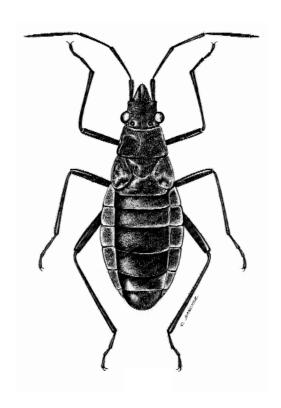
# WĒKIU BUG BASELINE MONITORING

### QUARTERLY REPORT 2<sup>nd</sup> QUARTER 2004





Pacific Analytics, L.L.C.

Cover: Wēkiu Bug drawn by Mr. C. Sanchez of the University of the Philippines College of Science and Humanities.

# WĒKIU BUG BASELINE MONITORING

### QUARTERLY REPORT 2<sup>nd</sup> QUARTER 2004

Prepared for

The Outrigger Telescopes Project WM Keck Observatory Kamuela, Hawai'i



Pacific Analytics, L.L.C.

P.O. Box 219 Albany, Oregon 97321 www.statpros.com

#### Prepared by:

Pacific Analytics, L.L.C. Post Office Box 219 Albany, Oregon 97321 Tel. (541) 926-0117 mail@statpros.com www.statpros.com

Gregory Brenner Senior Associate / Project Manager

The pictures contained in this report are for the exclusive use by Pacific Analytics, L.L.C and its clients. All photographs are copyrighted by Pacific Analytics, L.L.C. and may not be reproduced or used without the express written permission of Pacific Analytics, L.L.C.

#### Wēkiu Bug Baseline Monitoring TABLE OF CONTENTS

#### WĒKIU BUG BASELINE MONITORING

# QUARTERLY REPORT 2<sup>nd</sup> QUARTER 2004

#### I. TABLE OF CONTENTS

		Pa	ge
I.	TABLE OF CONTENTS	:	1
II.	EXECUTIVE SUMMARY	2	2
III.	INTRODUCTION	4	4
IV.	QUESTIONS OF INTEREST	(	6
V.	METHODS	8	8
VI.	RESULTS	12	2
VII.	DISCUSSION	2	7

#### Wēkiu Bug Baseline Monitoring EXECUTIVE SUMMARY

#### II. EXECUTIVE SUMMARY

The Mauna Kea Science Reserve (MKSR) is located on the summit of Mauna Kea, the tallest mountain in Hawai'i. Within this reserve are the world's two largest optical telescopes, constituting the W. M. Observatory (WMKO). The slopes of Pu'u Hau'oki directly adjacent to and below the WMKO are part of a unique natural environment that supports the Wēkiu bug, a rare insect. Wēkiu bug habitat generally occurs on the upper elevations of Mauna Kea. Populations of Wēkiu bugs also occur on other cinder cones above about 11,700-ft (3,570-m) elevation.

The National Aeronautics and Space Administration (NASA), together with the California Institute of Technology/ **Tet** Propulsion Laboratory (CalTech/JPL), California the Association for Research in Astronomy (CARA) and University the Hawai'i/Institute for Astronomy (UH/IfA), have proposed to protect and enhance Wekiu bug habitat on Pu'u Hau'oki to mitigate potential disturbance by on-site construction and installation of the Outrigger Telescopes. To that end these participants have prepared the Wekiu Bug Mitigation Plan and Wekiu Bug Monitoring Plan. They are also the participants in this Wekiu Bug Baseline Monitoring Plan.

Sampling of Wekiu bug habitat was approved to establish baseline population estimates of the Wekiu bug in the area surrounding the site of the proposed Outrigger Telescopes Project and at a control site on Pu'u Wēkiu. The intended purpose of this activity is to gather reliable scientific information about population trends in both areas that can be used to determine the effectiveness of habitat protection and restoration, and the impacts, if any, due to construction of the Outrigger Telescopes Project.

