WILDLIFE HABITAT ASSESSMENT FOR THE KOOTENAI AND IDAHO PANHANDLE PLAN REVISION ZONE (KIPZ)

Prepared for

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EXECUTIVE SUMMARY

Ecosystem Research Group (ERG) was contracted by the U.S. Forest Service (USFS) to conduct an independent wildlife habitat analysis of the potential effects of the alternatives in the Idaho Panhandle National Forests (IPNF) and Kootenai National Forest (KNF) Environmental Impact Statements (EIS) for the revised Land Management Plans (USDA 2011a; USDA 2011b). This study evaluates the level of currently available habitat and models potential future habitat in ten year increments over fifty years for the following wildlife species: Canada lynx, black-backed woodpecker, fisher, flammulated owl, pygmy nuthatch, Hammond's flycatcher, olive-sided flycatcher, American marten, northern goshawk, chipping sparrow, dusky flycatcher, and pileated woodpecker. In addition to specific wildlife habitats, we also modeled whitebark pine probable areas and habitat connectivity (defined here as mid- and late-seral forest sustainability and recruitment).

The wildlife species selected are similar in that the literature suggests habitat quality and availability are likely the limiting factors for those species, as opposed to other non-habitat factors such as competition from exotic species or loss from human-caused mortality. Furthermore, the species are comparable in that all are "specialists" rather than "generalists," which is notable because specialists require a narrow set of vegetative conditions for suitable habitat and are thus more likely to become at-risk from changes in habitat over time. Lastly, the 12 wildlife species occupy substantially different habitats across the Kootenai and Idaho Panhandle Planning Zone (KIPZ) (Figure ES-1).

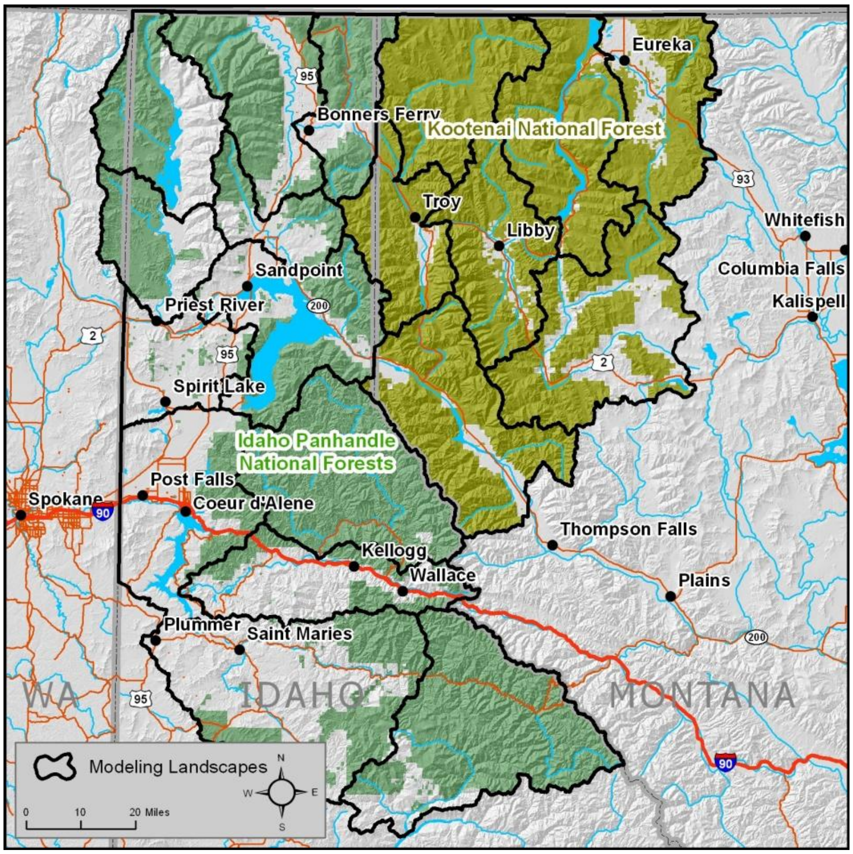

Figure ES-1 KIPZ vicinity map

The KIPZ is comprised of the KNF and IPNF. Like all national forests in the Northern Rockies, the KIPZ is exposed to substantial disturbance including wildfire, diseases, and insects. The KIPZ is also highly productive, allowing in-growth and stand succession to rapidly change the mix of forest stand structures. The fluctuations in habitat we predict can be attributed almost exclusively to combinations of these disturbances and growth versus the influence of forest management activities.

METHODOLOGY

SIMPPLLE is a spatially explicit model which predicts how forests respond over time to disturbances based on cover types, size classes, crown closure, aspect, and slope (Chew et al. 2012). It employs logic pathways based on foundational and time-tested research (Chew et al. 2012; Pfister et al. 1977; Rothermel 1972). We used the SIMPPLLE model to predict how habitat may be affected by wildfires, disease, insects, and succession, as well as by interactions and sequences of these occurrences under different management scenarios (i.e., different levels of active management practices such as timber harvesting, the use of prescribed fire, pre-commercial thinning, and tree planting). Five decades were modeled in order to assess long term effects. Year 2010 (decade zero) is the baseline condition and year 2060 (decade five) represents long term outcomes. In addition, 2010 through 2030 represents the anticipated time span of the KNF and IPNF Forest Plans.

Eleven management scenarios were modeled, including no treatment and treatment scenarios. All treatment scenarios listed in Table ES-1 refer to alternatives as presented in the IPNF and KNF Forest Plan EIS. While we modeled all of the scenarios listed in Table ES-1, the results and discussion in this assessment are limited to Scenario 3, Scenario 6, and Scenario 7. Scenario 3 provides a comparison for no treatment (no timber harvesting, prescribed fire, pre-commercial thinning, and tree planting) with the level of wildfire suppression that the USFS currently performs, and is not the same as continuation of existing management ("no action") in the EIS. Scenario 6 is the equivalent of the EIS preferred Alternative B with budget constraints and Scenario 7 is the equivalent of the EIS preferred Alternative B without budget constraints. In addition, two climate scenarios representing no change from current climate, and a trend to continued warmer, drier conditions were modeled. The KIPZ Climate Change Report (USDA 2010b) provides an evaluation of warmer, drier trends for resources and ecosystems of the KIPZ and informed the decision to simulate warmer, drier conditions in SIMPPLLE for Scenarios 3, 6, and 7.

Table ES-1 SIMPPLLE Modeling Scenarios

Model Run Type	Scenario	Climate Trend	Wildfire Suppression	Treatments	Budget
No Treatment Scenario	Scenario 1	Normal	Normal	No	Not available
	Scenario 2	Normal	Reduced	No	Not available
	Scenario 3	Warmer/Drier	Normal	No	Not available
Treatment Scenario	Scenario 5	Warmer/Drier	Normal	EIS Alternative B	With Budget Constraints
	Scenario 6	Warmer/Drier	Normal	EIS Modified Alternative B	With Budget Constraints
	Scenario 7	Warmer/Drier	Normal	EIS Modified Alternative B	Without Budget Constraints
	Scenario 8	Warmer/Drier	Normal	EIS Alternative A	With Budget Constraints
	Scenario 9	Warmer/Drier	Normal	EIS Alternative B	Without Budget Constraints
	Scenario 10	Warmer/Drier	Normal	EIS Alternative C	With Budget Constraints
	Scenario 11	Warmer/Drier	Normal	EIS Alternative D	With Budget Constraints

Thirty replications of each scenario were run through SIMPPLLE to determine a range of possible outcomes. However, results were compiled and analyzed based a single SIMPPLLE run, chosen to represent a realistic scenario close to the average of projected future conditions. Selection of a single run ensures that the landscape conditions are feasible, and also allows the analyst to draw a map of future landscape conditions (Henderson pers. comm.). The representative run was selected based on severe fire disturbance. Specifically, it was the run that was closest to the average severe fire disturbance across all runs, based on the least squared deviation from the average in each time period. The modeling for KIPZ made major advancements to SIMPPLLE, particularly in terms of projecting wildfire spread, wildfire spotting, and post-wildfire vegetative response.

Much of the vegetative data used in this analysis was based on the Region One Vegetation Mapping Program (R-1 VMap), which is composed from satellite imagery. As such data inevitably contains errors in classifications, including cover type, size class, and crown closure, we regularly compared R1-VMap data with other available broad-scale analyses based on different data sources. We also compared the results of our modeling against other wildlife assessments that were based on Forest Inventory and Analysis (FIA) fixed plot data. We used Samson (2006b), which enabled a rigorous FIA-based comparison for northern goshawks, flammulated owls, pileated woodpeckers, and identification of suitable black-backed woodpecker habitat within areas disturbed by wildfire and insects from 2000 to 2003.

VMap data limitations were also addressed by comparing species-specific habitat identification criteria to FIA summary data for the KIPZ planning unit (USDA 2006). We determined how many of the 723 forested fixed plots in the KIPZ met both of these criteria, and then compared these results to VMap-based, SIMPPLLE-modeled data. Where species occurrence data were available, such data was overlaid with VMap-predicted habitat to refine the accuracy of the data and query design. This was the case with goshawk nests and flammulated owls (USFS, unpublished inventory data).

EFFECT OF MANAGEMENT SCENARIOS

We hypothesized that human-caused disturbance (i.e., timber harvesting, prescribed burning, planting and pre-commercial thinning) would have resulted in long-term differences when compared to the IPNF and KNF EIS no treatment scenarios. Instead, natural disturbances (in the form of wildfire and certain insects and diseases) are projected to have effects on habitat that render the effects of management less than remarkable at the *planning scale*. The Spectrum forest management model results used to quantify and plan treatments over the 50-year period in the model represents a relatively small percentage of forest growth in the planning unit. Thus, treatments that may have considerable effects at the unit or project scale are lessened in the larger context of the total amounts of wildfire, disease, insects, and succession at the individual national forest or the KIPZ scale. Even so, treatment scenarios outperformed no treatment in terms of improving habitat for more species and reduced the amount of wildfire and root disease on the landscape. Although for some species no treatment and treatment results were mixed depending on the Forest analyzed. For example, treatment scenarios produced more hairy woodpecker habitat on the IPNF while no treatment produced slightly more habitat on the KNF.

WILDFIRE

Wildfires will increase substantially across both Forests in the next five decades. Factors responsible include fuel accumulations due to long-term wildfire suppression and a projected continuity of the current weather trend towards warmer, drier climatic conditions (Hessburg et al. 2005; Saunders et al. 2008; USDA 2010b). SIMPPLLE-modeled comparisons between no treatment Scenario 3, and treatment Scenarios 6 and 7 indicated that the treatment scenarios will reduce the acres burned and wildfire severity over five decades (USDA 2011a; USDA 2011b). The most noticeable effect of treatments is the reduction of stand replacing fire. Figure ES-2 and Figure ES-3 show predicted levels of fire on the IPNF and KNF. No treatment Scenario 3 is abbreviated as S3, treatment Scenario 6 is abbreviated as S6, and treatment Scenario 7 is abbreviated as S7 on all figures. Likewise, time step one is equal to modeled year 2020, time step 2 equals modeled year 2030, and time step five equals modeled year 2060.

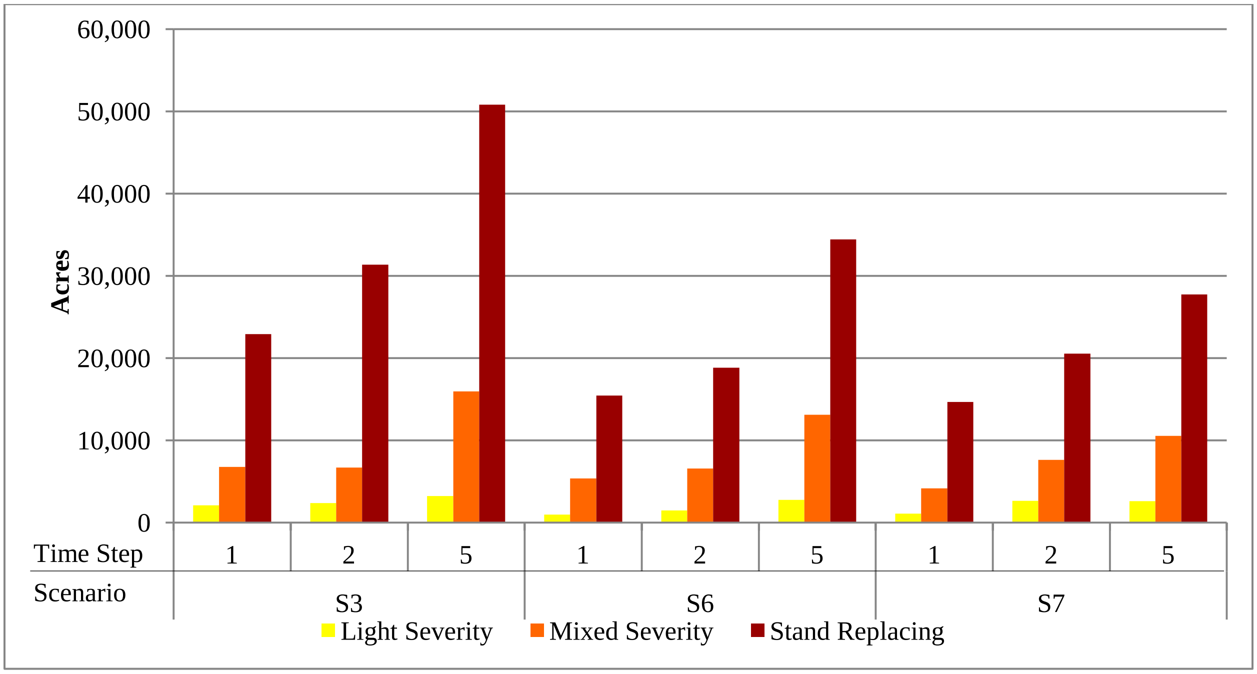

Figure ES-2 Predicted levels of wildfire for the IPNF

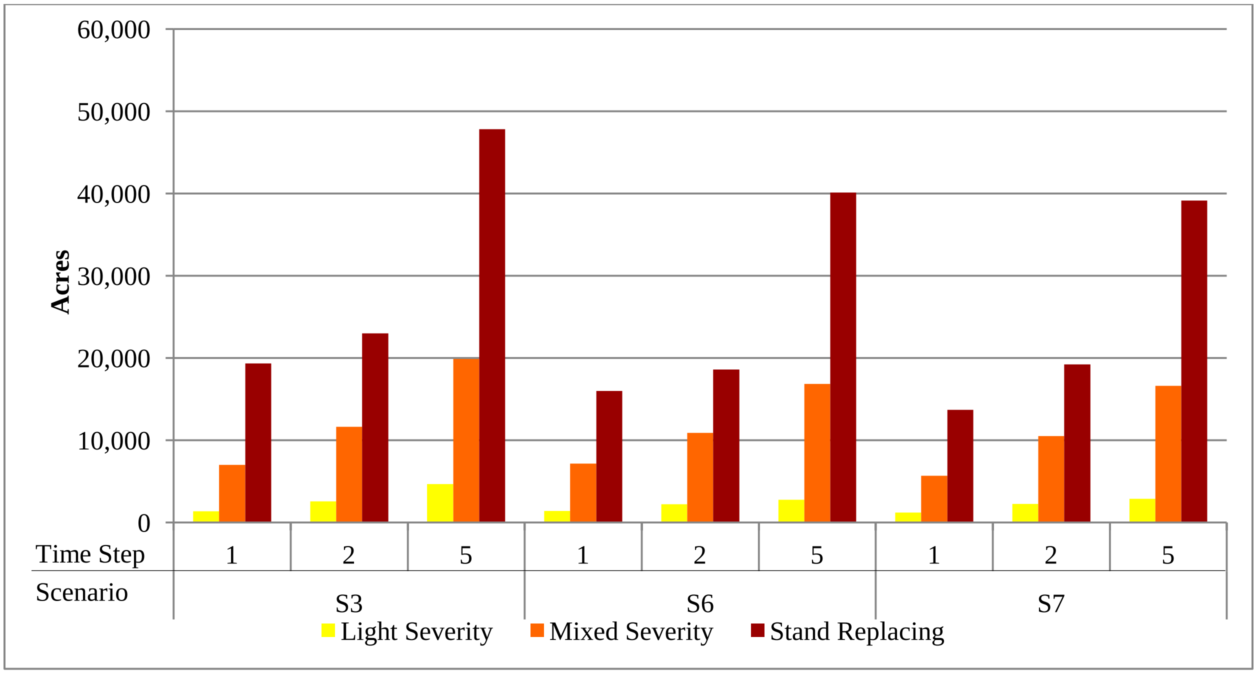

Figure ES-3 Predicted levels of wildfire for the KNF

ROOT DISEASE

Root disease will also increase across the KIPZ, particularly on the IPNF (Figure ES-4). Factors responsible for the projected increase include the high percentage of root-disease-susceptible Douglas-fir/grand fir habitat types, loss of western white pine to blister rust (which immediately converted the seral white pine stands into susceptible Douglas-fir/grand fir cover types), loss of resistant seral species during pre-1960 "high-grading" logging practices, and long-term wildfire suppression, which also allowed susceptible climax Douglas-fir/grand fir cover types to increase (Hagle et al. 2000; Pederson 2004; USDA 2011a; USDA 2011b). While future management activities, such as planting root disease resistant species and conducting prescription burns to maintain and increase root disease resistant species will reduce the acreage affected, activities are not predicted to affect the overall increasing trend.

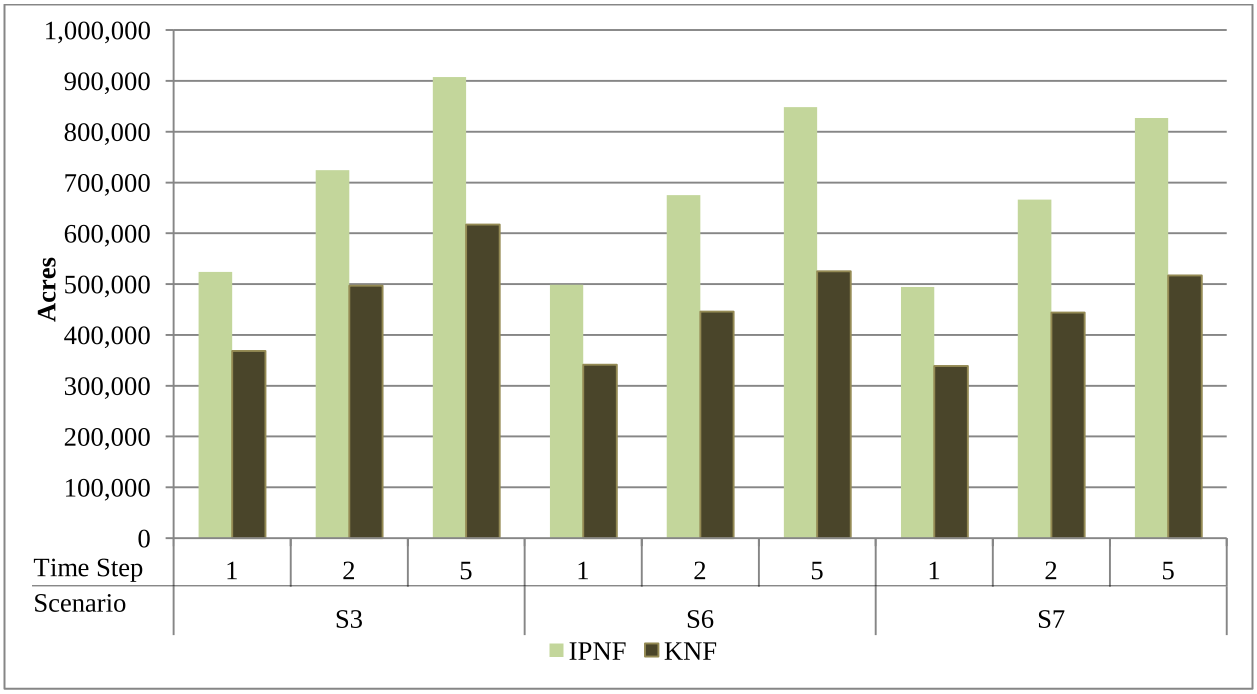

Figure ES-4 Root disease trends for the IPNF and KNF

INSECTS

The greatest modeled occurrence of mountain pine beetle (*Dendroctonus ponderosae*) is in the lodgepole cover type, but infestation is also found in the Douglas-fir and spruce-fir cover types, indicating a presence of pine. Cumulatively, only 4% of the 4.4 million acre forested landscape of the KIPZ will be impacted by mountain pine beetle (MPB) by decade five. Widespread outbreaks of MPB are common in landscapes dominated by lodgepole pine, but given the relatively small percentage of lodgepole pine across the KIPZ, MPB disturbances are kept at endemic levels (Hagle et al. 2003). The decreasing trend in MPB on the KIPZ correlates with the increasing trend in wildfire during the 50-year period. Scenario 6 provides the most reduction in MPB by decade five and outperforms no treatment by 20% on the IPNF and 4% on the KNF.

Western spruce budworm (*Choristoneura occidentalis*) is the most widely distributed defoliator of coniferous forests in Western North America; hosts include Douglas-fir, all true firs, spruce, and larch

(Hagle et al. 2003). Less than 3% of the 4.4 million acre forested landscape of the KIPZ is affected by western spruce budworm by decade five under all scenarios. Approximately 1% of the KIPZ is impacted by Douglas-fir beetle (*Dendroctonus pseudotsugae*) during the 50-year period.

