CONSERVATION ASSESSMENT for

Cypripedium fasciculatum Kellogg *ex* S. Watson

Originally issued
as Management Recommendations
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USDI Bureau of Land Management, Oregon and Washington

CONTENTS

Preface

Management Recommendations

Some of the content in this document was included in a previously transmitted Management Recommendation (MR) developed for management of the species under the previous Survey and Manage Standards and Guidelines (USDA and USDI 1994a,b). With the removal of those Standards and Guidelines, the previously transmitted MR has been reconfigured into a Conservation Assessment (CA) to fit the BLM Oregon/Washington and Region 6 Forest Service Special Status/Sensitive Species Programs (SSSSP) objectives and language.

Since the transmittal of the MR in December 1998, new information has been gathered regarding habitat, number of sites, and distribution relative to land allocation within the Northwest Forest Plan (NWFP) area. A significant amount of new information has been included in this CA, including new information regarding management and impacts on species sites. New information regarding the occurrence of this species outside of the NWFP area in Oregon and Washington has not been included.

Assumptions on site management

In the Final Supplemental Environmental Impact Statement (FSEIS) and Record of Decision (ROD) to Remove or Modify the Survey and Manage Standards and Guidelines, assumptions were made as to how former Survey and Manage species would be managed under agency Special Status Species policies. Under the assumptions in the FSEIS, the ROD stated "The assumption used in the final SEIS for managing known sites under the Special Status Species Programs was that sites needed to prevent a listing under the Endangered Species Act would be managed…For species currently included in Survey and Manage Categories C and D (which require management of only high-priority sites), it is anticipated that loss of some sites would not contribute to the need to list… Authority to disturb special status species lies with the agency official that is responsible for authorizing the proposed habitat-disturbing activity" (USDA and USDI 2004). This species was in Survey and Manage Category C at the time of the signing of the ROD, and the above assumptions apply to this species' management under the agencies' SSSSP.

Management Considerations

Under the "Managing in Species Habitat Areas" section in this Conservation Assessment, there is a discussion on "Management Considerations". "Management Considerations" are actions or mitigations that the deciding official can utilize as a means of providing for the continued persistence of the species' site. These considerations are not required and are intended as general information that field level personnel could utilize and apply to site-specific situations.

Management of this species follows Forest Service 2670 Manual policy and BLM 6840 Manual direction. (Additional information, including species-specific maps, is available on the Interagency Special Status Species website.)

SUMMARY

Species *Cypripedium fasciculatum* Kellogg *ex* S. Watson (Clustered Lady's Slipper/Brownie lady's slipper)
Taxonomic Group Vascular Plants

Other Management Status NatureServe ranks *Cypripedium fasciculatum* with a global ranking of G4 (not rare and apparently secure, but with cause for long-term concern, usually with more than 100 occurrences) (Oregon Natural Heritage Center 2004). Oregon Natural Heritage Information Center ranks the species S3 (rare or uncommon) and Heritage List 2, threatened with extirpation in the state of Oregon. The Washington Natural Heritage Program ranks the species S3 (rare or uncommon; 21-100 occurrences). The USDI Bureau of Land Management lists *C. fasciculatum* as a Bureau Sensitive species in Oregon, Bureau Assessment in Washington. The species is Forest Service Region 6 Sensitive.

Range and Habitat The global range of *Cypripedium fasciculatum* spans eight states in the western United States: Wyoming, Colorado, Utah, Montana, Idaho, Washington, Oregon, and California. The northern range limit for *C. fasciculatum* is the northern Cascades of Washington. The southern range limit is the Santa Cruz Mountains of the central California coast. It occurs in mountainous areas from the coastal and interior far west to the interior-west and the mid Rocky Mountain Range.

Habitat requirements include shade of mature coniferous forest canopies, but most frequently is found in mixed successional forests in overstory openings and edges where the shade is provided by shrubs, saplings, and large perennial forbs. Because of its strong connection with mycorrhizal fungi and a pollinator that preys on fungal gnats, the habitat includes a rich organic layer that supports microflora.

Threats Threats include activities that alter the moisture or temperature regime, actions that disturb the soil and litter layer, or decrease vegetation cover. Specific concerns associated with these activities are discussed in the Conservation Assessment.

Management Considerations

- Maintain sufficient cover to avoid any more than intermittent direct solar radiation on *C. fasciculatum* plants.
- Maintain decayed down logs (decay class 4 and 5), snags, and duff layer within the species habitat area for favorable forest floor conditions, habitat, soil moisture and mycorrhizal associates. Where fuel concentrations are within the historic range of variability, provide for future recruitment of coarse woody debris.
- Avoid activities that alter or remove soil, duff, or the organic matter in the species habitat area.
- Manage sites to include entire populations plus an area large enough to maintain current habitat and associated microclimate, primarily temperature and moisture.
- Where fuel concentrations exceed historic range of variability (fuel condition class 2 and

3), treat fuels within and adjacent to the site to reduce risk of high intensity fire.

- Restrict activities within species habitat areas during the species' growing season which ranges from March (or whenever leaves visible) through August (or when capsules split and shed seeds). Growth season can vary from site-to-site and year-to-year and should be checked before activity takes place.
- Because plants do not appear above ground every year, it is important to buffer species locations in order to capture dormant plants.

Data and Information Gaps

- Reproductive processes and biology most critical to maintaining the viability of *C. fasciculatum* populations. Environmental and ecological factors that influence population fluctuations.
- Identification of fungal associates, their habitat requirements, and the role they play in the life history of *C. fasciculatum*.
- Number of extant populations within Oregon and Washington.
- Population census and structure of known populations.
- Completion and updating of interagency or agency specific databases.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Scientific name: *Cypripedium fasciculatum* Kellogg ex S. Watson
Common name: Clustered Lady's Slipper, Brownie's Lady's Slipper
Family: Orchidaceae
Subfamily: Cypripedioideae

Cypripedium fasciculatum was originally described in the literature by Watson (1882) and Hickman (1993) from a collection made by Wilhelm Suksdorf in May 1880, "on the White Salmon River, Washington Territory, above the falls." Other collections mentioned in the description were made in California in Plumas County and probably in Del Norte County. Thomas Howell collected the first specimen in Oregon in 1884 in Josephine County, near Grave Creek (Siddall et al. 1979).

Genus: *Cypripedium* contains about 45 species in the Northern Hemisphere. Eleven are native to North America (Cribb 1997).

Citations: *Cypripedium fasciculatum* Kellogg ex S.Watson, 1882. Proceedings of the American Academy of Arts and Sciences 17:380. (Watson 1882). LECTOTYPE: White Salmon River, above the falls, Washington Territory, May 1880, W. N. Suksdorf. *Cypripedium pusillum* Rolfe, in Bull. Misc. Inform. Kew 1892:211 and in Gard. Chron. III, 12:364 (Rolfe 1896). *Cypripedium fasciculatum* Rolfe var. *pusillum* (Hooker 1893). Botanical Magazine plate 7275. (Hooker 1893). *Cypripedium knightae* (Nelson, 1906). Botanical Gazette 42:48. (Nelson 1906). Two species of *Cypripedium*, *C. pusillum* (Rolfe 1892) and *C. knightae* (Nelson 1906), were later described as being notably different from *C. fasciculatum*. However, Hitchcock et al. (1969) suggest that differences between *C. knightae* and *C. fasciculatum* do not merit specific or infraspecific designation. Rolfe based the name *C. pusillum* on a cultivated plant of uncertain origin that was considered a synonym of *C. fasciculatum* by Hitchcock et al. (1969). Characters formerly proposed for separating eastern and western races of *C. fasciculatum* are of little use and formal recognition of infra-specific taxa is not warranted on the basis of existing information (Brownell and Catling 1987).