Sampling of Wēkiu bugs is being conducted to answer two main Questions of Interest. They are:

- 1) How, where and when are the Wēkiu bug populations changing? Locations of interest include current habitat on Pu'u Hau'oki crater and undisturbed Wēkiu bug habitat at Pu'u Wēkiu (for comparison).
- 2) Are weather phenomena, human activities, and/or other factors associated with Wēkiu bug and/or other resident arthropod population change?

#### Wēkiu Bug Baseline Monitoring EXECUTIVE SUMMARY

Nondestructive sampling is one of the best approaches to monitoring rare and sensitive invertebrate species. Special live-traps were developed and tested during the 1997-98 MKSR arthropod assessment and were deployed during Baseline Monitoring setup. Subsequent modifications to the trap design were implemented to reduce mortality in the traps. Ten livetraps are installed at the summit of Mauna Kea at designated locations, five on Pu'u Hau'oki and five on Pu'u Wēkiu.

The 2<sup>nd</sup> Quarter 2004 three-week sampling session was conducted from May 22, 2004 through June 13, 2004. During this sampling session a total of 383 Wēkiu bugs appeared in or near the live-traps. Three hundred eleven Wēkiu bugs were found on Pu'u Hau'oki, and 72 were found on Pu'u Wēkiu. Trap capture rates ranged from 0.2 to 25.4 Wēkiu bugs per trap per 3 days of sampling.

The average trap capture rate on Pu'u Hau'oki during the 2<sup>nd</sup> Quarter 2004 monitoring session was 8.76 Wēkiu bugs per trap per 3 days of sampling. This rate is about equal to the average capture rate measured on Pu'u Hau'oki during the 2<sup>nd</sup> Quarter 2002 baseline monitoring session (10.26 WB), and about one tenth the average capture rate measured on Pu'u Hau'oki during the 2<sup>nd</sup> Quarter 2003 baseline monitoring session (90.6 WB).

The average trap capture rate on Pu'u Wēkiu during the 2<sup>nd</sup> Quarter 2004 monitoring session was 2.06 Wēkiu bugs per trap per 3 days of sampling.

About 10% of the Wēkiu bugs were captured in the 2<sup>nd</sup> Quarter 2004 sampling session were immature stages. The appearance of juvenile stages is a clear indication that Wēkiu bugs are breeding.



Silversword near Mauna Kea Access Road. Picture taken May 28, 2004.

# Wēkiu Bug Baseline Monitoring INTRODUCTION

#### III. INTRODUCTION

The Mauna Kea Science Reserve is located on the summit of Mauna Kea. the tallest mountain in Hawai'i. Within this reserve are the world's two largest optical telescopes, constituting the W. M. Keck Observatory (WMKO). The slopes of Pu'u Hau'oki directly adjacent to and below the WMKO are part of a unique natural environment that supports the Wekiu bug, a rare insect. Wēkiu bug habitat generally occurs on the upper elevations of Mauna Kea. Populations of Wēkiu bugs also occur on other cinder cones above about 11,700-ft (3,570-m)elevation.

Current plans call for adding four, and possibly up to six Outrigger Telescopes on the WMKO site. The Outrigger Telescopes would be placed strategically around the existing Keck Telescopes.

The National Aeronautics and Space Administration (NASA), together with the California Institute of Technology/ Jet Propulsion Laboratory (CalTech/JPL), the California Association for Research in Astronomy (CARA) and the University of Hawai'i/ Institute for Astronomy (UH/IfA), have proposed to protect and enhance Wēkiu bug habitat on

Pu'u Hau'oki to mitigate potential disturbance by on-site construction and installation of the Outrigger Telescopes Project. To that end these participants have prepared the Wēkiu Bug Mitigation Plan and Wēkiu Bug Monitoring Plan. They are also the participants in this Wēkiu Bug Baseline Monitoring Plan.

