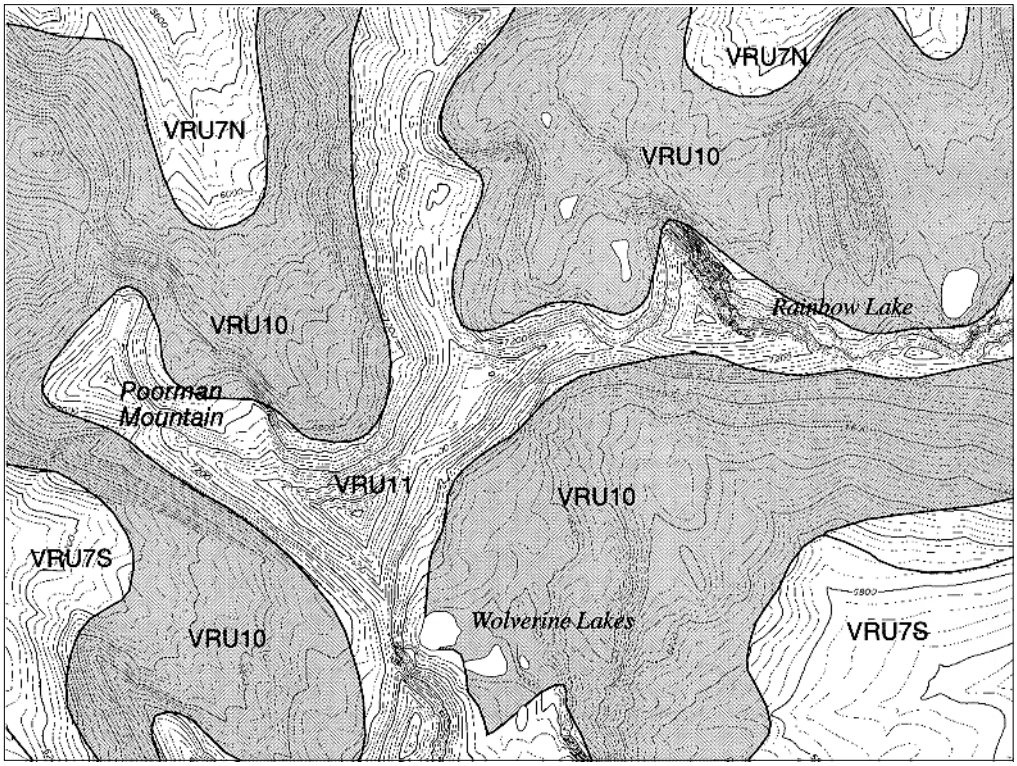
Vegetation Response Unit Description
VRU 10
Cold and Moderately Dry Habitat Setting

Ecosystem Setting and General Description

This vegetation response unit occurs in a transition zone between the forest and alpine tundra. It is typified by cold and moderately dry conditions with short day lengths, and low to moderate solar input. The climate is characterized by a short growing season with early summer frosts. Annual precipitation ranges from 50-80 inches, mostly in the form of snow. Soil moisture is often limited during the summer months due to the low water holding capacity of the shallow soils, and slope position. This setting occurs on most aspects and is generally found on upper reaches of fairly steep, convex mountain slopes (Map 9). Elevations average 6,400 feet and range from 4,500-7,800. Most landforms within VRU 10 have been influenced by alpine glaciation. The dominant landtypes include 401,403,405, and 406. It is estimated that only 2% of the Forest is currently mapped as VRU 10, in areas such as the Cabinet Mountain Wilderness, Whitefish Range, and Northwest Peaks Scenic Area.



Map 9- Typical Physical Setting of VRU 10

Vegetative Composition

In the upper subalpine setting of western Montana, Abies lasiocarpa/Luzula hitchcockii is the dominant habitat type (Pfister et al. 1977)(see Table 18) . This near timberline setting is generally bordered by Abla/Mefe or Abla/Xete (VRU 7 and 9) below and Pial-Abla or Laly-Abla above (VRU 11). Subalpine fir is the indicated climax species with whitebark pine, Engelmann spruce, and lodgepole pine the principal seral species. The distribution of lodgepole pine is more prevalent where temperature and conditions are moderate. Whitebark pine dominance increases with increasing elevation and site severity (Fisher and Smith 1997). In recent decades its distribution has decreased because of mountain pine beetle and white pine blister rust. A limited distribution of alpine larch may occur on rockslides and talus. In fact, the largest recorded hybrid larch (alpine/western larch cross) is located in the Madge Creek area, north of Doonan Peak.

The Tsuga mertensiana/Luzula hitchcockii habitat type also occurs in VRU 10 and is similar to Abla/Luhi except for the addition of mountain hemlock as a major climax component. In general, these sites are above the limits of Douglas-fir, western larch, and western white pine.

The dominant understory vegetation in VRU 10 includes a well distributed smooth woodrush, as well as whortleberry, beargrass, and heart-leaf arnica. Warmer sites may also include huckleberry, and elk sedge. With the exception of areas disturbed by roads or hiking trails these areas are expected to have lower levels of nonnative plants than other vegetative response units. Sensitive plants that may occur within microsites at high elevations include candystick, possibly in overmature lodgepole pine stands.

