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NATIONAL PARK SERVICE

CONTRACT NUMBERS

 CX 8000 7 0003
 CX 8000 7 0004
 CX 8000 7 0005
 CX 8000 7 0006
 CX 8000 7 0007
 CX 8000 7 0008
 CX 8000 7 0009
 CX 8000 8 0011
 CX 8000 8 0012
TABLE OF CONTENTS

Coordinating Committee.................................................. 1

Report of Director.......................................................... 2

Hawaii Volcanoes and Haleakala National Parks

   Bird Survey, & Conant.................................................. 3

Hawaii Volcanoes National Park

   Role of Fire in the Natural Ecosystem, C. W. Smith... 4

   Vegetation Recovery Following Goat Removal,
       D. Mueller-Dombois............................................. 5

   Investigation of Avian Malaria, C. van Riper III..... 6

   History of Endemic Hawaiian Birds, W. E. Banko........ 8

   Biology of Rats and Mongoose, J. K. Baker.............. 9

   Diseases of Endemic Plants, D. E. Gardner.............10

   Chemical and Biological Control of Exotics,
       D. E. Gardner...................................................12

   Phenology of Andropogon virginicus, J. Sorenson.....14

   Studies on Banana Poka, Anne M. LaRosa...............15

Haleakala National Park

   Resources Basic Inventory, C. W. Smith.................16

   Mammal Enclosure Studies, J. D. Jacobi................17

   Crater District Vegetation Map, L. D. Whiteaker.......18

   Kīpahulu Valley Feral Pig Study, C. H. Dione........20

Other Unit Activities..................................................22

Publications......................................................................23

CPSU/UH Past Reports Status.........................................24
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No biannual report will be presented for the projects listed below. Insufficient progress has been made to merit a full report. Since none of the projects are under contract I am submitting these brief statements outlining the status of each project:

Pu'uhonua o Hōnaunau National Historical Park

Impact of boating on reefs, Hōnaunau Bay
Robert A. Kinzie, III
The report is undergoing revision after review.

Survey of vascular plants
Evangeline Funk
The report is still in a draft form. A personal tragedy has distracted the author's attention from this project. A list of the species present has, however, been given to the Superintendent.

Hawaii Volcanoes National Park

Plant Survey of Kalapana Extension
Frederick R. Warshauer
The author has been employed on another project for the past six months. He has returned his attention to this work recently.

Colonization of Intertidal Zone at Keauhou
Daniel P. Cheney
The report is undergoing some revisions. Unfortunately, the author is incommunicado in Micronesia for much of the year.

Haleakala National Park

Studies on Hawaiian Tarweeds
Gerald D. Carr
Work on the cytogenetics of the Hawaiian Tarweeds continues under the sponsorship of the National Science Foundation. Further studies on the physiological ecology of the Haleakala silversword by Dr. Robert Robichaux, UC at Berkeley, and Dr. Carr are about to begin. Large stocks of plants for experimental purposes are to be grown on Haleakala with the cooperation of the Superintendent, HALE. The BBC Open University Program is organizing several lessons on Hawaiian biology including the evolution of the Hawaiian Tarweeds. Dr. Carr is the principal advisor and both National Parks have considerable exposure in the planned documentaries.
Contribution Number CPSU/UH 004/11

HAWAII VOLCANOES AND HALEAKALA NATIONAL PARKS

BIRD SURVEY

Project Leader: Dr. Sheila Conant
Assistant Professor of General Science
University of Hawaii at Manoa

Contract Numbers: CX 8000 7 0007 and CX 8000 6 0031
Started on January 1, 1976
Anticipated termination on May 1, 1980

Objectives: 1. To provide an updated checklist of birds in Hawaii Volcanoes National Park and Haleakala National Park Crater District.

2. To provide population density figures for each species, in each park.

3. To provide provisional distribution maps for each species, in each park.

Progress: The Kalapana Report is ready for internal review. Figures have been drawn and draft copies of the report will be circulating shortly.

The final report for HAVO is in preparation. Completion is anticipated during the summer months.

Field work in the Kīpahulu District HALE continues. A trip was made in early January, but coincided with a severe tropical storm. Nevertheless the lower valley floor below 3000 ft. was surveyed. It is anticipated that several additional trips to the higher elevation sectors of both upper and lower floors will be needed. Both Gordon Joyce and Alvin Yoshinaga have reported the Warbling Silverbill (Lonchura malabarica) to be present in the pasture area near 'Ohe'o stream. Though the species was first reported from Maui over a year ago, these are the first records for the Kīpahulu area.

At the November AIBS Conference on Research in National Parks a paper entitled "Endangered Birds in Hawaii's National Parks" was presented.

