Downloaded from by guest on April 17, 2024. Copyright 2003

Propagation Protocol for Endangered MAUNA LOA SILVERSWORD

Argyroxiphium kauense (Asteraceae)

| Patty Moriyasu and Robert Robichaux |

KEY WORDS
reintroduction, Hawaiian plants, container plants

NOMENCLATURE
Carr (1985)

The Mauna Loa silversword, *Argyroxiphium kauense* (Rock and Neal) Degener and I. Degener (Asteraceae), is one of Hawai'i's highest-profile endangered plants and exemplifies the challenges confronting Hawai'i's endemic flora. The Mauna Loa silversword formerly was prevalent in open mesic and wet ecosystems between 1500 and 2700 m (4920 and 8860 ft) elevation on Mauna Loa Volcano and may have occurred on Hualālai Volcano on the island of Hawai'i (Carr 1985; USFWS 1996). Primarily because of the impact of nonnative ungulates, such as goats, mouflon sheep, and pigs, the Mauna Loa silversword has suffered a severe decline in distribution and abundance and is now limited to 3 small remnant populations totaling fewer than 700 plants.

The Mauna Loa silversword is a long-lived, rosette shrub with silvery, dagger-shaped leaves. Most plants produce a single basal or elevated rosette, which may grow for 20 to 30 y, and may reach 40 to 70 cm (1.3 to 2.3 ft) in diameter before flowering (USFWS 1996). At maturity, the rosette produces a single large compound inflorescence containing 100 to 350 heads (or capitula), each with 50 to 220 flowers (Carr 1985). The rosette dies after flowering, such that plants with a single rosette are strictly monocarpic. The plants appear to be self-incompatible (Carr and others 1986; USFWS 1996).

An informal public/private partnership has recently initiated a large-scale reintroduction effort for the Mauna Loa silversword (Robichaux and others 2000; Robichaux and others 2001). The partnership includes the Volcano Rare Plant Facility, Hawai'i Division of Forestry and Wildlife, National Park

Figure 1. Mauna Loa silversword *(Argyroxiphium kauense)*.
Photo by Marie Bruegmann

Figure 2. Flowering Mauna Loa silversword.

Figure 3. Part of the managed-breeding program, these plants at the Volcano Rare Plant Facility have been cross-pollinated by hand. Harvested seeds are used to produce plants for reintroduction.

Service, Biological Resources Division of the US Geological Survey, US Fish and Wildlife Service, ʻŌlaʻa-Kīlauea Partnership, and Hawaiian Silversword Foundation. The objective of the partnership is to reintroduce 20000 to 25000 plants into intact or restored native ecosystems in multiple protected sites across the historical range. As part of the effort, the partnership has implemented a managed-breeding program, which has enabled it to use many founders from the remnant populations and to control their representation in the reintroduced populations. The partnership also has implemented an outplanting program involving large numbers of seedlings each year. Though rapid progress is being made with the reintroduction effort, nonnative species continue to pose serious threats to its long-term success (Robichaux and others 2001).

Here, we describe the protocol used to propagate Mauna Loa silversword seedlings in large numbers at the Volcano Rare Plant Facility. During the past 3 y, the facility has grown more than 11500 Mauna Loa silversword seedlings for outplanting by the partnership, and thus has produced seedlings at a scale unprecedented for Hawai'i's endangered plant species. The health and vigor of the propagated seedlings have likely contributed to their high survivorship following outplanting, which has exceeded 80% to 90% at most sites over the first 1 to 2 y.

PROPAGATION PROTOCOL

Achenes produced by the managed-breeding program (Robichaux and others 2001) are cleaned to remove remaining floral and inflorescence parts. (Each achene, or dry fruit, contains a single seed.) Cleaning helps to reduce fungal contamination of the achenes in storage. The achenes are placed in plastic bags and stored at about 4 °C (40 °F) in a refrigerator at the facility. Achenes for each maternal line (or maternal founder) are kept in separate, labeled bags. Because of the recency of the reintroduction effort, achene longevity in storage is unknown. Based on our experience to date, achene viability has not declined significantly across many maternal lines for at least the first 2 to 3 y in storage.

Prior to germination, the achenes are soaked overnight in water. The achenes are then sown in labeled bulb pans 20 cm (8 in) in diameter. The number of achenes sown per maternal line each year is determined by the target number of seedlings and by the percent viability of the line. (Achene viability varies across the maternal lines and has ranged from less than 1% to more than 55%.) The achenes are sown on the surface of the medium, which is a 3:1 (v:v) mixture of perlite to vermiculite. The achenes are covered by a thin layer of #2 hen grit, a feed-store product for chickens that has a 3 to 6 mm (0.1 to 0.2 in)

