COMMUNITY AND POPULATION MONITORING IN AQUARIUS RESEARCH NATURAL AREA, CLEARWATER NATIONAL FOREST

I. PLOT ESTABLISHMENT AND BASELINE DATA, 1991

by

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January 1992

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Purchase Order No. 43-0276-1-0573

ABSTRACT

Aquarius Research Natural Area encompasses a cross-section of the North Fork of the Clearwater River Canyon-one of the foremost examples of a refugium environment in the Northern Rocky Mountains. Aquarius was established to preserve a prime example of such an environment, characterized by western redcedar forests with fern-dominated understories, large stands of Pacific-disjunct red alder, and a large representation of other coastal disjunct taxa. Thirteen plant taxa on the Forest Service's Watch Plant List occur in the North Fork Canyon, ten within the RNA. Relatively little research has been done within the confines of the newly established Aquarius RNA.

This report documents methods used in establishing monitoring sites within the RNA to describe and monitor community types characteristic of this refugium environment, and to monitor populations of Forest Service Sensitive Plants occurring there. Nine community monitoring sites were established representing western redcedar habitat types with understory unions of maidenhair fern, lady fern, and shield fern; and seral red alder communities. In addition, two plots were established specifically to monitor rare plant populations. ECODATA methods were used to describe the vegetation in tenth-acre circular plots. All of the community data recorded will be entered into the Forest Service's ECOPAC data system. Plant composition data are presented in this report for each site. Maps of the RNA show locations of monitoring plots and known locations of Forest Service Sensitive Plant Species.

Recommendations for follow-up to this study include yearly measurement of four population monitoring plots and measurement of community plots at 3-yr intervals.

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INTRODUCTION

Research Natural Areas (RNA) are established by the US Forest Service to preserve forest, aquatic or geologic types with special or unique characteristics of scientific interest and importance (USDA Forest Service 1987). Areas so designated are removed from management and public use is not promoted. Aquarius RNA, on the Clearwater National Forest, is located in the canyon of the North Fork of the Clearwater River. The North Fork Canyon is one of the foremost examples of what have been termed refugium environments --vestiges of pre-Miocene vegetation developed under milder and wetter climatic conditions than now exist in the region (Johnson and Steele 1978, Moseley and Wellner 1988). These low-elevation canyon enclaves of western redcedar forest with fern-dominated understories have many affinities to coastal forests. They persist in lower canyons of the Clearwater basin due to a combination of low elevation, high rainfall and maritime climatic influences (Daubenmire 1975).

The Aquarius RNA is a cross-section of the North Fork Canyon encompassing many of the elements characteristic of coastal refugia, including an extraordinary assemblage of disjunct and endemic plant and animal taxa, and the best representations of several western redcedar/fern habitat types. Its coastal affinities are evidenced by the best representation of red alder east of the Sierra/Cascade crest.

The purpose of the Aquarius RNA is to ensure the continued existence of its various terrestrial and aquatic habitats along with their full complement of plant and animal communities in as near an undisturbed (by humans) condition as possible (Moseley and Wellner 1988). As such, it can provide 1) an undisturbed example of a refugium environment for study and interpretation and 2) a baseline study area for determining short- and long-term ecological changes.

Little research has been conducted within what is now the Aquarius RNA since Steele described red alder habitats of the North Fork Canyon and recorded several disjunct and endemic plants (Steele 1971). This report documents the establishment of permanent monitoring plots within vegetation types and rare plant populations which are indicative of the unique biological environment preserved in Aquarius.

By establishing permanent monitoring plots within the rare communities found in Aquarius, our objectives are to 1) characterize the vegetation of this unique ecosystem, 2) detect changes in community structure and composition over time, and 3) obtain baseline data needed to assess the

condition of comparable, managed ecosystems. This knowledge is of great value in determining characteristics, limitations and trends of the present vegetation and hence is of consequence to present and future management of Northern Rocky Mountain Forests (Moseley and Wellner 1988).

Associated with coastal refugium forests in Aquarius are a large number of rare plant taxa including eight species currently on the Forest Service Sensitive Plant List (USDA Forest Service 1991). The RNA thus presents an opportunity to monitor populations of these rare species to determine changes in numbers over time and their causes. Demography is the study of life cycle characteristics of a species that determine abundance and persistence through time. Demographic monitoring studies can help determine the factors that control the abundance and distribution of a species. To obtain this information, permanent plots are established in which individuals are mapped, or marked, and followed over time.

