

PLANT

Conservation

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Springtime in the Southwest:

From Texas to Southern California, CPC botanists are saving unique plants

What's your image of the Southwest? For many, the region is still the "Wild, wild west": endless miles of orange desert, dotted with cactus and bright wildflowers. But in reality, the Southwest comprises a wide variety of habitats, including dry woodlands, mesic canyons, mountains, wetlands, springs, and other aquatic systems. This variety of habitats supports a wealth of biodiversity, but these natural resources are facing more and more challenges. A booming economy, spurred on by growth in mining, oil and gas exploration, changes in agricultural markets, and expanded recreational use is bringing land development, habitat degradation and loss, and water projects that disrupt natural hydrology. These changes are threatening a valuable natural asset too often overlooked: the region's unique native flora.

The wildflowers, cactus, and other native plants of the Southwest have adapted to an extreme and very unreliable arid climate. These natural treasures are experts at resource hoarding. They have adapted their natural processes to require as little energy as possible, and save surplus resources to combat the extreme heat, cold, and drought.

Drought-tolerant plants, like cacti, are structurally adapted to store and limit loss of water. Cacti use their swollen stems to store water for future use, and limit their release of water and gases to night hours, when the temperatures are cooler. Some plants store their

water underground, in large tubers or roots, and limit their aboveground growth forms to those needed for photosynthesis. These structures often contain self-defense mechanisms such as spines or chemical substances within the plant that discourage would-be grazers, thus keeping stored water safe. For improved drought-resistance, shrubs and trees in this region tend to have only small leaves, or no leaves at all.

Wildflowers of the region have also managed to adapt to the lack of water. The seeds of flowering plants have an increased dormancy mechanism, restricting germination to the infrequent rainfalls. The entire lifecycle of these plants is accelerated to occur during the rainy season. The results are often spectacular fast-forward blooming cycles.

Because these unique plants have often adapted to fill very specific niches in the landscape, they're particularly sensitive to the disturbances and habitat-loss that comes with ever-growing development of roads, subdivisions, and industry. When development or changing land management practices inadvertently disturbs the specific condition the plants need to survive, they could be lost from the landscape forever.

That's why CPC botanists around the region are working to save the vanishing natural treasures of the region. This month, *Plant Conservation* brings you a little taste of springtime in the southwest with stories of rare plant recovery. See pages 3 - 4 for more.

Sacramento prickly-poppy (*Argemone pleiacantha* ssp. *pinnatisecta*), a National Collection species from New Mexico.



photo by Joyce Maschinski

Mahogany Mystery Solved

Like many islands, Catalina Island off the coast of southern California has a unique ecosystem where plants and animals, isolated from the mainland, have developed adaptations quite distinct from their more common mainland counterparts. Such is the case of the federally endangered **Catalina mahogany** (*Cercocarpus traskiae*), one of the rarest shrubs in the continental United States.

An evergreen member of the rose family, Catalina mahogany was not discovered until 1897, when there was a single population of forty individuals. Since these rare shrubs had evolved without the presence of mainland animals like pigs, goats and cattle, the introduction of domesticated and later feral animals had a big impact on the small populations. The Santa Catalina Conservancy has since fenced off Wild Boar Gully, the single dry arroyo where the mahogany grows, to protect it from browsing animals. But as of last year,

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Director's Letter:

Entering my fourth calendar year with CPC, I was amazed at how time has simply flown by. Even more amazing is that 2004 is the 20th anniversary of CPC! *That* doesn't seem possible to me either. I remember the beginning. In 1984 I attended the AABGA meeting in San Diego. I heard two young men I'd never met, Don Falk and Frank Thibodeau, explain their concept for CPC. They were convinced botanical institutions could help secure and recover the nation's most endangered plants. Their appeal for help with seed banking and research was followed by a vigorous discussion by many young garden staff people about the pros and cons of the concept, and how much of a contribution gardens could really make. Overall, there was guarded enthusiasm, and 15 institutions signed up to see if they could make a difference.



Kathryn Kennedy

Today, many of those bright young staffers are directors of departments or gardens. We've seen a lot of change, hard work, and challenges. The botanical community—our staff, institutions, directors, conservation officers, donors, volunteers, Board of Trustees, and science advisors can be very proud of what CPC has achieved. All deserve a large measure of thanks. Stay tuned for a retrospective issue later this year, and quips and quotes as we go, reflecting on our history.

