A Case for Conserving Imperiled Plants by Ecological Area

TONY POVILITIS

Cochise Conservation Center, Willcox, Arizona

Abstract: Imperiled plants are sometimes protected as endangered or threatened species at state and national levels. However, politically based geographic units fall short for conservation purposes. For example, only 19 percent of plant species considered imperiled in the San Juan region of Colorado and New Mexico appeared on recent state or federal endangered species lists. Conservation of imperiled plants by ecological area is proposed. This would help (a) safeguard plant populations of evolutionary significance; (b) maintain the integrity of biotic communities; (c) draw attention to imperiled regional endemics, which often fail to make government endangered species lists; and (d) preserve wild plant populations locally for conservation education and for medicinal, aesthetic, scientific, and other cultural reasons. A focus on ecological areas would broaden modern conservation practice, making it better able to protect and restore the natural world.

Plant species in danger of disappearing from significant geographic areas of the United States often receive little or no attention in conservation planning. For example, a recent tally of imperiled plants of the San Juan Mountains and adjacent areas of Colorado and New Mexico revealed that only 10 of 54 (19%) of these species appeared on federal or state endangered species lists (Povilitis 2000; Table 1). Of 28 imperiled plant species in the San Juan region occurring in New Mexico, less than half were on the rare plant list of the New Mexico Rare Plant Technical Council (2000). The council, which encourages conservation by landowners and others, does not list plants that are rare in New Mexico if substantial populations occur elsewhere.

In cases where a species is imperiled throughout its geographic range, protection for each existing population can be justified to help prevent extinction of the species as a whole. This is true for federally listed San Juan region plants like Mancos milkvetch *Astragalus humillimus* and Mesa Verde cactus *Sclerocactus mesae-verde*. It is also true for vulnerable local endemic species such as skiff milkvetch *Astragalus microcymbus* and Pagosa gilia *Ipomopsis polyantha*, which for one reason or another are not currently listed.

What about protecting species that are jeopardized over portions—but not all—of their ranges? This paper proposes recognizing and conserving imperiled plants by ecological area. An ecological area can be defined as a sizable land area that differs broadly from other areas in its biological, edaphic, and geographical features or patterns. For illustrative purposes, the San Juan Mountains and surrounding highlands, valleys, and basins are considered an ecological area. Ecological area boundaries can be determined by examining the distribution of organisms and coinciding physical landscape features (such as soils, topography, and climate).

Some observers may argue that it is unnecessary to protect a species in every ecological area in order to maintain it, and that attempting to do so would spread conservation resources too thin. Why not focus on state or nationally endangered species and on conserving them in places where environmental conditions are most optimal? Notwithstanding its practical appeal, this approach neglects important evolutionary, ecological, and cultural aspects of plant and animal populations; it implies "preservation" of species as diminished evolutionary units, truncated ecologically, and divorced from a larger relevance to humans. I find three compelling reasons to conserve species by ecological area:

1. *Adaptation and organic evolution* – Species that are geographically widespread over varied environments tend to have large, diverse gene pools (Hamrick and Godt 1989, Soltis et al. 1997). Consequently, they are best able to environmentally adapt and generate new taxa (Fisher 1956, Fréville et al. 1998). Significant genetic differences are commonly recorded between populations of wide-ranging plant species across ecological areas. Examples from North America include wake-robin *Trillium ovatum* (Fukuda 1989) and Skinner's purple false foxglove *Agalinis skinneriana* (Kercher and Sytsma 2000).

There are 21 imperiled plants of the San Juan region with broad geographic distributions and another 20 species with more restricted yet still

Table 1. Geographic and legal status of imperiled plant species of the San Juan ecological area (based on Povilitis 2000). (P) indicates species whose San Juan populations are peripheral or disjunct from their main geographic ranges. (L) indicates species that appear on federal or state endangered species lists.

