Hawaii's Forests and Wildlife

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Avian Malaria Fatal to Juvenile I'iwi

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National Wildlife Health Research Center, Volcanoes National Park

The i'iwi (*Vestiaria coccinea*), with its bright scarlet plumage and long salmon-colored beak, is one of the most spectacular native honeycreepers still found in upper elevation forests on Hawaii, Maui, and Kauai. Populations have declined steadily during the past 20 years however, and birds of this species have disappeared from many mid-elevation native forests where they were formerly common.

Avian disease, particularly malaria and pox virus infections, may be playing a significant role in limiting the present distribution of this species—especially at elevations between 1000 m and 1600 m, where native bird and mosquito populations overlap.

We conducted a challenge experiment to test the susceptibility of i'iwi to an isolate of avian malaria obtained from a wild apapane (*Himatione sanguinea*) at Hawaii Volcanoes National Park. This type of experiment is essential in field studies of avian disease. The approach allows us to estimate morbidity and mortality that may be occurring in wild populations and also to determine whether native birds are capable of developing effective immune responses to introduced malarial parasites.

A total of 33 juvenile i'iwi were captured in high elevation forests above known ranges of mosquito vectors. The birds were divided randomly into three groups of 10, 11, and 12 birds. Birds in the low-dose group were exposed to the bite of a single malaria-infected *Culex* mosquito. Birds in the high-dose group were bitten by 5-10 infected mosquitoes. A third group of i'iwi was exposed to the bites of 5-10 uninfected mosquitoes as a control.

Eight nutmeg mannikins (*Lonchura punctulata*), a common non-native seed eater that ranges into high-elevation forests, were also exposed to the bites of 5-10 infected mosquitoes to test their relative susceptibility to similar doses of malaria. A number of variables were measured over the course of the experiment, including weight, bill length, tarsus length, fat levels, nectar consumption, and parasitemia (number of malarial parasites per 1000 blood cells).

Malarial infections in the high- and low-dose experimental groups were almost 100% fatal to juvenile i'iwi. All of the high-dose birds and 90% of the low-dose birds died from acute malarial anemia within 35 days after being bitten by infected mosquitoes. The non-native nutmeg mannikins

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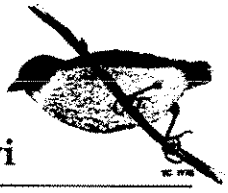
Po'ouli Again Seen at Hanawi



Thane Pratt, Fish and Wildlife Biologist, USFWS
Betsy Gagné, NARS Exectutive Secretary, and Tonnie Casey, Wildlife Biologist, KS/BE

Po'ouli, a little brown bird with a bandit's black mask, eluded discovery by biologists until 1973 because it lives only in a small area far up on remote forested slopes of Haleakala Volcano, Maui. Accessible by helicopter or an exhausting day's walk, this location has not been visited routinely by biologists who might check on the bird's status. The last sightings were in 1988 and 1992.

In September this year, we spent four days at Hanawi Natural Area Reserve and were lucky to find po'ouli. On September 12th, one bird was seen briefly by Thane and Betsy in a flock of Maui creepers foraging near the site where a po'ouli nest had been found in 1986. We waited, hoping to see the bird again. Although it failed to appear, a po'ouli was heard singing there in the late afternoon.

The next day, Tonnie and Thane returned to the same area, but did not locate the bird in the morning. Bad weather may have prevented us from finding it in the afternoon.

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Brown Tree Snakes: The Threat Continues

Ernest Kosaka, Federal Aid Coordinator
USFWS Pacific Region

The very high densities of brown tree snakes *(Boiga irregularis)* on Guam represents a potent invasion/colonization force. Guam's central location in the western Pacific and its role as a major hub for military and civilian commerce represents dispersal opportunities for this exotic, harmful, pest species. Notwithstanding efforts to inspect aircraft and ships, baggage, cargo, and shipping containers, brown tree snakes have managed to disperse to many widely scattered locations. A summary of verified brown tree snake dispersal is provided below:

By aircraft, air cargo, or in baggage

1 to Kwajalein in the Marshall Islands
1 to Wake Island (before 1955)
2 to Saipan
6 to Hawaii (Honolulu International Airport/Hickam Air Force Base and Barbers Point Naval Air Station)
1 to Okinawa

By ships, ship cargo, or in containers

1 to Diego Garcia (commercial freighter contracted by the Navy)
1 to Tinian (local barge service from Guam)
1 (at least)to Saipan (18 sightings within the past year)
2 to Rota
1 to Pohnpei
1 to Corpus Christi, Texas

The Corpus Christi dispersal record is the most recent and disturbing record. A brown tree snake survived this long trip in a container which contained a washer, dryer, and other household goods which had been bonded and caulked on Guam. The container was packed on Guam in October 1992, arrived in Texas in December, and was not unpacked until May 12, 1993. The snake which came out of the packing material was recognized by the transferee as a brown tree snake. One of the movers severed the head with a blow from a crowbar and threw away the carcass, notwithstanding the transferee's assurance that it was not poisonous. This snake survived in the container for 7 months! One wonders how many others might have been similarly dispersed, but not discovered.

Merely inspecting cargo, baggage, containers, aircraft, etc. for snakes has been shown to be less than satisfactory in preventing dispersal of brown tree snakes.

Efforts must be made to exclude these snakes from air and surface shipping situations. Reducing snake populations in "sanitized" cargo loading areas also reduces the likelihood of snakes getting into cargo and being dispersed to other areas.

A stringent inspection protocol in combination with the "sanitized" areas offers some promise in preventing dispersal of this pest species.

Preventing dispersal of brown tree snakes from shipping situations on Guam is much more practical and more likely to be successful than trying to intercept snakes at many separate destination points.

USFWS Seeks 'Alala Volunteers

The U.S. Fish and Wildlife Service is recruiting volunteers to assist with the endangered Hawaiian crow ('alala) recovery project. Duties include locating and monitoring nests, conducting behavioral and foraging observations, radio-tracking, and predator trapping. Housing, equipment, training, and $300 monthly food stipend will be provided. Applicants must provide their own airfare to Kona, Hawaii. Two positions are available for January 1 - April 30, 1994; and two for the period May 1 - July 31, 1994. Exact dates are negotiable.

Qualifications: B.S. in Wildlife Biology or similar field, plus six months field research experience. Must be in excellent physical condition and able to work and live in primitive conditions in rainforest. Demonstrated ability to work well with various people under close conditions. Send SF-171, transcripts or class list, plus names and phone numbers of 3 references with cover letter to: Scott Johnston, U.S. Fish and Wildlife Service, Pacific Islands Office, Box 50167, Honolulu, HI 96850.

Call for Natural Resource Projects

For the past few years, the Pacific Islands Office of the U.S. Fish and Wildlife Service has provided funds for natural resource projects in Hawaii and the Pacific. A limited amount of funds will again be available in 1994.

Projects to be considered for funding should fall into the following categories: endangered and threatened species listing, endangered and threatened species recovery, environmental contaminants, or wetland restoration and enhancement.

Projects that have been funded in the past range from scientific research and habitat improvements to public information programs. Examples of projects that have received funding from this office include the construction of pig-proof fences and feral ungulate control on Maui, a survey for contaminants in Hawaiian owls, terrestrial snail surveys in American Samoa, the establishment of endangered plant propagation facilities in Hawaii, and wetland restoration and enhancement projects in Guam.

Proposals for fiscal year 1994 (October 1, 1993 - September 30, 1994) should be submitted to the Pacific Islands Office of the USFWS. before December 31, 1993.

Not all proposals will receive funding. Proposals will be funded based upon how they fit into the Service's agenda and budget for fiscal year 1994. Decisions on which proposals will be funded will be made in early January, 1994.

Proposals should include the following information: background and justification, objectives, research plan (project site, materials and methods, schedule, publication of results), personnel involved, and an itemized budget. For further information, contact Karen Rosa, Recovery Branch Coordinator at (808) 541-2749.

Captive Propagation — What has it done for you lately?

Peter Shannon, Captive Propagation Program Manager
DOFAW, Olinda, Maui

In an era of accelerating species extinctions, wildlife managers around the world face the daily battle over the best ways to use precious financial resources to save beleaguered ecosystems and the species they support. Conservation often takes a back seat to the social realities of famine in the horn of Africa, civil unrest in the former Soviet Union, or devastating natural disasters. But amidst the trials of everyday life, people still hold on to a certain empathy for the planet and the multitude of life forms that share it with us. And because of that, we devote resources to preservation and restoration programs that are deemed important.

But in the scramble for conservation dollars, how does captive propagation fit in, and can we afford it? Would it be better to spend the money on habitat preservation or basic species research? What has captive propagation done for you lately?

Well, have you ever driven across the great plains and spied a lumbering herd of bison on the horizon? Decimated by settlers moving west along the Oregon trail and the ever expanding railroad lines, the species disappeared as a feature of the American landscape. Through the efforts of the New York Zoological Society, animals from their captive herd were used as seed stock to repopulate part of the former range and restore the bison to a wild denizen of the prairies.

How about the mythical unicorn? Although it never existed as a living species, the legend is thought to have originated with the Arabian oryx which, when viewed in profile from a distance, appears to have a single horn. The oryx truly became a creature of legend after the last herds were hunted to extinction in the deserts of the Arabian peninsula. From a breeding program begun at the Phoenix Zoo in the early 1960's, animals have been sent back to the Middle East for release and this creature of legend is once again roaming the Arabian deserts.

In other efforts, Bali mynahs raised by zoos across the country in a cooperative program are being released on the island of Bali to help bolster the wild population, while efforts to protect the habitat and prevent poaching are underway. The U.S. Fish and Wildlife Service is developing breeding and release techniques for the Mississippi sandhill crane in order to reverse the decline of this insular subspecies on small coastal preserves along the Gulf of Mexico. And the black-footed ferret is now being reintroduced from captive breeding centers into prairie dog towns.

Closer to home, the nene has been brought back from the brink of extinction with a decades long program of propagation and release. Were it not for the development of propagation techniques as species declined to the point of extinction in the wild, there would be no California condors, Guam rails, or Micronesian kingfishers. Without propagation, Spix's macaw, *Partula* snails, and Lake Victoria cichlids might soon join the great auk and the quaga as species to be viewed only between the covers of a book or in dusty museum cases.

