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

May 2010

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I. TABLE OF CONTENTS

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 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.

This study, conducted in March 2010 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 2010. 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.

This monitoring project provides a means of gathering 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.

No new invasive arthropods were detected at the HO ATST site nor at the HALE Entrance Station.

Populations and diversity of Hawaiian indigenous species were lower than observed during June 2009. This is likely due to seasonal fluctuations in these populations.

The endemic plant, *Tetramolopium*, found growing in rock crevice at the HO ATST site.

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. In 1961, an Executive Order of Hawai`i Governor Quinn established the Haleakalā High Altitude Observatories Site, sometimes referred to as “Science City”. The site is managed by the University of Hawai`i.

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). 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. Baseline sampling was conducted at the HALE Entrance Station in June 2009.

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 re-sources 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.

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 study, conducted in March 2010 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 2010. 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.

Because the areas proposed for development remain fairly intact, they represent important habitat for unique and highly adapted native arthropod species (Loope and Medeiros 1994).

Sampling of arthropod habitats was approved in a permit obtained from the Department of Land and Natural Resources (Permit # FHM09-188) issued in June, 2009 and the National Park Service (Permit # HALE-2010-SCI-0001) issued on March 22, 2010. Sampling began on March 23, 2010 and was completed on March 29, 2010.

The ATST site at HO has sparse vegetation among bare lava flows and cinder.

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 the 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, 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 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 an 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.

The Haleakalā National Park Entrance Station is at about 2,072 m (6,800 ft) on the western slope of Haleakalā. Sampling locations were determined with guidance and cooperation from HALE personnel. Annual precipitation here averages 1,750 mm (70 in), falling primarily as rain and mist during the winter months from November through April.

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 makes only a small impact on the populations of interest. While that 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 Traps

After consultation with HALE natural resources staff, ten pitfall traps were installed (five below the road and five above the road) near the HALE entrance station. 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 six 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 the 2007 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 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 will be run every night for seven nights (a total of 14 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 beat 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 morpho-species 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).
Schedule/Start and End dates

Sampling was conducted over seven days and five nights in March 2010, starting on March 23, 2010 and ending on March 29, 2010. Sampling typically began at 9:00 am and run until about 2:00 pm. A break was taken to prepare for night sampling which resumed at 8:00 pm and continued until midnight. Pitfall traps were open for 120 trap nights, and light traps were deployed for 18 trap nights.

Lucosid wolf spider in leaf litter under a *Dubautia* at the ATST site.

VI. RESULTS and DISCUSSION

HO ATST SITE

Thirty-three species of arthropods were collected at the HO ATST site. The species included fourteen endemic Hawaiian arthropods, twelve non-indigenous arthropods, and five species of unknown status.

Two species of endemic noctuid moths were collected in the light traps along with and one non-indigenous species. No adult specimens of the Haleakalā flightless moth (Thyrocopa apatela) were found, but several were captured in June 2009 (Pacific Analytics 2009). It is possible that they are not as active in March.

Four endemic *Nysius* (Heteroptera: Lygaeidae) species were seen, three feeding on *Dubautia* and *pūkiawe* and one under shrubs. Several mating pair of *Nysius lichenicola* were observed. At least one species of endemic yellow-faced bee (Family Colletidae) was also collected on these shrubs. All; species were less abundant than that observed in June 2009.

Lycosid spiders, *Lycosa hawaiiensis* Simon, occurred in pitfall traps and were seen foraging among rocks or in *Dubautia* plants. Juvenile spiders were not as abundant as that observed during June 2009. *Lycosa hawaiiensis* is the predominant predator of the arthropod fauna in from the crater district of Haleakalā (Medeiros and Loope 1994).

The pitfall traps also captured three noctuid larvae (caterpillars) and one specimen of the non-indigenous carabid beetle, *Trechus obtusus* Erichson. Neither were abundant at the site.

Several species of purposely introduced lady bird beetles were collected, as well as four species of non-indigenous flies.

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 that observed in June 2009.

HALE ENTRANCE STATION SITE

Twenty-two species of arthropods were collected and observed at sites near the HALE Entrance Station. The species included nine endemic Hawaiian arthropods, eleven non-indigenous arthropods, and two species of unknown status.

Several species of moths were collected with light traps. All but one species were collected in June 2009. The one new species, *Ophiusa disjungens*, a non-indigenous moth (Family Noctuidae), is called the guava moth but it also feeds on other Myrtaceae including gum trees. This species is known from many of the main islands of Hawaiʻi.

Earwigs, abundant during the June 2009 sampling, were in low abundance. Only a few immature specimens were collected in pitfall traps.

One ant species, *Hypoponera opaciceps*, was observed. They occurred only near the small fee station parking lot, and in low abundance. This ant species was also collected during the June 2009 sampling.

Six specimens of the non-indigenous carabid beetle, *Trechus obtusus* Erichson were found, but none of the endemic *Mecyclothorax* species collected during June 2009 were detected.

No new invasive species were observed that could impact native arthropod species. The species of indigenous arthropods have been observed at the site during other surveys. Diversity was lower than that observed in June 2009.

DISCUSSION

No new invasive arthropods were detected at the HO ATST site nor at the HALE Entrance Station.

Populations and diversity of Hawaiian indigenous species were lower than observed during June 2009. This is likely due to normal seasonal fluctuations in these populations. The trend of these populations will be carefully monitored during future Programmatic Monitoring session.

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APPENDIX A
HO ATST ARTHROPOD SPECIES LIST

A list of Arthropod species detected during the March 2010 sampling at the HO ATST site.

