WĒKIU BUG BASELINE MONITORING

QUARTERLY REPORT 1st QUARTER 2003

Prepared for

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

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WĒKIU BUG BASELINE MONITORING

QUARTERLY REPORT 1st QUARTER 2003

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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 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 on-site construction and installation of the Outrigger Telescopes Project. To that end these participants have prepared the Wekiu Bug Mitigation Plan and Wekiu 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 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).
- 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 are being deployed during Baseline Monitoring. Ten live-traps are installed at the summit of Mauna Kea at designated locations, five on Pu'u Hau 'Oki and five on Pu'u Wēkiu.

The 2002 1st Quarter three-week sampling session was conducted from February 1, 2002 through February 22, 2002. The trap capture rate during that sampling session ranged from 0 to 2.4 Wēkiu bugs per trap per 3 days of sampling. Thirty-four of the thirty-five Wēkiu bugs captured appeared in live-traps on Pu'u Hau 'Oki. The average trap capture rate on Pu'u Hau 'Oki was 0.99 Wēkiu bugs per trap per 3 days of sampling.

The 2002 2nd Quarter three-week sampling session was conducted from April 29, 2002 through May 24, 2002. The majority of the Wēkiu bugs appeared in or near traps on Pu'u Hau 'Oki, and only one of the 360 Wēkiu bugs captured were collected from Pu'u Wēkiu. The capture rate during the 2002 2nd Quarter session ranged from 0 to 38.8 Wēkiu bugs per trap per 3 days of sampling. The average trap capture rate on Pu'u Hau 'Oki in May

2002 was 9.56 Wēkiu bugs per trap per 3 days of sampling.

The 2002 3rd Quarter three-week sampling session was conducted from August 6, 2002 through August 28, 2002. During that sampling a total of 154 Wēkiu bugs appeared in or near the live-traps. One hundred and forty-four were found on Pu'u Hau 'Oki, and ten on Pu'u Wēkiu. Trap capture rates ranged from 0.0 to 6.6 Wēkiu bugs per trap per 3 days of sampling. The average trap capture rate on Pu'u Hau 'Oki in August 2002 was 4.01 Wēkiu bugs per trap per 3 days of sampling.

The 2002 4th quarter three-week sampling session was conducted from November 8, 2002 through November 29, 2002. During that sampling a total of 145 Wēkiu bugs appeared in or near the live-traps. One hundred and thirty-nine were found on Pu'u Hau 'Oki, and six on Pu'u Wēkiu. Trap capture rates ranged from 0.0 to 12.2 Wēkiu bugs per trap per 3 days of sampling. The average trap capture rate on Pu'u Hau 'Oki in November 2002 was 3.97 Wēkiu bugs per trap per 3 days of sampling.

The 2003 1st Quarter three-week sampling session was conducted from March 22, 2003 through April 11, 2003. During this sampling session a total of 708 Wēkiu bugs appeared in or near

Wēkiu Bug Baseline Monitoring EXECUTIVE SUMMARY

the live-traps. Six hundred and eight were found on Pu'u Hau 'Oki, and one hundred on Pu'u Wēkiu. Trap capture rates ranged from zero to 43.6 Wēkiu bugs per trap per 3 days of sampling.

The average trap capture rate on Pu'u Hau 'Oki during the 1st Quarter 2003 monitoring session was 18.29 (±4.79) Wēkiu bugs per trap per 3 days of sampling. This rate is about seventeen times greater than the average capture rate measured on Pu'u Hau 'Oki during the 1st Quarter baseline monitoring session in February 2002, and about 80% greater that measured during the 2^{nd} Quarter baseline monitoring session in May 2002.

The average trap capture rate on Pu'u Wēkiu during the 1st Quarter 2003 monitoring session was 2.87 (±1.03) Wēkiu bugs per trap per 3 days of sampling. This rate is about 94 times greater than the average capture rate measured on Pu'u Wēkiu during the 1st Quarter baseline monitoring session in February 2002. These rates cannot be directly compared because trap locations changed on Pu'u Wēkiu in 2003.

Seventy-nine (11%) of the Wēkiu bugs captured during the 1st Quarter 2003 monitoring session were juveniles, an indication that the population is breeding.



Adult Wēkiu bug found in live-traps on Pu'u Hau 'Oki. Actual size is about ¼ inch (~5 mm).

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 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 Wēkiu 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 Regents. Board This new activity will provide monitoring 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 impacts, if any, due to construction of the Outrigger Telescopes Project.

