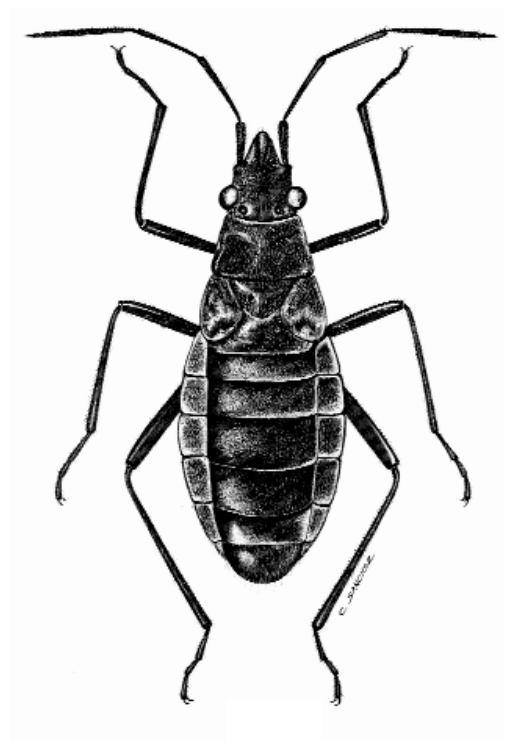


WĒKIU BUG BASELINE MONITORING

2nd QUARTER 2002
QUARTERLY REPORT



Revised April 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

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QUARTERLY REPORT

Prepared for

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

Revised April 2004



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WĒKIU BUG BASELINE MONITORING

2nd QUARTER 2002 QUARTERLY REPORT

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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 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 bugs generally occupy habitat encompassing an estimated 300 acres (121 hectares) of the summit of Mauna Kea. Populations of Wēkiu bugs also occur on other cinder cones near the summit.

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 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 at these sites in 1998 during an arthropod assessment conducted as part of the Environmental Impact Statement prepared for the Mauna Kea Master Plan approved in 2000 by the UH Board of Regents. This new monitoring activity will update that 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 impacts, if any, due to construction of the Outrigger Telescopes Project.

Wēkiu Bug Baseline Monitoring
INTRODUCTION

This is the second Quarterly Report of Baseline Monitoring. The results of the sampling effort conducted April 29 28 through May 24 are reported. Comparisons to previously collected

data will be presented, along with new analysis and interpretations of correlations of changes in Wēkiu bug populations with weather related phenomena.



Pu'u Ala, Pu'u Makanaka, and Pu'u Poepoe viewed from Pu'u Mahoe. Wēkiu bugs have been found on Pu'u Makanaka and other cinder cones near the summit of Mauna Kea.

Wēkiu Bug Baseline Monitoring
QUESTIONS OF INTEREST

Question 2

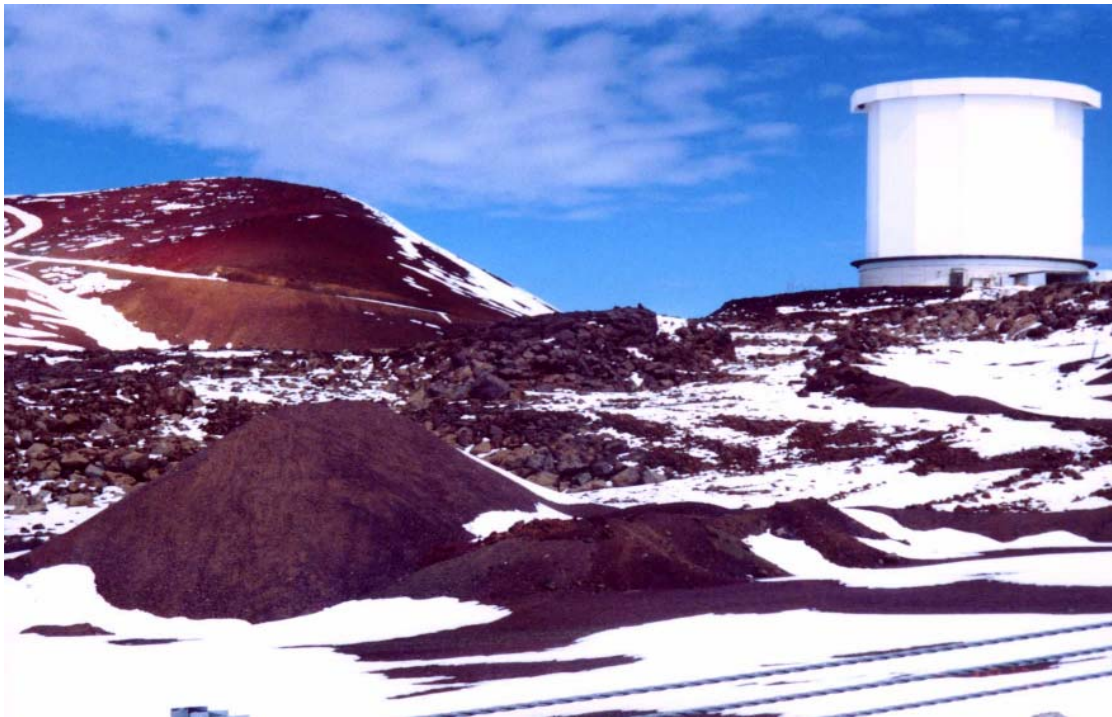
Are weather phenomena, human activities, and/or other factors associated with Wēkiu bug and/or other resident arthropod population change?

