1. Purpose
The Final Environmental Impact Statement for the Thirty Meter Telescope Project (2010, page 3-76 and page 3-195) commits the TMT Observatory Corporation to monitoring arthropods on the alpine cinder cone habitat in the vicinity of the Access Way before, during, and for two years after construction of that portion of the Access Way. Details of this requirement are clarified in the CDUA Appendix E, Arthropod Access Way Monitoring Plan. The monitoring sites include sections of the cinder cone(s) that will likely be impacted by road construction, and sections that should remain relatively undisturbed. The purpose of monitoring in that area of the Access Way is to provide baseline data regarding the presence of arthropods, including both wēkiu bugs and potential invasive species prior to, during, and after construction.

In addition, the Final Environmental Impact Statement requires weekly monitoring for the detection of new invasive plants and arthropods in the vicinity of construction-related worksites during periods of construction activity. Weekly monitoring primarily targets invasive ant and weed species and provides the opportunity to correct any conditions that might promote invasive species introduction or establishment, such as the accumulation of garbage or waste construction material.

The TMT permit, Maunakea Comprehensive Management Plan, and Maunakea Invasive Species Management Plan also require inspection of certain deliveries to mitigate risks of introducing invasive species.

Pursuant to Conservation District Use Permit HA-3568, this report provides results of all Monthly Access Way Monitoring, Weekly Invasive Species Monitoring, and Invasive Species Inspections by a DLNR-approved biologist. OMKM also prepares an annual summary report of arthropod trap findings each calendar year as part of OMKM’s Annual Maunakea Invasive Species Report.

2. Methods
Methods are summarized in the TMT Conservation District Use Application (CDUA) Appendix E and discussed in detail in the Maunakea Invasive Species Management plan, Standard Operation Procedure (SOP) #02: Inspection of Vehicles, Construction Materials, Scientific Equipment, & Supplies; SOP #10: Invasive Invertebrate Early Detection: Surveys of Facilities; and SOP #11: Arthropod Early Detection and
Monitoring. A summary of these approved methods are found in SOP #Y: TMT Specific Instructions (available upon request). Methods and sites chosen for the Access Way Monitoring and other components conform to monitoring methods used throughout the UH Managed Lands, and variations are made only in consultation with OMKM, the State Entomologist (DLNR), and approved by DLNR if substantive changes from the TMT permit.

As part of the monthly biological monitoring four trap types are used to detect and monitor both alien and native arthropods at eleven sites along the route of the TMT Access Way. Three sites are on pahoehoe lava, where wēkiu are unlikely to be found; two are known wēkiu bug sites that are distant from the Access Way construction; and six are known wēkiu sites that may be disturbed by, or are in the vicinity of, Access Way construction. The four trap types include yellow pan traps, ant attractant sticks, baited pitfall traps, and unbaited pitfall traps. The traps target flying insects, invasive ants, crawling insects attracted to protein bait (e.g. wēkiu), and a random assortment of crawling insects, respectively.

Wēkiu bugs are primarily monitored using the baited pitfall traps, which are provisioned with adequate food and water for three to four days. Wēkiu captured in these traps are recorded and released on site. Unbaited pitfall traps contain a liquid preservative that traps and kills insects that fall into them, and are not used in sites likely to have Wēkiu bugs.

During weekly invasive species monitoring two trap types are used. Sticky traps (Hoyhoy cockroach traps) are deployed to ensnare arthropods attracted to the baits (spam, peanut butter, sugar water). The sticky traps are left out for a period of 4-7 days. Baited vials (spam, peanut butter, sugar water) are placed at trap sites for 1 hour periods during weekly monitoring.

During inspections, baited vials may be used to augment the inspection.
Figure 1: TMT Monitoring Sites for monthly monitoring.
Table 1: List of monthly TMT access way monitoring sites.

