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GOVERNOR OF HAWAII



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In reply, please refer to:
REF: DOFAW

Mr. Les Segundo
Acting Director
Office of Environmental
and Quality Control
220 South King Street, 4th Floor
Honolulu, HI 96813

Dear Mr. Segundo,

Subject: Negative Declaration for Waikamoi Preserve Natural
Area Partnership Program, District of Makawao,
County of Maui, Hawaii; TMK: 2-3-05-4.

The Department of Land and Natural Resources, Division of
Forestry and Wildlife has reviewed and responded to the comments
during the 30-day public comment period which began on January
23, 1994. The agency has determined that this project will not
have significant environmental effect and has issued a negative
declaration. Please publish this notice in the April 8, 1994
OEQC Bulletin.

We have enclosed a completed OEQC Bulletin Publication Form
and four copies of the final EA.

Please contact Betsy Gagné at 587-0063 if you have any
questions.

Sincerely,

Michael G. Buck,
Administrator

1994-04-08-MA-*FEA-Waikamoi Preserve Natural Area Partnership*

APR - 8 1994

FINAL ENVIRONMENTAL ASSESSMENT
FOR WAIKAMOI PRESERVE
NATURAL AREA PARTNERSHIP

This document prepared pursuant to Chapter 343, HRS

March 28, 1994

Prepared by
The Nature Conservancy of Hawaii
Maui Project Office
P.O. Box 1716
Makawao, Hawaii 96768

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I. SUMMARY

CHAPTER 343, HAWAII REVISED STATUTES (HRS) ENVIRONMENTAL ASSESSMENT

Project Name: Waikamoi Preserve Natural Area Partnership

Proposing Agency / Applicant:
State of Hawaii
Department of Land and Natural Resources
Division of Forestry and Wildlife
1151 Punchbowl Street
Honolulu, Hawaii 96813

The Nature Conservancy of Hawaii
1116 Smith Street, Suite 201
Honolulu, Hawaii 96817

Approving Agency:
State of Hawaii
Department of Land and Natural Resources
Division of Forestry and Wildlife

Project Location:
Waikamoi Preserve, 5,230 acres in the District of Makawao, County of
Maui, State of Hawaii

<u>Tax Map Key</u>	<u>Acreage</u>
2-3-05-4	5,230

Agencies Consulted During EA Preparation:

Federal:

US Department of Interior/Haleakala National Park
US Department of Agriculture/ Soil Conservation Service—Maui District
US Fish & Wildlife Service
US Department of Agriculture/Animal Damage Control

State:

Aquatic and Wildlife Advisory Committee—Maui
DLNR/Aquatic Resources Division—Maui District
DLNR/ Division of Forestry & Wildlife—Maui District
DLNR/ Division of Land Management—Maui District
DLNR/ State Historic Preservation Division

County:

Planning Department—Maui County

Private:

Conservation Council for Hawaii
East Maui Irrigation Co.
Haleakala Ranch Company
Hawaii Audubon Society
Humane Society of Hawaii
Keola Hana Maui, Inc.
Native Hawaiian Advisory Council
Native Hawaiian Legal Corporation
Natural Resources Defense Council
Sierra Club Legal Defense Fund
Sierra Club/ Maui Group

II. PROJECT DESCRIPTION

Waikamoi Preserve was established in 1983 through a perpetual conservation easement with the landowner, Haleakala Ranch Company. The primary goal of this project is to maintain the preserve's native ecosystems and protect the area's rare plants and animals. Previous management work was approved by, and conducted in accordance with, Conservation District Use Permit number SH-2028A.

SUMMARY DESCRIPTION OF THE AFFECTED ENVIRONMENT

Location

The 5,230-acre Waikamoi Preserve is in East Maui, west of the state's 7,500-acre Hanawi Natural Area Reserve (NAR). Its southern boundary adjoins Haleakala National Park (HALE). These managed areas, together with other state and private lands on the northeast slopes of Haleakala, represent one of the largest intact native areas in the state, comprising more than 100,000 acres (Figure 1). The Conservancy has cooperative agreements with several of its public and private neighbors to undertake joint management projects in areas adjacent to Waikamoi.

Native Natural Communities

Fourteen vegetated native natural communities are represented in Waikamoi Preserve. These communities vary from lowland shrublands to subalpine forests. Two of the communities are considered rare. They are *Deschampsia nubigena* Subalpine Mesic Grassland and Mamane (*Sophora chrysophylla*) Subalpine Dry Forest (Figure 2; also see Appendix 1).

Waikamoi Preserve also contains the upper reaches of many large streams (including Waikamoi and Honomanu Streams) and numerous tributaries. The preserve's streams are classified as Hawaiian Intermittent Streams because they are discontinuous (the water in these streams is harvested below the preserve) and, hence, do not contain the suite of native diadromous animals (e.g., 'o'opu, 'opae, hihiwai) characteristic of perennial streams in Hawaii. The Hawaiian Intermittent Stream community is not considered rare.

In addition to vegetated and aquatic communities, Waikamoi contains several examples of two rare subterranean communities: Uncharacterized Montane Lava Tube and Uncharacterized Subalpine Lava Tube. Both are classified as "uncharacterized" because they have not yet been inventoried by cave biologists. However, similar lava tubes in HALE contain native cave invertebrates.

Figure 1
Location of Waikamoi Preserve

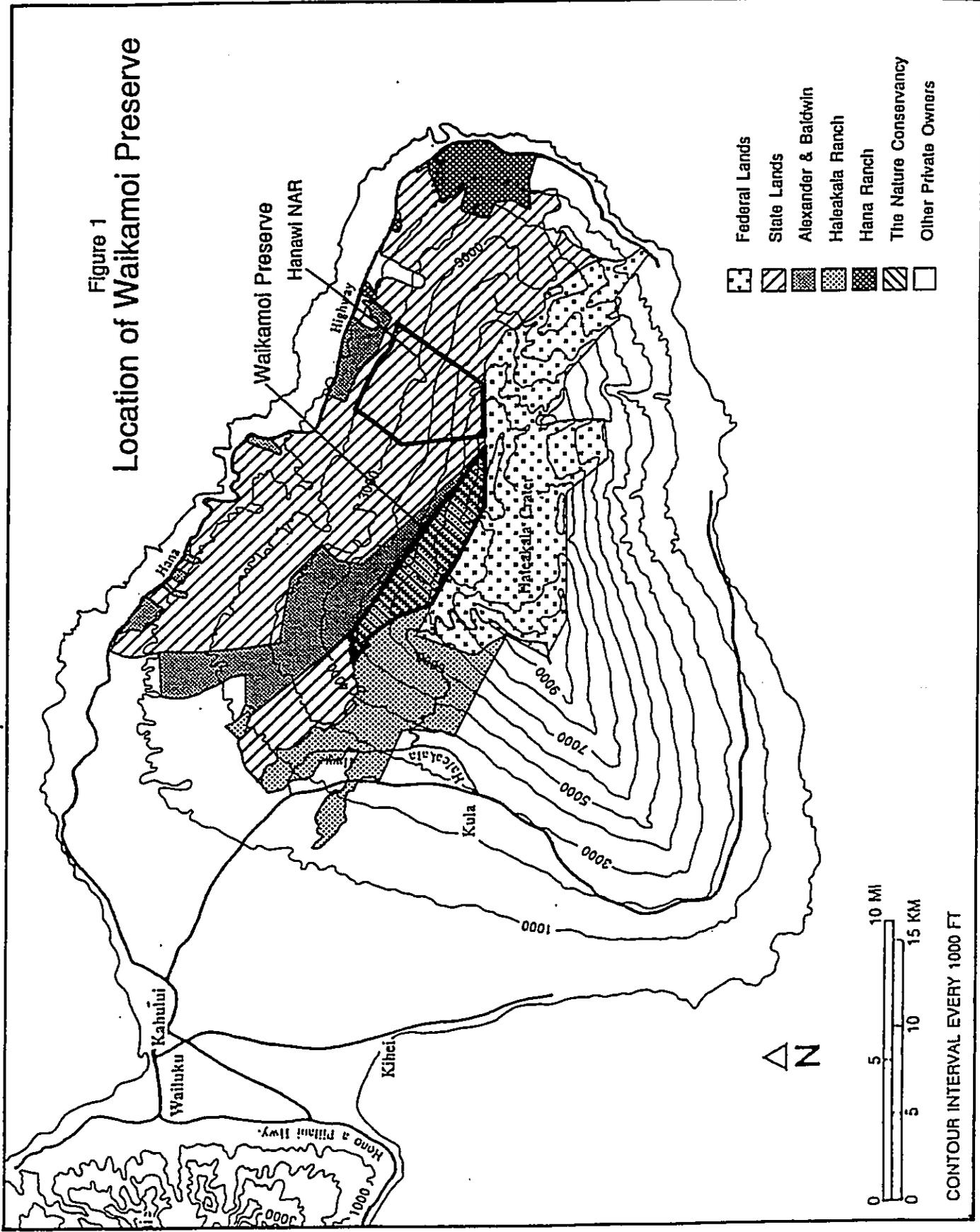
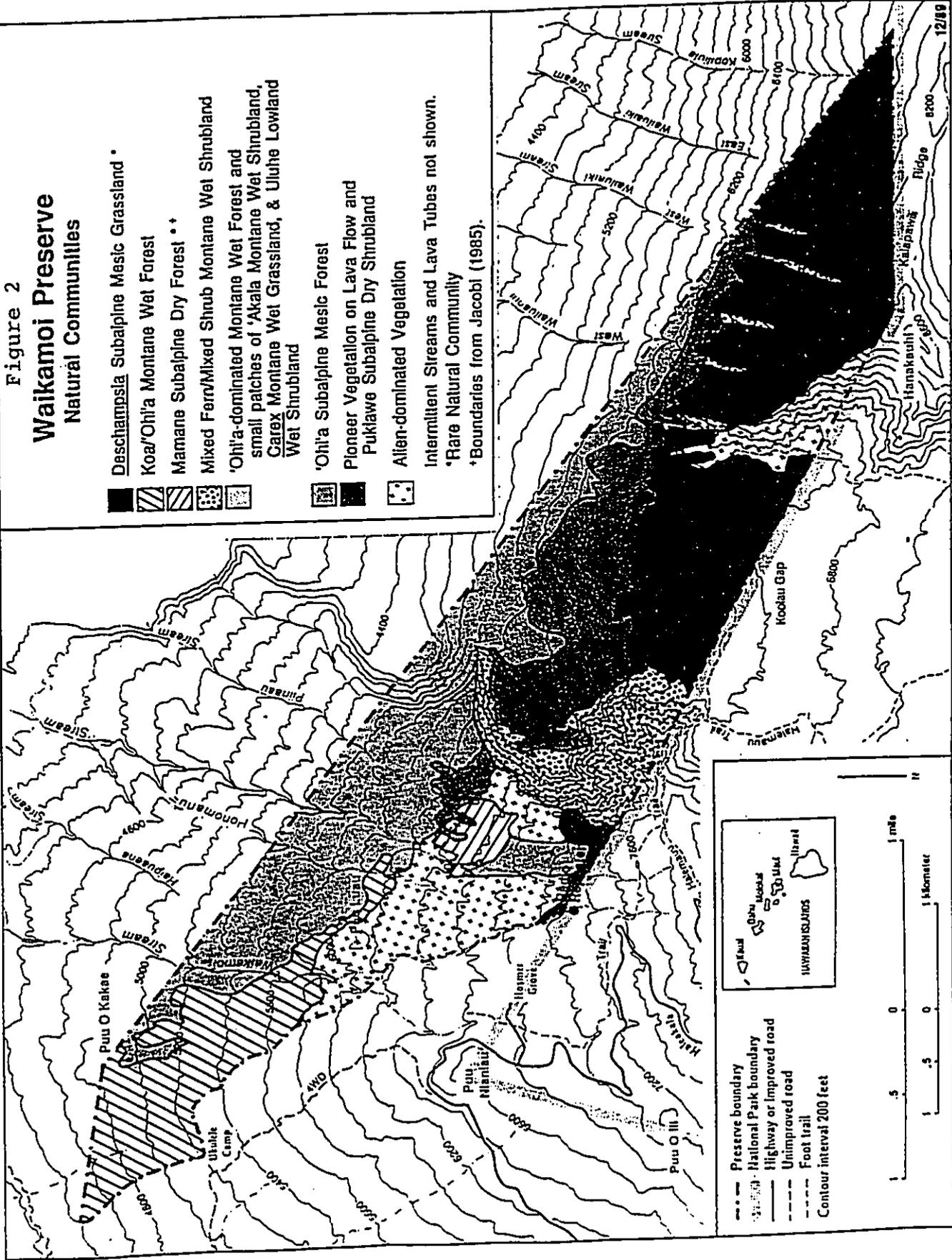


Figure 2

Waikamoi Preserve Natural Communities

-  *Deschampsia* Subalpine Mesic Grassland *
-  Koa/'Ohia' Montane Wet Forest
-  Mamane Subalpine Dry Forest **
-  Mixed Fern/Mixed Shrub Montane Wet Shrubland
-  'Ohia'-dominated Montane Wet Forest and small patches of 'Akala Montane Wet Shrubland, Carex Montane Wet Grassland, & Uluhe Lowland Wet Shrubland
-  'Ohia' Subalpine Mesic Forest
-  Pioneer Vegetation on Lava Flow and Puklawa Subalpine Dry Shrubland
-  Alien-dominated Vegetation
-  Intermittent Streams and Lava Tubes not shown.
-  *Rare Natural Community
-  **Boundaries from Jacobi (1985).



