Programmatic Arthropod Monitoring at the Haleakalā High Altitude Observatory Site and Haleakalā National Park

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Prepared for

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Maui, Hawai'i

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II. EXECUTIVE SUMMARY

The National Science Foundation (NSF) has authorized the development of the Daniel K. Inouye Solar Telescope (DKIST), previously known as the Advanced Technology Solar Telescope (ATST)) within the 18-acre University of Hawai`i Institute for Astronomy Haleakalā High Altitude Observatory (HO) site. An Environmental Impact Statement was completed for the DKIST project (NSF 2009), and the NSF issued a Record of Decision in December of 2009.

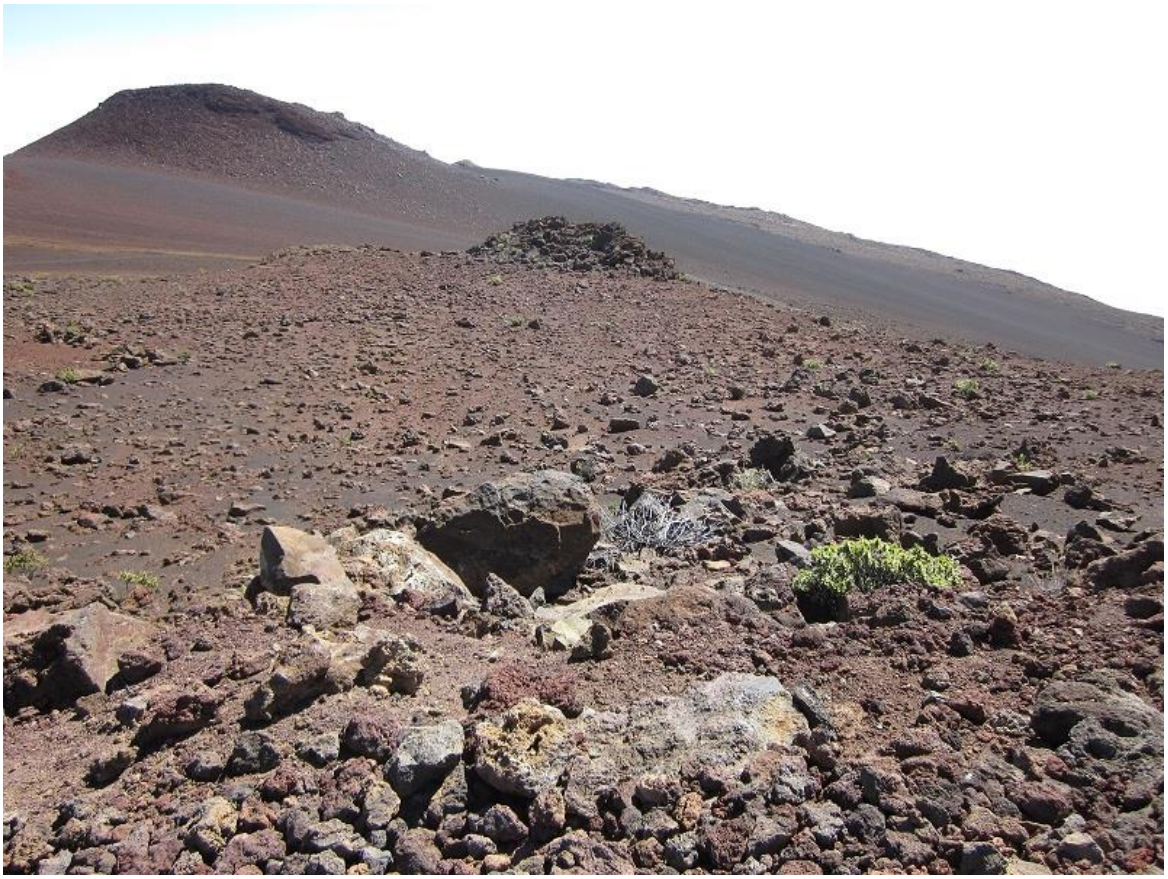
The DKIST represents a collaboration of 22 institutions, reflecting a broad segment of the solar physics community. The DKIST project will be the largest and most capable solar telescope in the world. It will be an indispensable tool for exploring and understanding physical processes on the Sun that ultimately affect Earth. The DKIST Project will be contained within a 0.74 acre site footprint in the HO site
The Haleakalā National Park (HALE) Road Corridor is being used for transportation during construction and use of the DKIST. 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 were considered to be minor, NSF 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 DKIST Project.

After preliminary sampling near the HALE Entrance Station and at the DKIST site in 2009, Programmatic Arthropod Monitoring and Assessment at the Haleakalā High Altitude Observatory site and Haleakalā National Park was initiated with two sampling sessions in 2010. Monitoring continues to be conducted twice a year during the construction phase of the DKIST which began in December 2012 and is anticipated to be completed in 2019.

This report presents the results of the Winter 2016 sampling. The goal is to monitor the arthropod fauna at the DKIST

site and along the HALE Road Corridor, identify Hawaiian native arthropod species or habitats, if any, that may be impacted by construction of the DKIST, 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 Haleakalā High Altitude Observatory Site by promoting the good stewardship of the natural resources located there.



Undisturbed alpine habitat near the Haleakalā High Altitude Observatories.

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 Daniel K. Inouye Solar Telescope (DKIST), previously known as the Advanced Technology Solar Telescope (ATST)) within the 18-acre University of Hawai`i Institute for Astronomy Haleakalā High Altitude Observatory (HO) site. An Environmental Impact Statement was completed for the DKIST project (NSF 2009), and the NSF issued a Record of Decision in December of 2009.

The DKIST represents a collaboration of 22 institutions, reflecting a broad segment of the solar physics community. The DKIST 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 DKIST Project will be contained within a 0.74 acre site in the HO site. The Haleakalā National Park (HALE) Road Corridor is being used for transportation during construction and use of the DKIST. Construction began in December 2012 and was ongoing during the Winter 2016 sampling.

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 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 HO site. This inventory and assessment was updated in December 2005 to provide a more detailed description of the arthropod fauna at the two proposed DKIST sites, and identify Hawaiian native arthropod species or habitats, if any, that could be impacted by construction of the DKIST. 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 DKIST 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 biological changes.