But propagation in and of itself will not save species. Both the passenger pigeon and the Carolina parakeet had been bred in captivity prior to their extinction, but this did not save them from their fate. In the battle for species preservation, all the available techniques and technologies must be brought into play and new ones developed.

When we have the luxury of time, much can be learned of a species' biology in a captive setting which would not be feasible in the wild. Knowing how to rear and handle a species in a captivity provides additional options for restoration. Such experience can help in development of reintroduction or translocation techniques and potentially produce individuals to bolster wild populations.

In extreme cases, captivity buys time. Time to identify and correct the reasons for decline. Time to protect and enhance habitat. Time to educate people about what is being lost and to gain additional financial support.

Around the world, there is a growing movement toward organized, cooperative captive management plans for endangered species. In the U.S. alone, there are currently over 60 Species Survival Plans for various species of mammals, birds, reptiles, amphibians, fish and invertebrates. The goals of these programs vary but each strives to maintain a genetically viable self-sustaining captive population of the target species while working to help with habitat issues, develop new techniques for reproduction and reintroduction, and educate the public and local governments about the species, conservation, and the impact of extinction.

So, what has captive propaga-

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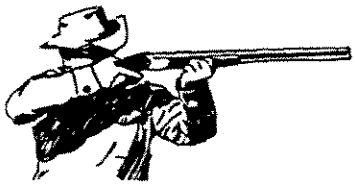
Olinda ESPF Hosts Open House

On Saturday, November 20th, the Olinda Endangered Species Propagation Facility at Olinda, Maui will hold an open house for the public to view the new facilities. These will include the newly constructed forest bird aviaries. The hand rearing/incubation rooms, the veterinary clinic, and quarantine building will also be open.

Poster presentations are being developed by various agencies on Hawaiian conservation topics.

The open house will be held from 12:00 to 5:00 pm on November 20th. Prior to the public open house, State, Federal and NGO staff are invited to preview the facility on Wednesday, November 17th, from 12:00 to 5:00 pm. For more information, call the facility at 572-0690.



Hunter Education

by Wendell Kam,
Division of Conservation and Resources Enforcement, Honolulu

The Fine Mesh Net

Tod Lum, Hunter Education Coordinator
DOCARE, Waimea

At one time, becoming a Hunter Education Instructor was simply a matter of signing up and BINGO, "Welcome Aboard." Those days are longggg gone. It used to be like a fine mesh net that caught everything—not very selective in its harvest. True, folks gave of their time and energy but, what was their motivation for volunteering?

Did you ever wonder what motivates folks to volunteer as hunter education instructors or volunteer staff? We know it's certainly not the pay! So what could it possibly be? As humans we can divide our motivations into two basic categories—we do things to either gain pleasure or avoid pain. Let's look at some of the more common reasons for volunteering.

Gaining Pleasure

- prestige of being associated with a positive organization (team playing)
- relish sharing their experience and teaching others (human interaction)
- enjoy giving back to a resource that's been good to them (gratitude)
- feels good to promote safety, responsibility, and conservation (helping others)
- fun way to contribute public service to the community (satisfaction)
- appreciate instructor discounts and incentive awards (benefits)
- like wearing the uniform you have earned (achievement)

Avoiding pain

- involvement means safeguarding my hunting privileges
- if people hunt *with* their kids they won't have to hunt *for* them.

The fine mesh net hauled in folks with all kinds of motivations for getting involved with the program. Some only wished to promote organizations outside of the program and/or promote their own business.

Today there are many checks and balances in place to assure the recruitment of quality instructors. Student evaluations have assisted us in our recruitment efforts by asking the student if they are interested in volunteering as a staff member or instructor. If they are interested, a prospectus is mailed out to the student with an application form. The prospectus "lays everything out on the table" and explains what is expected of them and the program. If they are still interested, they submit the application and once their references and Criminal Background Check come back clean, we set up an interview.

The interview really sets everyone straight and is an opportunity to clear up any questions about the program and its policies.

No question—there are a few hurdles to negotiate before signing on as a volunteer. However, it's time well spent when the volunteer comes aboard with a better understanding of the program and his/her responsibilities. In the past, all too often in our rush to recruit volunteers we forgot the importance of quality over sheer quantity. Now we keep in mind— it is easy to find volunteers, it is hard to find good ones.

Anyone who wishes to purchase a 1993-1994 Hawaii Hunting License must have in their possession either a Hawaii Hunter Education Certification Card or a "Letter of Exemption." An individual must have one of these two documents in his/her name in order to legally purchase a hunting license for the State of Hawaii. For further information about hunting licenses call the Division of Conservation Resources Enforcement (DOCARE) in Honolulu at 587-0077.

A schedule of Hunter Education classes is provided here. Each class is divided into two or more sessions, for a total of 11 to 12 hours.

For more information about Hunter Education Classes call:
Oahu: 587-0200, Big Island: 885-0335
Kauai: Call "Operator" and ask for "Enterprise 5212"
Maui, Molokai, and Lanai: Call "Operator" and ask for "Enterprise 5209"

Hunter Education Class Schedule

November 1993

19 Oahu	Schofield	5:45pm-10:15pm
20 "	Kolekole Ave., T-2003	7:45am 3:30pm
19 Oahu	Nimitz Bus. Ctr.,	5:45pm-10:15pm
20 "	Room B-298	7:45am-3:30pm

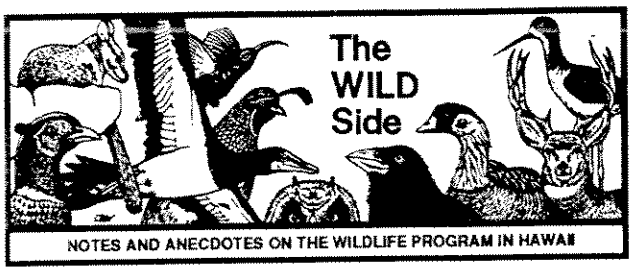
December 1993

1 Hawaii	Waimea	6:15pm 9:00pm
2 "	Conference Room	" "
8 "	"	" "
9 "	"	" "
3 Hawaii	Pahala Community Ctr.	5:45pm-10:15pm
4 "	"	7:45am-3:30pm
10 Oahu	Nimitz Bus. Ctr.,	5:45pm-10:15pm
11 "	Room B-298	8:00am-3:30pm

Advanced Bow Hunting Class

12 Oahu	Nimitz Bus. Ctr.,	5:45pm-9:30pm
13 "	Room B-298	9:00am-2:30pm

For more information on this class, call "Operator" and ask for "Enterprise 5209."



Ronald L. Walker, Wildlife Program Manager
DOFAW, Honolulu

Wetland Update

Kawai Nui Marsh, Oahu. After two public workshops and a public informational meeting, the consulting firm of Wilson-Okamoto and Associates has come out with a "Kawai Nui Marsh Master Plan Project Development Report" which summarizes progress to date and gives three alternatives for developing and managing the cultural, educational, ecological, and recreational attributes of the marsh and environs.

The U.S. Army Corps of Engineers has selected a flood control alternative (levee rise and wall) to mitigate against disastrous flooding like that which occurred in January of 1988. The project is due to start in early 1994. 187 acres of land around the periphery of the wetland have been acquired by the State as a buffer zone against urban encroachment. Dave Smith, Oahu District biologist, continues to work closely with the Kauai Nui Marsh Advisory Committee to assure public input to the planning process.

Hamakua, Oahu. Ducks Unlimited Inc., through the auspices of former DOFAW employee Andy Engilis, is charging ahead with the plan to improve this urban wetland. A recent report on "Paleoenvironmental Investigations at Hamakua Marsh, Kailua, Oahu, Hawaii" published by the International Archaeological Research Institute Inc., reveals some fascinating secrets about the site. Sediments recovered from corings show ages of from 276-727 A.D. to about 1400. Below these strata, materials are entirely marine in nature—indicating the site was once part of the sea or shoreline ("landward edge of the Kailua sand berm"). Pollen records indicate the area was once covered with *Pritchardia* palms. The study concluded that there was "...no indication that the marsh was ever used for taro cultivation or other purposes by prehistoric Hawaiians."

Pouhala, Oahu. On September 10, 1993 the Board of Land and Natural Resources approved a cooperative agreement between it and the U.S. Fish and Wildlife Service (USFWS) to enhance 80 acres at Pouhala marsh near Pearl Harbor as a wildlife sanctuary. After twenty years of talk by others, Oahu District biologists Dave Smith and Jennifer Crummer worked out an arrangment with the City and County of Honolulu, which owns a portion of the site, and got a commitment of $25,000 from the USFWS to finally protect this small threatened wetland.

Opaeula, Big Island. In late 1965, a small (7.5 acre) wetland situated at Makalawaena in North Kona was recognized for its value to endangered waterbirds and migratory waterfowl along this arid coastline. Over the years, several proposals to acquire it from the landowner (Bishop Estate) and preserve it in perpetuity were advanced. These included purchase by the state or federal government, incorporation in a resort development, and a cooperative agreement with the owner. The lattermost

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1993 Lanai Mouflon Results

It was a successful 1993 mouflon sheep hunting season on Lanai this year. Rifle season consisted of nine consecutive Saturdays, from August 28 to October 23. It was preceded by two Saturdays each, for archery (July 31 and August 7) and muzzleloader hunting (August 14 and 21). Four hundred and forty-one bucks and 281 ewes were taken for a total of 722 animals, and an over all success ratio of 44%. A breakdown of results follows:

Archery. Two hundred and twenty-seven hunters participated. A total of 15 animals were taken for a hunter success ratio of 6%. Area 1 yielded 9 bucks and 6 ewes to archers.

Muzzleloaders. Thirty-eight animals were harvested with 140 hunters participating for a success ratio of 27%. Nine bucks and 6 ewes were taken in Area 1, while Area 2 yielded 16 bucks and 7 ewes.

Rifle. 1,306 people hunted, harvesting a total of 669 sheep for a success ratio of 51%. 196 bucks and 126 ewes were taken in Area 1 and Area 2 yielded 211 bucks and 131 ewes.

Hunter Success High in 1993 Black-tailed Deer Season

According to Tom Telfer, Kauai District Wildlife Manager, this year was one of the better black-tailed deer hunts of record. The results are as follows:

Archery. Archery hunting was open on the weekend of September 11 and 12 in Hunting Units A, F, and H. Two hundred and eighteen permits were issued, but only 107 hunters turned out, for a total of 49% participation. No deer were taken with bow and arrow, but 107 archers made their best effort, and had a good time doing it. "Look out next year Blackie!"