B. Species Description

1. Morphology and Chemistry

The following description is taken from (Hitchcock et al. 1969): Stems from short rootstocks, 0.5-2 dm. tall, lanate-pilose, usually with a single sheathing bract near ground level, a pair of opposite leaves at to well above mid-length, and often 1 or 2 lanceolate bracts near the inflorescence; leaves sessile, broadly elliptic to oblong-elliptic or elliptic-oval, mostly 4-8 cm broad, rounded-obtuse to slightly acute; flowers (1) 2-4 in a rather tight cluster, subtended by conspicuous greenish bracts usually as long as the densely pilose ovary; sepals lanceolate-acuminate, 12-25 mm long, greenish-brown or greenish-purple and usually purple-lined or -mottled, the lower pair fused completely or free at the tips only; petals similar to the sepals but usually somewhat broader; lip depressed-ovoid, shorter than the sepals, greenish-yellow with brownish-purple margins and often with a purplish tinge; staminodium 2.5-3 mm long, about equaling the longest lobe of the stigma (Figure 1).

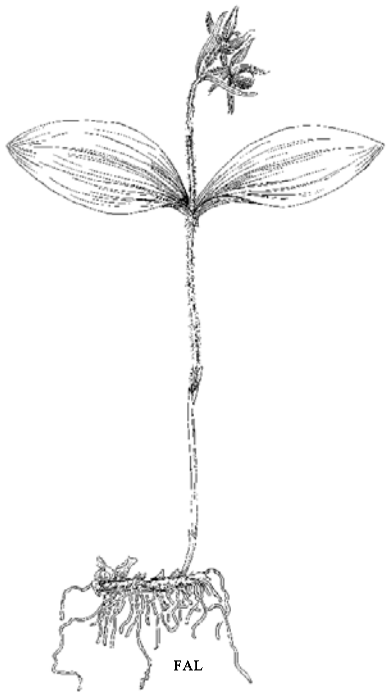

Figure 1—Botanical drawing of *Cypripedium fasciculatum***.**

This species cannot be mistaken for any other *Cypripedium* growing in the same range because of its small size, two sub-opposite leaves on a hairy stem, and the tight cluster of greenish-brown flowers with large pouches (Knight 1994). The 2 cm long, oblong capsules contain thousands of small dust-like seeds. The stem is flexible when in flower and the inflorescence may arch down to touch the ground (Luer 1975). Later when capsules are formed the stem elongates and becomes erect.

The genus *Cypripedium* has been well documented in the literature. Abrams (1940), Peck (1961), Hickman (1993), Case (1994), Coleman (1995), Cribb (1997), Doherty (1997), provide general descriptions of morphology, life history, cytology, phylogenetic relationships, biogeography, ecology including mycorrhizal associations, uses, culture and propagation, artificial hybridization, and taxonomy.

2. Reproductive Biology

C. fasciculatum, like other Cypripediums, begins from a top-shaped protocorm that develops a rhizomatous structure (Cribb 1997). The corm may persist for a few years as the seedling develops, but for the first few years the emergent stem elongates each year becoming a segmented rhizome that replaces the corm. The growth of the rhizome is sympodial, i.e., the terminal bud gives rise to the aerial shoot rather than to the extension of the rhizome (Curtis 1943, Stoutamire 1991). Near the base of the sympodial bud, roots are initiated and grow out from the ventral side of the rhizome (Stoutamire 1991). As the plant matures individual aerial stem scars along the branch correspond to individual roots, many of which are senescent (Curtis 1943). The root system grows in the organic soil layer close to the soil surface but with roots extending into mineral soil. Knecht (1996) reported that rhizomes of plants located east of the Cascades were found approximately 3-7 cm (1.2-2.75 in) below the surface of the mineral soil. In populations west of the Cascade Crest, rhizomes were typically deeper, but never greater than 12 cm (4.7 in) below the surface (Knecht 1996). It generally takes several years before the seedling emerges with an aerial stem above ground.

Rhizomes produce buds during the growing season that remain dormant through the winter below the soil surface. Each bud may develop into an emergent aerial shoot with a single stem and commonly two leaves the following spring if conditions are favorable. Harrod (1994b) dated rhizomes by counting stem scars (assuming one stem scar per year). He estimated the rhizome he excavated to be between 25 and 30 years old assuming it was intact. Niehaus (1974) reported studying a *C. fasciculatum* plant that he thought was at least 95 years old. It should be noted that if a rhizome has broken or rotted off, only the minimum age can be determined.

Spring growth of orchids arises from over-wintering buds produced the preceding growing season. Unlike most other plants, however, if fire, late frost, foraging animals, disease, accident, or damaging management practices destroy new spring growth, an orchid cannot replace the lost tissues until the following year (Sheviak 1990, Stoutamire 1991). Although dormant buds may be present, they will not initiate growth that growing season. The root system will remain and a new bud may form, or a dormant bud may enlarge, but the plant will suffer a major setback and it may die (Sheviak 1990). *Cypripedium* plants that lose their growth before midsummer will commonly appear the next year but will not bloom (Primack et al. 1994, Vance 2002). Depending on how severely depleted their energy reserves are, plants may require two or more subsequent vegetative seasons before blooming (Primack et al. 1994, Case 1994). The emergence of the aerial parts of the plants above ground has been observed to vary from year-to-year. Differences in local climate appear to be related to the differences in emergence that have been monitored over four years (Peck 1961, Latham and Hibbs 2001).

Curtis (1943) attributed the increase in the numbers of *C.candidum* aerial stems to the development of adventitious buds at the tips of two- or three-year old roots. Within a clump, several plants may belong to one genet (a plant derived from a single seed) so that several individuals grouped together may be clones (genetically identical) (Harrod et al. 1997). The importance of a pollinating vector for producing seed indicates that the species relies on attracting a pollinator for sexual reproduction to extend its distribution as well as maintain a diverse gene pool (Knecht 1996, Lipow et.al. 2002). In other deceptive non-rewarding orchids increasing the floral density in a cluster may result in attracting more pollinators, thus greater reproductive success (Davis 1986). Therefore, vegetative reproduction may be more important for increasing the number of flowering stems than as a direct means of expanding a population.

