# RECONNAISSANCE AND MAPPING OF HABITAT TYPES WITHIN A CENTRAL PORTION OF THE FRANK CHURCH-RIVER OF NO RETURN WILDERNESS

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BILLY G. ALEXANDER, JR.
HAINES, OREGON

## Introduction

Habitat type classifications reflect patterns of similarity and dis-similarlty between distinct units of an ecosystem as observed by man. In the sense that plant species abundance may illustrate continuums, a classification is somewhat artificial. However, patterns in ecosystem distributions can be observed and communicated, and as such can be used as tools of communication in illustrating ecosystem trends and gradients.

This study is a reconnaissance of ecosystem patterns as illustrated in habitat type occurrence. As such, the data is not a quanitative statistical survey and is subject to the bias of the observer. The objectives of this study include mapping the occurrence of habitat types as defined in Steele et al. (1981), comparing the relative abundance of habitat types, and concieve generalizations which may further ellucidate ecosystem patterns. This study is intended to provide the inspiration for more extensive quanitative studies.

A habitat type classification has been developed for central Idaho by Steele et al. (1981), in which the vegetation, geographic, topographic, climatic, and edaphic features of habitat types are described for central Idaho. Along with general features the ecological relationships and successional trends of the types are discussed. Mueggler and Harris (1966) describe sites of mountain grassland, one of which occurs near the study area of this project. These authors describe the Festuca idahoensis- Agropyron spicatum- Antennaria rosea type which occurs within this projects' study area. It is likely that more study sites within the present study area would establish a

distinct Festuca Idahoensis-Agropyron spicatum habitat type from that described for the entire Central Idaho area by Mueggler and Harris (1966). Other studies give breif general descriptions of vegetation patterns (Hornocker 1970, Claar 1973).

**Study Area**

The study area occupies approximately 123 square miles of the Frank Church River of No Return Wilderness (Figure 1). Table 1 describes the legal location of the study area. To the south the study area is bordered by Big Creek, while to the west the border runs west of Cold Mountain and Cold Meadows Guard Station. The northern border runs north of Black Lake and before the breaks of the Salmon River, while to the east the border begins near the mouth of Goat creek and transects Cottonwood Butte. Three major drainages are represented by tributaries in the study area; the Salmon River to the north, the Middle Fork of the Salmon River to

Table 1: Legal description of location of Study Area in the Frank Church River of No Return Wilderness.

| TOWNSHIP | RANGE | SECTIONS* |
|---|---|---|
| T21N | R12E | 1,2,11-14, portions 25 and 26 |
| T21N | R13E | 1-30, portions 31,32-36 |
| T22N | R12E | 1,2,11-14,23-26,35,36 |
| T22N | R13E | 1-36 |
| T23N | R13E | 13,14,23-26,35,36 |
| T23N | R13E | 13-36 |

* Sections are inclusive of study area.

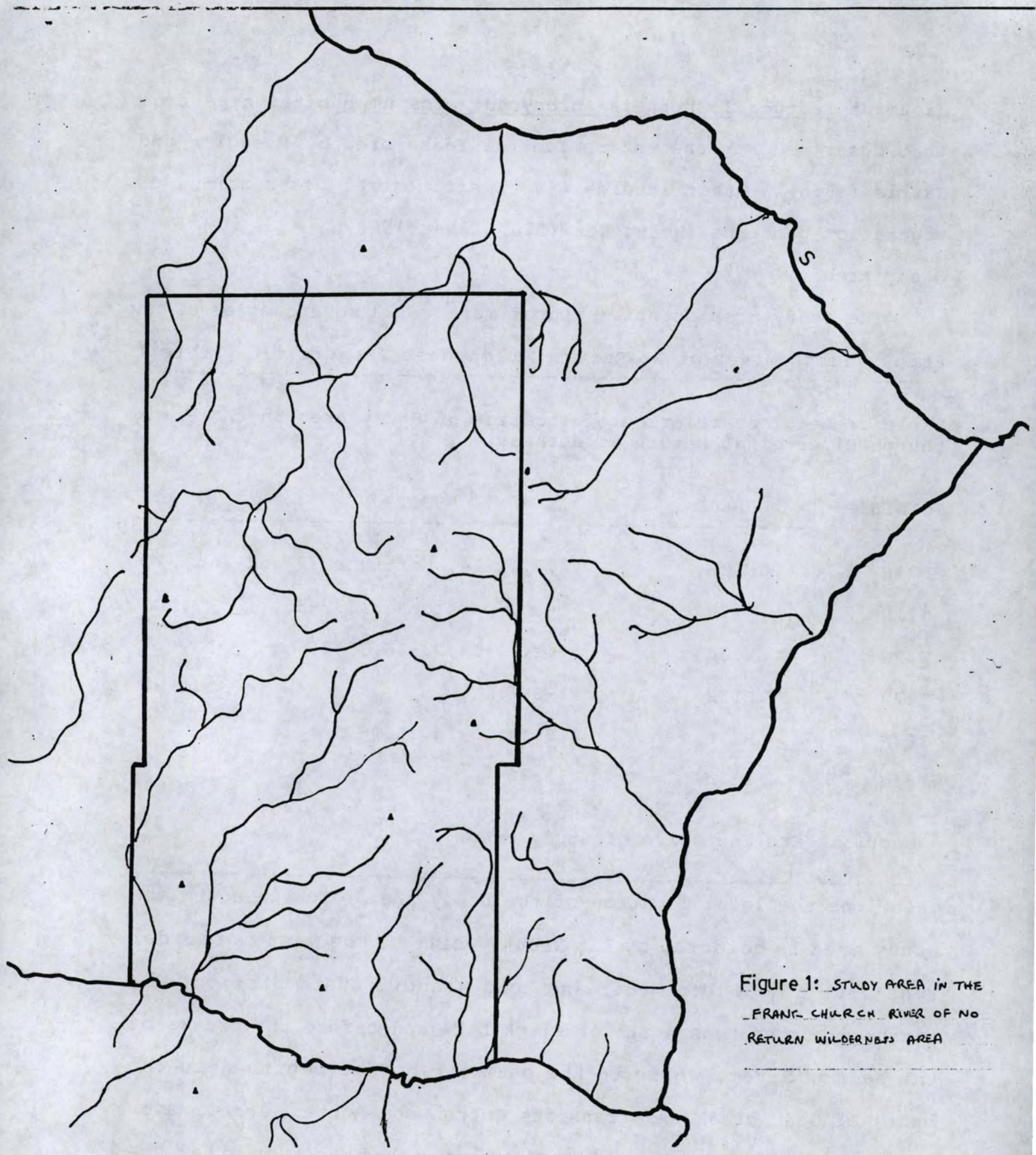

Figure 1: STUDY AREA IN THE FRANK CHURCH RIVER OF NO RETURN WILDERNESS AREA

the east, and Big Creek to the south. Figure 2 shows the area of the study area covered by these drainages.

