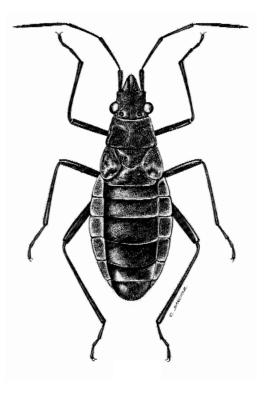
# WĒKIU BUG BASELINE MONITORING

# QUARTERLY REPORT 1<sup>st</sup> QUARTER 2005





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 1<sup>st</sup> QUARTER 2005

Prepared for

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



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# WĒKIU BUG BASELINE MONITORING

## QUARTERLY REPORT 1<sup>st</sup> QUARTER 2005

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#### 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 the 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' (3,570 m) elevation.

The National Aeronautics and Space Administration (NASA), together with the California Institute of Technology (CalTech)/Jet Propulsion Laboratory (JPL), the California Association for Research in Astronomy (CARA) and the University of Hawai'i (UH), have proposed to protect and enhance Wēkiu bug habitat on Pu'u Hau'oki to mitigate potential disturbance by onsite 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 Wekiu bug in the area surrounding the site of the proposed Outrigger Telescopes Project and at a control site on Pu'u Wekiu. 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:

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

DEDERED DE DE LE CUTIVE 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 are being deployed during Baseline Monitoring. Twenty live-traps stations were installed at the summit of Mauna Kea at designated locations, ten on Pu'u Hau'oki and ten on Pu'u Wēkiu.

The 1<sup>st</sup> Quarter 2005 three-week sampling session was conducted from March 16, 2005 through April 2, 2005. During this sampling session a total of 458 Wēkiu bugs appeared in or near the live-traps. Four hundred seventeen Wēkiu bugs were found on Pu'u Hau'oki and forty-one were found on Pu'u Wēkiu. Trap capture rates ranged from 0.0 to 49.2 Wēkiu bugs per trap per 3 days of sampling.

The average trap capture rate on Pu'u Hau'oki during the 1<sup>st</sup> Quarter 2005 monitoring session was 15.92 Wēkiu bugs per trap per 3 days of sampling. This rate is about sixteen times the lowest average capture rate measured on Pu'u Hau'oki during a 1<sup>st</sup> Quarter baseline monitoring session (1.0 WB 2002) and almost equal to the highest average capture rate measured on Pu'u Hau'oki during a 1<sup>st</sup> Quarter baseline monitoring session (18.5 WB 2003).

The average trap capture rate on Pu'u Wēkiu during the 1<sup>st</sup> Quarter 2005 monitoring session was 1.14 Wēkiu bugs per trap per 3 days of sampling. This rate is about thirty-eight times the average capture rate measured on Pu'u Wēkiu during the 1<sup>st</sup> Quarter 2002 baseline monitoring session (0.03 WB), and about 40% of the average capture rate measured on Pu'u Wēkiu during the 1<sup>st</sup> Quarter 2003 baseline monitoring session (2.8 WB).

Twenty-one percent (96/458) of the Wēkiu bugs captured in the 1<sup>st</sup> Quarter 2005 sampling session were immature stages. More than 90% of these juvenile stages were captured in the two 3-day sampling periods with the warmest average temperatures.

#### 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 the 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 11,700' (3,570 m) elevation.

Current plans call for adding four 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 (CalTech)/Jet Propulsion Laboratory (JPL), the California Association for Research in Astronomy (CARA) and the University of Hawai'i (UH), have proposed to protect and enhance Wēkiu bug habitat on Pu'u Hau'oki to mitigate potential disturbance by onsite 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 establish baseline to 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 at 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 activity will monitoring provide 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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impacts, if any, due to construction of the Outrigger Telescopes Project.

The Hawai'i Department of Land and Natural Resources (DLNR) approved a recommendation for doubling the number of traps for Wēkiu bug monitoring. Five new monitoring stations were established on Pu'u Hau'oki and five on Pu'u Wēkiu during the 3<sup>rd</sup> Quarter 2004 monitoring session. All of the traps deployed for Wēkiu Bug Baseline Monitoring continue to be of the improved livetrap design described in previous quarterly reports.

This is the thirteenth Quarterly Report of Baseline Monitoring. The results of the sampling effort conducted March 16, 2005 through April 2, 2005 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.