References addressing historical vegetative composition (Losensky 1993) found that alpine and noncommercial cover types were dominated by lodgepole pine, whitebark pine or mixtures of subalpine fir and spruce or they were rocky and steep slopes with limited tree cover.

Table 18 - **Habitat Groups and Fire Groups - VRU 10**

Habitat Type Code	Habitat Type	Regional Habitat Group	Climatic Modifier	Fire Group Code MT	% of HG
820	Abla-Pial/Vasc	HG 10	Cold and Mod Dry	10	2
830	Abla/Luhi	HG 10	Cold and Mod Dry	10	73
831	Abla/Luhi-Vasc	HG 10	Cold and Mod Dry	10	7
840	Tsme/Luhi	HG 10	Cold and Mod Dry	10	13
841	Tsme/Luhi-Vasc	HG 10	Cold and Mod Dry	10	1
842	Tsme/Luhi-Mefe	HG 10	Cold and Mod Dry	10	2
925	Pico/Xete c.t.	HG 10	Cold and Mod Dry		0
940	Pico/Vasc	HG 10	Cold and Mod Dry	7	<1

Disturbance Processes

Site factors such as climate and soils play an important part in forest development on these sites. The cold, moist, rocky, snowbound, unproductive, and otherwise fire-resistant environment that characterizes many of the sites limits the extent and frequency of fire (Fisher and Bradley 1987). Lightning-caused fires often do not spread due to accompanying rains and the lack of continuous fine surface fuels. Stand replacing disturbances are infrequent and may be caused by snow and wind damage, rock slides, and talus slippage as well as by fire (Fisher and Smith 1997). Losensky (1993) found only 2 percent of areas sampled for historic vegetation information had been burned.

Fire Regime - Fire Group 10 dominates this vegetative group (Table 18). Fires are typically of low or mixed severity, except where canopy cover is dense and fuels are heavy. Most fires are of low severity because of discontinuous fuels (Arno 1989). As fires often burn few trees in a stand, determining fire frequency is difficult and does not apply well in upper subalpine and timberline sites (Fisher and Bradley 1987). Stands are susceptible to severe fires that originate at lower elevations (Arno 1986; Arno and Hoff 1989). Arno (1980) reported great variation in presettlement fire regimes on high elevation sites in the Northern Rocky Mountains; average fire-free intervals ranged from 60 to 300 years. Other historical fire frequencies range from 35-300 (Romme 1980) and over 200 years for stand replacement fires in more continuous forests of this group (Fisher and Bradley 1987). Crane and Fisher (1986) report a frequency of 100-300 years for stand replacement fire. Extensive fire spread may be most likely in early succession, when fine fuels are available, and in late succession, when fuel loadings increase and shade tolerant species provide fuel ladders (Arno and Petersen 1983; Morgan and Bunting 1990). Lethal fires may also occur as a result of microbursts or sustained upland wind events, and extended summer drought followed by episodes of dry lightning (pers. comm. Triepke 199). Mixed severity fire was typical in stands with seral whitebark pine (Keane 1992). In the Selway-Bitterroot Wilderness, whitebark pine stands experience stand replacing fires every 180 years. Nonlethal underburns occurred at an average interval of 56 years (Brown et al. 1994).

Fuels and Nutrient Cycling - Inventory data of fuels in these forest types is scarce. This fire group is characterized by relatively sparse fine fuels and moderate to heavy loadings of widely scattered large diameter fuels, estimated to range from 7 to 25.8 tons per acre (Fisher and Bradley 1987). The upper end of this range is generally a result of increased dead and down fuels following mountain pine beetle mortality. When fires do occur, they burn unevenly through the patchy fuels (Barrett and Arno 1991).

Insects and Disease - The ecology of whitebark pine is interwoven with that of lodgepole pine, mountain pine beetle, and white pine blister rust (Hoff and Hagle 1990; Kendall and Arno 1980). When beetle-caused mortality is high in lodgepole pine stands, it is followed by high mortality in neighboring whitebark pine stands (Gibson 1994; Kendall and Arno 1990). Heavier fuels have the potential to increase fire severity and cause mortality in whitebark pine, reducing seed sources necessary for stand regeneration. This seed source has also been severely impacted by loss of mature trees due to blister rust infection. In general, endemic levels of associated insects and pathogens also occur in these settings.

Weather - Snow damage, isolated windstorms and lightning are a common occurrence. Drying winds, cold temperatures during the growing season, and either persistent snowpacks or droughty soils are also characteristic.

Successional Pathways

Changes in stand development following disturbance will vary depending on whether whitebark pine or a mixture of seral species dominate. In general, secondary succession begins with a mix of herbs and shrubs that dominate the site for an extended period. Fire may initiate secondary succession, but is unlikely to have a role in maintaining it (Fisher and Bradley 1987). As discussed, stand replacing disturbances caused by snow and wind damage, and rock slides may be more of an influence than fire in maintaining early stages of succession. This is particularly true on north slopes and moist sites. It may take many decades for conifers to dominate the site, and considerably longer to attain a mature forest condition. During this phase, surface fires occurring on south slopes and ridges reduce fuels and kill some of the overstory trees. Other sites that experience lightning-caused low severity fires can occur most anytime without a substantial effect on succession. While the occurrence of lethal fires is unlikely at this time, their presence would be limited and result in a vegetative mosaic. Over time the maturing forests will develop some breakage, windthrow, insect and disease-caused tree mortality, etc. Stand replacing fires, especially those that advance from adjacent lower elevation stands become a more assured possibility during extended drought.

