Ecology of Common Understory Plants in Northwestern Oregon and Southwestern Washington Forests

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In 1993, Ted Dyrness and I initiated a project to summarize key ecological characteristics of the most prominent plant species in the understory of forests in northwestern Oregon and southwestern Washington. We intended that this information would be included in an enhanced version of the forest simulation model ZELIG, and that we would produce a publication. At the time, Ted had retired from the U.S. Forest Service and was volunteering, and I was a research faculty member in the College of Forestry at Oregon State University. We had been working with Steve Garman, also in the College of Forestry, and Andy Moldenke and Jack Lattin of the Department of Entomology at Oregon State University, with the aim of using ZELIG to investigate the implications for biological diversity of alternative methods of forest management (see Garman et al. 1992). The attributes we intended to describe for each species are shown in Table 1.

Table 1. Outline for description of understory plant species.

Distribution	Geographic range
	Elevational range
	Vegetation type and associated species
Growth habit	Average and maximum height
	Deciduousness
	Number of stems at root crown
	Crown architecture
Phenology	Vegetative growth
	Flowering
	Fruit set
	Seed dispersal
Reproductive characteristics	Vegetative
	Amount of seed (viability)
	Germination and seedling establishment
Site requirements	Soil or substrate
	Shade tolerance
	Soil moisture
	Soil fertility
Response to disturbance	Canopy removal
	Fire

We divided understory species into two groups: upright shrubs, and herbs and trailing shrubs. We attempted to include all species which are common in any stage of forest succession within the area of consideration. This area included the Sitka spruce zone, western hemlock zone, and subalpine forest area in northwestern Oregon and southwestern Washington. Physiographic provinces included the Olympic Peninsula, Puget Trough, Coast Ranges, and Southern Washington Cascades (west of the crest) in Washington. Provinces in western Oregon were the Coast Ranges, Willamette Valley, Western Cascades, and High Cascades (west of crest), extending as far south as the Willamette R.-Umpqua R. divide (Franklin and Dyrness 1973). We omitted very specialized habitats, including those which are either very wet or very dry. For trees we referred to Little's Check List of U.S. Trees (1979), but included several species treated as trees by Little but considered as shrubs on the permanent plots studied by our research group (e.g., *Acer circinatum* and *Amelanchier alnifolia*; see Acker et al. 1998 concerning the permanent plots). For herbs and trailing shrubs we referred to Franklin and Dyrness 1973, Hemstrom and Logan 1986, and Hemstrom et al. 1987.

The species we intended to include are listed in Tables 2 and 3. Ted wrote the species accounts in this document in 1993 and 1994. He wrote accounts for 33 of 38 upright shrub species, and 45 of 50 species of herbs and trailing shrubs. I do not recall why we did not return to this project. Fred Swanson of the U.S. Forest Service, Pacific Northwest Research Station, brought this project back to my attention following Ted's death in August of 2010. We agreed that the information that Ted assembled is still valuable for students of northwest vegetation. So we have assembled the pieces from the work in 1993 and 1994. I invite anyone with an interest to contact me about writing the descriptions for the remaining few species.

Table 2. Upright shrub species common in the forest understory in northwestern Oregon and southwestern Washington.

Garrison Code	Scientific Name	Common Name
ACCI	*Acer circinatum* Pursh	vine maple
AMAL	*Amelanchier alnifolia* Nutt.	Saskatoon serviceberry
ARCO3	*Arctostaphylos columbiana* Piper	hairy manzanita
ARPA	*Arctostaphylos patula* Greene	green manzanita
BEAQ	*Berberis aquifolium* Pursh	tall Oregongrape
BENE	*Berberis nervosa* Pursh	Oregongrape
CEIN	*Ceanothus integerrimus* H. & A.	deerbrush
CESA	*Ceanothus sangiuneus* Pursh	redstem ceanothus
CEVE	*Ceanothus velutinus* Dougl. ex Hook.	snowbrush ceanothus
COCO2	*Corylus cornuta* Marsh.	western hazel
CYSC	*Cytisus scoparius* (L.) Link	Scotch broom
GASH	*Gaultheria shallon* Pursh	salal
HODI	*Holodiscus discolor* (Pursh.) Maxim.	creambush

		oceanspray
MEFE	*Menziesia ferruginea* Smith	rustyleaf
OECE	*Oemlaria cerosiformis*	Indian plum
OPHO	*Oplopanax horridum* (J.E. Smith) Miq.	devilsclub
PAMY	*Pachistima myrsinites* (Pursh.) Raf.	Oregon boxwood
RHMA	*Rhododendron macrophyllum* G.Don.	Pacific rhododendron
RHDI	*Rhus diversiloba* T. & G.	Pacific poison oak
RIBR	*Ribes bracteosum*	currant
RISA	*Ribes sanguineum* Pursh	red flowering currant
ROGY	*Rosa gymnocarpa* Nutt.	baldhip rose
RULAZ	*Rubus laciniatus* Willd.	evergreen blackberry
RULE	*Rubus leucodermis* Dougl. ex T. & G.	black raspberry
RUPA	*Rubus parviflorus* Nutt.	thimbleberry
RUPR	*Rubus procerus* Pursh	Himalayan blackberry
RUSP	*Rubus spectabilis* Muell.	salmonberry
SACE	*Sambucus cerulea* Raf.	blue elderberry
SALIX	*Salix* L. spp.	willow
SARA	*Sambucus racemosa* L.	red elderberry
SYAL	*Symphoricarpos albus* (L.) Blake	common snowberry
SYMO	*Symphoricarpos mollis* Nutt.	creeping snowberry
VAAL	*Vaccinium alaskaense* How.	Alaska huckleberry
VADE	*Vaccinium deliciosum* Piper	blueleaf huckleberry
VAME	*Vaccinium membranaceum* Dougl. ex Hook.	big huckleberry
VASC	*Vaccinium scoparium* Leiberg	grouse huckleberry
VAOV	*Vaccinium ovalifolium* Smith	ovalleaf huckleberry
VAOV2	*Vaccinium ovatum* Pursh	evergreen huckleberry
VAPA	*Vaccinium parvifolium* Smith	red huckleberry

Table 3. Herb and trailing shrub species common in the forest understory in northwestern Oregon and southwestern Washington.

Garrison Code	Scientific Name	Common Name
ACTR	*Achlys triphylla* (Smith) DC	Vanillaleaf
ADBI	*Adenocaulon bicolor* Hook.	pathfinder
ADPE	*Adiantum pedatum* L.	maidenhair fern
ANDE	*Anemone deltoidea* Hook.	threeleaf anemone

ASCA3	*Asarum caudatum* Lindl.	wild ginger
ATFI	*Athyrium filix-femina* (L.) Roth	lady fern
BLSP	*Blechnum spicant* (L.) With.	deer fern
CASC2	*Campanula scouleri* Hook.	bellflower
CHUM	*Chimaphila umbellata* (L.) Bart.	prince's pine
CIVU	*Cirsium vulgare* (Savi) Airy-Shaw	bull thistle
CLUN	*Clintonia uniflora* (Schult.) Kunth	queencup beadlily
COLA	*Coptis laciniata* Gray	cutleaf goldthread
COCA	*Cornus canadensis* L.	Bunchberry
DIHO	*Disporum hookeri* (Torr.) Nicholson	Fairybells
EPAN	*Epilobium angustifolium* L.	Fireweed
EPPA	*Epilobium paniculatum* Nutt.	autumn willow-weed
FEOC	*Festuca occidentalis* Hook.	western fescue
GATR	*Galium triflorum* Michx.	sweet-scented bedstraw
GOOB	*Goodyera oblongifolia* Raf.	rattlesnake plaintain
GYDR	*Gymnocarpium dryopteris* (L.) Newm.	Woodfern
HIAL	*Hieracium albiflorum* Hook.	white hairy hawkweed
IRTE	*Iris tenax* Dougl.	Oregon iris
LIBO2	*Linnaea borealis* L.	Twinflower
LICA3	*Listera caurina* Piper	Northwest listera
LOCR	*Lotus crassifolius* (Benth.) Greene	big deervetch
LUPA	*Luzula parviflora* (Ehrh.) Desv.	Woodrush
LYAM	*Lysichitum americanum* Hult. & St. John	skunk cabbage
MOSI	*Montia sibirica* (L.) How.	Indian lettuce
OSCH	*Osmorhiza chilensis* H. & A.	sweet cicely
OXOR	*Oxalis oregana* Nutt. ex T. & G.	Oregon oxalis
PHEM	*Phyllodoce empetriformis* (S.W.) D. Don	pink heather
PTAQ	*Pteridium aquilinum* (L.) Kuhn	bracken fern
RULA	*Rubus lasiococcus* Gray	dwarf bramble
RUPE	*Rubus pedatus* J.E. Smith	strawberry leaf blackberry
RUUR	*Rubus ursinus* Cham. & Schlecht.	trailing blackberry
SESY	*Senecio sylvaticus* L.	wood groundsel
SMST	*Smilacina stellata* (L.) Desf.	starry Solomonplume
STRO	*Streptopus roseus* Michx.	twisted stalk
SYRE	*Synthyris reniformis* (Dougl.) Benth.	round-leaved syntheris
TITR	*Tiarella trifoliata* L.	trefoil foamflower
TIUN	*Tiarella unifoliata* Hook.	coolwort foamflower
TRLA2	*Trientalis latifolia* Hook.	Starflower
TROV	*Trillium ovatum* Pursh	Pacific trillium
VASI	*Valeriana sitchensis* Bong.	Valerian

VAHE	*Vancouveria hexandra* (Hook.) Morr. & Dec.	inside-out flower
VEVI	*Veratrum viride* Ait.	false hellebore
VIAM	*Vicia americana* Muhl. ex Willd.	American vetch
VISE	*Viola sempervirens* Greene	evergreen violet
WHMO	*Whipplea modesta* Torr.	Whipplevine
XETE	*Xerophyllum tenax* (Pursh) Nutt.	Beargrass

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Acer circinatum Pursh

Distribution - Acer circinatum occurs from Alaska to coastal northern California and from the east side of the Cascade Mountains to the coast (Hitchcock et al. 1961). Its incidence generally decreases with increasing elevation (Klinka et al. 1989) and it is most abundant in the western hemlock zone, where it occurs under Pseudotsuga menziesii, Tsuga heterophylla, and Thuja plicata. However, it is also present in the Picea sitchensis, Abies anabilis, and Tsuga mertensiana zones, as well as in conifer forests of Willamette valley and in the mixed conifer zone of southwestern Oregon (Franklin and Dyrness 1973, Hemstrom et al. 1987). Acer circinatum commonly grows with the following understory plants: Polystichum munitum, Berberis nervosa, Gaultheria shallon, Corylus cornuta, Holodiscus discolor, Tiarella unifoliata, and Oxalis oregana (Franklin and Dyrness 1973). Examples of communities which include A. circinatum include Pseudotsuga menziesii/Acer circinatum/Gaultheria shallon, Tsuga heterophylla/Acer circinatum/Berberis nervosa, and Tsuga heterophylla/Acer circinatum/Polystichum munitum - Oxalis oregana (Franklin and Dyrness 1993).

Growth characteristics - Acer circinatum is a large deciduous shrub 1-8 m tall (Hitchcock et al. 1961). On the H.J. Andrews Experimental Forest vine maple clumps in clearcuts had an average of 34 stems per clump, with an average stem length of 195 cm. Under mature stands of Douglas-fir and hemlock, there were only an average of three stems per clump with a mean average length of 332 cm. Vine maple stems were noticeably more decumbent under mature trees and maximum stem age was 130 years (Russel 1974). Young stems are purplish-red and become brown with age. Leaves are 7-9 lobes, serrate, and are 3-6 cm. in length (Hitchcock et al. 1961).

Phenology - Small reddish flowers occur on the end of short, lateral, mostly two-leaved shoots during March to June (Hitchcock et al. 1961). Fruits are samaras with wings widely spread to the horizontal and ripen from September to October. Seeds are dispersed during October and November and it is reported that large seed crops occur every one to two years (USDA Forest Service 1974).

Reproductive characteristics - Seeds of Acer circinatum are about 7-8 mm in diameter and require a 1-2 month period of warm, moist stratification followed by a 3-4 month cold, prechilling period for maximum germination. They are wind-disseminated and may travel long distances (USDA Forest Service 1974). Vegetative regeneration occurs frequently by layering (Hitchcock et al. 1961) and vigorous stump sprouting (Klinka et al. 1989).

Russel (1974) found no regeneration from seed at the H.J. Andrews Experimental Forest. Vine maple regeneration was from stump sprouts following logging slash burning and exclusively by layering under mature stands of Douglas-fir and hemlock.

Site requirements - Vine maple occupies a wide range of habitats but generally is found on warm, well-watered sites with well-drained, moist soils (USDA Forest Service 1986). These soils are usually

nitrogen-rich and characterized by mull humus (Klinka et al. 1989). Vine maple is only moderately shade tolerant and therefore is largely absent from dense tree stands. It is plentiful and persistent in open-canopy forests and clearings (Klinka et al. 1989). Vine maple is very vigorous in recently logged areas, is scarce in closed-canopy stands 40-70 years of age, but becomes increasingly abundant in mature to old-growth stands (Russel 1974).

Response to disturbance - Vine maple, because of its ability to thrive in open locations, increases in abundance following tree removal. Logging followed by slash burning causes vigorous stump sprouting and a marked increase in vine maple coverage (Russel 1974). This species has also been observed to play an active role in primary succession on stony colluvial soils.

Amelanchier alnifolia Nutt.

Distribution - Amelanchier alnifolia is widely distributed in the western U.S. from southern Alaska southward to California and to the east Alberta, Canada, North and South Dakota, Colorado, New Mexico, and Arizona. It is found at elevations ranging from sea level to the subalpine (Hitchcock et al. 1961). It is of scattered occurrence in some of the driest stands within the Tsuga heterophylla zone in western Oregon and western Washington (e.g. in the Pseudotsuga menziesii/Holodiocus discolor associations). Commonly associated species in these stands include Rhus diversiloba, Gaultheria shallon; Rosa gymnocarpa, Holodiscus discolor, Symphoricarpos albus, and Corylus cornuta. In western Oregon Saskatoon serviceberry also occurs in oak stands, shrub thickets in Willamette valley grasslands, and under mixed conifers in the Siskiyous. In eastern Oregon and Washington Amelanchier is found in ponderosa pine and subalpine fir stands, as well as in certain shrub communities within the steppe vegetation (Franklin and Dyrness 1973).

Growth characteristics - Amelanchier alnifolia is a low spreading to erect deciduous shrub ranging from 0.5 to 10 m in height (Hitchcock et al. 1961). Young stems are reddish-brown, with bark becoming gray with age. Leaves are oval and alternate, two to four cm long, toothed on the upper half of the blade. The species varies considerably in morphology (Hitchcock et al. 1961).

Phenology - Short clusters of fragrant white flowers appear in May through June. Fruits are dark purple to black berrylike pomes which ripen during July through August. Fruits are generally eaten by animals and birds as soon as they ripen (USDA Forest Service 1974).

Reproductive characteristics - Seeds require four to six months of cold stratification for successful germination. Following stratification 84 to 99 percent germination occurred at 35° to 41° F. Under field conditions Amelanchier seeds are able to germinate in early spring under snow cover (USDA Forest Service 1974).

Site requirements - Amelanchier is only moderately tolerant of shade and favors openings or open-canopy tree stands. It generally occurs on moderately dry sites, but will grow on more moist soils. Soils are of moderate fertility, with medium levels of nitrogen. Amelanchier occurrence increases with increasing continentality and decreases with increasing precipitation and elevation (Klinka et al. 1989).

Response to disturbance - Amelanchier alnifolia is reported to be common on disturbed sites and in seral forests (Klinka et al. 1989). Regeneration following disturbance probably involves some stump sprouting, but its extent is unknown at the present time.

Arctostaphylos columbiana Piper

Distribution - Arctostaphylos columbiana is found along the coast and west of Cascades from Mendocino County, California northward to southern British Columbia (Hitchcock et al. 1959). This species occurs in the Sitka spruce zone, western hemlock zone, and subalpine forest areas. It is generally associated with unforested, seral shrubby vegetation. However, it has been reported under open stands of Douglas-fir in southern British Columbia (Klinka et al. 1989) and open stands of Douglas-fir and subalpine fir on lava deposits near Santiam Pass in Oregon (Franklin and Dyrness 1973). A. columbiana is a common species in shrub communities along the Oregon coast. With advancing succession these communities are replaced with Pinus contorta or Picea sitchensis. Species it commonly occurs with include Vaccinium ovatum, Ceanothus integerrimus, Myrica californica, Rhododendron macrophyllum, and Pteridium aquilinum (Franklin and Dyrness 1973).

Growth characteristics - A. columbiana is an evergreen shrub 1-4 m tall. Growth habit can be either erect or spreading and it is usually simple at the base. Young stems are usually distinctly bristly with hairs (hence the common name, hairy manzanita). Older stems have purplish-red bark. Leaves are ovate or lanceolate to elliptic, 2-5 cm long and 1-2.5 cm wide (Hitchcock et al. 1959).

Phenology - Flowers are borne on a paniculate inflorescence, are white to pink, 6-7 mm long, and appear from May to July. Fruit is a berry, 6-8 mm broad, and appears August through September (Hitchcock et al. 1959).

Reproductive characteristics - Seed dispersal is almost certainly mainly by animals and birds. Following disturbance or fire hairy manzanita would be expected to regenerate by sprouting from the root crown.

Site requirements - A. columbiana is intolerant of shade and is therefore a distinctly seral species. It is considered an indicator of moisture deficient sites and is often found on shallow, stony soils. It is also tolerant of soils with low fertility levels and more humus forms (Klinka et al. 1989).

Response to disturbance - A. columbiana would be expected to recover from serious disturbance rather readily due to vigorous sprouting from the root crown.

Arctostaphylos patula Greene

Distribution - Green manzanita occurs in the Cascades of Oregon southward in the Coast Ranges and Sierra Nevada to southern California and eastward to Colorado (Hitchcock et al. 1959). A. patula may be of scattered occurrence in seral shrub communities on dry sites in the western hemlock zone. It is a common dominant species in brushfields both in southwestern Oregon and central Oregon. It is a scattered component of the understory in the mixed conifer, Abies concolor, and Abies magnifica shastensis zones of southwestern Oregon. In the ponderosa pine zone of central Oregon it is a common understory dominant as in, for example, the Pinus ponderosa/Purshia tridentata-Arctostaphylos patula and Pinus ponderosa/Arctostaphylos patula - Festuca idahoensis associations. Typical associated species in western Oregon include Arctostaphylos nevadensis, Achillea millefolium var. lanulosa, Solidago canadensis, Apocynum pumilum, and Lupinus spp. (Franklin and Dyrness 1973).

Growth characteristics - Green manzanita is a spreading, much-branched evergreen shrub from 1-2 m tall. Several stems grow from an enlarged burl or root-crown and are generally glabrous with distinctively reddish-brown mature bark. Leaves are yellow-green, smooth and leathery, blades are 2-5 cm long, usually over half as broad, and rounded to acute (Hitchcock et al. 1959).

Phenology - Pink flowers, borne in fairly large panicles, appear in May and June. Smooth, brownish berries, 7-10 mm broad ripen in August and September. Seed dispersal by birds and animals generally occurs during September and October (Hitchcock et al. 1959, USDA Forest Service 1974).

Reproductive characteristics - A. patula seeds have such a hard seed coat that generally exposure to fire followed by cold stratification is necessary for germination. Nursery-men usually favor the use of rooted cuttings for propagation (USDA Forest Service 1974). Most vegetative reproduction in the field is probably a result of sprouting from the root crown.

Site requirements - A patula is only somewhat tolerant of shade and prefers open stands and clearings. It is common in brushfields ("chaparral") in both southwestern and central Oregon. It is most often found on moderately dry soils with moderate levels of nutrients.

Response to disturbance - A. patula recovers quickly from clearing and fire because of its ability to sprout from its root-crown. In addition, fire greatly aids seed germination by scarifying very hard seed coats. Consequently, fires are often followed by abundant A. patula seed germination. Thus the species is a common component of seral shrub communities, especially in southwestern and central Oregon.

Berberis aquifolium Pursh.

Distribution - Berberis aquifolium is found in southern British Columbia and northern Washington to northeastern Idaho, southward from the eastern base of the Cascades to the coast as far as the Columbia River Gorge, and in Oregon to the southern Willamette Valley (Hitchcock et al. 1964). It is of sporadic occurrence in open-canopy stands of Douglas-fir. It is also reported to occur in the mixed conifer zone of southwestern Oregon (Franklin and Dyrness 1973). B. aquifolium occurs in the Pseudotsuga menziesii/Bromus orcuttianus-Whipplea modesta community in the South Umpqua River drainage. Associated species include Berberis nervosa, Rosa gymnocarpa, Rubus ursinus, Syntheris reniformis, Lathyrus polyphyllus, and Adenocaulon bicolor (Franklin and Dyrness 1973).

Growth characteristics - B. aquifolium is a generally erect, stiff-branched and woody, evergreen shrub 1.5 to 45 dm. tall. Leaves are glossy, green and pinnately compound. Leaflets are oblong to ovate-lanceolate, 3-8 cm long, 2-5 cm wide, and have 12-29 prominent spinose teeth. It sometimes assumes a stoloniferous form with many stems (Hitchcock et al. 1964).

Phenology - Bright yellow flowers in 3-8 cm-long racemes appear in March through May (Hitchcock et al. 1964). Fruits are deep glaucous blue berries (7-14 mm) which ripen September to October (USDA Forest Service 1974).

Reproductive characteristics - Seed requires a 3-month cold stratification period before germination. However, even after proper stratification germination percentages are low, averaging about 25% (USDA Forest Service 1974). Vegetative regeneration occurs by means of sprouting of underground plant parts, especially following disturbance.

Site requirements - Berberis aquifolium is only moderately tolerant of shade and is therefore characteristically found under open-canopy tree stands. It is characteristic of moisture-deficient sites and has been reported to occur on very dry to moderately dry soils. It is reported to increase in occurrence with increasing summer drought and continentality. It occurs on soils with moderate fertility and medium levels of nitrogen (Klinka et al. 1989).

Response to disturbance - B. aquifolium would be expected to respond quickly to disturbances due to its ability to sprout from underground plant parts.

Berberis nervosa Pursh

Distribution - Berberis nervosa is found west of the Cascade Mountains from southern British Columbia to central California (Hitchcock et al 1964) where it is primarily found on sites from low to mid elevations (USDA Forest Service 1986). Berberis nervosa is very common in the Tsuga heterophylla zone, but it also occurs in smaller quantities within the Picea sitchensis, Abies amabilis, and Tsuga mertensiana zones (Franklin and Dyrness 1973, Hemstrom and Logan 1986, Hemstrom et al. 1987). In addition, it occurs in the mixed evergreen, mixed conifer, Abies concolor, and Abies magnifica shasteusis zones of southwestern Oregon (Franklin and Dyrness 1973). It is characteristically found under Douglas-fir or hemlock stands with species such as Acer circinatum, Gaultheria shallon, Polystichum munitum, and Eurynchium oregonum (Klinka et al. 1989). Forest communities within which this species is common include Pseudotsuga menziesii/Acer circinatum/Berberis nervosa, Tsuga heterophylla/Acer circinatum/Berberis nervosa, and Tsuga heterophylla/Rhododendron macrophyllum/Berberis nervosa (Franklin and Dyrness 1973).

Growth characteristics. Berberis nervosa is an evergreen shrub with aerial stems 1 to 3 dm long, which are ascending to erect. Maximum height is about 6 dm. Leaves are pinnately compound and tufted, with 9-19 leaflets which are shiny, ovate-lancolate, 3-6 cm. long and coarsely serrate-spinulose (Hitchock et al. 1964).

Phenology. Berberis nervosa has bright yellow flowers appearing from March to June (Hitchcock et al. 1964). In Oregon the berries are a deep glaucous blue, 8-11 mm long, and ripen during August (USDA Forest Service 1974).

Reproductive characteristics. Berberis nervosa is reported to be strongly rhizomatous (Hitchcock et al. 1964). Therefore it is probably safe to assume that vegetative reproduction is common by means of rhizome sprouting. Good fruit crops are borne almost annually and each berry contains 1 to several seeds. Seeds are largely distributed by animals and birds (USDA Forest Service 1974).