It takes a number of years for a germinant to develop into a mature flowering plant. In a study of five *Cypripedium* species germination and seedling development, Curtis (1939) found that about 8 to 16 years elapsed from seed germination to flowering. Curtis (1939) noted that for each species the time interval to flowering was quite variable and weather or site dependent. The flowering period occurs from March at low elevation sites through June and occasionally July at higher elevations (Coleman 1995). Flowering of an individual plant may last several weeks depending upon the number of individual flowers in the inflorescence. *Cypripedium fasciculatum* is self-compatible (does not reject its own pollen) but requires an insect vector for successful pollination (Knecht 1996, Lipow et al. 2002). It is generally thought that the shape of flowers and position of reproductive structures have coevolved with a particular pollinator to achieve cross-fertilization (Luer 1969, Stoutamire 1967). For *C. fasciculatum* there is no evidence to confirm this hypothesis as most other *Cypripedium* species are pollinated by bees (Cribb 1997). However, the floral morphology could determine the likely pollinators (Cribb 1997). For example, the size of the escape route under the stigma and anthers prevents pollinia from being picked up by the specific insect pollinator until after it passes the stigma as it exits the labellum in *C. fasciculatum* (Lipow et.al. 2002).

Recent research on the pollination biology of *C. fasciculatum* in southwestern Oregon suggests that stingless parasitic wasps (Family Diapriidae, Subfamily Belytinae, genus *Cinetus*) serve as pollinators of *C. fasciculatum* (Ferguson and Donham 1999, Ferguson et al. 2000). Prior research presumed *C. fasciculatum* was pollinated by flies or fungal gnats due to its morphology, inconspicuous coloration, and unique odor (Knecht 1996). However, more recent studies document only female diapriid wasps carrying *C. fasciculatum* pollinia and suggest diapriid wasps as pollinators (Ferguson and Donham 1999, Ferguson et al. 2000). Diapriid wasps oviposit in dipteran hosts (primarily fungal gnats), which may be attracted to the orchid. Although wasps are known to visit the orchids *Epipactis helleborine* and *E. purpurata* with flowers similar in color to *C. fasciculatum* (Proctor et al. 1996), the mechanism by which the orchid attracts the wasp is unknown. It is possible that attracting the wasp pollinator involves a complex series of steps beginning with attracting the fungal gnat to the flower.

Cypripedium fasciculatum is a non-rewarding orchid (no nectar or pollen benefits to the pollinator) and as such may have difficulty attracting pollinators. Generally with non-rewarding orchids the reproductive success rate is relatively low. The average for North American nectarless orchids is around 20 percent (Lipow et al. 2002). Correll (1950) and Barker (1984) suggest that *C. fasciculatum* has relatively low fruit production. Barker (1984) believes that pollination is an infrequent event. Harrod (1993) found that only 31 percent of the observed flowers produced capsules. However, fruit set in open pollinated flowers of *C. fasciculatum* was found to be 69 percent for plants in a site sampled in southern Oregon—higher than in plants sampled at sites in Idaho and Colorado (Lipow et al. 2002). The large number of seeds produced per capsule is estimated to average 3,874 per fruit (Harrod and Knecht 1994) which may compensate for relatively low levels of fruit production. A greater limitation to population persistence may be due to factors that relate to the post seed production phase of the life cycle.

The stem of *C. fasciculatum* bearing the capsule that contains the maturing seed becomes elongated and erect enhancing seed dispersal (Doherty 1997). The small, fusiform-shaped seeds of *C. fasciculatum* are 1 to 2 mm long, very light, weighing up to 2µg. Once the seed are dispersed it is unknown how long they remain viable. The lightness of the seed and the hard testa (seed coat), which enables the seed to float, favors dispersal by wind and water (Cribb 1997). However, because air circulation is inhibited in the forest understory, seeds generally were found to disperse up to only about 2 m from the parent plant (Harrod 1993). Harrod and Everett (1993) and Harrod (1994a) developed a model to predict seed dispersal. Their model suggests that *C. fasciculatum* seed dispersal is relatively limited to a little over 1 m (43 in) dispersal distance in a 10 mph wind, which is consistent with preliminary results presented by Harrod (1993). This may indicate that poor seed dispersal is one factor in the patchy distribution of *C. fasciculatum*. Based on spatial distribution patterns and the hard testa which allows the seed to float, seed may also be dispersed by water movement during overland flow and rain splash. Animal trails are interlaced among the plants, making it possible that ungulates or other animals may be vectors of seed dispersal (Harrod 1993). No study has confirmed this but it may explain why individual plants are often widely separated from each other.

3. Genetic Variation

The genetic variation within sampled populations indicates that genetic variation is sufficient and well structured despite many populations being widely separated. Several genetic studies show that this species has greater genetic variation within populations than among populations (Aagaard et al. 1999, Vance and Doerksen, unpublished data). At present genetic alleles are well dispersed among the populations with little evidence of genetic drift among the populations located in Washington, Oregon and California. However, population distribution includes isolated populations with little chance of gene flow that ensures alleles are shared with other populations, so the potential for genetic drift could increase for these populations. Analysis of five populations in southern Oregon showed that a population located in a campground on the edge of the North Umpqua River was spatially separated and greatly disjunct from most other populations in the Klamath province. This population had lower genetic diversity than the other populations sampled (Vance 2001). Lack of reproductive success of the plants at this campground site might be contributing to reduction in genetic diversity as well as its possibly long-term isolation.

Aagaard et al. (1999) analyzed the genetic variation among three populations sampled on the Leavenworth Ranger District (RD), and the Wenatchee NF using isozyme analysis. Genetic variation at the population level was slightly lower than those of long-lived perennial herbaceous plants in a Hamrick and Godt (1989) review of genetic variation in plant species. At the species level the variation is higher based on isozyme analysis of 33 populations across the range of the species (Vance and Doerksen, unpublished data). This variation is consistent with other long-lived perennials that reproduce sexually, are in mid-to late-successional status, and have wind-dispersed seed (Hamrick and Godt 1989). Among populations in California, Oregon, and Washington there was little evidence of genetic drift or bottleneck despite the distance among disjunct populations and the widespread and regional distribution of the species (Aagaard et al. 1999, Vance and Doerksen, unpublished data). This suggests that there may have been greater connectivity among populations in the past and occurrence of gaps in distribution across the region may be a fairly recent phenomenon. Levels of genetic variability appear similar to other North American species of *Cypripedium* (Case 1994).

4. Ecological Roles

An important ecological consideration is the relation between mycorrhizal fungi and the orchid. It determines how the species reproduces and persists. It is complex and varies over the life cycle of the plant (Curtis 1939, Rasmussen 1995). Orchid seeds require the colonization by a specific mycorrhizal fungus to germinate (Arditti 1967, Doherty 1997, Wells 1981). Doherty (1997) reports that there is no question that developing orchids depend on its fungal symbiont for survival. Some native orchids are completely mycotrophic when immature, spending several years in a dependent, subterranean condition, relying on the fungus for water and nutrition before sufficient growth occurs and stored food accumulates for leaf production. Only after adequate food storage will the plant produce the aerial stem and leaves. Once an orchid reaches maturity and becomes autotrophic, the degree of dependence and the symbiont fungal species may change. Fungi performing as orchid mycorrhizae are diverse; more than one species are found colonizing orchid roots after the species is autotrophic (Kristiansen et. al. 2001). In unpublished reports, Latham isolated and identified forty-three different fungal species of endophytic and ectomycorrhizal fungi that apparently colonized *C. fasciculatum* roots. Latham also found a positive correlation between numbers of new roots and percent colonization of endophytic fungi and the reverse for ectomycorrhizal fungi (Latham 2002). Establishment of new populations requires suitable conditions for forest fungi. What constitutes suitable conditions is not known, but can be presumed to be moist at least for part of the growing season and shady with adequate organic material to support growth of heterotrophic fungi. Decaying wood, rich in fungi, may be important symbionts of the plant and an attractant for fungal gnats which are part of the species' pollination system.