If disturbance doesn't occur, mature trees eventually progress into a climax stand. Low to moderate severity fires rarely have much of an impact on these mature stands because of the open structure and lack of continuous fine fuels. However, lethal fires that enter the crowns and kill the cambium revert the conditions to a stand initiation stage.

Compared with the lower subalpine forest (i.e. VRU 9), vegetative recovery following most fires is usually slow because of the short growing season and cold climate. This disturbance is an important means of perpetuating the abundance of whitebark pine. The effects of blister rust infection on whitebark pine seed production and establishment may be creating different patterns of succession than would historically occur.

Vegetative Structure

Disturbance processes are largely responsible for the forest structure that develops across the landscape. On these high elevation sites, the stand structure and the distribution of trees is strongly influenced by the soil type and other physiographic features. Mature forests are often open, with trees growing in clusters. On the severe sites, tree height is generally short; less than 60 feet is not uncommon (Cooper et al. 1991). Most fires are small and discontinuous, resulting in a complex vegetation mosaic typical of high elevation stands. On the Kootenai, the size of mapped polygons for VRU 10 approximates 2,400 acres, ranging from 200 to over 30,000 acres. This is likely a reasonable approximation of its historic extent, as well.

Age Class Diversity

Quantitative information on historic age class distributions is not available for these high elevation sites. It is assumed that the proportion of successional stages present within this setting would have varied over long periods of time. To gain a general idea of what **historic age class** proportions in upper subalpine ecosystems might be, forest conditions with a fire regime comparable to this setting were modeled (Triepke 1999). Table 16 displays the results that are based on the variability found in modeling a 200 and 300 year fire cycle for stand replacement in VRU 10.

Table 16 - **Age Class Distribution**

Age Class	Reference Condition	Existing Condition
0-40	10-20%	7%
41-100	10-30%	39%
101-150	10-20%	28%
150+	40-60%	22%
nonstocked	unknown	4%

Table 19 also displays the **existing age class** distribution in VRU 10 based on stand year of origin data for Habitat Group 10 taken from the Timber Stand Management Record System (TSMRS). These figures should be viewed with scrutiny as approximately 49% of the stands in this grouping does not have complete inventory information and are not represented in this age class distribution.

A lack of local information on historic stand structures and incomplete stand exam data on existing conditions does not enable a good **comparison** with existing age class distribution. However, in general it appears that early seral and late seral conditions are less than the modeled referenced conditions. In contrast, mid seral and mature conditions are currently higher. Trends depicted in the ICBEMP scientific assessment for subalpine community types in all of Forest Cluster 4 (includes the Kootenai) show many similarities with this observation. These findings indicate a reduction in early seral stands (-4%), an increase in mid-seral types (+8%), and a reduction in late-seral (-91%) from historic levels. It is very likely that the decrease in stand initiation and increase in intermediate-aged stands may be due to the reduction in acres of low to moderate severity fires in recent decades and the general aging of stands since the last stand replacement event. The significant reduction in late-seral stands can be partially attributed to early spruce logging, and harvest of bark beetle killed lodgepole pine stands on lands considered suitable for timber production.

Ecological Function

Landscape Linkages - Within this VRU, connectivity is relatively high and results in important wildlife corridors for seasonal wildlife movement. This is largely attributed to patch sizes which are generally large and include primary topographic ridges within them. Where suitable hiding cover and structurally complex mid-seral and mature forest conditions are present, movement of lynx between forage and denning habitat can occur.

Old Growth and Interior Habitat - This VRU makes up a very small percentage of the functional old growth and interior habitat across the forest, while trees frequently reach ages greater than 150 years. The high elevation subalpine ecosystem typically did not produce quality old growth habitat. Large, multi-aged patches do function as interior habitat and provide big game security, travel cover, and habitat for neotropical migratory birds. Gaps created by fire have value for wildlife species that prefer such small openings.

Wildlife Habitat - This VRU provides valuable summer range habitat of elk, moose and mule deer, as well as summer and fall bear use and fall denning habitat for bears. Hiding cover is generally good due to high stocking levels and clustered trees. Young, dense subalpine fir stands offer decent thermal cover.

Due to the high elevation and cold and moderately dry conditions, understory vegetation is limited as is high quality forage. However, beargrass and huckleberry are commonly available for bears.

Although snow and wind breakage creates numerous opportunities for the creation of snags, they are of generally low quality with limited distribution. Preferred snag species such as western larch are available in adjacent landscapes and typically offer high quality habitat for dependent species.

Availability of habitat for small mammals is good in numerous downed trees, broken-topped snags, and because of an abundance of cones.

