Revision Topic - Vegetation

Need for Change

Principles of biological diversity and landscape, fire, wildlife, and human ecology have advanced and are better understood since development of the 1987 Forest Plans. There is now an increased focus and scientific understanding of sustainability, disturbance processes, and vegetation management. The 1987 Forest Plans were generally focused on single resources, narrow in scope, and output-driven. Standards and guidelines were at times conflicting, with little recognition of the interrelationship of resources and the need to manage ecosystems at various scales. Management Areas (MA) tended to be small and fragmented. Most MAs fell under a timber-management emphasis, with silvicultural prescriptions that maximized growth and yield of timber. Resources other than timber were a constraint to the production of timber outputs. Although most MAs were defined generally along topographic features, they were not based on ecological systems.

Forest Plan monitoring, Geographic Area (GA) assessments, the Northern Region Overview, and the Interior Columbia River Basin Ecosystem Management Project (ICBEMP) have identified problems and demonstrate a need for change in maintaining terrestrial sustainability on NFS lands. Examples of findings from these documents include:

- A lack of early seral tree species (examples include ponderosa pine and western larch in the uplands, cottonwood in riparian areas, and blue wildrye in grasslands)
- An increased amount of shade-tolerant, fire intolerant, and insect and disease prone tree and shrub species dominating the landscape.
- Higher fuel loading resulting from decades of fire suppression
- A reduction in large snags on portions of the landscape.
- A decrease in interior habitat in late successional stands as a result of past timber harvest.

Laws and Regulations

The concept of sustainability of the ecosystem has been an important objective on NFS lands since Congress passed the Organic Administration Act of June 4, 1897. The Organic Act gave the Forest Service the authority to "regulate the Forests occupancy and use and to preserve the forests therein from destruction" (16 U.S.C. 551).

Congress enacted the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et seq.) "…to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man, [and] enrich the understanding of the ecological systems and natural resources important to the nation" (42 U.S.C. 4321).

The National Forest Management Act (NFMA) of 1976 (16 U.S.C. 1660(6)), requires the Forest Service to manage national forests and grasslands under land management plans that provide for multiple uses and sustained yields. Development of the land management plans as directed under the NFMA must include "integrated consideration of physical, biological, economic, and other sciences" (16 U.S.C. 1604(b)). The act requires regulations which "…provide for diversity of plant and animal communities" and also "…steps taken to preserve the diversity of tree species similar to that existing in the region."

The 1982 Planning Regulations (36 CFR 219) strengthen and amplify the diversity requirements in NFMA. The 1982 Planning Regulations require the Forest Service to "…preserve and enhance the diversity of plant and animal communities…so that it is at least as great as that would be expected in a natural forest and the diversity of tree species similar to that existing in the planning area." Minimum management requirements include:

- Preservation of diversity
- Prevention of "impairment of the productivity of the land"
- Using "ecologically acceptable" strategies to "prevent or reduce serious, long lasting hazard and damage from pest organisms"

The 1982 Planning Regulations also require that "inventories shall include quantitative data making possible the evaluation of diversity in terms of prior and present conditions".

In addition to, and in concert with NFMA and NEPA, one of the purposes of the Endangered Species Act (ESA) of 1973 is "to provide means whereby the ecosystems upon which endangered species and threatened species depend may be conserved…" (16 U.S.C. 1531(b) 1973, as amended).

Forest Service Strategic Plan

The goals and objectives of the USDA Forest Service Strategic Plan (Revision 2000) guide future agency actions. The current mission statement is "To sustain the health, diversity and productivity of the Nation's forests and grasslands to meet the needs of present and future generations." The goals and objectives related to terrestrial sustainability are:

Goal 1 "Ecosystem Health" states: Promote ecosystem health and conservation using a collaborative approach to sustain the Nation's forests, grasslands and watersheds.

> *Objective 1b states:* Provide ecological conditions to sustain viable populations of native and desired non-native species and to achieve objectives for management indicator species (MIS)/focal species.
>
> *Objective 1c states:* Increase the amount of forests and grasslands restored to or maintained in a healthy condition with reduced risk and damage from fires, insects and diseases and invasive species.

Strategies to achieve the objectives above are detailed on pages 16-19 of the Strategic Plan (USDA 2000a).

The Forest Plans and Monitoring and Evaluation

Fifteen years of implementation and monitoring of management activities also demonstrate a need to revise vegetation management direction. There have been extensive changes in vegetation type and size classes (e.g. western white pine, whitebark pine, ponderosa pine, western larch, aspen, cottonwood, some native forbs and grasses, snags, down wood) from historic ranges, which may increase the risk and uncertainty in managing for contributions towards ecological sustainability. Current management direction does not address these changes or provide tools for restoring these ecosystems.

Disturbance processes, such as wildfire and insects and disease, have also changed from historic ranges. Increased tree density and fuel loading as a result of fire suppression has created stress on forests, resulting in increased insect and disease activity. This, in turn, has resulted in more intense wildfires over a greater land area than existed historically. In addition, there is an increase in the number of people living adjacent to and within the forests. This increase of population in the wildland-urban interface limits fire activity and creates a need to deal with acceptable fuel treatment options. Current management direction does not address these changes and the need for increased fuel treatments.

State Weed Management Plans (Idaho, 1999 and Montana, 2001), Forest Plan monitoring, and assessments, indicate noxious weeds are increasing their infestation areas (USDA 1998a pg. 59, 1998b). Several new invaders have been found, indicating an increase in noxious weed diversity. The 1987 Forest Plans do not adequately cover weed management.

The listing of additional species under the Endangered Species Act (ESA) since the 1987 Forest Plans were approved (e.g, water howellia, Ute ladies tresses, and Spalding's catchfly) also demonstrates the need for updating Forest Plan direction for vegetation. The number of sensitive plants, as designated by the Regional Forester, has also increased dramatically since the 1987 Forest Plans (USDA, 1995b).

Management of late successional forests is an issue on many forest projects. Monitoring indicates both forests are meeting current direction for maintaining and providing for old growth conditions. There may be a need for change to develop revised goals, objectives, or standards for late successional forests to better reflect landscape scale issues related specifically to old growth conditions.

Planning Questions For Vegetation

Planning questions have been developed to provide context to the vegetation revision topic. These questions are followed by a description of the historic and current condition and form the baseline to compare the effects of the alternatives. Additional analysis will be completed for the DEIS to more fully address these questions. This information will provide the decision maker with the knowledge necessary to understand the issue and make a decision.

Planning Question - What are the historic and current disturbance processes on the KIPZ and what are the trends?

Historic And Current Disturbance Processes - Weather

The overall climatic condition and vegetative composition on the KNF and IPNFs has remained relatively uniform for approximately the past 2,500 years (Chatters and Leavell 1994). Variations have occurred during this time period such as the warmer and drier Little Climatic Optimum (900-1300 AD) and the more moist and cool Little Ice Age (1300-1860 AD). Within this timeframe, disturbance processes together with landform and other environmental elements are the major factors influencing the patterns of habitats across the landscape. In turn, species abundance and distribution are a result of this dynamic pattern. Native plants and animals today have adapted to these climatic and disturbance regimes throughout the past 2,500 years.

Climatic Variability

The Interior Columbia River Basin, which includes the KNF and IPNFs, is particularly dynamic because it has a transition-type climate, which is influenced by three competing air masses:

1. moist, moderate temperature, Pacific inland maritime airflow, from the west;
2. dry continental air mass with more extremes in temperature, from the east;
3. cold, dry arctic air, from the north.

Because of the strong influence of inland marine airflow, precipitation in northern Idaho and northwest Montana is generally heavy compared to the rest of the Rocky Mountains. However, precipitation tends to vary on a decadal basis, with wet periods and dry periods each lasting several years to decades (Finklin and Fischer 1987). Extended droughts raise the fire danger and stress trees, especially the more drought intolerant species. During drought times, these stressed trees are less able to resist insect and pathogen attacks.

This climatic variability creates an environment prone to a high frequency of a variety of disturbances. Rocky Mountain forest ecosystems are (and were historically) a mosaic of disturbance-derived patches of various ages and composition. Historically, fire was the primary disturbance agent throughout most Rocky Mountain ecosystems (Barbour and Billings 2000), but insects, pathogens, and weather events were also important.

Weather Disturbances

Extended droughts, windstorms, ice storms, heavy wet snow storms, and sudden extreme freezes are all weather disturbances that impact forests, either by direct damage to trees or by creating high stress that increases the probabilities of impact from other disturbance agents. In general, weather events raise the probability of subsequent insect or fire disturbances. Trees broken or blown down in severe weather events provide breeding grounds for some bark beetles, which can lead to bark beetle epidemics. Blowdown from weather events and trees killed by insects create woody fuels that increase fire hazard.

Historic And Current Disturbance Processes - Wildfire

Wildfire greatly influenced the composition, structure, and function of vegetation across the landscape. Where fire disturbance was common, ecosystems favored the long-lived, fire-adapted, shade-intolerant tree species (ponderosa pine, larch, white pine, lodgepole pine, and whitebark pine). Shorter-lived, shade-intolerant, fire-adapted tree species (Douglas-fir) were also present in significant amounts, particularly in younger stands, but declined through time due to effects of insects and pathogens. Shade-tolerant, fire-intolerant tree species (cedar, western hemlock, grand fir, and spruce-alpine fir) were certainly present, but rarely survived long enough to dominate stands, except where the interval between fires was unusually long.

Stand-Replacing Fires

Stand-replacing fires remove more than 90% of overstory tree canopy over a significant area and restart the successional sequence. Historically, on landscapes dominated by moist habitat types (as found on the KNF and IPNFs), the mean fire return interval was approximately 200 years, with drier sites burning more frequently and wetter sites burning less frequently (Smith and Fischer 1997; Zack and Morgan 1994).

Major fire years occur most commonly during regional summer droughts. Lightning storms and wind contribute to the likelihood of a major fire year. During major fire years, stand-replacing fires were commonly on the order of tens of thousands of acres, with some individual fire patches 50,000 acres or larger (Pyne 1982; Zack and Morgan 1994). The Coeur d'Alene Fire Study, (based on approximately 1500 tree records) shows that over the last 450 years, there was one-major stand replacing fire episode an average of once every 19 years somewhere in that 570,000 acre river basin.

During major fire events some watersheds were almost entirely burned over, while other large areas were unaffected. In any particular watershed, major stand-replacing disturbances came in pulses, with long intervals between the pulses.

While stand-replacing fires favor long-term dominance by early successional, shade-intolerant tree species, the mean time interval between stand replacing fires was long enough to allow development of mature and old growth forest structural stages, particularly in landscapes where fire intervals tended to be longest.

Re-burns of fires have occurred throughout history. Re-burns have been associated with, and have normally followed, severe fire years that have burned in high intensity conditions. Stand-replacing fires can create a high fuel loading in both standing and down wood. When these fuels season after several years, the load becomes a strong candidate for re-burn when high temperatures, low humidity, and winds combine.

Mixed-Severity Fire

Mixed-severity fires kill at least 10% of the overstory tree canopy, but do not replace the whole stand. Mean fire return intervals typically ranged from 55-85 years, depending upon landscape location. On very moist sites they may have been significantly less common, while on drier sites return intervals were 25 years or less (Smith and Fischer 1997; Zack and Morgan 1994). Mixed-severity fires create an irregular patchy mosaic of small to moderate-sized openings, thinned areas, underburned areas, and unburned areas. Mixed severity fires generally prolonged the period of dominance by early successional fire-adapted species and at a larger scale, allowed for the development of mature and old growth structural stages dominated by large trees. Fire also played many additional ecological roles as a carbon and nutrient recycling agent, dormancy breaking and stimulating agent for herb and shrub seeds and sprouts, and creator of tree cavities and snags (used by wildlife). Historically, mixed-severity fires were extremely variable in size (less than one acre to more than 1,000 acres) and introduced both variable sized patches and internal diversity within larger blocks created by the less frequent stand-replacing fires.

Low-Severity Fire

Low-severity fires are typically underburns that kill less than 10% of the overstory tree canopy. They are most important on drier habitat types where conditions are dry enough to burn more frequently. Mean fire return intervals typically range from 10 to 30 years (Smith and Fischer 1997). Low-severity fires typically remove most small understory trees, particularly the more shade-tolerant, fire-intolerant species. On drier habitat types where these fires are common, the frequent burns maintain a large portion of the landscape in relatively open stands of large, shade-intolerant, fire-tolerant species (larch and ponderosa pine with lesser amounts of Douglas-fir).