Diversity within the study area covers the range of major vegetation zones in the area as described by Daubenmire (1952). Major zones include the ponderosa pine zone, the Douglas fir zone, the spruce-fir zone, and the alpine zone (Daubenmire 1952). At lower elevations sites of warmer aspects support a steppe zone, dominated by Agropyron spicatum and Cercocarpos ledifolius. The overstory tree series include the Pinus albicalus series at higher elevations, the Abies lasiocarpa series (includes Pinus contorta as successional) at mid- to upper elevations, the Pseudotsuga menziesii series at mid- to lower elevations, and minor amounts of the Pinus ponderosa series at low elevations. Cottonwood Butte is the highest point in the study area at 9349 feet (2850 m), with points along Big Creek as the lowest at 3800 feet (1160 m).

The Frank Church-River of No Return Wilderness shows little disturbance by man . Alteration of the floristic composition has been confined to areas of high stock use such as ranch in-holdings and established campsites. Timber removal has occurred near Cabin Creek and Taylor ranch but impacts have been kept to a minimum.

Fire has been, and most likely will continue to be, the major disturbance factor in the study area. The Pseudotsuga menziesii and Abies lasiocarpa forest types can be characterized as low frequency-high intensity types of fire regimes. Major successional changes occur in the Abies lasiocarpa forest following a fire to a successional Pinus contorta dominance.

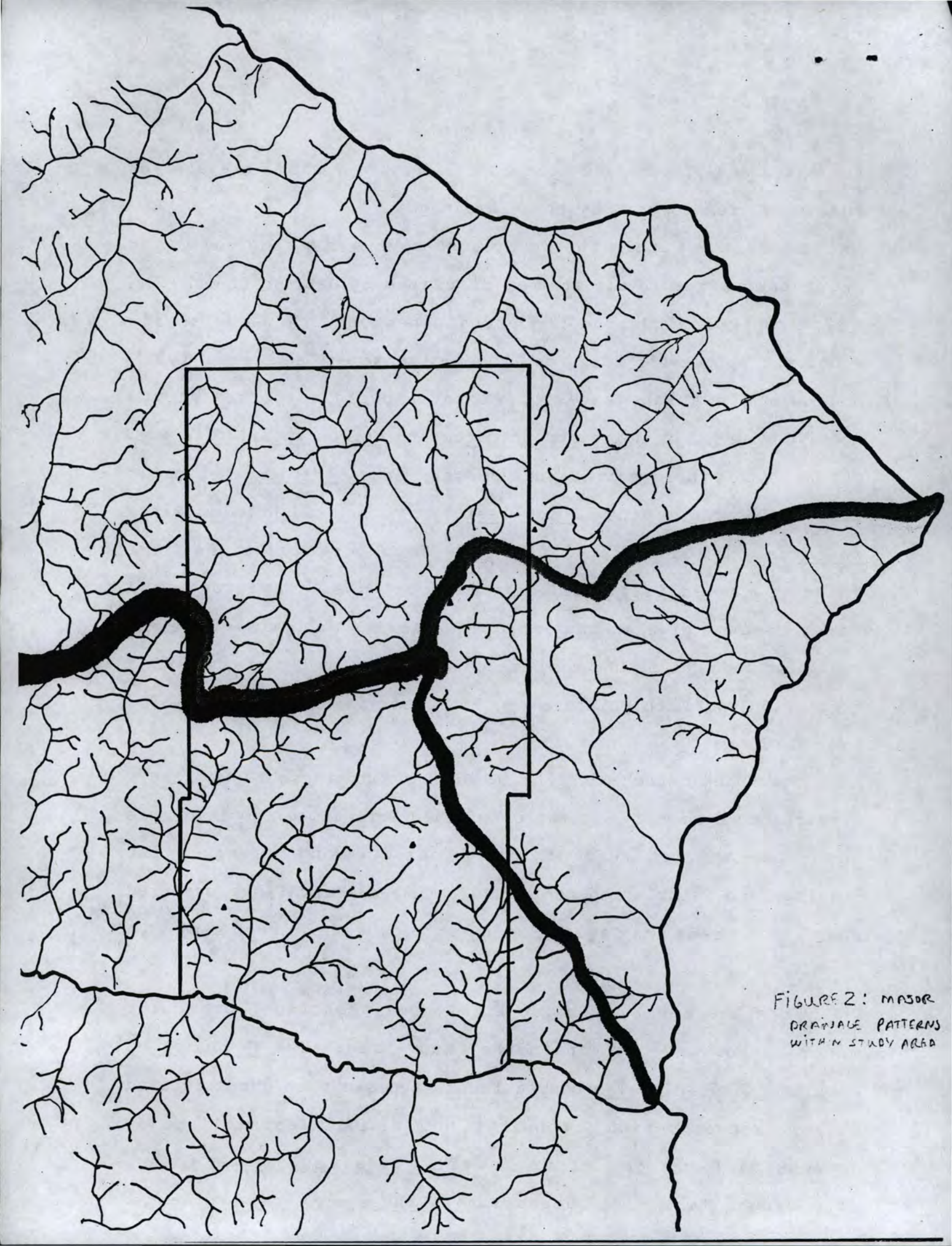

FIGURE 2: MAJOR DRAINAGE PATTERNS WITHIN STUDY AREA

Pseudotsuga menziesii remains successional on P. menziesii climax sites, but major changes can occur in the undergrowth. These situations lead to a mosaic pattern of successional forests throughout the study area. Further descriptions of successional changes within individual habitat types can be found in appendix A.

Current Forest Service practices include fire suppression within the Frank Church River of No Return Wilderness. However, due to the isolated nature of the wilderness, its large size (2.5 million acres), and the lack of roads total fire exclusion has not been achieved.

**Methods**

This reconnaissance mapping study was accomplished from field observations and aerial photo interpretation. Habitat types were identified using habitat type keys in Steele et al.(1981). Non-forested habitat types not found in Steele et al. (1981) were assigned names based on dominant (determined by ocular estimate) vegetation species.

The mapping of habitat types was greatly facilitated by the recognition of patterns within the study area, which can only be observed by close association in the field. Travel throughout the study area was confined to trails; traveled on horseback and foot. Field glasses were used to identify patterns in overstory throughout wide areas, while actual on site study established the correlated undergrowth patterns. These patterns were located and noted on field maps and later transfered to office maps. Remote sensing of patterns was achieved by aerial photo interpretation and fly overs.

