

Banking on Seeds to Avert Extinction

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ON SUTTON MOUNTAIN in the dry canyonlands of eastern Oregon, above a waterfall that flows only in spring, grows one of a handful of known stands of the arrowleaf thelypody, *Thelypodium eucosmum*. It is in the mustard family, a tall, showy, purple-flowered perennial. Endemic to a region that has been grazed for most of this century, the plant has the misfortune of being delectable to cows. It once flourished in riparian areas in three or four counties, but has retreated to the few moist places that cows just can't reach.

It's not easy for people to reach, either. Three of us have hiked several miles and scrambled over crumbled columns of basalt rimrock to collect the plant's seed. I am with botanist Julie Kierstead, curator of the Berry Botanic Garden rare plant seed bank in Portland, and Nature Conservancy ecologist Jimmy Kagan. Kagan coordinates the Oregon Natural Heritage Program, which keeps track of the state's rare flora and fauna. He rediscovered this population of arrowleaf thelypody in 1982.

It is July, the waterfall is bone dry, and the plant's seeds should be ripe. Kierstead instructs us to collect from at least fifty plants—if we can find that many—so that our sample is genetically diverse, but to take only one or two seed pods from each, so as not to impair the plants' reproductive ability. "If a lot of seeds have already fallen out," she warns, "we'll just have to take what we can get." Kierstead searches along one draw leading down into the waterfall, and back up another. Kagan scouts the main draw. I head down another, nervously. We're out of shouting range. I'm told there are rattlesnakes around.

When we finally regroup, Kagan's wax-paper collecting bags are stuffed with the plant's siliques—long, skinny, twin-chambered seed pods peculiar to mustards. Kierstead has a smaller take. I've come up empty-handed after crisscrossing the streambed and looking under every juniper, where the plants are supposed to grow. "When they're blooming they just jump right out at you," Kagan reports. But at this stage the seed stalks are brown and the plants are hard to see. "They hide in plain sight," Kierstead says, offering me some small comfort.

That evening we meet up with Cheryl McCaffrey, a U.S. Bureau of Land Management botanist new to the district. Many of Oregon's threatened plants grow on land managed by the

BLM, and she wants to get a feel for the plants—and the people with whom she'll be dealing. The next day the four of us set out to find several more rare plants, including Howell's thelypody (*Thelypodium howellii* ssp. *spectabilis*), another pretty, purple-flowered mustard. It has just three remaining toeholds, all in the Powder River Valley in northeast Oregon. Like its relative on Sutton Mountain, it is what Kagan calls an "ice-cream plant" to cows. Both thelypodiums are high-priority species—plants for which convincing evidence exists for listing under the Endangered Species Act.

The seeds we gather on this trip hold much of what remains of the genetic variability of the two species—a constellation of plant traits that can never be recaptured once lost. Kierstead will store them in the Berry Botanic Garden's seed bank, where they should remain viable for at least fifty years. Berry will also grow out some plants on its grounds. If either thelypodium disappears from the wild, the garden will have its germ plasm, or hereditary material, and the horticultural knowledge needed to restore it.

Of the approximately 25,000 to 30,000 species, subspecies, and varieties of vascular plants native to the United States, about 3,000—more than a tenth of the total—are thought to be edging toward extinction. Berry's work with the rare thelypodiums—involving *ex-situ*, or off-site, conservation—is part of a new response by botanical gardens to the urgency of this situation. Joining in a network called the Center for Plant Conservation, nineteen gardens from Hawaii to Massachusetts have made an unprecedented commitment to creating reserves, on their grounds, of the endangered plants in their biogeographic regions.

Off-site conservation might not seem like news to those who have followed the efforts to save peregrines or condors by breeding them in captivity and reintroducing them into the wild. Like zoos, botanical gardens represent a tremendous resource for conserving endangered species in a protected environment, and for conducting biological research needed to protect species in the wild. Yet, surprisingly, they are a resource largely untapped. Botanists who seek out rare plants and horticulturists who tend the plant collections back at the botanical gardens seem to exist in two different worlds. "Botanists often don't have the faintest idea of how to grow things," says Julie Kierstead. "And horticulturists may not



have the faintest idea of where they grow in the wild."

To date, the preservation of beleaguered plants has been accomplished largely by protecting their habitats. To save the arrowleaf thelypody, for example, the Nature Conservancy is trying to arrange a land swap between the owners of the plant site and the BLM; if it goes through, the Conservancy will work to assure that the BLM manages the site properly as a research natural area, a spot designated by the federal government as ecologically significant.