Class	Order	Family	Genus	Species	Subspecies	Authority	Status	host 1	host 2
Arachnida	Araneae	Lycosidae	Lycosa	hawaiiensis		simon	endemic		
Insecta	Coleoptera	Carabidae	Trechus	obtusus		Erichson	non-indigenous		
Insecta	Coleoptera	Coccinellidae	Coccinella	septempunctata		Linnaeus	non-indigenous	Dubautia	
Insecta	Coleoptera	Coccinellidae	Olla	v-nigrum		(Mulsant)	non-indigenous	Dubautia	
Insecta	Coleoptera	Coccinellidae	Psyllobora	taedata		LeConto	non-indigenous	Dubautia	
Insecta	Coleoptera	Curculionidae							pukiawe
Insecta	Diptera	Calliphoridae	Calliphora	vomitoria		(Linnaeus)	non-indigenous		
Insecta	Diptera	Calliphoridae	Lucilia	sericata		(Meigen)	non-indigenous		
Insecta	Diptera	Muscidae	SP1						
Insecta	Diptera	Muscidae	SP2						
Insecta	Diptera	Syrphidae	Toxomerus	marginatus		(Say)	non-indigenous		pukiawe
Insecta	Heteroptera	Lygaeidae	Nysius	coenosulus		Stål	endemic	Dubautia	pukiawe
Insecta	Heteroptera	Lygaeidae	Nysius	communis		Usinger	endemic	Dubautia	pukiawe
Insecta	Heteroptera	Lygaeidae	Nysius	lichenicola		Kirkaldy	endemic	pukiawe	
Insecta	Heteroptera	Lygaeidae	Nysius	terrestris		Usinger	endemic		Pukiawe
Insecta	Heteroptera	Miridae	Orthotylus	sp.1			endemic	Dubautia	
Insecta	Heteroptera	Miridae	Orthotylus	sp.2			endemic	Dubautia	pukiawe
Insecta	Heteroptera	Miridae	Trigonotylus	hawaiiensis		(Kirkaldy)	endemic	Dubautia	
Insecta	Homoptera	Delphacidae	Nesosydne	osborni		Muir	endemic	Dubautia	pukiawe
Insecta	Homoptera	Psyllidae	SP1						
Insecta	Homoptera	Psyllidae	Trioza	ohiacola		Crawford	endemic		
Insecta	Hymenoptera	Colletidae	Hylaeus	nivicola		Meade-Waldo	endemic	Dubautia	pukiawe
Insecta	Hymenoptera	Unknown 1							
Insecta	Hymenoptera	Unknown 2							
Insecta	Hymenoptera	Unknown 3							
Insecta	Hymenoptera	Unknown 4							
Insecta	Hymenoptera	Unknown 5							
Insecta	Lepidoptera	Cosmopterigidae	Hyposmocoma	sp.2			endemic		
Insecta	Lepidoptera	Noctuidae	Agrotis	biliopa		Meyrick	endemic		
Insecta	Lepidoptera	Noctuidae	Agrotis	mesotoxa		Meyrick	endemic		
Insecta	Lepidoptera	Noctuidae	larvae						
Insecta	Lepidoptera	Noctuidae	Peseudaletia	unipunctata		(Haworth)	non-indigenous		
Insecta	Lepidoptera	Pterophoridae	Stenoptilodes	taprobanes	brachymorpha	(Meyrick)	non-indigenous		

APPENDIX B
HALE ARTHROPOD SPECIES LIST

A list of Arthropod species detected during the March 2010 sampling at the HALE Entrance Station.

Class	Order	Family	Genus	Species	Subspecies	Authority	Status	host 1
Crustacea	Isopoda	Porcellionidae	Porcellio	scaber		Latreille	non-indigenous	
Diplopoda	Julida	Allajulus	latistriatus			(Curtis)	non-indigenous	
Insecta	Coleoptera	Carabidae	Trechus	obtusus		Erichson	non-indigenous	
Insecta	Coleoptera	Cerambycidae	Plagithmysus	funebris		Sharp	endemic	mamane
Insecta	Dermaptera	Forficulidae	Forficula	auricularia		Linnaeus	non-indigenous	
Insecta	Diptera	Calliphoridae	Calliphora	vomitoria		(Linnaeus)	non-indigenous	
Insecta	Diptera	Calliphoridae	Lucilia	sericata		(Meigen)	non-indigenous	
Insecta	Diptera	Muscidae	SP1					
Insecta	Heteroptera	Miridae	Orthotylus	sp.2			endemic	mamane
Insecta	Homoptera	Psyllidae	SP1					
Insecta	Hymenoptera	Formicidae	Hypoponera	opaciceps		(Mayr)	non-indigenous	
Insecta	Lepidoptera	Cosmopterigidae	Hyposmocoma	sp.1			endemic	
Insecta	Lepidoptera	Cosmopterigidae	Hyposmocoma	sp.2			endemic	
Insecta	Lepidoptera	Crambidae	Eudonia	sp.			endemic	
Insecta	Lepidoptera	Crambidae	Udea	pyranthes		(Meyrick)	endemic	
Insecta	Lepidoptera	Noctuidae	Agrotis	epicremna		Meyrick	endemic	
Insecta	Lepidoptera	Noctuidae	Agrotis	xiphias		Meyrick	endemic	
Insecta	Lepidoptera	Noctuidae	Megalographa	biloba		(Stephens)	non-indigenous	
Insecta	Lepidoptera	Noctuidae	Ophiusa	disjungens		(Walker)	non-indigenous	
Insecta	Lepidoptera	Noctuidae	Peseudaletia	unipunctata		(Haworth)	non-indigenous	
Insecta	Lepidoptera	Noctuidae	Spodoptera	exigua		(Huebner)	non-indigenous	
Insecta	Lepidoptera	Torticidae	Cydia	sp. 1			endemic	