We've made a difference. No doubt we held off extinction for many species. Today CPC is a vital network of 32 institutions, with over 600 species in our National Collection, and over 80 restoration projects nationwide. We've struggled and grown, learned a lot, published books (our third came out in February) and established a reputation as a committed partner for agencies and others determined to save our native plant biodiversity. One species (Robbins' cinquefoil) has been removed from the endangered species list. There is great hope for work in the wild we're doing with many others.

Correction

The Autumn 2003 issue of CPC's *Plant Conservation* (Vol. 16, No. 4) mistakenly reported that the Fish and Wildlife Service had proposed downlisting the status of Virginia sneezeweed (*Helenium virginicum*) from endangered to threatened. This is not true. The sneezeweed is in fact federally listed as threatened, and no change to the federal listing status of this plant has been proposed by FWS.

We apologize for the error.

Traditionally in the year's first issue we recognize Friends, who make the CPC program possible. This is a celebratory year, one we want to be significant for its accomplishments. I hope all of you in the CPC network and family of cooperators and supporters will stop and give yourselves a pat on the back—and then get right back to work getting the word out, growing CPC, and saving those species!

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The Center for Plant Conservation is a national not-for-profit organization hosted by the Missouri Botanical Garden in St. Louis and governed by an independent board of trustees.

A network of more than 30 botanical gardens and arboreta, the Center's mission is to conserve and restore the rare native plants of the United States.

This newsletter is printed on recycled paper with soy ink.



Donations secure future of imperiled Texas plant

Yet another of the more than 600 imperiled plants in the CPC National Collection of Endangered Plants has been fully sponsored, preserving more of America's native flora for the future. Thanks to generous donors, the **Texas trailing phlox** (*Phlox nivalis* ssp. *texensis*) is now fully supported, ensuring funds that help scientists bank this rare native plant's seeds, conduct research on the plant, and plan for and implement restoration to the wild.

Texas trailing phlox, a ground creeper with thin, needle-like leaves and pink to magenta to white flowers, is so vulnerable it was once thought extinct. A handful of remaining populations have since been found, and the species was federally listed as endangered in 1991. This Texas native is endemic to the Pineywoods region of southeastern Texas, where long-leaf pine savanna once dominated.

Researchers at **Mercer Arboretum and Botanic Garden**, a CPC participating institution in Humble, Texas, are working with other partners to restore this beautiful native wildflower to its original habitat. Scientists from the

Lady Bird Johnson Wildflower Center, a CPC participating institution in Austin, Texas, maintain a bank of wild-collected seeds that ensures the genetic diversity of future restorations, and the Texas trailing phlox is on display in Mercer's Endangered Species Garden, where visitors often enjoy blooms year-round.

The CPC National Collection is a bank of seeds, cuttings and other plant material from more than 600 of the nation's most imperiled native plants. Botanists in the CPC network around the country gather and catalogue these plant materials according to strict standards developed by CPC's science advisory council. The materials are then stored and maintained at the participating institution, preserving our options for restoration.

National Collection material is used to study the life cycle and germination requirements of these rare treasures, and plants propagated from the collection are used by botanists and researchers



photo by Suzanne Chapman

Texas trailing phlox (*Phlox nivalis* ssp. *texensis*)

for private, state, and federal plant and habitat restoration projects. Sponsorship endows a fund that provides secure, regular payments to the institution caring for the at-risk plant, as well related data management and conservation activities at CPC's national office.

Sponsorship of the Texas trailing phlox began in April 2002 with a donation from a Mercer veteran native plant volunteer, inspiring the participation of a number of other individuals, the River Oaks Garden Club, the Mercer Memorial Trust, and the Mercer Society.

Salvaged Arizona Cliffrose Thriving in Protected Habitat

When the Arizona Department of Transportation plotted a new road through one of the few remaining populations of the **Arizona cliffrose** (*Purshia subintegra*) in the white mesas of Verde Valley, the future looked bleak for the tiny, bright blooms of this federally listed endangered plant. But with the help of dedicated volunteers, botanists at **The Arboretum at Flagstaff**, a CPC participating institution, stepped in to rescue the plants. Now, the latest results show that after more than six months, 84 percent of the plants are thriving in their new home.

Since the plants at the proposed road site had grown into woody shrubs five or six feet tall, it was impossible to transplant whole plants. Instead, the scientists focused on collecting seeds and cuttings from the population over the course of a year, later growing cloned plants in the greenhouse from these materials.

Then last spring, scientists located protected lands, owned by the Forest Service and the county, with habitats similar to the original site. With the hard work of many volunteers, Flagstaff botanists transplanted the greenhouse-grown plants along

with other species such as the lavender-flowered **Verde Valley sage** (*Salvia dorrii* ssp. *mearnsii*), designated a sensitive species by the Forest Service, which grows among the cliffrose.

