THE STATUS OF THE MAUNA KEA SILVERSWORD

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The Mauna Kea silversword was first brought to the attention of the scientific community through the efforts of Scottish botanist James Macrae. Macrae ascended Mauna Kea from Laupāhoehoe in 1825 and at a point near the summit, after walking three miles over sandy pulverized lava, noted, "The last mile was destitute of vegetation except one plant of the Syginesia tribe, in growth much like a Yucca, with sharp pointed silver couloured 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" (Wilson 1922, p. 54). Specimens of these 'truly superb' plants reached De Candolle and in 1836 were christened Argyroxiphium sandwicense DC.

Early in 1834, David Douglas ascended Mauna Kea and observed the same species, specimens of which reached W. J. Hooker and were initially given the name Argyrophyton douglasii Hook. (1837a), but Hooker very soon accepted De Candolle's earlier name for the taxon (Hooker 1837b).

The species was again collected on Mauna Kea by Charles Pickering in 1841 as part of the U. S. South Pacific Exploring Expedition (cf. Pickering 1876, Keck 1936). Pickering also collected material he presumed to belong to the same taxon on Haleakalā, Maui, but this was considered distinct by Asa Gray and was named Argyroxiphium macrocephalum (cf. Gray 1852, Pickering 1876).

Both Pickering and Douglas observed Argyroxiphium on Mauna Loa and Mauna Kea, Hawai'i and considered them to be the same taxon (Pickering 1876, Wilson 1922). There appears little doubt, however, that the plants they saw on Mauna Loa belong to a similar, yet distinctive taxon that was not named until 1957. The Mauna Loa plants are now known as Argyroxiphium kauense (Rock & Neal) Deg. It would have been easy for Pickering and Douglas to confuse the Mauna Kea and Mauna Loa taxa if one or both of the plants were in a vegetative state.

In 1892, Alexander considered the silversword to be nearly extinct along Humu'ula Trail, the southern approach to the summit of Mauna Kea. A single plant was seen in this area by Neal in 1935 (Hart & Neal 1940). Bryan noted a few patches of silverswords on the northeast flank of Mauna Kea at about 10,000 feet elevation in 1922. Skottsberg (1926) reported seeing dead silverswords on the west side of Mauna Kea at about 10,000 feet elevation. On the northwest flank of the mountain Neal also saw dead silversword plants (Hart & Neal 1940). Archeologist Pat McCoy (pers. comm.) has found silversword plants preserved in situ at about 11,800 feet elevation on the southern slopes of Mauna Kea. Today, it is generally

accepted that the only remaining natural population of the Mauna Kea silversword is limited to about 35 individuals in the upper portion of the Wailuku River drainage on Mauna Kea.

Thus, a species that was once locally dominant and whose distribution formerly encircled the upper flanks of Mauna Kea (Figure 1) is now severely restricted. Notwithstanding total elimination of feral animal activity in its habitat, extinction of this magnificent product of insular evolution appears imminent.

Perhaps some of the apathy towards the fate of the Mauna Kea silversword has stemmed from its frequent taxonomic confusion with the Haleakalā silversword. The two had been considered separate species until Hillebrand (1888) combined the Haleakalā silversword, Argyroxiphium macrocephalum Gray, with the Mauna Kea silversword, A. sandwicense, treating the former as a variety of the latter. Keck (1936) relegated A. macrocephalum to synonymy under A. sandwicense, stating that the characters used to separate the taxa were not reliable. Degener (1930) originally considered these taxa distinct at the species level, then, swayed by Keck's monograph, reduced A. macrocephalum to synonymy under A. sandwicense (Degener 1936). More recently, he reaffirmed his earlier conviction that they should be considered separate species (Degeners & Sunadas 1976). In his recent checklist St. John (1973) considered A. macrocephalum a synonym of A. sandwicense.

No new information bearing on this taxonomic problem had been sought until Meyrat began comparing these and other populations of Argyroxiphium in 1977 (Meyrat 1982). He used a morphometric approach to assess the variation of 45 characters among populations. He found that the Mauna Kea and Haleakalā silverswords were significantly different in 18 of these characters (Table 1). In fact, a consideration of three features allowed complete resolution of all four taxa included in his study (Figure 2). The number of ray florets per head (Figure 3) and the proportions and shape of the inflorescence (Figure 4) are among the most reliable and practical features that can be used to distinguish the Mauna Kea and Haleakalā silverswords. In view of the degree of differentiation and geographical isolation of these taxa, we are proposing that they be formally recognized at the level of subspecies.

The inescapable conclusion is that the Mauna Kea and Haleakalā silverswords are similar, yet unique products of evolution. Conservation efforts directed at either of these taxa must take this into account. Ample evidence now exists (Carr & Kyhos 1981) that genetic contamination through hybridization would be the result of planting these or any other forms of Argyroxiphium within cross-pollinating distance of one another. Thus, extreme caution must be exercised in any recovery program involving transplantation or seeding of silverswords.

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TABLE 1. Characters that differ significantly between Mauna Kea and Haleakalā silverswords as determined by the F test from one way analysis of variance.