Effects of Historic Fires

These disturbances of large, infrequent stand-replacing wildfires created a dynamic shifting mosaic of forest successional stages on a very large scale. In between the stand-replacing fires, vegetation, aquatic systems, and wildlife habitat had long periods to develop. Intermediate disturbances (low and mixed severity fire; some insect, pathogen, and weather events) introduced finer scale variability within these larger patches. As a result, blocks of wildlife habitat tended to be large, and blocks of mature/late-successional forest also tended to be large, but internally diverse. Terrestrial/aquatic interactions meant that watershed conditions and fish habitat also tended to form a dynamic, large-scale shifting mosaic. Over time any individual watershed could vary from predominantly mature/old forest (with wildlife and fish habitat that results) to almost all recently burned over. However, at any given time, at the larger scale of a river sub-basin (500,000 – 2,000,000 acres), the whole range of these conditions was represented in watershed-sized blocks of thousands, to tens of thousands of acres.

Current Fire Disturbance Process

The Forest Service has been suppressing wildfires for many decades. Suppression efforts have been particularly effective for low and mixed-severity fires, virtually removing this agent as a significant disturbance process for the last 60 years. Rapid suppression of all fire starts has also removed most opportunity for fires to grow in size and intensity to become stand-replacing fires. For example, on the northern portion of the IPNFs, over the last 60 years, there were only a few stand-replacing fires greater than 1,000 acres. Only two of these fires were greater than 10,000 acres, and these occurred in the same month during an extreme weather event.

The success of fire suppression efforts and resource management activities over the last 100 years has had a large influence on the structure and composition of forest and rangeland fuel conditions. The function and process of ecological systems has changed. Fire suppression and some management activities have altered fuel loadings. See the Fire Risk Revision Topic for further discussion of increased fire risk.

Historic And Current Disturbance Processes – Timber Harvest And Prescribed Burn

Timber Harvest

Timber harvests peaked on NFS lands in the 1970's and began to decline. Because of fire suppression, regeneration timber harvests are the current, predominant stand-replacing disturbance process. The majority of acres treated for timber harvest under the goals and objectives of the 1980's Forest Plans were even-age, regeneration prescriptions.

Regeneration harvest systems (clearcut, seed-tree, shelterwood) followed by prescribed fire can emulate some of the functions of stand-replacing fire, but not all of them. These silvicultural systems are generally successful in regenerating mixed species stands dominated by early successional shade-intolerant species. However, traditional regeneration harvest created unnaturally uniform conditions, and did not leave the scattered residual snags, residual live tree patches and scattered fire-tolerant large live trees (larch and ponderosa pine) that were characteristic of historic fires. In addition, the size of regeneration harvest units (2 to 40 acres) has been much smaller than patches created by historic, natural-fire regimes. This is now beginning to change, with greater utilization of snag retention standards, new silvicultural systems such as irregular seed-tree and shelterwood systems with reserves, and increasing size of regeneration harvest units. Results of even-age, regeneration prescriptions primarily limited to 40 acres in size while deferring all acres in between from any disturbance have shaped the landscape and modified habitat and processes all across the KIPZ.

Historically, approximately 20% of the overall, generalized landscape of the KIPZ was in an "old growth", or late seral condition (Losensky 1993). Since every acre had the potential to be old growth, this successional stage of vegetative development shifted across the landscape in response to the intensity and frequency of disturbance. Old growth was classical, multi-story, multi-age forest only in moist riparian areas and upper elevation cool, moist sites. Old growth in warm, dry stands with historic frequent, low intensity fire events were characterized by open, park-like, mature trees with light understory. Approximately 20% of the historic landscape was also in an early seral state (Losensky 1993). Stand replacing fires occurred at different rates and patch sizes throughout. Intervals between stand replacing events varied from 150 to 400 years in the cool, moist environment and 150 to 200 years in warm, moist habitats (Leavell 2000).

Approximately 60% of the landscape was in a varied, mixed-age, mixed-height, mixed-conifer, and mid-seral condition (Losensky 1993). The historic landscape within a range of variability was a shifting, dynamic mosaic of all these age and size class proportions as diverse as the dissected landscape and environment. Structure, composition, and function shifted proportionally in response to disturbance. The historic landscape was very different from the landscape being shaped by the 1980's Forest Plans (Leavell 2000).

Salvage and partial cut harvesting (sanitation harvest, individual tree selection, commercial thin) somewhat emulate the effects of low and mixed-severity fire in terms of thinning stands. However, these harvest systems also differ from low and mixed-severity natural fire. The salvage and sanitation harvests remove larger dead and dying trees that historically remained to contribute to nutrient cycling, wildlife habitat, and aquatic functions. In most cases, partical cuts maintain a dense overstory canopy.

Prescribed Fire

The effects of timber harvest on successional processes often depend on whether or not harvest is accompanied by prescribed fire. Where prescribed fire is used, impacts on understory vegetation may more closely replicate the effects of natural fire, and favor fire-adapted, shade-intolerant tree species. Where there is timber harvest with neither prescribed fire, nor any other type of site preparation, advanced regeneration of shade-tolerant, drought and fire-intolerant species are more likely to dominate the post-harvest stand (Zack 1994).

Prescribed fire has the potential to emulate many natural-fire ecosystem functions. However, the scale, seasonality, severity, and internal variability of natural fires need to be considered in developing fire prescriptions. To date, prescribed fire efforts of this sort have been relatively small scale compared to natural disturbances.

Historic And Current Disturbance Processes – Insects And Disease

Historic Role of Native Insects and Pathogens

Historically, insects and pathogens played a significant role as disturbance agents. Mountain pine beetles in white pine and lodgepole pine (and occasionally spruce beetles) are capable of serving as stand-replacing agents. These beetles have a mixed effect on succession. They can open canopies enough to provide regeneration opportunities for shade-intolerant tree species, but more commonly they release shade-tolerant understory tree species. By the fuels they create, these bark beetles increase the probability of large stand-replacing fires, which reset the successional sequence. In some situations, Douglas-fir bark beetle can also do the same thing on a smaller scale.

Historically, root pathogens most commonly acted as thinning agents. In natural mixed-species stands, root pathogens caused the greatest mortality in Douglas-fir, followed by true firs. White pine and larch were the most resistant tree species (Hoff and McDonald 1994; Monnig and Byler 1992). Root pathogens thinned out the Douglas-fir and favored the pines and larch, which increased the amount of pine and larch over the first 150+ years of stand life (Rockwell 1917).

White Pine Blister Rust (an Exotic Disturbance)

Historically, western white pine was a common tree species, particularly on the IPNFs, and dominated a very large part of the moist habitat types. In the early part of the 20th century, white pine blister rust (a Eurasian disease) was accidentally introduced to western North America. This exotic disease has been the primary cause for the loss of white pine in this area (Neuenschwander et al. 1999). With the loss of white pine, there have been large increases in the amount of Douglas-fir and subalpine fir cover types, and a major acceleration of forest succession toward shade-tolerant, late-successional true firs, hemlocks, and cedars.

Current Role of Insects and Pathogens

With the impact of white pine blister rust and the decrease in fire, the role of insects and pathogens as disturbance agents is growing and changing. White pine blister rust accounts for major changes in forest successional patterns, having removed more than 90% of two conifer species (white pine and whitebark pine). With the absence of white pine and decreased amounts of ponderosa pine and larch, root pathogens have been transformed from thinning agents into major stand-change agents in Douglas-fir and true fir stands. Root pathogens now produce significant canopy openings on many sites. Depending upon the habitat type, root pathogens may either stall stands in a diseased shrub/sapling/open pole successional stage, or strongly accelerate succession towards shade-tolerant species.

Bark beetles have also changed their role. Because there is more Douglas-fir relative to historical conditions, Douglas-fir bark beetles are now more important change agents than they were historically. In all but the driest habitat types, Douglas-fir bark beetles accelerate succession in the short-run, and in the long-run create fuel conditions and stand structures that may increase the risk of stand-replacing wildfires.

Native insects and pathogens are also now responsible for a relatively much larger proportion of forest disturbance than they were historically. The impact of all these insects and pathogens in the short-run is to strongly accelerate succession towards late seral, shade-tolerant tree species. A recent analysis of pathogen and insect impacts in ecoregion section M333d (Bitterroot Mountains Section) (Hagle et al. 2000) examined successional changes for the period 1935 to 1975. This analysis shows that in 40 years, pathogens and insects changed forest cover types to more late-successional, shade-tolerant tree species on over 80% of the area dominated by moist forest habitat types (Byler and Hagle 2000). The same analysis of insect and pathogen impacts also showed that almost 40% of the moist habitat type area analyzed was either stalled in small tree structures or was actually moving back towards the small tree structures as a result of the removal of the largest trees.

Planning Question - What are the historic and current structures, compositions, and functions of vegetation on the KIPZ and what are the trends?

Historic and Current Structures and Compositions

Ecosystem characteristics include three basic components: structure, composition, and function.

- Structure is the horizontal and vertical physical elements of forests and grasslands and the spatial interrelationships of ecosystems.

- Composition is the component tree, shrub, grass, and forb classes in a stand or community. Function includes energy flows of materials across and within the landscape and how one ecosystem influences another.
- Function also relates to energy processes such as fire, hydrological processes (including floods), and matter and energy exchange throughout the food chain.

Structure can be measured by heights and quantities of the classes listed above. Composition can be measured by numbers and abundances of the same classes. An example of a measurement of fire as a process is intensity and frequency of fire events.

Acres by forest cover type and size class for the KNF and IPNFs are shown in Tables 1-1 and 1-2. These tables are from the Forest Inventory and Analysis (FIA) inventory program and reflect summary information from the data collected. The tables indicate that conifer forests dominate both forests, predominantly in large diameter Douglas-fir. Both forests also have a large amount of acreage in large diameter Englemann spruce/subalpine fir, and lodgepole pine. In addition, the IPNFs has a large amount in the large diameter fir/spruce/mountain hemlock group.

Figure 1-1 shows the forest type composition of KIPZ.

Figure 1-1. KIPZ Forest Types

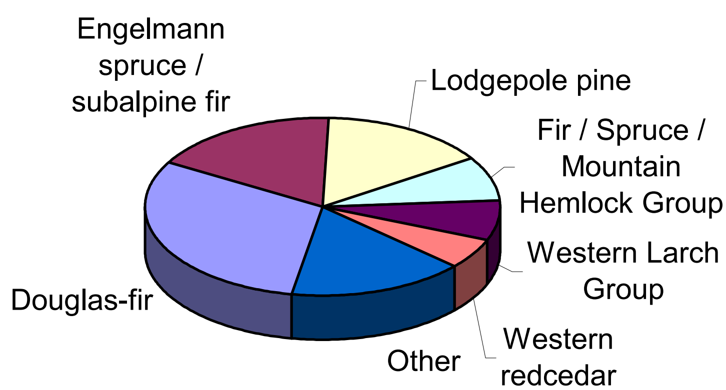


Table 1-1. Acres by Forest Type and Size Class on the Idaho Panhandle National Forests

National Forests: Idaho Panhandle						
	Total	Large diameter	Medium diameter	Small diameter	Non-stocked	Not collected
Douglas-fir	713,900	595,700	45,500	72,700	0	0
Ponderosa pine	36,400	27,300	0	0	9,100	0
Western white pine	81,800	18,200	36,300	27,300	0	0
Fir / Spruce / Mountain Hemlock Group	300,000	227,300	18,200	54,500	0	0
Engelmann spruce	32,000	23,000	0	9,000	0	0
Engelmann spruce / subalpine fir	459,800	341,600	63,600	54,600	0	0
Mountain hemlock	90,900	81,800	9,100	0	0	0
Lodgepole pine	368,400	227,200	104,800	18,200	18,200	0
Western hemlock	136,400	109,100	9,100	0	18,200	0
Western redcedar	190,900	190,900	0	0	0	0
Western Larch Group	118,200	90,900	27,300	0	0	0
Unavailable	42,800	0	0	0	0	42,800
Total	2,571,500	1,933,000	313,900	236,300	45,500	42,800

Source: FIA summary report

Table 1-2. Acres by Forest Type and Size Class on the Kootenai National Forest

National Forest: Kootenai						
	Total	Large diameter	Medium diameter	Small diameter	Non-stocked	Not collected
Douglas-fir	753,700	572,100	49,100	107,900	24,600	0
Ponderosa pine	42,900	18,800	0	18,300	5,800	0
Western white pine	6,300	0	0	6,300	0	0
Fir / Spruce / Mountain Hemlock Group	83,700	77,900	5,800	0	0	0
Engelmann spruce	110,600	79,200	0	31,400	0	0
Engelmann spruce / subalpine fir	358,700	210,400	37,600	87,000	23,700	0
Mountain hemlock	64,700	41,400	17,800	5,500	0	0
Lodgepole pine	372,300	158,300	145,100	68,900	0	0
Western hemlock	57,100	50,800	0	6,300	0	0
Western redcedar	72,000	72,000	0	0	0	0
Western Larch Group	235,900	130,500	61,400	44,000	0	0
Whitebark pine	6,300	6,300	0	0	0	0
Unavailable	82,300	0	0	0	0	82,300
Total	2,246,500	1,417,700	316,800	375,600	54,100	82,300

Source: FIA summary report

Forest-Wide Comparison of Historic vs. Current Vegetation

Figures 1-2 and 1-3 illustrate the change from historic to current vegetation on the KNF and IPNFs. Proportions have obviously been altered from a combination of management activities and fire suppression. Source of data used in making these graphs are a result of TSMRS summaries and historic maps, photos, and fire scar analyses.