Muzzleloaders. This season was held on the weekend of September 18 and 19. Two hundred and twenty permits were issued and 116 hunters turned out (53% participation). Six deer were harvested for a success ratio of 5%.

Rifle. The rifle hunt was held for five consecutive weekends, from Saturday, September 25 through Sunday, October 24. Permits were issued to 1,742 hunters and 1,128 of them participated (65%). There were 2,021 hunter trips with 62 deer taken for a success ratio of 6%.

WildSide *(cont.)*

idea has recently been implemented, but only to permit predator control around the wetland habitat as an interim measure. The Department is currently involved in advancing a plan for a "Kona Coast State Park and Wildlife Sanctuary" which would include Opaeula as a State sanctuary and the rest of the lands as a "wild and natural park." The current idea is to consider a land swap with Bishop Estate for the Opaeula site.

Shooting Preserves

A new Commercial Shooting Preserve was authorized by the Board of Land and Natural Resources at its September 10, 1993 meeting. The Sugi Pine Game Bird Ranch, owned and managed by Mr. Warren B. Katz, is a 100 acre site located in the Olaa area of the Big Island. The ranch will be raising and releasing ring-necked pheasants, chukar partridges, and bobwhite quail. The only other commercial shooting preserve on file with DOFAW is the 500 acre Ulupalakua Hunting Club operation on the Island of Maui. Anyone interested in this type of enterprise should call John Bedish, DOFAW Staff Game Biologist in Honolulu (587-0166) for further information.

New FedBucks Available

Although a federal grant Non-game Program authority has been on the books for many years, until recently there was no funding associated with it. In 1983, we suggested several schemes to the USFWS to produce revenue, including taxes on camping and backpacking equipment, trapping paraphanalia, and off-road vehicles. On October 4, 1993 the USFWS notified us of an expected $1,000,000 appropriation to fund the new nationwide "Partnerships for Wildlife Act" in 1994. It would involve the USFWS, the National Fish and Wildlife Foundation, other private parties, and the state fish and wildlife agency. The goals of this legislation are to preserve native wildlife diversity and to provide viewing opportunities for the public.

In terms of wildlife projects, it will exclude those involving threatened or endangered species, game species or marine mammals—as funding for these program areas are available from other federal sources. Funding will be on the basis of 1/3 federal, 1/3 state, and 1/3 private, to be administered by the National Fish and Wildlife Foundation. Elgible projects can include management; research; census; law enforcement; habitat acquisition, maintenance, restoration and development; information and education; propagation; trapping and transplanting; and technical guidance to the private sector. In other words, almost anything which contributes to biological diversity and the public's enjoyment of it.

Army Legacy Program Helps Protect Hawaii's Native Species

Kristine Bacharach, Staff Writer
U.S. Army, Schofield Barracks

The Department of Defense manages about 25 million acres of land in the United States. These lands possess an irreplaceable collection of natural and cultural resources. In Hawaii alone, the U.S. Army-Hawaii is steward for more than 165,000 acres. The Legacy Resource Management Program was established by the Department of Defense in 1991 to identify, protect, and provide guidance for the management of significant biological, geophysical, cultural, and historical resources on or involving defense lands. Recently, the Legacy program has received a new level of priority. Funding has gone from $10 million in 1991, to $25 million in 1992, and $50 million in 1993.

The Schofield Barracks project with The Nature Conservancy of Hawaii's Heritage Program was one of 90 nation-wide demonstration projects. These projects were selected based on their biological or cultural importance, and as examples of what the Legacy Program could do.

One project the Legacy Program is working on now in Hawaii is to inventory the biological resources of major army installations. The goals of the projects are to enhance threatened and initiate endangered species protection and rare ecosystem protection. The protection will come from identifying the location and status of resources, assessing management issues, and implementing key management actions.

"Inventories of Schofield Barracks, Makua Military Reservation, and Kawailoa Training Areas are nearing completion," said Mark Salley, Army Environmental Protection Specialist. In the next two to three years, Salley hopes the Legacy Program will be working on a variety of management projects, including fencing, goat hunting programs, and widening firebreak roads to reduce the threats to the endangered plants and animals in these areas. According to Patrick Ching, army agronomist and land manager, there is a four-part plan to conserve the resources in Hawaii. First, an inventory of biological resources will be completed; second, the threats to those resources will be evaluated; third, a management plan will be developed; and the fourth stage is the implementation of management activities. Schofield Barracks is currently at the third stage of this plan.

"The plan will put us on a course to protect the species of plants and animals," Ching said. With the biodiversity of plant and animal life in Hawaii—with more endangered species than any other installation in the nation—the Legacy Program will have its hands full. "We are trying to find the best ways to protect the plants and animals, while at the same time, fulfilling the military's mission in Hawaii." Salley said.

Among the agencies assisting in army legacy projects are: the University of Hawaii, TNCH, U.S. Fish and Wildlife Service, National Park Service, State Department of Land and Natural Resources, and Colorado State University.

Oahu Wildlife

David Smith, Wildlife Manager
DOFAW, Oahu District

Non-game Program

Wetlands. Work continues on the Kawainui Marsh Master Plan by the consulting firm Wilson Okamoto and Associates, and their sub-consultants. The plan will continue from where the 1983 State DBED Resource Management Plan for Kawainui Marsh leaves off. Emphasis is on specific implementation activities for development of a waterbird wildlife sanctuary, an interpretive/education center, research and restoration of cultural/historic sites, and compatible recreation/interpretive activities around the periphery of the marsh. The public is welcome to participate in the planning process. Plans call for the plan to be completed by December 1993. Call David Smith at 587-0166 for more information.

The U.S. Fish and Wildlife Service has granted the Oahu District $25,000 to restore and enhance Pouhala Marsh in Waipahu. The area is used by endangered Hawaiian waterbirds and migratory waterfowl. The money will be used for predator control (fencing, trapping) and habitat enhancement.

The wildlife staff has also been working to develop sanctuaries at Heeia Marsh and Salt Lake.

Offshore Islands. Work on the offshore island sanctuaries has been limited to surveys, education, and enforcement. A huge Mahalo! to Mike Solomonson and his gang of boatmen for their careful watch over the Mokulua Islands. Because of their efforts at keeping people out of the nesting areas, we have the best nesting season there in the last 30 years (personal observations from long-time locals). Baby shearwaters are surviving right down to the beach—amazing! Keep up the good work!

Mahalo, as always, to Henry Ho and his volunteers at Malaekahana for their careful watch over Mokuauia Island. Surveys have been conducted on Kaohikaipu, Manana, Mokuluas, Popoia, Mokolea, Kapapa, Mokolii, and Mokuauia Islands.

Kure Atoll. This summer the Wildlife and NARS crews descended upon Green Island, Kure Atoll for the first step in an eradication effort of Polynesian rats on the island—a major source of predation on the seabirds nesting there. Under the supervision of USDA, Animal Damage Control, crews established a 50 meter grid over the entire island (260 acres) and used a combination of traps and bait stations to reduce the rat population to a very low level. When the last people left the island in September, the bait stations were loaded and if we are lucky, they will eliminate the few rats that still remain. Crews will be back this spring to assess the effectiveness of the program.

The Coast Guard has officially pulled out of Kure—the Loran Station there a victim of the new satellite based

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Alien Animal Introductions Continue

Carol J. Terry, Wildlife Biologist
DOFAW, Honolulu Staff

Charles Christensen is a Land Animal Specialist for the State Department of Agriculture (DOA). He is one of 55 DOA inspectors who regulate the introduction of plants, non-domestic animals, and microorganisms seven days a week throughout the State.

His primary duty is to review and issue permits, as well as to find, confiscate, and/or trap those animals which have been brought into Hawaii illegally.

Periodically he stops by our Honolulu Office to see if one of our wildlife biologists can identify some exotic animal he has found. Recently, he was telling me about a monitor lizard that he was trying to find around Tantalus. Once these illegal lizards, snakes, or mammals get loose in the dense undergrowth here, it is virtually impossible to find them again, so I was not surprised about his failure to capture the illusive lizard. What I was surprised about was the large number of animals that are constantly being brought into Hawaii, either intentionally by people who do not realize the threat these alien animals pose to our native ecosystems; or unintentionally as stowaways in cargo.

Charles does not have all of the figures for 1993 in yet, but he was kind enough to go through his records and put together a list of those alien introductions that he had been involved with in 1992. That list is printed here. Keep in mind that this list does not include all alien animals brought into Hawaii during that year, but merely those that one DOA inspector on Oahu has personally dealt with.

Arthropods - 5,686, including:
- land hermit crabs
- tarantulas
- giant meal worms
- beetle jewelry
- scorpions
- Mexican jumping beans (A moth larva inside the bean makes it jump.)

Amphibians - 193, including:
- African clawed frogs
- Golden flying frogs
- Rough skinned newts

Snakes - 38, including:
- Burmese pythons
- boa constrictors
- ribbon snakes
- garter snakes
- pit viper
- ball pythons
- gopher snakes
- corn snakes

Lizards - 102, including:
- monitor lizard
- iguanas
- alligator lizards
- Cuban Knight Anole
- spiny lizards

Turtles - 40, including:
- common snapping turtles
- box turtles
- red eared sliders
- alligator snapping turtle

Mammals - 43, including:
- ferrets (at least half of which were loose)
- wolf-hybrid
- hamster
- squirrels
- gerbils
- bat

Total = too many

'Alala Progressing Well After Malaria Scare

Almost seven weeks after their release, the five 'alala juveniles reared in captivity and released to the wild on the Kona side of the Big Island are adapting well, despite one confirmed case of malaria and possible infections in the other four birds. Close monitoring of the young birds continues, by staff from both The Peregrine Fund and the U.S. Fish and Wildlife Service.

With from 40% to 50% of the mosquitos captured at the aviary site testing positive for malaria, biologists have been watching carefully for any signs of the disease. On the morning of September 10, Malama, one of the two males, abruptly exhibited symptoms of lethargy—one symptom of malaria infection. The four other crows had shown similar symptoms, but only for a single morning each. All five birds were more active in the afternoons and early evenings, feeding well, and flying strongly. However, Malama continued to behave lethargically on successive mornings.

On September 12, Dr. Pat Redig of the University of Minnesota and Dr. Greg Massey from the Olinda ESPF were called, and arrangements were made to capture all five birds to take blood samples and do a general health screening. Dr. Carter Atkinson of the USFWS and other disease experts associated with the `alala recovery project also were consulted.