Rare Elements and Specialized Habitat - The relatively high precipitation and deep snowpack on these upper subalpine environments also make them important for water storage. Springs and wallows are undoubtedly present and function as valuable habitat for dependent wildlife species. Nonforested, natural openings also occur and contain shrub and herbaceous vegetation often uncommon elsewhere in the response unit. Specialized habitat exists between large, contiguous interior habitat and can be of benefit to bears and some species of owls.

Many alpine areas with a species mix of lodgepole pine, subalpine fir and Engelmann spruce may provide suitable forage and denning habitat for lynx. Young lodgepole pine stands are particularly important for lynx due to the high quality prey base that depends on early successional habitat. Late seral stands with abundant downed, woody debris are suitable denning habitat.

Unique Ecological Importance - Habitat types at these high elevations are named for their dominant tree component rather than an indicated climax species. Where whitebark pine occurs, it provides an important food source for Clark's nutcrackers, red squirrels, grizzly bears and black bears. Nutcrackers cache the seeds, and squirrels cache the cones during the fall.

Ecosystem Health, General Trends and Management Implications

Fire exclusion has increased the average interval between fires in seral whitebark pine stands (Arno 1986) and many stands are being replaced by mixed conifer and subalpine fir forests (Arno et al. 1993). In recent decades whitebark pine distribution has also decreased because of mountain pine beetle and white pine blister rust.

As outlined earlier, nonnative plants are becoming more persistent in disturbed areas and represent a concern in many areas. This includes the spread of weeds along trails used by hikers and backcountry horseman. These noxious weeds pose a great threat to biodiversity as they have the potential to eliminate or adversely affect native flora and fauna. When undisturbed, subalpine forest typically have closed canopies or dense shrub cover, and are not susceptible to invasion by most noxious weeds.

Desired Future Conditions and Silvicultural Strategies

Landscape Attributes - The desired forest structures would reflect the limited extent and variety of conditions caused by fire as a disturbance agent. These patchy burns often killed fire-intolerant trees in lethal underburns, and occasionally large fires killed many trees in crown fires. The maintenance of a mosaic of pure and mixed species stands of various age and size classes would reflect the site capability and the historical pattern of fire and other disturbances.

Within stands the species composition would likely consist of pure or mixed stands of lodgepole pine, whitebark pine, and Engelmann spruce (Steele 1994). Alpine larch may occur to a limited extent, as will subalpine fir or mountain hemlock as an understory component.

Stand structures are relatively open and mostly uneven-aged, reflecting the slow recruitment of trees on these harsh sites. A variety of successional stages would be represented across the landscape. Size classes would vary from saplings to mature trees, although often stunted and deformed. Animal seed caches and the sheltering effect of pioneer species enables the regeneration of trees commonly in clusters.

Prescribed Fire and Species Composition - Where compatible with other objectives, the use of prescribed fire to restore high elevation ecosystems may be desirable to perpetuate whitebark pine and its dependent wildlife. Periodic underburns of a patchy nature could be used to reduce the area occupied by climax species and create seedbeds for the seral tree species. Historically, fires in this setting often originated from lower elevation sites. In many situations today, these adjacent sites have high fuel loadings due to fire exclusion and natural changes. Regeneration using rust-resistant varieties is also an option to bolster the potential for regeneration of whitebark pine.

It is important that adequate coarse woody debris be retained following any natural fuels treatment. Based on studies that used ectomycorrhizae as an indicator of healthy, productive soils, it is recommended that forest practices in this VRU retain an average of 7 to 15 tons/acre on most sites (Graham et al. 1994). The amount of woody debris retained will vary somewhat with the habitat needs and may be higher or lower depending on the site. The recommendations include the contribution of standing dead as well as down woody fuels, and are not designed to immediately replace the present forest floor but to ensure their replacement over the next 100 years or more.

Wildlife Needs and Special Considerations - Whitebark pine is an important food for Clark's nutcrackers, red squirrels, grizzly bears, and black bears. As a decline in whitebark pine is likely to be accompanied by some loss or migration of wildlife species, any efforts to maintain historic forest structures and their function in high subalpine stands would minimize these losses.