Native Flora

To date, 22 rare plants have been reported in Waikamoi Preserve, 6 of which are endemic to East Maui (Appendix 2). The rare plants include the federally listed endangered silversword (*Argyroxiphium sandwicense* ssp. *macrocephalum*) and hinahina (*Geranium multiflorum*).

Native Fauna

Vertebrates

Thirteen native birds have been reported from Waikamoi Preserve, and of those, eight are federally listed as endangered: the crested honeycreeper ('akohekohe), Maui parrotbill, Maui 'akepa, po'ouli (sighting unconfirmed), dark-rumped petrel, nene, Maui nukupu'u, and 'o'u (now considered extinct on Maui) (Appendix 3). Five common native birds found in the preserve are 'apapane, 'i'iwi, 'amakihi, pueo, and the Maui creeper. The endangered Hawaiian hoary bat is also known from the preserve. No native diadromous fishes are known from Waikamoi (both stream diversion and the high elevation make this unlikely).

Invertebrates

Terrestrial arthropods include some of the most diverse taxonomic groups at Waikamoi, and are known to perform important ecosystem functions. These functions include pollinating native plants and serving as a food resource for insect-eating forest birds. However, most of Waikamoi's terrestrial invertebrate species have not been studied and are not well documented.

Waikamoi's aquatic invertebrates are also poorly understood. It is unlikely that native diadromous crustaceans and mollusks would be found in intermittent streams and at such high elevations; however, native aquatic insects are almost certainly present. We plan to improve both monitoring and research for the preserve's invertebrates in the coming years.

Historical/Archaeological and Cultural Sites

Most archaeological and historical sites in Hawaii occur at low elevations. In higher areas such as Waikamoi Preserve, trails and/or temporary shelters might be expected. According to records at the State Historic Preservation Division (SHP), no archaeological surveys have been conducted at Waikamoi Preserve, so the presence or absence of historical sites has not been determined. A survey of pre-1930 maps at the SHP office in Honolulu indicated that there are two long-established trails in the preserve (Waikau and Ainahou) that might have nearby potential prehistoric or historic sites. The survey also identified one site with potential historic significance, Waikau Cabin. This structure, which burned down many years ago, was built by the Civilian

Conservation Corps in the 1930s. Its ruins are in the "50-year or older" category for historic site consideration. Therefore, the Conservancy will have the site checked by qualified archaeologists before doing anything at that site that would disturb the ground. No other records indicating additional sites with potential historic significance were located.

Conservancy and DOFAW staff consulted with SHP staff to ensure that the full scope of proposed activities was known to SHP. SHP concurs that the proposed project appears to involve minimal ground disturbance. However, SHP staff recommended that preserve staff contact them prior to any major site disturbance. In the long term, the proposed management activities should provide protection for historical resources by eliminating disturbance from ungulates.

Adjacent Natural Resources

Waikamoi Preserve is adjacent to three other large natural areas that are actively managed: HALE, the state's forest reserve, and Hanawi NAR. These managed areas, together with other private lands on the northeast slopes of Haleakala, represent one of the largest intact native areas in the state, comprising more than 100,000 acres. The East Maui watershed region is the largest single source of harvested surface water in the state with an average harvested flow of 60 billion gallons per year.

Eight of the 14 vegetated native natural communities found in Waikamoi Preserve, including the rare *Deschampsia nubigena* Subalpine Mesic Grassland, are also found in Hanawi NAR (Appendix 1). Of the 22 rare plants found in Waikamoi, 6 are known from the Hanawi NAR (Appendix 2). Six of the eight endangered bird species listed earlier are also found in Hanawi NAR (Appendix 3). The majority of the preserve's rare elements are also known from HALE, and many are known from other adjacent areas.

Sensitive Habitats

The habitats and resources listed above and in the appendices are regarded as sensitive and are found both within and adjacent to Waikamoi Preserve. The intent of all proposed management activities is to provide long-term protection to these habitats and resources. Potential negative effects of management activities such as introduction of new weeds along newly constructed fences, trails, or monitoring transects are recognized, and standard precautions will be taken to minimize the risks. Management activities that affect adjacent sensitive habitats in Hanawi NAR, HALE, or on privately owned lands will be coordinated with appropriate staff from these organizations to reduce any potential negative impacts.

GENERAL DESCRIPTION OF THE ACTION'S TECHNICAL, SOCIO-ECONOMIC AND ENVIRONMENTAL CHARACTERISTICS

Technical

Management Considerations

This project is long term, consisting of several different phases. The primary goal is to maintain native ecosystems and protect the habitat of rare plants and animals in the designated area.

This section describes specific management strategies that will be undertaken to maintain and enhance the native ecosystems and species of Waikamoi Preserve. To facilitate management, six management units have been defined (see discussion on page 10). The Nature Conservancy of Hawaii will be responsible for the completion of the management work. These management strategies are shaped by the following considerations.

1. Waikamoi Preserve was established in 1983 when The Conservancy received a permanent conservation easement over the property from the landowner, Haleakala Ranch Company. This easement ensures the Conservancy's perpetual rights to manage the preserve for the benefit of native species and ecosystems, and to prohibit a wide range of potentially unsuitable activities by the landowner. The document also reserves certain rights for the landowner, including the right to enter and inspect, to hunt so long as game animals are present and such hunting does not interfere with the Conservancy's work, and to harvest surface water from the established water development systems, which may be expanded within clear limits described in the easement.

The Conservancy and the Ranch have also entered into a license agreement with East Maui Irrigation Co. (EMI) to allow the Conservancy to conduct certain management activities within EMI property adjacent to the legal boundary with the preserve. This agreement prevents forest protection from being unduly constrained by parcel boundaries, enabling field staff some flexibility to take advantage of topography and other natural conditions. Agreements with the National Park Service support collaboration on management activities (e.g., fencing, hunting, safety) that benefit HALE and the preserve. An agreement with the state Department of Land and Natural Resources supports teamwork on wildfire suppression. The Conservancy is also a signatory to the East Maui Watershed Partnership agreement, which recognizes the intent of the major landowners, land managers, and the County of Maui to cooperate to ensure the protection of windward East Maui's upland watershed as an important source of water. This partnership is focused on pooling expertise and resources to provide

the best available management for the forests and upland ecosystems within this 100,000-acre area.

2. The primary strategy for protection of Waikamoi Preserve is to reduce damage to native vegetation and soils by removing all non-native ungulates (hoofed animals). Through the Conservancy's management activities, high levels of feral pig and goat damage in the roughly 2-square-mile management unit 5 have been dramatically reduced and held at very low levels for the past 3 years. Similar success has been achieved more recently in other management units. Feral goat numbers in Waikamoi have been reduced from several thousand to fewer than 12 through the efforts of HALE and the Conservancy. These last remaining feral goats must be removed and efforts maintained to detect any new animals that might enter the preserve (including axis deer).
3. Waikamoi's 5,230 acres are dominated by native species, with the exception of about 800 acres of introduced pines (*Pinus* spp.) adjacent to the HALE's Hosmer Grove area. Management activities will focus on removing the most destructive non-native weed species preserve-wide, including gorse (*Ulex europaeus*), kahili ginger (*Hedychium gardnerianum*), invasive pines, and blackberry (*Rubus argutus*). These are the plants that pose the greatest long-term threat to Waikamoi at this time.
4. A primary management objective is to *prevent* the further introduction or spread of damaging non-native species. Special care must be taken to avoid negative side-effects of management activities. For example, all personal and field equipment is carefully cleaned to remove weed seeds or insects to prevent inadvertent introductions into pristine areas.

Much of Waikamoi is remote and relatively inaccessible by foot. Therefore, most management activities must be supported by helicopter. For the most part, field staff will fly to one of three existing remote camps and work for 3 to 5 days at a time. This strategy will minimize the inadvertent introduction of destructive alien species by reducing foot traffic from alien-infested areas, and will minimize injuries to field staff.

5. As long as ungulates remain in the preserve, volunteer hunting will be allowed on a limited basis. Specifically, state-licensed public hunters who request access for a certain date will be allowed to hunt in the company of a staff person under three conditions: 1) if Conservancy staff have a scheduled working trip to Waikamoi for the day requested, 2) if hunting activities will not interfere with other scheduled management activities or Haleakala Ranch employee hunting, and 3) if hunters agree to follow the Conservancy's rules and guidelines, including completing a liability waiver and a Conservancy volunteer application.

Management Units

Waikamoi is managed in six units (Figure 3). The units are defined by topographic and legal boundaries, similarity of natural community types, and threats. Topographic features and legal boundaries determined the placement of fences built by the Conservancy and HALE. The Conservancy's fences tie into the HALE fence at Puu Nianiau and Waikamoi's easternmost tip, and extend downward in elevation. Cooperative agreements with HALE, Haleakala Ranch, and EMI allow the Conservancy to work outside the preserve boundaries on specified projects.

Unit 1A

Unit 1A is the westernmost portion of the preserve and the lowest in elevation. Ranging from 4,400 feet to nearly 6,000 feet elevation, it is primarily comprised of Koa/'Ohi'a (*Acacia koa*/*Metrosideros polymorpha*) Montane Wet Forest. This is one of the most accessible units, and ungulate management has been limited to Haleakala Ranch employee, volunteer, and contract hunting. It currently contains some of the highest pig activity in the preserve. The unit is entirely fenced except for the eastern boundary, which is formed by the very steep Waikamoi gulch. Nearly half the unit's western boundary is bordered by Haleakala Ranch pasture. Unit 1A contains localized infestations of kahili ginger, blackberry, tropical ash (*Fraxinus uhdei*), gorse, *Eucalyptus* species, and pasture grasses.

Unit 1B

Unit 1B ranges from 5,200 feet to 6,200 feet elevation and is primarily 'Ohi'a Montane Wet Forest with small patches of 'Akala (*Rubus hawaiiensis*) Montane Wet Shrubland, *Carex* Montane Wet Grassland, and Uluhe (*Dicranopteris*) Lowland Wet Shrubland. A 0.5-mile fence has been built along a portion of the unit's lower northwest boundary to prevent ungulate ingress from EMI lands below. This unit contains breeding populations of Maui parrotbill and 'akohekohe, and has been the site of several forest bird research projects. The upper boundary is bordered by conifers and other alien vegetation. This unit contains small patches of blackberry, ginger, eucalyptus, and conifers.

Unit 2

Unit 2, below HALE's Hosmer Grove, is primarily dominated by dense stands of various species of conifers. Sprinkled throughout the conifers are many patches of gorse and blackwood acacia (*Acacia melanoxylon*). The vast majority of gorse has already been treated, and only seedlings and occasional regrowth remain. The understory is comprised of velvet grass (*Holcus lanatus*) and other alien grasses, with a few native shrubs and ferns. However, the gulches that cross this unit are often dominated by native vegetation. There is also a small degraded patch of rare Mamane (*Sophora chrysophylla*) Subalpine Dry Forest near the center of this unit. Unit 2 once had high

levels of pig activity; however, regular hunting has greatly reduced this threat. Many of our educational hikes are led in this unit.

Unit 3

Unit 3 is comprised of 'Ohi'a Subalpine Mesic Forest in its upper areas; the lower area is predominately 'Ohi'a Montane Wet Forest. This unit contains many rare plants and birds. A small portion of this unit, along the Ainahou pali, was once used for summer pasture by Haleakala Ranch. This formerly grazed area is infested with blackberry and pasture grasses. Formerly high levels of ungulate damage have been reduced; however, pigs routinely move into this unit from Koolau Gap (outside the preserve).

Unit 4

Unit 4 is comprised primarily of pioneer vegetation on lava flows and Pukiawe (*Styphelia tameiameia*) Subalpine Dry Shrubland. The ground is predominately 'a'a and pahoehoe lavas. HALE's fence crosses Koolau Gap and forms unit 4's north boundary and divides it from the rest of the preserve. Unit 4 has very low pig activity and scattered patches of alien grasses.

Unit 5

Unit 5 is comprised of 'Ohi'a Montane Wet Forest in its lower portions. The larger upper portion is Pukiawe Subalpine Dry Shrubland, with a narrow band of *Deschampsia nubigena* Subalpine Mesic Grassland along the southern boundary below Hanakauhi. This unit extends from 5,600 feet to nearly 8,600 feet elevation, and contains potential habitat for an extremely rare forest bird, the po'ouli. Management activities have reduced the formerly heavy impact of goats and pigs in this unit. This unit contains large patches of blackberry in the easternmost areas.

