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Rare Plants of Eastern Oregon and Washington

Abstract

Rare plants are an important consideration for managing forest health and productivity in eastern Oregon and Washington. The floristic diversity of this area reflects the complex biophysical environment. There are many endemic vascular plants whose ranges lie entirely within this region; many are restricted to very small geographic areas or highly specialized habitats. A common element is adaptation to natural disturbance; non-natural threats include exotic plant invasion, agricultural conversion, road construction, recreation, fire suppression activities, livestock grazing, herbicide spray that reduces pollinators, and altered fire and hydrological regimes. Because various species are adapted to different successional stages, maintaining a diversity of stages would provide for a variety of these species. Restoration of the natural fire regime and reduction of grazing would benefit upland shrub communities. Mitigation of activities for rare plants is site-specific and may include altering the timing, level of intensity, or methods used.

Introduction

Plants are the most ubiquitous and taxonomically diverse macroorganisms east of the Cascade Range. These organisms function as primary producers, capturing sunlight and carbon, and producing oxygen, via the process of photosynthesis. As such, they are the most critical components in the maintenance of dynamic, functional ecosystems. Plants provide foods for animals, stabilize watershed functions, provide habitat and cover for numerous organisms, influence climatic patterns on local and regional scales, contribute to soil development and stabilization, have specialized relationships with pollinators and seed dispersers, and provide a variety of other critical ecological functions such as nitrogen fixation. In addition to these essential ecological functions, vascular plants and plant communities (assemblages of species) provide the foundation for the economic and social fabric of this area. Commercial resources critical to the region's economy are provided by vascular plants, including timber, forage, and other special plant products; these resources are harvested on both large and small scales. In addition, vascular plants are a very important part of the cultural history of native peoples in the Pacific Northwest.

Owing to large-scale vegetation shifts related to climatic changes, the presence of a high diversity of geological substrates, and barriers to gene flow caused by mountainous topography and other geographical barriers, western North America has been an area of very active evolution for vascular plants. The flora of the area reflects this history of divergence (Hitchcock et al. 1969). The native flora of eastern Oregon and Washington includes a spectacular diversity of plant taxa that range from geographically restricted endemics, some known only from one or a few occurrences, to those that are common and widespread across the interior West. Vascular plant life forms range from the largest terrestrial organisms, trees up to 100 meters in height, to the smallest flowering plants known (aquatic plants in the genus *Wolffia*, the individuals of which are 1 mm or less in size). Especially noteworthy is the high number of endemic vascular plants whose ranges lie wholly or partially within this region. Many plant taxa are local endemics; those taxa restricted to very small geographic areas (e.g., one portion of a mountain range, one canyon, etc.). Local endemics are often also restricted to highly specialized habitats, e.g., chemically unique rock outcrops such as serpentine, and are best addressed at the site or stand scale of analysis. In addition, many more plant taxa are regional endemics; these have larger geographic ranges than local endemics, but are still confined to a relatively small region (e.g., southeast Washington, northern Idaho, and northwest Montana for a Palouse grassland endemic). Regional endemics may also be closely associated with certain habitats, and their ranges may again lie either entirely within the eastern region or extend beyond state boundaries. These taxa can be best addressed at the subwatershed or landscape scale. An example of a local endemic is *Lomatium ochocense*, a species that occurs only

in a single river drainage on the north fork of the Crooked River in central Oregon (Helliwell and Constance *In press*). *Silene spaldingii*, an example of a regional endemic, occurs in four states: Montana, Idaho, Oregon, and Washington. It once was broadly distributed across the Palouse Prairie and today is proposed for federal listing as threatened (U.S. Fish and Wildlife Service 1999c).

The evolutionary history and resultant floristic diversity of the analysis area is a reflection of the complexity of biophysical environments in the interior West. The influence of many of these environments has been manifested through natural selection in edaphically or physically unique habitats, e.g., chemically stringent substrates weathered from ultramafic (serpentine) or calcareous (limestone) bedrock, coarse-textured soils, and climatically harsh alpine environments. The presence of extreme environmental gradients with respect to temperature and moisture has also contributed to evolutionary diversification in the flora of the area. This area is unique in North America in containing habitats that range from extremely arid deserts to temperate forests, across elevations from sea level to over 14,000 feet. Owing to this floristic and environmental diversity, this area also contains a very large number of seral and climax plant community types (Franklin and Dryness 1973).

