program provides concerned citizens the opportunity to get involved. In 1997, over 150 citizens logged more than 2,300 volunteer hours at community events, office renovation, monitoring water quality and assisting in the office with administrative tasks. In addition, Sanctuary volunteers have contributed more than \$4,000 dollars in donations. The efforts of Sanctuary volunteers have been recognized by Vice President Al Gore, NOAA, and the County of Maui's Community Work Day Program.
- A 25-member Sanctuary Advisory Council (SAC) was formed in March 1996. The SAC provides advice and recommendations to the Sanctuary Manager. This citizen advisory council ensures local participation in sanctuary management and allows sanctuary staff to stay in touch with various constituencies. Currently, new non-government members are being selected to serve.
- A Maui Visitor Center is being developed at the Sanctuary's headquarters office in Kihei, Maui.
- Hawaiian Fishpond Restoration is taking place on the grounds of the Maui Sanctuary office. Sanctuary staff, volunteers and local community groups are assisting in this effort.
- *Careers on the Water* is an innovative program for high school age students. The program introduces students to a wide variety of marine related careers on board a whale watch cruise. It is a cooperative program developed by the Hawai'i Sanctuary, Farrington High School, University of Hawai'i Curriculum Research and Development Group, and Royal Hawaiian Cruises/Navatek I.
- O'ahu Whale Count is a annual effort to provide volunteers with the opportunity to participate in an island-wide count to estimate the number of whales that can be seen from various shore sites around O'ahu in a three-hour period. In 1997, over 165 people participated and logged 490 volunteer hours. In 1998, the number of participants grew to approximately 300 volunteers.
- The Hawai'i Sanctuary continues to support educational and outreach efforts on the island of Kaua'i. Partnerships have been developed with the US Coast Guard, Kīlauea Point National Wildlife Refuge, and the Kaua'i Children's Discovery Museum.
- Interpretive Enforcement. Since 1997, the Hawai'i Sanctuary has worked with the NOAA Fisheries Enforcement Office to have a NOAA Fisheries Enforcement Officer stationed at the Maui Sanctuary Office during the whale watch season. The officer works with sanctuary staff to promote interpretive enforcement of humpback whale approach regulations. The Sanctuary also sponsors annual community workshops to educate citizens about humpback whale approach regulations.
- Humpback Whale Research. The Hawai'i Sanctuary has been involved in a number of different research projects regarding humpback whale population assessment and behavior around the Hawaiian Islands. Most recently, the Hawai'i Sanctuary funded a 1998 island wide aerial survey for the Hawaiian Islands to help provide estimates for the humpback whale population. A final report is expected in August 1998.
- The Hawai'i Sanctuary is funding a study to examine all water quality parameters within the Sanctuary. A water quality report is expected in the future.

- The Hawai'i Sanctuary, West Maui Watershed, and the Hawai'i Department of Health co-sponsored a project called "Na Pale O Ke Kai" or Protectors of the Ocean. This is a Maui volunteer coastal monitoring program in which volunteers walk select beaches and collect data on nuisance seaweed (algae) accumulations and water clarity. The project began in 1995 and is expected to continue for several more years.

Honolulu Zoo

Tom Higashino, Assistant Director

<http://www.co.honolulu.hi.us/Depts/zoo/educ.htm>

The Honolulu Zoo is operated by the City and County of Honolulu, Department of Parks and Recreation. It is open every day except Christmas and New Year's and displays plants and animals of tropical ecosystems. A wide range of education programs are offered including: Zoo By Moonlight, Zooper Birthday Parties, Vacation Adventures, Snooze at the Zoo, botanical tours and arts and crafts. The Zoo's Master Plan will portray three ecosystems: the African Savanna which was completed in 1994, the Tropical Forest, and Islands. It has had a long tradition of working with Galapagos tortoises, being the first zoo in North America to breed these in captivity, as well as working with birds of paradise and endemic forest birds. The Honolulu Zoo is an accredited member of The American Zoo and Aquarium Association (AZA), and participates in a number of AZA programs such as the Species Survival Plan (SSP), Animal and Medical Record Keeping Systems (ARKS & MedARKS) and chairs the bird of paradise Species Interest Committee.

Current Initiatives and Accomplishments:

- Collaborative work with mainland zoos and US Fish and Wildlife Services on endemic forest birds and avifauna of the Mariana Archipelago, Galapagos tortoises, birds of paradise, komodo dragons and tropical amphibians.
- The building of a komodo dragon exhibit expected to be completed in early 1999.

Kaho'olawe Island Reserve Commission

Noa Emmett Aluli, Chairperson

<http://www.hawaii.gov/kirc/>

The Kaho'olawe Island Reserve Commission (KIRC) is the State of Hawaii's managing entity for the 45 square mile island that was used for over 50 years as a US military target. The KIRC is the State's single-point-of-contact for the congressionally mandated and funded cleanup of the island, scheduled to begin in the summer of 1998.

The Hawai'i Legislature defined the Kaho'olawe Island Reserve as the island and a two-mile radius of ocean from its shoreline. The Reserve can only be used for Native Hawaiian cultural, spiritual and subsistence purposes. No commercial uses will be permitted. The Reserve will be transferred to a sovereign Native Hawaiian entity following recognition of the entity by the state and federal government.

Congress mandated in 1993 that the island be returned to the State of Hawai'i and that the Navy conduct a cleanup of unexploded ordnance. The Navy was given 10 years and an authorization of \$400 million to conduct the cleanup. Congress makes appropriations for the cleanup each year. Eleven percent of the annual appropriation is transferred to the KIRC to be used for planning and restoration purposes.

The Commission is chaired by Dr. Noa Emmett Aluli, a Moloka'i physician who was an early leader in the movement to stop the bombing on the island. Dr. Aluli and other activists made illegal occupations of the island in the mid-1970's which help to galvanize public sentiment against continued Navy control of the island. The entire island was placed on the National Register of Historic Places in 1981.

Current Initiatives and Accomplishments:

- Environmental Restoration

From the mid-1800's through 1992, feral goats and sheep overgrazed Kaho'olawe, eliminating the forest and all ground cover. The resulting massive soil erosion reduced the top one third of the island to hardpan. Reefs and coastal waters have also been damaged by silt run off.

The KIRC restoration effort is guided by the Kaho‘olawe Island Use Plan which began the process of setting priorities for the cleanup according to broad, general land use categories for future use of the Reserve.

The Kaho‘olawe Restoration Plan is in the process of being printed. The Plan is the result of a two-year collaboration between Hawai‘i scientists, indigenous practitioners, and other interested individuals. The Plan outlines steps for the control of erosion and replanting of the island. Much of the labor required for restoration will have to be provided by volunteers.

From July 1998 to June 1999, restoration efforts on the island will begin at Lua Makika, the summit of the island’s single volcano. Some areas there were cleared of ordnance during the 1995 “model cleanup” and other areas will be cleared in the earliest stages of the regular cleanup. Trips will be made to control erosion and begin planting.

Other restoration efforts in the next 12 months include the purchase of native plants, the construction of a plant nursery on Maui, and the start of design plans for a water catchment system at Lua Makika. Efforts to control alien species on island will continue along with efforts to monitor earlier planting areas and identify special ecological areas where there are intact native species.

- Ocean Resource Management and Cultural Development

Currently the only fishing permitted in Kaho‘olawe is on-island fishing for consumption and trolling in Reserve waters on two designated weekends per month. Due to enforcement difficulty, illegal fishing within the Reserve boundaries is commonplace and has affected fishing stock.

New administrative rules regarding fishing will be proposed during the summer of 1998. The rules will follow the policy set in the Ocean Resource Plan released in 1998. The Plan calls for the establishment of different types of fishing zones around the island. In some areas all fishing would be prohibited; in other areas, the type of equipment used would be specified.

The KIRC’s Ocean Resource Program is based on regular resource monitoring of fish, reefs, sediment and inter-tidal activity. There will be an increased enforcement presence in the waters in the next few months.

All workers in the Kaho‘olawe clean-up will be receiving cultural training prior to work on island and during their stay. The training will be done by KIRC’s Cultural Coordinator. The Coordinator will also conduct appropriate ceremonies for the start of cleanup activities. Cultural practices on island are guided by a cultural protocol and a use plan.

Kamehameha Schools Bishop Estate

Tonnie Casey, Wildlife Biologist, Hawai‘i Island Region

<http://www.ksbe.edu/ksbehome.html>

Kamehameha Schools Bishop Estate, (KSBE) is the largest private landowner in Hawai‘i. Forty-eight percent of the lands owned by KSBE are designated for conservation. Seventy-eight thousand acres of this land are grouped as private forest reserves.

Current Initiatives and Accomplishments:

- On the Big Island, KSBE is a partner in the Ola‘a-Kīlauea Cooperative Agreement with Hawai‘i Volcanoes National Park, State Division of Forestry and Wildlife, Kulani Correctional Facility, US Fish and Wildlife Service, USGS Biological Resources Division, US Forest Service and other private landowners. The Kīlauea Forest encompasses 2,995 acres and has been divided into three fenced management parcels. In these management parcels, pigs are being incrementally eliminated. Following pig eradication, small mammalian predators and weeds will be eliminated.
- KSBE continues to plant koa (*Acacia koa*) on 9,200 acres at Keauhou Ranch to provide habitat for native birds and plants. At Keauhou Ranch, research is being conducted on aerial predator control strategies that have been successful in New Zealand, in collaboration with the US Fish and Wildlife Service, USGS Biological Resources Division, State Division of Forestry and Wildlife and The Peregrine Fund. Predators are currently managed on 2,000 acres. Native plant propagation for outplanting include the endangered Hawaiian vetch (*Vicia menziesii*), in cooperation with the Center for Plant Propagation, and *Clermontia hawaiiianesis*, in cooperation with USGS Biological Resources Division and Hawai‘i Volcanoes National Park. The alien pest plant faya (*Myrica faya*) is

inoculated with defoliating molds dispersed by the State Department of Agriculture. Research into aerial applications of a mosquito larvacide is being conducted with the USGS Biological Resources Division.

