Appendix 11
Descriptions of Habitat Groups
from Flathead National Forest Biophysical Classification and Vegetation Response Unit Characterizations (1999)

PVG 1: Warm and Dry
(Habitat Groups 1, 2, & 3)

Habitat Group 1 – Warm and Dry
Summary: This habitat type group is characterized in naturally functioning ecosystems by dry and open-grown park-like stands of Pinus ponderosa or Pseudotsuga menziesii with bunch grass understories. Most of the sites occur on hot and dry landscapes at lower elevations and on west and south aspects. A natural fire free interval of 5 to 25 years on these sites maintained grassy and open park-like stands dominated by large and old ponderosa pine (*Pinus ponderosa*) and some Douglas-fir (*Pseudotsuga menziesii*) (Fischer, 1987). These were low severity, under-burning fires. Stand replacement fires were probably rare.

Ecosystem Setting and General Description: This habitat group is a mix of forested and nonforest sites, characterized as a warm, dry setting. Where tree cover is present, it is ordinarily composed of open-grown park-like stands of mature, large diameter ponderosa pine at low stocking levels, with thickets of Douglas fir and a bunchgrass understory. Trees tend to be clumped where soil development is adequate. The sites are well drained mountain slopes and valleys or steep west and southerly aspects. Elevation ranges from 2,000 to 5,400 feet but averages 3,400 feet. Annual precipitation ranges from 14 to 25 inches, with most of that falling as rain. While the growing season is fairly long, the high solar exposure and shallow soils result in soils that usually dry out early in the growing season. This lack of soil moisture can create harsh growing conditions in late summer. This portion of the landscape in considered very low in vegetative productivity.

Vegetative Composition: This HG is characterized as large ponderosa pine with open, grassy understories and occasional shrubs. The density and distribution of Douglas-fir understory and codominant trees varies directly with the degree that fire has been excluded. Western larch and lodgepole pine are largely absent on most sites due to high temperatures and lack of moisture. Historic vegetation research (Losensky 1994) indicates that around 1900 the ponderosa pine cover type occurred in 17% of section M333B and .8% of section M333C.

This HG is composed primarily of habitat types within the warm and dry habitat group (Table 1). There are small inclusions of more moderate habitat types such as DF/ninebark, DF/snowberry, DF/elk sedge and occasionally some grand fir. These types are best represented in HG 2 and are not featured in this description.

Vegetative Structure: Disturbance processes are largely responsible for the forest structure that develops across the landscape. Stand structure and the distribution of trees is also strongly influenced by the soil type and other physiographic features. As a product of low severity, frequent fires this HG is generally made up of multiple age classes. Small patches of even-aged, single storied trees do occur. The periodic ground fires created a mosaic of microsites that

facilitated age/size class diversity, and some species mix. Late successional multi-storied stand structure exists as scattered stands or stringers in protected areas that burned less frequently. Historic stocking levels were generally low and estimated to have ranged from 50 to 80 square feet of basal area per acre consisting of 5 to 20 overstory trees per acre (Steele 1994). Higher densities may occur on benches and areas with moderate soil depths.

Fire and aspect contrasts are the primary determinants of patch size and shape. With the rare exception of high fire severity events, induced vegetation diversity is created by fire boundaries, which often conform to aspect changes. Inherent boundaries also occur on aspect changes, as well as along streamsides, on abrupt slope changes, and where rock outcrops limit fire spread. Commonly occurring nonlethal ground fires will likely result in canopy gaps that provide a high amount of inherent edge. These openings support grass, forb and shrub communities. Vegetative diversity would likely be inherently high with the amount of edge represented by small openings. Patches that determine the extent of this response unit are irregular and vary significantly in size. Studies in the Bristow Creek area (KNF 1993) indicate a patch size of 20 to 200 acres may be a representative range for this HG.

Age Class Diversity: It is interesting to note that while early and mid-seral stands were represented, late successional stages were more likely a dominant feature of the historic landscape largely due to the inherent nature of a low severity fire regime. Habitat with old forest characteristics (>151 years) was very common under natural conditions and was found to represent both multi-storied (16%) and single storied (48%) structural conditions (Losensky 1994). ICBEMP scientific findings (USDA 1996) suggest that around the time of pre-European settlement, within the dry potential vegetation group (PVG), 30-50% of this portion of the landscape was composed of mature and old forest conditions (both single and multi-storied), and 5-10% in openings that contain primarily grasses, shrubs, and forbs. This PVG is considered the Douglas-fir series with and without ponderosa pine, as well as the dry end of the grand fir series.

Habitat Group 2 – Moderately Warm and Dry

Summary: These habitat types are characterized in naturally functioning ecosystems by open-grown stands of ponderosa pine or Douglas-fir (*Pinus ponderosa* or *Pseudotsuga menziesii*) with grass and brush understories. Most of the sites normally occur at lower elevations on many aspects, but are also found at higher elevation on more southerly and westerly aspects. The natural fire-free interval for underburning was 5 to 50 years (Fischer, 1987). These mostly low and moderate severity fires maintained open park-like stands dominated by Pinus ponderosa. In some cases, stand composition was high in Douglas-fir and western larch (*Pseudotsuga menziesii and Larix occidentalis*). Little information is available for stand replacement fires, but these severe intensity fires occurred only after a fire-free interval probably exceeding 500 years on the drier types and 50-200 years on the more moist types (Smith, 1995).

Ecosystem Setting and General Description: This vegetation response unit is characterized as moderately warm and dry but is a transitional setting that includes warm, dry grasslands and moderately cool and dry upland sites. The dry, lower elevation open ridges are composed of mixed Douglas-fir and ponderosa pine in well stocked and fairly open grown conditions. Moist, upland sites and dense draws also include western larch and lodgepole pine, with lesser amounts of ponderosa pine. Tree regeneration occurs in patches and is largely absent in the understory.

While the growing season is fairly long, high solar input and moderately shallow soils often result in soils that often dry out early in the growing season. This lack of soil moisture results in low to moderate site productivity.