The scientific scope of the current phase of Arthropod Monitoring is to repeatedly sample arthropod habitats that may be impacted by construction of the DKIST, document changes to native arthropod populations, and detect new or potentially threatening invasive species of arthropods that may impact the native

resident arthropod fauna. Programmatic Arthropod Monitoring includes identification and taxonomy for both ground and shrub dwellers and is being conducted in both developed and undeveloped areas of HO (excluding the Air Force site).

Arthropod Programmatic Monitoring consists of one week sampling sessions conducted in the Summer and Winter months using standard arthropod sampling methods similar to those used during the 2007 inventory of arthropods within HALE (Krushelnycky et al. 2007), collecting invertebrates both day and night, with identification and taxonomy for both ground and shrub dwellers in developed and undeveloped portions of the sampling areas.

The primary areas being sampled are the Haleakalā High Altitude Observatory (HO) site on Kolekole Hill, but not including the Air Force site, the DKIST Construction Site, and selected portions of the HALE Road Corridor. The 18 acre HO facility hosts several existing observatories and their support buildings, and also includes several undeveloped sites where native vegetation and the associated arthropod fauna is relatively undisturbed. Although the overall footprint of DKIST is about 0.74 ac, the site where DKIST construction is currently taking place is approximately 0.24-ha (0.6 ac) of previously undisturbed land located east of the existing Mees Solar Observatory facility. The portions of the HALE Road Corridor being sampled are determined in collaboration with the HALE staff biologists at the beginning of each sampling session.

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 report describes the results of sampling conducted in February of 2016, the first of two sampling sessions for Programmatic Arthropod Monitoring and Assessment this year, and continues monitoring that began in September 2009. The goal is to monitor the arthropod fauna at the HO site, the DKIST construction site, and along the selected portions of the HALE Road Corridor, identify Hawaiian native arthropod species or habitats, if any, that may be impacted by construction of the DKIST, 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 staff biologists.

Sampling of arthropod habitats was approved in permits obtained from the Department of Land and Natural Resources (Permit # FHM16-407), effective date January 20, 2016 – January 20, 2017, and the National Park Service (Permit # HALE-2010-SCI-0003) issued on April 16, 2015. Sampling began on February 16, 2016 and was completed on February 24, 2016.

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 the Annual Inspection, and are the focus of this report.

Question 1

What are the characteristic arthropod populations at the DKIST site, the larger HO site (excluding the Air Force site), and along selected areas of the HALE Road Corridor?

Justification:

Programmatic Monitoring will yield a comprehensive list of the characteristic arthropod fauna at the DKIST site, developed and undeveloped areas of the HO site, and along selected areas of the HALE Road Corridor.

Monitoring goals:

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

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

The results of this sampling are combined with information gathered during previous studies to develop a comprehensive list of arthropods at the Haleakalā High Altitude Observatory (HO) site, the DKIST site, and along selected areas of the HALE Road Corridor, and a qualitative description of seasonal variations in their abundance.

Question 2

What adverse impacts can be detected, if any, on characteristic populations of arthropods at the DKIST site, the larger HO site (excluding the Air Force site), and along selected areas of the HALE Road Corridor that may be due to DKIST construction?

Justification:

Programmatic Monitoring of native arthropod species will yield reliable scientific information about the current status (presence and abundance) of these species at the sampling sites. The information will be useful to detect changes and trends that may be due to the construction of the DKIST.

Monitoring goals:

1) To detect changes, trends, periodicities, cycles, and/or other patterns of change in arthropods at the DKIST site, the larger HO site, and along the HALE Road Corridor during the construction of the DKIST.

Programmatic Monitoring reports provide a discussion of the results of sampling, a description of changes in presence or abundance, and an assessment of those changes that may be due to the DKIST construction, and provide opportunities for adaptive management of construction processes, through the use of control measures, where these changes and/or trends negatively affect the arthropod population.

Question 3

What non-indigenous invasive arthropod species, if any, are detected at the DKIST site, the larger HO site (excluding the Air Force site), and along selected areas of the HALE Road Corridor during DKIST construction?

Justification:

Programmatic Monitoring for non-indigenous invasive arthropod species will detect potential threats to the nearby native ecosystems before they have an opportunity to establish resident populations. Early detection will allow implementation of control measures to eradicate invasive arthropod species (e.g. ants and spiders) before they can damage the nearby native ecosystems.

Monitoring goals:

1) To detect non-indigenous invasive arthropod species at the DKIST site, the larger HO site, and along selected areas of the HALE Road Corridor during construction of the DKIST.

If any invasive arthropod species (e.g. ants and spiders) are detected, eradication measures will be implemented to prevent these species from establishing resident populations.

V. METHODS

Site Description

The Haleakalā High Altitude Observatories (HO) site is located on Kolekole Hill. The highest point on the HO site is at 3,052-m (10,012-ft) above sea level. The 7.3-ha (18.1-ac) site was established in 1961 by Executive Order (EO) 1987, amended by EO 4452, and the first telescope, the Mees Solar observatory was dedicated in 1964. The site now consists of several substantial and smaller telescope facilities.

The DKIST site is on undeveloped land located east of the existing Mees Solar Observatory facility at 3,042-m (9,980-ft) above sea level. 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.

Monitoring 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 within HO, in both developed and undeveloped areas, and ten pitfall traps were deployed specifically within the

DKIST 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 seven days at the DKIST site and for seven 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. Efforts were made to avoid known burrows. Pitfall traps are placed below ground and covered with a heavy cap rock. This makes it very unlikely that petrels could access the traps.

All pitfall traps were installed on February 16, 2016 and their contents collected on February 24, 2016. The sampling represents 80 traps nights for each of the three sites, for a total of 240 trap nights.

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.

Battery-powered ultraviolet light traps were operated near the HALE Entrance Station, at the HO site, and at the DKIST site. The traps consisted of a 3.5 gallon polypropylene bucket, a smooth surface funnel, a 22 watt Circline black light 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 for six nights at the DKIST

site, HO site, and the HALE site. An additional night of sampling was suspended due to weather conditions.

Light traps were deployed for six trap nights at each sampling site, and were allowed to run overnight or until batteries failed.

