Propagation of Oregon's Rare and Endangered Plants

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The Need to Conserve Native Species. Of the estimated 250,000 different kinds of plants on earth—species, subspecies, and varieties—over one in every ten is threatened with extinction in their wild habitats. Approximately 25,000 of these rare and endangered plants are in the continental United States, Hawaii, and Puerto Rico. The Pacific Northwest has 250 to 300 of them.

In 1984, a national organization called the Center for Plant Conservation (CPC) was formed to use the resources of botanical gardens and arboreta to help conserve rare and endangered native plant species. The Berry Botanic Garden was one of the charter participating institutions for the CPC, and is responsible for the plants of our region, including Oregon, Washington, and northern California. We are joined by 19 other botanic gardens, including the Missouri Botanical Garden, New York Botanical Garden, the University of California at Berkeley Botanical Garden, and the Rancho Santa Ana Botanical Garden in Claremont, California. The mission of the CPC is to use resources of botanic gardens, such as institutional contacts and the knowledge of plant taxonomy and propagation, to conserve plants at risk of extinction in the United States.

At The Berry Botanic Garden, we maintain a Seed Bank for Rare and Endangered Plants of the Pacific Northwest, which was set up in 1983 by a grant from the Meyer Memorial Trust In 1991, we had over 1100 accessions of approximately 250 taxa of rare plants, and well over a million seeds in cold storage. These seeds are meticulously cleaned, counted, dried, and labelled before being stored at 5° F. These standard procedures help conserve them for long periods, perhaps centuries.

Our job, however, just begins with seed storage. If we do not know how to propagate these plants, seed storage itself is an empty exercise. Consequently, much of our effort is aimed towards propagation of rare species. The seeds are stored against the time when they might be needed for re-establishment in the wild. Other possible needs might be research, including horticultural breeding

The Horticultural Merit of Oregon's Rare Plants. Rare species are also of interest to propagators since many of them have horticultural value which a comparison of plants listed as rare or endangered in Oregon and *Hortus Third* shows us. The number of taxa listed in any category of rarity in Oregon includes 572 taxa (species, subspecies or varieties) (Oregon Natural Heritage Program, 1991). Many of these (125) are also candidates for listing under the U.S. Endangered Species Act, or are already listed as "Threatened" or "Endangered." These rare plants of Oregon are in 208 different genera. When compared against *Hortus Third*, I found 109 taxa in both lists, meaning that 19% are of direct horticultural significance. These included 17 endangered or threatened throughout their range, 48 that are rare in Oregon but more common elsewhere, 15 thought to be rare, and 29 on the equivalent of a "Watch List " Of the 208 genera on the total list, 187 or 90% are listed in *Hortus Third*. Another 51 plants listed by subspecies or varieties in the Oregon list were listed to the species level in *Hortus Third*.

The significance is that nearly one fifth of Oregon's rare plants are of horticultural interest on their own merit; most of the rest are related to horticultural species Some of these species are scarce everywhere in nature, and others only at the edge of their ranges here in Oregon. However, all of these have horticultural significance, since rare plants are often found in special habitats, such as alpine areas, making them especially suitable for horticulture Also, plants at the edge of their ranges have characteristics slightly different than the "main population", making them extremely valuable for horticultural breeding and selection of forms that grow under varying soil types and climates. Rare plants are a horticultural resource that we cannot afford to loose

The list includes native members of horticultural genera such as *Allium, Erythronium, Fritillaria, Gentiana, Lewisia, Lilium, Penstemon, Polemonium,* and *Sedum*. Plants of the genus *Lewisia* are perhaps the best known natives, grown by alpine enthusiasts and rock gardeners around the world. They propagate easily from seed, making them a natural for the nursery trade. They are available from many nurseries. Five different kinds of *Lewisia* are listed as rare or endangered in Oregon.

Propagation of Endangered Species at the Berry Garden. We at the Berry Garden propagate plants out of a basic love of plants, and out of our obligation to help conserve the botanic diversity of our entire region To us, it is the biological features of rarity that are important. For example, we are interested in learning to grow some plants to re-establish plants once found in the state of Oregon, but which no longer occur here. *Clintonia andrewsiana* is a native of California and southwest Oregon with bright blue berries each August and September It has been wiped out from the redwood forests in Oregon, and there is some interest in returning the plant as an Oregon native. Also, the very rare golden paintbrush, *Castilleja levisecta,* was once found in Oregon. There has also been interest expressed in re-establishment of this plant now known only from the state of Washington Propagation information is essential if these future projects are to be successful.

We have carried out extensive work already on two species. One is *Stephanomeria malheurensis*, the rarest plant in Oregon. It occurs on land owned by the Bureau of Land Management a few miles south of Burns. It is an annual plant and very near extinction due to a complex set of factors occurring at its single known site. In the first few attempts to germinate seeds of this species, the staff of the Berry Garden had very little success Upon inquiry, we learned that the researcher who had described the plant botanically had also learned its germination requirements (Gottlieb, 1973). It germinates in only a very narrow temperature range of 12 to 20° C in the dark, again pointing the need to know propagation requirements for rare species to carry out conservation work. Under these particular conditions, 85% of seeds germinated in less than 48 hours.