Submitted by: S. Conant
HAWAII VOLCANOES NATIONAL PARK

ROLE OF FIRE IN THE NATURAL ECOSYSTEM

Project Leader: Dr. Clifford W. Smith
Director, CPSU/UH
University of Hawaii at Manoa

Contract Number: CX 8000 7 0008 and CX 8000 6 0031
Started in January 1976
Anticipated termination on May 1, 1980

Objectives: 1. To evaluate the recovery of six ecosystems within Hawaii Volcanoes National Park after fire.
2. To measure the effect of fire on the survival, reproduction, and growth of plants.
3. To determine whether or not the damage by fire to a particular ecosystem would merit intervention by the National Park Service.

Progress: The Six Tanks fire report has been reorganized and the data re-evaluated. The report is still in a rough draft form but will be completed shortly.

Data from the Namakani Paio and Ainahou burns are being evaluated. All results so far show that Andropogon virginicus rapidly invades or increases in density after a fire. At the Ainahou burnsite, a fungus was found on dead burnt Andropogon tussocks. It is not known whether the fungus can only colonize the dead shoots or whether it attacks the grass after the fire. There was an obvious correlation between the presence of the fungal fruiting bodies and less vigorous or dead grass tussocks. The problem has been passed on to Dr. Gardner for further analysis.

The Puu Kaone area was visited soon after the fire. Hyparrhenia rufa had resprouted within 10 days of the fire and has continued growing. A large number of Indigofera seedlings have germinated in the area. Five planted wiliwili trees in the area were severely damaged but one has now begun to produce new leaves.

A paper on the Hilina Pali fire and the subsequent re-vegetation was presented at the Second Conference on Scientific Research in the National Parks.

Submitted by: C. W. Smith
VEGETATION RECOVERY FOLLOWING GOAT REMOVAL

Project Leader: Dr. Dieter Mueller-Dombois
Professor of Botany
University of Hawaii at Manoa

Contract Numbers: CX 8000 7 0006 and CX 8000 6 0031
Started on November 1, 1975
Anticipated termination on June 1, 1980

Objectives: 1. To monitor the changes in vegetation in previously established sites.
2. To produce a new vegetation map for the coastal lowland.
3. To project the probable path of recovery and identify potential problems in the new ecosystem.

Progress: An outline for a map report has been prepared and most of the field data has been assembled. A photomosaic was made to serve as a base map for transferring the vegetation boundaries from a preliminary map tracing. However, the mosaic shows some scale distortions so that a different base map may still have to be prepared.

Progress on Objective 3 has continued with 8 additional sites being established during December, 1979. This brings the total number of floristic relevés and quantitative enumeration transects to 30. During May, 1980, 10 more sites will be fully established. The final total of 40 sites will be fully analyzed during the Summer, 1980.

Concentrations of several aggressive exotic plants in the study area have been passed on to the resource manager. During mid-March a meeting was held with Dr. Dan Taylor discussing various management options in some of the remote coastal grasslands.

Submitted by: D. Mueller-Dombois
INVESTIGATION OF AVIAN MALARIA IN HAWAII'S NATIONAL PARKS

Project Leader: Dr. Charles van Riper III
Unit Leader, CPSU
University of California, Davis

Contract Number: CX 8000 7 0009
Started in May 1977
Anticipated termination in May 1980

Objectives: 1. To determine susceptibility of native Hawaiian birds to malarial parasites.

2. To determine if the night-flying mosquito (Culex quinquefasciatus) is the vector of avian malaria in Hawai'i.

3. To determine methods of transmission and potential vectors of other avian blood parasites in Hawai'i.

4. To determine what percentage of the birds in the National Park are affected today.

5. To determine if introduced bird species can act as potential reservoirs of avian parasites in Hawai'i.

Progress: Blood slides of all wild-caught and experimental birds have been read, and the results are presently being entered into a computer data bank. Netting and bleeding of wild-caught birds is being continued on a monthly basis at the Hawaii Volcanoes National Park Research Center.

Studies on mosquito transmission of Plasmodium have been completed. Culex quinquefasciatus was infected with the malaria parasite, development of sporozoites followed, and the mosquito successfully transmitted the disease back to another host. We were unsuccessful in transmitting malaria with Aedes albopictus. Results of the mosquito distribution work will be presented by Dr. M. Lee Goff at the Third Conference in Natural Science at Hawaii Volcanoes National Park in June 1980.