Wide Distribution

(P) Venus'-hair fern *Adiantum capillus-veneris;* (P) American spikenard *Aralia racemosa;* (P) Alpine aster *Aster alpinus* variety *vierhapperi;* (P) Bodin milkvetch *Astragalus bodinii;* Green sedge *Carex viridula;* (L) Little beeplant *Cleome muticaulis;* (L) Yellow lady's-slipper *Cypripedium parviflorum* variety *pubescens;* (P) Mountain bladder fern *Cystopteris montana;* Gaint helleborine *Epipactis gigantea;* (P) Low fleabane *Erigeron humilis;* (P) Altai cottongrass *Eriophorum altaicum* variety *neogaeum;* (P) Dwarf rattlesnake-plantain *Goodyera repens;* (P) Spiny-spored quillwort *Isoetes echinospora;* (P) Gay-feather *Liatris ligulistylis;* (P) (L) Wood lily *Lilium philadelphicum;* Canyon bog-orchid *Platanthera sparsiflora* variety *ensifolia;* Marsh cinquefoil *Potentilla palustris;* Parish's alkali grass *Puccinellia parishii;* Hoary willow *Salix candida;* Blue-eyed grass *Sisyrinchium demissum;* (P) Wild hyacinth *Triteleia grandiflora.*

Restricted Distribution

Galisteo sand verbena *Abronia bigelovii;* (P) Sessile-flowered false carrot *Aletes sessiliflorus;* Brandegee milkvetch *Astragalus brandegei;* Cronquist milkvetch *Astragalus cronquistii;* (L) Mancos milkvetch *Astragalus humillimus;* Chaco milkvetch *Astragalus micromeris;* Naturita milkvetch *Astragalus naturitensis;* Kachina daisy *Erigeron kachinensis;* Comb Wash buckwheat *Eriogonum clavellatum;* (L) Clay-loving wild buckwheat *Eriogonum pelinophilum;* New Mexico butterfly plant *Gaura neomexicana neomexicana;* Colorado desert-parsley *Lomatium concinnum;* Eastwood monkey-flower *Mimulus eastwoodiae;* Little penstemon *Penstemon breviculus;* Abajo penstemon *Penstemon lentus;* Adobe beardtongue *Penstemon retrorsus;* Splendid scorpionweed *Phacelia splendens;* (P) Giant cinquefoil *Potentilla ambigens;* (L) Mesa Verde cactus *Sclerocactus mesae-verde;* and Pale blue-eyed grass *Sisyrinchium pallidum.*

Regional Endemic

Gunnison milkvetch *Astragalus anisus;* (L) Cliff-palace milkvetch *Astragalus deterior;* Skiff milkvetch *Astragalus microcymbus;* Taos milkvetch *Astragalus puniceus* variety *gertrudis;* Ripley milkvetch *Astragalus ripleyi;* Schmoll milkvetch *Astragalus schmolliae;* Sleeping Ute milkvetch *Astragalus tortipes;* San Juan saltplant *Atriplex pachypoda;* (L) Aztec gilia *Gilia formosa;* San Juan Gilia *Gilia sedifolia;* Mesa Verde stickweed *Hackelia gracilenta;* Pagosa gilia *Ipomopsis polyantha;* Pagosa bladderpod *Lesquerella pruinosa;* (L) Knowlton cactus *Pediocactus knowltonii;* Pagosa phlox *Phlox caryophylla;* (L) Brack's cactus *Sclerocactus cloveriae brackii.*

sizable ranges (see Table 1). San Juan region populations of these plants could be important evolutionary units, though their genetic uniqueness has not been tested. Testing for allozyme or DNA variation would of course be useful in assessing their distinctiveness. However, given current technical limitations, such work would be time consuming, expensive, and possibly inconclusive (Schaal et al. 1991). Moreover, genetic information may be of limited value to long-term conservation planning because the degree of existing differentiation is not necessarily predictive of future change. Based on Hunter et al. (1988) and Lammi et al. (1991), populations occupying distinct ecosystems and subjected to varied regimes of natural selection deserve protection, regardless of their current degree of genetic or morphological differentiation.

Some observers may question the value of conserving geographically peripheral populations, arguing that they occupy marginal habitat where conservation efforts are unlikely to succeed. In the San Juan Mountains region, 22 of 54 (41%) regionally imperiled plants occur as peripheral or disjunct populations (see Table 1). Nevertheless, these populations may be, or may become, the most differentiated, being subject to physical and biotic challenges of marginal environmental conditions (Hazlett and Sawyer 1998). As Lesica and Allendorf (1995) have argued, peripheral populations are an important potential source of local adaptation and future speciation events.