Vegetative Composition: These moderately dry sites are mostly within the Douglas-fir habitat type series. At the low elevations they contain Douglas-fir and ponderosa pine with a shrub understory. On the higher and moister sites ponderosa pine is less evident and lodgepole pine and western larch make up the general stand composition. Lodgepole pine is typically a dominant seral in the DF - dwarf huckleberry habitat type. Coniferous species within the grand fir habitat types include lodgepole pine and western larch on moist sites with Douglas-fir and ponderosa pine occurring as persistent serals on the dry sites. Western white pine and grand fir are a minor component on the mesic sites, but otherwise generally absent.

Historic vegetation research (Losensky 1994) indicates that around 1900, the Douglas-fir cover type occurred in 2% of western Montana and northern Idaho. Under these more natural forest conditions, associated seral species were more common due to availability of growing space and periodic fire disturbances.

This HG is composed of habitat types that are categorized within the moderately warm and dry habitat types. There are inclusions of several warm and dry habitat types (Psme/Phma-Caru, Psme/Caru-Pipo, Psme/Spbe) and several moderately cool and dry habitat types (Psme/Vagl, Psme/Libo-Caru, Psme/Caru).

Vegetative Structure: Forest structure has a primary influence over ecological function and ultimately the inherent biological diversity. Disturbance processes are largely responsible for the forest structure that has developed in this vegetation response unit. Stand structure and the distribution of trees are also strongly influenced by the soil type and other physiographic features. As a product of frequent low-to-moderate severity ground fires, and occasional stand replacement events, this HG is generally made up of a mosaic of stand ages and forest types. The characteristic low to moderate fire regimes tend to creep along the ground with occasional flare-ups. The accompanying short, fire-free interval perpetuates two storied and multi-aged stands of ponderosa pine, western larch and Douglas-fir, with inclusions of lodgepole pine. Multi-storied stands representing late successional stages also occur as stringers in protected areas that burned less frequently. Patches of even-aged, single-storied stands develop after severe burning conditions within a dense understory or an overstocked pole stand after a long fire-free period.

Based on studies of forest structural conditions in stands on the Lolo, Bitterroot and Flathead Forests (Arno et al. 1995) stocking levels around 1900 ranged from 57-100 sq. ft. of basal area per acre on DF - dwarf huckleberry habitat types and 65-150 on DF - pinegrass habitat types. The upper end of these ranges occurred on benches and areas with moderate soil depths. These studies of historic age class structures were based on reconstruction of fire history records and individual tree measurement data. Other research (Steele 1994) estimates stand density at 15-30 overstory trees per acre with a total stand basal area of 60-100 sq. ft., slightly higher on northerly slopes.

Commonly occurring nonlethal ground fires will likely result in canopy gaps that provide a high amount of inherent edge containing a diverse compliment of vegetation within the openings. Induced edge refers to plant communities of different successional stages that have more likelihood of change with time. With the exception of rare, high fire severity events that typically create large patches, induced diversity is created by fire boundaries, which mostly conform to aspect changes. Both inherent and induced edge are a direct reflection of the total

diversity in the area and are important to consider when evaluating stand structures at a landscape level.

The size of a particular habitat is very important in consideration of species richness. Patches that determine the extent of this response unit are irregular and vary significantly in size. Studies in the Bristow Creek area (KNF 1993) indicate a patch size from 20 to 200 acres may be a representative range for this HG. Vegetative diversity would likely be inherently high given the amount of edge represented by small openings and their irregular shape.

Age Class Diversity: Losensky found that stands where ages exceeded 150+ years (37%) were evenly mixed as multi-storied and single storied. The latter condition was facilitated by the frequent, low severity and mixed fire regimes that typify this HG. Based on research of Fire Group 6 in northwest Montana (Lesica 1995) it was estimated that 34% of the moist Douglas-fir type was in an old growth structural stage (>200 yrs.) prior to European settlement, approximately the mid 1800's. Losensky also found that approximately 15% of the area was nonstocked openings with shrubs and grasses.

Although intended for application at a much broader scale, scientific findings from ICBEMP (USDA 1996) suggest that around the time of pre-European settlement, within the dry potential vegetation group (PVG), 30-50% was composed of mature and old forest conditions (both single and multi-storied) and 5-10% in openings. The dry PVG is considered the Douglas-fir series with and without ponderosa pine, as well as the dry end of the grand fir series.

Habitat Group 3 – Moderately Warm and Moderately Dry

Summary: This group contains a highly variable collection of habitat types. It is a transition between the dry and more moist types, and includes types characteristic of each. The group is characterized in naturally functioning ecosystems by mixed species stands of ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), lodgepole pine (*Pinus contorta*) and grand fir (*Abies grandis*). Understories in the absence of fire or other disturbance are composed primarily of dense Douglas-fir (*Pseudotsuga menziesii*) or grand fir (*Abies grandis*) thickets, though other tree species may be present. The natural fire-free interval for underburning was 15 to 50 years. Mixed intensity of moderate and severe fires commonly created mosaics of even-aged stands with survivor individual and groups of trees (Smith. 1995). Also common are open park-like stands dominated by ponderosa pine, western larch, and Douglas-fir.

Ecosystem Setting and General Description: This vegetation response unit occupies a moderately warm and moderately dry habitat between the drier, warmer sites featuring the Douglas-fir series (HG 1, HG 2) and the warmer and moister sites featuring western redcedar and hemlock (HG 5). Being a transitional setting, it includes characteristics of each.

The habitat types classified within HG 3 typically occur on the lower to mid-slope landtypes on benches and well drained slopes. Timber productivity is moderate to high as a result of loess deposits, a favorable moisture regime, and a good growing season.