Since greenhouse conditions had encouraged the plants to put out more leaves than could normally be sustained by mesa's arid climate, the new home was made temporarily even more hospitable with an aboveground irrigation system, which will be tapered off to give the plants an opportunity to adjust.

Six months later, the progress report shows that all the hard work is paying off. While previous transplant experiments resulted in only 50 percent survival, this time 84 percent of the cliffrose plants are still doing well. Department of Transportation funds have supported twice-weekly water-

ing, and when that grant runs out the work will be shouldered by volunteers from the Forest Service and the Nature Conservancy, which plans to buy the cliffrose habitat currently owned by the county. And that means that the coyotes and lizards will still be able to enjoy the shade of this native treasure, and Arizona will have preserved another piece of the Southwest's natural heritage.



Arizona cliffrose
(*Purshia subintegra*)

photo by Joyce Maschinski

Can a plant be loved to death?

As southwest landscaping grows in popularity, so does illegal poaching of threatened native cacti. In the wide-open spaces of West Texas and Big Bend National Park, these rare floral gems are rapidly disappearing as collectors root them out of their few remaining populations. Now, two threatened desert cacti are getting a helping hand from **Desert Botanical Garden**, a CPC participating institution in Phoenix, Arizona.

The **Chisos Hedgehog cactus**



photo by Michael Gardner

Chisos hedgehog cactus
(*Echinocereus chisoensis* var. *chisoensis*)

(*Echinocereus chisoensis* var. *chisoensis*), found only in Big Bend National Park, offers beautiful bright-pink blooms with crimson centers. Unfortunately, there may be less than a dozen sites of this threatened desert cacti left in the wild. Illegal commercial poaching of this showy cactus has contributed to its decline. In partnership with botanists at the Park and at Angelo State University, Kathy Rice of Desert Botanical Garden is testing germination requirements for the cactus.

First, researchers from the University conducted controlled cross-pollinations of individual plants growing in the wild. Then, the resulting seeds were collected and sent to the Garden's greenhouse, where trained volunteers grew the seed into plants and recorded the germination success of each seed. These plants will be re-introduced into the wild in mid-

April, tucked under larger "nurse" plants to ensure their survival. The information from the experiment will help researchers understand the relative genetic strength of the wild-growing population.

Another at-risk cactus found at Big Bend, **Lloyd's mariposa cactus** (*Sclerocactus mariposensis*), is prized for its diminutive size. Like the Chisos Hedgehog cactus, Lloyd's mariposa cactus has been decimated in many areas by over-collection.

But as with all our imperiled plants, there are other threats pushing the species towards extinction. Development of a road outside of Big Bend National Park will destroy one of the 30 remaining sites for this species, so Rice will salvage the plants there. Once safely in the greenhouse, new seed will be propagated to augment the Garden's seed bank, thus providing greater genetic diversity for future restoration projects.

Mahogany Mystery

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only five genetically unique individual plants were known to exist.

Now, thanks to work done at the **Rancho Santa Ana Botanic Garden**, a CPC participating institution in Claremont, California, yet another Catalina mahogany individual has been added to the ranks. Using molecular genetic analysis, researchers at Rancho Santa Ana have determined that an individual shrub, collected in the 1920's and currently growing on an estate in Berkeley, Calif., is indeed a pure Catalina mahogany plant.

Confirmation of the identity of this individual shrub, long separated from other members of its species, increases the known genetic material of this taxon by twenty percent—an important achievement to maintain genetic diversity as plants are cross-bred to increase the number of healthy individuals.

In the Rancho Santa Ana greenhouses, botanists have used cuttings from this newly identified plant to propagate additional plants, and will continue lab work and propagation of this taxon.

Updating Conservation Priorities:

Species Surveyed in Southern California

The **Santa Barbara Botanic Garden** has been developing a database, through grant support, on the distribution of approximately 400 plant species considered by regional botanists to be rare in the central coast region between Monterey and Ventura counties. This area, the central coast bioregion, is the focus of the Garden's conservation program, especially with regard to potential candidates for CPC sponsorship.

Last year, several species were identified as deserving special attention, including the **Nipomo Lupine** (*Lupinus nipomensis*) and the **Arroyo de la Cruz Manzanita** (*Arctostaphylos cruzensis*).

Previous reports had cited twelve different occurrences for the Arroyo de la Cruz manzanita, with about half located on public lands. However, fieldwork conducted through collaboration with the Los Padres National Forest found only one occurrence, with only five plants, on public lands. In December 2003, the population was aug-

mented with an additional 25 plants secured as cuttings the previous year. This year, plans include securing seeds and additional cutting to establish additional populations.

