

**FIELD INVESTIGATIONS  
OF SELECTED SENSITIVE PLANT SPECIES  
ON THE CLEARWATER NATIONAL FOREST**

**by**

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## INTRODUCTION

This work was conducted through the cooperative efforts of the Clearwater National Forest and the Idaho Natural Heritage Program working through the Challenge Cost Share Program. It includes information on selected Sensitive Plant Species of the Northern Region of the U.S. Forest Service.

The focus of this study was a field inventory for two Sensitive Northern Region Sensitive Plant Species on lands administered by the Clearwater National Forest. One of these, Mimulus clivicola, has been recommended as a Federal Candidate species; the other, Calochortus nitidus, is currently a Federal Candidate species and recently has been recommended for Category 1 status (Caicco, 1988). Only one small population of the Mimulus is reported here. No populations of the Calochortus are thought to exist on the Clearwater National Forest.

Information on two other sensitive species encountered during the course of this field investigation is also reported here.

The methodology used was consistent throughout the study, although the amount and type of data collected varied in relation to the intended focus of the study in each area. It included an attempt to relocate historical collection localities of the selected taxa; if relocated, data were collected on the distribution, abundance, habitat, and potential threats.

Where sufficient data were available upon which to make an interpretation of the status of these taxa, I have discussed the data and their management implications, and have made recommendations concerning future work. Throughout this report, references to a "Vol." indicate the appropriate volume of Vascular Plants of the Pacific Northwest (Hitchcock et al., 1959).

Mimulus clivicola Greenm.

CURRENT STATUS recommended Category 2 Federal Candidate Species; Northern Region Sensitive Species

#### TAXONOMY

Family: Scrophulariaceae (figwort)

Synonymy: Eunanus clivicola

Common Name(s) bank monkey-flower

Alpha Code MIMCLI\*

Numeric Code 7658

Description Simple, or occasionally branched, annual up to about 1.5 dm tall (on Selway District < 1.0 dm); glandular-hairy (pubescent) on leaves, stems, and calyx; flowers (corollas) purple, 1-2 cm long, conspicuously marked with yellow in the throat and tube (Vol. 4, p. 340).

Distinguishing Features The annual habit, and purple flowers 1-2 cm in length are distinctive.

Similar Species Within all but perhaps the very southern portion of its range (i.e., the southern end of Hells Canyon), the only other species of similar aspect and flower color is M. breweri which has flowers (corollas) less than 10 mm in length (at least ten times smaller than those of the bank monkeyflower).

Comments None.

#### DISTRIBUTION

Range The bank monkeyflower is apparently distributed from northern ID and adjacent WA, south to the southern end of the Snake River Canyon (near Pine Creek, in Union Co., OR). Only two recent sightings of M. clivicola have been made in OR (OR Natural Heritage Program, 1987); further information is needed before a status can be assigned to this species in Washington (WA Natural Heritage Program, 1987).

The northernmost report in Idaho is based on a collection by Sandberg in the 1890's from "near the foot of Wiessner's Peak, Kootenai Co., Ida." This peak, now known as Mt. Wiessner, lies in southeastern Kootenai County about 12 air miles northeast of the town of St. Maries. Other historic localities are from Latah, Clearwater, and northern Idaho Counties; in these areas, it has been collected from northeast of Harvard, near Elk Creek Falls, downstream of Lowell along the Middle Fork of the Clearwater River (in 1936), and along the Lower Selway River.

Habitat Cronquist describes the habitat as "moist to moderately dry slopes in the foothills and valleys" (Vol. 4, p. 340). The site examined for this species in the vicinity of Elk Creek Falls was a dry grassland in which Agropyron spicatum was predominate on the steep east-facing slopes above Elk Creek. The grassland occurs adjacent to forest of Pinus ponderosa and Pseudotsuga menziesii.