Vegetative Composition: Fire has been an important agent in shaping the species composition of this landscape. Characteristic low to moderate severity fires favor western larch and ponderosa pine over Douglas-fir. The less common severe fires favored the development of single species stands, especially lodgepole pine. Although characterized as a moderately warm and moderately dry grouping, this vegetation response unit contains a highly variable assemblage of habitat

types, reflective of its wide environmental distribution. The Douglas-fir habitat types and the Abgr/Libo habitat types represent the moderately cool and moist areas that transition between HG 5 and the driest end of HG 2. The Abgr/Xete habitat types represent cooler and drier conditions at the limit of the grand fir series. The Abgr/Clun-Xete habitat type is intermediate between warm Clun sites and the colder, drier Xete sites. The majority of habitat types within HG 3 are from the grand fir series.

This HG is likely near the climatic (cold) limit of ponderosa pine, where mixed stands give way to more pure stands of Douglas-fir. Also, fire history literature and modeling efforts (Keane et al. 1990) suggest that a 50-year average fire return interval is near the maximum that would allow the perpetuation of pine as a major stand component when it is in competition with Douglas-fir. Across this gradient a mixture of tree species that include ponderosa pine, Douglas-fir, western larch, lodgepole pine and grand fir—in both seral and climax stands—is distributed. Douglas-fir is a major component of seral stands in all represented habitat types. Ponderosa pine is a major component in some Abgr/Libo-Libo habitat types (Steele 1994). Lodgepole pine is a major component in young stands of the Psme/Libo-Vagl habitat type (KNF 1993). With the exception of isolated cool sites, conditions in late summer are typically too hot and dry to support Engelmann spruce and western white pine.

This HG has less of a maritime influence than HG 4, which contains the Abgr/Clun types and a greater abundance of subalpine fir and spruce. The composition of western larch is relatively sporadic, depending on frequency of fire disturbance, which favors its establishment and development. Grand fir is slow to establish and grow. It typically forms a subordinate layer to the seral species on the site.

Where disturbance has not recently occurred, dense thickets of Douglas-fir and grand fir occur in the understory. Ponderosa pine regeneration is generally absent under these circumstances.

Vegetative Structure: The actual historic patch size is not well known but would vary from small openings to larger, even-aged patches resulting from mixed lethal to lethal burns. Underburning likely occurred across large expanses of open, park-like areas. Investigations on the Kootenai National Forest following the 1994 fire season (KNF 1994) estimate patch size at somewhere between 5 and 50 acres for commonly occurring nonlethal and mixed severity fires. Research in Bristow Creek indicate an historic patch size of 20-200 acres. Vegetative diversity would likely be inherently high given the amount of edge represented by relatively small openings and their irregular shape.

This response unit is a mix of open stands, brushfields, well stocked mixed conifer and dense lodgepole pine stands. These forest conditions are the result of primarily low to moderate intensity wildfires that left varying amounts of fire-tolerant overstory trees throughout the landscape. The open stands of Douglas-fir, western larch, and ponderosa were historically maintained by underburning, which tended to clean out the understory. Multi-storied conditions were generally maintained by the mixed lethal fires that facilitated the development of an all-aged condition. Patches of even-aged, single storied stands were also the product of moderate intensity fires that created medium sized canopy gaps. These forest structures and fire regimes occurred mostly in the drier portions of this landscape.

On the moister sites, where fire return intervals were longer, periodic lethal fires also occurred. These large-scale crown fires occurred under varying conditions that included dense understory thickets and root disease pockets and the conditions following bark beetle infestations and reburns. Most trees were killed and the development of essentially even-aged and single-storied stands was favored. The extensive areas of lodgepole pine are largely attributed to this

fire regime. Within these intense burn areas, it is conceivable that islands of unburned trees remained.

Historic stand structures varied but were an average density of 80-120 sq.ft. of basal area (Steele 1994), and likely higher in riparian areas. Tree densities varied from 15-30 tpa, where ponderosa pine overstory was prevalent to as much 60 tpa in the cooler, more moist habitat types. Fire history research on the Bitterroot NF (Arno et al. 1995) indicate that vegetative conditions around 1900 in the Abgr/Libo habitat types was multi-aged, represented by a very broad distribution across most age classes, averaging 90 sq.ft. of basal area. Ponderosa pine occurred in all size classes (approximately 40 tpa), dominating the diameter classes above 17 inches. Douglas-fir and grand fir (approximately 15-20 tpa) were exclusively in the small and medium size classes as intermediate and co-dominant crown classes. This research shows a stark contrast with conditions in 1993 that have a stocking level of 135 sq.ft. of basal area, in Douglas-fir and grand fir trees less than 11 inches in diameter (>250 tpa), as well as most of the original overstory of ponderosa pine. Recent conditions also display that Douglas-fir is aggressively moving into the mid-seral class that ponderosa pine dominated in the historic scenario. The absence of Douglas-fir in larger size classes may be attributed to mortality from root disease or bark beetles.

PVG 2: Warm and Moist
(Habitat Groups 4 & 5)

Habitat Group 4 – Moderately Warm and Moist

Summary: These are warm and moist habitats occurring along lower slopes and valley bottoms. The group is highly diverse and nearly all the conifer species in the area can occur on these types. Understory vegetation may be dominated by a wide variety of species. Fire-free interval is ranges from 50 years on the drier types to over 200 years on the more moist types. Typical fires are minor ground fires that create a mosaic within the stand. On the other extreme, complete stand replacement fire occur on dry sites. Many times this is the result of a fire burning from an adjacent and drier type. Fire exclusion on these sites has changed them very little except that it has reduced the number of acres in early successional stages.

Ecosystem Setting and General Description: This vegetation response unit occupies some of the moderately warm and moist sites along lower slopes and valley bottoms. Ecologically influenced by the moderating effects of the inland maritime climate, it is typically bounded by warmer and drier upland sites (e.g. HG 2 and 3), moderately cool and moist sites (e.g. HG 5), and some cooler sites (e.g. HG 7 and 9).