Figure 1-2. Historic vs. Current Vegetation for the IPNFs

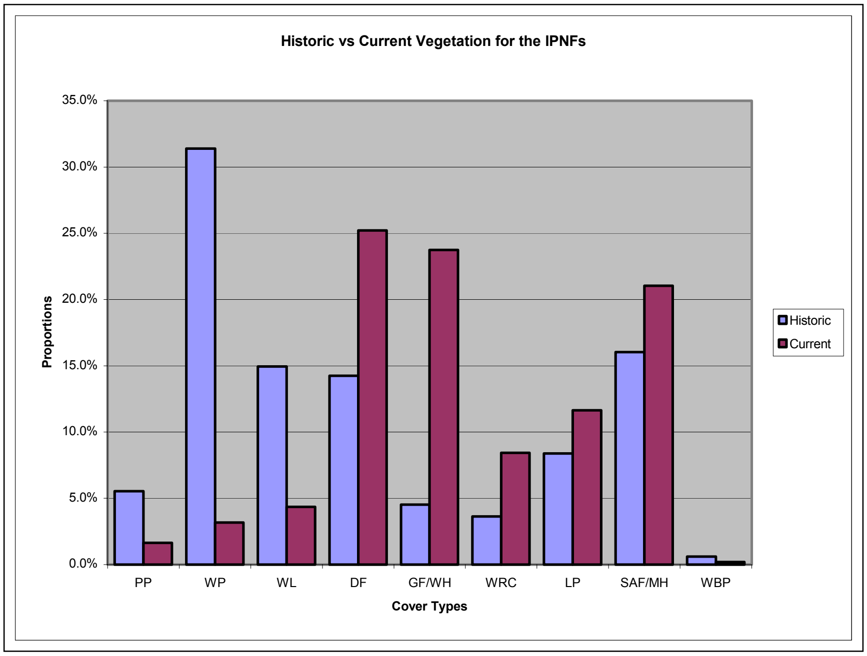
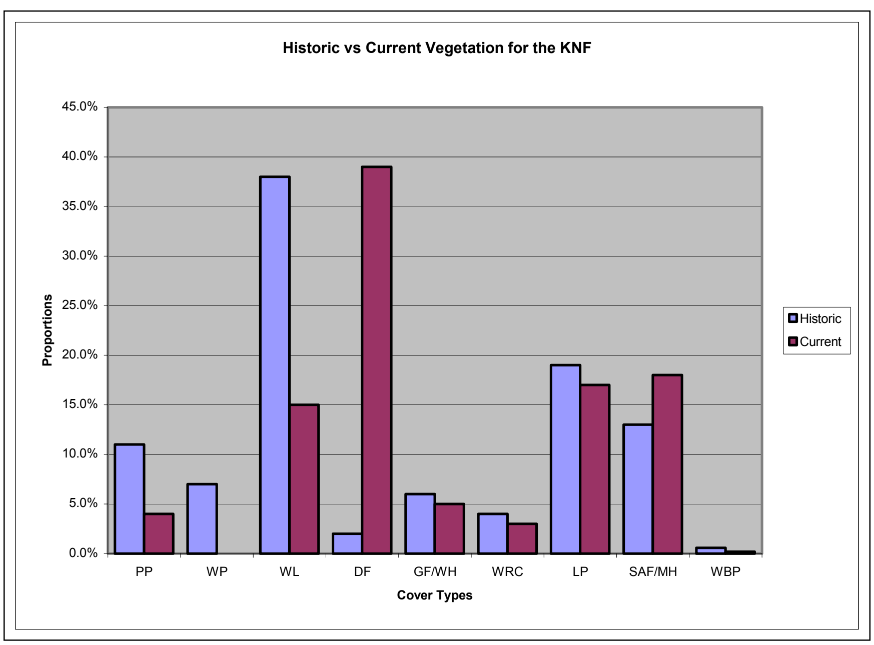


Figure 1-3. Historic vs. Current Vegetation for the KNF



Key Vegetative Changes that have Occurred Across the KIPZ (Coarse scale)

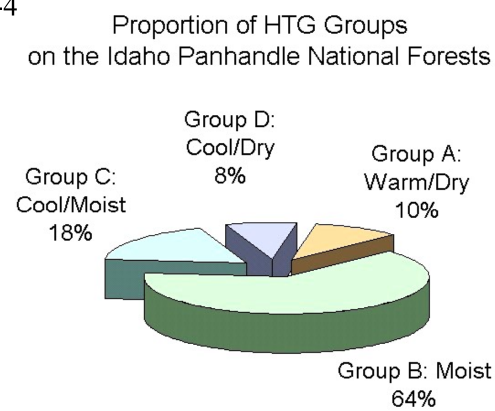
1. The shift from species that generally need high quantities of sunlight to persist, (more sun loving) to those that can tolerate denser and more shaded forest conditions. This condition is considered to be a factor in reducing the resilience and sustainability of the forest.
    a. Beginning in the 1930s, the loss of western white pine in the more moist forest environments (due to the combination of mountain pine beetle, and subsequent white pine blister rust that can continue to cause massive mortality of this species) is particularly significant in forested ecosystems throughout the KIPZ. This forest type has been replaced by fairly large expanses of Douglas-fir, western hemlock, and fir/spruce/mountain hemlock type. Due to the current composition of dense forest conditions and the subsequent susceptibility to bark beetles and root disease, these current types will likely experience future insect, disease and fire disturbance that will effect sustainability of a large portion of the forest ecosystem.
    b. A similar situation exists in the higher elevation settings of the KIPZ with whitebark pine. A combination of mountain pine beetle, whitepine blister rust and fire exclusion has resulted in a replacement to Engelmann spruce/subalpine fir forests. These dense, multi-storied forests are now highly susceptible to very large scale fires and have greatly declined levels of whitebark pine compared to 20-30 years ago.
    c. In both the moist and cool potions of the KIPZ, the shade-intolerant western larch was much more prevalent than today. Large overstory western larch trees were a preferred species for historic logging, and with fire suppression, this species is in decline as a predominant forest type in many areas. This type has been replaced by dense Douglas-fir, and fir/spruce/mountain hemlock forest types that are much less resistant to insects, diseases, and moderate intensity fire.
    d. Within the drier portions of the KIPZ, less large ponderosa pine are present than occurred historically. These large, relatively open grown pines were easily accessible to historic lower elevation logging and with the combination of subsequent fire suppression, many areas have been replaced by dense Douglas-fir. These current conditions are much more susceptible to Douglas-fir beetle, root disease, and severe wildfire.

2. A shift in forest structure including the pattern or arrangement of the forest communities has occurred, and could affect resilience and the sustainability of historic ecological relationships.
    a. In some areas, increases in density have created conditions that make the forest more susceptible to insects, diseases, and severe wildfire, especially if you consider the above species compositional changes that have occurred during the same timeframe.
    b. The pattern and arrangement of forest structures have changed as well. Due to the small-scale pattern of timber harvest during the past several decades, large, spatial “patches” historically common, are now replaced by smaller patches less typical of historical conditions.

Vegetation Response Units and Vegetation Change (Fine-scale)

Vegetation Response Units (VRUs) are aggregations of land having similar capabilities and potentials for management. These ecological units have similar patterns in potential natural communities; soils; hydrologic function; landform and topography; lithology; climate; air quality; and natural processes (nutrient and biomass cycling, succession, productivity, and fire regimes). Each VRU has an associated description of its ecological structure, composition, and function.

Figure 1-4

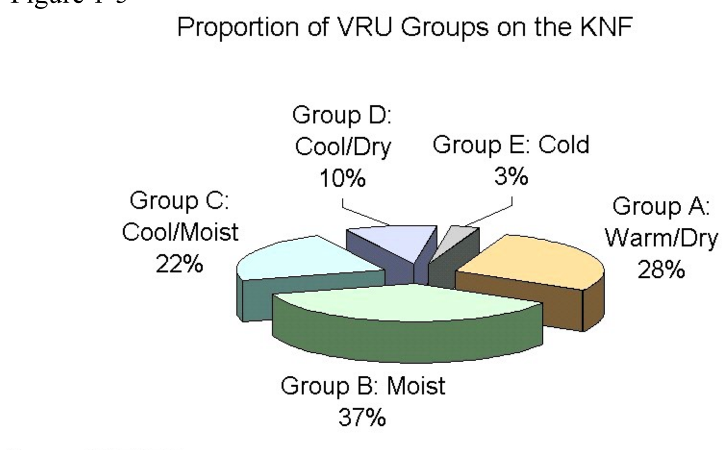


VRUs provide a means to describe and define the components of ecosystems. The structure and function of the component types that make up the ecosystem are an indication of the relative health of ecosystems (USDA Forest Service 1999d).

Vegetation on the IPNFs has been summarized by Habitat Type Groups (HTGs), which are fairly synonymous with VRUs. There are 11 HTGs on the IPNFs and the HTGs were combined into 4 groups that correspond with the VRU groups. There are only 4 groups because the IPNFs further combined the cool/dry and cold HTGs since there is a negligible amount of land in cold habitat types. Figure 1-4 displays the proportion of HTG groups on the IPNFs. For ease of discussion, the term VRU will be used to represent HTG as well.

There are 11 VRUs on the KNF and for ease of discussing historic and current vegetation, similar VRUs have been combined into 5 groups. Figure 1-5 displays the proportion of VRU groups on the KNF.

Figure 1-5

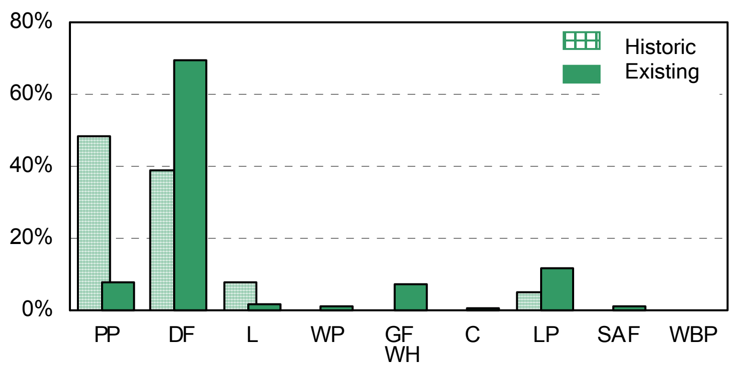


Following is a description of each VRU group on the national forests, including composition, structure, and disturbance processes. For composition and structure, current condition as percentages of species or size class are compared to historic percentages. Because of the uncertainty and change that occurs over time, it is appropriate to display historic conditions as a range. The analysis to determine historic ranges will be completed as part of the DEIS.

Group A: VRU 1/HTG 1 (Warm/Dry), VRU 2/HTG 2 (Moderately Warm/Dry), and VRU 3/HTG 3 (Moderately Warm/ Moderately Dry)

Description: This group contains the more warm and dry habitat types with VRU 1 being the warmest and driest to the more moderate conditions of VRU 3. These sites include warm, dry grasslands to 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. Moderately moist, upland sites and dense draws also include larch and lodgepole pine, with lesser amounts of ponderosa pine. Tree regeneration occurs in patches and is largely absent in the understory, particularly in the driest sites. Annual precipitation ranges from 14” to 30”, about 75% of that falling as rain. While the growing season is fairly long, high solar input and moderately shallow soils often result in soils that dry out early in the growing season, which results in low to moderate site productivity.

Figure 1-6 Warm/Dry Habitat Groups on the IPNF
Comparison of Existing and Historic Forest Types

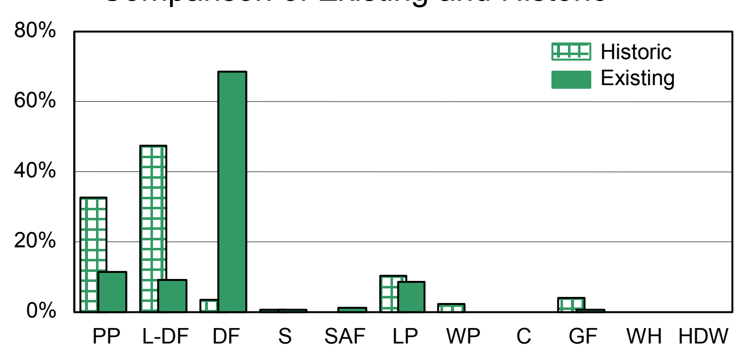


A) SAF also includes MH.
Source: Existing data comes from TSMRS database. Historic data is on file at the IPNF office.