Adaptation to Disturbance

A common element found among all this biotic diversity, is the adaptation to disturbance. Given the dynamic nature of these diverse habitats, all these species are adapted to many scales of disturbance, to both fine-scale patch events, such as windfall, and broad-scale physical events (fire and climate change) and biotic disturbances (insects and disease) (Brown and Smith 2000, Johnson et al. 1994).

To best assess the effects and role of disturbance or management activities on rare vascular plants, Croft et al. (1997) assigned rare taxa to geographic distribution categories. These categories help to place the distribution of populations in context with the scale of activities. Definitions for these categories are as follows:

- Local endemics—populations are restricted to a very small geographic area (i.e., one portion of a mountain range, one canyon, etc.), these taxa are often also restricted to highly specialized habitats, and their range may lie entirely within a project boundary (i.e. *Lomatium erythrocarpum*, found only in the Elkhorn Mountains in Baker County, OR, on gravelly granodiorite soils and argillite talus);
- Regional endemics—populations inhabit a larger geographic area than that of a local endemic (i.e., southeast WA, northern ID, and northwest MT for a Palouse endemic); these taxa may also be closely associated with certain habitats, and their range may lie entirely within a subbasin or province;
- Scattered distribution—populations are sparsely distributed within and outside the subbasin or landscape area; the overall geographic range of these taxa is wide (i.e., they may be found in many western states, *Spiranthes diluvialis* is a good example), but they are nowhere common on the landscape;
- Disjunct distribution—populations are within, or straddling, the area boundary and are substantially separated geographically from the remainder of the taxon's range (i.e. *Musineon lineare*, one occurrence in Washington, rest of the distribution is in Alaska);
- Peripheral distribution—populations are within, or straddling, area boundaries, lie on the margin of the taxon's range, and are geographically contiguous with that range.

The majority of rare vascular plant taxa in eastern Oregon and Washington are either locally endemic in their distribution pattern, or have broader distributions but are associated with highly specialized habitats. The latter case usually involves plant taxa that are tightly confined to highly specialized habitats that occupy very small (< 1 km^2) patches on the landscape or are highly imperiled local endemic or ecologically specialized plants, that cannot be meaningfully analyzed at a broad scale. The viability and conservation of these narrowly distributed or ecologically restricted taxa are best addressed at the local or sub-regional level, e.g., on the pertinent National Forest(s)or Bureau of Land Management unit(s) or by eco-regions or provinces (Lehmkuhl et al. 1997). Appropriate approaches in these cases include the development of conservation strategies or the incorporation of specific standards and guidelines into the management plans for planning areas.