Site requirements. Berberis nervosa is reported to be moderately shade tolerant (Klinka et al. 1989). It occupies a fairly wide variety of sites from moist to very dry and stony, but generally is more abundant on drier sites. Soil fertility levels are moderate to low, with medium levels of nitrogen (Klinka et al. 1989)

Ceanothus integerrimus H. & A.

Distribution - Although Hitchcock et al. (1961) give the range of deerbrush as "the east side of the Cascades from Washington to Baja, California and east to New Mexico," Peck (1941) describes it as "lower slopes of the Cascades, to Washington and California, and from Josephine and southern Douglas counties westward to the coast." Deerbrush occurs sporadically in early seral communities on dry sites within the western hemlock zone. However, this shrub species is much more commonly found in southwestern Oregon. Here deerbrush occurs in oak woodland and mixed evergreen forests within interior valleys of southwestern Oregon. In addition, it is typically found in seral shrub communities within the mixed conifer zone and on the southern Oregon coast. Other species occurring in these shrub communities include Ceanothus velutinus, C. sanguineus, Castanopisis chrysophylla, Quercus chrysolepis, Amelanchier alnifolia, Arctostaphylos canescens, and Lithocarpus densiflorus (Franklin and Dyrness 1973).

Growth characteristics - Deerbrush is an erect to widely spreading deciduous shrub 1-4 m in height. Leaves are alternate with the blades thin and entire, 1.5-6 cm long, oblong to ovate, usually sparsely to densely perberulent on the lower (or both) surfaces, and generally with 3 prominent veins (Hitchcock et al. 1961).

Phenology - White to blue flowers are borne on large, terminal panicles during April through July. Seeds are borne in capsules 5-7 mm long and ripen during June through August (Hitchcock et al. 1961, USDA Forest Service 1974).

Reproductive characteristics - Deerbrush seed requires both a heat treatment and a cold stratification period of 1-2 months for optimum germination (USDA Forest Service 1974). It resembles Ceanothus velutinus in its reproductive strategy. That is, long-term storage of seed in the forest floor and following fire large-scale germination and establishment of seedlings.

Site requirements - Deerbrush is intolerant of shade and is restricted to openings or very open tree stands. It is characteristic of dry sites, but occupies more mesic habitats on the southern Oregon coast. Nutrient requirements tend to be low but it often occupies sites with at least medium levels of fertility.

Response to disturbance - Deerbrush is often found in early seral communities. It quickly establishes itself after fire because of the interaction between heat and seed germination. Logging also tends to favor it because of its preference for openings and its ability to sprout from root crowns.

Ceanothus sanguineus Pursh

Distribution - Ceanothus sanguineus is found on both sides of the Cascades from British Columbia to California and east to Idaho and western Montana (Hitchcock et al. 1961). In the western hemlock zone C. sanguineus is confined to the driest sites--e.g., dry talus slopes or the upper Skagit River-Ross Lake area of Washington. It also occurs frequently in seral communities in the mixed conifer zone of southwestern Oregon and in the ponderosa pine and grand fir zones of eastern Oregon and Washington. Two forest communities in which it occurs are Pseudotsuga menziesii-Pinus contorta/Berberis nervosa-Spirea betulifolia and Pinus ponderosa/Physocarpus malvaceus. Species which C. Sanguineus commonly occurs with include Pachistima myrsinites, Salix sp., Linnaea borealis, Pteridium aquilinum, amelanchier alnifolia, Corylus cornuta, and Holodiscus discolor (Franklin and Dyrness 1973).

Growth characteristics - An erect, deciduous shrub 1 to 3 m in height. The stems are usually glabrous and somewhat purplish. The leaves are alternate with slender petioles 1-2 cm long and blades ovate to ovate-elliptic, 3-10 cm long, and usually hairy, at least along the veins on the underside. Leaf margins are finely crenate-serrate and glandular (Hitchcock et al. 1961).

Phenology - White, paniculate flowers appear April through June. Seeds occur in 4 mm-long capsules during June through July (USDA Forest Service 1974).

Reproductive characteristics - Seed germinates well with both a heat treatment and a 60-day cold stratification treatment. Therefore, under field conditions C. sanguineus seed germinates in great quantities during the spring following a previous summer's fire. In addition, it reproduces vegetatively from root crowns (USDA Forests Service 1974).

Site requirements - C. sanguineus is very intolerant of shade and is therefore restricted to early seral or very open forest communities. It occurs on very dry to moderately dry soils. Fertility requirements are moderate and it has symbiotic nitrogen-fixing bacteria in root nodules. Its abundance increases with increasing continentality (Klinka 1989).

Response to disturbance - Because of its seed response to heat treatment, C. sanguineus is well suited for quick response to fire disturbance. Even though seed may have lain dormant for years in the forest floor, fire triggers rapid germination, giving the species a capacity to quickly dominate a fire-disturbed site. In addition, vegetative regeneration often occurs from root crowns following disturbance.

Ceanothus velutinus Dougl. ex Hook.

Distribution - Widely distributed in the western U.S. from coastal British Columbia to California, east to South Dakota and Colorado (mainly in the mountains) (Hitchcock et al. 1961). Snowbrush is an important shrub in early successional stages within the western hemlock zone, especially on sites which have been burned. Species which it commonly occurs within these seral communities include Epilobium angustifolium, E. paniculatum, Salix spp., Rubus ursinus, Acer circinatum, Berberis nervosa, Rhododendron macrophyllum, and Gaultheria shallon. In southwestern Oregon snowbrush is often a dominant species in brushfields and as an invader following logging in the mixed-conifer, Abies concolor, and A. magnifica shastensis zones. In addition, Abies concolor/Ceanothus velutinus communities occur in the high Cascades province. In eastern Oregon and Washington snowbrush is a common understory species within the ponderosa pine zone and a Pinus ponderosa/Ceanothus velutinus community has been described. Generally it is not an important species in subalpine areas but it does occur on lava flows near Santiam Pass, Oregon (Franklin and Dyrness 1973).

Growth characteristics - Snowbrush is a spreading evergreen shrub with a distinctive odor. Height ranges from .5 to 4 m. Branch twigs are minutely puberulent to glabrous. Leaves are alternate having petioles 1-2 cm long, blades ovate to ovate-elliptic, 5-10 cm long, glabrous, varnished and shiny, grayish and puberulent to glabrous beneath, strongly 3-veined from the base, and closely and finely serrate (Hitchcock et al. 1961).

Phenology - White flowers, borne in large terminal clusters appear in May through July. Fruits are 3-lobed capsules 4-5 mm long which ripen July through September (Hitchcock et al. 1961, USDA Forest Service 1974).

Reproductive characteristics - Successful snowbrush seed germination requires both a heat treatment and a cold stratification period (of approximately 3 months). The seed coat is impermeable to water. However, heat treatment causes a permanent and irreversible opening of the hilar fissure which renders the seed water permeable. This may explain the observed abundance of snowbrush seed germination following fire (USDA Forest Service 1974).

Site requirements - Snowbrush is intolerant of shade and is thus restricted to clearings or very open tree stands. In the western hemlock zone it quickly dies out when it is over-topped by Douglas-fir. It occurs on moderately dry to medium moisture sites; it is not found on very dry sites. Snowbrush is characteristic of sites with medium supplies of nutrients. Root nodules contain symbiotic nitrogen-fixing bacteria. Therefore the presence of snowbrush enhances the supply of available nitrogen in the soil (Klinka et al. 1989).

Response to disturbance - In western Oregon and Washington snowbrush is almost entirely restricted to early seral communities. In the western hemlock zone it can quickly invade logged sites, especially if they have been burned. Apparently seed may be stored in the forest floor for upwards of hundreds of years until heat from a fire causes the seed to absorb water and germinate. Therefore, despite the fact snowbrush is classed as an invader, it is an invader whose propagules are already on-site (Franklin and Dyrness 1973).

Corylus cornuta Marsh.

Distribution - Corylus cornuta is widespread in North America. It is found in the north from British Columbia to Newfoundland and in the south to Georgia, Ohio, and Missouri. In the western United States, it is present in northern Idaho, Washington and Oregon, and south to Sierran and coastal central California (Hitchcock et al. 1964). It occurs in generally small to moderate quantities in the Tsuga heterophylla zone, under Douglas-fir and oak in the Willamette Valley, and in the mixed evergreen, mixed conifer, and Abies concolor zones of southwestern Oregon. Understory species Corylus often occurs with are Acer circinatum, Holodiscus discolor, Berberis nervosa, Polystichum munitum, Whipplea modesta, Festuca occidentalis, and Bromus vulgaris. Examples of communities which include Corylus are Pseudotsuga menziesii/Holodiscus discolor and Quercus garryana/Corylus cornuta/Polystichum munitum (Franklin and Dyrness 1973). In British Columbia the elevational range of Corylus is sea level to 1200 meters (Haeussler and Coates 1986).

Growth characteristics - Corylus cornuta is a deciduous shrub, characteristically growing in clumps from 1 to 5 m in height. The young twigs are hirsute, but become glabrous in one to two years. Leaves are 4-10 cm long, doubly serrate, more less pubescent on both sides, and paler beneath. The staminate catkins appear before the leaves (Hitchcock et al. 1964). After seed germination the Corylus seedling produces a deeply penetrating taproot. At about 7-12 years in age the seedling begins to develop underground stems in the surface 20 cm. of soil (Haeussler and Coates 1986).

Phenology - On the Oregon coast Corylus cornuta vegetative growth began about April 1, by June 16 three-fourths of the leaves were fully developed, and by August 11, all vegetative growth had ceased (Haeussler and Coates 1986). Flowering occurs January through March (Hitchcock et al. 1964) and fruits ripen during August and September in British Columbia (Haeussler and Coates 1986). Large seed crops are generally produced every two to three years (USDA Forest Service 1974).

Reproductive characteristics - Rate of fruit production increases with stem age and peaks at about 10-11 years. Following 11 years, fruit production decreases and stops completely when stems become about 18 years old. Production rates vary from about 30 to 32,000 nuts per hectare. Seed dispersal is primarily by small mammals (squirrels and chipmunks). Two to six months of chilling are required for seed germination; however, germination rates are low, averaging about 30-60% in laboratory tests.

By far the most common mode of Corylus cornuta regeneration is vegetative by means of sprouting from underground stems. The rate of spread of clones is slow, but increases with age. A 6-year-old clone had two shoots and was 2 cm in diameter. By 38 years it had 25 shoots and was 250 cm in diameter. Growth rate and vigor of the sprouts increases with the age and size of the clone (Haeussler and Coates 1986).

Site requirements - Corylus cornuta grows best on loamy mineral soils. It does poorly on organic substrates or on fine-textured clay soils or on coarse-textured sandy soils. Corylus favors open tree

stands and has been found to require at least 30 percent full sunlight (Haeussler and Coates 1986). It occupies moderately dry to moist sites (Klinka et al. 1989) and does poorly on very wet, poorly aerated sites (Haeussler and Coates 1986). Corylus requires calcium and nitrogen rich soils (Klinka et al. 1989). Haeussler and Coates (1986) characterize Corylus as needing soils which are rich to very rich in nutrients.

Response to disturbance - Removal of overstory most often results in rapid expansion of Corylus cornuta by sprouting from underground stems. Corylus also quickly recovers from fire as a result of sprouting from the root crown (Haeussler and Coates 1986). Halpern (1989) found continuous recovery of Corylus cornuta following logging and slash burning in the H.J. Andrews Experimental Forest and that the rate of recovery was inversely proportional to the intensity of disturbance.

Cytisus scorparius (L.) Link

Distribution - Scotch broom is an introduced species (originating from Europe) which is now spreading rapidly west of the Cascades from British Columbia southward to California (Hitchcock et al. 1961). It occurs in early seral communities in the Sitka spruce zone, Puget Sound and the Willamette Valleys, and the western hemlock zone (Franklin and Dyrness 1973). It is most abundant on disturbed sites, such as roadsides (Klinka et al. 1989). Scotch broom occurs with a wide variety of early seral species such as grasses, Epilobium spp, Senecio spp., Pteridium aquilinum, and Rubus spp.

Growth characteristics - Scotch broom is a deciduous shrub which may grow up to 3 m in height. Branches are very strongly angled. Leaves at the base of the branch are three-foliate, but become simple above (Hitchcock et al. 1961).

Phenology - Bright yellow flowers appear during May and June. Fruits ripen in August and disperse in September. The fruit is a narrow pod 3-5 cm long which is brownish-black when ripe. Seeds are also brownish-black and are about 3 mm long (USDA Forest Service 1974).

Reproductive characteristics - Seeds have very hard seed coats and require soaking in hot water or sulfuric acid in nursery practice. Under natural conditions perhaps seed weathering for several years might be necessary for germination. Scotch broom may also be propagated from cuttings (USDA Forest Service 1974).

Site requirements. Scotch broom is intolerant of shade and requires almost full sunlight to grow. It requires well-drained, bare mineral soil for germination and establishment. These sites are often moderately to very dry. Scotch broom has the capacity to thrive on relatively nutrient-poor soil partly because of nitrogen fixation in root nodules -- a characteristic it shares with other legume species (Klinka et al. 1989).

Response to disturbance. Scotch broom is characteristically a pioneer species on disturbed sites and has shown a remarkable ability to vigorously spread on these types of habitats. Because of this it has been successfully used to provide early cover on strip-mined lands in the eastern U.S. (USDA Forest Service 1974).

Gaultheria shallon Pursh

Distribution - Gaultheria shallon is found on the west coast of the Cascades and in the Coast Ranges from British Columbia to southern California (Hitchcock et al. 1964). It is common in Sitka spruce, western hemlock, and Pacific silver fir zones and infrequent in the mountain hemlock zone. In addition, salal commonly occurs in conifer forests in the Willamette Valley and in the mixed evergreen and mixed conifer zones of southwestern Oregon as well as in many coastal communities. It is abundant on many sites and tends to occur in association with Acer circinatum, Rhododendron macrophyllum, Berberis nervosa, Linnaea borealis, Corylus cornuta, and Holodiscus discolor. Two of the most widespread communities in which it dominates are Pseudotsuga menziesii/Acer circinatum/Gautheria shallon and Tsuga heterophylla/Rhododendron macrophyllum/Gautheria shallon (Franklin and Dyrness 1973).

Growth characteristics - Gaultheria shallon is a creeping to an erect evergreen shrub with stems 1-12 dm long (Hitchcock et al. 1964). It is loosely to densely branched with a maximum height of 2.5 m. Especially in coastal locations, it sometimes forms impenetrable thickets. Its root system is shallow, with rhizome-like structures. Leaves are leathery and ovate and have finely toothed margins (Haeussler and Coates 1986).

Phenology - Gaultheria shallon has pinkish flowers in terminal or subterminal racemes which bloom from May to July (Hitchcock et al. 1964). In Washington bud burst occurred in early April and vegetation growth peaked in early June (Haeussler and Coates 1967). Fruits ripen from August until October and persist on the stem into December (USDA Forest Service 1974).

Reproductive characteristics - Once established on a site, Gaultheria shallon reproduces primarily by vegetative means, including layering, and sprouting from roots or stem bases (Haeussler and Coates 1986). Fruits are dark purple to bluish black in color, ranging from 6 to 10 mm in size. G. shallon plants have an average of 8.5 fruits per cluster and each fruit contains an average of 126 very small seeds (USDA Forest Service 1974). Heavy crops of fruit are produced each year in open stands, but crops decrease with tree crown closure. Seed dispersal is largely accomplished by birds and mammals who feed on the fruit. Even though large crops of seed are produced and germination occurs, most germinants do not survive. Seedlings which do survive are reported to grow very slowly during their first few years (Haeussler and Coates 1986).

Site requirements. Gaultheria shallon thrives in open sunlight and partial shade, but has very low vigor under dense forest canopies. It often dominates the understory of lowland coastal forests and thrives in open shoreline habitats where it can form dense thickets. It grows on a wide variety of substrates including shallow, stony soils, sand dunes, glacial till, and peat. Soils often tend to be podzolic with thick more humus layers. Salal will thrive under a variety of soil moisture conditions, ranging from xeric to poorly drained. However, in the western hemlock zone, it generally favors drier sites. Salal tolerates a wide range of nutrient conditions, but is generally most abundant on lower fertility soils (Haeussler and Coates 1986).

Holodiscus discolor (Pursh) Maxim.

Distribution - Holodiscus discolor occurs from British Columbia southward along the coast to southern California and eastward to western Montana, northern Idaho, and northeastern Oregon. In Oregon and Washington it is most common west of the Cascade summit (Hitchcock et al. 1961). Holodiscus discolor is reported to decrease in abundance with increasing elevation (Klinka et al. 1989). It occurs in small to moderate quantities in the Tsuga heterophylla zone of western Oregon and Washington, as well as in conifer forests in the Willamette Valley. In southwestern Oregon Holodiscus occurs in the mixed-evergreen, mixed-conifer, and Abies concolor zones and in eastern Oregon and Washington it occurs in the Pinus ponderosa and Pseudotsuga menziesii zones. Understory species with which it typically occurs are Corylus cornuta var. californica, Acer circinatum, Berberis nervosa, Gaultheria shallon, and Whipplea modesta. Examples of communities which include H. discolor are Pseudotsuga menziesii/Holodiscus discolor and Pseudotsuga-Abies grandis/Holodiscus discolor-Gaultheria shallon (Franklin and Dyrness 1973).

Growth characteristics - Holodiscus discolor is a generally erect deciduous shrub with slender, arching branches, O.5- -3 m in height. Bark is grayish-red and leaves are 4-10 cm long, ovate to ovate-lanceolate, green and smooth on the upper surface and paler and pilose on the lower surface (Hitchcock et al. 1961). It most often occurs in small clumps.

Phenology - small, white to cream-colored flowers occur in loose panicles 10-17 cm. long (Hitchcock et al. 1961). Flowering occurs during June and July, fruit ripens in August and September, and seed dispersal occurs until the end of November. Fruits are light yellow achenes, 2 mm long (USDA Forest Service 1974).

Reproductive characteristics - Holodiscus achenes require at least four months of cold stratification before successful germination can be obtained (USDA Forest Service 1974). Although published reports are lacking, it probably is safe to assume that Holodiscus, like most other large shrubs in western Oregon and Washington, reproduces vegetatively by sprouting from the root crown.

Site requirements - Holodiscus discolor favors moderately to very dry sites (Klinka et al. 1989) and often occurs on slopes with south or west aspects and shallow stony soils (USDA Forest Service 1986). Nutrient status of sites it occurs on is generally moderate with medium amounts of nitrogen (Klinka et al. 1989). Shade tolerance of Holodiscus is only moderate; therefore, it generally occurs under open-canopy tree stands (Klinka et al. 1989).

Response to disturbance - Removal of trees results in an increase of Holodiscus discolor coverage. The species also quickly recovers from moderately intense fire because of its ability to sprout from the root crown.

Menziesia ferruginea Smith

Distribution - Menziesia ferruginea occurs along the coast from Alaska to California and into the mountains up to subalpine areas. Its eastward distribution extends to Montana (Peck 1941). M. ferruginea occurs in the Sitka spruce, western hemlock, and upper slope zones, as well as in higher-elevation forest types in eastern Oregon and Washington. West-side forest communities in which Menziesia occurs include Tsuga heterophylla-Picea sitchensis/Gaultheria shallon/Blechnum spicant and Chamaecyparis nootkatensis/Rhododendron albiflorum. Other species with which it commonly occurs include Vaccinium ovalifolium, V. parvifolium, V. membranaceum, Polystichum munitum, Oxalis oregana, Rubus pedatus, Valeriana sitchensis, and Viola sempervirens (Franklin and Dyrness 1973).

Growth characteristics - Menziesia is a somewhat straggling, deciduous shrub 0.5 to 2 m in height. Young branches tend to be finely puberulent and somewhat glandular, while older branches are just puberulent or glabrous. It has thin green leaves, usually brownish-pilose, often glandular above, paler beneath and usually glandular-pubescent, crenulate-serrulate, ovate-elliptic to elliptic-obovate, 4-6 cm long (Hitchcock et al. 1959).

Phenology - Yellowish-red flowers (6-8 mm long) appear May through July. Ovoid capsules (5-7 mm long) mature in August and September (Hitchcock et al. 1959, Viereck and Little 1972).

Reproductive characteristics - The capsule contains many tiny seeds which are spread by gravity and wind when the capsule opens. Vegetative reproduction occurs by sprouting from the root crown, not by rhizomes (Haeussler and Coates 1986).

Site requirements - Menziesii is moderately shade tolerant. It grows on soils exhibiting a wide range of moisture conditions ranging from moderately dry to poorly drained coastal bogs. It usually grows on sites ranging from poor to moderate in nutrient regime, but it can occur over a wide range of sites, generally possessing a more humus type (Haeussler and Coates 1986, Klinka et al. 1989).

Response to disturbance - Despite its ability to sprout from root crowns, Menziesii is slow to recover from fire and has been labeled a fire sensitive species. With forest canopy removal it is apparently able to persist, but not increase in coverage (Haeussler and Coates 1986).

Oemlaria cerasiformis (H. and A.) Landon

Distribution - Indian plum occurs from British Columbia southward from the coast to the west slopes of the Cascades to northern California and the west side of the Sierra Nevada (Hitchcock et al. 1961). Oemlaria cerasiformis is largely restricted to low elevational stands in the western hemlock zone. It also commonly occurs under oak and Douglas-fir in the Puget Sound and Willamette Valley. For example, it is present in the Quercus garryana/Corylus cornuta/Polystichum munitum community in the Willamette Valley. Species Oemlaria commonly is associated with include Symphoricarpos albus, Crataegus douglasii, Rubus paviflorus, Pteridium aquilinum, Goodyera oblongifolia, Corallorhiza maculata, and Tellima grandiflora.

Growth characteristics - Oemlaria is a deciduous shrub from 1.5 to 5 m in height. Bark on mature stems is purplish-brown in color. Leaves, with petioles 5-6 mm long, are oblong-lanceolate or -elliptic to -obovate, 5-12 cm long and up to 4 cm wide, glabrous above and slightly paler and often pubescent on the lower surface (Hitchcock et al. 1961).

Phenology - Drooping racemes of white flowers (petals 5-6 mm long) generally appear during March and April, concurrently with leaf development. Fruits are single-seeded drupes 1 cm long and are deep blue-black with whitish bloom when mature. Ripening occurs during May through July and fruit is dispersed by birds and gravity (USDA Forest Service 1974).

Reproductive characteristics - Seed germination rate is about 95 percent after 4 months of cold stratification. In nature germination begins in mid-February during the year following seed dispersal. Vegetative regeneration has been reported both by means of cuttings and root sprouts (USDA Forest Service 1974).

Site requirements - Oemlaria is typically a species of flood plains or other water-receiving sites. Soils often have a fluctuating water table and are often gleyed. It is only moderately shade tolerant and favors open stands. Generally, supplies of nutrients are high and sites supporting it tend to be nitrogen-rich and have mull humus types (Klinka et al. 1989).

Response to disturbance - Statements regarding Oemlaria's response to disturbance are lacking in the literature. However, in view of its root sprouting ability it is likely that it has considerable capacity for recovery following fire or overstory removal.

Oplopanax horridum (J.E. Smith) Miq.

Distribution - Oplopanax horridum occurs from Alaska southward along the coast and west side of the Cascades to southern Oregon. In Washington and British Columbia it extends east to Idaho and Montana. It also occurs in Michigan and Ontario (Hitchcock et al. 1961). The species is widely distributed in western Oregon and Washington -- from the coast to subalpine forests. Specifically, Oplopanax horridum is common in the Picea sitchensis, Tsuga heterophylla, Abies amabilis, and Tsuga mertensiana zones west of the Cascades. It also occurs in the Tsuga heterophylla zone of eastern Washington and northern Idaho. Other understory species which often occur with Oplopanax include Vaccinium alaskaense, Athyrium filix-femina, Blechnum spicant, Gymnocarpium dryopteris, Tiarella sp., and Achlys triphylla. Two forest communities dominated by Oplopanax are Thuja plicata - Tsuga heterophylla/Oplopanax horridum/Athyrium filix-femina and Abies amabilis/Oplopanax horridum (Franklin and Dyrness 1973).