Ectoparasites are being sorted and will be given to a number of scientists for identification. A general overview of the ectoparasites collected to date has been released as a CPSU/UH technical report #29. Endoparasites have been sorted, and most have been sent out for identification. Flukes are being worked on by Dr. Alan Bush at the University of Alberta and nematodes by the Nematology Department at the University of California, Davis. Results of this research will be forthcoming next year.
Some problems have been encountered with data reduction and analysis because of a change in computer systems. This has caused a delay in the completion of the project, and the final report is not expected until after the start of the 1981 fiscal year. Preliminary results of this work were presented at the Second Annual National Park Service Science Conference in San Francisco, 26-30 November 1979.

Two CPSU/UH Technical Reports from this contract were published. They are: Technical Report #29 Mites (Chelicera: Acari) Parasitic on Birds in Hawaii Volcanoes National Park by M. Lee Goff. The abstract reads as follows:

'The external parasites of native and exotic birds captured in Hawaii Volcanoes National Park are recorded. Forty-nine species of mites in 13 families were recovered from 10 species of birds. First records of Harpyrhynchidae are given for 'Amakihi and 'Apapane; Cytodites sp. (Cytoditidae) is recorded from the Red-billed Leiothrix for the first time in Hawai'i. Two undescribed species of Cheyletiellidae, 1 undescribed species of Pyroglyphidae, and 19 undescribed feather mites of the super-family Analgoidea are noted.'

Technical Report #30, Distribution of Mosquitoes (Diptera: Culcidae) on the East Flank of Mauna Loa Volcano, Hawai'i by M. Lee Goff. The abstract reads as follows:

'Through a network of sampling stations from sea level to 6000 feet (2000 m), two species of mosquitoes, Culex quinquefasciatus and Aedes albopictus, were collected from the east flank of Mauna Loa Volcano. These collections expanded the altitudinal distribution for C. quinquefasciatus from 900 feet to 4500 feet (300 m - 1500 m). A. albopictus was recovered only below 900 feet (300 m). Upper elevation distribution of C. quinquefasciatus was restricted to kipukas. No difference in egg production was observed with increasing altitude during this study. Breeding sites on the east flank of Mauna Loa were primarily tree holes rather than the ground pools and large artificial containers used by this species in other areas of the South Pacific. The "mosquito-free sanctuary" above 1800 feet (600 m) noted for the island of Kaua'i does not exist on the east flank of Mauna Loa.'

Submitted by: C. van Riper III
HAWAII VOLCANOES NATIONAL PARK

A HISTORICAL SYNTHESIS OF ENDEMIC HAWAIIAN BIRDS WITH SPECIAL EMPHASIS ON SPECIES FOUND WITHIN HAWAII'S NATIONAL PARKS

Project Leader: Winston E. Banko
Research Associate
Hawaii Volcanoes National Park

Contract Number: CX 8000 8 0012
Started on January 1, 1978
Anticipated termination on September 30, 1982

Objectives: 1. To produce six manuscripts analyzing the role of food depletion, competition by foreign organisms, predation, disease, and habitat alteration and destruction in the decline and extinction of recent Hawaiian avifauna.

2. To produce eleven manuscripts describing in detail the known history of endemic Hawaiian birds.

Progress: Reports 1 and 2 have been completed, printed and distributed; 3 remains pending; 4, 5 and 6 have been completed and presumably at the printers. Report 7 has just been received back for possible changes following comments by reviewers. Work continued during the period on Report 8. A total of 1,292 records of the 'Amakihi (4 subspp.) have been extracted from literature and unpublished material, sorted geographically, arranged chronologically, and typed. Drafting of text for the 'Amakihi historical account is in the final phase.

Extraction and systematic arrangement of historical records has been completed for Loxops parva and L. sagittirostris, the 6 subspecies of L. maculata, the 4 subspecies of L. coccinea and Melamprosops phaeosoma. Typing of records has been completed for 2 of the above 13 taxa. It is anticipated that the final draft of Report 7, in line with reviewer's comments, and initial manuscripts comprising historical accounts of the 17 taxa in Report 8 will be completed in April.

Reorganization of this contract into a more flexible format is under discussion.

Submitted by: W. E. Banko
HAWAII VOLCANOES NATIONAL PARK

BIOLOGY OF RATS AND MONGOSES

Project Leader: James K. Baker
Research Biologist
Hawaii Vield Research Center
Hawaii Volcanoes National Park

Not under contract
Started in October 1977
Anticipated termination in September 1980

Objectives: To study the distribution, numbers, and ecological impact of non-native rats and mongooses on native plant and animal species in Hawaii Volcanoes National Park.

Progress: A 500 m² grid site was selected in the coastal low-lands of the park as a third area to study population and home range sizes of rats and mongooses, and basic food habits. Site selection was made on the basis of a nearby nene enclosure; in part to determine if marked mongooses would be attracted by the presence of nene to the vicinity of a nesting site. A vegeta-tional analysis of the study grid was made, and an initial trapping program started. We encountered Polynesian rats, Rattus exulans, for the first time in our park-wide studies. Scats of feral house cats were relatively abundant in the study area, and one house cat was trapped.