Once habitat patterns were correlated with topographical, aspect, and elevation occurrence they were extrapolated to areas not visted on foot. Field checks were made by visiting some areas of extrapolation to see if patterns of habitat type occurrence correlated with reality.

Once habitat type distributions were mapped on USGS quadrangle maps their relative abundance was calculated. A planimetric measure was made of acreage of each mapped cell representing habitat type boundaries. Planimetric measurements did not take into account slope which tends to increase the actual acreage covered by each cell. A bias is interjected in the relative abundance in that some types only occur on steep slopes and others may occupy more moderate slopes, hence, creating a bias against the steep slope types. To correct for this bias a slope factor correction value was calculated by sampling various cells on the map and averaging the slope factor. This average figure was then applied to the planimetric values and relative abundance recalculated (see table 2 ).

**Results**

Table 2 lists the habitat types and phases found on the study area. There are eighteen habitat type units on the study area, 16 of which are distinct habitat types and 2 are phase breakdowns of types. Each habitat type is described in appendix A as to diagnostic vegetation, topographical and elevational occurrence, successional patterns, and adjacent habitat types and ecotones. More extensive descriptions for forested types can be found in Steele et al. (1981).

Table 2: List of Habitat types found in the Study area

| Habitat type Name | Abbreviation |
|---|---|
| **Non-Timbered types** | |
| *Cercoparpos ledifolius* habitat type | CELE HT |
| *Agropyron spicatum* habitat type | AGSP HT |
| Subalpine wet meadow habitat type | Meadow HT |
| **Timbered types** | |
| *Pinus ponderosa/Festuca idahoensis* habitat type | PIPO/FEID HT |
| *Pseudotsuga menziesii/Cercocarpos ledifolius* habitat type | PSME/CELE HT |
| *Pseudotsuga menziesii/Agropyron spicatum* habitat type | PSME/AGSP HT |
| *Pseudotsuga menziesii/Acer glabrum* habitat type | PSME/ACGL HT |
| *Pseudotsuga menziesii/Physocarpos malvaceous* habitat type | PSME/PHMA HT |
| *Pinus ponderosa* phase | PIPO PH |
| *Pseudotsuga menziesii/Calamagrostis rubescens* habitat type | PSME/CARU HT |
| *Abies lasiocarpa/Vaccinium scoparium* habitat type | ABLA/VASC HT |
| *Calamagrostis rubescens* phase | CARU PH |
| *Abies lasiocarpa/Carex geyeri* habitat type | ABLA/CAGE HT |
| *Abies lasiocarpa/Luzula hitchcockii* habitat type- *Vaccinium scoparium* phase | ABLA/LUHI HT VASC PH |
| *Abies lasiocarpa/Xerophyllum tenax* habitat type- *Vaccinium scoparium* phase | ABLA/XETE HT VASC PH |
| *Pinus albicaulis-Abies lasiocarpa/Vaccinium scoparium* habitat type | PIAL-ABLA/VASC HT |
| *Pinus albicaulis-Abies lasiocarpa/Luzula hitchcockii* habitat type | PIAL-ABLA/LUHI HT |
| *Picea engelmannii-Abies lasiocarpa*/riparian habitat type | PIEN-ABLA/riparian HT |

## Habitat Type Maps

Appendix B is USGS quadrangle maps of the study area with Mylar overlays mapping the occurrence of the habitat types. Black lines mark the boundaries of the habitat types and the cells thus defined are labled with acronyms (see table 2) identifying the habitat type. Boundaries of habitat types on the ground do not form as discreet a line as they do on maps. Some on-site boundaries are fairly discreet representing abrupt environmental change (ie. the boundary between the PSME/PHMA HT and the AGSP HT). However, most boundaries are represented by ecotones, which are areas where characteristics of one habitat type grade into characteristics of another. It is important that this aspect of boundaries be taken into account in trying to apply the maps to in-field situations. At some point individuals mapping habitat types and individuals applying maps on site must make an arbitrary decision concerning exact boundary placement.

## Relative abundance of Habitat Types

Table 3 shows the relative abundance of the habitat types found on the study area. Planimetric acres are shown and corrected to take into account slope.

The ABLA/VASC HT is the most abundant habitat type of the study area with 43,011 acres. This is far greater than the next largest habitat type PSME/PHMA HT with 9,011 acres. Taken together the habitat types of the Abies lasiocarpa series (A. lasiocarpa is climax) account for 46,369 acres, or 56.2% of the study area. The Pseudotsuga menziesii series accounts for 22,214 acres, or 27% of the study area. Pinus alicaulis series types

Table 3: Number of Acres and Relative Abundance for Habitat types in the Study Area

| HABITAT TYPE NAME | PLANIMETRIC ACRES | RELATIVE ABUNDANCE PLANIMETRIC ACRES | SLOPE FACTOR | SLOPE FACTOR ACRES | RELATIVE ABUNDANCE SLOPE ACRES | RANKING |
|---|---|---|---|---|---|---|
| CELE HT | 1695 | 2.20 | 1.210 | 2051 | 2.50 | 4 |
| AGSP HT | 3228 | 4.30 | 1.160 | 3744 | 4.50 | 8 |
| WET MEADOW HT | 947 | 1.40 | 1.000 | 947 | 1.10 | 11 |
| PIPO/FEID HT | 134 | 0.20 | 1.140 | 153 | 0.20 | 17 |
| PSME/CELE HT | 757 | 1.00 | 1.180 | 893 | 1.00 | 12 |
| PSME/AGSP-FEID HT | 4174 | 5.50 | 1.140 | 4758 | 5.80 | 4 |
| PSME/ACGL HT | 829 | 1.00 | 1.000 | 829 | 1.00 | 13 |
| PSME/PHMA HT | 7904 | 10.40 | 1.140 | 9011 | 11.00 | 2 |
| PSME/PHMA PIPO PH | 261 | 0.30 | 1.190 | 311 | 0.40 | 15 |
| PSME/CARU HT | 5777 | 7.70 | 1.110 | 6412 | 7.90 | 3 |
| ABLA/VASC HT | 40197 | 53.10 | 1.070 | 43011 | 52.10 | 1 |
| ABLA/VASC CARU PH | 1154 | 1.50 | 1.080 | 1246 | 1.50 | 10 |
| ABLA/CAGE HT | 1703 | 2.20 | 1.060 | 1805 | 2.20 | 9 |
| ABLA/LUHI VASC PH | 171 | 0.20 | 1.090 | 189 | 0.20 | 16 |
| ABLA/XETE VASC PH | 109 | 0.10 | 1.080 | 118 | 0.10 | 19 |
| PIAL-ABLA/VASC HT | 725 | 1.00 | 1.110 | 805 | 1.00 | 14 |
| PIAL-ABLA/LUHI HT | 119 | 0.20 | 1.000 | 119 | 0.10 | 18 |
| PIEN-ABLA/RIPARIAN HT | 3487 | 4.60 | 1.000 | 3487 | 4.20 | 6 |
| OPEN | 2353 | 2.10 | 1.120 | 2635 | 3.20 | 7 |
| ** TOTAL ** | 75724 | 100.00 | | 82524 | 100.00 | |