Sites previously examined by the author along the lower Selway River were also steep, south-facing, slopes (Caicco, 1987a). The vegetation is comprised of open stands of Pinus ponderosa with a Festuca idahoensis understory. These sites probably are representative of the Pinus ponderosa/Festuca idahoensis habitat type of Cooper et al. (1987) although, depending upon the scale at which one is working, they may also be considered representative of the Pseudotsuga menziesii/Festuca idahoensis habitat type. Both Pseudotsuga menziesii and various shrubs are restricted to microsites such as ravines on the lower slopes where M. clivicola is found, but become more common with only a slight increase in elevation.

At both of these sites, bank monkeyflower is most often found growing in pockets of mineral soil in openings between pine trees. Soils at Elk Creek Falls were shallow and rocky with outcrops of the underlying basalts from which they were derived near or at the surface. The soils along the lower Selway are relatively deep, sandy loams derived from schist; the sandy nature of the soils and the steep slope make them highly erodible. Bank monkeyflower was not found growing on the thin soil and moss mats found on bedrock outcrops.

#### Associated Species

Although M. clivicola commonly is found in pockets of mineral soil, a few other species are associated with this habitat as well. These include Achillea millefolium, Balsamorhiza sagittata, Pteridium aquilinum, and Lithophragma bulbifera. The lower Selway sites are notably weedy with Bromus tectorum, Panicum scribnerianum?, and Tridonis perfoliata common. The noxious weeds Hypericum perforatum and Centaurea maculosa are often found in this area as well.

#### RESULTS OF FIELD INVESTIGATION

Prior to the 1988 field season, two sites for M. clivicola had been reported from the Clearwater National Forest. One is slightly downstream of Lowell along the Middle Fork of the Clearwater River. The second was based on a sighting along the North Fork of the Clearwater River (Caicco, 1987b). An additional site had been reported from the Elk Creek Falls area

on the portion of the St. Joe National Forest which is administered by the Clearwater National Forest.

For documentation, these localities are based on the following collections:

Rollins and Constance 1628. May 5, 1936. Sandy banks about three miles below Lowell along Middle Fork Clearwater near mouth of Three Devils Creek. (WS)

Wellner 1746. May 20, 1979. Elk Creek Falls. (ID)

I was unable to relocate the bank monkeyflower along the Middle Fork of the Clearwater River during the 1988 field season. I also looked for it with no success during the 1987 field season. The specific habitat given is ambiguous in that it could refer to sandy slopes which have probably been eliminated by highway construction and/or maintenance, or to the sandy banks of the river. The latter area receives moderate to heavy recreational use during the summer, primarily by swimmers. Other historic collection localities in the vicinity along the lower Selway River have also not been relocated (Caicco, 1987a).

In the Elk Creek Falls area, I found one very small population of about nine individuals on the slope above the upper falls (Map , Appendix I). These were located next to an area of serious erosion along an unofficial foot trail down to Elk Creek. Despite a thorough search of all of the other grasslands in the vicinity of the Upper, Middle, and Lower Falls areas, no other populations were seen.

## DISCUSSION

Mimulus clivicola appears to have disappeared from its historic collection locality along the Middle Fork of the Clearwater River, and only a few individuals were seen in the vicinity of the historic collection locality near Elk Creek Falls. It has also not been found at historic localities along the lower Selway River on the Nez Perce National Forest, although a few small unreported populations were found (Caicco, 1987a).

The bank monkeyflower was also noted to occur in the proposed Aquarius Research Natural Area along the North Fork of the Clearwater River (Caicco, 1987b). During a rare species inventory of two potential routes of the Dworshak access road through the proposed Aquarius Research Natural Area, Moseley (1988) documented the occurrence of six populations, each comprised of between one and several dozen individuals. All of these populations are threatened by road construction, which has also contributed to the overall demise along the lower Selway.

Many historic populations Mimulus clivicola have disappeared, a fact which can be attributed to the direct effects of road construction and the consequent invasion of exotic weeds such as Centaurea maculosa (spotted knapweed); chemical control methods for the weeds may constitute a further threat to the species (Caicco, 1987a).

It appears that the bank monkeyflower may be most abundant, although still quite rare, within the proposed Aquarius Research Natural Area, where all known populations are threatened by road construction.