Malama was trapped early the next day, and despite an overall healthy appearance, blood tests indicated the presence of malaria, so treatment was begun immediately. The tests indicated that the bird had passed the crisis stage of infection and was beginning to recover on his own before treatment began. Although Malama was slow to fully recover, on September 20 he was behaving normally and lab results were reported to be normal, so he was released to rejoin the other birds.

The blood samples taken from the other four `alala were negative for malaria, although it has been suggested that they may also have been infected, but had survived the infection. Compared to some native species like the i'iwi, that die from a single infected mosquito bite, this indication that the 'alala may actually survive a malaria infection provides one more glimmer of hope for the long-term survival of this species.

Another slight complication surfaced on September 14 when Hiwa Hiwa lost her two tail feathers and the radio transmitter attached to them. A new transmitter had to be sent from Greenfaulk Consultants, who are conducting surrogate crow research in Idaho. The new transmitter was attached to her leg and she was released back into the wild at the same time as Malama. Both birds were welcomed back by the remaining three juvenile 'alala. Hiwa Hiwa's new transmitter is working well, and she appears to be having no problems with the new placement.

All the birds are ranging farther and farther from the aviary, and have been seen as much as two kilometers away. Food trays, supplied with a variety of food items including native fruits typical of the wild bird diet, have been moved off of the aviary platform and into the forest to encourage independence. Field biologists have documented the birds foraging on their own.

The Kalahiki adults remain in close proximity to the young birds, especially when roosting. The juveniles no longer return to the aviary area for safety, and appear calmer around the adults. The adults have perched as close as two meters away from the young birds, with all of the birds relaxed and preening.

Peter Harrity of The Peregrine Fund calls the 'alala release "both exciting and exhausting," with new information about the birds and the requirements for their successful establishment in the wild being gathered every day. He credits the continuing concern and cooperative efforts exhibited by all the parties involved in the 'alala recovery effort for the progress of the project.

Oahu Wildlife *(cont.)*

Global Positioning System—and Kure is now once again strictly "for the birds."

Game Program

Thomas Franco has been working as an emergency hire Wildlife Management Assistant at Kuaokala Game Management Area and has been repairing and maintaining water units, maintaining feed stations, and trapping predators in an effort to increase game bird production in Oahu's only game bird hunting area. The USDA, Animal Damage Control unit has been trapping predators in the area three days a week and it seems to be having a positive effect, as many more healthy Erkel's francolins and pheasants have been seen there. Oahu wildlife personnel have released 132 ring-necked pheasants on the mountain, and along with some beautiful birds released by a volunteer, the area now has some good hunting and breeding stock.

Existing game bird water units will be rebuilt and new units added in the coming year. New, larger volume feed stations have been installed, safety zone signs posted, and habitat enhancement work is underway. Volunteers are needed and plans exist to manage a volunteer program, but we have so far been unable to devote the time to getting volunteers rolling. Sorry for the delay, but don't give up, we're working on it.

Game mammal work on Oahu is also underway. New public hunting area (PHA) signs have been installed, a new check station (mailbox) has been installed at Kahana Valley, and hunters are being recruited to establish a hunters advisory group to help district personnel improve the game management program on Oahu. Any hunter who has suggestions for the formation of this group should call David Smith at 587-0166.

Enforcement officers have been quite helpful the past few months. With their assistance, the hunting for archers in Nuuanu PHA has improved to the point where hunters are regularly—and legally—bringing animals out of the area.

Ecological Nightmares

Don Reeser, Superintendent
Haleakala National Park, Maui

Early in 1993, the Hawaii Conservation Biology Initiative (HCBI), an informal consortium whose members consist of organizations and agencies concerned with research and management of Hawaii's natural resources, decided to organize a Hawaii Conservation Conference, with the idea of making it an annual event. A major objective was to bring a broad spectrum of people together to exchange information in order to help us achive our common goals.

The first annual Hawaii Conservation Conference was held on August 4th and 5th in Hilo. As part of the conference, a panel of resource managers was asked to discuss their three worst conservation-related nightmares. The following nightmares were those of Don Reeser, Superintendent of Haleakala National Park.

In my first nightmare I leave my office at Haleakala National Park to go for a walk to check out the resources and I see widespread devastation. I come across Resource Specialist, Steve Anderson, who is wandering around looking beleaguered and dejected. The mammane and ohelo are girdled, and even pukiawe looks pretty bad.

Much to my dismay I see rabbits running here and there. Alarmed, I ask, "Steve what in the world is going on?" He says, "The eight rabbits somebody dropped off at Hosmer Grove got out of control, now they are in the crater and even exploding through the Kula cabbage farms."

"Oh my God," I cry. "Steve, I thought we put out 1200 snares and fenced the infestations with chicken wire to get them?"

Shaking his head, Steve walks away. As I stumble back to headquarters I see them—demonstrators with placards which read "NPS Cruel to Bunnies."

In my second nightmare I am reading the *Maui News* and get physically ill as the following articles on the front page of the newspaper leap out at me:

"Haleakala Builds 10' Fences to Keep Out Axis Deer"

"Bana Poka Discovered in Kipahulu Valley"

"Haleakala Implements 'Adopt a Feral Pig' Program"

"Visitors Enjoy Pampas Grass Plume Display in Haleakala Crater"

"Haleakala Helicopter Noise Problem Solved—NPS Requires Hikers to Wear Ear Plugs"

In my third nightmare the year is 2030 and I am 92 years old and I return to Maui aboard a 1000 passenger airliner—via South America and Guam. My purpose is to make one last visit to Haleakala National Park. It's been 35 years since I left and I know I don't have much time left. I must see how things have been going.

Before disembarking I conscientiously fill out the agricultural declaration form. I don't know anybody at Haleakala any more and so I look up the Resource Chief. I tell him I used to be Superintendent and brag that I remember the 1990's when Ron Nagata and Steve Anderson were working their butts off to save some of the park's native ecosystems by building fences, and getting rid of pigs and goats and alien plants; and Lloyd Loope and Art Medeiros were on top of problems of alien species coming into the island and invading into the park; and Bob Butterfield, Elizabeth Cheeseman, Peter Connally and the interpretive staff were doing all they could to get the public to understand and appreciate Hawaii's natural heritage.

The Chief thoughtfully said, "Yes I've read some of their reports and I must say, your effort was commendable. But with the construction of the international airport in Kahului in 1996, it's been downhill ever since. We have been pretty successful saving the native pukiawe and let me show you something the visitors really enjoy." He showed me a specially designed greenhouse—an interpretive exhibit containing silverswords that alien insects could not penetrate. He said, "The visitors love to look in there and see what the crater used to be like in the 1990's.

I asked him about the birds—the nene and forest species. This got the Chief noticeably agitated. He said, "You can still find a few white-eyes if you know where to look, but in 2001 the brown tree snake leaked though quarantine into the sugar cane and they have been absolutely relentless.

"Where were you guys—the U. S. Fish & Wildlife Service, the Wilderness Society, DLNR, Department of Agriculture, Hawaiian groups, and all the other environmental protectors in the early 1990s—when they were planning to bring big jets in from all over the world?" You must have been asleep at the switch! What in heaven's name were you all doing?" I winced and defensively said, "We all got together and had some great conferences."

Po'ouli *(cont.)*

However, Betsy, who spent the day exploring other Hanawi trails, saw a po'ouli along the East Hanawi trail. As both sightings were only about 300 meters apart, we do not know if they represent the same or different birds.

Both sightings were at about 5900', around 3:00pm. The birds appear to prefer dense understory comprised of akala (*Rubus hawaiensis*), pilo (*Coprosma* sp.), pukiawe (*Styphelia tameiameiae*), alani (*Pelea* sp.), Kanawao (*Broussaisia arguta*), and olapa (*Cheirodendron trigynum*).

Epidemic Pox and Malaria in Native Forest Birds

Carter T. Atkinson, Robert J. Dusek, and William M. Iko
USFWS, National Wildlife Health Research Center,
Volcanoes National Park

Studies by Warner in the 1950's and van Riper in the 1970's identified disease as a potential limiting factor in the distribution and abundance of Hawaii's native forest birds. Mosquito-transmitted protozoan and viral infections caused by malarial parasites and pox virus were especially significant. Both organisms were introduced to the islands after the arrival of Europeans and are thought to have affected avian communities the same way that measles devastated native Hawaiian peoples.

Our current investigations are looking at the ecology and potential impacts of avian malaria and pox in a comprehensive manner that will hopefully allow us to develop strategies for their control. Our initial findings have documented the prevalence of disease among forest birds. We have also followed the course of an epidemic of malaria and pox in native honeycreepers in Hawaii Volcanoes National Park between September and December, 1992.

We used mist-nets to capture native and non-native species at mid- and high elevation study sites at Kilauea volcano (elevation 1200 m) and Kulani Prison (elevation 1700 m). A small blood sample was collected from each bird and every individual was examined carefully for pox lesions. We found significantly higher prevalence of both diseases in mid-elevation habitats where native birds and mosquito populations overlap.

The prevalence of pox and malaria in apapane (*Himatione sanguinea*) at Kilauea varied seasonally and ranged from approximately 30% during the abnormally dry spring and summer of 1992 to almost 100% by the fall and winter of 1992, when rainfall and mosquito populations increased. Prevalence of malaria and pox in non-native species such as the Japanese white eye (*Zosterops japonica japonica*), by contrast, never exceeded 3%—even in areas where we were able to demonstrate active transmission of both diseases by exposure of sentinel canaries.

The prevalence of pox and malaria in upper elevation forests at Kulani Prison, where three species of endangered honeycreepers still occur, was less than 5% for apapane and other non-native species. We have never trapped adult mosquitoes or found larvae at this higher site, suggesting that the few infected birds we have found had acquired their infections at lower elevations where mosquitoes are more abundant.

The detrimental effects of malaria and pox infections in native birds were clearly demonstrated between September and December, 1992, when we found 18 dead or moribund apapane and common amakihi (*Loxops virens*) on roadsides, trails, and backyards in and around the town of Volcano and Hawaii Volcanoes National Park (elevation 1200 m). None of the birds had broken bones or other evidence of traumatic injuries. All of the birds were infected with malaria, displaying the enlarged, discolored spleens and livers, and large numbers of intraerythrocytic parasites that are characteristic of acute malarial infections. More than 75% of these individuals also had large necrotic pox lesions on their feet and legs. Histopathology of tissues from these birds revealed few abnormal changes other than those associated with malarial infection and pox lesions. Death in all cases was probably due to anemia or secondary bacterial infections associated with the pox lesions, or both.