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.



Cinder Stockpile near the James Clerk Maxwell Telescope. Cinder from this stockpile is used for road maintenance, and is being considered for Wēkiu bug habitat restoration. Pu‘u Poli‘ahu is in the background.

Wēkiu Bug Baseline Monitoring
METHODS

Weather Data

Daily weather data from the UKIRT Observatory on the summit of Mauna Kea was downloaded from the World Wide Web at *www.maunakeaweather.hawaii.edu*. The UKIRT Observatory is located on Pu'u Kea, and is adjacent to the Pu'u Wēkiu sampling sites, and is less than one-half mile away from the Pu'u Hau 'Oki sampling sites.

Average temperature, average wind-chill temperature, average barometric pressure, and average humidity were

calculated for each 3-day sampling session from the UKIRT Observatory weather data. Minimum and maximum temperatures for the 3-day sampling sessions were also noted from the data.

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.



Pu'u Kea Observatories. A view of Pu'u Kea from Pu'u Hau 'Oki. UKIRT Observatory, where weather data were collected, is the last building on the right. IRTF Observatory on Pu'u Hau 'Oki is in the foreground on the left.

Wēkiu Bug Baseline Monitoring
RESULTS

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 and 2002 Baseline
Monitoring. Average trap capture rates for the 1997/98 Arthropod Assessment and 2002
Baseline Monitoring are in **RED**.

	Aug. 1997	Jan. 1998	April 1998	July 1998	Avg. 1997/98	Feb. 2002	May 2002	Avg. 2002
Pu'u Wekiu	0.15	0.00	0.07	0.15	0.11	0.03 (±0.03)	0.03 (±0.03)	0.03 (±0.00)
Pu'u Hau Oki	0.20	0.00	0.20	1.10	0.38	0.99 (±0.37)	9.56 (±5.19)	5.28 (±4.28)

Wēkiu Bug Baseline Monitoring
RESULTS

TABLE 4. MAY 2002 WĒKIU BUG TRAP CAPTURE DATA

	5/2/02		5/8/02		5/11/02		5/15/02	
	adult WB	juvenile WB	adult WB	juvenile WB	adult WB	juvenile WB	adult WB	juvenile WB
Pu'u Wēkiu								
Trap 1	0	0	0	0	0	0	0	0
Trap 2	0	0	0	0	0	0	0	0
Trap 3	0	0	0	0	0	0	0	0
Trap 4	0	0	0	0	0	0	0	0
Trap 5	0	0	0	0	0	0	0	0
Pu'u Hau Oki								
Trap 1	5	0	0	0	2	2	18	0
Trap 2	1	0	0	0	5	1	17	0
Trap 3	0	0	0	0	1	0	5	0
Trap 4	0	0	0	1	4	0	22	0
Trap 5	0	0	2	0	9	0	36	0
	5/18/02		5/21/02		5/24/02		SUM	
	adult WB	juvenile WB	adult WB	juvenile WB	adult WB	juvenile WB	adult WB	juvenile WB
Pu'u Wēkiu								
Trap 1	0	0	0	0	0	0	0	0
Trap 2	0	0	0	0	0	0	0	0
Trap 3	1	0	0	0	0	0	1	0
Trap 4	0	0	0	0	0	0	0	0
Trap 5	0	0	0	0	0	0	0	0
Pu'u Hau Oki								
Trap 1	10	0	6	0	24	0	65	2
Trap 2	6	0	1	0	34	0	64	1
Trap 3	1	0	2	0	22	0	31	0
Trap 4	3	0	0	0	60	0	89	1
Trap 5	3	0	2	0	54	0	106	0