Conservationists dedicated to habitat preservation are understandably

*Julie Kierstead, curator of the rare plant seed bank at Berry Botanic Garden in Portland, Oregon, checks seedlings of endangered wildflowers that are destined for replanting in their natural habitats. Species of great concern to botanists in the Northwest include an evening primrose (*Oenothera wolffii*), top right; and Nelson's checkermallow (*Sidalcea nelsoniana*), left. A vial of seeds for preservation represents forty hours of work—counting, logging, cleaning, desiccating, and then freezing.*



Discovered on a cliff about to be blasted for a lock, a stand of rare *Penstemon barrettiae* is transplanted by Berry Garden volunteers to a safe site at Bonneville Dam.



worried that growing plants off site might be perceived as an acceptable alternative to saving rare plant habitat in the wild—especially in difficult situations, such as when an endangered plant gets in the way of powerful development interests. “It’s a touchy situation to come in with an *ex-situ* plan and deal with people who are used to working with *in-situ* conservation,” Kierstead says. “They’re fairly skittery—afraid it may undo years and years of work.”

But preservationists can’t always act quickly enough or save every population of a rare plant. Everyone has

stories about stands’ being destroyed by dam construction or roving cows or bulldozers before anyone could prevent it.

To provide some insurance against situations like these—a second line of defense—two young Boston botanists, Donald Falk and Frank Thibodeau, came up with the idea for a botanical-garden-based, off-site program. The final design for their Center for Plant Conservation took shape in discussions with Peter Ashton, director of Harvard University’s Arnold Arboretum in Jamaica Plain, Massachusetts, and Jonathan Shaw, then director of the New

England Wild Flower Society’s Garden in the Woods, a native plant garden in nearby Framingham. Their goal was nothing less than to create a national collection of endangered plants—a sort of Library of Congress of rare plant genes.

Several botanical gardens, such as the North Carolina Botanical Garden and the Waimea Arboretum and Botanical Garden in Hawaii, were already working to protect endangered species, and during the previous decade the botanical community had done some soul-searching along these lines. “I think it was the right time for the idea,” says Falk. Conservation groups were also receptive. The Nature Conservancy lent its extensive computer files on endangered plants, as did the Office of Endangered Species at the U.S. Fish and Wildlife Service.

In April 1984 the center opened shop, with Falk and Thibodeau as co-directors. It operates out of a renovated attic in the administration building at the Arnold Arboretum and has a staff of seven, including four botanists.

AS PART OF the Center for Plant Conservation, the Berry Botanic Garden is responsible for plants native to the West Coast, from Washington to northern California and as far east as the Cascade Mountains. Just a decade

ago Berry's six, mostly wooded acres belonged to Rae Selling Berry, an extraordinary plantswoman. She created there a very unusual species garden for plants she collected from all over the world, especially primroses, rhododendrons, and alpenines. She also grew a great many native northwestern wildflowers. When she died in 1976, having left no provision for continuing the garden (her children, in fact, had planned to sell it for a housing subdivision), her gardening friends in Portland and around the world raised money to buy the land. In 1979, when it became a botanical garden, it already had a good collection of natives, including many rare species.

Its offices are in Mrs. Berry's large, white frame house. As we sit in the comfortable kitchen, Julie Kierstead tells me about Berry's endangered plant program. The garden really has two overlapping programs—the Center for Plant Conservation and the Seed Bank for Rare and Endangered Plants of the Pacific Northwest, which also includes plants from the dry eastern part of Oregon. The two thelypodiums we collected, while not technically in Berry's territory under the center, will be grown out and maintained as part

of the center's collection.

We set off on a tour of the garden. The first stop is the mud room, where the seed bank, an old Amana freezer, is lodged unceremoniously. Looking inside, I see four trays of vials. Kierstead explains that each vial represents about forty hours of work. Most of the seeds are gathered for her by volunteers, amateur and professional botanists who get out in the field to look for rare plants. Kierstead herself cleans the seeds, counts or weighs them, and bottles them. Careful records of each collection are entered into the computer files.

Before the seeds go into the freezer, they must spend several weeks in a desiccator; otherwise, the water they contain would freeze and puncture the cell membranes. Every five years or so, following accepted seed-banking procedures, Berry will thaw out the seeds and test their germination rates.