At the same time we were finding dead and dying native birds, caged sentinel canaries that we had placed at Ola'a Forest (elevation 1300 m), Kilauea Volcano (1200 m), and Napau Crater (800 m) began to develop pox and malarial infections, indicating significant activity of the mosquito vectors at those low to intermediate elevation sites.

The prevalence of malaria and pox in wild birds captured at Kilauea Volcano also increased dramatically and reached almost 100% in December, 1992.

We failed to find similar mortality or increases in prevalence of pox and malaria at Kulani Prison, indicating that this high elevation habitat is still relatively free of avian disease and near or probably above the upper limits of mosquito activity.

The epidemic of pox and malaria appeared to end in late December, 1992, with the onset of cooler winter temperatures and corresponding decreases in vector activity. We have continued to monitor sites in Hawaii Volcanoes National Park since then and have found that the prevalence of malaria in the apapane population has remained significantly higher than pre-epidemic levels.

Precipitation patterns in 1993 have been similar to those in 1992, with abnormally dry weather during the first six months of the year followed by large increases in rainfall. If mosquito populations show a corresponding increase this fall, we are anticipating another outbreak of pox and malaria.

Transmission of these diseases to native birds can be reduced through control of mosquito populations. This can be done around human dwellings by eliminating or covering places where *Culex* mosquitoes prefer to breed such as in old tires, buckets, poorly sloped rain gutters, catchment tanks, and other containers that hold rainwater for long periods of time.

Control of mosquitoes in remote forest habitats will be much more difficult, but will probably be essential in order to prevent epidemic transmission of pox and malaria in upper elevation forests.

Malaria-Causing Mosquitos Found at Olinda ESPF

Fern P. Duvall, III, Head Aviculturist
DOFAW, Olinda ESPF, Maui

The Olinda site for the State's endangered species captive propagation facility had many advantages for the captive breeding of Hawaii's rare and endangered birds. Among these were altitude, temperature regimes, rainfall, presence and condition of physical structures, ownership, and the near absence of a significant population of mosquitoes (*Culex quinquefaciatus*) which cause avian malaria. This September we discovered that the mosquito factor had changed.

From the end of 1986, until September 1993, only two ornithophilous ("bird-loving") night-biting mosquitoes had been observed at the Olinda facility and the nearby environs. After the 'alala had been moved to Olinda, and as an experimental precautionary measure, trapping for *Culex* mosquitoes was done.

Beginning in March, 1987 and until 15 February a light trap failed to catch any of the night-biting species at Olinda. After this no more trapping was done, primarily since no mosquitoes were observed.

Only twice in seven years were *C. quinquefaciatus* mosquitoes captured, until September 3, 1993. On September third I observed, then killed, two night-biting mosquitoes in the kitchen at Olinda. On September 6th five more were seen and killed and nine more were seen in the next five days. On the 11th a Reiter's Ovaposition Trap was sent to Olinda and set up. On the 12th a light-trap was also set up. Eight mosquitoes were captured on the 12th, these were dissected to look for avian malaria sporozoites or oocysts. Two of these mosquitoes were found to contain oocysts.

This result was the first record of avian malaria for the Olinda area. Unfortunately, it was not an isolated find. From 15 to 21 September, 25 more mosquitoes were captured and dissected; of these 5 were found to carry malaria parasites. More and more mosquitoes were also being seen in the areas immediately surrounding Olinda. On September 22, in one evening's catch, 86 mosquitoes were found in the single Reiter's trap at Olinda.

These were all sent to Carter Atkinson for dissection and study at the National Wildlife Health Center's laboratory in Hawaii Volcanoes National Park. Initial dissections of 20 of the 86 Olinda mosquitoes, have not found malarial oocysts or sporozoites. Monitoring of the current influx will be continued due to the potential health threat to the captive endangered birds if the insect-proofing of aviaries were to be comprised.

Dissections and captures of mosquitoes at Olinda will continue until mosquito numbers decline. This generally happens near the end of November. It is hoped that this irruption at Olinda, 3,800' elevation, is only the result of a short-term influx of mosquitoes from lower and warmer climes, instead of a case of adaptive radiation and/or acclimation to higher altitudes and lower temperatures by the night-biting mosquito.

I'iwi Malaria *(cont.)*

appeared to be totally resistant to the malarial infection, and never developed detectable parasites in the peripheral bloodstream. A single control i'iwi died during the experiment from a bacterial peritonitis of undetermined cause.

It is significant and disturbing that a minimal infective dose of only one mosquito bite was sufficient to kill 90% of the i'iwi in the low-dose group. We frequently capture wild mosquitoes with malarial infections of comparable intensity to those that were used to infect the experimental birds. Our findings indicate that malarial infections alone can cause high mortality in i'iwi. The high susceptibility of this species to malaria could explain its disappearance from mid-elevation habitats where we have documented natural transmission of the parasite. Consequently, the presence of i'iwi in areas with suitable habitat may be an excellent indicator for determining whether the habitats are still relatively free of this disease.

Other factors in combination with avian malaria may increase mortality in wild native birds. During a recent malaria epidemic in Hawaii Volcanoes National Park, approximately 75% of dead or moribund birds found suffered from large necrotic pox lesions in addition to severe malarial infections. We suspect that the combined effects of the two diseases are additive and much more severe than either infections alone. Availability of food; environmental stresses caused by wind, cold temperatures, and rain; and predation by rats, feral cats, and mongoose, may also decrease the chances that native birds will survive malarial infections.

During our experiment, sick birds were almost totally sedentary and lost significant body mass, even though food was readily available. In the wild, it is unlikely that the birds would have had the strength or stamina to escape predation. We believe that endangered forest birds like the akiapola'au (*Hemignathus wilsoni*) that are currently restricted in distribution to upper elevation habitats are equally susceptible to avian malaria.

Should epidemic transmission of malaria and pox shift from mid-elevation forests where these diseases are common, to upper elevation habitats, recovery of endangered forest bird populations will be severely threatened.

Captive Propagation *(cont.)*

tion done for you lately? Probably a lot more than you realize. What can it do for you down the road? It just may play a role in preserving some of Hawaii's unique avifauna for future generations. And is it worth the cost? A better question might be:

How will conservationists a hundred years from now view our efforts in the late 20th century to save the planet's biodiversity? Hopefully they will say that we may not have saved it all, but we used all the tools available to us to do everything we could.

Trailmix: Tales of Topographic Adventure

Curt Cottrell, Trails and Access Specialist
DOFAW, Oahu District

Maunawili Demonstration Trail. Through the fantastic efforts of the Hawaii Service Trip Program (HSTP) of the Sierra Club, this trail has been extended almost another two miles. Work has been initiated on the trail from the Waimanalo end with the assistance of about 130 marines stationed at Kaneohe. The marines have come out twice, and intend to work two more days before being stationed in Okinawa in December. It is the hope of the Captain to tie into where HSTP is working before they leave.

We have also been getting help from a couple of Boy Scout troops and the Hawaii Ultra Racing Team (HURT)—a group of runners who especially enjoy running on long trails through the mountains. Other groups scheduled to assist at the Waimanalo end of the trail in the near future include the Kamehameha Schools Earth Club, high school hiking clubs, and volunteers from Belt, Collins and Associates.

Through the efforts of all of these groups, we may be able to finish the main trail by December, about a year earlier than planned. The section left to construct in order to complete the entire trail will be the portion connecting the trail to the Pali Lookout. Planning is now underway to resolve potential parking problems that may develop when hikers are able to park at the Waimanalo end of the trail.

Manoa Cliff Trail. On September 24, the BLNR approved a Memorandum of Understanding between the DLNR and Bishop Estate/Kamehameha Schools (BE/KS) that would insure continued public access along the portion of the Manoa Cliff trail owned by BE/KS.

DLNR, through DOFAW, will continue to maintain the trail on a regular basis, and also indemnify BE/KS for the potential liability of allowing the public to traverse through their property. If approved by the trustees of BE/KS, this document will be the first agreement with a private landowner on Oahu that includes indemnification as a result of H.R.S. Chapter 198D, the statute that delineates the role of Na Ala Hele.

Oahu Trails Workshop. As a result of such issues as the increased use of bicycles on hiking trails, the potentially negative affects of increased public use in areas that contained threatened or endangered species, and the gradual trend of increasing trail use and the needs of conflicting uses, the need for an Oahu trails workshop is becoming more apparent.

Oahu NAH, with the help of staff from the Center for Alternative Dispute Resolution (ADR), is formulating an agenda and deciding upon a date some time in early December. Approximately 20 organizations will be invited who represent recreational users, retail merchants, research groups and individuals, and environmental education coordinators.

The goal will be to educate the various trail user groups about each other, their specific trail needs and issues associated with conflicting uses, and ways to mitigate the potential impacts to the natural resource. The assembled group will help Oahu NAH decide the future direction of the program. This workshop will be hosted through the Oahu Na Ala Hele Advisory Council and assisted by staff from ADR.

The Oahu NAH program has had a busy several months.

NARS NOTES - Oahu

Randy Kennedy, NARS Biologist
DOFAW, Oahu District

Kaala. The NARS crew continues to battle blackberry with the enthusiastic aid of volunteers. Those wishing to join the effort should contact the Sierra Club and join the bimonthly volunteer work crews. Feral pigs and goats are still in the area. Special permits are available for public hunters to assist with the goat removal. A monitoring program of goat damage and populations will be commenced in the near future.

Pahole. Non-natives plant control continues to require a great deal of our overall time and energy. The continuing praise from users of the area makes us feel that we are on the right course for this long term native forest restoration program.

Kaena. Work continues with the eradication of introduced plants and the trapping of predators. The area is looking good as is attested to by Best of Honolulu in *Honolulu Magazine* which rated Kaena Point as the best place to take visitors on Oahu. Still there is evidence that some mountain bikers continue to ride off the trail. Hopefully these few individuals will take the time to get off their bikes and enjoy this special place in a way that will allow Keana to maintain its "sacred nature."

This last summer the crew took on an important project far away—at the Kure Wildlife Refuge, in the Northwest Hawaiian Islands—aiding with a rat eradication program. Hopefully our efforts will lessen the predatory pressure from Polynesian rats on the nesting seabirds there. Next summer a small crew will return to determine whether this year's efforts succeeded in eradicating the rats, or a longer term control project will be required.