<table>
<thead>
<tr>
<th>OMKM LocationGroup</th>
<th>SiteCode</th>
<th>SiteNum</th>
<th>SiteID</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Number of Traps</th>
<th>Substrate</th>
</tr>
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<tbody>
<tr>
<td>Poliahu</td>
<td>Poli</td>
<td>07</td>
<td>Poli07</td>
<td>19.82405</td>
<td>-155.48028333</td>
<td>3</td>
<td>Cinder</td>
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<td>Oki</td>
<td>08</td>
<td>Oki08</td>
<td>19.82490000</td>
<td>-155.47691667</td>
<td>3</td>
<td>Cinder</td>
</tr>
<tr>
<td>TMT/SMA</td>
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<td>TMT01</td>
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<td>-155.48087999</td>
<td>4</td>
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<tr>
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<td>TMT02</td>
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<td>-155.48046995</td>
<td>4</td>
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<td>TMT</td>
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<td>TMT03</td>
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<td>4</td>
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<td>TMT/SMA</td>
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<td>04</td>
<td>TMT04</td>
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<td>Cinder</td>
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</table>
Figure 2: Map of TMT weekly monitoring sites. Weekly monitoring sites also include 3 sites 100m downhill from Maunakea visitor information center.
Frequency
Activities included in this report occur at the following frequencies:

Monthly Biological Monitoring
• Pre-Construction Monitoring: June 2019 (CDUA Appendix E and SOP #11)
• Monthly, snow-free season monitoring, during Construction: May, June, July, August, September, October. (CDUA Appendix E and SOP #11)
• Twice per year monitoring for two years post-construction (CDUA Appendix E and SOP #11).

Invasive Species Monitoring
• Weekly during periods of active construction – Invasive Species monitoring methods (SOP #10)
• Inspections of goods and deliveries by a DLNR-approved biologist.
• As needed – Inspections by a DLNR-approved biologist (SOP #02)

Taxonomic Detail
Detailed guidance is provided in the Maunakea invasive species plan regarding the level of detail required in specimen identification. Identification is done to species when possible, however, some Orders or Suborders of arthropods are low risk (e.g. common herbivores) and little more detail is required to dismiss concern. Positive identification of unusual species may be delayed until subject matter experts can be found to review specimens. OMKM’s Maunakea Invasive Species Management Plan, SOP C: Maunakea Invertebrate Threats, Identification, Collection & Processing Guide and SOP D: Maunakea Plant Threats, Identification, Collection & Processing Guide provides the most recent guidance. As of February 2015, OMKM invertebrate guidance specifies:

Arthropod threats of concern on Maunakea are to ecological stability, cultural resources, and human health and safety. Specific arthropod taxa of concern include:

• Ants (Order: Hymenoptera, Suborder: Apocrita, Family: Formicidae) and other taxa that are morphologically similar, i.e. look like ants.
• Wasps (Order: Hymenoptera, Suborder: Apocrita, Families: Vespidae, Pompilidae, & Mutilidae) and other taxa that are morphologically similar, i.e. look like large wasps [Excluded are: Suborder Apocrita, Families: Bradynobeanidae, Falsiformicidae, Rhopalosomatidae, Sapygidae, Scoliidae, Sierolomorphidae, Tiphiiidae].
• Spiders (Order: Aranae)
• Beetles (Order: Coleoptera) [Excluded are Suborder: Polyphaga, Family: Coccinellidae – i.e. ladybugs).
• Centipedes (Order: Scolopendromorpha, Family: Scolopendridae, Genus: Scolopendra).

Specimen identification of the above taxa will be to the lowest practical level when encountered, typically to species. While native species, such as lycosa (wolf) spiders may also occur within these taxonomic divisions, specimen identification will still be to the lowest taxonomic level feasible, typically species. Although in the example of lycosa spiders, as with many other specimens, identification may
frequently be only to genus given difficulty in identifying to the species level. This will facilitate both understanding of invasive species threats and well as native biodiversity.

All other specimens, not in the list above, will be identified to the lowest practical taxonomic level, yet without seeking 3rd party input to resolve identification concerns while maximizing efficacy in processing specimens. This typically, based on experience from 2009 – 2012 with the Bishop Museum, is to genus or species level. Although in instances where the specimen is incomplete, identification is particularly time consuming, or threat is nominal; identification to Family or similar taxonomic level is acceptable.