**Wēkiu Bug Baseline Monitoring
RESULTS**

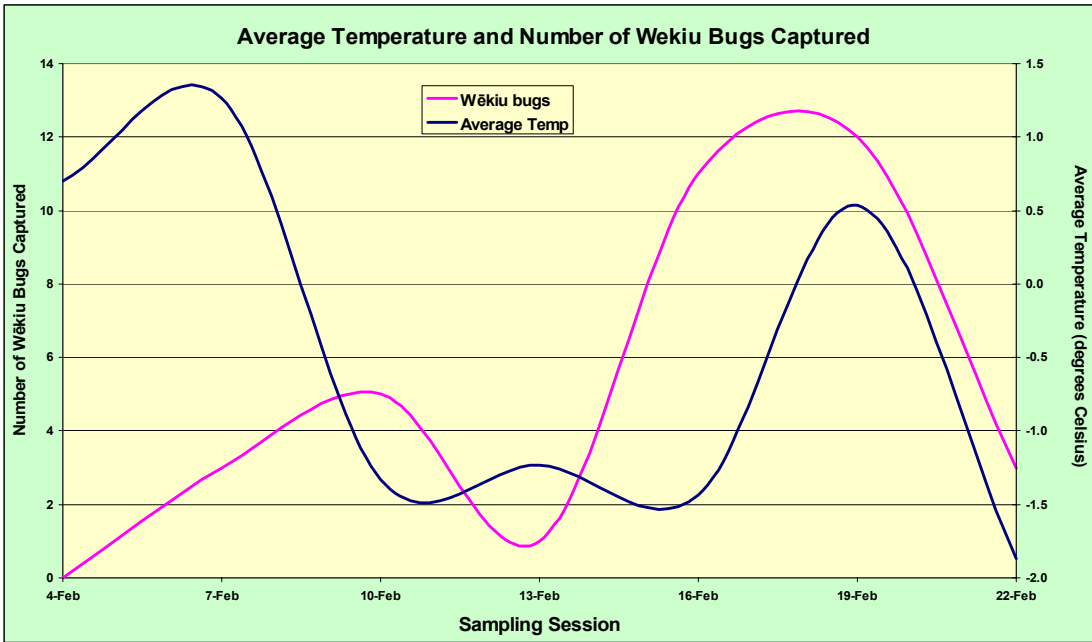


FIGURE 1. Plot of Average Temperature and Total Wēkiu Bug Captured for Seven Sampling Periods in 1st Quarter 2002.