Management Goals

The management programs that follow are listed in order of priority for the next 6 years of work. Each program goal is followed by a brief description of program strategies, and how we foresee these strategies changing over the next 6 years. A timetable is provided for each program.

Though each program is described separately, together they form an integrated management approach. Management priorities are focused on removing ungulates and habitat-modifying weeds. In addition, we have established a comprehensive network of management trails, and monitoring stations throughout the preserve. This system will continue to be maintained and expanded where needed to support management activities.

In addition to threat abatement, we have begun a more proactive program to protect the rare native birds for which Waikamoi was established. A jointly funded research

program on the biology and ecology of five native forest birds has been undertaken in Waikamoi. Funding for this research has been committed by the state Division of Forestry and Wildlife, the U.S. Fish and Wildlife Service (USFWS), and The Nature Conservancy. We will continue to support this research under new project leadership from the USFWS and the National Biological Survey.

Because no rare aquatic natural communities, plants, or animals are known from Waikamoi, the Conservancy does not currently monitor or directly manage aquatic communities or taxa. However, management targeted at the preserve's rare terrestrial resources will indirectly benefit aquatic resources. For example, successful ungulate and weed control programs will decrease erosion and its subsequent siltation of streams. Controlling ungulates is also expected to improve water quality by lowering the potential for bacterial coliform and leptospirosis in the water. Finally, management that improves the health of native terrestrial communities will also promote a more stable water regime by reducing the potential for rapid runoff.

Non-Native Species Control Programs

Ungulate Control

Program Goal: To remove all ungulates from Waikamoi, and prevent future invasion.

The Waikamoi ungulate control program focuses on feral pig control because 1) the impacts of pigs can be severe and long-lasting (e.g., extinction of plant or invertebrate populations, loss of soil and, via erosion, dispersal of habitat-modifying weeds), and 2) pigs occupy the entire preserve and, at the outset of our program, were severely impacting large areas of high-quality native habitat. The effectiveness of pig control efforts is gauged by monitoring a preserve-wide network of 29 transects (see Figure 3), utilizing standard monitoring methodology developed by the National Park Service. At the outset of monitoring in 1988-89, 60 percent of the 1,450 stations on these transects showed some indication of pig activity.

The ungulate control program utilizes a combination of fencing, hunting, and snaring to bring pig and goat populations down as rapidly as possible and prevent them from re-establishing. Wherever the terrain permits, management units are fenced to minimize the number of feral animals that must be removed to protect the forest. Wherever possible, hunting is the preferred method of animal removal. Snares are utilized only in areas that cannot be accessed readily enough and thoroughly enough to effectively control feral animals by hunting. The use of snares in remote areas also reduces impact on fragile understory vegetation by field staff by minimizing their presence, and reduces staff exposure to injury in this extremely rugged, wet terrain.

In units 1A and 2 we have implemented and maintained a volunteer and contract hunting program. The program has been very successful in unit 2; however, unit 1A remains the one area of the preserve with unacceptable levels of pig damage. During the next 6 years, we will continue to improve our hunting program by increasing the

number of scheduled hunting trips, and recruiting the best hunting teams. In addition, we will increase funding for the purchase, training, and care of well-trained hunting dogs. The ungulate control program will be monitored by collecting pig sign data along the existing network of 29 transects semi-annually, and by contracting a helicopter equipped with a Forward Looking Infra-red (FLIR) camera to locate ungulates in open areas of the preserve. Annual FLIR overflights will help the Conservancy to identify and respond to new ungulate threats to the preserve.

In portions of units 1B, 3 and 5, snares have sharply reduced pig activity. In unit 5, which has been managed for the longest period, pig activity has been reduced from 66 percent in December 1988 to the current level of 3 percent. Recovery of vegetation has been dramatic. This level of protection is now being maintained; only one animal per month is captured in snares in this 1,200-acre unit. Data from Units 3 and 1B where snaring has been in use for a shorter period indicate that similar results are achievable.

Our objective is to utilize snaring only where no other method is available to safely and effectively protect the forest. Meanwhile, the Conservancy is working to reduce the need for snares by investing in additional fencing, improving the capability of our hunting program, and working with other colleagues to accelerate the development of additional control methods that can protect the forest as effectively and humanely as possible. Waikamoi staff will participate in this research effort.

We are also testing the feasibility of radio telemetry snares that would allow us to quickly dispatch captured pigs. When a pig is captured, a signal would be sent through our existing radio system, revealing the location of the captured animal. Staff would then travel to that location and remove the animal. If radio telemetry snares prove effective and practical, we will retrofit the snaring network with this technology.

Goats have been reduced from several thousand to less than 12 animals over the past 6 years through organized hunts. Goats also occasionally jump the fence from HALE's crater district into Waikamoi. Under a Memorandum of Understanding between HALE and the Conservancy, cooperative management projects are undertaken that benefit both areas. HALE undertakes aerial hunts to control goats and includes Waikamoi on these hunts; the Conservancy pays for the helicopter time spent hunting in Waikamoi.

In addition to active control methods, strategic fences will be built where needed, and existing boundary fences will be maintained. During 1994, we expect to complete an additional 0.75 mile of strategic fencing along the unit 1B lower boundary that will link the existing Waikamoi fence from unit 1A to Honomanu gulch. This fence will protect an important breeding area for the Maui parrotbill and 'akohekohe in Waikamoi Preserve.

Many land managers and researchers in Hawaii have recommended fencing the entire preserve. We have proceeded in this direction by completing over 6 miles of new fence along the lower and western boundary to supplement HALE's 9 miles of fence along the upper boundary. However, approximately 8 miles of fence still needs to be built,

through very rugged, wet, and remote terrain, to completely enclose Waikamoi Preserve. The cost of such a project would be at least \$400,000, and the existing legal Waikamoi Preserve lower boundary is not the most strategic location for this fence. Adjacent state and EMI lands contain high quality native forest that would be impacted if a fence were constructed without effective ungulate control below the new fence.

The East Maui Watershed Partnership (EMWP) may acquire funds to fence the upper elevation areas of the East Maui watershed region from Hanawi, across Hana Mountain and Koolau Gap, to the existing Waikamoi Flume area while maintaining active control programs on both sides of the fence. Such a strategy provides maximum protection for the remote upper elevation forests. However, if the EMWP cannot obtain funding to pursue this project by the end of December 1994, the Conservancy may seek a one-time supplemental funding package from the Natural Area Partnership Program to fund this project. Fence construction would then be contracted out to the most qualified and competitive bidder.

In the past few years, axis deer have greatly expanded their range on Maui to include areas immediately adjacent to Waikamoi Preserve. Control efforts for axis deer will probably be needed in the near future to protect the preserve's resources. Meanwhile, we will continue to monitor for their presence within and adjacent to the preserve. Axis deer may soon become the most important ungulate threat to East Maui's natural areas. Cooperative interagency and private efforts are needed for successful long-term control of axis deer on Maui.

Ungulate Control Timeline

Year 1

- * Complete fence to west Honomanu Stream (begun in early 1994).
- * Maintain boundary and strategic fences and identify areas for new fences.
- * Continue and improve volunteer and contract hunting program in units 1A and 2 by completing a minimum of 24 hunts.
- * Enhance pig hunting capability through improving hunting dog breeds and animal husbandry practices of volunteer, contract, and/or staff hunters.
- * Maintain existing snares through routine checking; replace if damaged; remove where possible.
- * Begin upgrading snaring network with radio telemetry, if feasible.
- * Re-monitor existing network of 29 ungulate transects semi-annually.
- * Complete one ungulate FLIR census overflight for goats, pigs, and axis deer.
- * Support HALE aerial hunting program by contributing 7 hours of helicopter time.
- * Monitor axis deer populations adjacent to Waikamoi.
- * Assist East Maui Watershed Partnership with cooperative ungulate control efforts; promote upper watershed ungulate fence.

Year 2

- * Maintain boundary and strategic fences and identify areas for new fences.

- * Continue and improve volunteer and contract hunting program in units 1A and 2 by completing a minimum of 24 hunts.
- * Enhance pig hunting capability through improving hunting dog breeds and animal husbandry practices of volunteer, contract, and/or staff hunters.
- * Maintain existing snares through routine checking; replace if damaged; remove where possible.
- * Continue upgrading snaring network with radio telemetry.
- * Re-monitor existing network of 29 ungulate transects semi-annually.
- * Complete one ungulate FLIR census overflight for goats, pigs, and axis deer.
- * Support HALE aerial hunting program by contributing 7 hours of helicopter time.
- * Monitor axis deer populations adjacent to Waikamoi.
- * Assist East Maui Watershed Partnership with cooperative ungulate control efforts; promote upper watershed ungulate fence.

Years 3 & 4

- * Maintain boundary and strategic fences and identify areas for new fences.
- * Continue and improve volunteer and contract hunting program in units 1A and 2 by completing a minimum of 24 hunts; expand program to other units, if feasible.
- * Enhance pig hunting capability through improving hunting dog breeds and animal husbandry practices of volunteer, contract, and/or staff hunters.
- * Maintain existing snares through routine checking; replace if damaged; remove where possible.
- * Continue upgrading snaring network with radio telemetry.
- * Re-monitor existing network of 29 ungulate transects semi-annually.
- * Complete one ungulate FLIR census overflight for goats, pigs, and axis deer.
- * Support HALE aerial hunting program by contributing 7 hours of helicopter time.
- * Monitor axis deer populations adjacent to Waikamoi.
- * Assist East Maui Watershed Partnership with cooperative ungulate control efforts.

Years 5 & 6

- * Maintain boundary and strategic fences and identify areas for new fences.
- * Continue and improve volunteer and contract hunting program in units 1A and 2 by completing a minimum of 24 hunts; continue to expand program to other units.
- * Enhance pig hunting capability through improving hunting dog breeds and animal husbandry practices of volunteer, contract, and/or staff hunters.
- * Maintain existing snares through routine checking; replace if damaged; remove where possible.
- * Continue upgrading snaring network with radio telemetry.
- * Re-monitor existing network of 29 ungulate transects semi-annually.
- * Complete one ungulate FLIR census overflight for goats, pigs, and axis deer.

- * Support HALE aerial hunting program by contributing 7 hours of helicopter time.
- * Monitor axis deer populations adjacent to Waikamoi.
- * Assist East Maui Watershed Partnership with cooperative ungulate control efforts.

Weed Control

Program Goal: To control habitat-modifying weeds in the preserve and prevent the introduction or spread of problem weeds to areas where they are not currently established.

The emphasis of our weed control program is to reduce current infestations of the worst habitat-modifying weed species at Waikamoi. Of the weeds already established in the preserve, many are shade intolerant and pose no major problem, if the native forest canopy and ground cover remain intact. There are other alien plants, however, that have demonstrated the ability to displace native vegetation over large areas; these habitat-modifying weeds are considered "priority weeds" for management (Appendix 4).

In some cases, our control programs strive to prevent any further spread of a priority weed, while in others, we will attempt complete elimination. Weed control strategies will be based on the degree of threat for a particular priority weed, and the potential for successful, cost effective control. We will also strive to prevent the introduction of additional alien plants, especially those that pose a great threat to the preserve. For example, banana poka (*Passiflora mollissima*) could cause severe damage to the forest if it becomes established. Strict procedures to remove weed seeds from equipment and clothing before entering the preserve will be enforced (see Appendix 5).

Weeds are controlled manually (by pulling or cutting), chemically (using herbicide), or with a combination of manual and chemical control methods. Herbicide use is strictly limited, and in full compliance with the state Department of Agriculture's pesticide branch. (Weed control staff are licensed by the state Department of Agriculture's pesticide branch.) The most commonly used herbicides used are Garlon 3A and Roundup, usually at a concentration of 2 percent or less. Very small quantities are used. Occasionally, staff may employ additional chemicals as appropriate, under the direction of the state Department of Agriculture's pesticide branch.

Gorse patches are scattered throughout roughly 400 acres of unit 2. All mapped gorse colonies have been successfully treated. Current emphasis is on monitoring and controlling seedling recruitment, as well as any regrowth. Several tons of kahili ginger were dug up and bagged in units 1A and 1B. As complete control of all seed-bearing populations nears, efforts will shift to treatment of seedlings and updating maps. Recruitment (germination and growth of new plants) is likely to be caused by birds spreading seeds from lands below. We plan to work with the EMWP to control kahili ginger below the preserve. Blackberry is currently dispersed throughout the preserve,

but especially well established in subalpine shrubland habitat (units 2, 3, and 5). In these units, established canes threaten to alter this native community through expansion and increased densities. Conservancy staff are currently treating large pilot control plots. The blackberry control program will be expanded as these treatment plots clearly indicate measurable effectiveness. Blackberry control efforts will be coordinated with HALE and the state through the EMWP; this weed poses a similar threat to both agencies in similar native habitats.

