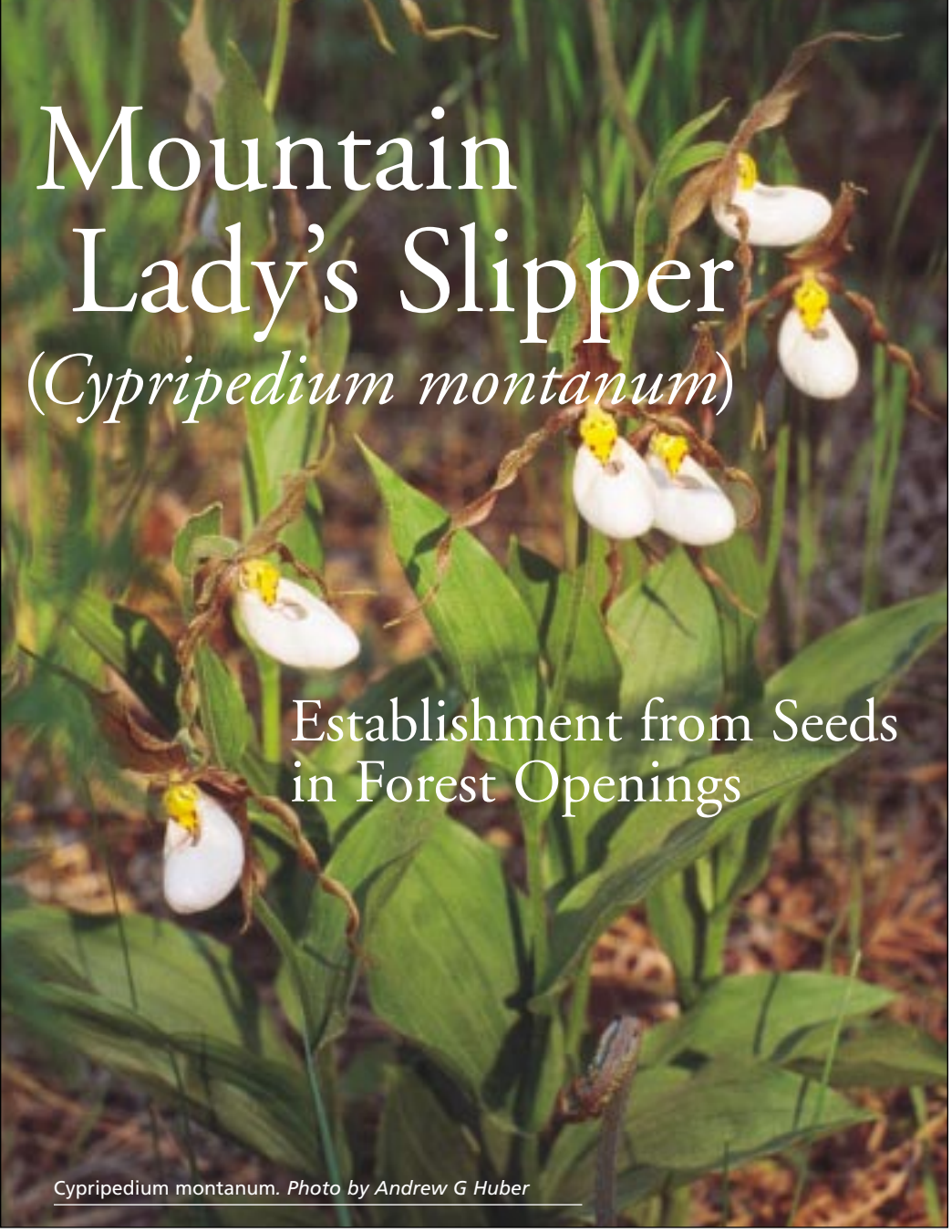
Mountain Lady's Slipper (*Cypripedium montanum*)

Establishment from Seeds in Forest Openings



Cypripedium montanum. *Photo by Andrew G Huber*

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ABSTRACT

Since 1993, mountain lady's slipper (*Cypripedium montanum* Douglas ex Lindley [Orchidaceae]) has been successfully established in the forest of the Grande Ronde Overlook Wildflower Institute Serving Ecological Restoration (GROWISER). Emergence in the field generally requires 2 to 3 y and seems to be associated with the level of tree canopy and decomposing forest litter. More plants appear to be established when seeds are mixed with a carrier such as forest soil, sugar, or cracked corn prior to scattering. Plots have been established annually since late autumn 1998 to investigate seeding techniques and the orchid's life cycle, particularly time until flowering.