The two one-hectare trap sites in a Kipuka Puaulu Osmanthus tree grove and at a Hibiscadelphus tree area, which had been trapped free of rats, were retrapped for reinvacion studies. We found that rats will reinvade a trapped-out area within one to two months.

Additional rats were trapped in Kipuka Puaulu; up the Mauna Loa Strip Road, and in the rain forest study area adjacent to the Hawaii Field Research Center for further stomach analyses on food preferences.

Results of radio-telemetry work on rats and mongooses have been less than successful. Our most recent effort on a radio-collared mongoose failed. After the mongoose was released it couldn't be found again. We suspect the mongoose worked its collar loose in a den or burrow down under rocks, and we were not able to receive the radio signals thereafter.

Submitted by: K. Baker
C. Russell
HAWAII VOLCANOES NATIONAL PARK

DISEASES OF ENDEMIC PLANTS

Project Leader: Dr. Donald E. Gardner
Research Scientist
CPSU/UH
University of Hawaii at Manoa

Not under contract
Started in October 1977
Anticipated termination in September 1980

Objectives: To evaluate the role of plant diseases in native HAVO ecosystems, with emphasis upon as yet undescribed or little-understood diseases or physiological conditions affecting rare plant species or which otherwise exert a significant influence upon components of native ecosystems.

Progress: Primary emphasis was placed on the koa rust disease caused by Uromyces koae. This has long been recognized as a prominent, and presumably destructive, disease condition among Acacia koa stands in Hawaii Volcanoes National Park. However, the complex disease cycle, which involved several distinct spore stages and infection manifestations was not understood prior to the present investigations. To determine the life cycle of the fungus, observation of nuclear behavior among the various spore stages was necessary. The development of satisfactory techniques for spore germination and nuclear staining to enable these studies was difficult and required a considerable amount of time and effort, as did the observations themselves. These investigations have resulted in the discovery of two formerly unrecognized spore stages. U. koae may now be described as a macrocyclic, autecious rust, although unique in its failure to produce basidiospores or typical basidia. This information is currently being prepared for publication.

Tissue of diseased leaves and twigs of Dodonaea sp. and Vaccinium sp. showing the pathological condition of unknown origin described in previous reports was examined microscopically and compared with normal tissue. This was accomplished by preparing the tissue for, and embedding the tissue in paraffin, sectioning the embedded tissue with a microtome, and mounting and staining the sections to make permanent microscope slides. Evaluation of these observations is continuing.

Diseased leaf tissue of Canavalia kauensis was processed and prepared as described above for observation to determine the cause of a potentially severe leafspot disease. Fungus material from diseased plants in the field was cultured on
artificial medium in the laboratory, and this was used to inoculate healthy plants grown from seed in the greenhouse. The fungus material was re-isolated from greenhouse plants developing the disease and re-cultured. Since *C. kauensis* is a relatively newly discovered leguminous species, these are among the first investigations of its diseases.

Submitted by: D. E. Gardner
CHEMICAL AND BIOLOGICAL CONTROL OF EXOTIC PLANTS

Project Leader: Dr. Donald E. Gardner
Research Scientist
CPSU/UH
University of Hawaii at Manoa

Not under contract
Started in October 1977
Anticipated termination in September 1980

Objectives: To determine the feasibility of exotic plant control through means not being presently utilized at HAVO. Such means include the evaluation of herbicides not formerly approved for use in NPS areas and the development of new techniques for their application. Also, to determine pathogenic biological agents which may show promise as potential biocontrol organisms.

Progress: Emphasis was placed on determining and testing the procedure through which application is made for the introduction of potential biocontrol agents into Hawaii. Preliminary information indicates that this process is at best involved, lengthy, under the complete jurisdiction and control of the State Board of Agriculture. Highest priority is given to the protection of economic crops. Where incomplete information is available concerning the biology and host range of the biocontrol agent in question, or where control of exotic plants related to economic crop or ornamental plants is desirable, approval for introduction of organisms under any conditions is generally not granted. A particular fungus reported by other investigators to be pathogenic on Myrica faya in the native habitat of this species was of primary interest in the present investigation. Host range studies of this organism had previously been conducted in Portugal on plants of economic value in Hawaii. The investigating plant pathologist has expressed a willingness to cooperate in supplying cultures of the fungus for our investigations. The latter would be directed at ascertaining the probable effectiveness or limitations of this pathogen as a biocontrol agent under local conditions. Further host range studies and an evaluation of virulence on particular crop plants it has been reported to attack would also be conducted under local conditions.