## MANAGEMENT IMPLICATIONS

Although the overall status of the remaining populations of the bank monkeyflower remains uncertain, the total number of plants observed during the 1987 and 1988 is very small. Identifiable threats exist to much of its known habitat from the direct and indirect effects of the Dworshak access road construction proposal. Road construction is the major factor indicated in the historic decline in populations of the species. Continued disregard for the conservation of the habitat of Mimulus clivicola will inevitably lead to the necessity for formal listing of the species under the Endangered Species Act.

## RECOMMENDATIONS

Until populations of Mimulus clivicola are found to remain on the Lochsa District, there is no need for formal management recommendations. I recommend, however, that the Clearwater National Forest closely review the impacts of their proposed management actions with respect to the viability of the bank monkeyflower on lands under their administration.

Calochortus nitidus Dougl.

CURRENT STATUS Category 2 Federal Candidate Species;  
recommended Northern Region 1 Sensitive Species

#### TAXONOMY

Family: Liliaceae (lily)

Synonymy: Cyclobothra nitida, Calochortus pavonaceus,  
C. douglasianus

Common Name(s) broad-fruit mariposa

Alpha Code CALNIT\*

Numeric Code 6150

Description Perennial herb from an deep-seated bulb; stem erect 2-4 dm (8-16 in) in height, usually with a single reduced leaf about midway; basal leaf broad and flat (Vol 1, p. 773).

Distinguishing Features 1-4 large, showy, lavender flowers, each petal with a deep purple crescent above a triangular-lunate gland. Fruit erect, elliptic to nearly circular in outline, 3-winged.

Similar Species Within its range, C. nitidus can be confused with C. macrocarpus var. macrocarpus, which is also lavender; the ovaries and fruits of the latter species, however, are linear and not winged. It may also be confused with C. eurycarpus, which has a purple blotch rather than a crescent on the petals. Other species within its range have either non-lavender petals or nodding fruits (Table I).

Comments Some historic confusion existed concerning the proper application of the name C. nitidus; Ownbey cleared up the confusion by examining the original material collected by Douglas (Vol. 1, p. 775). Despite the early confusion over the proper application of the name, C. nitidus is a well-defined and easily identifiable species. It is the only tetraploid species of Calochortus in the northwestern flora (N=20).

#### DISTRIBUTION

Range Ownbey described the historic range of C. nitidus as "extending from the eastern border of the Palouse Prairie in Whitman County, WA, and Latah County, ID, to the Salmon-Clearwater Divide (from about Grangeville, ID, to the Snake River) and in the Seven Devils Mts. above Riggins" (Vol 1, p. 775). It is now known to occur along the Middle Fork of the Clearwater River to within 10 miles of Lowell.

Table I. Conspectus of *Calochortus* species found within the range of *C. nitidus*. (based on Vol. I, pp. 768-779).

Species	Petal Color	Fruit	
		Position	Shape
<i>C. nitidus</i>	purplish-lavender w/ deep purple crescent	erect	elliptic/ orbicular
<i>C. eurycarpus</i>	creamy white to lavender w/ red-purple blotch	erect	elliptic/ oblong
<i>C. macrocarpus</i>	lavender or white	erect	linear
<i>C. apiculatus</i>	yellowish-white	nodding	elliptic
<i>C. elegans</i>	greenish-white w/ purple crescent	nodding	elliptic/ orbicular

Ownbey also commented that "except along the eastern border of its range, *C. nitidus* grows in potential farm land. As a consequence, it has become one of the rarest of our species of *Calochortus*. In the last 25 years, perhaps half of its known populations - none very large - have been destroyed."

**Habitat** Although it is primarily a grassland species, throughout its range *Calochortus nitidus* is found in a wide variety of habitats. Many early collections from the Palouse Prairie of southeastern Washington and adjacent Idaho record the habitat as "low meadows", as did Ownbey himself (Vol. 1, p. 775). All of the recorded sites having this description have since been converted to agriculture or, in some cases, monotypic stands of *Phalaris arundinacea*. The general elevation in the vicinity of Moscow is about 2600 ft.