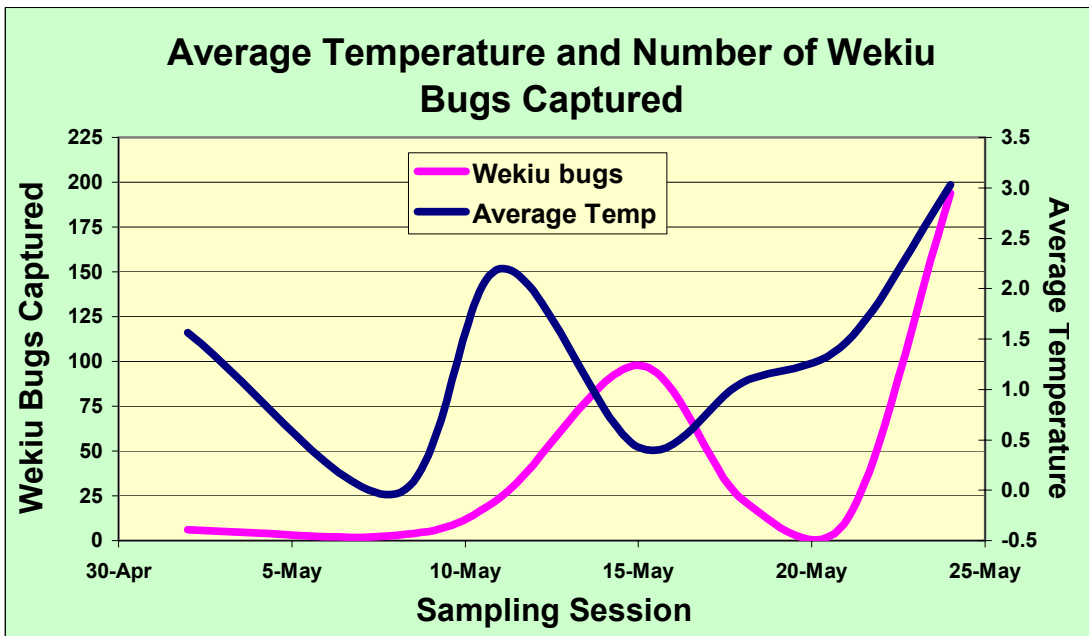


FIGURE 2. Plot of Average Temperature and Total Wēkiu Bug Captured for Seven Sampling Periods in 2nd Quarter 2002.

Wēkiu Bug Baseline Monitoring
RESULTS

MAY 2002



Pu'u Hau 'Oki inner slope
May 02, 2002



Pu'u Hau 'Oki inner slope
May 08, 2002



Pu'u Hau 'Oki inner slope
May 11, 2002



Pu'u Hau 'Oki inner slope
May 15, 2002

Wēkiu Bug Baseline Monitoring
RESULTS

Pu'u Hau 'Oki Outer Slope Photographic Archive

FEBRUARY 2002



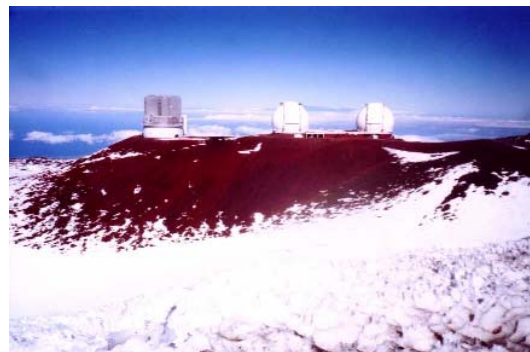
**Pu'u Hau 'Oki outer slope
February 07, 2002**



**Pu'u Hau 'Oki outer slope
February 10, 2002**



**Pu'u Hau 'Oki outer slope
February 13, 2002**



**Pu'u Hau 'Oki outer slope
February 16, 2002**

Wēkiu Bug Baseline Monitoring
RESULTS



Pu'u Wēkiu inner slope
February 22, 2002

MAY 2002



Pu'u Wēkiu inner slope
May 02, 2002



Pu'u Wēkiu inner slope
May 08, 2002

Wēkiu Bug Baseline Monitoring
RESULTS

Pu'u Wēkiu and Hau Kea Photographic Archive

FEBRUARY 2002



Pu'u Wēkiu and Hau Kea
February 01, 2002



Pu'u Wēkiu and Hau Kea
February 07, 2002



Pu'u Wēkiu and Hau Kea
February 10, 2002



Pu'u Wēkiu and Hau Kea
February 13, 2002

Wēkiu Bug Baseline Monitoring
RESULTS



**Pu'u Wēkiu and Hau Kea
February 16, 2002**



**Pu'u Wēkiu and Hau Kea
February 22, 2002**

MAY 2002



**Pu'u Wēkiu and Hau Kea
May 02, 2002**



**Pu'u Wēkiu and Hau Kea
May 08, 2002**

Wēkiu Bug Baseline Monitoring
RESULTS



**Pu'u Wēkiu and Hau Kea
May 24, 2002**

Wēkiu Bug Baseline Monitoring
DISCUSSION

transporting a covered trash container to the WMKO. Solid trash was removed from the WMKO site in this container. An inspection of the truck and trash container found them clean and free of any arthropods.



Pickup transporting a trash container.

The deep snow that accumulated during January and February attracted many people to the summit for snow play. During February 2002 visitors were observed from Pu'u Hau Kea and other lower cinder cones all the way to the summit on Pu'u Wēkiu. Snow play was observed on slopes where Wēkiu bug habitat is known to exist.

In May 2002, snow fall was less frequent and less intense than in February 2002. Snow play was observed only once during the May 2002 sampling session. The impacts on Wēkiu bugs due to snow play on the Mauna Kea summit cones are unknown.

Other Events

April 2002 - Wēkiu bug survey

The US Fish and Wildlife Service, the Smithsonian Institution, and the B.P. Bishop Museum conducted a survey to determine the extent of Wēkiu bug distribution on Mauna Kea. That information and the information from Baseline Monitoring will be given to the Office of Mauna Kea Management to be used in natural resource management planning for the MKSR.