Snow accumulated on the Summit cinder cones during the 1<sup>st</sup> Quarter 2005 sampling session (Photo taken March 30, 2005 from Pu'u Wēkiu).

#### 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.



A storm on March 29, 2005 left ice frozen to the guard rails along the summit roads. Picture taken on March 30, 2005.

#### 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 livetraps 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.

During the 1<sup>st</sup> Quarter 2005 sampling session eleven live-traps total were set, 5 traps on Pu'u Hau'oki and 6 traps on Pu'u Wēkiu. Traps were set at the same monitoring stations installed during previous sampling sessions. Some of the previous monitoring stations were not available because they were covered by snow or frozen in ice.

#### **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.

Monitoring stations were established in previous sampling sessions 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 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 at each available monitoring station by placing reservoir cups into the wire tubes and pouring about 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 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,  $\frac{1}{2}$ " to 1" in diameter were added and the trap cups were placed into the reservoir cups such that the coffee-filter wicks made contact with the water reservoirs (Step 6).

Chum, consisting of pre-moistened 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, ten to fifteen inches 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, or as weather permitted. During each live-trap check, an area about 20 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 livetrap. Dead arthropods 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 monitoring stations will be used for future sampling.

Traps were opened for the 1<sup>st</sup> Quarter 2005 baseline monitoring session on March 16, 2005. The traps were checked every three days beginning March 18, 2005 and were closed on April 2, 2005. Summit winds in excess of 115 mph delayed the start of sampling resulting in only six 3-day sampling periods. Nine trap locations (five on Pu'u Hau'oki and four on Pu'u Wēkiu) were covered with snow or frozen in ice and were unavailable for use.

#### Wēkiu Bug Baseline Monitoring METHODS

## Setting a Wēkiu Bug Live-Trap



Step 1 Dig Trap Hole



Step 2 Install Wire Tube



Step 3 Create Trap Apron



Step 4 Fill Reservoir



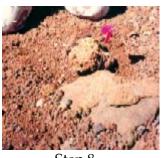
Step 5 Bait Trap



Step 6 Add Cinder Habitat



Step 7 Distribute Chum Bait



Step 8 Emplace Cap Rock

#### METHODS

## Weather Data

In order to improve the accuracy of temperature measurements and more closely correlate them with trap capture rates, data loggers were placed on each of the sampled cinder cones, Pu'u Hau'oki and Pu'u Wēkiu at the request of the Office of Mauna Kea Management (OMKM). Special permission for these data loggers was obtained from the Hawai'i Department of Land and Natural Resources (DLNR). The data loggers were placed near the middle of the sampled slopes at the top of the ash layer and covered with native cinder to the original depth (about 4-6 inches). The data loggers measure and record temperature and humidity every 15 minutes. Data was downloaded every three days using a data shuttle. Data loggers used are the HOBO<sup>©</sup> H8 Pro Series model number H08-030-08 from Onset (www.onsetcomp.com). The

HOBO<sup>©</sup> Shuttle, model number H09-003-08 was used to download temperature data from the loggers.

Weather data are being collected using the data loggers beginning with the 3<sup>rd</sup> Quarter 2004 monitoring session. This information represents measurements of substrate conditions. Before the 2<sup>nd</sup> Quarter 2004, weather information was obtained from the UKIRT Observatory Weather Station and represented general conditions of the summit area.

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 other changes in Wēkiu bug habitats through time.



HOBO<sup>©</sup> Temperature Data Logger.

RESULTS

## VI. RESULTS

#### SAMPLING

During the 1<sup>st</sup> Quarter 2005 baseline monitoring session severe weather delayed deployment at the start of the sampling session. There were a total of seventeen sampling nights, make of one 2-day sampling period and five 3day sampling periods. Snow covered five trap locations on Pu'u Hau'oki and four monitoring stations on Pu'u Wēkiu. These monitoring stations were unavailable for monitoring.

A total of four hundred fifty-eight Wēkiu bugs were captured, four hundred seventeen on Pu'u Hau'oki and forty-one on Pu'u Wēkiu. The trap capture rate (number of Wēkiu bugs per trap per 3-days) ranged from 0.0 to 49.2 Wēkiu bugs. The overall trap capture rate during the 3-week sampling session was 15.92 (±8.7) Wēkiu bugs for Pu'u Hau'oki, and 1.14 (±1.01) Wēkiu bugs for Pu'u Wēkiu (Table 1). For perspective, average trap capture rates from previous baseline monitoring sessions and the 1982 and 1997/98 Arthropod Assessments are provided (Table 2 and Table 3). Average trap capture rates reported for the 1982 and 1997/98 arthropod assessments are those measured in comparable locations on Pu'u Hau'oki crater and Pu'u Wēkiu as those measured for Wēkiu Bug Baseline Monitoring. The 1982 measurements were recorded during July and August, and therefore should not be used to compare to the current quarter of baseline monitoring.