As a consequence, no populations of *Calochortus nitidus* are currently known from the area north of Lewiston and west of the Ahsahka Grade near Orofino. The broad-fruit mariposa occurs in low numbers in an open *Pinus ponderosa* series forest at 2000 ft on the breaks to the north of the Clearwater River. Ten miles west of Lowell, scattered individuals can be found in a similar habitat at 1600 ft along the valley bottom. The latter site is within a few miles of the boundary of the Clearwater National Forest.

The few populations known from along the Clearwater-Salmon Divide near Grangeville are found in Festuca idahoensis series grasslands and range in elevation from 3400-5000 ft. All of these sites have soils unsuited for crop agriculture and have received limited use by livestock.

Calochortus nitidus reaches the southern limit of its range in the Cold Springs Mountains on the Salmon River District of the Nez Perce National Forest. Along the broad lava-capped crest of this range, it is most frequently found in the Festuca idahoensis/ Koeleria cristata (ridgetops) plant association as described by Johnson (1986).

Less frequently, it may be found growing in Festuca idahoensis/ Koeleria cristata (high elevation), Festuca idahoensis/Agropyron spicatum, or Eriogonum douglasii/Poa sandbergii plant associations on upper west- and southerly-facing slopes. It can also be found on the slopes of similar aspect along spur ridges to either side of the crest. Near Cow Creek Saddle, at the most southerly known location for the species, the broad-fruit mariposa may be found growing in a mosaic of Artemisia rigida and A. tridentata ssp. vaseyana dominated communities at an elevation of about 5280 ft.

Associated Species Not applicable on the Clearwater National Forest. (see next section)

## RESULTS OF FIELD INVESTIGATION

No populations of Calochortus nitidus were found during the 1988 field season on that portion of the Clearwater National Forest which lies along the Middle Fork of the Clearwater River. Although the species was previously reported to occur on private land several miles downstream of the National Forest boundary (Caicco 1987a, 1988), the habitat at the known site differs significantly from any seen within the National Forest.

The known site is a closed-canopied forest of scattered Pinus ponderosa with a sparse shrub and graminoid understory. It is the only site at which the broad-fruit mariposa has been found growing in the understory of a closed-canopied forest. On the original visit to the site during 1985, only three individuals were seen. During a revisit to the site in 1988, I was unable to find any individuals of the species.

The forests on public lands are comprised of closely-spaced Pseudotsuga menziesii and Pinus ponderosa with occasional Abies grandis, with a dense shrub layer.

## DISCUSSION

I do not believe that satisfactory habitat for Calochortus nitidus occurs on public land administered by the U.S. Forest Service along the Middle Fork of the Clearwater River. There does not appear to be any need for the Clearwater National Forest to maintain Calochortus nitidus on its Sensitive Plant Species list.

## RECOMMENDATIONS

Drop Calochortus nitidus from the Clearwater National Forest list of Sensitive Plant Species. If the species is discovered to occur on lands administered by the Clearwater National Forest, its status should be re-evaluated.

Cypripedium fasciculatum Kell. ex Wats.

CURRENT STATUS Northern Region Sensitive Species

## TAXONOMY

Family: Orchidaceae (orchid)

Synonymy: C. pusillum, C. knightae

Common Name(s) clustered lady's-slipper

Alpha Code CYPFAS

Numeric Code 6536

Description Somewhat rhizomatous herb, 0.5-2 dm tall, usually with a single sheathing bract near ground level, and a pair of broad opposite leaves near or above midlength. 2-4 flowers in a terminal cluster, the lip strongly purplish-mottled or -tinged.

Distinguishing Features The two (sub)opposite leaves distinguish the clustered lady's-slipper from other species of Cypripedium in our flora.

Similar Species Two other species of Cypripedium can be found on the Clearwater National Forest. Neither of these, however, have the characteristic opposite leaves at midstem of C. fasciculatum.

Comments None.