The purpose of this study was to describe the composition of selected western redcedar and red alder associations within the RNA and initiate a system for long-term monitoring of these communities and of representative populations of Forest Service Sensitive Species.

BACKGROUND

The unique biological qualities of the North Fork Clearwater drainage were first evidenced in the discovery of large stands of red alder (Alnus rubra), a disjunct coastal species rare in Idaho. The first scientific documentation of the area's vegetation was that of Steele (1971) who studied plant communities along the North Fork with special attention to red alder habitats. He sampled red alder and western redcedar stands which bore many affinities to coastal forest types. About two-thirds of his study area, extending downstream from Aquarius RNA, was flooded in the early 1970s under Dworshak Reservoir. Steele and others discovered a large number of coastal disjunct and endemic plant taxa in the North Fork drainage (Steele 1971, Johnson and Steele 1978). A review of coastal disjuncts in central Idaho and their probable origins is presented by Lorain (1988).

The area that now makes up Aquarius RNA was first recommended for RNA status by Fred Johnson in 1972. Its establishment was controversial and management of the area will remain so because of its biological value and proximity to public and private timber lands. The primary barrier to establishment was a proposal to build a road along the north side of the river to transport logs to Dworshak Reservoir. Many new rare plant sites were reported

by Moseley (1988) in his survey of proposed routes for the road. Establishment of Aquarius RNA, issues surrounding it, and considerations involved in the determination of its boundaries are discussed in the Establishment Record (Moseley and Wellner 1988) and in Caicco (1987a).

The proposed Aquarius RNA was evaluated by Caicco in 1987 for features of national ecological significance to see if the area merited National Natural Landmark (NNL) designation. Based on its national significance Caicco gave the area the highest NNL recommendation.

Aquarius did not receive RNA designation until 1991. As an RNA, the area is to be managed primarily for research and preservation of natural systems. However, the designation does not automatically preclude road building or other land development.

Because Aquarius has had Proposed RNA status since 1972 it has not been part of the timber base and most rare plant survey work has concentrated on adjacent Clearwater NF lands. Within the upper North Fork drainage many records of rare, disjunct and endemic plants have been found including bank monkeyflower (Mimulus clivicola), Case's corydalis (Corydalis caseana var. hastata), clustered lady's slipper (Cypripedium fasciculatum), Constance's bittercress (Cardamine constancei), crinkle-awn fescue (Festuca subuliflora), Henderson's sedge (Carex hendersonii), deer-fern (Blechnum spicant), licorice fern (Polypodium glycyrrhiza), redwoods violet (Viola sempervirens), Sierra wood-fern (Thelypteris nevadensis), soft rush (Juncus effusus var. pacificus), sticky tofieldia (Tofieldia glutinosa var. brevistyla), western starflower (Trientalis latifolia), and white shooting star (Dodecatheon dentatum). Most of these species are already known from the RNA and it is likely that further surveys will result in many additional records, and possibly the discovery of taxa currently known only from outside the RNA such as deer-fern and licorice fern.

Three plant taxa occurring in Aquarius RNA are endemic, or nearly so, to the Clearwater Basin: Case's corydalis, Constance's bittercress, and the Idaho or barren-ground strawberry (Waldsteinia idahoensis). The latter species is the only representative of its genus in the western United States. All three are former Federal candidate species for listing as Threatened or Endangered. Caicco (1987b) discovered the presence of bank monkeyflower (Mimulus clivicola), a Federal Candidate (C2) species, in brushfields along the north side of the river.

SITE CHARACTERISTICS

Location: Aquarius RNA is located in Clearwater County, Idaho, and encompasses 3900 acres along both sides of the North Fork of the Clearwater River. The area lies within Townships 40N and 41N, and Ranges 6E and 7E (Boise Meridian) and is approximately centered at latitude 46°51'35" N and longitude 115°39'28" W. Boundaries of the area are based on topographic features; the southern boundary adjoins private lands owned by Potlatch Forest Industries. The eastern limit is where the road leaves the river at Isabella Creek. On the south side of the river the RNA extends east to Thompson Point, about 1/2 mile past the fill line of Dworshak Reservoir (Appendix 1).