Figure 1 graphs the average trap capture rates for all Baseline Monitoring on Pu'u Hau'oki (beginning 1<sup>st</sup> Quarter 2002). Figure 2 shows the quarterly variation in average trap capture rates for Baseline Monitoring on Pu'u Hau'oki.

Overall mortality was 11% (50 of 458). This mortality rate is significantly less than the 40% experienced with the previous live-trap design used in the 1997/98 arthropod assessment.

#### Wēkiu Bug Baseline Monitoring

#### RESULTS

#### TABLE 1.

## 1<sup>st</sup> QUARTER 2005 SAMPLING PERIOD

#### AVERAGE TRAP CAPTURE RATES The average number of Wēkiu bugs per trap per 3-days for each sampling period during 1<sup>st</sup> Quarter 2005 Baseline Monitoring.

Location	3/18/2005	3/21/2005	3/24/2005	3/27/2005	3/30/2005	4/2/2005	AVERAGE ± SE
Pu'u Wēkiu	0.00*	0.20	6.17	0.00	0.17	0.33	$1.14 \pm 1.01$
Pu'u Hau'oki	36.30*	1.80	49.20	0.00	1.80	6.40	$15.92 \pm 8.7$

\* - 2-day sampling results adjusted to 3-day average

#### 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 <sup>*</sup>	0.03	0.03	0.3	0.2	0.1
Pu'u Wēkiu 2003	2.8	11.5	0.5	0.0	3.7
Pu'u Wēkiu 2004	0.00	2.0	0.03	0.06	0.5
Pu'u Wēkiu 2005	1.14				1.14
Pu'u Hau'oki 2002	1.0	10.3	4.0	4.0	4.8
Pu'u Hau'oki 2003	18.5	90.6	12.4	0.8	30.6
Pu'u Hau'oki 2004	2.1	8.8	0.4	0.21	2.9
Pu'u Hau'oki 2005	15.92	141-1 :			15.92

\* - different trap locations on Pu'u Wēkiu in 2002

#### 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 1982 and 1997/98 Arthropod Assessments. Average trap capture rates for the 1997/98 Arthropod Assessment are in RED.

Location	Aug. 1997	Jan. 1998	Apr-98	Jul-98	1997/98 Avg.	Jul-82
Pu'u Wēkiu	0.15	0	0.07	0.15	0.11	225
Pu'u Hau'oki	0.2	0	0.2	1.1	0.38	105.6

#### RESULTS

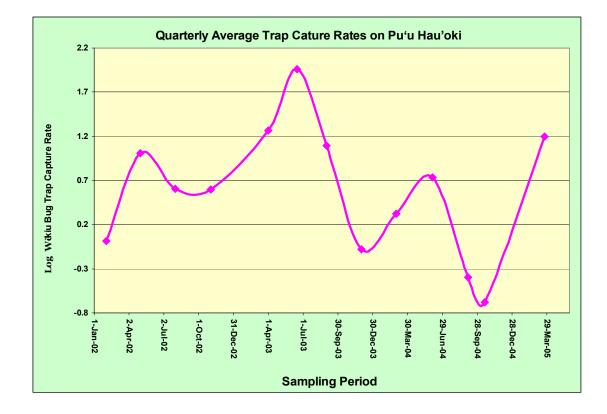


FIGURE 1. Graph of the Log Average Wēkiu Bug Trap Capture Rate per Sampling Period on Pu'u Hau'oki since Wēkiu Bug Baseline Monitoring began in February 2002.