Recently, the Garden also identified another species, **satintail grass** (*Imperata brevifolia*), as deserving special conservation attention. Several botanists have wondered whether this species was native or exotic, rare or invasive.

Prompted by a recent treatment in the Flora of North America, and comments from local botanists, the Garden has gathered information that strongly suggests this species is probably native. What's more, it is represented by only a few remaining populations in California, and may be rare or extirpated in its previously known distribution from California through Arizona to Texas.

The Garden has begun efforts to secure conservation collections from the remaining California populations.

Meet the Network:

Dr. Ed Guerrant, Berry Botanic Garden

A native of the suburbs of Los Angeles, Ed Guerrant, Conservation Director and Seed Bank Curator at the Berry Botanic Garden, says that living right on the edge of suburbia gave him a love of the mountainous open spaces near his home. As an undergraduate at the University of Washington in the late sixties and early seventies, he was a zoology major until he sampled courses in botany and taxonomy. “At that point I said, ‘Okay, I’m a botany major,’” he reports. He took off one term to collect ferns in Hawaii and then finished his Bachelor of Science degree in both zoology and botany.

After several years working for the US Forest Service in the mountains of southern California, traveling, and working as a VW mechanic, Ed returned to school for his master’s degree in biology at Sonoma State College, studying pollination ecology of yellow larkspur (*Delphinium luteum*, now in the National Collection at UC Berkeley). “Hindsight is twenty-two,” Ed reflects. “Now I realize I should have counted these plants, because their numbers have declined so dramatically. At that point, I was busy comparing it with two close relatives, the hummingbird-pollinated *D. nudicaule* and the bumblebee-pollinated *D. decorum*. I knew this was what I wanted to do, so I went to Berkeley for my PhD in Botany, studying

Ed and Berry intern Sydne Record take a break after monitoring threatened plants as part of a BLM project.



photo by Kira Donnelly

the ecological and developmental bases of evolutionary shape change in plants.

“I remember one truly eureka moment. I had noticed that the flower of the hummingbird-pollinated plant, which was clearly evolutionarily derived, looks just like the buds of the more primitive ones. So I dissected the buds and was able to describe the growth mathematically; the growth-size-shape trajectory of the hummingbird-pollinated species was the same as the bumblebee-pollinated species, but it grew a bit more slowly, so that when it reached maturity it still looks like a bud. I discovered that what seems to be a huge morphology shift could result from small changes in developmental rates. That became the first chapter of my doctoral dissertation.”

Have your views about plant conservation changed during your time at Berry Botanic Garden? “When I started in 1989, the thought of actually doing plant conservation was very exciting, but I wasn’t at all sold on the idea of seed banks. I was skeptical: in our zeal to preserve plants in the seed bank, are we actually hurting them in the wild? But the group of colleagues at CPC really helped to educate me tremendously. I came to appreciate the proper role for ex situ as a means to an end: supporting species survival in the wild. I’m now convinced that ex situ really is a net good, and I’ve become quite vocal in that regard.”

Big projects you’ve been working on lately? Ed spent countless hours co-editing with Kay Havens and Mike Maunder, and writing parts of, CPC’s latest book, *Ex Situ Plant Conservation, Supporting Species Survival in the Wild*, now available through the CPC website, www.centerforplantconservation.org. “The book is in many ways a comprehensive summary statement of what we are working to do here at Berry,” Ed says, “and it gave us a great opportunity to ask the most knowledgeable people in various fields to write chapters about topics the editors thought we



photo by Nancy Drye

Ed Guerrant with sons Correy and Grady.

should know more about.”

At the same time, though, Ed continues to conduct research and restoration for endangered plants in the Pacific Northwest, pursuing partnerships with federal agencies to maximize the impact of and to help pay for this important work. For example, one major long-term project with the BLM is focused on how an understanding of population biology can inform our reintroduction efforts. “Based on computer modeling work I did in preparation for writing a chapter in CPC’s second book, *Restoring Diversity: Strategies for reintroduction of endangered plants*, I hypothesized that we should be better off starting with not the smallest propagule possible, but something bigger. We are testing that hypothesis with Western Lily (*Lilium occidentale*), which we planted in 1996, and have been monitoring ever since. So far, we’re definitely seeing a huge survivorship advantage of plants that were put in as small bulbs over seeds. Ultimately, we’re interested in restoring the population, but the science of reintroduction is so new that we need to do these things with controlled experimental reintroductions, to learn as much as possible from the process.”