Sampling of Wekiu bug habitat was approved to establish baseline population estimates of the Wekiu bug in the area surrounding the site of the proposed Outrigger Telescopes Project and at a control site on Pu'u Wēkiu. The populations of Wekiu bugs were last measured near these sites in 1998 during an arthropod assessment which became part of the Environmental Impact Statement prepared for the Mauna Kea Science Reserve Master Plan approved in 2000 by the UH Board of Regents. This new monitoring activity is providing current information.

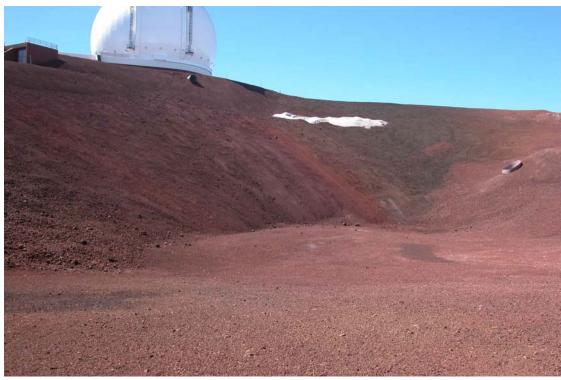
The intended purpose of the current activity is to gather reliable scientific information about population trends in both areas that can be used to determine the effectiveness of habitat protection and restoration, and the

#### Wēkiu Bug Baseline Monitoring INTRODUCTION

impacts, if any, due to construction of the Outrigger Telescopes Project.

This is the tenth Quarterly Report of Baseline Monitoring. The results of the sampling effort, conducted May 22, 2004 through June 13, 2004, are

reported. Comparisons to previously collected data are presented, along with new analysis and interpretations of correlations of changes in Wēkiu bug populations with weather related phenomena.



The inner slopes and crater floor of Pu'u Hau'oki where proposed Wēkiu bug habitat restoration would be implemented. Photo taken May 22, 2004.

#### Wēkiu Bug Baseline Monitoring QUESTIONS OF INTEREST

#### IV. QUESTIONS OF INTEREST

Important Questions of Interest are those with answers that can be efficiently estimated and that yield the information necessary for management decision-making. The following Questions of Interest were developed in the Baseline Monitoring Plan and are the focus of this report.

#### Question 1

How, where and when are the Wēkiu bug populations changing? Locations of interest include current habitat on Pu'u Hau'oki crater and undisturbed Wēkiu bug habitat at Pu'u Wēkiu (for comparison).

#### Justification:

Baseline monitoring of Wēkiu bugs will yield reliable scientific information about the current status of Wēkiu bugs, and trends in their population. The information will be useful to compare to status and trends during construction of the proposed Outrigger Telescopes.

#### Monitoring goals:

- 1) To provide historical records of change in Wēkiu bug population attributes, and characteristics,
- 2) To detect trends, periodicities, cycles, and/or other patterns in those changes, and
- 3) To associate auxiliary phenomena, attributes, and characteristics with trends and patterns of change in Wēkiu bug population attributes, and characteristics.

#### Wēkiu Bug Baseline Monitoring QUESTIONS OF INTEREST

#### Question 2

Are weather phenomena, human activities, and/or other factors associated with Wēkiu bug and/or other resident arthropod population change?

#### Justification:

Snow, rain, day/night temperatures, and other weather phenomena may be associated with Wēkiu Bug population change. Monitoring these indirect factors will aid in understanding trends in Wēkiu Bug population change.

#### Monitoring goals:

To associate environmental phenomena and attributes, and characteristics of human activities with trends and patterns of change in Wēkiu Bug populations.



Lycosid spider on the bottom of a cap rock near one of the monitoring stations. Photo taken May 25, 2004.

#### Wēkiu Bug Baseline Monitoring METHODS

#### V. METHODS

#### **Live Traps**

Nondestructive sampling is one of the best approaches to monitoring rare and sensitive invertebrate species. Data on relative abundance can be collected with specially designed live-traps that cause minimal disturbance to species and their habitats. Nondestructive live-traps for Wēkiu bugs were developed and tested during the 1997-98 MKSR arthropod assessment. These live-traps provide Wēkiu bugs with food, moisture, and protection from predators and changing weather conditions, and can sustain captured individuals for several days.