include 924 acres, or 1%, while the Picea engelmannii series accounts for 3,487 acres, or 4.2% of the study area. Non-forested types (includes open scree slopes) represent 9,487 acres, or 11.4%. Pinus ponderosa only accounts for 153 acres, or 0.2%. Appendix C is an acetate overlay combining habitat types into a series level and illustrating their occurrence over the study area.

The importance of relative abundance of habitats lies in the associated characteristics, such as successional qualities, food abundance for consumers, etc., of the various habitat types. For instance; ungulants utilize different portions of the habitat at varying times of the year. For a predator who is dependant on a particular ungulant for a major portion of its diet the relative abundance of habitats it has to travel through to reach a species is important to energy spent obtaining that species. As more data is collected concerning use and dependance on the habitat types relative abundance may shed some light on models describing species habits.

Ecological Zones of the Study Area

From on site observation of the habitat type distribution and study of the relative abundance derived from the maps patterns of ecological zones for the study area are proposed. These zones certainly reflect distinct differences in vegetation patterns and are believed to represent differences in environmental influences. These influences include topographical affects resulting in patterns of temperature intensities manifested as warm and cold aspects, canyon situations subject to orographic slippage, and local climatic influences. These

environmental influences are difficult to measure quatitatively, hence, patterns of vegetation are used to represent the patterns. There are five zones identified for the study area which are illustrated with the acetate overlays of appendix D.

The warmest end of the xeric-mesic gradient is represented by the Steppe zone, which includes the warm non-timbered habitat types; CELE HT and AGSP HT. The steppe zone is characterized by warm exposures with little residual snowpack. It is most common along the Big Creek drainage, the lower Cabin Creek, and Cave Creek drainages. The warm exposures and resultant decrease in available moisture results in tree species not establishing on these sites. There is little data at this point which points to this lack of overstory as a disclimax feature. The steppe zone is the primary site for the wintering ungulates of the region; deer, elk, sheep, and goats. The Bighorn Sheep are the most conspicuous users of this zone in the summer, although scattered individuals of other species also use this zone. Predator species dependant on these species also shift to wintering in the Steppe zone.

Adjacent to the Steppe zone is the Orographic Zone found mostly in the side canyons of Big Creek, and includes the PSME/PHMA HT and the PSME/ACGL HT. This zone indicates cold air drainage and an abundance of moisture. The transition from the Steppe Zone to this zone is abrupt indicating changes in climatic influences. The Orographic Zone is used extensively as cover by wildlife species and is often associated at lower elevations with a primary wildlife requirement- water.

The third zone is the Ridge Zone which includes PIPO/FEID HT, PSME/CELE HT, PSME/AGSP-FEID HT, and PSME/CARU HT. This zone indicates areas of residual snow but with mild (relative to higher elevations) temperatures. As the name implies the primary topographic occurrence is on ridge tops and upper slide slopes. This is an important zone for ungulate cover during occupation of wintering sites.

A forth zone is the Subalpine fir Zone which includes the habitat types of the Abies lasiocarpa series; ABLA/VASC HT, ABLA/CAGE HT, ABLA/LUHI HT, and ABLA/XETE HT. This zone also includes the PIEN-ABLA/RIPARIAN HT and the Subalpine Wet Meadow habitat. This zone indicates areas of substantial snowpack along with cold temperatures. As such, this area is characterized by a short growing season and provides little or no winter range for wildlife species. This zone is the primary summer range for the large ungulates of the area.

The fifth ecological zone, the White Bark Pine zone, is represented by the Pinus albicaulis series habitat types; PIAL-ABLA/VASC HT and PIAL-ABLA/LUHI HT. This ecological zone is indicative of extreme climatic conditions; cold temperatures and high winds. Much of the white bark pine shows signs of wind flagging. This zone is restricted to the high elevation ridges, resulting in limited geographical coverage. This limited size makes the zones' influence on predator prey relationships unclear.

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**Appendix A:** Description of Habitat Types found on Study Area.

**Non-Forested Types**

Cercocarpos ledifolius habitat type
(CELE HT; curl leaf mountain mahogony)

This habitat type is defined by the dominance of Cercocarpos ledifolius as a shrub layer. The occurrence of Pseudotsuga menziesii is accidental and isolated to micro-niches. C. ledifolius occurs from sparse cover (5%) to higher coverage values (20-25%). Agropyron spicatum is abundant in the grass layer.

This habitat type is often associated with steep rock faces of canyon sideslopes with aspects ranging from south to southwest. The abundance of C. ledifolius may be associated with fractured rocky soils with little organic material. The CELE HT is most abundant along the south side of the Big Creek drainage, ranging from 3800 feet (1160 m) near the creek to over 6800 feet (2075 m) up slope. This type is also found on isolated microsites up drainage canyons on steep shallow soil sites.

The CELE HT is not abundant in the forested uplands but is found on warm low elevation sites where steppe vegetation is common. It is most often adjacent to the Agropyron spicatum habitat type, which is also a non-timbered type. It is often adjacent to forested slopes of the Pseudotsuga menziesii/Cercocarpos ledifolius habitat type or the Pseudotsuga menziesii/Agropyron spicatum habitat type.

Agropyron spicatum habitat type
(AGSP HT; bluebunch wheatgrass)

The AGSP HT is characterized by the dominance of Agropyron spicatum, with the absence of a shrub or tree canopy. Festuca idahoensis may be abundant but rarely as dominant as A. spicatum. Typical sites in the study area commonly have Lupinus spp. and Lomatium spp. present.

The AGSP HT is most common along the south to southwest slopes of Big Creek with numerous sites on south exposures up the tributaries of the creek. This type decreases in abundance as elevations increase up drainages. Slopes are not as steep as in the CELE HT and soils are deeper and more compact. Elevations range from 3800 feet (1160 m) near Big Creek to over 6600 feet (2010 m) up the Cave creek drainage. The lack of tree canopy on these sites is a compound factor of warm exposures resulting in less residual snow-pack and possible competition with the bunchgrass dominance.