Physiography: The North Fork of the Clearwater River is incised deeply into mountainous terrain characteristic of the Clearwater River basin. The south canyon wall in the vicinity of Aquarius RNA exhibits an average of 2500 ft of relief, often in a horizontal distance of less than 1 mile. The relief of the north canyon wall approaches 4500 ft, although this is expressed more gradually, over about 4 miles of horizontal distance.

Within Aquarius the river lies at a relatively low elevation of about 1650 ft. Several major perennial tributaries enter the North Fork within the RNA, Thompson and Beaver Creeks from the south and Marquette Creek from the North. In addition, numerous ephemeral streams carry large volumes of water in spring.

Geology: Aquarius RNA lies along the border zone of the Idaho batholith, where quartz monzonite has intruded Precambrian metamorphic rocks; the latter include gneiss, quartzite, and coarse- to medium-grained schists (Rember and Bennett 1979). Several landslides and slumps occur within the area, as well as alluvial and colluvial fans in the bottom of the canyon.

Climate: The climate of the area represents the warm and moist extreme of all environments within the Northern Rocky Mountain Natural Region (The Nature Conservancy et al. 1982). Although no detailed weather data are available, data from 11 miles west of the RNA indicate average annual precipitation of 43 inches (1965-70). Based on vegetation differences between the weather station and Aquarius, and on partial data from Canyon Work Center just upriver, it has been assumed that temperatures are more moderate and precipitation higher at Aquarius (Caicco 1987a). However, refugial plant associations and disjunct species represented in Aquarius are also found along the lower Selway River where the weather station at Fenn Ranger Station (elev. 1600 ft) shows average annual precipitation of only 38 inches (US Weather Bureau 1989).

Floristic history: The abundant precipitation and moderate

temperatures of the Clearwater River basin, combined with its geologic and floristic history, have produced an ecosystem which is unique in the northern Rocky Mountains. Although the pre-Miocene flora of the region had close affinities to the present-day flora of eastern North America, mountain-building events which culminated in the Miocene severed any physical connection nearly 25 million years ago. In a similar fashion, the rise of the Cascade chain, complete in the Pliocene, eliminated the physical connection to the coastal forests of the Pacific Northwest and led to gradual drying and greater temperature extremes (Daubenmire 1975). Although only mountain glaciers were present in the Clearwater Basin during the Pleistocene, the existing flora of the deep canyons suggests that they may have served as refugia for warmth- and moisture-requiring plant species (Johnson and Steele 1978, Crawford 1980).

Vegetation: This portion of the North Fork drainage is notable for the abundance and diversity of fern species and fern understory unions represented. North-facing slopes within the canyon are dominated by western redcedar and grand fir. The dominant habitat type above 2500 ft is western redcedar/wild ginger (THUPLI/ASACAU), being replaced below by western redcedar/maidenhair fern (THUPLI/ADIPED), especially on mid to lower slopes above the river. In side drainages near the river the understory changes to lady fern. Some of these north slopes as well as the river terraces, support old-growth redcedar stands. Old river terraces support some of the largest redcedar trees with understories of maidenhair fern or shield fern.

The north side of the river is dominated by sparse Douglas-fir and grand fir, with areas of mature western redcedar on river benches and in the major drainages. Extensive brushfields also occur, dominated by tall shrubs of Rocky Mountain maple (Acer glabrum) and ocean spray (Holodiscus discolor), and by bracken fern (Pteridium aquilinum). There are occasional rock outcrops and small stands of red alder.

One of the outstanding features of the RNA, and one that indicates its affinities with coastal environments, is the presence of extensive stands of red alder. The largest stand of red alder east of the Cascade/Sierra Crest occurs beneath Thompson Point on the south side of the river, where it persists due to unstable soil conditions.

COMMUNITY TYPES SAMPLED

The following are western redcedar habitat types characteristic of Aquarius RNA. They all have fern-dominated understory unions. Some of the best representations of these types can be found along the lower

North Fork Clearwater River, therefore these habitat types were targeted for establishment of community monitoring plots. In addition, two seral red alder stands were sampled. The red alder stands are on alluvial fans at the mouths of tributaries, on the north side of the river. The following descriptions are drawn from the general treatment of Cooper et al. (1987) and from Steele (1971), who described western redcedar habitat types within the North Fork drainage.