- KSBE works with the Dryland Forest Restoration Group at Kaupulehu to find new techniques for fountain grass (*Pennisetum setaceum*) control by application of the herbicide Fusilade DX by helicopter in key areas, and to control rodent and mongoose populations using bait stations. Endangered plants are propagated by the National Tropical Botanical Garden, outplanted, and drip irrigated using a new water tank/fire suppression system. Roads are bulldozed for easier access to lower areas and to maintain firebreaks.
- KSBE contributes to predator control at 'Ōpae'ula pond in Makalawena to help endangered Hawaiian waterfowl. In Recent meetings with Ducks Unlimited, plans have been made to restore the pond habitat.
- KSBE and The Nature Conservancy work together at Ukoa Marsh on O'ahu to control predators by laying a bait line around the edge of the marsh to protect the Hawaiian stilt (*Himantopus mexicanus knudseni*) and the gallinule (*Gallinula chloropus sandvicensis*). Plans are underway for restoration of the lower ponds to utilize the area for ecotourism.
- KSBE's Hāmākua sugar lands, leased for forestry with Prutimber, are cultivated to increase water infiltration and prevent soil runoff, which keeps streams clean and saves our reefs.
- KSBE participates with the Po'ouli Project by contributing resources for predator control and assistance with surveys.

Manaaki Whenua - Landcare Research, New Zealand

Bruce Clarkson, New Zealand Coordinator

<http://www.landcare.cri.nz/>

Manaaki Whenua - Landcare Research is an independent New Zealand Crown Research Institute (owned by the New Zealand Government) which focuses on sustainable management of land resources. A national network of more than 400 staff works on all aspects of resource management understanding the effects of climate change on carbon storage in terrestrial ecosystems, developing sustainable land use systems which maintain the underlying quality of the environment, managing weeds and pests, understanding the dynamics and functioning of indigenous ecosystems and conserving the diversity of native species. The organization also maintains nationally important flora and fauna collections, and a range of resource databases. Landcare Research is committed to high quality science concerning land and landscapes, soil and soil water, plants and animals, and the relationships among all these in natural and modified ecosystems. Attention is given to the economic, social and cultural impacts of land use as well as to conservation. As well as ensuring excellence in its research, the organization develops innovative technology (e.g., satellite imagery and remote sensing, radio telemetry equipment) to assist resource management, maintains a wide range of analytical laboratories, and provides a variety of consulting services including specialist training (e.g., in Geographic Information Systems).

Landcare Research is the lead New Zealand agency for the New Zealand-Hawai'i Conservation Exchange Program which facilitates exchange programs between Hawai'i and New Zealand of appropriate conservation managers, researchers and educators. Exchanges are to enhance communication of approaches, techniques and philosophies relevant to the common natural resource management issues of New Zealand and Hawai'i. The most recent Hawaiian participant was Pat Bily from the Nature Conservancy of Hawai'i who visited New Zealand in November 1997 mainly to observe pest plant control techniques in natural areas and community based, Department of Conservation, and Regional Council weed control strategies. Graham Nugent of Landcare Research visited Hawai'i in May 1998 to attend a workshop on feral ungulate monitoring techniques and assist with the development of a research program on the movements and management of axis deer on Maui. He also assessed the history of involvement of wildlife in the long history of Tb infection in cattle on Moloka'i and the present management practice and monitoring programs in several preserves on Moloka'i.

Landcare Research has been represented at each Hawai'i Conservation Conference since its inception in 1993. Two representatives are attending this year. Dianne Gleeson, a conservation geneticist, will present a paper on a species approach to invertebrate conservation and will contribute to a discussion panel on the approach and components of a comprehensive invertebrate conservation plan for Hawai'i. Andrew Pearce (CEO), who together with Colin Bassett of the Secretariat for Conservation Biology was instrumental in formulating the exchange program, will also be attending.

Maui Nui Botanical Gardens, Inc.
Lisa Schattenburg-Raymond, President

Maui Nui Botanical Gardens, Inc., is a non-profit organization established in 1995. The organization (formerly the Friends of the Maui Zoo and Botanical Gardens) began as an off shoot of the Native Hawaiian Plant Society to give its primary attention to the improvement of the Maui Zoological and Botanical Gardens. In 1997, Maui Mayor Linda Lingle, citing budgetary restrictions, closed the zoo exhibits at the garden. The Maui Zoological and Botanical Garden Advisory Committee recommended that if the zoo were closed the botanical gardens should be retained and expanded. The County Council then granted \$90,000 for the creation of a master plan for the garden. The Maui Nui Botanical Gardens, Inc., along with representatives of the Native Hawaiian Plant Society, the Maui County Water Department, Office of Hawaiian Affairs, State Department of Land and Natural Resources, Maui Community College, and the Tri-Isle Resource Conservation and Development Board Inc., are developing the master plan for the 7.5-acre site.

The mission of the Maui Botanical Gardens is to foster an appreciation and understanding of the living Hawaiian islands of today, emphasizing Maui Nui (Maui, Moloka'i, Lāna'i and Kaho'olawe) plants and providing a center for environmental education, Hawaiian cultural expression, conservation, biological study, and recreation. The focus of the garden will be the conservation of coastal and dry forest species of Maui Nui, a xeriscape demonstration garden and a collection of important Hawaiian ethnobotanical plants. The botanical garden adjoins a 20-acre partially lithified sand dune located in the middle of the recently developed Keōpūolani Park. There exists potential for the restoration of the dune and the out planting of endangered species there. The Maui Nui Botanical Gardens, Inc. Board is proposing that a partnership with the Maui County Parks Department be formed and that the non-profit organization manage and develop the garden.

Maui Pineapple Company, Ltd.
Randy Bartlett, Supervisor

Since February of 1988, Maui Pineapple Company, Ltd. (a subsidiary of Maui Land & Pineapple Company, Inc.) has actively managed over 8,000 acres of its privately-owned, conservation-zoned lands on Mauna Kahalawai - otherwise known as Halemahina ("House of the Moon") or West Maui. Beginning in partnership with The Nature Conservancy of Hawai'i, and in 1993 as a participant in the State of Hawai'i's Natural Area Partnership Program, Maui Pine's Pu'u Kukui Watershed team has aggressively worked to preserve and protect the rare and endangered natural resources of the area, including: Hawai'i's only endemic land mammal species; the Hawaiian hoary bat (*Lasiurus cinereus semotus*); four endemic bird species, pueo (*Asio flammeus sandwichensis*), 'amakihi (*Hemignathus virens wilsoni*), 'apapane (*Himatione sanguinea sanguinea*) and 'i'iwi (*Vestiaria coccinea*); six endemic tree snail species, *Auriculella uniplicata*, *Perdicella kuhnsi*, *Partulina perdix*, *P. splendida*, *P. tappaniana* and a species not seen on Maui for half a century, *Newcombia cumingi*; and 261 endemic and 68 indigenous plant species; including twenty-four species listed by the US Fish and Wildlife Service as either Candidate or Species of Concern as well as eight on the Federal Endangered Species List.

Long-Range Management Plan objectives, developed with The Nature Conservancy and refined by the State's Natural Area Partnership Program, include:

- 1) Feral Ungulate Control of pig (*Sus scrofa*), Chital deer (*Axis axis*) and goat (*Capra hircus*) through a private-permit hunting program and a combined fencing and snaring program.
- 2) Invasive Pest Plant Control by manual, chemical or biological means of priority weed species.
- 3) Small Mammal and Invertebrate Control of several pest species by baiting and trapping.
- 4) Rare and Endangered Species Protection through enclosure fencing, baiting and trapping and ex situ propagation and out-planting.
- 5) Monitoring and Research of immediate threats through feral ungulate and alien plant monitoring belt transects and spot monitoring/photo-point stations, and of the overall health of the 12 native natural plant and animal communities within the watershed by long-range monitoring of vegetation plots.

Current Initiatives and Accomplishments:

- Continued sponsorship of a guided Pu‘u Kukui Trail interpretive hike award for Maui winning team of the Hawai‘i Audubon Society’s Paradise Pursuits environmental quiz show for Hawai‘i’s high school students.
- Continued sponsorship of a guided Pu‘u Kukui Boardwalk interpretive hike award (\$500 value) for the winner of a conservation essay contest for Maui high school students sponsored by the Kapalua Nature Society during the annual Earth Maui Nature Summit held at the Kapalua resort each summer.
- Continued construction of the Pu‘u Kukui Boardwalk to protect the fragile montane bog habitat on ML&P property and the State’s Honokōwai Natural Area Reserve along the upper Pu‘u Kukui trail from being damaged by limited foot traffic.
- Continued limited participation in the Maui Axis Deer Group (MADG) to determine best action solutions to control/limit the spreading populations of Chital deer (*Axis axis*) on Maui that pose a serious threat to Maui’s remaining native rainforest habitat, as well as the remaining rare/endangered dry/mesic forest plant species.
- Continued limited participation in the Secretariat for Conservation Biology’s Hawai‘i Natural Resources Monitoring Working Group to document monitoring methods currently being used throughout the state by various conservation-oriented agencies and to provide informative workshops to train and update resource managers and staff on appropriate monitoring methods and protocols.
- Continued participation in the Tri-Isle RC&D’s Melastome Action Committee (MAC) to coordinate interagency strategies, obtain funding and to determine best action solutions to combat Melastomataceae alien pest plant species which are silently invading Hawai‘i.
- Participation in formation and organization of the Tri-Isle RC&D’s Maui Invasive Species Committee (MISC) with the State Division of Forestry and Wildlife (Fern Duvall III), UH-CPSU (Cliff Smith), USDA-NRCS (Ranae Ganske), USGS-BRD (Joan Canfield), to coordinate interagency strategies, obtain funding and to determine best action solutions to prevent and/or eradicate emergent invasive animal (other than large vertebrates) and plant species introductions to Maui County.
- Maintained cooperative ties with the Bernice Pauahi Bishop Museum, the Harold L. Lyon Arboretum, the National Tropical Botanical Garden, the Smithsonian Institution and the Maui office of the State Division of Forestry and Wildlife for the delivery of rare plant seed and material for ex situ propagation and/or biological collection archives.
- New populations found of the following rare taxa: pauoa (*Ctenitis squamigera*), *Cyanea asplenifolia*, *Cyrtandra filipes*, *C. lydgatei*, *C. munroi*, nanu (*Gardenia remyi*), *Joinvillea ascendens ssp. ascendens*, pupu kuahiwi (*Newcombia cumingi*), pupu kuahiwi (*Partulina perdix*), *P. tapanianana*, nuku i‘iwi (*Strongylodon ruber*).
- Continued logistical support of and/or biological collections for valid research of natural systems/elements of the Pu‘u Kukui Watershed Management Area, including:
 - Dr. Robert Cowie (B.P. Bishop Museum), *Philonesia* spp., *Tornatellinides* spp.
 - Mr. Curtis Ewing (University of Hawai‘i), *Nitidullidae*
 - Dr. Chrissen Gemmill (Smithsonian Institute), *Pittosporum* spp.
 - Dr. Michael Hadfield (University of Hawai‘i), *Newcombia cumingi*, *Partulina* spp.
 - Ms. Amanda Heddle (University of Hawai‘i), *Lepidoptera*; *Scotorythra* sp.
 - Dr. Gustavo Hormiga (G. Washington University/Smithsonian Institution), *Labulla* spp.
 - Dr. Frank Howarth (B.P. Bishop Museum), *Oliarus* spp.
 - Dr. Greg Koob (H. L. Lyon Arboretum), *Acaena exigua*, *Ctenitis squamigera*, *Cyrtandra munroi*, *Joinvillea ascendens ssp. ascendens*, *Liparis hawaiiensis*, *Myrsine vaccinioides*, *Phlegmariuris phyllanthus*, *Pritchardia forbesiana*, *Pteris lidgatii*
 - Dr. Dan Palmer (Honolulu), *Adiantum* sp., *Asplenium contiguum*, *A. cookii*, *Callistopteris* sp., *Dryopteris sandwicensis*, *D. unidentata* var. *paleaceae*, *Huperzia* sp., *Hymenoasplenium* sp., *Nephrolepis* sp., *Ophioderma* sp., *Sphaerocionium* sp., *Vandenboschia* sp.
 - Dr. Dan Polhemus (Smithsonian), *Anomalochrysa* sp., *Megalagrion koelense*, *Nabis* sp.
 - Ms. Malia Rivera (University of Hawai‘i), *Argyrodes* spp., *Labula* spp.
 - Dr. Clifford W. Smith (University of Hawai‘i), lichens

