U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Nysius wekiuicola

Common Name:

Wekiu bug

Lead region:

Region 1 (Pacific Region)

Information current as of:

06/02/2011

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

___ Continuing Candidate

_X_ Candidate Removal

> ___ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status
>
> _X_ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species
>
> ___ Range is no longer a U.S. territory
>
> ___ Insufficient information exists on biological vulnerability and threats to support listing
>
> ___ Taxon mistakenly included in past notice of review
>
> ___ Taxon does not meet the definition of "species"
>
> ___ Taxon believed to be extinct
>
> ___ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 05/11/2004

90-Day Positive:05/11/2005

12 Month Positive:05/11/2005

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **No**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Not Applicable**

Explanation of why precluded:

We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions (including candidate species with lower LPNs). During the past 12 months, the majority our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements; meeting statutory deadlines for petition findings or listing determinations; emergency listing evaluations and determinations; and essential litigation-related administrative and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of Progress on Revising the Lists, in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov/).

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: Hawaii
- **US Counties**: Hawaii, HI
- **Countries**: United States

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Hawaii
- **US Counties**: Hawaii, HI
- **Countries**:Country information not available

Land Ownership:

This species occurs on land owned by the State of Hawaii and administered by the University of Hawaii through the Office of Mauna Kea Management (OMKM).

Lead Region Contact:

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Biological Information

Species Description:

The adult wekiu bug is approximately 0.13 to 0.19 inches (in) (3.4 to 4.9 millimeters (mm)) long and 0.04 to 0.07 in (1.0 to 1.8 mm) wide. The head is black, with pale reddish-brown median bars from the base of head to just short of the anterior eye margins. The pronotum (the top of the first thoracic segment in insects) is black and grayish-brown, the abdomen is black with pale lateral margins, and the legs are black. The bug has extremely small wings (micropterous); has by far the longest, thinnest appendages in relation to body length of any lygaeid (seed bugs or milkweed bugs) in the world; and the most elongate head as well (Ashlock and Gagne 1983). The mean head width in millimeters of each immature stage is as follows: 1st instar (developmental immature stage between molts) .0.353; 2nd instar 0.432; 3rd instar 0.553; 4th instar 0.639; and the 5th instar 0.748. Eggs of the wekiu bug are elongated, narrow, and oval-cylindrical (~1 mm long and 0.3 mm wide) with a yellow-cream color, becoming red-orange as the embryo matures. The chorion is wrinkled and iridescent yellow-gold in color (Eiben and Rubinoff 2010).

Taxonomy:

Nysius wekiuicola was described as a distinct taxon by Ashlock and Gagne in 1983, the most recent and recognized taxonomic work for this species. The wekiu bug is a hemipteran, or true bug in the family Lygaeidae (seed bugs) (ITIS 2011).

Habitat/Life History:

The island of Hawaii today consists of five volcanic mountains. All are very young and three have been active in recent history (MacDonald et al. 1983). Mauna Kea is the highest of these volcanoes, rising 13,796 feet (ft) (4,206 meters (m)) above sea level. The surface lavas of this volcano are all younger than middle Pleistocene; however it has probably not been active during the last 2,000 years. During the Pleistocene epoch, an ice cap existed on the summit of Mauna Kea, with at least four distinct glacial episodes during the last 300,000 years (Porter 1979). The most recent glacial event (the Makanapa ice cap) disappeared from Mauna Kea about 9,000 years ago, but permanent ice still exists in the cinder of the summit cones just a few feet below the surface (Woodcock 1976).