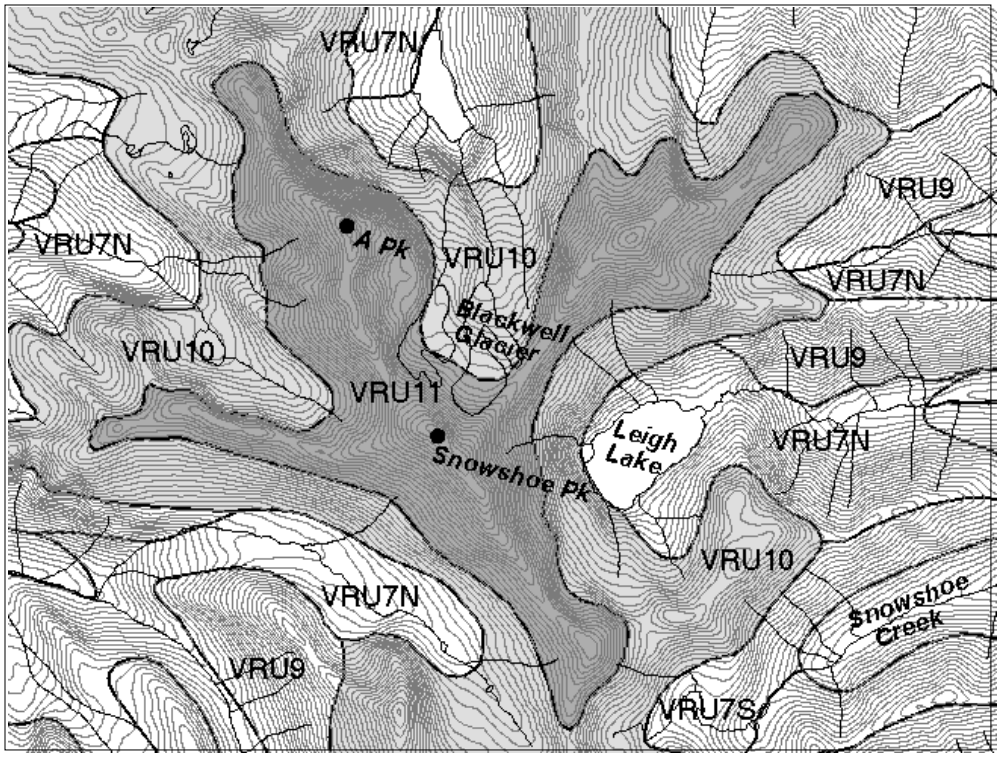
Management activities within this vegetation response unit should promote native vegetation and consider strategies that do not encourage the spread of nonnative vegetation.

Maintaining the health and vigor of forests by promoting a structural, species and age class diversity within a natural range also promotes a forest resilient to insect and pathogens.

Vegetation Response Unit Description
VRU 11
Cold Habitat Setting

Ecosystem Setting and General Description

This vegetation response unit occurs on high elevation cold sites near timberline. It is typified by cold and dry conditions with short day lengths, and low solar input. The climate is characterized by a short growing season with early summer frosts. Annual precipitation ranges from 60-90 inches, mostly in the form of snow. Soil moisture is generally limited during the summer months due to the low water holding capacity of the shallow soils, and slope position. This setting occurs across all aspects often on very steep alpine ridges and glacial cirque headwalls (Map 10). Elevations average 6,900 feet and range from over 5,300-8,600 feet above sea level. The landforms within VRU 11 have been influenced by alpine glaciation and are a complex of forest, avalanche chutes and rock outcrop. The dominant landtypes include 401,403, and 405. It is estimated that less than 1% of the Forest is currently mapped as VRU 11, largely confined to the Cabinet Mountain Wilderness, Whitefish Range, and Vermilion Pass.



Map 10- Typical Physical Setting of VRU 11

Vegetative Composition

The predominant habitat type within timberline settings of the Northern Rockies, most of Montana and the Kootenai NF is the **Pinus albicaulis-Abies lasiocarpa** habitat type (Pfister et al. 1977). While there is considerable variation in vegetation composition and tree life-forms there seems to be little field data available to subdivide the complex undergrowth and describe individual habitat types. Habitat types at these high elevations are named for their dominant tree component rather than an indicated climax species (see Table 20. These sites are generally bordered by cold and moderately dry sites dominated by the Abies lasiocarpa/Luzula hitchcockii habitat types, characteristic of VRU 10.

Table 20 - **Habitat Groups and Fire Groups - VRU 11**

Habitat Type Code	Habitat Type	Regional Habitat Group	Climatic Modifier	Fire Group Code MT	% of HG
850	Pial-Abla ht's	HG 11	Cold	10	84
860	Laly-Abla ht's	HG 11	Cold	10	15
870	Pial ht's	HG 11	Cold	10	-

Subalpine fir, whitebark pine, and Engelmann spruce occur in varying proportions, often as clusters. Whitebark pine is a potential climax species in this timberline setting, rather than a seral species as described in VRU 10. Subalpine fir is much less vigorous in this environment, appearing stunted, wind deformed and shrublike. On the contrary, whitebark pine and spruce are typically long lived

serals being very hardy in this setting and able to successfully coexist with the more shade-tolerant subalpine fir. In fact, whether or not subalpine fir develops any size is often the result of the protective canopy cover afforded by its associates. This habitat setting is within or near timberline and above the cold limits of species such as Douglas-fir, lodgepole pine, and western larch.

Distribution of understory vegetation is quite variable. Lee slopes and moist sites carrying a heavy snowpack contain mountain arnica, whortleberry, beargrass, woodrush and possibly orange hawkweed and mountain heather.

The Larix-lyallii-Abies lasiocarpa habitat types also occur in VRU 11, most prevalent on the heavily glaciated, highest rocky sites with exposures that are cooler than where Pial-Abla is typically found. Alpine larch is a long-lived dominant on these sites, with varying amounts of whitebark pine, subalpine fir and Engelmann spruce. Alpine larch can also form almost pure groves on sites above the limits of its associates. Understory vegetation present in Laly-Abla is generally similar to Pial-Abla habitat types and includes a greater number of very stunted or shrublike subalpine fir.