NA ALA HELE
Hawai'i Trail & Access System

Christina Meller, Program Director
DOFAW, Honolulu

Accessibility Guidelines. The State of Hawaii Architectural Access Committee has drafted guidelines for trail design specifications which are not covered in the Americans with Disabilities Act Accessibility Guidelines, 36 CFR Part 1191. The design specifications were based upon a set prepared by a team of USDA, Forest Service and USDI, National Park Service personnel.

In reviewing the design guidelines for trails we note that the guidelines may impact on two other federal laws—ones dealing with endangered species and historic sites.

Trail Inventory. We are into the computerized mapping process of trail and access information on public and private property. We are using a DBASE IV software program for specific information about each trail, and trail mapping on an ARC/INFO program.

The two programs are linked so that we can call for specific trail information and ask for a map of the trail, or start with a trail map and ask for a display of the data. The data are being tied into the Statewide Geographic Information System (GIS). When completed we are planning to put the data on PC Arch View software that can be used by DOFAW district personnel.

There is potential application of GIS for report writing, maintenance updating, informational brochures, resource management and planning. We can use it to readily determine how many trails are on private or public lands, their total number of miles, the last time a trail was maintained, modes of transportation allowed on the trail, and when the trails were built.

We will have a head start on making informational brochures about a trail because the data base contains information on seasonal restrictions, and features such as scenic, nature study, and archeological sites. Our data, when combined with layers of mapping done by other State departments, can be used for management and planning purposes to assist in fire fighting, connecting trails, or determining trail usage based on natural or cultural resources.

Ala Kahakai Conference. Na Ala Hele is sponsoring a conference for November 5 and 6 on the Ala Kahakai Demonstration Trail, at the King Kamehameha Hotel in Kona. This is being held prior to the National Park Service study of the Ala Kahakai in January 1994—a precursor to establishing it as a National Historic Trail. The demonstration trail is mentioned in the May 1991, Na Ala Hele Trail and Access Program Plan and is much shorter than that nationally nominated by Senator Akaka in 1992.

The purpose of the conference is to inform and have the residents participate in the planning and development of a trail over public and private lands.

Two mainland speakers, Mr. Dan Sharp and Mr. Alan Pinkam, will be giving presentations on the National Historic Trails in their areas. Mr. Sharp is a rancher who has allowed 10 miles of the Santa Fe Trail to be established through his property in Oklahoma. Mr. Alan Pinkam is a Native American Indian who serves on a tribunal council which is involved with the Nez Perce Trail in Idaho. The speakers will discuss landowner and cultural heritage rights.

The welcome and opening remarks to the conference include the Honorable Steve Yamashiro, Mayor of Hawaii and Mr. Keith Ahue, Chairperson, Department of Land and Natural Resources. The Honorable Senator Akaka has been asked to give a speech on the Ala Kahakai nomination as a National Trail.

The history, vision, and future of the trail will be presented by several speakers including Hannah Springer, Kona Hawaiian Civic Club; Virginia Macdonald, AIA; Deborah Chang, former NAH Program Director; and Meredith Kaplan, National Park Service.

Dona Hanaike, Deputy Director DLNR; Virginia Goldstein, Hawaii County Planning Director; Les Wishard, Kona Hiking Club; Leilani Hino, Mauna Lani Resort; and Hugh Montgomery, E Mau Na Ala Hele will speak on trail issues such as liability, management, land use (plans, policies, and procedures), landowner rights, and trail users.

Call the NAH office at 587-0058 if you are interested in registering.

State Fuel Tax Legislation. The State of Hawaii fuel tax bill is going in for readjustment. The current language says that DOT shall "report" the amount of fuel revenues. We would prefer to have it refer to the amount of fuel revenues actually "deposited."

Symms Recreational Trails Act. The U.S. Senate Sub-Committee on Transportation has reported on an appropriation of $15 million for the Symms Recreational Trails Act, while the House has put in a zero budget. This is the same thing that happened last year and we ended up with $7.5 million after conference committee meetings were over.

The Hawaii appropriation last year was $69,000. You can help us double last year's appropriation by asking Senator Dan Inouye to informally contact Senator Lautenberg and ask him to do all that he can to keep the $15 million funding level intact for FY 1994. Congress just increased the fuel tax by 5¢ so, what better place to put the money than on trails!

Trail End Note. I was recently at a conference where a line was quoted that really stood out for me. The speaker quoted a poet of this century named Woody Allen who said, "The world is run by those who show up." So for NAH, we should always have presence, sense, and cents; and maybe even some nonsense.

Update on Hawaii's Forestry Cost-Share Programs

Nelson L. Ayers, Service Forester
DOFAW, Honolulu Staff

Forest Stewardship

An important discussion on our agenda has been determining how to divide the approximately $2.0 million that was earmarked through a portion of the Conveyance tax to fund projects approved by the Natural Area Partnership and Forest Stewardship programs. A workshop on August 23, 1993 gave refreshing solutions to this dilemma by bringing together members from the Natural Area Reserves Commission and Forest Stewardship Committee to discuss the appropriate division of funds for the two programs. It was decided that of these unappropriated funds, $800,000 will be used to help fund Natural Area Partnership projects and $200,000 to fund Forest Stewardship projects. The balance will be used to fund either program as needed.

As a result of the outcome of this workshop, the Forest Stewardship Committee decided to develop a marketing strategy to bring additional landowners and quality projects into the program. This led to creating two subcommittees to develop strategies for prioritizing forested areas in Hawaii. The committee felt that this was the best way to elevate stewardship program participation. The two subcommittees will present their recommendations at the next committee meeting in December.

A much needed Department administrative rule for Tree Farms was presented for endorsement at the October 8, 1993 Board of Land and Natural Resources meeting on Kauai. It drives the authority for which Chapter 186 H.R.S. relating to tree farms is implemented by the Department. This law has long been in the books, but with no administrative rules to enact the law. This enactment of the rules will allow private landowners to produce a management plan approved by the Division of Forestry and Wildlife, to have their properties officially designated as tree farms.

Kaulunani, Hawaii the Beautiful

Over 1,000 participants from the continental United States, Hawaii, Guam, Saipan, Bahamas, Costa Rica, Italy, Slovakia, and Ukraine gathered in Minneapolis for the Sixth National Urban Forestry Conference. The conference was made possible through the combined efforts of the American Forests, U.S.D.A. Forest Service, and Minnesota Shade Tree Advisory Committee.

The conference keyed on the theme "Cooling Your Communities" and the importance of promoting partnerships with utilities, government, and private businesses. Conference participants attended five days of exhaustive, but informative presentations describing the future of urban forestry in America. Conference sessions dealt with citizen forestry programs, urban tree management strategies, partnership and budgeting strategies, people empowerment; and partnerships with utilities, corporate, and government entities. Partnerships provide the most efficient use of resources needed to promote urban forestry throughout the country.

Five people from Hawaii attended this conference. The most useful information came from a presentation by Pearlman Marketing Group who explained that community tree planting appeals to corporate business because, it simply is an honest and good thing to do. Furthermore, corporations across America are actually giving time, money, and volunteers to promote and beautify community areas with trees. This definitely fits Hawaii's needs because of the great interest in establishment of partnerships with corporate businesses and utility companies.

Kohala Volunteers Plant Native Trees

How many people does it take to plant 160 native Hawaiian trees? If the trees are planted as a beautification project along Akoni Pule Highway one mile of Kohala Foundation's Adopt-A-Highway responsibility on the Big Island, it takes 75 fast-moving able-bodied volunteers. These are folks who care enough about trees that they would spend six blustery hours in the autumn sun and good, honest exercise to plant 160 native trees.

This project is funded by the *Kaulunani, Hawaii the Beautiful Program* through the State Division of Forestry and Wildlife. Since the project is located along the main road, it is being done according to the Department of Transportation, Highway Division requirements. Volunteers were asked to begin preparing the planting site by clearing and digging planting holes during the week of October 31 through November 5.

The next day, the Kohala Lion's Club loaded saplings bought from Aikane Nursery and dropped one at each tree planting hole. Koaia, milo, ulei, and wiliwili were among the tree species planted. Trucks transported compost and mulch from several supply shops to the planting site and crews began to spade fertilizer into the holes while adding compost, soil, and fertilizer before the trees were planted. A water truck went down the line of trees and gave them a thorough soaking.

By mid-morning, all of the 160 trees were planted to add to the growing number of 3,000 trees that have already been planted by the Kohala Foundation Adopt-A-Tree program. It took nearly four years by a core of volunteers to beautify the area of North Kohala with trees. This project just adds to the dedication that the people have to planting trees around this small town called Kohala.

Another Puzzle Piece Found OR The Rediscovery of *Cyanea shipmanii*

Jack Jeffrey, USFWS Biologist
Hakalau Forest National Wildlife Refuge

Those of us who spend a lot of time in the field know that finding a rare plant or beast during our sojourns into the forest, is something to get excited about. Especially when the discovery is a species that hasn't been seen in many years or was thought to be extinct.

In mid-June of this year, Andy Kikuta and several of the maintenance staff from Hakalau Forest National Wildlife Refuge were conducting a feral animal control hunt in the Pua Akala Tract of the Refuge. While combing the forest for feral pigs, Andy, the observant man that he is, noticed a plant that he hadn't seen before. This plant, resembling a fern on a broom stick, was growing at the base of a large koa tree. A clump of green and orange berries hung from the bare stem just below the leaves. Andy recognized the plant as a possible *Cyanea* and picked a leaf for later identification. At the office, Andy showed the leaf to me and to my astonishment it proved to be *Cyanea shipmanii*.

Last seen in the late 1970's by botanists of the USFWS Hawaii Forest Bird Survey (HFBS), this plant has been the focus of numerous, but obviously fruitless searches. Over the past few years every opportunity has been taken to follow gulches and streams on the Refuge, searching the steep gulch walls in hopes of finding the last *Cyanea shipmanii*. During one search our hopes were raised when old brittle blue flagging, most likely from the HFBS, was found at the edge of a gulch. A rotted stump of what appeared to be *Cyanea* was found, but no living plants were seen.

How this newly rediscovered plant survived the ravages of cattle grazing and pig rooting without the protection of steep gulch walls, we'll never know. Not long after its discovery, the maintenance crew returned to construct a fence around this candidate endangered species, protecting it from the mouths and feet of feral ungulates.