Other Light Sampling at Night

Night collecting can be aided by a UV light source. Small handheld ultraviolet black lights were 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 vegetation intact.

Nets

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

Baited Traps

Baited traps were deployed to detect the presence of ants. These traps consisted of fresh canned tuna, peanut butter, and honey placed on an index card and weighted down with a small rock. Traps were set near areas where ants could be introduced or where they may be foraging for food. Baited traps were deployed on the DKIST and the greater HO site on three different days. The traps were checked after forty-five minutes at which time the traps were be removed. Baited traps were not left opened overnight in order to avoid attracting unwanted pests.

On February 21, 2016 fifty baited ant traps were deployed at the HO/DKIST sites and ten baited ant traps were deployed at the HALE ES site.

Inspection of construction lay-down and storage areas

Construction material and equipment in developed lay-down areas were visually inspected for invasive arthropod species and evidence of their presence. Specifically, these areas were inspected for the presence of ants, spiders, spider webs, and indications of the presence of other potentially invasive arthropod species.

Population Estimates

Although NSF committed to "population estimates for developed and undeveloped areas within HO, the DKIST Construction Site, and selected areas of the HALE road corridor" (NSF 2009), they are not possible with the approved sampling techniques. A consultation with the NPS determined that any data collected would be only a snapshot in time, reflective only of the sites sampled, and that the results are seasonal and could not be extrapolated beyond those limits. They also expressed an opinion that any "population estimates" would not be comparable over time and that accurate population estimates for arthropods are not possible with the sampling methods approved for use. In consultation with NPS staff biologists, it was decided that sampling results would be presented as presence/absence, and that qualitative abundance estimates would be a suitable substitute for "population estimates" described in the FEIS (NSF 2009).

Sampling results in this report are presented as presence/absence, and, for selected species, qualitative abundance estimates are substituted for "population estimates" described in the FEIS (NSF 2009). Relative abundance categories are

- *infrequent* (individuals captured or observed < 10),
- *uncommon* (10 < individuals captured or observed < 25),
- *common* (25 < individuals captured or observed < 100), and
- *abundant* (100 < individuals captured or observed).

It should be noted that abundance designations are based exclusively on the capture or observation of specimens encountered at the sampling sites visited during each sampling session, and may be biased against certain species. For example, some ground dwelling species may be under-sampled because traps will not be baited and therefore not attractive to these species. Other species may be more or less abundant at other times of year than those sampled, or not efficiently captured with the sampling methods used. These species may generally be more or less common than indicated from the results. The results presented in reports are only snapshots in

time, reflective only of the sites sampled, and the results are seasonal and should not be extrapolated beyond those limits.

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 accurate identification and 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), Gagné (1997), Polhemus (2002, 2005, 2011, 2014), and Asquith (1994, 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.

After identification, the specimens were deposited in the University of Hawai'i Insect Museum.

Schedule/Start and End Dates

Sampling was conducted over nine days and eight nights beginning on February 16, 2016 and ending on February 24, 2016.

Kupaoa (*Dubautia menziesii*) provides food and shelter for several native arthropod species at the Haleakalā High Altitude Observatory site.

VI. RESULTS and DISCUSSION

Programmatic Monitoring

HALEAKALĀ HIGH ALTITUDE OBSERVATORY SITE

The HO site covers about 18 acres and contains observatory facilities. Several areas of the site are being used to store materials and equipment. Sixty-seven species of arthropods were detected at the HO site (excluding the Air Force Facility and the DKIST site). The species included twenty-two endemic species, thirty-three non-indigenous species, and twelve of unknown status.

Spiders and Mites - Arachnida

Juvenile and adult Lycosid spiders, *Lycosa hawaiiensis* Simon, occurred in pitfall traps, and were actively foraging among rocks. Small spiders of the family Linyphiidae were observed under rocks, and one crab spider (family Thomisidae) was found on vegetation.

Springtails - Collembola

At least one species of Collembola (family Entomobryidae) was observed at the HO site. These small insects were common in leaf litter under plants.

Beetles – Order Coleoptera

Thirteen beetle species were observed at the HO site. A few specimens of a native carabid beetle, *Mecyclothorax micans* (Blackburn), were observed near Reber Circle in leaf litter under *Dubautia* plants.

Many species of arthropods are found in leaf litter that accumulates under *Dubautia.*

Another small carabid beetle, *Trechus obtusus* Erichson, is infrequently found on the HO site. Nine species of non-indigenous ladybird beetles (family Coccinellidae) were observed. Several species of these predatory beetles have been introduced for biological control of harmful insects in Hawai'i. A small feather-winged beetle (family Ptiliidae) was collected in a pitfall trap.

A single specimen of the Lantana Leafminer Beetle, *Octotoma scabripennis* Gurein-Meneville was collected. The odd looking beetle was purposely introduced for biological control of *Lantana* in Hawai'i

Lantana Leafminer Beetle, Octotoma scabripennis. (Photo courtesy of Brisbane Insects)

Flies - Order Diptera

Fifteen species of flies were detected at the HO site. One endemic species of fruit fly (family Tephritidae) was uncommon on vegetation. Eleven species of non-indigenous flies were observed. The status of three species of flies collected was unknown.

True Bugs – Orders Heteroptera and Homoptera

Eleven species of true bugs (order Heteroptera) were observed including adults and nymphs of four Hawaiian endemic species in the genus *Nysius* (family Lygaeidae). Four species from the family Miridae including two endemic Hawaiian species and one adventive, pantropical species, *Taylorilygus apicalis* (Fieber). *Geocoris pallens* Stål (family Geocoridae) were uncommon on vegetation at the HO site, and the predatory Pale Damsel Bug (*Nabis capsiformis*) was infrequent at the HO site.

Six species of Homoptera were found, including an endemic species of plant hopper of the genus *Nesosydne*, abundant on *Dubautia*. Acacia psyllids, *Acizzia uncatoides* (Ferris & Klyver) and aphids were common on vegetation.