Rare Taxa

Vascular Plants

Of the hundreds of rare plant taxa in this region, currently, there are only nine vascular plant taxa that are protected, or proposed for protection, under the Endangered Species Act. *Astragalus applegatei* (endangered) is a local endemic known from two populations near Klamath Falls, Oregon. The largest population is on private land leased by the Nature Conservancy (U.S. Fish and Wildlife Service 1993). Disturbance in the form of seasonal flooding may have played in important role in maintaining habitat for this species. *Hackelia venusta* (proposed endangered) is a local endemic limited to one small population on unstable granitic scree in Tumwater canyon, Washington. A single natural or human-caused random environmental disturbance could destroy a significant percentage of the entire distribution for this taxon (U.S. Fish and Wildlife Service 2000). *Howellia aquatilis* (threatened) is an ecologically highly specialized aquatic, pothole pond, monotypic genus with a scattered distribution that historically occurred from California to the Willamette Valley and east to Washington, Idaho, and Montana. Today it is only found in Washington, Idaho, and Montana (Lesica et al. 1988; Shelly and Moseley 1988; Shelly 1988, 1989; Rice 1990; Shelly and Schassberger 1990; Schassberger and Shelly 1991; Gamon 1992; Lesica 1992; Roe and Shelly 1992; U.S. Fish and Wildlife Service 1994; Mantas 1995). *Mirabilis macfarlanei* (threatened) is a local grassland endemic found in the Snake River Canyon (Baker 1985, Barnes and Wolf 1994, Carter 1994). Invasion of habitat by exotic species continues to threaten this species. While fire may be a useful tool in habitat restoration, the presence of cheatgrass, knapweed and yellow starthistle at most sites, contraindicates its use as a broadly applied restoration tool. *Sidalcea oregana* var. *calva* (endangered) is a local endemic restricted to five meadows in the Wenatchee Mountains of Chelan County, Washington (U.S. Fish and Wildlife Service 1999a). Fire may play a role in the development and maintenance of populations for this species as it occurs in early successional stages of habitat. *Stephanomeria malheurensis* (endangered) is a local endemic found at only one location in Harney County, where it resides on an old zeolite mining claim (Parenti and Guerrant 1990). *Spiranthes diluvialis* (threatened) is a riparian orchid with a scattered distribution from Washington to Utah. Urban development and watershed alterations in riparian and wetland habitat adversely affect this plant. *Silene spaldingii* (proposed threatened) is a Palouse prairie relic plant with a regional distribution. Threats to the viability of this species stem from continued habitat conversion, livestock grazing, the lack of fire, the invasion of exotic plant species, and herbicide spray and drift. Prescribed fire may be a useful tool for managing habitat for this species (Lesica 1997). *Thelypodium howellii* ssp. *spectabilis* (threatened) is a local endemic currently known from 11 sites on private land in Baker and Union Counties of Oregon. Agricultural and urban development, livestock grazing, and competition from non-native vegetation threaten it (U.S. Fish and Wildlife Service 1999b).

Both the Oregon and Washington Natural Heritage Programs maintain lists of special species that have been determined to be of State conservation concern. Species are organized into four lists depending upon the degree of conservation concern and threat of extinction. In addition, the state of Oregon in 1987 passed the Oregon Endangered Species Act under which plants may be designated as threatened or endangered. The Federal land management agencies also maintain lists of species that are of conservation concern.

The general trend for rare plants has been a decline in habitat and population integrity from the historical condition to the present. The declines from historical to current conditions for vascular plant taxa have generally resulted from habitat conversion, or shifts in habitat suitability resulting from successional changes due to fire suppression and other land management activities (e.g., grazing, timber harvest).

As rare taxa vary in their successional habitat relationships, this can significantly influence the effectiveness of management projects and accompanying mitigation. Some endemic taxa are associated with early seral habitats (e.g., *Penstemon glaucinus*, (Croft et al. 1997)). Such species are nonetheless often considered of range-wide conservation concern, despite their occurrence in disturbed settings, because of their limited geographic ranges and the typically low number of populations that occur in more stable habitats. Their affinity to ephemeral, frequently disturbed habitats renders them more susceptible to frequent local

extirpations. In these cases, prescriptions that include maintenance or creation of canopy openings, via silvicultural treatment or prescribed burning, were rated as more likely to produce favorable habitat and population conditions.

Mid-seral species include such taxa as *Cypripedium fasciculatum* (scattered distribution) and *Castilleja chlorotica* (regional endemic). For the former species, the alternatives that include prescriptions involving thinning or prescribed burning, such that partial shade or small openings might be enhanced, were rated as being likely to produce more favorable outcomes (Brownell and Catling 1987, Kagan 1990). Many of the rare plant taxa are associated with early to mid-seral successional stages, would benefit from restoration treatments given adequate mitigation measures, and provide a mosaic of habitats and structural stages.

Species that are essentially confined to late-seral community types include those affiliated with the Palouse grasslands throughout all, or a significant portion, of their ranges. The Palouse prairie vegetation type is estimated to have been eliminated from 98% of its original acreage owing primarily to agricultural conversion of non-federal lands. Four of the rare plant taxa are associated with this community type, and have some of their occurrences on federal lands; these include *Calochortus nitidus*, *Haplopappus liatriformis*, *Polemonium pectinatum*, and *Silene spaldingii*. All of these have suffered extensive historical losses of habitat and populations in the non-federal portions of their ranges (Schassberger 1988, Caicco 1992, Lesica 1993). In addition, one species that occurs exclusively on non-federal lands is also associated with this community type; its viability has been even more seriously adversely affected, *Aster jessicae* (Lorain 1991). Extant populations of these taxa are found only in high-quality remnants of such habitats. These species are all of serious conservation concern within the Region as is the remaining extant Palouse grassland in general. These species exemplify the critical role that federal lands play as refugia for the extant habitats and populations of these, and many other, plant taxa of range-wide conservation concern.