Disturbance Processes

Site factors such as climate and soils play a dominant role in forest development on these sites. The cold, rocky, snowbound, unproductive, and otherwise fire-resistant environment that characterizes many of the sites limits the extent and frequency of fire (Fisher and Bradley 1987). Lightning caused fires often do not spread due to accompanying rains and the lack of continuous fine surface fuels. Stand replacing disturbances are infrequent and may be caused by snow and wind damage, rock slides, and talus slippage as well as fire (Fisher and Smith 1997). Research of historic vegetation (Losensky 1993) found only 2 percent of the alpine areas sampled for historic vegetation information had evidence of burns. Fire appears to be secondary to environmental factors in its influence on stand dynamics in the upper subalpine environment.

Fire Regime - Fire Group 10 dominates this vegetative group (Table 20). As fires often burn few trees in a stand, determining fire frequency is difficult and does not apply well in upper subalpine and timberline sites (Fisher and Bradley 1987). The fire free interval varies considerably from 35 to over 300 years (Romme 1980). **Fires are typically of low or mixed severity** because of discontinuous fuels (Arno 1989). Where canopy cover is dense and fuels are heavy, stand replacement fires can occur after intervals of more than 200 years (Fisher and Bradley 1987). Stands are susceptible to severe fires that originate at lower elevations (Arno 1986; Arno and Hoff 1989). Arno (1980) reported great variation in presettlement fire regimes on high elevation sites in the Northern Rocky Mountains; average fire-free intervals ranged from 60 to 300 years. Crane and Fisher (1986) report a frequency of 100-300 years for stand replacement fire. Extensive fire spread may be most likely in early succession, when fine fuels are available, and late succession, when fuel loadings increase and shade tolerant species provide fuel ladders (Arno and Petersen 1983; Morgan and Bunting 1990). The short snow-free period, high moisture, low site productivity, low fuels accumulations, and slow recovery of regenerating stands predisposes the upper subalpine ecosystem to lethal fires only in circumstances involving: microbursts or sustained upslope wind events, fuels accumulations associated with insect and disease outbreaks, and extended summer drought followed by episodes of dry lightning (Triepke 1999). Mixed severity fire was typical in stands with seral whitebark pine (Keane 1992). In the Selway-Bitterroot Wilderness, whitebark pine stands experience stand replacing fires every 180 years. Nonlethal underburns occurred at an average interval of 56 years (Brown et al. 1994).

Fuels and Nutrient Cycling - This fire group is characterized by relatively sparse fine fuels and moderate amounts of widely scattered, large diameter fuels, estimated to average 11 tons per acre (Fisher and Bradley 1987). Inventory data of fuels in these forest types is scarce. When fires do occur they burn unevenly through the patchy fuels (Barrett and Arno 1991).

Insects and Disease - The ecology of whitebark pine is interwoven with that of lodgepole pine, mountain pine beetle, and white pine blister rust (Hoff and Hagle 1990; Kendall and Arno 1980). When beetle-caused mortality is high in lodgepole pine stands, it is followed by high mortality in neighboring whitebark pine stands (Gibson 1994; Kendall and Arno 1990). Heavier fuels have the potential to increase fire severity and cause mortality in whitebark pine, reducing seed sources necessary for stand regeneration. This seed source has also been severely impacted by loss of mature trees due to blister rust infection. In general, endemic levels of associated insects and pathogens also occur in these settings.

Weather - Snow damage, isolated windstorms and lightning are a common occurrence. Drying winds, cold temperatures during the growing season, and either persistent snowpacks or droughty soils are also characteristic. These and other site factors are a primary influence on forest development.

Successional Pathways

Changes in stand development following disturbance will vary depending on whether whitebark pine or a mixture of seral species dominate. In general, secondary succession begins with a mix of herbs and shrubs that dominate the site for an extended period. Fire may initiate secondary succession, but is unlikely to have a role in maintaining it (Fisher and Bradley 1987). As discussed, stand replacing disturbances caused by snow, wind damage, and rock slides may be more of an influence than fire in maintaining early stages of succession. This is particularly true on north slopes and moist sites. It may take many decades for conifers to dominate the site, and considerably longer to attain a mature forest condition. During this phase, surface fires occurring on south slopes and ridges reduce fuels and kill some of the overstory trees. Lightning-caused low severity fires can occur most anytime without substantial effect on succession. While the occurrence of lethal fires is unlikely at this time, their presence would be limited and result in a vegetative mosaic. Over time the maturing forests will develop some breakage, windthrow, insect and disease-caused tree mortality, etc. Stand replacing fires, especially those that advance from adjacent lower elevation stands become a more assured possibility during extended drought.

If disturbance doesn't occur, mature trees eventually progress into a climax stand. Low to moderate severity fires rarely have much of an impact on these mature stands because of the open structure and lack of continuous fine fuels. However, lethal fires that enter the crowns and kill the cambium revert the conditions to a stand initiation stage. Because of its thin bark, alpine larch is easily damaged by fire but is moderately resistant because it occupies the generally moist but cold rocky sites. Fires enter these high elevation sites from adjacent lower elevation sites, with more continuous fuels, but often do little damage to alpine larch stands.