KEY WORDS: GROWISER, life cycle, orchid, planting, propagation

NOMENCLATURE: ITIS (2002)

The flower of mountain lady's slipper (*Cypripedium montanum* Douglas ex Lindley [Orchidaceae]) is awe inspiring because of its large size, brilliant white color, and wooden shoe shape (Figure 1). Its range extends from southeastern Alaska to California and Colorado (Cribb 1997). Like many native orchids, however, its numbers are declining from loss of habitat and human predation (Cash 1991). Efforts at reestablishment are severely limited because its ecology and reproductive biology have not been well documented. Other terrestrial orchids are extremely slow growing, at first parasitically underground with mycorrhizae, then photosynthetically several years before flowering (Rasmussen 1995). An excellent review of the species, with respect to its management, has been made by Seevers and Lang (1998). They admit, however, that much of what is supposed about the life cycle of *C. montanum* comes from research on other *Cypripedium* species. Five *Cypripedium* species, for example, were germinated in natural conditions, and produced green aerial leaves during their third year (Curtis 1943). He also found that *C. acaule* Ait. flowered 8 to 10 y after germination, and *C. reginae* Walt. after 14 to 16 y. Others found that it took 13 to 16 y before *C. calceolus* L. flowered (Harper and White 1974; Wells 1981), and some *C. fasciculatum* Kellogg ex S. Wats. plants were still vegetative after 12 y of growth (Harrod 1993).

THE STUDY

At Grande Ronde Overlook Wildflower Institute Serving Ecological Restoration (GROWISER) in northeastern Oregon, a long-term study has been set up to learn the orchid's life cycle and possible propagation techniques. My study site is a 40 ha (100 ac) forest on a north-facing slope at 1024 to 1085 m (3360 to 3560 ft) elevation. The forest overstory consists mainly of 5 species: grand fir (*Abies grandis* (Douglas ex D. Don) Lindley [Pinaceae]), Douglas-fir (*Pseudotsuga menziesii* (Mirbel) Franco [Pinaceae]), western larch (*Larix occidentalis* Nuttail [Pinaceae]), ponderosa pine (*Pinus ponderosa* P. & C. Lawson

Photo by Andrew G Huber

Figure 1 • *Mountain lady's slipper plant and flower.*

[Pinaceae]), and Rocky Mountain maple (*Acer glabrum* Torrey [Aceraceae]). The soil phase is Tamara (Tolo), a deep loess, covered by a duff layer ranging in depth from 1.9 to 5.1 cm (0.75 to 2.0 in) (Allen 2001). Several hundred mountain lady's slipper plants are scattered across GROWISER's 40 ha (100 ac) forested north slope. Canopy closure, measured as percent of midday shade, for the existing mature mountain lady's slipper plants ranged from 50% to 65% and averaged 56% on 6 June 2001 (Allen 2001). The site's annual average precipitation is 58 cm (23 in), average minimum daily temperature in January is –6 C (21 °F), and the average maximum in July is 29 °C (85 °F).

Mountain lady's slipper seeds, from several hundred resident plants, were first harvested in late August of 1993, air dried, and planted in early November. In 1995 and 1996 it appeared that new seedlings were growing in some of the areas where seeds were distributed (Figure 2). Because germination seemed sooner than for the *Cypripedium* species reported by Curtis (1943), I planned a study to determine how long it takes for plants to emerge from soil and eventually flower. In 1997, potential planting sites lacking mountain lady's slipper plants, under a tree canopy of approximately 60%, and with limited ground vegetation were chosen. On 7 and 8 November 1998, I established 154 plots, approximately 1 m^2 (3.3 ft^2) in size. *Cypripedium* seeds are very small, very light, and are easily blown in the wind. Capsules often contain thousands of seeds; Harrod and Knecht (1994) found an average of 3874 seeds per capsule of *C. fasciculatum*. To facilitate its distribution over the plots, I mixed seeds with one of three carriers: cracked corn, sugar, or forest soil. The control treatment consisted of seeds broadcast without a carrier. Each plot was sprinkled with 4 capsules (fruits) of seeds mixed with approximately 0.5 l (1 pt) of carrier. Altogether, I installed 38 plots of each carrier and 40 plots with seeds alone. On 6 November 1999, I seeded 50 more plots using the same carriers and methods (12 plots with each of the carriers and 14 without).

