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. Two additional sampling sessions occurred in 2011.

This is a report of the sampling conducted in October 2012, the second of two sampling sessions that were conducted in 2012. 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.

Vegetation at the ATST site. A pitfall trap flag is visible under the large rock.

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 October 2012 is the second of two sampling sessions for Programmatic Arthropod Monitoring and Assessment at the Haleakalā High Altitude Observatories and Haleakalā National Park conducted in 2012 and continues monitoring that began in September 2009. 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 # FHM12-296) issued in September, 2012 and the National Park Service (Permit # HALE-2010-SCI-0001) issued on March 22, 2010. Sampling began on October 10, 2012 and was completed on October 14, 2012.

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 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.

Pitfall Trapping

After consultation with HALE natural resources staff, ten pitfall traps were installed near HALE Entrance Station site (five below the road and five above the road). 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 at the ATST site and for four days at the HALE site. 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 near the HALE Entrance Station 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 three nights at the ATST site and for three nights at the HALE site.

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 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 five days and four nights in October 2012, starting on October 10, 2012 and ending on October 14, 2012. High winds averaging 20-25 mph with gusts of more than 40 mph limited the effectiveness of sampling. Sampling typically began at 8:00 am and ran 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 or until weather conditions prevented further sampling. Pitfall traps were open for 80 trap nights, and light traps were deployed for 6 trap nights. Light traps were allowed to run overnight or until batteries failed.

The native Hawaiian owl, Pueo (*Asio flammeus sandwichensis*) was observed hunting near the HALE Entrance Station, October 2012.

VI. RESULTS and DISCUSSION

HO ATST SITE

Twelve species of arthropods were collected at the HO ATST site during the October 2012 sampling session. The species included five endemic Hawaiian arthropods, four non-indigenous arthropods, and three species of unknown status.

Moths – Order Lepidoptera

One moth was collected in the light traps, a specimen of the Haleakalā flightless moth (*Thyrocopa apatela*).

True Bugs – Orders Heteroptera and Homoptera

Two species of seed bugs (Heteroptera: Lygaeidae) were observed including One species was particularly abundant, *Nysius coenosulus* Stål. The other was the non-indigenous *Geocoris pallens*, present as nymphs. 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. ATST Observatory site preparation and construction had not yet begun.

Nymphs of an endemic species genus of plant hoppers (*Nesosydne*) were found. These bugs can be abundant at times but were also in low abundance during this trip.

Bees and Wasps – Order Hymenoptera

One species of a very small parasitic wasp was the only Hymenoptera observed at the site. Normally present indigenous yellow-faced bees were not seen, perhaps due to the high winds.

Flies - Order Diptera

Non-indigenous blowflies *Calliphora vomitoria* (Linnaeus) and *Lucilia sericata* (Meigen) and a non-indigenous Tachinidae were observed flying at the site. One species of cranefly (family Tipulidae) was captured in a light trap. No fruit flies (family Tephritidae) were found.

Beetles – Order Coleoptera

One specimen of the indigenous genus *Plagithmysus* was captured in a pitfall trap.

Spiders -Araneae

Juvenile and adult Lycosid spiders, *Lycosa hawaiiensis* Simon, occurred in pitfall traps, but only juveniles were seen 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

Thirty-four species of arthropods were collected and observed near the HALE Entrance Station. The species included nine endemic Hawaiian arthropods, twelve non-indigenous arthropods, and thirteen species of unknown status.

Moths – Order Lepidoptera

Six species of Lepidoptera were observed or captured during this study. One species of endemic Noctuid moth was captured in the light traps, *Agrotis xiphias* Meyrick. A nonindigenous Noctuid was also captured in the light traps, *Peseudaletia unipunctata* (Haworth). Indigenous species of microlepidoptera, one Cosmopterigidae, *Hyposmocoma* sp., and two species of Crambidae, *Eudonia* sp. and *Udea pyranthes (Meyrick)*, were observed flying during the day. One unknown species of microlepidoptera was also captured.

True Bugs – Orders Heteroptera and Homoptera

Four species of true bugs (Heteroptera) were found, three from the family Miridae and one from the family Lygaeidae. All have been previously reported from the higher elevations of Haleakalā. An *Orthotylus* species was abundant on mamane trees, and an *Opuna* species were common on Pilo (*Coprosma montana)*.

Four species of Homoptera were also observed, including the indigenous genera *Nesosydne* (family Delphacidae), and Nesophrosyne (family Cicadellidae).

Bees and Wasps – Order Hymenoptera

The five species of Hymenoptera found near the HALE Entrance Station included honey bees uncommon on manane and pukiawe, two parasitoids,

and two invasive ants, *Hypoponera opaciceps* (Mayr) and *Linepithema humile* (Mayr). The latter are serious pests and efforts are being made to eradicate them in HALE. All Hymenoptera observed have been previously reported from Haleakalā.

Flies – Order Diptera

Nine species of flies were seen, including a species of crane fly (family Tipulidae), a likely indigenous species that comes to the light traps. Also observed were non-indigenous species of the families Calliphoridae, Tachinidae, Muscidae, and Syrphidae, as well as species from the families Phoridae, Sciaridae, and Chironomidae of unknown status.