- Ms. Michelle Stephens (University of Hawai‘i), *Argyroxiphium* spp.
- Dr. Robert Thacker (University of Hawai‘i), *Newcombia cumingi*, *Partulina* spp.

National Tropical Botanical Garden

Diane Ragone Ph.D, Chair of Plant Science and Senior Curator

<http://www.ntbg.org/>

The National Tropical Botanical Garden (NTBG) was chartered by Congress in 1964, as a privately funded, non-profit research and education institution dedicated to the study and conservation of tropical plants, especially endangered species. The NTBG includes four gardens (Allerton, Kahanu, Lāwa‘i, and Limahuli), and three preserves (Limahuli, Ka‘ūpūlehu, and ‘Āwini) in Hawai‘i and one garden (The Kampong) in south Florida. These sites total about 1,400 acres and include aquatic and marine resources as well as extensive botanical collections, and contain significant historical and archaeological sites.

Plant Science Department research efforts are closely integrated with the Garden’s living collections and encompass research in systematics, floristics, conservation, native plant propagation, reproductive biology, restoration ecology and economic botany and ethnobotany with a regional focus on Hawai‘i and the Pacific Islands. Living collections consist of more than 3,000 taxa including significant collections of palms, Zingiberales, Rubiaceae, native Hawaiian plants, island endemics, and germplasm collections of economic plants such as breadfruit. Close to 200 native Hawaiian taxa are grown for conservation, education, and research. New Ph.D. positions include: Chair of Horticulture, McBryde Chair of Hawaiian Plant Studies, and Curator of Living Collections.

The NTBG herbarium was established in 1971 and houses approximately 35,000 specimens of vascular plants, including 70 types, bryophytes, lichens and marine algae. The collection focuses on the Hawaiian islands, especially Kaua‘i, the plants of other Pacific Islands, and research collections of selected taxa. The Hawaiian islands collections include native, naturalized and cultivated plants as well as vouchers of Garden plant accessions. Several thousand vouchers are added each year, primarily through field expeditions but also through exchanges with other herbaria.

Current Initiatives and Accomplishments:

Field botanists are active in conducting surveys of vegetation, plant communities and rare and endangered species, collecting seeds and living material for propagation, specimens for molecular and other studies, and herbaria at the NTBG and other institutions. More than 1,500 field expeditions have been carried out in the Hawaiian islands since 1990 resulting in collection and documentation of close to 800 native taxa. On-going propagation research has resulted in determining germination requirements for more than 500 native taxa, a third of which are endangered.

- Conservation work on native Hawaiian plants is carried out in collaboration with State Division of Forestry and Wildlife, US Fish and Wildlife Service, The Nature Conservancy, Center for Plant Conservation, and botanical gardens in Hawai‘i, among others.
- In 1998, the NTBG will begin offering a graduate course in tropical botany with a focus on ethnobotany and conservation. Courses in tropical botany will also be offered for journalists and school teachers.
- The Hawai‘i Stream Research Center is carrying out a long-term research and monitoring program in the Limahuli Valley watershed on the north shore of Kaua‘i. Information gained from this program will be directly applied by NTBG in the management and restoration of the Limahuli and Lāwa‘i streams.
- A Forest Restoration Project in the Limahuli Upper Preserve is now in its second year. The project is funded by a cooperative management agreement between the NTBG and the US Fish and Wildlife Service. This project focuses on restoring areas of severely hurricane-damaged forest and includes: removal of *Clidemia hirta*, control of other alien plant species, and planting native mesic forest species. Research activities are underway which investigate methods for alien plant control, regeneration of native species from the soil seed bank, and the recovery of hurricane-damaged forest vegetation.
- A restoration ecology initiative was launched in 1995 at NTBG’s six-acre Ka‘ūpūlehu Preserve, north Kona, to control fountain grass (*Pennisetum setaceum*) and rats, outplant selected species, and monitor regeneration of native species. A two-year grant from the National Science Foundation is supporting in-depth research by NTBG and the Institute of Pacific Island Forestry on native plant regeneration and establishment in the preserve.

- The NTBG, in collaboration with State Division of Forestry and Wildlife's Natural Area Reserve Program, established exclosures at Mahanaloa Gulch in Ku'ia Natural Area Reserve, Kaua'i, to study the effect of excluding ungulates on regeneration of native plants with support from the US Fish and Wildlife Service.

Native Hawaiian Plant Society

Lisa Raymond, Board Chair

<http://www.mrtc.org/~thomasp/nhps/>

The Native Hawaiian Plant Society (NHPS) is a non-profit organization founded in 1980. The mission of NHPS is to support the rescue and preservation of native Hawaiian plants, increase public awareness of native Hawaiian plants by working on projects cooperatively with governmental agencies, public and private groups and individuals, and to use the Maui Botanical Gardens and other resources for public education. To accomplish this, the society has formed partnerships with landowners and other conservation organizations to establish a number of conservation sites and exclosures. Currently, there are 11 exclosures and three natural areas maintained by the society which total approximately 65 acres. The society cares for these sites by scheduling monthly service trips. Occasional member hikes are also offered. The society annually sponsors two or three public informational lectures on topics that impact native plant conservation. These meetings are very well attended and have been invaluable in raising public awareness on native plant issues. The NHPS works in partnership on various projects: Kahanā Pond Wildlife Sanctuary (State Division of Forestry & Wildlife and US Fish and Wildlife Service); Gressitt Rare Plant Sanctuary (Maui Land & Pineapple Company and Kapalua Nature Society); Auwahi exclosures (Ulupalakua Ranch, USGS, Biological Resources Division, and US Fish and Wildlife Service: Ma'ō Hau Hele exclosures (Landmark Ranch); 'Āwikiwiki exclosure (Ulupalakua Ranch); La Perouse Anchialine Ponds (Ulupalakua Ranch); and with the Center for Plant Conservation Rare Plant Recovery Group.

Current Initiatives and Accomplishments:

- **Maui Botanical Gardens Master Plan:** The NHPS is working in partnership with the Tri-Isle Resource Conservation and Development Council, Inc. to develop a master plan for the Maui Botanical Gardens. The 7.5 acre botanical garden will focus on the conservation of coastal and dry forest species of Maui Nui (Maui, Kaho'olawe, Moloka'i, Lāna'i) as well as culturally important Polynesian introduced plants. The master plan will be completed in 1998, with development of the garden beginning in January of 1999. The NHPS supported the establishment of the non-profit Maui Nui Botanical Gardens, Inc. group to implement the master plan and develop the garden.
- **Kahanā Pond Wildlife Sanctuary:** The NHPS began this project in 1989 in cooperation with the State Division of Forestry and Wildlife. Over the last ten years, 20 acres of alien plants such as *Pluchea sp.* and kiawe (*Prosopis pallida*), have been removed and native plants and bird habitat restored. Hundreds of dedicated volunteers have work on this ambitious project. The pond is regularly visited and studied by school groups. The NHPS is also participating in a sand dune restoration and endangered species conservation project funded by the State of Hawai'i and the US Fish and Wildlife Service.
- **Gressitt Rare Plant Sanctuary:** 90% of this sanctuary was burned in an accidental fire on February 2, 1998. This 40 acre sanctuary was leased from Maui Land and Pineapple Company in 1984. It was named as a memorial to Dr. J. L. Gressitt, Bishop Museum Entomologist. It's mission is "to preserve a living collection of rare and endangered endemic plants of Hawai'i". The sanctuary contained approximately 70 species of rare plants. Due to the recent fire and the resulting spread and establishment of invasive broom sedge (*Andropogon virginicus*) and *Tibouchina herbacea*, the society has decided to discontinue its outplanting, monitor the burn area and work with the Kapalua Nature Society to use the site for a koa reforestation project.
- **Auwahi Exclosures:** This once-great dry land forest covered the south slope of Haleakalā. The society maintains nine exclosures in this important remnant forest, ranging in area from 280 to 8,900 square feet. These exclosures contain 24 species, three of which are endangered. A new ¼ acre exclosure is proposed and will contain 22 species, including nine clumps of *Melicope adscendens*, approximately ¼ of the known population and found only in Auwahi.
- **'Āwikiwiki Exclosure:** This ¼ acre exclosure was built in 1987 on Ulupalakua Ranch land to protect the rare 'āwikiwiki (*Canavalia pubescens*) from grazing by goats.

- La Perouse Anchialine Ponds: The ponds are a newly acquired project. There are approximately six pools in this two acre area. The site is in good condition and the NHPS will monitor against the establishment of non-native plants.
- Ma'ō Hau Hele Enclosure: This enclosure protects *Hibiscus brackenridgei ssp. brackenridgei*, our State flower, and is located near Ma'alaea on West Maui.