Fire Disturbance: Historically, frequent, low-severity fires were the predominant fire regimes. Mixed-severity fires were also common, particularly in VRU 3. In extreme cases, stand-replacing fires could also occur. Due to fire suppression, numerous fire cycles have been missed in this group, particularly in VRUs 1 and 2. Fires are more likely to be mixed-lethal to lethal as ladder fuels and biomass increases.

Forest Cover Types: A comparison of historic and existing cover types shows some changes and trends (figures 1-6 and 1-7). In general, there is a decrease in seral species such as ponderosa pine and larch and an increase in Douglas-fir. As stated earlier, this is most likely due to a combination of historic logging of seral ponderosa pine and larch and fire suppression, which allowed understory Douglas-fir to develop.

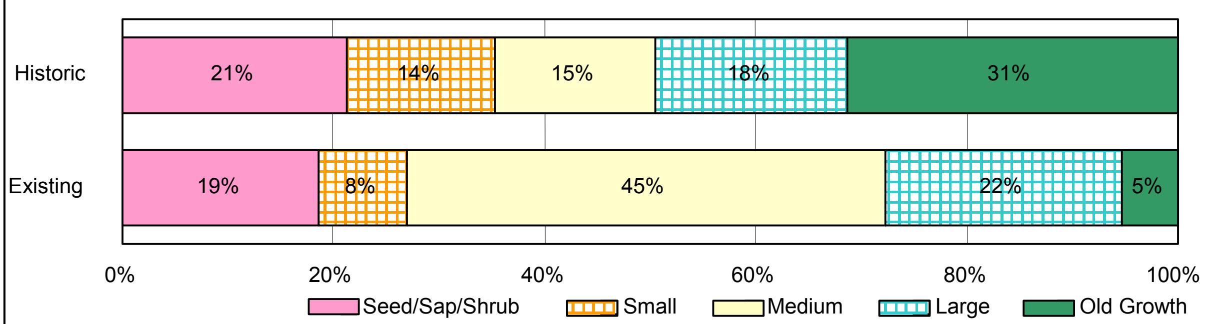
Figure 1-7
Warm/Dry VRUs on the
Comparison of Existing and Historic



A) Existing condition DF also includes MC forest type. C) Historic condition L consists of L/DF.
B) Existing condition SAF also includes MAF. D) Historic conditon SAF also includes S.
Source: Existing data comes from TSMRS database. Historic data is on file at the KNF office.

Figure 1-8

Warm/Dry Habitat Groups on the IPNF
Comparison of Existing and Historic Successional Stages

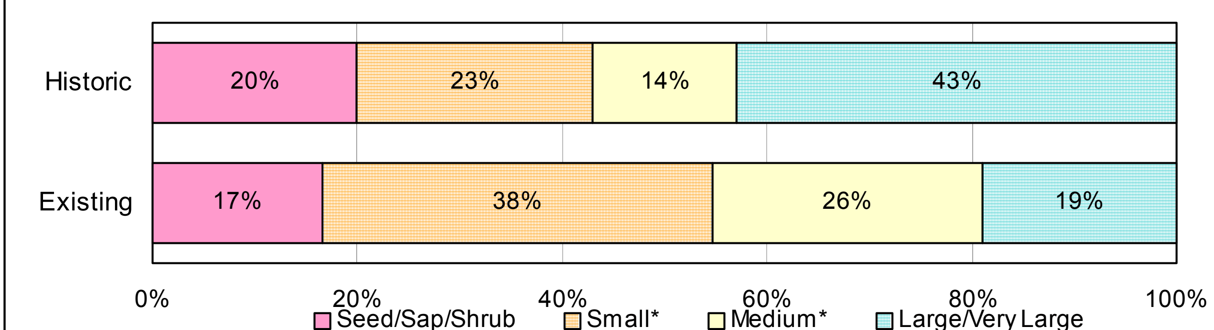


Source: Existing data comes from TSMRS database. Historic data is on file at the IPNF office.
*Acres of existing old growth are based on management area allocations.

Successional Stages: A comparison of historic and existing age-classes shows some changes and trends (figures 1-8 and 1-9). In general, there is currently a higher proportion in the mid- successional stages and a lower proportion in the late-successional stages in comparison to historic conditions. This may be due to historic timber harvest of large overstory ponderosa pine and larch since many areas in this group were easily accessible for timber harvest in the early part of the 20th century. Many stands that were harvested then would now be in mid-successional stage.

Figure 1-9

Warm/Dry VRUs on the KNF
Comparison of Existing and Historic Successional Stages



A) The existing age class Large/Very Large includes all stands coded as multi-aged.
B) A range of conditions existed historically. In Group A this variability is negligible at the 6th or 7th code HUC scale.
Source: Existing data is from TSMRS database. Historic data on file at the KNF office.

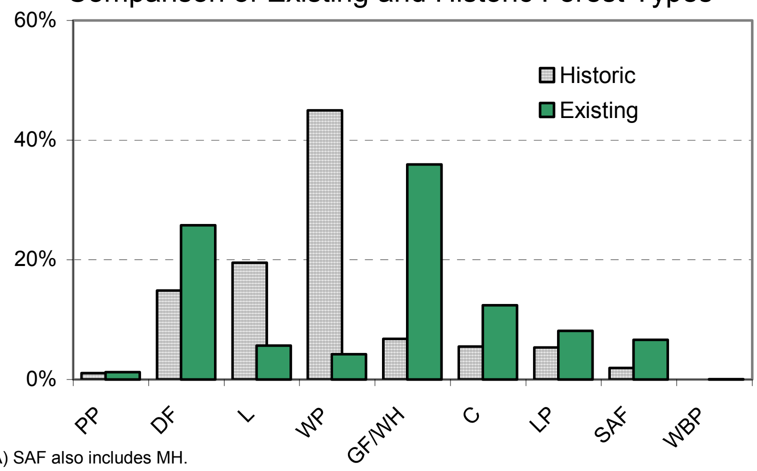
Group B: VRU 4/HTG 4 (Moderately Warm/Moist), VRU 5/HTG 5 (Moderately Cool/Moist), and VRU 6/HTG 6 (Moderately Cool/Wet)

Description: This group occupies most of the moist sites along benches and stream bottoms. The moderating effects of the inland maritime climate ecologically influence this group. This group includes the more moderate sites of VRU 4 and scattered riparian and wet sites of VRU 6. This group is widespread throughout the forest and has the most biological productivity. Precipitation is moderate to high ranging from 30” to 55” per year.

Fire Disturbance: Mixed-severity and stand-replacing fires were common historically in this group.

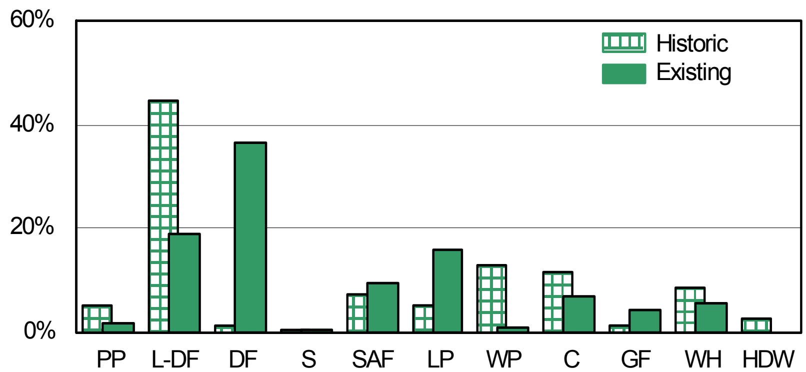
Forest Cover Types: A comparison of historic and current cover types shows some changes and trends (figures 1-10 and 1-11). Major changes are decreases in seral larch and white pine and increases in Douglas-fir and grand fir. The large decrease in white pine is most likely a result of white pine blister rust. The loss of larch may be due to historic logging of overstory larch. Douglas-fir and grand fir now dominate many stands in this group due to the removal of white pine and larch combined with effects due to fire suppression.

Figure 1-10 Moist Habitat Groups on the IPNF
Comparison of Existing and Historic Forest Types

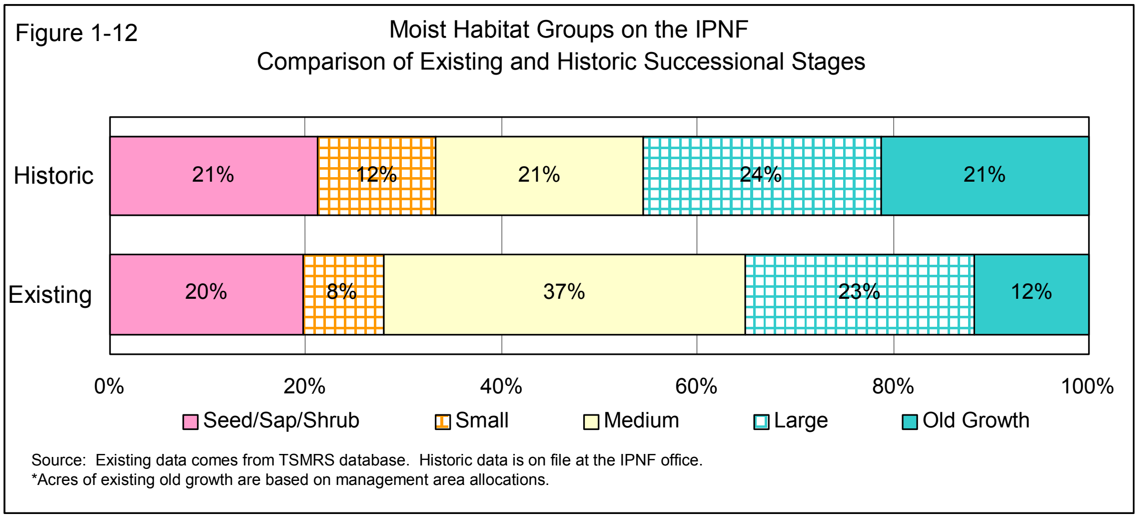


A) SAF also includes MH.
Source: Existing data comes from TSMRS database. Historic data is on file at the IPNF office.

Figure 1-11 Moist VRUs on the KNF
Comparison of Existing and Historic Forest Types

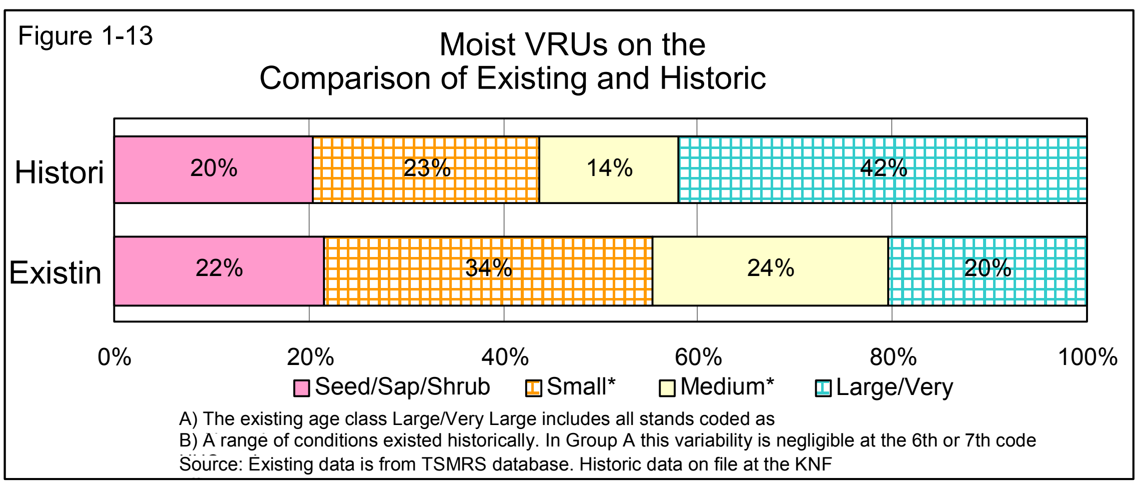


A) Existing condition DF also includes MC forest type. C) Historic condition L consists of L/DF.
B) Existing condition SAF also includes MAF. D) Historic conditon SAF also includes S.
Source: Existing data comes from TSMRS database. Historic data is on file at the KNF office.



Successional Stages: A comparison of historic and existing age-classes shows some changes and trends (figures 1-12 and 1-13).