Modifications have been made to the original 1997 trap design that reduces mortality of Wēkiu bugs in the traps. Efforts will continue to be made to reduce trap mortality even further.

Ten live-traps were set on Pu'u Hau'oki and Pu'u Wēkiu at the same locations where traps were installed during the previous sampling session. Trap locations on Pu'u Wēkiu were moved after the 2002 sampling year. Trap locations in 2004 are the same as those used in 2003 in both locations.

#### **Protocol for Setting Live-Traps**

The sampled habitat was accessed with a minimum of disturbance to the habitat and cinder slopes. Care was taken to avoid creation of new trails or evidence of foot traffic.

Traps were previously installed at each sampling station by carefully digging into the cinder, disturbing only the amount of cinder necessary to set up the trap (Step 1). A hardware cloth tube was inserted into the holes so that the top of the tube was slightly below the existing surface (Step 2). The hole around the tube was refilled with the cinder that was removed from the hole and a 4-inch (10-cm) apron of local ash and small-sized cinder was created around each trap (Step 3). The apron allows Wēkiu bugs to easily walk into the traps.

Traps were set by placing 20-oz reservoir cups into the wire tubes and pouring about 0.5-oz (15-ml) of purified water into the reservoir (Step 4). About a teaspoon of shrimp paste was spread on the coffee filter wick in the 16-oz trap cups and two to three pieces of re-hydrated shrimp were added to each cup (Step 5). Four to five pieces of native cinder, ½ to 1-inch (1

#### Wēkiu Bug Baseline Monitoring METHODS

to 2.5 -cm) in diameter were added and the trap cups were placed into the reservoir cups such that the coffeefilter wicks made contact with the water reservoirs (Step 6).

Chum, consisting of pureed premoistened shrimp, was distributed around the traps and a teaspoon of shrimp paste was spread on the bottom of the cap rocks (Step 7). Irrigation flags to mark the locations were wrapped around cap rocks, 10 to 15-inches (25 to 37-cm) in diameter. The cap rocks were then placed over each trap such that the entire trap was shaded from sunlight (Step 8).

Traps were checked for Wēkiu bugs every three days during the sampling session. During each live-trap check, an area about 1-ft (30-cm) in diameter around the live-trap was checked for the presence of Wēkiu bugs. The cap rock was also inspected for the presence of Wēkiu bugs. The trap cups were then removed and carefully inspected for Wēkiu bugs. Live Wēkiu

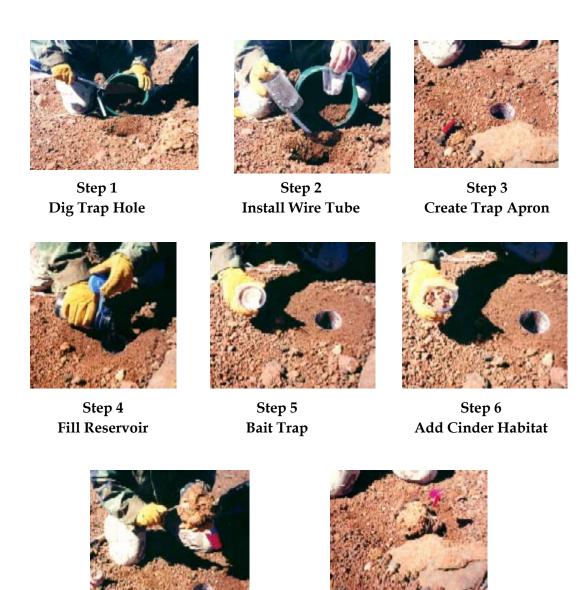
bugs were counted and released to cinder habitat one to two meters away from the live-trap. Dead bugs were collected in vials filled with alcohol.