‘Ola‘a – Kīlauea Management Group

Tanya Rubenstein, Coordinator

The ‘Ola‘a- Kīlauea Management Group is a cooperative land management effort for 32,000 acres on the Big Island. State, federal and private partners signed a cooperative agreement in 1994 to jointly manage project lands across land ownership and management boundaries. Managers of these project lands as well as representatives from the USGS Biological Resources Division and the US Forest Service meet regularly to make decisions about the direction of the project. The project area and partners includes:

- Hawai‘i Department of Public Safety - Kulani Correctional Facility
- Hawai‘i Department of Land and Natural Resources - Pu‘u Maka‘ala Natural Area Reserve
- Hawai‘i Volcanoes National Park - ‘Ola‘a tract
- Kamehameha Schools Bishop Estate - Kīlauea Forest
- US Fish and Wildlife Service

The project area contains one of the best remaining native forest ecosystems in Hawai‘i. Natural communities within the project area are notable for their high degree of diversity and general lack of invasive, problematic weed species. The project area is considered essential habitat for four species of endangered forest birds. The area also supports the endangered ‘io (*Buteo solitarius*), nēnē (*Nesochen sandvicensis*), Hawaiian hoary bat (*Lasiurus cinereus semotus*) and 22 rare plant species including ten endangered species. Management actions are critical for the stabilization and recovery of these rare species and will also keep other native species from declining and being listed as endangered. Overall project goals include enhancing the long-term survival of native ecosystems and managing a large contiguous area across ownership boundaries. Management and research are currently focused on removing or reducing impacts from feral animals, alien plants and non-native predators, documenting the response of native and alien species to management, restoring native habitat and rare and endangered species, and providing work training and education to Kulani inmates. All partners provide funding and in-kind support to contribute to the success of the project.

Current Initiatives and Accomplishments:

- Kulani inmates have built 20 miles of fence to enclose approximately 5,000 acres in three management units. These units join existing fences built by the National Park Service and Natural Area Reserves to form a large area protected from feral pigs. Additional fencing projects are currently underway. Inmate crew labor saves conservation agencies approximately \$84,000/year and accomplishes more conservation work than would normally be done in these tight fiscal times.
- State Department of Land and Natural Resources personnel trapped feral pigs from within fenced units prior to staff control efforts and released pigs in public hunting areas elsewhere on the Big Island.
- National Park Service crews removed feral pigs from one fenced unit and are currently working on two additional units, as well as assisting with pig control in fenced units within Pu‘u Maka‘ala Natural Area Reserve.
- Researchers and managers are mapping, monitoring and controlling invasive alien plant species, and mapping, propagating and protecting rare and endangered plants. The project plans to continue and expand alien plant control efforts and work to restore rare plant species to protected, pig-free management units.
- Researchers perform annual bird surveys to assess the distribution and status of native bird species. Other ongoing research includes work on plant community structure and composition, avian disease and vector control, native invertebrates, and alien yellowjacket wasp control.
- Project cooperators are assisting in environmental educational efforts for Kulani Correctional Facility inmates, and inmates are gaining valuable work skills and training on the conservation workline. The project plans to expand educational efforts for the general public and increase the use of volunteers.

- Landowners, managers and researchers have recently completed a joint management plan to guide resource management and research in the project area.

Protect Kohanaiki ‘Ohana

Angel Pilago, President

<http://hawaii-nation.org/nation/turningthetide-7-2.html>

The Protect Kohanaiki ‘Ohana (PKO) is a community group centered in North Kona on the island of Hawai‘i. Our members and supporters are adults and young people from all over whose aim is to protect the exceptional Kohanaiki coastal area. This is a favorite coastal area where families come together to gather food, surf, camp, fish and enjoy the natural bounties. It is a prime cultural and recreational spot on an otherwise rugged coastline. Its outstanding historic and environmental resources include one of the last and most extensive anchialine pond systems left in Hawai‘i. For hundreds of years these important ponds and ancient systems of aquaculture have been used by local fishermen and have provided unique habitat for endangered plant and animal species such as the Hawaiian black-necked stilt or ae‘o (*Himantopus mexicanus knudseni*). Our mission is to educate and involve the community in activities that protect our environment as well as perpetuate and restore cultural practices and values.

Current Initiatives and Accomplishments:

- Our efforts have led to a landmark Supreme Court victory. (PASH and Angel Pilago v The Hawai‘i County Planning Commission and Nansay Hawai‘i). The groundwork was laid years before by the work of many dedicated individuals and organizations, and builds on a series of efforts to ensure the resurgence, restoration and continuation of the living Hawaiian culture and value of aloha. The Kohanaiki Supreme Court decision mandates all government agencies to affirm and support native Hawaiian rights, traditions, customs and usage while considering permits for development. A broad based coalition of attorneys and organizations formed to support the Kohanaiki case and link cultural practices with protection of our environment. Their contributions and analysis provided a unified position and helped move the case through the legal system. The effort shows that coalition building and citizen participation at the grassroots level does make a difference.
- The Hui He‘enalu o Kona is an off shoot of the PKO brought together in friendship and camaraderie by a common interest in the ancient activity of he‘enalu” (wave-sliding). Through education, positive environmental action and recreational activity, the primary purpose of the ‘hui” is to encourage preservation of the surf and coastline for generations to come. The motto, “Na Kia‘i o ka Nalu” (Guardians of the Surf) declares commitment to this purpose. The Hui He‘enalu of Kona has directed its energy towards preserving Kohanaiki and other lands in the region of Kekaha, north Kona. These “eco-surfers” include many families in the Kona area who are concerned with maintaining class AA water quality and coastal ecosystems as well as beach access. The Hui He‘enalu works with The Protect Kohanaiki ‘Ohana on projects which focus on the youth of today who are working to perpetuate the culture and protect the environment. Both organizations participate in the planning process by offering public testimony and as interveners at public hearings maintaining the position that the protection and preservation of environmental resources are crucial to the continuation of cultural practices and that citizens’ participation in the public hearing process is a guaranteed constitutional and human right.
- PKO helped initiate a bill in the legislature to require Cultural Impact Statements (CIS) to accompany Environmental Impact Statements (EIS) to help implement the Kohanaiki decision into the planning process and to assure that as development occurs it is consistent with the constitutional laws of our state. PKO received a Congressional Award from Congresswoman Patsy Mink for protecting important environmental and cultural resources at Kohanaiki and a Certificate of Appreciation from Governor Benjamin Cayetano for our community efforts.
- The Hui helps sponsor and run the annual “Keiki Surf for the Earth” contest and beach clean-up in conjunction with Earth Day at Kohanaiki. Hui members also help organize and raise money for the health and sanitation project at Kohanaiki and send out monthly reminder notices to keep funds coming in for the dumpster and portable toilets.
- Kohanaiki has always nurtured the children. To protect the land for future generations we currently implement several projects which include the Kona community in caring for the land and water:
 - Joint Projects sponsored by PKO and Hui involving youth include:
 - Annual “Keiki Surf for the Earth” held in conjunction with Earth Day activities

- Beach Health and Sanitation - raise money for two lua and a dumpster at the beach
- Biannual Na Ala Hele Trail restoration and clean up with 8th grade students
- T-Shirt, Video, and Bumper sticker Fund Raising-Beach Clean-Ups at Kohanaiki
- Poster board - Video Presentations to High Schools and College Classes
- Newsletter reaching over 600 families youth contributors
- Set up and man display Booths at Environmental Fairs

The two organizations work closely on all projects. The combined member and resource people include Hawaiians, non - Hawaiians, practitioners, cultural experts, and environmentalists. The Kohanaiki 'Ohana has been working with the youth since 1991. Consequently, we have a group of youth already actively involved. Many have participated in environmental and cultural projects since they were very young and as young adults continue to participate on a volunteer basis. Many have gone on to college and are part of the youth environmental movement in Hawai'i.

Protect Kohanaiki 'Ohana has focused on projects that foster an understanding of the value of our cultural treasures and historic resources unique to our Kona community and to this particular geographic region of Kekaha.

We credit the "Keiki" Surfers for the Earth" for the major victory won at Kohanaiki. Their dedication protects the environment and quality of life for Kona and Hawai'i. As stewards and responsible youth, they ensure their future by learning their connection to Hawai'i's natural resources. For instance, the "Ala Kahakai" (Road to the Sea) is a network of ancient coastal trails. By working on a historical treasure, the youth not only clean and restore the trail for us today and for the children of the future, but they gain many other skills for survival. They get actual hands on experience in anthropological and archaeological studies, sociology, interpersonal and communication skills. These activities support building and maintaining a society that lives in harmony with the environment.

Guided by our kupuna (elders), inspired by our keiki (children), and with responsibility to all future generations who will come again, the Kohaniki 'Ohana is committed to building strong bonds within our Kona community to support na mea Hawai'i (things Hawaiian). We are working to make Kohanaiki a park where our community can demonstrate a model in innovative park stewardship. We visualize a kauhale (community center) where cultural values can be shared; a gathering place for learning, healing, and teaching; a foundation upon which to build our skills, share knowledge, awaken our deepest sensibilities and focus on perpetuation of Hawaiian values, stewardship of natural resources, human rights and environmental justice. Our 'ohana (extended family) has grown, our core group has matured, our efforts have led to substantive social change. We are part of a global movement to recognize respect for indigenous knowledge, culture, and traditional practices in sustainable management of the environment.