Our strategy for other priority weeds including pines, blackwood acacia, and eucalyptus is to control infestations as needed to prevent expansion from their current ranges. Isolated pockets of eucalyptus in unit 1B will be completely eliminated. Field staff will continue to re-treat tropical ash as needed until all populations are removed from unit 1A. Alien species prevention procedures will also be adhered to and improved. Weed maps for all priority weeds will be updated as needed and detailed records of all treatment programs will be maintained.

The Conservancy will support marijuana eradication enforcement in the preserve by contributing helicopter time to the state's Division of Conservation and Resources (DOCARE) every year.

Weed Control Timetable

Year 1

- * Re-treat all gorse populations in Waikamoi as needed and monitor recruitment.
- * Dig and remove remaining kahili ginger populations while continuing to scout, map, and control smaller outlying populations.
- * Expand blackberry pilot control in unit 2 shrublands and evaluate effectiveness.
- * Continue removing pine outliers from unit 2 shrubland.
- * Re-treat tropical ash in unit 1A and monitor and treat recruitment.
- * Treat blackwood acacia outliers in unit 2 shrublands, develop strategy to prevent range expansion.
- * Treat eucalyptus outliers in unit 1B native forest.
- * Monitor presence and absence of weed species on existing 29 ungulate transects annually.
- * Continue to implement and improve protocol for prevention of alien species introduction.
- * Support DOCARE for marijuana overflights and enforcement.

Year 2

- * Monitor and treat gorse recruitment in unit 2; map gorse on Haleakala ranchland within 100 meters of unit 1A.
- * Control kahili ginger recruitment in units 1A and 1B; map kahili ginger on the state land within 100 meters of unit 1A fence.
- * Expand blackberry pilot control in unit 2 shrublands.
- * Continue removing pine outliers from unit 2 shrubland.
- * Re-treat tropical ash in unit 1A and monitor and treat recruitment.

- * Treat blackwood acacia outliers in unit 2 shrublands and hold at current range.
- * Treat eucalyptus outliers in unit 1B native forest.
- * Monitor presence and absence of weed species on existing 29 ungulate transects annually.
- * Continue to implement and improve protocol for prevention of alien species introduction.
- * Support DOCARE for marijuana overflights and enforcement.

Years 3 & 4

- * Re-treat all gorse populations in Waikamoi as needed and monitor recruitment; begin removing gorse populations on adjacent ranchland within 50 meters of preserve.
- * Control kahili ginger recruitment in units 1A and 1B; begin controlling ginger within 50 meters below unit 1A fence.
- * Complete blackberry pilot control in unit 2 shrublands, expand to units 3 and 6, if successful.
- * Continue to scout and remove pine outliers and new seedlings from unit 2 shrubland.
- * Monitor tropical ash treatments in unit 1A, re-treat if needed.
- * Continue treating blackwood acacia outliers in unit 2 shrublands.
- * Re-treat eucalyptus outliers in unit 1B native forest.
- * Monitor presence and absence of weed species on existing 29 ungulate transects annually.
- * Continue to implement and improve protocol for prevention of alien species introduction.
- * Support DOCARE for marijuana overflights and enforcement.
- * Update Waikamoi weed control plan; use long-term baseline monitoring data to guide management strategies.

Years 5 & 6

- * Re-treat all gorse populations in Waikamoi as needed and monitor recruitment; complete treatment of gorse populations on adjacent ranchland within 50 meters of preserve.
- * Control kahili ginger recruitment in units 1A and 1B; continue controlling ginger within 50 meters of unit 1A fence.
- * Monitor blackberry treatment in unit 2 shrublands and continue treatment in units 3 and 6.
- * Continue to scout and remove pine outliers and recruitment from unit 2 shrubland.
- * Monitor tropical ash treatments in unit 1A, re-treat if needed.
- * Continue treating blackwood acacia outliers in unit 2 shrublands.
- * Monitor and re-treat eucalyptus outliers in unit 1B native forest, as needed.
- * Monitor presence and absence of weed species on existing 29 ungulate transects annually.
- * Continue to implement and improve protocol for prevention of alien species introduction.

- * Support DOCARE for marijuana overflights and enforcement.

Invertebrate and Small Mammal Control

Program Goal: To increase our understanding of threats posed by non-native invertebrates and small mammals, and reduce their negative impact where possible.

Even though threats posed to native species by non-native insects, mollusks, and small mammals (rats, mongooses, feral cats, etc.) are poorly understood, they are potentially very serious. For example, a non-native ant is currently the greatest threat to the survival of the famed Haleakala silversword; it decimates the native insects that pollinate the plant. Rats and mongooses are major predators on certain bird species.

We will continue to implement procedures for preventing the introduction of new non-native invertebrates and small mammals. Trapping for cats, mongooses, and rabbits will be conducted if needed. The existing 29 ungulate/weed transects will be monitored for small mammal sign. Field staff are already trapping rats at all campsites and will continue to do so. As we begin to understand these threats better (see Rare Species Protection and Research section), the Conservancy will refine and expand our control programs.

Invertebrate and Small Mammal Control Timeline

Year 1

- * Follow strict procedures for preventing the introduction of new non-native invertebrates and small mammals.
- * Trap for cats, mongooses, and rabbits if needed.
- * Use existing 29 ungulate/weed transects to collect data on the presence or absence of small mammals.
- * Set and regularly visit rat traps at all campsites.

Year 2

- * Follow strict procedures for preventing the introduction of new non-native invertebrates and small mammals.
- * Trap for cats, mongooses, and rabbits if needed.
- * Use existing 29 ungulate/weed transects to collect data on the presence or absence of small mammals.
- * Set and regularly visit rat traps at all campsites.
- * Use research results (see Rare Species Protection and Research section) to begin expanding rat control program to protect rare birds.

Years 3 & 4

- * Follow strict procedures for preventing the introduction of new non-native invertebrates and small mammals.
- * Trap for cats, mongooses, and rabbits if needed.

- * Use existing 29 ungulate/weed transects to collect data on the presence or absence of small mammals.
- * Set and regularly visit rat traps at all campsites.
- * Continue expanding rat control program as guided by research results.

Years 5 & 6

- * Follow strict procedures for preventing the introduction of new non-native invertebrates and small mammals.
- * Trap for cats, mongooses, and rabbits if needed.
- * Use existing 29 ungulate/weed transects to collect data on the presence or absence of small mammals.
- * Set and regularly visit rat traps at all campsites.
- * Continue expanding rat control program as guided by research results.

Monitoring

Program Goal: To track biological and physical resources of the preserve and evaluate changes in these resources over time; to identify new threats to the preserve before they become established pests; and to promote research to guide management programs.

Resource monitoring documents and quantifies natural resources (vegetation, birds, and invertebrates) and tracks them over time, identifying trends. Resources will eventually be mapped and tracked with help from the Hawaii Heritage Program (HHP) and its Geographic Information System (GIS). Maps and data from the monitoring program will be used to update the research needs lists, refine long-term management plans, write research proposals and grants, and refine future budget proposals.

Monitoring yields better management of the preserve. Accurately quantifying changes in natural resources provides land managers with the information needed to determine efficacy of past management programs, and to plan future research and management in Waikamoi. We will use a comprehensive network of quantitative monitoring plots and supplementary vegetation plots in different management units to improve the way we classify vegetation. The data collected will help managers prioritize management efforts by defining unique qualities and threats that exist in each management unit.

We will complete baseline monitoring of the vegetation and birds of Waikamoi in 1994 and begin baseline monitoring of invertebrates in 1995. All monitoring is consistent with the methods compiled by the Conservancy's Stewardship Ecologist through a series of statewide workshops with experienced land managers and researchers. This methodology is described in *NARS Statewide Monitoring Guidelines*, completed in 1992 for the state, and the *Waikamoi Long-Term Monitoring Plan* (in preparation). Baseline data will be analyzed, mapped, and summarized in a report during 1995. We will continue to seek ways to refine our techniques and integrate this program with other management activities.

Monitoring Timetable

Year 1

- * Conduct yearly resource and threat monitoring.
- * Provide data to HHP staff to incorporate monitoring information into statewide database.
- * Incorporate and refine the use of vegetation plots for rare species and weed treatment monitoring.
- * Complete staff training to conduct regular bird census.
- * Complete report on the implementation of baseline monitoring guidelines developed in 1994.
- * Plan and implement supplementary vegetation plots where necessary.

Year 2

- * Conduct yearly resource and threat monitoring.
- * Provide data to update statewide HHP monitoring database.
- * Plan and develop invertebrate monitoring protocol.
- * Begin monitoring supplementary vegetation plots where necessary.
- * Contract entomologist to collect baseline monitoring data for preserve's invertebrates.

Years 3 & 4

- * Conduct yearly resource and threat monitoring.
- * Provide data to HHP for statewide monitoring database.
- * Update report comparing previous and new vegetation, invertebrate, and bird monitoring data.
- * Begin monitoring supplementary vegetation plots where necessary.
- * Review entomologist's report and incorporate into invertebrate monitoring protocol.

Years 5 & 6

- * Conduct yearly resource and threat monitoring.
- * Provide data to HHP for statewide monitoring database.
- * Update report comparing vegetation, invertebrate, and bird monitoring data.
- * Begin monitoring supplementary vegetation plots where necessary.

Rare Species Protection and Research

Program Goal: To prevent the extinction of rare species in the preserve, and to encourage research, predator control, and captive propagation to increase populations of rare plant and bird species.

To date, 22 rare plants and 9 rare birds have been reported from Waikamoi preserve (one of the rare birds, however, is now considered extinct on Maui) (Appendices 2 and 3). The Conservancy uses data compiled by the Hawaii Heritage Program to identify

rare species, and uses the Heritage Program's definition of rare: species that exist in fewer than 20 populations worldwide.

In 1996 we will develop a rare species protection plan incorporating an ecosystem approach that will focus on protecting rare bird and plant populations both *in situ* (in the wild), and *ex situ* (in propagation facilities). The rare plant portion of the plan will involve mapping the rare plant populations, quantifying the numbers of individuals and populations, assessing threats to population survival in the wild, documenting observed reproductive biology, and using supplemental vegetation plots to define rare species habitat and augment the statewide database. Rare plant monitoring will be handled by the preserve's Field Biologist and other experts.

We will also support rare plant propagation, potentially at the Olinda Endangered Species Facility, a high priority site for a Maui mid-elevation nursery for rare and endangered plants. Propagation facilities are the top priority need of government and private agencies collaborating to prevent further plant extinctions in Hawaii. The Maui facility will help rescue up to 80 native Hawaiian plant taxa whose populations have declined to extremely low levels, and whose wild habitats currently offer uncertain refuge. This approach will "buy time," 1) allowing researchers to study the ecological needs of these unique species, and 2) allowing managers to improve protection of wild habitats. The ultimate goal is to return the nursery plants to the wild once conditions have improved.

The rare bird portion of the protection plan will rely on extensive support from the ongoing Endangered Forest Bird Research Program, which began in 1992 and will likely continue for at least the next 6 years. This is a cooperative research program with the National Biological Survey (NBS), DOFAW, USFWS, the Nature Conservancy of Hawaii (TNCH), and San Francisco State and other universities. Research objectives are to elucidate the breeding behavior and population ecology of 'akohekohe and Maui parrotbill. This will provide information to support 'akohekohe and parrotbill captive propagation and habitat management. Captive propagation could, if necessary, augment wild populations or maintain the species in captivity to forestall extinction if the last wild birds die. The study will supply information on social and breeding behavior that can be applied to breeding the birds in aviaries. Researchers will also investigate demography and factors limiting endangered forest birds to improve management of wild populations. This will include determining when in the birds' life cycle most mortality happens and how to reduce mortality.

A research/management study on the impacts of small mammals on native and endangered forest birds will begin in 1995. Unlike feral pigs, the direct impacts of small mammals are poorly quantified. Although small mammals have been identified as a significant threat to Hawaii's forest birds for more than a decade, the impacts of small mammal predation are unstudied for most of Hawaii's endangered forest birds. This project will focus on predation by small mammals to determine the relationships between intensity of small mammal control and forest bird population responses. This

type of research by management is a central research tenet in New Zealand and has led to significant advances in natural resource management and knowledge.

Rare Species Protection and Research Timetable

Year 1

- * Cooperate with the state for the captive propagation of five species of endangered Maui forest birds.
- * Develop rare species protection plan.
- * Provide cooperative funding for contracted forest bird research with NBS, DOFAW, USFWS, and TNCH.
- * Support research/management project on the effects of small mammals on forest birds.
- * Support Maui mid-elevation nursery for rare and endangered plants.
- * Update research needs list and promote to research institutes; provide logistical support to researchers when feasible.