Another species we have worked with is Barrett's penstemon, *Penstemon barrettiae*, known from about 15 sites on rock outcrops in the Columbia River Gorge and tributaries of the Columbia River. One site was at the Bonneville Dam located directly in the path of a planned new navigational lock. Working with the U.S. Corps of Engineers, staff of the Berry Garden took cuttings of every plant that could be reached with a "cherry picker" to establish genetic lines at the Garden Woody penstemons were known to root from cuttings, so it was felt this approach

would work Cuttings were chosen because they would generate the exact same population characteristics as the plants already at the site This was important since botanists had already observed large variations in the plants from each population, and we felt it was important to maintain this genetic diversity. Unfortunately, differences in ease of propagation also were observed among individual plants, and the offspring from cuttings of some of the plants were lost because they proved to be resistant to establishment; others are surviving quite nicely awaiting the time when they will be re-established close to their original sites Several small populations are already being re-established on an experimental basis.

Propagating endangered plants is, for the most part, not any more difficult than propagating any wild plants, but it is certainly different than propagating most plants in horticulture or agriculture. Wild plants typically have built-in germination controls to help them survive in nature (Phillips, 1985; Young and Young, 1984; Thompson, 1967). Typical germination controls are thick, impermeable seed coats, which require repeated freezing and thawing or abrasion to crack in nature. Other seeds have chemical germination inhibitors in the seed coats or endosperm; in nature these degrade over time, are leached out by water, or require cold temperatures to break down. Some seeds have delayed maturity of the embryos which only time will cure. Suggested treatments include scarification of the seed coat, acid or heat treatment, stratification (cold, moist storage for varying times), and, in some cases, embryo excision

When looking to methods to germinate seeds or rare and endangered native plants, we turn first to the literature on propagating native plants in general. Several overall references are available, including Young and Young (1986) and Phillips (1985) Other sources are specific literature from scientific research.

Seeds of many rare and endangered plants germinate quite easily, and grow in garden settings very well. It is not necessarily the species reproductive system that limits its distribution in nature, but rather its reliance on certain habitats. Seeds of *Plagiobothys hirtus,* known from only one extended population in southern Oregon, germinate readily and grows to profusion in cultivation. Seeds of another species, *Oenothera wolfii*, known from about seven sites in coastal areas of northern California and southern Oregon, germinate without any treatment under standard greenhouse conditions. The silvery phacelia, *Phacelia argentea*, also known from the same coastal region, roots well from cuttings, and sows itself freely in our cold frames. The silvery phacelia is a pioneer on inner coastal sand dunes, binding the sand very well It is threatened in nature by off-road vehicles, grazing, and beach stabilization efforts where it cannot compete.

However, even as there are puzzles for more common native plants, there are problems in germinating seeds of some of the rare and endangered ones A few examples will suffice. Let's return first to the golden paint-brush, *Castilleja levisecta* (St Hilaire, 1987, St. Hilaire, 1988) This beautiful paint-brush shares the characteristic of many other paint-brushes in being a hemi-parasite It relies on a parasitic association with a host plant during at least part of its life cycle in order to survive and grow In the case of the golden paint-brush, we can germinate the seeds An intern at the Berry Garden found that seeds required a minimum of 6 weeks stratification in a refrigerator, resulting in 80 to 87% germination. However, getting the seedlings established is another thing, and we have been

unsuccessful to date, even though they have been planted with seeds of possible hosts from its native habitat. We have learned of a native plant enthusiast in Washington State who has maintained a population of this species in her garden for over ten years. The host plants she used were several species native to Australia, certainly not its host in the wild in the Pacific Northwest However, this information may be the key to learning how to propagate this plant for possible reintroduction efforts when we are able to pursue these in the future.

Another puzzle to us in *Howellia aquatilis*, a plant once found in Oregon. Its biology is described by Lesica (1990) in a special report to the U S. Forest Service This species spends its entire life cycle under water, and even blooms and self-pollinates with under-water flowers. It occurs sporadically in very small and isolated populations across the Pacific Northwest states, as far east as Montana. Seeds germinate in September, overwinter in ponds, produce flowers the following spring, and seeds by June. By September, 90% of the seeds from the year's seed crop have germinated. Only 10% are estimated to winter over to the next year. Germination of this species is fairly easy, but seed storage for conservation purposes is not so easy. For a plant that germinates so quickly, there may be little or no dormancy requirements. If there is no dormancy mechanism, we were not sure whether seeds could withstand drying and freezing necessary for seed storage conditions of our seed bank. We are currently testing these in experiments at the Garden in cooperation with the U.S. Fish and Wildlife Service.

A rare species of Washington State, *Hackelia venusta*, is extremely difficult to propagate, the seedlings being highly susceptible to fungal infection. Seed germination was finally obtained by clipping off the end of hard seed coats, treating the seeds and all equipment with a 10% bleach solution, and excising the embryos after they had imbibed water. These were procedures worked out through correspondence with specialists in the genus *Hackelia*. Seedlings died none-the-less shortly after germination. Some limited success was then obtained by using all procedures but not excising the embryos as had worked for other members of the genus.

Frittilaria gentneri had another problem. No seed germination was observed in early trials. This recently described species (Gilkey, 1951) has only a few populations in the wild, the largest being about 250 plants. Upon further examination of seeds, it was found that all examined lacked embryos, which presents some interesting question for its biology and propagation in the wild.

Here, I have attempted to show some of the problems we have encountered, which may (or may not) resemble many of the problems you encounter in your own work. My main point is that rare and endangered plants are, for the most part, like any native plants in their germination and propagation requirements. If we were doing this exercise for horticulture alone, we might not choose to work on the difficult species However, since our work is for conservation purposes to help conserve the botanic diversity of the Pacific Northwest, we work on the biology and reproduction of even the most difficult and obscure species

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