Currently on Mauna Kea, an alpine lava community is present above 9,843 ft (3,000 m). This community is sparsely vegetated with growths of foliose lichens and the moss *Racometrium lanuginosum* (Gagne and Cuddihy 1999). Prior to the 1980s, due to an apparent lack of vegetation, it was popularly believed the Mauna Kea summit was a lifeless alpine desert (Waldrop 1981). However, in 1979 with the discovery of the wekiu bug, and subsequently into the early 1980s, an entire aeolian (brought or dispersed by the wind) community of arthropods was discovered at the summit (Mull and Mull 1980; Papp 1981; Gagne and Howarth 1982). Aeolian ecosystems are characterized by a near lack of natural producers; a windborne supply of nutrient material; a few plants such as algae, mosses, and lichens; and a community of mostly arthropod predators and scavengers evolved to feed on the windborne food supply. On Mauna Kea's summit, the major faunal components include a flightless moth (*Thyrocopa kikaelekea*) whose caterpillars feed on the lichens; a *Lycosa* wolf spider that preys on other insects; a centipede that preys on moribund insects blown to

the summit; and the unique, flightless wekiu bug, also a predator/scavenger (Howarth and Stone 1982).

At least six major habitat types can be recognized within this alpine ecosystem, and not all are suitable for each of the aeolian species (Howarth and Stone 1982): (1) snow patches that provide moisture and help retain food for the summit arthropods, but are not directly utilized by any of the species; (2) tephra (fragmental material produced by a volcanic eruption) ridges and slopes on cinder cones, which are important habitat for the spider, the wekiu bug, and smaller arthropods such as springtails; (3) loose, steep tephra slopes with smaller cinders that are not suitable habitat for the wekiu bug; (4) lava flows with large outcrops of andesitic (iron-poor gray lava) rock that are the primary habitat for the moth, the spider, and the centipede, although the wekiu bug is rare in this habitat due to the lack of suitable microclimate; (e) talus slopes and fractured rock outcrops that are typically smaller areas occurring within more extensive andesitic(fine grained, grey) lava flows and are suitable habitat for the wekiu bug; (5) compacted ash, silt, and mud along roadsides and in depressions; and (6) large expanses of pulverized cinder and ash between cinder cones in areas that had previously been subject to glaciation that is not suitable habitat for the wekiu bug, although lycosa spiders are occasionally found there. Because the interstitial voids among the cinders are filled, the aeolian arthropods cannot utilize this habitat (Howarth and Stone 1982, Porter and Englund 2006).

The wekiu bug is a unique component of the high elevation aeolian ecosystem on Mauna Kea (13,796 ft above sea level) (4,206 m). Along with its close relative, *Nysius aa*, on Mauna Loa (13,679 ft above sea level (4,169 m), the wekiu bug differs from all other *Nysius* species in its predatory habits and unusual physical characteristics and high elevation habitat (Polhemus 1998). Wekiu bugs are most often found under rocks and cinders. They are diurnally active and feed on moribund and dead insects that blow up from lower elevations. The presence of
high-altitude arthropods on Mauna Kea has been known since the 1920s (Bryan 1923, 1926; Swezey and Williams 1932; Wentworth et al. 1935; Usinger 1936; Gagne 1971), but it was not until 1980 that the wekiu bug and other arthropods were identified as being resident predator/scavengers.

In field conditions, the wekiu bug has been observed feeding upon adult lady beetles, recently dead adult syrphid and other flies, and even dead birds. The wekiu bug has not been observed feeding upon other resident aeolian arthropods (Ashlock and Gagne 1983; Howarth 1997a). Larval and adult wekiu bugs can remain active during winter months, and exhibit activity at ambient air temperatures of 19 degrees Fahrenheit (F) (minus 7 degrees Celsius (C)) (Howarth and Stone 1982). Cold temperatures associated with annual snowfall on Mauna Kea may assist the wekiu bug by immobilizing and preserving prey that are carried by winds up to the upper elevations and summit of Mauna Kea.