Year 2

- * Cooperate with the state for the captive propagation of five species of endangered Maui forest birds.
- * Implement rare species protection plan.
- * Provide cooperative funding for contracted forest bird research with NBS, DOFAW, USFWS, and TNCH.
- * Support research/management project on the effects of small mammals on forest birds.
- * Support Maui mid-elevation nursery for rare and endangered plants.
- * Update research needs list and promote to research institutes; provide logistical support to researchers when feasible.

Years 3 & 4

- * Cooperate with the state for the captive propagation of five species of endangered Maui forest birds.
- * Continue to implement rare species protection plan.
- * Provide cooperative funding for contracted forest bird research with NBS, DOFAW, USFWS, and TNCH.
- * Support Maui mid-elevation nursery for rare and endangered plants.
- * Update research needs list and promote to research institutes; provide logistical support to researchers when feasible.

Years 5 & 6

- * Cooperate with the state for the captive propagation of five species of endangered Maui forest birds.
- * Refine rare species protection plan.
- * Provide cooperative funding for contracted forest bird research with NBS, DOFAW, USFWS, and TNCH.
- * Support Maui mid-elevation nursery for rare and endangered plants.

- * Update research needs list and promote to research institutes; provide logistical support to researchers when feasible.

Public Outreach Programs

Program Goal: To build public understanding and support for the preservation of natural areas, and enlist volunteer assistance for preserve management.

Conservancy staff routinely give presentations to community and school groups on the importance of protecting natural areas in Hawaii. Also, Conservancy staff provide various hiking opportunities in Waikamoi Preserve (5,000 people visited Waikamoi in the last 4 years). People are encouraged to join a volunteer work party so they can contribute to the protection of Waikamoi while learning about the preserve. Over the past 4 years, 4,120 volunteer hours were contributed to Waikamoi efforts.

As part of our public outreach efforts, we have established an internship program for three interns per year. We will continue to hire three interns per year to expose high school and college students to careers in conservation.

New trails will be designed and existing trails will be maintained to promote natural area education. It is our goal to provide the Maui community with high-quality, regular opportunities to visit Waikamoi Preserve. Most of our hikes will continue to be led on the existing Waikamoi Bird Loop Trail (once an old cattle trail). This trail is well maintained by staff and volunteers, and no negative impacts have been observed during the past 5 years of use. However, on a second frequently used interpretive trail below Hosmer Grove, we have noticed some damage. During 1994 up to 500 feet of boardwalk will be installed along muddy portions of this trail to prevent further damage.

In 1992 we launched a very successful Waikamoi volunteer docent program, which resulted in the training of 30 new volunteer hike leaders. Many of our current public hikes are led by these knowledgeable guides who have completed a minimum 40 hours of training in the field by Maui biologists and naturalists. We expect to expand this program over the next several years. Docents also routinely lead small custom hikes for community groups, donors, and community leaders. These will continue to be offered weekly when possible.

During the past 5 years, HALE has led an average of two hikes per week on the Waikamoi Bird Loop Trail. The regularly scheduled Monday and Thursday hikes have allowed many Maui residents and visitors to see Waikamoi. Well trained HALE guides provide an informative and enjoyable experience for all participants.

The Conservancy is also exploring the possibility of limited, low-impact, commercial hikes on the Waikamoi Bird Loop Trail. This project is in the design stages; we require more information on necessary state and federal permits and impacts. We will proceed slowly on this project, obtaining all of the necessary approvals.

Public Outreach Program Timetable

Year 1

- * Continue bi-weekly interpretive hikes, and encourage HALE to continue providing two hikes per week into Waikamoi Preserve.
- * Present slide shows and talks as requested by community and school groups.
- * Continue volunteer work projects.
- * Continue internship program at three interns/year.
- * Continue to expand interpretive program through increased community oriented hikes.
- * Complete short boardwalk below Hosmer Grove.
- * Continue to train and use volunteer docents to lead hikes for school children and community groups.

Year 2

- * Expand boardwalk below Hosmer Grove, if feasible.
- * Continue bi-weekly interpretive hikes, and encourage HALE to continue providing two hikes per week into Waikamoi Preserve.
- * Present slide shows and talks as requested by community and school groups.
- * Continue volunteer work projects.
- * Continue internship program at three interns/year.
- * Continue to expand interpretive program through increased community oriented hikes.
- * Continue to train and use volunteer docents to lead hikes for school children and community groups.

Years 3 & 4

- * Expand boardwalk below Hosmer Grove, if feasible.
- * Continue bi-weekly interpretive hikes, and encourage HALE to continue providing two hikes per week into Waikamoi Preserve.
- * Present slide shows and talks as requested by community and school groups.
- * Continue volunteer work projects.
- * Continue internship program at three interns/year.
- * Continue to expand interpretive program through increased community oriented hikes.
- * Continue to train and use volunteer docents to lead hikes for school children and community groups.

Years 5 & 6

- * Expand boardwalk below Hosmer Grove, if feasible.
- * Continue bi-weekly interpretive hikes, and encourage HALE to continue providing two hikes per week into Waikamoi Preserve.
- * Present slide shows and talks as requested by community and school groups.
- * Continue volunteer work projects.
- * Continue internship program at three interns/year.

- * Continue to expand interpretive program through increased community oriented hikes.
- * Continue to train and use volunteer docents to lead hikes for school children and community groups.

Personnel, Equipment, and Facilities

The Conservancy currently has seven full-time stewardship staff on Maui: a project director, assistant preserve's manager, administrative coordinator, field biologist, and three field technicians. Staff split their time between Waikamoi and Kapunakea Preserves with about 4.5 FTE's (full-time equivalents) dedicated to Waikamoi Preserve. Beginning in mid-1994, we expect to add another 1.5 FTE's to Waikamoi to support expanding public education, monitoring, research, rare species protection, and office support needs.

In addition to routine field duties, Maui staff must also be prepared to fight fires. In 1990 Maui Project staff completed a fire-management plan for Waikamoi Preserve that includes, among other important information, a fire resources map (Figure 4) depicting roads, helicopter landing sites, water resources, and other important information about the preserve. The Conservancy will work cooperatively with DOFAW to prevent and suppress any fires in and around the preserve, as outlined in the fire management plan. Several field staff will continue to upgrade their fire training and readiness as opportunities arise.

Socio-economic

Three general types of socio-economic benefits will result from the proposed project: 1) watershed protection, 2) maintenance of biodiversity, and 3) public education and recreation. This project will also create conservation jobs on Maui.

The forests of East Maui serve as a stable water source for Maui's residents and industries. All of the domestic fresh water for the upper Kula, Olinda, and Makawao areas is harvested just below the western portion of Waikamoi Preserve. Native vegetation is an essential component of this watershed system. Forest cover protects fragile mountain soils from erosion, and acts like an immense sponge that absorbs heavy rains. Water is gradually released into streams and groundwater aquifers, rather than running off the surface in torrents to the sea. Management activities will promote a more stable water regime both within and below the project area by reducing the potential for rapid runoff from disturbed or degraded areas within the East Maui watershed area.

Preservation of biodiversity has been recognized as a legitimate and necessary goal for society. This project provides multiple opportunities to protect and preserve rare natural ecosystems and endemic species.

Waikamoi Preserve staff routinely give presentations to community and school groups on the importance of protecting natural areas in Hawaii, and Waikamoi's important biota. Conservancy staff and trained docents also provide hiking opportunities to the general public and school children. (We have accommodated more than 5,000 visitors during the past 4 years.) In addition, volunteers are routinely used in many management projects. Community volunteers have gained hands-on conservation experience while learning about Hawaii's unique plants and animals.

Environmental

This project has benefitted, and will continue to benefit the environment, by maintaining and enhancing native ecosystems, preserving biological diversity, and promoting improved water quality.

At least 22 rare plants, 7 (extant) endangered birds, and 4 rare natural communities reported from Waikamoi Preserve are better protected as a result of this project. By reducing the potential for rapid runoff from ungulate-damaged areas, a stable water regime will be promoted. In addition, the maintenance of a natural "viewshed" enhances the aesthetics of the area. Occasionally there will be an increase in noise levels when helicopters are used to transport staff and supplies to remote areas.

III. SUMMARY OF MAJOR IMPACTS

MAJOR IMPACTS — POSITIVE

- Reduction of ungulate activity to a level that will promote and sustain measurable recovery of native vegetation in all management units. (The long-term goal is to eliminate ungulates from Waikamoi.)
- Reduction of the range of habitat-modifying weeds and prevention of introduction of new problem weeds.
- Tracking of biological and physical resources in the preserve and evaluation of changes in these resources over time to identify new threats.
- Logistical and financial support to approved research projects will improve management understanding and protection of the preserve's resources as well as other natural areas in the state.

- Prevention of the extinction of rare species in the preserve.
- Promotion of a more stable water regime both in and below the project area by reducing the potential for rapid runoff from disturbed or degraded areas within Waikamoi through removal of feral animals and habitat-modifying weeds.
- Improved water quality (within and below the preserve) due to:
 - 1) decreased erosion and its subsequent siltation of streams and nearshore waters, and
 - 2) ungulate control, which lowers the potential for bacterial coliform and leptospirosis in the water.

MAJOR IMPACTS — NEGATIVE

One potential impact is the accidental introduction or spread of new weed species by managers or visitors on equipment, supplies or transport vehicles. Also, because herbicides are sometimes used to control habitat-modifying weeds in the preserve, there is a remote possibility of localized soil contamination. However, with care, no major negative impacts are expected to result from the proposed activities.

IV. ALTERNATIVES CONSIDERED

Although we (the Conservancy) considered a variety of alternatives involving lower levels of management, we decided that the actions outlined in this assessment are all necessary to assure the continued protection of rare species and valuable habitat. Slowing the pace of management could jeopardize progress made in controlling feral pigs, weeds, and other serious threats. A no-action alternative would promote the loss of rare Hawaiian ecosystems, plants, and animals. Furthermore, erosion of fragile forest top soils would continue at an accelerated rate, degrading one of the largest watershed areas in the state and nearshore reefs and fisheries.

V. PROPOSED MITIGATION MEASURES

To prevent the accidental introduction or spread of weed species, anyone entering the watershed area will be required to clean their clothing, boots, equipment, and camping gear of soil and plant material. Wherever possible, helicopter flights into the preserve will originate from weed-free areas such as wooden platforms or pavement, and all materials hauled in will be inspected and cleaned to remove soil, plant material, and insects. Helicopter landing sites and areas frequented by staff will be inspected for weeds each trip.

To prevent contamination of soil or water with herbicides, all field staff have been trained in the safe application of chemicals. Weed control staff are licensed by the state Department of Agriculture's pesticide branch. Herbicides are used according to label instructions.

VI. DETERMINATION

No significant negative impacts to the environment are expected to result from the implementation of the proposed activities.

VII. FINDINGS, AND REASONS SUPPORTING DETERMINATION

The proposed activities are expected to benefit rare species and native natural communities both in the project area and on adjacent lands. For example, ungulate control will protect rare plants and rare natural communities from browsing and other types of ungulate damage (including the spread of certain weeds). Active weed control in the project area will also help protect rare plants and natural communities, and will indirectly help rare and other native animals. Active management of Waikamoi Preserve will also promote a more stable water regime both in and below the project area by reducing the potential for rapid runoff from disturbed or degraded areas.

The risk of significant negative impact is low. Through a rigorous cleaning and monitoring program, the introduction or spread of new weed species by humans is expected to be minimal. Management-related impacts on any historical resources in the area is expected to be negligible. Furthermore, the risk of herbicidal contamination is low because 1) only small volumes of approved herbicides are used, 2) staff are well-trained in herbicidal application, and 3) all chemical use is in compliance with the state Department of Agriculture's pesticide branch.

VIII. LIST OF PREPARERS

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1. As this project is a joint state—private partnership agreement, the environmental assessment was prepared in consultation with Peter Schuyler and Betsy Gagné,

staff members in the Department of Land and Natural Resources/Division of Forestry and Wildlife/Natural Area Reserve System program. In addition, this environmental assessment incorporates many sections and figures from the Waikamoi Preserve Long Range Management Plan (e.g., all maps, descriptions of resources, and proposed activities). The long range plan was prepared by The Nature Conservancy in October 1993 and submitted to the Natural Area Reserve System Commission in November 1993 for consideration as a Natural Area Partnership (NAP) project. The Commission approved the plan and recommends the project be approved by the Board of Land and Natural Resources pending the completion of this environmental assessment.

