

Exhibit B.19i

<http://www.malamamaunakea.org/environment/flora>

Flora

Botanist James Macrae and Party Travel to Mauna Kea 1825

The Silver Sword Plant

*The last mile was destitute of vegetation except one plant of the Synginesia tribe, in growth much like a Yucca, with sharp pointed sliver coloured leaves and green upright spike of three or four feet producing pendulous branches with brown flowers, truly superb, and almost worth the journey of coming here to see it on purpose.* From [Maly, 2005](#), page 108

At lower elevations such as at Halepōhaku, native vegetation is primarily clumps of Māmane (*Sophora chrysophylla*) trees interspersed with occasional patches of grass or shrubs along with open areas of bare soil or rocky outcroppings. Understory plants tend to be concentrated under the Māmane trees, where they receive fog drip, an important source of moisture in this dry environment. Common grasses include two native grasses, alpine hairgrass (*Deschampsia nubigena*) and pili uka (*Trisetum glomeratum*), and an introduced needlegrass *Nassella cernua*. Shrub species include 'Āheahea (*Chenopodium oahuense*), Pūkiawe (*Leptecophylla tameiameiae*) and Nohoanu (*Geranium cuneatum*).

Three native fern species, Kalamoho (*Pellaea ternifolia*), 'Iwa'iwa (*Asplenium adiantum-nigrum*), and Olali'i (*Asplenium trichomanes*), are also found among the rocks, along with Hawai'i catchfly (*Silene hawaiiensis*), a Federally Threatened Species. Two native mint vines, little-leaf stenogyne (*Stenogyne microphylla*) and Mā'ohi'ohi (*Stenogyne rogosa*) are found climbing into the canopy of some Māmane trees.

Traveling up the mountain towards the summit, the vegetation decreases in diversity, density, and size. Alpine plant communities on Maunakea begin just above the treeline, at approximately 9,800 ft (2,987 m). Alpine plant communities can be divided into shrublands, grass desert, and stone desert; with shrublands found just above treeline and stone desert at the summit.

Alpine shrublands are inhabited mainly by low-lying shrubby species such

as Pūkiawe (*Leptecophylla tameiameiae*), 'Ōhelo (*Vaccinium reticulatum*), and Mauna Kea dubautia (*Dubautia arborea*); scattered grasses such as Hawaiian bentgrass (*Agrostis sandwicensis*), and Pili uka (*Trisetum glomeratum*); and native ferns such as Douglas' bladderfern (*Cystopteris douglasii*), Kalamoho (*Pellaea ternifolia*), 'Olali'i (*Asplenium trichomanes*), and 'Iwa'iwa (bird's nest ferns, *Asplenium adiantum-nigrum*). Historically common, but now rare species found in this community include 'Āhinahina (the Mauna Kea silversword, *Argyroxiphium sandwicense* ssp. *sandwicense*), lava dubautia (*Dubautia ciliolata* ssp. *ciliolata*), 'Ōhelopapa (Hawaiian strawberry, *Fragraria chiloensis*), 'Ena'ena (*Pseudognaphalium sandwicense*), Nohoanu (*Geranium cuneatum* ssp. *hololeucum*), and alpine tetramolopium (*Tetramolopium humile* ssp. *humile* var. *humile*).

Lichens and mosses dominate the alpine stone desert in terms of diversity and abundance. Lichens, which are not really plants, but instead are a symbiotic relationship between a fungus and either a green alga or a blue green bacterium, or both, are found throughout the summit of Maunakea. The highest densities and diversity of lichens tend to be found on andesite (lava) rocks, in north and west facing protected locations away from direct sun exposure. Areas to the west of the major cinder cones have a low density and diversity of lichens, most likely due to a rain shadow effect created by the cinder cones.

A survey of lichens on the summit of Maunakea identified 21 species (plus five possible other species). Around half of the lichen species found on Maunakea are endemic (found only in Hawai'i), two of which (*Pseudephebe pubescens* and *Umbilicaria pacifica*) are limited to Maunakea alone. The remaining species are indigenous to the Hawaiian Islands. *Lecanora muralis*, the most abundant lichen on Maunakea, is found throughout the summit on all substrate types including cinders and colluvial material on the cinder cones up to the summit of Pu'uwēkiu. Other common species on the summit are *Lecidea skottsbergii* and *Candelariella vitellina*, both of which are found on rocks "larger than a small fist".

For more information refer to the [Environmental Factors](#) page. For citations please refer to the [CMP](#), pg 5.24-5.41. A complete inventory of the vegetation of University managed lands is available in Dr. Grant Gerrish's 2013 report and accompanying data "[Botanical Baseline Survey \(2011\) of the University of Hawaii's Managed Lands On Mauna Kea](#)".