The relationship between fungus and orchid is not well understood, but the interaction is highly regulated by the plant and changes over the season (Anderson 1992). It appears that it is a dynamic interaction that may be affected by disturbance to the microenvironment (Sheviak 1990). Further research is needed to firmly establish the nature and extent of the relationship.

C. Range and Sites

The range of *Cypripedium fasciculatum* is broad, spanning eight states in the western United States. It occurs in mountainous areas in the coastal and interior far west, the interior-west and the mid Rocky Mountain Range. The far west includes the Sierra Nevada Range near the Nevada border and the Santa Cruz Mountains on the central coast of California, the California and Oregon Coast Ranges, the Klamath Mountains, the southern Cascades, and the northern Cascades in Washington. Occurrences in the Northern Rockies include the Bitterroot Range in northern Idaho and western Montana, the Mission and Swan Range in western Montana, the Clearwater and Coeur d'Alene Mountains in northern Idaho, and the Blue Mountains in northeastern Oregon. *Cypripedium fasciculatum* also occurs in the Rocky Mountains of Utah (Wasatch and High Uinta Mountains), Colorado (Park and Front Ranges), and the Medicine Bow and Park Ranges in Wyoming (Brownell and Catling 1987).

In Oregon and Washington the northern range limit for *C. fasciculatum* is the northern Cascades of Washington. The southern range limit in Oregon is the Siskiyou/Klamath Mountains. Across its range populations are scattered and widely separated.

Portions of the species' range include rugged mountainous terrain under increasing influence of the Pacific Ocean in the western Cascades and western portion of the Klamath region with cool climate, mild temperatures and high precipitation occurring during the winter months. Along the more northern latitudes and higher elevations, most precipitation occurs as snow. In these regions snow pack is an important source of moisture in the dry summer particularly in the eastern Oregon Cascades and the southern provinces where precipitation rarely exceeds 60 cm (24 in).

Within these provinces, the species has been found at elevations ranging from about 100 to 6400 feet (30 to 1,951 meters) and on all aspects. Habitats are diverse in soil type, elevation, aspect, and associated vegetation. Sites vary from dry to damp, rocky to loamy, with no apparent restriction to parent material. However, even in damp areas the soil is well drained. For example, *C. fasciculatum* has been described on serpentine landslides (Fowlie 1988), old stream terraces (Kagan 1990), and in ponderosa pine communities within dry Douglas-fir series (Knecht 1996). The majority of sites are located in the Oregon Klamath and the California Klamath provinces. These physiographic provinces represent relatively warm, dry forest zones and dry Douglas-fir types (Franklin and Dyrness 1973). This is not surprising since much of this species' entire range includes the interior Columbia basin and the dry northern Rockies.

D. Habitat Characteristics and Species Abundance

Across its range, *C. fasciculatum* occupies diverse habitats. It has been found growing along stream banks and on slopes that vary in steepness and aspect. It is also commonly found under shrubs and cover of hardwoods in mixed conifer/hardwood forests (Coleman 1995). Its strong association with *Pseudotsuga menziesii* suggests habitats that have had disturbance such as fire, and even has been found growing in roadcuts or skid trails (Vance personal observation, Coleman 1995). Because of its strong connection with mycorrhizal fungi and a pollinator that preys on fungal gnats, the habitat includes a rich organic layer that supports the associated micorflora. It is found under mature coniferous forest canopies, but most frequently is found in mixed successional forests in overstory openings and edges where the shade is provided by shrubs, saplings, and large perennial forbs. Individuals of this species, particularly those growing in early seral conditions, may not complete the life cycle without some kind of an overtopping herb, shrub, or tree. Evidence of the potentially damaging effects of prolonged direct solar radiation is sun scald and prematurely senescent leaves and/or inflorescences (Vance 2002).

Suitable habitat includes above and below ground conditions. Under early successional conditions, particularly in large forest openings where there is insufficient overstory canopy cover, a shrub component is important to providing needed cover for *C. fasciculatum.* Large flowering plants have been observed growing in forest canopy gaps, road cuts, and roadside ditches, but almost always under saplings or shrubs (Coleman 1995, Vance personal observation). With respect to the below ground habitat, this species is associated with a number of mycorrhizal fungi and may require a mycorrhizal symbiont, not only as an adult, but also for seed germination similar to other *Cypripedium* species (Arditti 1967). Historically, suitable habitat conditions for *C. fasciculatum* likely shifted across the landscape over time or were found in fire refugia (Camp 1995). Greenlee (1997) suggests that *C. fasciculatum* on the Lolo NF in Montana, is distributed as a metapopulation linked by recurrent extinctions and recolonizations over time. In this view, *C. fasciculatum* populations moved across the landscape as suitable habitat appeared and disappeared as disturbances and successional changes occurred over time. Because of the flow of water and the lightness and smallness of seed, populations may tend to drift down slope as seed is carried by snowmelt and rain. *Cypripedium fasciculatum* populations are found on drainage slopes at varying distances from streams, which suggest that portions of a population furthest upslope might have been prone to extirpation by fire.

Kagan (1990) notes that in southwestern Oregon (Rogue River, Siskiyou, Umpqua and Klamath NF, and the Medford District BLM) the species occurs primarily in mature Douglas-fir forests. Douglas-fir is the dominant species in the canopy (highest in frequency and cover) in the majority of plant communities in which *C. fasciculatum* has been reported on the Medford District BLM. Within these habitats, there are a variety of plant associations in which *C. fasciculatum* is found. These plant associations most often include variations of the Douglas-fir/dwarf Oregon-grape (*P. menziesii/Berberis nervosa*), Douglas-fir/poison oak (*P. menziesii/Toxicodendron diversilobum*), tanoak/dwarf Oregon grape (*Lithocarpus densiflorus/B. nervosa*), grand fir/California hazelnut/vanilla leaf (*A. grandis*/*Corylus cornuta*/*Achlys triphylla*), and grand fir/dwarf Oregon grape/vanilla leaf (*A.grandis*/*B. nervosa*/*A.triphylla*) associations. Other associated dominants include western hemlock (*Tsuga heterophylla*), white fir (*A. concolor*), white oak (*Q. garryana*), big leaf maple (*Acer macrophyllum*), and tanoak (*L. densiflorus*). Understory associated species include sword fern (*Polystichum munitum*), Oregon grape (*B. nervosa*), dogwood (*C. nuttallii*), and hazel (*Corylus cornuta*). Species strongly associated with *C. fasciculatum* east of the Cascade crest may include ponderosa pine (*Pinus ponderosa*), grand fir (*A. grandis*), spirea (S*pirea betulifolia*), rattlesnake plantain (*Goodyera oblongifolia)*, heartleaf arnica (*Arnica cordifolia*), big-leaf sandwort (*Arenaria macrophylla*), and arrow leaf balsam root (*Balsamorhiza sagitatta*). One site in Washington west of the Cascades is in the Pacific silver fir/thinleaf huckleberry (*A. amabilis/Vaccinium membraneceum*) series.