Measuring of soil moisture levels in the M. faya habitat as reported in the previous report continued.

In support of the exotic plant control programs of the HAVO Resources Management Division, I have consulted closely with these personnel and participated in a meeting among NPS and other interested and knowledgeable people. This effort was directed at evaluating actual and potential threats posed by particular exotic plant species and establishing priorities for plant control based on this information as well as feasibility of control.
I attended the Second Conference on Scientific Research in the National Parks and presented a paper reporting earlier biocontrol work using a plant pathogenic fungus.

Submitted by: D. E. Gardner
Project Leader: James C. Sorenson
Research Assistant in Botany
University of Hawaii at Manoa

Not under contract
Started on August 10, 1979
Anticipated termination on September 1, 1980

Objectives: 1. To determine the effects of substrate and climate on the phenology of Andropogon virginicus.

2. To determine under what conditions, if any, A. virginicus is vulnerable to competition.

3. To analyze the fire hazard of A. virginicus at various times of the year.

4. To evaluate the impact of A. virginicus on succession in native Hawaiian ecosystems.

Progress: Data analysis and interpretation is completed and the final report is being written.

Preliminary indications are that the raw data related mostly to objective 1, whereas the conclusions regarding the other objectives must be based on observational information coupled with reported results of previous investigators.

Data analysis has revealed that A. virginicus is not adapted to Hawaii's moisture seasonality, but may be responding to other seasonally fluctuating variables such that it is indifferent to the moisture seasonality.

Other conclusions and explanations will be made available shortly in the final report.

Submitted by: J. C. Sorenson
HAWAII VOLCANOES NATIONAL PARK

STUDIES ON BANANA POKA

Project Leader: Anne M. LaRosa
Graduate Student
Botany Department
University of Hawaii at Manoa

Not under contract
Started in January 1980
Anticipated termination in August 1981

Objectives: 1. To evaluate the role of the feral pig in the dispersal and establishment of banana poka.

2. To determine the requirements for seed germination.

3. To determine seedling growth rates and light requirements.

Progress: Three study sites have been selected on the island of Hawaii: Ola'a Tract, Hawaii Volcanoes National Park; Keanakolu, Manowaialee Forest Reserve above Laupahoehoe; and Honuaula Forest Reserve on Hualalai. The density, population structure, vigor and phenology of banana poka, koa and/or 'ohi'a will be measured in each area.

With the assistance of the resource management specialist at HAVO, pig preference of banana poka as a food will be evaluated and the retention time of seeds in the gut established. The seeds passed through the gut will be tested for viability and compared with undigested seeds.

Submitted by: C. W. Smith
HALEAKALA NATIONAL PARK
RESOURCES BASIC INVENTORY

Project Leader: Dr. Clifford W. Smith
Director, CPSU/UH
Associate Professor of Botany
University of Hawaii at Manoa

Contract Numbers: CX 8000 7 0003 and CX 8000 6 0031
Started in June 1975
Anticipated termination on May 1, 1980

Objectives: 1. To produce an annotated checklist of the
insects, birds, flowering plants, conifers, ferns, mosses,
liverworts, and lichens.

2. To produce distribution maps for all of the above.

3. To provide a comprehensive collection of all specimens
for Haleakala National Park.

4. To produce a monograph on the organisms of the Crater
District, with comments on their distribution.

Progress: The final report on the insects of the Crater
District has just been submitted for review. The resource
management recommendations have been re-evaluated. A paper
on the resources and management problems in the area was
delivered to Sigma Xi in Hilo in late March.

A paper on the endangered species of Hawaii's National
Parks emphasizing some of the Crater District problems was
presented at the Second Conference on Scientific Research in
the National Parks.

Submitted by: C. W. Smith
HALEAKALA NATIONAL PARK

MAMMAL ENCLOSURE STUDIES:
COMPETITION BETWEEN NATIVE AND EXOTIC PLANT SPECIES

Project Leader: James D. Jacobi
Graduate Student in Botany
University of Hawaii, and
U.S. Fish and Wildlife Service, Hawaii

Contract Number: CX 8000 7 0005
Started in August 1973
Anticipated termination on May 1, 1980

Objectives: 1. To assess the competitive effects of Holcus lanatus (velvet grass or Yorkshire fog) in Deschampsia grassland and Sophora scrub.

2. To monitor the effect of excluding exotic mammals from the above communities.

Progress: The principal investigator has been unable to complete this year's inventory of the grassland enclosure due to a recurrent back problem. A paper summarizing the results of this investigation was presented at the Second Conference on Scientific Research in the National Parks. This paper forms the nucleus of the final report of the project which is about to be submitted for review.