Although difficult to establish, it is widely believed the wekiu bug has some obligatory association with snow or permafrost, the former for food, and the latter especially for year-round moisture. This may at least explain its restriction to higher elevations on Mauna Kea (Englund et al. 2002). Wekiu bugs are fairly susceptible to dehydration, which may be related to extreme swelling of the abdomen (physogastricity) after feeding (Ashlock and Gagne 1983). Wekiu bugs will emerge from beneath the 3 to 10 in (7.6 to 25 centimeter (cm)) diameter tephra (volcanic pyroclastic rock) to feed and mate when the sun has warmed the rock surfaces, particularly at the margins of snow fields. They may prefer the narrow melting, outer perimeter of snowfields where they can take advantage of any frozen insects that drop from the receding snowfield perimeter (Howarth 1997a). The onset of a shadow or the sunset will result in a quick retreat of the bugs into the tephra.

Numerous surveys show that the distribution and biology of these bugs is strongly linked with the tephra cinder cones present on Mauna Kea, especially in the summit area; tephra habitats have yielded the highest capture rates of wekiu bugs (Ashlock and Gagne 1983; Englund et al. 2002). The tephra may facilitate vertical movement through the interstitial spaces according to day and night or seasonal temperatures. The bugs may also follow shifting snowfield edges by means of the spaces between the tephra (Howarth 1997b). Eiben and Rubinoff (2010) described a narrow range of temperatures in which wekiu bugs can develop and breed in captivity (75.2-82.4 degrees F (24-28 degrees C)), and they concluded that wekiu bugs survive and increase in numbers on tephra cinder cones because the deeper rock tephra with interstitial spaces in such

areas allows for more effective diurnal thermoregulation. By contrast, the formerly glaciated till areas between cinder cones are heated and cooled to temperatures both below and above wekiu bug developmental thresholds, creating greater challenges in terms of behavioral thermoregulation for optimum growth.

Since 2002, OMKM and NASA have funded annual wekiu bug surveys on Mauna Kea. In 2007, OMKM expanded the surveys to include not only the wekiu bug but other arthropods in strategic locations determined by the Wekiu Bug Scientific Advisory Committee (WBSAC). Founded in 2004, the WBSAC provides management recommendations to the OMKM. The WBSAC is composed of experts in insect ecology and biology, life in extreme environments such as the summit of Mauna Kea, and data collection and analysis. These experts are affiliated with Hawaii Community College, the University of Hawaii (UH), the State's Department of Land and Natural Resources (DLNR), and the U.S. Geological Survey's Biological Resources Division. In addition, the Service provides technical expertise to the OMKM.

In the fall of 2005, the OMKM funded research on the life history of the wekiu bug by Jesse Eiben and Dr. Daniel Rubinoff, both at the UH. The scope of the study was expanded in 2007 to include a population genetics study. The life history and captive rearing of the wekiu bug is described in a May 2010, paper in the *Journal of Insect Conservation* (Eiben and Rubinoff 2010). In that study, Eiben found that at 82.4 degrees F (28 degrees C) eggs averaged 17.4 days to hatch, the 1st instar stage lasted 7.45 days, 2nd instar 5.44 days, 3rd instar 5.2 days, 4th instar 5.79 days, and the 5th instar 8.2 days. Therefore, time for maturity of the wekiu bug at 82.4 degrees F (28 degrees C) was 31.9 days after hatching. Nymphs had a survival rate of 75 percent, and the average egg mortality was 48.5 percent. The average number of eggs laid per female was 75.7, with a rate of 3.3 eggs laid per day. The net reproductive rate (the average number of females hatching from one female "mother") was 15.4, the gross reproductive rate (the average number of female eggs laid by one female "mother") was 38.15, the average generation time was 39.7 days, and the intrinsic rate of increase (r - the average number of female young per breeding female per day) was 0.069. If r is positive (as in this captivity case) the population is growing (Eiben and Rubinoff 2010). These values were obtained at a constant temperature that never occurs on Mauna Kea in the wekiu bug habitat range, but ongoing studies are quantifying the thermal tolerances, and growth and reproduction rates of wekiu bugs to provide estimates of generation times and reproduction rates under field conditions. Preliminary data from simulating field conditions has shown an intrinsic rate of population increase of 0.036 (Eiben pers. comm. 2011). In the field, the generation time will be much longer than 40 days, with the initial estimate from this ongoing research of over 100 days for successive generations (OMKM 2008; Eiben 2010, pers. comm.). It is anticipated that a dissertation based on this 5-year study will be completed in 2011.