Much of Ed’s work focuses on plants in the CPC national collection of endangered plants, such as Koehler’s rock cress (*Arabidopsis koehleri* var. *koehleri*) and Gentner’s mission-bells (*Fritillaria gentneri*). But recently the large, BLM-sponsored project to develop native plants for use in post-forest-fire resto-

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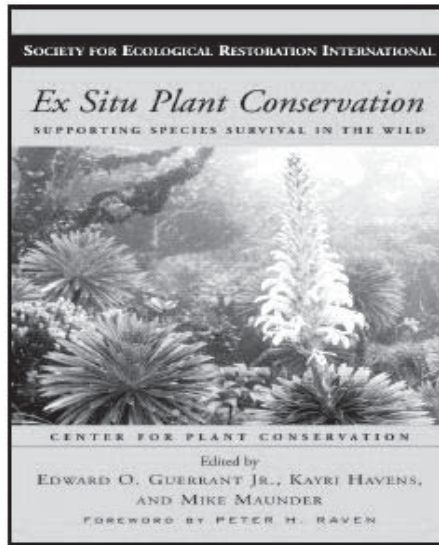
New CPC publications now available

The product of many hours of collaborative work in the field and in the laboratory, CPC's latest book is now available. *Ex Situ Plant Conservation: Supporting Species Survival in the Wild* is the first book to address integrated plant conservation strategies and to examine the scientific, technical, and the strategic bases of the ex situ approach. It outlines the role, value, and limits of ex situ conservation as well as updating best management practices for the field.

Edited by three CPC conservation officers, the book is sure to become a useful guide for all who are involved in natural resource management and conservation around the country.

Order your copy today at <http://www.centerforplantconservation.org/Publications.html>

Also available from the website is the newly revised *Plant Conservation Directory*, including over 800 entries of professionals working in plant conser-



vation from all over the United States. Organized by state with a improved, user-friendly format, the directory is an invaluable resource for anyone interested in connecting with others working on plant conservation.

Profile: Ed Guerrant

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ration has also allowed for useful investigations. "We're testing seed germination of a bunch of different things, which is all ultimately directed towards developing germination protocols and other data for using natives for restoring fire-damaged lands. By choosing which populations to examine, we were able to begin to address the question of what is an appropriate seed source for native plants. I always try to piggyback as much knowledge gaining ability as possible on each of our projects, since there are so few resources available for plant conservation."

Describe a day in your life: "There's no typical day, which is one of the wonderful things about my work. There are different seasons; during field seasons, when we go out and monitor, there will be a few intensive field days. For now, though, a typical day includes checking all the machinery and temperatures and monitoring the seed ger-

mination experiments. Then I try to write as much as I can; I'm currently writing a couple of articles with other CPC folks. And of course there's always a lot of administration stuff."

What inspires you? "I have a strong desire to do something meaningful, something that will be lasting, that feels good deep down. I feel I'm really making the world a better place for humanity, and that's really what drives me. You're swimming against the tide, but we're saving species that would otherwise go extinct, and that could open up long-term positive gains for humanity. I really feel that what I'm doing makes a difference and that's what keeps me going."

What his co-workers say about him: "One of the best things about working with Ed is that he appreciates the big picture of conservation practice while at the same time having the specific details to work in the field. He's been a great mentor; I've really learned a lot from him." – Andrea Raven, Conservation Biologist at Berry Botanic Garden.

20 Years of CPC

Who are these young men?



In 1982, these two students, Frank Thibodeau and Don Falk, realized that no major environmental group had considered endangerment in the plant kingdom, and they knew botanical institutions could do something to change that. With the help of other key founders, these two young men went on to found the Center for Plant Conservation. Twenty years later, we applaud their vision.

Longtime CPC officer new director of Fairchild

The **Fairchild Tropical Garden**, a CPC participating institution in Miami, has appointed Mike Maunder to its helm. Mike has worked with CPC for many years, first as the Director of Conservation at the National Tropical Botanical Garden in Hawaii, and, since 2002, as Director of Horticulture at Fairchild. He was a co-recipient (one of three) of CPC's Star Award in 2002, in recognition of his dedication to plant conservation through the work of editing, along with Ed Guerrant of Berry Botanic Garden and Kayri Havens of Chicago Botanic Garden, CPC's latest book, *Ex Situ Plant Conservation: Supporting Species Survival in the Wild*. We are delighted to congratulate Mike on his new post!



