

**Programmatic Arthropod Monitoring at
the Haleakalā High Altitude Observatories
and Haleakalā National Park**

Maui, Hawai'i

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Prepared for

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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 October 2011, the second of two sampling sessions that were 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.

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.

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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

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.

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 session, sampling was conducted in the area near the HALE Entrance Station, at about 2,072 m (6,800 ft) on the western slope of Haleakalā.

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.


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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 Hawai‘i (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 Hawai‘i (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 October 2011, starting on October 17, 2011 and ending on October 23, 2011. Sampling typically

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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 90 trap nights, and light traps were deployed for 9 trap nights.



A typical pitfall trap sampling location at the HALE site, October 2011.

VI. RESULTS and DISCUSSION

HO ATST SITE

Thirty-one species of arthropods were collected at the HO ATST site during the October 2011 sampling session. The species included twelve endemic Hawaiian arthropods, eight non-indigenous arthropods, and eleven species of unknown status.

Moths - Order Lepidoptera

Seven moths were collected in the light traps consisting of two native species from the family Noctuidiae. 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.

True Bugs - Order Hemiptera

Five species of seed bugs (Heteroptera: Lygaeidae) were observed including four endemic *Nysius* species feeding on *Dubautia* and *pūkiawe*. One species was particularly abundant, *Nysius coenosulus* Stål. Several species that are normally observed at the site were not present. Insect populations can fluctuate

seasonally, and abundance is often influenced by weather and other environmental factors. One specimen of *Geocoris pallens* Stål was captured. This non-indigenous species was not abundant, but has been observed in high numbers in other years on Haleakalā (Pacific Analytics, unpublished data).

Other Heteroptera present include two indigenous plant bugs (family Miridae) and a non-indigenous species of the family Rhopalidae. The two plant bugs were *Trigonotylus hawaiiensis* (Kirkaldy), collected from the base of grasses and a species of *Orthotylus*, found on *Dubautia*. Both species were common on the site. The Rhopalid, *Jadera haematoloma* (Herrich-Schaeffer). This species has been reported from several states, and from Mexico, the West Indies, southward to Central America and Colombia. It was first reported in Hawaii in 1970 and appears on all the major islands.

One species of the endemic genus of plant hoppers (*Nesosydne*) was found.

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These bugs can be abundant at times but were in low abundance during this trip.

Bees and Wasps - Order Hymenoptera

One species of endemic yellow-faced bee (Family Colletidae) was collected on pūkiawe. Yellow-faced bees have been seen in high diversity and abundance in previous collecting trips at the ATST site, but during this trip, only one specimen was found, probably due to the time of year. Wasps include four species of small parasitoids and one Ichneumonid.

Flies - Order Diptera

Two species of fruit flies (family Tephritidae) were found. One was an indigenous species of *Trupanea*, a genus of endemic flies that are important pollinators. This species was common on pūkiawe. A non-indigenous species of fruit fly was also common at the site on pūkiawe. Other flies include common species that can be seen throughout Hawaii.

Beetles - Order Coleoptera

Five species of purposely introduced lady bird beetles were collected. These species have been reported previously from the ATST site. A species of bark beetle (family Scolytidae) was also collected. This is the first time this species has been collected during Programmatic Monitoring and may have been blown up the mountain from lower elevations. Only one specimen was seen.

Spiders

Juvenile and adult Lycosid spiders, *Lycosa hawaiiensis* Simon, occurred in pitfall traps, but only juveniles were actively foraging among rocks.

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.

HALE SAMPLING SITE

Twenty-one species of arthropods were collected and observed near the HALE Entrance Station. The species included six endemic Hawaiian arthropods, eight non-indigenous arthropods, and seven species of unknown status.

Moths - Order Lepidoptera

Three species of Lepidoptera were observed or captured during this study. Two species of moths were captured in the light traps, *Agrotis biliopa* and a microlepidoptera and one species, *Cydia plicata*, on mamane trees (*Sophora chrysophylla*). Lepidoptera were very uncommon during this study, likely due to seasonality.

True Bugs - Order Hemiptera

Three species of true bugs (Heteroptera) were found, all from the family Miridae and all previously reported from the higher elevations of Haleakalā. An *Orthotylus* species was abundant on mamane trees, a *Sarona* species was common on Pilo, *Coprosma montana*, and *Opuna sharpianus* (Kirkaldy), a low-land species was uncommon on shrubs.

Three species of Homoptera were also observed, including an indigenous species of *Nesosydne* (family Delphacidae). Others were a species of

leaf hopper (family Cicadellidae), and a species of the family Psyllidae.

Bees and Wasps - Order Hymenoptera

The three species of Hymenoptera found near the HALE Entrance Station were all non-indigenous. Honey bees were common on manane and pukiawe. Two invasive species, *Vespula pensylvanica* (Saussure) and *Hypoconera opaciceps* (Mayr) are serious pests and efforts are being made to eradicate them in HALE.

Flies - Order Diptera

At least two species of common flies were seen, along with a species of crane fly (family Tipulidae), likely an indigenous species that came to the light traps.