In general, there is an increase in mid-successional stages and a decrease in late-successional stages in comparison to historic conditions. As the most productive areas on the Forests, timber harvest activities have occurred throughout this group. In particular, older or decadent stands as well as disease-ridden white pine stands have been regenerated, which may be the reason for the decrease in the late-successional stage. In addition, portions of this group experienced stand-replacing fires in the late 1800s and early 1900s, which may contribute to the increase in the mid-successional stages.



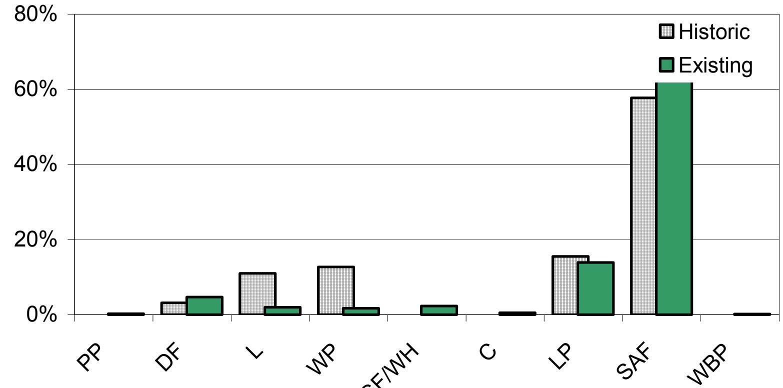
Group C: VRU 7/HTG 7 (Cool/Moist) and VRU 8/HTG 8 (Cool/Wet)

Description: This group 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. This landscape is typically bordered by warmer sites (Group B) and cool, drier subalpine sites (Group D). This group includes characteristics of each. Average precipitation is estimated between 35" and 55" per year, less than half as rain. Vegetative productivity is moderate to high as a result of the high moisture-holding capacity and nutrient productivity of loess deposits, adequate precipitation, and a good growing season.

Fire Disturbance: Both stand-replacing fires and mixed-severity fires occurred in these environments. Thin bark and shallow roots of the dominant tree species mean that low-severity underburns were rare. Little detailed fire history data has been analyzed for these areas. Short snow-free seasons, cooler temperatures, and relatively moist environments mean that conditions for large stand-replacing fires are likely uncommon in these environments.

Figure 1-14

Cool/Moist Habitat Groups on the IPNF
Comparison of Existing and Historic Forest Types

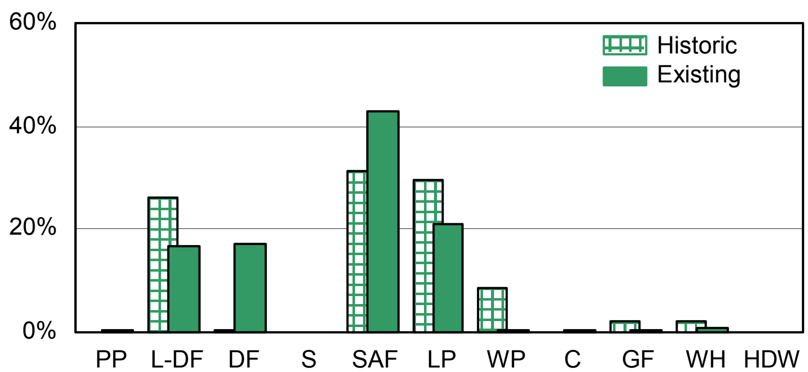


A) SAF also includes MH.
Source: Existing data comes from TSMRS database. Historic data is on file at the IPNF office.

However, records of fires are common and some were clearly stand-replacing. The larger stand-replacing fires may be related to major fire events originating in lower elevation, warmer, drier environments. In general, fires were likely to be smaller and patchier in subalpine environments than in warmer low elevation sites. Mean fire return intervals average 150-175 years, but can be much longer or shorter depending upon fire regimes on adjacent lower elevation sites (Smith and Fischer 1997). Although fire suppression has the potential to change landscape patterns on subalpine sites, a smaller suite of potential species means that there's less opportunity for complete change of landscape successional processes.

Figure 1-15

Cool/Moist VRUs on the KNF
Comparison of Existing and Historic Forest Types

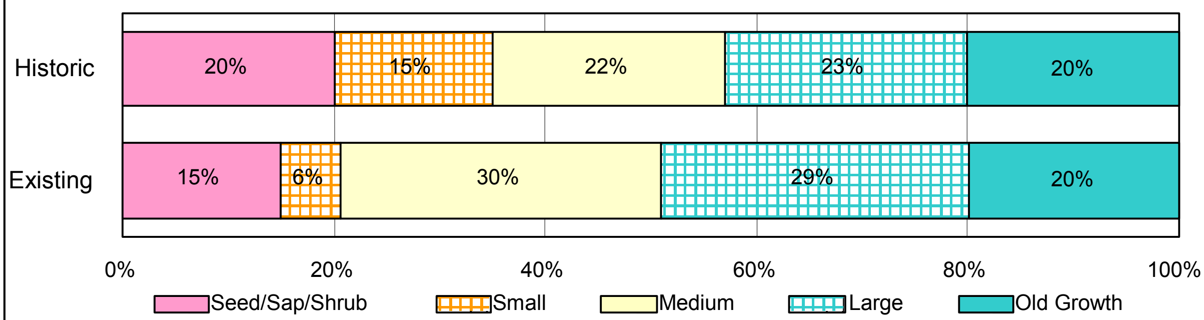


A) Existing condition DF also includes MC forest type. C) Historic condition L consists of L/DF.
B) Existing condition SAF also includes MAF. D) Historic conditon SAF also
Source: Existing data comes from TSMRS database. Historic data is on file at the KNF

Forest Cover Types: A comparison of historic and existing cover types shows some changes and general trends (figures 1-14 and 1-15). Major changes are decreases in seral white pine, larch and to a lesser extent, lodgepole pine, and increases in Douglas-fir and spruce-subalpine fir. The large decrease in white pine is most likely a result of white pine blister rust. Logging of overstory larch may contribute to the decrease in larch. The loss of lodgepole pine may be due to mountain pine beetle and subsequent salvage harvesting of dead and dying lodgepole pine stands. Spruce-subalpine fir and Douglas-fir now dominate many stands in this group with declines in seral white pine, larch, and lodgepole pine.

Figure 1-16

Cool/Moist Habitat Groups on the IPNF
Comparison of Existing and Historic Successional Stages



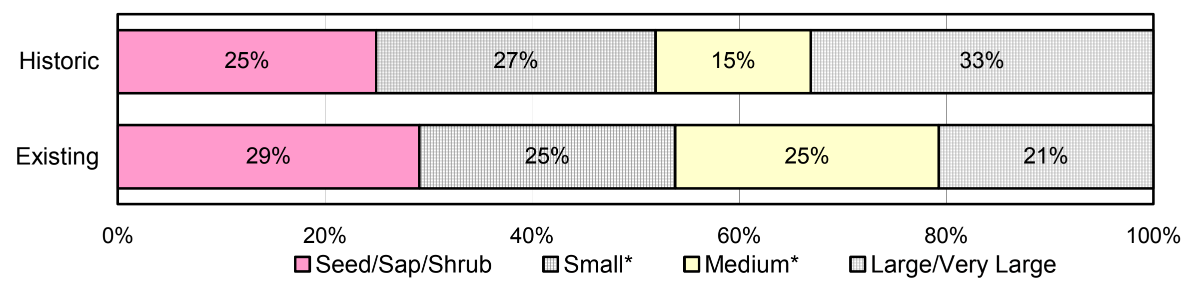
Source: Existing data comes from TSMRS database. Historic data is on file at the IPNF office.
*Acres of existing old growth are based on management area allocations.

Successional Stages: There are slight differences between the KNF and the IPNFs. On the IPNFs, there are increases in the medium and large size classes and a decrease in the small size class (figure 1-16).

On the KNF there is a higher proportion in a medium successional stage and a lower proportion in the large/very large successional stage in comparison to historic conditions (figure 1-17). Areas in this group are highly productive and timber harvest activities have occurred here. In particular, older or decadent stands as well as insect and disease prone lodgepole pine and white pine stands have been regenerated, which may be the reason for the low proportion in the large/very large class. In addition, portions of this group experienced stand-replacing fires in the late 1800s and early 1900s, which may contribute to the high proportion in the medium successional stage.

Figure 1-17

Cool/Moist VRUs on the KNF
Comparison of Existing and Historic Successional Stages

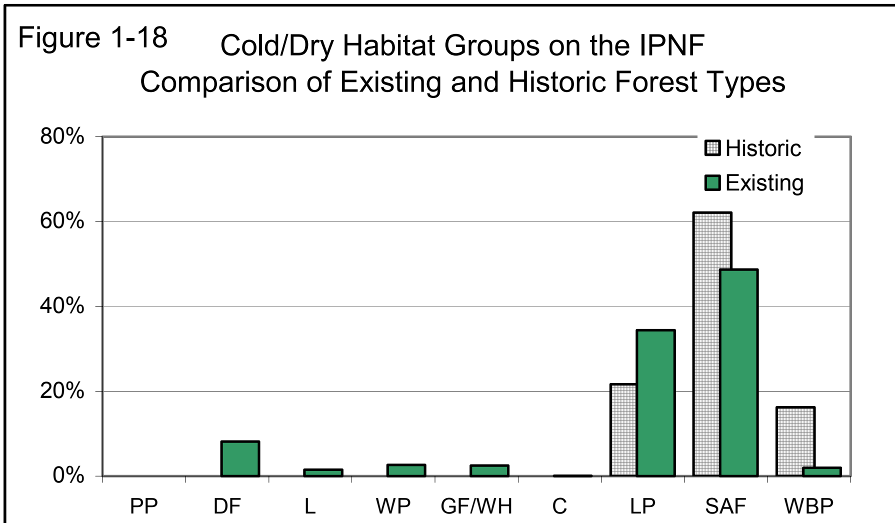


A) The existing age class Large/Very Large includes all stands coded as multi-aged.
B) A range of conditions existed historically. In Group A this variability is negligible at the 6th or 7th code HUC scale.
Source: Existing data is from TSMRS database. Historic data on file at the KNF office.

__Group D: VRU 9/HTG 9 (Cool/ Moderately Dry) On the IPNFs HTG 10 (Cold/Moderately Dry) and HTG 11 (Cold)__

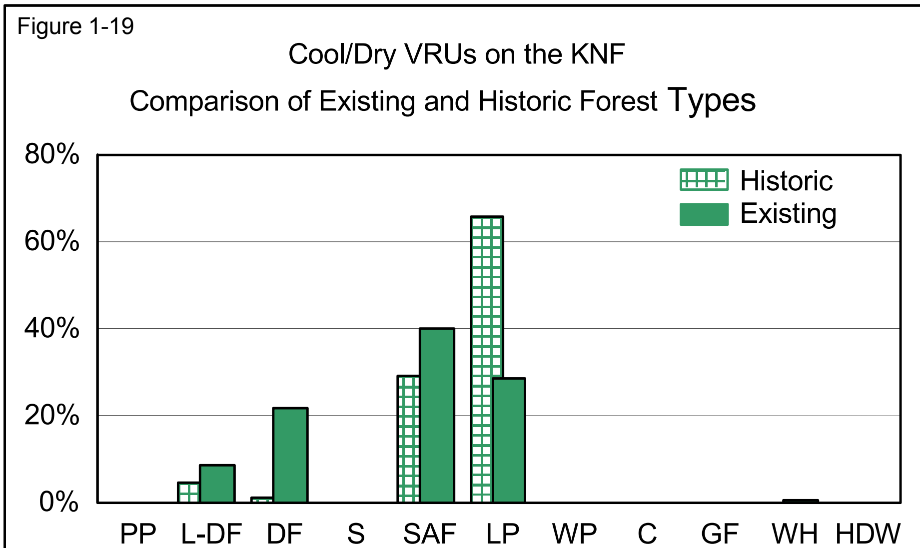
Description: This group is typified by cool and moderately dry conditions with moderate solar input. The climate is characterized by a short growing season with early summer frosts. Annual precipitation ranges from 35”-70”, mostly in the form of snow. Due to generally shallow soils (low water holding capacity), slope position, and aspect, soil moisture is often limited during late summer months. It is generally found on rolling, ridges and upper reaches of convex mountain slopes. Due to slight differences in how the two Forests combined the VRUs, there may be some differences in the comparisons made below. Some of the discussion for Group E would also apply to the IPNFs portion of this group.

Fire Disturbance: The predominant fire regime was stand-replacing. In lodgepole pine dominated areas, the fire return interval averaged 100-115 years.

