

UPDATED FIELD RECONNAISSANCE OF THE TMT DEVELOPMENT SITE

At the request of the TMT Observatory Corporation, ASM Affiliates conducted an updated archaeological reconnaissance as well as a Botanical Survey of the 5-acre development site and graded access road associated with the proposed construction of the Thirty Meter Telescope (TMT) within the astronomy precinct of the Mauna Kea Science Reserve (MKSr), in TMK: (3) 4-4-015:009, Ka'ohē Ahupua'a, Hāmākua District, Island of Hawai'i. The Botanical Survey is attached as a separate document prepared by H.T. Harvey & Associates (Shahin Ansari, Ph.D.). Archaeological fieldwork for the current study was conducted on December 11, 2015 by Robert B. Rechtman, Ph.D., Matthew R. Clark, B.A., Teresa Gotay, M.A., and Lauren Kēpa'a. The purpose of the updated reconnaissance was to identify any constructions that could be interpreted as recent find spots within the proposed development site that were erected subsequent to the initial reconnaissance survey conducted by ASM Affiliates on July 7, 2015. The boundaries of the study area were identified using GPS coordinates provided by TMT Observatory Corporation, and were clearly marked by pins in the field. As a result of the survey, the five constructions identified during the previous fieldwork (Ahu 1, Ahu 2, Ho'okupu Spot 1, Ho'okupu Spot 2, and Rock Stack 1) were relocated, and one new construction was identified (Rock Stack 2). Rock Stack 2 appears to have been constructed recently, and could be interpreted as a potential new find spot. The location of the newly identified construction is shown in Figure 1 (and attached .kml file), and its description and GPS coordinates are presented below.



Figure 1. Google Earth™ image showing locations of the five previously identified constructions in addition to the newly identified construction relative to the development site.

ROCK STACK 2

A rock stack consisting of a few rocks assembled around a ti leaf was observed atop a bedrock outcrop located along the southern boundary of the development area, between boundary corner points 3 and 4 (Figures 2 and 3).

GPS Coordinates (UTM Zone 5N NAD 83)

Easting: 240145 / Northing: 2194758



Figure 2. Rock Stack 2, view to the southeast.



Figure 3. Rock Stack 2, view to the north.

BOTANICAL SURVEY ATTACHMENT



H. T. HARVEY & ASSOCIATES

Ecological Consultants

January 5, 2016

Bob Rechtman
Vice President
ASM Affiliates
571A E. Lanikaula Street
Hilo, HI 96720

Subject: Report of Findings—Botanical Survey on Mauna Kea

Dear Bob:

Thirty Meter Telescope (TMT) is planning to remove its equipment from the summit of Mauna Kea, on the Big Island of Hawaii, and required baseline archaeological and botanical inventories of the project site. To assist ASM Affiliates in meeting this need, H. T. Harvey & Associates botanist Dr. Shahin Ansari conducted a botanical survey of the approximately 6-acre project site in the Mauna Kea Science Reserve, near the Smithsonian Observatory. This letter report summarizes the findings of the botanical survey, which was performed on December 11, 2015.

The objectives of the botanical survey were as follows:

- To identify and document the presence and relative abundance of plant species and vegetation communities found on the project site.
- To record photos and Global Positioning System coordinates of any Mauna Kea silversword (*Argyroxiphium sandwicense* ssp. *sandwicense*), which is the only federally listed endangered plant species found in the alpine vegetation community of the project area.

The botanist walked the project site and documented all observed plant species. Clear, dry, and sunny conditions with moderate to high winds prevailed during the survey period. The terrain undulates markedly in most parts of the project site, with cinder and lava covering the ground surface. The plants observed and recorded during the survey reflect the season (“rainy” versus “dry”) and the environmental conditions at the time of the survey.

No plant species that are state or federally listed as threatened, endangered, or candidates for listing (USFWS 2015), nor any rare native Hawaiian plant species, were observed on the project site during the survey. Six plant species were recorded (Table 1). Of these, three are endemic, one is indigenous, and two are introduced to the Hawaiian Islands (Table 1). The plant community at the project site can be described as alpine stone desert with extremely low plant density (Figure 1). The few scattered plants found were restricted to the base of rocky outcrops, where some soil and moisture accumulates and plants are somewhat protected from wind. Although

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scattered sparsely throughout the project site, Hawaiian bentgrass (*Agrastis sandwicensis*) was the most common of the six observed species. Only a few individuals of the remaining five species were observed on the site.