This is the fifth Quarterly Report of Baseline Monitoring. The results of

Wēkiu Bug Baseline Monitoring INTRODUCTION

the sampling effort conducted March 22, 2003 through April 11, 2003 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.



Immature Wēkiu bugs found on Pu'u Hau 'Oki near the summit of Mauna Kea.

Actual size is less than ¼ inch (~3 mm).

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 found in Live Trap on Pu'u Wēkiu. Actual size is about 1 ½ inches (~40 mm).

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.

Five live-traps were opened at the same locations where traps were installed during the previous sampling sessions, five on Pu'u Hau Oki. Because of disturbance, four of the five traps on Pu'u Wēkiu were relocated for this sampling to previously approved sites along the Pu'u Wēkiu Col trail. One site was not moved.

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 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 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, ½" 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).

Wēkiu Bug Baseline Monitoring METHODS

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, 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. 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 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.

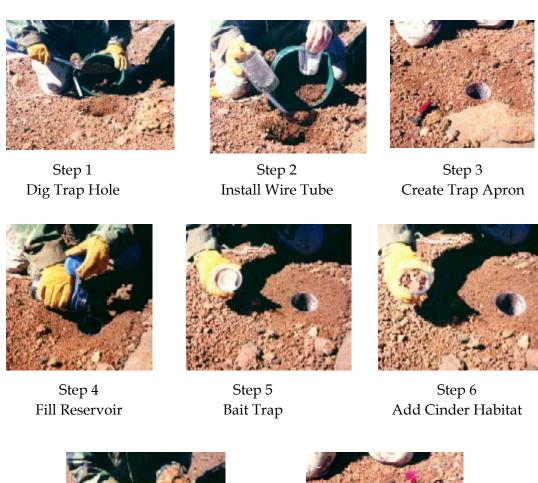
Traps were opened for the 2003 first baseline monitoring session on March 22, 2003. The traps were checked every three days and were closed on April 11, 2003.



Red arrow points to live-trap buried by recent snow fall. Traps buried by snow generally do not capture many Wēkiu bugs. Photo taken April 11, 2003.

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 was downloaded from the Internet/World Wide Web at www.maunakeaweather.hawaii.edu. The UKIRT Observatory is located on Pu'u Kea 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 windchill 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.



During snow events live-traps can fill with wind-blown snow, making it possible for Wēkiu bugs to escape from the traps. Photo taken April 11, 2003.

Wēkiu Bug Baseline Monitoring RESULTS

VI. RESULTS

SAMPLING INFORMATION

During the 2003 1st Quarter baseline monitoring session there were a total of twenty sampling nights, making six 3-day sampling periods and one 2-day sampling period. A total of seven hundred and eight Wēkiu bugs were captured, six hundred and eight on Pu'u Hau 'Oki and one hundred on Pu'u Wēkiu. The trap capture rate (number of Wēkiu bugs per trap per 3-days) ranged from zero to 43.6 Wēkiu bugs. The overall trap capture rate during the 3-week sampling session was

18.29 Wēkiu bugs for Pu'u Hau 'Oki, and 2.87 Wēkiu bugs for Pu'u Wēkiu (Table 1). For comparison, average trap capture rates from previous baseline monitoring sessions in 2002 and the 1997/98 Arthropod Assessment are provided (Table 2, Table 3, and Table 4).

Overall mortality was about 31% (221 of 712). Mortality in modified traps was about 9% (35 of 379).

TABLE 1. 1st QUARTER 2003 SAMPLING PERIOD AVERAGE TRAP CAPTURE RATES

The average number of Wēkiu bugs per trap per 3-days for each 3-day sampling period for 1st Quarter 2003 Baseline Monitoring.

Location	03/25/03	03/27/03	03/30/03	04/02/03	04/05/03	04/08/03	04/11/03
Pu'u Wekiu	0.0	0.3*	4.6	3.6	4.4	7.0	0.2
Pu'u Hau							
Oki	43.6	19.2*	10.4	15.4	20.8	15.8	2.8

^{* -} 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 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter	Year Avg.
Pu'u Wekiu 2002	0.03	0.03	0.26	0.17	0.12
Pu'u Wekiu 2003*	2.87				2.87
Pu'u Hau Ok 2002	0.99	9.56	4.01	3.97	4.63
Pu'u Hau Ok 2003	18.29				18.29

^{*} 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 Wekiu	0.15	0	0.07	0.15	0.11
Pu'u Hau Oki	0.2	0	0.2	1.1	0.38

WEATHER INFORMATION

The number of Wēkiu bugs found in traps was plotted with average temperature during the 3-day sampling periods. The pattern reveals that during the 1ST Quarter 2003 sampling session the number of Wēkiu bugs varies considerably with average temperature.