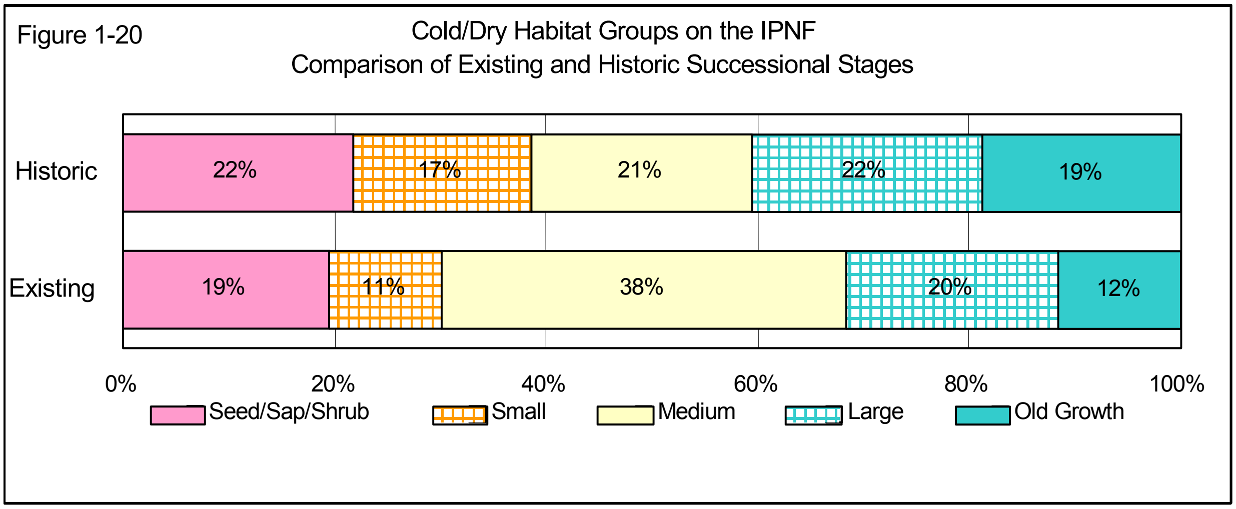


A) SAF also includes MH.
Source: Existing data comes from TSMRS database. Historic data is on file at the IPNF office.

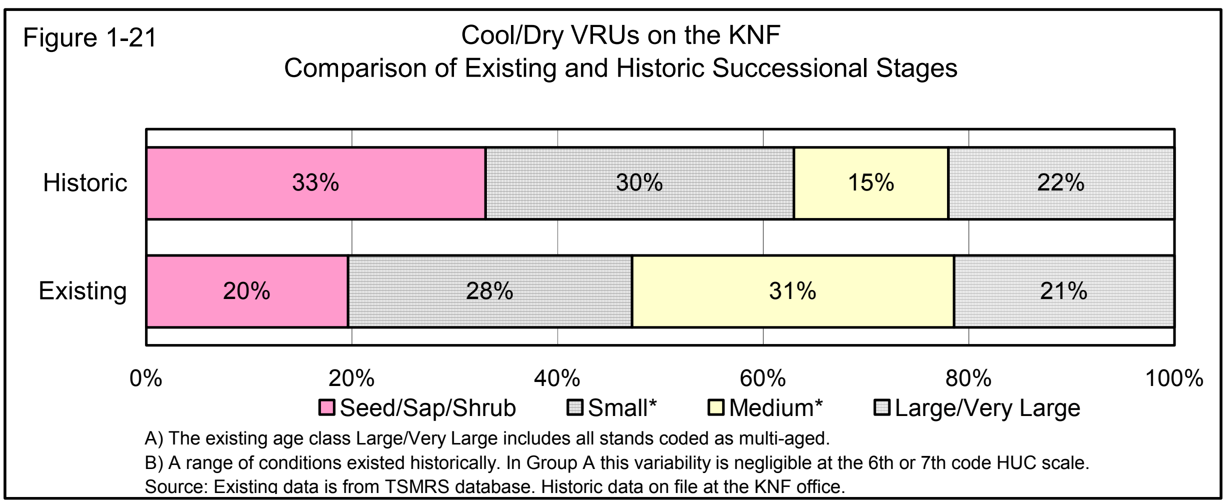
Forest Cover Types: On the IPNFs, whitebark pine occurs in this group. Major changes here are decreases in whitebark pine and spruce-subalpine fir and an increase in lodgepole pine. Whitebark pine has declined dramatically due to white pine blister rust and fire suppression (figure 1-18). On the KNF there has been a decrease in lodgepole pine and increases in Douglas-fir and spruce-subalpine fir (figure 1-19). The loss of lodgepole pine may be due to mountain pine beetle and fire suppression, as lodgepole pine tends to regenerate following stand-replacing fires. The proportions of spruce-subalpine fir and Douglas-fir may have increased due to fire suppression and natural succession from lodgepole pine stands.



A) Existing condition DF also includes MC forest type. C) Historic condition L consists of L/DF.
B) Existing condition SAF also includes MAF. D) Historic conditon SAF also includes S.
Source: Existing data comes from TSMRS database. Historic data is on file at the KNF office.



Successional Stages: On the IPNFs, there is an increase in medium size class and decreases in old growth and small size classes (figure1-20). On the KNF there is a higher proportion in the medium size class and a lower proportion in the small size class in comparison to historic conditions (figure 1-21). These shifts may be due to the suppression of potentially stand replacing fires.



Group E: VRU 10 (Cold/Moderately Dry) and VRU 11 (Cold)

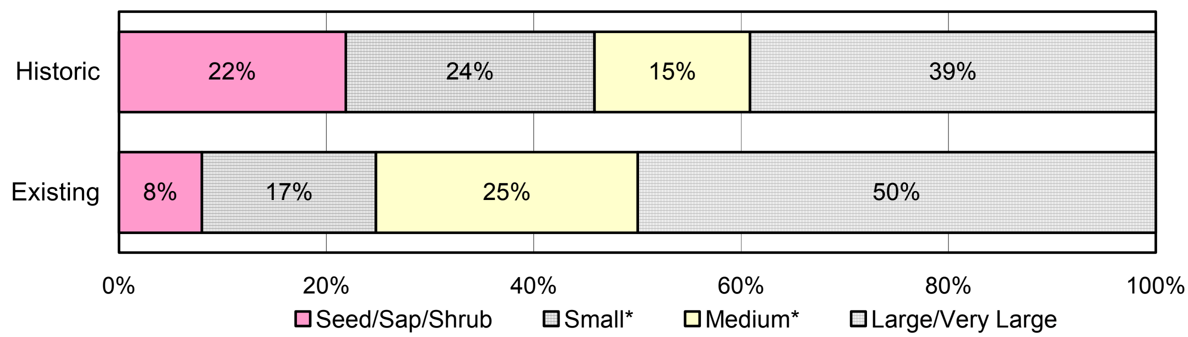
Description: This group occurs on high elevation, cold sites between forest and alpine tundra. It is typified by cold and moderately dry conditions with short day lengths and low to moderate solar input. The climate is characterized by a short growing season with early summer frosts. Annual precipitation ranges from 50" to 90", 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 found on upper reaches of fairly steep, convex mountain slopes. It also occurs on very steep alpine ridges and glacial cirque headwalls. The landforms within VRU 11 have been influenced by alpine glaciation and are a complex of forest, avalanche chutes, and rock outcrops.

Fire Disturbance: The predominant fire regime was low to mixed-severity at 35-300+ years. Stand-replacement fires could also occur at 200+ years.

Forest Cover Types on the KNF: Quantitative historic data for cover types was not available as in the other groups. Therefore, this discussion is based on the VRU descriptions (USDA Forest Service 1999d). Based on a TSMRS query, the most common forest type in this group is spruce-subalpine fir (84%). Historically, common species were whitebark pine, Engelmann spruce, lodgepole pine, with some subalpine fir and mountain hemlock. Due to fire exclusion, many whitebark pine stands are being replaced by mixed coniferous and spruce-subalpine fir forests. In recent decades whitebark pine distribution has also decreased because of mountain pine beetle and white pine blister rust.

Successional Stages on the KNF: A comparison of historic and existing age-classes shows some changes and general trends (figure 1-22). In general, there is currently a higher proportion in the large/very large successional stage and a lower proportion in the younger seed/sap/shrub successional stage in comparison to historic conditions. Most of the area in this group occurs in subalpine settings with very limited harvest activities. This factor combined with fire suppression has favored the development of older stands.

Figure 1-22 Cold VRUs on the KNF
Comparison of Existing and Historic Successional Stages



A) The existing age class Large/Very Large includes all stands coded as multi-aged.
B) A range of conditions existed historically. In Group A this variability is negligible at the 6th or 7th code HUC scale.
Source: Existing data is from TSMRS database. Historic data on file at the KNF office.

Historic And Current Function

Ecosystem function includes energy flows of materials across and within the landscape and how one ecosystem influences another. Function also relates to energy processes such as fire, hydrological processes (including floods), and matter and energy exchange throughout the food chain.

To understand how ecosystems function, KIPZ needs to know more than just how much of various components or structures are present. Among other things, it is important to understand the patterns of how things are arranged on the landscape. Landscape pattern affects wildlife habitat and dispersal, plant habitat and dispersal, disturbance (fire, insects, pathogens) spread and size, ecosystem response to disturbance, and human esthetic values.

Some important interrelated concepts in assessing landscape patterns are patches, interior habitat, and fragmentation. A patch is defined as an area of continuous habitat or as an area capable of facilitating particular habitat functions for given species or species groups. Patches can be identified according to key habitat features of forest structure, composition, and process (UKSB). Interior forest habitat is defined as "The environmental conditions typical of the central or interior part of a habitat patch. They are usually relatively stable and uninfluenced by the changing climatic conditions and other variables (noise, wind, sunlight, temperature, moisture) associated with edge conditions" (Dunster and Dunster 1996). In general, interior habitat is the opposite of fragmentation (the greater the fragmentation, the fewer acres of interior forest habitat). The size and shape of forested areas largely determines the size of interior habitat. Obviously, the larger the forested patch is the larger the interior habitat would be. The shape of the forested patch is also important. Interior habitat is maximized when the shape of the forested patch is circular and minimized when the forested patch is linear. Some forested patches may be so narrow that they only provide edge habitat and no interior habitat.

Compared to the historical condition, there are several important changes in landscape patterns. Generally, patch sizes are smaller today than they were historically.

Analysis on the IPNFs shows that early and late-successional patches are smaller and more homogenous in size than historic. Compared to the historical situation, the late successional structural stages are much more fragmented. They are divided into smaller patches with generally more edge and less interior and they are more homogeneous in patch size (fewer large patches). In contrast, the medium size class is a larger percent of the landscape; however, the large patches of medium size class are internally fragmented by numerous small patches of early successional stages created by timber harvest, or patches of medium sized trees are linked together by long skinny leave strips.

The Upper Kootenai Subbasin Review, an analysis conducted on the KNF, shows that patch sizes have decreased across all patch types, including early successional patches (USDA Forest Service 2002). Corresponding with smaller patch sizes are less interior habitat and greater fragmentation. On the KNF, the cool and the moist habitat types seem to have deviated most from historic conditions although all habitat types have declined in amount and size of interior habitat (USDA Forest Service 2002e).

Planning Question - What is the historic and current condition of riparian vegetation on the KIPZ and what are the trends?

Historic Condition Of Riparian Vegetation

Riparian vegetation makes up the green zones bordering lakes, potholes, springs and seeps, peatlands, wet meadows, vernal pools, and ephemeral, intermittent, or perennial streams. This vegetative zone is the interface or linkage between the upland (terrestrial) and deepwater (aquatic) zones (Hansen et al. 1995). Riparian vegetation stabilizes streambanks and aids in reducing streambank damage from ice, log debris, and animal trampling. Trees, shrubs, and herbaceous vegetation within the riparian area provide cover for animals and reduce the velocity and erosive energy of overbank flow during floods (Schumm and Meyer 1979).

Geomorphic and other disturbance processes of both upland and fluvial origin affect aquatic and riparian ecosystems. Geomorphic and fluvial disturbance processes determine the spatial pattern and successional development of riparian vegetation. Valley floor landforms, in particular, valley width, gradient and substrate size, influence the types of streams, riparian vegetation, their extent and distribution. This in turn creates an array of physical habitats within active channels and associated floodplains. Streamside plant communities are major determinants of the abundance and quality of nutritional sources for stream ecosystems (Gregory et al. 1991).

Biotic integrity of aquatic ecosystems depends on the natural and dynamic character of those systems. Streamflow (includes magnitude, frequency, duration, timing, and rate of change) is a critical component of water supply and water quality. Streamflow is strongly correlated with many critical physical-chemical characteristics of rivers and streams. Some of these characteristics include water temperature, channel geomorphology, and habitat diversity. Natural streamflow variability is important in maintaining healthy aquatic ecosystems (Poff et al. 1997).