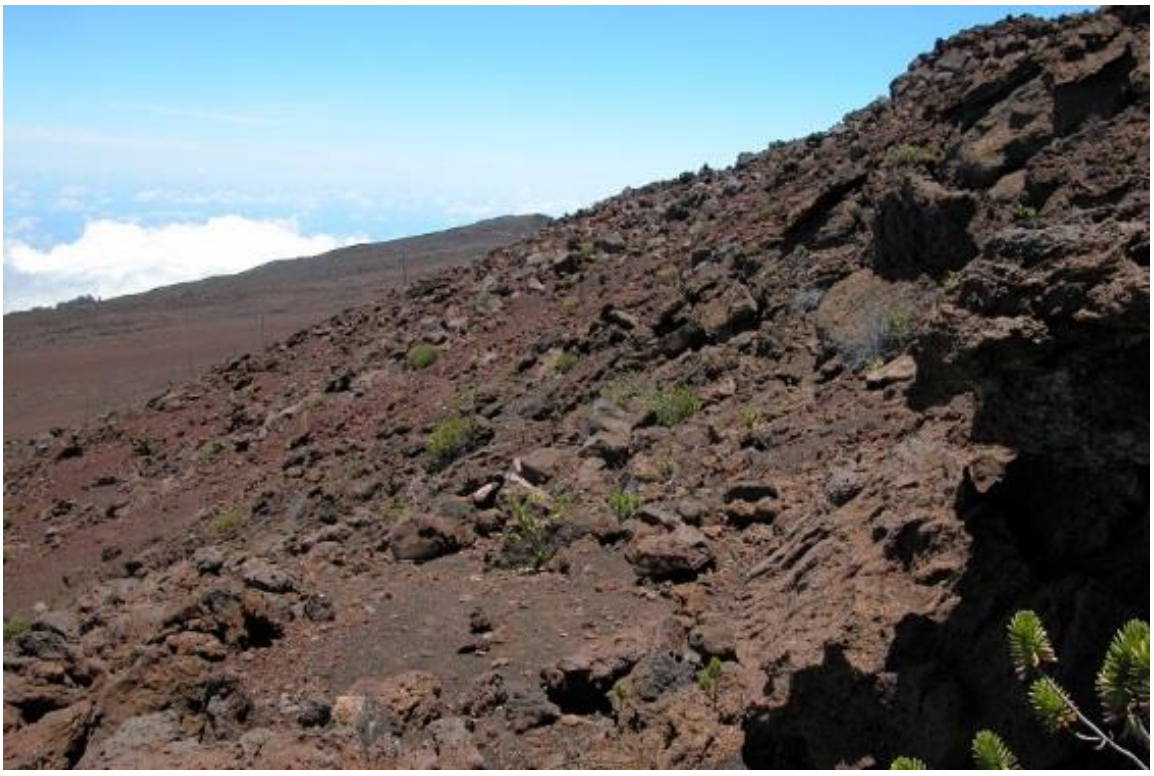
Bees and Wasps – Order Hymenoptera

Six species of Hymenoptera were observed at the HO site, including two species of endemic yellow-faced bees. One specimen of a small parasitic wasp was found in a pitfall trap. The specimen is a species of *Sierola* (Bethylidae), the most specious genus of Hymenoptera in Hawai'i with approximately 180 species. Three species of non-indigenous parasitic wasps were infrequent at the HO site.

Butterflies and Moths – Order Lepidoptera

Eight species of Lepidoptera were found at the HO site. These include four endemic species in the genus *Agrotis*, and the non-indigenous *Pseudalecia unipuncta* (Meyrick). Adults of the Haleakalā flightless moth (*Thyrocopa apatela* (Walsingham)) were collected in pitfall traps. Several caterpillars were found in pitfall traps.

A complete list of arthropods observed during this sampling session at the HO 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.



Undisturbed habitat on the north slope of HO.

DKIST CONSTRUCTION SITE

Construction was started on the DKIST in December 2012 and was ongoing during the Winter 2016 sampling session. Excavation was completed in 2014 and most earth-moving equipment has been removed from the site.

Fifty-two species of arthropods were collected at the DKIST site during the Winter 2016 sampling session. The species included twenty endemic Hawaiian arthropods, twenty-two non-indigenous arthropods, and ten species of unknown status.

Spiders and Mites - Arachnida

Juvenile and adult Lycosid spiders, *Lycosa hawaiiensis* Simon, were common on the DKIST site. Small Linyphiidae spiders were seen under rocks, and one species of crab spider (Family Thomisidae) was collected from vegetation.

Springtails - Collembola

Collembola (family Entomobryidae) were common under were common in leaf litter under plants and rocks.

Beetles – Order Coleoptera

Six species of beetles were observed at the DKIST site, all non-indigenous. The species included five ladybird beetles, and the non-indigenous carabid beetle *Trechus obtusus* Erichson.

Flies - Order Diptera

Fourteen species of flies were detected at the DKIST site. Three endemic species of fruit flies (family Tephritidae), and two species of unknown status were observed. The rest were non-indigenous and have been observed at the site during previous sampling.

True Bugs – Orders Heteroptera and Homoptera

Eight species of true bugs (Order Heteroptera) were observed at the DKIST site, including five endemic species. Adults and nymphs of four species of the Hawaiian endemic seed bug genus *Nysius* were present on vegetation and in leaf litter under plants, and a species of plant bug (family Miridae) was collected from vegetation. Two other species, both non-indigenous, were also present on vegetation.

Four species of Homoptera were collected, including a species of the endemic genus *Nesosydne* that was abundant on *Dubautia*. Non-indigenous species include a species of aphid and plant hopper and the abundant Acacia psyllid.

Bees and Wasps – Order Hymenoptera

The endemic species of yellow-faced bees, *Hylaeus nivicola* Meade Waldo, was common on *pukiawe*. Other Hymenoptera observed include small parasitic wasps and honey bees.

Moths – Order Lepidoptera

Seven species of Lepidoptera were collected, including six endemic species. Three large moths in the genus *Agrotis* were captured in light traps. Caterpillars of the genus *Agrotis* were found in pitfall traps. Haleakalā flightless moths (*Thyrocopa apatela* (Walsingham)) were found in pitfall traps. Two other endemic Hawaiian species include a grass moth (*Omiodes monogona* Meyrick) and a small moth of the genus *Hyposmocoma*.