#### RESULTS

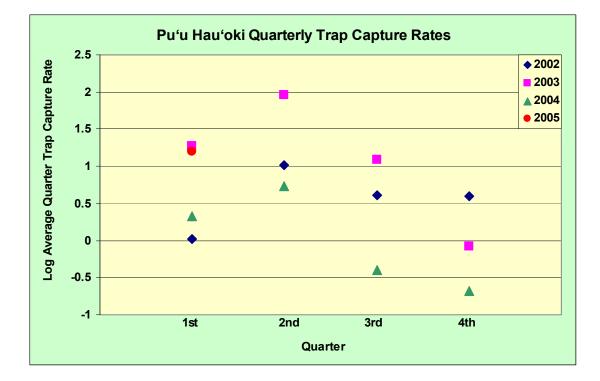


Figure 2. Pu'u Hau'oki Quarterly Average Trap Capture Rates. The log average quarterly trap capture rate of Wēkiu bugs on Pu'u Hau'oki for four years of Wēkiu Bug Baseline Monitoring.

#### RESULTS

#### WEATHER INFORMATION

Figure 3 is a graph of the number of Wēkiu bugs captured in trap rates and temperature for the 1<sup>st</sup> Quarter 2005 monitoring session, and uses temperature data collected from the HOBO<sup>®</sup> data loggers. There was a strong indication that as average temperature decreased, the number of Wēkiu bugs in the traps also decreased.

Graphs of previous monitoring sessions (before 2<sup>nd</sup> Quarter 2004) were based on temperature data collected by the UKIRT Observatory. Weather information was not available for the 2<sup>nd</sup> Quarter 2004 monitoring session due to damage at the UKIRT weather station. A Graph of the log average Wēkiu bug trap capture rate plotted with average temperature for quarterly sampling sessions up to the 2<sup>nd</sup> Quarter 2004 sampling session appears in Figure 4.

In previous Baseline Monitoring sessions, there was a general trend that indicated the number of Wēkiu bugs captured changed with average temperature. That trend continued in this sampling session. It appears from Figure 3 that Wēkiu bugs are not very active below an average temperature of about 2°C.

In past monitoring sessions, weather data was collected from nearby observatories that measure air temperature near those buildings. Because the two measurements appear to be quite different, new graphs will be presented that compare temperature and trap capture data for each quarterly sampling session (see Figure 3). Figure 4 will no longer be updated.

#### Wēkiu Bug Baseline Monitoring

RESULTS

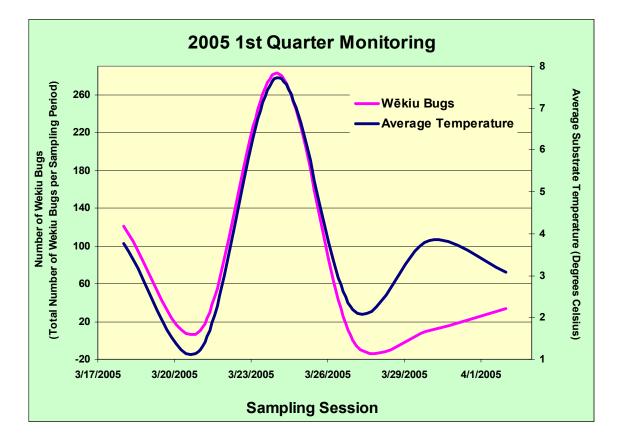


FIGURE 3. Plot of Average Temperature (Celsius) and Total Number of Wēkiu Bugs Captured per Sampling Period at all sampling locations during the 1<sup>st</sup> Quarter 2005 sampling session.

#### Wēkiu Bug Baseline Monitoring



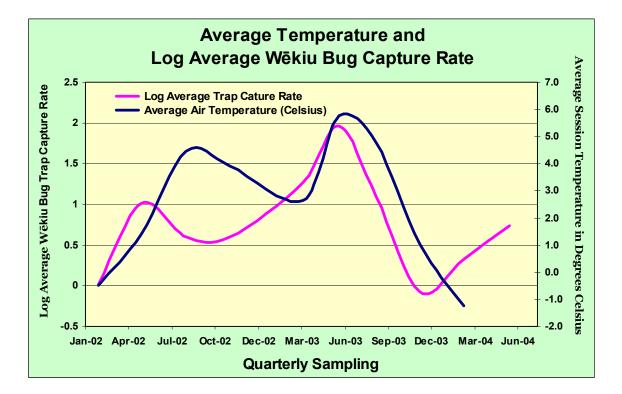


FIGURE 4. Plot of Baseline Monitoring Session Average Temperature (Celsius) and Natural Log Average Number of Wēkiu Bug Trap Capture Rate per Session on Pu'u Hau'oki.