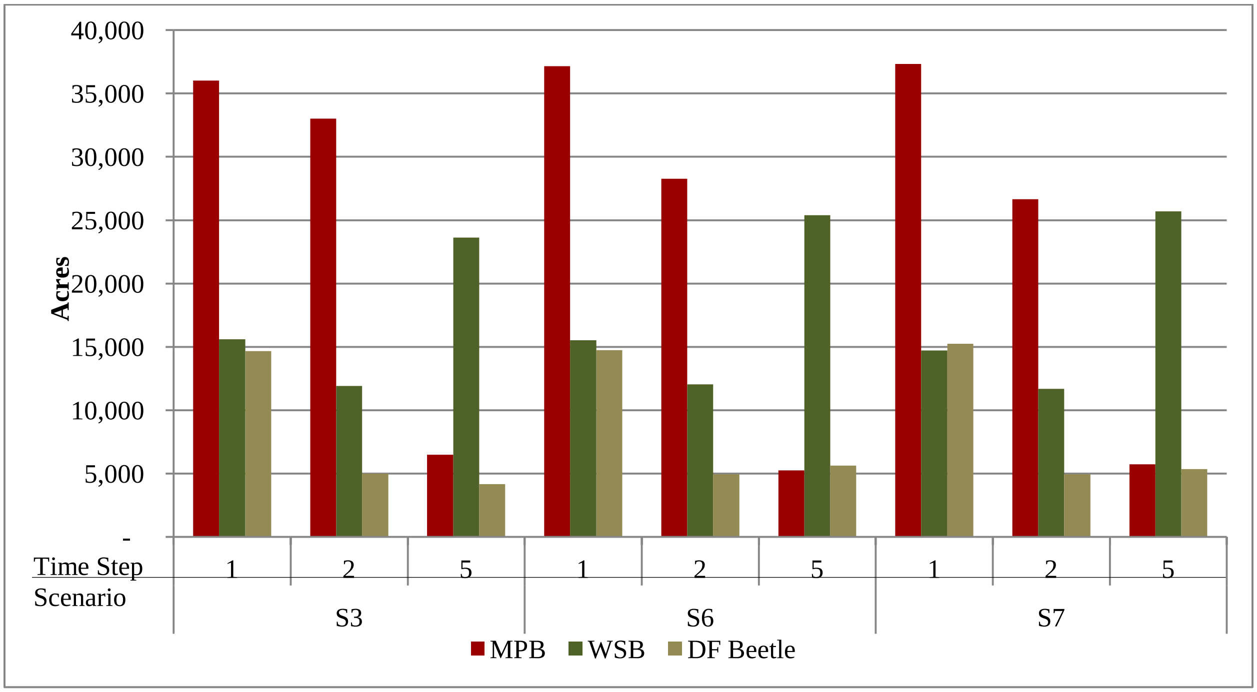

Figure ES-5 Modeled insect disturbance on the IPNF

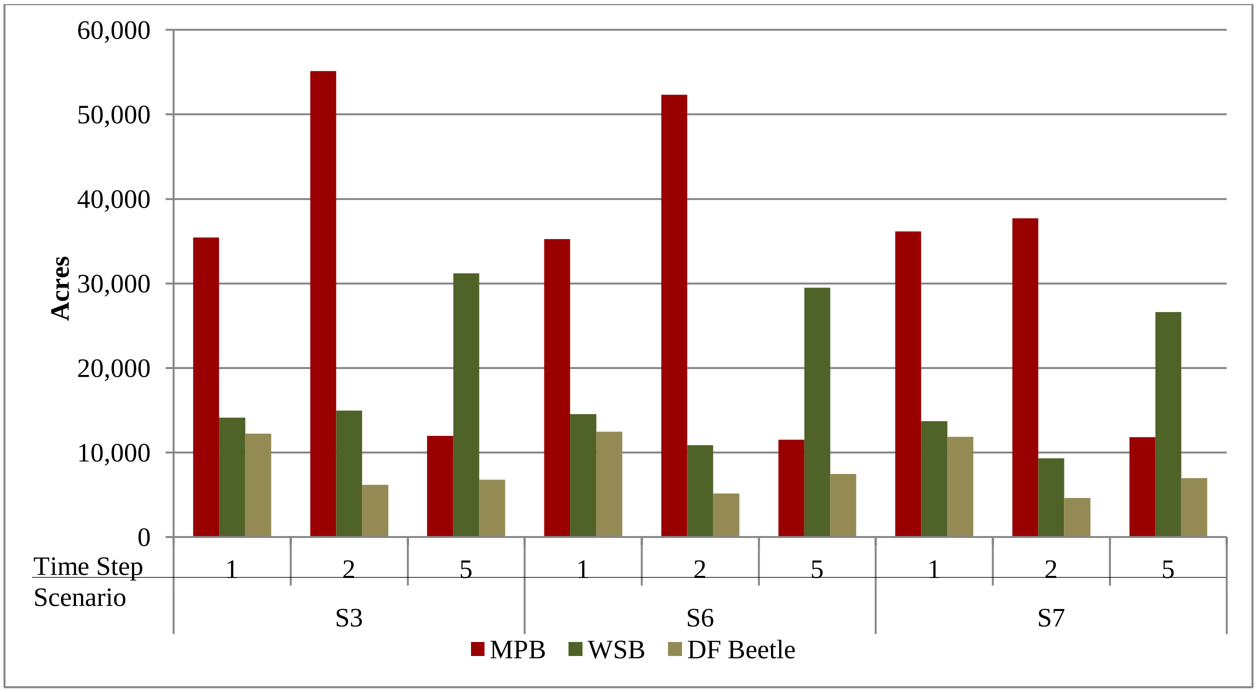

Figure ES-6 Modeled insect disturbance on the KNF

DECREASING WILDLIFE HABITAT: AMERICAN MARTEN, FISHER, FLAMMULATED OWL, NORTHERN GOSHAWK, AND OLIVE-SIDED FLYCATCHER

Even though we found the differences between scenarios to be small, the SIMPPLLE modeling projected a considerable fluctuation in levels of habitat for most species over five decades. This was expected, as different species have different habitat needs. Often, a stand structure that is good for one species is bad for another.

Natural disturbances will reduce habitat for American martens, fishers, northern goshawks, and olive-sided flycatchers on both Forests, under all scenarios. In addition, flammulated owl habitat decreases slightly on the IPNF under all scenarios and remains fairly static on the KNF. Despite these projected declines, habitat for those species will stay within or close to the lower limits of the Historic Range of Variability (HRV).[1] This suggests that none of these species are at risk (Hahn and Curnutt 2012). These habitat declines will be the result of increased acreages of wildfires bark beetles, and, particularly on the IPNF, root disease. Forest growth (the maturation of stands to species-specific tree diameter) will offset the loss from wildfire and root disease to some degree.

Despite the projected declines, habitat for American martens, fishers, northern goshawks, and olive-sided flycatchers will remain abundant and widespread. Unlike the findings for mesic marten habitat, all

[1] HRV data is from analysis completed by the KNF and IPNF Forest Plan revision. See Appendix B of the EIS for more information.

marten habitat declines slightly but remains fairly stable over the five decade period on the IPNF and KNF. The small amount of existing habitat for flammulated owls on both Forests will remain low throughout the period. Potential flammulated owl habitat increases on both Forests under all scenarios. Habitat for flammulated owls is limited by the KIPZ's lack of dry, open forest types, and by a lack of low and moderate severity wildfire and/or actions that mimic such disturbances.

INCREASING WILDLIFE HABITAT: BLACK-BACKED WOODPECKER, HAIRY WOODPECKER, HAMMOND'S FLYCATCHER, CHIPPING SPARROW, DUSKY FLYCATCHER, AND PYGMY NUTHATCH

Habitat for black-backed woodpeckers, hairy woodpeckers, Hammond's flycatchers, and pygmy nuthatches will increase due to disturbances, forest growth, and/or advancing succession in all modeled management scenarios. Chipping sparrow and dusky flycatcher habitat will increase on the IPNF under the no treatment scenario and will be reduced by treatment scenarios. On the KNF chipping sparrow and dusky flycatcher habitat will increase under all scenarios with Scenario 6 providing the most benefit. There are no risks to the viability of any of these species.

Our SIMPPLLE modeling predicts an increase in wildlife habitat for these species for a variety of reasons. Black-backed woodpeckers will benefit from the increasing levels of wildfires, since they are post-fire dependent (Caton 1996; Hoyt and Hannon 2002). Hairy woodpeckers are found in medium to very large-sized trees in all cover types (Hutto and Young 1999). This preference makes their habitat abundant compared to other woodpeckers. Since hairy woodpeckers are snag-dependent, increasing tree mortality from fires, root disease, and insects will provide ample nesting and foraging opportunities. Hammond's flycatchers require dense forests with large trees, and also have no preference for cover type (Hutto and Young 1999). Although some Hammond's flycatcher habitat will be lost to wildfires and root disease, the SIMPPLLE model indicates that forest growth (including stands getting denser in the absence of disturbance) will fully offset losses, thereby resulting in an increase in habitat. Pygmy nuthatches occur in dry ponderosa pine-dominated cover types on the forest periphery (Ghalambor and Dobbs 2006). Increased wildfires are likely to benefit fire dependent communities like ponderosa pine and ponderosa pine-associated species like pygmy nuthatches (USDA and USDI 2000). However, the limited number of acres in dry ponderosa pine cover types provides a small sample size for modeling, which makes predictions difficult.

CANADA LYNX HABITAT

Under all scenarios, habitat will increase on both Forests for the federally-threatened Canada lynx, an effect which is consistent with the Northern Rockies Lynx Management Direction. Recent research on the KNF, Flathead, and Lolo National Forests concluded that lynx almost exclusively select for multi-storied-hare habitat, which is composed of multi-storied spruce-fir stands with dense spruce-fir understories (Squires et al. 2006). Although high elevation subalpine fir-Engelmann spruce habitat cover types are limited on the KIPZ, they are well-suited to produce multi-storied-hare habitat. Subalpine fir-Engelmann spruce cover types are productive. Tree growth is rapid. And, in an absence of disturbance, understories fill in rapidly with dense seedling/saplings even when overstories are relatively dense. Our

SIMPPLLE modeling predicted that multi-storied-hare habitat will increase over the next fifty years no matter which scenario is chosen. Further, the percentage of subalpine fir-Engelmann spruce cover types occupied by subalpine fir-Engelmann spruce and not other seral species (Douglas-fir, lodgepole pine) is also projected to increase.

This modeling result is uncertain, however, because wildfires will likely increase on the KIPZ (USDA 2010b), and increasing wildfire usually results in post-fire subalpine fir habitat groups being occupied by seral Douglas-fir or lodgepole pine. Analysis of the SIMPPLLE-generated wildfire polygons, however, shows that wildfires will likely start at low to mid elevations and then stop at upper elevations. This logic of the model, which accurately portrays average wildfire year events, does not take into account higher-than-average-severity wildfires, such as those of 1988, 2000, and 2003, all of which burned from valley bottom to tree line. In sum, the modeled increase in suitable habitat for Canada lynx (climax subalpine fir-Engelmann spruce) is uncertain.

PILEATED WOODPECKER HABITAT

Habitat for pileated woodpeckers will generally remain stable, above the HRV on the IPNF and within HRV on the KNF after fifty years. Pileated woodpeckers require large western larch or ponderosa pine snags for nesting, and they may occasionally nest in Douglas-fir snags (Bull and Jackson 1995, Bull and Meslow 1988, (McClelland 1977). Local observations indicate they may use western redcedar snags as well, and likely used western white pine snags before the loss of that cover type to blister rust. Our modeling indicates that stands containing large-diameter larch or ponderosa pine will remain relatively stable on both Forests. Since the SIMPPLLE query did not attribute any habitat value to large western redcedar or white pine, the modeled outcome is conservative.

NORTHERN GOSHAWK HABITAT AND NEST DENSITY

Northern goshawk habitat will decline by about a third over five decades due to increasing wildfire, root disease, and insect disturbance but nest density will not be affected. Habitat will remain extremely well distributed within the KIPZ, suggesting that no landscapes will lack suitable nest habitat. Species territoriality rather than limited habitat will likely keep populations at normal low densities. Scenario 6 produces slightly more habitat on both Forests.

Several additional factors corroborate these findings for northern goshawk. First, we used 154 inventoried nest locations in combination with published research to design the query (Clough 2000; Kirkley pers. comm.; Squires and Ruggiero 1996). These locations are a huge sample that strengthens the credibility to the existing VMap estimate of goshawk nesting habitat. Since many of these are located in stands that are much smaller or more open than the VMap estimate of goshawk habitat, our findings are conservative. Lastly, the SIMPPLLE model oversimplifies changes in habitat that follow disturbances. For instance, the model concludes that northern goshawk habitat disappears after moderate severity fire. While this may be true some of the time, also we know from local northern goshawk nest data that many goshawks select for microsites such as a cluster of large, live trees within a stand that is very young or open. The projected increase in wildfires and root disease will retain a lot of these microsites that are too small for the SIMPPLLE model to include.

WHITEBARK PINE REGENERATION

Due to whitebark pine's dependence on wildfire for regeneration, we tracked wildfires in a whitebark pine probable layer with the assumption that these disturbances would have a high probability of regenerating whitebark pine stands. Simulated results used this whitebark pine probable layer as a 'footprint' to query for wildfires that had occurred in the previous time step. Thus all figures for whitebark pine in this assessment are not acres of whitebark pine cover type, but acres that had a high probability of whitebark pine establishment within the past ten years due to wildfire occurrence.

The level of whitebark pine establishment declines substantially in decade one due to less wildfire occurrence and then increases steadily to near current levels at decade five. The trends are comparable for both Forests (Figure ES-7 and Figure ES-8). The increasing habitat trend is equivalent to the trend of burned acres including all wildfire severity classes. The no treatment scenario provides more acreage on the IPNF by decade five, while treatment scenarios restore more acreage on the KNF. Whitebark pines are limited to very high elevations, with only a small acreage currently found on the KIPZ (Arno and Hoff 1990). Whitebark pine initially declined due to white pine blister rust (introduced to North America in the early 1900s), but has been exacerbated more recently by competition from encroaching subalpine fir, loss of Clark’s nutcracker caching sites, and mortality from mountain pine beetles (*Dendroctonus ponderosae*) (Keane and Morgan 1994). The SIMPPLLE model predicts a slow increase over 50 years, since whitebark pine is fire dependent. This prediction is uncertain, however, because of the limited existing acreage, which provides only a small sample size for analysis. The prediction of increasing whitebark pine is also uncertain due to the potential mortality from MPB, blister rust, and potential climate change effects.

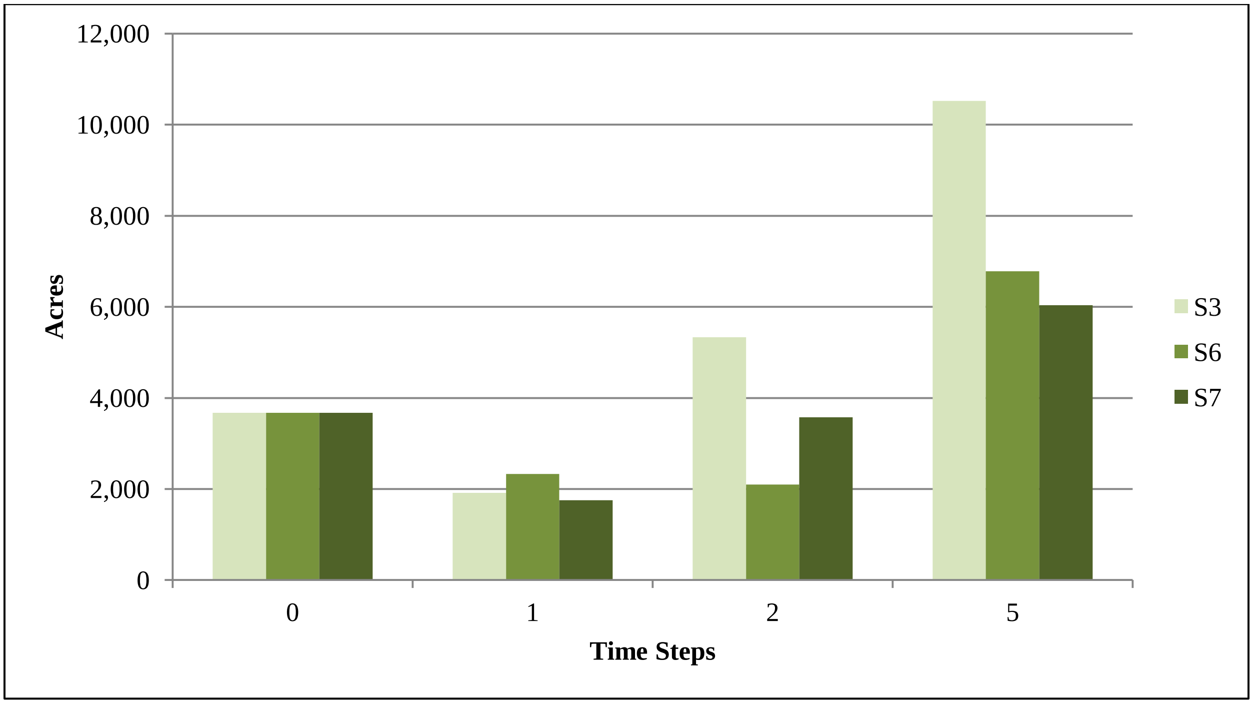

Figure ES-7 Potential whitebark pine regeneration habitat for the IPNF

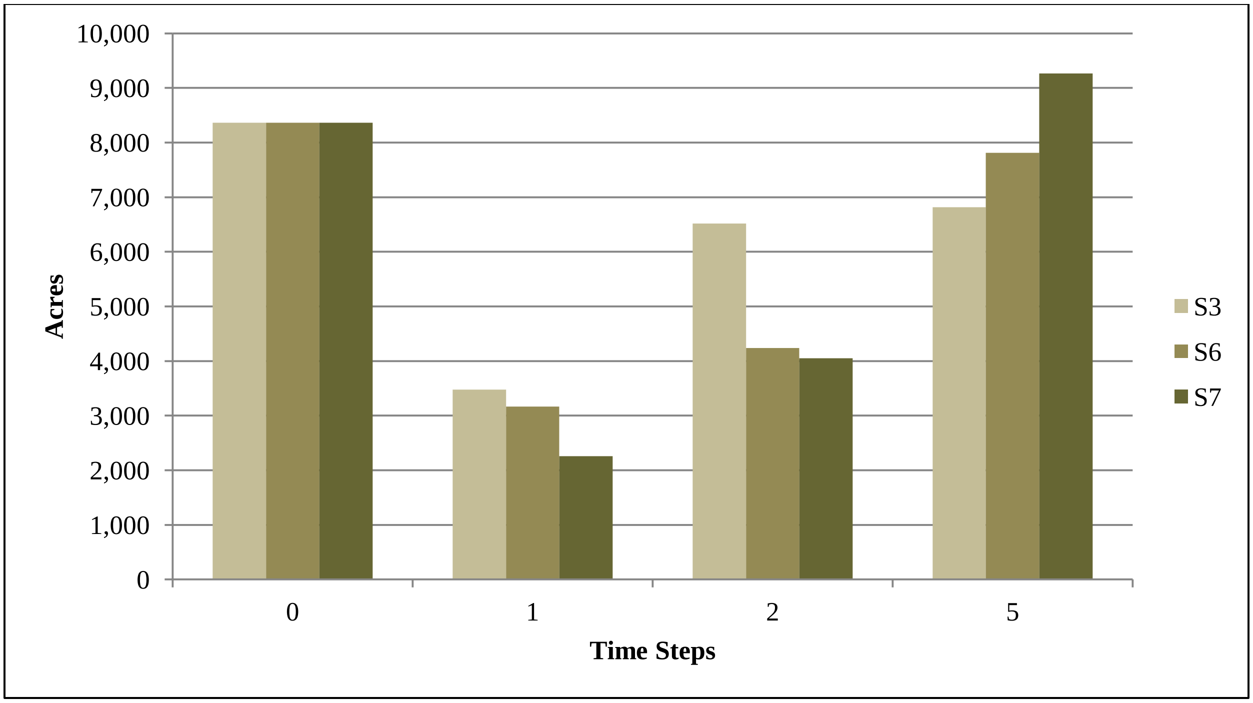

Figure ES-8 Potential whitebark pine regeneration habitat for the KNF

HABITAT CONNECTIVITY

Maintaining habitat connectivity so that species' habitats do not become isolated is an issue of increasing concern among biologists and land managers (American Wildlands 2008; Klenner et al. 2000; USDA 1997). One strategy for maintaining the connection between mature habitat areas is to designate corridors which prohibit management actions that would disturb forested communities. Protecting corridors for habitat connectivity is important in places where natural disturbances are infrequent and where trees are long-lived. The KIPZ, in contrast, is characterized by short fire return intervals and trees such as interior Douglas-fir, grand fir, and lodgepole pine, which are relatively short-lived. These conditions suggest that disturbances typical to the Northern Rockies may make the establishment of protected corridors a less effective habitat conservation strategy than applying management actions designed to reduce wildfire, insect, and disease severity.

To answer the critical question of how management actions will affect wildfire, insect, and disease severity, we compared the modeling results of how stands of medium and large trees both persisted and were recruited in the no treatment and treatment scenarios. ERG used the marten and flammulated owl habitat queries of medium and large trees in moderately dense to dense forests (Ruggiero et al. 1994) to determine the current acreage of medium and large trees at low and high elevations. We measured two changes over fifty years: habitat persistence and habitat recruitment by forest growth. The treatment scenario consistently had a higher level of persistence; that is, stands present at decade zero had not succumbed to wildfire or other disturbance and were still there at decade five, and showed a higher level of recruitment via in-growth, than the no treatment scenario. This important finding clearly shows that in the disturbance-prone Northern Rockies, management actions taken to reduce the severity of wildfires, minimize other disturbances, and recruit large-tree-dominated stands will net more medium and large tree-dominated stands than will no treatment over time.

1. INTRODUCTION

The Kootenai National Forest (KNF) and Idaho Panhandle National Forests (IPNF) are engaged in a joint Land Management Plan (Forest Plan) revision effort. Ecosystem Research Group (ERG) was contracted by the U.S. Forest Service (USFS) to conduct an independent analysis of the effects of the KNF and IPNF Forest Plan alternatives on 12 wildlife species, including federally listed and certain Management Indicator Species (MIS), over a 50-year timeframe. Whitebark pine habitat and habitat connectivity (defined here as mid- and late-seral forest sustainability and recruitment) were also modeled for 50 years and according to Forest Plan alternatives.

ERG conducted the assessment using the USFS SIMPPLLE (SIMulating Patterns and Processes at Landscape scaLEs) model. The SIMPPLLE model is a spatially explicit model which predicts how forests respond over time to succession, wildfires, and insect and disease risks based on cover types, size classes, crown closure, aspect, and slope (Chew et al. 2012). The SIMPPLLE model also allows the logic coefficients to be adjusted to reflect the potential that the future climate may become warmer and drier in the Northern Rockies as a result of global climate change impacts. In order to ensure the relevance of the modeled variables to a particular forest or landscape, they must be adjusted to fit local growing sites, insect risks, and fire behaviors. Adjustments to the SIMPPLLE model system knowledge for the Kootenai and Idaho Panhandle Planning Zone (KIPZ) were completed in 2012 (Chew 2012).

The SIMPPLLE model was used to evaluate how habitat changes over a 50-year period by Forest Plan alternative and under two climate scenarios. The two climate scenarios include no change from current climate, and a trend to continued warmer, drier conditions as documented in the KIPZ Climate Change Report (USDA 2010b). The KIPZ Climate Change Report provides an evaluation of those trends for resources and ecosystems of the KIPZ and informed the decision to simulate warmer, drier conditions in SIMPPLLE for this assessment.