II. CURRENT SPECIES SITUATION

A. Status History

NatureServe ranks *Cypripedium fasciculatum* with a global ranking of G4 (not rare and apparently secure, but with cause for long-term concern, usually with more than 100 occurrences) (Oregon Natural Heritage Center 2004). Oregon Natural Heritage Information Center ranks the species S3 (rare or uncommon) and Heritage List 2, threatened with extirpation in the state of Oregon. The Washington Natural Heritage Program ranks the species S3 (rare or uncommon; 21-100 occurrences). The USDI Bureau of Land Management lists *C. fasciculatum* as a Bureau Sensitive species in Oregon, Bureau Assessment in Washington. The species is Forest Service Region 6 Sensitive in Oregon & Washington.

B. Major Habitat and Viability Considerations

Individuals are long-lived, may take a number of years to mature to flowering, have a symbiotic relation with fungi that derive nutrition from the rhizosphere of nearby trees and shrubs, require an organic layer of soil for part or all of its life, have a specific pollinator, and have a shallow root crown and rhizome system sensitive to mechanical and fire disturbance. Knecht's (1996) observations indicate that plants growing in areas with little canopy cover were small and appeared faded. It is not known how long plants growing under these conditions will survive.

Population structure—Based on site data for stem counts (ISMS 2003), abundance of CYFA at any one site may range from 1 to 100 stems with one site having over 300 stems. This data is based on 328 site entries in the years between 1997 and 2000, 91 the following two years, and 6 in 2003. Nearly all sites (96 percent) have stem counts less than 50, with most ranging between 1 and 20. Current data indicate that 72 percent of sites have less than 10 stems per site. According to ISMS (Interagency Species Management System) data, the largest reported population throughout the range of *C. fasciculatum* within the NWFP is a historic site with 2,251 stems near Chumstick Creek, located June 15, 1990 in the Wenatchee NF. Sighting reports indicate that many of the locations occurred within timber sale units. Total number of extant sites may be lower than historic numbers. More recent sighting reports indicate that some sites with small numbers of stems may not receive protection (Scott 2001). The large number of sites with 10 or fewer stems suggests fragmentation or a dispersed pattern not well understood. It is not known if such small populations can successfully reproduce and increase in number, although studies of other long-lived terrestrial orchids have shown they can (Willems and Bik 1991). Even if the numbers increase over time, the genetic variation of those populations may be limited. Other studies of orchids have shown that population fluctuations may be cyclical influenced by climate, and changes in suitable habitat (Vanhecke 1991, Willems and Bik 1991).

In addition to spatial analyses, demographic information i.e., recruitment, vegetative plants, and mature plants that flower and produce seed helps in characterizing population structure. Flowering, fruit production and recruitment rates may also be cyclic so that long-term trends are masked by year-to-year variation. Tamm (1991) studied orchid species in Sweden and observed the varying effects on different species of successional changes in their habitat from meadow to dense forest. Tamm found that the longevity of ramets may prolong the existence of a small population that no longer is able to reproduce or expand and concluded that long term observations of plant populations are essential for understanding how to manage populations for their conservation.

There is no practical way to determine if stems are shoots from a single rhizome, ramets (independent members of a clone) or genets (individuals derived from seed) short of submitting individuals to genetic analysis. In a study of genetic structure of plants in relation to their spatial distance, individual stems in clusters separated by several centimeters were found to be ramets or clones, but some stems as close together as 3.5 cm were genets or genetically distinct (Vance 1998). Whether an aerial stem is a ramet or one of several genets, it is capable of growing to maturity and reproducing. Year-to-year variation in populations based on stem counts may not be representing absolute growth through recruitment of new individuals or losses due to mortality but rather the fluctuations in the emergence of old established plants (Knecht 1996) although recruitment and new seedling growth have been observed (Latham 2001, ISMS 2003). Meaningful censuses would involve repeat visits that monitor specifically identified individuals and not just counts. An important question is whether individuals in a small population can increase in number over time through successful reproduction. Evaluation of the ISMS 2003 database has revealed that very few sites have been visited more than once and fewer, two times. Because of this no trends can be determined.

A major consideration for the long-term survival of *C. fasciculatum* is loss of populations due to land management activities that directly or indirectly impact the species and its associated habitat. Populations of *C. fasciculatum* in some areas tend to be small and scattered, which makes them vulnerable to extirpation. Small populations are much more vulnerable to extinction from human and natural causes than are larger populations. Small populations are more likely than larger populations to succumb to natural catastrophes such as high intensity wildfire, floods, landslides, drought, and loss of pollinating insects (Falk and Holsinger 1991); or to human activities that include plant collections and that affect habitat as well as plants such as timber harvest, road building, and grazing. Small populations are also at greater risk of extirpation through management activities occurring near or within their habitat where machinery can inadvertently destroy the entire population. Small populations are more likely to have reduced genetic variability and loss of fitness which might make them less adaptable to changing environmental conditions.

Maintaining a minimum effective population size at a *C. fasciculatum* site is essential for species survival (Heinze and Hensen 2002). However, the minimum effective population size for this species is not known: it depends upon a number of factors including genetic variability and the distribution of neighboring populations versus the relative isolation of a population. Determining an effective population size for long-lived plants that do not necessarily reproduce every year and additionally do not necessarily produce aerial stems every year can be problematic.

Soils—Cypripedium fasciculatum is not restricted to a particular parent material. Populations have been found on ultra basics, granitics, schist, limestone, and quartz-diorite substrates. Fowlie (1988) states that *C. fasciculatum* occurs on serpentine landslides in northwestern California. However, Fowlie also notes that the plants were acomposted (growing in organic matter) in a serpentine landslide of vast extent, matted with fallen California Douglas-fir needles, and that the plants sometimes grew between the roots of the fir. In Idaho, plants are observed growing on no more than six inches of matted organic matter resting on granitic bedrock suggesting that soil organic matter is more important than parent material (Vance personal observation).

Because of the association between orchids and fungi and the heterotrophic mode of fungal nutrition, the important environmental factor controlling distribution of *C. fasciculatum* might be more the nature of the upper organic layers of the soil profile than the mineral soil. Some soil factors that may be important include soil organic layer, soil microbial composition, soil depth, source, and rate of decomposition, moisture content, and pH. The bryophyte communities that cover shallow soils in which *C. fasciculatum* rhizomes grow is likely important for recycling nutrients and retaining moisture (Binckley and Graham 1981). Downed coarse woody material may not only support fungi, but also help retain moisture, and provide shade and protect the duff and upper soil layers from disturbance.

Fire—The role of fire is not clearly understood in direct relation to *C. fasciculatum* but the species' most common plant associates are fire-adapted species. Populations have been found to increase and decrease after fire events, and this variable response to fire seems to be related to fire severity. Fires severe enough to burn through the duff layer and into the organic horizons may damage the shallow rhizome/root system. Harrod et al. (1997) studied fire effects on *C. fasciculatum* on the Wenatchee NF. Their work suggests that the species cannot tolerate high-intensity fire that eliminates the duff layer, as indicated by a lack of roots and rhizomes found in excavations after fire. Plants were found to survive where the duff layer was not eliminated. Continued monitoring revealed that three years after the fire, plants had reestablished in the area where they appeared to have been extirpated (Knecht**,** Botanist, Wenatchee National Forest, pers. comm. 2002). A similar recovery effect was noted on the Lolo National Forest in Montana (Applegate 2004 unpublished data) and on the Klamath National Forest (Knorr and Martin 2003).