Growth characteristics - Oplopanax horridum is a deciduous shrub 1-3 m in height with thick and punky stems. Stems, petioles, and leaf veins are armed with spines 5-10 mm long. Leaves are palmately 7 to 9-lobed, doubly serrate, and 1-3.5 dm wide. Flowers are 5-6 mm long and occur in small captate umbels borne on elongated racemes (Hitchcock et al. 1961).

Phenology - Flowering occurs during May through July (Hitchcock et al. 1961). Fruit, consisting of large clusters deep red berries, appears during August and September (USDA Forest Service 1986).

Reproductive characteristics - Very little information is available on Oplopanax regeneration. It quickly occupies suitable sites and apparently readily reproduces both by seed and vegetatively.

Site requirements - Oplopanax is shade tolerant and is found under fairly dense tree stands. It occurs on moist to wet soils and often occupies seepage areas. Soil fertility is generally high with large amounts of nitrogen (Klinka et al. 1989).

Response to disturbance - Oplopanax often increases in occurrence after logging and in some cases provides serious competition for tree growth (USDA Forest Service 1986).

Pachistima myrsinites (Pursh) Raf.

Distribution - Pachistima myrsinites occurs from British Columbia southwest to California and eastward to the Rocky Mountains. The species usually occurs at medium elevations except for western Washington where it is found down to sea level (Hitchcock et al. 1961). In western Oregon and Washington Pachistima has been reported to occur under western red cedar and grand fir in the San Juan Islands, in the mixed conifer and Abies concolor zones in southwestern Oregon, and under very open stands of Douglas-fir, subalpine fir, and grand fir on lava flows near Santiam Pass in the Oregon Cascades. East of the Cascades it is very common in the Abies grandis, Tsuga heterophylla, and Abies lasiocarpa zones. Two westside communities which include Pachistima are Thuja plicata - Abies grandis/Pachistima myrsinites (San Juan Islands) and Abies concolor-Tsuga heterophylla/Acer cincinatum-Taxus brevifolia (southwestern Oregon). Species Pachistima commonly occurs with include Symphoricarpos albus, Rosa nutkana, Berberis nervosa, Rubus ursinus, Whipplea modesta, Achlys triphylla, and Chimaphila umbellata (Franklin and Dyrness 1973).

Growth characteristics - Pachistima is an evergreen shrub 2-10 dm tall. The leaves are glossy, oblong-lanceolate to lanceolate, serrate, and 1-3 cm long (Hitchcock et al. 1961).

Phenology - Maroon flowers, 3-4 mm wide, appear in April to June. Capsules are 3-4 mm long, bearing dark brown seeds which are about 2/3 covered with a thin, whitish aril and mature in early fall (Hitchcock et al. 1961).

Reproductive characteristics - Despite the fact that Pachistima is cultivated as an ornamental, we have been able to find very little published about its regeneration. Indications are that it reproduces readily both from seed and vegetatively.

Site requirements - Pachistima is intermediate in its shade tolerance (similar to Gaultheria shallon). It is reported to increase in occurrence with increasing continentality. It generally occurs on moderately dry sites, but it also can occupy moist soils. Soils supporting Pachistima are usually only moderately fertile and have low levels of nitrogen. On fertile sites, it is most often growing in rotten wood. It is characteristic of more humus types (Klinka et al. 1989).

Response to disturbance - Pachistima persists on cutover sites probably because of its ability to sprout from underground plant parts (Klinka et al. 1989).

Rhododendron macrophyllum G. Don

Distribution - This rhododendron is found along the coast in British Columbia and Washington and in Oregon also in the Cascades, reaching down into northern California (Hitchcock et al. 1959). Rhododendron commonly occurs in the Sitka spruce, western hemlock, and Pacific silver fir zones in Oregon (R. macrophyllum) has very scattered occurrence in Washington). It is also found in the mixed conifer zone and under redwood and Port Orford cedar in southwestern Oregon. Its elevational range is approximately sea level to 4,000 feet. Two of the most commonly occurring communities in which it is present in large amounts are Tsuga heterophylla/Rhododendron macrophyllum/Gaultheria shallon and Tsuga heterophylla/Rhododendron macrophyllum/Berberis nervosa. Typical species it occurs with include Acer circinatum, Vaccinium parvifolium, Rubus ursinus, Linnaea borealis, Viola sempervirens, Coptis lacineata, and Goodyera oblongifolia (Franklin and Dyrness 1973).

Growth characteristics - Rhododendron is an evergreen shrub which may be 1-5 m tall. Branches are perberulent when young, becoming glabrate. Leaves are leathery and glabrous, oblong-elliptic, 8-20 cm long and entire (Hitchcock et al. 1959).

Phenology - Pale pink to deep rose-purplish flowers (corolla 2.5-4 cm long) borne in terminal corymbs appear in April through May. Fruit (woody capsules 1.5-2 cm long) ripen during August and September and seeds are dispersed during the late summer and fall (Hitchcock et al. 1959, USDA Forest Service 1974).

Reproductive characteristics - Plants begin to bear seeds at about 5 years of age. Seeds are so tiny (about 2 mm long) that it takes approximately 2,000,000 to make 1 lb. The most successful germination occurs under low light intensities. However, even under the best of conditions, germination percentages range from only 3 to 27 percent (USDA Forest Service 1974). Following disturbance rhododendron readily sprouts from root crowns (Franklin and Dyrness 1973).

Site requirements - This rhododendron is moderately shade tolerant and will persist in climax tree stands. It does, however, also thrive in the open and therefore can be present in all stages of succession. It tends to occur on medium sites with respect to moisture; it is not found on either very wet or very dry sites. Supplies of available soil nutrients tend to be moderately low to medium on sites where rhododendron occurs.

Response to disturbance - Following tree removal rhododendron sprouts from root crowns and often increases in occurrence. It is not often an invading species, but simply an increaser after disturbance (Franklin and Dyrness 1973). Intense fire can severely reduce rhododendron occurrence and favor other invading species such as Ceanothus velutinus.

Rhus diversiloba T. & G.

Distribution - Poison oak is found from the Puget Sound area to Mexico on the west side of the Cascades and Sierra Nevada (Hitchcock et al. 1961). Although poison oak sometimes occurs on warm, dry sites in the western hemlock zone, it is most common within the interior valleys of western Oregon. Undoubtedly it reaches its fullest development in the Willamette Valley where it is commonly found in grasslands, oak forests, and conifer forests (largely Douglas-fir) along the valley margins. An example of an oak community in which it is a dominant is the Quercus garryana/Rhus diversiloba. Poison oak is also common in southwestern Oregon where it is found in shrub and conifer communities in the Umpqua and Rogue River Valleys as well as occupying warm, dry sites within the mixed evergreen and mixed conifer zones. Understory species typically occurring with poison oak include Symphoricarpos albus, Rubus ursinus, Amelanchier alnifolia, Ligusticum apiifolium, Elymus glaucus, Bromus vulgaris, Osmorhiza chilensis, and Vicia americana (Franklin and Dyrness 1973).

Growth characteristics - Poison oak can grow either as a shrub or as a vine ranging in height from 1 to 15 m. The roots are shallow and it often forms thickets. Leaflets occur in threes (rarely five) and are ovate to obovate, sinuate to rather deeply lobed, rounded to shortly acute and are 3 to 7 cm long (Hitchcock et al. 1961).

Phenology - Yellowish-green flowers in slender panicles appear from April to June. Glabrous fruit about 5 mm long ripens in August and September (Hitchcock et al. 1961).

Reproductive characteristics - Poison oak bears small white seeds which germinate in the spring. However, once established, spread is largely vegetative by sprouting from shallow root systems. Apparently the same root system may support both vine and shrub growth forms (Franklin and Dyrness 1973).

Site requirements - Poison oak is moderately shade tolerant but seems to grow best in the open. Throughout its range, poison oak is characteristic of dry, hot sites. Accordingly, in the western hemlock zone it is found only on the driest sites. Its soil nutrient requirements are low to moderate.

Response to disturbance - Because of its shallow rooting habit and ability to sprout, poison oak will increase in occurrence with mechanical disturbance. However, fire, especially if it is severe, would be expected to decrease poison oak cover. Because of its toxic effect on humans, poison oak growth is often curtailed by the use of herbicides.

Ribes bracteosum Dougl. ex Hook.

Distribution - Found from Alaska southward to northwestern California, common from the Cascades to the coast (only occasionally east of the Cascades) (Hitchcock et al. 1961). Stink currant is only of scattered occurrence and is, for the most part, restricted to wet sites in the Sitka spruce and western hemlock zones. For example, it is sometimes present in the Picea sitchensis/Polystichum munitum/Oxalis oregana association on the Olympic Peninsula. Other species present in these stands include Rubus spectabilis, Blechnum spicant, Tiarella trifoliata, Vaccinium parvifolium, Athyrium filix-femina, Vaccinium alaskaense, Rubus pedatus, and Acer circinatum (Henderson et al. 1989).

Growth characteristics - Stink currant is a spreading, deciduous shrub from 1 to 3 m in height. It has a distinctive sweetish, somewhat disagreeable odor (hence its common name). Leaf blades are 4-12 cm wide and generally not quite as long, upper surfaces are sparsely pubescent to glabrous and under surfaces are paler with glands, leaves are deeply 5 to 7-lobed, the main segments ovate-lanceolate, shallowly lobate and once or twice serrate, and petioles range from shorter to much longer than the blades (Hitchcock et al. 1961).

Phenology - Numerous white flowers on erect racemes occur during May and June (Hitchcock et al. 1961). Black berries about 1 cm long ripen in July with dispersal largely in August. Leaves emerge in April. In Oregon stink currant is apparently one of the first species in streamside locations to begin losing its leaves in the fall although the rate of abscission is slow (Haeussler and Coates 1986).

Reproductive characteristics - Seeds of stink currant are almost entirely dispersed by birds and mammals after ingestion of the fruit. Most germination occurs during the spring following fruit ripening. Propagation by seed is thought to be the most important form of reproduction for this species. Vegetative regeneration is confined to sprouting from the root crown or possibly some layering (Haeussler and Coates 1986).

Site requirements - Stink currant is only somewhat tolerant of shade and prefers open sites or stands where there are considerable openings in the canopy (e.g. streamside locations). It occurs on very moist to wet soils and is especially common along streams (Klinka et al. 1989). Because of its association with alluvial soils, stink currant probably has at least fairly high nutrient requirements including high levels of nitrogen (Haeussler and Coates 1986).

Response to disturbance - Stink currant readily resprouts following cutting or fire but it does not spread aggressively by vegetative means. Scarification of alluvial sites favors seed germination (Haeussler and Coates 1986).

Ribes sanguineum Pursh.

Distribution - Ribes sanguineum is found from British Columbia southward to the California Coast Range south of San Francisco and from the coast to the eastern slopes of the Cascades in Washington and northern Oregon, but only west of the Cascades to the south (Hitchcock et al. 1961). The species occurs in late seral vegetation or under open stands of Douglas-fir. It is found at low to medium elevations and its occurrence decreases with increasing elevation (Klinka et al. 1989).

Growth characteristics - Ribes sanguineum is an erect deciduous shrub 1-4 m tall. Its bark is reddish-brown and leaves are 2.5 to 6 cm wide, much paler and more densely hairy on the lower than on the upper surface. Showy pale pink to very deep red flowers are borne on erect racemes (Hitchcock et al. 1961).

Phenology - R. sanguineum in Oregon flowers during April and May and fruit ripening occurs from July through August (USDA Forest Service 1974). Fruit is a nearly glabrous berry about 7-9 mm long, glaucos-black and is unpalatable (Hitchcock et al. 1961).

Reproductive characteristics - Cold stratification of 3-4 months is required for successful germination of R. sanguineum seed. Even after proper treatment, germination is low, averaging about 60-65%. Birds are the principle vector for seed distribution (USDA Forest Service 1974). Little is known about vegetative regeneration of this species.

Site requirements - Ribes sanguineum is found on moderately dry to very dry sites. Soils are moderate with respect to nutrients, with medium supplies of nitrogen. R. sanguineum is intolerant of shade (Klinka et al. 1989).

Response to disturbance - Because of its preference for sunlight, removal of trees results in an increase of Ribes sanguineum cover.

Rosa gymnocarpa Nutt.

Distribution - Found from sea level to 6,000 ft. in southern British Columbia and northwestern Montana (west of the Continental Divide) southward along the western edge of Idaho, nearly to Boise, and southward in and west of the Cascades to the Sierra Nevada in California. It is also found in the Wallowas, Ochoco, and Blue Mountains of eastern Oregon (Hitchcock et al. 1961). The species commonly is found on drier sites within the western hemlock zone in Oregon and Washington. It is also found in the understory of conifer forests in the Willamette, Umpqua, and Rogue River valleys, as well as in the mixed evergreen, mixed conifer, and Abies concolor zones of southwestern Oregon. Species which it commonly occurs with include Holodiscus discolor, Corylus cornuta, Gaultheria shallon, Berberis nervosa, Symphoricarpos albus, Chimaphila umbellata, Adenocaulon bicolor, Achlys triphylla, Campanula scouleri, and Vicia americana (Franklin and Dyrness 1973).

Growth characteristics - Small-stemmed deciduous shrub 3-12 dm in height. Stems vary from prickly with many slender thorns to being almost thorn-free. Leaves are pinnately compound with 5-9 leaflets which are elliptic to elliptic-obovate, rounded to less often acute at the tip, 1-4 cm long and 0.5-3 cm wide, mostly doubly serrate with teeth commonly gland-tipped, otherwise leaflet surfaces are generally glabrous (Hitchcock et al. 1961).

Phenology - Light pink to deep rose flowers are borne singly at the end of branches during June and July. One-cm-wide red hips mature from late August through September (USDA Forest Service 1974, Hitchock et al. 1961).

Reproductive characteristics - Achenes require about 3 months of cold stratification for successful germination. The achenes are dispersed by a wide variety of birds and mammals which eat the hips. Apparently germinability of seeds are enhanced by passing through the digestive tracts (USDA Forest Service 1974).

Site requirements - Rosa gymnocarpa is moderately shade tolerant and occurs on very dry to moderately dry sites. It is characteristic of nutrient-medium soils. Its occurrence is reported to decrease with increasing precipitation, latitude, and elevation (Klinka et al. 1989).

Response to disturbance - R. gymnocarpa is reported to persist in cutover areas but not to greatly increase its occurrence following disturbance (Klinka et al. 1989).

Rubus laciniatus Willd.

Distribution - Evergreen blackberry is an exotic species believed to be of European origin. It is widely distributed on the west side of the Cascades from southern British Columbia to California and occasionally east to Idaho and is also found on the Atlantic coast (Hitchcock et al. 1961). Evergreen blackberry occupies disturbed sites in western valleys and adjacent lands within the western hemlock zone. Species it is often associated with include Epilobium angustifolium, Pteridium aquilinum, and Rubus parviflorus (Klinka et al. 1989).

Growth characteristics - R. laciniatus is a very prickly deciduous shrub with ascending or arched, but usually trailing to clambering stems up to 10 m long. The leaves are primarily 5-foliate, having leaflets from laciniately lobed to divided into secondary leaflets, irregularly incised to jagged-lobed or coarsely serrate-dentate, greenish and generally glabrous above, and pilose-hirsute to copiously soft-pubescent on the under-side (Hitchcock et al. 1961).

Phenology - Numerous flowers in flat-topped racemes appear during June and July. Fruit (drupelets which are black when ripe) matures during August and September. Fruits are most often eaten by birds and animals leading to seed dispersal during October and November (USDA Forest Service 1974).

Reproductive characteristics - Seeds of evergreen blackberry are slow to germinate because of a hard, impermeable endocarp. Laboratory tests have shown that a heat treatment followed by cold stratification are necessary for successful germination (USDA Forest Service 1974). Once evergreen blackberry is established it spreads vegetatively by layering and sprouting of underground plant parts.

Site requirements - Evergreen blackberry is intolerant of shade and therefore is exclusively restricted to open, seral communities. It is generally found on moist to very moist sites with generally high fertility and rich in nitrogen (Klinka et al. 1989).

Response to disturbance - There is some evidence that seeds may remain viable in the soil for several years (USDA Forest Service 1974). In some areas it quickly invades cutover and burned sites (Klinka et al. 1989).

Rubus leucodermis Dougl. ex T. & G.

Distribution - Black raspberry occurs from British Columbia southward to southern California and from the coast eastward to Montana, Utah, and Nevada (Hitchcock et al. 1961). It grows on disturbed sites from low elevations to the subalpine (Klinka et al. 1989). It is a common invader following clearcut logging and slash burning in the western Cascades of Oregon (Halpern 1989). It commonly occurs in association with species such as Epilobium angustifolium, Pteridium aquilinum, Rubus parviflorus, and R. ursinus (Klinka et al. 1989).

Growth characteristics - Black raspberry is a very prickly, deciduous shrub with erect but generally arching stems up to 2 m long. Stems are glaucous with numerous hooked prickles. Leaves are 3- (infrequently 5) foliolate, greenish and glabrous above, white-tomentose on the under surface, leaflets are ovate to ovate-lancelolate, 1.5-8 cm long, acute to acuminate, and from shallowly lobed to lobulate and doubly serrate (Hitchcock et al. 1961).

Phenology - Small white flowers appear on racemes from late April to early July. Coherent drupelets reddish purple to black in color ripen in August and September (Hitchcock et al. 1961).

Reproductive characteristics - Black raspberry vegetatively reproduces by sprouting from rhizomes and sometimes by layering when branch tips come in contact with the soil. Seed coats are so hard that passage through animals and birds followed by a cold treatment is necessary for germination (Hitchcock et al. 1961, USDA Forest Service 1974).

Site requirements - Black raspberry is intolerant of shade and is therefore restricted to early seral communities. It occurs on moderately dry to moist soils having medium to high levels of nutrients (Klinka et al. 1989).

Response to disturbance - This species is characteristic of cutover and burned sites. Initial establishment may at least partially be due to germination of buried seed (Halpern 1989). Once established it spreads rapidly by sprouting, layering and seed until it is over-topped by trees and shaded out.

Rubus procerus Muell.

Distribution - Originally from Europe, Himalayan blackberry is now distributed from southern British Columbia to California mostly on the western side of the Cascades, but it is also common along the Snake River in southwestern Washington (Hitchcock et al. 1961). This species spreads quickly and is especially common along roadsides in western Oregon and Washington. Increasingly it is moving from valley bottoms into forested uplands and it is anticipated that it will become more and more common in early stages of succession following logging.

Growth characteristics - It is a deciduous shrub with ascending to nearly erect but eventually clambering to sprawling stems up to 10 m long. Stems are armed with very sharp, strong, flattened prickles. Leaves are mostly 5- foliate, leaflets broadly ovate to oblong, usually abruptly short-acuminate, 6-12 cm long, bright green and nearly glabrous above, grayish-tomentose beneath, and sharply serrate-dentate (Hitchcock et al. 1961).

Phenology - Five to 20- flowered inflorescences bloom in June and July. Globose blackberries approximately 1.5 cm thick ripen during August and September. Birds and animals eat the fruit and are the principal seed dispersing agents. (USDA Forest Service 1974, Hitchcock et al. 1961).

Reproductive characteristics - Seeds have a hard impervious seed-coat and require both warm and cool stratification periods for successful germination. There is strong evidence that seeds retain viability after several years' storage in the soil and forest floor (USDA Forest Service 1974). Vegetative regeneration is accomplished by sprouting from root crowns and some limited layering of stems.

Site requirements - Himalayan blackberry is intolerant of shade. The species is tolerant of a fairly wide range of soil moisture conditions but is generally found on moderately dry to moist sites. Soil nutrient requirements are medium to the high end of the scale.

Response to disturbance - This is a species which is largely restricted to recently disturbed sites. Disturbance stimulates germination of seeds which may have remained dormant for years. Once established in an area, it generally spreads rapidly principally by seed.

Rubus parviflorus Nutt.

Distribution - This is an extremely variable species which is widely distributed in the western U.S. It occurs from sea level to subalpine areas from Alaska southward to southern California and east to the Great Lakes region, including the Dakotas, Wyoming, Colorado, New Mexico, and northern Mexico (Hitchcock et al. 1961). Rubus parviflorus is widely distributed throughout Oregon and Washington. On the west side of the Cascades it occurs in virtually all of the major vegetational areas. On the Oregon coast it occurs in shrub-dominated headland communities. In the Sitka spruce zone R. parviflorus is a common component of seral shrub communities. In the western hemlock zone it occurs both in seral communities and as an understory species. In subalpine areas in the Cascades of western Oregon and Washington R. parviflorus is a common component of meadow communities. In addition, it occurs in oak stands in the Willamette valley and in Shasta red fir forests of southwestern Oregon. An example of a forest community in which it occurs is Thuja plicata/Acer circinatum/herb community in the Washington Cascades (Franklin and Dyrness 1973). Rubus parviflorus is commonly associated with Alnus rubra, Athyrium filix-femina, Epilobium angustifolium, Oplopanox horridum, Rubus spectabilis, Sambucus racemosa, Streptopus roseus, and Tiarella unifoliata (Klinka et al. 1989).

Growth characteristics - R. parviflorus is an upright deciduous shrub .5-3 m in height. In early growth stages it is puberulent and stipitate-glandular and later becomes glabrate with gray, flaking bark. The leaf blades are deeply cordate-based, palmately mostly 5-lobed, 6-15 cm long and somewhat broader, doubly dentate-serrate, and glabrous to somewhat hairy (Hitchcock et al. 1961). It is a strongly rhizomatous species with the canes surviving 2-3 years. Especially when it is open-grown, thimbleberry produces a dense canopy with a very large leaf area (Haeussler and Coates 1986).

Phenology - White flowers occur in terminal corymbs or flat-topped panicles during May and June (Hitchcock et al. 1961). Vegetative buds may burst as early as late February, but generally bud burst occurs from early April to early June. Leaves are fully grown about one month after bud burst. Leaf fall occurs from late August to late October (Haeussler and Coates 1986). The fruits are drupelets which are coherent as a thimble-like aggregate containing many seeds (Hitchcock et al. 1961). Fruits ripen from early June to mid-September, depending on elevation (Haeussler and Coates 1986).

Reproductive characteristics - Seed distribution is principally by birds and mammals. Seeds may remain viable in the forest floor for a period of years. Ninety days of chilling are required for seed germination. Even after stratification, maximum germination is only about 60 percent. Once established, most regeneration within a colony is vegetative through the spread of rhizomes (Haeussler and Coates 1986).

Site requirements - R. parviflorus is only moderately shade tolerant and therefore favors open tree stands (Klinka et al. 1989). It is common on a wide variety of soils and landforms ranging from avalanche tracks to riparian habitats. Thimbleberry reaches its best growth on moist, well-drained soils, although it can also grow on drier sites. It is not found on very wet, poorly aerated soils. Thimbleberry is apparently tolerant of a wide range of nutrient levels (Haeussler and Coates 1986). Klinka et al. (1989)

describe thimbleberry as requiring nitrogen-rich soils with moder or mull humus forms in British Columbia.

Response to disturbance - Because of its rhizomatous growth habitat, R. parviflorus responds vigorously to logging and burning. Following both types of disturbance it quickly increases its coverage and distribution (Haeussler and Coates 1986).

Salix scouleriana Barr.

Distribution - Scouler's willow occurs from the lowlands to moderate elevations in the mountains from Alaska and Yukon to California, Arizona, and New Mexico, extending eastward to the Black Hills in South Dakota and in Canada to Manitoba (Hitchcock et al. 1964). It is characteristic of riparian communities in western Oregon and Washington. It also occurs in early seral communities on less moist sites within the Sitka spruce and western hemlock zones. In addition, Salix scouleriana is often an invader on disturbed sites within the Abies grandis zone in eastern Washington and Oregon (Franklin and Dyrness 1973).

Growth characteristics - A tall deciduous shrub from 2-12 m. in height and with a trunk up to 1 dm, or occasionally up to 4 dm, in thickness. Leaf blades are hairy when young (more densely beneath), mature leaves are dark green and glabrous above and glaucos beneath, usually broadly oblanceolate to obovate, with cuneate base and rounded or sometimes abruptly short-acuminate tipped, size of blade commonly 3.5-8 cm long and 1-3.5 cm wide, typically entire but sometimes more or less toothed (Hitchcock et al. 1964).