Historical Range/Distribution:

The wekiu bug was first discovered in 1979 by F.G. Howarth, S.L. Montgomery, and W.P. Mull on Puu Wekiu, the summit cinder cone of Mauna Kea on the island of Hawaii (Ashlock and Gagne 1983). By 1999, the species had been found on a total of six cinder cones (puu) including Puu Wekiu, Puu Hau Oki, Puu Makanaka, Puu Mahoe, Puu Lilinoe, and Puu Kea (Howarth et al. 1999). Two of the pu'us (Puu Hau Oki and Puu Kea) occur within the 525 acrea (ac) (213 hectares (ha)) Astronomy Precinct, an area set aside for construction of telescopes and related structures. Between 1979 and 1999 the wekiu bug was known from elevations above 12,800 ft (3,902 m) with the exception of one collection at 12,075 ft (3,681 m) on Puu Makanaka (Howarth et al. 1999).

Current Range Distribution:

Currently, the wekiu bug is known from a total of 16 pu'us on Mauna Kea, all above approximately 11,400 ft (3,474 m) in elevation. Wekiu bug populations are found on the following summit puu: Puu Poliahu, Puu Wekiu, Puu Hau Oki, Puu Hau Kea, Puu Kea, and Puu Pohaku (west of the summit); Puu Mahoe, Puu Ala, Puu Poepoe, Puu Makanaka (northeast of the summit); Puu Lilinoe, Puu Kookoolau, and unnamed cinder cones lying north and south of the Very Long Baseline Array (VLBA); and two cinder cones to the east of

the VLBA. In addition, there are a few unnamed cinder cones that are likely to support wekiu bugs at the far northewest and northeast margins of their currently recorded elevational range (to about 11,400 ft (3,474 m)), although none have ever been recorded from them (Porter and Englund 2006; Eiben 2010, pers. comm.). Wekiu bugs are seldom found on the habitat between cinder cones characterized by ash and rocks and known as ”glacial wash.”. Of the cones mentioned above, only Puu Hau Oki and Puu Kea occur within the 525 ac (213 ha) Astronomy Precinct.

Population Estimates/Status:

No quantitative estimates of the population are currently available but surveys show regular occurrence at specific sites, which likely indicates a stable population (Englund et al. 2002). In addition, wekiu bug populations at any given site vary widely in regard to annual population densities, a pattern recently confirmed by the 2010 wekiu bug survey (Englund 2010, in litt.), which documented dramatic increases in numbers at regularly monitored sites compared to the 5 previous years. Therefore, it is likely that the wekiu bug on Mauna Kea is stable within normal bounds of natural population variance for this species.

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Originally believed to be limited to six puu when first considered a candidate species, the construction of telescopes on these puu was the major cause of destruction and modification of wekiu habitat. However, under current long term management plans, no puu will be destroyed to build telescopes.

The UH is responsible for managing the 11,288-ac (4,568-ha) Mauna Kea Science Reserve (Reserve), which is located on the summit of Mauna Kea. These lands are leased by the UH from the DLNR. The Reserve’s lower boundary is between 11,700 ft (3,566 m) and 12,100 ft (3,688 m) elevation. Above 12,000 ft (3,658 m), approximately 3,800 ac (1,538 ha) of the Reserve within the State’s Mauna Kea Ice Age Natural Area Reserve (RCUH 1983). In 1983, the UH prepared the Mauna Kea Science Reserve Complex Development Plan (1983 Plan) for the summit area. This plan recognized the sensitivity of the wekiu bug and its habitat and recommended that construction activities minimize disturbance to the surrounding areas. Although the 1983 Plan identified important wekiu bug habitat in the summit area, and stated that development in this sensitive area was to be avoided, poor communication and the lack of monitoring during construction of the Subaru telescope facility resulted in the loss of what the State Auditor believed, at that time, was most of the wekiu bug habitat in Pu’u Hau Oki (State Auditor 1998).