Submitted by: C. W. Smith
HALEAKALA NATIONAL PARK

CRATER DISTRICT VEGETATION MAP

Project Leader: Louis D. Whiteaker
Research Assistant in Botany
University of Hawaii at Manoa

Contract Number: CX 8000 7 0004
Started on October 1, 1976
Anticipated termination in May 1, 1980

Objectives: 1. The production of a map of the ecosystems of Haleakala National Park Crater District, to include a large-scale master map which will be reproduced in such a manner that it will overlay the standard "quad" maps.

2. Quantitative descriptions of each vegetation unit.

3. Correlation analysis of recognized ecosystems with soil and environmental data.

Progress: The final report for this contract is being prepared for publication as CPSU/UH Technical Report #31 entitled "Vegetation Map of Haleakala National Park Crater District" by Louis D. Whiteaker. The abstract follows:

'A vegetation map of the Crater District of Haleakala National Park was produced at a scale of 1:24,000 which can be used as an overlay of the United States Geological Survey (USGS) topographic quadrangle maps. Fifty-three structural-floristic communities were mapped which were grouped into four structural vegetation-types (forest, scrub, grassland, and high altitude desert). Areas were calculated for each community using an electronic planimeter. The total area mapped was 7544.8 ha (18,643 acres).

Topographic vegetation profiles were constructed which show changes in vegetation-types in relation to climatic gradients. Also, matching correlations were observed between certain substrates and community types.

Phytosociological analysis of relevé (vegetation sample) data by the synthesis table technique and the dendrograph technique resulted in ecologically meaningful groupings. Both analyses produced similar groupings though detailed comparison of the results of the two methods revealed interesting minor variations. Some relevés were left ungrouped. These were interpreted as unique community types within the sampling area.

The hypothesis that the community types that are characteristic of other tropical alpine and subalpine ecosystems occur in the Crater District of Haleakala National Park was partially supported by the map units and phytosociological analyses of the relevé data. Ericaceous (pukiawe-type) scrub, tussock grassland, and high altitude desert occur as mappable
vegetation units. Only arborescent and rosette life-forms did not occur as mappable units. However, a rosette life-form, *Argyroseriphium sandwicense* (silversword), does occur in the study area and may have had a wider and more abundant distribution in the past.

The hypothesis that the vegetation map of the Crater District of Haleakala National Park has similar vegetation units and vegetation-types as those mapped by Mueller-Dombois and Fosberg (1974) for the tropical alpine and subalpine ecosystem on the slopes of Mauna Loa in Hawaii Volcanoes National was supported by a comparison of the two maps.

Variation of the vegetation within the study area was associated with variations in climate, substrate, mechanical influences, and the effects of exotic plant species. Climate diagrams confirmed the tropical high mountain character of the study area, while they also illustrated the considerable variation of climate within the Crater as well as its seasonal variation. It was concluded that the diurnal (daily) frost boundary, as indicated by the vegetation, should be used to define the lower limit of the alpine zone in tropical high mountain areas. This conclusion implies that the subalpine zone be defined as those areas below the diurnal frost boundary and above the montane forests and grasslands.'

Submitted by: L. D. Whiteaker
HALEAKALA NATIONAL PARK

KI'PAHU LU VALLEY FERAL PIG STUDY

Project leader:  C. H. Diong
Research Assistant in Zoology
University of Hawaii at Manoa

Contract Number:  CX 8000 8 0011
Started on October 1, 1977
Anticipated termination on December 31, 1980

Objectives: 1. To determine the distribution, abundance, and biology of feral pigs in Ki'pahulu Valley, Maui.
2. To determine the ecological impact of feral pigs in that area.
3. To provide management recommendations relating to these exotic animals.

Progress: Studies on home range and movement patterns continue with monthly tracking from fixed ground stations, and from ground tracking with hand-held yagi antennae. Two of the three low elevation collared subjects had been shot by hunters. Data are being collected from 8 subjects - one at low elevation, 5 at mid and high elevation on the upper plateau and 2 on the lower floor. The size of home range is typically small, ranging from 0.9 sq.km. to 3.2 sq. km. Movement and activity pattern are found to be affected by heavy and continuous rain, rivers, terrain and fruiting of the strawberry guava. Below 2200 ft. the movement is much affected by hunting pressure. The tracking study has shown that there is pig movement between the two plateaus, between the upper plateau and the Koukouai Gulch, and between the Koukouai Gulch and the lower plateau. These pig trails have been located.

Some of the problems encountered in the tracking studies are: (1) frequency drift, which proved annoying but not problematic yet, since all transmitters are distinguishable, (2) signal extinction especially during daylight hours, sometimes for long periods, and then reappearing again.