Rare Care wins national award

The Rare Care team at the University of Washington's **Center for Urban Horticulture**, a CPC participating institution in Seattle, has been awarded the national joint US Forest Service and Bureau of Land Management's Conservation Project Award. This prestigious award "recognizes a project with outstanding conservation accomplishments for ... native plants and their habitats on public lands."

The nomination names Rare Care as "a leader in conservation work in Washington State [that] provides a valuable service to state agencies and private groups as well as the federal agencies in Washington State."

"We are thrilled with this honor," says Sarah Reichard, CPC conservation officer and assistant professor at the University of Washington. "It is tremendous recognition of the hard work of our staff and volunteers and validates the trust of



photo by Rod Clausnitzer

Left to right: Kathleen Clarke, BLM Director; Carolyn Alfano, Rare Care Program Manager, and Dale Bosworth, USFS Chief.

those who have supported us."

Edward K. Love Foundation sponsors two CPC plants

Last year saw the generous sponsorship of two plants in the CPC National Collection of Endangered Plants by the Edward K. Love Conservation Foundation. Annual support for the **Virginia sneezeweed** (*Helenium virginicum*) and the **small whorled pogonia** (*Isotria medeoloides*) is now secure through this generous gift of \$20,000. The Edward K. Love Conservation Foundation, named for the father of CPC board member Andrew Love, has been a long-time supporter of plant conservation, having sponsored eleven plants in the collection in 2001. "We are very appreciative of the vision and far-sightedness of the Edward K. Love Foundation, and the tremendous assistance it has given to conservation of imperiled plants over the years," said Kathryn Kennedy, CPC director.

Botanists seek vanishing plants

Going on a wildflower hunt along Utah's Green River

What's harder than finding a needle in a haystack? How about combing unforgiving southwestern landscape for a small, rare plant that grows among mixed desert shrubs along the steep shale slopes of Utah's Green River Formation? It may be daunting, but it's worth it, according to Jennifer Lewinsohn, conservation botanist at Red Butte Garden and Arboretum, a CPC participating institution in Salt Lake City.

The White River Penstemon (*Penstemon scariosus* var. *albifluvis*), a perennial herb that grows from 15 to 30 cm tall and offers delicate lavender or pale blue flowers in May and June, is a candidate for listing under the federal Endangered Species Act. This taxon was discovered in the mid-1970's by Larry England, the botanist at the USFWS in Utah at that time. The number of individuals was estimated at 22,780 plants in 1994, and approxi-

mately 73 percent of those individuals occur on BLM lands. Threats to this taxon include livestock grazing, oil and gas exploration and development, and recreational off-road vehicle use.

Throughout April and May, Lewinsohn, along with Drs. Sylvia Torti and Vincent Tepedino, will be working with the Bureau of Land Management to select two populations for long-term monitoring of this and another candidate Penstemon species, Graham's Penstemon (*Penstemon grahamii*). Once the long-term monitoring plots are established, ecological and life history data will be collected on both taxa.

In addition, the breeding system, pollinators and pollinator requirements of each taxa will be studied over the next two years. "Studying the breeding system of rare plants enables us to determine if pollinators are necessary accomplices for the plant's sexual reproduction," explains Tepedino. "Once



photo by Matthew Utley

White River Penstemon (*Penstemon scariosus* var. *albifluvis*)

that has been shown, we need to identify the important pollinators and learn something of their natural history so that any management decisions can also plan for their needs."

If all goes well in this 6th year of drought for the state of Utah, researchers will be able to collect seed in late July. This will add to an ex situ seed collection that will allow further research and could be used to help restore this plant to its natural wild habit.

Growing the Collection

If you've been following our 'Road to Recovery' series, you know that plant restoration takes many steps. Last issue, we told you about the care conservation botanists must take to appropriately collect and store seeds of imperiled plants. But even once the seeds are safely stored, the research keeps going. Botanists need to learn about the biology of the species, the way the seed germinates and the way the plant grows to maturity and reproduces. Much can be learned about imperiled species in the lab that can be used to better understand the species in the wild: their relationship to nature, and how we can help them to recover from endangered or threatened status. "Work that we do in a greenhouse always informs the work that we do in the field," explains Kim McCue, CPC conservation officer at Missouri Botanical Garden. "But the opposite is true also. We take observations from both places."

The work of documenting how a plant grows best begins in the field, says Kayri Havens of Chicago Botanic Garden. "When in the field collecting seed, we also collect habitat information and use that to determine germination and pollination protocols," she explains.