Vegetative Composition: The most efficient way to maintain biological diversity in a forested landscape is to have a diverse array of stands and ecosystems with their constituent species (Hunter 1990). Unlike other vegetation response units that have been significantly influenced by the effects of fire, species composition in HG 4 is largely the result of longer fire-free intervals and an inland maritime climate. The existence of grand fir as a predominant forest component and the indicated climax species is evidence of the moderating effects of this environment. Where grand fir development is successful, it is ordinarily attributed to the area being beyond the

ecological and geographical limits of western hemlock and wester redcedar (Minore 1979), which are more shade tolerant and moisture dependent.

The nature of varying fire regimes creates ideal conditions for the development of a mosaic of seral and climax species. Habitat types and topographic settings that characterize HG 4 are bordered by the Douglas-fir series on the drier and warmer sites, cedar and hemlock on the warm and more moist sites, and the subalpine fir series in the cooler sites. Floristically, this vegetation response unit is one of the most diverse. The exceptional species diversity is largely attributed to the climate, which transitions between the Pacific maritime and the continental.

Situated on most aspects, the forest community is broadly distributed across the numerous benches and valley bottoms of this vegetation response unit. Grand fir is a climax dominant, consistently present during most successional stages. However, due to slower initial establishment and growth, it is usually subordinate to Douglas-fir and western larch. Douglas-fir is a major seral on all sites, except those with saturated soils. Engelmann spruce and lodgepole pine occur on wet, colder habitat types. Western larch can be a major seral where fire has created favorable conditions, but is otherwise sporadic. Western white pine and ponderosa pine are scattered and a very minor seral component. Paper birch is occasional. Being more shade tolerant and moisture dependent, western redcedar and western hemlock are not usually reproducing successfully in HG 4, and only appear as incidentals.

Vegetative Structure: A natural disturbance regime of primarily mixed severity fires with infrequent lethal fires, in addition to mortality-caused root disease, created a mosaic of horizontal and vertical forest structure across this landscape. The characteristic distribution and diversity of forest communities within HG 4 was less than uniform, varying by topographic position and habitat type. Large valley bottoms were often composed of fairly open-grown, mature western larch with younger lodgepole pine, Douglas-fir and grand fir understories. Upland sites had a mixed species composition with a narrow age class distribution and few canopy strata. Tree stocking levels varied across the landscape and with time, but may have ranged from an average of 150-200 sq.ft. of basal area and 30-50 overstory trees per acre (Steele 1994) to over 200 sq. ft. in riparian areas.

Mixed severity fires tended to create more multi-aged and storied conditions as creeping fires flared up, killing trees and creating canopy gaps. At times, some of these resulting patches may have been as much as 20-75 acres in mosaic burns. Stands within HG 4S had greater vertical structure as more trees survived these moderate-severity fires. Even-aged stands developed following lethal, stand replacing fires. Characteristic of HG 4N, these fires resulted in a number of scattered, relic overstory trees (i.e. Douglas fir and western larch) and irregular unburned patches in protected areas. Numerous snags were created as a result of both fire regimes. Patch size following large fires varied by habitat type but was fairly large, averaging 100-300 acres. However, depending on fuel conditions, weather, and insect and disease conditions, the potential existed for larger patch size. In fact, fire history studies in the Clark Fork River Corridor (Barrett 1991) indicate a mean patch size of 437 acres, with a range of 5 to 2,000 acres.

Root disease pathogens create openings in otherwise closed canopies. This provides a unique stand structure not created by any other means. Where root disease has been a factor, forest conditions are generally discontinuous. The distribution of root pathogen colonies results in patches of tree mortality anywhere from less than an acre to an average of five to ten acres, and occasionally larger. These discrete areas are more continuous, where age and density of host trees is fairly uniform.

Age Class Diversity: The fire regime in this HG does facilitate the development of old growth characteristics in many areas. Relatively long fire free intervals and mixed severity fires are typical disturbance events for HG 4. This is supported by the historic vegetation research that documented an average of 21% of the representative cover types in late seral conditions, both multi-storied and single storied (Losensky 1994). Based on fire history research in Fire Group 11 for northern Idaho and western Montana (Lesica,1995) it was estimated that an average of 26% of the grand fir, cedar, and hemlock cover types were in an old growth structural stage prior to European settlement. Findings from ICBEMP for moist habitat types indicate an historic distribution of 15-25% in mature and multi-storied old forest, 5-10% mature and single storied old forest.

Habitat Group 5 – Moderately Cool and Moist

Summary: These are moderately cool and moist sites. They contain many species, including wester redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), Engelmann spruce *(Picea engelmannii*), grand fir (*Abies grandis*), lodgepole pine (*Pinus contorta*), mountain hemlock (*Tsuga mertensiana*) western larch (*Larix occidentalis*) and western white pine (*Pinus monticola*). Very high basal areas can be achieved on these types. Fire frequency can be low due to the maritime influence on these sites. Fire severity can be highly variable due the moist conditions, which are common. But fire severity is severe during periods of drought. Fire free intervals range from 50 to greater than 200 years (Fischer, 1987). Many species do well on these sites and may thrive for centuries without disturbance. Western redcedar is the most notable example.

Ecosystem Setting and General Description: This vegetation response unit occupies most of the moderately cool and moist sites along benches and stream bottoms. HG 5 is ecologically influenced by the moderating effects of the inland maritime climate and is typically bounded by the more moderate sites (e.g. HGs 3, 4), and some cooler sites (HG 7). Some scattered riparian areas and wet site vegetation response units (HGs 6, 7) are occasional intrusions. This vegetation response unit probably has the most biological productivity in the subbasin.

Vegetative Composition: The environmental conditions within HG 5 are very favorable for promoting vegetative growth, species diversity and habitat variety. Situated primarily on north aspects, the forest community of this HG is broadly distributed across the numerous benches and bottomlands. Topographic settings and habitat types that characterize this HG are bordered by the grand fir series on drier upland sites, subalpine fir series on the cool and moist higher elevations sites, and some unique western redcedar types (e.g. Thpl/Opho) in adjacent riparian areas.