Severe fires were observed to have destroyed sites on the Klamath NF (Barker 1984) when thousands of acres were burned by wildfires on the Klamath National Forest in 1987. However, sites with *C. fasciculatum* that had burned at a low-level of intensity were observed having increased numbers of individuals (stems) and expanded population areas (Knorr and Martin 2003). Populations may be invigorated by low-intensity fires with many small individuals that perhaps were seedlings. Greenlee (1997) reported the effects of a fire on the Clearwater NF that led him to conclude that *C. fasciculatum* could survive low-to-moderate intensity fires but not fires of high intensity. Because the rhizosphere of the plant is usually 3-12 cm (1-5 in) below the soil surface, fire at sufficiently high temperatures can damage or kill the plants at any level in the profile. On sites in dry forest associations such as Douglas-fir/ninebark, even light burns including those ignited for fuels reduction can eliminate shrub or sapling cover that protects the plant from high irradiance. The plant's two leaves are shade adapted and will quickly senesce under high light and temperature load which may prevent maturation of the seed capsule and abort reproduction (Vance 2002).

C. Threats to the Species

Major threats to this species include disturbances or activities that can severely alter the light regime and forest floor such as tree harvest activities that remove most of the overstory or critical cover under open canopies as well as duff and organic layer, equipment use that can severely compact the soil, road and trail construction, grazing sheep and/or cattle that put plants at risk of being trampled and eaten, intensive recreation, or other human activities including collecting plants without permits (Latham and Hibbs 2001).

Fire—Stand replacing fires or fires that burn the organic layer are considered a threat to this species. It is suggested in Appendix J2 (USDA and USDI 1994a) that the reintroduction of prescribed fire might reduce the risk of extirpation of *C. fasciculatum* due to catastrophic, stand replacing fires. Fire appears to have a variable effect on *C. fasciculatum*. Observed responses to fire vary from emergence of new seedlings to loss of plants. Burning releases nutrients and eliminates competition, two conditions that are beneficial. But reproduction could be reduced for several years if vital understory cover in the dry forest types is not sufficient to ensure survival of the plant through its reproductive cycle, that is, until seed are dispersed. Fires of such severity that burn through the duff or upper organic layer appear to kill the rhizome where the buds for new growth are located (Knecht 1996, Vance 2002).

For northern California, sites were analyzed in relation to a California statewide GIS layer (GRID format) of historical fire regime and condition class (deviation from the historical regime) developed by the Fire and Resource Assessment Program (FRAP) of the California Division of Forestry using ArcView Spatial Analyst. The grid data have a 100 square meter pixel resolution. These data were derived from FRAP Multi-source Land Cover data v02_2, FRAP Fire Rotation data v02_1, and FRAP Fuel Rank data v03_1. The FRAP Condition Class GIS cover is available on the web at: http://frap.cdf.ca.gov/data/frapgismaps/select.asp. Metadata for this cover is available via the web at: http://frap.cdf.ca.gov/data/frapgisdata/output/cafrcc.txt

An analysis of the ISMS site data for California CYFA sites in relation to fuel condition class shows that CYFA sites are in Condition Class 1, 2, and 3 with the majority (less than 90 percent) in condition classes 2 and 3. The analysis, using the FRAP model, indicates that a high percentage of CYFA sites in northern California (79 percent) within the NWFP area are at high risk of loss from high intensity fire, and the implementation of fuels treatments to reduce this risk is an important component in the management of these species. Note that the other ingredient in the catastrophic fire equation is weather. Whitlock et al. (2003) show projections of increased summer drought that suggest fire frequency or fire severity could increase in most western United States forests. These two factors taken together raise concern about the persistence of CYFA within the southwestern edge of their range.

For Oregon, the current mapped condition class 2 and condition class 3 lands are considered inconsistent with their historical fire patterns and are undergoing revision. Because these lands need an updated assessment and classification, the USDI BLM Medford and Coos Bay Districts, Rogue and Siskiyou National Forests, and Oregon Department of Forestry are jointly preparing a fire management plan which includes an assessment of Fire Regime and Condition Class (FRCC). A spatial construction of plant association groups to describe the historic fire regime is close to completion and analysis of vegetation departure from reference condition maintained by the historic fire regime is in progress (Charles Martin, fire ecologist, USDI Bureau of Land Management, Medford District, personal communication). For CYFA sites plant association, current vegetation, and historic fire records could be used in the interim to assist in determining the risk of loss from high intensity fire.

The single site in western Washington was determined to be a Condition Class 1 based on its Pacific silver fir/Thinleaf huckleberry association, long stand history without fire, and using above described condition class definitions.

Soil disturbance—Harrod (1994b) and Knecht (1996) found that activity that exposes or damages the rhizome appears to kill plants. Physical disturbance of the site also may affect the mycorrhizal fungus. Stoutamire (1991) reports that the adventitious roots of *C. candidum* are particularly sensitive to disturbance. He found that damaged roots are slow to repair and are replaced slowly from the most recently produced rhizome sections. However, depending on the soil type, certain types of disturbance may be tolerated by C. *fasciculatum*. In 1993 a portion of a study plot was run over by a bulldozer. Studies begun in 1994 found no aerial plants in the bulldozer tracks. By 1995, a number of stems appeared clustered in the track, including several that flowered (Knecht 1996).

Loss of habitat—Forest structure probably provides important microhabitat conditions for *C. fasciculatum*. Extreme modification of forest structure (e.g., total canopy removal) may have a significant effect on interior microclimate variables such as light, temperature, and moisture (Chen et al. 1993, 1995). The woody and herbaceous understory vegetation composition and structure are correspondingly altered after the occurrence of disturbances such as overstory removal and broadcast burning (Stein 1995). Greenlee (1997) reported a drop of 58 plants to 2 plants after a blow down on the Nez Perce NF in Idaho, although without excavation, it is not known whether plants died or were dormant. It is difficult to precisely define the above and below-ground habitat requirements of the species. But there is evidence that disturbance such as logging that affects habitat appears to also have an effect on orchid populations (Coleman 1995). In one example from the Klamath National Forest, data was collected from revisits to sites over approximately a ten year period. Out of 82 sites revisited, 34 or 41% were dropped from protection. Revisits to these sites indicated most were extirpated. Based on observation extirpation could be attributable to destruction of habitat that included removal of key overstory protection, soil disturbance, and changes to microhabitat (Knorr and Martin 2003).

Browsing, grazing, herbivory—Grazing activity and associated trampling by cattle and sheep has been shown to be detrimental to populations of terrestrial orchids (Hutchings 1989, Waite and Hutchings 1991). Observations in the Wenatchee NF (Harrod 1993), Siskiyou NF (Kagan 1990), and Medford District BLM (Knight 1994), indicate a noticeable degree of browsing on mature fruit capsules by unknown herbivores. In populations monitored in southern Oregon, herbivory from browsing in one observed clear-cut resulted in a reduction in leaf area by 25 to 50 percent (Latham 2002).