Thuja plicata/Adiantum pedatum (THUPLI/ADIPED): This habitat type is restricted by the limited geographic occurrence of Adiantum pedatum which in Northern Idaho occurs almost exclusively between the St. Joe and Selway Rivers. No where is it found more abundantly than in the North Fork Canyon where it is by far the most abundant of the three fern unions, occurring on mid to lower slopes and benches on both sides of the river. Along the North Fork this habitat type is richer in species than in general. A similar THUPLI/ADIPED association has been described for the Oregon coast (Cooper et al. 1987).

The Adiantum union is the driest of the fern unions. Adiantum pedatum and/or Polystichum munitum dominate, with coverage of Polystichum increasing on drier sites. Other highly constant species include: Acer glabrum, Adenocaulon bicolor, Anemone piperi, Asarum caudatum, Athyrium filix-femina, Bromus vulgaris, Circaea alpina, Clintonia uniflora, Coptis occidentalis, Cornus canadensis, Disporum hookeri, Galium triflorum, Gymnocarpium dryopteris, Lonicera utahensis, Montia sp., Osmorhiza chilensis, Rosa gymnocarpium, Rubus parviflorus, Smilacina stellata, Streptopus amplexifolius, Symphoricarpos alba, Taxus brevifolia, Tiarella trifoliata, Vaccinium globosa, and Viola orbiculata. Conifer seedlings seldom occur in the climax understory except on rotting logs (Steele 1971). The sensitive

orchid species, Cypripedium fasciculatum, frequently occurs in the THUPLI/ADIPED habitat type.

Thuja plicata/Athyrium filix-femina (THUPLI/ATHFIL): This habitat type is less extensive than THUPLI/ADIPED, occupying low or seepage areas on river terraces and side drainages (wetter sites) in old-growth cedar stands, where it often grades into an Adiantum pedatum phase. In addition to Adenocaulon bicolor, Asarum caudatum, Circaea alpina, Clintonia uniflora, Coptis occidentalis, Gymnocarpium dryopteris, Tiarella trifoliata and Streptopus amplexifolius, which are common to the Adiantum union, the species Senecio triangularis, Trautvetteria caroliniensis and Viola glabella also have high constancies.

Thuja plicata/Dryopteris spp. (THUPLI/DRYOPT): This habitat type was described by Steele (1971) from type locations in the North Fork drainage where it occupies colluvial and alluvial terraces. In the system used by Cooper et al. (1987) this association is encompassed by THUPLI/ATHFIL, Adiantum pedatum phase. Steele found that, in spite of their similar physiognomy, THUPLI/DRYOPT is not closely related floristically to THUPLI/ATHFIL, but is more similar to THUPLI/OPLHOR, an association characteristic of moist sites receiving cool air flow from above. Steele noted a high constancy of the coastal disjunct sedge species Carex hendersonii in the Dryopteris union and higher constancies of Cardamine constancei, Cornus canadensis, Dryopteris filix-mas, Festuca subulata, Mitella pentandra, Trientalis latifolia, and Viola orbiculata than in the Oplopanax and Athyrium unions.

The THUPLI./DRYOPT habitat type occurs on colluvial and alluvial terraces that lie in pockets at the base of steep slopes and near the mouths of short, steep creeks. In the fern-dominated understory, Athyrium filix-femina, Dryopteris filix-mas and D. expansa occur in various proportions. Dryopteris spp. tend to establish on decaying wood (Steele 1971). Common forbs are those of the Adiantum union, plus Carex dewyana, C. hendersonii, Dryopteris filix-mas, Festuca subulata, Mitella caudatum, M. pentandra, Oplopanax horridum, Trautvetteria caroliniensis, Trillium ovatum and Viola glabella. The Dryopteris union is further distinguished from the Adiantum union by a decreased frequency of Cornus canadensis, Lonicera utahensis, Rosa gymnocarpium, Rubus parviflorus, Streptopus amplexifolius, Symphoricarpos albus, Taxus brevifolia, and Vaccinium globosa.

RARE PLANT SPECIES

Table 1 lists rare plants presently known from Aquarius RNA. Two are endemic to the Clearwater basin, and nine are

coastal disjuncts in Idaho, their main range being along the Cascade/Sierra crest or further west. Eight species were classified as Sensitive by the Forest Service at the time of this study. Monitoring was initiated for five of these Sensitive Species: clustered lady's-slipper, Constance's bittercress, crinkle-awn fescue, Henderson's sedge, and western starflower. A monitoring program for bank monkeyflower on the Clearwater National Forest is in its second year. The single known location of soft rush in Aquarius was not revisited in 1991.