The nature of a mixed severity fire regime creates ideal conditions for the development of a mosaic of seral and climax species. Western redcedar and western hemlock are the indicated climax species, occupying similar environments with the former extending onto slightly drier sites. Western hemlock can dominate over cedar and others as it can reproduce under a dense forest canopy in late succession. However, western redcedar can maintain itself indefinitely as a minor climax species due to shade tolerance, longevity, and ability to regenerate vegetatively (Habeck 1968). Western larch and Douglas-fir are often dominants in seral stands, and occasionally Engelmann spruce will be dominant. Lodgepole pine, western white pine and birch are minor components of seral stands. Grand fir and subalpine fir are usually either a minor seral

or minor climax. The exceptional species diversity is largely attributed to the tremendous growing conditions and the long fire-free intervals.

Vegetative Structure: A natural disturbance regime of primarily mixed severity and infrequent lethal fires can create a great diversity of stand structures and species composition. In particular, mixed severity fires tend to create more multi-aged and storied conditions as creeping fires flare up, killing trees to produce gaps in the canopy. This fire regime promotes highly diverse landscapes because of widely varying fire frequencies, severities, and spread patterns (Barrett 1996). Mixed severity understory fires frequently shorten the duration of dense stem exclusion stages by thinning and breaking holes in uniform canopies (Zack 1996). These fires tend to produce more heterogeneous stand structures and more within-stand structural diversity than would be expected from lethal stand replacement fires.

The characteristic distribution and diversity of forest communities within HG 5 historically was not uniform and varied by topographic position and habitat characteristic. Low elevation riparian zones and moist slopes were often composed of mature western redcedar and western hemlock, with codominant Douglas-fir, Engelmann spruce, and western larch. Understories of both seral and climax species became established after disturbances and developed beneath the dominant overstory. Following lethal, stand replacing fires, more homogenous, even-aged stands developed under the scattered surviving overstory and snags. These fires undoubtedly left a number of scattered and irregular unburned patches of cedar and hemlock in protected areas. The drier, upland sites were more open, having greater vertical structure as additional trees survived these more frequent low to moderate-severity fires. This significant component of two-aged stands typically occurred with western larch and Douglas-fir dominating the overstory. Through all forest development stages, favorable growing conditions enabled high tree stocking levels. Tree stocking levels varied across the landscape and with time, but may have ranged from an average of 150 to 200 sq.ft. of basal area and 30 to 50 overstory trees per acre (Steele 1994) to over 200 sq. ft. in riparian areas.

Patch size following most stand replacement fires was fairly large, averaging 100 to 300 acres. However, depending on fuel conditions and topography, insect and disease conditions and weather, the potential for larger patch sizes exists. Fire history studies in the Clark Fork River Corridor (Barrett 1991) indicate an average patch size of 437 acres, ranging from 5 to 2,000 acres. Mixed severity fires left very diverse stand structures but over a less extensive area (100 acre or less). Characteristic of the diversity of HG 5, size classes range from sapling to mature trees. Old growth characteristics were fairly common due to the long interval fire events that allow the development of multi-strata stand conditions.

Although less influential, the forest structural attributes also reflect the effects of root disease, pathogens, etc. Root disease pathogens create openings in otherwise closed canopies. This provides a unique stand structure not created by any other means. Where root disease has been a factor, forest conditions are generally discontinuous. The distribution of root pathogen colonies results in patches of tree mortality anywhere from less than an acre to an average of five to ten acres, and occasionally larger. These discrete areas are more continuous where age and density of host trees is fairly uniform.

Age Class Diversity: The proportion of successional stages present in a setting like HG 5 would have varied over time. An indication of this is presented in historic vegetation research (Losensky 1997). As evidenced by the historic vegetation data, the fire regime in this HG does facilitate the development of old growth characteristics in many areas. This is particularly true on exposed upper slope ridges and protected riparian areas, benches, etc. Relatively long fire-free

intervals and mixed severity fires are typical disturbance events for HG 5. This is supported by Losensky's research that documented an average of 48% of the stands in these cover types in a late seral condition, both multi-storied and single storied. Based on fire history research in Fire Group 11 for northern Idaho and western Montana (Lesica, 1995) it was estimated that an average of 26% of the grand fir, cedar, and hemlock cover types were in an old growth structural stage prior to European settlement. While this estimate is lower than suggested by Losensky's research, it is an average condition that represents a range of habitat characteristics. While broader in scope, ICBEMP scientific findings (USDA 1996) applicable to moist habitat types indicate an historic distribution of 15-25% mature and multi-storied old forest, 5-10% mature and single storied old forest.

PVG 3: Cool and Moist
(Habitat Group 7)

Habitat Group 7 – Cool and Moist

Summary: These types are characterized by cool and moist site conditions. Species diversity can be high with western larch (*Larix occidentalis*), Douglas-fir (*Pseudotsuga menziesii*), western white pine (*Pinus monticola*), Engelmann spruce (*Picea Engelmannii*), lodgepole pine (*pinus contorta*), subalpine fir (*Abies Lasiocarpa*), and grand fir (*Abies grandis*). Other sites are dominated by lodgepole pine after stand replacement burns. These sites are probably too cool for western hemlock (*Tsuga heterophylla*) and western redcedar (*Thuja plicata*). Fire history information is scarce. Fire intervals are estimated at greater than 120 years for most sites (Fischer, 1987).

Ecosystem Setting and General Description: This vegetation response unit occurs in the moist lower subalpine forest setting and is common on northwest to east facing slopes, riparian and poorly drained subalpine sites, and moist frost pockets. It is typically bordered by warmer sites (HG 5) and cool, drier subalpine sites (HG 9) and includes characteristics of each.

This vegetation response unit typically occurs on the mid to upper slopes but is also found within alluvial fans and stream floodplains. The majority of the landform has been affected by glaciation.

Vegetative Composition: This HG occupies a broad subalpine zone that is typically bordered by grand fir, cedar and hemlock habitat types on the warmer, more productive sites with subalpine fir and lodgepole pine at cool and dry higher elevations. As both grand fir and subalpine fir represent transitional vegetative zones, this distributional overlap is apparent. Ordinarily, subalpine fir would be found in the colder and less productive areas where growing seasons are shorter.