Once the seeds are in the lab, some are brought into the greenhouse to serve as propagules. However, this is more difficult than it may seem. "These seeds are not like seeds you buy at the garden center, add water, and they grow," notes McCue. "A lot of effort has gone into the domestication of those species. This is not the case with these wild organisms and they often require very different strategies."

So conservation botanists set to work developing germination protocols. First, they must get the seed to germinate, or sprout, using existing protocols as a trial. In many cases, however, there are no existing protocols, so our scientists must start from scratch. They use their observations from the field, or what they suspect happens in nature as a guideline.

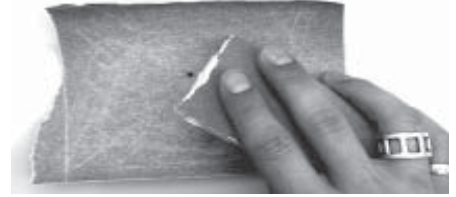
They can also use species that are close relatives or within the same fam-

ily as a guideline. "Usually species in the same genus germinate in the same way," notes Havens. A conservation botanist can usually guess that seeds with a hard seed coat need to be scarified (define) or nicked. Similarly, if few seeds of a rare plant are available, scientists will use the seeds of a more common close relative to practice.

Sometimes, figuring out germination protocols can take lots of time and many trials. Sometimes, a botanist may think she's got the process down to a "T"—only to find out the plant performs differently in the wild than in the greenhouse. "With beach jacquemontia (*Jacquemontia reclinata*), we have no difficulty germinating it in the greenhouse," shares Joyce Maschinski of Fairchild Tropical Garden. "But we have had real problems determining what it needs in the field. Greenhouse tests indicated that the plant should germinate well. We outplanted on a dune, using PVC pipe to protect the plants, and watered according to the protocols we had developed, but germination in the field was extremely low. There's lots of interest from land managers to do reintroductions, so we're working with moving existing plants into the wild in further experimental reintroductions. We're concerned about whether there is possibly a problem with seeds produced by particular populations. We've done genetic studies, and still don't know for sure if that is the problem."

"Another example is the Arizona cliffrose (*Purshia subintegra*). With this woody shrub, we had difficulty propagating from cuttings. It turned out that the time of year that you collected the cuttings determines if it would root or not: if the stems were too woody, it won't work; and if they were too soft, it won't work. We also found that seed germination required a cold stratification period of about six weeks, and heat was also needed to get them to root."

Once germination protocols are established, the work moves on to setting growth protocols. "We try growing them in a media that matches where



Pyne's ground-plum (*Astragalus bibullatus*) seeds are scarified (above) and then soaked in warm water (below) before being sown in the appropriate medium at Missouri Botanical Garden.



photos courtesy of Kim McCue

they occur in nature," says Havens. "For example, we always grow species from the Pitcheri genus in sand because it is a sand dune species." To truly understand the biology of the species, we need to grow the plant to flowering and have it complete its life cycle, and understand how it is pollinated. Says McCue, "You can have a healthy robust plant and not know if it will flower." And once they do flower, botanists work to find out if the species is self-compatible (that is, it can successfully pollinate itself), or if it must be out-crossed (that is, it must receive pollen from a different individual). This is done by hand pollination tests and bagging the flowers to isolate them from unintended pollen.

After the long process of determining these various protocols, CPC botanists contribute information to update a database maintained in our national office. This way, the hard work of one scientist can be shared with the professional conservation community.

"Along the Road to Recovery" is a CPC series highlighting the steps to recovery for imperiled plant species. For an overview of the road to recovery, see the Winter 2003 issue of *Plant Conservation*, available on the CPC Web site at www.centerforplantconservation.org.

CPC Publicity Inspires Collaboration to Save Imperiled Goldenrod

by Megan Cotter

How powerful is the message of plant conservation? Just hearing about our work can often move people to action. We've heard many stories of donors and volunteers moved to help CPC in our fight to save America's vanishing flora.

This past summer, a working botanist was inspired to add his work to our cause after hearing a National Public Radio's Science Friday discus-

sion featuring Dr. Kathryn Kennedy, CPC president. Gregory Copenhaver, assistant professor at the University of North Carolina at Chapel Hill happened to be listening.

As a professor and researcher of botany, he knew he could personally make a difference. A visit to our web site informed him that the **North Carolina Botanical Garden** was a CPC participating institution, and coincidentally, also part of UNC-Chapel Hill! Copenhaver called Johnny Randall, Assistant Director for Conservation and CPC Conservation Officer at the NCBG, to offer his assistance, and was soon helping to plan research and recovery projects for an intensely threatened goldenrod growing on the banks of the Yadkin River in central North Carolina.