Historically, aquatic ecosystems on the KNF and IPNFs were areas of greatest vegetation species diversity, refugia for wildlife and vegetation from most upland disturbances, and provided connectivity corridors across the landscape.

<u>Current Condition Of Riparian Vegetation</u>

Disruption and/or alteration of natural flow regimes can change the established pattern of hydrologic variation and disturbance. This alters habitat dynamics and may create new conditions to which native biota may be poorly adapted. A loss in the ability of an aquatic ecosystem to support natural processes and native species may result (Poff et al. 1997).

The INFS of 1995 (USDA Forest Service 1995d) amended the Forest Plans to maintain the integrity of upland and riparian areas within watersheds. The INFS amendment established riparian management objectives, standards and guides, and monitoring guidelines. Since that time, the guidelines have proved generally effective in achieving INFS objectives, but not effective in addressing needs at a finer scale of resolution. An example is related to stream widths. INFS prescribed four categories of interim standard stream widths. These were to be applied until a completed watershed analysis provided an ecological basis for change. The Aquatic Response Unit (ARU) classification completed for the Kootenai addresses modifications to INFISH.

An ARU classification is the preferred method to understand the composition, structure, and function of riparian vegetation. ARUs are determined by temporal and spatial patterns of hydrologic and geomorphic processes within defined valley bottoms of predetermined widths. Departure from a range of variability and/or a proper functioning condition can be determined by either comparison to reference stream reaches within a given valley bottom type (or ARU) undisturbed by human influence or from an understanding of aquatic processes developed through ARUs.

The KNF has developed an ARU classification and inventory. Table 1-3 is a summary description of these ARUs. Additional information can be found in the draft ARU document on file at the Supervisor's Office in Libby. The ARUs have been grouped based on overall similar descriptive characteristics. Each ARU is coded so the first number reflects the dominant stream order. The second and third letters reflect the overall gradient (stream gradient) where "A" is the highest gradient and "C" is the lowest gradient. These classes follow the Rosgen system gradient breaks.

Table 1-3. Summary of ARUs on the Kootenai National Forest

Group	ARU	Proportion of the KNF	Description	Vegetation
1	1A	33%	First and some second order, very steep streams. Commonly found at elevations between 3000-5500'. Major landtype groups are 300 and 400 series. Valley bottoms are narrow.	Grand fir, Black Cottonwood, Western Redcedar, Western Hemlock, Common Snowberry,
1	1AB	19%	First and 2nd order, steep streams. Commonly found at elevations between 2500-5500'. Major landtype group is 300 series. Valley bottoms are fairly narrow.	Western Redcedar, Mountain Alder, Sitka Alder, Fools's Huckleberry, Drummond Willow, Arnica
1	3AB	1%	Third order, steep streams. Commonly found at elevations below 4500'. Major landtype groups are 300 and 400 series, followed by 100 series. Valley bottoms are fairly narrow.	Grand fir, Western Redcedar, Rocky Mountain Maple, Common Prince's-pine, Twinflower, Thimbleberry
2	1B	17%	First and second order, moderate gradient streams. Mainly found at elevations between 2500-5000'. Most common landtype group is 300 series, followed by the 100 then the 400 series. Valley bottoms are moderately wide.	Engelmann Spruce, Western Redcedar, Sitka Alder, *Sphagnum sp.,* Ticklegrass, Oak-fern
2	1B	17%	First and second order, moderate gradient streams. Mainly found at elevations between 2500-5000'. Most common landtype group is 300 series, followed by the 100 then the 400 series. Valley bottoms are moderately wide.	Engelmann Spruce, Western Redcedar, Sitka Alder, *Sphagnum sp.,* Ticklegrass, Oak-fern

Group	ARU	Proportion of the KNF	Description	Vegetation
2	3B	4%	Third order, moderate gradient streams. Mainly found at elevations between 2500-4500'. Most common landtype group is the 300 series, followed by the 100 and 400 series. Valley bottoms are moderately wide.	Grand fir, Paper Birch, Western Redcedar, Western Hemlock, Sitka Alder, Fools's Huckleberry, Devil's Club,
2	4B		Characteristics of this group include 1st, 2nd, and 3rd order streams with low gradient, higher sinuosity, and wide valley bottoms.	
3	1C	7%	First and second order, low gradient streams. Commonly found at elevations between 2000-4000'. Major landtype groups are 100 and 300 series. Valley bottoms are wide.	Spruce, Sitka Alder, Thimbleberry, Reedgrass, Ladyfern,
3	3C	5%	Third order, low gradient streams. Commonly found at elevations between 2000-4500'. Major landtype groups are 100 and 300 series. Valley bottoms are wide.	Grand fir, Engelmann Spruce, Black Cottonwood, Red-osier Dogwood, Douglas Spiraea, Ticklegrass,
4	4C	6%	Fourth order, low gradient streams. Mainly found at elevations below 4000'. Major landtype groups are 100 and 300 series. Valley bottoms are wide.	Paper Birch, Paper Birch, Balsam Poplar, Scouler Willow, Bentgrass, Beaked Sedge, Reed Canarygrass, Fowl Bluegrass
4	5C	2%	Fifth order, low gradient streams. Commonly found at elevations below 3500'. Major landtype group is the 100 series. Valley bottoms are wide.	Black Cottonwood, Western Redcedar, Shrubby Cinquefoil, Reed Canarygrass, Ladyfern
4	6C	1%	Average gradient is 1%. Gradient and sinuosity were computer generated and may differ from actual measurements. Sixth order streams are large and typically occur in the lowest reaches of the watershed at elevations under 3000'. The average width of the valley bottom in ARU 6C is 355 meters.	Paper Birch, Western Larch, Engelmann Spruce, Western Redcedar, Western Hemlock, Common Snowberry
5	LT32	1%	These streams are within landtype group 325. Streams are generally low to moderate gradient and occur in fairly wide valley bottoms. Stream order is generally 3rd order or smaller.	Engelmann Spruce, White Spruce, Rocky Mountain Maple, Alder, Alder Buckthorn, Redtop, Field Horsetail

The IPNFs does not have an ARU classification and inventory at this time. Riparian information for the forest will be summarized and analyzed for the DEIS.

Planning Question - What is the historic and current condition of noxious weed species on the KIPZ and what are the trends?

<u>Historic Condition Of Noxious Weeds</u>

Prior to the appearance of weed species, native plants existed together in a well-established system of plant succession, growth, competition, and natural disturbances that maintained plant communities in a dynamic equilibrium. When natural disturbance occurred, native pioneer plants colonized a site, and started a string of successional stages appropriate for the site.

Noxious weeds are any exotic plant species, which may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses or that may harm native plant communities. Exotic species were introduced both inadvertently and intentionally, and changed the nature of many plant communities. Non-native plants were brought to the North American continent as ornamentals, food crops, forage for domestic animals or for use in rapid revegetation of a site or erosion control. Many were transported by accident, in crop seed, or in soil of other plants, or in ships ballasts. Most introduced species never became pests. They could thrive without special care, or did not compete well with native vegetation, and remained confined to gardens, agricultural fields, or minor components of wildland vegetation. Some even became valuable crop and landscaping plants.

However, in the absence of competitors and natural enemies with which they evolved, a few exotic species spread and dominated to the detriment of native vegetation. For example, knapweed came into the United States from Eurasia in clover and alfalfa seed. Canada thistle was introduced to Canada in cropseed. Oxeye daisy was spread around the northwest in forage grass and legume seed after its introduction in the late 1800s. Houndstongue came from Eurasia in cereal seed. Some strains of leafy spurge probably came to the country in cereal seed. Intentional introduction have brought invasive weeds into the area as well. Common St. John's-wort seed was brought with English and German settlers as seed for gardens. Dalmatian toadflax came from Europe as an ornamental, as did orange hawkweed and absinth wormwood. These species then spread from their point of introduction to the inland northwest, by the same means that brought them to the country and over the road network.

Once established, these weeds spread mainly along roads and railways. They were also transported on heavy equipment, in hay, by livestock, wildlife and humans as well as other vectors. Disturbance such as roadbuilding and timber harvest created ideal conditions for the establishment of noxious weeds. These plants also invaded certain intact communities. Native plants were replaced by exotic species, often to the extent of the exotic species forming a monoculture. The structure, diversity, and function of the infested plant communities were dramatically altered.

Exotic species were able to accomplish this takeover due to several characteristics, depending on the species. Deep taproots, dense rosettes of leaves, prolific seed production, vegetative reproduction, and the ability to generally out-compete native plants for space and resources, along with the absence of natural checks and balances, afforded some exotic species a great advantage over native species. Some exotic species even exude chemicals that reduce the vigor of nearby plants, reducing their competitive ability.

Another factor that allowed noxious weeds to degrade native plant communities was a lack of effort to control these species while their numbers were low. In the absence of control measures, invasive exotic species spread and their populations increased, sometimes exponentially.

Current Condition Of Noxious Weeds

Noxious weeds have invaded and dominate many roadsides, disturbed areas, and susceptible habitats across the forest. They continue to be spread by vehicles, machinery, animals and humans. These vectors distribute weeds into native plant communities, putting them at risk for infestation. There are many areas not infested with weeds that are vulnerable to noxious weed invasion, particularly at low to mid elevations. These plant communities are likely to be overtaken by noxious weeds if introduced.

The degree and extent of infestation makes management of these species seem daunting. Indeed, eradication of many species is prohibitively expensive and time consuming. With current funding and staffing, at best the spread of these species can be contained.

Due to the aggressive nature of certain exotic plant species, they are designated noxious weed species by the states of Montana and Idaho. Noxious weeds are: "Those plant species designated as noxious weeds by the Secretary of Agriculture or by the responsible State official. Noxious weeds generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insects or disease and being native or new to or not common to the United States or parts thereof." (FSM 2080.5).

The Federal Noxious Weed Act of 1974 defines a federal noxious weed as of foreign origin as is new to or not widely prevalent within the United States. Federal noxious weeds are specified as aquatic weeds, parasitic weeds, or terrestrial weeds. For the purpose of weed management on federal lands, a federal agency shall adopt any list classified as noxious by federal or state law. The states and counties have laws and ordinances for the implementation and enforcement of weed management.

In Idaho, state laws and county ordinances require that all landowners be responsible for control of noxious weeds on their lands. The IPNFs has several district-wide Noxious Weed environmental documents that provide an adaptive strategy to treat both existing and new weed infestations. Currently, the IPNFs is also a partner with county, state and other federal agencies in two Cooperative Weed Management Areas, which promote the integrated management and education on noxious weeds across jurisdictional boundaries.

The Montana County Noxious Weed Control Law was established in 1948 to protect Montana from destructive noxious weeds. Local county government has the responsibility for implementation and enforcement of weed management in Montana. The County Noxious Weed Control Act is implemented and enforced at the local county level. Each county government is required to appoint a county weed control board and develop a long-term management plan for the control of noxious weeds in their county. In 1991, the KNF signed a memorandum of understanding with Lincoln County regarding noxious weed management standards in which the KNF agreed to assist and cooperate with the weed board. The KNF is also working with Sanders and Flathead counties on noxious weed control.

Current control efforts are aimed at eradicating new invaders and containing existing infestations. Every known site occupied by a new invader species is treated and monitored. Logging equipment is cleaned before entering a sale area to reduce the potential for the introduction of weed species not yet present in a sale area. Tactics used to attempt to contain large infestations include spraying roadsides, seeding major disturbances caused by road and skidtrail building and landing piles and treating gravel pits. Biocontrols have been released for spotted knapweed, dalmatian toadflax, St. John's wort, purple loosestrife and Canada thistle. Infestations in some sites have been reduced by these measures. However, in spite of these control efforts, existing infestations continue to invade disturbed areas and intact plant communities.

Findings of the Interior Columbia River Basin Ecosystem Management Project (ICBEMP) Regarding Noxious Weeds

The ICBEMP assessment made the following findings regarding noxious weeds that apply to the KNF and IPNFs (USDA, USDI. 1999c).

Noxious weeds are spreading rapidly, and in some cases exponentially, in rangelands.

- Rangelands on the KNF have infestations of knapweed, common St John's-wort, absinth wormwood, Canada thistle, common hound’s-tongue, leafy spurge, and sulfur cinquefoil. Weeds with potential to be invasive that do not have noxious designation are also common, including smooth brome, orchard grass and sweet clover. These species reduce forage value for livestock and big game.

Cheatgrass has taken over many dry shrublands, increasing soil erosion and fire frequency and reducing biodiversity and wildlife habitat. Cheatgrass and other exotic plant infestations have simplified species composition, reduced biodiversity, changed species interactions and forage availability, and reduced the system's ability to buffer against changes.