The wildlife species selected are similar in that the literature suggests habitat quality and availability are likely the limiting factors for those species, as opposed to other non-habitat factors such as competition from exotic species or loss from human-caused mortality. Furthermore, the species are comparable in that all are “specialists” rather than “generalists,” which is notable because specialists require a narrow set of vegetative conditions for suitable habitat and are thus more likely to become at-risk from changes in habitat over time. Lastly, the 12 wildlife species occupy substantially different habitats across the KIPZ including large diameter, open-grown ponderosa pine (habitat for flammulated owls and pygmy nuthatches), mid-elevation stands (habitat for chipping sparrows and dusky flycatchers), large diameter larch, ponderosa pine and western redcedar snags (habitat for pileated woodpeckers), and mid-upper elevation interior, mature forests (habitat for American martens). If there are situations created by wildfire, disease, insects, or human actions that place a given species at risk, we can identify that situation in terms of “when” (what decade in the 50-year period), and “where” (which landscape) critical shortages of habitat will occur by analyzing changes in species-specific habitat.

Because the SIMPPLLE model is a spatially explicit model, it allows for the evaluation of available habitat over time and the arrangement of that habitat in terms of patch size. For example, the analysis for American marten includes a species-specific habitat assessment and an examination of general changes in patch size and habitat connectivity over time, and assumes that the assumption that long-term habitat persistence may be important for any or all wildlife species.

1.1 AREA DESCRIPTION

The KIPZ represents the portion of USFS Region One (R1) with the lowest relative elevations, highest precipitation, and most productive growing sites. Valley bottoms typically are forested with mixes of ponderosa pine, Douglas-fir, western larch, western white pine, western red cedar, western hemlock, and grand fir. Mid-elevations are forested with stands of Douglas-fir, western larch, or lodgepole pine, although western redcedar may extend upslope well away from the riparian zone on cooler aspects. High elevations contain stands of subalpine fir or Engelmann spruce with lodgepole pine, mountain hemlock, and whitebark pine at the highest elevations (USDA 2011a; USDA 2011b).

1.2 QUESTIONS ADDRESSED

The habitat assessment addresses the following questions:

- How does habitat change during the 50-year period?
- Are projected long-term vegetation changes consistent with the recovery of federally listed species as mandated by the Endangered Species Act (ESA)?
- Are projected long-term vegetation changes consistent with sustaining long-term viability[2] of indigenous species as required in the 1982 planning regulations (1982 rule provision 219.19 (a)(6)) ?
- Is the availability of habitat more at risk in some landscapes than others during specific time periods?
- How do KNF and IPNF Forest Plan alternatives affect habitat availability over time, and are management activities that are included in the alternatives more or less important in influencing future wildlife habitats than are natural disturbances that are predicted to occur?
- For at-risk species, do the Forest Plan alternatives improve habitat over time?

[2] The National Forest Management Act regulations require that wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area.

2. METHODS

The following sections explain the SIMPPLLE modeling process, landscape and vegetation parameters, and wildlife habitat query designs.

2.1 MANAGEMENT SCENARIOS MODELED

Eleven management scenarios were modeled for a period of 50 years in order to assess long term effects. Year 2010 (decade zero) is the baseline condition and year 2060 (decade five) represents long term outcomes. In addition, 2010 through 2030 represents the anticipated time span of the KNF and IPNF Forest Plans.

All treatment scenarios listed in Table 1 refer to alternatives as presented in the IPNF and KNF Forest Plan EIS. While we modeled all of the scenarios listed in Table 1, the results and discussion presented in this assessment are limited to Scenario 3, Scenario 6, and Scenario 7. Scenario 3 provides a comparison for no treatment (no timber harvesting, prescribed fire, pre-commercial thinning, and tree planting) with the level of fire suppression that the USFS currently performs, and is not the same as continuation of existing management ("no action") in the EIS. Scenario 6 is the equivalent of the EIS preferred Alternative B with budget constraints and Scenario 7 is the equivalent of the EIS preferred Alternative B without budget constraints. In addition, two climate scenarios representing no change from current climate, and a trend to continued warmer, drier conditions were modeled. The KIPZ Climate Change Report (USDA 2010b) provides an assessment of warmer, drier trends for the KIPZ and informed the decision to simulate warmer, drier conditions in SIMPPLLE for Scenarios 3, 6, and 7. The modeled results for other EIS alternatives are similar to Scenarios 6 and 7 and have been provided to the USFS as a digital appendix.

Table 1 SIMPPLLE Modeling Scenarios

Model Run Type	Scenario	Climate Trend	Wildfire Suppression	Treatments	Budget
No Treatment Scenario	Scenario 1	Normal	Normal	No	Not available
	Scenario 2	Normal	Reduced	No	Not available
	Scenario 3	Warmer/Drier	Normal	No	Not available
Treatment Scenario	Scenario 5	Warmer/Drier	Normal	EIS Alternative B	With Budget Constraints
	Scenario 6	Warmer/Drier	Normal	EIS Modified Alternative B	With Budget Constraints
	Scenario 7	Warmer/Drier	Normal	EIS Modified Alternative B	Without Budget Constraints
	Scenario 8	Warmer/Drier	Normal	EIS Alternative A	With Budget Constraints
	Scenario 9	Warmer/Drier	Normal	EIS Alternative B	Without Budget Constraints
	Scenario 10	Warmer/Drier	Normal	EIS Alternative C	With Budget Constraints
	Scenario 11	Warmer/Drier	Normal	EIS Alternative D	With Budget Constraints

2.2 SIMPPLLE MODELING

SIMPPLLE was initially developed for USFS Region One as a management tool to integrate disturbance processes and vegetation conditions at a range of spatial scales.

Specifically, SIMPPLLE's purpose is to provide the user with the ability to:

- Simulate ranges of conditions of plant communities and processes that can be expected for specific landscapes;
- Provide a basis for identifying the probability of disturbance processes and vegetation conditions;
- Simulate future vegetation changes caused by disturbance processes at multiple landscape scales;
- Simulate how changes in vegetation patterns influence the activity of fire, insect, and disease processes;
- Simulate management treatment alternatives for their impact on disturbance processes and the attainment of desired conditions at landscape scales; and
- Identify areas of high priority for treatments that can help achieve and sustain desired conditions at landscape scales.

By using SIMPPLLE's GIS interface results from simulations can be presented spatially at any point in time. For the SIMPPLLE model to be an accurate predictor of future conditions, the logic must be adjusted to fit local ecological settings, growth rates, successional pathways, and wildfire, disease, and insect risks. This task was performed for the KIPZ in 2012 (Chew 2012). Modeling the effects on wildlife habitats, given the current condition of KIPZ stands, future disturbance with and without warmer, drier climate trends, and under all Forest Plan alternatives also involved the following steps:

- Identifying the best available and relevant science that effectively explains how each species responds to major disturbances over time.
- Identifying those parameters to be predicted with SIMPPLLE modeling and the time frames and scales at which they need to be predicted.
- Evaluating the modeling results to assess Forest Plan alternatives over time.

Further details on how the SIMPPLLE model works is provided in the Region One Forest Service User's Guide (Chew et al. 2012).

2.3 AREA FILE CREATION FOR SIMPPLLE

A SIMPPLLE area file was built for each geographic area on the KIPZ to describe existing vegetation. The existing vegetation layer was the primary data used in describing the landscape to the model, along with information on insect and disease disturbances, ownership, and management area (USDA 2007c).

The Region One Vegetation Mapping Program (R1-VMap) is the existing vegetation layer used to assign vegetative attributes for the SIMPPLLE modeling. R1-VMap is a geospatial database for existing vegetation and associated attributes (e.g., elevation, slope, and aspect) available at different spatial resolutions. This provides a vegetation dataset across all ownerships and allows for the appropriate level of analysis (Berglund et al. 2009). Map products that are derived from the VMap database include vegetation lifeform, dominance type for trees, shrubs, and herbaceous vegetation communities, canopy cover classes for trees and shrubs, and tree diameter classes (USDA 2009).

R1-VMap data served as the basis for the existing vegetative data used in the analysis for the KIPZ Forest Plan Revisions. According to the *Draft Comprehensive Evaluation Report for the Kootenai and Idaho Panhandle Proposed Land Management Plans* (USDA 2006) other sources of data included:

- Vegetation Response Units (VRU) – units of land with vegetative communities that have broadly similar disturbance responses and successional pathways and that produce similar landscape-scale vegetation patterns
- Water bodies – areas of water greater than five acres in size
- Plantations – developed using the Forest's Timber Stand Management Record System database and associated stands coverage
- Wildfire – areas with wildfire by severity class
- Old Growth – information from the KIPZ old growth map

The above coverages were combined with VMap to create a layer of existing vegetation attributes. These data were used throughout the forest planning process and were converted to a format for use in SIMPPLLE in a manner that was compatible to subsequent vegetation treatment and timber production modeling with Spectrum and modeling of wildlife habitat using GIS (USDA 2006).

R1-VMap provides dominance type, size class, and canopy cover data which translated well into SIMPPLLE's required values, but provided no information as to the vertical layering of the forested stands. SIMPPLLE portrays stands as single storied, two storied, or multi-storied. Canopy cover is a useful parameter in identifying habitat for species that prefer dense forests or dense stands for nesting or habitat for species that prefer open forests. Tree canopy cover included the total non-overlapping tree canopy in a delineated area as seen from above and is not defined by a hemispherical projection as seen from below (Brewer et al. 2004). Vertical layering, another important habitat parameter, was added to the dataset through expert panels of Forest staff and via crosswalking real stand data by cover type and habitat group (Bollenbacher pers. comm.).

Combining these data layers resulted in a dataset of irregular polygons that have variation in size and shape. This variability can impact the spread of disturbance processes and regeneration from adjacent plant communities. Thus a SIMPPLLE toolkit for ArcGIS was used to make the conversion from irregular polygons to equal sized cells. The polygon size used depends on analysis objectives and the issues to be addressed; five acre cells were selected to model the effects of the proposed management activities.

2.4 CALIBRATING THE SIMPPLLE DEFAULT LOGIC FOR THE KIPZ

Major advancements were made to SIMPPLLE's default Westside Region One default logic (system knowledge) as part of this modeling exercise (Chew 2012). Successional pathways were edited for each Forest by IPNF, KNF, Rocky Mountain Research Station (RMRS), and Regional staff. SIMPPLLE’s default logic was based on extensive input from Forest and District silviculturists regionwide, and was calibrated to allow for site specific accuracy. Between July 8 and September 28 of 2011, eight video-conference meetings were conducted between IPNF, KNF, RMRS, and Regional staff. During the initial meeting past KIPZ modeling was reviewed, areas in the logic were identified where improvements could be made, and specific logic adjustments were proposed. Simulations were made on test landscapes and at subsequent meetings the logic adjustment results were evaluated and refined. The following is a brief summary of the advancements made:

- Created logic for wildfire spotting and made a user interface screen to have the logic accessible to the user. The new logic can vary by size of wildfire event and incorporate current research on the interaction of wildfire and mountain pine beetle (MPB) killed lodgepole pine.
- Added an additional probability level into SIMPPLLE’s wildfire suppression logic. This new level is at the wildfire event level and can vary by a combination of season of year and land designation. A new user interface screen makes this logic available for use in designing management scenarios.
- Created new user interface screen for identifying combinations of variables to change level of wildfire suppression efforts based on land designations. Users can now adjust wildfire suppression production values by vegetative conditions or land designation.
- Reviewed the impact that the distribution of species, by their “wildfire resistance” (high, moderate, or low) has on wildfire behavior across a landscape.
- Calibrated wildfire logic, extreme wildfire spread probability, and regional climate settings
- Adjusted the probability of weather ending wildfire events
- Adjusted the slope break (% slope) between units that determines the topographic relationship
- Adjusted the probability of extreme wildfire spread
- Revised wildfire type and spread logic to make consistent with species wildfire resistance rating and evaluated how it varies with influence by MPB in lodgepole, root disease, warmer, drier conditions, and spread under wind driven events.

- Incorporated new wildfire occurrence numbers by geographic area to give an updated basis for SIMPPLLE's probability of a wildfire event occurring.
- Adjusted the probability of root disease to reflect the latest hazard rating maps. The VMap characteristics that are used in the hazard ratings have been built into SIMPPLLE's probability function.
- Made adjustments in root disease logic and relationship to wildfire processes
- Adjusted default treatment logic to allow silvicultural treatments to better match those modeled by SPECTRUM. Added "plant rust resistant white pine" as a follow-up treatment for commercial treatments.

2.5 TRANSLATING SPECTRUM TREATMENTS INTO SIMPPLLE

The Spectrum model was used by IPNF and KNF staff primarily to determine a management strategy (i.e., treatments) to achieve Desired Conditions, and the SIMPPLLE model was used by ERG to project these treatments spatially and determine what the resulting wildlife habitats might look like. To coordinate these two models, several steps were taken to "translate" the management information determined by the Spectrum model for use by the SIMPPLLE model.

Spectrum is a linear programming-based forest management model developed by the Forest Service for use in forest planning. The primary function of the Spectrum model for this exercise was to determine a management strategy (set of silvicultural prescriptions) to move the forest to desired vegetation conditions. To determine this strategy, the model is given a list of possible management treatments and timings for different categories of land/vegetation type combinations[3]. The model then chooses the best timing and type of management for each combination such that forest-wide Desired Condition is best met. The different treatments available to the different cover type groups modeled with Spectrum are presented in Table 2.

Table 2 Silvicultural Prescriptions by Cover Type

Cover Type (Layer 5)	No Mgmt[1]	Regen[2]	ITS[3]	CT[4]	GS[5]	PB[6]	Nat Disturb[7]
Douglas-fir Ponderosa pine	yes	yes	yes	yes	yes	yes	yes
Douglas-fir wet	yes	yes	no	yes	yes	yes	yes
Grand fir mix	yes	yes	no	yes	no	no	yes
Lodgepole Pine	yes	yes	no	yes	no	no	yes

[3] Example: An 80-year old Ponderosa Pine stand on Suited land. One management choice would be to simply not manage it. Another might be to underburn. Still another might be to thin in 10 years, or clearcut in 20 years.

Cover Type (Layer 5)	No Mgmt[1]	Regen[2]	ITS[3]	CT[4]	GS[5]	PB[6]	Nat Disturb[7]
Larch	yes	yes	no	yes	yes	yes	yes
Subalpine fir mix	yes	yes	no	yes	yes	no	yes

1No Mgmt - No management. All analysis areas were given the option of no management.
[2]**Regen** – Even-aged regeneration harvest with reserves (includes clearcut, seedtree and shelterwood with reserves). Includes commercial thinning where appropriate.
[3]**ITS** - Individual Tree Selection
[4]**CT** - Commercial Thin
[5]**GS** - Group Selection
[6]**PB** - Prescribed Fire
[7]**Nat Disturb**: Stand replacing fire

The default SIMPPLLE treatment logic was adjusted to ensure that treatments were consistently applied to vegetation in the way they were modeled in Spectrum. This required adjustment to the allowable cover type and size class categories for each treatment, as well as the regeneration logic that describes the vegetation resulting from the treatment. Additionally, some treatments that were not in the Spectrum model were added, namely, planting after wildfire and planting of Rust-resistant white pine. Finally, the prescriptions were applied differently in SIMPPLLE depending on the scenario. Table 3 and Table 4 show which prescriptions were modeled for which scenarios.

Table 3 Scenario 6 – Acres of Treatment by Type

Forest	Treatment	Time Steps				
		1	2	3	4	5
KNF	Regen[1]	18,325	18,315	20,960	21,995	20,960
	CT[2]	40,055	40,085	29,995	-	30,375
	GS[3]	35	-	-	-	35
	PB[4]	99,885	100,040	91,010	58,620	100,030
	Total	**158,300**	**158,440**	**141,965**	**80,615**	**151,400**
IPNF	Regen[1]	16,885	16,865	16,405	17,090	16,635
	CT[2]	27,950	34,370	17,335	-	25,215
	GS[3]	65	-	-	80	65
	PB[4]	50,005	49,985	50,075	50,120	50,075
	Total	**94,905**	**101,220**	**83,815**	**67,290**	**91,990**

[1]**Regen** – Even-aged regeneration harvest with reserves (includes clearcut, seedtree and shelterwood with reserves
[2]**CT** - Commercial Thinning – Thin prescription was modeled independently of the management regime in Spectrum
[3]**GS** - Group Selection – Individual Tree Selection and Group Selection prescriptions were lumped together into a “Selection” harvest
[4]**PB** - Prescribed Fire

Table 4 Scenario 7 – Acres of Treatment by Type

Forest	Treatment	Time Steps				
		1	2	3	4	5
KNF	Regen[1]	49,855	43,050	29,155	36,245	23,080
	CT[2]	40,065	40,065	40,040	-	46,255

Forest	Treatment	Time Steps				
		1	2	3	4	5
	GS[3]	5,025	575	5,015	5,015	5,025
	PB[4]	100,045	100,040	100,050	30,695	100,045
	Total	**194,990**	**183,730**	**174,260**	**71,955**	**174,405**
IPNF	Regen[1]	58,905	40,715	28,160	43,030	36,460
	CT[2]	28,140	50,065	50,035	-	43,630
	GS[3]	5,035	5,035	4,545	5,035	5,035
	PB[4]	50,040	50,060	50,075	39,460	50,040
	Total	**142,120**	**145,875**	**132,815**	**87,525**	**135,165**

[1]**Regen** – Even-aged regeneration harvest with reserves (includes clearcut, seedtree and shelterwood with reserves
[2]**CT** - Commercial Thinning – Thin prescription was modeled independently of the management regime in Spectrum
[3]**GS** - Group Selection – Individual Tree Selection and Group Selection prescriptions were lumped together into a "Selection" harvest
[4]**PB** - Prescribed Fire

2.6 SIMPPLLE SIMULATIONS

Thirty replications of each scenario were run through SIMPPLLE to determine a range of possible outcomes. However, results were compiled and analyzed based a single SIMPPLLE run, chosen to represent a realistic scenario close to the average of projected future conditions. Selection of a single run ensures that the landscape conditions are feasible, and also allows the analyst to draw a map of future landscape conditions (Henderson pers. comm.).

The representative run was selected based on severe fire disturbance. Specifically, it was the run that was closest to the average severe fire disturbance across all runs, based on the least squared deviation from the average in each time period. The equation used to choose the representative run was:

$$\min D_r = \sum_{t=1}^{T} (S_{rt} - \bar{S}_t)^2 \ \forall r$$

Where:

$D_r = Deviation\ of\ run\ r$

$S_{rt} = Severe\ fire\ of\ run\ r\ at\ time\ t$

$\bar{S}_t = average\ level\ of\ Severe\ fire\ at\ time\ t$

$t = time\ t\ of\ T\ timesteps$

$\forall$ = all

2.7 SUCCESSION AND DISTURBANCE PROCESSES

Succession is the progression of change in the composition, structure, and processes of a plant community through time (Winthers et al. 2004). Change occurs constantly in a natural ecosystem—sometimes in small ways, such as the death of an individual tree, or in large ways through a wildfire or management activity. Immediately following severe disturbance, the forest is classified in the early-seral stage, or stand initiation. This stage is often dominated by shade-intolerant, fast-growing trees which establish quickly (Tappeiner II et al. 2007). In the absence of disturbance, the forest progresses through mid-seral stages and into stand re-initiation, in which shade-tolerant species establish under the canopy.

The predominant natural disturbances on the KIPZ include insect outbreaks, diseases, and wildfires. These disturbances have shaped the current mix of size classes, stand structures, cover types, and patterns across the landscape. From approximately 1960 to the 1990s, timber harvests and road-building also modified much of the landscape in a pattern of small-patch regeneration units although during the last decade timber harvests and prescribed burning have re-focused on restoring more natural patterns of cover types, stand densities, and size classes. Other disturbances including wind-throw, avalanches, or floods may modify given stands, however, the scale is typically much smaller and generally non-detectable at the forest scale.

2.7.1 Wildfire

Northern Rockies ecosystems have evolved with wildfire as an important landscape process (Arno 1980). Wildfire has been identified as a key process that helped shape the structure and function of historical forests, often termed fire-dependent ecosystems (Arno 1980; Fischer and Clayton 1983). Wildfires, including the famous 1910 fire, have modified much of the KIPZ.

According to the IPNF and KNF EIS (USDA 2011a; USDA 2011b) the dominant, historical wildfire regime that occurred within forested vegetation on the KIPZ can be characterized as a mixed-severity fire regime. This type of fire regime commonly had a fairly short fire return interval for nonlethal or mixed severity fires, with lethal crown fires occurring less frequently (USDA 2011a; USDA 2011b). Compared to other fire regimes that are often recognized for forested vegetation—the nonlethal and stand-replacement regimes, the mixed-severity fire regimes are the most complex. Individual mixed-severity fires usually leave a mosaic of mortality on the landscape, which creates highly diverse communities. Mixed severity fires typically kill a large percentage of the more fire-susceptible tree species (e.g., hemlock, grand fir, subalpine fir, lodgepole pine) and a smaller percentage of the fire-resistant species, including western larch, ponderosa pine, whitebark pine, and western white pine (USDA 2011a; USDA 2011b).

Global climate model simulations consistently project increases in average annual and seasonal temperatures for the Pacific Northwest (USDA 2010b). Most modeled projections also show a decrease in summer precipitation. Given the observed correlation of large fire years with warm springs and dry summers over the last several centuries, it can be inferred that the projected changes in spring and summer climate will likely increase the frequency of large fire years (USDA 2010b). Yet there are many variables in addition to seasonal temperature and precipitation that influence the potential for large fires including fuel arrangement and continuity, topography, daily and hourly weather, fire management policies and tactics, and the timing and amount of ignitions (USDA 2010b).

Fire suppression practices over the last century have reduced natural fires that would have created a mosaic of age classes, species, and density. In addition to federal land management policies, roads, railroads, grazing by domestic livestock and big game, urbanization, agriculture in former grasslands, and rural settlement have all influenced fire exclusion (Hessburg et al. 2005). Large landscapes are increasingly homogeneous in their composition and structure, and regional landscapes are set up for wildfire, disease, and insect disturbance events (Hessburg et al. 2005).

2.7.2 Root Disease

Root disease is a major conifer pathogen within northern Idaho and western Montana national forests, with annual mortality rates exceeding mortality from all other forest insects and disease (Hagle 2010). Root disease has probably increased during the last 100 years, due to change in forest species composition to more root disease susceptible species. These forests were historically dominated by stands of western white pine, western larch, and ponderosa pine, species that are more resistant to root disease (Hagle et al. 2000).

Since1910 wildfire suppression, white pine blister rust, and timber harvests have led to a decline of western white pine, western larch, and ponderosa pine (Pederson 2004). The lack of fire has also resulted in denser stands of trees more susceptible to root diseases (USDA 2010b). Some of the forests are composed of perpetually young trees as older susceptible tree species are killed before reaching maturity, or have developed into long-term shrub fields (Hagle et al. 2000; Pederson 2004).