Beetles – Order Coleoptera

One species of beetle, the nonindigenous *Trechus obtusus* Erichson (family Carabidae) was captured in pitfall traps.

Araneae - Spiders

Two species of spiders were collected, both of unknown status.

Other arthropods include non-indigenous pillbug and a millipede and a booklice of unknown status.

DISCUSSION

The arthropods that were found during this sampling are characteristic of the fauna at both sites. Several species that have been observed during other samplings that were not present during this trip are likely absent because of the timing of the sampling, and weather conditions. No new invasive arthropods were detected at either site.

No trends in populations were detected beyond normal seasonal variation and weather related abundance. The species reported are reflective only of the sites sampled, and only qualitative data of abundance were taken.

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APPENDIX A
HO ATST ARTHROPOD SPECIES LIST

A list of Arthropod species detected during the October 2012 sampling at the HO ATST site.

Class	Order	Family	Genus	Species	Authority	Status
Arachnida	Araneae	Lycosidae	Lycosa	hawaiiensis	simon	endemic
Insecta	Coleoptera	Cerambycidae	Plagithmysus	sp.		endemic
Insecta	Diptera	Calliphoridae	Calliphora	vomitoria	(Linnaeus)	non-indigenous
Insecta	Diptera	Calliphoridae	Lucilia	sericata	(Meigen)	non-indigenous
Insecta	Diptera	Phoridae				Unknown
Insecta	Diptera	Tachinidae				non-indigenous
Insecta	Diptera	Tipulidae				Unknown
Insecta	Heteroptera	Lygaeidae	Geocoris	pallens	Stål	non-indigenous
Insecta	Heteroptera	Lygaeidae	Nysius	coenosulus	Stål	endemic
Insecta	Homoptera	Delphacidae	Nesosydne	sp.		endemic
Insecta	Hymenoptera	Cynipidae				Unknown
Insecta	Lepidoptera	Oecophoridae	Thryocopa	apatela	(Walsingham)	endemic

APPENDIX B
HALE ARTHROPOD SPECIES LIST

A list of Arthropod species detected during the October 2012 sampling at the HALE Entrance Station.

Class	Order	Family	Genus	Species	Authority	Status
Arachnida	Araneae	Unknown 1				unknown
Arachnida	Araneae	Unknown 2				unknown
Crustacea	Isopoda	Porcellionidae	Porcellio	scaber	Latreille	non-indigenous
DIPLOPODA	Julida	Allajulus	latistriatus		(Curtis)	non-indigenous
Insecta	Coleoptera	Carabidae	Trechus	obtusus	Erichson	non-indigenous
Insecta	Diptera	Calliphoridae	Calliphora	vomitoria	(Linnaeus)	non-indigenous
Insecta	Diptera	Calliphoridae	Lucilia	sericata	(Meigen)	non-indigenous
Insecta	Diptera	Chironomidae				unknown
Insecta	Diptera	Muscidae	SP3			unknown
Insecta	Diptera	Phoridae				unknown
Insecta	Diptera	Sciaridae				unknown
Insecta	Diptera	Syrphidae	Toxomerus	marginatus	(Say)	non-indigenous
Insecta	Diptera	Tachinidae				non-indigenous
Insecta	Diptera	Tipulidae				unknown
Insecta	Heteroptera	Lygaeidae	Nysius	coenosulus	Stål	endemic
Insecta	Heteroptera	Miridae	Opuna	sharpianus	(Kirkaldy)	endemic
Insecta	Heteroptera	Miridae	Orthotylus	sp.1		endemic
Insecta	Heteroptera	Miridae				unknown
Insecta	Homoptera	Cicadellidae	Nesophrosyne			endemic
Insecta	Homoptera	Cicadellidae	Nesophrosyne			unknown
Insecta	Homoptera	Cicadellidae	SP1			unknown
Insecta	Homoptera	Delphacidae	Nesosydne	sp.		endemic
Insecta	Hymenoptera	Apidae	Apis	mellifera	Linneaus	non-indigenous
Insecta	Hymenoptera	Braconidae	Apateles			unknown
Insecta	Hymenoptera	Formicidae	Hypoponera	opaciceps	(Mayr)	non-indigenous
Insecta	Hymenoptera	Formicidae	Linepithema	humile	(Mayr)	non-indigenous
Insecta	Hymenoptera	Ichneumonidae	Priostomerus	hawaiiensis	Perkins	non-indigenous
Insecta	Lepidoptera	Cosmopterigidae	Hyposmocoma	sp.1		endemic
Insecta	Lepidoptera	Crambidae	Eudonia	sp.		endemic
Insecta	Lepidoptera	Crambidae	Udea	pyranthes	(Meyrick)	endemic
Insecta	Lepidoptera	Microlepidoptera	SP1			unknown
Insecta	Lepidoptera	Noctuidae	Agrotis	xiphias	Meyrick	endemic
Insecta	Lepidoptera	Noctuidae	Peseudaletia	unipunctata	(Haworth)	non-indigenous
Insecta	Psocoptera					unknown