Sierra Club, Hawai'i Chapter

David Frankel, Director

<http://www.sierraclub.org/ecoregions/hawaii.html>

The Sierra Club Hawai'i Chapter's mission is to explore, enjoy and protect wild places and the environment. The Hawai'i Chapter of the Sierra Club, through the volunteer efforts of group leaders on O'ahu, Kaua'i, Maui and Hawai'i, conducts interpretive and educational outings; leads fun and challenging hikes; conducts service projects involving fencing, cleaning streams, trailbuilding and noxious plant control; and advocates and lobbies for environmental protection. The High School Hiker Program introduces students to wilderness areas and environmental issues. The Hawai'i Service Trip Program leads week-long trips to remote areas to preserve habitat. Hikes for the Visually Impaired introduce the visually impaired to the natural wonders of Hawai'i. Our conservation and political efforts focus on protecting the land, water and ocean resources from environmentally damaging and other inappropriate uses; protecting endemic flora and fauna, especially endangered species and their habitats; preserving the natural character of wilderness and coastal areas and ensuring non-motorized public access to them; supporting energy conservation and appropriate energy sources; preserving the character of rural, scenic and historic areas; and stabilizing population. Our twelve priority environmental issues are to: 1) retain the authority of the Land Use Commission; 2) stop beach erosion; 3) acquire coastal land throughout the State; 4) restore free-flowing streams; 5) protect endangered species and ecosystems; 6) reduce coastal water pollution; 7) restore public access to trails and beaches; 8) prevent excessive and destructive development; 9) keep our national parks and wilderness areas quiet; 10) increase enforcement of environmental and land use laws; 11) increase funding of environmental programs; and 12) extend the solar tax credit:

Current Initiatives and Accomplishment:

- Restoring public access to Onomea Bay, West Beach lagoons and the Wiliwilinui trail.
- Constructing the Maunawili Falls trail.
- Protecting the beach at Wailua (Kaua'i) from a beach-destroying revetment.
- Defeating a proposal to destroy coral reef in Kaka'ako for a parking lot and fake beach.
- Protecting a reef, sandy beach and prime surf sites from the Mauna Lani Resort's planned private cove development.
- Preserving Makaleha springs from inappropriate development.
- Protecting endangered species habitat in Ke'ehi Lagoon from commercial development.
- Preserving the coastline from destructive harbor projects at Ewa and Ma'alaea.
- Supporting a coastal land acquisition program to prevent the development of unique coastal sites (Maha'uлеpu, Kealia, Ka Iwi, Kahuku, Keka'a, Waihe'e, Kohanaiki and Makalawena).
- Opposing airport expansion plans for Kahului and Lihue.
- Protecting Mauna Kea from further development.
- Opposing the expansion of airports on Maui and Kaua'i.
- Protecting ridgelines from poorly placed radio towers on Kaua'i and Maui.
- Preserving the natural quiet of our wilderness areas by keeping helicopters away.
- Monitoring the health of coral reefs and educating the public about how to protect them.
- Ka'ala, Ka Iwi, Ka'ena, miconia Removal and Kāne'ohē Bird Sanctuary Service Projects.

The Nature Conservancy of Hawai'i

Alan Holt, Deputy Director

<http://www.tnc.org/>

The Nature Conservancy of Hawai'i (TNCH) is part of an international non-profit organization dedicated to biodiversity conservation through direct protection of key habitats and innovative partnerships with private landowners, government, and local communities. The Hawai'i program began in the late 1960's with the acquisition of Kipahulu valley on Maui in partnership with Haleakala National Park. A staffed program with local Board of Trustees and membership began in 1980, and has now protected over 50,000 acres in Hawai'i, including 22,000 acres in ten preserves managed by TNCH staff. The organization relies heavily on government and academic research teams for much of the science that underpins its decision-making, but invests heavily in three science strategies:

- Building greater capacity for conservation-related science by carrying Hawai'i's needs to Congress and the legislature, and supporting the work of the Secretariat for Conservation Biology at the University of Hawai'i
- Funding the development of improved field monitoring techniques and other selected research priorities through the organization's TNC/Mellon Ecosystem Research grants
- Maintaining the Hawai'i Natural Heritage Program databases on the status and location of rare taxa and natural communities as a planning and management tool for TNCH and other users

Current Initiatives and Accomplishments:

- Strengthening Hawaii's systems for prevention of further alien pest invasion and for effectively controlling those already present through a broad partnership with government, business, agriculture, and health interests. The primary foci of this partnership (the Coordinating Group on Alien Pest Species) this year have been 1) securing funding and legislation to promote prevention of brown tree snake invasion and eradication of the weed *Miconia calvenscens*, 2) maintaining an aggressive public awareness campaign, 3) establishing more capacity to gauge and improve port-of-entry inspection programs, and 4) building capacity to detect and contain or eradicate priority pests before they become widespread, with the Maui Invasive Species Committee as the prototype for this kind of work.
- Additional protection of vulnerable native habitats, with a special focus on expanding watershed/ecosystem-scale partnerships on Maui, Moloka'i, O'ahu, and the Big Island, and building the capacity of State programs to protect the vast habitat areas under their care. Follow-through on major fencing and other projects within the East Maui Watershed Partnership are our top priority.

- Dramatically expanding community support for conservation. We are re-tooling our O‘ahu program for a more aggressive community outreach strategy, and are working at Pu‘u Wa‘awa‘a on the Big Island on an ambitious plan for community-based management of that ahupuaa. We are preparing for a major capital fundraising campaign to further these and related strategies.

The Peregrine Fund

Alan Lieberman, Program Director

<http://www.peregrinefund.org/>

In 1993, The Peregrine Fund expanded its conservation focus from primarily birds of prey to include restoration programs for native Hawaiian passerine species, beginning with the incubation, captive-rearing and release of the ‘*alalā* (*Corvus hawaiiensis*). Supported by funds from the US Fish and Wildlife Service, State Department of Land and Natural Resources and also from the private sector, The Peregrine Fund now operates two captive propagation facilities; the Keauhou Bird Conservation Center in Volcano on the Big Island, and the Maui Bird Conservation Center in Olinda on Maui. The goal of this program is to restore endangered species of native Hawaiian birds through hands-on management programs to include rear and release as well as captive reproduction for release of birds.

Current Initiatives and Accomplishments:

- The Keauhou Bird Conservation Center completed its first two phases of construction in 1997. These phases include a complete brooder building which houses incubation and hand-rearing laboratories, bird food kitchen, eight fledgling aviaries, a meeting room/library, a video monitoring room, standby generator room, workshop and office space for staff. Also constructed are 19 forest bird aviaries, six ‘*alalā* aviaries, and caretakers' accommodations.
- Secured the funding to proceed with Phase III construction. Architecture and engineering are currently underway for a second Forest Bird Barn with full bird food kitchen, four to six ‘*alalā* aviaries, and expanded nēnē breeding facilities.
- The operation of the Maui Bird Conservation Center became the responsibility of The Peregrine Fund in March 1996. In the first two years of new management the captive population of ‘*alalā* produced 14 chicks and the nēnē produced 55 goslings. The facility also serves as an incubation and neonatal area for the endangered Maui forest bird eggs that are brought from the field for captive management.
- Since the inception of the program in 1993, 144 native Hawaiian forest birds of 11 species have been incubated, hatched and reared. Six are federally listed as endangered (‘*alalā*, Maui parrotbill, Hawai‘i creeper, ‘*akohekohe*, puaiohi, and palila), and five are non-endangered native species (‘*oma‘o*, ‘*elepaio*, ‘*apapane*, ‘*i‘iwi*, and common ‘*amakihi*). These latter species are surrogates for the development of captive propagation and release technology.
- With the wild population of ‘*alalā* numbering less than ten individuals, The Peregrine Fund joined the ‘*alalā* Partnership (US Fish and Wildlife Service, and McCandless, Kealia and Kai Molina Ranches) in an intensive reintroduction program in 1993. ‘*Alalā* have now been released into historical habitat in the South Kona District on the island of Hawai‘i. Five, seven, four and eight juveniles were released in 1993, 1994, 1996 and 1997, respectively, with twelve birds surviving to date (1998). Reproductive behavior has been observed in several of the release birds and it is hoped that there will be breeding in 1998.
- In 1995 and 1996, the first restoration attempt of a small Hawaiian passerine in disease-free, predator controlled habitat was made with the release of captive-reared ‘*oma‘o*, into the Pu‘u Wa‘awa‘a Forest Reserve; habitat that has been without this species for nearly 100 years. In 1995, two birds were reintroduced as a preliminary test release and in 1996, 23 birds were released in cohorts numbering from two to seven birds. Of the 25 released birds, 23 are known to have survived 30 days (life of the transmitters). Follow-up surveys in 1997 and 1998 indicate that many released ‘*oma‘o* have survived to sexual maturity and have bred.
- The puaiohi, which were produced from wild collected eggs in 1996 and 1997, are now breeding in captivity at the Keauhou Bird Conservation Center. As of this date (5/27/98) five pairs of puaiohi have laid 30 eggs, with nine chicks produced thus far and several more chicks anticipated hatching from fertile eggs being incubated at this time. It is anticipated that there will be at least two cohorts (five birds in each cohort) available for release in late 1998 or early 1999 in a pre-selected site in the Alaka‘i Wilderness Area on Kaua‘i. The release will use the

same strategies and techniques used successfully in 1995 and 1996 with the release of the 'oma'o in Pu'u Wa'awa'a.

- The first five years of this program presents a more optimistic future for the beleaguered avifauna of the Hawaiian islands. As the captive flocks of the endangered species grow, and the techniques for rearing and release are refined, it is hoped that many of the endangered Hawaiian birds will benefit from restoration efforts. However, captive propagation and reintroduction is only one aspect of the ecosystem management tools required in Hawai'i to conserve and restore endangered native bird species.
- Primary collaborators and donors for The Peregrine Fund's Hawaiian endangered bird program include: The US Fish and Wildlife Service, Pacific Ecoregion Office; USGS Biological Resources Division, Hawai'i Field Station; State Department of Land and Natural Resources; KSBE; McCandless Ranch; 'Alalā Partnership; Cooke Family Foundation; Atherton Foundation; McNerny Foundation; Dodge Foundation; Margaret H. Shipman Foundation; and the Zoological Society of San Diego.

The Trust for Public Land Scott Parker, Director

The Trust for Public Land (TPL) is a private, nonprofit land conservation organization that works nationwide to conserve land for people. Founded in 1972, TPL specializes in conservation real estate, applying its expertise in negotiation, public finance, and law to protect land for public use. Working with private landowners, communities, and government agencies, TPL has helped protect nearly 1,600 special places nationwide for people to enjoy as parks, playgrounds, community gardens, recreation areas, historic landmarks, and wilderness lands. TPL has protected nearly 1 million acres of land valued at approximately \$1.4 billion in 45 states and Canada.

Working with federal, state, county and municipal governments, and business, civic, and neighborhood organizations, TPL provides:

- Interim site protection.
- Assistance with real estate transactions and finance.
- Information and technical support on public finance campaigns for new public land.
- Independent negotiations with landowners.
- Bridge financing through revolving funds, loans, and lease-purchase agreements.
- Planning assistance and help identifying opportunities for parks and land protection.
- Effective public education campaigns to mobilize support for parks and open space.