Live-traps were reset by topping off the water reservoir, and by placing new bait and chum in and around the live-traps. When the 3-week sampling session was complete, both cups were removed, and cap rocks placed over the wire tubes. Small identification tags containing contact information were attached to the flag wires. The same locations will be used for future sampling.

Traps were opened for the 2<sup>nd</sup> Quarter 2004 baseline monitoring session on May 22, 2004. The traps were checked every three days and were closed on June 13, 2004. Severe weather conditions and closures road prevented sampling on June 6, 2004 as scheduled. Access was not allowed until June 7, 2004, making a four-day sampling period.

#### Wēkiu Bug Baseline Monitoring METHODS

#### Setting a Wēkiu Bug Live-Trap



Step 7

**Distribute Chum Bait** 

Step 8 Emplace Cap Rock

#### Wēkiu Bug Baseline Monitoring METHODS

#### Weather Data

Daily weather data from the UKIRT Observatory on the summit of Mauna Kea is usually downloaded from the Internet/World Wide Web at http://hokukea.soest.hawaii.edu. The UKIRT Observatory is located on Pu'u Kea adjacent to the Pu'u Wēkiu sampling sites, and is less than onehalf mile away from the Pu'u Hau'oki sampling sites. The UKIRT weather station was damaged during a recent storm and weather information was not available at the time this report was prepared.

Archive photographs were taken from fixed points on Pu'u Hau'oki and on Pu'u Wēkiu. Photographs were taken at the beginning of each sampling period to record snow coverage and changes in Wēkiu bug habitats through time.



Māmane tree at Hale Pōhaku Mid-Elevation Facilities. Photo taken on June 7, 2004.

#### Wēkiu Bug Baseline Monitoring RESULTS

#### VI. RESULTS

#### SAMPLING INFORMATION

During the 2<sup>nd</sup> Quarter 2004 baseline monitoring session there were a total of twenty-two sampling nights, making six 3-day sampling periods and one four-day sampling period.

A total of three hundred eighty-three Wēkiu bugs were captured, 311 on Pu'u Hau'oki and 72 on Pu'u Wēkiu. The trap capture rate (number of Wēkiu bugs per trap per 3-days) ranged from 0.2 to 25.4 Wēkiu bugs. The overall trap capture rate during the 3-week sampling session was 8.76 (±3.4) Wēkiu bugs for Pu'u Hau'oki, and 2.06 (±0.6) Wēkiu bugs for Pu'u Wēkiu (Table 1). For comparison, average trap capture rates from previous baseline monitoring sessions

and the 1997/98 Arthropod Assessment are provided (Table 2 and Table 3).

Overall mortality was 10.2% (39 of 383). There was evidence of Wēkiu bugs being eaten by spiders, and twenty-three of the dead Wēkiu bugs occurred in traps containing lycosid or linyphiid spiders. Trap mortality from other factors was estimated to be 4.4% (16/360). About one third of those occurred during the extended 5th sampling session, when trap checking was delayed because the summit access road was closed due to severe weather on the summit of Mauna Kea.

## TABLE 1. 2<sup>nd</sup> QUARTER 2004 SAMPLING PERIOD AVERAGE TRAP CAPTURE RATES

The average number of Wēkiu bugs per trap per 3-days for each sampling period during  $2^{nd}$  Quarter 2004 Baseline Monitoring.

Location	5/25/2004	5/28/2004	5/31/2004	6/3/2004	6/7/2004	6/10/2004	6/13/2004	AVERAGE ± SE
Pu'u Wēkiu	2.4	1.8	2.2	4.8	2.6	0.2	0.4	$2.06 \pm 0.6$
Pu'u Hau'oki	5.60	6.40	25.40	16.80	2.70	1.60	2.80	$8.76 \pm 3.4$

# TABLE 2. QUARTERLY BASELINE MONITORING AVERAGE TRAP CAPTURE RATES

The average number of Wēkiu bugs per trap per 3-days for each of the Quarterly Baseline Monitoring Sampling Sessions. Yearly average trap capture rates for Baseline Monitoring are in RED.