The AGSP HT is often adjacent to habitat types on the mesic end of the moisture gradient, often the Pseudotsuga menziesii/Physocarpos malvaceous habitat type (PSME/PHMA HT). This is a common situation in lower canyons where side drainages of a west to east aspect have a north side slope and a south side slope. The north slope will support the PSME/PHMA HT and the south slope will support the AGSP HT.

Subalpine Wet Meadow Habitat
(Wet Meadow H)

This habitat unit is not described as a habitat type, as it may be a compendium of units that can be described as habitat

types. Data is lacking that would clearly establish species dominance and relative abundance. The Subalpine Wet Meadow Habitat, as described here, reflects topographical distinctness rather than vegetal differences. This habitat is a non-forested meadow of high elevations. Graminoid and shrub species dominate these sites of stream deposits. Meandering streams have resulted in soil deposits creating wide valleys of near level slopes. Species of Carex and Juncus are prominent, but quantitative analysis is needed to establish a characteristic diversity.

This habitat is commonly adjacent to the Abies lasiocarpa/Vaccinium scoparium habitat type. Within the study area this habitat is common along Ginger Creek and Cottonwood Creek, where it is represented by large wet meadows. It can occur throughout the higher elevations, 7000 feet (2135 m) to 8500 feet (2590 m), within the study area. The major topo-climatic factor influencing vegetal patterns in this habitat is orographic slippage, which results in far lower temperatures than surrounding slopes.

**Forested Habitat Types**

Pinus ponderosa/Agropyron spicatum habitat type
(PIPO/AGSP HT; ponderosa pine/bluebunch wheatgrass)

Pinus ponderosa is the dominant overstory species present, with other tree species notably absent or accidental. The undergrowth is sparse being dominated by Agropyron spicatum with much of the site covered by bare soils. Although Purshia tridentata may be abundant in this habitat type, sites in this study area showed little P. tridentata.

This habitat type is relatively rare in this study area (see table 3). Greatest occurrence is near the Cabin Creek drainage where larger canyon sideslopes provide microsite conditions favorable to this type. The PIPO/AGSP HT is found between 4000 feet (1220 m) and 6000 feet (1830 m) in the study area, predominately on south aspects. The PIPO/AGSP Ht is found adjacent to either the AGSP HT or the PSME/PHMA HT, the latter being an abrupt change from xeric to more mesic timbered types.

The successional pattern of the PIPO/AGSP HT is not clear. There appears to be no successional overstory species and soils remain somewhat exposed even after recovery. Purshia tridentata may increase after disturbance, but little data is available to elucidate this pattern.

Pseudotsuga menziesii/Cercocarpos ledifolius habitat type (PSME/CELE HT; Douglas-fir/curl leaf mountain mahogany)

Pseudotsuga menziesii is the climax dominant tree species, although sparse in canopy coverage. Cercocarpos ledifolius is the dominant undergrowth of the shrub layer, with Agropyron spicatum the abundant grass. Artemisia tridentata, Purshia tridentata, and Chrysothamnus nauseous may be presnt, usually in scattered clumps.

This habitat type is a steep canyon type of rocky shallow soils. It occurs on south, southeast, and west slopes where exposures decrease the amount of snow retention. This habitat type ranges from 3800 feet (1160 m) in elevation in drainage stringers to over 6800 feet (2075 m) on upper slopes. This habitat type is usually associated with the CELE HT and denotes

the ability of the site to support an overstory.

Succession on sites of this habitat type is most likely a slow process, beginning with establishment of C. ledifolius leading to the eventual establishment of Pseudotsuga menziesii.

Pseudotsuga menziesii/Agropyron spicatum-Festuca idahoensis habitat type
(PSME/AGSP-FEID HT;Douglas-fir/Bluebunch wheatgrass-Idaho fescue)

Pseudotsuga menziesii is the dominant overstory species present with other species absent, although an occasional Pinus ponderosa may occur. Agropyron spicatum and Festuca idahoensis are codominant graminoids of this habitat type. F. idahoensis may be more abundant than A. spicatum under an overstory canopy, although this is a variable feature. F. idahoensis may show greater abundance on sites of higher elevations.

This habitat type occurs on warm aspects, southwest, south , and southeast, of canyon sideslopes. It is common throughout the Big Creek drainage, and will occur well into tributary drainages on south slopes. Elevations range from 3800 feet (1160 m) near Big Creek to over 7400 feet (2255 m) in adjacent drainages. The PSME/AGSP-FEID HT, like the PSME/CELE HT, signify the shift from conditions of no overstory (AGSP HT) to conditions which will support overstory (PSME/AGSP-FEID HT). This may relate to soil conditions and moisture requirements more favorable to seedling establishment.

The PSME/AGSP-FEID HT is adjacent to the AGSP HT at lower elevations and can be adjacent to a variety of timbered types at higher elevations. Near ridge tops the transition is often to

the Pseudotsuga menziesii/Calamagrostis rubescens habitat type and in canyon bottoms it is often to the Pseudotsuga menziesii/Physocarpus malvaceus habitat type (PSME/PHMA HT). Where temperature and moisture patterns reflect abrubt change this habitat type may border the Abies lasiocarpa/Vaccinium scoparium habitat type. This habitat type is important for wildlife as it is used extensively for cover during the use of winter range which occurs in the adjacent open habitat types.

Pseudotsuga menziesii/Acer glabrum habitat type
(PSME/ACGL HT;Douglas-fir/Vine maple)

The PSME/ACGL HT is restricted on the study area to riparian situations. This type is identified as dominating the streamside benches common along Big Creek, and is the low elevation riparian type of tributary drainages.

The overstory is dominated by Pseudotsuga menziesii, often forming closed canopys of 100% cover. Pinus ponderosa is accidental, usually occurring in the ecotone between this and other types. Acer glabrum is a prominent element of the tall shrub layer and is most abundant on sites with a stable overstory canopy. Other tall shrubs include; Crataegus columbiana, Amelanchier alnifolia, and Prunus virginiana. Lower shrubs are an important compositional element, with Symphoricarpos albus and Rosa woodsii often forming thickets of undergrowth. Berberis repens is the dominant ground cover on many sites.