The **Yadkin River Goldenrod** (*Solidago plumosa*) was discovered by John K. Small in August of 1894. It was lost to science for 100 years, until 1994, when two botanists, Alan Weakley and Steve Leonard, working independently, each spotted the rare plant within three days of each other. Today, this imperiled goldenrod is known from only one population occurring on the riverbank of the Yadkin River Gorge.

Yadkin River Goldenrod is a highly specialized species, requiring the shelter of rock crevices near a body of water to survive and flourish. This particular environment was more abundant before the Yadkin River was dammed twice upstream from the lone popula-



photo by Johnny Randall

Yadkin River Goldenrod (Solidago plumosa) remains in the wild at only one site in North Carolina.

tion. However, the little goldenrod is hanging on, and there is still a chance to save it from extinction.

The last population occurs on private land, and the North Carolina Plant Conservation Program has been working with the corporation that owns the property to develop a conservation agreement that would allow botanists to monitor the population and the surrounding area. Conservationists hope the corporation will eventually sign such an agreement, and in the meantime conservation efforts are proceeding slowly.

"Permission has been granted to collect seed from the plants in the population, and we have collected seed from all individuals that flowered this year, which was about 75 percent of the population," Randall reports. There are some invasive exotic plants that occur around the population, but as of yet, the botanists have not been given permission to remove them from the area.

Together, Randall and Copenhaver have received a \$4,000 grant to study the cytogenetics of this species and other aspects of the biology of the plant. Copenhaver and his graduate students at the university will be trying to determine the genetic variance present in the existing population and at the population being cultivated at NCBG.

"One of the important issues in conservation when trying to recover a population is genetic variation," Copenhaver explains. "You get a bottleneck of genetic fitness: a population with little genetic variability, giving the

population decreased resistance to changes in the environment."

The North Carolina Botanical Garden will also be working to compare the genetics of this plant in the wild with the genetics of cultivated collections. Randall is concerned, as are many botanists, that after seed from a wild population is collected and grown in cultivation, the subsequent generations may be selected for the cultivated environment and also inbred, thus unsuitable for reintroduction.

"This is probably affected by their genetic variation, but that is something we will be testing," Randall explains. He will be comparing the success of subsequent generations of cultivated garden "volunteer" individuals (plants that grow without botanist help) with "wild type" plants in experiments.

Randall will also look at *in situ* performance of the garden volunteer progeny planted along the Yadkin River. The garden-grown volunteer individuals will be removed from the Yadkin River site prior to flowering in order to prevent interbreeding with the naturally occurring plants.

The results of this study will be something to watch for, as they provide fundamental insights into the conservation value of garden-grown plants and the importance of genetically diverse *ex situ* germplasm collections.

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Plant Profile: Queen of the Night

by Megan Cotter

To say the odds are stacked against this cactus is an understatement. **Queen of the night** (*Peniocereus greggii* var. *transmontanus*), also known as desert night-blooming cereus, occurs as only one known population in the east central portion of Arizona. This rare cactus grows in the shade of another, more common desert plant, the creosote bush (*Larrea tridentata*). This “nurse plant” provides sturdy branches to support the slender stems of the Queen of the Night cactus.

As its common name implies, this cactus blooms only at night, and each flower lives for only that one night. Each plant may produce 3-5 flushes of flowers from late May to early June, leading to red, fleshy fruit that is a treat for local birds.

But the rare bloomings must draw a unique audience of the hawk moths required for pollination. Each hawk moth may have to travel a significant distance to find the next fragrant flower to complete the pollination process. Unfortun-

nately, the use of pesticides is decreasing these moth populations.

Human actions are hurting this spectacular plant in other ways as well. The cereus’ natural habitat is being destroyed by urban development.

Furthermore, the cereus has a long history of religious, medicinal and ornamental popularity, causing it to be a sought after species for commercial collectors. Collectors often dig up the entire plant, playing a large role in the depletion of the population.

The cactus produces a large underground tuber that grows on average to the size of a basketball and is thought to have been used as a food source for Native Americans.

Queen of the night is maintained in the National Collection of Endangered Plants at **Desert Botanical Garden**, a participating institution in Phoenix, Ari-



photo by Lynda Pritchett-Kozak

Queen of the Night is currently not sponsored. To sponsor or partially sponsor this plant, please contact CPC at (314) 577-9540, or cpc@mobot.org.

zona. Botanists there have three cuttings growing successfully in cultivation and a seed bank of about 10,000 seeds. Now, their hope is to restore this extraordinary plant to its natural role in the ecosystem.

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