Clustered lady's-slipper (Cypripedium fasciculatum Kell. ex Wats.) is a short-rhizomatous herb, 1-24 inches tall, with a pair of broad opposite leaves midway or higher up the stem. Two to four flowers are arranged in a terminal cluster.

Distribution: The clustered lady's-slipper is widely distributed in western North America. It is known from 15 widely separate areas in Idaho including the North Fork Clearwater drainage, but is scarce in all areas where it occurs. Clustered lady's-slipper is known from two locations in Aquarius, on either side of the river. A relatively large population about 1/2 mi west of Isabella Creek provided the ideal location for a monitoring plot.

Table 1. Rare plant species recorded in Aquarius Research Natural Area at the time of this study, and their conservation status (Idaho Natural Heritage Program 1991).

Common name	Latin name	Central ID Endemic	Coastal Disjunct	USFS[1] Region 1 Status	ICDC[2] Status	Federal[3] Status
Bank monkeyflower	Mimulus clivicola			S	G2/S2	C2
Case's corydalis	Corydalis caseana hastata		X	W	G5/S3	3c
Clustered lady's slipper	Cypripedium fasciculatum		X	S	G3/S3	3c
Constance's bittercress	Cardamine constancei		X	S	G3/S3	3c
Crinkle-awn fescue	Festuca subuliflora		X	S	G5/S2	
Phantom orchid	Eburophyton austiniae		X	no	G4/S2	
Henderson's sedge	Carex hendersonii		X	S	G5/S2	
Idaho strawberry	Waldsteinia idahoensis		X	W	G3/S3	3c
Rattlesnake-root	Prenanthes alata		X	S	G?/S1	
Redwoods violet	Viola sempervirens		X	no	G5/S3	
Soft rush	Juncus effusus pacificus		X	S	G5/S3	
Western starflower	Trientalis latifolia		X	S	G5/S3	
White shooting star	Dodecatheon dentatum		X	no	G4/S2	

[1] US Forest Service; S=Region 1 Sensitive Species, W=Watch Plant List, no=no special status

[2] Idaho Conservation Data Center; G=global, S=state; rarity increases with decreasing numbers from 5 to 1.

[3] C2 = listing as threatened or endangered probably warranted but more information needed; 3c = once

considered for listing but no longer believed to be threatened.

Habitat: In the Clearwater basin, Clustered lady's-slipper is associated with western redcedar, in Asarum or Adiantum understory unions, in heavy to light shade, often growing in heavy duff and on steep slopes.

Constance's bittercress (Cardamine constancei Detl.) is a member of the mustard family (Brassicaceae). It is rhizomatous and few of the stems produced in a given year flower. In fruits observed by Crawford (1981) only a few seeds developed.

Constance's bittercress is endemic to northern Idaho where it is known primarily from river valleys of the Clearwater drainage. It also occurs along the lower St. Joe River and a single population is known form the Coeur d'Alene River drainage (Crawford 1980). It is associated with relict habitat types and coastal disjunct species. The most extensive populations occur in the Lower Selway and Middle Fork Clearwater canyons. Crawford estimated the main population center in the North Fork to be from Isabella Creek downstream to the Little North Fork Clearwater tributary. Only about 7 mi of this canyon section now remain above the level of Dworshak Reservoir.

In the North Fork Canyon Constance's bittercress is typically found on moist, level to gently sloping benches just above the river (Appendix 2, Map A). These moist terraces support mostly western redcedar with understories dominated by fern species. However, it can also be found on somewhat exposed slopes with high grass and forb cover. Although it is a shade-requiring species, Crawford found that flowering was positively correlated with the amount of sunlight received. Belt transects were established to monitor Constance's bittercress at Site 003 where it is was particularly abundant in 1991.

Crinkle-awn fescue (Festuca subuliflora Scribn.) is a perennial, non-rhizomatous grass forming a small tuft of long, narrow, lax blades. Often only leaves are present. Open, delicate panicles have drooping branches. This species is difficult to distinguish from its much commoner congener F. subulata. The short, dense pubescence on the upper surface of the leaves of crinkle-awn fescue is one distinctive feature. Plants must be closely examined to be identified. It is likely that records of Crinkle-awn fescue are scarce in part because it is an inconspicuous plant that can be confused with the common F. subulata.