From 1952 to 1993, open stands of western white pine and western larch were replaced by dense stands of Douglas-fir, grand fir, and lodgepole pine (O'Laughlin et al. 1993). The forest component of grand fir and subalpine fir increased by 60% and lodgepole pine increased almost 40% during the 41-year period. Ponderosa pine and western white pine have declined by 40% and 60% respectively and it is estimated that western white pine may have survived on only 5% of its historic area (Neuenschwander et al. 1999). Today, these forests are dominated by highly root-disease susceptible species: Douglas-fir, grand fir and subalpine fir (Pederson 2004).

The root diseases with the highest impact on the KIPZ are Armillaria and fir Annosus root disease (Pederson 2004; USDA 2010b). Phellinus root disease and pine Annosus also have impact. Other root diseases found in the study areas are Schweinitzii butt rot and Tomentosus root disease. Armillaria root disease kills all species of young conifers, but is especially damaging to Douglas-fir, subalpine fir, and grand fir because these species remain susceptible throughout their lives (USDA 2010b). The effects of these root pathogens are long-lasting since they persist on a site affecting multiple generations of trees. Armillaria and other root pathogens affect forest species composition, structure, successional trajectories, and accelerate change to climax species or maintain stands in early seral stages (USDA 2010b).

According to the KIPZ Climate Change Report (USDA 2010b) incidence and severity of root disease have not been estimated across the KIPZ specifically, but a study performed by Bailey in 1994 included the southern IPNF and southern KNF and found evidence of root disease on 94% of the area sampled.

Root disease mortality occurs annually, with higher mortality rates in years of drought or other stress. Estimates at some permanent plots are between 2% and 4% mortality per year. Armillaria and Phellinus root disease are considered "diseases of the site." That is, the mycilea of the fungus is stable and essentially permanent on the site as long as susceptible host species exist (Hagle 2010). They can exist in decaying root systems of host species even after the host has died (Hagle et al. 2000).

SIMPPLLE currently models only the probability of occurrence of root disease within a polygon. The species of root disease is not identified in the model; however the plant associations reflect the probability of root disease occurrence based on the habitat type and species combination and a hazard rating of high, moderate or low. Intensity of root disease infection is not modeled.

An analysis was conducted to determine the root disease hazard rating on lands within the boundaries of the IPNF and KNF (USDA 2011a; USDA 2011b). On the IPNF the results indicate that approximately 18.2% of the area has a high hazard, 37.3% is moderate, 44.3% is rated as low, and roughly 0.1% has no hazard (USDA 2011a). On the KNF the results indicate that approximately 6.8% of the area has a high hazard, 27.2% is moderate, 65.2% is rated as low, and approximately 9.2% has no hazard (USDA 2011b). The probability of occurrence of root disease within SIMPPLLE reflects the latest hazard rating maps. Built into the probability function are the R1-Vmap characteristics that are used in the hazard ratings. Root disease is not included in the pathways until they reach pole size-class. For example, even though the site may have a "high" hazard rating (assigned an 80% probability) it will not indicate root disease until it grows into the pole size-class (Chew 2012).

Root disease mortality is confined to susceptible species and reflected in SIMPPLLE as cover type change. Root disease is dispersed over an area over a long period of time. Most root disease such as Armillaria and Phellinus are described as a disease of the site. Once established in an area that contains susceptible host species, root disease remains there as long as the area contains those susceptible host species. As root disease occurs within a polygon, the mortality function changes cover type to less dense stands, reduces size class and/or regenerates to generally root disease susceptible species.

2.7.3 Insects

Many insects are found on the KIPZ and most are native and exist at endemic levels (USDA 2011a; USDA 2011b). To varying degrees insects alter forest structure and ecosystem function, and they respond differently to vegetation conditions. Tree susceptibility to insects depends on factors such as forest composition, structure, age, and stress. Active insects within the landscape include MPB, western spruce budworm, and Douglas-fir bark beetle.

2.7.3.1 *Mountain Pine Beetle*

MPB in white pine and lodgepole pine are capable of serving as stand-replacing agents and can have a mixed effect on succession (USDA 2011a; USDA 2011b). These beetles 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 that bark beetles create, they can influence the probability of large stand-replacing fires, which in turn can reset the successional sequence (USDA 2011a; USDA 2011b).

Large-diameter mature stands are particularly vulnerable to attack because mature trees have a thick phloem layer which beetles prefer (Cole and Amman 1980). Outbreaks of beetles typically start in overstocked stands or in stands on poor sites and spread to healthier stands. Vigorous trees are sometimes able to repel attacking beetles with pitch, while stressed trees may not have the available resources for pitch production. However, during outbreak conditions an otherwise healthy tree may simply be overwhelmed by sheer numbers of beetles (USDA 1985). An epidemic will continue until no more beetles are left to attack host trees or no more green trees are left to be attacked (Cole and McGregor 1983). Factors such as stand density and host density are consistently identified as primary attributes associated with beetle infestations (Bentz et al. 2008; Christopher J.Fettig et al. 2007). The interaction of beetle infestation and wildfire risk varies with time; however, it has been found that MPB activity in the 1970s increased the odds of the Yellowstone Fires of 1988 over unaffected areas (Lynch et al. 2006). More recent studies have shown beetle outbreaks lead to increases and changes in wildfire behavior (Jenkins et al. 2008). Schmid et al. (2007) suggest that MPB-killed trees result in increases in dry fuel loads and thereby may increase the potential for severe wildfires.

There is evidence suggesting that due to warmer climate conditions MPB is active at higher elevations, higher latitudes, and/or for longer durations than seen previously this century for some geographic areas (Brunelle et al. 2008; Gibson et al. 2009; Nealis and Peter 2008). According to the KIPZ Climate Change Report (USDA 2010b), climate has an influence on bark beetle populations in multiple ways, including over-winter survival, reproductive rate and success, dispersal ability, and timing of egg and larval life stages, timing of adult emergence, and time required to complete a life cycle. In addition, climate variability and long-term trends will also influence the potential for large-scale outbreaks of MPB.

2.7.3.2 *Western Spruce Budworm*

Western spruce budworm (WSB) is a defoliating insect that affects mainly Douglas-fir. Current forest stand conditions and climate in western Montana are especially favorable for WSB (Bulaon and Sturdevant 2006). Development of outbreaks depends on suitable forest habitat, although the insect is greatly influenced by climate, weather, parasites, and predators (Carlson and Wulf 1989). WSB does well in dry climates and dry aspects (Carlson and Wulf 1989). WSB feeding can have pronounced effects on cone and seed production and tree growth. WSB-caused impacts are often short term and mature trees can recover quickly after populations subside; mortality is usually limited to smaller suppressed regeneration and pole-sized trees which collect falling larvae from the canopy (Bulaon and Sturdevant 2006). Vigorously growing stands typically withstand and recover from damage better than stressed stands. Reducing stand vulnerability using silvicultural methods or prescribed burning can be accomplished (Bulaon and Sturdevant 2006).

2.7.3.3 *Douglas-fir Beetle*

Douglas-fir beetle (DFB) is another bark beetle which is less aggressive than MPB, but often causes tree mortality. At endemic levels, it infests scattered trees and groups, including blow down and trees injured by fire, defoliation, or root disease (Schmitz and Gibson 1996). Disturbances can trigger increases in population size that can cause widespread mortality; outbreaks typically last 2–4 years (Negron et al. 2001). Douglas-fir forests evolved with DFB; outbreaks occurred historically and landscape patterns of vegetation resulted in spatially confined disturbances but modern outbreaks appear to occur for longer periods of time over entire landscapes. According to the KIPZ Climate Change Report (USDA 2010b), the IPNF underwent a large outbreak in the late 1990s after a major windstorm event in 1996.

2.8 WARMER, DRIER CLIMATE TRENDS

Future climate scenarios and ecological models suggest that the impact of climate change on some United States ecosystems may include increases in ecosystem productivity in the short-term, and shifts in the distribution of plants and animals in the long-term (Joyce and Birdsey eds. 2000). As climate change progresses, there are indications that there will be increases in disturbances such as forest fires, drought, and insects (Littell et al. 2009; USDA 2007b).

The KIPZ prepared a comprehensive report on climate change (USDA 2010b). The KIPZ Climate Change Report is over two-hundred pages in length and serves to compile and synthesize scientific information on past and projected trends in regional climate and climate-related impacts to forest resources. Possible management options to reduce ecosystem vulnerability to climate change are presented in the report, as are options for increasing ecosystem resilience to both climate and non-climate stressors. The KIPZ Climate Change Report went through a science consistency review by specialists from two Forest Service Research Stations (Rocky Mountain Research Station and the Pacific Northwest Research Station), the U.S. Geological Survey and universities. The KIPZ Climate Change Report informed the decision to simulate warmer, drier conditions in SIMPPLLE for this assessment. Based on these climate trends, SIMPPLLE simulations included warmer, drier conditions starting at decade three for eight of the eleven scenarios modeled (Table 1).

Climate models consistently project increasing average annual temperatures over the coming decades in the Pacific Northwest. The average of multiple climate model simulations (20 different climate models) predict that annual temperatures will increase 2.2° F by the 2020s and 3.5° F by the mid 21st century, compared to the average for 1970 to 1999 (USDA 2010b). Model projections show temperature increases occurring during all seasons, with the greatest increases projected in summer (USDA 2010b).

Annual precipitation has increased over the U.S. as a whole during the last century and in northern Idaho and northwestern Montana annual precipitation has increased approximately 12% over that timeframe, with greater increases in the spring and summer than autumn and winter (USDA 2010b). Fluctuations in Pacific Northwest precipitation are more variable among models, but generally suggest no substantial change in the average annual amount of precipitation from the variability experienced during the 20th century; however, given the variability in results among models, projections of precipitation are considered less certain than temperature projections (USDA 2010b). Yet most models project decreases in summer, increases in winter, and little change in annual mean precipitation (USDA 2010b).

Climate has varied, and will continue to vary, from year-to-year and decade-to-decade around the long-term trend and the effects of longer term climate trends may be either amplified or moderated by climate variability resulting from the shorter-term El Nino Southern Oscillation and the Pacific Decadal Oscillation (USDA 2010b). As a result of changes in long-term average trends, some conditions that are now considered to be extreme will occur more frequently or with greater magnitude, while others will occur less frequently (e.g., more unusually warm periods and fewer cold spells) (USDA 2010b). In many instances, changes in the frequency and magnitude of extreme events, such as droughts and severe wildfires, will have the most significant and long-lasting consequences for land and resource management (USDA 2010b).

Recent studies indicate that projected climate changes may increase the likelihood of MPB outbreaks in relatively high elevation forests of the Northern Rockies and decrease the likelihood in forests of low and middle elevation (USDA 2010b). Projected changes in climate may also increase the disturbance severity of forest insects that previously have had a relatively minor role in the forest dynamics of the Northern Rockies and some species that currently do not occur in the Northern Rockies may expand their range into the region (USDA 2010b). The amount, distribution, and susceptibility of host trees will be a critical factor determining the likelihood of major forest die-backs resulting from aggressive forest insects and pathogens and high elevation pine species, particularly whitebark pine, may be the most vulnerable (USDA 2010b).

Numerous studies suggest that projected climate changes are likely to increase the frequency of large wildfires in the Northern Rockies and much of the western U.S. (Arno and Allison-Bunnell 2002; Littell et al. 2009; USDA 2010b). Studies also suggest that projected climate changes are likely to result in increased number of days with high wildfire danger, longer wildfire seasons, more large wildfires, and an increase in the average annual acreage burned in coming decades (USDA 2010b).

In addition to potential changes in disturbance processes, projected climate changes are likely to stress many forest communities and tree species, and as a result a variety of models have been used to evaluate the potential effects of climate change on the distribution of suitable climate habitat for tree species and forest types in the Northern Rockies and western U.S. (USDA 2010b). Although these models do not produce constant results for individual forest types or tree species, projections indicate that climatic changes may limit the regeneration ability and increase mortality rates of some tree species within their current ranges (USDA 2010b).

There is an unavoidable increased difficulty in predicting how those warmer, drier trends might affect growth rates or wildfire severity. Fortunately, the SIMPPLLE model can be adjusted to reflect warmer, drier conditions based on research completed during extreme weather or burning conditions.

2.9 COMPARISON TO HISTORIC RANGE OF VARIABILITY

For wildlife species that are predominately limited by habitat availability, as is the case with the 12 species addressed in this report, if habitat available for a given species is within or near the Historic Range of Variability (HRV) over time, that species is unlikely to be at risk (Mehl et al. 2009). Conversely, if habitat declines to levels substantially below HRV, it was concluded that the species' viability may be at risk (Mehl et al. 2009).

For this analysis, habitat is compared against the KNF and IPNF developed HRV for the five decade timeframe (USDA 2011a; USDA 2011b). An exception was made for whitebark pine due to limited data, and black-backed woodpeckers—the viability of which generally needs to be assessed at scales larger than the KIPZ (Hillis et al. 2002; Samson 2006b).

The tables below show that for each VRU, the HRV includes: 1) high and low ranges of historic dominance class (i.e. ponderosa pine versus Douglas-fir); and 2) high and low ranges of historic size class (i.e. 0–5-inch DBH versus >15-inch DBH).

Table 5 Historic Range of Variation for Dominance Types on the KNF

Dominance Type	VRUs 1-3 Warm/Dry		VRUs 4-6 Warm/Moist		VRUs 7-11 Subalpine		Forestwide FS Lands	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
PP	21%	43%	0%	0%	0%	0%	5%	9%
DF	5%	11%	7%	15%	0%	0%	4%	8%
LP	7%	15%	0%	0%	25%	49%	12%	23%
WL	33%	65%	37%	73%	13%	25%	26%	52%
GF/C/WHmix	0%	0%	15%	29%	0%	0%	5%	11%
WP	0%	0%	8%	16%	3%	7%	4%	9%
Sfmix	0%	0%	0%	0%	26%	52%	11%	21%

PP = ponderosa pine; DF = Douglas-fir; LP = lodgepole pine; WL = western larch; GF/C/WH mix = grand fir/cedar/western hemlock mix; WP = white pine; and SF mix = subalpine fir mix.

Table 6 Historic Range of Variation for Size Classes on the KNF

Size Class	VRUs 1-3 Warm/Dry		VRUs 4-6 Warm/Moist		VRUs 7-11 Subalpine		Forestwide FS Lands	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
Seedling/Sapling	13%	27%	15%	31%	17%	33%	16%	31%
Small	9%	17%	10%	20%	10%	20%	10%	19%
Medium	7%	15%	9%	17%	8%	16%	8%	16%
Large	38%	74%	33%	65%	32%	64%	34%	67%

Seedling/sapling = 0-5-inch DBH trees, small = 5-10-inch DBH trees, medium = 10-15-icnh DBH trees, and large = greater than 15-inch DBH trees

Table 7 Historic Range of Variation for Dominance Types on the IPNF

Dominance Type	VRUs 1-3		VRUs 4-6		VRUs 7-11		Forestwide	
	Warm/Dry		Warm/Moist		Subalpine		FS Lands	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
PP	32%	64%	0%	0%	0%	0%	5%	10%
DF	26%	52%	14%	28%	0%	0%	12%	25%
LP	3%	7%	0%	0%	11%	23%	3%	6%
WL	5%	11%	13%	25%	8%	16%	10%	21%
GF/C/WHmix	0%	0%	10%	20%	0%	0%	6%	12%
WP	0%	0%	30%	60%	7%	13%	20%	39%
Sfmix	0%	0%	0%	0%	41%	81%	10%	20%

PP = ponderosa pine; DF = Douglas-fir; LP = lodgepole pine; WL = western larch; GF/C/WH mix = grand fir/cedar/western hemlock mix; WP = white pine; and SF mix = subalpine fir mix.

Table 8 Historic Range of Variation for Size Classes on the IPNF

Size Class	VRUs 1-3		VRUs 4-6		VRUs 7-11		Forestwide	
	Warm/Dry		Warm/Moist		Subalpine		FS Lands	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
Seedling/Sapling	14%	28%	15%	29%	14%	28%	14%	29%
Small	9%	19%	8%	16%	10%	20%	9%	17%
Medium	10%	20%	13%	27%	13%	27%	13%	26%
Large	33%	65%	31%	61%	29%	59%	31%	61%

Seedling/sapling = 0-5-inch DBH trees, small = 5-10-inch DBH trees, medium = 10-15-inch DBH trees, and large = greater than 15-inch DBH trees

To convert the forest-wide HRVs into species habitat-specific HRVs by Forest, the following formula was used.

Low range HRV = (Acres of VRU) x (low range percentage of dominance class) x (low range percentage of historic size class)

For example, pygmy nuthatches occur in warm dry habitats exclusively within large diameter (>15-inch DBH) ponderosa pine. Thus the low range HRV for pygmy nuthatch habitat is determined by the following formula: *Low range HRV = (Acres of warm, dry VRU) x (low range percentage of ponderosa pine) x (low range percentage of >15-inch DBH)*

Using the IPNF's acreage data for warm dry VRU and inserting the low range data for ponderosa pine dominance and large tree occurrence, the following formula was used:

Low range HRV = 379,912 acres (warm, dry VRUs 1-3) x .32 x .33 = 39,168 acres

Taking this formula and substituting high range numbers for ponderosa pine dominance and large tree occurrence provides the high range:

High range HRV = 379,912 acres (warm, dry VRUs 1-3) x .64 x .65 = 154,299 acres

A summary of the high and low range HRVs used for each species excluding whitebark pine and black-backed woodpeckers is included in the following tables.

Table 9 IPNF Low and High Range HRV

IPNF					
Species	**VRUs**	**Dominance Types**	**Size Classes**	**Low Range HRV (acres)**	**High Range HRV (acres)**
Lynx (Multi-storied-hare suitable habitat)	7-11	SAF mix	large	70,585	283,707
Fisher habitat	4-6	all	medium, large	652,018	1,304,037
Flammulated owl potential habitat	1-3	PP & DF	large	70,993	279,668
Pygmy Nuthatch	1-3	PP	large	39,168	154,299
Chipping sparrow/dusky flycatcher habitat	1-3	all	medium, large	159,492	315,275
Hairy woodpecker habitat	all	all	medium, large	1,076,427	2,128,390
Hammond's flycatcher habitat	all	all	large	758,392	1,492,319
Olive-sided flycatcher habitat	all	all	medium, large	1,076,427	2,128,390
American marten (all habitat)	4-6, 7-11	SAF mix	large	510,576	2,017,399
Northern goshawk habitat	all	all	medium, large	1,076,427	2,128,390
Pileated woodpecker habitat	1-3, 4-6	PP,WL	large	105,007	406,803

Table 10 KNF Low and High Range HRV

KNF					
Species	**VRUs**	**Dominance Types**	**Size Classes**	**Lower HRV (acres)**	**Upper HRV (acres)**
Lynx (Multi-storied-hare suitable habitat)	7-11	SAF mix	large	69,681	278,725
Fisher habitat	4-6	all	medium, large	343,760	671,150
Flammulated owl potential habitat	1-3	PP & DF	large	48,432	195,886
Pygmy Nuthatch	1-3	PP	large	39,118	155,983
Chipping sparrow/dusky	1-3	all	medium,	220,592	436,282

KNF					
Species	**VRUs**	**Dominance Types**	**Size Classes**	**Lower HRV (acres)**	**Upper HRV (acres)**
flycatcher habitat			large		
Hairy woodpecker habitat	all	all	medium, large	901,402	1,781,342
Hammond's flycatcher habitat	all	all	large	729,707	1,437,951
Olive-sided flycatcher habitat	4-6,7-11	all	medium, large	901,402	1,781,342
American marten (all habitat)	all	SAF mix	large	279,862	1,110,839
Northern goshawk habitat	1-3,4-6	all	medium, large	901,402	1,781,342
Pileated woodpecker habitat	1-3,4-6	PP,WL	large	200,526	780,138

2.10 WILDLIFE SPECIES AND HABITAT QUERY DESIGNS

This study evaluates the level of currently available habitat and models potential future habitat in ten year increments over fifty years for the following wildlife species: Canada lynx, black-backed woodpecker, fisher, flammulated owl, pygmy nuthatch, Hammond's flycatcher, olive-sided flycatcher, American marten, northern goshawk, chipping sparrow, dusky flycatcher, and pileated woodpecker. In addition to the wildlife species, we also modeled whitebark pine habitat and habitat connectivity (defined here as mid- and late-seral forest sustainability and recruitment).

As discussed above, habitats for wildlife species are correlated to vegetation parameters. These parameters were captured in remotely sensed R1-VMap and were used to create SIMPPLLE modeling landscapes. The literature was searched to find the best available science correlating vegetation characteristics to the species' habitat requirements. This process was repeated, refinements were made, and concurrence was achieved with key USFS personnel (Hahn pers. comm.).

The vegetation habitat component for each species composed the base layer with which the SIMPPLLE model was used to determine changes to that habitat layer from wildfire, insects and diseases, or vegetation treatments. The following sections describe the literature which helped determine necessary vegetation habitat components for the selected species, and the vegetation parameter query used to determine available habitat.

2.10.1 Canada Lynx

The Canada lynx (*Lynx canadensis)* is listed as a threatened species under the ESA.

Lynx habitat is generally described as moist, boreal coniferous vegetation with cold, snowy winters that provide a prey base of snowshoe hares (*Lepus americanus)*. Primary vegetation in the Northern Rockies that provides for snowshoe hare, and thus lynx, includes lodgepole pine (*Pinus contorta)*, subalpine fir (*Abies lasiocarpa)*, and Engelmann spruce (*Picea engelmannii)* forest types as well as aspen (*Populus tremuloides)* forests at mid to high elevations (Koehler and Aubry 1994). In the West, the highest lynx densities are in mature, multi-layer spruce/fir forests (Squires et al. 2006; Squires et al. 2010), and lynx disproportionately use multi-storied stands compared to the degree of availability.

Canada lynx require early-successional forests, older forests with dense seedling/sapling understories supporting high densities of prey, especially snowshoe hares, and late-successional forests for denning and the rearing of young (Butts 1992; Koehler and Aubry 1994).

Stand initiation hare habitat is made up of young, dense stands of saplings that have regenerated after a disturbance such as a timber harvest or stand-replacing wildfire. These stands provide adequate cover for reproduction and survival of snowshoe hares. Stands begin to provide habitat for snowshoe hares 15–20 years after disturbance (Koehler and Aubry 1994), once trees and shrubs are tall enough to extend above the snow (Koehler and Brittell 1990), and will often continue to provide habitat for another 20–25 years unless they are thinned. Denser stands appear to offer better habitat conditions for snowshoe hares; stands with <1,000 stems per acre are insufficiently dense to provide for hares (Griffin and Mills 2007).