The PSME/ACGL HT shows many microsite and successional consistencies throughout its occurrence. On older sites there appears to be three distinct elements of the larger benches; the

streamside area, the interior bench, and the upslope ecotone (see figure 3). The streamside area, immediately adjacent to the stream, shows an increase of riparian tree speceis, Betula occidentalis and Alnus rubra. These species may be thought of as the streamside colonizers as the stream bank is often subject to erosion or deposition. In sandy soils Equisetum spp. is abundant, as are many graminoids such as Bromus spp. The interior of the bench is the typical PSME/ACGL HT previously described. The upslope ecotone varies in prominence as to the topographical situation. A gently rising upslope results in a larger spatial representation of the ecotone, while steep slopes result in abrupt changes. This ectone will often appear close to the PSME/PHMA HT in composition. Physocarpos malvaceous will be common and replace the Symphoricarpos albus of the interior. In areas where the resulting upslope is the PSME/CELE HT, Cercocarpos ledifolious is common as is Agropyron spicatum.

The PSME/ACGL HT is the predominant narrow forest of the streams that are tributaries of Big Creek. Here the forest composition resembles that of the streamside area of the bench localities of this type. Alnus rubra and Betula occidentalis are the associated trees along with Acer glabrum. In these cool - moist drainages the PSME/ACGL HT will give way to the Picea engelmannii-Abies lasiocarpa/ Riparian habitat type near 7000 feet (2135 m) in elevation.

Relative to other habitat types of the study area the transition to adjacent habitat types from the PSME/ACGL HT is abrupt. This transition is largely determined by what is

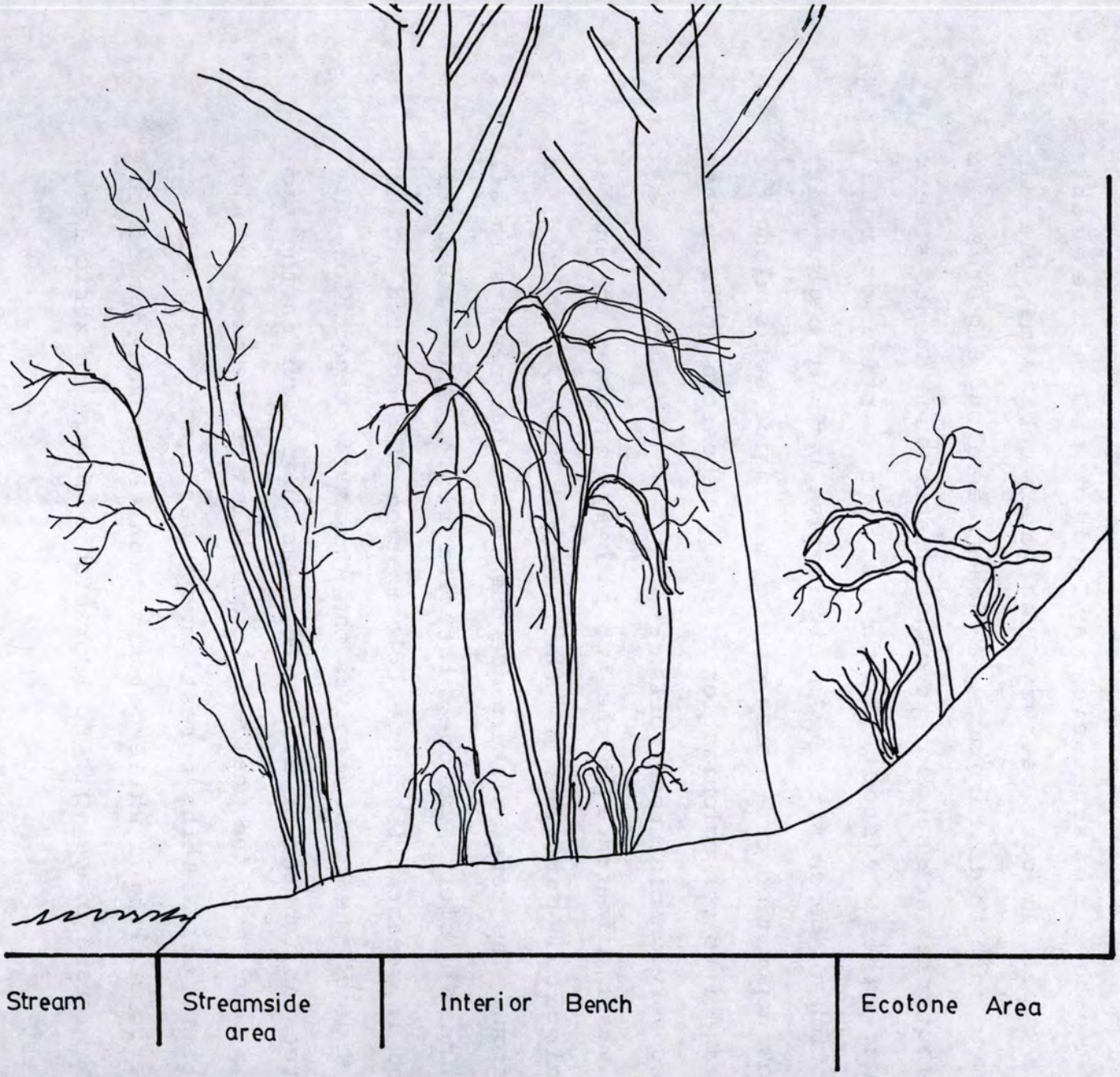


FIGURE 3: Ecological divisions of the PSME/ACGL HT on a Streamside bench.

immediately adjacent on the slope above the bench. The CELE HT, the AGSP HT, the PSME/CELE HT, the PSME/AGSP HT, and the PSME/PHMA HT are all adjacent to the PSME/ACGL HT on the study area.

Two pathways of succession may lead to a stable site of this habitat type. In both pathways the water course may play an important role in disturbance. Bench sites along Big Creek and the tributaries are subject to major disturbance due to stream washout. These washouts may result in partial or total distruction to bench sites. An alternative pathway begins with the slow deposition or erosion of the streamside soils along the bench, and involves colonization of newly deposited soils rather than recovery on disturbed soils.

A major difference in the two pathways involves the number of ecological portions of the habitat type involved in succession. The total disturbance due to washout results in all three areas upslope ecotone, interior bench, and streamside involved in reeastablishment. Colonization of deposited soil on the outside of the bench involves the streamside vegetation only. Major reestablishment of all three areas must occur in the face of major changes to the mesic-xeric qualities of the site. Major disturbance to existing forest canopy would shift the site to more xeric qualities while colonization along the edge of the site could take place with no appreciable change in xeric-mesic qualities.

Pseudotsuga menziesii/Physocarpus malvaceus habitat type (PSME/PHMA HT;Douglas-fir/ninebark)

The PSME/PHMA HT is a cold drainage habitat type common near Big Creek and in drainages in the northern end of the study area. Pseudotsuga menziesii is the dominant tree species present, with Pinus ponderosa a major seral tree on sites of the Pinus ponderosa phase of this habitat type. Physocarpus malvaceus is abundant and dominates the shrub layer, with Symphoricarpos albus often present.