Phenology - Staminate and pistillate flowers borne in catkins appear during April to June. Minute, hairy seeds are borne in capsules which ripen during May to July. Seeds are disseminated by wind and water also during early summer (May-July) (USDA Forest Service 1974).

Reproductive characteristics - Once ripe, the seed is only viable for a very few days. If the seed is deposited on a suitable medium (e.g. moist sandy soil) germination is prompt, usually within a day or two. Germination tests with Scouler's willow seed have resulted in 95 percent germination after only 2 days. The species also roots readily from cuttings (USDA Forest Service 1974).

Site requirements - Scouler's willow is intolerant of shade. It will grow on soils with a wide range of moisture conditions, but prefers moist conditions. Nutrient requirements are in the medium range (Klinka et al. 1989).

Response to disturbance - If a seed source is near, Scouler's willow has the capacity to invade a site quickly after disturbance, especially if mineral soil is exposed. For establishment to occur, however, conditions must be right at the time of seed dispersal, as seed viability decreases rapidly. The species will also sprout from root crowns following burning if the fire was not too severe.

Sambucus cerulea Raf.

Distribution - Blue elderberry is found from southern British Columbia to western Montana, southward to California, Arizona, and New Mexico. It occurs from sea level to moderate elevations in the mountains (Hitchcock et al. 1959). Although it occurs sporadically in the Sitka spruce and western hemlock zones, blue elderberry is probably more common in the lower-elevational forest zones east of the Cascades. For example, it is commonly present in seral vegetation within the grand fir zone of eastern Oregon and Washington. Common associates in these situations include Salix scouleriana, Spiraea betulifolia, Ceanothus velutinus, C. sanguineus, and Amelanchier alnifolia (Franklin and Dyrness 1973).

Growth characteristics - Blue elderberry is a coarse, deciduous shrub (sometimes tree-like) ranging from 1 to 6 m in height and generally having several stems from the base. Twigs are soft, pithy, and glaucous. Leaves are pinnately compound with 5 to 11 leaflets. Leaflets are lanceolate or lance-ovate to elliptic, strongly acuminate and sharply serrate, usually 5-15 cm long and 2-6 cm wide, and are glabrous or rarely slightly hairy beneath (Hitchcock et al. 1959). Seedlings are reported to have thick tap roots and a rapidly expanding lateral root system. Once established the shrub grows rapidly and can obtain a mature height of 3 m in only 3-4 years (Haeussler and Coates 1986).

Phenology - Bud burst occurs from April to mid-June and where it occurs with red elderberry leaf growth in S. cerulea appears to be about a month later. White or cream flowers (4-7 mm across) in umbel-like heads appear in May through July. Globose fruit (4-6 mm thick), bluish-black beneath a dense waxy bloom, ripens during August and September. Seeds, in the form of small nutlets, are dispersed through November (Haeussler and Coates 1986, Hitchcock et al. 1959, USDA Forest Service 1974).

Reproductive characteristics - Considerable viability of seed remains after many years of storage. In the field dispersal of seed is by birds and animals which eat the fruit. Several months of chilling is required for germination. Seed germination averages are about 50-80 percent. Blue elderberry reproduces vegetatively by sprouts from both stumps and rhizomes (Haeussler and Coates 1986).

Site requirements - Blue elderberry is slightly shade tolerant (less than red), but thrives best in the open. It is most often found on gravelly or stony soils, but in locations where soils remain moist. Blue elderberry requires at least medium levels of nutrients, though it may be slightly less demanding than red elderberry (Haeussler and Coates 1986).

Response to disturbance - There is a lack of information concerning how blue elderberry reacts to disturbance. Despite its reputed ability to sprout, there is at least one report that fire almost eliminates it because of its principal reliance on seed for reproduction. Probably it is able to hold its own with cutting and fire, but perhaps not increase (Haeussler and Coates 1986).

Sambucus racemosa L.

Distribution - Red elderberry occurs from coastal Alaska southward through western British Columbia to western Washington and Oregon (from the Cascades to the coast), to the California Coast Range as far south as San Francisco Bay. It most commonly occurs from low to moderate elevations (Hitchcock et al. 1959). Red elderberry is found in the Sitka spruce and western hemlock zones and is especially common in coastal and Coast Range locations. It is most often present in the Alnus rubra/Rubus spectabilis community. Species commonly occurring with red elderberry include Athyrium filix-femina, Blechnum spicant, Polystichum munitum, Rubus ursinus, Oxalis oregana, and Galium triflorum (Franklin and Dyrness 1973).

Growth characteristics - Sambucus racemosa is a large, sometimes tree-like, deciduous shrub, 2-6 m tall. It has soft, pithy, somewhat glaucous twigs and pinnately compound leaves with 5-7 leaflets. Leaflets are laceolate or lance-ovate, strongly acuminate, sharply serrate, 4.5-17 cm long and 2-6 cm wide (Hitchcock et al. 1959). Newly germinated seedlings are reported to grow as much as 30 cm during the first year. Well-established young shrubs can grow 1.3 to 2 m in a single year (Haeussler and Coates 1986).

Phenology - Vegetative growth of red elderberry begins early in the growing season and in most areas leaves are fully developed by mid-June. Small, white flowers in terminal clusters appear in May. Vegetative branches continue to elongate after flowering branches have ceased their growth. The red fruit (5-6 mm thick) generally ripens during June and each fruit contains two to five seed-like stones (Haeussler and Coates 1986).

Reproductive characteristics - Seeds of red elderberry have a hard seed coat and need several months of cold stratification before germination (USDA Forest Service 1974). Germination rates are often low. In one field experiment germination rates were only 1-8%. On undisturbed sites germinants are rare; however, on disturbed sites they tend to be common. Existence of rhizomes has not been demonstrated for red elderberry, but the species does sprout readily from root crowns (Haeussler and Coates 1986). Red elderberries can be readily propagated from cuttings (USDA Forest Service 1974).

Site requirements - Although it will tolerate shade, red elderberry grows best in forest margins or in open stands. It is associated with moist to very moist sites. On wet sites near the coast where soils are poorly drained it tends to occur on elevated hummocks. Red elderberry is generally found on deep, well-drained soils, ranging from silt loam to sandy loam in texture (Haeussler and Coates 1986). Soil fertility tends to be high and available nitrogen is plentiful (Klinka et al. 1989).

Response to disturbance - Most evidence points to an increase in occurrence of red elderberry following logging. This would be expected from observations of increased rates of seed germination following disturbance and the ability of red elderberry to quickly sprout from the root crown. Indeed, there are reports that these basal sprouts have prodigious growth rates--upwards of 3-4 m during the first year. Response to fire is not as clear cut. However, several reports indicate growth of red elderberry is favored, but not greatly enhanced, by fire (Haeussler and Coates 1986).

Sorbus sitchensis Roemer

Distribution - Mountain ash occurs in Alaska and Yukon southward through the Cascade and Olympic mountains of Washington and the Cascades of Oregon to northern California and extending eastward to eastern British Columbia, northern Idaho and northwestern Montana. It is generally found from 2,000 to 10,000 feet elevation in the mountains (Hitchcock et al. 1961). Sorbus is usually of scattered occurrence and is probably most abundant in subalpine areas near timberline. Other shrub species which it commonly occurs with include Rhododendron albiflorum, Vaccinium membranaceum, Menziesia ferruginea, Phyllodoce empetriformis, Vaccinium deliciosum, and Rubus pedatus (Franklin and Dyrness 1973).

Growth characteristics - Mountain ash is an erect, several-stemmed deciduous shrub 1-4 m tall. The bark is reddish-purple on young stems and grayish-red when mature. leaves are pinnately compound with 7 to 11 leaflets which are thick, glabrous and dark green above and paler beneath and often pubescent with hairs along the midvein, oblong to oblong-obovate, 2-5 cm long, and are coarsely serrate from about 3/4 their length to only near the tip (Hitchcock et al. 1961).

Phenology - Flowers occur in rounded corymbs during the month of June. One cm long fruits (red with a bluish cast) mature during August and September. Seed dispersal occurs from August to the following June (USDA Forest Service 1974).

Reproductive characteristics - Mountain ash seed requires two months or more of cold stratification for germination. However, even with proper handling germination rates are low (about 15-30 percent). Vegetative reproduction is confined to sprouting from root crowns (USDA Forest Service 1974).

Site requirements - Mountain ash is intolerant of shade and is therefore restricted to at least moderately open sites. It grows on moderately dry to moist soils with medium levels of fertility. It typically occurs on soils low in nitrogen, having a more humus type (Klinka et al. 1989).

Response to disturbance - Sorbus persists in clearings (Klinka et al. 1989), probably because of its capacity for sprouting.

Symphoricarpos albus (L.) Blake

Distribution - A widespread species occurring from sea level to moderate elevations from southeastern Alaska, east to Quebec, and southward to California, Idaho, Colorado, Nebraska, and Virginia (Hitchcock et al. 1959). Snowberry is a common shrub species throughout Oregon and Washington. West of the Cascades, however, the species is largely confined to valleys, valley margins, and dry sites within the western hemlock zone. For example, in the eastern portion of the Olympic Peninsula, snowberry is a common member of a Pseudotsuga menziesii/Gaultheria shallon community. Other species found in this community include Rosa gymnocarpa, Berberis nervosa, Chimaphila umbellata, Adenocaulon bicolor, Achlys triphylla, Campanula scouleri, and Vicia americana. Other west-side vegetation types in which snowberry occurs are Quercus garryana stands, conifer forests of the Willamette Valley, and grasslands of the Umpqua and Rogue River Valleys. On the east-side, snowberry is found in the ponderosa pine, Douglas-fir, and grand fir zones. It is also very common and sometimes a dominant in shrub-steppe communities, especially in the Columbia Basin (Franklin and Dyrness 1973).

Growth characteristics - Snowberry is an erect, deciduous shrub 0.5-2 m in height with a rhizomatous growth habit. Twigs are glabrous or faintly puberulent and petioles are only 2-4 mm long. Leaves are elliptic to elliptic-ovate, entire to having a few coarse, irregular teeth, generally 1.5-5 cm long and 1-3.5 cm wide, glabrous on the upper surface and glabrous or sparsely hirsute-puberulent beneath (Hitchcock et al. 1959).

Phenology - Bud burst is generally during early May and leaf elongation is complete within a month. Flowers appear on racemes during May through August. White fruit, about 1-1.5 cm long, ripens during late August and early September, often during the same time as leaf fall is occurring (Haeussler and Coates 1986, Hitchcock et al. 1959). Most often the fruit remains on the shrub throughout the winter (USDA Forest Service 1974).

Reproductive characteristics - Each berry-like fruit contains two nutlets. Seeds are usually dispersed in the winter by the fruit being eaten by birds and mammals. Seed coats are tough and seeds remain viable for a long period of time. A warm period followed by chilling is required to break seed dormancy. Vegetative regeneration is generally accomplished by sprouting from rhizomes (Haeussler and Coates 1986).

Site requirements - Snowberry is described as a species with a broad ecological amplitude. Although it is often found on stony dry soils in the interior, in coastal locations it grows on a variety of soils and parent material including food plains. It also occurs on soils with low nutrient levels, but it is also found on sites that are medium to rich in nutrients (Haeussler and Coates 1986). Snowberry is mildly tolerant of shade but in many locations it prefers open sites (Klinka et al. 1989).

Response to disturbance - Snowberry generally increases in abundance with canopy removal. Its rhizomes and roots are generally deep enough to avoid fire damage. Consequently, following fire, sprouts appear quickly resulting in increased snowberry cover (Haeussler and Coates 1986).

Symphoricarpos mollis Nutt.

Distribution - Occurs at low to moderate elevations from southern British Columbia to southern California. Usually S. mollis is restricted to in or west of the Cascades and Sierra Nevada but in our area it extends to northern Idaho and southwestern Washington (Hitchcock et al. 1959). Trailing snowberry is a common understory shrub in communities occupying dry sites within the western hemlock zone. For example, in the western Cascades of Oregon it is almost always present in the Pseudotsuga menziesii/Holodiscus discolor association. Other species it occurs with include Acer circinatum, Corylus cornuta, Berberis nervosa, Linnaea borealis, Trientalis latifolia, Whipplea modesta, and Festuca occidentalis. it also occurs frequently in seral communities in the western hemlock zone (e.g. Acer macrophyllum/Symphoricarpos mollis). In addition, trailing snowberry is a common understory plant within the mixed conifer zone of southwestern Oregon (Franklin and Dyrness 1973).

Growth characteristics - S. mollis is a trailing deciduous shrub 1-3 m long with a height of up to 0.5 meters. Twigs are more or less puberulent to subglabrous. Petioles are 1-3 mm long. The opposite leaves are elliptic or ovate, generally 1-3 cm long and 5-20 mm wide, entire or sometimes with a few coarse teeth or shallow lobes, upper surfaces are glabrous, and lower surface is sparsely to moderately hirsute - puberulent (Hitchcock et al. 1959).

Phenology - Flowers in dense, terminal racenes appear during June and July. The characteristic white fruit (5-6 mm long) matures during August and September (Hitchcock et al. 1959).

Reproductive characteristics - The berry-like fruit is disseminated by mammals and birds. Seeds germinate in the spring after an over-winter cold period. Once established, it is highly likely that trailing snowberry largely spreads vegetatively. Vegetative regeneration is both by layering at nodes and sprouting from roots and rhizomes.

Site requirements - Trailing snowberry is reported to be intolerant of shade, however it can exist under open tree stands. It grows on dry to moderately dry soils having medium amounts of nutrients. Its occurrence is reported to decrease with increasing latitude, elevation, precipitation, and continentality (Klinka et al. 1989).

Response to disturbance - Trailing snowberry would be expected to increase its occurrence with tree removal. Likewise, its ability to sprout from underground plant parts indicates an ability to thrive after fire disturbance.

Achlys triphylla (Smith) DC.

Distribution - Vanilla leaf is found from British Columbia, in Washington from the east base of the Cascades to the coast, in Oregon west of the Cascades, as well as in the Columbia Gorge and in Sherman and Wasco Counties, and southward to northwestern California (in North Coast Ranges south to Mendicino County) (Hitchcock et al. 1964, Munz 1968). Vanilla leaf occurs infrequently in the Sitka spruce zone. It is common throughout the western hemlock zone, but occurs in larger quantities on wet sites such as those occupied by the Tsuga heterophylla/Polystichum munitum-Oxalis oregana association. It is probably most widely distributed in the Pacific silver fir zone, but once again is most abundant at the moist end of the spectrum typified by such associations as the Abies amabilis/Oplopanox horridum. At higher elevations, in the mountain hemlock zone, it is only infrequently present. Vanilla leaf is also common in the forests of southwestern Oregon, occurring in the mixed evergreen, mixed conifer, Abies concolor, and Abies magnifica shastensis zones. Species it typically occurs with include Polystichum munitum, Oxalis oregona, Vancouveria hexandra, Asarum caudatum, Blechnum spicant, Athyrium filix-femina, Oplopanox horridum, Tiarella unifoliata, and Gymnocarpium dryopteris (Franklin and Dyrness 1973, Hemstrom and Logan 1986, Hemstrom et al. 1987).

Growth characteristics - A scapose perennial herb spreading largely by rhizomes. Lacking a central stem, both flower-bearing scapes and leaves rise directly from rhizome nodes. Leaves have petioles 1-3 dm long, blades are 5-20 cm broad and are 3-foliate, glabrous, with segments coarsely sinuate-dentate. Scapes are 2-4 dm long, bearing spikes 2.5-5 cm long (Hitchcock et al. 1964).

Phenology - Small flowers borne on spikes appear from April to July. Reddish-purple fruits, 3-4 mm long, ripen in August and September (Hitchcock et al. 1964).

Reproductive characteristics - Vanilla leaf can readily be propagated both by seed and collected rhizomes (Kruckeberg 1982). In the field vanilla leaf, once established, spreads largely by sprouting from rhizomes. This pattern is reflected by dense colonies which are so characteristic of vanilla leaf growth.

Site requirements - Vanilla leaf is shade tolerant and thus is able to grow under dense tree stands. Although it can grow on sites with a range of moisture conditions, it tends to be most abundant on very moist to wet soils. Its nutrient requirements are fairly high and it is generally found on nitrogen-rich soils with mull humus (Klinka et al. 1989).

Response to disturbance - Largely unknown. However, because of its rhizomatous growth pattern, vanilla leaf would be expected to hold its own following disturbance.

Adenocaulon bicolor Hook.

Distribution - Trail plant is found from southern British Columbia southward to northern California (to Santa Cruz County in the Coast Ranges and Tulare County in the Sierra Nevada) and eastward to northern Idaho and northwestern Montana, and also in northern Michigan and northern Minnesota (Hitchcock et al. 1955, Munz 1959). It occurs infrequently in the Sitka spruce zone, is widely distributed in the western hemlock and Pacific silver fir zones, and is infrequent in the mountain hemlock zone. It also occurs in the mixed conifer, Abies concolor, and Abies magnifica shastensis zones in southwestern Oregon and in the Abies grandis and Abies lasiocarpa zones in eastern Oregon and Washington. Two communities in which trail plant is a characteristic herb are Pseudotsuga menziesii - Tsuga heterophylla/Berberis nervosa and Tsuga heterophylla/Achlys triphylla. Other understory species it tends to occur with include Acer circinatum, Symphoricarpos mollis, Polystichum munitum, Hieracium albiflorum, Anemone deltoidea, Goodyera oblongifolia; Linnaea borealis, and Trientalis latifolia (Franklin and Dyrness 1973, Hemstrom and Logan 1986, Hemstrom et al. 1987).

Growth characteristics - A slender perennial herb growing to almost 1 m in maximum height, having fibrous roots. Large leaves, with long petioles growing largely near the base, deltoid-ovate to cordate or subreniform, 3-15 cm wide, glabrous above, and closely white-wooly underneath, entire to more often coarsely-toothed to shallowly-lobed (Hitchcock et al. 1955).

Phenology - Small, whitish flowers bloom from June through August. Achenes, 5-8 mm long, mature in September and October (Hitchcock et al. 1955).

Reproductive characteristics - Sticky seeds are widely distributed by animals when they adhere to their fur. Seed germination is optimum in disturbed areas (Kruckeberg 1982). There is no evidence that vegetative regeneration occurs.

Site requirements - Trail plant is moderately shade tolerant. Despite its wide distribution within the western hemlock and Pacific silver spruce zones, trail plant appears to slightly favor moderately dry sites. Apparently nutrient requirements are moderate, although nitrogen levels are often high. It is characteristic of mull humus types (Klinka et al. 1989).

Response to disturbance - Trail plant is probably slow to recover from disturbance. Because it is restricted to establishment from seed, occupying disturbed areas quickly would be dependent on nearby seed sources.

Adiantum pedatum L.

Distribution - A widespread species found in forested areas throughout North America and eastern Asia (Hitchcock et al. 1969). On the west coast, its range extends from Cook Inlet, Alaska (Hulten 1968) southward to the San Gabriel Mountains in southern California (Munz 1959). It is of scattered occurrence (though occasionally plentiful) along streams and wet sites. Maidenhair fern is sometimes found in the Sitka spruce zone, but in our area it is most common in the western hemlock zone. It is generally associated with the wettest forest communities, e.g. Tsuga heterophylla/Polystichum munitum - Oxalis oregana. Other understory species it is often found with include Tiarella trifoliata, Athyrium filix-femina, Blechnum spicant, Asarum caudatum, Vancouveria hexandra, and Achlys triphylla (Franklin and Dyrness 1973, Hemstrom and Logan 1986).

Growth characteristics - A rhizomatous deciduous fern 1-6 dm tall. Leaves are few or solitary with an erect, purple or purplish-black petiole, the blade at right angles to the petiole, more or less parallel to the ground, about 1-4 dm long and approximately as wide, orbicular when well developed, divided into two recurved-spreading rachises which bear two to several progressively shorter pinnae along the outside of the curve; larger pinnae with 15-35 alternate, short-stalked, pinules on each side of the costa; pinnulas generally 12-22 mm long and 5-9 mm wide (Hitchcock et al. 1969).

Phenology - No information available.

Reproductive characteristics - Once established in an area, maidenhair fern most likely spreads largely by rhizome. We can find little information about the regeneration of this species from spores.

Site requirements - Maidenhair fern is moderately shade tolerant. It is found on very moist to wet soils having generally high levels of nutrients, especially nitrogen and calcium. Soils generally have mull humus types (Klinka et al. 1989).

Response to disturbance - Although data are lacking, maidenhair fern would be expected to be sensitive to disturbances such as fire and logging. Because of its rhizomatous growth habit, some recovery might occur even if at a slow pace.

Anemone deltoidea Hook.

Distribution - West of the Cascades (not on Olympic Peninsula) from King County, Washington southward to Mendocino, Humboldt, and Siskiyou Counties in northern California (Hitchcock et al. 1964, Munz 1959). Three-leaved anemone occurs only infrequently in the Sitka spruce zone. It is most widespread within the western hemlock and Pacific fir zones but even here it tends to be found in rather small quantities. It is of scattered occurrence in the mountain hemlock zones and also occurs in the mixed-conifer, Abies concolor, and Abies magnifica shastensis zones in southwestern Oregon. Three-leaved anemone is almost always present in communities such as the Tsuga heterophylla/Berberis nervosa/Achlys triphylla in the western Cascades of Oregon. Other understory species it commonly occurs with include Acer circinatum, Rosa gymnocarpa, Adenocaulon bicolor, Goodyera oblongifolia, Linnaea borealis, Polystichum munitum, Smilacena stellata, Tiarella trifoliata, and Viola sempervirens (Franklin and Dyrness 1973, Hemstrom and Logan 1986, Hemstrom et al. 1987).

Growth characteristics - Perennial herb, 1-3 dm. in height, with slender, widespread rhizomes. The leaves are basal, usually solitary, and trifoliate. Leaflets are short-petiolulate, ovate, 2-6 cm. long, deeply and coarsely crenate-serrate, sometimes lobate halfway to the midvein, and usually glabrous. Flowering stems are tall (1-3 dm), glabrous to hirsute, and 1-flowered (Hitchcock et al. 1964).

Phenology - White flowers appear in April and May. Seeds, borne in achenes, ripen in late summer (Hitchcock et al. 1964).

Reproductive characteristics - Once established, primary mode of reproduction is probably sprouting from rhizomes.

Site requirements - Three-leaved anemone has a fairly wide ecologic amplitude in the western hemlock and Pacific silver fir zones where it is found on wet to fairly dry sites. However, it appears to reach its maximum development on mesic sites in the middle of the spectrum. It is shade tolerant but also grows well in openings.

Response to disturbance - Although documentation is lacking, it is hypothesized that three-leaved anemone would show relatively little change in abundance following disturbance. After fire and/or logging it would reproduce both from seed and vegetatively at a slow rate until reaching pre-disturbance levels.

Asarum caudatum Lindl.

Distribution - Wild ginger is found from British Columbia southward from the Cascades to the coast to Santa Cruz Mountains, California and eastward to Idaho, W. Montana and northeastern Oregon (Hitchcock et al. 1964). Wild ginger is of scattered occurrence in the Sitka spruce zone and occurs in small amounts in wet-site communities within the western hemlock zone. It is most abundant within the Pacific silver fir zone where it attains an average of 6% cover in the Abies amabilis/Acer circinatum/Tiarella trifoliata community. It also occurs in eastern Oregon and Washington within the Abies grandis zone and southwestern Oregon within the Abies magnifica shastensis zone. Species which commonly occur with wild ginger include Chimaphila umbellata, Achlys triphylla, Adenocaulon bicolor, Clintonia uniflora, Smilacinca stellata, Athyrium filix-femina, Polystichum munitum, and Oxalis oregana (Franklin and Dyrness 1973, Hemstrom and Logan 1986, Hemstrom et al. 1987).

Growth characteristics - A rhizomatous, mat-forming, evergreen, perennial herb. It is low growing, with a height of 10-20 cm. There are 2 leaves per node, petioles are glabrous to hairy and 5-20 cm. long, blades are cordate-reniform 4-10 cm long and up to 15 cm wide, obtuse to acute, persistent Hitchcock et al. 1964).

Phenology - Small brownish-purple flowers borne on short peduncles appear during April to July. Seeds, 3 mm long, ripen during August and September (Hitchcock et al. 1964).