Compared with the lower subalpine forest (i.e. VRU 9), vegetative recovery following most fires is usually slow because of the short growing season and cold climate. This recovery is not much different from that of the upper subalpine forest setting (i.e. VRU 10). Fire is an important means of

perpetuating the abundance of whitebark pine. The effects of blister rust infection on whitebark pine seed production and establishment may be creating different patterns of succession than would historically exist.

Vegetative Structure

As described, disturbance processes are largely responsible for the forest structure that develops across the landscape. On these high elevation sites, the stand structure and the distribution of trees is strongly influenced by the soil type and other physiographic features. Where fire does occur, the extent is usually limited and discontinuous, resulting in a complex vegetation mosaic typical of high elevation stands. Where trees in VRU 11 achieve maturity the forests are generally open, with trees growing in clusters. With increasing elevation the spacing between groves of clustered trees widens and crowns begin to show more deformity due to wind and snow damage. On the severe sites tree height is generally short; less than 60 feet is not uncommon (Cooper et al. 1991). The subalpine fir and spruce may even approach a shrublike form and reproduce principally by layering of lower branches. On the Kootenai, the size of mapped polygons for VRU 11 averages 725 acres, ranging from 200 to over 2,200 acres. This is likely a reasonable approximation of its historic extent.

Age Class Diversity

Quantitative information on historic age class distributions is not available for these high elevation sites. It is assumed that the proportion of successional stages present within this setting would have varied depending on the type of disturbance, and its frequency. It is assumed that changes would occur, but over very long periods of time. To gain a general idea of what **historic age class** proportions in upper subalpine and timberline ecosystems might be, forest conditions with a fire regime comparable to this setting were modeled (Triepke 1999). Table 21 displays the results that are based on the variability found in modeling a 200 and 300 year fire cycle for stand replacement in VRU 11.

Table 21 - **Age Class Distribution**

Age Class	Reference Condition	Existing Condition
0-40	10-20%	2%
41-100	10-30%	23%
101-150	10-20%	33%
150+	40-60%	28%
nonstocked	unknown	14%

Table 21 also includes an estimate of **existing age class** distribution based on stand year of origin data for Habitat Group 11 taken from the Timber Stand Management Record System (TSMRS). These figures should be viewed with scrutiny as approximately 59% of the stands in this grouping does not have complete inventory information and are not represented in this age class distribution.

A lack of local information on historic stand structures and incomplete stand exam data on existing conditions does not enable a statistically accurate **comparison** with existing age class distribution. However, in general it appears that early seral stands (0-40 yrs.) and late seral (150+ yrs.) stands are below reference levels. Stands considered mature (101-150 years) are currently higher. Trends depicted in the ICBEMP scientific assessment for subalpine community types in all of Forest Cluster

4 (includes the Kootenai) also indicates a reduction in early seral stands (-4%), and a reduction in late-seral (-91%) from historic levels. In contrast to what our data shows, these findings also indicate an increase in mid-seral types (+8%). As the grouping used in ICBEMP includes a very broad array of habitat types that encompass VRUs 9, 10 and 11 its relevance may not be entirely appropriate here. It is very likely that the decrease in stand initiation and increase in mature stands may be due to the reduction in acres of low to moderate severity fires in recent decades and the general aging of stands since the last stand replacement event. The significant reduction in late-seral stands may not apply to our local conditions as harvest has typically not occurred in this setting.

Ecological Function

Landscape Linkages - Within this VRU, connectivity is relatively high and results in important corridors for seasonal wildlife movement. This can be attributed to patch sizes which are generally large and include primary topographic ridges within them. Movement of lynx might occur from suitable denning habitat to forage or cover areas, particularly early seral lodgepole pine stands within the lower subalpine settings.

Old Growth and Interior Habitat - This VRU makes up a very small percentage of the functional old growth and interior habitat across the forest. The high elevation subalpine ecosystem typically did not produce quality old growth habitat. Large, multi-aged patches do function as interior habitat and provide big game security, travel cover, and habitat for neotropical migratory birds. Gaps created by fire have value for wildlife species that prefer such small openings.

Wildlife Habitat - The area provides summer range habitat for mountain goat, elk, and mule deer, summer and fall grizzly bear use and fall denning habitat for bears. Hiding cover varies due to generally low stocking of trees, but can be good due to the clustered trees. Young, dense subalpine fir stands offer decent thermal cover.

Due to the high elevation and cold dry conditions, understory vegetation is limited as is high quality forage. However, beargrass and huckleberry are commonly available as seasonal food sources for grizzly bears.

Although snow and wind breakage creates numerous opportunities for the creation of snags, they are of generally low quality with limited distribution. Preferred snag species such as western larch are available in adjacent landscapes and typically offer high quality habitat for dependent species.

Availability of small mammal habitat is good in numerous downed trees, broken-topped snags, and abundance of cones.