Downloaded from by guest on April 17, 2024. Copyright 2003

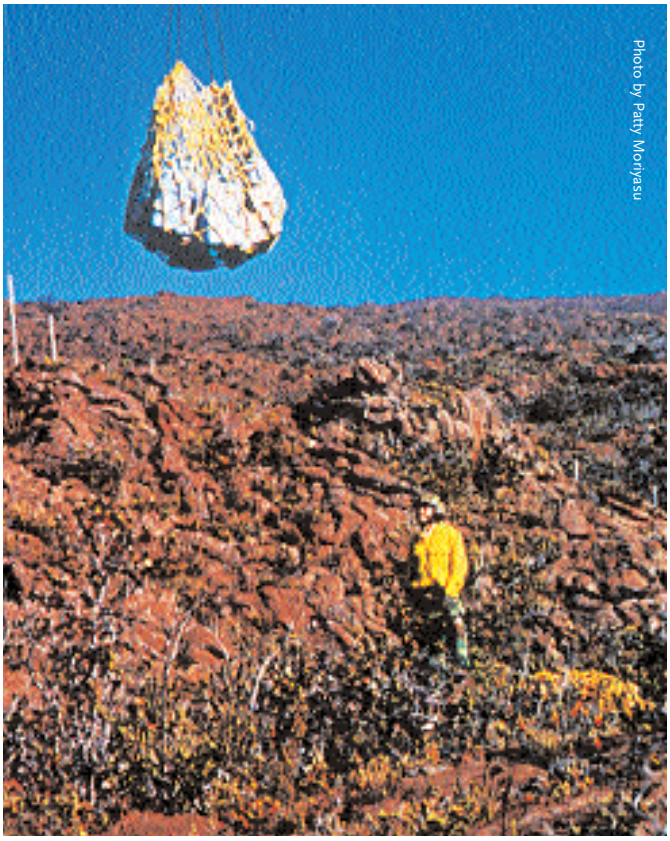

Figure 4. Steve Bergfeld of the Hawai'i Division of Forestry and Wildlife guides a sling-load of Mauna Loa silverswords to an outplanting site.

diameter gravel size. The grit serves as a mulch to prevent the achenes from being disturbed by overhead watering.

Young seedlings are transplanted, typically before they reach 2 to 3 cm (0.8 to 1.2 in) in height, into 7.6-cm (3-in) diameter, labeled pots. The medium differs from that in the germination pans, consisting of a 3:1 (v:v) mixture of black cinder to Sunshine #5 peat seedling mix. The seedlings are hand watered every other day and fertilized twice monthly with a foliar fertilizer (12N:24P_2O_5:24K_2O plus minors). The seedlings are treated with several fungicides used in rotation, both to reduce fungal contamination and to minimize the risk that resistant fungal strains will develop. Specific fungicide recommendations are provided by the University of Hawai'i Agricultural Extension Service.

Seedlings are typically grown for 6 to 9 mo prior to outplanting, at which time they have reached about 7 to 10 cm (2.7 to 4 in) in height. The seedlings are provided in large numbers to the respective agencies for outplanting into multiple protected sites across the historical range. Because the maternal line of each seedling is tracked throughout the propagation and outplanting effort, it is possible to balance founder representation in the large reintroduced populations.

ACKNOWLEDGMENTS

We thank all individuals participating in the public/private partnership, including Ane Bakutis, Steve Bergfeld, Kealii Bio, Marie Bruegmann, Joan Canfield, Tonnie Casey, Elizabeth Friar, Jim Jacobi, Lyman Perry, Tanya Rubenstein, Tim Tunison, and Rick Warshauer. In addition, we thank the US Fish and Wildlife Service, National Park Service, Hawai'i Division of Forestry and Wildlife, Kamehameha Schools, National Wildlife Federation, Tides Foundation (on behalf of Arthur L Canfield), and private donors for generous financial support of the silversword propagation efforts at the Volcano Rare Plant Facility.

REFERENCES

Carr GD. 1985. Monograph of the Hawaiian Madiinae (Asteraceae): *Argyroxiphium, Dubautia,* and *Wilkesia*. Allertonia 4:1–123.

Carr GD, Powell EA, Kyhos DW. 1986. Self-incompatibility in the Hawaiian Madiinae (Compositae): an exception to Baker's rule. Evolution 40:430–434.

Robichaux R, Bakutis A, Bergfeld S, Bio K, Bruegmann M, Canfield J, Friar E, Jacobi J, Moriyasu P, Perry L, Rubenstein T, Tunison T, Warshauer F. 2001. Reintroduction of the endangered Mauna Loa silversword, *Argyroxiphium kauense* (Asteraceae). Abstracts of the Society for Conservation Biology Fifteenth Annual Meeting. p 133.

Robichaux R, Bergfeld S, Bruegmann M, Canfield J, Moriyasu P, Rubenstein T, Tunison T, Warshauer F. 2000. Reintroducing Hawai'i's silverswords. Endangered Species Bulletin 25:22–23.

[USFWS] US Fish and Wildlife Service. 1996. Recovery plan for the Kau silversword, *Argyroxiphium kauense*. Portland (OR): US Fish and Wildlife Service.

AUTHOR INFORMATION

Patty Moriyasu
Volcano Rare Plant Facility
Center for Conservation Research and Training
University of Hawai'i
1115 West Kawailani Street
Hilo, HI 96720
trees@interpac.net

Robert Robichaux
Hawaiian Silversword Foundation
PO Box 1097
Volcano, HI 96785
and
University Distinguished Professor
Department of Ecology and Evolutionary Biology
PO Box 210088
University of Arizona
Tucson, AZ 85721-0088
robichau@u.arizona.edu

Downloaded from by guest on April 17, 2024. Copyright 2003