Jaan Lepson, a UH grad student doing bird work on the Refuge, visited the plant a short while later. While there, he decided to check a nearby gulch for other rare plant possibilities. Lo and behold he found a second plant within 50 meters of the first, but this plant was protected by its precarious perch on a gulch wall. Another surprise was the discovery of six *Clermontia lindseyana* plants, another candidate endangered species, inside the gulch. Only five other *C. lindseyana* plants are known on the Refuge. All this was too much to bear and I had to see this "Lost World" for myself. While walking the same gulch, yes, amazingly, I found a third *C. shipmanii*. All of this was discovered along a 100 meter portion of a small steep walled stream.

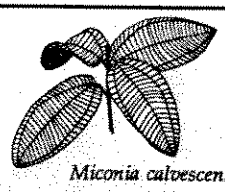
Fruits from the *C. shipmanii*, apparently never described for this species before, were collected from the first plant found, as neither of the other two plants had fruit. Fruits were sent to Greg Koob at the Lyon Arboretum and to Fern Duvall at the Olinda Facility for seed extraction and germination. Both have great expertise in germinating and growing rare lobelias. Upon returning to the plant several weeks later to collect more fruit, we found that all had been eaten by rats and that a rat had taken up residence at the base of the plant. (It's nice to live next to the supermarket.) We checked the *Clermontia lindseyana* plants nearby and found nearly all of the fruit had been heavily damaged or completely eaten by rats.

Greg called the other day to say that many of the *C. shipmanii* seeds had germinated and were growing well. If all goes well, seedlings from this plant will be out-planted on the Refuge to help stave off the threat of extinction.

As managers of the Hawaii's forest ecosystems, we all too often have to start with many parts of the great forest puzzle missing. Find a piece here, loose a piece there, but like an old puzzle, some of the pieces are gone forever. The rediscovery of *Cyanea shipmanii* means we may have saved another piece of the great forest puzzle, but, as all of us know, we've joined the game too late, it will never again be complete.

Do You Have a Green, or Purple, Thumb for Growing *Miconia*?

Victor Tanimoto, Entomologist
DOFAW, Honolulu Staff



Miconia calvescens

One of the most important tools we have in combating the invasion of alien plants into our native ecosystems is biocontrol. This often consists of finding an insect predator or disease that will reduce the reproduction of, or kill introduced weeds. Before any biocontrol agent is released, it must be rigorously tested to insure that after release it does not become another alien pest.

There may be innumerable possibilities awaiting us, but the first step is to determine if a potential biocontrol agent actually will eat or infect a target species. Right now we are looking for biocontrols for *Miconia*, a member of the melastoma family. We need very large numbers of *Miconia* plants—and this is where we need some help.

What we are interested in is methods of making *Miconia* seeds germinate and effective ways to root cuttings.

So if your purple passion is for blasting *Miconia* from Hawaii, and you have tricks for hastening seed germination or rooting *Miconia* cuttings—Please share them with us!

Send your ideas to Victor Tanimoto, Entomologist, Division of Forestry and Wildlife, 1151 Punchbowl St., Honolulu, HI 96813-3089; or call (808) 587-0166. Vic will see to it that you get proper recognition.

Heads of Forestry Meeting Held in Fiji

Carl T. Masaki, Forestry Program Manager
DOFAW, Honolulu Staff

Carl T. Masaki represented Hawaii at the 1993 Heads of Forestry Meeting during the week of 19-24 September 1993 in Nadi, Fiji. At this fourth annual Heads of Forestry meeting, fifty-four Heads of Forestry, including representatives from fourteen Pacific island states, territories, and countries met to discuss the topic "What value forests and trees?" Although Hawaii and Guam are not countries, their representatives are considered delegates representing Pacific countries and can vote and hold official positions within the organization. Other participants are observers and do not have voting rights.

After hearing country reports and agency statements, twenty-nine papers on the theme of the meeting were presented and discussed. A report on the observations and recommendations for each paper was made by the group. A field trip to view the efforts of a village to develop eco-tourism as a means to generate revenues from the forest was made on September 23. Pine and native forests were also seen enroute to the village. Eco-tourism is one of the many land uses that have been suggested for the leased Hamakua sugar cane lands that will be returned to the State.

Although presentations provide useful information, one of the most beneficial aspects of conferences is the meeting of one's counterparts from other states and countries to discuss issues of mutual concern. Every agency has fiscal constraints and needs to find means to stretch their dollars. Ideas and current operating methods were shared and discussed.

A particularly good example of the importance of this personal interaction was the discovery of *Clidemia hirta*, or Coster's curse, at the Fijian village. Mr. Masaki informed his Fijian counterpart that Hawaii is fielding a number of biological control agents for clidemia and could share this information with him.

Other areas of interest were the native Fijian land tenureship and gathering rights and how each village is trying to manage their resources more effectively. Since these are becoming issues in Hawaii, information on how Fiji handles them will help us in Hawaii as we deal with our own.

Hawaii is often looked to as the leader in threatened and endangered species management. Through these conferences we are provided with an opportunity to share our experiences in this area with other Pacific nations and territories.

Fire Prevention Partners Meet in Makawao

Glenn Shishido, Protection Forester
DOFAW, Maui District

Sparky the Dalmatian, a well known fire prevention mascot, joined forty-nine year old Smokey Bear, in a special appearance to spread the fire prevention message to an audience at the Fourth of July Parade in Makawao town on Maui.

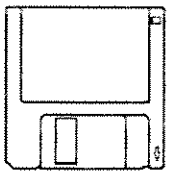
Smokey and Sparky were joined by thirteen enthusiastic western dressed pint sized supporters atop Mikioi, a vintage Maui County Department of Fire Control fire engine. Children and adults applauded their presence in the parade.

Partners In Prevention: Mikioi, Sparky, Smokey and fans

Wildlife Assistant John Medeiros and Firefighter Kirk Pocock of the Department of Fire Control decorated Mikioi late into the evening prior to the parade. Their decorative effort was appreciated by these prominent fire prevention experts.

Mikioi, itself, is a unique mascot of the Department of Fire Control. This 1945 engine no longer responds to alarms. She was rescued from the scrap heap by George Tavares. He refurbished Mikioi and donated her back to the Department. Her assignment now is to transport special guests of the Department at functions. She is proudly maintained by Pocock and County Firefighter George Andrade of the Makawao Fire Station.

GIS—The Technology Arrives at DOFAW/DLNR



Ronald Cannarella, RETS Forester
DOFAW, Honolulu Staff

GIS (geographical information system) is a technology which has promised much, but has so far been slow to deliver. For years, people have dreamed of combining the most powerful capabilities that computers have to offer—database functions, computer aided design (CAD), and the ability to store large amounts of information. Until recently, however, hardware and software had not been developed to a level to make GIS practical.

GIS is computerized mapping, plus a whole lot more. Spatial data (map data), and attribute data (table data) are entered into the system to create thematic "layers" of information. The State of Hawaii GIS database contains layers such as land use, administrative boundaries, roads, bird habitat, and soils information, to name only a few. Once developed, these layers can be combined as one would combine transparencies, to create composite maps. The output maps can be at virtually any scale, and are easily tailored to a variety of tasks.

Currently, the State's GIS is jointly operated and maintained by the Information and Communication Services Division (ICSD) of the Department of Budget and Finance, and the Office of State Planning (OSP). ICSD maintains the hardware and provides technical services, while OSP is responsible for development of the database and provides support to the growing community of users, including DLNR.

Several Divisions within DLNR are currently utilizing the State's GIS, which is conveniently located in the basement of the Kalanimoku building. Most active are the Division of Aquatic Resources (DAR), Division of Historic Preservation (DHP) and Division of Forestry and Wildlife (DOFAW).

All three divisions are finding innovative ways to use GIS to do things that were difficult or impossible to do previously. For example, DAR is using GIS to store and retrieve fisheries catch data. DHP is compiling various source maps to assist in the location of archaeological features such as fish ponds. DOFAW is using GIS to inventory forest plantations on the Big Island.

GIS took a significant step forward this month with the opening of the DLNR GIS lab. The GIS lab will be a cooperative effort, initially supported by the Fiscal Division and Division of Forestry and Wildlife. It is anticipated that other Divisions will join in as resources become available and the demand for GIS grows.

As the hardware and software become more powerful, GIS becomes easier to use. Those who know GIS feel that this technology will have the same kind of impact on resource management that the word processor and computer database have had on office organization.

Within a few years, administrators and resource managers will be able to pull up map images on their desktop computers, overlay thematic layers, and retrieve data such as timber volume, annual catch, and endangered species occurrences. And for those GIS skeptics who have been disappointed by the technology's ability to deliver so far, bear in mind the timeless adage: a picture is (still) worth a thousand words.

GIS for Hawaii's Rarest Taxa and Ecosystems Now Housed at Hawaii Heritage Program Office

Dwight Matsuwaki, GIS Coordinator
The Nature Conservancy of Hawaii, Honolulu

The Nature Conservancy's Hawaii Heritage Program has just added a powerful new tool in accomplishing its task of maintaining an extensive natural heritage database. Our new Geographic Information System (GIS) will relate to the HHP database files and produce map products and analyses for conservation in Hawaii.

Our Heritage database traditionally used USGS 1:24,000 scale quadrangles and hand-drawn maps in our reports to help fulfill information requests and other specialized services for public and private users.

Typically, the maps and database reports provide information on status and distribution of rare and endangered species.

The Hawaii Heritage Program will be using the GIS to assist in the precise mapping of the rare and endangered species, as well as speed up production of maps and analyses. We designed the system to be compatible with ARC/INFO and AutoCAD users with data requests, foremost of which are our State and USFWS colleagues.

The goal of the GIS is to efficiently assist those using biological resource information including Heritage data in land use planning decisions, as well as biological resource questions and management needs. Our GIS does not yet include some very basic layers critical to those land use planning goals.

We are working with the State to develop data sharing and layer update agreements. We are also looking into incorporating other sources of appropriate data. We are in the process of updating the Hawaii Heritage Program data layer—over 1,000 new or updated locations—representing the ongoing influx of biological information from the field over the last two years.

We invite all of our colleagues to come and see the new system. Contact Dwight Matsuwaki for an appointment at 537-4508.

Summer Interns Strike Again!