Rare Elements and Specialized Habitat - Glacial cirque lakes can contain important habitat for cutthroat and rainbow trout. Nearby streams can provide important spawning habitat for these trout species. The relatively high precipitation and deep snowpack on these upper subalpine environments also make them important for water storage. Springs and wallows are undoubtedly present and function as valuable habitat for dependent wildlife species. Nonforested, natural openings also occur and contain shrub and herbaceous vegetation often uncommon elsewhere in the response unit. Specialized habitat exists between large, contiguous interior habitat and can be of benefit to bears and some species of owls.

Some areas may be used by lynx as denning cover, where suitable hiding cover and structurally complex forest conditions are present. Late seral stands with abundant downed, woody debris are suitable denning habitat. The absence of early seral lodgepole pine stands makes it unlikely that there would be an adequate prey base for lynx in this VRU.

Unique Ecological Importance - A fair number of unique traits exist for sites in VRU 11. As described, fire is secondary to site factors as an influence on forest development on these sites. Another interesting characteristic of this area is that alpine larch is closely restricted to the outer fringe of the maritime mountain environments throughout its distribution in the northern US, southern BC, and along the eastern slope of the northern Cascades (Arno and Habeck 1972). Some unique forest structural traits are that trees in this setting characteristically grow in groups with open area in between. Competition among tree species due to differences in tolerance is not as pronounced at timberline as it is in lower forests (Fisher and Bradley 1987). Finally, where whitebark pine occurs, it provides an important food source for Clark's nutcrackers, red squirrels, grizzly bears, and black bears. Nutcrackers cache the seeds, and squirrels cache the cones during the fall.

Ecosystem Health, General Trends and Management Implications

Where fire exclusion is having an impact, whitebark pine may not be regenerating as well and may be giving up space to subalpine fir. Not only does fire create suitable sites for seed germination, it also keeps the stand conditions more open and reduces stocking of subalpine fir. In recent decades whitebark pine distribution has also decreased because of white pine blister rust. Where the presence of whitebark pine has significantly declined, there may be an accompanying loss of historic structure and function in high subalpine stands. This may also include the loss of valuable habitat for species such as grizzly bear, Clark's nutcracker, etc. that utilize some important habitat components.

Establishment and growth of alpine larch is characteristically slow with historic fires serving to reduce fuels and provide mineral soil exposure for periodic seed germination. The absence of fire is not likely to be greatly impacting subalpine larch, at this point, but eventually will add to the fuel loadings and favor further advancement of subalpine fir.

As outlined earlier, nonnative plants are becoming more persistent in disturbed areas and represent a concern in many areas. This includes the spread of weeds along trails used by hikers and backcountry horseman. These noxious weeds pose a great threat to biodiversity as they have the potential to eliminate or adversely affect native flora and fauna. When undisturbed, subalpine forests typically have closed canopies or dense shrub cover, and are not susceptible to invasion by most noxious weeds.

Desired Future Conditions Related to Vegetation Management

This setting has high potential for recreation. Hiking, hunting, fishing, berry picking and winter recreation are common uses. Watershed and scenic values are particularly important. Management objectives for this setting recognize these values and focus on their maintenance.

Landscape Attributes - The desired forest structures would reflect the limited extent and variety of conditions caused by fire as a disturbance agent. These patchy burns often killed fire-intolerant trees in lethal underburns, and occasionally large fires killed many trees in crown fires. The maintenance of a mosaic of pure and mixed species stands of various age and size classes would reflect the site capability and the historical pattern of fire and other disturbances.

Within stands the species composition would likely consist of pure or mixed stands of subalpine larch, whitebark pine, and Engelmann spruce. Subalpine fir will likely be more of an understory component.

Stand structures are relatively open and mostly uneven-aged, reflecting the slow recruitment of trees on these harsh sites. A variety of successional stages would be represented across the landscape. Size classes would vary from saplings to mature trees, although often stunted and deformed. Animal seed caches and the sheltering effect of pioneer species enables the regeneration of trees commonly in clusters.

Prescribed Fire and Species Composition - The use of prescribed fire to restore high elevation ecosystems may be desirable to perpetuate whitebark pine and its dependent wildlife. Periodic underburns of a patchy nature could be used to reduce the area occupied by climax species and create seedbeds for the whitebark pine and subalpine larch. Historically, fires in this setting often originated from lower elevation sites. In many situations today, these adjacent sites have high fuel loadings due to fire exclusion and natural changes. Regeneration using rust-resistant varieties is also an option to bolster the potential for regeneration of whitebark pine.

It is important that adequate coarse woody debris be retained following any natural fuels treatment. The amount of woody debris retained will vary somewhat with the habitat needs and may be higher or lower depending on the site. Any recommendations should include the contribution of standing dead as well as down woody fuels and are not designed to immediately replace the present forest floor but to ensure their replacement over the long term.

Wildlife Needs and Special Considerations - Whitebark pine is an important food for Clark's nutcrackers, red squirrels, grizzly bears, and black bears. As a decline in whitebark pine is likely to be accompanied by some loss or migration of wildlife species, any efforts to maintain historic forest structures and their function in high subalpine stands would minimize these losses.

Management activities within this vegetation response unit should promote native vegetation and consider strategies that do not encourage the spread of nonnative vegetation.

Maintaining the health and vigor of forests by promoting a structural, species and age class diversity within a natural range also promotes a forest resilient to insect and pathogens.