Location	1 <sup>st</sup> Quarter	2 <sup>nd</sup> Quarter	3 <sup>rd</sup> Quarter	4 <sup>th</sup> Quarter	Year Avg.
Pu'u Wēkiu 2002	0.03	0.03	0.29	0.17	0.13
Pu'u Wēkiu 2003*	2.81	11.5	0.51	0.00	3.71
Pu'u Wēkiu 2004	0.00	2.06			1.03
Pu'u Hau'oki 2002	1.04	10.26	4.01	3.97	4.82
Pu'u Hau'oki 2003	18.46	90.6	12.37	0.83	30.57
Pu'u Hau'oki 2004	2.10	8.76			5.43

<sup>\*</sup> Different trap locations on Pu'u Wēkiu in 2003

#### TABLE 3. SAMPLING PERIOD AVERAGE TRAP CAPTURE RATES

The average number of Wēkiu bugs per trap per 3-days for each sampling period during the 1997/98 Arthropod Assessment. Average trap capture rates for the 1997/98 Arthropod Assessment are in RED.

Location	Aug. 1997	Jan. 1998	April 1998	July 1998	Avg. 1997/98
Pu'u Wēkiu	0.15	0.0	0.07	0.15	0.11
Pu'u Hau'oki	0.20	0.0	0.20	1.10	0.38

#### WEATHER INFORMATION

Weather information was not available, due to damage at the UKIRT weather station. Attempts are being made to obtain weather information from other sources, but weather data were not available for this report. Graphs of the number of Wēkiu bugs found in traps plotted versus average temperature during 3-day sampling periods for previous monitoring sessions appear below.

In previous Baseline Monitoring sessions, there was a general trend that indicated the number of Wēkiu bugs captured increased as average temperature increased. It appears from these figures that Wēkiu bugs are not active below an average temperature of about -2°C.

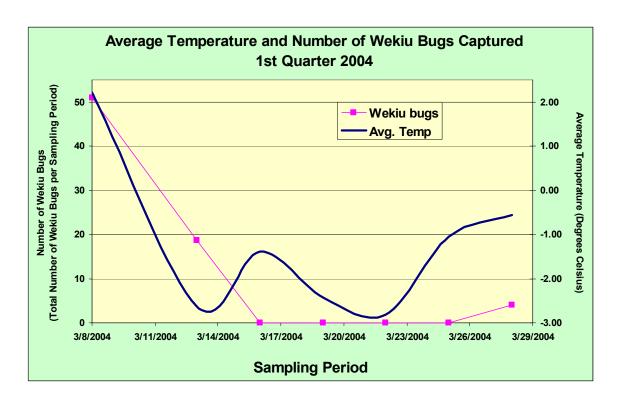


FIGURE 1. Plot of Average Temperature (Celsius) and Total Number of Wēkiu Bugs Captured per Sampling Period during the 1st Quarter 2004 sampling session.

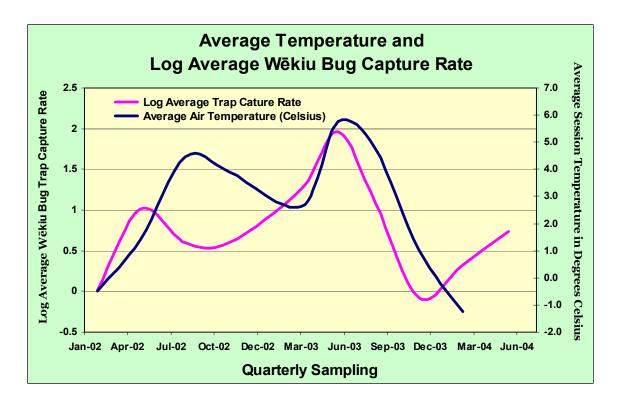


FIGURE 2. Plot of Baseline Monitoring Session Average Temperature (Celsius) and Natural Log Average Number of Wēkiu Bugs Captured per Session at both monitoring locations.