The Maunakea 'Wēkiu bug working group’ periodically may review and revise these priorities and individual member entomologists consulted regarding merits of level of detailed taxonomic identification when questions arise regarding efficacy.

Prioritization for vegetation implements the weed risk assessment program (http://www.botany.hawaii.edu/faculty/daehler/wra/) in SOP D: Maunakea Plant Threats, Identification, Collection & Processing Guide.

3. Results

Weekly Invasive Species Monitoring Data
Construction did not begin, no weekly invasive species monitoring occurred, and therefore no data has been generated.

Inspections
Seventy-four (74) inspections occurred in July 2019. A single inspection of the Goodfellow Brothers International (GBI) baseyard, representing the “Port Staging Area” for this phase of construction, was conducted prior to initiation of all other inspections. Six (6) inspection certificates identify remediation was required. Two (2) inspection certificates identify that the cargo was rejected for delivery. Seventy-two (71) inspections certificates identify that the cargo was approved for delivery. Refer to the attached inspection log for July 2019 for complete details.

No inspections occurred in August – December 2019.

Biological Monitoring Data

New Threats Identified in 2019:
No new threats to discuss for this report.
4. Specimens

**Collected Specimens:**
Refer to the latest attached specimen list for 2019.

**Observed Specimens:**
Refer to the latest attached data spreadsheet for species observed during 2019.

5. Cumulative Results
Monitoring under CDUP HA-3568 (approved September 2017) began with pre-construction monitoring in June 2019. Additional details will be added once construction begins.

**Threats Identified, Cumulative:**
No new threats identified.

**Wēkiu Bug results, Cumulative**
“Trap Day” or wēkiu bugs per trap day also known as "capture rate" is calculated with the following formula: (Total number of bugs/ total number of traps) / number of trap days.
Table 2. Wēkiu Bug Results, Cumulative

<table>
<thead>
<tr>
<th>Date</th>
<th>Access Way Glaciated Lava Sites</th>
<th>Access Way Cinder Cone Sites</th>
<th>Cinder Cone Control Sites</th>
<th>Days traps set</th>
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<tr>
<td></td>
<td>TMT01</td>
<td>TMT02</td>
<td>TMT03</td>
<td>TMT04</td>
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<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
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<tr>
<td>Captures per Trap Day</td>
<td>0</td>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<td>Captures per Trap Day</td>
<td>N/A</td>
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<td></td>
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<td>August 2019</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<td>N/A</td>
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<td>December 2019</td>
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<tr>
<td>Captures per</td>
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<tr>
<td>Trap Day</td>
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<td></td>
<td>N/A</td>
<td>N/A</td>
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</tr>
</tbody>
</table>
Species List
Refer to the attached spreadsheet for list of species found during 2019 and in previous years.

6. Discussion
In 2019 no construction activity occurred. Construction was anticipated to begin in July 2019 and thus pre-construction monitoring took place in June 2019 and various inspections of goods and materials occurred prior to departing for Maunakea. Access to the TMT site was not possible once the start of construction was announced and so no weekly monitoring occurred.

No new threats to discuss at this time.

Monthly monitoring could not be conducted due to protest activities blocking access to the summit.

Regular monthly monitoring will proceed on the snow-free months, from May through at least October, once construction has begun.

Weekly monitoring will be initiated when construction activities commence on the summit.

Monitoring Recommendations
No new recommendations at this time.

Invasive Species Prevention Recommendations
No new recommendations at this time.

7. Attachments
Spreadsheet 01: Current, 2019, spreadsheet for arthropod monitoring activities on UH-Managed Maunakea lands

Spreadsheet 02: Cumulative species list for TMT-related biodiversity and invasive species monitoring.

Spreadsheet 03: Current, 2019, inspection log spreadsheet for all inspections associated with deliveries to UH-Managed Maunakea lands.

8. Bibliography


University of Hawaiʻi at Hilo. 2010. Final Environmental Impact Statement: Volume 1 – Thirty Meter Telescope Project. [PDF]

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University of Hawaiʻi at Hilo. 2010. Final Environmental Impact Statement: Volume 3 – Appendices – Thirty Meter Telescope Project. [PDF]


[Released: 13 January 2020]