D. Distribution Relative to Land Allocations

Most sites in the NWFP area are found in Matrix/Riparian Reserves and Adaptive Management Areas. Based on ISMS records, 10 percent are found in Late-Successional Reserves.

These land use allocations were based on field information entered into the ISMS database. The primary source of information for spatial analysis of *C. fasciculatum* has been the ISMS database. Known site data for *C. fasciculatum* were obtained from the ISMS database on December 8, 2003 using the ISMS ArcView Query Utility (Version 1.12, 06/05/03). Each dataset represents 97 percent of the known sites in ISMS within the area of analysis. The known sites data was reduced by three percent because some sites were co-incident with a grid value defined as non-wildlands for which a Condition Class value was not assigned.

III. MANAGEMENT GOALS AND OBJECTIVES

Management for this species follows FS Region 6 Sensitive Species (SS) policy (FS Manual 2670), and/or BLM Oregon and Washington Special Status Species (SSS) policy (6840).

For Oregon and Washington BLM administered lands, SSS policy details the need to manage for species conservation. Conservation is defined as the use of all methods and procedures that are necessary to improve the condition of SSS and their habitats to a point where their Special Status recognitions no longer warranted. Policy objectives also state that actions authorized or approved by the BLM do not contribute to the need to list species under the Endangered Species Act.

For Region 6 of the Forest Service, SS policy requires the agency to maintain viable populations of all native and desired non-native wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands. Management "must not result in a loss of species viability or create significant trends toward federal listing" (FSM 2670.32) for any identified SS.

IV. HABITAT MANAGEMENT

A. Lessons from History

- Greenlee (1997) and (Vance 2002), indicate that *C. fasciculatum* individuals in a clear-cut and in a burn with a fairly open canopy tend to dry up and turn yellow earlier than plants in less open canopy conditions.
- Past forest management activities, such as timber harvest and intensive site prep, may have contributed to declines in population numbers (USDA and USDI 1994a).
- Activities that expose or excessively damage the rhizomatous root crown of *C. fasciculatum* seem to eliminate the plant (Stoutamire 1991, Knecht 1996).

- Low-intensity fire that does not eliminate the duff layer or destroy the canopy appears to have no adverse impact or may benefit *C. fasciculatum* (Harrod and Knecht 1994, Applegate 2004).
- High-intensity fire that eliminates the duff layer also destroys *C. fasciculatum* rhizomes (Harrod and Knecht 1994).

B. Identifying Species Habitat Areas

A species habitat area is defined as the suitable habitat occupied by a known population. Sites of *Cypripedium fasciculatum* on federal lands administered by FS Region 6 and BLM Oregon and Washington are identified as areas where the information in this conservation assessment could be implemented. Not all sites need management to meet FS or BLM agency policy objectives for Special Status/Sensitive species management. Below are some general considerations to use when evaluating whether species habitat areas might need to be delineated around sites/populations:

- If the site is outside the 300-foot community-at-risk associated with Wildland Urban Interface zones.
- Distribution of sites across the landscape (number of known sites within the 6th field watershed and even distribution of sites throughout the watershed).
- If the site position is on the edge of the species' natural range or an outlier
- Sites with number of stems greater than 10 if applicable.
- If the site has active research or monitoring taking place.
- If the site is in administratively protected areas such as Research Natural Area, Area of Critical Environmental Concern, Wilderness Area, or Botanical Area.
- If the site is in any other land use allocation such as a reserve where de facto protection may occur. Consideration of reserves or other land use allocations should be based on whether land use objectives are compatible with maintaining the site persistence of the species.

C. Managing in Species Habitat Areas

The objective of a species habitat area is to maintain habitat conditions for *Cypripedium fasciculatum* such that species viability will be maintained at an appropriate scale, in accordance with agency policies.

Management in the species habitat area should consider the below ground environment. Undisturbed duff and soil layers protect mycorrhizal networks, and species roots and rhizomes. Therefore, mitigation of ground disturbing activities (including wildfire and prescribed fire) is essential to avoid habitat reduction and population fragmentation.

Specific management considerations for sites managed by field units may include:

- Maintain sufficient cover to avoid any more than intermittent direct solar radiation on *C. fasciculatum* plants.

- Maintain decayed down logs (decay class 4 and 5), snags, and duff layer within the species habitat area for favorable forest floor conditions, habitat, soil moisture and mycorrhizal associates. Where fuel concentrations are within the historic range of variability, provide for future recruitment of coarse woody debris.

- Avoid activities that alter or remove soil, duff, or the organic matter in the species habitat area.

- Manage sites to include entire populations plus an area large enough to maintain current habitat and associated microclimate, primarily temperature and moisture. The size should be determined by a field visit and should consider factors such as canopy cover, slope, aspect, topographic position, vegetation structure (such as growth form, stratification, and coverage), and species composition.

- Where fuel concentrations exceed historic range of variability (fuel condition class 2 and 3), treat fuels within and adjacent to the site to reduce risk of high intensity fire.

- Restrict activities within species habitat areas during the species' growing season which ranges from March (or whenever leaves visible) through August (or when capsules split and shed seeds), growth season can vary from site-to-site and year-to-year and should be checked before activity takes place.

- Because plants do not appear above ground every year, it is important to buffer species locations in order to capture dormant plants.

D. Fuels Management Issues and Considerations

The following management considerations could apply to fuels management activities for sites managed in species habitat areas:

Broadcast burning: Fall burns are preferred. Manage for low severity/low intensity fire in order to retain sufficient cover for retaining partial shade and to retain a duff layer. Remove heavy fuels (pull back) from sites in order to avoid consumption of the duff layer during the burn. Pruning of canopy trees may be done prior to ignition to reduce the risk of crowning. If the site is located in the bottom of a draw, control heat intensity at the site by lighting fire from the top down and burning in stages out from the line. If spring burning must occur, care must be taken to avoid trampling or other mechanical disturbance to *C. fasciculatum* plants, and place a hand or black line around a site to protect the plants.

Hand or dozer lines: Keep dozer and hand lines out of sites. If a site occurs near a dozer or hand line and there is some flexibility in terms of line location, construct line between burn area and the site. During dozer line construction, avoid injuring or killing trees whose canopies contribute to maintaining microsite conditions.

Piling and pile burning: Keep dozers off the site. Locate piles, considering slope and aspect, far enough from the site that radiant heat does not disturb the site or burn duff, and trampling of the site does not occur. Locate piles far enough away from trees such that heat generated does not damage tree crowns important for maintaining microsite conditions.

Thinning: Maintain partial canopy or understory shade to retain favorable microsite conditions at the site. Special care should be taken to avoid mechanical damage from trampling and soil compaction when treatments occur during the spring and summer growing season. Avoid disturbing plants or duff layer around plants when yarding or skidding materials out of sites. Exclude mechanized equipment from sites.

Pruning: Maintain partial canopy or understory shade to retain favorable microsite conditions at the site. Avoid mechanical damage such as trampling and soil compacting. Special care should be taken to avoid mechanical damage from trampling and soil compaction when treatments occur during the spring and summer growing season.

Chipping, raking: Keep mechanized equipment out of sites. Material can be hand pulled from the site to a chipper located outside. Chips should be directed away from the site as well. Any activity within the site should take place outside the growing season to avoid trampling of plants.