#### Wēkiu Bug Baseline Monitoring

RESULTS

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

#### MARCH 2005 TRAPS 1 - 5



Pu'u Hau'oki inner slope March 16, 2005



Pu'u Hau'oki inner slope March 18, 2005



Pu'u Hau'oki inner slope March 21, 2005 Pu'u Hau'oki inner slope March 24, 2005

#### Wekiu Bug Baseline Monitoring

RESULTS

**TRAPS 1 - 5** 



Pu'u Hau'oki inner slope March 27, 2005

Pu'u Hau'oki inner slope March 30, 2005



Pu'u Hau'oki inner slope April 2, 2005

# Wēkiu Bug Baseline Monitoring

RESULTS

### MARCH 2005 TRAPS 6 - 10



Pu'u Hau'oki inner slope March 16, 2005



Pu'u Hau'oki inner slope March 18, 2005



Pu'u Hau'oki inner slope March 21, 2005



Pu'u Hau'oki inner slope March 24, 2005

#### Wēkiu Bug Baseline Monitoring

RESULTS

TRAPS 6 - 10



Pu'u Hau'oki inner slope March 27, 2005

Pu'u Hau'oki inner slope March 30, 2005



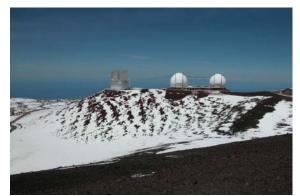
Pu'u Hau'oki inner slope April 2, 2005

#### Wēkiu Bug Baseline Monitoring

RESULTS

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

#### **MARCH 2005**



Pu'u Hau'oki outer slope March 16, 2005



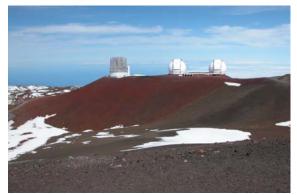
Pu'u Hau'oki outer slope March 18, 2005



Pu'u Hau'oki outer slope March 21, 2005 Pu'u Hau'oki outer slope March 24, 2005

## Wēkiu Bug Baseline Monitoring

RESULTS



Pu'u Hau'oki outer slope March 27, 2005



Pu'u Hau'oki outer slope March 30, 2005



Pu'u Hau'oki outer slope April 2, 2005

## Wēkiu Bug Baseline Monitoring

RESULTS

## Pu'u Wēkiu Photographic Archive

#### MARCH 2005 TRAPS 1 - 5



Pu'u Wēkiu inner slope March 16, 2005



Pu'u Wēkiu inner slope March 18, 2005



Pu'u Wēkiu inner slope March 21, 2005 Pu'u Wēkiu inner slope March 24, 2005

#### Wekiu Bug Baseline Monitoring

RESULTS

**TRAPS 1 - 5** 



Pu'u Wēkiu inner slope March 27, 2005



Pu'u Wēkiu inner slope March 30, 2005



Pu'u Wēkiu inner slope April 2, 2005

# Wēkiu Bug Baseline Monitoring

RESULTS

### MARCH 2005 TRAPS 6 - 10



Pu'u Wēkiu inner slope March 16, 2005



Pu'u Wēkiu inner slope March 18, 2005

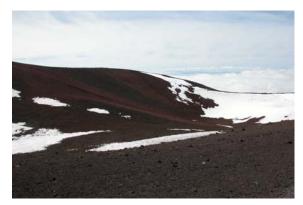


Pu'u Wēkiu inner slope March 21, 2005 Pu'u Wēkiu inner slope March 24, 2005

#### Wēkiu Bug Baseline Monitoring

RESULTS

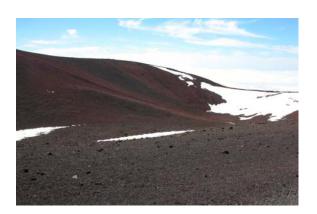
TRAPS 6 - 10



Pu'u Wēkiu inner slope March 27, 2005



Pu'u Wēkiu inner slope March 30, 2005



Pu'u Wēkiu inner slope April 2, 2005

#### Wēkiu Bug Baseline Monitoring

RESULTS

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

#### **MARCH 2005**



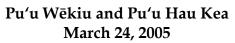
Pu'u Wēkiu and Pu'u Hau Kea March 16, 2005



Pu'u Wēkiu and Pu'u Hau Kea March 18, 2005



Pu'u Wēkiu and Pu'u Hau Kea March 21, 2005



## Wēkiu Bug Baseline Monitoring

RESULTS



Pu'u Wēkiu and Pu'u Hau Kea March 27, 2005



Pu'u Wēkiu and Pu'u Hau Kea March 30, 2005



Pu'u Wēkiu and Pu'u Hau Kea April 2, 2005

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-trap monitoring stations 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 captured in 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 3day trapping period on Pu'u Wēkiu.