Another plant community group of major importance in providing habitat for vascular plants of range-wide conservation concern in this region is the Upland Shrub group, specifically the sagebrush steppe region of the upper Snake in Idaho and the Columbia River plains. Taxa in the genus *Astragalus* (*A. mulfordiae*, *A. oniciformis*, *A. solitarius*, and *A. yoder-williamsii*) are associated primarily with such upland shrub communities (Barneby 1989, Mancuso and Moseley 1993). Restoration prescriptions, especially those that restore the natural fire regime and reduce grazing, have the possibility of returning some habitat to historical conditions. The presence of exotic species will present a challenge in the application of prescribed fire as fire enhances the spread of invasive plant species. Such prescriptions would be favorable to all of these species, though much of the former habitat for some has been converted by range seedings and will be difficult to restore (Kennison 1980, Franklin 1990, Owen et al. 1994). The improvement in available habitat is limited due to the spread of exotic species, habitat conversion to non-native grass seedings, grazing, and changes in the fire regime (Smithman 1990, 1993; Wright 1988).

Botrychium (moonwort fern) species also have scattered distribution across the Region (Wagner and Wagner 1981, 1983, 1986, 1993: Vanderhorst 1993). Most occurrences of these widespread taxa occur sparsely on federal lands across the area, although their distributions and status are much less understood than for the other vascular plants analyzed. While little is known about the effects of management activities on a species-specific basis, generalizations can be made for the group as a whole. For example, it is known that *Botrychium crenulatum*, a species that is often associated with moist old-growth stands of *Thuja plicata* (western red cedar), would benefit from any aquatic buffers that may be established. The projected effects from management activities indicate further loss of habitat, primarily as a result of timber harvest (Whittier 1973, Zika 1992, Zika et al. 1995). It appears Botrychium can survive fire as long as burning is not done under drought conditions and is of low to moderate intensity (Cindy Johnson-Groh, Gustavus Adolphus College, personal communication)

In addition, there are many vascular plant taxa that, while secure on a range-wide level, are rare at the state level in one or more states in the interior West. Conservation of these species of local concern is also an important consideration, as their populations often occur largely or wholly on federal lands. These peripheral or disjunct populations may also be genetically divergent from those within

the main range of the species. Many such taxa of state or sub-regional concern are currently designated as sensitive by the Forest Service and BLM, along with those that are of concern on a range-wide scale.

Nonvascular Plants and Fungi

Much of the conservation efforts for rare plants in eastern Washington and Oregon has focused on vascular plants, as there is little known of the rare bryophytes, lichens, or fungi, and few have legal federal status (Castellano 1995, Christy and Harpel 1995). However, the State Heritage programs in both Washington and Oregon have several bryophytes and lichens on their state sensitive plant lists. In Oregon, only one lichen, *Texosporium sancti-jacobi,* in the past was federally listed as a candidate species under the Endangered Species Act. Nonvascular plants play an important role in rangeland ecosystems as well as contribute significantly to the biodiversity of the region.

The region has a rather low diversity of lichens, but they are a major component of rangeland systems. In many habitats, their surface area cover is 30% or greater (Kaltenecker and Wicklow-Howard 1994). In the sagebrush steppe and the Columbia River grasslands, a mixture of bryophytes, lichens, and cyanobacteria collectively referred to as "microbiotic crusts" fill the interspaces between the shrubs and bunchgrasses. This association of species is similar in many other parts of the world, including Asia and Australia. These microbiotic crusts vary slightly by region but have many similar species that are well adapted for these habitat conditions.