This HG typically experiences relatively infrequent lethal fires and periodic, moderate severity fires. Depending on when and where they occur, these disturbances favor seral stands of western larch, lodgepole pine and Douglas-fir with Engelmann spruce. The composition of western larch is relatively sporadic depending on frequency of fire disturbance, which favors its establishment and development. Mature, all-aged stands of spruce, western white pine and subalpine fir are of more significance in moist, protected basins. In these conditions spruce is often a fairly long-lived seral species. On drier sites, spruce is usually less prevalent unless lodgepole pine mortality opens up growing space. These sites are generally too cool for the

successful development of western redcedar and western hemlock. While grand fir is often present, much of this HG is at its upper elevational limit. In some areas, stand replacement fires created pure even-aged stands of lodgepole pine. In some areas Douglas-fir is absent because the sites are either too wet or too cool (e.g. frost pockets).

The prevalent habitat types within HG 7 are Abla/Clun and Abla/Mefe. The former is an extensive moderately warm, moist habitat type found in all but the dry south facing slopes. Douglas-fir, Engelmann spruce, lodgepole pine and western larch are important seral species in Abla/Clun habitat type Older stands often are dominated by spruce with grand fir and subalpine fir understory. Abla/Mefe is an indicator of the maritime influence on cool exposures and upper elevations. Subalpine fir is the most common species in mature stands along with spruce and lodgepole pine. Western larch and Douglas-fir may occur to a lesser extent. Generally, lodgepole pine won't persist beyond 120-160 years (Cooper et al. 1991), particularly where its seed source has not been maintained due to long fire free intervals.

In areas where lodgepole pine has died and/or during periods where fire disturbances have not recently occurred, dense thickets of subalpine fir and Engelmann spruce occur in the understory. Stands within this HG typically have substantial herbaceous and shrub cover, despite the closed canopy. A number of sensitive plant species are likely to occur within specialized habitat of this HG. The occurrence of any one of these plants varies from site to site, depending on the requirements of the vegetation and the environmental conditions.

Vegetative Structure: The extent of horizontal diversity and natural patch size is not well understood in this HG. However, the general nature of patchy uneven fires burning within productive cool and moist sites is known to create structurally diverse conditions.

Small to moderate size patches (< 100 ac.) were the likely result of periodic moderate intensity fires. Fire history analysis in the Good Creek watershed of the Flathead Forest found that small nonlethal to moderate severity fires ranged from less than 1 acre to tens of acres (USDA 1998). This assessment was primarily within the cool-moist HG in a western larch-lodgepole pine forest cover type. Dry sites were more conducive to moderate intensity burns and resulted in the maintenance of multi-storied stand structures with variable age classes. Resulting structures were horizontally and vertically diverse in these cases, as well as in old stands that seldom burned. In most cases, overstory was primarily western larch and Douglas-fir with western white pine and Engelmann spruce. Patches of even-aged, single storied stands were also the product of moderate-intensity fires that created medium sized canopy gaps.

Infrequent stand replacement fires had the potential to be fairly large in scope and could have been as extensive as several hundred to several thousand acres (Green 1997). Analysis in Beaver Creek (Draft DEIS 1997) indicated that stand replacement fires burned a minimum of 200 acres. Other investigations (Mutch 1992) reported that fires in this fire regime often burn 5,000 to 100,000 acres. Fire history analysis in the Good Creek watershed of the Flathead Forest found the more prevalent large fires varied from thousands to tens of thousands of acres (USDA 1998).

Overall, the vegetative diversity would likely be inherently high in HG 7, given the multiple age classes and variable patch size on the landscape. Past vegetative compositions were a mix of well-stocked stands of mixed conifer species, brushfields with scattered overstory, spruce basins, and dense lodgepole pine stands. Stand densities of 80-120 sq ft of basal area were likely (Steele 1994). Open forest conditions were not common due to the lack of frequent surface fires required to maintain these stand structures. On the majority of sites in HG 7, cool and moist conditions favored stand replacement fires at a long fire return interval. Besides occasionally occurring as reburns, these large scale crown fires occurred under varying forest conditions that

included dense understory thickets of subalpine fir, root disease pockets, and lodgepole pine mortality following bark beetle infestation. These fires resulted in heavy tree mortality and the development of a nonuniform distribution of mostly even-aged stands that were both single and two storied. Western larch and Douglas-fir often constituted the relic overstory. In some conditions, extensive lodgepole pine patches regenerated following this fire regime. Within these intense burn areas, islands of unburned trees remained and contributed to the overall vegetative diversity of the landscape.

Age Class Diversity: Relatively long fire-free intervals and mixed severity fires are typical disturbance events for HG 7. This fire regime enhances the suitability of this HG for the maintenance and development of old growth characteristics in many areas. This is particularly true on exposed upper slope ridges and protected riparian areas, benches, etc. This is supported by Losensky's research that documented an average of 48% in multi-storied, old forest conditions for these cover types. In addition, fire history research in Fire Group 9 for northern Idaho and western Montana (Lesica,1995) estimated that 19-37% of the moist lower subalpine cover types were in an old growth structural stage (trees > 200 yrs.) prior to European settlement. While this estimate is lower than suggested by Losensky's research, it is a useful representation of average conditions that may be fairly typical for the Flathead. Lesica's estimate of historic vegetative conditions is also closer to the findings in the ICBEMP assessment that estimated 20-30% levels for historic distributions of mature and late seral forest in moist forests.

PVG 4: Cold and Moist
(Habitat Group 9)

Habitat Group 9 – Cool and Moderately Dry

Summary: These are the cooler subalpine fir (*Abies lasiocarpa*) habitat types. The fire free interval of these types is 50 - 130 years (Fischer, 1987). These periodic fire disturbances and the fact that many of the fires are of low to moderate intensity, favors species such as lodgepole pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii*) and western larch (*Larix occidentalis*). Other species on these sites are commonly subalpine fir (*Abies lasiocarpa*), spruce (*Picea*) and whitebark pine (*Pinus albicaulis*).

