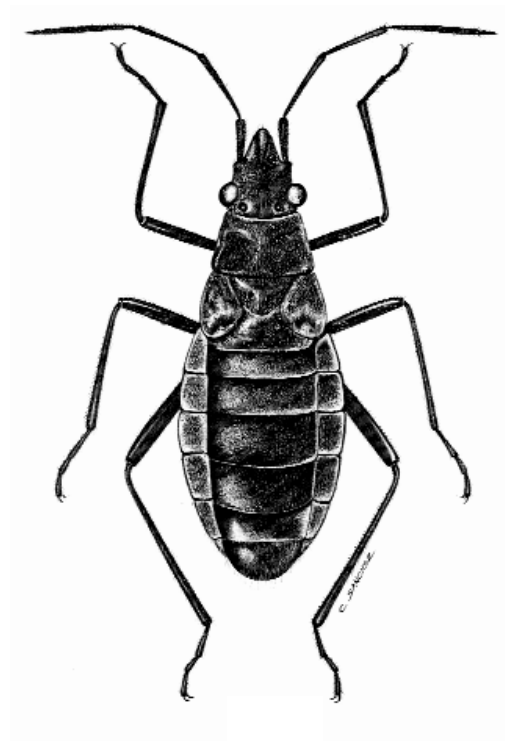


WĒKIU BUG

BASELINE MONITORING

QUARTERLY REPORT
2nd 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
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Prepared for

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



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WĒKIU BUG BASELINE MONITORING

QUARTERLY REPORT 2nd QUARTER 2004

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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 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.

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 Wēkiu bug habitat was approved to establish baseline population estimates of the Wēkiu 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 Wēkiu 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

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**Wēkiu Bug Baseline Monitoring
QUESTIONS OF INTEREST**

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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.

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Wēkiu Bug Baseline Monitoring
METHODS
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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. Non-destructive 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
RESULTS

VI. RESULTS

SAMPLING INFORMATION

During the 2nd 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. 2nd QUARTER 2004 SAMPLING PERIOD
AVERAGE TRAP CAPTURE RATES**

The average number of Wēkiu bugs per trap per 3-days
for each sampling period during 2nd 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 \pm 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

**Wēkiu Bug Baseline Monitoring
RESULTS**

**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 st Quarter	2 nd Quarter	3 rd Quarter	4 th 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

* 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

**Wēkiu Bug Baseline Monitoring
RESULTS**

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.