IX. APPENDICES

APPENDIX 1

NATIVE NATURAL COMMUNITIES OF WAIKAMOI PRESERVE

NATURAL COMMUNITY NAME	GLOBAL RANK
Lowland	
Uluhe (<i>Dicranopteris linearis</i>) Lowland Wet Shrubland	G4
Montane	
'Akala (<i>Rubus hawaiiensis</i>) Montane Wet Shrubland †	G3
<i>Carex</i> Montane Wet Grassland †	G3
Koa/'Ohi'a (<i>Acacia Koa</i> / <i>Metrosideros polymorpha</i>) Montane Wet Forest †	G3
Mixed Fern/Mixed Shrub Montane Wet Shrubland †	G3
'Ohi'a/Hapu'u (<i>Metrosideros polymorpha</i> / <i>Cibotium</i> spp.) Montane Wet Forest	G3
'Ohi'a (<i>Metrosideros polymorpha</i>)/Mixed Shrub Montane Wet Forest†	G3
'Ohi'a/Olapa (<i>Metrosideros polymorpha</i> / <i>Cheirodendron</i> spp.) Montane Wet Forest	G3
'Ohi'a/Uluhe (<i>Metrosideros polymorpha</i> / <i>Dicranopteris</i>) Montane Wet Forest†	G3
Subalpine	
<i>Deschampsia nubigena</i> Subalpine Mesic Grassland* †	G2
Mamane (<i>Sophora chrysophylla</i>) Subalpine Dry Forest*	G2
'Ohi'a (<i>Metrosideros polymorpha</i>) Subalpine Mesic Forest †	G3
Pukiawe (<i>Styphelia tameiameia</i>) Mixed Subalpine Dry Shrubland	G3
Multizonal	
Pioneer Vegetation on Lava Flow	G3
Subterranean Communities	
Uncharacterized Montane Lava Tube*	GU
Uncharacterized Subalpine Lava Tube*	GU
Aquatic Communities	
Hawaiian Intermittent Stream	G4

* Rare natural community

† Also known from Hanawi NAR

Key to Global Ranks as defined by Heritage Program:

G2 - Imperilled globally (typically 6-20 current occurrences).

G3 - Restricted range (typically 21-100 current occurrences).

G4 - Apparently secure globally (> 100 occurrences).

GU - Natural community rank uncertain (rank uncertain, provisionally considered rare).

APPENDIX 2

RARE NATIVE PLANTS OF WAIKAMOI PRESERVE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	FEDERAL STATUS
<i>Argyroxiphium sandwicense</i> ssp. <i>macrocephalum</i> *	'Ahinahina, silversword	G2T2	LT
<i>Argyroxiphium virescens</i> *	Greensword	G1	3A
<i>Asplenium hobdyi</i>		G1	-
<i>Asplenium schizophyllum</i>		G1	C2
<i>Bidens campylotheca</i> ssp. <i>pentamera</i> ‡	Ko'oko'olau, koko'olau	G2T2	C2
<i>Calamagrostis expansa</i> ‡ †		G2	C2
<i>Clermontia tuberculata</i> *	'Oha, 'oha wai	G1	-
<i>Cyanea horrida</i> * †	'Oha, haha 'oha wai	G2	-
<i>Cyanea kunthiana</i> ‡	'Oha, haha 'oha wai	G2	C2
<i>Cystopteris douglasii</i>		G2	-
<i>Diplazium molokaiense</i>		G1	PE
<i>Dryopteris tetrapinnata</i> ined.(a)*		G1	-
<i>Geranium multiflorum</i> * †	Hinahina, nohoanu	G2	LE
<i>Lagenifera maviensis</i>	Howaiulu	G2	-
<i>Melicope orbicularis</i> ‡	Alani	G1	3C
<i>Phyllostegia bracteata</i> ‡ †		G1	C2
<i>Plantago princeps</i> var. <i>laxiflora</i>	Ale	G2T1	C1
<i>Platanthera holochila</i> †		G1	C2
<i>Ranunculus hawaiiensis</i>	Makou	G1	C2
<i>Ranunculus mauiensis</i>	Makou	G2	C2
<i>Sicyos cucumerinus</i>	'Anunu kupala	G1	C2
<i>Wikstroemia villosa</i> ‡	'Akia	GH	C2

‡ Known only from Maui * Known only from East Maui † Also known from Hanawi NAR

Key to Global Ranks as defined by Hawaii Heritage Program:

- G1 - Species critically imperilled globally (typically 1-5 current occurrences).
- G2 - Species imperilled globally (typically 6-20 current occurrences).
- GH - Species known only from historical occurrences (not observed in last 15 years).
- T1 - Subspecies or variety critically imperilled globally.
- T2 - Subspecies or variety imperilled globally (typically 6-20 current occurrences).

Appendix 2. continued

Key to Federal Status:

- LE - Taxa formally listed as endangered.
- LT - Taxa formally listed as threatened.
- PE - Taxa already proposed to be formally listed as endangered.
- PT - Taxa proposed to be formally listed as threatened.
- C1 - Candidate taxa for which the USFWS has substantial information on biological vulnerability and threats to support proposals to list them as endangered.
- C2 - Candidate taxa for which there is some evidence of vulnerability, but for which there are not enough data to support listing proposals at this time.
- 3A - Taxa for which the USFWS has persuasive evidence of extinction. If rediscovered, such taxa might acquire high priority for listing.
- 3C - Taxa that are no longer being considered for listing as endangered or threatened because they have proven to be more abundant or widespread than previously believed and/or those that are not subject to any identifiable threat. If further research or changes in habitat indicate a significant decline in any of these taxa, they may be reevaluated for possible inclusion in categories 1 or 2.
- - - - - No federal status. Recommended as rare by Hawaiian biologists and confirmed by Hawaii Heritage Program data.

(a) ined. - abbreviation for "ineditus," referring to a scientific name that has not been published.

APPENDIX 3

RARE NATIVE ANIMALS OF WAIKAMOI PRESERVE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	FEDERAL STATUS
Mammals			
<i>Lasiurus cinereus semotus</i> †	'Ope'ape'a, Hawaiian hoary bat	G5T2	LE
Birds			
<i>Hemignathus lucidus affinus</i> † *	Maui nukupu'u	G1T1	LE
<i>Loxops coccineus ochraceus</i> †	Maui 'akepa, 'akepeu'ie	G2T1	LE
<i>Melamprosops phaeosoma</i> ††	Po'ouli	G1	LE
<i>Moho</i> sp. 1 (Maui) ‡	'O'o	G1	-
<i>Nesochen sandwicensis</i> †	Nene, Hawaiian goose	G1	LE
<i>Palmeria dolei</i> †	'Akohekohe, crested honeycreeper	G2	LE
<i>Pseudonestor xanthophrys</i> †	Maui parrotbill	G1	LE
<i>Psittirostra psittacea</i> •	'O'u	G1	LE
<i>Pterodroma phaeopygia sandwichensis</i>	'Ua'u, Hawaiian dark-rumped petrel	G2T2	LE

† Also known from adjacent Hanawi NAR.

†† Unconfirmed sighting; known from adjacent Hanawi NAR.

* Known in adjacent areas, thought to occur in Waikamoi.

‡ Possible audio sightings on numerous dates between 1973-1979 by P. & W. Banko.

• Considered extinct on Maui.

Key to Global Ranks as defined by Hawaii Heritage Program:

- G1 - Species critically imperilled globally (typically 1-5 current occurrences).
- G2 - Species imperilled globally (typically 6-20 current occurrences).
- G3 - Restricted range (typically 21-100 current occurrences).
- G5 - Demonstrably secure globally.
- T1 - Subspecies or variety critically imperilled globally.
- T2 - Subspecies or variety imperilled globally.

Key to Federal Status:

- LE - Taxa formally listed as endangered.
- - No federal status. Recommended as rare by Hawaiian biologists and confirmed by Hawaii Heritage Program data.

APPENDIX 4
PRIORITY WEEDS OF WAIKAMOI PRESERVE

SCIENTIFIC NAME	COMMON NAME
<i>Ulex europaeus</i>	Gorse
<i>Hedychium gardnerianum</i>	Kahili ginger
<i>Rubus argutus</i>	Blackberry
<i>Pinus</i> spp.	Pines
<i>Acacia melanoxylon</i>	Blackwood acacia
<i>Fraxinus uhdei</i>	Tropical ash
<i>Eucalyptus</i> spp.	Eucalyptus

APPENDIX 5

RESPONSES TO COMMENTS ON THE WAIKAMOI DRAFT
ENVIRONMENTAL ASSESSMENT

DOCUMENT CAPTURED AS RECEIVED

Sarah E. Sykes

February 7, 1994

State of Hawai'i-DLNR
Division of Forestry and Wildlife
1151 Punchbowl Street
Honolulu, Hawai'i 96813

RE: DRAFT ENVIRONMENTAL ASSESSMENT FOR WAIKAMOI
PRESERVE NATURAL AREA PARTNERSHIP

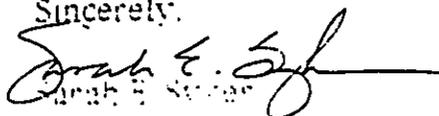
Pleased to note that The Nature Conservancy-Hawai'i, working with DOFAW and other interested parties, has submitted a basically good plan.

But I must of course take issue with the preponderance of references to ungulate dangers and disturbances. Cattle and human activity, even ecotourism, certainly pose threats at least equal to those of feral pigs and goats. Perhaps if the hunting permitted as outlined on Page 9, Item 5, were encouraged, rather than (as it appears) discouraged, ungulate numbers could be kept within a reasonable range. As noted on Page 10, in reference to Unit 2, regular hunting helps control game populations.

The extraordinary focus on ungulate eradication as explained on Page 12 ignores the basic Hawaiian precept of *lokahi*. It also ignores the fact that impacts of cattle and people can be severe and long-lasting. Perhaps the key to understanding why ungulate eradication is so high on the management goal list is on Page 26. "The Conservancy is also exploring the possibility of limited, low-impact, commercial hikes on the Waikamoi Bird Loop Trail." Bingo! If all the pigs are gone, it's safe to bring in the tourists. There won't be any more pigs or smelly goats, hunters, and their dogs and guns to worry about. . . it will just be WaikamoiLand at MauiWorld. And it will depend on snaring and aerial hunting to survive. That's wrong.

Please, stop blaming all management problems on the pigs and goats and work with Maui hunters in ways similar to those found effective on Molokai. Also, please incorporate by reference with these comments the two attached articles from the January/February, 1994 issue of *National Parks*. Thank you for the opportunity to comment.

Sincerely,


Sarah E. Sykes

P.O. Box 576

Kaunakakai, Hawai'i 96748

PHONE: 935-2529

FORUM

Sharing the Wealth

The needs of the world's rural poor, who live surrounded by biological riches, must be included in plans for preservation.

By R. Michael Wright

"We travel together, passengers on a little spaceship, dependent on a vulnerable reserve of air and soil; all committed for our safety to its security and peace; preserved from annihilation only by the care, the work, and I will say, the love, we give our fragile craft. We cannot maintain it half fortunate, half miserable, half confident, half despairing, half slave to the ancient enemies of man, half free in the liberation of resources undreamed of until this day. No craft, no crew can travel safely with such vast contradictions. On their resolution depends the survival of us all."

—Adlai Stevenson, 1965

OUTSIDE MANY national parks, impoverished people seek land on which to grow crops or to graze their meager herds of goats. People desperate for firewood to cook meals or to stave off the night cold live next to forest reserves. In Africa, children struggling to survive with little or no food live side by side with vast herds of legally protected wildlife. Throughout the world, the face of poverty is one of growing despair, and, more often than not, it is the face of a woman farmer eking out a living for herself and her family in an ever more ecologically impoverished landscape.

The rural poor, who, ironically, live

surrounded by biological wealth contained in protected areas, are trapped in a vicious downward spiral. To survive, they have no alternative but to overexploit whatever resources are available and to seek those "locked away" in nearby parks. Add rapid population growth and inequitable resource ownership to this equation and the

From ethical and practical perspectives, conservationists cannot be indifferent to the fate of our poor neighbors.

situation is stark indeed. In this environment, it is impossible to separate the human needs of local populations from the ecological needs of forests, wildlife, and national parks. To paraphrase Stevenson, parks, species, and conservationists cannot survive for long amid such vast contradictions.

The international community's response to this dilemma is "sustainable development," defined as development that "meet(s) the needs and aspirations of the present without compromising the ability to meet those of the future."

While this concept has been proclaimed conservation's message for the new millennium, sustainable development is in many ways an idea that was explored by Gifford Pinchot at the beginning of this century. And like John Muir's denunciation of Pinchot's unapologetic utilitarianism, sustainable development has drawn critics determined to debunk it. In the March 1993 issue of *Conservation Biology*, John Robinson asserts that sustainable development, at least as presently promoted, is a form of wishful thinking. After all, he argues, improvements in human prosperity have always come at the expense of biological diversity.

Of course, Robinson and his colleagues are right, but this perspective raises questions. What level of diversity loss can be justified by what improvements in the human condition, and who shall decide? Throughout the world, a series of ad hoc experiments seeks to answer these questions. Most of the projects are relatively new and modest in scale. They often lack a clear link between economic and protection goals, frequently do not have the necessary baseline data to allow careful evaluation, and commonly depend on the dedication of a small cadre of individuals. Yet, with all their shortcomings, these experiments can offer lessons, inspiration, and hope. And they can show us a way to the future.