The PSME/PHMA HT is restricted to northern aspects on sideslopes of ridges, but can be found on all aspects of lower canyon slopes where orographic slippage will occur. This type will extended farther upslope out of canyons on the east aspects of drainages than on west exposures. The PSME/PHMA HT is a good indicator of cool air drainage patterns and cold north aspects.

As a result of its association with cold air drainage patterns the adjacent habitat types commonly represent the other extremes of the mesic-xeric moisture-temperature gradient. On side tributaries of east to west drainages there will often be abrupt change from the AGSP HT on southerly aspects to the PSME/PHMA HT on north exposures. The PSME/PHMA HT will usually border the PSME/ACGL HT that occurs in the bottom of drainages. Upslope the PSME/PHMA HT often borders the Pseudotsuga menziesii/Calamagrostis rubescens habitat type (PSME/CARU HT) where the cold air slippage enterfaces with more moderate temperatures.

Successionally the PSME/PHMA HT is dominated by Physocarpus malvaceus after disturbance with gradual reestablishment of

Pseudotsuga menziesii in the overstory. Pinus ponderosa may play a role as a major successional species, but this seems to be confined more to the Pinus ponderosa phase of this habitat type.

**Pinus ponderosa phase**
(PIPO PH)

The PIPO PH is common in drainages of larger canyon widths, such as in the Cave Creek and Cabin Creek drainages. Pinus ponderosa is the characteristic vegetation indicating the occurrence of this phase. P. ponderosa is the major seral tree of these sites and remains an integral part of the overstory well into the climax stages of stands. Reproduction of P. ponderosa is extremely sparse in the older PSME/PHMA HT sites. Often this phase will border the PIPO/AGSP HT.

Pseudotsuga menziesii/Calamagrostis rubescens habitat type
(PSME/CARU HT; Douglas-fir/pinegrass)

The PSME/CARU HT is dominated by Pseudotsuga menziesii in the tree overstory. Old sites of this habitat type show scattered P. menziesii regeneration under mature trees, which commonly occurs in clumps as the canopy becomes senescent creating openings from tree fall. This can create a mosaic of succession throughout stands of this habitat type. The shrub layer is sparse, with Symphoricarpos albus common. Calamagrostis rubescens dominates the grass undergrowth, which commonly accounts for 90% cover on some sites.

The PSME/CARU HT occupies sites of ridge tops and upper sideslopes of canyons. This is a type of mild conditions, usually exposed slopes which are likely to remain snow covered into the late season but not subject to cold drainage. The

PSME/CARU HT occurs from near 6000 feet (1830 m) to near 8000 feet (2440 m) on warmer slopes, and can be found on all aspects throughtout its elevational range. At lower elevations it is likely to be found on north and east aspects, but, as elevation increases it is more abundant on west and south aspects.

The shrub layer increases when canopy overstory is removed or opened up. Calamagrostis rubescens decreases while Symphoricarpos albus and species of Ribes increase. At least one successional example was found at lower elevations where the PSME/CARU HT was adjacent to the PSME/CELE HT. Here the successional shrub layer was partly composed of Cercocarpos ledifolius and the grass layer of Agropyron spicatum. As patches of the overstory filled in the undergrowth composition shifted to Calamagrostis rubescens and Symphoricarpos albus. As with the PSME/AGSP HT, this habitat type is used extensively by wildlife for cover during the wintering season.

*Abies lasiocarpa/Vaccinium scoparium* habitat type
(ABLA/VASC HT;subalpine fir/grouseberry)

*Abies lasiocarpa* is the climax dominant of this habitat type. On cold drainage sites *Picea engelmannii* can be abundant, but for this study area it is rarely codominant. *Pinus contorta* is the primary successional tree species present, often the only tree species present after a catatrosphic disturbance. The dominant understory species is *Vaccinium scoparium* which can cover nearly 100% of a stand.

The ABLA/VASC HT can occupy all aspects throughout its elevation range, 6500 feet (1980 m) to 9000 feet (2745 m). At the lower elevations 6500 feet (1980 m) to 7000 feet (2135 m) this habitat type will be restricted to northerly aspects, while at higher elevations it can be found on all aspects. This habitat type is found adjacent to a variety of other types. Abrupt environmental changes are signalled by the AGSP HT being adjacent. The PSME/CARU HT, and the PSME/PHMA HT are the most common low elevation adjacent types. At higher elevations the *Abies lasiocarpa/Carex geyeri* habitat type will be found at the transitions to warmer aspects. The *Pinus albicaulis* series is adjacent on transitions to colder-windy sites.

*Calamagrostis rubescens* phase
(CARU PH)

The *Calamagrotis rubescens* phase is characterized by an abundance (generally greater than 5% cover) of *Calamagrostis rubescens* in association with *Vaccinium scoparium*. This phase occurs at the lower elevation range of the habitat type, usually on west facing aspects. It is often adjacent to the PSME/CARU HT, and can form ecotones between this habitat type and the

ABLA/VASC HT.

Succession on sites of the ABLA/VASC HT follow distinct patterns. If disturbance results in canopy removal, such as a fire, Pinus contorta will regenerate the site and establish a successional dominance. P. contorta will not regenerate successfully under a closed canopy which leaves Abies lasiocarpa to establish under the successional canopy. A. lasiocarpa will eventually dominate the site with the loss of P. contorta. Stages of this successioanl pattern can be found throughout the study area, from sites where A. lasiocarpa is absent under a P. contorta canopy to sites where A. lasiocarpa is the only tree species present.

Abies lasiocarpa/Carex geyeri habitat type
(ABLA/CAGE HT;subalpine fir/elk sedge)

Abies lasiocarpa is the climax dominant occurring in open canopy stands. Pinus contorta is the major seral species, often persisting into latter stages of stand development. Overstory composition is often a mix between A. lasiocarpa and P. contorta throughout much of the stands preclimax history. The overstory is often sparse and patchy leading to areas of dense graminoid cover.

Carex geyeri is the dominant graminoid, at times forming the ground cover in open areas. Trisetum spicatum and Stipa lettermannii can be found on higher ridge sites, while Vaccinium scoparium is sparse or absent.

The ABLA/CAGE HT is a warm type of the Abies lasiocarpa series. It occurs on upper ridge slopes of warm exposures, south

to southeast, or in areas not affected by orographic slippage on south to west aspects. Elevations range from 6800 feet (2075 m) to8000 feet (2440 m). Soils are often skeletel made of decomposed granite.