Other Orders

Two species of brown lace wings (Neuroptera: Hemerobiidae) were found at the DKIST site. Both are endemic Hawaiian species known from lower elevations of Haleakalā National Park.

A complete list of arthropods observed during this sampling session at the DKIST site can be found in Appendix B 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.

HALEAKALĀ ENTRANCE STATION

Sampling in HALE occurred near the Entrance Station (HALE ES) at 6,250 feet elevation. Seventy-six species of arthropods were collected and observed there during the Winter 2016 sampling. The species included twenty-seven endemic Hawaiian arthropods, thirty-seven non-indigenous arthropods, and eleven species of unknown status.

Spiders and Mites - Arachnida

Five species of spiders were recorded at the HALE ES site. A non-indigenous hunting spider (*Cheiracanthium mordax* L. Koch) was uncommon, usually found on the surfaces of green leaves or in a retreat formed by curling them into a tube Another non-indigenous species recorded was a comb-footed spider (Steatoda grossa (C. L. Koch)). Similar in appearance to the black widow, this uncommon species was found under logs and rocks. Specimens of the bold jumping spider (*Phidippus audax* (Hentz)) was seen on vegetation. These jumping spiders are easily identified both by their relatively large size and their iridescent green or blue chelicerae. These species have reported from HALE in the past.

Also seen were two endemic spider species, a common crab spider (*Mecaphesa sp. nr. kanakanus* (Karsch)) and a small sheet web spider (family Linyphiidae).

Two species of mites were observed at the HALE ES, their status is unknown.

Collembola - Springtails

Collembola were observed at the HALE site under rocks and on the ground.

Beetles – Order Coleoptera

Nine species of beetles were observed, including an endemic ground beetle (genus *Mecyclothorax*) and a similar-looking, but somewhat smaller, non-indigenous ground beetle, *Trechus obtusus* Erichson.

Other non-indigenous species include two ladybird beetles, three weevils, and a leaf beetle (*Paropsisterna m-fuscum* (Boheman), the latter a pest on Eucalyptus trees.

Flies – Order Diptera

Ten species of flies were seen at the HALE ES. Ten species were from families of common non-indigenous flies (e.g.: blow flies, and bee flies) previously reported from HALE ES.

Fruit fly, fungus gnats, and craneflies of unknown status, complete the species found at the HALE ES.

True Bugs – Orders Heteroptera and Homoptera

Six species of true bugs (Heteroptera) were found, two endemic species from the family Miridae. *Orthotylus coprosmophila* Polhemus, common on *Coprosma*, and *Orthotylus sophoriodes* Polhemus, abundant on *manane*, two endemic species of seed bug, and two non-indigenous species.

Six species of Homoptera were observed, including two Hawaiian endemic species, and four non-indigenous species.

Bees and Wasps – Order Hymenoptera

The seven species of Hymenoptera found near the HALE Entrance Station included five indigenous species, one endemic Hawaiian species, and a species of unknown status.

The native bee found near the HALE ES was a yellow-faced bee (*Hylaeus nivicola* Meade-Waldo) was common on flowering shrubs. Among the non-indigenous species were honey bees, a small wasp, a yellow jacket, and two ants. All have been collected from HALE in the past and are not recent introductions.

Butterflies and Moths – Order Lepidoptera

Lepidoptera were the most diverse group with twenty-one species, seventeen endemic to Hawai'i. The native Hawaiian species include small moths from several families, and three species of larger noctuid moths of the genus *Agrotis*.

The non-indigenous are mostly larger noctuid moth species, but also include two lantana biocontrols and two smaller tortricid moths.

Other Observations

Other arthropods were observed at the HALE ES, including centipedes, millipedes, and sowbugs common in pitfall traps, under rocks, and in decaying vegetation.

A complete list of arthropods observed during this sampling session at the HALE ES site can be found in Appendix C 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.

Programmatic Monitoring Discussion

The arthropods that were found during this sampling are characteristic of the fauna found during previous monitoring. All the non-indigenous species represent species collected in Hawai'i previous to this sampling.

Sampling at the sites was limited by high winds and wet conditions. The abundance of insects was lower during this sampling than in the previous sampling in August 2015, which has been typical for winter sampling at the sites. 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.

There are three main Questions of Interest that are to be answered by this monitoring:

Question 1

What are the characteristic arthropod populations at the DKIST site, the larger HO site (excluding the Air Force site), and along selected areas of the HALE Road Corridor?

The Characteristic arthropods found at the monitored sites can be found in the species lists in the appendices at the end of this report.

Question 2

What adverse impacts can be detected, if any, on characteristic populations of arthropods at the DKIST site, the larger HO site (excluding the Air Force site), and along selected areas of the HALE Road Corridor that may be due to DKIST construction?

There have been only minor adverse impacts on indigenous arthropod species at the monitored sites, largely the result of the removal of native vegetation from the construction site during site excavation. This reduced the size of arthropod populations at the site, however, vegetation is already recovering and it can be expected that native arthropods will return to the site to exploit the renewed plant resources.

Question 3

What non-indigenous invasive arthropod species, if any, are detected at the DKIST site, the larger HO site (excluding the Air Force site), and along selected areas of the HALE Road Corridor during DKIST construction?

There were no new non-indigenous arthropod species detected at the HO and DKIST sites. The non-indigenous species observed were those that have been collected while sampling during previous monitoring sessions.

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APPENDIX A
HO ARTHROPOD SPECIES LIST

A list of Arthropod species detected during the Winter 2016 sampling at the HO site.