Generally, as average temperature increases, the number of Wēkiu bugs captured also increases (Figure 1). This is similar to the general pattern found during the 2002 Baseline Monitoring sampling sessions (Figure 2, Figure 3, Figure 4, and Figure 5).

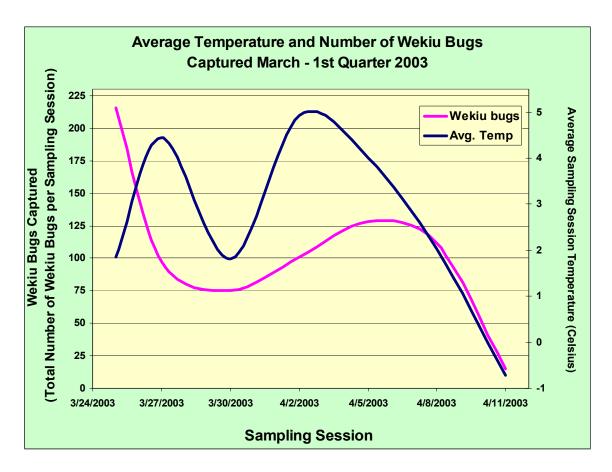


FIGURE 1. Plot of Average Temperature (Celsius) and Total Number of Wēkiu Bugs Captured for Seven Sampling Periods in March – April 2003.

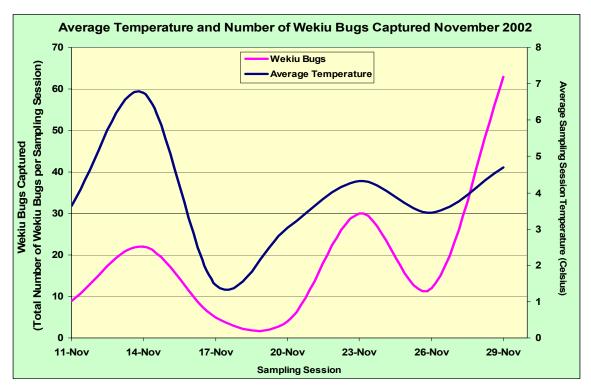


FIGURE 2. Plot of Average Temperature (Celsius) and Total Number of Wēkiu Bugs Captured for Seven Sampling Periods in November 2002.

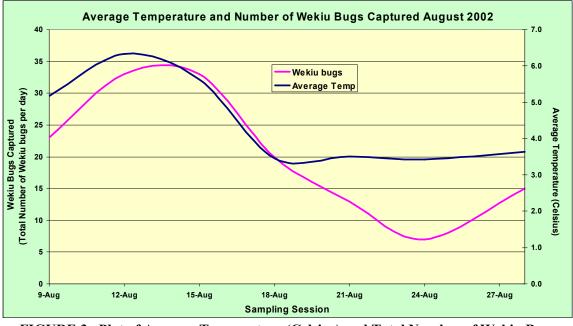


FIGURE 3. Plot of Average Temperature (Celsius) and Total Number of Wēkiu Bugs Captured for Seven Sampling Periods in August 2002.

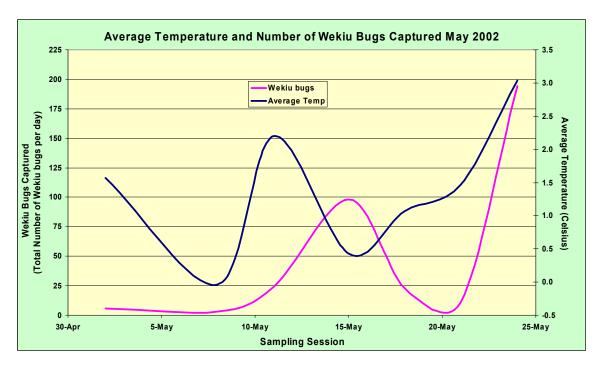


FIGURE 4. Plot of Average Temperature (Celsius) and Total Number of Wēkiu Bugs Captured for Seven Sampling Periods in May 2002.