#### Pu'u Hau'oki Inner Slope Photographic Archive

#### **MAY - JUNE 2004**



Pu'u Hau'oki inner slope May 22, 2004



Pu'u Hau'oki inner slope May 25, 2004



Pu'u Hau'oki inner slope May 28, 2004



Pu'u Hau'oki inner slope May 31, 2004



Pu'u Hau'oki inner slope June 3, 2004



Pu'u Hau'oki inner slope June 7, 2004



Pu'u Hau'oki inner slope June 10, 2004



Pu'u Hau'oki inner slope June 13, 2004

#### Pu'u Hau'oki Outer Slope Photographic Archive

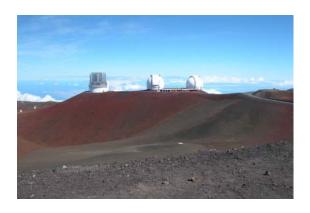
#### **MAY - JUNE 2004**



Pu'u Hau'oki outer slope May 22, 2004



Pu'u Hau'oki outer slope May 25, 2004



Pu'u Hau'oki outer slope May 28, 2004



Pu'u Hau'oki outer slope May 31, 2004

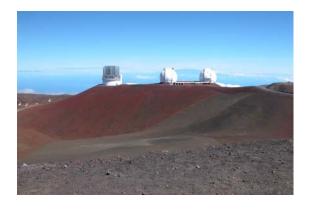
NOTE TO THE STATE OF THE PROPOSITION OF THE PROPOS



Pu'u Hau'oki outer slope June 3, 2004



Pu'u Hau'oki outer slope June 7, 2004



Pu'u Hau'oki outer slope June 10, 2004



Pu'u Hau'oki outer slope June 13, 2004

#### Pu'u Wēkiu Photographic Archive

#### **MAY - JUNE 2004**



Pu'u Wēkiu inner slope May 22, 2004



Pu'u Wēkiu inner slope May 25, 2004



Pu'u Wēkiu inner slope May 28, 2004



Pu'u Wēkiu inner slope May 31, 2004



Pu'u Wēkiu inner slope June 3, 2004



Pu'u Wēkiu inner slope June 7, 2004



Pu'u Wēkiu inner slope June 10, 2004



Pu'u Wēkiu inner slope June 13, 2004

#### Pu'u Wēkiu and Hau Kea Photographic Archive

#### **MAY - JUNE 2004**



Pu'u Wēkiu and Hau Kea May 22, 2004



Pu'u Wēkiu and Hau Kea May 25, 2004



Pu'u Wēkiu and Hau Kea May 28, 2004



Pu'u Wēkiu and Hau Kea May 31, 2004



Pu'u Wēkiu and Hau Kea June 3, 2004



Pu'u Wēkiu and Hau Kea June 7, 2004



Pu'u Wēkiu and Hau Kea June 10, 2004



Pu'u Wēkiu and Hau Kea June 13, 2004

#### Wēkiu Bug Baseline Monitoring DISCUSSION

#### VII. DISCUSSION

#### **Trapping Data**

Permission to begin Baseline Wēkiu bug monitoring was received on January 21, 2002. On January 28, 2002 Pacific Analytics personnel installed 10 live-traps in designated areas, five on the inner slopes of Pu'u Hau'oki and five on the slopes of Pu'u Wēkiu. Sampling began in February 2002.



Adult Wēkiu bug on cinder near a live-trap.

Over the four quarters of monitoring during 2002, 696 Wēkiu bugs were captured in live-traps, and Wēkiu bug trap capture rates averaged 4.82 bugs per trap per 3-day trapping period on Pu'u Hau'oki, and 0.13 bugs per trap per 3-day trapping period on Pu'u Wēkiu.