One type of protected area allows people to live within its boundaries. Examples include the U.K.'s North York Moors National Park, Nepal's Annapurna Conservation Area, and Brazil's extractive reserves.

U.K. parks such as North York Moors were created with the understanding that people and land are inseparable, and, along with nature conservation, the creation of healthy rural economies is central to the parks' mission. Ecologically beneficial practices, such as maintenance of hedgerows by local farmers, are fostered through a system of financial incentives and reciprocal legal agreements. As fewer and fewer natural areas exist where parks can be established free of people, the U.K. system may be the model for es-

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ing future protected areas. Created within an already populated, settled landscape, the U.K. system has been maligned by parks. But people already have settled within the limits of nearly 86 percent of America's national parks, and forced relocation should be no acceptable for national parks than World Bank development project. In fact, local people can be engaged in the important job of protecting

and. How incidents so dramatically capture the struggle to preserve the rain-

forest ecosystem than the earlier of Chico Mendes in the Brazilian Amazon. Mendes' efforts to organize the rubber trappers led to a conservation movement. The trappers and Mendes moved to create an extractive reserve system to gain legal rights over the rubber. Cattle barons, however, wanted to clear the land, a conflict that led to Mendes' tragic death.

The extractive reserve system seeks to provide economic return and maintain biodiversity by using non-timber forest products, such as the latex tree sap. The extractive reserve idea of multiple-use protected areas has spread but, in each instance, depends on the exploitation of a complex and changing mix of resources. In Brazil the focus is on rubber, palm heart, acai palm, or Brazil nuts. In the Petén of Guatemala, the resources are allspice and chicle, a gummy substance used in gum, among other things. A wide range of products is taken from the forests of Kalimantan, Indonesia, most prominently rattan, and on Cameroon's Mount Oku, medicinal plants and honey are the primary resources. The economic and conservation results have been mixed, depending on a number of factors: resource potential, market demand and proximity, conditions of transportation

and tenure, the impact of the harvest method on regeneration, and the potential of competing land uses. While they are not a panacea, extractive reserves are a necessary component of any conservation strategy in the tropics.

Another set of projects links improvements in the human condition in multiple-use buffer zones to conservation in a protected core area. Local people played key roles in these projects as well.

In 1986, conservationists Mingma Norbu Sherpa, Chandra Gurung, and Broughton Coburn spent six months

in Zambia, led by Ackim Mwenya, Gilson Kaweche, and Dale Lewis under a Zambian program, safari hunting revenue that previously disappeared into the central treasury now constructs schools, builds clinics, and employs local game guards. An unlikely partnership has resulted among villages, traditional chiefs, political leaders, and government officials and has begun to have an effect on the poaching that has devastated elephants and other wildlife.

Are these diverse approaches a substitute for national parks? The answer is emphatically "no." National parks

retain an important role in preservation, but they are also insufficient. Most of the globe's biological diversity remains, and will remain, outside of parks, because few parks encompass intact ecosystems and most remain susceptible to external threats. From ethical and practical perspectives, conservationists cannot be indifferent to the fate of our poor neighbors. Intensive agriculture and the restoration of wastelands, both of which can help meet human needs and reduce pressure on parks, are fundamental elements of an inclusive



DOUGLAS MACGREGOR

visiting the 300 villages that ring the snowcapped peaks around the Annapurna Himal. The team wanted to establish protection for the area but also wanted to enlist in their efforts the support of the resident Gurungs, Magars, Thakalis, and the other diverse peoples. The result of this unprecedented local participation in design was a new Nepali approach to conservation. The approach not only protects the area's ecological integrity but also provides alternative energy sources, health and family planning services, improved water supply, and lodgeowner training, all funded by a charge to the 25,000 trekkers who come to Annapurna annually.

Projects that rely on wildlife are particularly prevalent in Africa. As con-

servation mix.

Multiple-use areas, whether they are Zambia's game-management areas, Brazil's extractive reserves, Nepal's conservation area, or the U.K. park system, even with their potentially diminished density and diversity of species, are as important as guards and fences in the conservation strategy for our ever more crowded planet. Ultimately the resolution to Stevenson's contradictions of wealth and want will emerge from a mosaic of land uses within which we can balance a complex set of rights and responsibilities between local communities and society at large.

R. Michael Wright is a senior fellow with the World Wildlife Fund.

Ecotourism in the National Parks of Latin America

By Ruth Norris

A COUPLE OF DECADES AGO, if you were to win the lottery, or perhaps commit the perfect crime, you might think of escaping to a place like Manuel Antonio National Park. It's a fantasy tropical paradise: white-sand beach and blue-green waters, on the Pacific side of Costa Rica, shaded by lush tropical forest nearly reaching the water's edge. No traffic, no roads—for company, just the birds and the white-faced squirrel monkeys.

But today you don't have to be lucky or a conspirator. You can catch any one of the dozen or so daily international flights to San José, rent a car, hop on a bus and go to Manuel Antonio by highway. You'll still find the beach and the forest. The solitude, however, is long gone.

One of the most-visited protected areas in Central America, 1,700-acre Manuel Antonio receives nearly a thousand visitors a day during the peak of the high season. It is surrounded by a hotel "strip." Some 300 monkeys are still there, but their migration corridors have been disturbed, and like the bears of Yellowstone in years past, many have become garbage feeders.

Welcome to Costa Rica, whose parks are the crown jewels among developing country protected areas. In the 1980s, this West-Virginia-sized country won international acclaim for setting aside 12 percent of its national territory as



More than two-thirds of the international visitors to Costa Rica come to enjoy the country's national parks and other protected areas, such as Monteverde Biological Reserve (left), and to see wildlife, such as the keel-billed toucan (above).

parks—and received more than half of all the U.S. public and private funding for international conservation. In the 1990s, Costa Rica is again a trend-setter, this time in the booming ecotourism industry.

The Costa Rica Tourism Institute, or ICT, and tour operators have aggressively promoted Costa Rica as a destination. ICT uses travel-industry

shows, advertisements, and offices in Miami, Los Angeles, and other cities to entice potential visitors with visions of romance and adventure. "Picture graceful, tall mountains, their tips wreathed in clouds," its brochure invites. "Imagine lush green meadows with rushing rivers and arching waterfalls; conjure up a vision of a population whose smiles reveal their inner happiness and pride in their land." In case your imagination fails you, there are 16 pages of color photographs.

It works—and then some. In August of 1993, tourism surpassed bananas as the country's number-one industry. For the past three years, the number of visitors to Costa Rica has increased at a rate approaching 15 percent per year and should reach three-quarters of a million visitors annually in the next year or two, a million by decade's end. Tourism income has grown even faster, and now exceeds a million dollars a day.

More than two-thirds of the international tourists in Costa Rica say they came to enjoy the country's national parks. The parks are popular recreational destinations for local residents as well, as confirmed by park agency visitation figures. In 1992, 598,003 visitors were registered, nearly triple the visitation level in 1982.

For the parks, this surging interest is a mixed blessing. To be sure, the dollars from aid agencies and conservation



organizations continue to flow. But the visitors are leaving more than footprints. A recent study by the Inter-American Development Bank ranked growth in visitation, coupled with the park service's inability to manage visitors effectively, as one of the five most serious threats to Costa Rica's national park system.

"Many tourists, few animals," a writer grumbled in a major travel magazine, writing about a stroll on the trails of Manuel Antonio. A protected-areas specialist working at Corcovado National Park, on the relatively undeveloped Osa Peninsula, notes, "You can see physical damage to the reef from boat moorings and [from] being stepped on."

"In general, the higher the volume of tourists, the greater the potential for negative impacts," says Ray Ashton, author of a manual for ecotourism in Central America, going on to catalog the possible damage: soil compaction, trail erosion, clearing for campsites and other facilities, litter, contamination of surface water, and trampling and collection of plants.

And what about the wildlife? How frequently animals may be disturbed before their behavior changes—and what level of behavioral change represents a threat—are still open questions. Different species of wildlife have dif-

ferent levels of tolerance toward interactions with humans. Some thrive; others retreat and decline. Impacts may vary depending on the type of tourist activity and by season and location within the animals' territory. Sea turtle beaches, for example, are vulnerable primarily during the nesting season. Other animals may be particularly sensitive during resting or feeding. Wildlife may also be threatened when local people collect feathers, shells, and skins for handicrafts to sell to tourists, or overfish reefs to supply restaurants and lodges.

This is primarily theory, logical and reasonable but difficult to document. Ask one of the experts—the ornithologists, herpetologists, and other researchers who have visited Costa Rica's protected areas continuously over the past few decades—and the answer will be something like this, from Laurie Hunter, an ornithologist at The Nature Conservancy.

"Everyone talks about the environmental impact of tourism, but it's hard to document. You would have to have information, for example, on the breeding and nesting behavior of quetzals—which of course necessitates having data beforehand."

Quetzals, of course, are one of the most emblematic species, and a fair amount of behavioral data has been

White-faced capuchin monkeys and tree frogs are among the diverse wildlife species found in Costa Rican parks.

collected. But no one knows how many species the Costa Rican parks harbor. Scientists generally concur that some 215 species are of special concern, ranging from vulnerable to immediately endangered. Many of these depend on the parks for their survival. Even so, there are not sufficient data to effectively monitor danger signals or determine their causes.

To see the least subtle tourism impacts, one only has to step outside a park boundary and look around. Admirable as Costa Rica's park system is, land outside the parks is all but unprotected. The immediate result has been what Tirso Maldonado, author of a volume on national-park carrying capacity recently published by Fundación Neotrópica, calls a "chaos of construction" surrounding the most-visited parks.

In 1993, more than 3,000 new hotel rooms were constructed in Costa Rica, a great many of them immediately outside protected areas. The construction brings deforestation, erosion, improper disposal of sewage, and a host of other problems. One of the most luxurious of the new resorts razed a hilltop during construction, changed the course of

river by taking out tons of sand, filled a swamp, violated health laws, and failed to get required permits for construction and dynamiting.

It's a classic vicious circle: more tourists bring more hotels, which bring more tourists. They come by land and by sea. One of the principal factors in the quintupling of visitors to Carara Biological Reserve over the past three years has been the cruise ships that have begun to dock nearby. Visitation is actually incompatible with the purposes of a biological reserve, as established by law—but the reserve's trails and scarlet macaws are an attraction.

If CRUISE SHIPS HAVE BEEN A BANE to conservation in parts of Costa Rica, they are one of the critical elements in the success of another of the Latin American crown jewels. Sail a few thousand miles to the south, to the Galápagos Islands, and it's possible to find some guidance on how to keep visitation under control.

During nearly a quarter-century of tourism, this desert archipelago, home of rare and wonderful wildlife made legendary by Charles Darwin, has seen growth rates similar to Costa Rica's. But visitation has generally been well managed, and it is still possible to encounter a blue-footed booby nesting right on the trail. Despite the fact that the annual limit of visitors is regularly exceeded, strict supervision, together with limited development of land-based facilities, has kept impact to a minimum.

The tourism industry in Galápagos has always been water-borne and water-based. A typical visit begins with a 600-mile flight from the mainland to one of the archipelago's two airports. Passengers immediately pay a rather steep entry fee (the current value is about \$40 for foreigners, less than \$1 for Ecuadorians), and transfer to a boat for a one- or two-week tour of the islands. All groups must be accompanied by interpretive guides licensed by the Galápagos Park Service, whose responsibility is to exercise direct control over

Photographing wildlife is a popular activity for visitors to the Galápagos.

visitor action in all areas of the park. Visitors are strictly restricted to official trails when they are on the islands. A small fleet of patrol boats also enforces regulations.

The Galápagos Islands are governed by a management plan—actually several distinct but related plans for the terrestrial and marine portions of the park—and a separate plan for tourism. The park's first management plan, approved in 1974, established a somewhat arbitrary limit of 12,000 visitors per year. As tourism increased, debate about management tended to focus—artificially, according to most experts—on how many tourists should be permitted, rather than on more complex aspects of carrying capacity.

In 1981, Ecuador's president appointed a high-level commission to propose guidelines for tourism management. The commission recommended freezing visitation at 25,000 per year until a tourism plan could be elaborated—again, a somewhat arbitrary limit, but based on the Galápagos Park Service's capacity for management and the approximate capacity for transportation available at that time. It was adopted as the official visitation ceiling when the master plan for Galápagos was revised in 1985.