Over the four quarters of monitoring during 2004, 518 Wēkiu bugs were captured in live-traps. Wēkiu bug trap capture rates averaged 2.9 bugs per trap per 3-day trapping period on Pu'u Hau'oki, and 0.5 bugs per trap per 3day trapping period on Pu'u Wēkiu.

During the 1<sup>st</sup> Quarter 2005 sampling session Wēkiu bugs appeared in four of six of the traps on Pu'u Wēkiu and all five traps on Pu'u Hau'oki. A total of 458 Wēkiu bugs appeared in or near the traps during the six trapping sessions. All live bugs were released back into their habitat.

Average 1<sup>st</sup> Quarter 2005 trap capture rate on Pu'u Hau'oki was 15.92 (±8.7) bugs per trap per 3-day trapping period. Average 1<sup>st</sup> Quarter 2005 trap capture rate on Pu'u Wēkiu was 1.14 (±1.01) bugs per trap per 3-day trapping period.

The 1st Quarter 2005 Wēkiu bug capture rate on Pu'u Hau'oki was sixteen times the capture rate

# DERECUSSION

measured in the 1st Quarter 2002 sampling session (1 WB), and almost equal to the highest average capture rate measured on Pu'u Hau'oki during the 1st Quarter 2003 baseline monitoring session (18.5 WB) (Table 2).

The average trap capture rate on Pu'u Wēkiu during the 1st Quarter 2005 monitoring session was 1.14 Wēkiu bugs per trap per 3 days of sampling. This rate is about thirty-eight times the average capture rate measured on Pu'u Wēkiu during the 1st Quarter 2002 baseline monitoring session (0.03 WB), and about 40% of the average capture rate measured on Pu'u Wēkiu during the 1st Quarter 2003 baseline monitoring session (2.8 WB) (Table 2).

It is interesting that the number of Wēkiu bugs captured declined significantly in 2004. There were no construction activities or chemical spills that could have resulted in major habitat disturbance during 2003 and 2004 that would account for the drop in trap capture rate. The decline was apparently part of a normal cycle, or was caused by other factors that were not readily apparent. Capture rates are back up for the 1st Quarter 2005 session and may indicate the potential for another year of higher capture rates.

Twenty-one percent (96/458) of the Wēkiu bugs captured in the 1<sup>st</sup> Quarter 2005 sampling session were immature

stages. More than 90% of these juvenile stages were captured in the two 3-day sampling periods with the warmest average temperatures.

Temperatures during the 1<sup>st</sup> Quarter 2005 sampling session were measured using data loggers placed directly in the cinder. Prior to the 2<sup>nd</sup> Quarter 2004 monitoring session, weather data was obtained from the UKIRT Observatory weather station. Since the data can not be directly compared, a new graph is included that shows the comparison of the data from the new source of information to total Wēkiu bug captures (Figure 3).



Mating pair of Wēkiu bugs captured on Pu'u Hau'oki. Notice the deflated state of the abdomen on these bugs indicating that they have not recently fed. Picture taken April 2, 2005

It is believed that using data loggers placed in the cinder substrate near the actual trapping locations provide better information about factors influencing Wēkiu bug trap capture rates. The tight correlation of total Wēkiu bugs captured to temperature is

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dramatic (Figure 3). Apparently, temperature strongly influences Wēkiu bug activity.

Less than 11% (50 of 458) of the Wēkiu bugs captured during the 1<sup>st</sup> Quarter 2005 sampling session did not survive. The improved live-traps appear to have significantly reduced trapping mortality compared to the 40% mortality measured in live-traps used during the 1997/98 arthropod assessment.

#### Other Observations

During the 1<sup>st</sup> Quarter 2005 monitoring session the WMKO site was free of loose trash and debris. Observatory vehicles parked near the WMKO were clean. Inspections of vehicles parked at the WMKO found no visible signs of alien arthropods.



View of snow on Mauna Kea from the Saddle Road. Picture taken March 30, 2005.