## DISTRIBUTION

Range The clustered lady's-slipper is widely distributed in western North America. It is known from 15 widely scattered locations in northern Idaho. On the Clearwater National Forest, three sites have been reported. Two of these sites are on the Lochsa Ranger District.

Habitat According to Hitchcock, the habitat of the species varies from moist to rather dry and rocky open coniferous forest. The site examined on the Clearwater National Forest was dominated by large Thuja plicata with a rather open herbaceous understory.

## RESULTS OF FIELD INVESTIGATION

This species was observed at Apgar Campground, along the Lochsa River, during both the 1987 and 1988 field season. In 1987, a cursory survey indicated the presence of fourteen stems, of which three (21%) had flowered and produced fruit; the rest remained vegetative.

A closer examination of the population during the 1988 revealed the presence of numerous smaller individuals. Many of these were probably also present, but overlooked, during the previous year. Colonies of the clustered lady's slipper are present in two distinct areas of the campground.

Each of these colonies has identifiable potential threats. Both could be threatened by trampling by campers and others. There is no evidence that this is happening to either colony. The trail which begins near one colony is seldom used, and the colony lies off to the side. The second colony lies at the edge of an area which receives moderate use.

An additional potential threat to the trailhead colony can be identified. It lies mostly within a dense patch of the ground cover *Vinca minor* (periwinkle). Periwinkle is a European ornamental which has been introduced west of the Cascades (Hitchcock *et al.*, 1976); the flora also notes that it is considered to be an excellent ground cover.

Because of these potential threats, I decided to install a permanent plot at each of the lady's-slipper colonies in order to monitor their status through time. The methodology used is described in the following section.

## PERMANENT PLOT METHODOLOGY

The primary objectives of the monitoring project were: i) to make a complete census of the above ground stems within each colony, ii) to make a permanent record of the location of each stem, and iii) to record the reproductive status of each stem.

In order to achieve these objectives, the following steps were taken. The two colonies were carefully searched for stems, and each stem identified was marked by placing a colored plastic toothpick near its base.

The location of each individual was recorded with reference to a fixed point. In the case of the trailhead colony, a metal (rebar) stake was placed at the base of the southwestern side of a western redcedar (dbh = 22.4 in) located about a meter west of trailhead sign. This stake marked the center of a coordinate axis to which each stem identified was referenced. The location of each stem was plotted on graph paper.

Because of the foot traffic near the colony at campsite #7, no stake was installed. Stems locations were plotted with reference to a nearby grand fir (dbh = 28.5 in).

After marking the stems in each colony and plotting their locations, the following data were recorded for each stem:

i) the number of flowers produced; ii) the number of fruit set; iii) the length of the stem from the ground to the pair of opposite leaves; and iv) the length and width of each leaf. In addition, damage to the plant by herbivores, as well as other observations were noted when appropriate. The vegetative cover of other vascular plant species with reference to a vertical projection of the perimeter of each colony was also estimated.

## RESULTS FROM PERMANENT PLOTS

Both colonies had about the same number of stems, twenty-six at the trailhead colony and twenty-eight at campsite #7. Seven stems (27%) at the trailhead colony produced fifteen flowers; all of these flowers produced fruit. At campsite #7, five stems (18%) produced eleven flowers, all of which produced fruit.

Herbivory was noted on nine of the fifty-four stems. It ranged from light nibbling and chewing, usually of leaves, to heavy damage. All but one of the stems for which herbivory was noted was reproductive. The exception had one heavily damaged leaf, yet produced two fruits.

## DISCUSSION AND RECOMMENDATIONS

It was not the intention of this study to answer immediate questions about the status of the colonies, although numerous such questions could be addressed. It was rather the intent to provide baseline information about the current status of the population against which any change through time could be referenced. No schedule for periodic re-examinations is suggested here. The establishment of a monitoring schedule should await an overall evaluation of the status of *Cypripedium fasciculatum* on the Clearwater National Forest.

Juncus effusus L. var. pacificus Fern. & Wieg.