TPL's Hawai'i Field Office Program Highlights:

- Kīlauea Point National Wildlife Refuge, Kaua'i, Hawai'i
- Waiahole Beach Park, O'ahu, Hawai'i
- Ka'apahu, Haleakalā National Park, Maui, Hawai'i

Current Initiatives and Accomplishments:

- With the Kaua'i Public Land Trust and the National Tropical Botanical Garden we have completed the purchase of two acres of land adjacent to Limahuli Gardens. The acquisition of this land, containing varied plant life and 700-year old auwai (irrigation ditches) and lo'i kalo (taro terraces), will allow the Gardens to provide visitors with a more comprehensive interpretation of Hawaiian taro cultivation.
- TPL has acquired a 1,500 acre ahupua'a at Ka'apahu on Maui, deemed one of the biologically richest locations in the islands, with majestic stands of virgin koa, innumerable rare and endangered species of plants and animals and numerous ancient Polynesian sites, all within a rainforest environment. Ka'apahu should be conveyed to Haleakala National Park later this year.
- We are also currently involved in negotiations with landowners concerning coastal properties of great scenic and recreational value that would be acquired for public use as beach parks.

US Army Garrison Hawai'i, O'ahu Training Area

Alvin Char, Chief

<http://www.angelfire.com/hi/ecosystem>

The goal of the Army's Ecosystem Management Program is to conserve native ecosystems and rare and endangered species on compliance with the Endangered Species Act while at the same time supporting the Army's training mission. The Army trains on land totaling 150,000 acres on the islands of Hawai'i and O'ahu. These lands contain 76 endangered plant taxa, 25 endangered animal taxa, and numerous native natural communities. The Army's conservation approach integrates both ecosystem and single species level management actions. Commitment to long term ecosystem management is demonstrated through long-term collaborative projects, and a five-year ecosystem management plan.

Current Initiatives and Accomplishments:

- Continued the construction of an ungulate control fence along the perimeter of Mākua Military Reservation. Established the 150-acre Kahanahaiki Gulch Management Unit (KGMU) in an area less prone to range fires. The KGMU will be one of the focal points in the Army's plan to mitigate adverse impacts due to training activities.
- Outplanted four *Cyanea superba* in the KGMU with the help of the Commanding General, 25th Infantry Division (Light) and US Army, Hawai'i and our partners at the US Fish and Wildlife Service, the State Division of Forestry and Wildlife, and the Lyon Arboretum.
- Revised Mākua Valley training procedures, developed a Soldier's Guide with environmental rules to protect endangered species and archaeological sites, and produced a fire awareness poster.
- Working with Kamehameha Schools Bishop Estate to fence a unique bog ecosystem on KSBE land near the Ko'olau summit (part of the Army's Kawaihoa Training Area).
- Formed Ukanipo Heiau Advisory Group to develop long-term management plan and provide greater public access to the religious site at Mākua Military Reservation.
- At the Pōhakuloa Training Area: Kīpuka Kalawamauna fence nearly completed (awaiting ungulate drive), successfully controlled Russian thistle (*Salsola Kali*) and constructed PTA greenhouse.
- Launched a web site to promote Ecosystem Management Program activities

US Army Garrison Hawai'i, Pōhakuloa Training Area

Scott Henderson, Chief Environmental Officer

The Pōhakuloa Training Area covers over 109,000 acres at 6,000 to 8,000 foot elevation in the saddle between Mauna Kea and Mauna Loa volcanoes on the island of Hawai'i. The environment is dominated by recent lava flows and dryland forests and shrublands which provide habitat for over 30 federally listed species of plants and animals. Primary threats to these tropical subalpine dryland ecosystems are alien plants, wildfires and feral ungulates. The US Army has an ongoing program which funds efforts to control those threats. That program has now been underway for four years.

Current Initiatives and Accomplishments:

- A 2,000 square-foot, clear-plastic-glazed greenhouse with attached 400 square-foot potting shed has just been completed. Nearby, a 6,500 square-foot, partially-shaded plant adaptation compound is nearly complete. These facilities will be used for propagation of rare plants and some common native rare plants that cannot be grown at low elevation. Rare plants will be outplanted in areas of protected and restored habitat at Pōhakuloa. Common native plants will be used to revegetate areas damaged by training activities.
- Over 25 acres of an incipient infestation of Russian thistle (*Salsola Kali*), a fire-prone and invasive weed, was successfully controlled by an aggressive herbicide program. This weed had the potential to overgrow large areas of native vegetation and to substantially increase the flammability of the vegetation.
- A 1,400-acre fenced enclosure was recently completed (by Hawai'i Volcanoes National Park personnel) at Kīpuka Kalawamauna, an area that harbors large numbers of rare plants. As soon as problems associated with

unexploded ordinance discovered within the area are resolved, feral sheep, goats and pigs will be driven out of the area and the fence will be closed.

- Construction of a 599-acre fenced enclosure recently started at Kīpuka ‘Alalā, another area that harbors large populations of rare plants. This fenced area will likely be linked to another fenced area of nearly 3,000 acres scheduled for construction within two years as a part of the Saddle Road Realignment package.
- Aerial censuses and radio tracking of goats and sheep have provided valuable information on the abundance, habits and ecosystem effects of those grazing animals. Home ranges of goats and sheep are noted as being relatively limited, usually within a radius of less than 3.5 miles.
- A reconnaissance-level survey of arthropods was conducted in a contracted effort by The Nature Conservancy of Hawai‘i. At least 485 taxa, about 33% considered native, were inventoried. At least two species are rare and the potential for new, undescribed species from the collection remains high.
- A small population of critically-endangered spiny popolo (*Solanum incompletum*), which was enclosed in small fences about two years ago, is doing very well and mature individuals are now fruiting. Prior to its rediscovery at Pōhakuloa, this spiny plant had not been seen for more than 50 years.
- Rodnet populations have now been monitored for over two years at Kīpuka ‘Alalā, an area of dryland māmane/naio forest which is targeted for habitat restoration for use as a future site for reintroduction of endangered palila (*Loxoides bailleui*) birds. Activity levels varied according to vegetation types and cyclical patterns were noted. Rodents appear to be more abundant in Kīpuka ‘Alalā than on the western slope of Mauna Kea where palila currently reside.

US Fish and Wildlife Service, Kaua‘i National Wildlife Complex Tom Alexander, Refuge Manager

Kaua‘i National Wildlife Complex includes two wetland refuges (Hanalei and Hulē‘ia NWR) and one seabird/coastal refuge (Kīlauea Point NWR). There are five species of endangered birds that inhabit the Refuge Complex: the Hawaiian goose or nene (*Nesochen sandvicensis*) found at Kīlauea Point NWR; and the Hawaiian duck or koloa (*Anus wyvilliana*), Hawaiian moorhen (*Gallinula chloropus sandvicensis*), Hawaiian coot (*Fulica americana alai*), and the Hawaiian stilt (*Himantopus mexicanus knudseni*) all found at Hanalei and Hulē‘ia NWRs. The Kīlauea Point NWR is a high profile refuge for visitors because of the historic lighthouse and the seven species of seabirds (five nesting species) that inhabit the refuge.

Initiatives for the complex are to stabilize problems between waterbirds and taro depredation, improve wetland management of refuge ponds, increase taro farming at Hulē‘ia and Hanalei NWRs, expand native plant programs at Hanalei and Kīlauea Point NWRs, continue to improve our environmental education which is available to schools, expand outreach to the community, and continue the visitor program at Kīlauea Point NWR.

US Geological Survey, Biological Resources Division, Pacific Island Ecosystems Research Center William W. M. Steiner, Director

<http://biology.usgs.gov/state.partners/hi.html>

The Pacific Island Ecosystems Research Center (PIERC) is one of 18 Regional Centers of the USGS Biological Resources Division conducting contract and governmental research on problems of environmental concern. The PIERC works with federal, state, local and private organizations to provide objective research, baseline information, and technical assistance relating to conservation of endemic and indigenous biological resources occurring within the cultural, sociological, political and environmental environs of all lands and islands under US jurisdiction in the Pacific Basin. The PIERC was established by federal mandate as the biological research arm of the Department of Interior in 1994 as the National Biological Service by combining research elements then existing in the US Fish and Wildlife Service (USFWS) and the National Park Service (NPS) in Hawai‘i. It was placed under USGS jurisdiction in 1997. The PIERC operates on federal base funding of about \$2.7 million/year, with additional variable income to conduct research from grants and partnerships. Hawai‘i is the major research area with roughly 26% of endemic plant species and 75% of endemic bird species extinct, listed or endangered, giving Hawai‘i the distinction as the state with the most endangered species act listings. Meanwhile, research on invertebrates has only just begun. Much of the

research PIERC conducts results in development of management and recovery strategies aimed at conserving the biota and island ecosystems under study.

Current Initiatives and Accomplishments:

- Assisted The Peregrine Fund by providing eggs of endangered bird species for captive propagation and providing information on biology.
- Continued to provide information to USFWS and DOFAW concerning the range, distribution, condition and biology of listed bird species found in the Hawaiian Islands.
- Provided the US Navy with an integrated resources management plan to manage their biological resources on Guam, and began projects to establish their baseline inventories for these resources.
- Provided information to the National Park Service to better enable them to manage Park biological resources including information on alien weed invasions.
- Continued funding the Hawaiian Ecosystems at Risk (HEAR) project, a major databasing effort showing distributions of weedy species in the Hawaiian Islands.
- Continued work on the distribution and status of endangered species in Hawai'i in collaboration with TNCH, USFWS, DLNR, and NPS.
- Continued to conduct overseas research and testing of biological control agents which attack and are host-specific to invading alien plant species.
- Began a major study of alien invasive weeds with national level funding from the Federal "Weeds in the West" program.
- Continued studies on avian disease and disease vector agents in order to discover new ways to manage disease impact on native bird species.
- Continued participating in mitigation efforts to restore the endangered bird palila on the Big Island; found that parasitization of caterpillars developing on māmane tree seed pods was extremely high and impacted a major bird protein source.
- Initiated studies on the single remaining and declining population of Laysan duck to establish a basis for restoration in the future.
- Established the numbers and distribution of endangered bird species in the Commonwealth of the Northern Marianas preliminary to begin studies on mitigation and restoration.
- Obtained funding to continue examining effects of different rat species as major avian predators and competitors for food resources.

