

**PETITION TO LIST THE WĒKIU BUG (*NYSIUS WEKIUCOLA*)
AS AN ENDANGERED SPECIES WITH CRITICAL HABITAT DESIGNATION
SUBMITTED TO THE UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BY KAHEA: THE HAWAIIAN ENVIRONMENTAL ALLIANCE
MAY 22, 2003**

I. INTRODUCTION

KAHEA: The Hawaiian-Environmental Alliance hereby petitions the Secretary of the Interior to list the wēkiu bug (*Nysius wekiuicola*) as an endangered species with critical habitat designation. This petition is made under the Administrative Procedures Act, 5 U.S.C. § 553(e), the Endangered Species Act, 16 U.S.C. § 1533, and federal regulation, 50 C.F.R. § 424.14.

KAHEA is a non-profit, public-interest organization, which includes Native Hawaiian practitioners, environmentalists, and others dedicated to protecting traditional and customary Native Hawaiian rights and the environment. KAHEA is working to improve the quality of life for Hawai'i's people and future generations through the revitalization and proper management of Hawai'i's unique natural and cultural resources. KAHEA encourages citizen participation in environmental protection through outreach and education, and actively participates in environmental policy-making.

KAHEA has an interest in the conservation of Hawaiian species and their habitat, including the wēkiu bug, and the timely and effective implementation of the Endangered Species Act, as intended by Congress. KAHEA played a pivotal role in obtaining protection for the Northwestern Hawaiian Islands, which provide essential habitat for numerous plants and animals, including endangered species. KAHEA is actively involved in raising awareness and support for the Natural Area Reserves System, which protects habitat for rare and endangered Hawaiian species on state-managed land. KAHEA recently launched a campaign to raise awareness and increase protection of the endangered ʻĪlio-holoikaua (Hawaiian monk seal).

II. GENERAL INFORMATION

A. NAME OF SPECIES

The subject of this petition is the wēkiu bug (*Nysius wekiuicola*). "Wēkiu" is a Hawaiian word that means "tip, top, topmost, summit." The species' common name, "wēkiu bug," was selected in reference to its habitat.

B. PRESENT AND PAST DISTRIBUTION

1. PRESENT DISTRIBUTION

The wēkiu bug is restricted to the alpine aeolian ecosystem in the summit area of Mauna Kea, Island of Hawai'i. The species' rarity is demonstrated by the fact that only 47 wēkiu bugs were trapped and an additional five were observed despite 398 total trap days of sampling effort by the Bishop Museum in April, May, and September 2002. Table 1 lists the areas in which wēkiu bugs were trapped or observed during the 2002 study.

Traps with negative wēkiu bug results may not necessarily have had zero wēkiu bugs in them due to the presence of large predators, such as Lycosid (wolf) spiders, which consume items within the traps.

Table 1 Summary of sampling effort and results of Mauna Kea cinder cones surveyed in April, May, and September 2002 by the Bishop Museum.

Cinder Cone	Wēkiu Bugs in Traps	Wēkiu Bugs Observed Only
Pu'u Hau Kea	9	4
Pu'u Māhoe	n/a	1
Pu'u Poepoe	33	0
Pu'u Ala	3	0
Pu'u Makanaka	1	0
Unnamed Pu'u 1W	0	0
Unnamed Pu'u near VLBA	1	0
Transit Area	0	0
Pu'u Keonehehe'e	0	0
Unnamed Pu'u 2W	0	0
Total	47	5

2. PAST DISTRIBUTION

The wēkiu bug was first discovered in 1979 by Francis G. Howarth, Steven Lee Montgomery, and William P. Mull on Pu'u Wēkiu, the summit cone of Mauna Kea, Island of Hawai'i. Up until the mid-1990s, the wēkiu bug was known from only a small number of areas above 12,800 ft (3,901 m) on the Mauna Kea summit.

Previous surveys of wēkiu bug habitat in selected areas within the Mauna Kea Science Reserve include a survey by the Bishop Museum in 1982 and a reconnaissance survey and trapping effort in 1997. Table 2 lists the areas in which the wēkiu bug was trapped or observed during the 1982 and 1997 studies. A total of 473 wēkiu bugs were also trapped on Pu'u Hau Kea in the Mauna Kea Ice Age Natural Area Reserve during a study by the Smithsonian Institution in June 2001.