Reproductive characteristics - Kruckeberg (1982) states that wild ginger may be propagated either by seed or rhizome pieces.

Site requirements - Wild ginger is shade tolerant and does not do well in the open. It is characteristic of wet to moist sites having generally high levels of nutrients, especially nitrogen. It is found on soils with generally mull humus types (Klinka et al. 1989).

Response to disturbance - Following logging disturbance wild ginger would be expected to recover slowly despite its strongly rhizomatous nature. Total recovery most probably would await re-establishment of shady conditions.

Athyrium filix-femina (L.) Roth

Distribution - A circum-boreal, widely distributed species. In our area it occurs from the Seward Peninsula, Alaska (Hulten 1968) southward to the San Jacinto and San Bernadino Mountains in southern California (Munz 1968) and eastward to the Rocky Mountains. Lady fern is found on very moist to wet sites within the Sitka spruce, western hemlock, Pacific silver fir, and mountain hemlock zones in western Oregon and Washington. In all four zones it is by far the most common on sites characterized by seepage and an understory dominated by Oplopanax horridum. It is also found in the western hemlock zone in eastern Washington where a Thuja plicata/Athyrium filix-femina association has been described. Other understory species with which it is associated include Acer circinatum, Vaccinium parvifolium, Cornus canadensis, Polystichum munitum, Tiarella trifoliata, and Vancouveria hexandra (Franklin and Dyrness 1973, Hemstrom and Logan 1986, Hemstrom et al. 1987).

Growth characteristics - A large fern which may attain heights of upwards of 1.5 m. Leaves are commonly 3-20 dm long, closely clustered in a vase-like tuft at the end of a short, stout ascending rhizome, petioles are usually much shorter than the blade, flattened below and 3-10 mm wide, blade is soft-textured and glabrous, 2-3 times pinnate, with commonly 20-35 pairs of mostly offset pinnae; larger pinnae commonly 4-25 cm long and 1-7 cm wide, with 12-25 pairs of toothed to pinnatifed, mostly offset pinnules (Hitchcock et al. 1969).

Phenology - No information available.

Reproductive characteristics - On wet sites lady fern is an aggressive species, coming in easily from spores (Kruckeberg 1982).

Site requirements - Lady fern is shade tolerant although it is also able to thrive in the open. It occupies very moist to wet soils and also is common in swamps and fens. It favors soils high in nutrients, especially nitrogen, having mull humus types (Klinka et al. 1989).

Response to disturbance - Data are lacking, but lady fern is probably able to withstand disturbance fairly well because of its ability to grow in the open. Of course, if disturbance causes a drier site, lady fern recovery would be severely hampered.

Blechnum spicant (L.) With.

Distribution - Deer fern is widely distributed in the northern hemisphere (almost circumboreal). In North America it occurs from Cook Inlet, Kodiak Island, and Aleutians in Alaska (Hulten 1968) southward to Santa Cruz County on the central California coast (Munz 1959). Although it occurs mostly west of the Cascades, it is also found in northern Idaho (Hitchcock et al. 1969). Deer fern is most abundant in the Sitka spruce zone where it attains 5% cover and 94% constancy in the Picea sitchensis/Menziesii ferruginea - Vaccinium parvifolium association (Hemstrom and Logan 1986). However, it is also very common in the very moist to wet communities within the western hemlock and Pacific silver fir zones (Franklin and Dyrness 1973, Hemstrom and Logan 1986, Hemstrom et al. 1987). Here it is most common in the Tsuga heterophylla/Oplopanax horridum association. It is also reported to occur, at least in small quantities, in the mountain hemlock zone on the Olympic Peninsula (Henderson et al. 1989). Some typical species that deer fern occurs with include Rubus spectabilis, Vaccinium parvifolium, Oxalis oregana, Polystichum munitum, Trillium ovatum, Montia sibirica, Viola sempervirens (Hemstrom and Logan 1986).

Growth characteristics - Rhizomatous fern up to 1 m in height. Leaves are dimorphic--sterile and fertile. Sterile leaves are once pinnate with broadly sessile pinnae, leaves are 2-10 dm long, petioles are 3-25 cm long, reddish- or purplish-brown, pinnae opposite or offset, 35-70 pairs, largest pinnae commonly near the middle of the blade, mostly 1-5.5 cm long and 3-7 mm wide. Fertile leaves are larger than sterile leaves and have a notably longer petiole (sometimes over 5 dm), pinnae are about as numerous as the sterile ones and are about as long, but much narrower (1.5-2 mm wide). Sori are covered by a conspicuous brown-hyaline indusium (Hitchcock et al. 1969).

Phenology - No information available.

Reproductive characteristics - Deer fern regenerates readily by spore and sporelings are often common on disturbed sites (e.g. banks of logging roads) (Kruckeberg 1982).

Site requirements - Deer fern is shade tolerant and is especially characteristic of old-growth forests. It grows best on black, greasy, well-decomposed organic soils. These soils, although low in nitrogen, generally are otherwise nutrient-rich and have more humus types. Optimum moisture levels tend to be very moist to wet (Klinka et al. 1989).

Response to disturbance - Removal of overstory, whether by fire or logging, would be expected to decrease the occurrence of deer fern substantially. Recovery would probably be delayed until re-establishment of moist, shady conditions.

Campanula scouleri Hook.

Distribution - Distributed from southeastern Alaska (about 56° N. latitude) southward to northern California (Humboldt, Trinity, and Sierra counties) (Hulten 1968, Munz 1959). In Oregon and Washington it occurs almost exclusively west of the crest of the Cascades up to an elevation of about 4,000 feet (Hitchcock et al. 1959). It is of scattered occurrence in both the western hemlock and Pacific silver fir zones. It tends to occur more commonly in the drier communities in the western hemlock zone (e.g., it is present in 67% of the sampled Pseudotsuga menziesii/Holodiscus discolor/grass stands). In the Pacific silver fir zone it is most abundant in the Abies amabilis - Abies grandis/Smilacina stellata association where it averages 5% cover and 58% constancy (Hemstrom et al. 1987). Scouler bellflower is also present in the mixed conifer, Abies concolor, and Abies magnifica shastensis zones of southwestern Oregon (Franklin and Dyrness 1973). Other understory species which it commonly occurs with include Corylus cornuta, Rhus diversiloba, Symphoricarpos mollis, Adenocaulon bicolor, Hieracium albiflorum, Trientalis latifolia, Acer circinatum, Berberis nervosa, Anemone deltoidea, Goodyera oblongifolia, Linnaea borealis, and Viola sempervirens (Hemstrom et al. 1987).

Growth characteristics - A perennial herb, 1 to 4 dm tall, arising from slender, branching rhizomes, with glabrous or inconspicuously short-hairy stems. Leaves are sharply serrate with the lower most ovate or rotund-ovate, 1-4 cm long, borne on a petiole of nearly equal length, the other leaves progressively narrower, more elongate with shorter petioles, until they pass, more or less abruptly, into the sessile, linear bracts of the false lax racemes. There are usually 4-10 leaves below the inflorescence (Hitchcock et al. 1959).

Phenology - Scouler bellflower blooms from June through August (Hitchcock et al. 1959).

Reproductive characteristics - Apparently germinates readily from small seeds if a mineral seedbed and sufficient moisture are present. Once established, further regeneration is largely vegetative by sprouts from rhizomes.

Site requirements - Scouler bellflower is only moderately tolerant of shade and therefore is generally common only in open-canopy stands. It is characteristic of very dry to moderately dry soils of generally low fertility. It tends to occur on soils with more humus types (Klinka et al. 1989).

Response to disturbance - Because of its affinity for full sunlight, Scouler bellflower tends to increase in abundance with disturbance (Klinka et al. 1989).

Chimaphila umbellata (L.) Bart.

Distribution - A widely distributed species which is found in the Rocky Mountains, eastern U.S., and throughout Eurasia. In our area it is distributed from southeastern Alaska (to 60° N. latitude) southward to the San Bernardino Mountains in southern California (Hulten 1968, Munz 1959). In California it is reported to extend up to the subalpine fir zone at 10,000 ft. (Munz 1959). In western Oregon and Washington prince's pine is commonly found in the western hemlock, Pacific silver fir, and mountain hemlock zones. It also commonly occurs in the mixed conifer, Abies concolor, and Abies magnifica shastensis zones of southwestern Oregon, as well as in the Pinus ponderosa and Abies grandis zones of eastern Oregon and Washington (Franklin and Dyrness 1973). It is most abundant in communities representing the dry end of the moisture spectrum. In the western Cascades of Oregon an Abies grandis/Chimphila umbellata association has been described in which prince's pine averages 28% cover. Other understory species with which prince's pine commonly occurs include Berberis nervosa, Holodiscus discolor, Rubus ursinus, Achlys triphylla, Anemone deltoidea, Goodyera oblongifolia, Hieracium albiflorum, and Pyrola secunda (Hemstrom et al. 1987).

Growth characteristics - Perennial, slightly woody herb with leathery, persistent leaves, 1-3 dm tall. Leaves are whorled, oblanceolate to oblanceolate-obovate, tapered to narrowly acute bases, blades 3-7 cm long, 0.5-2.5 cm. wide, sharply serrate, with petioles 3-7 mm long (Hitchcock et al. 1959).

Phenology - Small, pinkish flowers (5-15), borne on a raceme appear during June to August (Hitchcock et al. 1959).

Reproductive characteristics - Kruckeberg (1982) reports that prince's pine is very difficult to propagate mainly because it is a probable partial root parasite. Apparently the principle means of reproduction is from seed, although rhizomes are present.

Site requirements - Prince's pine is moderately shade tolerant and occupies dry to moderately dry soils. It is, however, not abundant on the driest sites. It tends to grow on soils which are deficient in nitrogen and have more humus types (Klinka et al. 1989).

Response to disturbance - Occurrence of prince's pine is severely reduced by burning and rate of recovery is slow (Halpern 1989). Although the species has deep, fibrous roots and rhizomes, new shoots apparently come only from rootstalks near the soil surface. Loss of the evergreen leaves by fire may also restrict survival and rate of recovery.

Cirsium vulgare (Savi) Airy-Shaw

Distribution - A circum-polar herb which is widely distributed in North America and Eurasia. In our area bull thistle extends from the southern tip of southeast Alaska (circa 55° N latitude) (Hulten 1968) southward to central California (Munz 1959). Bull thistle is a herb that widely invades disturbed areas both to the west and east of the Cascades. In the western hemlock zone it is a characteristic species within the early "weed stage" of succession following logging and burning (Franklin and Dyrness 1973). Species it commonly occurs with are Senecio sylvaticus, Epilobium augustifolium, Pteridium aquilinum, Acer circinatum, Rubus ursinus, Berberis nervosa, and Gaultheria shallon.

Growth characteristics - Bull thistle is a biennial herb, 3-15 dm tall. Stems are spiny-winged by the decurrent leaf bases and copiously hairy. Leaves are pinnatifid, the larger ones with lobes again toothed or lobed, scabrous-hispid above and thinly white-tomentose beneath (Cronquist 1955).

Phenology - Several flower heads per plant (purple or rarely white) appear during July through September. Achenes (less than 4 mm long) ripen and are wind distributed later in the fall (Cronquist 1955).

Reproductive characteristics - This species does not bear seeds until the second year of life, after which the plant dies. The seeds are abundant, light and wind-borne, and require a mineral soil seedbed for successful germination and seedling establishment.

Site requirements - Bull thistle is intolerant of shade and requires open, disturbed sites for successful growth. It apparently will thrive on sites representing a wide range of soil moisture and fertility conditions as long as the site is disturbed and competition from other species is minimal.

Response to disturbance - Cirsium vulgare reached its peak in cover (1-3%) three to five years after clearcut logging and slash burning. It then slowly decreased in importance until about 12 years after disturbance when it was virtually absent (Halpern 1989). Since its seeds are wind-disseminated, it can invade a disturbed site over long distances.

Clintonia uniflora (Schult.) Kunth

Distribution - Queencup beadlily is found from southeast Alaska near Juneau (Hulten 1968) southward to Tulare County in central California (Munz 1959). It occurs from near the coast eastward to southwestern Alberta, Montana, Idaho, and eastern Oregon (Hitchcock et al. 1969). It is found up to about 5,000 feet in Oregon and Washington (Hitchcock et al. 1969), and 6,000 feet in California (Munz 1959). Queencup beadlily is of scattered occurrence in Sitka spruce zone and is a little more common in the western hemlock zone where it is abundant in moist communities such as Tsuga heterophylla/Achlys triphylla. It is most abundant in the Pacific silver zone within the Abies amabilis/Vaccinium membranaceum/Clintonia uniflora and Abies/ amabilis/Rhododendron albiflorum/Clintonia uniflora associations in the western Cascades (Hemstrom et al. 1987) and the Abies amabilis/Vaccinium alaskaense/Clintonia uniflora association in the Olympic Mountains (Henderson et al. 1989). It is also found within the mixed conifer and Abies concolor zones of southwestern Oregon and Abies grandis, Tsuga heterophylla, and Abies lasiocarpa zones of eastern Washington and Oregon (Franklin and Dyrness 1973).

Growth characteristics - Clintonia uniflora is a rhizomatous herb 1-3 dm. in height. Each plant has 2-3 leaves, oblong or elliptic to oblong-ovate, tips are rounded to abruptly acute. Leaves are generally 7-15 cm long and about 1/3 as broad. The peduncle is usually 1-flowered and 1/2 to 3/4 as long as the leaves (Hitchcock et al. 1969).

Phenology - Bell-shaped white flowers (about 2 cm long) appear during June and July. Deep lustrous blue berries, 6-10 mm long, ripen in August and September. Each berry is several seeded (Hitchcock et al. 1969).

Reproductive characteristics - Once established in an area, queencup beadlily probably largely spreads by vegetative means (sprouting from rhizomes). Although the seeds germinate readily, growth to flowering proceeds at a very slow rate (Kruckeberg 1982).

Site requirements - Clintonia is very shade tolerant and is typically found in the understory of dense coniferous stands. Soils supporting it are most often moist and of medium fertility. More humus types are generally present (Klinka et al. 1989).

Response to disturbance - Because of its marked affinity for dense shade, queencup beadlily decreases sharply in abundance with overstory removal. Re-establishment is slow following serious disturbance and is not complete until deep shade re-occurs.

Coptis laciniata Gray

Distribution - Found from Grays Harbor County, Washington (Hitchcock et al. 1964) southward to Mendocino County, northern California (Munz 1959). Goldthread is commonly found on the Olympic Peninsula, Washington (Henderson et al. 1989) and in the western Cascades of Oregon (Hemstrom et al. 1987, Franklin and Dyrness 1973). It occurs, in generally small quantities, in the western hemlock and Pacific silver fir zones. It is most common in the Tsuga heterophylla/Rhododendron macrophyllum/Berberis nervosa (Franklin and Dyrness 1973) and Tsuga heterophylla/Rhododendron macrophyllum/Oxalis oregana (Hemstrom et al. 1987) associations where it has an average cover of about 5 percent. Other understory species with which it commonly occurs include Acer circinatum, Gaultheria shallon, Polystichum munitum, Linnaea borealis, and Chimaphila umbellata (Franklin and Dyrness 1973).

Growth characteristics - Goldthread is a small (usually under 20 cm.), perennial, evergreen herb. Its common name originated because of its slender, yellow rhizome. Leaves are ternate-pinnatifid, the leaflets are 2-5 cm. long, ternately divided nearly to the base, the secondary leaflets incised-lobate nearly halfway to the midvein, and sharply serrate-denticulate. Flower stalks are usually 5-12 cm. tall and bear 2 flowers (Hitchcock et al. 1964).

Phenology - Flowering occurs from late April until August. Dry fruits, 8-12 mm long, mature during the fall (Hitchcock et al. 1964).

Reproductive characteristics - No information is available concerning the regeneration of goldthread from seed. However, it has been reported that it readily expands vegetatively by means of its shallow, slender rhizomes (Halpern 1989). Kruckeberg (1982) states that goldthread may be rather easily propagated by use of the rhizomes.

Site requirements - Goldthread is shade tolerant and thrives under closed canopies. It occurs on moist soils of medium fertility. Most often it is characteristic of soil having more humus types.

Response to disturbance - In the western Cascades of Oregon, abundance of goldthread was about the same following logging and slash burning as it was before disturbance. Although abundance was greatly reduced in burned areas, it increased in occurrence where the forest floor was relatively undisturbed by sprouting from rhizomes (Halpern 1989).

Cornus canadensis L.

Distribution - Bunchberry dogwood is a widely distributed species which occurs in eastern Asia, Greenland, and northeastern U.S. In our area it is found from northern Alaska (Hulten 1968) southward to Mendocino County in northern California (Munz 1959). Bunchberry dogwood is commonly found in the western hemlock and Pacific silver fir zones and it is of scattered occurrence in Sitka spruce and mountain hemlock zones (Franklin and Dyrness 1973, Hemstrom et al. 1987). It is most abundant in the Abies amabilis/Vaccinium alaskaense/Cornus canadensis and Abies amabilis/Rhododendron macrophyllum - Vaccinium alaskaense/Cornus canadensis associations (Hemstrom et al. 1987). It averages 13 percent cover in these two associations. Other understory species it occurs with are Acer circinatum, Chimaphila umbellata, Achys triphylla, Clintonia uniflora, Linnaea borealis, and Trillium ovatum (Hemstrom et al. 1987).

Growth characteristics - Cornus canadensis is a rhizomatous, evergreen herb from 5 to 20 cm. tall. Stems are greenish to reddish, with flat hairs and bracts becoming larger on the upper portion of the stem. Four to 7 leaves occur in a terminal whorl. Leaves are elliptic or ovate-elliptic, 2 to 8 cm. long, nearly sessile, usually subglabous and green on the upper surface and paler and glaucos beneath (Hitchcock et al. 1961).

Phenology - Small greenish-white flowers in a solitary cyme, surrounded by 4 large white bracts, appear during June through August. Fruits, bright red drupes, 1-2 cm. long, ripen in September and October (Hitchcock et al. 1961).

Reproductive characteristics - After the fruits ripen, seed dispersal is accomplished largely by birds and animals. Seeds require 4 months of cold stratification for germination. However, even with proper pretreatment, germination rates for bunchberry dogwoods seeds are low (USDA Forest Service 1974). Once established in an area further spread is probably largely vegetative by sprouting from rhizomes.

Site requirements - Bunchberry dogwood is shade-tolerant and is characteristic of shady, mossy understories of coniferous forests. Soils are generally moist to very moist, low in nitrogen and have medium levels of other nutrients, and have more humus types. It also frequently grows on rotted wood (Klinka et al. 1989).

Response to disturbance - Timber harvesting or fire greatly reduce the occurrence of bunchberry dogwood. Recovery rates, during secondary succession, would be slow despite vegetative regeneration from rhizomes.

Disporum hookeri (Torr.) Nicholson

Distribution - Hooker's fairybells occurs from British Columbia southward through Oregon and Washington on both sides of the Cascades (Hitchcock et al. 1969) and in the California Coast Ranges as far south as Monterey County (Munz 1959). It is of scattered occurrence throughout the Sitka spruce, western hemlock, and Pacific silver fir zones. The species does appear to be slightly more abundant in the wettest communities, i.e., Picea sitchensis/Oplopanax horridum, Tsuga heterophylla/Polystichum munitum - Oxalis oregana, and Abies amabilis/Oplopanax horridum. Maximum abundance reached was an average of 2% cover and 87% constancy (Franklin and Dyrness 1973, Hemstrom and Logan 1986, and Hemstrom et al. 1987). It also is present in the mixed evergreen, mixed conifer, and Abies concolor zones of southwestern Oregon (Franklin and Dyrness 1973). Other understory species it tends to occur with include Acer circinatum, Vaccinium parvifolium, Berberis nervosa, Achlys triphylla, Vancouveria hexandra, Asarum caudatum, and Cornus canadensis.

Growth characteristics - Stems are sparingly branched and crisp-pubescent. Leaves are ovate to ovate-elliptic, acuminate, 5-15 cm. long, strongly cordate and oblique at base, and strongly pubescent beneath and sparsely so above (Hitchcock et al. 1969).

Phenology - Each branch has 2-3 terminal campanulate flowers which are creamy white, 9-18 mm long, and appear from April to June. Red berries, 7-9 mm long, ripen in July and August (Hitchcock et al. 1969).

Reproductive characteristics - Regeneration is primarily by seed. Each berry has 4-6 seeds and dispersal is principally caused by animals (Hitchcock et al. 1969).

Site requirements - Hooker's fairybells are shade tolerant and are especially common in broad-leaved forests. Soils are moist to very moist and generally have high levels of nutrients, especially nitrogen. Mull humus types are most common (Klinka et al. 1989).

Response to disturbance - Severe disturbance results in greatly reducing the occurrence of Hooker's fairybells. Complete recovery of populations is dependent on re-establishment of moist, shady conditions.

Epilobium augustifolium L.

Distribution - A widespread, circumpolar species occurring eastward to the Atlantic coast and in Eurasia. In our area it is found from northern Alaska (70° N. lat.) (Hulten 1968) southward to San Diego County in southern California (Munz 1959). Fireweed is distributed virtually over the entire area of Oregon and Washington -- from sea level up to 4,000 M elevation. West of the Cascades it is generally found in recently disturbed areas. For example, it is commonly found in logged and burned-over areas in all west-side forest zones. East of the Cascades it is frequently a component of forest understories, e.g., under stands of ponderosa pine and white fir. It is also a common component of subalpine communities in the Cascades (Franklin and Dyrness 1973). Fireweed is an important species colonizing sites following logging and slash burning in the western hemlock zone. Other species it occurs with include Senecio sylvaticus, Epilobium paniculatum, Cirsium vulgare, Pteridium aquilinum, Acer circinatum, Rubus ursinus, Berberis nervosa, Gaultheria shallon, Ceanothus velutinus, and Salix spp. (Franklin and Dyrness 1973).

Growth characteristics - A perennial herb growing from spreading, rhizome-like roots 1-3 m tall. Stems are usually unbranched and glabrous except for fine puberulence in the inflorescence. Leaves are alternate, lanceolate, subsessile, 5-20 cm long (Hitchcock et al. 1961).

Phenology - Shoots begin to emerge from late March through May. Leaves are fully developed about 1 month later and maximum biomass is reached between the middle of June and the end of August. Many rose to purple flowers are borne on terminal racemes. Flowers bloom from June to September starting at the base and proceeding to the terminal. Light wind-borne seeds have matured and been dispersed from the basal flowers by the time the terminal flowers are opening (Haeussler and Coates 1986, Hitchcock et al. 1961).

Reproductive characteristics - First year fireweed plants may bear seed and estimates of numbers of seed per plant range to over 80,000. The plumed seeds are very light and are widely disseminated by the wind. Fireweed seeds partially lose viability after 18 months, but some continue to germinate for up to 2 years. Germination of seed is stimulated by light and a chilling period. Seed germination occurs both in the fall following fire and during the following spring. Germination is best on moist mineral soil in the absence of competition. Once established from seed, fireweed colonies spread aggressively vegetatively. The perennial root system, 2-8 cm below the soil surface, continuously gives rise to new shoots, thus expanding the size of the colony (Haeussler and Coates 1986).

Site requirements - A very shade intolerant species which is characteristic of recently burned or logged-over sites. Fireweed is an outstanding example of a plant with a very wide ecologic amplitude--it is found on sites with an amazing variety of microclimates and soils. In many locations it appears that its primary requirement is recent disturbance or a lack of competition. However, it is important to remember that fireweed also occurs in undisturbed subalpine and open seral forest communities (e.g., ponderosa pine). Needless to say, fireweed grows on soils with a wide range of pH and nutrient concentrations. If nutrient levels are very low, however, the plants may not flower (Haeussler and Coates 1986).

Response to disturbance - Among species invading recently logged and burned sites in the western Cascades of Oregon, fireweed is unique. Not only does it come in quickly after disturbance, it maintains its cover and constancy during a long period of the successional sequence. Apparently this occurs because of fireweed's long-term, aggressive vegetative reproduction following establishment from seed (Halpern 1989).

Epilobium paniculatum Nutt.