Class	Order	Family	Genus	Species	Authority	Status
Arachnida	Araneae	Linyphiidae				unknown
Arachnida	Araneae	Lycosidae	*Lycosa*	*hawaiiensis*	Simon	endemic
Arachnida	Araneae	Thomisidae				endemic ?
CHILOPODA	Lithobiomorpha					unknown
Collembola	Entomobryidae					endemic
Crustacea	Isopoda	Porcellionidae	*Porcellio*	*scaber*	Latreille	non-indigenous
Gastropoda	Stylommatophora	Zonitidae	*Oxychilus*	*alliarius*	(J.S. Miller)	non-indigenous
Insecta	Coleoptera	Carabidae	*Mecyclothorax*	*micans*	(Blackburn)	endemic
Insecta	Coleoptera	Carabidae	*Trechus*	*obtusus*	Erichson	non-indigenous
Insecta	Coleoptera	Chrysomelidae	*Octotoma*	*scabripennis*	Gurein-Meneville	non-indigenous
Insecta	Coleoptera	Coccinellidae	*Coccinella*	*californica*	(Mannerheim)	non-indigenous
Insecta	Coleoptera	Coccinellidae	*Coccinella*	*septempunctata*	Linnaeus	non-indigenous
Insecta	Coleoptera	Coccinellidae	*Diomus*	*notescens*	(Blackburn)	non-indigenous
Insecta	Coleoptera	Coccinellidae	*Harmonia*	*conformis*	(Boisduval)	non-indigenous
Insecta	Coleoptera	Coccinellidae	*Hippodemia*	*convergens*	Gurein-Meneville	non-indigenous
Insecta	Coleoptera	Coccinellidae	*Olla*	*v-nigrum*	(Mulsant)	non-indigenous
Insecta	Coleoptera	Coccinellidae	*Rhyzobius*	*lophanthae*	(Blaisdale)	non-indigenous
Insecta	Coleoptera	Coccinellidae	*Rodolia*	*cardinalis*	(Mulsant)	non-indigenous
Insecta	Coleoptera	Coccinellidae	*Scymnus*	*loewii*	Mulsant	non-indigenous
Insecta	Coleoptera	Ptiliidae				unknown
Insecta	Diptera	Anthomyiidae	*Delia*	*platura*	(Meigen)	non-indigenous
Insecta	Diptera	Calliphoridae	*Calliphora*	*latifrons*	Hough	non-indigenous
Insecta	Diptera	Calliphoridae	*Calliphora*	*vomitoria*	(Linnaeus)	non-indigenous
Insecta	Diptera	Chamaemyiidae	*Leucopis*	*albipuncta*	Zetterstedt	non-indigenous
Insecta	Diptera	Drosophilidae				unknown
Insecta	Diptera	Phoridae	*Megaselia*			non-indigenous
Insecta	Diptera	Sarcophagidae	*Blaesoxipha*	*plinthopyga*	(Wiedemann)	non-indigenous
Insecta	Diptera	Sciaridae				unknown
Insecta	Diptera	Syrphidae	*Allograpta*	*exotica*	(Weidemann)	non-indigenous

Class	Order	Family	Genus	Species	Authority	Status
Insecta	Diptera	Syrphidae	*Eristalis*	*tenax*	(Linneaus)	non-indigenous
Insecta	Diptera	Syrphidae	*Simosyrphus*	*grandicornis*	(Macquart)	non-indigenous
Insecta	Diptera	Syrphidae	*Toxomerus*	*marginatus*	(Say)	non-indigenous
Insecta	Diptera	Syrphidae				non-indigenous
Insecta	Diptera	Tephritidae	*Trupanea*	*cratericola*	(Grimshaw)	endemic
Insecta	Diptera	Tipulidae	*SP1*			unknown
Insecta	Heteroptera	Anthocoridae				unknown
Insecta	Heteroptera	Geocoridae	*Geocoris*	*pallens*	Stål	non-indigenous
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*	*palor*	Ashlock	endemic
Insecta	Heteroptera	Miridae	*Engytates*	*hawaiiensis*	(Kirkaldy)	endemic
Insecta	Heteroptera	Miridae	*Hyalopeplus*	*pelucidus*	Stål	endemic
Insecta	Heteroptera	Miridae	*Taylorilygus*	*apicalis*	(Fieber)	non-indigenous
Insecta	Heteroptera	Miridae	*Trigonotylus*	*hawaiiensis*	(Kirkaldy)	endemic
Insecta	Heteroptera	Nabidae	*Nabis*	*capsiformis*	Germar	non-indigenous
Insecta	Homoptera	Aphididae	*SP1*			non-indigenous
Insecta	Homoptera	Cercopidae	*Clastoptera*	*xanthocephala*	Germar	non-indigenous
Insecta	Homoptera	Cicadellidae	*SP1*			unknown
Insecta	Homoptera	Delphacidae	*Nesosydne*	*sp.*		endemic
Insecta	Homoptera	Pseudococcidae	*SP 1*			unknown
Insecta	Homoptera	Psyllidae	*Acizzia*	*uncatoides*	(Ferris & Klyver)	non-indigenous
Insecta	Hymenoptera	Bethylidae	*Sierola*	*spp.*		endemic
Insecta	Hymenoptera	Braconidae	*Meteorus*	*laphygmae*	Viereck	non-indigenous
Insecta	Hymenoptera	Braconidae				unknown
Insecta	Hymenoptera	Colletidae	*Hylaeus*	*nivicola*	Meade-Waldo	endemic
Insecta	Hymenoptera	Colletidae	*Hylaeus*	*sp.*		endemic
Insecta	Hymenoptera	Ichneumonidae	*Gelis*	*tenellus*	(Say)	non-indigenous
Insecta	Lepidoptera	Cosmopterigidae	*Hyposmocoma*	*sp.1*		endemic
Insecta	Lepidoptera	Noctuidae	*Agrotis*	*baliopa*	Meyrick	endemic
Insecta	Lepidoptera	Noctuidae	*Agrotis*	*epicremna*	Meyrick	endemic
Insecta	Lepidoptera	Noctuidae	*Agrotis*	*giffardi (or mesotoxa)*		endemic
Insecta	Lepidoptera	Noctuidae	*Agrotis*	*xiphias*	Meyrick	endemic
Insecta	Lepidoptera	Noctuidae	*Pseudaletia*	*unipunctata*	(Haworth)	non-indigenous
Insecta	Lepidoptera	Oecophoridae	*Thyrocopa*	*apatela*	(Walsingham)	endemic

Class	Order	Family	Genus	Species	Authority	Status
Insecta	Lepidoptera	Tortricidae				unknown
Insecta	Psocoptera					unknown

APPENDIX B
DKIST ARTHROPOD SPECIES LIST

A list of Arthropod species detected during the Winter 2016 sampling at the DKIST site.