Stands dominated by lodgepole pine and over 80 years of age tend to build fuels to become part of large stand-replacement events encompassing thousands of acres (Fischer, 1987). These sites, especially in the *Vaccinium caespitosum* and *scorparium* types, are quite frosty.

Ecosystem Setting and General Description: This vegetation response unit is typified by cool and moderately dry conditions with moderate solar input. The climate is characterized by a short growing season with early summer frosts. Annual precipitation ranges from 35 to 70 inches, mostly in the form of snow. Due to generally shallow soils (low water holding capacity), slope position, and aspect, soil moisture is often limited during late summer months.

Vegetative Composition: These cool and moderately dry sites contain most of the dry subalpine fir habitat types. Lodgepole pine is the seral dominant in most stands, with western larch and Douglas-fir occurring as scattered overstory relics. Engelmann spruce and subalpine fir occur as minor stand components, particularly where stand replacement fires have been absent. Whitebark pine may occur as a minor seral species. Historic vegetation research (Losensky 1994) indicates

that around 1900 the lodgepole pine cover type occurred in 10% of western Montana and northern Idaho.

Vegetative Structure: This HG consists primarily of single age-class stands, often with a widely scattered overstory of mature, large diameter western larch. During periods of stand development, where fire has been absent, a younger cohort of shade-tolerant species occupies the understory. Stocking levels vary from dense, stagnated stands of lodgepole pine to more open conditions that include subalpine fir. Total stand density likely ranged from 80-120 sq.ft. of basal area (Steele 1994). Both stand structure and the distribution of trees are strongly influenced by the soil type and other physiographic features. Multi-storied conditions and old forest character are very rare. These may occur on isolated sites where fuel moisture or broken terrain prevent spreading crown fires.

Patches that determine the extent of this response unit are irregular and vary significantly in size. Fire and aspect contrasts are the primary determinants of patch size. With the exception of high fire severity events, induced diversity is created by fire boundaries, which often conform to aspect changes. Inherent boundaries also occur on aspect changes, as well as along streamsides, on abrupt slope changes, and where rock outcrops limit fire spread.

Nonlethal ground fires occurred and created a mosaic of patches of different size and age, in contrast to the large, single-aged uniform stands that are typical where lodgepole pine is seral. These fires created canopy gaps from 1 to 5 acres that provide a high amount of inherent edge. Lethal fires, which are more common and burn under very dry conditions, can result in stand replacement conditions over thousands of acres. Mutch (1992) reported that fires in this fire regime often cover 5,000 to 100,000 acres. This large patch size provides very little edge effect with low inherent diversity among plant communities. Mixed lethal burns regenerated uneven patches that may have been 50-300 acres in size.

Age Class Diversity

The proportion of successional stages present within this HG would have varied over time. Early and mid-seral stands were likely a dominant feature of this landscape. In fact, Losensky's findings indicate that stands less than 40 years in age accounted for 45% of the area and 19% were 41-100 years. Nonstocked openings with shrubs and grass accounted for 27% of the area.

The inherent fire regime and the species composition for HG 9 did not facilitate late successional stand development. This is supported by Losensky's historic vegetation research that found under natural conditions only 2% of the area in the lodgepole pine type was over 150 years old. However, the moist lodgepole pine sites, which more commonly experienced mixed severity fires (Fire Group 9), had better representation of a late successional stage due to longer fire return intervals. Lesica found an estimated 18% of the cool lodgepole pine sites was in an old growth structural stage (>200 years) prior to European settlement, approximately the mid 1800's. This particular study area had a mean stand replacement fire interval of 117 years. This same research in Fire Group 8 in drier, lower subalpine types of Montana had over 25% of the stands in an old growth structural stage during the same historical period. The average fire return interval for stand replacement fires in this case was almost 150 years. This is not consistent with Losensky's findings which have been described and demonstrate much less old growth represented in this type.

PVG 5: Cold
(Habitat Group 10 & 11)

Habitat Group 10 – Cold and Moderately Dry

Summary: These types are upper elevation cold and dry. Many of these sites are above the cold limits of conifers like Douglas-fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), and western white pine (*Pinus monticola*). Common species are whitebark pine (*Pinus albicaulis*), lodgepole pine (*Pinus contorta*), mountain hemlock (*Tsuga mertensiana*), subalpine fir (*Abies lasiocarpa*), and alpine larch (*Larix lyalii*). The fire-free interval ranges from 35 to over 300 years. Stand replacement fires occur after intervals of more than 200 years (Fischer et al. 1987). Most fires are of low severity because of discontinuous fuels (Arno. 1989).

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. Most landforms within HG 10 have been influenced by alpine glaciation.

Vegetative Composition: In the upper subalpine setting of western Montana, Abies lasiocarpa/Luzula hitchcockii is the dominant habitat type (Pfister et al. 1977). This near-timberline setting is generally bordered by Abla/Mefe or Abla/Xete (HG 7 and 9) below and Pial-Abla or Laly-Abla above (HG 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). But in recent decades, the distribution of whitebark pine has decreased because of mountain pine beetle and white pine blister rust. A limited distribution of alpine larch may occur on rockslides and talus.

The Tsuga mertensiana/Luzula hitchcockii habitat type also occurs in HG 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.

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.

Vegetative Structure

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.

Age Class Diversity

Quantitative information on historic age class distributions is not available for these high elevation sites. 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 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.

Habitat Group 11 – Cold

Summary: These types are high-elevation cold sites. They are near timberline and above the cold limits of species such as Douglas fir (*Pseudotsuga menziesii*) and western larch (*Larix occidentalis*). Common species are whitebark pine (*Pinus albicaulis*), mountain hemlock (*Tsuga mertensiana*), subalpine fir (*Abies lasiocarpa*), and alpine larch (*Larix lyalii*). The fire-free interval varies from 35 to over 300 years. Stand replacement fires occur after intervals of more than 200 years (Fischer et al. 1987).