Distribution - Widely distributed throughout the western U.S. (Hitchcock et al. 1961). In our area it extends from British Columbia southward on both sides of the Cascades to southern California (Munz 1959). West of the Cascades autumn willowweed is generally found in recently disturbed areas. For example, in the western hemlock zone it is usually present in early stages of succession following logging and slash burning. East of the Cascades it occurs in steppe communities of the Columbia Basin and as an understory species in ponderosa pine communities. Other species occupying early successional stages in the western hemlock zone include Senecio sylvaticus, Epilobium angustifolium, Cirsium vulgare, Pteridium aquilinum, Acer circinatum, Rubus ursinus. Berberis nervosa, Gaultheria shallon, Ceanothus velutinus, and Salix spp. (Franklin and Dyrness 1973).

Growth characteristics - A freely branched annual 3-10 dm. tall with glabrous stems. Leaves are generally alternate, petiolate, narrowly lanceolate to linear, usually entire but sometimes denticulate; leaves on the main stems are 3-7 cm long but those on side stems are much shorter. Small racemes generally terminate each branch (Hitchcock et al. 1961).

Phenology - Small rose to light pink flowers bloom during July and August. Small seeds, borne in a 1.5-2.5 cm linear capsule, ripen early in the fall (Hitchcock et al. 1961).

Reproductive characteristics - Like fireweed (E. angustifolium), autumn willowweed is a prolific seeder. The seeds are light, have fine hairs, and are disseminated by the wind over long distances. If a mineral soil seedbed is present, seeds readily germinate, both in the fall and the following spring.

Site requirements - A very shade intolerant species which, west of the Cascades, is characteristic of recently disturbed sites. Although it thrives on a large variety of sites, it apparently slightly favors soils toward the dry end of the spectrum. Autumn willowweed is moderate in its nutrient requirements.

Response to disturbance - In the western Cascades of Oregon the occurrence of autumn willowweed peaked during the second year after logging and slash burning and then abundance quickly declined. The species showed a marked preference for burned microsites. The general pattern was for autumn willowweed seed to germinate during the fall and over-winter as rosettes, with the life cycle completed during the following summer and fall (Halpern 1989).

Festuca occidentalis Hook.

Distribution - Western fescue occurs from British Columbia southward along the coast and in the mountains to Tulare County, California (Munz 1959), an eastward to Idaho, Montana, and Wyoming, and in Canada to Ontario, south to Michigan (Hitchcock et al. 1969). Western fescue seldom occurs in large quantities and it is generally scattered. It is only infrequently found in the Sitka spruce zone (Hemstrom and Logan 1986). It is widely distributed in the western hemlock zone in small amounts. There are indications that it favors dry sites and is most abundant in communities such as Pseudotsuga menziesii/Holodiscus discolor (Hemstrom et al. 1987). It is also commonly found in the mixed evergreen and mixed conifer zones of southwestern Oregon (Franklin and Dyrness 1973). Understory species it commonly occurs with include Holodiscus discolor, Corylus cornuta, Berberis nervosa, Symphonicarpos mollis, Polystichum munitum, Trientalis latifolia, and Chimaphila umbellata (Franklin and Dyrness 1973).

Growth characteristics - Western fescue is a perennial grass with large amounts of basal leaves and culms generally 6-11 dm tall. Leaf bases have glabrous sheaths, lack auricles, and have ligules barely 0.5 mm long. Blades are filiform, involute, soft, scaberulous-puberulent on the upper surface, and glabrous on the lower. Flower panicles are large and open and usually drooping, mostly 10-20 cm long; spikelets are loosely 3-7 flowered. Slender awns are 4-12 mm in length (Hitchcock et al. 1969).

Phenology - Western fescue flowers appear from late May through July (Hitchcock et al. 1969).

Reproductive characteristics - Each plant bears approximately 100-500 seeds which are disseminated primarily by animals. Information about germination requirements is lacking. Evidently prolific germination and establishment is uncommon because western fescue stands are generally very scattered.

Site requirements - Western fescue is only moderately tolerant of shade and therefore grows best under open tree stands. Soils supporting it are typically at least moderately dry and tend to be shallow and stony. Fertility levels are medium to low and supplies of nitrogen are generally low. It is characteristic of soils with more humus types (Klinka 1989).

Response to disturbance - Where it is eliminated by logging or fire, recovery of western fescue would be expected to be slow. Re-invasion probably would be dependent on a nearby seed source.

Galium triflorum Michx.

Distribution - Sweetscented bedstraw has a circumboreal distribution. In our area it is found from interior Alaska (65° N. lat.) southward to southern California (Hulten 1968, Munz 1959). It occurs as far south as Mexico in the west and Florida in the east (Hitchcock et al. 1959). Sweetscented bedstraw is widely distributed within the forests of Oregon and Washington, but generally occurs in small quantities. It has been found in the majority of described associations within the Sitka spruce, western hemlock and Pacific silver fir zones. However, it does have a slight tendency to favor wet types and be less abundant in the driest communities (Hemstrom and Logan 1987, Hemstrom et al. 1987, Franklin and Dyrness 1973). It also occurs in the Abies concolor and Abies magnifica shastensis zones in southwestern Oregon and the Abies grandis and Abies lasiocarpa zones in eastern Oregon and Washington. Understory species it often occurs within the hemlock zone include Acer circinatum, Berberis nervosa, Polystichum munitum, Linnaea borealis, Coptis lacinata and Tiarella unifoliata (Franklin and Dyrness 1973).

Growth characteristics - Perennial herb with square stems growing from creeping rhizomes. Stems are 2-8 dm long, usually hooked-scabrous on the angles, and are usually prostrate but can be ascending, especially on surrounding vegetation. Leaves are vanilla-scented, mostly 4-6 in a whorl, narrowly elliptic to somewhat oblanceolate, generally scabrous-ciliate on the margins and hooked-scabrous on the midrib beneath, otherwise mostly glabrous. Axillary peduncles generally bear 3 terminal flowers (Hitchcock et al. 1959).

Phenology - Small, whitish flowers appear during June through August. Fruits, 0.5-1 mm long, are covered with hooked bristles and ripen in the fall (Hitchcock et al. 1959).

Reproductive characteristics - The burred seeds are generally disseminated on animal fur. Regeneration also occurs vegetatively through sprouting from rhizomes.

Site requirements - Sweetscented bedstraw is a shade tolerant herb with a fairly wide ecologic amplitude. It is more common in broad-leaved forests than under conifers. It is generally found on moist to very moist soils with large amounts of nitrogen and at least moderate levels of other nutrients (Klinka et al. 1989).

Response to disturbance - Because of its tolerance of full sunlight and rhizomatous growth habit, sweetscented bedstraw is commonly present in early seral communities (Klinka et al. 1989).

Goodyera oblongifolia Raf.

Distribution Rattlesnake plantain has a transcontinental distribution, occurring in Michigan, Wisconsin, Minnesota, and Maine (Hitchcock et al. 1969). In the west it is found from southeast Alaska (60° N. lat.) (Hulten 1968) southward to central California (Marin and Mariposa counties) (Munz 1959). It is widely distributed, although in small quantities, throughout the western hemlock zone (Hemstrom et al. 1987, Franklin and Dyrness 1973). It is also commonly found in the mountain hemlock and Pacific silver fir zones, at least on the Olympic Peninsula (Henderson et al. 1989). In addition, rattlesnake plantain is present in the mixed evergreen and mixed conifer zones of southwestern Oregon (Franklin and Dyrness 1973). Apparently it is most abundant in the Tsuga heterophylla/Linnaea borealis association where it averages 2% cover with 80% constancy (Hemstrom et al. 1987). Other understory species it commonly occurs with include Rhododendron macrophyllum, Berberis nervosa, Acer circinatum, Coptis laciniata, Rubus ursinus, Viola sempervirens, Trillium ovatum, and Polystichum manitum.

Growth characteristics - Goodyera oblongifolia is a herb rising from short rhizomes and ranging from 2 to 4.5 dm. in height. Leaves are all basal, the petioles winged and broad, 5-20 mm long. Leaf blades ovate-lanceolate to elliptic-lanceolate, thickish, 3-7 cm long, dark green and usually mottled or striped with white especially along the midrib. The flowering stem has 2-4 small, membranous sheathing bracts and is glandular-pillose (Hitchcock et al. 1969).

Phenology - Small greenish-white and tightly packed flowers appear on a raceme during July and August. Seeds ripen within 2 cm-long capsules during the early fall. Frequently these seeds rattle, hence the species' common name (Hitchcock et al. 1969).

Reproductive characteristics - As is the case of most native Orchidaceae species, very little is known about the regeneration of rattlesnake plantain (Kruckeberg 1982). Based on its very scattered occurrence, one would be tempted to conclude that regeneration from seed must be rare.

Site requirements - Rattlesnake plantain is a shade tolerant herb found over a wide range of elevations. Soils are generally moderately dry to moist with relatively low amounts of available nutrients. It generally grows on moss-rich sites having more humus types (Klinka et al. 1989).

Response to disturbance - Rattlesnake plantain is very susceptible to disturbance from logging and slash burning. In the western Cascades of Oregon, recovery from disturbance was also very slow (Halpern 1989).

Gymncarpium dryopteris (L.) Newm.

Distribution - Oakfern has a circumboreal distribution and extends eastward in the U.S. to Iowa and Virginia (Hitchcock et al. 1969). In our area it is found from central Alaska (circa 65° N. lat.) (Hulten 1968) southward to Arizona (Hitchcock et al. 1969). It occurs in scattered small quantities in the Sitka spruce, western hemlock, Pacific silver, and mountain hemlock zones. Oakfern is especially prevalent on the Olympic Peninsula where it is most common on very moist to wet sites (Franklin and Dyrness 1973, Hemstrom et al. 1987, Henderson et al. 1989). For example, in the western hemlock zone on the Olympic Peninsula, oakfern is most abundant in the Tsuga heterophylla/Oplopanax horridum association. It commonly occurs with species such as Acer circinatum, Athyrium filix-femina, Polystichum munitum, Ribes bracteosum, Smilacina stellata, and Tiarella trifoliata (Henderson et al. 1989).

Growth characteristics - Oakfern is a shield fern with scattered, deciduous leaves growing from an underground stem. Maximum height is approximately 5 dm. Petioles are usually 1-3 dm long, blades are about 18 cm long and 25 cm wide, glabrous or occasionally slightly glandular especially along the rachis, bipinnate-pinnatifid to tripinnate-pinnatifid; pinnae several pairs, with the members of the lowest pair each nearly as large as the rest of the blade (Hitchcock et al. 1969).

Phenology - No information available.

Reproductive characteristics - Sprouting from underground stems create extensive colonies of oakfern. Portions of these colonies can be easily transplanted (Kruckeberg 1982).

Site requirements - Oakfern is shade tolerant and is especially common in seepage areas and along streams. It is also common, but less abundant, on moist to very moist soils having moderate to high levels of nutrients. It is most often found on soils with mull humus types (Klinka et al. 1989).

Response to disturbance - Since it requires shade to grow successfully, removal of tree cover would be expected to greatly reduce the occurrence of oakfern. Re-establishment would most likely be deferred until cool, moist, shady conditions return. At that time oakfern would be re-introduced by spore and then spread largely by sprouting from underground stems.

Hieracium albiflorum Hook.

Distribution - White hawkweed occurs from southeast Alaska and Yukon Territory (circa 62° N. lat.) (Hulten 1968) southward to San Diego County, California (Munz 1959). To the east it is found in forested areas as far as Colorado (Cronquist 1955). White hawkweed occurs in generally small quantities in the Sitka spruce (Hemstrom and Logan 1986), western hemlock (Franklin and Dyrness 1973, Hemstrom et al. 1989), and Pacific silver fir zones (Henderson et al. 1989). It is also present in the mixed evergreen, mixed conifer, Abies concolor, and Abies magnifica shastensis zones of southwestern Oregon, as well as the Pinus ponderosa, Abies grandis, and Abies lasiocarpa zones of eastern Oregon and Washington (Franklin and Dyrness 1973). Although it is widely distributed, white hawkweed is apparently most common in the Pseudotsuga menziesii/Holodiscus discolor associations. Other species it is commonly found with include Acer circinatum, Corylus cornuta, Berberis nervosa, Polystichum munitum, Linnaea borealis, Trientalis latifolia, Synthyris reniformis, Iris tenax, Festuca occidentalis, Whipplea modesta, and Chimaphila umbellata (Franklin and Dyrness 1973).

Growth characteristics - Hieracium albiflorum plants are generally 3-13 dm tall. Stems are long hairy towards the base, becoming glabrous above. Leaves are sparsely to moderately long hairy, entire or wavy-denticulate. Basal leaves are persistent, generally 4-17 cm long with a short petiole, and 1.2 to 4.5 cm wide. Middle and upper leaves are sessile, reduced in size, and are subclasping. There are usually several flower heads on slender peduncles to form an open inflorescence (Cronquist 1955).

Phenology - About 13-34 small white flowers per plant appear June through August (Cronquist 1955).

Reproductive characteristics - White hawkweed principally reproduces by means of abundant, wind-borne seeds that are disseminated in the fall. It reproduces less commonly by sprouting from short, shallow rhizomes (Halpern 1989).

Site requirements - White hawkweed is only moderately shade tolerant and thrives in the open or under open-canopied stands. It generally occupies site which are moderately dry to moist and is commonly present on patches of bare mineral soil. Therefore it is often found on recently disturbed sites (Klinka et al. 1989).

Response to disturbance - White hawkweed is a residual species which is temporarily released by logging and slash burning in western Oregon. It especially favors burned sites for seed germination and establishment. Expansion of white hawkweed is restricted to the first 4-6 years after disturbance; following this, its importance gradually declines (Halpern 1989).

Iris tenax Dougl.

Distribution - Found from Grays Harbor and Thurston Counties in southwestern Washington southward west of the Cascades to Humboldt County in northern California (Hitchcock et al. 1969, Munz 1959). Oregon iris is encountered in the western hemlock zone both in the Oregon Coast Range and the western Cascades (Franklin and Dyrness 1973, Hemstrom et al. 1987). Although it is apparently very scattered in occurrence, it is most common within the Pseudotsuga menziesii/Holodiscus discolor association. Other species it commonly occurs with include Acer circinatum, Corylus cornuta, Berberis nervosa, Symphoricarpos mollis, Polystichum minitum, Linnaea borealis, Trientalis latifolia, Festuca occidentalis, and Whipplea modesta (Franklin and Dyrness 1973).

Growth characteristics - Plants have slender rhizomes and form clumps up to 3-4 dm in diameter. Leaves are 2-5 mm wide and up to 4 dm long (usually a little longer than the flowering stem). Flowering stems are up to 3.5 dm tall, slender, with 1-4 leaves (Hitchcock et al. 1969).

Phenology - Generally one large, showy, lavender or blue to purple (sometimes white) flower per plant appears during April through June. Seed, borne in capsules 25-30 mm long, ripens in the fall (Hitchcock et al. 1969).

Reproductive characteristics - Oregon iris produces with ease both from seed and vegetatively. Vegetative regeneration is accomplished by sprouting from the rhizome. Seeds germinate readily and plants often flower during the second year (Kruckeberg 1982).

Site requirements - Oregon iris is only moderately tolerant of shade and therefore is most often found in the open or under very open stands (Hitchcock et al. 1969). Although it favors hot and dry sites, it is also frequently found in more moderate locations (Zobel et al. 1976).

Response to disturbance - Oregon iris is commonly found in disturbed areas such as logged sites and roadsides, as well as under open tree stands. As such, it probably should be considered an invading species which maintains a role (often a minor one) under established tree stands on certain sites (Halpern 1987).

Linnaea borealis L.

Distribution - Twinflower has a circumpolar distribution. In our area it extends from northern Alaska (circa 69° N. lat.) (Hulten 1968) southward to Humboldt and Plumas Counties in northern California (Munz 1959). To the east in the U.S. it extends to West Virginia (Hitchcock et al. 1959). Twinflower is widely distributed in the western hemlock, Pacific silver fir, and mountain hemlock zones. Apparently it is not found in the Sitka spruce zone. Elsewhere twinflower is found in the mixed evergreen, mixed conifer, and Abies concolor zones of southwestern Oregon and in the Abies grandis zone on the east slopes of the Cascades. Largest amounts of twinflower (upwards of 25% cover) occur in the Tsuga heterophylla/Berberis nervosa-Gaultheria shallon/Linnaea borealis (Franklin and Dyrness 1973), Tsuga heterophylla/Rhododendron macrophyllum/Linnaea borealis, and Tsuga heterophylla/Linnaea borealis (Hemstrom et al. 1987) associations. Other understory species it tends to occur with include Rubus ursinus, Vaccinium parviflolium, Anemone deltoidea, Goodyera oblongifolia, Trillium ovatum, and Viola sempervirens (Hemstrom et al. 1987).

Growth characteristics - A trailing plant with slender, woody, and creeping stems. Total height is generally under 2 dm. Stems are more or less hairy and often glandular, producing numerous suberect leafy stems usually less than 10 cm long, each bearing a terminal peduncle 3.5-8 cm long. Leaves are on short petioles, are firm and evergreen, broadly elliptic or obovate, generally with a few shallow teeth, 7-25 mm long and 5-15 mm wide, glabrous or sometimes long hairy along the veins and margins (Hitchcock et al. 1959).

Phenology - Two small, pink bell-shaped flowers are borne on each peduncle during June through September. Small, stipulate fruits ripen during the fall (Hitchcock et al. 1959).

Reproductive characteristics - Once established in an area, twinflower primarily spreads vegetatively. Expansion occurs by growth of the numerous trailing stems, accompanied by frequent rooting at the nodes. Apparently little is known about reproduction by seed in this species (Kruckeberg 1982).

Site requirements - Twinflower is moderately shade tolerant. Although it has a wide ecologic amplitude, it apparently favors moderately dry to moist sites. On wetter sites it tends to occupy topographic prominences. Twinflower most often occurs on soils with medium levels of fertility. On nutrient-rich sites it tends to be restricted to decaying coniferous wood (Klinka et al. 1989).

Response to disturbance - Twinflower would be expected to show little long-term change in abundance following disturbance. It responds well to full sunlight and it is reported to persist on undisturbed cutover sites (Klinka et al. 1989).

Listera caurina Piper

Distribution - Occurs from southeastern Alaska (circa 60° N. lat.) (Hulten 1968) southward to Humboldt County in northwestern California (Munz 1959), and to the east it is found in western Alberta, Idaho, and Montana (Hitchcock et al. 1969). Western twayblade is of scattered occurrence in the western hemlock, Pacific silver fir, and mountain hemlock zone and is apparently most common in our area on the Olympic Peninsula (Franklin and Dyrness 1973, Henderson et al. 1989). It is typical of wet habitats and reaches its maximum importance in the Tsuga heterophylla/Oplopanax horridum association (Henderson et al. 1989). Species it often occurs with include Acer circinatum, Achlys triplylla, Athyrium filix-femina, Galium aparine, Gymnocarpium dryopteris, Polystichum munitum, Ribes bracteosum, Smilacina stellata, Tiarella trifoliata, and Vaccinium parvifolium.

Growth characteristics - Plants, arising from a slender rhizome, are from 10 to 35 cm. tall. Stems are glabrous below the two leaves and strongly glandular-pubescent above. Leaves are subopposite and are usually located well above the middle of the stem, lanceolate to ovate or ovate-rotund, usually 2.5 to 6 cm. long and rounded to abruptly acute. Racemes are generally 5 to 25 flowered and have conspicuous bracts. Pedicels are very slender and 5-10 mm long (Hitchcock et al. 1969).

Phenology - Small yellowish-green flowers appear during June to early August (Hitchcock et al. 1969).

Reproductive characteristics - In common with other native orchids in the Pacific Northwest, very little is known concerning seed regeneration of western twayblade (Kruckeberg 1989). The principal means of vegetative reproduction is undoubtedly sprouting from slender rhizomes.

Site requirements - Western twayblade is shade tolerant and grows on moist to wet sites. It is found on soils of medium fertility generally having more humus types (Klinka et al. 1989). Western twayblade has also been found to have a preference for cold sites (Zobel et al. 1976).

Response to disturbance - Probably because of its scattered occurrence, little is known about western twayblade's response to disturbance. Despite its abundance being initially reduced by disturbance, from a long-term point of view amounts of western twayblade would most likely be affected very little.

Lotus crassifolius (Benth.) Greene

Distribution - Big deervetch is distributed from northwestern Washington southward on the west side of the Cascades to San Luis Obispo County in southern California (Hitchcock et al. 1961, Munz 1959). Big deervetch is a common component of early seral communities on moist sites within the western hemlock zone. Several workers have described a Pteridium aquilinum-Lotus crassifolius community in disturbed areas in the Oregon Coast Range. Other species it commonly occurs with include Acer macrophyllum, Alnus rubra, Acer circinatum, Gaultheria shallon, Vaccinium ovatum, Polystichum munitum, and Rubus spectabilis (Franklin and Dyrness 1973).

Growth characteristic - Big deervetch is a rhizomatous perennial 2 to 10 dm in height. Stems are erect to spreading and are usually glabrous. Pinnately compound leaves are 5-15 cm long and have triangular stipules. Leaflets 9-15, oblong to oblong-obovate, 1-3 cm long, bright green and glabrous on the upper surface and paler to glaucous on the lower surface, and margins are entire with acuminate tips. Peduncles vary from shorter to considerably longer than the leaves and bear 7-20-flowered umbels (Hitchcock et al. 1961).

Phenology - Whitish flowers, tinged with red or purple, appear from May to July. Dark brown seeds, borne 4-5 in a pod, ripen in August and September (Hitchcock et al. 1961).

Reproductive characteristics - Little is known concerning the reproduction of big deervetch from seed. Once established in an area, it likely spreads predominantly by sprouting from rhizomes.

Site requirements - Big deervetch is not tolerant of shade and is characteristic of open, recently disturbed areas. It prefers moist to wet soils with at least moderate levels of nutrients. Bare mineral soil is very likely required for successful seed germination and seedling establishment.

Response to disturbance - Big deervetch is characteristic of early seral vegetation and is therefore largely a species of recently disturbed areas. Animals disseminates the seed which readily germinate on bare, mineral soil following fire or mechanical disturbance. Sites are quickly occupied by rapidly expanding rhizomes which sprout to give rise to additional plants. With establishment of an overstory provided by tree or shrubs, big deervetch rapidly decreases in importance.

Luzula parviflora (Ehrh.) Desv.

Distribution - Small-flowered woodrush is a very widely distributed species found in Eurasia and Greenland and across the U.S. to New York (Hitchcock et al. 1969). In our area it extends from northern Alaska (circa 60° N. lat.) (Hulten 1968) southward to Kern County in southern California (Munz 1959). Small-flowered woodrush is of scattered occurrence in the western hemlock, Pacific silver fir, and mountain hemlock zones in western Oregon and Washington. On the Olympic Peninsula it is most common in the Abies amabilis/Polystichum munitum - Oxalis oregana and the Tsuga heterophylla/Polystichum munitum - Oxalis oregana associations (Henderson et al. 1989). Other understory species it commonly occurs with include Achlys triphylla, Blechnum spicant, Maianthemum dilatatum, Rubus ursinus, Tiarella trifoliata, Vaccinium alaskaense, and Vaccinium parvifolium.

Growth characteristics - Small-flowered woodrush is a perennial with several stems arising from the base. Plant height ranges from 2 to 5 dm. Stems are often more or less decumbent and semi-stolonous. There are usually 2-4 leaves borne on the stem, 3-10 mm wide. Flowers are generally borne singly in rather diffuse, nodding panicles up to 15 cm long (Hitchcock et al. 1969).

Phenology - Small greenish to deep purplish-brown flowers appear during May to August. Yellow to brown seeds, 1.2-1.6 mm long, ripen during September and October (Hitchcock et al. 1969).

Reproductive characteristics - Small-flowered woodrush reproduces largely by seed. Once a plant is established it often spreads vegetatively by the rooting of stolons.

Site requirements - Small-flowered woodrush is moderately tolerant of shade. It generally occurs on moist to very moist soils with medium amounts of nutrients. These soils most often have more humus types (Klinka et al. 1989).

Response to disturbance - Since small-flowered woodrush is able to thrive in full sunlight, it probably holds its own or, perhaps, increases in importance following disturbance.