This type is most abundant on high warm exposures on ridges of the upper tributaries of the Big Creek drainage. Isolated sites are common near Black Butte and Cold Mountain. The adjacent habitat types most often are the ABLA/VASC HT and the Abies lasiocarpa/Luzula hitchcockii habitat type (ABLA/LUHI HT), which occurs on adjacent cooler aspects.

Abies lasiocarpa/Xerophyllum tenax habitat type
Vaccinium scoparium phase
(ABLA/XETE HT VASC PH;subalpine fir/beargrass grouse huckleberry)

Abies lasiocarpa is the climax dominant with Pinus contorta the primary successional species. The overstory canopy can be sparse with open areas dominated by Xerophyllum tenax. Vaccinium scoparium is more abundant under the overstory canopy and gives way to X. tenax as the canopy thins.

This habitat type occurrs on ridge slopes of primarily east aspects. Elevation ranges from 7000 feet (2135 m) to 8000 feet (2440 m). This habitat type is of limited occurrence on the study area, being most abundant near the Cottonwood Creek area. The ABLA/XETE HT VASC PH is adjacent to the ABLA/VASC HT and is often found in isolated pockets near the Picea engelmannii-Abies lasiocarpa/riparian habitat type (PIAL-ABLA/RIPARIAN HT).

Abies lasiocarpa/Luzula hitchcokii habitat type
Vaccinium scoparium phase
(ABLA/LUHI HT VASC PH;subalpine fir/woodrush Grousehuckleberry)

Abies lasiocarpa is dominant on climax stands, rarely forming closed canopys. Pinus contorta is the major seral tree species, along with scattered individuals of Pinus albicaulis. Overstory canopys rarely form dense stands, creating a mosaic of open areas and patches of trees. Abies lasiocarpa often regenerates by layering at the lower branches.

Luzula hitchcockii is the dominant graminoid present although areas of ecotones, where Carex geyeri is abundant, are not uncommon. Vaccinium scoparium is abundant, but does not form a ground cover which can exclude other undergrowth species. The VASC phase is the only phase of this habitat type found in the study area (Steele 1981).

The ABLA/LUHI HT VASC PH occurs on ridge tops or upper ridge slopes of all aspects. It can be found between 8200 feet (2500 m) to 9000 feet (2745 m) in elevation. This habitat type is subject to more severe weather than the ABLA/VASC HT It is usually adjacent to the downslope ABLA/VASC HT and the Pinus albicaulis-Abies lasiocarpa/Luzula hitchcockii habitat type (PIAL-ABLA/LUHI HT) upslope on higher ridges. Although it can be found in a variety of locations it is somewhat uncommon on the study area.

Pinus albicaulis-Abies lasiocarpa/Vaccinium scoparium habitat type
(PIAL-ABLA/VASC HT;
white bark pine-subalpine fir/grousehuckleberry)

Abies lasiocarpa and Pinus albicaulis are co-climax on these sites although the successional relationship of the two species is not clearly known. Pinus albicaulis seems to be more abundant on sites of severe exposure. Vaccinium scoparium is dominant in the undergrowth species.

The PIAL-ABLA/VASC HT is found on upper ridge sites of higher elevations, greater than 8500 feet (2590 m). It is adjacent to the ABLA/VASC HT downslope and occassionaly the PIAL-ABLA/LUHI HT on upper ridge sites. In areas of abrupt environmental change this habitat type can become ecotonal between the ABLA/VASC HT and open ridge sites. The PIAL-ABLA/VASC HT is not common on the study area. It is primarily found in the Papoose Peak-Cottonwood Butte area.

Pinus albicaulis-Abies lasiocarpa/Luzula hitchcockii habitat type
(PIAL-ABLA/LUHI HT;white bark pine-subalpine fir/woodrush)

Pinus albicaulis and Abies lasiocarpa are codominants on sites of this habitat type. Relative abundance of these two species is variable. Pinus albicaulis seems to be more abundant on severe sites of cold temperatures and high winds. Successionally P. albicaulis occupies disturbed sites before Abies lasiocarpa but is not out competed on older sites. Luzula hitchcockii is the dominant graminoid present, with Vaccinium scoparium also abundant.

This habitat type is restricted to cold wind swept ridge

localities greater than 8500 feet (2590 m). This type may be more common on the ridge benches and low slope terrraces of ridge tops than along the steep ridge slopes. Like the PIAL-ABLA/VASC HT this habitat type often forms ecotones between the ABLA/VASC HT and the non-forested ridge sites. This type is most common near Cottonwood Butte on the study area.

Picea engelmannii-Abies lasiocarpa/riparian habita type (PIAL-ABLA/riparian HT;spruce-subalpine fir/riparian )

This habitat type as identified in this study describes the forest vegetation that occurs along wet drainages of higher elevations. This type is usually spatially narrow, being restricted to riparian situations, and often forms an ecotone between types on either side of the riparian drainage. A quantitative analysis of floristic composition was not conducted in this study resulting in a generalized description of high elevation riparian situations. More detailed study would likely define more than one habitat type ocurring within the area included in this discussion.

Picea engelmannii is often dominant on these sites, with Abies lasiocarpa also abundant. Major characteristics indicating the occurrence of this type is the inclusion of Picea engelmannii as a prominent component of the overstory. Numerous riparian undergrowth species occur under the canopy, including; Ledum glandulosum, Menziesia ferrungnea, Kalmia microphylla, Alnus incana, etc.

The PIEN-ABLA/riparian HT is restricted to cold moist drainages of the elevations of 7000 feet (2135 m) and higher.

Isolated stands can be found at lower elevations in cold north facing drainages. This type grades directly into the PSME/ACGL HT of lower elevation riparian sites.

**Appendix B**

Mylar overlays illustrating habitat type distribution on the study area covering USGS quadrangle maps.

**Appendix C**

Habitat types are grouped according to major overstory tree species and represented by color boundaries.

| | |
|---|---|
| Non-forested types | = Clear |
| Forested types | |
| *Pinus ponderosa* | = Green |
| *Pseudotsuga menziesii* | = Orange |
| *Abies lasiocarpa* | = Yellow |
| *Pinus albicaulis* | = Red |
| Riparian condition | = Blue |

**Appendix D**

Major ecological zones are identified and their occurrence illustrated by colors and acetate overlays of maps of the study area.

| | | |
|---|---|---|
| Zone 1 | Steppe Zone | = Red |
| Zone 2 | Orographic Zone | = Yellow |
| Zone 3 | Ridge Zone | = Green |
| Zone 4 | Subalpine Fir Zone | = Blue |
| Zone 5 | White Bark Fir Zone | = Orange |