Project-related disturbances, such as removal of equipment from the project site, are not expected to have a significant adverse impact on any plant species that is state or federally listed as threatened or endangered, or on species that are candidates for listing, or on other species of concern. However, given the naturally low abundance of plants and the harsh climatic conditions for plant recruitment and establishment, H. T. Harvey & Associates recommends that, wherever possible, the project should avoid causing disturbance of established native plants (i.e., those identified as indigenous or endemic in Table 1) on the project site.

Table 1. Plant Species Observed

Scientific Name and Author	Common Name	Status ¹	Qualitative Relative Abundance on Site ²
<i>Ferns and Fern Allies</i>			
Aspleniaceae			
<i>Asplenium adiantum-nigrum</i> L.	'Iwa 'Iwa	I	R
<i>Asplenium trichomanes</i> L. ssp. <i>densum</i> (Brack.) W. H. Wagner	Olali'i	E	R
<i>Monocots</i>			
Poaceae			
<i>Agrostis sandwicensis</i> Hillebr.	Hawaiian bentgrass	E	U
<i>Trisetum glomeratum</i> (Kunth) Trin.	Pili uka, mountain pili	E	R
<i>Dicots</i>			
Asteraceae			
<i>Conyza bonariensis</i> (L.) Cronquist	Hairy horseweed	X	R
<i>Taraxacum officinale</i> W. W. Weber ex F. H. Wigg.	Common dandelion	X	R

Notes: The plant names are arranged alphabetically by family, then by species, into each of three groups: ferns and fern allies, monocots, and dicots. The taxonomy and nomenclature of ferns and fern allies is in accordance with Palmer (2003) and Evenhuis and Eldredge (2011). The flowering plants are in accordance with Wagner et al. (1999); recent name changes are those recorded in Wagner and Herbst (1999) and Wagner et al. (2012).

¹ Status designations: E = endemic, occurring only in the Hawaiian Islands; I = indigenous, occurring naturally in the Hawaiian Islands but also elsewhere in the world; X = introduced or alien (all those plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact (i.e., Cook's arrival in the islands in 1778).

² Qualitative Relative Abundance on Site: U = uncommon, scattered sparsely throughout the area or occurring in a few small patches; R = rare, only a few isolated individuals in the survey area.



Figure 1. Alpine Stone Desert Community with Extremely Low Density of Plants (Circled in Red) at the Project Site

References

- Evenhuis, N. L., and L. G. Eldredge. 2011. Taxonomic changes in Hawaiian ferns and lycophytes. *Records of the Hawai'i Biological Survey for 2009-2010*. Bishop Museum Occasional Papers 110:11-16.
- Palmer, D. D. 2003. *Hawaii's Ferns and Fern Allies*. University of Hawai'i Press, Honolulu.
- [USFWS] U.S. Fish and Wildlife Service. 2015. ECOS: Environmental Conservation Online System, Listed Species Believed to or Known to Occur in Hawai'i. <http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=HI&status=listed>. Accessed December 18, 2015.
- Wagner, W. L., and D. R. Herbst. 1999. Supplement to the manual of the flowering plants of Hawai'i. Pages 1855-1918 in W. L. Wagner, D. R. Herbst, and S. H. Sohmer, editors, *Manual of the Flowering Plants of Hawai'i*. University of Hawai'i Press and Bishop Museum Press, Honolulu.
- Wagner, W. L., D. R. Herbst, N. Khan, and T. Flynn. 2012. *Hawaiian Vascular Plant Updates: A Supplement to the Manual of the Flowering Plants of Hawai'i and Hawai'i's Ferns and Fern Allies*. Version 1.3.
- Wagner, W. L., D. R. Herbst, and S. H. Sohmer. 1999. *Manual of the Flowering Plants of Hawai'i*. Two volumes. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu.

Please feel free to contact me (sansari@harveyecology.com; 808.499.9092) if you have questions or concerns regarding this letter report. Thank you for giving H. T. Harvey & Associates the opportunity to offer ecological services in support of your project.

Sincerely,



Shahin Ansari, Ph.D.
Project Manager, Senior Plant Ecologist