Lysichitum americanum Hult. & St. John

Distribution - Skunk cabbage is found from south central Alaska (circa 61° N. lat.) (Hulten 1968) southward to Santa Cruz County in central California (Munz 1959) and eastward to Montana and Idaho (Hitchcock et al. 1969). Skunk cabbage occurs sporadically in the Sitka spruce, western hemlock, Pacific silver fir, and mountain hemlock zones, especially in the Coast Range and on the Olympic Peninsula. Apparently it occurs less frequently in the Cascades (Franklin and Dyrness 1973, Hemstrom and Logan 1986, Hemstrom et al. 1987). It is most abundant (10-15% cover) in the Abies amabilis/Lysichitum americanum and Tsuga heterophylla/Lysichitum americanum associations described on the Olympic Peninsula (Henderson et al. 1989). It is most often associated with the following understory species: Acer circinatum, Rubus spectabilis, Vaccinium alaskaense, Athyrium filix-femina, Maianthemum dilatatum, Polystichum munitum, Rubus pedatus, and Tiarella trifoliata.

Growth characteristics - Skunk cabbage is a glaucous perennial with only basal leaves. Plant height is generally .5 to 2 m. Large leaves arise from short, flashy underground stems. Leaves are lanceolate to oblong-ovate, 4-15 dm long. The spathe is yellow and up to 2 dm long. Flowers are borne on a fleshy spadix 6-15 cm long (Hitchcock et al. 1969).

Phenology - Small greenish-yellow flowers appear from April through June. Berrylike fruits ripen during July and August (Hitchcock et al. 1969).

Reproductive characteristics - Skunk cabbage seed is reported to germinate readily provided it has a suitable wet substrate. Little is known about its ability to propagate vegetatively, though it is likely that the fleshy underground stem is able to divide and produce new plants (Kruckeberg 1982).

Site requirements - Although skunk cabbage is moderately shade tolerant, it also thrives in the open. It requires wet to very wet soils and is often found in swamps and other wetlands. It is most often associated with organic soils or strongly gleyed mineral soils. These souls are generally high in nutrients and have mull humus types (Klinka et al. 1989).

Response to disturbance - Provided that abundant soil water is preserved, skunk cabbage would be expected to hold its own and perhaps increase in importance following removal of the overstory.

Montia sibirica (L.) How.

Distribution - Western springbeauty is distributed from south-central Alaska (circa 60° N. lat.) (Hulten 1968) southward to Santa Cruz County in central California (Munz 1959), and eastward to Montana and Utah (Hitchcock et al. 1964). It is most common in the Sitka spruce zone, but it also occurs sporadically in the western hemlock and Pacific silver fir zones, especially in communities representing the moist end of the spectrum (Franklin and Dyrness 1973, Hemstrom and Logan 1986, Hemstrom et al. 1987, Henderson et al. 1989). Western springbeauty is most abundant in the Picea stichensis/Oxalis oregana association where it averages 4% cover with 92% constancy (Hemstrom and Logan 1986). Other understory species it is commonly associated with include Menziesia ferruginea, Vaccinium parvifolium, Athyrium filix-femina, Blechnum spicant, Rubus spectabilis, Galium triflorum, Maianthemum dilatatum, Polystichum munitum, Stachys mexicana, and Trillium ovatum.

Growth characteristics - Western springbeauty is usually an annual with a taproot, but occasionally it develops a short rhizome and persists for more than a year. Most often it has several glabrous stems 1-5 dm tall. Many basal leaves usually lanceolate or elliptic to rhombic-ovate, commonly 1-4 cm broad but sometimes narrowly lanceolate and 3-10 mm broad and petioles 2-3 times as long as the blades. Has 2 cauline leaves, opposite sessile to short-petiolate, 1-5 cm broad and up to 7 cm long. Plants have several many-flowered racemes which may reach lengths to 3 dm (Hitchcock et al. 1964).

Phenology - One cm-long pink to white flowers appear during March and April. Black, shiny seeds about 2 mm long ripen in early fall (Hitchcock et al. 1964).

Reproductive characteristics - Little is known concerning the regeneration of western springbeauty. Probably most reproduction is from seed. However, sprouting from rhizomes, where they occur, undoubtedly takes place.

Site requirements - Western springbeauty is shade tolerant. It requires moist to very moist soils and is often found on alluvial, floodplain, seepage, and stream-side sites. Soil fertility is generally high and soils tend to have mull humus types (Klinka et al. 1989).

Response to disturbance - The removal of overstory would be expected to severely reduce the occurrence of western springbeauty. Full recovery would only occur with the re-establishment of moist, shady conditions.

Osmorhiza chilensis H. & A.

Distribution - Mountain sweetroot is found from south-central Alaska (circa 60° N. lat.) (Hulten 1968) southward to San Diego County in southern California (Munz 1959). To the east it is found in northern New Hampshire and Newfoundland. It also occurs in Chile and Argentina (Hitchcock et al. 1961). Mountain sweetroot is found in generally small quantities in a wide variety of communities. It is found under Oregon white oak and Douglas-fir - grand fir stands in the Willamette Valley. It is also found in the Sitka spruce, western hemlock, and Pacific silver fir zones, often in very moist stands (e.g. in the Tsuga heterophylla/Oplopanax horridum association). In all cases amounts of mountain sweetroot are small with average cover never surpassing 1% (Franklin and Dyrness 1973, Henderson et al. 1989). The species also commonly occurs in the mixed conifer and Abies magnifica shastensis zones of southwestern Oregon, as well as in the ponderosa pine zone of northeastern Washington (Franklin and Dyrness 1973). Species it often occurs with include Achlys triphylla, Adenocaulon bicolor, Polystichum munitum, Ribes lacustre, Steptopus roseus, and Tiarella trifoliata (Klinka et al. 1989).

Growth characteristics - A perennial herb growing from a well-developed taproot. Stems may be solitary or sometimes 2 to 3, slender, 3-10 dm tall. Leaves have three divisions each of which is again divided into threes; leaflets are thin, narrowly to very broadly ovate, coarsely toothed and sometimes incised, usually 2-7 cm long and 1-5.5 cm wide, basal leaves several with long petioles, cauline leaves 1-3 with shorter petioles or subsessile. The stem is usually branched, producing several umbels (Hitchcock et al. 1961).

Phenology - The umbels bear small greenish-white flowers during April through June. Linear-oblong fruits, 12-22 mm long, ripen during late summer and fall (Hitchcock et al. 1961).

Reproductive characteristics - The fruits are barbed and disseminated principally in the fur of animals. Little is known in regard to seed germination requirements beyond the fact that mountain sweetroot is difficult to start from seed (Kruckeberg 1982).

Site requirements - Mountain sweetroot is only moderately shade tolerant and therefore is frequently found in open tree stands. It apparently has a wide ecologic amplitude and is found on dry to very moist sites. Soils supporting it generally have medium to high fertility and mull humus types (Klinka et al. 1989).

Response to disturbance - Unless it is very severe, disturbance would be expected to have a fairly minimal effect on the occurrence of mountain sweetroot. Its stout taproot tends to ensure its survival in areas free of deep soil disturbance.

Oxalis oregana Nutt. ex T. & G.

Distribution - Oregon oxalis is found from the Olympic Peninsula southward to Monterey County, California (Munz 1959). Its eastward extent is to the east slope of the Cascades (Hitchcock et al. 1961). Oregon oxalis is widely distributed on moist sites within the Sitka spruce, western hemlock, and Pacific silver fir zones of western Oregon and western Washington. It frequently carpets the forest floor and because of its abundance, oxalis appears in the names of many forest associations. Examples are Picea sitchensis/Polystichum munitum-Oxalis oregana, Tsuga heterophylla/Polystichum munitum-Oxalis oregana, and Abies amabilis/Vaccinium alaskaense/Oxalis oregana. In some stands, Oregon oxalis may have coverages of upwards of 75% (Franklin and Dyrness 1973, Hemstrom and Logan 1986, Hemstrom et al. 1987, Henderson et al. 1989). Understory plant species Oregon oxalis commonly occurs with include Acer circinatum, Berberis nervosa, Rubus ursinus, Vaccinium parvifolium, Galium triflorum, Polystichum munitum, Tiarella trifoliata, Trillium ovatum, and Vancouveria hexandra.

Growth characteristics - Oregon oxalis as a low-growing perennial arising from a scaly rhizome. Leaf petioles all grow from the base, are 3-20 cm long, and are brownish pilose. Leaves are palmately tri-foliate, with leaflets up to 4.5 cm broad. Flowering stalks, also arising from the base, are 5-15 cm tall, and each has one flower (Hitchcock et al. 1989).

Phenology - White to pinkish flowers, 13-20 mm long, appear from June to September. Ovoid-globose capsules, 7-9 mm long, mature during the fall (Hitchcock et al. 1961).

Reproductive characteristics - Little is known about regenerating Oregon oxalis from seed (almond shaped and about 4 mm long). Once established, oxalis spreads quickly by rhizomes and often carpets the ground (Kruckeberg 1982).

Site requirements - Oregon oxalis is shade tolerant and thrives under dense canopies. It also, however, tolerates a lack of shade and can maintain itself in the open. Oregon oxalis is characteristic of very moist to wet sites, but it generally is not found on very wet, periodically inundated sites. Environmental measurements in the western Cascades of Oregon showed that it preferred a warm and wet habitat (Zobel et al. 1976). Soils supporting Oregon oxalis tend to be high in nitrogen and at least moderate with respect to other nutrient elements.

Response to disturbance - Logging and slash burning in the western Cascades of Oregon caused very little change in the importance of oxalis. Prelogging and post-disturbance levels were essentially the same (Halpern 1989).

Polystichum munitum (Kaulf.) Presl

Distribution - Swordfern is found from southeast Alaska (circa 57° N. lat.) (Hulten 1968) southward to northern Baja California. It also extends eastward to northern Idaho, northwestern Montana, and the Blue and Wallowa Mountains of eastern Oregon and Washington (Hitchcock et al. 1969). It is a very common species in the forests of Oregon and Washington and is a dominant in many forest associations. Swordfern is abundant in the Sitka spruce, western hemlock, and Pacific silver fir zones and occurs sporadically in the mountain hemlock zone (Hemstrom and Logan 1986, Hemstrom et al. 1987, Henderson et al. 1989). It also commonly occurs in oak woodlands of the Willamette Valley and the mixed evergreen and mixed conifer zones of southwestern Oregon (Franklin and Dyrness 1973). Some of the associations in which swordfern is most abundant include Picea sitchensis/Polystichum munitum, Tsuga heterophylla/Gaultheria shallon/Polystichum munitum, Tsuga heterophylla/Polystichum munitum - Oxalis oregana, and Abies amabilis/Polystichum munitum. Other plant species commonly occurring with swordfern include Acer circinatum, Berberis nervosa, Rubus ursinus, Achlys triphylla, Vancouveria hexandra, Viola sempervirens, and Trillium ovatum.

Growth characteristics - Swordfern has stiff, arching fronds arising from a woody rhizome. Fronds are 2-15 dm long, petioles are stout, 0.5-4.5 dm long. Pinnae are offset, generally 35-70 on each side of the rachis, closely serrate, and at the base have a large projecting tooth on the upper side. The larger pinnae are usually 2-15 cm long and 0.8-1.5 cm wide above the basal tooth. Sori are mostly borne on the middle and upper pinnae (Hitchcock et al. 1969).

Phenology - In Oregon swordfern fronds unfurl during the month of May. By the end of July the fronds are usually mature and the spores are nearing maturity (Haeussler and Coates 1986).

Reproductive characteristics - Spores are produced first on fern plants which are 1 to 5 years old. Literally millions of spores are produced on one frond and under the best of conditions may maintain viability for 2-4 years. In swordfern many spores do not germinate until the following spring. The principal requirement for germination is that the spore must be soaked in water. Some vegetative regeneration of swordfern occurs through division of its perennial woody rhizome. However, most apparently uniform stands are not clones, but represent populations of individual sporophytes (Haeussler and Coates 1986).

Site requirements - Swordfern is shade tolerant, although it can grow fairly well in the open. It favors sites with moist to very moist conditions where moisture stress is limited. Swordfern grows on a wide variety of soils, but achieves best growth on deep, loamy soils, especially those derived from alluvium. Soils producing optimum stands of swordfern are those with high levels of nutrients, but swordfern is also found on soils with medium nutrient regimes (Haeussler and Coates 1986). It generally occurs on soils with mull humus types (Klinka et al. 1989). In the western Cascades of Oregon swordfern was found to be characteristic of warm-wet sites although it was found in small quantities in other locations (Zobel et al. 1976).

Response to disturbance - Following logging and slash burning swordfern importance is initially substantially reduced. However, gradual recovery occurs throughout early stages of secondary succession. The pattern of recovery suggests that largely vegetative regeneration is responsible rather seeding in from spores. The pace of long-term recovery of swordfern was found to be inversely proportional to the intensity of disturbance. Several workers have reported that frond-length in swordfern is considerably reduced in disturbed areas (Haeussler and Coates 1986, Halpern 1989).

Pteridium aquilinum (L.) Kuhn

Distribution - Bracken fern is a circumpolar species which is very widely distributed in Europe and North America. In our area it is found from southeast Alaska (circa 60° N. lat.) (Hulten 1968) southward to northwestern Mexico (Munz 1959) and eastward to Montana and Michigan (Peck 1941). Although bracken fern is principally known as an invading species in disturbed areas, it also occurs in small amounts in the understory of established tree stands. It has a very wide distribution in western Oregon and Washington, being found in the Sitka spruce, western hemlock, Pacific silver fir, and mountain hemlock zones (Hemstrom and Logan 1986, Hemstrom et al. 1987). In addition, it occurs in the mixed evergreen and mixed conifer zones of southwestern Oregon and subalpine meadow communities in the Cascades. Bracken fern is also common along the coast in headland communities and sand dunes (Franklin and Dyrness 1973). Two early seral communities in western Oregon which have large amounts of bracken fern are the Pteridium aquilinum - Gaultheria shallon and Pteridium aquilinum - Lotus crassifolius (Franklin and Dyrness 1973). Other species bracken fern commonly occurs with include Vaccinium parvifolium, Acer circinatum, Berberis nervosa, Rubus ursinus, Rubus spectabilis, Rubus parviflorus, Cirsium vulgare, and Epilobium angustifolium.

Growth characteristics - Bracken is a vigorously clonal deciduous fern, growing from rhizomes. Rhizomes are found at two depths -- deep rhizomes (about 50 cm), used for storing carbohydrates, and shallow rhizomes which produce fine feeder roots and shoots which develop into petioles. Rates of rhizome growth may be up to 2 m per year and well established clones may have 60,000 fronds per hectare and persist over 650 years. Petioles are erect and stiff, and up to 15 dm long. Leaf blades, which are generally at right angles to the petioles, are 3-10 dm long, pinnately or ternate-pinnately thrice compound with the ultimate segments crowded, sessile, and often confluent, glabrous or inconspicuously hairy above, and more or less densely villous beneath (Hitchcock et al. 1969, Haeussler and Coates 1986).

Phenology - Frond emergence times are controlled by spring temperatures. Generally frond growth will begin mid-March to early May, with maximum growth taking place in mid-May. Peak spore production is usually during late August and early September. Leaf senescence begins in August and by late October and early November all fronds are dead (Haeussler and Coates 1986).

Reproductive characteristics - A single bracken fern frond may produce 300 million spores. Spores are tiny and light and may be carried great distances by the wind. Once deposited, spores are able to germinate immediately or lie dormant for years. The ideal substrate for germination of spores is bare mineral soil with sufficient moisture and a pH of 5.5-7.7. Once established in a new area bracken fern vigorously spreads vegetatively by means of sprouting from rapidly growing rhizomes. Even very small rhizome fragments will reproduce quickly (Haeussler and Coates 1986).

Site requirements - Bracken fern is moderately shade tolerant, but it also grows very well in the absence of shade. It can flourish on a number of different soil types but it is unusually common in disturbed areas such as old fields, burned areas, and roadsides. Although it can grow on dry sites as well, bracken fern grows best on moist soils. In dry areas fronds tend to be shorter and smaller. Typically bracken fern is found on soils with medium to low levels of nutrients. However, nutrient supply is probably not the most important environmental factor influencing the distribution of bracken fern (Haeussler and Coates 1986, Klinka et al. 1989).

Response to disturbance - Bracken fern is a fire-tolerant species which is well adapted to periodic fires. Because of its deep rhizome it can survive even severe fires and then quickly sprout and occupy the site

free of competition. Even in the absence of pre-existing plants, bracken's light, wind-disseminated spores allow it to quickly invade recently burned-over areas. After clearcut logging in the western Cascades of Oregon bracken fern invaded quickly but rates of increase in cover were slow. Here it did not attain dominance until 15-20 years after logging (Haeussler and Coates 1986, Halpern 1989).

Rubus lasiococcus Gray

Distribution - Dwarf blackberry is found from British Columbia southward to Humboldt County in northern California. In Oregon and Washington its range is restricted to the Cascade and Olympic Mountains (Hitchcock et al. 1961, Munz 1959). Dwarf blackberry is characteristic of moderate to high elevations in the Cascades and Olympic Mountains. Therefore, it is found in the Pacific silver fir and mountain hemlock zones and in tree clumps in subalpine areas. It also occurs sporadically in the western hemlock zone, especially on the Olympic Peninsula (Franklin and Dyrness 1973, Henderson et al. 1989). In the Olympics it is most common (2-3% cover) in the Abies amabilis/Vaccinium alaskaense-Rhododendron albiflorum and Tsuga mertensiana/Rhododendron albiflorum-Vaccinium membranaceum associations (Henderson et al. 1989). Other understory species dwarf blackberry occurs with include Clintonia uniflora, Cornus canadensis, Linnaea borealis, Menziesia ferruginea, Pyrola secunda, Rhododendron macrophyllum, Rubus pedatus, Tiarella trifoliata, and Vaccinium ovalifolium.

Growth characteristics - Dwarf blackberry is a trailing perennial with freely-rooting herbaceous stems up to 2 m long. At intervals there are erect 1- to 3-foliate flowering stems up to 1 dm long. Leaves are broadly cordate-reniform, 3-6 cm broad, shallowly to deeply 3- lobed or sometimes divided into rounded or obtuse lobes or segments, doubly serrate margins. Each stem bears one or two flowers (Hitchcock et al. 1961).

Phenology - White flowers, with petals 5-8 mm long, appear from June to August. Red, puberulent drupelets, in aggregate less than 1 cm broad, ripen in late August and September (Hitchcock et al. 1961).

Reproductive characteristics - Once established in an area dwarf blackberry reproduction is accomplished primarily vegetatively by sending out runners which readily root. Little is known regarding regenerating this species from seed. Apparently the flowers frequently fail to produce fruit (Kruckeberg 1982).

Site requirements - Dwarf blackberry is shade tolerant and is seldom found growing in the open. It is generally found on moist to very moist soils with low levels of nutrients, especially nitrogen. It tends to increase in abundance with increasing elevation. Dwarf blackberry generally occurs on soils with more humus types.

Response to disturbance - Logging and fire disturbance would be expected to cause an abrupt decrease in dwarf blackberry importance followed by a period of very slow recovery. Full recovery would be delayed until the re-establishment of a tree canopy.

Rubus pedatus J.E. Smith

Distribution - Strawberry-leaf blackberry occurs from south-central Alaska (circa 62° N. lat.) (Hulten 1968) southward to southern Oregon. To the east it extends into western Montana and northern Idaho (Hitchcock et al. 1961). Strawberry-leaf blackberry is rarely found in forests of western Oregon but is common in forests in western Washington, especially those on the Olympic Peninsula. Here it is found in all forest zones -- Sitka spruce, western hemlock, Pacific silver fir, and mountain hemlock. It also commonly occurs in subalpine tree clumps (Franklin and Dyrness 1973, Henderson et al. 1989). Maximum amounts of strawberry-leaf blackberry are found in the Tsuga mertensiana/Vaccinium alaskaense and Abies amabilis/Vaccinium alaskaense-Rhododendron albiflorum associations with an average cover of 15% and 6%, respectively (Henderson et al. 1989). Other species it commonly occurs with include Blechnum spicant, Clintonia uniflora, Menziesia ferruginea, Streptopus roseus, Tiarella unifoliata, Vaccinium membranaceum, and Vaccinium ovalifolium.

Growth characteristics - Strawberry-leaf blackberry is a mat-forming perennial with trailing stems which freely root at the nodes. Horizontal stems, which lack thorns, give rise to erect stems seldom more than 2 cm long which bear 1-3 leaves and a single-flowered peduncle 2-6 cm long. The leaf blades are digitately 3- or 5-foliate with the lateral leaflets divided nearly to the base. Leaflets are obovate to deltoid-obovate, 1-3 cm long, and doubly serrate-dentate or incised-dentate (Hitchcock et al. 1961).

Phenology - Single, small, white flowers appear from May to early July. Red, juicy drupelets mature during August and September (Hitchcock et al. 1961).

Reproductive characteristics - Once established in an area, strawberry-leaf blackberry quickly spreads vegetatively by rooting of horizontal stems. The palatable fruit is undoubtedly eaten by animals and spread through their digestive tract. Very little is known concerning seed germination requirements (Kruckeberg 1982).

Site requirements - Strawberry-leaf blackberry is shade tolerant and is seldom a component of seral communities. Its occurrence increases with increasing elevation and it is characteristic of cool, moist to very moist sites. Soils tend to be moderate to low in nutrients, are generally nitrogen-deficient, and generally have more humus types (Klinka et al. 1989).

Response to disturbance - Logging and fire abruptly decreases amounts of strawberry-leaf blackberry. Recovery rates would be expected to be slow.

Rubus ursinus - Cham. & Schlecht.

Distribution - Trailing blackberry is found from British Columbia southward to Baja California and eastward to central Idaho (Hitchcock et al. 1961, Munz 1959). Trailing blackberry occurs in generally small amounts in forest associations within the Sitka spruce, western hemlock, Pacific silver fir, and mountain hemlock zones. It occurs in much greater quantities in many of the seral communities within these zones. Trailing blackberry also commonly occurs in the mixed evergreen, mixed conifer, Abies concolor, and Abies magnifica shastensis zones in southwestern Oregon (Franklin and Dyrness 1973, Hemstrom and Logan 1986, Hemstrom et al. 1987, Henderson et al. 1989). Its elevational range is approximately from sea level to 2,000 m. Species which it often occurs with include Rubus spectabilis, Polystichum munitum, Galium triflorum, Anaphilis margaritacea, Epilobicum angustifolium, Gaultheria shallon, Berberis nervosa, Pteridium aquilinum, Acer circinatum, Rhododendron macrophyllum, Ceanothus velutinus, and Salix spp.

Growth characteristics - A perennial trailing shrub armed with slender, hooked thorns. The slender, terminally-rooting primocanes range up to 5-6 m long. Numerous erect floral branches are mostly 1-3 dm long, bear several leaves, and 1 - several 4- to 10-flowered corymbs. The leaves are trifoliate with lateral leaflets ovate-lanceolate, 3-7 cm long, doubly serrate-dentate, and the terminal leaflet is larger (up to 10 cm long), frequently 3-lobed and occasionally divided (Hitchcock et al. 1961).

Phenology - Both staminate and pistillate flowers bloom during April through July. The fruit, a globose to elongated drupe or blackberry up to 2.5 cm long, ripens in August and September (Hitchcock et al. 1961).

Reproductive characteristics - Seed dissemination is principally by mammals and birds which are quick to eat the highly palatable fruit. Little is known about seed germination but Rubus seeds are often slow to germinate because of very hard seed coats. Once established, the fast-growing trailing stems readily root at the terminals, providing an efficient means of vegetative regeneration.

Site requirements - Although trailing blackberry is moderately shade tolerant, it grows best in full sunlight. It has a wide ecologic amplitude and is found on dry to wet sites. It apparently favors warmer sites and therefore its occurrence generally decreases with increasing elevation. Trailing blackberry thrives on recently disturbed sites having soils with at least moderate amounts of nutrients (Klinka et al. 1989).

Response to disturbance - Out of all the residual species in the western hemlock zone, trailing blackberry expands most quickly and dramatically following logging and fire disturbance. Its abundance rapidly increases to high levels which persist until tree crown closure. The increase is due to the vigorous spread of trailing stems over logs, stones, and stumps and even up into the crowns of adjacent tall shrubs and trees (Halpern 1989).

Senecio sylvaticus L.