Multi-storied hare habitat includes older forest stands that provide lynx denning habitat as well as dense coniferous understories that maximize cover and browse for hares at varying snow depths throughout the winter. Only multi-storied stands in which tree limbs typically touch the snowline and in which the understory is dense provide winter habitat for snowshoe hares. Horizontal cover found in multistory forest stands is a major factor affecting winter hare densities. Thinning which reduces the value of these stands for snowshoe hares affects the suitability of these habitats for lynx.

In winter, lynx do not appear to hunt in openings, where lack of above-snow cover limits habitat for snowshoe hares (Mowat et al. 2000); yet while cover is important to lynx when searching for food (Brand et al. 1976), lynx often hunt along edges (Mowat et al. 2000). Lynx habitat within the boreal forest landscape is naturally patchy because the boreal forest contains stands of differing ages and conditions, only some of which are suitable as lynx foraging or denning habitat at any point in time (McKelvey et al. 2000).

Squires et al. (2006) found that the highest lynx densities are in extensive mesic, spruce/fir forests. Extensive dry, cold lodgepole pine forests have few, if any, lynx. Breeding populations in Montana are limited to the northwest portion of the State, including the Yaak and Seeley Swan drainages.

The Northern Region Lynx Management Direction (USDA 2007a) provides specific direction for management of stands within lynx habitat. The standards most applicable to long-term changes in vegetation conditions include: 1) limiting regeneration harvesting within given Lynx Analysis Units (LAUs) so that "unsuitable habitat" (stands too young to provide stand initiation-hare habitat) does not exceed 15% of the LAU per decade, and 30% total; 2) avoiding timber harvesting within stands having multi-storied-hare characteristics; and 3) avoiding pre-commercial thinning within stands having stand-initiation-hare characteristics.

2.10.1.1 *Query Design*

We conducted two analyses for lynx to assess their distinct habitat requirements: a stand initiation habitat analysis, and a multi-storied hare habitat analysis. Additionally, multi-storied habitat was stratified into potential habitat and suitable habitat. Potential habitat includes habitat groups in which subalpine fir/Engelmann spruce is the climax vegetation (Pfister et al. 1977), i.e., habitats in which subalpine fir will become dominant in the absence of disturbance. For instance, if potential habitat is currently forested with Douglas-fir/larch (typical seral species on warmer subalpine fir habitat types), that habitat is considered "potential" but not "suitable" habitat (since lynx do not utilize Douglas-fir/larch cover types). Suitable habitat is limited to cover types that contain subalpine fir or Engelmann spruce within subalpine fir habitat groups.

Stand Initiation Hare Habitat

The query design for lynx stand initiation hare habitat includes the following layers:

- Habitat group/cover type: subalpine fir series (excluding the E1 mesic habitat group), including the following habitat groups:
    - D3, cool and moist
    - F1, cool and moderately dry
    - F2, moderately cool and moderately dry
    - G1, cold and moist
    - Suitable Habitat: Since lynx primarily use spruce-fir forests (Squires et al. 2006; Squires et al. 2010), the following cover types were retained from within the habitat groups as suitable habitat: AF, AF-ES-MH, AF-MH, DF-AF, DF-ES, DF-LP-AF, DF-LP-ES, ES, ES-AF, L-DF-AF, L-DF-ES, L-ES, L-ES-AF, LP-AF.
    - Lynx do not use pure Douglas-fir or Douglas-fir/western larch cover types.
    - Lynx do not use highly mesic habitats such as western redcedar (*Thuja plicata)*; thus, habitat groups E1 and E2 were removed.
- Tree size class: 0–5-inch diameter at breast height (DBH) seedling/sapling
- Canopy cover 70–100%

Multi-Storied Hare Habitat

The query design for lynx multi-storied hare habitat includes the following layers:

- Habitat group/cover type: subalpine fir series (excluding the E1 mesic habitat group), including the following habitat groups:
    - D3, cool and moist
    - F1, cool and moderately dry
    - F2, moderately cool and moderately dry
    - G1, cold and moist
    - Suitable Habitat: Since lynx primarily use spruce-fir forests (Squires et al. 2006; Squires et al. 2010), the following cover types were retained from within the habitat groups as suitable habitat: AF, AF-ES-MH, AF-MH, DF-AF, DF-ES, DF-LP-AF, DF-LP-ES, ES, ES-AF, L-DF-AF, L-DF-ES, L-ES, L-ES-AF, LP-AF.
    - Potential Habitat: This includes all cover types within the above habitat groups (D3, F1, F2, G1), as cover types within these habitat groups can eventually become suitable habitat through succession.
    - Lynx do not use pure Douglas-fir or Douglas-fir/western larch cover types.
    - Lynx do not use highly mesic habitats such as western redcedar (*Thuja plicata)*; thus, habitat groups E1 and E2 were removed.
- Tree size class: >15-inch DBH including:
    - 15–20.9-inch DBH
    - ≥21-inch DBH
- Stands >15% canopy cover including:
    - 15–39.9%
    - 40–69.9%
    - 70–100%

The Northern Region Lynx Management Direction is highly prescriptive and is incorporated into all KIPZ Forest Plan alternatives. Thus this SIMPPLLE analysis identifies subtle differences in the amount and arrangement of stand initiation hare and multi-storied hare habitat over the 50-year time period.

2.10.2 Whitebark Pine

Whitebark pine (*Pinus albicaulis)* is designated as an ESA Candidate species, as well as a sensitive species in Region One.

The whitebark pine is slow-growing and occurs in high-elevation forests and timberlines (Arno and Hoff 1990). It is regarded as a keystone species for its significant role in subalpine ecosystems (Keane and Parsons 2010; Tomback et al. 2001; Tomback and Kendall K.C. 2001). Whitebark pine can serve as a climax species at the uppermost elevations and as a minor early seral species in mixed conifer stands.

Whitebark pine trees occur on some of the higher ridges and mountain tops on the IPNF and KNF (USDA 2011a; USDA 2011b).

Fires are important to whitebark pine regeneration and long-term maintenance; fires rejuvenate and maintain the productivity of seral whitebark pine stands. Whitebark pine is well adapted to frequent, light to moderate burns which create openings for regeneration, but also has historically experienced infrequent stand-replacing burns in many of its seral communities (Arno 2001). High-intensity, stand-replacing wildfires in dense subalpine fir-spruce forests often allow whitebark pine to become established due to seed caching by the Clark's nutcracker (*Nucifraga columbiana)*. After establishment these seral whitebark pine communities are perpetuated by low-intensity fires that kill understory fir and spruce (Arno and Hoff 1990). Long-term wildfire suppression has led to the successional replacement by more shade-tolerant, competitive trees such as spruce and fir and has resulted in a loss of suitable openings for seed germination (Keane and Morgan 1994).

White pine blister rust (*Cronartium ribicola)* is a non-native fungal disease that accounts for major changes in forest successional patterns, having removed more than 90% of white pine (*Pinus monticola)* and whitebark pine. Whitebark pine mortality from the combination of blister rust and MPB exceeds 50% in areas including Glacier National Park, northwestern Montana, north-central Idaho, and northern Washington (Kendall and Keane 2001).

The most recent inventory information indicates that whitebark pine trees occur on approximately 1.2% of the forested area of the IPNF (USDA 2010a) and 2 percent of the forested area on the KNF (USDA 2011b).

2.10.2.1 *Query Design*

R1-VMap greatly underestimated the amount of whitebark pine across the KIPZ. At time step zero all cover types involving whitebark pine totaled 1,700 acres across the entire KIPZ. Silviculturists from each Forest and the R1 Regional Office determined that this was unrealistic, and collaboratively came up with the following process of modeling whitebark pine into the future using SIMPPLLE. The KNF developed a spatial data layer of whitebark pine probable areas and the IPNF used VRUs 10 and 11 since these VRUs represent the areas on the landscape that whitebark pine plays a significant successional role. The KNF and IPNF layers were combined to create a KIPZ-wide whitebark pine probable layer which totaled 411,101 acres across the KIPZ. Due to whitebark pine's dependence on fire for regeneration, we tracked wildfires in the pine probable layer with the assumption that these disturbances would have a high probability of regenerating whitebark pine stands. Simulated results used this whitebark pine probable as a 'footprint' to query for fires that had occurred in the previous time step. Thus all figures for whitebark pine in this document are not acres of whitebark pine cover type, but acres that had a high probability of whitebark pine establishment within the past ten years owing to fire occurrence.

2.10.3 Black-backed Woodpecker

Black-backed woodpeckers (*Picoides arcticus)* are associated with boreal and montane coniferous forests that have experienced recent burns. Black-backed woodpeckers are known to use three types of forested habitat: 1) post-fire areas that have burned within one to six years, 2) areas with extensive bark beetle outbreaks causing widespread tree mortality, and 3) areas of smaller disturbances scattered throughout the forest caused by wind throw, ice damage, or other occurrences that produce small patches of dead trees. These conditions all provide habitat for the black-backed woodpecker's primary food source, woodborer beetles, and larvae.

Within those habitats, black-backed woodpeckers select a diverse mixture of conifer species, none of which is by itself essential to the species. These include ponderosa pine (*Pinus ponderosa)*, spruce (*Picea* spp), western larch (*Larix occidentalis)*, mountain hemlock (*Tsuga mertensiana)*, Douglas-fir (*Pseudotsuga menziesii)*, and lodgepole pine *(Pinus contorta)* (Dixon and Saab 2000).

Black-backed woodpeckers nest in snags at high densities in burned areas from one to six years after fires (Caton 1996; Hitchcox 1996) and can colonize very small, isolated burns (Hitchcox 1996). Black-backed woodpeckers in the Northern Rockies have a high degree of relatedness and can colonize burns across a wide geographic range (Pierson 2009). Hoyt and Hannon (Hoyt and Hannon 2002) concluded that black-backed woodpeckers can colonize new burns from up to 50 kilometers away.

High-severity stand-replacing wildfires may be particularly important for this species (Hutto 1995), though the woodpeckers may also select lower-intensity fires such as controlled burns (Russell et al. 2009). Hejl et al. (2000) concluded that salvage logging eliminated black-backed woodpecker habitat, even when some unburned trees were left.

2.10.3.1 *Query Design*

The query design for black-backed woodpecker includes the following layers:

Habitat group/cover type: all habitat groups (excluding high elevation alpine cover types WB, WB-ES-AF, and AL-WB-AF) including:

- A1, hot and very dry
- A2, warm and very dry
- B1, warm and dry
- B2, moderately warm and dry
- B3, warm and moderately moist
- C1, moderately warm and moderately moist
- C2, moderately warm and moist

  - D1, moderately cool and moist
  - D2, moderately cool and moderately moist
  - D3, cool and moist
  - E1, moderately cool and wet
  - E2, cool and wet
  - F1, cool and moderately dry
  - F2, moderately cool and moderately dry
- Tree size class >5-inch DBH including:
  - 5–8.9-inch DBH
  - 9–14.9-inch DBH
  - 15–20.9-inch DBH
  - ≥21-inch DBH

No canopy cover was selected, as canopy cover is of minor importance in predicting black-backed woodpecker habitat (Saracco et al. 2011).

For time step zero, a GIS layer including the locations of all severities of fire (low, moderate, and high severity) in the past ten years was used to select existing habitat. This incorporated Caton's (1996) six-year occurrence following fires. Because the SIMPPLLE model is set up to measure habitat at 10-year intervals, it will overestimate habitat by 40%, since suitable habitat is only available for six years after a fire. For modeled future time steps, black-backed woodpecker habitat includes those stands meeting the habitat group and tree size class that are modeled to burn during those time steps.

Since black-backed woodpeckers are not directly tied to MPB-killed habitats as they are tied to post-fire habitats, MPB-killed habitats are not specifically analyzed.

The SIMPPLLE model is dependent upon stand-level data (R1-VMap) and thus is unable to incorporate snag densities. We assume that nest snags exist in sufficient numbers for black-backed woodpeckers (Hitchcox 1996). Further, the availability of nest snags is non-limiting for black-backed woodpeckers.

2.10.4 Fisher

Fisher (*Martes pennanti)* prefer dense, mesic, mature and late-seral coniferous stands with high canopy closure in low to mid-elevation forests (Arthur et al. 1989; Jones and Garton 1994). Fisher require specific structural elements, particularly large trees and coarse woody debris (CWD) (Ruggiero et al. 1994). Fallen logs, stumps and seedlings, shrubs, and herbaceous cover are important habitat characteristics (Meyer 2007). In addition, fisher are disproportionately tied to large, low to mid-elevation forested stream bottoms (Jones and Garton 1994).

Fisher prefer late-seral forests over other habitats (Ruggiero et al. 1994). Yet, studies have shown that in the Rocky Mountains, there are times of the year where young to medium-age stands of conifers are preferred (Jones 1991; Roy 1991). Fishers do not have as strong a habitat relationship to interior forests as do American martens. Yet fishers avoid open areas with low canopy closure, an aversion that may limit population expansion Ruggerio et al. (1994) . Accordingly, it has been concluded that fishers are at risk from large wildfires, insect outbreaks, and habitat modification (USDI 2009).

2.10.4.1 *Query Design*

The query design for the fisher is based on a combination of R1-VMap, Montana Natural Heritage Program, and Forest Inventory and Analysis (FIA) data. The following mapped fields are included in the mapped layer:

- Cover type: mesic cool Douglas-fir to mid-subalpine fir
- Habitat groups:
    - C1, moderately warm and moderately moist
    - C2, moderately warm and moist
    - D1, moderately cool and moist
    - D2, moderately cool and moderately moist
    - D3, cool and moist
    - E1, moderately cool and wet
    - E2, cool and wet
- Tree size class: >10-inch DBH including:
    - 10–14.9-inch DBH
    - 15–20.9-inch DBH
    - ≥21-inch DBH
- Canopy cover > 40% including:
    - 40–69.9%
    - 70–100%

We considered stream proximity in the query by limiting habitat groups and cover types to those that intrinsically have riparian characteristics.

Fine scale habitat selection includes determining the presence of snags and CWD. VMap data does not provide information on these variables. Our query design uses FIA data to identify stands where the presence of snags and CWD is likely.

2.10.5 Flammulated Owl

Flammulated owls are strongly associated with mature xeric ponderosa pine/Douglas-fir stands in montane forests with snags (Hays and Rodrick 2003; Hayward and Verner 1994; Samson 2006b). While they prefer ponderosa pine forests, flammulated owls will also use open Douglas-fir forests (Marti 1997).

Flammulated owls prefer open canopy (less than 40% cover) (Samson 2006a) and avoid dense young stands of Douglas-fir (Wright et al. 1997). Flammulated owls also avoid clear-cuts and intensively cutover areas, but will use thinned or selectively logged stands.

Flammulated owls are secondary cavity nesters that often use abandoned pileated woodpecker (*Dryocopus pileatus)* or northern flicker (*Colaptes auratus)* cavities as nest sites. These may be reused for several years (McCallum 1994). These nest sites may have pockets of dense Douglas-fir below the nest (Wright 1996).

Marti (Marti 1997) found nests in aspen/Douglas-fir cover types on the Wasatch Front in areas without ponderosa pine. Linkhart et al. (1997) found lower nest densities in Douglas-fir/aspen compared to ponderosa pine.

2.10.5.1 *Query Design*

We designed two queries for flammulated owl: suitable habitat and potential habitat. These determinations were made based on differences in canopy cover. Ponderosa pine communities are at severe risk due to fire exclusion, which has caused open, ponderosa pine stands to convert through succession to dense stands of Douglas-fir. Early logging removed the largest ponderosa pines. Forest Service owl monitoring often reports flammulated owls within relatively dense stands (>40% crown closure), yet the research (Hayward and Verner 1994; Wright 2000) suggests that flammulated owls require open understories to successfully forage for moths and grasshoppers. Since few existing mature ponderosa pine stands are open (<40% crown closure) due to long-term fire exclusion, flammulated owls may be selecting dense stands simply because those are all that remain in most areas. Therefore, the query for flammulated owls assumes that potential habitat includes any mature ponderosa pine or dry Douglas-fir stands that are greater than 15-inch DBH. Suitable habitat is limited to stands with 15-inch DBH and crown closures of less than 40%. SIMPPLLE logic pathways show that dense stands of potential habitat will convert to suitable habitat if treated by underburning, are burned by low-to-moderate wildfire, or are mechanically thinned from below.

Suitable Habitat

The query design for flammulated owl suitable habitat includes the following layers:

- Cover types: ponderosa pine to cool Douglas-fir.
- Habitat groups:
  - A1, hot and very dry
  - A2, warm and very dry
  - B1, warm and dry
  - B2, moderately warm and dry
  - B3, warm and moderately moist
- Tree size class: >15-inch DBH including:
  - 15–20.9-inch DBH
  - 21+-inch DBH
- Stands of 15–39.9% canopy cover

The SIMPPLLE model is dependent upon stand-level data (R1-VMap) and did not allow the incorporation of snag densities. Thus we integrated FIA summary data to determine if snags for nesting exist at sufficient numbers within the larger size classes.

Potential Habitat

The query design for potential habitat is the same as the query design for suitable habitat except that canopy cover includes denser stands.

- Stands of 15–69.9% canopy cover including:
  - 15–39.9%
  - 40–69.9%

2.10.6 Pygmy Nuthatch

Pygmy nuthatches can be found in ponderosa pine forest or other habitats with a ponderosa pine component (Jones 1998). Within the KIPZ, ponderosa pines can be found within warm and dry Douglas-fir habitat groups.

Pygmy nuthatches prefer heterogeneous stands of well-spaced, old pines and vigorous trees of intermediate age (Balda et al. 1983). They prefer dense pine forests with significant understory, yet healthy ponderosa pine forests tend to be quite open. It is not known what density of crown closure is intolerable to pygmy nuthatches. Pygmy nuthatches are widely distributed (their habitat ranges from South Dakota to the Mexican border). Ponderosa pine habitat on the KIPZ is relatively uncommon when compared with other forests within the species' range. This habitat is a risk on the KIPZ due to wildfire suppression (USDA and USDI 2000).

Pygmy nuthatches nest in cavities in large dead pines and in live trees with dead sections, so they tend to prefer mature, undisturbed forests with a number of large snags (Ghalambor and Dobbs 2006). Pygmy nuthatches also roost in large trees year-round.

2.10.6.1 *Query Design*

The query design for pygmy nuthatch includes the following layers:

- Cover type: Ponderosa pine to dry Douglas-fir
- Habitat groups:
    - A1, hot and very dry
    - A2, warm and very dry
    - B1, warm and dry
    - B2, moderately warm and dry
        - Within B2, cover types are limited to those that include the following species: DF, DF-LP, DF-PP-GF, DF-PP-LP, DF-RRWP, DF-WP, L-DF-PP, L-PP, L-PP-LP, PP, PP-DF
- Tree size class >15-inch DBH including:
    - 15–20.9-inch DBH
    - 21+-inch DBH
- Stands >15% canopy cover including:
    - 15–39.9%
    - 40–69.9%
    - 70–100%

While pygmy nuthatches can utilize stands smaller than 15-inch DBH; there tend to be fewer snags in these size classes, thereby providing less of this important habitat characteristic. The SIMPPLLE model is dependent upon stand level data which does not include snag densities. We therefore integrated FIA summary data to determine if ponderosa pine snags for nesting exist at sufficient numbers within the larger ponderosa pine size classes.

2.10.7 Chipping Sparrow and Dusky Flycatcher

The dusky flycatcher (*Empidonax oberholseri)* and chipping sparrow (*Spizella passerine)* habitat assessments were combined due to their similar habitat preferences. In the 13 national forests in the USFS Northern Region, both species are mainly found in ponderosa pine forests, cottonwood/aspen forests, and forests that are open through post-fire or timber harvesting activities (Hutto and Young 1999).

Dusky flycatchers occupy relatively open habitats, including mixed coniferous forests, willow riparian zones, and open ecotonal woodlands of Douglas-fir, ponderosa pine, sagebrush, mountain juniper, and aspen groves (Sedgwick 1993). Habitats often include forest edges, agricultural borders, and shrub habitats (Kelly 1993). In central Idaho, dusky flycatchers responded positively to increases in shrub cover and density and number of vegetation height classes, and negatively to increases in overstory conifer density (Kroll 2007).

In northern or montane regions, chipping sparrows breed in open, early successional or low-growth woodlands with shrubby vegetation, and have a strong preference for conifers (Middleton 1998).

2.10.7.1 *Query Design*

The query design for chipping sparrow/dusky flycatcher includes the following layers:

- Cover type: ponderosa pine through grand fir
- Habitat groups:
    - A1, hot and very dry
    - A2, warm and very dry
    - B1, warm and dry
    - B2, moderately warm and dry
    - B3, warm and moderately moist
    - C1, moderately warm and moderately moist
- Because they prefer openings, chipping sparrow and dusky flycatchers do not select dense, mesic forests. Thus, the following cover types were removed from suitable habitat:
    - DF-GF, DF-RRWP-GF, DF-WP-GF, ES, GF, L-GF, L-WP-GF
- Tree size class >9-inch DBH including:
    - 9–14.9-inch DBH
    - 15–20.9-inch DBH
    - 21+-inch DBH
- Stands 15–69.9% canopy cover including:
    - 15–39.9%
    - 40–69.9%

2.10.8 Hairy Woodpecker

Hairy woodpeckers (*Picoides villosus)* are year-round resident primary cavity nesters, which subsequently provide nest cavities for a myriad of other small birds and mammals. Hairy woodpeckers nest and forage in mid- and large-sized snags. Nests can occur within fairly short, small diameter snags, although like pileated woodpeckers, they often locate nest cavities near the top of snags (Bull 1987; Thomas 1979).

The hairy woodpecker occupies both deciduous and coniferous forest habitats, as well as forest edges and openings (Jackson et al. 2002).

In the Northern Region, Hutto and Young (1999) found hairy woodpeckers in most forest types, including aspen forests and associated wetlands. They were found more often in cut than in uncut forests, and detected most frequently within early post-fire stands. Because they utilize snags that are often fairly short and of small diameter, hairy woodpeckers, along with northern flickers, are generally not considered at risk in most locales.

2.10.8.1 *Query Design*

- Habitat group/cover type: all habitat groups (excluding high elevation alpine cover types WB, WB-ES-AF, and AL-WB-AF) including:
    - A1, hot and very dry
    - A2, warm and very dry
    - B1, warm and dry
    - B2, moderately warm and dry
    - B3, warm and moderately moist
    - C1, moderately warm and moderately moist
    - C2, moderately warm and moist
    - D1, moderately cool and moist
    - D2, moderately cool and moderately moist
    - D3, cool and moist
    - E1, moderately cool and wet
    - E2, cool and wet
    - F1, cool and moderately dry
    - F2, moderately cool and moderately dry
- Tree size class >9-inch DBH including:
    - 9–14.9-inch DBH
    - 15–20.9-inch DBH
    - ≥21-inch DBH
- Stands >15% canopy cover including:

- 15–39.9%
- 40–69.9%
- 70–100%

As the SIMPPLLE model is dependent upon stand level data (R1-VMap), it does not allow for the incorporation of snag densities. FIA summary data (Bollenbacher et al. 2009a; Bollenbacher et al. 2009b; USDA 2006) was independently evaluated to determine if snags exist in sufficient numbers for nesting hairy woodpeckers.