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 to 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. The landforms within HG 11 have been influenced by alpine glaciation and are a complex of forest, avalanche chutes and rock outcrop.

Vegetative Composition: The predominant habitat type within timberline settings of the Northern Rockies and most of Montana 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. These sites are generally bordered by cold and moderately dry sites dominated by the Abies lasiocarpa/Luzula hitchcockii habitat types, characteristic of HG 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 HG 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.

The *Larix-lyallii-Abies lasiocarpa* habitat types also occur in HG 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.

Vegetative Structure: 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 HG 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.

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. 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 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 HGs 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.

PVG 6: Riparian

Habitat Groups 6 & 8 – **Moderately Cool and Wet & Cool and Wet**

Summary: The habitat characterization for HG 6 and 8 will be described generally as one, given their common features and limited extent. These are very wet sites. They are forested riparian areas along streams and associated with wetlands. Due to this very wet condition, the fire-free interval can be long. Intervals between severe, stand replacement fires are probably much longer than the majority of fire group nine, 90 to 130 years. They probably exceed 150 years.

Ecosystem Setting and General Description: These sites are very wet forest riparian areas, generally located along streams and associated with wetlands. Streamsides within these areas vary from expansive floodplains with wide channel bottoms to narrow, steep headwater rivulets. There is a noticeable habitat transition as one moves from the steep headwater sections down into the low gradient depositional flats. Slopes are moderate, averaging 15-20%. These vegetation response units are generally adjacent to HG 5 and 7.

Vegetative Composition: Although HG 6 and 8 occupy a minor portion of the forest ecosystem, they are nonetheless important. Both habitat groups occur as stringers with distinctive habitat features. Vegetation that occupies these sites is adapted to a setting with a very high water table associated with ravine bottoms, near streams or springs.

The major habitat type in HG 6 is Thpl/Opho. It is found in wet bottoms and toe-slope seepage areas (Pfister et al. 1979). Another important habitat type is Thpl/Atfi, located on slightly warmer sites than Thpl/Opho. The typical setting is a diverse herbaceous/shrub layer well established under an old overstory of moist site conifer species. Devil's club is the dominant vegetation and normally found in bottoms having high water tables and cold-air drainage. Undergrowth also includes lady fern, starry Solomon-plume, oak fern, queen's cup beadlily, sweetscented bedstraw, pathfinder, and Pacific yew. The Thpl/Opho habitat type is generally associated with low gradient slopes on any aspect; landforms tend to be lower benches, valleys, and lower stream terraces (Cooper et al. 1991). Most stands are composed of climax species such as western hemlock, western redcedar, subalpine fir, and Engelmann spruce. Hemlock and cedar are considered codominant in most cases. Where mortality, wind or fire has opened the stand seral species such as western white pine, Douglas-fir or western larch may also occur. Hardwood species such as black cottonwood, paper birch and quaking aspen occur also.

The most common habitat types in HG 8 are Picea/Eqar, Abla/Opho, and Abla/Gatr. While rare on the Forest, they are important. The major floristic difference in conifer species from HG 6 is attributed to its generally higher setting, an environment that reaches the cold limits of western redcedar. Most stands have old growth characteristics dominated by Engelmann spruce and subalpine fir. Most sites have such a high water table that species other than spruce cannot establish except on hummocks. Occurrence of western hemlock and western redcedar is sporadic at best. Seral species such as western white pine, western larch, and Douglas-fir occur to some extent, generally where some type of disturbance has occurred. Hardwoods are less common than in wide bottom settings of HG 6 but they do occur in seral stands.

Vegetative Structure: Most native stands in riparian habitat settings have old growth characteristics that develop a fairly open canopy composed of large, evenly-spaced trees, with mostly cedar or hemlock regeneration beneath (Smith and Fisher 1997). As described earlier, basins above the cold limit of these species are dominated by spruce overstory with some level of subalpine fir. Hardwood species in the wide valley bottoms are a common strata. The vigorous component of shade tolerant understory trees seems to establish and grow well in the small canopy gaps, and less in the shade. High stand densities create ideal conditions for canopy gaps as a result of blowdown, stem exclusion, breakage, etc.

Overall biological diversity is high in HGs 6 and 8, as stand structures are generally storied with multiple age classes. Very long fire return intervals for stand replacement, combined with nonuniform mixed severity burns, encourage development of high species and structural diversity in stream bottom forests. The nature of this fire regime creates a forest environment that does not change very much and is conducive to the development of old forest characteristics. In

addition, the high composition of shade tolerant, climax species with a predisposition to stem decay also contributes to a structurally diverse forest condition. Patch size varies considerably across these linear vegetation response units and is dependent on the length of the stream bottom and the nature of fire regimes in adjacent stands.

Age Class Diversity: In comparing the existing age class distribution for stands between the ages of 41 and 150 years it appears that both HG 6 and 8 are highly correlated. Average stand age at the other extremes (0-40 and 150+ yrs.) are very different. This may be due to a higher degree of past regeneration harvest in HG 8 and is consistent with the lower amount of 150+ year old stands. The high proportion of 150+ year old stands in HG 6 is very consistent with the nature of vegetative development envisioned. The data does not support this for HG 8, although it should be somewhat comparable. Although change in these ecosystems is comparatively slow, the variation in successional stages between HGs may be a function of where harvest or wildfire have occurred in this part of the landscape.

The proportion of early seral stands in HG 8 is well above reference conditions, while that in HG 6 is much lower. This is conceivable given that many stands in HG 8 are located near roads and on very productive lands that may have been entered for timber harvest at one time. The current proportion of mid-seral stands is higher now. The distribution of mature stands is within the range of historic conditions. The amount of late seral in HG 8 is below the range of reference conditions, likely due to active management. Late seral stages in HG 6 continue to be an important component of the vegetative condition and within the range of reference conditions. The amount of area in nonstocked openings of mostly shrubs and grasses is at the low end of the estimated range of conditions around 1900.