Beetles - Order Coleoptera

Only one species of beetle, of the indigenous genus *Mecyclothorax* (family Carabidae). These small beetles were captured in pitfall traps.

Lacewings - Order Neuroptera

One species of brown lacewings (family Hemerobiidae) was collected, *Hemerobius pacificus* Banks. This introduced species is known from previous studies in HALE.

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APPENDIX A HO ATST ARTHROPOD SPECIES LIST

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

Class	Order	Family	Genus	Species	Authority	Status
Arachnida	Araneae	Lycosidae	Lycosa	hawaiiensis	simon	endemic
Insecta	Coleoptera	Coccinellidae	Coccinella	septempunctata	Mulsant	Introduced
Insecta	Coleoptera	Coccinellidae	Hippodemia	convergens	Guerin	Introduced
Insecta	Coleoptera	Coccinellidae	Olla	v-nigrum	(Mulsant)	non-indigenous
Insecta	Coleoptera	Coccinellidae	Psyllobora	taedata	LeConto	non-indigenous
Insecta	Coleoptera	Coccinellidae	Scymnus	sp.		non-indigenous
Insecta	Coleoptera	Scolytidae				
Insecta	Diptera	Calliphoridae	Calliphora	vomitorea	(Linnaeus)	non-indigenous
Insecta	Diptera	Lonchaeidae				
Insecta	Diptera	Muscidae	SP3			
Insecta	Diptera	Phoridae				
Insecta	Diptera	Tephritidae	Trupanea	sp.		endemic
Insecta	Diptera	Tephritidae				
Insecta	Heteroptera	Lygaeidae	Geocoris	pallens	Stål	non-indigenous
Insecta	Heteroptera	Lygaeidae	Nysius	coenosulus	Stål	endemic
Insecta	Heteroptera	Lygaeidae	Nysius	communis	Usinger	endemic
Insecta	Heteroptera	Lygaeidae	Nysius	nemorivagus	White	endemic
Insecta	Heteroptera	Lygaeidae	Nysius	terrestris	Usinger	endemic
Insecta	Heteroptera	Miridae	Orthotylus	sp.1		endemic
Insecta	Heteroptera	Miridae	Trigonotylus	hawaiiensis	(Kirkaldy)	endemic
Insecta	Heteroptera	Rhopalidae	Jadera	haematoloma	(Herrich-Schaeffer)	non-indigenous
Insecta	Homoptera	Delphacidae	Nesosydne	sp.		endemic
Insecta	Hymenoptera	Braconidae				
Insecta	Hymenoptera	Colletidae	Hylaeus	sp.		endemic
Insecta	Hymenoptera	Ichneumonidae				
Insecta	Hymenoptera	Unknown 12				
Insecta	Hymenoptera	Unknown 13				
Insecta	Hymenoptera	Unknown 2				
Insecta	Lepidoptera	Noctuidae	Agrotis	biliopa	Meyrick	endemic
Insecta	Lepidoptera	Noctuidae	Agrotis	epicremna	Meyrick	endemic
Insecta	Psocoptera					

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APPENDIX B HALE ARTHROPOD SPECIES LIST

A list of Arthropod species detected during the October 2011 sampling at the
HALE Entrance Station.

Class	Order	Family	Genus	Species	Authority	Status
Crustacea	Isopoda	Porcellionidae	Porcellio	scaber	Latreille	non-indigenous
DIPLOPODA	Julida	Allajulus	latistriatus		(Curtis)	non-indigenous
Insecta	Coleoptera	Carabidae	Mecyclothorax	spp.		endemic
Insecta	Dermoptera	Forficulidae	Forficula	auricularia	Linnaeus	non-indigenous
Insecta	Diptera	Calliphoridae	Calliphora	vomitoria	(Linnaeus)	non-indigenous
Insecta	Diptera	Muscidae	SP4			
Insecta	Diptera	Tipulidae	SP1			
Insecta	Heteroptera	Miridae	Opuna	sharpianus	(Kirkaldy)	endemic
Insecta	Heteroptera	Miridae	Orthotylus	sp.1		endemic
Insecta	Heteroptera	Miridae	Sarona	sp.		endemic
Insecta	Homoptera	Cicadellidae	SP1			
Insecta	Homoptera	Delphacidae	Nesosydne	sp. 1		endemic
Insecta	Homoptera	Psyllidae	SP1			
Insecta	Hymenoptera	Apidae	Apis	mellifera	Linnaeus	non-indigenous
Insecta	Hymenoptera	Formicidae	Hypoconera	opaciceps	(Mayr)	non-indigenous
Insecta	Hymenoptera	Vespidae	Vespula	pennsylvanica	(Saussure)	non-indigenous
Insecta	Lepidoptera	Microlepidoptera	SP1			
Insecta	Lepidoptera	Noctuidae	Agrotis	biliopa	Meyrick	endemic
Insecta	Lepidoptera	Tortricidae	Cydia			
Insecta	Neuroptera	Hemerobiidae	Hemerobius	pacificus	Banks	non-indigenous
Insecta	Psocoptera					