2.10.9 Hammond's Flycatcher

Hammond's flycatchers (*Empidonax hammondii)* prefer dense, mature, coniferous or mixed forests ranging from cool and moist to warm and dry sites up to timberline (Sedgwick 1994). Hutto and Young (1999) found them most frequently in relatively uncut conifer forests, as well as in riparian areas, which may be closely associated with conifer forests.

Hammond's flycatchers build open cup nests in tall, large-diameter trees and tend to avoid young stands and stands with openings of scattered large trees (Sakai and Noon 1991). They are likely to be negatively affected by the conversion of mature and old-growth stands into younger age classes.

Since Hammond's flycatchers are aerial foragers, they require openings and airspace in the canopy. It is assumed that in dense forests (70–100% canopy cover), fly-catching opportunities are found in breaks that exist naturally such as riparian sites.

2.10.9.1 *Query Design*

The query design for Hammond's flycatcher includes the following layers:

- Cover type: Douglas-fir through subalpine fir
- Habitat groups:
  - A2, warm and very dry
  - B1, warm and dry
  - B2, moderately warm and dry
  - B3, warm and moderately moist
  - C1, moderately warm and moderately moist
  - C2, moderately warm and moist
  - D1, moderately cool and moist
  - D2, moderately cool and moderately moist
  - D3, cool and moist

  - E1, moderately cool and wet
  - E2, cool and wet
  - F1, cool and moderately dry
  - F2, moderately cool and moderately dry
  - G1, cold and moist
- Tree size class: >15-inch DBH including:
  - 15–20.9-inch DBH
  - ≥21-inch DBH
- Stands > 40% canopy cover including:
  - 40–69.9%
  - 70–100%
- In dense forests (70–100% canopy cover), fly-catching opportunities are found in natural breaks such as riparian sites.

2.10.10 Olive-sided Flycatcher

Olive-sided flycatchers (*Contopus cooperi)* are found in montane and northern coniferous forests, most often in forest openings, forest edges near natural openings (meadows, canyons, rivers) or human-made openings, and in open to semi-open forest stands (Altman and Sallabanks 2000). They can be found in dry to moist sites across a range of elevations. Occurrence of olive-sided flycatchers is influenced by relatively open canopies and the presence of tall trees for aerial flycatching/foraging, and perches for singing (Altman and Sallabanks 2000).

In mixed conifer forests and in redcedar-western hemlock forests in Idaho, they were found to be significantly more abundant in a matrix of clearcuts than in landscapes of old-growth forest (Evans and Finch 1994; Hejl and Paige 1994). Olive-sided flycatchers have also been found to be more abundant in early post-fire communities than in other major cover types in the Northern Rocky Mountains (Hutto 1995).

2.10.10.1 *Query Design*

The query design for olive-sided flycatcher includes the following layers:

- Cover type: Douglas-fir through subalpine fir
- Habitat groups:
  - A2, warm and very dry
  - B1, warm and dry

  - B2, moderately warm and dry
  - B3, warm and moderately moist
  - C1, moderately warm and moderately moist
  - C2, moderately warm and moist
  - D1, moderately cool and moist
  - D2, moderately cool and moderately moist
  - D3, cool and moist
  - E1, moderately cool and wet
  - E2, cool and wet
  - F1, cool and moderately dry
  - F2, moderately cool and moderately dry
  - G1, cold and moist
- To determine both the mid-seral forest as well as openings that olive-sided flycatchers require, two distinct tree size classes are examined:
  - 0–5-inch DBH
  - ≥9-inch DBH including:
    - 9–14.9-inch DBH
    - 15–20.9-inch DBH
    - ≥21-inch DBH
- For the same reason as above, we examined two distinct canopy cover classes:
  - Within the 0–5-inch DBH size class: all canopy covers 15–100%
  - Within the ≥9-inch DBH size class: ≥40% canopy cover including:
    - 40–69.9%
    - 70–100%

Olive-sided flycatchers require edges between openings and stands of mature forest. Analysis of seedling/sapling habitat (at all canopy cover levels) adequately represented openings in the landscape. The relative abundance of the seedling/sapling habitat and mature forest habitat was assessed in the time series modeling results. We assume that if the ratio of seedling/sapling to mature forest stays within HRV over the five decade period, then olive-sided flycatchers will not be at risk. If either openings or mature forests drop to levels below HRV, then olive-sided flycatchers would be determined to be at risk. Olive-sided flycatchers may be found to be at no risk at the planning unit scale, but will be at risk in certain landscapes for a given time period as a consequence of larger-than-normal wildfires.

2.10.11 American Marten

Marten (*Martes americana)* prefer mid- to late-seral coniferous forests with moderate- to high-canopy closure at mid-to-high elevations (Ruggiero et al. 1994). Martens are often labeled as an "interior forest species," since they prefer large patches of late-seral forest (Ruggiero et al. 1994). Marten prefer high densities of snags and CWD (Buskirk et al. 1989) as complex physical structure near the ground provides refuge sites, access to prey, and a protective thermal environment (Buskirk and Ruggerio 1994). Martens are "subnivean" foragers (Ruggiero et al. 1994) and are thus well suited to deep snow conditions.

2.10.11.1 *Query Design*

Two approaches were used for the query design. All appropriate marten habitat was examined. As a separate query, only mesic habitat was examined. This split was performed to acknowledge the emphasis from Wasserman et al. (2010) of the preference found for western redcedar. However, Tomson (1999a) found most martens occurred in spruce/fir habitats.

All Habitat

The all habitat query design for marten includes the following layers:

- Cover types: cool Douglas-fir through subalpine fir
- Habitat groups:
    - B3, warm and moderately moist
    - C1, moderately warm and moderately moist
    - C2, moderately warm and moist
    - D1, moderately cool and moist
    - D2, moderately cool and moderately moist
    - D3, cool and moist
    - E1, moderately cool and wet
    - E2, cool and wet
    - F1, cool and moderately dry
    - F2, moderately cool and moderately dry
    - G1, cold and moist
- Tree size class: >10-inch DBH including:
    - 10–14.9-inch DBH
    - 15–20.9-inch DBH
    - >21-inch DBH

- Stands > 40–100% canopy cover, including:
    - 40–69.9%
    - 70–100%
- Although CWD and snags are important for marten, there is no feasible way to measure or collect data to evaluate snag density or CWD.

Mesic Habitat Only

- Cover type: cool Douglas-fir through subalpine fir,
- Habitat groups:
    - C2, moderately warm and moist
    - D1, moderately cool and moist
    - Mesic habitats may be preferred by marten. Thus, only the cover types that included grand fir, western red cedar, and western hemlock were selected from the above habitat groups:
        - DF-GF, DF-LP-GF, DF-PP-GF, DF-RRWP-GF, DF-WP-GF, GF, L-DF-GF, L-GF, L-LP-GF, L-RRWP-GF, L-WP-GF, LP-GF, WH-C-GF, C, WH-C, WH
- Tree size class: >10-inch DBH including:
    - 10–14.9-inch DBH
    - 15–20.9-inch DBH
    - >21-inch DBH
- Stands > 40–100% canopy cover, including:
    - 40–69.9%
    - 70–100%

2.10.12 Northern Goshawk

Northern goshawks (*Accipiter gentilis)* typically select nest sites in mature coniferous forests with relatively closed canopies (50–90%) and open, multi-storied stands (Brewer et al. 2007; Kennedy 2003; Reynolds et al. 1992; Reynolds et al. 2008) of at least 30 acres or greater (Reynolds et al. 1994). Northern goshawks are not limited to continuous old growth (USDI 1998). Northern goshawks are adept at finding dense, multi-storied microsites suitable for nesting within dry, cold lodgepole pine-dominated stands that otherwise do not appear suitable for nesting (Squires and Ruggiero 1996). Trees used as nest sites average 14-inch DBH in the USFS Northern Region (Samson 2006a). Fledgling success in Montana was higher in landscapes that contained a mix of open and dense forested stands than in landscapes with only dense stands (Clough 2000). Northern goshawks use all cover types and age classes for foraging habitat (Kennedy 2003).

2.10.12.1 *Query Design*

The query design for northern goshawk includes the following layers:

- Cover type: All, excluding high elevation alpine cover types WB, WB-ES-AF, and AL-WB-AF
- Habitat groups:
  - A1, hot and very dry
  - A2, warm and very dry
  - B1, warm and dry
  - B2, moderately warm and dry
  - B3, warm and moderately moist
  - C1, moderately warm and moderately moist
  - C2, moderately warm and moist
  - D1, moderately cool and moist
  - D2, moderately cool and moderately moist
  - D3, cool and moist
  - E1, moderately cool and wet
  - E2, cool and wet
  - F1, cool and moderately dry
  - F2, moderately cool and moderately dry
- Tree size class > 10-inch DBH including:
  - 10–14.9-inch DBH
  - 15–20.9-inch DBH
  - 21+-inch DBH
- Stands > 40% canopy cover including:
  - 40–69.9%
  - 70–100%

Point data on northern goshawk nest locations received from the IPNF and KNF were intersected with R1-VMap (Version 11) to corroborate habitat queries. The data points were overlaid on a digital elevation model, and the minimum and maximum elevations were analyzed. The maximum elevation was used to determine an upper elevation limit of 5,000 feet for nesting habitat.

Additionally, the IPNF and KNF had nest location data for 154 nests. Our analysis does not segregate active from inactive nests, or successful from unsuccessful nests. Nor was any effort made to identify territories from clusters of active nests. The nest locations were located within R1-VMap polygons to identify what size class and canopy closures are being selected for by northern goshawks. This allows the query to be based not just on published data, but to be modified based on what northern goshawks actually use on the KNF and IPNF. Figure 1 illustrates the distribution of 154 northern goshawk nests by tree size class and canopy cover.

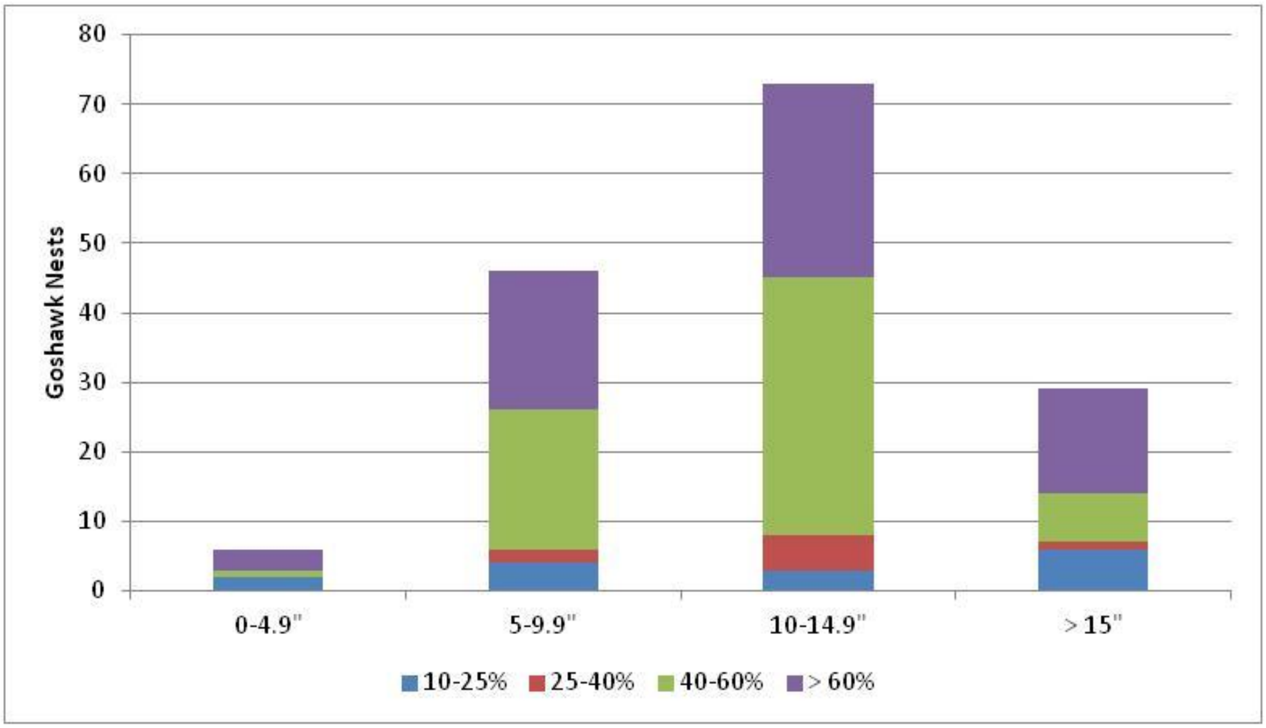

Figure 1 Goshawk nest location habitat characteristics within the IPNF and KNF

The data suggests that there is a preference for large (10–15-inch DBH and 15+-inch DBH) versus small trees and a preference for moderately dense (40-60% crown closure) and dense (60% plus crown closures) stands.

Interestingly, a small percentage of nests are in stands normally considered too small (<10-inch DBH), or in stands too open (<40% crown closure) for nesting northern goshawks. This phenomenon is typical for northern goshawk nest distribution and explains why (McGrath et al. 2003) had difficulty in predicting suitable nest locations from random sites in a blind sample test. McGrath et al. (2003) concluded from data collected at the nest that such small stands (0–5-inch DBH), or very open stands (10–40% crown closure), contain a microsite of large, dense trees that were undetectable at the stand scale. Squires and Ruggiero (1996) found similar nesting situations in Wyoming, where northern goshawks were nesting in dense, multi-storied microsites within lodgepole pine stands that were too small or open to typically support nesting goshawks. Thus the following assumptions were made:

- Ponderosa pine stands may not have >40% crown cover, but ponderosa pine is a very minor component on the KIPZ.
- The northern goshawk habitat layer is limited to nesting habitat. It is assumed that foraging habitat is non-limiting (Brewer et al. 2007; Kennedy 2003).

2.10.13 Pileated Woodpecker

Pileated woodpecker (*Dryocopus pileatus)* are most often associated with mature forests (Ritter et al. 2000; Shackelford and Conner 1997). Bull and Meslow (1977) found that pileated woodpecker nests are generally in large ponderosa pine snags.

The species is a primary cavity excavator that nests in western larch, ponderosa pine, and black cottonwood (*Populus trichocarpa)* snags (Bull 1987; McClelland 1977). In Montana, pileated woodpeckers select larch for nesting more frequently than other tree species, followed by ponderosa pine, black cottonwood, aspen, western white pine, grand fir, and lastly, Douglas-fir (McClelland and McClelland 1999). Snags selected for nesting are large diameter (≥20-inch DBH) and tall (≥40 feet) (Bull 1987; McClelland 1977).

2.10.13.1 *Query Design*

The query design for pileated woodpecker includes the following layers:

- Cover type: Ponderosa pine to mid-subalpine fir
- Habitat Groups:
    - A1, hot and very dry
    - A2, warm and very dry
    - B1, warm and dry
    - B2, moderately warm and dry
    - B3, warm and moderately moist
    - C1, moderately warm and moderately moist
    - C2, moderately warm and moist
    - D1, moderately cool and moist

Pileated woodpeckers selectively prefer western larch, and ponderosa pine for nest sites (McClelland and McClelland 1999). Thus, the following cover types were included for suitable habitat:

- DF-PP-GF, DF-PP-LP, L-DF-PP, L-PP, L-PP-LP, PP, PP-DF, L, L-DF, L-DF-AF, L-DF-ES, L-DF-GF, L-DF-LP, L-DF-RRWP, L-DF-WP, L-ES, L-ES-AF, L-GF, L-LP, L-LP-GF, L-RRWP, L-RRWP-GF, L-WP, L-WP-GF, C, WH-C, WH-C-GF
- Tree size class: >15-inch DBH including:
    - 15–20.9-inch DBH
    - ≥21-inch DBH
- Stands > 15% canopy cover including:
    - 15–39.9%
    - 40–69.9%
    - 70–100%

Although pileated woodpeckers use large-diameter snags, the SIMPPLLE model is dependent upon stand level data (R1-VMap) and did not allow the incorporation of snag densities. FIA summary data were evaluated to ensure that sufficient large snags exist at the forest scale to provide nesting habitat assuming random distribution.

2.10.14 Habitat Connectivity

Connectivity, as coined in 1984 by Merriam (USDA 1997), refers both to the abundance and spatial patterning of habitat and to the ability of animals to move from patch to patch of similar habitat. Corridors are a means by which connectivity is provided. They are strips or stepping stones of "hospitable territory traversing inhospitable territory providing access from one area to another" (USDA 1997). The effectiveness of a corridor depends upon the species using it, the type of movement, and the type of corridor (Hunter 1996). Animals need connectivity to forage within their home range, for dispersal to new home ranges, and for migration between locations. According to American Wildlands (2008), maintaining the ecological connections, or wildlife movement corridors, between major wildland habitats is one of the most pressing challenges for habitat and wildlife conservation in the Northern Rockies today.

The availability of vegetative cover may affect the movement of some animals. Some species, such as marten and fisher, require moderate to high canopy cover (Ruggiero et al. 1994), while other species prefer more open or mixed habitats (Tomson 1999a). Characteristics favorable for corridor/linkage zone functionality for most species, especially the large carnivores and ungulates, include low road density, low concentrations of human occupancy, an abundance of productive foraging habitat, a robust mix of forested and non-forested habitats with abundant edge, and gentle to moderate terrain (Craighead and Vyse 1996; Servheen et al. 2003; Walker and Craighead 1997). In general, a variety of "open habitats" such as montane grasslands, wet meadows, shrublands, early-seral forest, riparian shrub associations, open-grown forest, talus slopes, and burns generously distributed amongst blocks of mature interior forest provide a favorable linkage environment that will accommodate a wider variety of species than unbroken forest alone (Costain 2009).

While there is no empirical evidence to support the concept of corridors (Rosenberg et al. 1997), many conceptual models have been built to project connectivity across landscapes (Noss et al. 1996; Walker and Craighead 1997). For example, the Northern Region Connectivity Protocol (USDA 1997) provides a framework for describing corridors and the effects of forest projects and other human activities.

2.10.14.1 *Query Design*

The aforementioned research suggests that sustaining historic mixes of vegetation in terms of cover types, size classes, and patch sizes and arrangement all contribute to sustaining well-distributed wildlife populations and avoiding genetically isolated populations. Much of the research focuses on habitat fragmentation and isolation caused by urbanization and residential development, which fortunately, are not a problem on large blocks of national forest land such as the KNF and IPNF. Rather, barriers to animal movement are more likely to occur on adjacent private, developed lands. Public comments on Forest Plans, wilderness legislation, or individual projects often suggest that the establishment of large, permanent reserves of late seral forest be provided for habitat connectivity. Such permanent reserves may indeed provide long-term habitat when located within disturbance regimes where natural disturbances are infrequent or occur at very small scales. Within the Northern Rockies, however, natural, unavoidable disturbances like wildfire, insect outbreaks, or root disease make the benefits of permanent reserves more questionable.

Because American martens prefer late seral forest and large blocks of interior forest, they provide a reasonable indicator for habitat connectedness. As a means of assessing long-term habitat connectivity, and as a means of assessing the benefits of permanent reserves, sample landscapes at year 2010 and 2060 were compared by acres of marten habitat, average patch size, and percent habitat occurring in 2010 against the modeled habitat that still remained at 2060. In order to compare mature xeric ponderosa pine/Douglas-fir stands with sample landscapes flammulated owl habitat was also evaluated.

2.10.15 Comparison of Samson 2006 Viability Findings and KIPZ Habitat Query Designs

Query designs used in this analysis were the result of an iterative process between KIPZ, ERG, and Region One wildlife staff. The query designs used were compared with work by Samson (2006b). Samson was able to construct detailed queries from large quantities of FIA vegetative data. However, these data points cannot be modeled spatially. Since we wanted to perform spatial analysis, R1-VMap was the principal data source used during the SIMPPLLE modeling. Table 11 compares Samson and the KIPZ query designs.

Table 11 Comparison between Query Designs used by Samson (2006) and KIPZ Query Designs

Species	Habitat Criteria	Samson 2006	KIPZ Wildlife Queries
Northern goshawk	Nesting Minimum DBH	>10.6-inch DBH	≥10-inch DBH
	Percent Crown Closure	>34%	≥40%
	Basal Area	9.6 sq. m./Ha	None
	Cover types	All except whitebark pine	All except whitebark pine
Black-backed woodpecker	Minimum DBH	---------	>5-inch DBH
	Post-fire	1–8 years	1–6 years
	Post-MPB	1–8 years	1–6 years
	Cover Types	All except whitebark pine	All except whitebark pine
Flammulated owl	Minimum DBH	>12.2-inch DBH	>10-inch DBH
	Crown Closure	35-85% years	>40%
	Aspect	Warm aspects	None
	Cover Types	Ponderosa pine, Douglas-fir	Ponderosa pine, Douglas-fir, aspen
	Structure Class	1 (one-story), 2 (two-story)	None
Pileated woodpecker	Minimum DBH	>15.6-inch DBH	>15-inch DBH
	Cover Types	Ponderosa pine, Douglas-fir, Engelmann spruce, cottonwood	Ponderosa pine, Douglas-fir, western red cedar, cottonwood
	Habitat limited by actual pileated woodpecker distribution	No, overestimates habitat by roughly double	No, distributed across KNF and IPNF

2.11 ASSUMPTIONS

No model can with 100% certainty predict the future vegetative condition of national forests, especially considering the multitude of disturbance vectors and climate variables. While research on successional pathways, growth rates, insect and disease impacts, and wildfires has been extensive in the last several decades, there is always some uncertainty in how a given stand or landscape will respond over time to multiple interdependent disturbances. Changing climate adds another level of uncertainty. While the recent trend of a warmer, drier climate is pronounced and well-documented, and forecast to continue with that warmer, drier trend, there are unknown variables (USDA 2010b).

Lastly, the vegetation data are imperfect. USFS ground truthing of R1-VMap data produced by the Northern Region Geospatial Group indicates that it provides a good approximation of the cover type, size class, and crown closure of most stands. However, errors in one or more of those variables are common. FIA plots, while statistically meaningful at the landscape scale, are non-spatially explicit sample data. Thus, while FIA data are useful for corroborating or identifying the level of error inherent in R1-VMap data, such comparisons can only be done at the landscape or forest scale.