In 2000, the UH prepared the Mauna Kea Science Reserve Management Plan (Master Plan) (Group 70 International 2000), which established the 525-ac (213-ha) Astronomy Precinct within the Reserve’s summit region for astronomy studies. The Astronomy Precinct is one of the foremost places in the world for astronomy studies due to its unique atmospheric and weather conditions. The Astronomy Precinct is the only area within the Reserve where telescope construction can occur. The remaining 10,763 ac (4,356 ha) of the Reserve is designated a cultural and natural preservation area where no telescope development can occur. The Master Plan was adopted by the University of Hawaii’s Board of Regents in June 2000. Currently, there are 13 telescopes (including one removed in 1994) and several buildings and associated structures that have been constructed in the Mauna Kea summit area. In addition, there is a radio telescope facility located off the summit to the southeast.

The adoption of the 2000 Master Plan established management guidelines for the next 20 years and reflects the community's concerns over the use of Mauna Kea, including respect for Hawaiian cultural beliefs, protection of environmentally sensitive habitat, recreational use of the mountain, as well as astronomy research. The Master Plan established the OMKM, as part of the UH system, at Hilo. The OMKM and the

Mauna Kea Management Board have responsibility for stewardship and management of the natural and cultural resources of Mauna Kea, and for other Master Plan elements, including review of all proposals for new development and consultation with the local community on proposed projects.

In December 2006, the UH Institute for Astronomy submitted a report to the Hawaii State Legislature entitled "Report on long-term development of observatory sites on the summit of Mauna Kea", in response to HCR (House Concurrent Resolution) 314 (2006). The report projected a substantially smaller scope of future development on Mauna Kea than was projected in the Master Plan. This was corroborated in the Decommissioning Plan, which was approved by the Board of Land and Natural Resources (BLNR) in March 2010. The Decommissioning Plan states that by the end of the lease in 2033, there may be 10 telescopes compared to the current 13. Only one of the existing telescope facilities is a candidate for expansion and the extent of that expansion is much less than suggested in the Master Plan.

Most recently, in 2009 the UH Hilo Instructional Telescope was constructed within the footprint of, and replaced, the UH 24” telescope (Nagata 2010, pers. comm.). In 2010, an Environmental Impact Statement (EIS) for the Pan-STARRS project was initiated. This project is proposed to replace the existing UH 2.2-m telescope. However, completion of the EIS has been put on hold and it is not certain when it will resume nor when work on this project might begin (Nagata 2011, pers. comm.). The Pan-STARRS project involves construction of a new telescope facility within the existing footprint of the UH 2.2-m telescope. There will be no construction on undisturbed land.

At this time, the only new project approved or scheduled for construction on the summit of Mauna Kea is the thirty meter telescope(TMT). The Final EIS for the proposed construction of the TMT on Mauna Kea’s northern plateau was published in April 2010, and accepted by the Governor in May 2010. There were no challenges to the Final EIS (Nagata 2010, pers. comm.). While the wekiu bug is not known to occur in the TMT project area, the Final EIS contains numerous mitigation measures including the development and implementation of a wekiu bug habitat restoration study; wekiu bug monitoring surveys prior to, during, and post construction; and implementation of an invasive species prevention plan. These measures were included in the application from UH to the BLNR for a Conservation District Use Permit (CDUP) to build and operate the TMT on Mauna Kea. The application was approved in February 2011, and the UH is required to implement the mitigation measures included in their CDUP permit application.