RESULTS AND DISCUSSION

When orchid seeds germinate, the first root exits the seed to form a parasitic relationship with an underground fungus. Usually, leaves do not emerge until 1.5 y after germination. A total of 33 seedlings emerged during May and June of 2000 from plots established in 1998. The plants usually emerged with 2 leaves; each leaf grew to about 2 to 3 cm (1 in) in length by the end of the first summer. Seedlings were initially very weak, supported mainly by the ground surface. For their future identification, reference stakes were placed beside each new plant. In spring 2001, the 1998 plots produced 49 more new plants. In the plots planted in 1999, however, no plants emerged in 2001.

All 3 carriers appeared to work better than the control: by the third spring (2001), seeds distributed in 1999 mixed

with forest soil produced 29 seedlings, sugar 21, cracked corn 20, but only 12 plants in plots sown without a carrier.

This ongoing study (additional plots were installed in 2000 and 2001) is intended to eventually provide more information on seeding techniques, seedling survival, and timing of the orchid's morphological stages. A few general observations, however, may be useful to growers while more data are being collected. The lack of seedling growth in the 1999 plots may have been a result of both weather and site location. The summer of 2000 was extremely dry, perhaps limiting soil mycorrhizal activity and negating seed germination and/or growth. Many of the 1999 plots, furthermore, were in sites with more than 60% shade. The amount of sunlight seems to be a critical factor for germination and early growth of these orchids. Paradoxically, without adequate sunshine the soil remains too cool to stimulate germination. Excessive direct sunlight, however, results in desiccation of young leaves and later loss of soil moisture. Observations of where the young plants thrive has led me to conclude that optimum sites for reestablishment of mountain lady's slipper are in small forest openings. Such transition areas may have enough light for soil warmth and photosynthesis but sufficient shade to maintain soil moisture.

Mountain lady's slipper seeds have been collected and scattered at GROWISER since 1993. Many plants have grown. An exact correlation between seeding date and plant emergence was unknown until the 2001 plants of the 1998 plots. However, from my general observations, it appears that flowering only occurs after at least 4 y of aboveground growth. This would mean a minimum of 6 y is required from seeding to first flower, at least an additional 2 y of growth are necessary to produce a stem with 2 flowers, and I assume at least two more years before the final, third flower. If undisturbed, the plants seem to be very long lived. Better evidence of time between seeding and flowering will be obtained as the plants of the 1998 plots mature.

RECOMMENDATIONS

Although further studies are underway, my experiences with direct-seeding mountain lady's slipper over the past 8 y lead me to believe the following 4 steps will help establish this plant in forests:

1. Before scattering mountain lady's slipper seeds, mix them thoroughly with soil from a site that has grown mature plants. This ensures inoculation with appropriate mycorrhizae and physically aids seed distribution. Broadcasting 4 capsules of seeds with 0.5 l of soil per m^2 (1 pt/3.3 ft^2) has been successful, but that is a very high seeding rate (thousands of seeds per m^2). Fewer seeds per area may be sufficient, and advisable, in a non-research situation.

2. Plant on north and east slopes that have enough trees to shade about 60% of the ground area. Avoid, as much as possible, sites with competing vegeta-

Photo by Andrew G Huber

Figure 2 • *Site originally growing 1 mature Mountain lady's slipper plant was seeded from 1993 to 1996 and now has over 30 plants in various stages of development.*

tion. Very few mountain lady's slipper seedlings were found in the direct shade of other herbaceous plants.

3. Choose sites that have a thick layer of decomposing forest litter and sow under western larch if the choice is available.

4. If planted in fall, begin looking for seedlings during the second spring following planting, but don't be surprised if more years of patience are necessary.

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