Reintroduction of endangered plants

Biologists worry that mitigation may be considered an easy option in the political and legal frameworks of conservation

When he was coordinator of the Endangered Plant Program for the California Department of Fish and Game, biologist Ken Berg would repeatedly get frantic phone calls from developers who needed his approval to continue with a subdivision construction project. It was and still is a common scenario in the mitigation wars, the struggle to reduce damage to endangered plants: a developer would learn from state biologists that the land on which he was building was the habitat of an endangered plant.

Berg would check the plant's status and meet with the developer, who would spread out project blueprints five years in the making. The developer, who already was counting on his profits from the project, would want to know quickly what he had to do to comply with laws governing endangered species. The clock was ticking on loans and investments that the developer already had sunk into the project. As the negotiations would begin, the pressure was on Berg to reconcile the long-term realities of ecology with the short-term imperatives of the economic bottom line. "Anything I would try in terms of mitigation to reduce the ecological impact was seen as taking profits out of his pockets," says Berg, who recently became program manager for special-status plants with the Bureau of Land Management in Washington, DC.

When negotiating a mitigation, the participants may trade off an existing population of plants or habitat for creation or protection of a population elsewhere. As law, politics, economics, and science play out, mitigation may mean that to keep the plant viable, the developer cannot build on all the lots. Or it may mean he has to pay to transplant the plant population to an area beyond the boundaries of the subdivision. After all, conservation biologists have learned how to reintroduce plants into old habitat or new areas. Or have they?

Reintroduction, when practiced in the context of mitigation, is an uncertain tool in need of a scientific underpinning, researchers concluded last April at the conference entitled "Restoring Diversity: Is Reintroduction an Option for Endangered Species?"[1] The St. Louis meeting was sponsored by the Center for Plant Conservation (CPC), which is headquartered at the Missouri Botanical Garden.

Biologists at the conference agreed that reintroduction can only be considered complete when a species is safely reestablished in its ecological and evolutionary context. But they need a sound method to measure success of reintroduction efforts.

Today, reintroduction techniques still cannot be considered much more than experimental, biologists warn. They admit that they know relatively little about endangered plants and how to restore them in their natural areas, much less move them successfully to new areas. But as biologists increasingly apply reintroduction techniques, they wonder whether they have opened a Pandora's box that could speed the demise of endangered plant species.

by William H. Allen

[1]Island Press in Washington, DC, plans to publish the proceedings in 1994.

A fairy tale

Reintroduction, sometimes loosely used to describe any movement of plants in a conservation context, more specifically refers to planting plants where they occurred historically. The field also now includes three more specific types of plantings. First, in enhancement, a population of plants on the brink of disappearing is boosted by the addition of plants of the same species but from different areas. Enhancement increases population numbers and diversifies the gene pool.

Second, in introduction, a more drastic step, a species is planted in areas where it is not known to have occurred, although the plants still remain within their normal range, or ecological envelope. These sites sometimes are protected as part of a strategy to prevent the species' extinction.

Third, translocation, or relocation, is the most dramatic of the reintroduction techniques and the one where success is the most uncertain, especially for species that are rare or restricted to rare habitats. Translocation requires completely removing naturally occurring mature plants from one spot and reestablishing them elsewhere. The other methods can be done with seeds or with propagated material. Most mitigations currently do not involve translocation of species. However, if biologists can learn enough about how and when to use these techniques, conservationists may no longer be limited mainly to protecting shrinking pockets of natural land from development.

"The overwhelming apprehension about mitigation among people com-

mitted to conserving diversity has been that it's been treated as something we know how to do with a high degree of confidence, when in fact it's surrounded by uncertainty and partial success at best and failure more frequently," says Don Falk, former executive director of CPC and now executive director of the Society for Ecological Restoration, which is based in Madison, Wisconsin. "At its worst, mitigation can be a charade, a fairy tale."

Yet, mitigation is also one of the few ways biologists have to address the loss of diversity. "At its best, it is a healing art of ecology," Falk says. "It is the art of the possible."

Successes, failures, and sabotage

Reintroduction is already under way in many parts of the country. Approximately one-fourth of all the recovery plans aimed at bringing back plants under the Endangered Species Act include some form of reintroduction, say Falk and Peggy Olwell, manager of CPC's conservation programs. The exact number of reintroductions is not known, but they reach into the thousands and involve hundreds of plant species.

Despite their popularity, reintroductions are not 100% successful. Of 45 reintroduction projects in California in the past decade, 4 were completely successful, 15 partly successful, and 10 failed, where success is defined as the ability of the population to survive and reproduce. It is too soon to tell for the rest. In a 1991 British Nature Conservancy Council study of 144 plant reintroduction attempts, only 22% were deemed successful. More than half had appeared to have failed.