Table 2. Reported occurrences of the wēkiu bug in selected areas within the Mauna Kea Science Reserve in 1982 and 1997.

Location	1982	May 1997	August 1997
Wēkiu Summit Ridge	x		x
Wēkiu Inner Crater Slope	x		x
Wēkiu Upper Crater Floor			x
Wēkiu Col	x		
Hau'oki Crater Floor		x	
Hau'oki Undisturbed Inner Slope		x	x
Hau'oki Disturbed Inner Slope		x	x
Hau'oki Outer North Slope	x		
Hau'oki Outer East Slope			x
C.I.T. Site	x		
North Slope Plateau	x		
Northwest Plateau	x		
Poli'ahu	x		
South Slope	x		

3. POTENTIAL HABITAT

The following areas were identified as among the most promising wēkiu bug habitats in a preliminary report on an arthropod assessment within selected areas of the Mauna Kea Science Reserve in 1997.

a. TALUS HABITAT

- **North Slope** – There are two talus habitats near the end of the road along the north base of Pu'u Hau'oki. The first area is on the ridge from Pu'u [Hau?] Kea, and the second area is west of Pu'u Māhoe. The two areas total approximately 49 acres (20 ha), of which 25% is suitable habitat.
- **South Slope** – The south slope contains talus habitat between the Summit Road and Pu'u Lilinoe, which connects with broken lava habitat on the south face of Pu'u Wēkiu and continues downslope nearly to the access road to the Very Long Baseline Array facility. The total area of the blocky outcrop is about 72 acres (29 ha), of which between 40 to 50% appear to be suitable talus habitat. Blocky lava flows and glacial till make up the remaining substrate. The talus habitat also connects with excellent scoria habitat on Pu'u Lilinoe.
- **West Slope** – The south-facing cliff of the northwest lava plateau contains patches of talus along its entire length from Pu'u Poli'ahu to near the edge of the Science Reserve. About one half of the upper part of this area lies within the Mauna Kea Ice Age Natural Area Reserve outside the Science Reserve.
- **Other Talus Deposits** – Smaller patches of talus habitat occur as islands in the blocky lava flows, especially on the northwest plateau, near the unnamed cone south of the VLBA facility, and on the slopes between the scoria cones. Some of these patches may be suitable wēkiu bug habitat, especially if they are interconnected by crevices in the broken lava.

b. **SCORIA HABITAT**

- **Pu'u Lilinoe** – The scoria habitat on Pu'u Lilinoe covers about 99 acres (40 ha). More than 50% of the surface is composed of fist-size vesicular scoria and appears to be excellent habitat for the wēkiu bug. Scoria on the northern and western slopes of Pu'u Lilinoe is larger, and this area is probably better habitat than the eastern and southern outer slopes.
- **Pu'u Māhoe** – The outer slopes of the more accessible southern portion of Pu'u Māhoe is composed of fist-size scoria. The southern-most crater also contains excellent habitat. Approximately 50% of the remaining surface of Pu'u Māhoe also appears to be good to excellent wēkiu bug habitat, but the northern portion is too remote for efficient sampling. The total area of the cone is about 153 acres (62 ha).
- **Unnamed Cone South of VLBA** – This cone is composed of finer material with a shallow surface layer of larger scoria. The total area covers about 80 acres (32.5 ha). It is relatively small and steep, but a larger area of scoria continues downslope between deposits of glacial moraines. There is a breached crater and many blocky lava outcrops at the summit. About 40% of the steeper main cone is promising wēkiu bug habitat, especially the lower portion of the east slope and portions of the summit ridge.
- **Southeast Boundary Cone** – This unnamed cone on southeast boundary of the Science Reserve is composed of a very loose deposit of fist-size scoria with scattered blocks deposited by the glacier. Most of the cone appears to be excellent wēkiu bug habitat, and the site would be a good location to test the lower limit of the bug's distribution within the Science Reserve. The total area is 44 acres (18 ha), of which about one-half is within the Science Reserve.
- **Pu'u Poli'ahu** – A deep deposit of fist-size scoria on the lower northwest outer slopes of approximately 10 acres (4 ha) appears to be excellent wēkiu bug habitat. The scoria connects with the valley bottom of periglacial pavement made up of fallen scoria and weathered tephra. The pavement habitat is fair and covers about 8 acres (3.4 ha).
- **Lilinoe Iki** – A small unnamed cone of about 37 acres (15 ha) between Pu'u Lilinoe and the VLBA facility has more compact scoria than on Pu'u Lilinoe, but deep deposits of loose scoria occur in patches as solifluction lobes. About 50% of the cone is promising wēkiu bug habitat.
- **West Boundary Cone** – Most of the slopes of this large unnamed cinder cone downslope and west of Pu'u Pōhaku are too remote and steep to safely survey, but may contain large areas that appear to be promising wēkiu bug habitat. The total area is estimated to be 371 acres (150 ha), of which more than one-half of the lower slopes is of unknown composition. Up to 124 acres (50 ha) may be suitable wēkiu bug habitat.

c. **ESTIMATED NUMBERS – PAST AND PRESENT**

Petitioner is not aware of any population estimates for the wēkiu bug. The number of wēkiu bugs captured in the 1982 study was higher than the numbers captured in the 1997 and 2002 studies. However, biologists note that population trends cannot be made based on the 1982, 1997, and 2002 data because of varying methodologies and other factors. Any decline that might have occurred in the population as a whole, or in localized areas, may have been the result of climate change, a possible long-term trend downward trend in winter snowpack depth and persistence, introduction of predatory alien arthropods, mechanical habitat disturbance from telescope construction, recreational impacts, vehicle impacts, and the possible presence of environmental contaminants from human activities. A relatively large number of wēkiu bugs were trapped during a 2001 study on Pu'u Hau Kea in the Mauna Kea Ice Age Natural Area Reserve, which is undeveloped, but nonetheless threatened by human-

related activities. (The 1982 and 1997 studies did not include sampling on Pu'u Hau Kea in the Natural Area Reserve.)

Petitioner is aware that, since the 1960s, when the first modern road to the summit was bulldozed, approximately 62 acres (25 ha) of potential wēkiu bug habitat have been lost to astronomy development on the Mauna Kea summit, and that more than two-thirds of the wēkiu bug's potential range is unprotected from astronomy development. Tourism, recreational activities, all-terrain vehicles, and alien species introductions also threaten the wēkiu bug and its habitat.

D. ECOLOGICAL REQUIREMENTS

1. GENERAL SETTING

Mauna Kea is the highest of five volcanoes that produced Hawai'i Island, rising 13,796 ft (4,205 m) above sea level. The surface lavas are all younger than mid-Pleistocene, and the volcano probably has 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. The most recent glacial event (the Mākanapa 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.

The summit of Mauna Kea above 9,843 ft (3,000 m) is currently an alpine lava community sparsely vegetated with growths of foliose lichens, algae, and the moss, *Racomitrium lanuginosum*.

At least six major habitat types are recognized on the Mauna Kea alpine summit:

- **Snow Patches** – Snow patches provide a moisture and food resource for all of the summit arthropods, including the wēkiu bug.
- **Tephra Ridges and Slopes on Cinder Cones** – Tephra ridges and slopes on cinder cones are important habitat for the wēkiu bug and spider.
- **Loose, Steep Tephra Slopes with Smaller Cinder** – Loose, steep tephra slopes with smaller cinder may contain suitable habitat for the wēkiu bug.
- **Lava Flows with Large Outcrops of Andesitic Rock** – Lava flows with large outcrops of andesite rock are primary habitat for the moth, spider, and centipede, but the wēkiu bug is rare in this habitat due to the lack of suitable microclimate.
- **Talus Slopes and Fractured Rock Outcrops** – Talus slopes and fractured rock outcrops are typically smaller areas that occur within areas of andesitic lava flows and are suitable habitat for the wēkiu bug.
- **Compacted Ash, Silt, and Mud Along Roadsides and in Depressions** – Compacted ash, silt, and mud along roadsides and in depressions are not utilized by aeolian arthropods because the interstitial voids among the cinders are filled.

The major faunal components of the Mauna Kea summit area include the wēkiu bug, a flightless moth whose caterpillars feed on the lichens, a *Lycosa* wolf spider, and a centipede. These animals are part of an aeolian ecosystem, which is 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.

2. NATURAL HISTORY

The wēkiu bug is a member of the Lygaeidae (seed bugs) family in the order of insects known as Hemiptera (true bugs). The family is characterized as a variable group, usually recognized by their four-segmented antennae, four-segmented beak, ocelli (small eyes), and four or five simple veins in the membrane of the hemelytra (wings). Body length varies from 0.079 to 0.71 in (2 to 18 mm), and many species are brightly marked with bands of black, white, or red. Although the order Hemiptera contains many predators, including entire families of predators, Lygaeidae itself contains few predators.

In Hawai'i, the genus *Nysius* is characterized by the following physical attributes: conspicuous pubescence and erect setae (hairs), which clothe the greater part of the dorsal surfaces; the breadth of the head across the eyes is less than the narrowest breadth of the pronotum (plate covering the thorax); and the hind margins of the metapleura (side of thorax) are concave with the postero-lateral angle rounded off. Hawaiian *Nysius* also exhibit a wider range of characters than is exhibited worldwide by *Nysius*. In Hawai'i, *Nysius* has radiated into over 26 endemic species that feed on the seeds of native plants, with the exception of the wēkiu bug and its close relative and Mauna Loa counterpart, *Nysius aa*.

Adult wēkiu bugs are about 0.13 to 0.19 in (3.4 to 4.9 mm) in length and 0.039 to 0.07 in (1.0 to 1.8 mm) in width. The wēkiu bug's head is black with pale reddish-brown median bars from the base of the head to just short of the anterior eye margins. The pronotum is black grayish-brown, the abdomen is black with pale lateral margins, and the legs are black.

The wēkiu bug is microperous (possessing nearly microscopically small wings). It has the longest, thinnest appendages in relation to the body length of any Lygaeid in the world, and the most elongated head as well. The wēkiu bug is susceptible to dehydration, which is probably related to its attribute of abdominal physogastricity (extreme swelling) exhibited after feeding.

The wēkiu bug occupies a predator-scavenger niche on the summit of Mauna Kea. It is dependent upon organic aeolian matter for food – insects and other matter blown

up the mountain from lower elevations. It utilizes the tephra to its benefit by migrating vertically through the interstitial spaces according to day and night or seasonal temperature. It is most often found under rocks and cinders where, diurnally, it preys upon moribund and dead insects, and even birds blown up the mountain from lower elevations. In field conditions, the wēkiu bug has been observed feeding upon adult lady beetles, recently dead adult syrphid flies, and dead birds. It has not been observed feeding on other resident arthropods.

It is widely believed that the wēkiu bug has some obligatory association with snow and/or permafrost, the former for food and the latter especially for year-round moisture. This would explain its restriction to higher elevations on Mauna Kea. The wēkiu bug uses snow to its advantage by feeding on insects that are either kept “fresh” or immobilized by the cold when they are blown by winds to the Mauna Kea summit. The white surface of the snow may attract additional insects to land on the surface, especially if prey or some food has already been trapped.

Seasonal differences related to a wide variety of factors, such as substrate, moisture, temperature, prey availability, and weather, likely influence wēkiu bug activity. Wēkiu bugs, both larvae and adults, apparently remain active during winter months, and even exhibit activity at ambient air temperatures of 19° F (-7° C). It is known that antifreeze properties found in the blood of wēkiu bugs allow them to inhabit the alpine zone of Mauna Kea. The 2002 Bishop Museum study indicates that, although weather was most likely the factor limiting any recaptures in traps that were rebaited in the spring 2002, wēkiu bugs can withstand a broad range of climatic variables. For example, mid-day surface temperatures in September 2002 at Pu’u Hau Kea were recorded up to 106° F (41.1° C) at Trap 5, a trap that collected two wēkiu bugs, and subsurface temperatures 3 in (7.6 cm) down into the substrate were recorded at 75° F (24° C) at Trap 5.

3. LIMITING FACTORS

Limiting factors for the wēkiu bug include: its specific ecological requirements relating to substrate, snow, and temperature; availability of food and moisture; and availability of suitable habitat.

E. HABITAT

1. GENERAL HABITAT NEEDS

Wēkiu bugs occur, or have been reported from volcanic cones, including floors, inner and outer slopes, and ridges; crevicular habitat associated with lava flows; and talus slopes in the alpine region of the Mauna Kea summit area. The current lower elevational limit of the wēkiu bug is 11,715 ft (3,572 m).

Along with the upper elevation cinder cone rim areas facing prevailing winds, substrate characteristics are one of the most important factors influencing wēkiu bug distribution. The type of substrate dictates the presence of the other parameters important for the wēkiu bug. Substrate factors include substrate type, slope, and pore spaces. Presumably, some slope gives the animals greater opportunity to move vertically within the substrate to find more optimal micro-climatic conditions, especially given the extreme diurnal temperature range in the wēkiu bug's habitat. The larger pore spaces allow greater range of movement and more hiding or resting spaces. Abundant interconnected interstitial spaces also allow the resident animals to migrate and exploit the resources without being exposed to surface weather.

2. SPECIFIC HABITAT NEEDS

During the 1982 Bishop Museum study, wēkiu bugs were most commonly found in loose cinders and tephra rocks where the interstitial spaces were large enough to allow the insects to migrate downward in times of inclement weather or nighttime to find moisture and shelter. An examination of the substrate characteristics from areas with the greatest wēkiu bug captures during the 2002 Bishop Museum study corroborates the 1982 findings.

The 2002 Bishop Museum study found a pronounced pattern of wēkiu bugs becoming increasingly more common in traps as elevations increased. Wēkiu bugs generally were restricted to the rims and inner craters of each alpine cinder cone where they occurred, and with one exception, they were found within 150 ft (50 m) of the peak elevation of each cone. Traps containing the greatest numbers of wēkiu bugs were set on Pu'u Poepoe and Pu'u Hau Kea. The substrates in these locations were similar in that gravels and small cobbles were predominant and loosely packed, and both prime habitat areas were within 20 ft (6 m) of the peak elevations of the cinder cones. Trap 5 on Pu'u Poepoe, which captured 9 wēkiu bugs, was located at the very summit towards the outer edge of the crater in a windy and exposed area. The substrate at Trap 5 at the surface consisted of mostly small cobbles 1.5-2.5 in (4-6 cm) in diameter. This cobble layer was 4-5 in (10-13 cm) thick and overlaid a fine reddish ash. The cinders in this area were loose with airspaces between them.

Pu'u Hau Kea substrates are also of great importance to understanding wēkiu bug habitat requirements because of the relatively high number of captures during the 2001 Smithsonian study and the 2002 Bishop Museum study. Trap 6 in the 2002 Bishop Museum study was set on the outer rim. The substrate here is periglacial pavement made up of 70% gravels (0.5-1 in/1.3-2.5 cm) and 30% cobbles (1-4 in/2.5-10 cm) at the surface, loosely packed. Two inches (5 cm) down, the substrate consisted of 50% sand, 25% gravels, and 25% cobbles, with the sand dry until a depth of 4 in (10 cm), where the sand became moist.

F. SIGNIFICANCE OR SPECIAL CONSIDERATIONS

The wēkiu bug is one of the few native components of the uncommon aeolian alpine ecosystem on Mauna Kea. The wēkiu bug is also significant because it is a particularly unique component of this ecosystem due to the evolution of its predatory habits. The wēkiu bug and its Mauna Loa counterpart, *Nysius aa*, differ from all the world's *Nysius* species in their predatory habits and unusual physical characteristics. The wēkiu bug may be the most unusual of the 106 species of *Nysius* worldwide.

G. REPRODUCTIVE POTENTIAL

Petitioner is not aware of any information on the reproductive potential of the wēkiu bug.

III. REASONS FOR LISTING CONSIDERATION

A. RANGE OR HABITAT DESTRUCTION, MODIFICATION

The Mauna Kea Science Reserve, administered by the University of Hawai'i Institute for Astronomy (State of Hawai'i), occupies approximately 11,200 acres (4,536 ha) on the Mauna Kea summit. The Science Reserve includes nearly all the wēkiu bug's known habitat. The Reserve's lower elevational boundary ranges from 11,700 ft (3,569 m) to 12,100 ft (3,691 m).

Since the 1960s, when the first modern road to the Mauna Kea summit was bulldozed, approximately 62 acres (25 ha) of wēkiu bug habitat and potential habitat have been lost to astronomy development on the summit. In addition, more than two-thirds of the wēkiu bug's potential range is unprotected from future astronomy development. To date, at least 13 telescopes and associated infrastructure have been constructed in the Science Reserve, including at least one long baseline array with multiple extensions,

The wēkiu bug and its habitat have been destroyed by telescope construction in the past, and they continue to be threatened by the construction of new and replacement telescopes, associated buildings, access roads, parking areas, tourist facilities, and temporary storage areas. Construction includes excavating and dumping excavated material; grading and filling; drilling for piles and piers; pouring massive amounts of concrete for piles, piers, footings, and other foundations; paving roads and foot paths; directing runoff from paved surfaces to collection basins and dry wells, and allowing runoff to percolate into the subsurface; and excavating conduit trenches and other structures for utilities. Septic systems and leach fields also have been constructed, and wastewater ultimately discharges into the ground, threatening the wēkiu bug and its habitat as well.

Tephra cinders – important habitat for the wēkiu bug – are easily crushed to dust-size particles, and vehicular traffic quickly and permanently changes a rocky tephra habitat to one of compacted silt and mud, which is unusable by the wēkiu bug. Heavy equipment typically

used in telescope construction includes hoisting equipment, such as large mobile cranes, air compressors, welding machines, forklifts, and large trucks. Silt and mud destroy nearby tephra habitat by filling the interstitial spaces between cinders that are used by the wēkiu bug and other arthropods. Indirect impacts are also significant. Telescope and other construction changes the pattern of snow drift, snow melt, and aeolian fallout in the area, and these changes threaten the wēkiu bug. Oil spills, contaminants, and constant traffic to the summit with the associated human dispersal of trash and alien species, also pose serious threats.

The current management plan for the Mauna Kea Science Reserve limits the number of telescopes to 13, which includes the Smithsonian telescope with a large baseline array and multiple extensions. The proposed outrigger telescopes at the W. M. Keck Observatory and associated infrastructure and activities are the latest threat to the wēkiu bug and its habitat on and near Pu'u Hau'oki.

The Institute for Astronomy considers new proposals for telescope construction on Mauna Kea on an ongoing basis. In addition to new facilities, many of the existing structures are over 20 years old. Old facilities will be torn down and replaced with submillimeter arrays, which can have up to 20 times the surface impact of construction of a standard telescope and still count as "one telescope." Mauna Kea is a potential site for an array facility with up to 40 antennae arrays, and the construction of new telescopes in undeveloped areas of the Science Reserve is currently being planned on the north slope and elsewhere.

According to the Institute for Astronomy, the development of interferometers on Mauna Kea also may continue under the current management plan because they do not count as telescopes. Interferometers are specialized antennae for observing astronomical occurrences. Interferometers and their associated buildings, roads, cable trenches, and other features would take up at least as much surface area as large telescopes, and cause as much destruction of wēkiu bug habitat.

B. OVERUSE FOR COMMERCIAL, RECREATIONAL, SCIENTIFIC, OR EDUCATIONAL PURPOSES

The wēkiu bug's sole habitat has been reduced, and is currently threatened by the construction of telescopes and associated infrastructure in the Mauna Kea Science Reserve. The species and its habitat are further threatened by tourism, recreation, off-road vehicle use, and alien species introductions.

C. DEPLETION THROUGH DISEASE, PREDATION, OR GRAZING

Since the wēkiu bug relies on the mechanics of an aeolian system for obtaining food, the amounts and types of prey upon which the species depends may be affected by introductions of alien arthropods and parasites. The wēkiu bug now competes with at least one introduced species of Linyphiidae (small sheetweb spiders), which has become established on the

summit. Of even greater concern is the recent establishment of *Meriola arcifera* native to South America. This introduced spider actively hunts on the ground, since it is not a web-builder, and is common enough in the Mauna Kea Science Reserve to be preying on, and reducing populations of the smaller native arthropods, including the wēkiu bug. The constant human traffic to the Mauna Kea summit associated with astronomy-related activities, tourism, and recreation, increases the likelihood that additional alien species will be introduced to the wēkiu bug's habitat. Controlling such species will not be possible without threatening the wēkiu bug and other native species.

D. INADEQUATE PROTECTIVE LAWS OR REGULATIONS

Existing laws and regulations are insufficient to protect and recover the wēkiu bug. Provisions in Chapter 195D, Hawai'i Revised Statutes, do not apply to the wēkiu bug until it is listed as threatened or endangered. The State has made no effort to list this species as threatened or endangered. State agencies also lack the political will and/or necessary resources to protect the wēkiu bug and its habitat. Even with constant public involvement, the State has been reluctant to take action to properly manage and protect the Mauna Kea summit, including the wēkiu bug and its habitat.

The Mauna Kea summit lies within a state Conservation District, and any construction in the District requires a permit from the Hawai'i Department of Land and Natural Resources. Important wēkiu bug habitat was identified as sensitive as early as 1983 and was supposed to be avoided in the development of astronomical facilities on Mauna Kea. However, lack of communication and monitoring during construction of the Subaru telescope, and indifference to the needs of the wēkiu bug and other native animals on Mauna Kea, resulted in the loss of wēkiu bug habitat on Pu'u Hau'oki and Pu'u Wēkiu. Required mitigation measures and permit conditions to protect the wēkiu bug and its habitat were ignored. The Board of Land and Natural Resources approved the use of Pu'u Hau'oki's inner crater as a dump for the material excavated during the construction of the Subaru telescope. The approval was given with full knowledge of the importance of this area to the wēkiu bug.

A report on the State of Hawai'i's audit of the management of Mauna Kea and the Mauna Kea Science Reserve, dated February 1998, noted the following:

We found that the University of Hawai'i's management of the Mauna Kea Science Reserve is inadequate to ensure the protection of natural resources. The university focused primarily on the development of Mauna Kea and tied the benefits gained to its research program. Controls were outlined in the management plans that were often late and weakly implemented. The university's control over public access was weak and its efforts to protect natural resources were piecemeal. The university neglected historic preservation, and the cultural value of Mauna Kea was largely unrecognized. Efforts to gather information on the wēkiu bug came after the damage had already been done. Trash from construction was cleaned up only after concerns were raised by the public. Old testing equipment constructed in the early years of development has not been removed as required by the lease agreement.

The State Department of Health reported that solvents were illegally released into the ground. Large oil spills also have occurred.

Tourism and recreational activities, including hiking and off-road vehicle use, threaten the wēkiu bug and its habitat in the Mauna Kea Science Reserve. These activities occur on state-managed land, including the Mauna Kea Ice Age Reserve, which includes some of the best remaining wēkiu bug habitat. The Natural Area Reserve is administered by the Department of Land and Natural Resources, which is under-funded and under-staffed. There is no management plan for the Natural Area Reserve, no recovery actions are being taken to conserve the wēkiu bug, and there is no full-time presence to ensure adequate protection of the species and its habitat from human activities.

At the federal level, protection and recovery provisions in the Endangered Species Act do not apply to the wēkiu bug until it is listed as threatened or endangered with critical habitat designation. Since the wēkiu bug was discovered in 1979, the U.S. Fish and Wildlife Service has not participated in the planning and construction of telescopes and associated infrastructure in the Mauna Kea Science Reserve. The Service also has been reluctant to get involved in land-use conflicts on Mauna Kea and has deferred to the Department of Land and Natural Resources. For example, the Service considers Pu'u Hau'oki prime habitat for the wēkiu bug. Yet, it failed to protect this essential habitat during construction of the Subaru telescope. The crater floor, currently approximately 40,000 ft² (3,716 m²), was graded and compacted. The entire inner crater of Pu'u Hau'oki and the crater walls were cut. The surface of the filled and leveled crater were scored or raked, leaving parallel ridges. The crater ridge and side opposite the Subaru telescope were leveled. The crater rim, much of the inner walls, and floor were compacted. These activities destroyed the loose cinders that are essential habitat for the wēkiu bug. Previously excellent wēkiu bug habitat, the area no longer provides thermal or daytime hiding cover for wēkiu bugs. Prime wēkiu bug habitat on Pu'u Wēkiu was also filled with material when an access road along the summit and adjacent to the Gemini telescope was realigned.

The Service is aware that approvals to construct outrigger telescopes at the W. M. Keck Observatory on Pu'u Hau'oki are pending. If these telescopes are approved, the California Association for Research in Astronomy (operator of the observatory), proposes to attempt to restore about 6,200 square feet of land on the crater floor (15.5 percent of the total area of the crater floor). Petitioner is not unaware of any previous efforts to restore wēkiu bug habitat on Mauna Kea. The proposed restoration is unproven and could actually harm the wēkiu bug and its habitat. In addition, the proposed mitigation plan for the Keck telescopes does not address direct and cumulative adverse impacts of the telescope industry on the wēkiu bug or its habitat. The proposed mitigation plan is limited to the immediate vicinity of the

observatory and does not address the overall population status of the wēkiu bug or any impacts that may occur in other areas.

Apparently, the Service is preparing a Candidate Conservation Agreement with the Institute for Astronomy or other state agency for the wēkiu bug. The agreement has not been finalized or released to the public, and petitioner is not aware of any provisions that will ensure the long-term survival of the wēkiu bug. Given the State's refusal to enforce past and existing requirements and the Service's "hands-off" policy regarding State matters, it is unlikely that such an agreement would ever be enforced. It is also highly unlikely that such an agreement would lead to the recovery of the wēkiu bug. As long as the telescope industry is on Mauna Kea, the wēkiu bug and its habitat will be in danger.

E. OTHER NATURAL OR MANMADE FACTORS AFFECTING THE SPECIES' EXISTENCE

Shifts in global climate (toward warmer winters with less snowfall on the Mauna Kea summit) may threaten the wēkiu bug. The summit area has been warmer and has had less snowfall since 1982. The capture rates for wēkiu bugs in 1997 and 2002 were lower than the capture rate in 1982. It is possible that, as the summit area becomes warmer over time, alien predators and parasites could more easily establish themselves or have indirect effects on the wēkiu bug's food supply. In addition, if available habitat is seriously reduced by development, the wēkiu bug will likely be less capable of responding and surviving during climatic changes.

IV. ADDITIONAL COMMENTS

A. CURRENT STATUS

The federal Endangered Species Act requires the U.S. Fish and Wildlife Service to base its decisions on the best available scientific and commercial information. The wēkiu bug is currently designated by the Service as a candidate for listing as threatened or endangered. Candidate species are those species for which the Service has sufficient biological information to indicate that listing the species as threatened or endangered may be warranted. According to the Service, the wēkiu bug is one of its highest-priority species for listing, and according to the wēkiu bug's candidate status, there is enough information available to do so. The Global Heritage Status Rank for the wēkiu bug is G1, which means the species is imperiled globally.

The wēkiu bug is naturally rare, highly specialized, and geographically restricted. It is found only on certain substrates within certain habitat-types above 11,700 ft (3,566 m) on the summit of Mauna Kea. It is highly specialized to exploit the harsh aeolian alpine ecosystem. It depends on organic matter blown up the mountain from lower elevations to survive, and may be obligately associated with snow. Approximately 62 acres (25 ha) of wēkiu bug habitat and potential habitat have been lost to astronomy development on the Mauna Kea summit. More than two-thirds of the wēkiu bug's potential range is unprotected from future astronomy development. The wēkiu bug's imperiled status is unlikely to change given the increasing

demand for additional and replacement telescopes, and associated infrastructure. Increased human activity associated with the telescopes, tourism, and recreation directly threatens the wēkiu bug and its habitat, and increases the likelihood of alien species introductions.

B. CRITICAL HABITAT

Petitioners request the designation of critical habitat for the wēkiu bug concurrent with its listing. Because the wēkiu bug is restricted to the summit region of Mauna Kea, critical habitat should include the summit area of Mauna Kea above 11,700 ft (3,566 m), including all locations from which the wēkiu bug has been observed or reported, and any unoccupied habitat deemed necessary to recover the species. A topographic map with the general petitioned critical habitat boundary is included as Figure 1.

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**PETITION TO LIST THE WEKIU BUG (*NYSIUS WEKIUICOLA*)
AS AN ENDANGERED SPECIES WITH CRITICAL HABITAT DESIGNATION
KAHEA: THE HAWAIIAN ENVIRONMENTAL ALLIANCE
MAY 22, 2003**

Figure 1. Petitioned critical habitat for the wēkiu bug: the summit area of Mauna Kea, Island of Hawai'i, above 11,700, ft (3,566 m), including all locations from which the wēkiu bug has been observed or reported, and any unoccupied habitat deemed necessary to recover the species.

Petition to List the Wēkiu Bug (*Nysius wekiuicola*) as an Endangered Species with Critical Habitat Designation.

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