The nitrogen-fixing lichens and cyanobacteria that are part of the biotic crust are important in improving soil fertility, and microbiotic crusts in general increase soil stability, influence water infiltration, and may improve seed germination for various plant species (Johansen et al. 1984). Intact microbiotic crusts may also interfere with the establishment of exotic plants such as cheatgrass. Relative to many other groups of microorganisms, microbiotic crusts have been well studied. Nonetheless, details of the ecological role of microbiotic crust species as soil stabilizers and nitrogen fixers are still being elucidated (Belnap 1994); the role of microbiotic crusts as potential barriers to the establishment of cheatgrass needs to be studied further and correlated with patterns of land use, disturbance histories, and soil properties.

Many of these lichen species are widespread globally, yet the area they now cover in the United States has been greatly reduced compared to historical times (McCune and Rosentreter 1992). The major threats to survival of microbiotic crusts in this region include invasion of exotic annual grasses and resulting increases in fire frequency, the conversion of rangelands to agriculture and suburban developments, and livestock trampling (St. Clair and Johansen 1993). Increased fire frequency (>40 times) owing to introduction of cheatgrass has led to dramatic changes in ecosystem structure (Wisenant 1990). Much of the shrub steppe has been converted to a dense, closed stand of annual exotic grasses to the exclusion of crust communities. Areas still containing shrubs and microbiotic crusts can be grazed when the soil is moist with little harm to the biotic crusts (Kaltenecker and Wicklow-Howard 1994), but many areas have been severely impacted by livestock trampling in the dry season (St. Clair and Johansen 1993). One microbiotic crust species, the woven-spored lichen, (*Texosporum sancti-jacobi*), is restricted to two general localities within the region (McCune 1992, 1994).

Threats and Mitigation

Threats to plants include natural disturbances such as normal fire regimes, climate change, pathogens, and pests. Major non-natural threats include exotic plant invasion, agricultural conversion, road construction, and recreation. Several threats represent a complex combination of factors such as the invasion of exotic species owing to livestock overgrazing, road construction, or increased fire frequency. Fire associated threats include fire suppression activities, stand-replacing fires, increased frequency of fire in rangeland ecosystems, and fire exclusion in forested ecosystems. Threats from both direct and indirect management-related activities include livestock grazing, timber harvest, effects of hydrological regime changes owing to timber harvest or grazing, and loss of pollinators that may be associated with management activities (Croft et al. 1997).

Determining the effects of management actions on many rare vascular and nonvascular plants is difficult at a broad scale of analysis for the region. The viability and conservation of all of the highly restricted taxa, as well as determinations

of the effects of management actions on them, is best undertaken at the local, regional, or provincial level. Yet it is important to ensure consistent management for these species across their range. One way this can be accomplished is by establishing mitigation measures for both the broad scale and project level that may be used in the planning, analysis, implementation and monitoring of projects to insure viability of native vascular plants and bryophytes, lichens, and fungi at all scales of planning. In concert with this, a further management objective is to maintain the distribution of native plant communities at both the broad and local scale of planning, and to maintain, protect, or restore special habitat features (e.g., peatlands, bogs, fens, azonal lithologies, mineralized areas, geothermal areas).

During the implementation of management activities, specific mitigation measures for restricted plant occurrences are best designed on a project-level basis. Site-specific mitigation is typically accomplished by changing the temporal or spatial characteristics, level of intensity, or methodology of the project. For example, the effects of livestock grazing or prescribed fire can be minimized or eliminated by timing the activity to fall outside critical periods of the species' life history (e.g., to avoid blooming or fruiting periods).

For those species whose viability may be at risk, the key considerations, when detailed demographic monitoring data are not available, include, but are not limited to:

1. Relation of the species to vegetation succession under various disturbance regimes,
2. Fidelity of the habitat relation; is the species highly restricted to one habitat type or is it less specific in its requirements?

Important geographic considerations are aimed primarily at the retention of the distribution of the species (i.e., whole populations or subpopulations where the species has a patchy distribution in the analysis area). This approach should be able to maintain underlying population and metapopulation structure, genetic variation patterns, demographic processes, and other less-easily analyzed aspects of population viability (Croft et al. 1997, Croft and Shelly 1998, Croft and Owen 1999).

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Note

This special issue of *Northwest Science* is a set of papers reviewing the state of knowledge about disturbance processes in eastern Oregon and Washington, related management practices, and effects on key management issues.