For the estimation of abundance, 42 animals have been captured, marked, and released. A partial analysis of the data together with data from track counts show that: (1) the density ranges from 5-10 pigs per sq. km., (2) recapture data do not fit a poison distribution, suggesting either non-random captures or unequal catchability, (3) retention of tags is 100%, with no loss of either eartags or collars. The population appears to be thinly distributed, with a higher density in the mid elevations. Pigs have a tendency to disappear from some areas for long periods.

Autopsy studies and direct observation show that breeding is an all-year activity. There is evidence, however, for two farrowing peaks, one from November to March and another from June to September. Data on prenatal litter size (number of live fetuses per uterus) and postnatal litter size suggest a piglet mortality of at least 35%. For objective (3), more specifically for control measures, total percentage of sows pregnant or suckling will be computed.
for use together with the trapping data to determine when, how and where reduction of densities could be most effectively carried out with minimum cost and effort.

Observations on the high incidence of dental caries and the fewer old animals have lead to the formulation and testing of the following hypothesis: that dental caries and tooth loss, probably the result of food habits, may be an important factor in cropping animals, especially older ones 'from the top'. A caries index is being developed to quantitatively evaluate the incidence of tooth loss and deterioration in the population.

The January storm damaged three shelters and completely devastated one other shelter, destroying all food and live-in items. One double yagi, 8-element tracking antenna was blown down and into pieces by winds well over 80 m.p.h. (I arrived at this conclusion because the antenna can only withstand wind speeds up to 80 m.p.h.). Other losses, due to tree fall, were a beacon transmitter and a metal box trap. More disheartening was the total loss of some 6 months of frozen specimens due to a 7-day power failure. These include serum, whole blood and tissue samples destined for laboratories in Honolulu and on the Mainland as well as specimens and stomach contents. Those specimens previously stored at the Hana Fisherman's Club were also destroyed.

In January, the most severe winter storm in recent memory struck East Maui. On the Lower Floor of Kipahulu Valley between 610m (2000 ft.) and 910m (3000 ft.), approximately 22.1 trees per hectare (9 per acre) were blown down. Most were Acacia koa growing on exposed inclines. The number of trees lost along the top of the central escarpment between 610m (2000 ft) and 1500m (4980 ft.) was negligible. However, many trees suffered loss of branches, and much of the mossy epiphyte layer was blown away.

In addition to the exclosure at 660m (2150 ft.), a new 0.1 hectare (0.25 acre) exclosure was constructed at 1450m (4750 ft.) and a 0.3 hectare (0.75 acre) exclosure at 950m (3100 ft.), both near the central escarpment. The 1450m exclosure is to test the effect of pig exclusion on 'Ohi'a forest vegetation as yet uninvaded by exotics. The 950m exclosure will test effects of exclusion on a Koa forest where native ground layer has already been replaced by Hil grass.

One and a half years of records are now available for the 660m exclosure. So far there have been only small changes inside the exclosure and in the non-enclosed control area. Except for an apparent increase in litter within the exclosure, the changes have been more-or-less parallel, including an increase in the frequency of strawberry guava in both areas.

No strawberry guava seedlings have yet appeared at the 950m (3100 ft.) 10m x 10m (33' x 33') monitoring site. At both the 820m (2700 ft.) and 640m (2100 ft.) sites, a number of seedlings appeared in the first few months after removal of all strawberry guava, but in the most recent inventories, the numbers have declined.

Submitted: C. H. Diong
A. Y. Yoshinaga
OTHER UNIT ACTIVITIES

Western Regional Office 1. Met with Regional Chief Scientist in San Francisco to discuss Unit progress and future.

2. Responded to a number of Region requests for ideas and suggestions.

Hawaii Regional Office 1. Conferred with Mr. Barrel on several occasions to keep him informed on the developments and problems.

2. Discussed Lower Kipahulu problems and identified important biological resources and scientific concerns in the area.

Pu'ukohola Heiau N.H.S.

Pu'uhonua o Hōnaunau N.H.P. 1. Discussed koa haole eradication project.

2. Discussed management problems in coastal waters of Hōnaunau Bay.

Hawaii Volcanoes N.P. 1. Organized discussion by interested local biologists and conservationists who reviewed the revised exotic plant control program thereby assisting the resource management specialist establish priorities.

2. Published Proceedings of Second Conference in Natural Sciences at Hawaii Volcanoes National Park.

3. Met with Superintendent on several occasions to discuss resource management problems and possible research input.

4. Began assisting resource management specialist in the reorganization of the resource management program and related research needs.

5. Continued monitoring of Ainahou Burn. Also organized evaluation and monitoring of Kaone Burn.

Haleakala National Park 1. Met with Superintendent on several occasions to discuss resource management problems identified by HALE RBI.