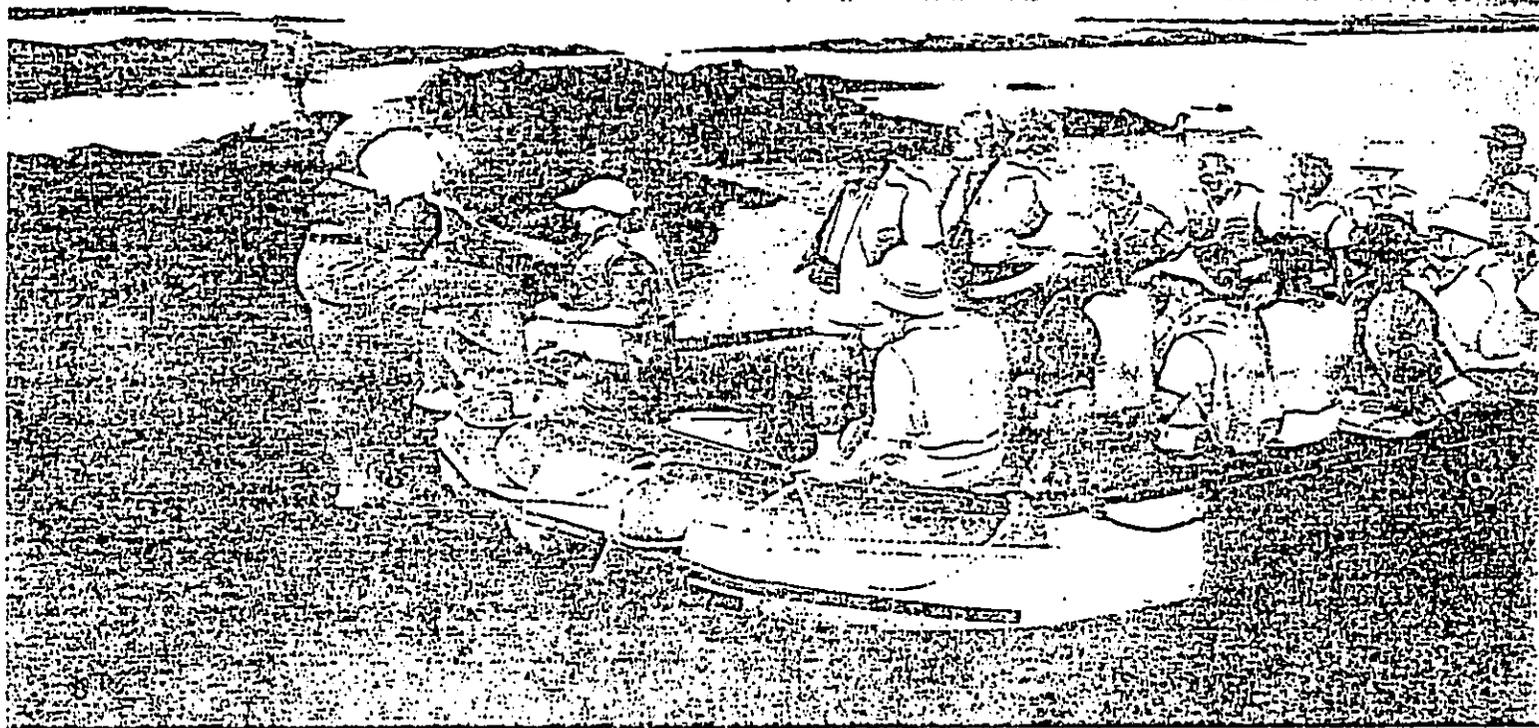
Unfortunately, a decade passed before the tourism plan was adopted in 1991. Meanwhile, a second airport was

constructed. The visitor ceiling was reached and exceeded, and economic problems caused a deterioration in the park service's management capacity. In the decade preceding adoption of the tourism plan, according to Fausto Cepeda, who serves on the Galápagos Permanent Commission, the number of concessioners offering lodging on the islands doubled, to 82, and the number of places available on touring boats increased from 664 to 1,400.

Still, despite the burgeoning tourism, wildlife has fared well. Galápagos management plans have established a system designating zones for tourism according to their accessibility, presence of wildlife, coastal scenery, and hiking opportunities. The tourist-use areas are categorized for either intensive use (groups up to 90 people), or extensive use by groups limited to 12. All groups must be accompanied by a licensed guide.

The main problems, as in Costa Rica, are concentration and crowding at the most popular sites. The most serious negative effect, says Cepeda, has been the direct and indirect impacts of the development of industries supporting tourism. "Planning was based on carrying capacity and management of tourist activity, and on the limits of the visitation sites in the park, without recognition of the other problems caused by economic activity."





The new plan for tourism has taken measures to address these problems. There are more regulations on the granting of concessions. To visit boats and ships must follow assigned itineraries and limit their tours to assigned areas of operation. By causing more dispersal of visitors and encouraging use of additional, less vulnerable sites, the plan will strengthen the Galapagos Park Service's management capacity.

Can Costa Rica implement similar measures to control its national park visitors? The tourism ministry, says Tirso Maldonado, has financed several studies of carrying capacity and is pressuring the park service to establish new visitation limits for the parks, many of which are exceeding current limits two or three times over. However, Maldonado warns, there is no "magic formula"

and focusing on ecotourism may serve to obscure more important issues.

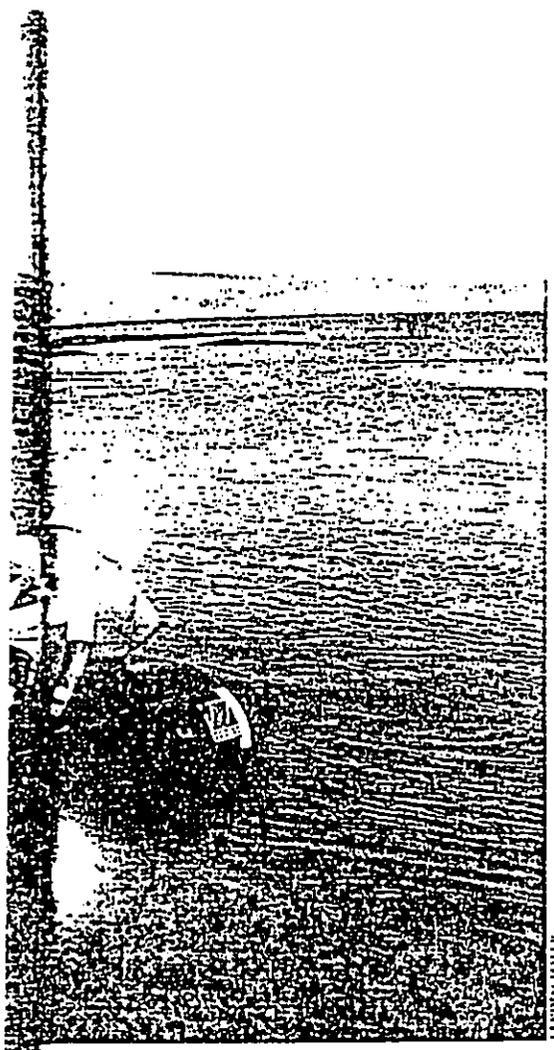
In fact, says Jim Barborak, a parks expert and longtime Costa Rica resident, visitation in Costa Rican parks is "so far below the levels reached in U.S. parks that it's laughable." Grand Canyon National Park, which is roughly the same size as Costa Rica's parks put together, receives 4.5 million visitors per year, while the Costa Rican parks receive just 600,000 annual visitors.

"What you're hearing is the aesthetic eyes of people who loved Costa Rica in the old days," says Barborak's colleague David Carr, a second-generation sea-turtle expert who has devoted much of his life to conserving the nesting beaches of Tortuguero National Park on the Atlantic coast. "Those days are over. I'm not trying to save Tortuguero like it was in my childhood. We can save the

park, the turtle beach—but I've abandoned any notion that we should preserve the quaint old ways."

In the mountains a few hours' drive from San José is the Monteverde Biological Reserve, a private cloud forest reserve where tourists flock to see resplendent quetzals and many other beautiful birds, plants, and butterflies. One portion of the reserve has trails suitable for hiking; another portion is all but inaccessible. The reserve takes in nearly a half-million dollars a year from its relatively high entry fee—about \$100, fees for guide services, and gift shop. The guide program provides employment and training for local residents while also helping to keep visitors on the trails and otherwise in compliance with rules designed to keep disturbance to wildlife to a minimum.

The substantial income makes it



Although tourism rates in the Galápagos Islands are growing as rapidly as those of Costa Rica, careful management and well-enforced restrictions have helped to keep visitation under control. All tour groups are accompanied by interpretive guides licensed by the Galápagos Park Service, which strictly supervises all visitor activity. Far left, tourists prepare to explore Fernandina Island. Above and left, visitors to the Galápagos encounter sea lions, land iguanas, and other wildlife at close range.

able to invest in trail maintenance, including reinforcement and hardening of erosion-prone areas. Staff maintain the trails and carefully monitor the number of visitors in the region, as well as the number on each trail at any given time. When a trail reaches its limit, new arrivals must choose another route or wait until earlier visitors exit. On busy days, lines can form as early as 11 a.m. Visitors, however, cheerfully accept both the high cost and the occasional wait, knowing that they will encounter wildlife rather than crowds, and that they can enjoy the cloud forest in relative comfort, safety, and quiet.

The national parks may not be able to adopt all of these measures. By law, they have an entry fee of less than \$2, and there is a chronic shortage of staff, due in part to civil-service cutbacks im-

posed by economic restructuring. Although the Costa Rican park staff are generally praised for their level of training and esprit de corps, none are specifically trained in visitor management, and few have the time to spend assisting visitors, directing them onto appropriate trails, and explaining or enforcing rules of conduct. Most of the parks do have trail systems, but few if any are designed to concentrate visitors in the less fragile scenic areas, leaving sensitive ecosystems undisturbed.

Proposals to increase staffing and programs, even if financed by visitor fees, pose problems. But private organizations have a long history of hiring personnel to work in the parks and managing programs of assistance. Visitor management—training, tools, and staff—is a promising area for private assistance.

If it is no longer possible to pass a week in perfect solitude at Tortuguero or Manuel Antonio, neither is it very likely that thundering herds of tourists will ultimately despoil the Costa Rican parks. Eventually, word of mouth about crowded conditions in Costa Rica and the growing promotion of equally beautiful parks in Guatemala, Honduras, and Panama are likely to cause the international visitors to disperse. And there is every reason to believe that Costa Rica, with its outstanding conservation record and its special access to international funding and support, will again take the lead in ensuring both good experiences for visitors and conservation of parks and their wildlife.

Ruth Norris is a Washington, D.C.-based freelance writer specializing in international conservation issues.

The Nature Conservancy of Hawaii



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March 18, 1994

Sarah E. Sykes
P.O. Box 370
Kaunakakai, HI 96748

Dear Sarah,

Thank you for your comments on the Draft Environmental Assessment for Waikamoi Preserve Natural Area Partnership. We greatly appreciate your interest and concern for protecting Waikamoi's Hawaiian plants, animals, and ecosystems.

Regarding the threat of feral pigs and goats to the preserve's rare plants, animals, and natural communities relative to other threats such as cattle and human activity: the damage caused by pigs and goats in Hawaii's natural areas has been well-documented. Pigs and goats destroy vegetation and disturb the soil, spreading weeds, accelerating erosion, and disrupting the habitat of rare plants and invertebrates. In the specific case of Waikamoi, pigs and goats have caused widespread and extreme damage that has only recently been brought under control. Although, the draft assessment does not specifically acknowledge the threat posed by cattle, we agree with you that cattle are potentially a very serious threat to Waikamoi Preserve. To address this threat we have built over 8 miles of fence to prevent cattle from entering the preserve, and we routinely maintain and inspect those fences. You'll be pleased to know that due to these fences and other management efforts, there has been no record of cattle on the preserve for at least the last eight years. We also acknowledge that human activity is a potential threat and we have developed policies and a permit process which strictly guide all human activities on the preserve. We will continue to closely monitor and control all human activity and associated impacts on the preserve, especially with regard to the inadvertent introduction of alien species.

Regarding your suggestion to expand the role of public hunters in our ungulate control program on Maui: in contrast to the situation on Molokai, there are legal limitations on hunting at Waikamoi. As stated in the draft assessment, our agreement with the landowner, Haleakala Ranch Company, gives the ranch and its employees the right to hunt in Waikamoi so long as game animals are present and such hunting does not interfere with other management work. Even with this limitation, we have established a program whereby public hunters can become Conservancy volunteers and hunt as part of our field crew.

Finally, public hiking in Waikamoi will follow a number of Conservancy-imposed limitations. For example, all hikes are limited in group size and restricted to the western edge

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of the preserve. All plans for expanding public hiking (referred to as "limited, low-impact, commercial hikes" in the draft assessment) will be reviewed by state officials and proceed only with the necessary permits and approvals. Moreover, we do not consider the presence of feral animals, hunters, or hunting dogs a serious threat to the hiking mentioned in the plan. Ranch employees currently have hunting access to several areas where current and future public hikes will be led. Naturally, schedules of both parties are carefully coordinated for safety purposes.

Thank you for the attached articles on 1) including local people in conservation planning, and 2) the pros and cons of ecotourism. We are very interested in both of these topics, and acknowledge that they are relevant to our work. The articles do, in fact, reflect the direction in which The Nature Conservancy is heading.

Sincerely



Mark L. White
Maui Project Director