**US Marine Corps, Marine Corps Base Hawai'i
Arnold Fields, Brigadier General**

Marine Corps Base Hawai'i (MCBH)'s mission is to provide and maintain facilities and services for its infantry, aviation, and combat service support tenants. MCBH's primary component is the 2,951 acre Mōkapu peninsula on O'ahu, and has consolidated control over the other Marine Corps assets in Hawai'i: The 220 acre Camp H. M. Smith, 137 acre Pu'uloa Range Facility, 27 acre Pearl City Warehouse Annex, 63 acre Mānana Housing area, 187 acres of Waikāne Valley and the 12 acre Moloka'i Training Facility. On Mōkapu, managers control over 1,200 structures, nearly 2,200 family housing units, and many recreation areas. They successfully support about 17,000 military and family member residents over 2,000 civilian employees, and about 10,000 retirees who access Base service facilities.

Marine Corps Base Hawai'i is also a recognized leader in environmental stewardship, having received the top Navy Natural Resources Conservation Award for the past five years in a row, as well as a total of 23 various natural resource and environmental quality national awards in the past 15 years as well as state and local recognition. A key basis of our approach to environmental leadership is that Marine Corps Base Hawai'i integrates resources management with the military mission through an ecosystem-based approach. For example, on Mōkapu peninsula, amphibious assault vehicle "mud ops" maneuvers have helped double the Base endangered waterbird population in 15 years at the Nu'upia Ponds Wildlife Management Area. Native Hawaiian stone masons helped Marines build protective barriers for sensitive ancient Hawaiian burial dunes. Over 3,000 red-footed booby birds thrive on an active weapons firing range through comprehensive brush fire management. Better environmental planning has improved wildlife habitat at a busy golf course and incorporated wetland restoration into a new barracks design. Major non-native pest mangrove removal has restored bird nesting, water quality, and cultural features in a 486 acre historic fishpond/wetland complex. Implementation of a major watershed-based planning/restoration initiative is underway as

an outcome of following an ecosystem-based approach. Continued community outreach through oral histories, education and service partnerships has built a shared vision of ecosystem recovery and military training support that is sustainable for years to come.

USDA APHIS Wildlife Services

Tim J. Ohashi, Assistant State Director

To more accurately reflect the broad spectrum of wildlife damage management services provided by the agency to its public and private customers, Animal Damage Control (ADC) was renamed Wildlife Services. The name Wildlife Services goes back to 1965, when under the Department of the Interior, the Branch of Predator and Rodent Control was renamed the Division of Wildlife Services.

Wildlife Services (WS) in Hawai'i continues to provide assistance to state and federal military cooperators in the management of bird hazards at the major state-operated airports and military airfields to prevent collisions with aircraft. WS is also providing services to address health and safety concerns caused by introduced birds and feral animals; predation by introduced predators on endangered Hawaiian waterbirds at federal refuges; predation on game birds at state game management areas; herbivory on endangered plants and natural areas by introduced goats and pigs; and crop damage by introduced birds.

One major area of WS involvement in the Pacific area is the control and interdiction of brown tree snakes on the island of Guam to prevent the snake from spreading to other Pacific Islands, especially Hawai'i and the US mainland via military and civilian air and surface vessels and cargo. WS works closely with the US Department of Defense, State of Hawai'i, Territory of Guam, commonwealth of the Northern Marianas, and the Department of the Interior to develop strategies to control the brown tree snake. WS supports research on the efficacy of control operations and the development of new and emerging technologies. A website to coordinate brown tree snake activities by the various participants is being developed by our Legislative and Public Affairs Staff.

Administratively, WS has completed National Environmental Protection Act requirements for all projects in Hawai'i and Guam. WS is currently establishing baseline measures to determine program effectiveness for wildlife hazard management operations at airports and operations to protect threatened and endangered species pursuant to the Government Performance Review Act.

USDA National Wildlife Research Center, Hawai'i Field Station

Earl Campbell, Wildlife Ecologist

The National Wildlife Research Center (NWRC) is the primary agency within the federal government conducting research on wildlife management problems, particularly vertebrate pests and the reduction of damage these species cause to agriculture, human health, and natural resources. The NWRC functions as the research arm of the Wildlife Service Program (WS) within the US Department of Agriculture's (USDA) Animal Plant and Health Inspection Service (APHIS). The NWRC's main offices are located in Ft. Collins, Colorado and the center has field stations in nine states, including one in Hilo, Hawai'i. The NWRC was formerly known as the Denver Wildlife Research Center. In existence since the 1920's, the Center is the only research facility in the world devoted exclusively wildlife damage management. NWRC research activities emphasize the development of socially acceptable techniques to reduce or stop wildlife damage effectively and economically, minimizing risks for humans, wildlife, and the environment.

Current Initiatives and Accomplishments:

- Research and technical assistance in cooperation with the State Department of Land and Natural Resources, US Fish and Wildlife Service, USGS Biological Resources Division - Pacific Islands Ecosystem Research Center, University of Hawai'i at Mānoa and private landowners, which may ultimately lead to the development and application of cost effective rodent control techniques for the conservation of endangered species in Hawai'i.
- Biologists at the NWRC Headquarters in Ft. Collins, Colorado, as well as staff of the Hawai'i Field Station, are one of several groups of investigators developing techniques to control brown tree snake populations on the island of Guam. Staff of the NWRC have been funded by the Department of Defense to develop snake toxicants, lures, and baits.

- NWRC - Hawai'i Field Station staff, in cooperation with staff of USGS Biological Resources Division - Patuxent Wildlife Research Center, organized a three-day symposium on brown tree snake research. This symposium was intended to give managers and researchers working for federal, territorial, state, university, military, and private organizations an opportunity to be updated on current directions in brown tree snake research.
- A resource for information on wildlife damage management, invasive species, and pesticide registration issues in Hawai'i.
- Assistance to a graduate student from the Department of Zoology at the University of Hawai'i at Mānoa who recently completed laboratory bioassays on the toxicity of Ramik Green (a pelleted form of the rodenticide diphacinone) to Polynesian rats (*Rattus exulans*) and black rats (*Rattus rattus*). This research is intended to support the regulatory approval of Ramik Green for broadcast applications (by hand or helicopter).

USDA - Natural Resources Conservation Service

Kenneth Kaneshiro, State Conservationist

The Natural Resources Conservation Service (NRCS) is an agency of the US Department of Agriculture. It was formerly called the Soil Conservation Service and came to public notice during the dust bowl years of the 1930's. At that time massive wind and soil erosion were destroying the nation's cropland. In 1995, Congress changed the agency's name to reflect its expanded mission. The protection of all natural resources with emphasis on water quality is now the goal of NRCS.

In Hawai'i, a staff of 72 people help landusers manage and conserve their natural resources. We work with individuals, organizations, communities, state, and county governments to provide the knowledge and technical expertise necessary to apply conservation practices that reduce erosion, improve water quality, and enhance forest land, wetlands, grazing lands, and wildlife habitat. The NRCS mission is focused on three major areas: natural resource conservation; natural resource surveys; and community resource protection and management.

Current Initiatives and Accomplishments:

1) Natural Resource Conservation: To assist landusers with the cost of installing best management practices, the agency offers several financial incentive programs. These include:

- Environmental Quality Incentives Program (EQIP). Since the start of the EQIP program in 1997 over 980 acres of cropland, 21,600 acres of grazing land and 46 acres in confined animal operations have completed conservation plans and begun installing best management practices.
- Wildlife Habitat Incentives Program (WHIP) This program focuses on restoration and the enhancement of wildlife habitat on privately owned or leased lands, including native forests, montane bogs, abandoned taro lo'i, and caves with rare species. For its first year (1998), NRCS received \$250,000 cost share dollars to pay 75% of wildlife restoration projects up to \$10,000 per project. NRCS has received over 40 applications, proposing improvements to 4,500 acres of private lands in Hawai'i. Projects will be funded by highest amount of wildlife benefit per cost of the conservation practices. Money is still available. The sign-up period ends July 31, 1998.
- Wetlands Reserve Program (WRP) NRCS, with partner, Ducks Unlimited has initiated in 1998 the Wetlands Reserve Program. This program is intended for the restoration, enhancement, and development of wetlands on agricultural lands. Three large landowners on the Big Island have signed up for the program for one overall project, The Restoration of Montane Wetlands for Hawaiian Duck. The project will create and enhance complexes of ponds to increase the population of the endangered Koloa duck (200 individuals known on the island). NRCS will pay 75% of the cost of the practices. Currently, almost \$200,000 of WRP funding has been approved from NRCS headquarters, with an additional \$80,000+ requested to fund the project. WRP is available to all landowners/lessees who are interested in restoring, enhancing, or creating wetlands on private lands, through a continual sign-up period.
- Forestry Incentives Program (FIP). The Forestry Incentive Program is now available to assist landowners who harvest timber. FIP will pay 50% of the cost to replant trees on harvested acres. NRCS, in a partnership with the State Division of Forestry and Wildlife, will hire a forester to administer the program and has \$15,800 available for cost share assistance in fiscal 1998.

- Conservation Reserve Program (CRP). This program has been around since 1985, but due to the national Conservation Buffer Initiative, a broader range of conservation practices is eligible for CRP. For example, landowners may now put in strip practices such as windbreaks, grass waterways, filter strips, and riparian buffers. If a landowner puts in one of these practices, he/she will receive a 20% bonus and half of the cost to establish the practice.

2) Natural Resource Surveys: Soil Survey

- All the major islands have had some degree of soil mapping done by the 1960's. These reports are outdated. Therefore, the Big Island is presently being remapped. This year the three Soil Survey Mapping Crews have mapped over 105,000 acres. This brings the total acres remapped to 860,000 acres.
- NRCS is responsible for conducting a National Resource Inventory (NRI) every five years. We have just completed the inventory for 1997. NRI is building a data base on the status of the natural resources and landuse trends on private and state lands. Data analysis and statistical reports should be available by the end of the year. The agency is moving towards conducting a continuous inventory versus once every five years. NRCS is encouraging partnering with other interested groups such as The Nature Conservancy to increase the quality and quantity of data collected.

3) Community Resource Protection and Management: Resource Conservation and Development (RC&D). The RC&D program differs from most other NRCS activities. NRCS provides a coordinator to local non-profit councils to seek out and obtain grant money for projects. These projects address natural resource, economic and/or social issues in the local community. There are over 50 projects ongoing in the state. RC&D areas are presently established on Kaua'i, Maui and the Big Island. Currently, an effort is underway on O'ahu to develop a RC&D area. Examples of RC&D projects include:

- The Miconia Eradication Project on Maui. The Tri-Isle RC&D Council working in conjunction with State Division of Forestry and Wildlife and other entities is coordinating efforts to eradicate miconia on Maui.
- Faya and gorse control projects on the Big Island. The Big Island RC&D council is coordinating faya and gorse control.
- Trees for Tomorrow. The Garden Island RC&D Council on Kaua'i is encouraging revegetation of native species on private and state owned lands.