The TMT project is awaiting approval from the UH Board of Regents, the TMT Board, and the BLNR to sublease the land (proposed project site) within the Astronomy Precinct on which the TMT will be constructed (TMT 2011). The proposed project site is described as 5 percent talus slopes and highly fractured rock outcrops (talus slopes), usually found as islands within aa (fragmented, rough, spiny, cinder like in appearance) and pahoehoe (smooth, ropy, billowy in appearance) lava flows. Wekiu bugs can be found in moderate abundance in such areas during periods of high population density. The remaining 95 percent of the terrain is comprised of aa and pahoehoe lava flows (lava flows) with large outcrops of andesitic rocks. Lava flows are not considered suitable wekiu bug habitat, and wekiu bugs have not been collected in these areas. The access road leading to the TMT site will pass through about 750 ft (about 229 m) of a loose steep tephra slope, a habitat type where wekiu bugs are found in low abundance. Therefore, the TMT project will not significantly impact the species and does not present a threat to the species or its habitat now or in the foreseeable future.

On April 1, 2009, The UH published an environmental assessment for the Mauna Kea Comprehensive Management Plan (CMP) and a subsequent 2009 Natural Resources Management Plan. Both documents incorporate field survey data, including descriptions of the habitat and abundance of the wekiu bug. On April 9, 2009, the State’s BLNR approved the draft CMP with conditions. The conditions required that the UH develop and submit four sub-plans to the BLNR for approval: (1) a natural resources management plan (NRMP), (2) a cultural resources management plan (CRMP), (3) a decommissioning plan, and (4) a public access plan. In addition, a framework for reviewing new projects was required (S. Nagata, pers. comm. 2009). The BLNR approved all four sub-plans and the framework for reviewing projects on March 25, 2010.

The four sub-plans and the CMP comprise the management plan for UH's managed lands on Mauna Kea. The CMP and the four sub-plans contribute to the protection and conservation of the wekiu bug.

OMKM will continue annual surveys of the wekiu bug until it is determined by the WBSAC that the frequency of surveys should be changed . Additional studies will be initiated based on the results of current research studies. Data resulting from the surveys and studies will be used to implement some of the management actions described in the CMP and NRMP. The OMKM is required by the BLNR to provide annual reports on the status of the implementation of the CMP and sub-plans.

Thus, as a result of the expansion of the known range into protected areas, the ban on building on new puu, and a management plan in place to protect the species the present or threatened destruction, modification, or curtailment of the habitat or range is not a threat to the wekiu bug.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

There are no known threats from overutilization. Occasionally OMKM receives requests for collection or manipulation of wekiu bugs for scientific studies, but generally these requests are limited to areas that are not prime wekiu bug habitat (for example, along the road leading up to the summit). Most of the current wekiu bug studies have been initiated by OMKM and are related to surveys and research to investigate wekiu bug life history and abundance. The results of these studies provide critical information for developing management programs to protect the wekiu bug. Therefore, we do not consider overutilization a threat to the species now or in the foreseeable future.

C. Disease or predation:

Currently, we do not have any information indicating that disease or predation impacts the wekiu bug. It is possible that in the future, ants or other predatory arthropods may become established and thereby potentially pose a threat to the wekiu bug. Since 2007, OMKM has funded and continues to fund surveys to monitor and identify species with the potential to become established in the higher elevations on Mauna Kea that could have a negative impact on the wekiu bug. Based on the best available information, we do not believe the wekiu bug is threatened by disease or predation now or in the foreseeable future.

D. The inadequacy of existing regulatory mechanisms:

While Hawaii has an endangered species law (HRS, Sect. 195-D), the wekiu bug receives no protection under this law or any other existing regulatory mechanism.

Despite the lack of regulatory mechanisms to protect the wekiu bug, we found that there are no threats to the species (Factors A, B, C, and E) that require regulatory mechanisms to protect the species. Although not a regulatory mechanism, the 2000 Master Plan effectively provides for protection and management of the species as described above under Factor A. Therefore, we do not consider the inadequacy of existing regulatory mechanisms to be a threat to this species now or in the foreseeable future.