Character	F Calculated	Degrees of Freedom	Level of Significance
Plant height excluding branched plants	15.7721	1, 56	***
Rosette diameter	26.8872	1, 72	***
Inflorescence length			
including branched plants	7.8618	1, 61	**
excluding branched plants	33.7284	1, 55	***
Inflorescence width	16.3924	1, 48	***
Leaf length	4.1113	1, 73	*
Leaf width	25.2133	1, 73	***
Capitulum diameter	11.5901	1, 44	**
Number of ray florets per capitulum	26.3980	1, 44	***
Number of disk florets per capitulum	12.1072	1, 44	**
Peduncle length	7.2074	1, 45	*
Peduncle width	7.0565	1, 44	*
Receptacle diameter	34.9928	1, 44	***
Number of peripheral receptacular bracts per capitulum	15.0202	1, 44	***
Number of main veins per ligule	7.6906	1, 43	***
Ray floret tube length	5.5789	1, 44	**
Ray achene length	7.4286	1, 44	**
Disk floret style length	2.7403	1, 44	*
Stamen filament length	8.0963	1, 44	**

NOTE: * = probability of larger F value is lower than 0.05 but higher than 0.01, ** = probability of larger F value is lower than 0.01 but higher than 0.001, *** = probability of larger F value is lower than 0.001.

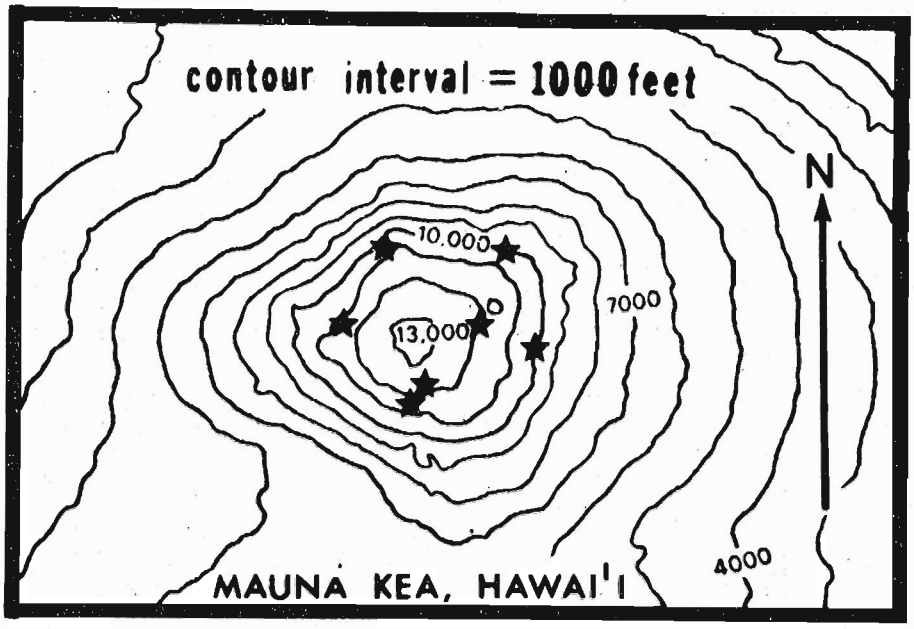

FIGURE 1. Former distribution of Mauna Kea silversword on the upper slopes of Mauna Kea, Hawai'i (see text).