CURRENT STATUS Northern Region Sensitive Species

## TAXONOMY

Family: Juncaceae (rush)

Synonymy: possibly J. effusus var. caeruleomontanus St. John (see Comments below)

Common Name(s) soft rush

Alpha Code JUNEVP

Numeric Code 2438

Description Strongly tufted perennial with stout rhizomes; culms cylindrical (1.5) 2-10 (13) dm tall, finely grooved and about (1.0) 1.5-3.0 mm thick (Slide 1, Appendix I). Inflorescence apparently lateral, the involucre bract cylindrical and resembling the stem. Perianth segments (petals and sepals) usually greenish with little or no brownish border. Basal sheaths usually deep brown (Vol. 1, p. 194).

Distinguishing Features Perianth segments mostly 2.5-3.5 mm long, born in a loose panicle 2.5-15 cm long.

Similar Species The similar Juncus effusus var. compactus also can be found in Clearwater County, where it is "probably introduced" (Vol. 1, p. 194); the perianth segments of this variety are rarely more than 2.5 mm long and the panicle is compact, 1-4.5 cm long.

Comments It appears that both var. compactus and var. pacificus occur in Clearwater County and, on occasion, are found growing together.

## DISTRIBUTION

Range The species Juncus effusus occurs throughout most of the temperate regions of the North America and other continents. It is an extremely variable taxon throughout this range, with three varieties in the Pacific Northwest (Vol. 1, p. 194). Of the two varieties known from Idaho, var. compactus is more widely distributed with a range from Nez Perce to Bonner Counties. Until the 1988 field season, the var. pacificus was known in Idaho only from the vicinity of Beaver Creek and the North Fork of the Clearwater River. A newly discovered population, near the town of Elk River, is reported here.

## RESULTS OF FIELD INVESTIGATION

Juncus effusus var. pacificus was not within the scope of this years work, although its status in the North Fork of the Clearwater River area was previously studied (Caicco, 1987b). A very large population of the taxon was, however, sighted at Elk River Pond where, it forms a broken, but often continuous band around the edge of the pond. This pond was formerly used for holding logs, but was drained in about 1949. Local residents refilled the pond during the 1960s for recreational purposes.

In addition, a small population of this variety was found along the road leading to the Bull Run Creek Research Natural Area near the center of Section, T39N, R2E.

## DISCUSSION

The occurrence of the largest population of soft rush known in Idaho in a man-created setting suggests that the species is not as sensitive to some management actions as it may be to others. The newly discovered population at Elk River Pond also, however, casts some doubt on the natural occurrence of the variety in Idaho.

## RECOMMENDATIONS

The status of Juncus effusus var. pacificus on National Forest lands in the vicinity of the town of Elk River should be investigated. Decisions concerning the conservation status of the taxon should be postponed until this information is available.

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APPENDIX I

MAPS SHOWING PRECISE LOCATIONS OF  
PERMANENT PLOTS AND SPECIES OCCURRENCES

APPENDIX II

ECODATA FIELD FORMS

APPENDIX III

DATA FROM PERMANENT PLOTS

PERMANENT PLOT 055C88X005

Description: A permanent plot with all individuals of Cypripedium fasciculatum located and marked with colored toothpicks. The plot is laid out along perpendicular axes with an origin at the southwestern base of a Thuja plicata near the head of trail #337 at Apgar Campground.