Distribution: Crinkle-awn fescue is a Pacific coastal disjunct associated with refugial forests in northern Idaho. It has been recorded along the Selway River and in the vicinity of Elk Creek Falls as well as along the North Fork of the Clearwater.

Habitat: Crinkle-awn fescue is found in moist, THUPLI habitats with heavy to moderate shade, often within the Adiantum union. It is almost always found growing in rich humus soils over granitic parent material. The most common landscape positions are on river benches and in draws. It is sometimes associated with canopy openings, including trails and old roads, indicating some tolerance to disturbance (Lorain 1989).

Henderson's sedge (Carex hendersonii L.H. Bailey) is a non-rhizomatous sedge with wide, bright green leaves that have prominent mid-veins. The inflorescence bears several slender, erect spikes, the terminal spike bearing staminate flowers and the lateral spikes pistillate. Large, leafy bracts subtend the lower spikes. Plants are easily spotted and identified due to their size and robustness.

Distribution: Henderson's sedge is a Pacific coastal disjunct in Idaho. Populations are known in Idaho from the Clearwater, Selway, and Lochsa River drainages.

Habitat: Henderson's sedge is most abundant in the shady understory of THUPLI/ADIPED habitat types, on moist sites in valley bottoms. In Aquarius it occurs as high as 2500 ft, even on the north side of the river in THUPLI/CLIUNI habitat types (Appendix 2, Map A).

Western starflower (Trientalis latifolia Hook.) is a rhizomatous, evergreen, perennial forb 4-10 inches tall. Small white flowers bloom in early summer.

Habitat: Western starflower is a disjunct coastal species occurring in Clearwater and Latah Counties. It is widespread and abundant in Aquarius, growing on moist to mesic sites on both sides of the river, in habitat types ranging from THUPLI/CLIUNI to THUPLI/DRYOPT. It is most abundant in the Adiantum union and slightly drier Asarum union. It occurs at least as high as 2000 ft on both sides of the river (Appendix 2, Map A) and was observed under closed THUPLI canopy where it was one of the only understory species present.

METHODS

Stand selection: Western redcedar/fern communities occur on mid to lower slopes in the river drainage and on old terraces. Eleven sites along both sides of the North Fork Clearwater River were selected for study. Precise plot locations are shown in Appendix 1. Plots were established in three western redcedar/fern habitat types: THUPLI/ADIPED, THUPLI/ATHFIL, and THUPLI/DRYOPT; and in two seral, red alder stands. Two plots (010 and 011) were located specifically to sample rare plant populations. Other rare plant monitoring was established at community monitoring sites. All of the western redcedar sites were in old-growth stands. Six are on river terraces. The alder stands are on relatively recent alluvial fans at the mouth of tributary streams.

Sampling methods: At each site a circular, tenth-acre plot (37-ft radius) was located in a representative and uniform portion of the community to be sampled, in as inconspicuous a location as possible with respect to trails. Such a plot can be easily and unambiguously marked with a single post at the center. A heavy duty steel fence post was used in this study to mark plot center. The top was painted red and inscribed with the 15-digit plot ID number (ECODATA key ID).

ECODATA methods (USDA Forest Service 1991b) were used to record plant composition (Form PC) and physical site characteristics (General Form and Location Linkage). The actual forms used, modified slightly for this study, are shown in Appendix 3. ECODATA provides a useful system that is well documented and provides standardized sampling techniques used throughout Region 1. Data can be accessed through the Forest Service ECOPAC data system.

For plant composition we listed all species present, along with a cover class (1-10) and height class (1-ft classes). Shrub cover was recorded by height class. Trees were broken down by DBH class into seedling, sapling, pole, medium, large, and extra large. The ECODATA General Form contains many parameters related to old-growth determination and successional status of stands such as estimates of downed wood diameter, basal area of dead trees, and average dead tree diameter. Basal area was estimated using a "tree finder" and a variable plot size. Basal area estimates may be somewhat low because we only counted trees that could be seen by standing at the center post and rotating around (i.e., we did not move side to side to look behind trees).

Population monitoring: Monitoring was initiated for five, Region 1 Sensitive plants: clustered lady's-slipper, Constance's bittercress, crinkle-awn fescue, Henderson's sedge, and western starflower. Where possible, monitoring of sensitive plant populations was set up at community monitoring plots. This was not possible for clustered lady's-slipper and crinkle-awn

fescue which did not occur in any plot, so additional ECODATA plots were established in populations of these two species. The methods used to record individuals depended on the species, its growth habit and abundance.