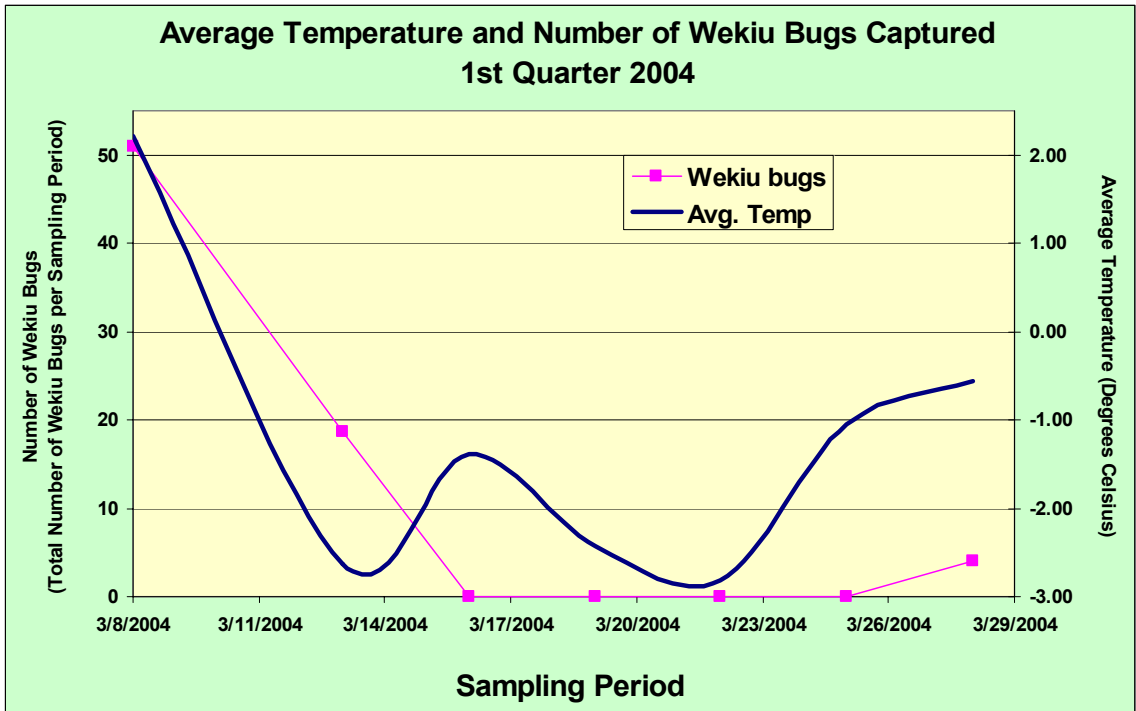


FIGURE 1. Plot of Average Temperature (Celsius) and Total Number of Wēkiu Bugs Captured per Sampling Period during the 1st Quarter 2004 sampling session.

Wēkiu Bug Baseline Monitoring
RESULTS

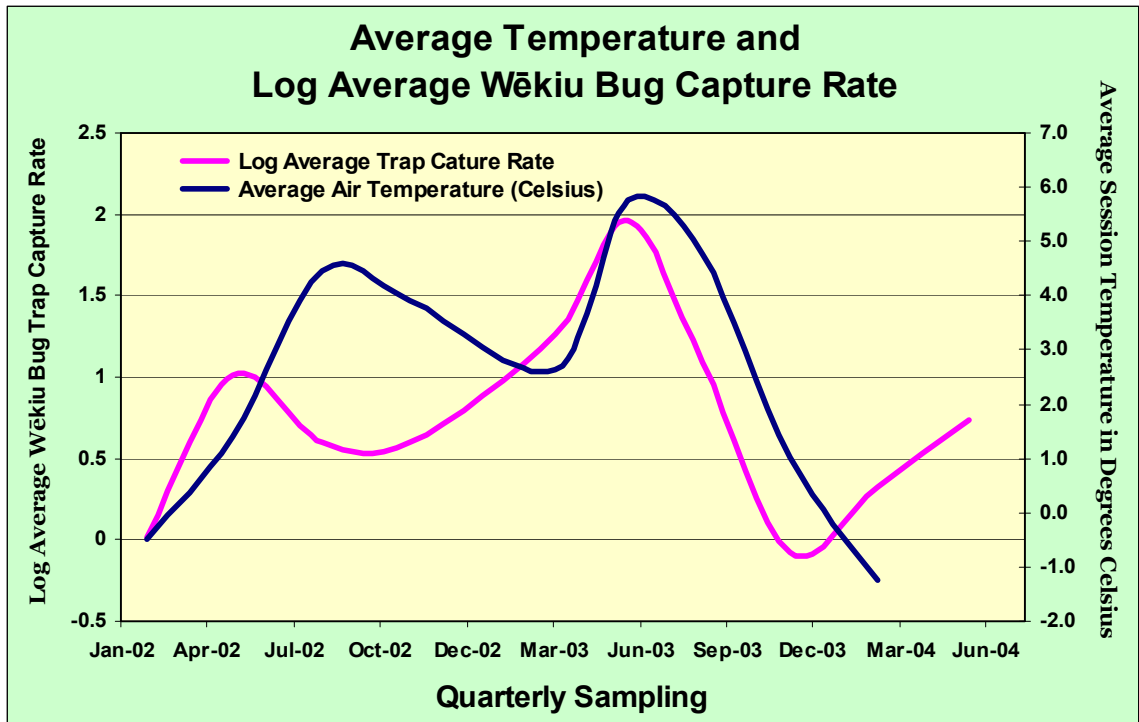


FIGURE 2. Plot of Baseline Monitoring Session Average Temperature (Celsius) and Natural Log Average Number of Wēkiu Bugs Captured per Session at both monitoring locations.