Class	Order	Family	Genus	Species	Authority	Status
Insecta	Heteroptera	Miridae	Engytates	hawaiiensis	(Kirkaldy)	endemic
Insecta	Homoptera	Cicadellidae	SP1			unknown
Insecta	Homoptera	Delphacidae	Nesosydne	sp.		endemic
Insecta	Psocoptera					unknown
Arachnida	Araneae	Lycosidae	Lycosa	hawaiiensis	Simon	endemic
Insecta	Coleoptera	Coccinellidae	Coccinella	septempunctata	Linnaeus	non-indigenous
Insecta	Diptera	Chamaemyiidae	Leucopis	albipuncta	Zetterstedt	non-indigenous
Insecta	Diptera	Sciaridae				unknown
Insecta	Diptera	Syrphidae	Allograpta	exotica	(Weidemann)	non-indigenous
Insecta	Diptera	Syrphidae	Toxomerus	marginatus	(Say)	non-indigenous
Insecta	Heteroptera	Lygaeidae	Nysius	coenosulus	Stål	endemic
Insecta	Heteroptera	Lygaeidae	Nysius	lichenicola	Kirkaldy	endemic
Insecta	Heteroptera	Lygaeidae	Nysius	palor	Ashlock	endemic
Insecta	Homoptera	Aphididae	SP1			non-indigenous
Insecta	Homoptera	Psyllidae	Acizzia	uncatoides	(Ferris & Klyver)	non-indigenous
Insecta	Hymenoptera	Braconidae				unknown
Insecta	Lepidoptera	Noctuidae	Agrotis	baliopa	Meyrick	endemic
Insecta	Lepidoptera	Noctuidae	Agrotis	epicremna	Meyrick	endemic
Arachnida	Araneae	Thomisidae				unknown
Insecta	Coleoptera	Carabidae	Trechus	obtusus	Erichson	non-indigenous
Insecta	Coleoptera	Coccinellidae	Coccinella	californica	(Mannerheim)	non-indigenous
Insecta	Coleoptera	Coccinellidae	Harmonia	conformis	(Boisduval)	non-indigenous
Insecta	Coleoptera	Coccinellidae	Hippodemia	convergens	Gurein-Meneville	non-indigenous
Insecta	Diptera	Calliphoridae	Calliphora	latifrons	Hough	non-indigenous
Insecta	Diptera	Drosophilidae				unknown
Insecta	Diptera	Phoridae	Megaselia			non-indigenous
Insecta	Diptera	Syrphidae	Simosyrphus	grandicornis	(Macquart)	non-indigenous

Class	Order	Family	Genus	Species	Authority	Status
Insecta	Diptera	Tephritidae	Trupanea	beardsleyi	Hardy	endemic
Insecta	Diptera	Tephritidae	Trupanea	limpidapex	(Grimshaw)	endemic
Insecta	Heteroptera	Anthocoridae				unknown
Insecta	Heteroptera	Lygaeidae	Nysius	communis	Usinger	endemic
Insecta	Heteroptera	Miridae	Hyalopeplus	pelucidus	Stål	endemic
Insecta	Heteroptera	Miridae	Taylorilygus	apicalis	(Fieber)	non-indigenous
Insecta	Heteroptera	Nabidae	Nabis	capsiformis	Germar	non-indigenous
Insecta	Hymenoptera	Apidae	Apis	mellifera	Linneaus	non-indigenous
Insecta	Hymenoptera	Ichneumonidae	Barichneumon	californicus	(Ashmead)	non-indigenous
Insecta	Lepidoptera	Cosmopterigidae	Hyposmocoma	sp.1		endemic
Insecta	Lepidoptera	Crambidae	Omiodes	monogona	Meyrick	endemic
Insecta	Lepidoptera	Noctuidae	Agrotis	xiphias	Meyrick	endemic
Insecta	Lepidoptera	Nymphalidae	Vanessa	cardui	(Linnaeus)	non-indigenous
Insecta	Lepidoptera	Oecophoridae	Thyrocopa	apatela	(Walsingham)	endemic
Insecta	Neuroptera	Hemerobiidae	Hemerobius	pacificus	Banks	non-indigenous
Insecta	Neuroptera	Hemerobiidae	Micromus	sp.		endemic
Arachnida	Araneae	Linyphiidae				unknown
CHILOPODA	Lithobiomorpha					unknown
Collembola	Entomobryidae					endemic
Insecta	Coleoptera	Coccinellidae	Olla	v-nigrum	(Mulsant)	non-indigenous
Insecta	Diptera	Calliphoridae	Calliphora	vomitoria	(Linnaeus)	non-indigenous
Insecta	Diptera	Syrphidae				non-indigenous
Insecta	Diptera	Tephritidae	Trupanea	cratericola	(Grimshaw)	endemic
Insecta	Diptera	Tipulidae	SP1			unknown
Insecta	Hymenoptera	Colletidae	Hylaeus	nivicola	Meade-Waldo	endemic

APPENDIX C
HALE ES ARTHROPOD SPECIES LIST

A list of Arthropod species detected during the Winter 2016 sampling at the HALE Entrance Station.

Class	Order	Family	Genus	Species	Authority	Status
Arachnida	Acari		SP1			unknown
Arachnida	Acari		SP2			unknown
Arachnida	Araneae	Clubionidae	Cheiracanthium	mordax	L. Koch	non-indigenous
Arachnida	Araneae	Linyphiidae				unknown
Arachnida	Araneae	Salticidae	Phidippus	audax	(Hentz)	non-indigenous
Arachnida	Araneae	Theridiidae	Steatoda	grossa	(C. L. Koch)	non-indigenous
Arachnida	Araneae	Thomisidae	Mecaphesa	sp. nr. kanakanus	(Karsch)	endemic
CHILOPODA	Lithobiomorpha					unknown
Collembola	Entomobryidae					endemic
Crustacea	Isopoda	Porcellionidae	Porcellio	scaber	Latreille	non-indigenous
DIPLOPODA	Julida	Allajulus	latistriatus		(Curtis)	non-indigenous
Gastropoda	"Slugs"					non-indigenous
Gastropoda	Stylommatophora	Zonitidae	Oxychilus	alliarius	(J.S. Miller)	non-indigenous
Insecta	Coleoptera	Carabidae	Mecyclothorax	spp.		endemic
Insecta	Coleoptera	Carabidae	Trechus	obtusus	Erichson	non-indigenous
Insecta	Coleoptera	Chrysomelidae	Paropsisterna	m-fuscum		non-indigenous
Insecta	Coleoptera	Coccinellidae	Coccinella	septempunctata	Linnaeus	non-indigenous
Insecta	Coleoptera	Coccinellidae	Rhyzobius	lophanthae	(Blaisdale)	non-indigenous
Insecta	Coleoptera	Curculionidae	Gonipterus	scutellatus		non-indigenous
Insecta	Coleoptera	Curculionidae	Otiorhynchus	cribricollis	Gyllenhal	non-indigenous
Insecta	Coleoptera	Curculionidae	Pantomorus	cervinus	(Boheman)	non-indigenous
Insecta	Coleoptera	Staphylinidae				unknown
Insecta	Dermaptera	Forficulidae	Forficula	auricularia	Linnaeus	non-indigenous
Insecta	Diptera	Anthomyiidae	Delia	platura	(Meigen)	non-indigenous
Insecta	Diptera	Calliphoridae	Calliphora	latifrons	Hough	non-indigenous