Pauline Sato, Environmental Education Coordinator
The Nature Conservancy of Hawaii, Honolulu

If you look back to your Fall 1992 issue of "Hawaii's Forests and Wildlife" you will see an article describing TNC's H.K.L. Castle Conservation Career Program: Hoa'aina, Stewards of the Land. This summer, we offered an expanded program and were fortunate to work with 10 bright, energetic, enthusiastic, and determined interns and a new teacher assistant.

One of the neat things about Hoa 'aina is that all of the interns are from Hawaii or going to school here—and they want to stay here.

Through direct participation, our interns learned about resource management problems and techniques that local conservation agencies and organizations use to solve these problems. The eight week program had the students work as a team on various projects all over the Islands, giving them exposure to natural communities that most students do not even know exist in Hawaii.

The interns worked on TNC's preserves on Oahu, Lanai, Molokai, and Maui; DOFAW's Natural Area Reserves on Oahu; NPS's Haleakala and Volcanoes National Parks; and USFWS' Hakalau Forest National Wildlife Refuge. They worked with the State Parks at Huiloa fishpond and DAR at Manoa Stream, and they visited numerous offices and labs such as those at Lyon Arboretum, UH's HEB program, NMFS, Sea Life Park, and DOA's Plant Quarantine Division.

As an added dimension, some days were spent focusing on Hawaiian culture and the environment. The interns learned about Hawaiian cultural values that are reflected in how the early Hawaiians related to their environment. Their teachers were respected cultural specialists such as those at the Cultural Learning Center at Kaala in Waianae Valley.

Hoa 'aina opened the interns' eyes to the wide range of jobs in the conservation field. "I knew there were environmental lawyers and researchers in the lab and in the field, but it didn't occur to me that there would be mappers, regional planners, directors of protection, fund-raisers, video people, artists, geographers, and just about any other career conceivable. There are even people who have a more cultural approach to conservation. The possibilities are endless." said J. D. Ho, a Williams College student.

The 1993 session of the H.K.L. Castle Conservation Career Program was made possible by major funding from the Harold K.L. Castle Foundation; and additional support from the National Fish & Wildlife Foundation, and the Samuel N. & Mary Castle Foundation, including in-kind support from our partners: DOFAW/DLNR, USFWS, NPS, DOE, EPA, Moanalua Gardens Foundation, and several other agencies and organizations.

TNC would like to thank all who gave their time, effort, and resources to participate in this program.

Kapua Kawelo, a student at U.C. Davis, leaves us with a feeling that we have really made a difference as she said, "I've decided definitely that conservation is where I want to be, the career for me. I really owe this decision to the Nature Conservancy, the Hoa 'aina internship, and to all the people we've talked with. Every one of them has made a lasting impression on me, I feel that I've found my calling."

The interns in this year's Hoa 'aina team, led by Pauline Sato and Kerriann Paracuelles, were: Keoni Fox, Aarin Gross, J.D. Ho, Kapua Kawelo, Erin Mendelson, Layne Napuelua, Rachel Ord, John Padre, Carilee Pang, and Elizabeth Stampe.

In a few years, we hope that these former interns will be knocking on our doors. Let's welcome them with open arms.

Iniki Update: Weeds Threaten Native Forests

Victor Tanimoto, Entomologist
DOFAW, Honolulu Staff

Since Hurricane Iniki struck Kauai in September 1992, the State Division of Forestry and Wildlife has been actively involved in obtaining recovery funds and assessing the biological damage there. We have been particularly concerned about the potential pest buildup in Kauai's forests as the result of hurricane damage.

In June 1993, the Division completed an assessment of the post-hurricane situation. Today, we are in the midst of conducting searches for biological and ecological information to formulate forest health enhancement options. After an action plan is written, we will be moving into an implementation mode.

As may well be expected, the assessment team and others in the Division believe that—all things considered—weeds present the most important immediate threat to the native forests on Kauai.

Weeds are usually specifically adapted to moving into ecologically disturbed areas—and that is just what Hurricane Iniki left on Kauai—hundreds of acres of broken native forest. Initially we will be focusing on them.

The U.S Forest Service's Institute of Pacific Island Forestry entomologist Rex Friesen is on special duty to DOFAW to develop and write the weed action plan.

Iniki recovery funds have been made available through Congress.

The Buck Stops Here

Michael G. Buck, Administrator
Division of Forestry and Wildlife

Forest Industry and Hawaii's Economy

Hawaii has a rich tradition in forest management. This has resulted in the 11th largest state-owned forest reserve system in the United States in addition to substantial acres of privately owned forest. Over 100 years ago, the relationship between our mauka watershed forests, water for development and agriculture, and a healthy economy were realized by the Hawaii Sugar Planter's Association. Upon their urging and direct involvement, partnerships between the Territory, private landowners, and the sugar industry resulted in the Nation's first forest reserve system. Hundreds of thousands of acres were fenced, wild cattle and other damaging animals removed, and millions of trees were planted. It is both ironic and appropriate that 100 years later as Hawaii's sugar industry is downsizing that we look again to Hawaii's forests and their relationship to Hawaii's economy.

In 1991, the forest industry in Hawaii contributed 26 million dollars and 736 jobs to Hawaii's economy. Its payroll exceeded 21 million dollars and the average salary was over $14/hour. This made the forest industry the 6th largest diversified agricultural industry in the State. The primary raw material is Hawaii's premier native hardwood, *Acacia koa*. Approximately 1 million board feet of koa was used, which represents the estimated equivalent of 600 acres of managed koa forest harvested per year.

The downsizing of Hawaii's sugar industry has created exciting potentials for commercial forestry. Many of the same attributes that made plantation sugar a viable industry are also conducive to commercial forestry. The Department of Land and Natural Resources has finished a preliminary scoping study for forestry potentials in Hawaii. We worked with Mr. John Groome, Executive Chairman of Groome Poyry Ltd., the largest forestry consultant company in the Pacific Asia region.

Groome reinforced the value of Hawaii's land asset for commercial forestry, especially its sugar land (Forestry Scoping Report, DLNR 1993). Hawaii's major advantages for forest investment are its political stability, ideal growing conditions, skilled workers with relatively easy transition of skills and machinery from the sugar industry, infrastructure (roads, ports, communication), research and development institutions, attractive living conditions, and easy access to both US and Pacific/Asia markets.

We have the opportunity to create a forest industry that is environmentally sustainable, and economically profitable for both the potential investor and the people of Hawaii. A desired forest industry should:

- employ a skilled local labor force with a meaningful wage rate;
- provide increased recreational opportunities for both our local citizens and our tourist industry;
- include a range of forest products that allow for a diversification of market options that are attractive and economically viable for both small and large landowners;
- develop an adequate forest resource base to support value added processing that increase jobs for Hawaii's local economy;
- utilize state of the art forest management technology that is both environmentally sensitive and sustainable; and
- be a model for tropical forest management that supports and attracts research and development opportunities.

There are four broad commercial forest management scenarios to consider in Hawaii: 1) short rotation (6-12 years) sustainable forest plantations, 2) long rotation (25-50 years) sustainable forest plantations, 3) afforestation of mauka pasture lands and enhancement of degraded native forests, and 4) agroforestry.

The majority of land under scenarios 1 and 2 would occur on former sugar lands or existing forest plantations in lower elevations. The majority of land under scenario 3 (natural forest management) would be in higher elevation pasture lands on former forest sites and revolve around *Acacia koa*, which is both commercially and ecologically valuable. Agroforestry could occur on all elevations in conjunction with farming and pasture use. A strategic mix of a short rotation crop (6-12 years) to recoup initial investments and help carry a longer rotation crop (25-50 years) of higher value hardwoods will probably be needed in the former sugar lands to attract needed outside investment.

One of the short term products recommended by Groome was laminated veneer plywood made from eucalyptus trees. The plywood is made of veneer sheets of wood laminated together and used for form wood to build concrete structures. This has been the primary use of the wood harvested from Asian rainforests, which may go down in history as one of the tragic misuses of primary tropical rainforests. The veneer process creates value and eliminates the wasteful use of high value tropical timbers. Other short rotation products include production of chips for export or value added products such as medium density particle board. The long term product would be higher value hardwoods such as mahogany, tropical maples and cedars, and our native *Acacia koa* which could support many value added opportunities in Hawaii such as fine furniture and assorted craftwood products.

Our efforts to date indicate that development of forestry industry is not only feasible but economically attractive enough to bring in outside investment monies. A forest investment prospectus is being prepared with the Department of Business and Economic Development, interested private landowners, and financial institutions. It will be available in early 1994 for potential investors. It will focus on Hamakua sugar lands, but addenda will address other potential areas around the State.

Hawaii's investment strategy should leverage its current availability of high quality agricultural land and existing forest resource to attract

(continued on page 20)

Forest Industry *(cont.)*

needed forestry investment, technology, and value-added processing. The State of Hawaii can positively influence forest industry development by using its own land to help create the forest resource. State and County incentives, such as deferring all or part of the annual rentals for the use of its land and reasonable property tax rates will also help create the forest resource. Although this may be of lessor importance to the corporate grower, it is essential to the individual or smaller forest grower. Other government assistance to encourage forest cooperatives of smaller landowners can help create the forest resource, provide public support for the industry, and create a healthy forest market climate.

Forest plantations should blend into the landscape. Fast growing short rotation "cropping type" plantations should be visually screened from public roads by slower growing higher value hardwoods. The existing forest in the numerous gorges that divide up the sugar fields should be extended by planting higher value hardwood buffer strips. These forests are harvested selectively which reduces visual impact and can provide quality walkways for recreational activities as well as habitat corridors for wildlife. Reforestation efforts in the mauka pasture lands and degraded forests will involve salvage harvesting, scarification to promote natural regeneration, fencing, weed control, and tree planting where needed. These forests should only be harvested selectively, maintaining a forest canopy for native birds, watershed enhancement, and recreational opportunities.

Forestry should not compete with other forms of higher value agriculture. Quality agricultural lands that are accessible to existing irrigation systems should be reserved for other diversified agricultural crops (e.g. taro, tropical fruits, ginger, nurseries, aquaculture). The commercial forestry potential, however, could compete with pasture as a land use. Agroforestry systems, which combine trees and pasture can help diversify and augment existing mauka pasture operations. In lands coming out of sugar production, analysis of benefit/cost, investment potential, and jobs created should be done to compare commercial forestry and pasture.

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Hunter Hotline: 587-0171 on Oahu
Outer islands call "Operator" and ask for "Enterprise 6315."

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