E. Other natural or manmade factors affecting its continued existence:

By 2100, Christensen et al. (2007) projected a global monthly average temperature increase in Hawaii of about 4.1 degrees F (2.3 degrees C) with a range of 2.7 to 6.7 degrees F (1.5 to 3.0 degrees C) from the current value of over 74 degrees F (23 degrees C) to between 77 to 86 degrees F (25 to 30 degrees C). Historically in Hawaii, temperature has risen over the last 100 years with the greatest increase after 1975 (Giambelluca et al. 2008). The rate of increase at low elevations, 0.16 degrees F (0.09 degrees C) per decade, is below the observed global temperature rise of 0.32 degrees F (18 degrees C) per decade (Christensen et al.

2007). However, at high elevations, the rate of increase, 0.48 degrees F (0.27 degrees C) per decade, greatly exceeds the global rate. Overall, the daily temperature range in Hawaii is decreasing, resulting in a warmer environment, especially at higher elevations and at night. Christensen et al. (2007) projected that by 2100, precipitation at sea level near the Hawaiian Islands will decrease in winter by about 4 to 6 percent, with no significant change during summer. Downscaling of global climate models indicates that wet-season (winter) precipitation will decrease by 5 to 10 percent, while dry-season (summer) precipitation will increase by about 5 percent (Timm and Diaz 2009). Historically, precipitation in the Hawaiian Islands shows a steady and significant decline of about 15 percent over the last 15 to 20 years (Diaz et al. 2005; Chu and Chen 2005). These data are also supported by a steady decline in stream flow in the Hawaiian Islands, beginning in the early 1940s (Oki 2004).

In 2005 OMKM funded a study to review historical weather data dating back to the early 1990s to mid-2000s on Mauna Kea. The purpose of this review is to look at weather patterns and how they might have affected wekiu bug numbers. This study has been expanded to include weather data for Mauna Loa dating back to 1958 and compares the Mauna Loa data with weather patterns for Mauna Kea, where data dating back to the 1960s was not collected. The objective is to develop a model to extrapolate weather data for Mauna Kea that predates observatory development on Mauna Kea. It is anticipated that information from this study will provide improved understanding of the relationship between weather and wekiu bug abundance. In addition, in 2005 OMKM funded a study to examine the influence of the summit terrain and wind systems on the distribution of insects blown up from lower elevations. The objective of this study is the development of a predictive model that will provide OMKM with data needed to manage wekiu bug habitat. Lastly, OMKM is funding a long range climate change study to assist in addressing this concern.

No information is available at this time to suggest that climate change is currently a substantive threat to this species, given uncertainty of Pacific Basin climate models, and consequent uncertainty as to whether future tropicoalpine weather regimes on the Mauna Kea summit will differ in terms of temperature or precipitation from current regimes. However, the ongoing activities described above will provide improved data upon which to assess future changes, and adjust management strategies as needed. Therefore, based on the best scientific and commercial information available, we conclude that climate change and other natural or manmade factors are not a threat to the wekiu bug now or in the foreseeable future.

Conservation Measures Planned or Implemented :

Summary of Threats :

Currently, the wekiu bug is not threatened by habitat destruction or modification on Mauna Kea.
With the exception of the TMT project, there are no new projects approved or scheduled for construction on undisturbed land in the summit area. While the wekiu bug is not known to occur in the TMT project area, the UH is required to implement numerous mitigation measures that will conserve and protect the wekiu bug as a condition of TMT project approval. These measures include the development and implementation of a wekiu bug habitat restoration study; wekiu bug monitoring surveys prior to, during and post construction; and implementation of an invasive species prevention plan.

There are no known threats to the wekiu bug from overutilization, disease or predation. While it is possible that, in the future, ants or other predatory arthropods may become established on Mauna Kea and thereby potentially pose a threat to the wekiu bug, OMKM funds studies and surveys to monitor and identify species with the potential to become established in the higher elevations on Mauna Kea that could have a negative impact on the wekiu bug. Measures to control predatory species that become established in wekiu bug habitat will be developed according to the NRMP and recommendations from the WBSAC.