Distribution - Woodland groundsel is native to Europe and introduced in the northwest. Its present distribution in our area is from British Columbia southward to Marin County, California (Munz 1959) and eastward to the crest of the Cascades (Cronquist 1955). Woodland groundsel is an herb which occupies recently disturbed areas. In the western hemlock zone it is often an invading species important in early stages of succession following clear-cut logging and slash burning. In addition to Senecio, these early seral communities usually contain such species as Epilobium angustifolium, E. paniculatum, Cirsium vulgare, and Pteridian aquilinum (Franklin and Dyrness 1973).

Growth characteristics - An annual herb, generally with an evident taproot, 1.5-8 dm tall. Stems are leafy and usually unbranched to the inflorescence. Foliage is moderately pubescent to subglabrous. Leaves are all pinnatifid and irregularly toothed, 2-12 cm long and 4-40 mm wide. Each plant usually has several flower heads (Cronquist 1955).

Phenology - Small, yellow composite flowers appear during June through August. Light, wind-disseminated seeds mature in early fall (Cronquist 1955).

Reproductive characteristics - Woodland groundsel's copious seeds are wind disseminated in western Oregon during the period of late July through September. Most seeds germinate in the fall and produce small rosettes which over-winter. A few seeds may germinate the following spring, but the life cycles of all germinants are completed by late summer (Halpern 1989).

Site requirements - Woodland groundsel is intolerant of shade and is only found in open, recently disturbed areas. It is found on exposed mineral soil having at least moderately high levels of nutrients, especially nitrogen. Although it sometimes ranges into the Abies amabilis zone, its occurrence decreases with increasing elevation (Klinka et al. 1989).

Response to disturbance - Following logging and slash burning in western Oregon woodland groundsel quickly invaded and was often present in large quantities by the second year after burning. Following its peak, woodland groundsel's importance was found to decrease rapidly. It occurs in especially large quantities on burned microsites. Woodland groundsel's affinity for burned soils and transient nature have been attributed to a high nutrient requirement which is satisfied by burned soils and an unusually poor competitive ability (Halpern 1989).

Smilacina stellata (L.) Desf.

Distribution - Starry Solomonplume has a transcontinental range which extends to the east coast (Hitchcock et al. 1969). In our area it is found from south-central Alaska and Northwest Territories (circa 65° N. lat.) (Hulten 1968) southward to the Sierra Nevadas of central California (Munz 1959). Starry Solomonplume is widely distributed in the forests of the northwest, but generally in small quantities. It is found in the Sitka spruce, western hemlock, Pacific silver fir, and mountain hemlock zones (Hemstrom and Logan 1986, Hemstrom et al. 1987, Henderson et al. 1989). It is also reported to be present in the mixed conifer and Abies magnifica shastensis zones of southwestern Oregon and the Abies grandis zone of eastern Oregon and Washington (Franklin and Dyrness 1973). It is most abundant in the Pacific silver fir zone where it has an average of 22% cover in the Abies amabilis - Abies grandis/Smilacina stellata association and 25% cover in the Abies amabilis/Oplopanax horridum association (Hemstrom et al. 1987). Other understory species which starry Solomonplume commonly occurs with include Chimaphila umbellata, Vaccinium membranaceum, Achlys triphylla, Adenocaulon bicolor, Anemone deltoidea, Asarum caudatum, Clintonia uniflora, Pyrola secunda, and Trillium ovatum.

Growth characteristics - Rhizomatous herb from 2 to 7 dm. in height. The flowering stem is usually erect, straight below and somewhat zigzag above. Leaves are sessile, arranged in two ranks to spirally, lanceolate to oblong-lanceolate or elliptic, acuminate, 5-17 cm long, 1.5-5 cm broad, glabrous to strongly pubescent at least on the lower side, and heavily veined. Five to 10 flowers are borne on a terminal raceme about 3-6 cm long (Hitchcock et al. 1969).

Phenology - Small, creamy-white, star-shaped flowers appear during May and June. The fruit -- a berry 7-10 mm long, greenish-yellow becoming blackish -- ripens during early fall (Hitchcock et al. 1964).

Reproductive characteristics - Starry Solomonplume is easily grown from rhizome pieces (Kruckeberg 1982). It is likely that once it is established in an area this type of vegetative regeneration predominates. Little is known concerning reproduction from seed.

Site requirements - Starry Solomonplume is very shade tolerant but also can grow in the open. It generally occurs on moist soils, but it can exist on drier sites if they are cool. It grows best on nutrient-rich soils with mull humus types (Klinka et al. 1989, Zobel et al. 1976).

Response to disturbance - Despite an initial decrease in occurrence of starry Solomonplume immediately after disturbance, long-term changes in its abundance would be expected to be minor.

Streptopus roseus Michx.

Distribution - Purple twistedstalk is found from southeastern Alaska (circa 60° N. lat.) (Hulten 1968) southward to the mountains of northern Oregon and eastward to southeastern British Columbia (Hitchcock et al. 1969). Purple twistedstalk is widespread, but of scattered occurrence, in the Cascade and Olympic Mountains of western Oregon and Washington. It is found in the western hemlock, Pacific silver fir, and mountain hemlock zones (Hemstrom et al. 1987, Henderson et al. 1989). It apparently is not found in the coastal Sitka spruce zone. Maximum average cover of about 3% occurs in the Abies amabilis/Vaccinium alaskaense/Tiarella unifoliata and Abies amabilis/Achlys triphylla - Tiarella unifoliata associations (Henderson et al. 1987). An Abies amabilis/Streptopus roseus association has been described in British Columbia (Franklin and Dyrness 1973). Species occurring with purple twistedstalk include Athyrium filix-femina, Berberis nervosa, Clintonia uniflora, Cornus canadensis, Gymnocarpium dryopteris, Linnae borealis, Polystichum munitum, Rubus pedatus, Smilacina stellata, Tiarella trifoliata, and Vaccinium membranaceum.

Growth characteristics - Stems, sometimes branched, are 15-40 cm tall, sparsely pubescent and fringed at the nodes. Leaves generally are ovate-elliptic, 3-10 cm long, 1/3 to over 1/2 as broad, and ciliate-denticulate. Axillary peduncles are mostly 1-flowered, coarsely pubescent, and are 9-20 mm long (Hitchcock et al. 1969).

Phenology - Campanulate whitish flowers, 6-10 mm long, appear during June and July. Red berries, 5-6 mm long, ripen during the early fall (Hitchcock et al. 1969).

Reproductive characteristics - Each berry has several seeds which are about 3 mm long and apparently germinate readily. Purple twisted stalk is also strongly rhizomatous and therefore regenerates often by sprouting from rhizomes (Hitchcock et al. 1969, Kruckeberg 1982).

Site requirements - Purple twistedstalk is moderately shade tolerant. It generally occurs on moist to very moist soils having moderate to high levels of nutrients and mull humus types. Its occurrence increases with increasing latitude and precipitation (Klinka et al. 1989).

Response to disturbance - Unless disturbance is unusually deep, purple twistedstalk would be expected to recover quickly by sprouting from rhizomes. Soil moisture supply is probably the single most important factor controlling its growth. Therefore, the effect of the disturbance on moisture supplies would be crucial in determining the post-disturbance fate of purple twistedstalk.

Synthyris reniformis (Dougl.) Benth.

Distribution - Snowqueen is found from southwestern Washington southward to Marin County, California. It does not extend further east than the crest of the Cascades (Hitchcock et al. 1959, Munz 1959). It is of scattered occurrence in the western hemlock and Pacific silver fir zones in Oregon (Hemstrom and Logan 1986, Hemstrom et al. 1987). It also is found under conifer forests in the Willamette Valley and in the mixed conifer zone of southwestern Oregon (Franklin and Dyrness 1973). By far the largest amounts of snowqueen occur in the Pseudotsuga menziesii/Holodiscus discolor association with an average cover of 4% and 90% constancy (Franklin and Dyrness 1973, Hemstrom et al. 1987). Other species with which it commonly occurs include Acer circinatum, Corylus cornuta, Berberis nervosa, Symphoricarpos mollis, Polystichum munitum, Linnaea borealis, Trientalis latifolia, Hieracium albiflorum, Festuca occidentalis, Whipplea modesta, and Chimaphila umbellata.

Growth characteristics - Perennial growing from a short rhizome, 1-2 dm tall. Leaves, all arising from the base, have long petioles, blades are cordate-ovate to reniform-cordate, palmately veined, 2-8 cm long and wide, sparsely hirsute-strigose above, and hairy or glabrous beneath, shallowly lobulate all around with the lobules again toothed. Each plant has several peduncles which are slender and weak and less than 1.5 dm long. Three-7 flowers are borne in a short raceme (Hitchcock et al.)

Phenology - Campanulate pale blue flowers, 5-7 mm long, appear during the early spring (March and April). Seeds, borne in capsules, mature during late summer (Hitchcock et al. 1959).

Reproductive characteristics - Seeds, collected during the early fall, are reported to germinate readily (Kruckeberg 1982). Information is lacking concerning vegetative regeneration, but sprouting from the short rhizome probably does occur on occasion.

Site requirements - Snowqueen is a moderately shade tolerant plant which is often found growing in openings. It reaches its greatest development on hot and dry sites, but it also grows in cooler, more moist locations (Zobel et al. 1976). Snowqueen is generally found at elevations lower than 1000 m.

Response to disturbance - Snowqueen in the western Cascades of Oregon showed minimal recovery after logging and slash burning. The pace of recovery is slow perhaps because the species relies almost entirely on regeneration from seed, not because of an inability to grow in the open (Halpern 1989).

Tiarella trifoliata L.

Distribution - Three-leaved coolwort is found from southcentral Alaska (ca 61° N. lat.) (Hulten 1968) southward to northern Oregon and east to northern Montana and western Idaho (Hitchcock and Cronquist 1961). It is a fairly common understory species in the Sitka spruce, western hemlock and Pacific silver fir zones of Oregon and Washington and occurs only sporadically in the mountain hemlock zone. Associations in which it is most abundant are Picea sitchensis/Polystichum munitum - Oxalis oregana, Tsuga heterophylla/Polystichum munitum - Tiarella trifoliata, and Abies amabilis/Acer circinatum/Tiarella trifoliata (Henderson et al. 1989, Hemstrom et al. 1987). Three-leaved coolwort cover averages about 7 to 12% in these communities. Other species with which it commonly occurs include Achlys triphylla, Athyrium filix-femina, Blechnum spicant, Linnaea borealis, Rubus ursinus, Vaccinium parvifolium.

Growth characteristics - A slender perennial herb with flowering stems 2-6 dm tall growing from horizontal to ascending rootstocks. Basal leaves are hirsute and usually glandular and have long slender petioles mostly 2-3 times as the blades. Leaf blades are 1.5-7 cm long and up to 9 cm broad, have 3 leaflets lobed no more than half their length, the lobes secondarily deeply crenate-dentate and bristly. The flowering stems are glandular-hirsute and have a panicle up to 15 cm long (Hitchcock and Cronquist 1961).

Phenology - Small white, campanulate flowers appear during May through August. Small (1.5 mm long) seeds are borne in capsules during the fall (Hitchcock and Cronquist 1961).

Reproductive characteristics - Although the principle means of regeneration is from seed, sprouting from short rhizomes is also noted in three-leaved coolwort. Little is known concerning requirements for seed germination (Kruckeberg 1982).

Site requirements - Three-leaved coolwort is moderately shade-tolerant. It is characteristic of cool, moist to very moist sites. Soils supporting three-leaved coolwort are generally high in nitrogen, medium to high in other nutrients, and have mull humus types (Klinka et al. 1989).

Response to disturbance - Three-leaved coolwort would be expected to recover slowly from disturbance. However, this is based on species characteristics rather than hard data from disturbance studies.

Tiarella unifoliata Hook.

Distribution - Western coolwort is found from southeast Alaska (circa 59° N. lat.) (Hulten 1958) southward to Santa Cruz County, central California (Munz 1959) and eastward to Idaho and western Montana (Hitchcock and Cronquist 1961). Although widely distributed in the forests of western Oregon and western Washington, it generally occurs in small quantities. Western coolwort has been reported to occur in all principle forest zones of the region -- Sitka spruce, western hemlock, Pacific silver fir, and mountain hemlock. It also occurs east of the Cascades in the Abies concolor and Tsuga heterophylla zones. Western coolwort is found most frequently in the western hemlock and Pacific silver fir zones and the Tsuga heterophylla/Polystichum munitum, Abies amabilis/Achlys triphylla - Tiarella unifoliata, and Abies amabilis/Vaccinium alaskanese/Tiarella unifoliata associations (with an average cover of about 3-4%) (Franklin and Dyrness 1973, Henderson et al. 1989). Other species it commonly occurs with include Athyrium filix-femina, Berberis nervosa, Clintonia uniflora, Cornus comadensis, Gymnocarpium dryopteris, Linnoea borealis, Oplopanax horridum. Rubus pedatus, Smilacina stellata, Stereptopus roseus, Tiarella trifoliata, Vaccinium membranaceum, and Viola sempervirens.

Growth characteristics - Perennial herb growing from a slender short rhizome and 2-4.5 dm in height. Basal leaves are more or less hirsute and generally glandular, with slender petioles usually 2-3 times as long as the blades, leaf blades up to 12 cm broad and 8 cm long, broadly cordate in outline and palmately 5-lobed with lobes of unequal size, crenate-toothed to more or less doubly crenate-dentate and bristly-apiculate. Cauline leaves are similar or more deeply 3-lobed. Small white flowers are borne in elongate leafless panicles (Hitchcock and Cronquist 1961).

Phenology - Flowers appear during June through August and fruits, in the form of capsules containing a few small, black seeds, ripen in the fall (Hitchcock and Cronquist 1961).

Reproductive characteristics - Requirements for seed germination are not known. Some vegetative regeneration occurs as sprouting from the short rhizomes.

Site requirements - Western coolwort is moderately shade tolerant. It is characteristic of cold, moist to very moist sites. It grows on acid soils with medium levels of nutrients and more humus types (Klinka et al. 1989, Zobel et al. 1976).

Response to disturbance - Based on its characteristics, we would expect western coolwort to recover slowly from disturbance.

Trientalis latifolia Hook.

Distribution - Starflower is found from southern British Columbia southward to San Luis Obispo County, California and eastward to Alberta and northern Idaho (Hitchcock et al. 1959, Munz 1959). It is widely distributed in generally small amounts throughout the Sitka spruce, western hemlock, and Pacific silver fir zones (Hemstrom and Logan 1986, Hemstrom et al. 1987, Henderson et al. 1989). Starflower is also found in the mixed evergreen, mixed conifer, Abies concolor and Abies magnifica shastensis zones of southwestern Oregon (Franklin an Dyrness 1973). It is probably most common in the western hemlock zone where in western Oregon it favors dry sites occupied by associations such as Pseudotsuga menziesii/Holodiscus discolor/grass (Hemstrom et al. 1987). However, on the Olympic Peninsula starflower tends to occur most frequently on very moist sites. Here it averaged a high of 6% cover in the Tsuga heterophylla/Polystichum munitum-Tiarella trifoliata association (Henderson et al. 1989). Other understory species it commonly occurs with include Acer circinatum, Berberis nervosa, Gaultheria shallon, Linnaea borealis, Hieracium albiflorum, Synthyris reniformis, Festuca occidentalis, Whipplea modesta, and Chimaphila umbellata.

Growth characteristics - Starflower is a perennial herb that grows from an erect tuber 1-2 cm long, with stems 1-2.5 dm tall. Four-8 leaves, borne in a terminal whorl, are broadly ovate-elliptic to obovate, 3-10 cm long and 1.5-4 cm broad. Each plant bears about 6 or 7 flowers on slender pedicels arising from leaf axils (Hitchcock et al. 1959).

Phenology - Pinkish, star-shaped flowers, 8-12 mm in diameter appear during April through July. Capsules containing numerous seeds ripen in the fall (Hitchcock et al. 1959).

Reproductive characteristics - Starflower is reported to have, in addition to tubers, thin underground stolons which enhance its ability to persist and spread. Little is known concerning regeneration from seed (Kruckeberg 1982).

Site requirements - Starflower is moderately shade tolerant. As far as soil and microclimate is concerned, it is one of the least discriminating species. In the western Cascades of Oregon it was found on all sites except the coldest (Zobel et al. 1976). It is found on dry to very moist sites and on soils with a variety of fertility levels. All in all Starflower is a species which shows a low degree of site specificity (Klinka et al. 1989).

Response to disturbance - Following logging and slash burning starflower importance gradually increased for 4-5 years, followed by a gradual decrease. Starflower's ability to withstand disturbance was attributed to its deeply buried tuberous root system. Apparently the underground plant parts are in a position to expand vigorously after the disturbance (Halpern 1989).

Trillium ovatum Pursh

Distribution - Trillium is found from British Columbia southward to Monterey County in central California (Munz 1959) and eastward to Wyoming and Colorado (Hitchcock et al. 1969). Trillium is very widely distributed in small quantities throughout the forest of western Oregon and western Washington. It is present in all principle forest zones -- Sitka spruce, western hemlock, Pacific silver fir, and mountain hemlock, as well as in the forest of southwestern Oregon, and the Abies grandis zone of eastern Oregon and Washington (Franklin and Dyrness 1973). The only areas where trillium occurrence is reduced is in the mountain hemlock zone and the driest communities within the western hemlock zone. In most forest associations average abundance of trillium is about 1% or less cover and 50% constancy (Hemstrom and Logan 1986, Hemstrom et al. 1987, Henderson et al. 1989). Understory species trillium often occurs with include Acer circinatum, Rhododendron macrophyllum, Vaccinium parvifolium, Berberis nevosa, Viola sempervirens, Polystichum munitum, Linnaea borealis, Coptis laciniata, and Tiarella unifoliata.

Growth characteristics - Trillium is a perennial herb with annual stems arising from a short, thick rhizome. The entire plant is glabrous with stems 1-4 dm tall. Usually 3 leaves (rarely 4 or 5) occur in a whorl at the top of an otherwise naked stem. Leaves are nearly or quite sessile, ovate to deltoid-obovate, mostly 5-15 cm long and often as broad, acute to abruptly acuminate. A solitary flower is situated above the leaf whorl on a peduncle 2-8 cm long. Three green sepals are 1.5-6 cm long and 2-15 mm broad, and 3 large petals are usually white, larger than the sepals and are up to 3 cm broad (Hitchcock et al. 1969).

Phenology - Flowers appear in the spring -- March through May. The fruit, a slightly winged, many-seeded, fleshy capsule, ripens in late summer (Hitchcock et al. 1969).

Reproductive characteristics - Trillium can spread vegetatively to a limited extent by sprouting from its short rhizome. However, it is likely that most regeneration occurs from seed, which are reported to germinate readily (Kruckeberg 1982).

Site requirements - Trillium is moderately shock tolerant. It is a species with an unusually wide ecologic amplitude, occurring on sites with a wide range in temperature and moisture characteristics (Zobel et al. 1976). Trillium prefers soils with at least moderately high levels of nutrients and which have mull humus types. Its occurrence decreases with increasing elevation, latitude, and continentality (Klinka et al. 1989).

Response to disturbance - Because of its rhizomatous growth habit, trillium would be expected to be somewhat successful in recovering from disturbance. Recovery might be slowed since it is known that trillium will not flower for 1 or 2 years after disturbance.

Valeriana sitchensis Borg.

Distribution - Sitka valerian is found from south-central Alaska (ca 63° N. lat.) (Hulten 1968) southward to Humboldt County in northern California (Munz 1959) and eastward to western Montana and central Idaho (Hitchcock et al. 1959). It is characteristically a species of the higher elevations and is therefore found in the Pacific silver fir and mountain hemlock zones and not in the Sitka spruce and western hemlock zones (Hemstrom and Logan 1986, Hemstrom et al. 1987, Henderson et al. 1989). It also occurs in the Abies magnifica shastensis zone of southwestern Oregon. However, it is in subalpine and alpine meadow vegetation that Sitka valerian reaches its maximum importance in Washington and Oregon. In forest communities it generally is only of scattered occurrence. Perhaps the association in which it is the most common is the Chamaecyporis nookatensis/Rhododendron albiflorum (Franklin and Dyrness 1973). Other species which tend to occur with Sitka valerian include Menziesia ferraginea, Sorbus sitchensis, Rubus pedatus, Rubus lasiococcus, Viola sempervirens, Listera caurina, and Erythronium montanum.

Growth characteristics - Perennial herb with opposite glabrous leaves, growing from a stout, branched rhizome, and 3-12 dm tall. Leaves are generally cauline, mostly 2-5 pairs with the lower-most one on two pairs reduced in size. Middle leaves have long petioles, pinnatifid, with enlarged terminal segment up to 10 cm long and 7 cm wide and 1-4 smaller, lateral pairs up to 7.5 cm long and 4.5 cm wide. Upper leaves are usually reduced and are sessile or sub-sessile. Leaves are all coarsely crenate to sometimes entire. The terminal inflorescence is a compact corymb, 2.5-8 cm wide (Hitchcock et al. 1959).

Phenology - Small white flowers appear during June through August, depending on elevation. Ovate, glabrous and plumed fruits, 3-6 mm long and 2-2.5 mm wide, ripen in the fall (Hitchcock et al. 1959).

Reproductive characteristics - The plumed fruit is light enough to be fairly widely distributed by the wind. Sitka valerian also spreads readily by sprouting from rhizomes (Kruckeberg 1982).

Site requirements - Sitka valerian is moderately shade tolerant, but reaches its greatest development in open habitats such as subalpine and alpine meadows. It requires moist to very moist soils which are high in nitrogen and are at least moderately high in other nutrients. Generally soils supporting Sitka valerian have mull humus types (Klinka et al. 1989).

Response to disturbance - Because of its affinity for open sites and rhizomatous growth habit, Sitka valerian would be expected to increase in importance following most types of disturbance.

Vancouveria hexandra (Hook.) Morr. & Dec.

Distribution - Inside-out flower is found west of the Cascades from the southern end of the Puget Sound Trough, Washington southward to Mendocino County in northern California (Hitchcock and Cronquist 1964, Munz 1959). In our area it is virtually restricted to forests of western Oregon where it is found in the Sitka spruce, western hemlock, and Pacific silver fir zones as well as the mixed conifer, Abies concolor, and Abies magnifica shastensis zones of southwestern Oregon (Hemstrom and Logan 1986, Hemstrom et al. 1987, Franklin and Dyrness 1973). Inside-out flower is most abundant in the western Cascades of Oregon in the following associations: Tsuga heterophylla/Oplopanax horridum, Tsuga heterophylla/Polystichum munitum - Oxalis oregana. and Tsuga heterophylla/Achlys triphylla (average cover of 4-6% and constancy of 60-65%) (Hemstrom et al. 1987). Other understory species which tend to occur with inside-out flower include Acer circinatum, Rubus spectabilis, Vaccinium parvifolium, Athyrium felix-femina, Cornus canadensis, Galium triflorum, Similacina stellata, Tiarella trifoliata, and Viola sempervirens.

Growth characteristics - A rhizomatous, perennial herb 2-4 dm in height. Leaves have long petioles and are 1-4 dm long, biternate or incompletely triternate, the leaflets cordate-ovate, 3-lobed, and sparsely pubescent. Both petioles and flowering stems are usually brownish pilose especially near the base. Ten-30 flowers are borne in loose panicles with recurved, slender pedicles 15-40 mm long (Hitchcock and Cronquist 1964).

Phenology - Large white flowers ("inside-out_ because the petals and sepals are reflexed, exposing the stamens and pistil) appear during May and June. Several-seeded fruits (follicles mature in the fall (Hitchcock and Cronquist 1964).

Reproductive characteristics - Inside-out flower reproduces both from seed and vegetatively by sprouting from rhizomes. Since seeds have a limited period of viability, once established in an area it probably regenerates largely by vegetative means (Kruckeberg 1982).

Site requirements - Inside-out flower is moderately shade tolerant but is also able to thrive in the open. It is widely distributed in small quantifies on a variety of sites, but it appears to grow best on very moist soils (Zobel et al. 1976). Soils supporting inside-out flowers are generally moderate to high in fertility and have mull humus types.

Response to disturbance - On the basis of species characteristics it appears that inside-out flower is adapted to survive disturbance and perhaps even to increase in importance.

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