2. *Ecosystem integrity* – Conservation of locally occurring populations is needed to maintain the biological integrity of natural (Callicot et al. 1999) or quasi-natural communities, where composition, diversity, and functional organization remains comparable to what occurred naturally (Angermeier and Karr 1994). Maintaining viable populations of all native species in situ is a primary goal of ecosystem manangement (Grumbine 1995, Temple 1997). As species disappear due to human causes, the ecosystems of which they were part become degraded and artificialized, often irreversibly so.

In terms of ecosystem management, Aldo Leopold's (1946) observation that keeping "every cog and wheel is the first precaution of intelligent tinkering" certainly has merit. However, apart from the obvious loss of a natural element, it is often difficult to determine what the disappearance of a species may mean for a given ecosystem as a whole. Nevertheless, each species affects the biotic community to a greater or lesser degree, be it through competition, predation, herbivory, parasitism, mutualism, modification of the abiotic environment, or some other mechanism (Roughgarden and Diamond 1994). Seldom can biologists say what is ecologically consequential, except perhaps after the fact.

Although many imperiled plants of the San Juan Mountains region appear insignificant in terms of the region's overall flora, they may have important roles in shaping local biotic communities. For example, Adobe beardtongue *Penstemon retrorsus*, Colorado desert-parsley *Lomatium concinnum*, and Pagosa gilia *Ipomopsis polyantha* grow on clay soils derived from Mancos shale, a substrate that limits plant community development and presents special adaptive challenges to plant and animal life.

Whatever the precise function of a species in an ecosystem, its extirpation by humans serves notice that other species and the ecological processes upon which they depend may be at risk. An imperiled species typically means an imperiled habitat. Indeed, threats identified for imperiled plant species of the San Juan region, such as livestock overgrazing or poorly planned land and water development (Povilitis 2000) adversely impact a host of other plants and animals, many of which could eventually be lost.

3. Cultural value – Since the dawn of *Homo sapiens*, people have relied on wild plants for food, medicine, clothing, shelter, tools, weapons, insect repellants, dyes, use in rituals, aesthetic appeal, and other purposes. For example, American spikenard *Aralia racemosa*, an imperiled plant of the San Juans, has been used in soups, teas, and as medicinal preparations to treat respiratory ailments, skin conditions, backache, and menstrual and birthing problems (Moore 1989, Swerdlou 2000).

Intact local floras could provide new scientific, medical, and educational benefits as well as continued historical uses. For instance, populations of American spikenard and other species occurring along the margins of their geographic ranges may produce a greater concentration of bioactive chemicals, being exposed to tighter environmental constraints that restrict range (Hazlett and Sawyer 1998). New technologies may soon allow rapid assessment by plant aficionados of potentially important substances from local plant populations at various levels of development (bioactive substances may be present only at certain life history stages; recall, for instance, that opium is present only in unripe seedpods of *Papaver somniferum*).

Perhaps the greatest contemporary benefit of an intact local flora is the opportunity for people to gain first-hand knowledge of vulnerable plant species. For someone living in the San Juans, for example, the experience of seeing attractive or unusual rare species like Wood lily *Lilium philadelphicum* or Giant helleborine *Epipactis gigantea* may trigger heightened appreciation of the challenges that living things face in a human-dominated world. If lack of public awareness of the extinction problem is an impediment to conservation (Wilson 2000), the opportunity to learn about it in one's own "neighborhood" should have considerable merit.

Conservation ultimately succeeds or fails to the extent that people lessen their impacts on the biota and engage nature in a harmonious manner. Cultural shifts of this type have occurred in the past (Nabhan 1994), and they can occur in today's world (Western et al. 1994). There is no fundamental reason why we cannot develop a culture that sees humans as being part of nature, and protects and nurtures the local biota as a matter of everyday stewardship (Povilitis 2001).

Biologists can help enormously by identifying imperiled plant and animal populations by ecological area and by working to conserve them in collaboration with private landowners, environmental organizations, and public natural resource and planning agencies. They can also advocate that state and federal agencies adopt the ecological area approach in endangered species management. At the very least, doing so would help focus attention on currently unlisted imperiled endemics, including 12 plant species found only in the San Juan ecological area (see Table 1). At best, it would also substantially broaden the scope of modern conservation practice, making it more successful at protecting and restoring the natural world.

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