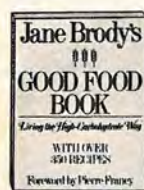
Seed banking is the easiest, cheapest, and most compact way of saving the genetic diversity of a species. But some seeds don't take to freezing or drying, and for these a "full," self-perpetuating collection of fifty plants must be maintained under the center's guidelines. (The current scientific

thinking is that a population of this size holds about 95 percent of a species' possible genetic permutations.) It's not easy to keep a large troupe of rare plants alive and reproducing. As Kierstead notes, "In a garden setting, you more or less expect to lose a certain number of things every year. And when you have to manage something knowing that you can't replace it, it becomes a lot more critical. When something dies you can't just say, 'Oh well... darn!'"

Fortunately, the seeds of most of the plants with which Berry is working can be stored. But Berry's gardeners will grow at least a few plants of each species so they can figure out how to propagate it and keep it alive. Kierstead also believes it important for a garden to display rare plants: "People don't get excited about conservation unless there's something real. The average person—even the gardener who's really interested in plants—will likely never see an endangered species in the wild."

Of the dozen or so endangered species Berry is now working with, perhaps two-thirds have not yet grown large enough to be planted out in the garden. A small greenhouse shelters plants that are being started from cut-

3 BOOKS, 3 BUCKS.



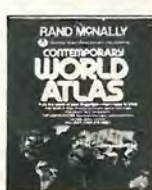
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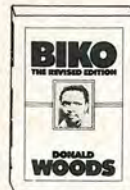
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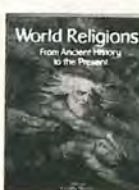
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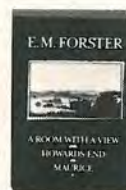
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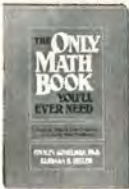
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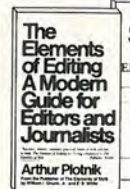
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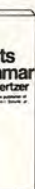
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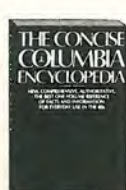
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tings; just outside are rows of plastic cups sprouting seedlings. Cold frames house young plants that need extra protection. Eventually, Berry hopes to cultivate all of the sixty or so endangered species in its territory.

The garden's director, David Palmer, a lean, red-haired Englishman, is working near the greenhouse. Palmer supervises the three paid gardeners as well as a number of volunteers. Few of the plants have ever been grown before, and next to nothing is known about their germination and growing requirements. The gardeners try to match a plant's habitat, he says, although sometimes a plant behaves very differently in a garden. Good instincts come in handy.

Kierstead takes me through the rock garden, which slants up a gentle incline behind the house. Here rare and endangered species grow among the garden alpenes. She quickly reels off Latin names: *Penstemon peckii*, endemic to the eastern slope of the Cascades; *Luina serpentina*, known from only one place in central Oregon, where it grows in sparsely vegetated soils; *Arabis koehleri* var. *koehleri*, whose seed came from plants that survived blasting during the retro-

fitting of a dam.

Other threatened natives grow in the perennial beds of the Lily Garden, which was recently redesigned to be more of a meadow garden, better suited to natives. This is where the two thelypodiums will go. She shows me a few specimens of the silvery phacelia (*Phacelia argentea*), a dune plant of the southern Oregon coast, where it is being crowded out by a European beach grass, trampled by cattle, and overrun by dune buggies.

My tour concludes with a walk through the woodland area and the primrose collection begun by Mrs. Berry. We head back to the kitchen for lunch. Tomorrow we'll be collecting seed from a recently discovered stand of Barrett's penstemon (*Penstemon barrettiae*), a rare Columbia River Gorge endemic. It grows on a cliff near the Bonneville Dam that is about to be blasted to make way for a new navigation lock, and the garden is helping to reestablish it elsewhere on the dam's grounds.

The blasting took place this summer; the seed collected at the time of my visit has been stored; the cuttings taken have all done well. But not every plant can be preserved through seed

collecting and cultivation. Terrestrial orchids, for example, have so far resisted all attempts to grow them. No one has been able to unravel the details of their symbiosis with soil fungi. Indeed, little beyond taxonomy is known about most of our rarest species: Their survival and reproductive strategies, ecology, genetics, and biochemistry remain a mystery. By gathering information on how to grow endangered species and by making them more accessible for research, the Center for Plant Conservation has the potential to advance our understanding greatly. What biologists learn about a species should contribute much to its preservation in the wild.

Don Falk cautions, "I think everyone still views this as a grand experiment. The whole idea will take a few years to prove itself." Although two hundred of the most endangered species have been brought into cultivation by the gardens in the center's network, the sheer number of plants that await preservation is daunting. Says Frank Thibodeau, "One of the things that pushes us onward is the notion that there needs to be at least an attempt to work with any plant that is really at the edge of extinction."

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