# (color) <sup>1</sup>	leaf <sup>2</sup> length	leaf <sup>2</sup> width	stem <sup>3</sup> length	reproductive structure	fate	comments
1 (wh)	8.0	5.7	10.5	-		
2 (gr)	8.3	5.6	9.8	2 fls ->	2 fr	
3 (or)	7.1	4.9	6.0	-		
4 (yw)	9.8	7.7	12.0	3 fls ->	3 fr	
5 (or)	8.0	5.5	11.5	1 fl ->	1 fr	
6 (bl)	4.8	2.9	11.0	-		
7 (or)	5.0	3.1	9.2	-		
8 (gr)	7.4	4.8	11.5	-		
9 (bl)	8.7	5.8	11.8	pedicel w/bracts,	no fls	
10 (wh)	9.0	6.9	15.0	-		
11 (rd)	7.4	4.5	14.0	small pedicel w/bract		
12 (gr)	9.0	5.0	14.0	2 fls ->	2 fr	herbivory
13 (wh)	7.8	5.4	9.0	-		
14 (bl)	7.8	5.4	10.8	-		
15 (gr)	9.9	6.1	12.6	2 fls ->	2 fr	
16 (or)	8.4	5.4	13.0	-		
17 (gr)	4.9	3.8	7.8	minor herbivory		
18 (or)	5.9	4.7	11.5	-		
19 (wh)	11.2	8.2	17.0	2 fls ->	2 fr	
20 (wh)	10.8	8.0	11.5	3 fls ->	2 fr	
21 (bl)	7.9	4.2	8.9	-		
22 (wh)	8.0	5.7	11.6	pedicel w/bracts,	no fls	
23 (bl)	4.8	2.7	8.5	-		
24 (gr)	6.9	4.3	11.0	dense <u>Vinca</u>		
25 (wh)	6.9	3.8	11.6	dense <u>Vinca</u> ,	herbivory	
26 (bl)	3.9	3.1	7.0			

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<sup>1</sup> Precise locations of individual plants within quadrats was marked with colored plastic toothpicks (bl=blue, gr=green, or=orange, rd=red, wh=white, yw=yellow).

<sup>2</sup> all leaf measurements are mean measurements of the two mid-stem leaves and are given in centimeters.

<sup>3</sup> measured from the ground surface to the attachment of the two mid-stem leaves and given in centimeters.

PERMANENT PLOT 055C88X006

Description: A permanent plot with all individuals of Cypripedium fasciculatum located and marked with colored toothpicks. The plot is laid out along perpendicular axes oriented with respect to a Abies grandis tree at Apgar Campground.

# (color) <sup>1</sup>	leaf <sup>2</sup>		stem <sup>3</sup>	reproductive	comments
	length	width	length	structure	fate
1 (yw)	11.1	8.1	8.8	-	
2 (gr)	6.2	4.5	14.7	-	
3 (wh)	7.9	5.9	9.5	-	
4 (or)	8.8	6.4	9.0	-	
5 (wh)	10.0	7.8	9.0	3 fls -> 3 fr	
6 (or)	11.0	8.0	9.0	4 fls -> 4 fr	
7 (wh)	6.7	3.7	7.0	stem broken at midlength	
8 (bl)	8.9	6.1	9.8	2 fls -> 2 fr	
9 (gr)	5.4	3.5	8.6	-	
10 (wh)	5.3	2.7	8.0	-	
11 (wh)	7.8	4.7	7.7	-	
12 (or)	7.3	6.1	10.0	1 fl -> 1 fr	
13 (gr)	6.0	5.1	8.5	1 fl -> 1 fr	
14 (bl)	5.8	3.3	8.4	-	
15 (wh)	6.5	4.0	8.4	-	
16 (yw)	3.0	1.7	3.0	-	
17 (bl)	3.8	2.3	6.8	-	
18 (or)	7.3	4.8	8.0	-	
19 (wh)	6.9	4.4	7.5	-	
20 (bl)	6.2	3.3	8.0	-	
21 (bl)	6.5	4.8	10.5	-	
22 (gr)	6.4	3.8	7.5	-	
23 (wh)	4.5	3.0	7.0	-	
24 (or)	2.8	2.2	5.0	leaf herbivory	
25 (gr)	5.3	3.7	7.7	one leaf aborted	
26 (bl)	7.4	4.8	10.8	-	
27 (wh)	1.8	0.9	3.5	-	
28 (gr)	4.7	3.8	9.6	-	

## APPENDIX IV

### DIAGRAMS SHOWING LOCATIONS OF INDIVIDUAL PLANTS WITHIN PERMANENT PLOTS

Each diagram shows the location of all located individuals of Cypripedium fasciculatum with respect to bearing trees. See Appendix III.