For clustered lady's-slipper and Henderson's sedge, individuals or groups of individuals were actually mapped within a circular, 37-ft radius ECODATA plot by taking an azimuth and distance to each plant location from the center post. For Henderson's sedge, numbers of vegetative and inflorescence-bearing culms were recorded. For clustered Lady's-slipper, stem heights and numbers of fruits were recorded (Appendix 6).

Constance's bittercress, western starflower and crinkle-awn fescue were counted in 1 x 3-ft or 3 x 3-ft microplots along continuous belt transects. Sampling designs are shown in Appendix 4. Where two sensitive species occurred in the same ECODATA plot they were sampled together using the same method.

RESULTS AND DISCUSSION

The redcedar stands sampled were floristically very similar (Appendix 5). Stands 001-003 and 005-008 represent common fern understory unions in Aquarius. Stands 010 and 011 were located specifically to characterize the habitat of populations of clustered lady's-slipper and crinkle-awn fescue respectively. Consequently, stand 010 happens to be in a THUPLI/CLIUNI habitat type. Lady fern was highly constant and usually common in the climax redcedar stands sampled. All three of the fern unions occur on gently sloping to level river terraces which vary greatly in size. The maidenhair fern union is also the most extensive type on moderate to steep slopes near the canyon bottom, on both sides of the river, but lady fern can also be common on these sites (see stand 008).

Because of their high coverage of shield fern, stands 001 and 008 best fit Steele's (1971) description of the shield fern (Dryopteris spp.), although the indicator plant he used, mitrewort (Mitella caulescens), was not observed in either stand. Table 2 shows the community types represented by each of the monitoring plots.

Table 2. Plant communities represented by monitoring plots established in 1991.

Community	Plots
Alnus rubra (seral)	004, 009
Thuja plicata/Clintonia uniflora HT[1]	010
Thuja plicata/Adiantum pedatum HT[1]	003, 011
Thuja plicata/Athyrium filix-femina HT[1]	002, 005, 006, 007
Thuja plicata/Dropteris spp. HT[2]	001, 008

[1] Cooper et al. 1987

[2] Steele 1971

Red alder stands (#s 004 and 009) have a complement of fern species similar to that of the redcedar stands, but have a much higher forb diversity and an almost continuous low forb cover of Siberian montia (Montia siberica). These stands are on alluvial fans formed by violent flood events in side drainages. Red alder forms a nearly closed canopy. The trees are large sapling to pole size with seedlings rare to absent.

Baseline data for clustered lady's-slipper, Constance's bittercress, Henderson's sedge, crinkle-awn fescue, and western starflower in population monitoring plots can be found in Appendix 6. The way in which data was recorded differed for different species. Where more than one of these species occurred in a microplot they were all counted.

RECOMMENDATIONS

The work outlined here represents the first step toward characterizing the unique plant associations in Aquarius and documenting their rare floristic elements.

Based on this study, I recommend the following:

1) In order to provide useful information, population monitoring plots should be remeasured on a yearly basis. Sites were chosen for their accessibility and methods used take little time or effort.

2) At least one additional population monitoring plot should be set up for each rare species sampled in this study. It is important to know if trends observed at one site are occurring elsewhere in the range of the species. A minimum of two plots for each species monitored should be established, in contrasting sites where possible.

3) Community monitoring plots should be remeasured every three years, using the same methodology outlined here.

4) One additional community monitoring plot should be established in one of the red alder stands near Thompson point. The western portion of the RNA, south of the river, is particularly unstudied due to problems of accessibility.

5) The status of Prenanthes alata , currently a Region 1 Sensitive Species, should be re-evaluated after specimens collected in 1991 have been verified. Specimens of Prenanthes sp. in flower, collected along the south bank of the North Fork Clearwater River, have been submitted to the University of Idaho Herbarium. All of the specimens of Prenanthes now resident in the herbarium are identified as Prenanthes sagittata. Based on my examination of these specimens, I question the presence of Prenanthes alata in Idaho. It is now known from only a single specimen collected in the same area that our 1991 collections were made.

6) A more thorough survey of rare plants within the RNA is warranted. If the limits of western starflower and Henderson's sedge can be determined they might be useful in defining the extent of the refugium environment. Also, it is likely that deer-fern and other rare species of the Clearwater basin are represented in the RNA.

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