There are no known threats to the wekiu bug from inadequate existing regulatory mechanisms.

No information is available at this time to suggest that climate change is currently a substantive threat to this

species, given the uncertainty of Pacific Basin climate models, and consequent uncertainty as to whether future tropicoalpine weather regimes on the Mauna Kea summit will differ in terms of temperature or precipitation from current regimes. The OMKM is funding a long-range climate change study to assist in addressing this potential concern. The ongoing activities described above (the review of historical weather data, and the study to examine the influence of the summit terrain and wind systems on the distribution of insects blown up from lower elevations) will provide improved data upon which to assess future changes and adjust management strategies as needed.

Once considered to be restricted to 6 puu, the wekiu bug has now been recorded from 16 puu. Two of these 16 puu occur in an area that has undergone development of observatory facilities. Construction on any new pu'us occupied by the wekiu bug will no longer occur. Management of the Mauna Kea summit area by OMKM includes continued monitoring and scientific studies to assist in managing and protecting wekiu bug populations and habitat.

Finding
The wekiu bug belongs to the true bug family, Lygaeidae, and occurs only on the summit of Mauna Kea on the island of Hawaii. The wekiu bug was believed to be limited in range to six puu in the summit area and was threatened by loss of habitat on Mauna Kea due to development of observatory facilities, which was believed to be causing a severe decline in its numbers. Surveys and other studies carried out over the last 11 years suggest the wekiu bug has a broader distribution on Mauna Kea than previously known. In 1999, this species was known to occur on 6 puu but surveys indicate that the wekiu bug is currently found on 16 puu. Two of these 16 puu occur in an area that has undergone development of astronomy observatory facilities. The previous trend toward loss of habitat due to observatory construction has been curtailed and no new construction, including the currently-planned TMT project, will occur on any puu occupied by the species. Management of the Mauna Kea summit area by the OMKM includes continued monitoring of the wekiu bug and its habitat and scientific studies to assist in managing and protecting wekiu bug populations and habitat. The 2000 Master Plan, the CMP, the four sub-plans (NRMP, CRMP, decommissioning plan, and public access plan), and a procedure for formal review of new projects on Mauna Kea all contribute to the protection and conservation of the wekiu bug.

Studies over the last 11 years indicate the wekiu bug has a stable population and demonstrate that this species exhibits extreme variability in terms of annual densities at any given site, such that the normal bounds of natural population variance for this species are much wider than previously understood. Based on our review of the best available information, we no longer conclude that threats across the wekiu bug's expanded range put the species in danger of extinction. In summary, because the wekiu bug is likely stable in numbers, is more widespread than previously believed, current threats are minimized and restricted within the larger range of the species, and future potential threats are monitored, we find listing of the wekiu bug (*Nysius wekiuicola*) is no longer warranted. The species no longer meets our definition of a candidate, and we have removed it from candidate status.

For species that are being removed from candidate status:

__No__ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

Not applicable, listing this species is no longer warranted and is being removed from the candidate list.

Description of Monitoring:

Indicate which State(s) (within the range of the species) provided information or comments on the

species or latest species assessment:

Hawaii

Indicate which State(s) did not provide any information or comment:

none

State Coordination:

The State of Hawaii Department of Land and Natural Resources considers the wekiu bug a species of greatest conservation need and is working cooperatively with OMKM.

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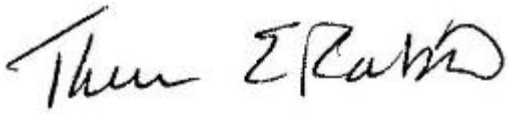
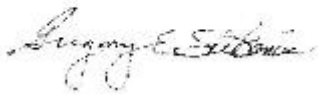
Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:  06/01/2011
Date

Concur:  10/07/2011
Date

Did not concur: _____ _____
Date

Director's Remarks: