Programmatic Arthropod Monitoring at the Haleakalā High Altitude Observatories and Haleakalā National Park Maui, Hawai'i

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II. EXECUTIVE SUMMARY

The National Science Foundation (NSF) has authorized the development of the Advanced Technology Solar Telescope (ATST) within the 18-acre University of Hawai`i Institute for Astronomy High Altitude Observatories (HO) site. The ATST represents a collaboration of 22 institutions, reflecting a broad segment of the solar physics community. The ATST project will be the largest and most capable solar telescope in the world. It will be an indispensable tool for exploring and understanding physical processes on the Sun that ultimately affect Earth. The ATST Project will be contained within a 0.74 acre site footprint in the HO site. An Environmental Impact Statement was completed for the ATST project (NSF 2009), and the NSF issued a Record of Decision in December of 2009.

The Haleakalā National Park (HALE) Road Corridor will be used for transportation during construction and use of the ATST. The HO and HALE road corridor contain biological ecosystems that are both unique and fragile. The landscape at HO is considered to be an alpine dry shrubland vegetation type and resources along the Park road corridor are grouped into alpine and subalpine shrubland habitat zones, depending upon the elevation. These habitats contain several native and non-native species of plants, animals, and arthropods. While the overall impacts on Hawaiian native arthropod resources within the Park road corridor during the construction phase would be considered minor, NSF has committed to several mitigation measures to reduce the impacts to these biological resources, including programmatic monitoring for active preservation of invertebrates before, during and after construction of the proposed ATST Project.

After some preliminary sampling near the HALE Entrance Station in 2009 Programmatic Arthropod Monitoring and Assessment at the Haleakalā High Altitude Observatories and Haleakalā National Park was initiated with two sampling sessions in 2010.

This is a report of the sampling conducted in July 2011, the first of two sampling sessions that will be conducted in 2011. The goal is to monitor the arthropod fauna at the proposed ATST site and along the HALE Road Corridor, identify Hawaiian native arthropod species or habitats, if any, that may be impacted by construction or operation of the ATST, and detect and identify alien invasive arthropod species that could have adverse impacts on the flora and fauna on Haleakalā. Programmatic

Arthropod Monitoring studies are being coordinated and conducted with the approval of HALE.

This monitoring project provides a means of gathering reliable information that can be used to protect the native Arthropod species during development of observatory facilities and supports astronomy programs at the Haleakala High Altitude Observatory Site by promoting the good stewardship of the natural resources located there.

A Hawaiian native fern along the HALE Road Corridor, May 2011.

III. INTRODUCTION

The Haleakalā volcano on the island of Maui is one of the highest mountains in Hawai`i, reaching an elevation of 10,023 feet (3,055 m) at its summit on Pu`u `Ula`ula. Near the summit is a volcanic cone known as Kolekole with some of the best astronomy viewing in the world.

The National Science Foundation (NSF) has authorized the development of the Advanced Technology Solar Telescope (ATST) within the 18-acre University of Hawai`i Institute for Astronomy High Altitude Observatories (HO) site. The ATST represents a collaboration of 22 institutions, reflecting a broad segment of the solar physics community. The ATST project will be the largest and most capable solar telescope in the world. It will be an indispensable tool for exploring and understanding physical processes on the Sun that ultimately affect Earth.

The ATST Project will be contained within a 0.74 acre site footprint in the HO site. An Environmental Impact Statement was completed for the ATST project (NSF 2009), and the NSF issued a Record of Decision in December of 2009. The Haleakalā National Park (HALE) Road Corridor will be used for transportation during construction and use of the ATST.

The HO and HALE road corridor contain biological ecosystems that are both unique and fragile. The landscape at HO is considered to be an alpine dry shrubland vegetation type. A diverse fauna of resident insects and spiders reside in the there (Medeiros and Loope 1994). Some of these arthropods inhabit unique natural habitats on the bare lava flows and cinder cones with limited vegetation. Vegetation covers less than 5% of the open ground, and food is apparently scarce.

The ecosystem at the HO is extremely xeric, caused by relatively low precipitation, porous lava substrates that retain negligible amounts of moisture, little plant cover, and high solar radiation. The dark, heat-absorbing cinder provides only slight protection from the extreme temperatures. Thermal regulation and moisture conservation are critical adaptations of arthropods that occur in this unusual habitat.

An inventory and assessment of the arthropod fauna at the HO site was conducted in 2003 as part of the Long

Range Development Plan (LRDP) for the Haleakalā High Altitude Observatories. This inventory and assessment was updated in December 2005 to provide a more detailed description of the arthropod fauna at the two proposed ATST sites, and identify Hawaiian native arthropod species or habitats, if any, that could be impacted by construction or operation of the ATST. In an effort to be complete, supplemental sampling was conducted in 2007 to provide a seasonal component and additional nighttime sampling not included in the previous two inventories. Sampling in June 2009 was conducted to establish baseline conditions for future Programmatic Monitoring.

The landscape along the HALE road corridor is classified as alpine and subalpine shrubland habitat zones, depending upon the elevation. These habitats contain several native and non-native species of plants, animals, and arthropods. The subalpine shrubland within the Haleakalā National Park is also host to a wide variety of indigenous arthropod species (Krushelnycky et al. 2007). The vegetation there covers most of the open ground, mostly with native trees and shrubs, with native and alien grasses growing between. Precipitation in the form of rainfall and fog is frequent, with about 70 inches falling throughout the year (Giambelluca et al. 1986).

While the overall impacts on arthropod resources within the Park road corridor during the construction phase would be considered minor, NSF has committed to several mitigation measures to reduce the impacts to these biological resources, including programmatic monitoring for active preservation of invertebrates during and after construction of the proposed ATST Project.

Environmental monitoring is the scientific investigation of the changes in environmental phenomena, attributes and characteristics that happen over time. Ecosystems are dynamic. Habitat conditions change daily, seasonally, and over longer periods of time. Animal and plant populations rise or fall in response to a host of environmental fluctuations. The general purpose of monitoring is to detect, understand, and predict the environmental changes.

Programmatic Monitoring will provide much of the data needed to protect and enhance natural resources, to modify management actions, to aid in compliance with environmental statutes, and to enhance public education and appreciation of the natural resources at the summit of Haleakalā.

The nomenclature used in this report follows the Hawaiian Terrestrial Arthropod Checklist, Third Edition (Nishida 1997) and the Manual of the Flowering Plants of Hawai'i (Wagner and others 1990). Hawaiian and scientific names are italicized unless major taxonomic revisions were available.

Species are discussed as being endemic, indigenous, non-indigenous, adventive, and purposely introduced. These terms are defined as:

Endemic – A species native to, or restricted to Hawai'i.
Indigenous – A species native to Hawai'i but that naturally occurs outside of Hawai'i as well.
Non-indigenous – A species not native to Hawai'i.
Adventive – Not native, a species transported into a new habitat by natural means or accidentally by human activity.
Purposely introduced – A species released in Hawai'i for a particular purpose, usually to control a weedy plant or another insect.

This work, conducted in May 2011 is the first of two sampling sessions for Programmatic Arthropod Monitoring and Assessment at the Haleakalā High Altitude Observatories and Haleakalā National Park to be conducted in 2011. The goal is to monitor the arthropod fauna at the proposed ATST site and along the HALE Road Corridor, identify Hawaiian native arthropod species or habitats, if any, that may be impacted by construction or operation of the ATST, and detect and identify alien invasive arthropod species that could have adverse impacts on the flora and fauna on Haleakalā. Programmatic Arthropod Monitoring studies is being coordinated and conducted with the approval of HALE staff biologists.

Sampling of arthropod habitats was approved in a permit obtained from the Department of Land and Natural Resources (Permit # FHM10-229) issued in June, 2010 and the National Park Service (Permit # HALE-2010-SCI-0001) issued on March 22, 2010. Sampling began on May 23, 2011 and was completed on May 28, 2011.

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 for Programmatic Monitoring and are the focus of this report.

Question 1

What are the characteristic arthropod populations at the ATST site and along the HALE Road Corridor?

Justification:

Programmatic Monitoring will yield a comprehensive description of the characteristic arthropod populations at the ATST site and along the HALE Road Corridor. The monitoring will provide reliable scientific information about their current status and trends in their populations, including all species of special interest.

Monitoring goals:

1) To describe the characteristic arthropod populations at the ATST site and along the HALE Road Corridor,

2) To provide historical records of change in native arthropod species population attributes, and characteristics.

Question 2

What adverse impacts can be detected, if any, on characteristic populations of arthropods at the ATST site and along the HALE Road Corridor, that may be due to ATST construction?

Justification:

Programmatic Monitoring of native arthropod species will yield reliable scientific information about the current status of these species, and trends in their population. The information will be useful to detect changes and trends that may be due to the construction of the ATST.

Monitoring goals:

1) To detect changes, trends, periodicities, cycles, and/or other patterns of change that may be due to construction of the ATST.

This question cannot be answered in this report because construction of the ATST has not yet begun. The results of this sampling will be combined with information gathered during previous studies to develop a comprehensive list of arthropods at the ATST site and along the HALE Road Corridor and a qualitative description of seasonal variation in their populations.

V. METHODS

Site Description

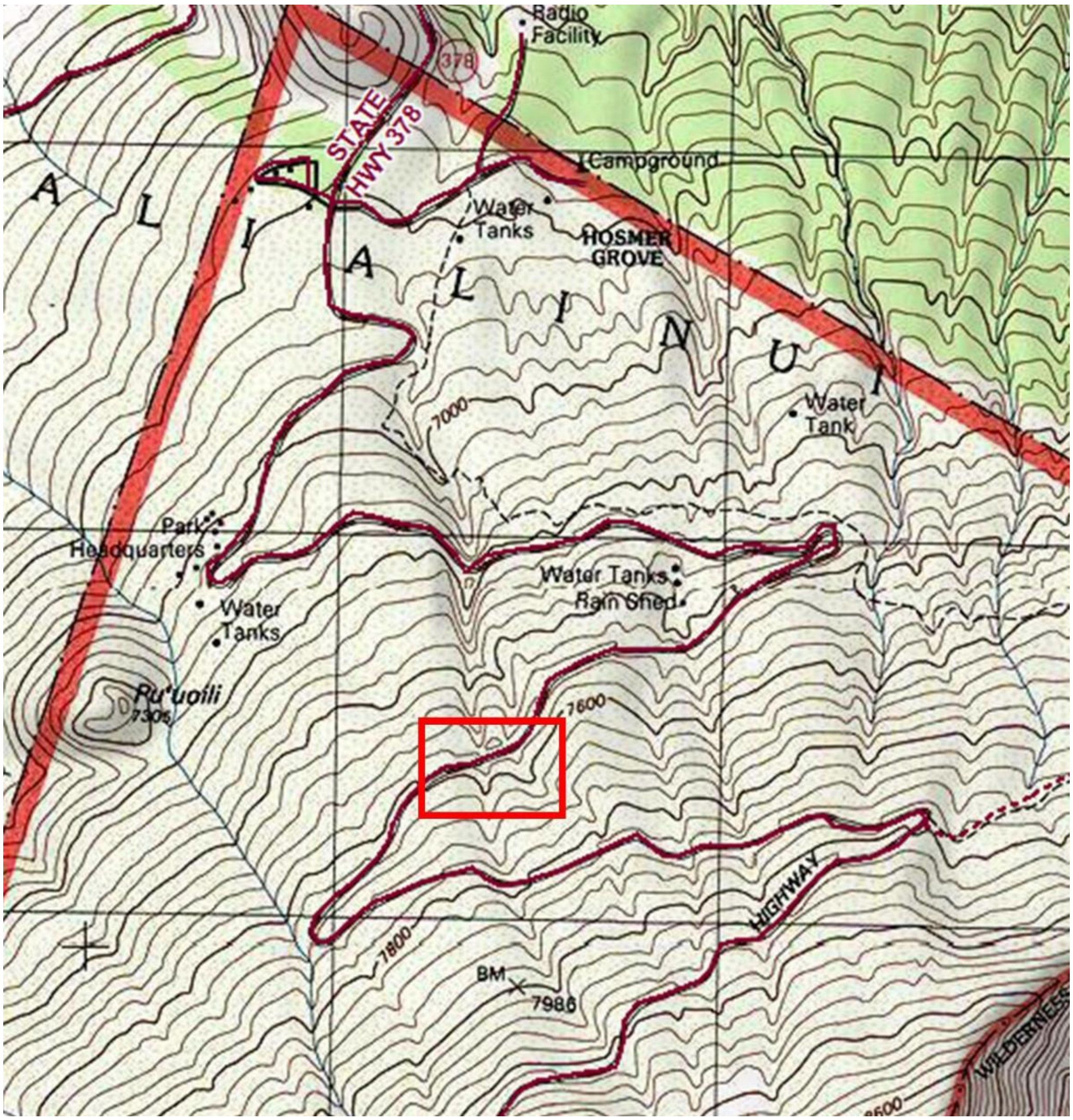
The Haleakalā High Altitude Observatories (HO) site is located on Kolekole Hill. The site is at 3,052-m (10,012-ft) above sea level, adjacent to Pu`u `Ula`ula, also known as Red Hill, the highest elevation on Maui, 3,055-m (10,023-ft). The 7.3-ha (18.1-ac) site was established in 1961, and the first telescope, the Mees Solar observatory was dedicated in 1964. The site now consists of five telescope facilities.

The ATST site is on undeveloped land located east of the existing Mees Solar Observatory facility. Annual precipitation averages 1,349.2-mm (53.14-in), falling primarily as rain and mist during the winter months from November through April. Snow rarely falls at the site.

Haleakalā sampling locations were determined with guidance and cooperation from HALE personnel. During this sampling session the HALE Road Corridor was sampled near the first paved turnout approximately 3 miles from the Entrance Station, between 7,550 and 7,650 ft elevation, in two gulches (see Map 1).

Procedures

The selection of a trapping technique used in a study was carefully considered. When the target species of the trapping system are rare or important for other reasons (i.e., endangered, keystone species, etc.) live-trapping should be considered. Entomologists have long believed that they can sample without an impact on the population being sampled. It has been assumed that collecting has only a small impact on the populations of interest. While this assumption remains to be tested, responsible entomologists consider appropriate trapping techniques to ensure survival of local populations of interest. The sampling methods that were used during this study are similar to those used during the 2007 arthropod inventory conducted on the western slope of Haleakalā and were reviewed by HALE natural resource staff and modified according to their comments.



Map 1. Sampling location along the HALE Road Corridor, May 2011.

Pitfall Traps

After consultation with HALE natural resources staff, ten pitfall traps were installed at the HALE Road Corridor site (five below the road and five above the road) on both sides of the gulch. Ten pitfall traps were installed at the ATST site. The traps (300 ml [10 oz], 80 mm diameter cups) were filled with soapy water solution as preservative. Concerns about endangered native birds precluded the use of ethylene glycol. The traps were spaced at least 2 m apart, and left open for four days. It was decided that pitfall traps would not be baited around the rim with blended fish because they might attract birds. This is a trapping method similar to that used during an arthropod survey conducted in 2007 (Krushelnycky et al. 2007).

Care was taken to avoid archeological sites. These sites have cultural and historical significance and precautions were made to prevent their disturbance. Traps were not placed in or near these sites. A map of significant historic and cultural sites within 50 feet of the road corridor was used to avoid such sites. Habitat was accessed with a minimum of disturbance to the habitat. Care was also taken to prevent creation of new trails or evidence of foot traffic.

Care was also taken to avoid disturbing nesting petrels and other wildlife species. The endangered petrels dig into cinder to make burrows for nesting. Incubation of fledglings was underway and all efforts were made to avoid active nests. Pitfall traps are placed below ground and covered with a heavy cap rock. This makes it very unlikely that petrels could access the traps.

Light-Trapping

Sampling for nocturnal insects is vital to understanding the complete faunal presence. Some insects are only active and moving around at night. Many insects have a nocturnal activity cycle to evade birds, and to locate certain food sources. Night collecting is important in environments like dry locations where insects may choose this strategy to avoid desiccation. Thyrocopa moths, for example, have been seen at lights in restrooms at the HALE Visitor Center, at 9,740 ft.

Battery-powered ultraviolet light traps were operated in the HALE gulches and at the ATST site. The traps consisted of a 3.5 gallon polypropylene bucket, a smooth surface funnel, a 22 watt Circline blacklight tube mounted on top of vanes under an aluminum lid that directs light downwards. The effective range of the 22 watt lamp is less than 100 feet, and traps were always located more than 100 feet from the nearest petrel burrow. Light traps were run every night for five nights (a total of 10 trap nights).

Other light sampling at night

Night collecting can be aided by a UV light source. An ultraviolet blacklight was placed on top of a white sheet and arthropods that were attracted to the light were collected as they are observed.

Small handheld ultraviolet blacklights were also used for additional sampling for foliage and ground-dwelling arthropods.

Visual Observations and Habitat Collecting Under Rocks and in Leaf Litter

Time was spent sampling under rocks, in leaf litter, and on foliage to locate and collect arthropods at each sampling station. Hand picking, while sorting through leaf litter and bunch grasses, and searching beneath stones was the most effective sampling for litter and soil associated forms.

Collecting on Foliage

Foliage of various common plant species was sampled by beating sheet. A one-meter square beating sheet or insect net was placed under the foliage being sampled and the branch hit sharply three times using a small plastic pipe. After the initial collection the foliage was beaten again to dislodge persistent individuals. Care was taken to avoid sensitive plants and to leave all vegetation intact.

Nets

Aerial nets and sweep nets were used as necessary to capture flying insects and arthropods that occur on grasses.

Collections

Arthropods that appear in traps were stored and later mounted for identification. Arthropods that are observed during hand collecting and netting were collected only as necessary to provide voucher specimens.

Curation

The contents of the traps were cleaned in 70% ethyl alcohol and placed in vials. The specimens were sorted into the morphospecies for identification. Hard-bodied species, such as beetles, moths, true bugs, flies, and wasps were mounted on pins, either by pinning the specimen or by gluing the specimens to paper points. Pinned specimens were placed into Schmidt boxes. Soft-bodied specimens, such as spiders and caterpillars were stored in vials filled with 70% ethyl alcohol.

Identification

Specimens were mounted and identified to the lowest taxonomic level possible within the time frame of the study. Many small flies and micro-Hymenoptera were sorted to morphospecies and will be sent to reliable experts for identification. Identification of arthropods is difficult, even for experts. More time needs to be allotted for this necessary task in all arthropod inventory projects. All specimen identifications are provisional until they can be confirmed by comparison to museum specimens or by group/taxon experts.

References for general identification of the specimens included Fauna Hawaiiensis (Sharp (ed) 1899-1913) and the 17 volumes of Insects of Hawaiʻi (Zimmerman 1948a, 1948b, 1948c, 1948d, 1948e, 1957, 1958a, 1958b, 1978, Hardy 1960, 1964, 1965, 1981, Tentorio 1969, Hardy and Delfinado 1980, Christiansen and Bellinger 1992, Liebherr and Zimmerman 2000, and Daly and Magnacca 2003). Other publications that were useful for general identification included The Insects and Other Invertebrates of Hawaiian Sugar Cane Fields (Williams 1931), Common Insects of Hawaiʻi (Fullaway and Krauss 1945), Hawaiian Insects and Their Kin (Howarth and Mull 1992), and An Introduction to the Study of Insects Sixth Edition (Borror, Triplehorn, and Johnson 1989).

For specific groups specialized keys were necessary. Most of these had to be obtained through library searches. Keys used to identify Heteroptera included those by Usinger (1936, 1942), Ashlock (1966), Beardsley (1966, 1977), and Gagné (1997). Keys used to identify Hymenoptera included Cushman (1944), Watanabe (1958), Townes (1958), Beardsley (1961, 1969, 1976), Yoshimoto and Ishii (1965), and Yoshimoto (1965a, 1965b).

Species identification of those specimens identified to genus or species levels are unconfirmed and subject to change after comparison to specimens in museums.

In many cases changes in family and generic status and species synonymies caused species names to change from those in the keys. Species names used in this report are those listed in Hawaiian Terrestrial Arthropod Checklist Third Edition (Nishida 1997) unless a recent major taxonomic revision was available.

Schedule/Start and End dates

Sampling was conducted over six days and five nights in May 2011, starting on

May 23, 2011 and ending on May 28, 2011. Sampling typically began at 9:00 am and run until about 3:00 pm. A break was taken to prepare for night sampling which resumed at 6:00 pm and continued until after midnight. Pitfall traps were open for 100 trap nights, and light traps were deployed for 8 trap nights.

A typical pitfall trap sampling location at the ATST site, May 2011.

VI. RESULTS and DISCUSSION

HO ATST SITE

Twenty-two species of arthropods were collected at the HO ATST site during the May 2011 sampling session. The species included eight endemic Hawaiian arthropods, eight non-indigenous arthropods, and six species of unknown status.

No moths were collected in the light traps but one noctuid caterpillar was captured in a pitfall trap. No specimens of the Haleakalā flightless moth (*Thyrocopa apatela*) were observed and no Blackburn's Sphinx (*Manduca blackburni*) moths were observed. The latter's host plant species do not occur at high elevations on Maui and this endangered species is unlikely to occur on or near the ATST site.

Four endemic *Nysius* (Heteroptera: Lygaeidae) species were seen feeding on *Dubautia* and *pūkiawe*. These species can be very abundant at times. At least one species of endemic yellow-faced bee (Family Colletidae) was also seen on these shrubs. A species of endemic fruit fly (*Trupanea* sp.) was also observed on *pūkiawe*.

An unusual endemic plant bug (*Trigonotylus hawaiiensis*) was collected from the base of grasses. This small, skinny bug the color of dead grass can be abundant at times on native grasses from the coast to the summit of Haleakalā (Zimmerman 1948c).

Lycosid spiders, *Lycosa hawaiiensis* Simon, occurred in pitfall traps and were seen foraging among rocks. The native wolf spider was not visibly abundant during this sampling session, but ten were captured in pitfall traps. These spiders (*Lycosa hawaiiensis*) are the predominant predators of the arthropod fauna in the crater district of Haleakalā (Medeiros and Loope 1994).

Three species of purposely introduced lady bird beetles were collected, as well as four species of non-indigenous flies. These species have been reported previously from the HO site

A complete list of arthropods observed during this sampling session at the ATST site can be found in Appendix A at the end of this report. No new invasive species were observed that could impact native arthropod species. The species of indigenous arthropods detected have been observed at the site during other surveys. Diversity was lower than observed in previous sampling sessions, likely due to the time of year sampling was conducted.

HALE SAMPLING SITE

Forty-four species of arthropods were collected and observed at sites in the two HALE gulches. The species included ten endemic Hawaiian arthropods, nineteen non-indigenous arthropods, and fifteen species of unknown status.

Ten species of Lepidoptera were observed or captured during this study. Four species of moths were captured in the light traps, two species of indigenous *Agrotis* (*A. biliopa* and *A. xiphias*) and two non-indigenous species previously known from HALE. Two other indigenous species found include, *Cydia plicata*, a small moth that lives on mamane trees (*Sophora chrysophylla*) and the blue *Udara blackburni* one of two native species of butterflies in Hawaii. Both are abundant throughout their ranges. The remaining Lepidoptera include three micro-moths (likely indigenous to Hawaii) and a biocontrol release.

Five species of Coleoptera (beetles) were observed in the gulchs, all non-indigenous and all known from previous surveys. Of special interest was a species of diving beetle found in pools of rain water. Both adults and larvae were observed. This beetle has been reported previously from HALE and it is remarkable that it can undergo an entire life cycle in these ephemeral pools.

Ten species of Diptera (flies) were collected, including a species of endemic fruit fly (*Trupanea* sp.).

Six species of true bugs (Heteroptera) were found, all but one (an Anthocoridae) previously reported from the higher elevations of Haleakalā.

Seven species of Hymenoptera (bees, wasps, and ants) were observed, all but one, a yellow-faced bee (*Hylaeus* sp.) are non-indigenous. One of the non-native species, a yellow jacket is a serious pest in Hawaii and significant efforts have been made to eradicate this species.

Three species of brown lacewings were collected including the Haleakalā lacewing (*Micromus haleakalae*). All are known from HALE from previous studies.

One ant species, *Hypoponera opaciceps*, was observed. They were abundant in the gulches and have been known from HALE for several years.

No new invasive species were observed that could impact native arthropod species. Most of the species of arthropods collected have been reported from HALE during other surveys. Diversity was higher than the monitoring session at the same locality in November 2010. This may be due to the time of year that sampling occurred.

DISCUSSION

Insects were in higher abundance and diversity at the ATST site during this sampling session, likely due to the timing of the sampling. No invasive arthropods were detected at the HO ATST site.

Insects were also in higher abundance and diversity at the HALE gulch sampling sites. Two particularly important invasive species were detected in the HALE gulches sampled, Argentine ants and yellowjackets. The Argentine ant has been previously detected in HALE and has had an important impact on native arthropod species (Cole et al. 1992, Krushelnycky and Reimer 1996). Yellowjackets have also been previously detected in the Park and may be having a detrimental impact on native Hawaiian species (Gambino 1992).

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APPENDIX A
HO ATST ARTHROPOD SPECIES LIST

A list of Arthropod species detected during the May 2011 sampling at the HO ATST site.

Class	Order	Family	Genus	Species	Subspecies	Authority	Status
Arachnida	Araneae	Lycosidae	Lycosa	hawaiiensis		simon	endemic
Insecta	Coleoptera	Coccinellidae	Coccinella	septempunctata		Linnaeus	non-indigenous
Insecta	Coleoptera	Coccinellidae	Hippodemia	convergens		Gurein-Meneville	non-indigenous
Insecta	Coleoptera	Coccinellidae	Olla	v-nigrum		(Mulsant)	non-indigenous
Insecta	Diptera	Calliphoridae	Calliphora	vomitoria		(Linnaeus)	non-indigenous
Insecta	Diptera	Drosohpilidae	Drosophila				
Insecta	Diptera	Lonchaeidae					
Insecta	Diptera	Muscidae					
Insecta	Diptera	Sepsidae	Sepsis	thoracica		(Robineau-Desvoidy)	non-indigenous
Insecta	Diptera	Tachinidae	SP1				non-indigenous
Insecta	Diptera	Tephritidae	Trupanea	sp.			endemic
Insecta	Diptera	Tephritidae					
Insecta	Heteroptera	Lygaeidae	Nysius	coenosulus		Stål	endemic
Insecta	Heteroptera	Lygaeidae	Nysius	communis		Usinger	endemic
Insecta	Heteroptera	Lygaeidae	Nysius	lichenicola		Kirkaldy	endemic
Insecta	Heteroptera	Lygaeidae	Nysius	terrestris		Usinger	endemic
Insecta	Heteroptera	Miridae	Trigonotylus	hawaiiensis		(Kirkaldy)	endemic
Insecta	Hymenoptera	Colletidae	Hylaeus	nivicola		Meade-Waldo	endemic
Insecta	Hymenoptera	Eurytomidae					
Insecta	Hymenoptera	Ichneumonidae	Barichneumon	californicus		(Ashmead)	non-indigenous
Insecta	Hymenoptera	Ichneumonidae	Diagegma	blackburni		(Cameron)	non-indigenous
Insecta	Lepidoptera	Noctuidae					

APPENDIX B
HALE ARTHROPOD SPECIES LIST

A list of Arthropod species detected during the May 2011 sampling at the HALE gulches site.

Class	Order	Family	Genus	Species	Subspecies	Authority	Status
CHILOPODA	Lithobiomorpha	Henicopidae	Lamyctes	emarginatus			non-indigenous
DIPLOPODA	Julida	Allajulus	latistriatus			(Curtis)	non-indigenous
Insecta	Coleoptera	Coccinellidae	Diamus	notescens		(Blackburn)	non-indigenous
Insecta	Coleoptera	Coccinellidae	Scymnus	sp.			non-indigenous
Insecta	Coleoptera	Dytiscidae	Rhantus	gutticollis		(Say)	non-indigenous
Insecta	Coleoptera	Scarabaeidae	Aphodius	lividus		(olivier)	non-indigenous
Insecta	Coleoptera	Staphylinidae	Philonthus	sp.			non-indigenous
Insecta	Diptera	Calliphoridae	Calliphora	vomitoria		(Linnaeus)	non-indigenous
Insecta	Diptera	Calliphoridae	SP1				
Insecta	Diptera	Lonchaeidae					
Insecta	Diptera	Muscidae					
Insecta	Diptera	Sepsidae	Sepsis	thoracica		(Robineau-Desvoidy)	non-indigenous
Insecta	Diptera	SP1					
Insecta	Diptera	Tachinidae	SP1				non-indigenous
Insecta	Diptera	Tephritidae	Neotephritis				
Insecta	Diptera	Tephritidae	Trupanea	sp.			endemic
Insecta	Diptera	Tipulidae	SP1				
Insecta	Heteroptera	Anthocoridae					
Insecta	Heteroptera	Lygaeidae	Nysius	terrestris		Usinger	endemic
Insecta	Heteroptera	Lygaeidae	Nysius				
Insecta	Heteroptera	Miridae	Orthotylus	sp.1			endemic
Insecta	Heteroptera	Miridae	SP1				
Insecta	Heteroptera	Pentatomidae	Nezara	viridula		Linnaeus	non-indigenous
Insecta	Homoptera	Cicadellidae	SP1				
Insecta	Hymenoptera	Apidae	Apis	mellifera		Linneaus	non-indigenous
Insecta	Hymenoptera	Braconidae					
Insecta	Hymenoptera	Colletidae	Hylaeus	sp.			endemic

Class	Order	Family	Genus	Species	Subspecies	Authority	Status
Insecta	Hymenoptera	Formicidae	Hypoponera	opaciceps		(Mayr)	non-indigenous
Insecta	Hymenoptera	Ichneumonidae	Diagegma	blackburni		(Cameron)	non-indigenous
Insecta	Hymenoptera	Ichneumonidae					
Insecta	Hymenoptera	Vespidae	Vespula	pensylvanica		(Saussure)	non-indigenous
Insecta	Lepidoptera	Cosmopterigidae	Hyposmocoma	sp.1			endemic
Insecta	Lepidoptera	Lycaenidae	Udara	blackburni		(Tuely)	endemic
Insecta	Lepidoptera	Microlepidoptera	SP1				
Insecta	Lepidoptera	Microlepidoptera	SP2				
Insecta	Lepidoptera	Noctuidae	Agrotis	biliopa		Meyrick	endemic
Insecta	Lepidoptera	Noctuidae	Agrotis	xiphias		Meyrick	endemic
Insecta	Lepidoptera	Noctuidae	Peseudaletia	unipunctata		(Haworth)	non-indigenous
Insecta	Lepidoptera	Pieridae	Pieris	rapae		(Linnaeus)	non-indigenous
Insecta	Lepidoptera	Pterophoridae	Stenoptilodes	littoralis	rhynchophora	(Meyrick)	non-indigenous
Insecta	Lepidoptera	Tortricidae	Cydia				
Insecta	Neuroptera	Hemerobiidae	Hemerobius	pacificus		Banks	non-indigenous
Insecta	Neuroptera	Hemerobiidae	Micromus	haleakalae		(Perkins)	endemic
Insecta	Neuroptera	Hemerobiidae	Micromus				endemic