Crushing, chopping, grinding, or mowing: It is unknown how these activities could be designed to create low risk to maintaining a site. It is expected that these activities have the potential to increase burn duration of fuels left on the ground. This would increase burn severity and have a negative effect.

Foam surfactant: It is unknown what, if any, impact foam may have upon this species. At a minimum, it is recommended that application of foam directly on *C. fasciculatum* plants be avoided. With ground application, avoid trampling of plants during the spring/summer growing period.

V. RESEARCH, INVENTORY, AND MONITORING OPPORTUNITIES

The objective of this section is to identify opportunities to acquire additional information which could contribute to more effective species management. The content of this section has not been prioritized or reviewed as to how important the particular items are for species management. The inventory, research, and monitoring identified below are not required. These recommendations should be addressed by a regional coordinating body.

A. Data and Information Gaps

- Reproductive processes and biology most critical to maintaining the viability of *C.*

fasciculatum populations.

- Environmental and ecological factors that influence population fluctuations.
- Identification of fungal associates, their habitat requirements, and the role they play in the life history of *C. fasciculatum*.
- Number of extant populations within Oregon and Washington.
- Population census and structure of known populations.
- Completion and updating of interagency or agency specific databases.

B. Research Questions

- What level of disturbance (fire and overstory removal) do *C. fasciculatum* plants tolerate?
- What mycorrhizal fungi are associated with *C. fasciculatum*? Is this association species-specific? What are the requirements for the fungal host? What soil environment is needed to support the symbiotic fungi ?
- What factors affect seedling recruitment, plant growth, reproduction, and population structure?
- What microclimate/microsite conditions favor the plants survival, growth, and reproduction?
- What specific site characteristics are necessary to maintain existing populations?
- What is the role of fire in the population structure and species distribution?

C. Monitoring Opportunities and Recommendations

Implementation monitoring and effectiveness monitoring could be conducted, and could have a demographic survey at the site visit before treatment or management action so that post treatment changes can be detected.

- Monitor to determine if site specific management is effective.
- Monitor that canopy cover and microhabitat conditions allow for complete life cycle through evidence of seedling recruitment, flowering, and seed set.
- Monitor long-term effects of specific management practices to determine the impact of action on survival. Should be long-term (greater than 20 years) to determine vigor, reproduction, and survival of the populations.
- Demographic monitoring by census of vegetative and reproductive stems over successive years.
- Monitor sites where management actions are occurring within species sites. There may be

treatments occurring in sites that are not being managed and this will create opportunities for evaluating species response to treatment.

- Monitor changes in canopy cover (trees, shrubs within 20 m) to determine greater than or equal to 20 percent change from pre-project conditions.
- Monitor changes in duff and litter depth within a 1-meter radius of CYFA aerial stems to determine greater than or equal to 50 percent change from pre-project conditions.
- Monitor changes for a minimum of two years post treatment in number of CYFA individuals to determine any changes from pre-project conditions.
- Report documented sites to Oregon Natural Heritage Information Center & Washington Natural Heritage Program.
- Report changes in documented and suspected status as quickly as possible to the interagency BLM Oregon and FS R6 Special Status/Sensitive Species Specialist in the Regional Office/State Office.
- Report sitings and survey work in the appropriate agency database: Geo-spatial Biological Observations (GeoBOB) or the Natural Resource Information System (NRIS).

GLOSSARY

Communities at risk

A group of homes and other structures with basic infrastructure and services (such as utilities and collectively maintained transportation routes) within or adjacent to Federal land (Healthy Forests Restoration Act of 2003).

Condition class

The general deviation of ecosystems from their pre-settlement natural fire regime can be viewed as a measure of sensitivity to fire damage to key elements and processes typical of those ecosystems, or fire-related risk to ecosystem health. Classes are assigned based on current vegetation type and structure, an understanding of its pre-settlement fire regime, and current conditions regarding expected fire frequency and potential fire behavior. Condition Classes were defined as the relative risk of losing key components that define an ecosystem (Hardy et al., 2001).

Connectivity

The linkage of similar but separated suitable habitat patches, by corridors or "stepping stones" of like habitat that permits interaction between individuals or populations over time. Connectivity must consider time in the context of its potential effects to genetic drift or isolation.

Fire regime

Fire Regime I: an area in which historically there have been low-severity fires with a frequency of 0 through 35 years; and that is located primarily in low elevation forests of pine, oak, or pinyon juniper.
Fire Regime II: an area in which historically there are stand replacement severity fires with a frequency of 0 through 35 years; and that is located primarily in low- to mid-elevation rangeland, grassland, or shrubland.
Fire Regime III: an area in which historically there are mixed severity fires with a frequency of 35 through 100 years; and that is located primarily in forests of mixed conifer, dry Douglas fir, or wet Ponderosa pine (Healthy Forests Restoration Act of 2003).

Fragmentation

The loss, division or isolation of patches of similar habitat at a scale relevant for the species being addressed.

ISMS database (Interagency Species Management System)

An interagency database containing information about Survey and Manage species, in the Northwest Forest Plan area. ISMS includes; data for surveys, species locations, and their associated habitats/environmental conditions.

Monitoring

The collection of information used to determine if management actions are meeting objectives of standards and guidelines and if they comply with laws and management policy. Monitoring is used to determine if standards and guidelines are being followed (implementation monitoring), if they are achieving the desired results (effectiveness monitoring), and if underlying assumptions are sound (validation monitoring). Monitoring usually collects information on a sampling basis, provides standardized data, and occurs at multiple levels and scales.

Site (Occupied)

The location where an individual or population of the target species (taxonomic entity) was located, observed, or presumed to exist and represents individual detections, reproductive sites or local populations. Specific definitions and dimensions may differ depending on the species in question and may be the area (polygon) described by connecting nearby or functionally contiguous detections in the same geographic location. This term also refers to those located in the future (USDA, USDI 1994a).

Range

The limits of the geographic distribution of a species.

Species Habitat Area

The geographic area managed to provide for the continued persistence of the species at the site; may include occupied and unoccupied habitats.

Suitable Habitat

Abiotic and biotic environmental conditions within which an organism is known to carry out all aspects of its' life history.

Viability

Ability of a wildlife or plant population to maintain sufficient size to persist over time in spite of normal fluctuation in numbers, usually expressed as a probability of maintaining a specified population for a specified period (USDA and USDI 1994a).

Viable populations

A wildlife or plant population that contains an adequate number of reproductive individuals appropriately distributed on the planning area to ensure the long-term existence of the species (USDA, USDI 1994a). For invertebrate, non-vascular plant and fungi species "appropriately distributed" may include; the species is well-distributed, the species is distributed with gaps or the species is restricted to refugia. Refer to page 123 in Chapter 3 and 4 of the FSEIS for the Northwest Forest Plan for further clarification.

Wildland Urban Interface

An area within or adjacent to an at-risk community that is identified in recommendations to the Secretary in a community wildfire protection plan; or in the case of any area for which a community wildfire protection plan is not in effect an area extending 1/2-mile from the boundary of an at-risk community or an area within 11⁄2 miles of the boundary of an at-risk community, including any land that has a sustained steep slope that creates the potential for wildfire behavior endangering the at risk community. (Healthy Forests Restoration Act of 2003).

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