- Dry shrubland habitat is not extensive on the KNF or IPNFs. Where it is present it can be valuable winter range for big game species. For example, the “Horse Range” on the KNF, located behind the Canoe Gulch Ranger Station, provides elk and mule deer winter range. This area is infested with cheatgrass, reducing its carrying capacity. This infestation prohibits prescribed burning, which could otherwise be used to stimulate desirable forage.

Declines in plants... are due to a number of human causes including... introduction of exotic species.

- The diversity, composition, and structure of native plant communities are adversely affected by the presence of noxious weed species. Native plant species on the KNF, including sensitive and proposed threatened species, are compromised by invasive exotic species.

Noxious weeds are spreading rapidly, and in some cases exponentially, in most dry forest types.

- Dry, open, Ponderosa pine forest types on the KNF and IPNFs have infestations of knapweed, common St John's wort, meadow hawkweed, cheatgrass, Dalmatian toadflax, and sulfur cinquefoil. These weeds reduce the value of dry forest types as winter range. They are likely to persist and spread indefinitely in dry forest types without control measures. They can also create undesirable responses to measures to maintain dry forest structure and overstory species composition. For example, the removal of Douglas-fir encroachment and under burning is necessary to maintain ponderosa pine stands, but creates open conditions that are conducive to the spread of many noxious weeds.

Primary causes for decline in native herbland, woodland, grassland, and sagebrush habitats are...invasion of exotic plants.

- Exotic species are found in all of these habitats on the KNF. In many cases, they have reduced the value of wildlife and rare plant habitat.

Within riparian shrublands, there has been extensive... introduction of exotic grasses and forbs.

- These habitats are not common on the KNF. However, extensive populations of exotic species, mainly reed canary grass and common tansy, border the Kootenai River. This likely reduces the value of waterfowl habitat. These species are also common along other riparian systems where exposure is relatively open. Also, Flower Creek has an infestation of Japanese knotweed along the portion that flows through Libby.

Planning Question - What rare vegetation species and communities exist on the KIPZ and what is their condition and trend?

<u>Plants And Communities Of Special Concern</u>

The term "special concern" includes plant species and plant communities that are rare, endemic, disjunct, threatened or endangered throughout their range in Montana and Idaho, or in need of further research.

- The IPNFs has three threatened plant species, 66 sensitive species and 37 Category 4 (formally termed watch species) species of concern.
- The KNF has two threatened plant species, 52 sensitive species, and 89 Category 4 species of concern.

“Threatened species” are those species that are likely to become endangered within the foreseeable future throughout all or a significant portion of its range. The threatened designation includes those species as listed or proposed for listing as threatened or endangered within the Federal Register (USFWS).

> Threatened species for both the KNF and IPNFs include water howellia, Ute ladies tresses (just the IPNFs) and Spalding’s catchfly. Water howellia grows in seasonally flooded, aquatic habitats. Suitable habitat consists of small potholes, ponds, or the quiet water of abandoned river oxbows that seasonally dry up and allow for seed germination. Ute ladies tresses habitat consists of low elevation (less than 3000’), alluvial valleys with open, and mixed conifer/deciduous cottonwood, grass and shrub mosaic communities. Spalding’s catchfly occurs within dry forest and grassland communities. All of these species are suspected to occur, but have not been found on either the IPNFs or KNF. Water howellia historically occurred in the northern portion of the IPNFs, but has since

> been extirpated. Spalding's catchfly does occur on private land adjacent to the KNF on the Dancing Prairie (administered by The Nature Conservancy), near Eureka, Montana.

"Sensitive plants" include those species, or recognized subspecies or variety, for which the Regional Forester has determined a concern for population viability within a State, as evidenced by significant current or predicted downward trend in population or habitat. All sensitive plant species are known or suspected to occur on NFS land.

> Most sensitive species occur over a variety of habitats. Riparian, aquatic, wet meadow/peatland habitats, subalpine moist cliff crevices, low to middle elevation moist rock outcrops and moist, mature coniferous forests present the greatest potential to support sensitive plant species.

"Category 4 species of concern" are considered to be secure at the global, regional and state levels, but may be at risk at the forest level.

Planning Question - What is the productivity of the soil and is it being maintained?

Soil Productivity

Physical Aspects of Soil Quality

Soil quality is defined as the capacity of a specific soil to function within its surroundings, support plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation (FSM 2500-99-1).

- Soil quality is central to modern forest management and is rooted in land ethic and law.
- Soil productivity is a requirement for sustainable forests.
- Soil quality standards are key to long-term soil productivity and sustainability.

Most of the affects on long-term soil productivity are caused by physical impacts. These generally include compaction, displacement, rutting, surface erosion, and soil mass movement. Other less obvious physical impacts, but still very closely related, are severe-burning and loss of surface organic matter. For the latter two, the initial impact is physical but the long-term impact is related more to chemical and biological (loss of nutrients as a result of the loss of organics).

Compaction, by far, is the most common physical impact. Compaction reduces the macropore porosity, which reduces soil aeration, reduces soil infiltration rates, reduces soil permeability, modifies or destroys soil structure, changes water supply to roots, and increases mechanical impedance of soils to root development. All these factors affect plant growth by reducing plant vigor because there is less available water and less nutrient and gas exchange. The roots can be short, deformed, stubby, and shallow. Susceptibility to disease will be increased as well as blow-down potential. Seed establishment will be reduced. Erosion potential is increased by compaction, as the soil is less able to absorb and transmit water. Also, the soil will freeze earlier and stay frozen longer, which will contribute to overland flow.

Displacement is the physical removal of soil material, which is generally the topsoil, which contains most of the soil nutrients. Rutting is the destruction of soil structure, which negatively affects infiltration and permeability. Soil mass movement is the bulk movement of topsoil and subsoil from one place on the landscape to another. Applying Soil and Water Conservation Practices will help to minimize any impacts.

Severely-burned soil can result from a high severity fire where all the surface organics have been removed as well as the soil organics, which result in negative physical, chemical, and biological changes. Loss of surface organic matter can cause nutrient and carbon cycle deficits, which negatively affect physical, chemical, and biological soil conditions (Dumroese et al. 2002, pages 201 - 210; Powers et al. 1982, pages 1 - 33).

The IPNFs Forest Plan created standards that are intended to supplement, not replace, national and regional policies, standards, and guidelines found in Forest Service manuals and handbooks and the Northern Regional Guide. The 1987 IPNFs Forest Plan directs that soil disturbing management activities will strive to maintain at least 80% of an activity area in an acceptable condition for vegetative production. Unacceptable production is where the soil is detrimentally compacted, displaced, puddled, or severely-burned. The KNF Forest Plan states that a standard will be established for those projects where the use of heavy equipment is required. The standard should establish how much of the project area will be allocated to skid trails, landings, temporary roads or similar areas of concentrated equipment use. The standard shall minimize the area allocated to those uses to the extent practical.

The latest version of the Soil Quality Standards is found in the Forest Service Manual (FSM 2500 Watershed and Air Management, R-1 Supplement No. 2500-99-1, Effective November 12, 1999, Soil Management Chapter, 2554 Soil Quality Monitoring). These standards include Detrimental Soil Disturbance, Organic Matter Guidelines, and Monitoring Methods. Detrimental Soil Disturbance includes compaction, rutting, displacement, severely-burned soil, surface erosion, and soil mass movement. Monitoring Methods includes Aerial Extent Sampling and Soil Sampling Techniques. This manual direction requires soil disturbance activities to maintain at least 85% or more of an activity area in a non-detrimental status. Permanent roads are not included.

The 1987 Forest Plan and Forest Service Manual direction have been adequate for the maintenance and protection of soil quality and do not present a significant "need for change".

<u>*Nutrient Aspects of Soil Quality*</u>

The 1987 IPNFs Forest Plan states that projects should strive to maintain sufficient large woody debris; and do a project analysis in the event of whole tree logging to make provision for the maintenance of sufficient nutrient capital. The 1987 KNF Forest Plan makes no reference to maintenance of nutrient capital. Organic Matter Guidelines are referenced to Graham et al. (1994). Applying the standards contained in Graham et al. (1994) related to coarse woody debris maintains an adequate long-term nutrient supply.

Research by the Intermountain Forest Tree Nutrition Cooperative (IFTNC) is showing that potassium (K) is inherently very low within portions of the Precambrian meta-sedimentary rocks known as the Belt Super-group (Garrison et al. 1998, IFTNC Supplemental Report, pages 7-9). Approximately 80% of the KIPZ is located on this Belt Super-group bedrock material. Research indicates that 20-30 % of this area may be inherently low in K (Moore et al. unpublished, pages 13 and 38).

Potassium that is available to plants is derived almost exclusively from the weathering of parent material. Once K is removed from the site, the loss is long-term because the weathering process is so slow (Garrison et al. IFTNC 1998 Supplemental Report, pages 2-7). Most K is stored in the needles, small limbs, and branches of plants (Pang et al. 1987). The fine biomass is the major source for recycling this limited nutrient. Cole et al. (1967) found that in a forested Douglas-fir ecosystem on glacial soils, about 45% of the total K pool was being held in trees. The remainder is held in understory vegetation and the forest floor.

Management activities that remove K from inherently low K sites can cause trees to fall below critical foliar nutrient levels (Moore et al. unpublished, pages 17 and 28). This situation can have a profound effect on forest health conditions, particularly armillaria root diseases, insect attacks, and possibly tree growth (Garrison-Johnson et al. 2001, Draft Manuscript, page 4; Garrison et al. 1998, Supplemental Report, page 8). Specifically, K nutrition has been shown to significantly affect Douglas-fir root biochemistry, including phenolic concentrations (Shaw et al. 1998, page 1571). Douglas-fir trees that produce low resin levels (phenolic compounds) are more likely to be successfully attacked and killed by Douglas-fir beetles. Also trees with low phenolic/sugar ratios are susceptible to armillaria root diseases (Shore et al. 1999 and IFTNC 1992).

The 1987 Forest Plans do not provide direction for management of loss to potassium on soils with inherently low potassium. Standards or guidelines may be needed to compensate for the potential loss in potassium on these soils.

What are the implications of continuing under current management direction for Vegetation?

Based on historic and current condition and trends, effective fire suppression since the 1930s, the introduction of an exotic disease (white pine blister rust), and human timber harvest and road-building patterns are the major causes of changes from historical disturbance and successional patterns. These causes work synergistically and create changes in forest species composition, structure, and function; which in turn can lead to further changes in disturbance and successional processes.

Some major changes as a result of past management, fire suppression, and implementation of the 1987 Forest Plans include:

- In warm and dry habitats, there has been a shift from ponderosa pine and larch to Douglas-fir.
- In moist habitats, there has been a shift from white pine and larch to Douglas-fir, grand fir, and hemlock.
- There has been a decrease in the late-successional stage forests.
- In general, patch sizes (uninterrupted blocks of forest) and interior habitat have decreased and fragmentation of the landscape has increased.
- There has been an increase in shade-tolerant, drought-intolerant tree species.

Shifts in successional and disturbance processes towards those that favor more shade-tolerant, drought-intolerant tree species mean that stress on forests will be greater during periods of drought that occur periodically in these ecosystems. That leads, in the short-run, to increased forest insect and pathogen activity and an increase in their importance as agents of change, as compared to historic conditions. Because insects and pathogens generally accelerate succession, this creates a positive feedback loop with accelerating transitions to even more shade-tolerant species, which in turn means further accelerating insect and pathogen activity.

Frequent insect and disease outbreaks create high levels of dead woody fuels, especially in the fine, small and medium size classes. This insect and disease activity also results in a multi-story forest canopy structure with shade-tolerant trees of all sizes growing together. This canopy structure provides continuous tree crown from near ground level to the top of the canopy. These “live fuel ladders” raise the probability of any fire becoming a crown fire. This combination of increasing dead fuel loads and hazardous forest canopy structures (live fuel ladders) leads to a growing risk of large and severe stand replacing wildfires. In warm and dry VRUs, fuel loadings have increased due to fire suppression, which increases the risk of more severe fires. In the long-run, this successional/disturbance regime makes it likely that growing fire risk will overcome human defenses with particularly large and severe burns during times of severe fire weather. This is the same finding that resulted from the ICBEMP.

The current trends in changed vegetation patterns result in declining habitat for wildlife species that depend upon large patch size (especially large patches of mature/old forest), large wood, large snags, or some other particular attribute of early successional vegetation. However, generalist species and edge species may generally benefit from many of these vegetation changes. The shift from pulse to press disturbance departs from conditions under which most native fish species evolved and also provides fewer watersheds capable of supplying habitat conditions historically associated with large patches of older forests. At the point where growing fire risk actually results in very large and severe wildfires, this will pose a different set of risks. Very large and severe fires pose risks to rare plant, animal, and fish communities; to soil productive potential; and to some aquatic processes.