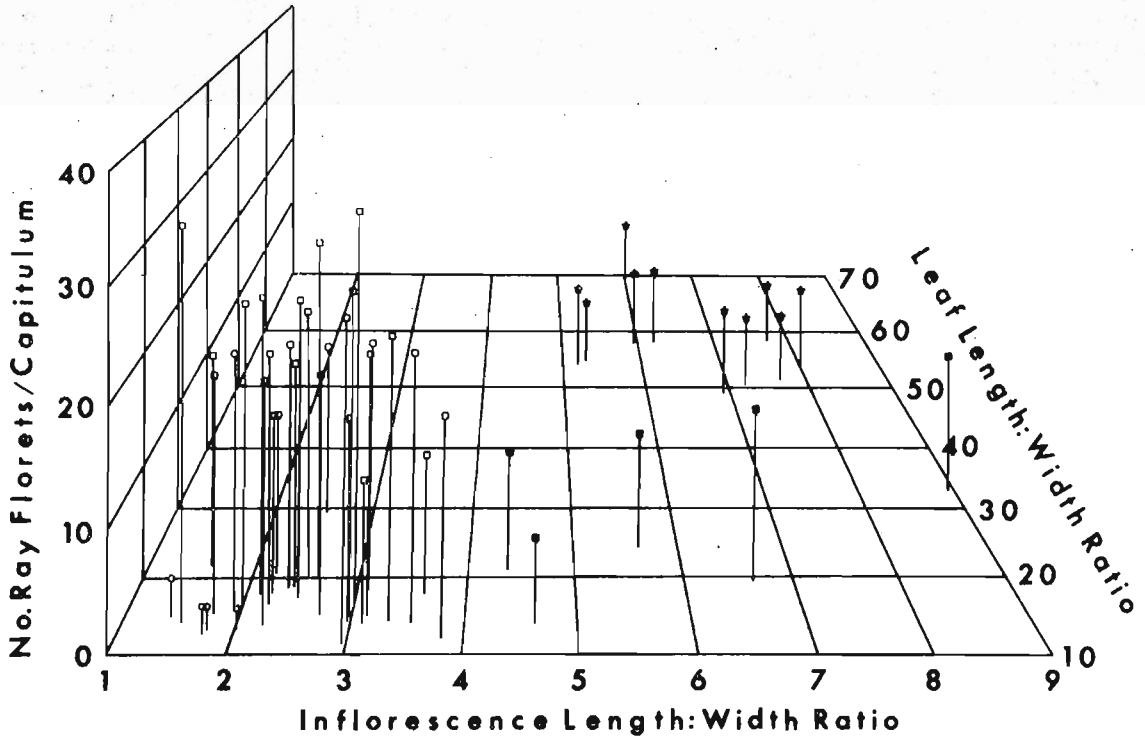

FIGURE 2. Scatter diagram of the relationship among inflorescence length: width ratio, leaf length:width ratio, and number of ray florets per capitulum of Argyroxiphium taxa. Open circles, East Maui greensword; stars, Ka'u silversword; open squares, Haleakalā silversword; solid squares, Mauna Kea silversword.

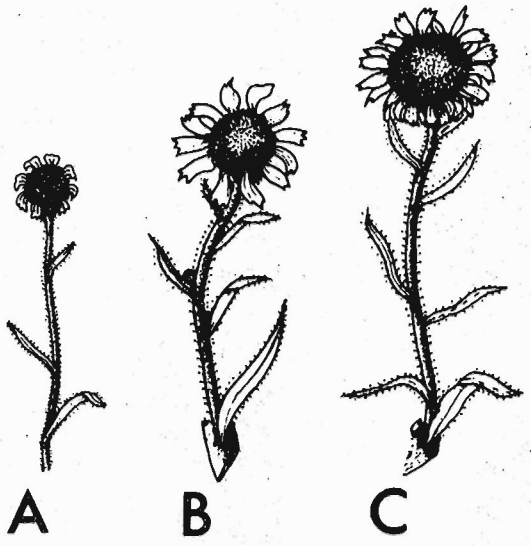

FIGURE 3. Capitulum and peduncle features of three taxa of Argyroxiphium. A, Ka'u silversword; B, Mauna Kea silversword; C, Haleakalā silversword. Reduced to 1/4.

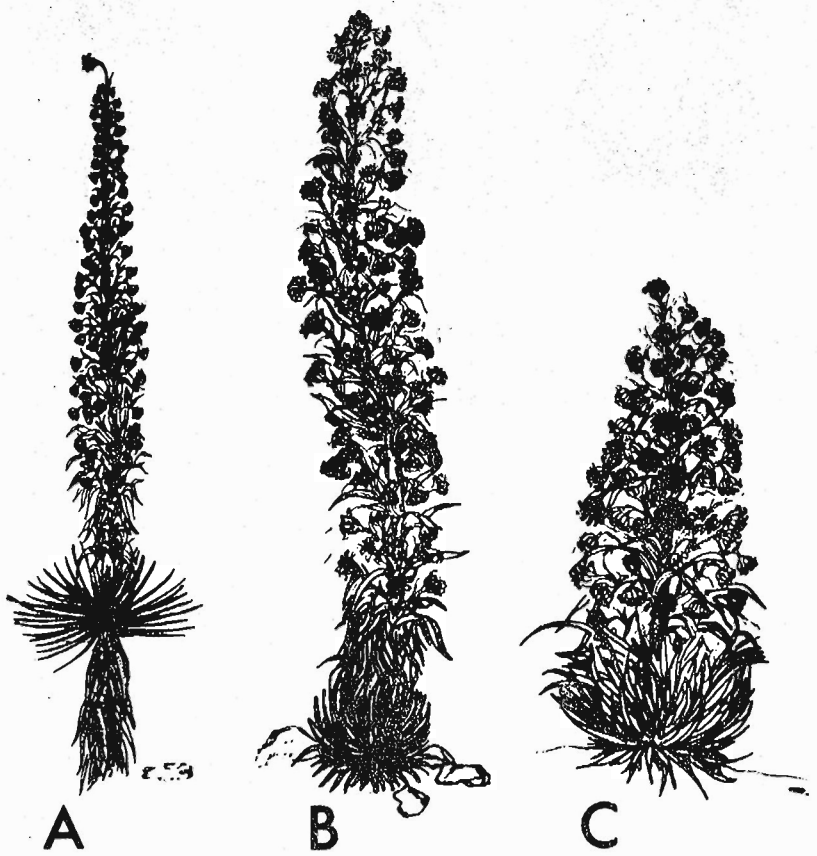

FIGURE 4. Habit of three taxa of Argyroxiphium. A, Ka'u silversword; B, Mauna Kea silversword; C, Haleakalā silversword. Note inflorescence proportions and shape. Reduced to 1/25.