Among mitigation successes so far is the reintroduction of running buffalo clover, *Trifolium stoloniferum*, to some of its native habitat in Missouri. The white-flowering clover with creeping stems once flourished from West Virginia to Kansas in the moist, shaded habitats along streams and animal trails. The clover has disappeared from many states and in 1983 made the federal list of threatened plants.

The Santa Cruz tarplant is one of the cautionary tales of plant reintroduction. After successful translocation of many plants, many of the transplants died unexpectedly. Photo: Ann Howald, California Department of Fish and Game.

Running buffalo clover once occurred across two-thirds of Missouri, but it could not be found in the state as recently as the 1980s. Biologists with the Missouri Department of Conservation and the Mark Twain National Forest discovered seedlings along a stream near St. Louis in 1990, and, with the help of the Missouri Botanical Garden, propagated specimens and transplanted them to selected sites in the national forest. So far, the transplanted clover is doing well.

But, as the case of the Santa Cruz tarplant illustrates, only time will tell whether the effort is successful. The tarplant, *Holocarpha macradenia*, is representative of many mitigation failures. The tarplant is a summer-blooming annual native to flat, coastal grasslands in part of the San Francisco Bay area, as well as the Central Coast region around Santa Cruz. Unfortunately for the plant, those grasslands are popular sites for development.

Not listed as an endangered species at the time, the plant was all but eliminated by the early 1980s. Neil Havlik, a biologist with the East Bay Regional Park District, realized the situation and mounted a last-ditch effort to save it. Havlik, along with family and friends, conducted a series of 22 translocations, "which admittedly were quite Johnny Appleseed in nature," says Howald. They scattered the plant widely and without a plan. Havlik is now with the Solano County Farmlands and Open Space Foundation in Fairfield, California.

Annual monitoring data had indicated that the plant could survive without much problem if transplanted. But something went wrong. "In 1990, the populations crashed," Howald says. "We don't know exactly why, possibly because of drought or grazing." One population survived to grow to more than 4000 plants in 1993 in Wildcat Canyon Regional Park in the San Francisco Bay area, but only a few of the other introduced populations hang on in groups of a few dozen or a few hundred. A survey by Howald in August 1993 found no remaining natural populations of the tarplant in the area. (A small, remnant native population in the Bay area, which is the tarplant's northern range, appeared to be unaffected by the crash that affected the transplants. However, this native remnant was destroyed in 1993 to make way for a shopping development.)

A separate reintroduction project failed in the plant's southern range, in the Santa Cruz region, but there

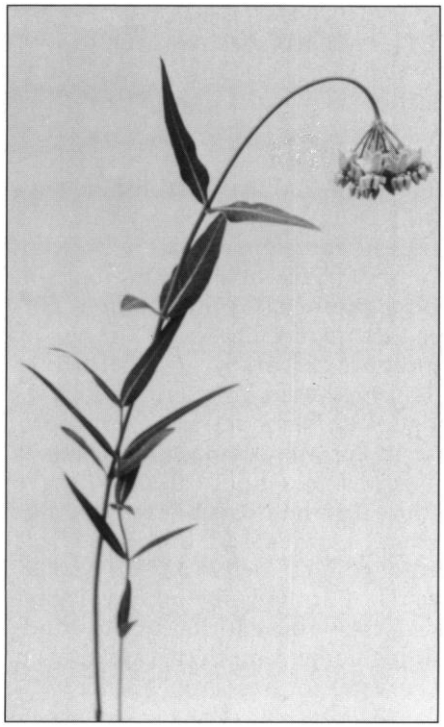
are at least two remaining natural populations: one in northern Monterey County on land protected by The Nature Conservancy, and the other, discovered in 1993, along runways at Watsonville Airport in Santa Cruz County.

"What we've learned here is that the time needed to evaluate these projects is a lot longer than what many of us had thought in the beginning," Howald says. "It may not be known for a decade or even more whether a particular translocation is going to work. Lengthy monitoring is going to be required to determine the results."

Even if they have good prospects for success, some mitigation projects may have enemies even within the conservation community. Consider the strange case of the missing Mead's milkweed, *Asclepias meadii*, a federally listed threatened species. The plant, a relative of more common milkweed plants found in yards and along railroad tracks, is a native of the tall-grass prairie of the Midwest.

Mead's milkweed is now extinct over a large part of its range. Most of its larger remnant populations grow in Kansas and Missouri, and a few small populations hang on in Illinois and Iowa. However, Barbara Schaal of Washington University in St. Louis has found that even large populations of the milkweed can have low genetic diversity.

When biologists with the Morton Arboretum, in Lisle, Illinois, transplanted a few Mead's milkweeds in 1991 into the Shawnee National Forest in southern Illinois, they thought they were rescuing a rare plant on the verge of extinction in the region. But someone who disagreed violently ripped the plants out of the remote spot where they had taken root and made off with them. Botanists, who declined to be identified, suspect that the unknown culprit may have been a scientist or environmentalist who believed that bringing in Mead's milkweeds from another area was not what nature had intended.