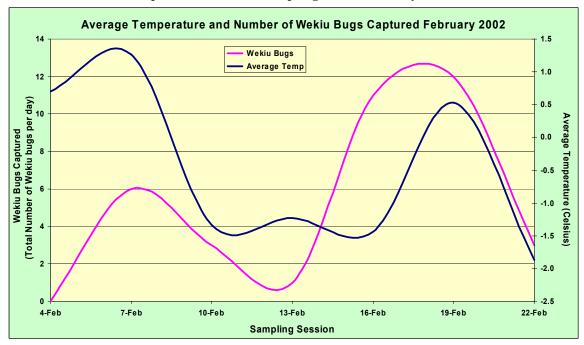


FIGURE 5. Plot of Average Temperature (Celsius) and Total Number of Wēkiu Bugs Captured for Seven Sampling Periods in February 2002.

NOOD TO THE TOTAL TH

Pu'u Hau 'Oki Inner Slope Photographic Archive

MARCH - APRIL 2003



Pu'u Hau 'Oki inner slope March 25, 2003



Pu'u Hau 'Oki inner slope March 27, 2003



Pu'u Hau 'Oki inner slope March 30, 2003



Pu'u Hau 'Oki inner slope April 02, 2003

Wēkiu Bug Baseline Monitoring RESULTS



Pu'u Hau 'Oki inner slope April 05, 2003



Pu'u Hau 'Oki inner slope April 08, 2003



Pu'u Hau 'Oki inner slope April 11, 2003

Wēkiu Bug Baseline Monitoring RESULTS

NOOD TO THE TOTAL TH

Pu'u Hau 'Oki Outer Slope Photographic Archive

MARCH - APRIL 2003



Pu'u Hau 'Oki outer slope March 25, 2003



Pu'u Hau 'Oki outer slope March 27, 2003



Pu'u Hau 'Oki outer slope March 30, 2003



Pu'u Hau 'Oki outer slope April 02, 2003

Wēkiu Bug Baseline Monitoring RESULTS



Pu'u Hau 'Oki outer slope April 05, 2003



Pu'u Hau 'Oki outer slope April 08, 2003



Pu'u Hau 'Oki outer slope April 11, 2003

Pu'u Wēkiu Photographic Archive

MARCH - APRIL 2003



Pu'u Wēkiu inner slope March 25, 2003



Pu'u Wēkiu inner slope March 27, 2003



Pu'u Wēkiu inner slope March 30, 2003



Pu'u Wēkiu inner slope April 02, 2003

Wēkiu Bug Baseline Monitoring RESULTS



Pu'u Wēkiu inner slope April 05, 2003



Pu'u Wēkiu inner slope April 08, 2003



Pu'u Wēkiu inner slope April 11, 2003

Pu'u Wēkiu and Hau Kea Photographic Archive

MARCH - APRIL 2003





Pu'u Wēkiu and Hau Kea March 25, 2003

Pu'u Wēkiu and Hau Kea March 27, 2003





Pu'u Wēkiu and Hau Kea March 30, 2003

Pu'u Wēkiu and Hau Kea April 02, 2003

Wēkiu Bug Baseline Monitoring RESULTS





Pu'u Wēkiu and Hau Kea April 05, 2003

Pu'u Wēkiu and Hau Kea April 08, 2003



Pu'u Wēkiu and Hau Kea April 11, 2003

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, 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. After a few days to allow the traps to settle in, the traps were baited and set.

Sampling began in 2002. The 2002 1st Quarter 3-week sampling session was conducted from February 1, 2002 to February 22, 2002 with samples acquired every three days (seven samples per trap). The 2002 2nd Quarter 3-week sampling session began on April 30, 2002, and sampling occurred every third day thereafter until May 24 (seven samples per trap). Traps were set for the 2002 3rd Quarter sampling session on August 6, 2002 and checked every third day beginning August 9 through August 28 (seven samples per trap). Traps were set for the 2002 4th Quarter sampling session on November 8, 2002 checked and everv third beginning November 11 through November 29 (seven samples per trap).

Sampling continued in 2003. The 2003 1st Quarter 3-week sampling session was conducted from March 22, 2003 to April 11, 2003 with samples acquired every three days (seven samples per trap).

During the 2003 1st Quarter sampling session Wēkiu bugs appeared in all ten of the traps, and a total of seven hundred and eight Wekiu bugs appeared in or near the traps. That represents twenty-fold about a increase over trap captures in February 2002, and about twice that captured during May 2002. eighty-six percent (608 Wēkiu bugs) of the Wekiu bugs captured appeared in live-traps on Pu'u Hau 'Oki. One hundred Wekiu bugs appeared in livetraps on Pu'u Wēkiu. All live bugs were released back into their habitat.

During the 1997/98 Mauna Kea Science Reserve Arthropod Assessment prepared for the 2000 Mauna Kea Master Plan, a standard was established to compare trap capture rates between various studies. The standard unit of measurement is the number of Wēkiu bugs per trap per 3 days of sampling.