The degree of uncertainty in the modeled results was lessened by using the following methods:

- Species analyzed are limited to specialists that utilize a rather specific habitat in terms of cover type, size class, and crown closure. Research for these species is extensive and well-understood. Risks to each species are generally limited to changes in habitat availability with a very limited number of variables.
- Throughout the analysis, results are focused on modeled outcomes that are comparative rather than predictive. For instance, comparing the level of fire severity between Scenario 3 and Scenario 6 will have a much higher level of certainty, than trying to predict the level of wildfire severity in Scenario 3 independently.

Conclusions focus on substantial differences between scenarios to identify situations where a given species may be at risk, or where a scenario substantially reduces that risk and improves habitat.

3. RESULTS

While all of the alternatives described in the IPNF and KNF EIS were modeled using SIMPPLLE, the results presented in this report are limited to Scenario 3, Scenario 6, and Scenario 7 (Table 12). Scenario 3 provides a comparison for no treatment and is not the same as existing management ("no-action") in the EIS. Scenario 6 is the equivalent of the EIS preferred Alternative B with budget constraints and Scenario 7 is the equivalent of the EIS preferred Alternative B without budget constraints. All three scenarios were modeled with warmer, drier climate for decades three through five and a fire suppression strategy consistent with what the USFS currently performs.

Table 12 Modeled Management Scenarios

Model Run Type	Scenario	Climate Trend	Wildfire Suppression	Treatments	Budget
No Treatment	Scenario 3	Warmer/Drier	Normal	No	Not available
Treatment	Scenario 6	Warmer/Drier	Normal	EIS Modified Alternative B	With Budget Constraints
	Scenario 7	Warmer/Drier	Normal	EIS Modified Alternative B	Without Budget Constraints

Habitats were modeled to project trends for a 50-year period. Year 2010 (decade zero) is the baseline condition and year 2060 (decade five) represents long term outcomes. In addition, 2010 through 2030 (decade two) represents the anticipated time span of the KNF and IPNF Forest Plans. Scenarios and decades are labeled in tables, graphs, and maps as shown below in Table 13.

Table 13 Acronyms for Management Scenarios and Decades Modeled

Full Label	Acronym
Management Scenarios	
Scenario 3	S3
Scenario 6	S6
Scenario 7	S7
Modeled Decades (Time Steps)	
Year 2010 = decade zero (Time Step 0)	T0
Year 2030 = decade two (Time Step 2)	T2
Year 2060 = decade five (Time Step 5)	T5

NATURAL DISTURBANCES

The results for natural disturbance processes are presented first since habitat fluctuations strongly correlate to disturbance trends.

3.1 SIZE CLASS COMPARISON WITH HISTORIC RANGE OF VARIABILITY

Many of the 12 wildlife species analyzed (i.e. flammulated owls, pileated woodpeckers) have some dependence on large diameter trees. The current distribution of tree size classes on the IPNF and KNF, including seedling/sapling (<5-inch DBH) and large (>15-inch DBH) trees, and SIMPPLLE-modeled changes in those size class distributions over 50 years is depicted in Figure 2 and Figure 3.

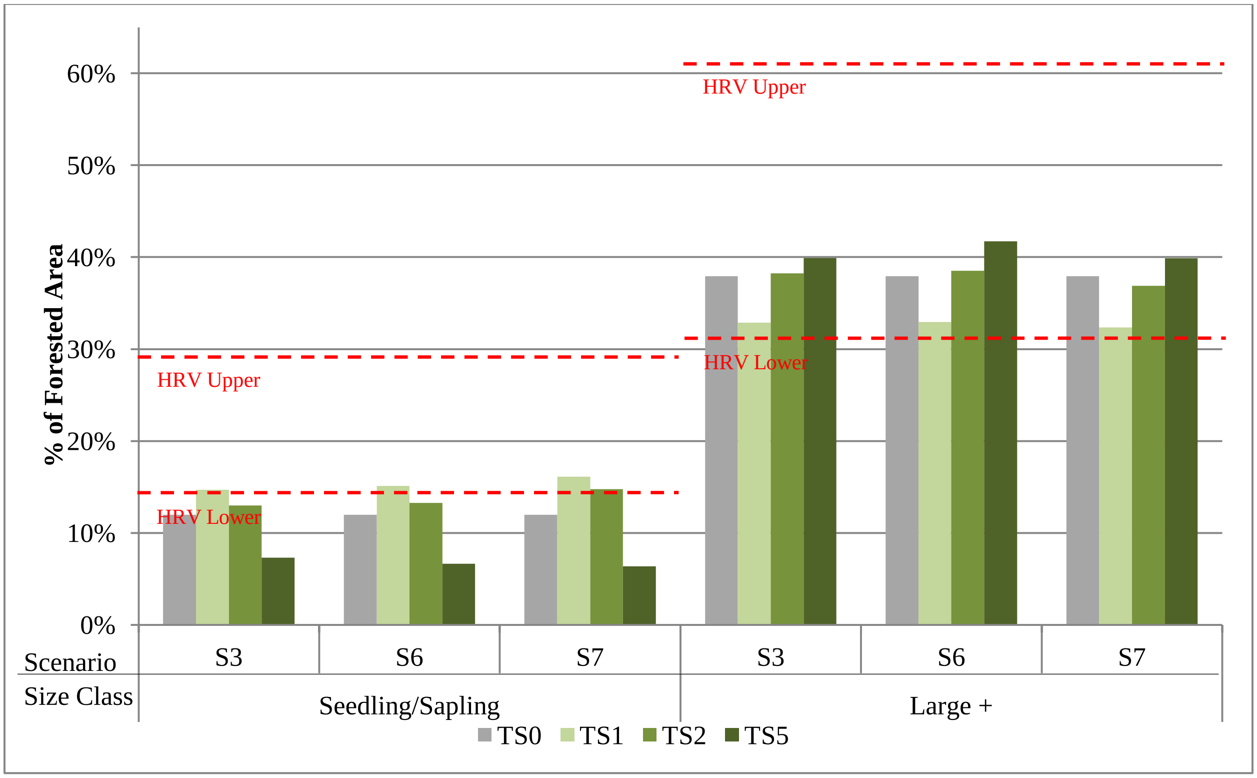

Figure 2 Existing and modeled changes in seedling/sapling and large size classes on the IPNF

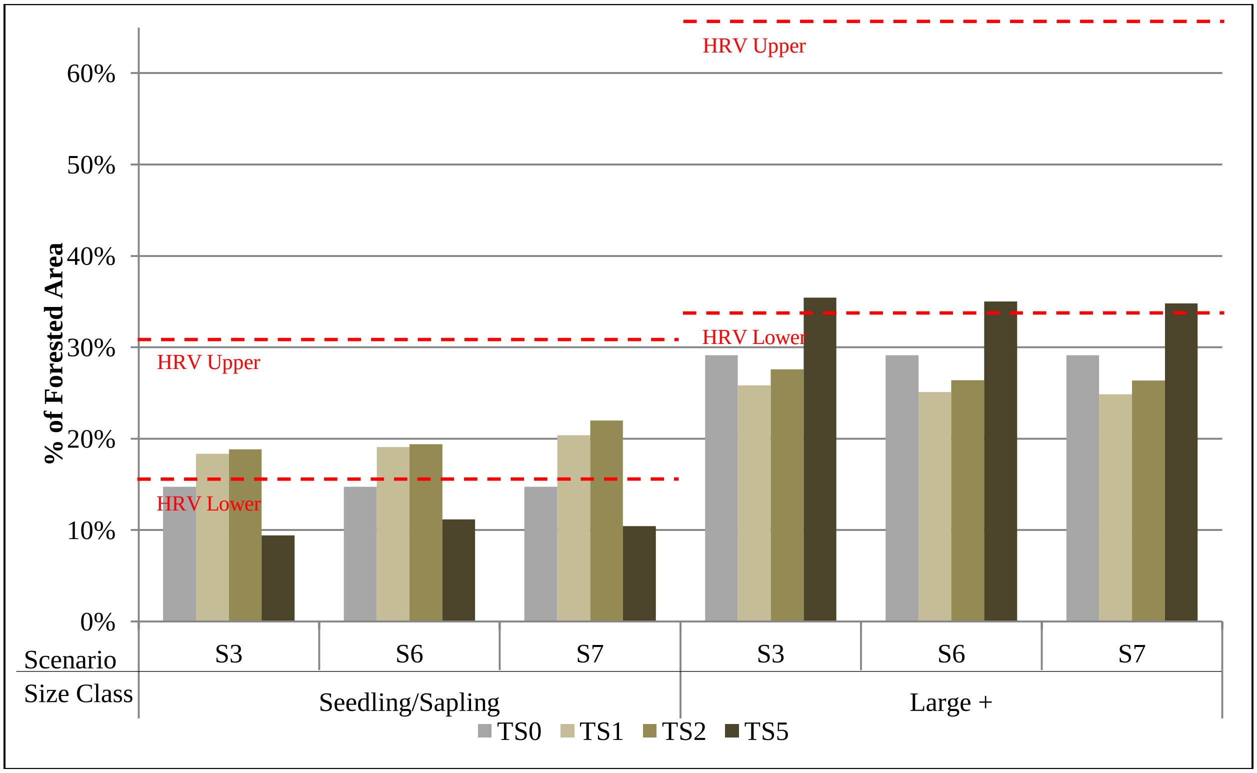

Figure 3 Existing and modeled changes in seedling/sapling and large size classes on the KNF

3.2 WILDFIRE

Figure 4 and Figure 5 illustrate modeled wildfires throughout the period. There is a slight but measurable reduction in stand replacing wildfire with implementation of treatment scenarios. Total stand replacing wildfire on the IPNF was reduced by 35% in Scenario 6 and by 40% in Scenario 7 when compared to Scenario 3. On the KNF stand replacing wildfire was reduced by 17% in Scenario 6 and by 20% in Scenario 7 when compared to Scenario 3.

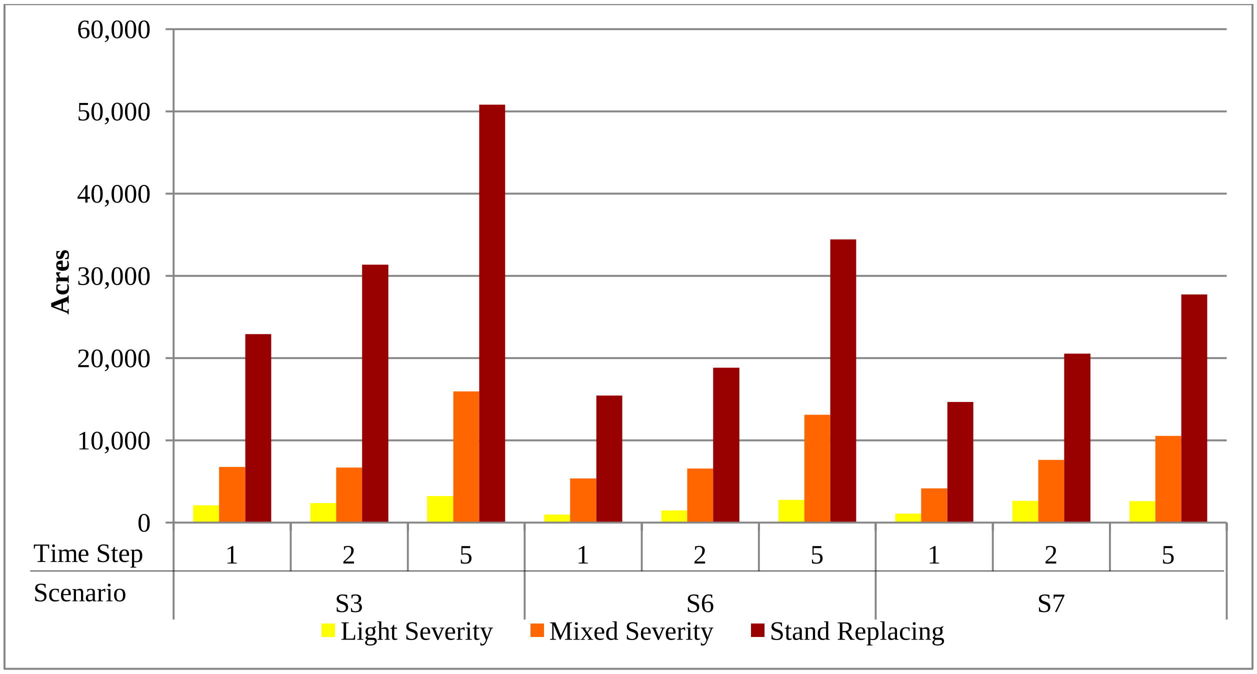

Figure 4 Modeled levels of wildfire for the IPNF

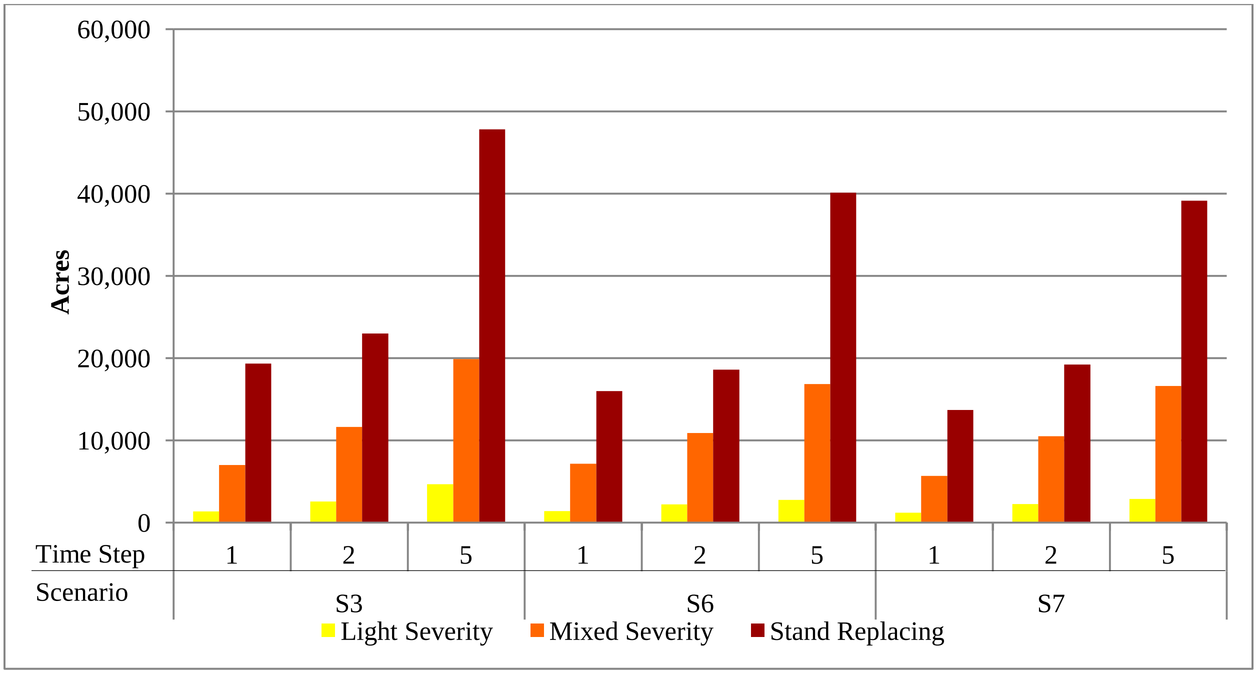

Figure 5 Modeled levels of wildfire for the KNF

3.3 ROOT DISEASE

Root disease trends for both Forests are shown in Figure 6. Modeled results indicate that more acres will be affected on the IPNF than the KNF. Implementation of treatment scenarios reduces the amount of acres subject to root disease on both Forests. Scenario 6 reduced the acres of root disease, across all time steps analyzed, by approximately six percent on the IPNF and by roughly twelve percent on the KNF when compared to Scenario 3.

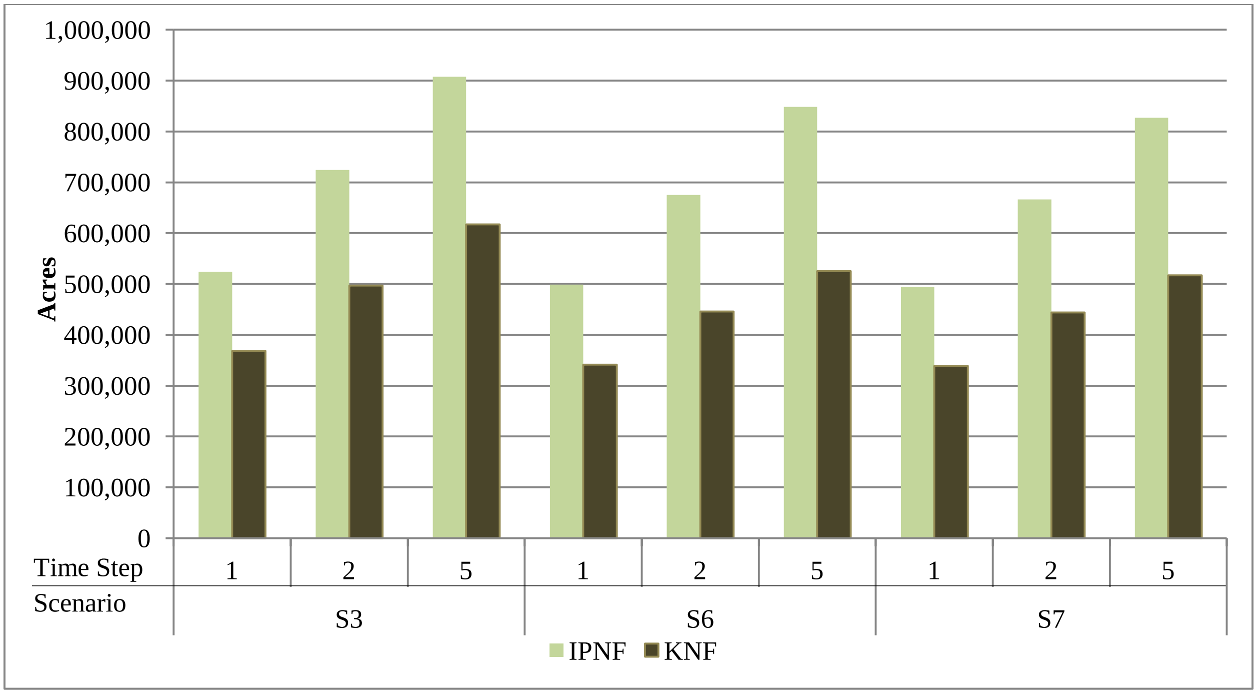

Figure 6 Root disease trends for the IPNF and KNF

3.4 INSECTS

Only 4% of the 4.4 million acre forested landscape of the KIPZ is affected by MPB by decade five. On both Forests and under all scenarios there is a considerable decrease in MPB affected acreage during the 50-year period (Figure 7 and Figure 8). Scenario 6 provides the most reduction in MPB by decade five and outperforms no treatment by 20% on the IPNF and 4% on the KNF.

Fewer acres are impacted by WSB on both Forests. Less than 3% of the 4.4 million acre forested landscape of the KIPZ is affected by WSB under all scenarios and all time steps. DFB modeled damage remains at endemic levels throughout the five decade modeling period.

Across all scenarios and time steps, approximately 1% of the 4.4 million acre forested landscape of the KIPZ is impacted by DFB.

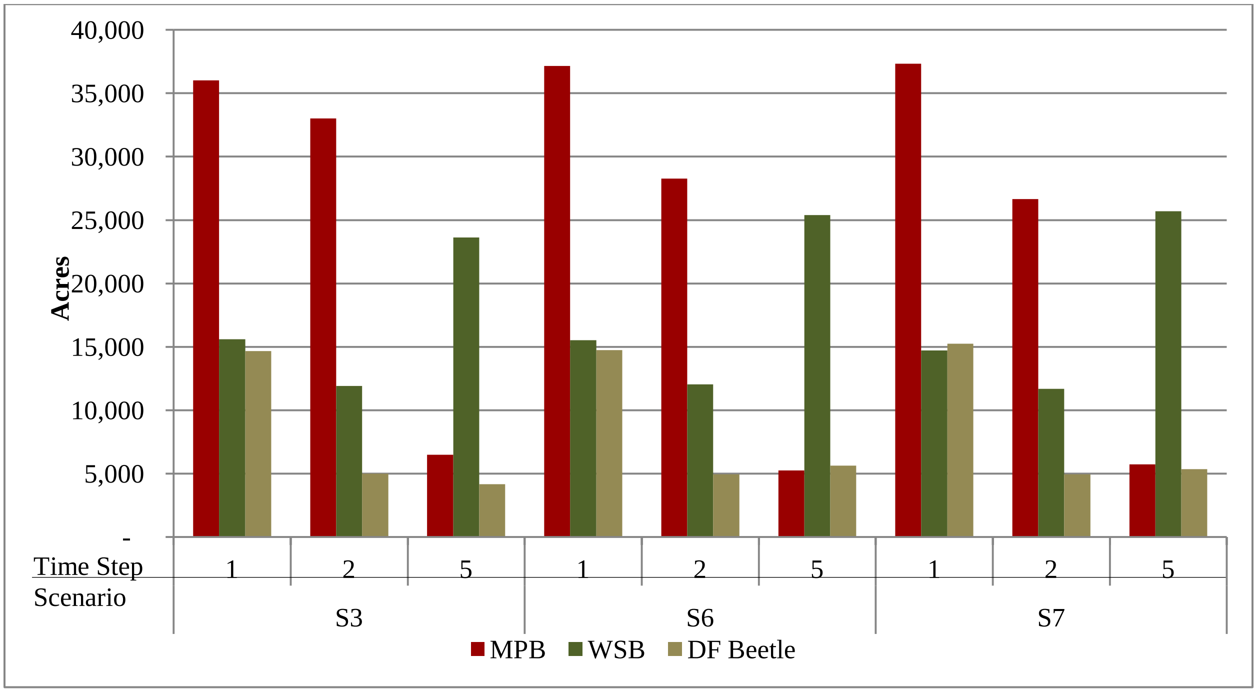

Figure 7 Modeled insect disturbance for the IPNF

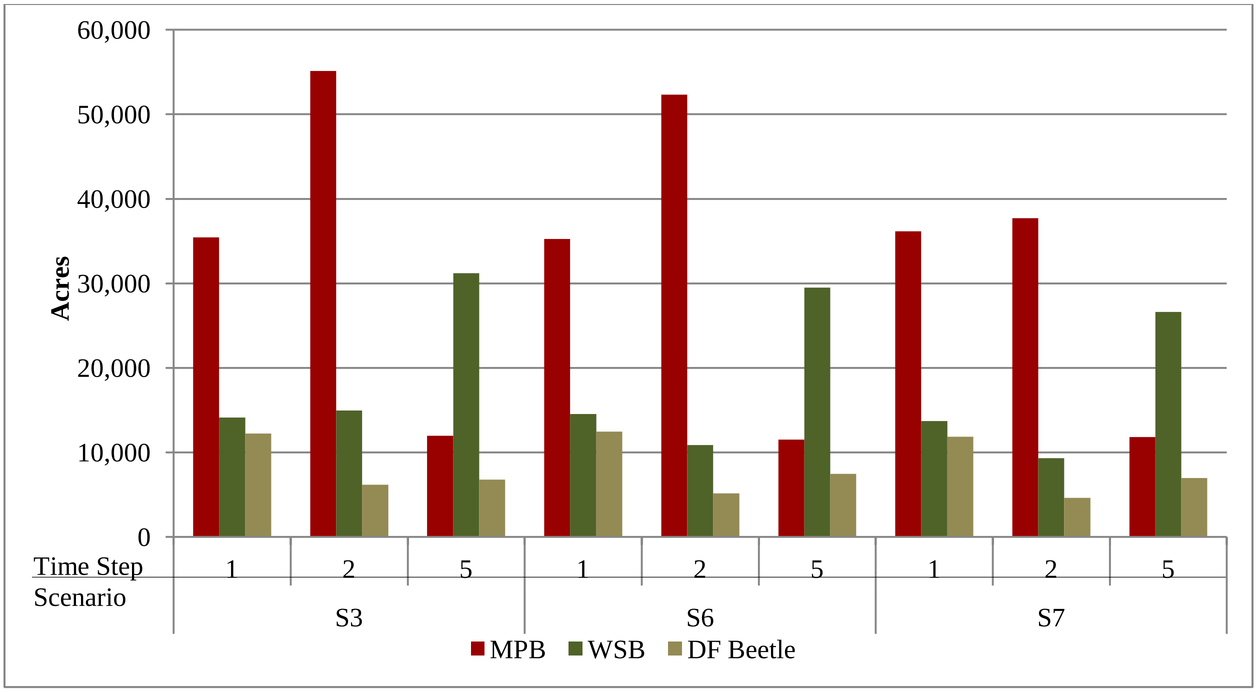

Figure 8 Modeled insect disturbance for the KNF

HABITATS

Comparisons of habitat available for each species by Forest follow.