Mead's milkweed only survives in protected tallgrass prairie or hay meadows of the Midwest. Biologists are debating whether new knowledge about transplanting now-endangered plants will actually hurt efforts to save them. Photo: Marlin Bowles, Morton Arboretum.

Faustian trading

Among some biologists, the uncertainty of this new art has gained mitigation a reputation as an "unsavory practice," Berg says. "Society accepts the concept of doctors practicing medicine and of lawyers practicing law," he says. "I hope it can accept the concept of conservation biologists practicing mitigation."

Some conservationists are leery of mitigation partly because it may give a false sense of security and because it violates a central doctrine of conservation: do no harm. "Theoretically, mitigation can be a loaded gun pointed at any natural area, even ones we think are securely protected. In essence, if mitigation tradeoffs begin to be used in very many situations, then hypothetically nothing would be off limits," says Falk.

That skepticism is compounded by the perception that people who most strongly advocate mitigation often have a different agenda: the economic bottom line. If botanists become proficient in restoring endangered plant populations in old and new habitats, it may encourage developers to push for moving rare plants out of the way of subdivisions, shopping centers, and other development. The result may be a kind of domino effect of natural habit destruction in which conservationists are forced to tamper with nature on many more fronts than they find acceptable.

"Is this a Faustian bargain?" asked Edward Guerrant, conservation director of the Berry Botanic Garden in Portland, Oregon. "If we develop the technology to do this, will it be used to destroy habitat later?"

Going beyond gardening

Implicit in biologists' concerns is apprehension about the dearth of data on the organisms and ecosystems at issue. "With many endangered plants, there's more unknown than there is known about them," says Ann Howald, a plant ecologist with the California Department of Fish and Game in Yountville, California. "For example, many times we know nothing about their pollination systems or germination requirements."

Moving plants around to novel habitats, including areas outside their historic ranges, also may interfere with natural variation and evolution. Some biologists are concerned that gene pools that were previously separated by natural boundaries will mix.

"The weight of opinion tends to be that this is not a good thing," says Howald. "But whether it has a positive or negative effect on the species is still a subject of debate."

Reintroductions need to establish ecosystem functions, not just the presence of a few individuals of a target species, say Joy Zedler of San Diego

State University and Donald Waller of the University of Wisconsin at Madison. This requirement includes having all worked out a self-sustaining population size, pollinators, mycorrhizal symbionts, seed dispersal agents, nutrient cycles, and hydrology.

Thus, conservation biologists need to go "beyond gardening" to restore plants in their ecological matrix, Waller says. Biologists in relevant fields should be consulted when reintroducing, for instance, a plant that is dispersed by a particular ant species or a plant that gains protection from herbivores by supporting a particular kind of repellent fungi.

In many cases, going beyond gardening will take decades, and therein lies a time-scale problem. The scale of mitigation (months) is dramatically different than that of ecology (years to centuries).

"Developers may not want to wait 25 years until we know if a reintroduction really works," says Falk. "But what we as ecologists are saying is, it may take that long to have a reasonable idea if we've established anything of lasting biological value."

Lest the conservation biology community push the panic button, some biologists remind their colleagues that there is still time for thought, research, and deliberate planning based on scientific knowledge. "Reintroduction is appropriate in certain circumstances, but it must be carried out carefully," says White of the North Carolina Botanical Garden. "If the world was really going to hell in a hand basket, we'd be out there like Johnny Appleseed, throwing caution to the wind, [doing something desperately, even if it were not based on science]."

The uncertain political arena

Among those who are skeptical that mitigation will succeed over the long run is George Gann-Matzen, an ecological consultant with Ecohorizons Inc. in Miami, Florida. Gann-Matzen has worked on several plant restoration projects for private contractors in Florida, particularly projects involving wetlands.

"Mitigation has serious functional problems in the political and economic context that will cause it not to achieve success," Gann-Matzen says. Among those problems are the traditional American belief in private property rights and the lack of a legal framework that recognizes biological complexity in areas threatened with or recovering from development.

"Mitigation is great for learning—I've learned a lot," says Gann-Matzen. "But as for no net loss? Forget it. We're losing everything. We might as well recognize it for what it is."

Responding to cautions like this, some biologists have called for their colleagues to get more involved in the policy-making process. These biologists say that even if the biological answers about reintroduction come in, they will not be nearly enough to overcome the hurdles ahead. Advances in reintroduction science and technology may change the landscape of the battleground over endangered species, but the greater need is for a political and legal framework to guide the conflict between conservationists and developers.

"We're up against the second-oldest profession in the world: land speculation," Berg says. The land-use planning that surrounds development and endangered species is a complex, multidisciplinary issue. Such planning is "90% politics and 10% biology," he said. "And biology is usually the easy part." ❑

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