Wēkiu Bug Baseline Monitoring DISCUSSION

The trap capture rate on Pu'u Hau 'Oki during 2003 1st Quarter Baseline Monitoring session ranged from 2.8 to 43.2 Wēkiu bugs per trap per 3-days (Table 1). The trap capture rate in 2002 1st Quarter, 2nd Quarter, 3rd Quarter, and 4th Quarter ranged from 0 to 2.4, 1.2 to 38.8, 2.6 to 6.6, and 0.6 to 12.2 Wēkiu bugs per trap per 3-days respectively. During the 1997/98 MKSR Arthropod Assessment, average trap capture rates on Pu'u Hau 'Oki ranged from 0 to 1.1 Wēkiu bugs (Table 3).

During the 2003 1st Quarter monitoring on Pu'u Wēkiu the trap capture rate ranged from 0 to 6.6 Wēkiu bugs. During the 1997/98 study trap capture rates ranged from 0 to 0.15 Wēkiu bugs (Table 3).

The 2003 1st Quarter average trap capture rate was 17.54 Wēkiu bugs per trap per 3 days of sampling on Pu'u Hau 'Oki and 2.80 on Pu'u Wēkiu (Table 2). During the last 3-day sampling period (April 08 - 11) there was a storm at the summit and several inches of snow accumulated. capture rates during this period fell dramatically. Wekiu bugs appeared to be less active, perhaps seeking shelter from adverse conditions rather than foraging. During the April 1998 sampling period of the 1997/98 Arthropod Assessment trap capture rates averaged 0.2 on Pu'u Hau 'Oki and 0.07 on Pu'u Wēkiu (Table 3). Trap capture rates in 2003 represented an increase of at least 40 times that measured in 1998. Apparently, Wēkiu bug populations may have increased since 1998.

The 2003 1st Quarter Wēkiu bug capture rate was about twice the capture rate measured in May 2002, the period of highest Wēkiu bug measured in 2002. It appears that Wēkiu bugs were more active in March - April 2003 than during any other period measured in 2002.

The average trap capture rate on Pu'u Wēkiu during the 2003 1st Quarter sampling was twenty times greater than the 2002 overall average (Table 2). Because of disturbance, traps on Pu'u Wēkiu were relocated for this sampling to previously approved sites along the Col trail. This probably accounts for some of the increase in trap capture rates.

Unfortunately not all Wēkiu bugs survived in live-traps. In 2002 sampling, mortality averaged about 38%. In an effort to reduce mortality, a modification was made to the trap, adjusting the coffee filter wick to reduce the amount of moisture in the trap cup. Trap mortality dropped to less than 9% in modified traps. Further testing is necessary to show that the modifications are responsible

Wēkiu Bug Baseline Monitoring DISCUSSION

for mortality reduction. Other factors may have contributed to the decrease, including weather conditions. Preliminary data indicate that trap capture rates are not affected by the trap improvement.

About 11% of the Wēkiu bugs captured during this sampling session were juveniles. Apparently, Wēkiu bugs are breeding. In August and November 2002, nearly 23% and 18% (respectively) of all Wēkiu bugs captured were juveniles. As more information is gathered through monitoring, a clearer picture should emerge about the Wēkiu bug life cycle and population dynamics.

Weather Data

The number of Wēkiu bugs captured in live-traps seems to vary with average air temperature (Figure 1, Figure 2, Figure 3, Figure 4, and Figure

Generally, higher trap captures occur when average air temperature is higher, and drop off when air temperature is lower. More information will need to be collected before conclusive inferences can be made about Wēkiu bug response to changes in air temperature, however the information gathered during the Baseline Monitoring in 2002 and 2003 sampling sessions is consistent with the hypothesis that Wekiu bug activity may be regulated by temperature.

Other Observations

No large trucks were observed at the WMKO during the 1st Quarter 2003 monitoring session. The site was free of loose trash and debris. Observatory vehicles parked near the WMKO were clean and free of mud and had no visible signs of alien arthropods.

Wēkiu Bug Baseline Monitoring DISCUSSION

Several signs that are posted provide safety for visitors but also help protect Wēkiu bug habitat. For example, on Pu'u Wēkiu, a sign prohibits off-road driving on Wēkiu bug habitat

Another sign, on Pu'u Hau 'Oki, asks visitors to limit speeds to prevent dust. Dust not only can damage observatory optics, but may also disturb Wēkiu bug habitat.