4) Small Watersheds Program (PL83-566). NRCS has used the Small Watersheds Program to assist local governments and conservation partners to evaluate, plan and install public works-scale projects to provide flood protection, wildlife and aquatic habitat enhancement and agricultural water management. Plans and EA/EISs for 12 watershed projects have been completed. Ten Cooperative River Basin Studies and Flood Plain Management Studies have been completed. Examples of current projects include:

- Honolua Watershed, Maui County. This project resulted in the installation of three flood control channels and eight sediment basins along five miles of West Maui coastline. The improvements have reduced flood damage and discharge of fine sediment into the nearshore waters. Benefits include improved reef habitat and water quality and increased recreational opportunities.
- Upcountry Maui Watershed, Maui County. This project proposes the installation of a separate agricultural pipeline system, with nearly 30 miles of pipeline, in the Upper Kula area to provide untreated agricultural water to nearly 70 farms. Benefits include adequate and consistent water supply to farmers and reduced water treatment costs at the Olinda Water Treatment Plant. The Watershed Plan and Environmental Impact Statement was completed in 1997 and structural components are currently being designed.
- Lower Hāmākua Ditch Watershed, Hawai'i County. This project, in the planning phase, will assist the State Department of Agriculture rehabilitate the Lower Hāmākua Ditch to provide water supply for diversified agriculture in the wake of the collapse of the sugar industry in Hāmākua. The establishment of an irrigation district will assure agricultural stability and a base for economic growth for the region. Other benefits of the project include the restoration of the Hi'ilawe twin falls and reduced diversion of Waipi'o Valley streams. The final Watershed Plan and EIS is expected to be completed in late 1998.

University of Hawai'i, Center for Conservation Research and Training

Kenneth Y. Kaneshiro, Director

<http://www2.hawaii.edu/eecb/>

The Center for Conservation Research and Training (CCRT) continues to move forward in developing the conservation biology program at UH despite declining budgets at the state level thanks in part to the external funding we have been able to secure. The Ecology, Evolution, and Conservation Biology (EECB) graduate program continues to attract some of the top students in the biological sciences at the UH Mānoa campus. For the Fall 1998 semester, students who received their Bachelors Degree from Harvard, Cornell, Stanford, UC Berkeley, MIT and other top undergraduate institutions across the US were applying for admission to the EECB Graduate Program. While most other programs have had declining enrollments, EECB continues to be one of the strongest graduate programs in the biological sciences at UH. In the Strategic Plan 1998-2007 for the University of Hawai'i at Mānoa which was recently approved by the Board of Regents, Conservation Biology and Evolutionary Biology were identified as among the top priority areas of programmatic specializations targeted for development over the next decade.

Current Initiatives and Accomplishments:

- CCRT is currently working with UH administrators in bringing The Nature Conservancy of Hawai'i's (TNCH) Natural Heritage Program to the UH campus. It is hoped that the conservation community at UH, its faculty and students, will be able to maintain and build on the extensive database already established for rare and endangered species of Hawai'i by TNCH over the past 8-10 years. The students in the program will not only have access to the database but will also be able to use the facility as a training tool in the use of GIS technology.
- CCRT continues to expand its initiatives into the international arena with several potential projects in the Asia-Pacific Region especially in collaboration with Okinawa. A joint proposal with Okinawan scientists has been submitted for consideration by the Japanese government. The project will involve UH and Okinawan researchers in developing a natural resource database/GIS system which can be used as a research and training facility for research staff throughout the Asia-Pacific Region. If funded, a major Biodiversity Database Center will be established in Okinawa with the cooperation of researchers from UH and TNCH. The project will embrace the "ahupua'a concept" and involve both terrestrial and marine ecosystems.
- Recently, as the result of the efforts of Mike Kido, Program Director of CCRT's Hawai'i Stream Research Center on Kaua'i, Hanalei River was selected among ten rivers in the US for designation as an American Heritage River. President Clinton is expected to make a formal announcement in early July. Once the designation is formalized, opportunities for various initiatives to "revitalize and restore" the Hanalei River and ahupua'a will be made available through various federal agencies. A federal facilitator referred to as the "River Navigator" will help cut red tape and provide focused federal support to the designated rivers.

University of Hawai'i, Harold L. Lyon Arboretum

Charles Lamoureux, Director

The Harold L. Lyon Arboretum, which occupies 194 acres in upper Mānoa Valley, is a research institute of the University of Hawai'i at Mānoa. Started by the Hawaiian Sugar Planters' Association (HSPA) in 1918 as part of an effort to reforest watershed areas seriously damaged by alien mammals in the 19th century, the Arboretum was given to the Regents of the University of Hawai'i by HSPA in 1953, with the stipulation that it continue to be used as a botanical garden and arboretum. The Arboretum coordinates, facilitates, and executes research, instruction and service activities that utilize its collections and resources. Its major emphases are tropical plants, native Hawaiian plants, conservation biology, and Hawaiian ethnobotany.

The Arboretum is responsible for:

- Developing a major resource center for tropical plants with a Hawai'i/Pacific Basin/Asian focus, by enhancing its living plant collections and establishing an appropriate reference library and herbarium.
- Making its collections and information available to a broad clientele including students, researchers, industry and the general public, by performing and disseminating the results of research, by appropriate outreach and educational activities, and through plant and seed exchange programs.
- Serving as an outdoor laboratory for schools, university students and classes.
- Identifying, improving through breeding, and introducing to the public, plants useful for horticulture, research, education or industry.

- Preserving and propagating germplasm of endangered plant species, especially those native to Hawai'i. Special attention is given to the use of micropropagation and tissue culture technology in conservation of native Hawaiian plants.
- Developing a research and training program in restoration of Hawaiian ecosystems.
- Serving as a university field station for terrestrial biology and stream biology.

Current Initiatives and Accomplishments:

- Recipient of the 1997 annual award for Program Excellence from the American Association of Botanical Gardens and Arboreta for its endangered species micropropagation program.
- Use of micropropagation as a tool to prevent extinction of some of the most critically endangered Hawaiian plants. Over 90 endangered plants, some with as few as one remaining plant in the wild, have been successfully propagated using tissue culture, embryo culture, and other in-vitro techniques. Some of these have already been returned to the wild to supplement existing wild populations. This is the largest and most successful project of its kind in the country, and probably the world.
- The Center for Conservation Research and Training and Lyon Arboretum are cooperating in an experimental approach to ecosystem restoration on a ten acre site within the Arboretum.
- Reducing the risk of new alien plant species establishment. The Arboretum is actively promoting the use of native Hawaiian plants in gardens, and conducting research on cultivation methods for Hawaiian species that can be utilized by home gardeners. Any newly introduced non-Hawaiian plants are evaluated before outplanting or release, and those that appear to be capable of invading natural ecosystems are culled. Research on production of sterile cultivars of non-Hawaiian plants is also underway.

University of Hawai'i, Hawai'i Stream Research Center

Michael H. Kido, Director

<http://www2.hawaii.edu/hsrc/home/>

The Hawai'i Stream Research Center (HSRC) is a research unit within the Center for Conservation Research and Training at the University of Hawai'i. It is the only organizational entity in the state focused solely on the study of Hawaiian stream ecology. The HSRC's mission is to "assist the State of Hawai'i in its efforts to develop responsible, effective, science-based management policies and strategies which provide for the long-term sustainability and enhancement of aquatic ecosystems". To fulfill its mission, the HSRC is pursuing basic and applied research directed at developing needed technologies, as well as understanding the ecological functioning of Hawaiian streams in relation to riparian zones, watersheds, estuaries, and nearshore marine habitat.

Current Initiatives and Accomplishments:

- The HSRC has recently been successful in having the Hanalei River on Kaua'i nominated as one of the nation's ten "American Heritage Rivers". Over 160 rivers across the US competed for this coveted title through proposals which were evaluated by a special advisory committee appointed by President Clinton. The Hanalei River designation brings a major program to the University of Hawai'i that will be focused on developing a community-based management system for the Hanalei River. The program will serve as a model for the state in engaging the community in partnership with government and the University to better manage Hawai'i's irreplaceable natural resources.
- The Hawai'i Stream Assessment (HSA) GIS Layer, developed by the HSRC through funding provided by the US Fish and Wildlife Service, has become an important tool for stream resource management application in the state. The project adapted data in the Hawai'i Stream Assessment for use in the Geographical Information System (GIS) as a first step in tailoring the technology for managing water resources in Hawai'i. The HSRC held a workshop for State agencies involved in water resource management and distributed copies of the HSA-GIS Layer on disks in addition to providing training for personnel.
- The long-term stream biomonitoring project in Limahuli Stream is generating new information about 'o'opu life histories, stream organic matter budgets, disturbance ecology, and primary productivity. In addition, new technologies for monitoring stream functional components have been developed as well as standardized protocols for assessing stream habitat and biological quality. These technologies were used to complete a biomonitoring

study of Onomea and Alakahi Streams on the island of Hawai'i where functional processes were compared. The Limahuli work is supported by funding from the State Aquatic Resources Division and the National Tropical Botanical Gardens. Funding for the Onomea/Alakahi work was provided by the Hawai'i Tropical Botanical Garden.

- Based on data and technologies generated in the Limahuli Stream biomonitoring project, Version 1.0 of the Hawai'i Stream Bioassessment Protocol (HSBP) was developed. The HSBP is a first generation methodology for assessment and monitoring of Hawaiian streams utilizing a standardized multimetric approach. Widespread use and refinement of the HSBP will provide biological insight into the health of Hawaii's streams within the context of assessing human-induced impacts. Emphasis on the linking of stream assessment data to the GIS is intended to provide managers with a working platform for information analysis in water resource planning applications. Work to further develop the HSBP is being funded by the State Department of Health, Stream Bioassessment Program, Environmental Planning Office.
- The HSRC continues to develop its internet site which was established to promote the sharing of information and ideas essential to the advancement of stream resource conservation in the State of Hawai'i. Our website provides access to a continually expanding base of information related to streams, including survey data, species information, maps, photos, and new technologies.