Class	Order	Family	Genus	Species	Authority	Status
Insecta	Diptera	Calliphoridae	Calliphora	vomitoria	(Linnaeus)	non-indigenous
Insecta	Diptera	Drosophilidae				unknown
Insecta	Diptera	Muscidae	SP1			unknown
Insecta	Diptera	Sarcophagidae	Blaesoxipha	plinthopyga	(Wiedemann)	non-indigenous
Insecta	Diptera	Sciaridae				unknown
Insecta	Diptera	Sepsidae	Sepsis	thoracica	(Robineau-Desvoidy)	non-indigenous
Insecta	Diptera	Syrphidae	Toxomerus	marginatus	(Say)	non-indigenous
Insecta	Diptera	Tipulidae	SP1			unknown
Insecta	Heteroptera	Lygaeidae	Nysius	coenosulus	Stål	endemic
Insecta	Heteroptera	Lygaeidae	Nysius	rubescens	White	endemic
Insecta	Heteroptera	Miridae	Orthotylus	coprosmaphila	Polhemus	endemic
Insecta	Heteroptera	Miridae	Orthotylus	sophoriodes	Polhemus	endemic
Insecta	Heteroptera	Nabidae	Nabis	capsiformis	Germar	non-indigenous
Insecta	Heteroptera	Rhyparochromidae	Brentiscerus	putoni (= australis)	(White)	non-indigenous
Insecta	Homoptera	Aphididae	SP1			non-indigenous
Insecta	Homoptera	Cicadellidae	Nesophrosyne	sp. 1		endemic
Insecta	Homoptera	Delphacidae	Nesosydne	sp. 2		endemic
Insecta	Homoptera	Pseudococcidae	SP 1			unknown
Insecta	Homoptera	Psyllidae	Acizzia	uncatoides	(Ferris & Klyver)	non-indigenous
Insecta	Homoptera	Psyllidae	Ctenarytaina	eucalypti	(Maskell)	non-indigenous
Insecta	Hymenoptera	Apidae	Apis	mellifera	Linneaus	non-indigenous
Insecta	Hymenoptera	Braconidae				unknown
Insecta	Hymenoptera	Colletidae	Hylaeus	nivicola	Meade-Waldo	endemic
Insecta	Hymenoptera	Formicidae	Hypoponera	opaciceps	(Mayr)	non-indigenous
Insecta	Hymenoptera	Formicidae	Linepithema	humile	(Mayr)	non-indigenous
Insecta	Hymenoptera	Ichneumonidae	Gelis	tenellus	(Say)	non-indigenous
Insecta	Hymenoptera	Vespidae	Vespula	pensylvanica	(Saussure)	non-indigenous
Insecta	Lepidoptera	Carposinidae	Carposina	sp. A		endemic
Insecta	Lepidoptera	Carposinidae	Carposina	sp. B		endemic
Insecta	Lepidoptera	Carposinidae?	Carposina?	sp. C?		endemic?
Insecta	Lepidoptera	Cosmopterigidae	Hyposmocoma	sp.1		endemic
Insecta	Lepidoptera	Cosmopterigidae	Hyposmocoma	sp.2		endemic

Class	Order	Family	Genus	Species	Authority	Status
Insecta	Lepidoptera	Crambidae	Eudonia	spp.		endemic
Insecta	Lepidoptera	Crambidae	Mestolobes			endemic
Insecta	Lepidoptera	Crambidae	Udea	heterodoxa	(Meyrick)	endemic
Insecta	Lepidoptera	Crambidae	Udea	pyranthes	(Meyrick)	endemic
Insecta	Lepidoptera	Crambidae	Uresiphita	polygonalis	(Butler)	endemic
Insecta	Lepidoptera	Geometridae	Eupithecia	sp.		endemic
Insecta	Lepidoptera	Geometridae	Scotorythra	rara	(Butler)	endemic
Insecta	Lepidoptera	Lycaenidae	Lampides	boeticus	(Linnaeus)	non-indigenous
Insecta	Lepidoptera	Lycaenidae	Udara	blackburni	(Tuely)	endemic
Insecta	Lepidoptera	Noctuidae	Agrotis	epicremna	Meyrick	endemic
Insecta	Lepidoptera	Noctuidae	Agrotis	giffardi (or mesotoxa)		endemic
Insecta	Lepidoptera	Noctuidae	Agrotis	xiphias	Meyrick	endemic
Insecta	Lepidoptera	Noctuidae	Haliophyle	sp. A		endemic
Insecta	Lepidoptera	Noctuidae	Megalographa	biloba	(Stephens)	non-indigenous
Insecta	Lepidoptera	Noctuidae	Pseudaletia	unipunctata	(Haworth)	non-indigenous
Insecta	Lepidoptera	Pterophoridae	Stenoptilodes	littoralis	(Meyrick)	non-indigenous
Insecta	Neuroptera	Hemerobiidae	Hemerobius	pacificus	Banks	non-indigenous
Insecta	Psocoptera					unknown
Insecta	Siphonaptera	Ceratophyllidae	Nosopsyllus	fasciatus	(Bosc)	non-indigenous