Over the four quarters of monitoring during 2003, 4,237 Wēkiu bugs were captured in live-traps. Wēkiu bug trap capture rates averaged 30.57 bugs per trap per 3-day trapping period on Pu'u Hau'oki, and 3.71 bugs per trap per 3-day trapping period on Pu'u Wēkiu.

During the 1<sup>st</sup> Quarter 2004 sampling session a total of eighty-six Wēkiu bugs appeared in or near the traps. The 1<sup>st</sup> Quarter 2004 average trap capture rate was 2.10 bugs per trap per 3-day trapping period on Pu'u Hau'oki and 0.00 on Pu'u Wēkiu.

During the 2<sup>nd</sup> Quarter 2004 sampling session Wēkiu bugs appeared in all ten of the traps on both cinder cones. A total of three hundred eighty-three Wēkiu bugs appeared in or near the traps during the seven trapping sessions. All live bugs were released back into their habitat.

Average 2<sup>nd</sup> Quarter 2004 trap capture rate on Pu'u Hau'oki was 8.76 (±3.4) bugs per trap per 3-day trapping period. Average 2<sup>nd</sup> Quarter 2004 trap capture rate on Pu'u Wēkiu was 2.06 (±0.6) bugs per trap per 3-day trapping period. Wēkiu bugs were not sampled in May or June during the 1982 nor the

#### Wēkiu Bug Baseline Monitoring DISCUSSION

1997/98 Arthropod Assessments, thus direct comparisons are not possible.

The 2<sup>nd</sup> Quarter 2004 Wēkiu bug capture rate was about equal to the capture rate measured in the 2<sup>nd</sup> Quarter 2002 sampling session, and about one tenth the capture rate measured in the 2<sup>nd</sup> Quarter 2003 sampling session (Table 2).

About 10% of the Wēkiu bugs were captured in the 2<sup>nd</sup> Quarter 2004 sampling session were immature stages. During the 2<sup>nd</sup> Quarter 2003 sampling session almost 80% were immature stages. The 2<sup>nd</sup> Quarter 2003 sampling session began about 3 weeks later in the sampling season than the 2<sup>nd</sup> Quarter 2004 sampling session. Immature stages do not appear to be active during the cold winter months. They have been most active during June and July (the time of highest proportion of immatures) of previous years of Baseline Monitoring.

About 10.2% (39 of 383) of the Wēkiu bugs captured during the 2<sup>nd</sup> Quarter 2004 sampling session did not survive. There was evidence of Wēkiu bugs being eaten by spiders, and twenty-three of the dead Wēkiu bugs occurred in traps containing lycosid or linyphiid spiders. Trap mortality from other factors was estimated to be 4.4% (16/360). About one third of those occurred during the

extended 5<sup>th</sup> sampling session, when trap checking was delayed because the summit access road was closed due to severe weather on the summit of Mauna Kea.

#### Other Observations

During the 2<sup>nd</sup> Quarter 2004 monitoring session the WMKO site was free of loose trash and debris. Observatory vehicles parked near the WMKO were clean. No vehicles had any visible signs of alien arthropods.



ATV's parked at the Hale Pōhaku construction staging area. Picture taken on May 22, 2004.

Two pickups with trailers containing ATV's were parked at the Hale Pōhaku Construction Staging Area. Recreational use of the *māmane* forest near Hale Pōhaku is popular.

The W. M. Keck Observatory summit crew received Natural Resource Awareness training on June 3, 2004. The training session made by Dr. Gregory Brenner of Pacific Analytics,

#### Wēkiu Bug Baseline Monitoring DISCUSSION

LLC included information about invasive non-indigenous species on Mauna Kea and their impacts on the natural ecosystem. The training session lasted about 45 minutes and was attended by the entire summit crew.

Dr. Brenner also delivered a lecture to the Honolulu Waldorf School about the flora and fauna of the ecological zones on Mauna Kea from the Visitors Center to the summit.



A noctuid caterpillar found crawling in the cinder near one of the monitoring traps on Pu'u Wēkiu. Actual size is about 2.5 cm (1 inch)