2. Assisted Chief Ranger in rewriting resource management and natural science project statements.

3. Continued development of Kipahulu Valley research program.

4. Met with Nature Conservancy on several occasions identifying important biological resources in lower valley and scope of resource management problems in the area.
PUBLICATIONS


<table>
<thead>
<tr>
<th>Technical Reports</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 01-Year First Progress Report</td>
<td>Available</td>
</tr>
<tr>
<td>2. Proposal for the Study of Rare and Endangered Birds in Hawaii's National Parks.</td>
<td>No longer available</td>
</tr>
<tr>
<td>3. The Ohia Dieback Problem in Hawaii</td>
<td>No longer available</td>
</tr>
<tr>
<td>4. Vegetation Map, HAVO</td>
<td>Available</td>
</tr>
<tr>
<td>5. Revised Checklist of Vascular Plants, HAVO</td>
<td>Available</td>
</tr>
<tr>
<td>6. 01-Year Final Report</td>
<td>Available</td>
</tr>
<tr>
<td>7. 02-Year First Progress Report</td>
<td>Available</td>
</tr>
<tr>
<td>8. HAVO Fern Checklist</td>
<td>Available</td>
</tr>
<tr>
<td>9. HALE 1975 RBI Narrative</td>
<td>Available</td>
</tr>
<tr>
<td>10. Halapē Marine Survey</td>
<td>Available</td>
</tr>
<tr>
<td>11. Kī-pahulu Expedition 1976</td>
<td>No longer available</td>
</tr>
<tr>
<td>12. Ohia Decline: The Role of <em>Phytophthora cinnamomi</em></td>
<td>Available</td>
</tr>
<tr>
<td>13. PUHE Marine Fauna</td>
<td>No longer available</td>
</tr>
<tr>
<td>14. Hawaiian Bird Bibliography</td>
<td>No longer available</td>
</tr>
<tr>
<td>15. PUHE Plant Survey</td>
<td>Available</td>
</tr>
<tr>
<td>16. PUHE Marine Flora</td>
<td>Available</td>
</tr>
<tr>
<td>17. Limnological Survey of Lower Palikea and Pīpīwai Streams, Kīpahulu, Maui</td>
<td>Available</td>
</tr>
<tr>
<td>18. The Hilina Pali Fire: A Controlled Burn Exercise</td>
<td>Available</td>
</tr>
<tr>
<td>19. Kīpahulu Valley Feral Pig Proposal</td>
<td>No longer available</td>
</tr>
<tr>
<td>20. Ohia Rain Forest Study</td>
<td>Available</td>
</tr>
<tr>
<td>21. Hawaiian Bird Bibliography</td>
<td>Available</td>
</tr>
<tr>
<td>Part 1--The Bibliography</td>
<td>Available</td>
</tr>
<tr>
<td>Part 2--Keyword Index</td>
<td>Available</td>
</tr>
<tr>
<td>Part 3--Author/Source Index</td>
<td>Available</td>
</tr>
<tr>
<td>22. Kīpahulu Valley Research Plan</td>
<td>Available</td>
</tr>
<tr>
<td>23. Evaluation of Rare and Endangered Bird Research Programs for Hawaii's National Parks</td>
<td>No longer available</td>
</tr>
<tr>
<td>24. Haleakalā National Park Crater District Resources Basic Inventory: 1976-77</td>
<td>Available</td>
</tr>
</tbody>
</table>
Technical Reports (continued)

25. Haleakala National Park Crater District Resources Basic Inventory: Mosses

26. Haleakala National Park Crater District Resources Basic Inventory: Birds

27. An Ecological Survey of Pua'alu'u Stream

28. Proposed Native Ecosystem Restoration Program for Halape, Kiahou, and Apua Point Hawaii Volcanoes National Park

29. Mites (Chelicerata: Acari) Parasitic on Birds in Hawaii Volcanoes National Park

30. Distribution of Mosquitoes (Diptera: Culcidae) on the East Flank of Mauna Loa Volcano, Hawai'i

Avian History Reports

HISTORY OF ENDEMIC HAWAIIAN BIRDS

1. Introduction

2. Report #2

Other Reports

01-Year Final Report

02-Year Final Report

Ohia Rain Forest Study - First Progress Report

Proceedings, First Conference in Natural Sciences, HAVO

Proceedings, Second Conference in Natural Sciences, HAVO

Biannual Report #5, February 1976

Biannual Report #6, June 1976

Biannual Report #7, September 1976

Biannual Report #8, March 1977

Biannual Report #9, September 1977

Biannual Report #10, March 1978

Biannual Report #11, September 1978

Biannual Report #12, March 1979

Biannual Report #13, September 1979

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