Wēkiu Bug Baseline Monitoring
RESULTS



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

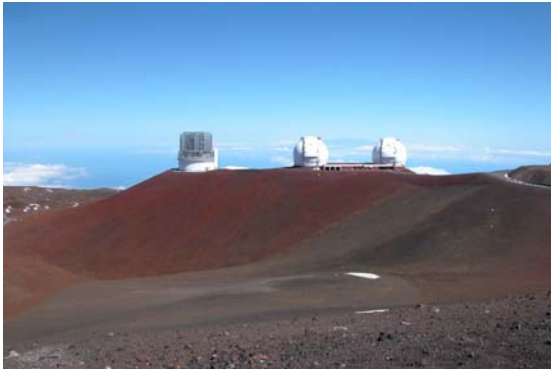


Pu'u Hau'oki inner slope
June 13, 2004

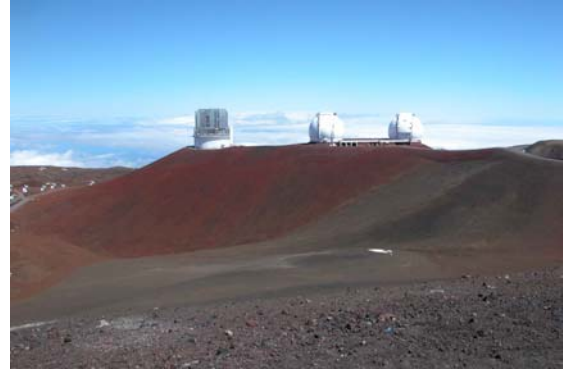
Wēkiu Bug Baseline Monitoring
RESULTS

Pu'u Hau'oki Outer Slope Photographic Archive

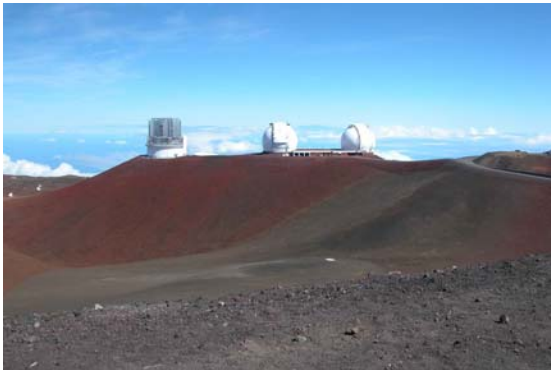
MAY - JUNE 2004



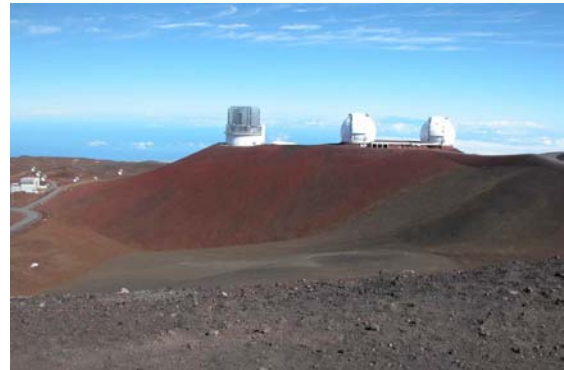
**Pu'u Hau'oki outer slope
May 22, 2004**



**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**

Wēkiu Bug Baseline Monitoring
RESULTS

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

Wēkiu Bug Baseline Monitoring
DISCUSSION

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

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

About 10% of the Wēkiu bugs were captured in the 2nd Quarter 2004 sampling session were immature stages. During the 2nd Quarter 2003 sampling session almost 80% were immature stages. The 2nd Quarter 2003 sampling session began about 3 weeks later in the sampling season than the 2nd 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 2nd 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 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.

Other Observations

During the 2nd 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,