3.5 CANADA LYNX

Results are offered for suitable stand initiation-hare habitat and suitable and potential multi-storied-hare habitat.

3.5.1 Comparison of Suitable Stand Initiation-hare Habitat

Table 14 shows that there is little suitable stand initiation-hare habitat in a 4.4 million acre forested landscape where past and future modeled disturbances should have produced substantial acreages. A review of the SIMPPLLE logic pathways revealed that potentially suitable stands did not regenerate densely enough to qualify as lynx stand initiation habitat following disturbance. See Discussion Chapter Section 4.6 for additional details.

Table 14 Acres of Suitable Lynx Stand Initiation-hare Habitat for IPNF and KNF

Forest	Time Step	Scenario 3 Acres	Scenario 6 Acres	Scenario 7 Acres
IPNF	0	1,032	1,032	1,032
IPNF	1	1,032	1,027	1,032
IPNF	2	1,032	1,007	1,032
IPNF	5	0	0	0
KNF	0	518	518	518
KNF	1	498	518	513
KNF	2	493	503	508
KNF	5	0	0	0

3.5.2 Comparison of Suitable and Potential Multi-storied-hare Habitat

As shown in Figure 9 and Figure 10, there is an increasing trend in suitable and potential multi-storied hare habitat on both Forests. On the IPNF, treatment scenarios outperform no treatment and on the KNF comparable suitable and potential habitat acres are produced under all scenarios.

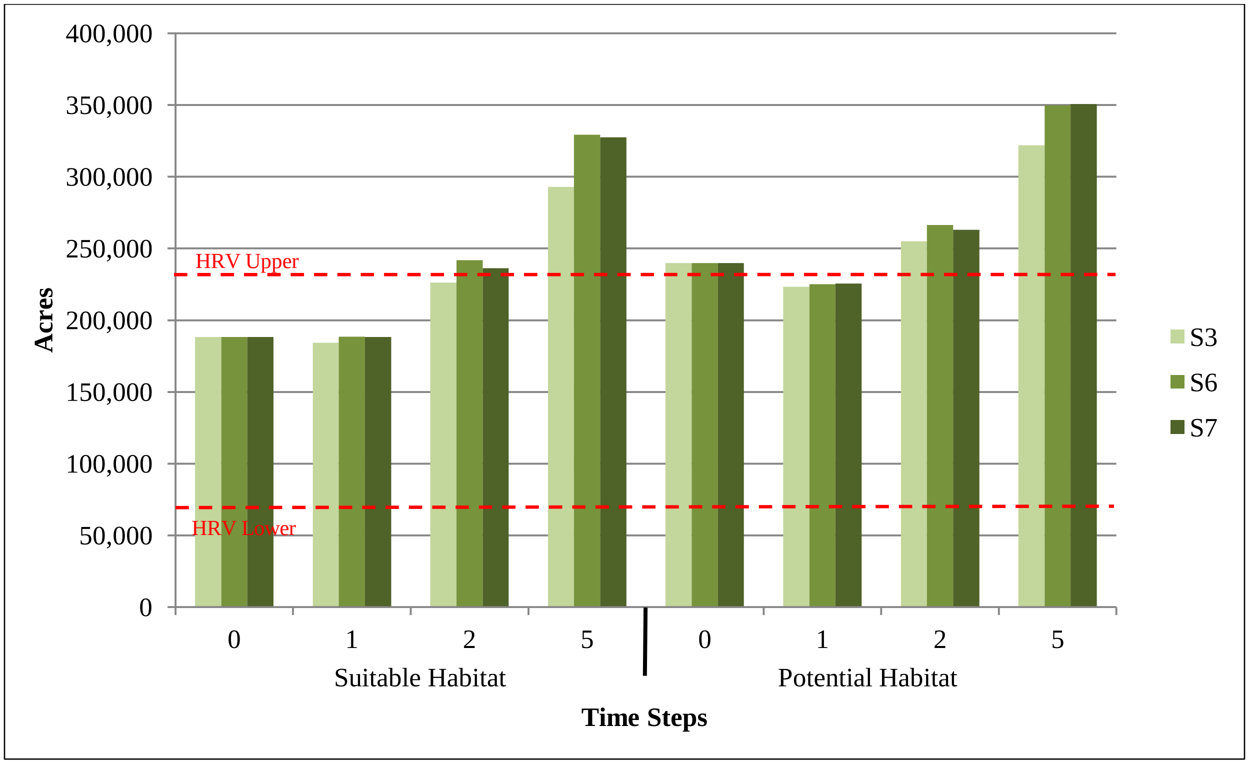

Figure 9 Existing and modeled acres of suitable and potential multi-storied hare habitat on the IPNF

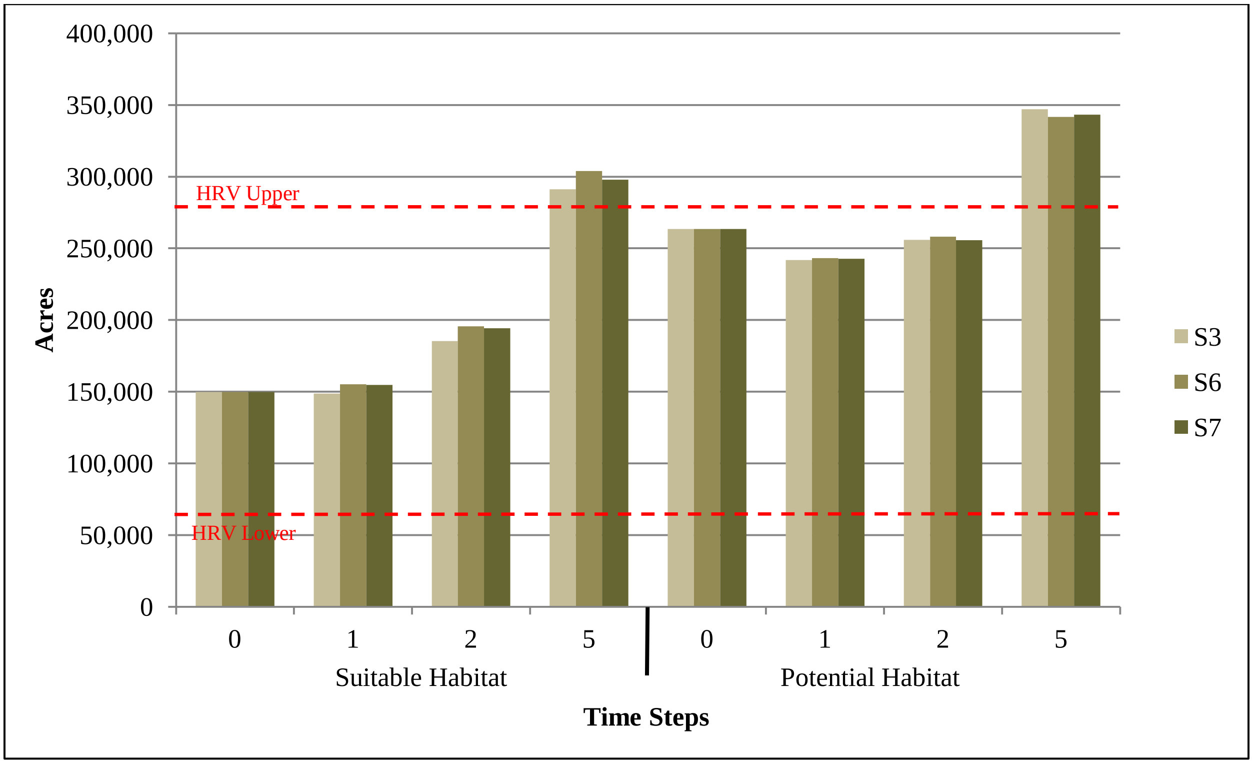

Figure 10 Existing and modeled acres of suitable and potential multi-storied hare habitat on the KNF

3.6 WHITEBARK PINE

Potential whitebark pine regeneration habitat acreages are low for both Forests and are correlated to levels of wildfire in the whitebark pine probable layer discussed in Section 2.10.2.1. Figure 11 and Figure 12 depict the modeled levels of potential whitebark pine regeneration habitat.

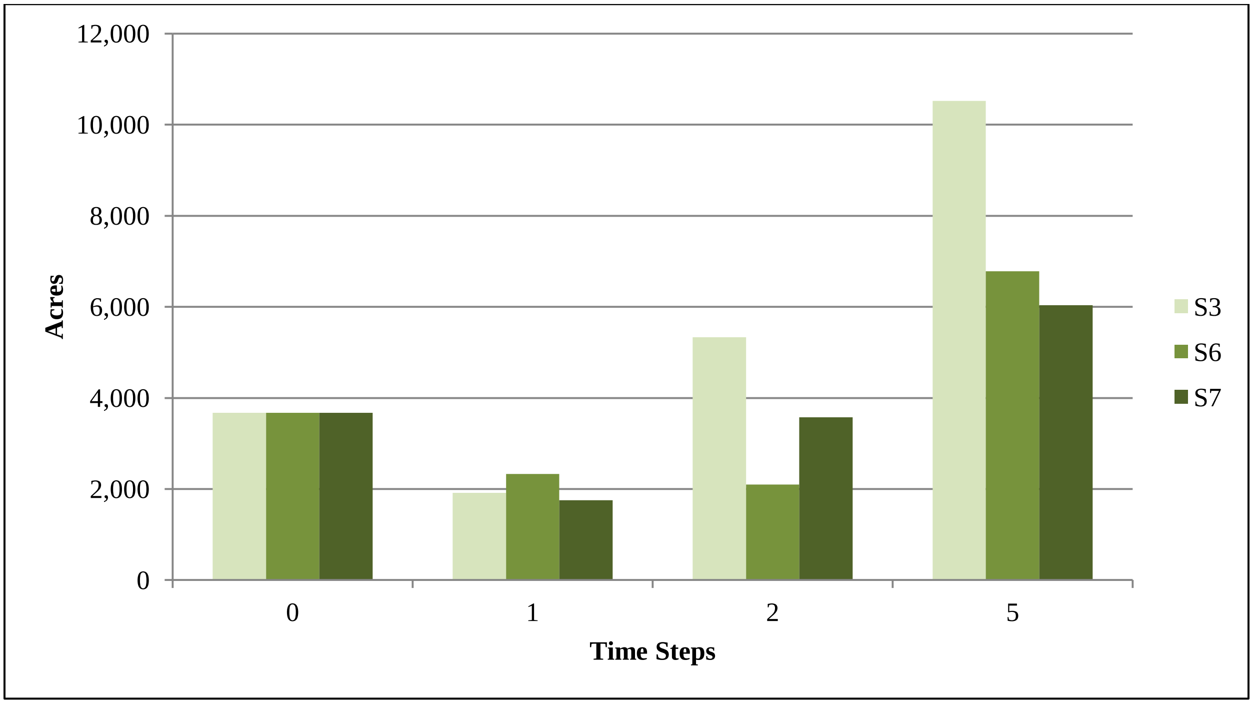

Figure 11 Potential whitebark pine regeneration habitat for the IPNF

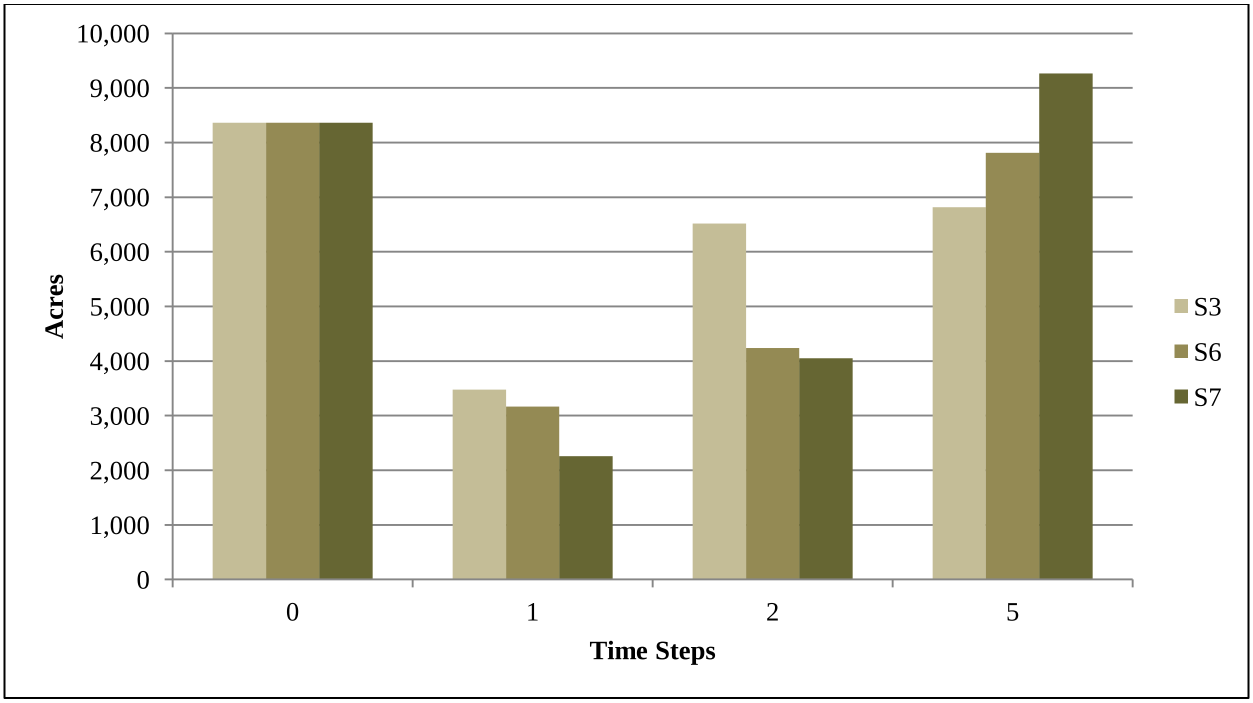

Figure 12 Potential whitebark pine regeneration habitat for the KNF

3.7 BLACK-BACKED WOODPECKER

Current levels of black-backed woodpecker habitat are relatively high, the result of recent wildfires. Existing habitat levels decline following the first decade and modeled levels increase through decade five on both Forests. This trend correlates with modeled wildfire activity as wildfire is expected to increase during the 50-year period on the IPNF and KNF (Figure 4 and Figure 5).

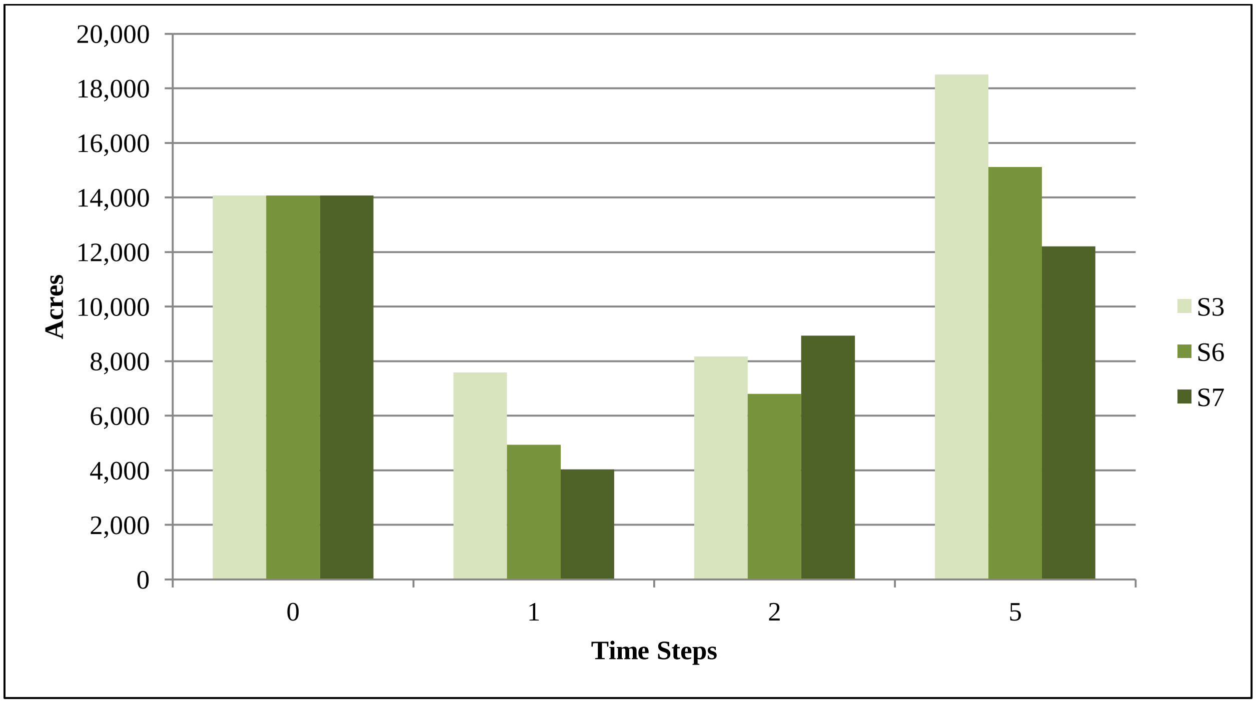

Figure 13 Existing and modeled levels of black-backed woodpecker habitat for the IPNF

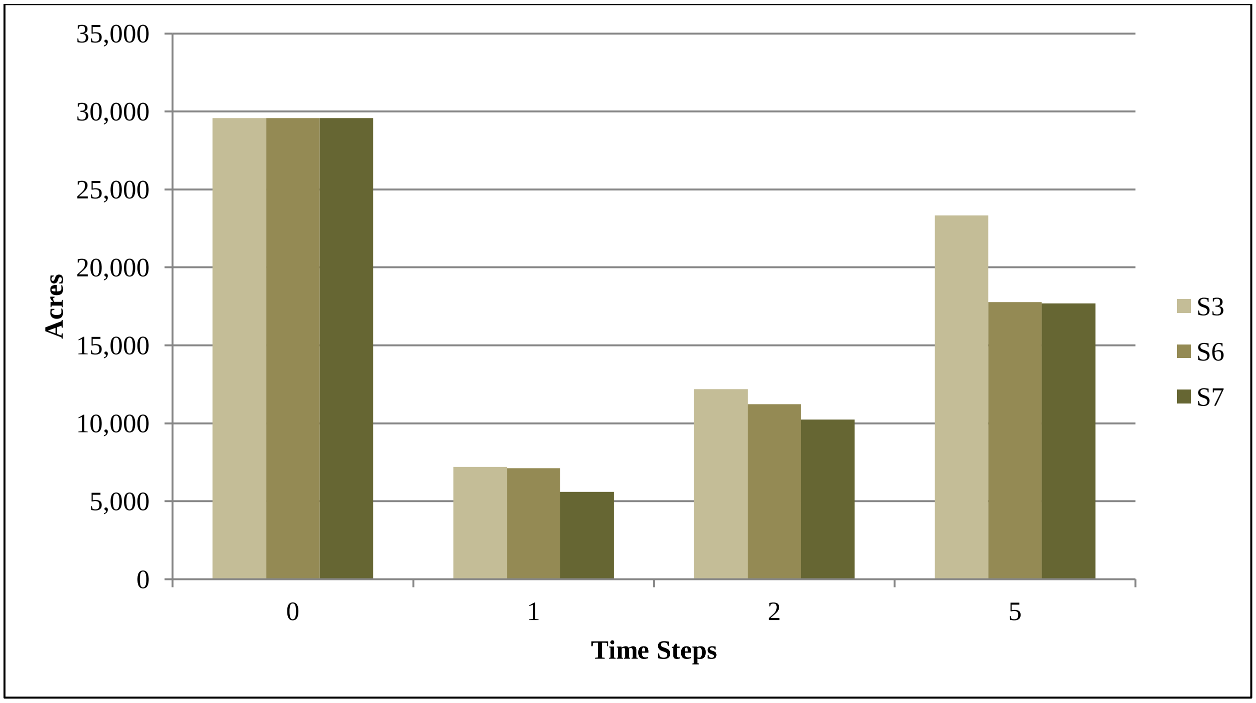

Figure 14 Existing and modeled levels of black-backed woodpecker habitat for the KNF

3.8 FISHER

Currently, there is abundant fisher habitat yet downward trends are apparent on both Forests. While differences between scenarios are minimal, the treatment scenarios produce more habitat acres by decade five on the IPNF and KNF. Scenario 6 results in six percent more habitat acres on the IPNF and four percent more habitat acres on the KNF when compared to Scenario 3.

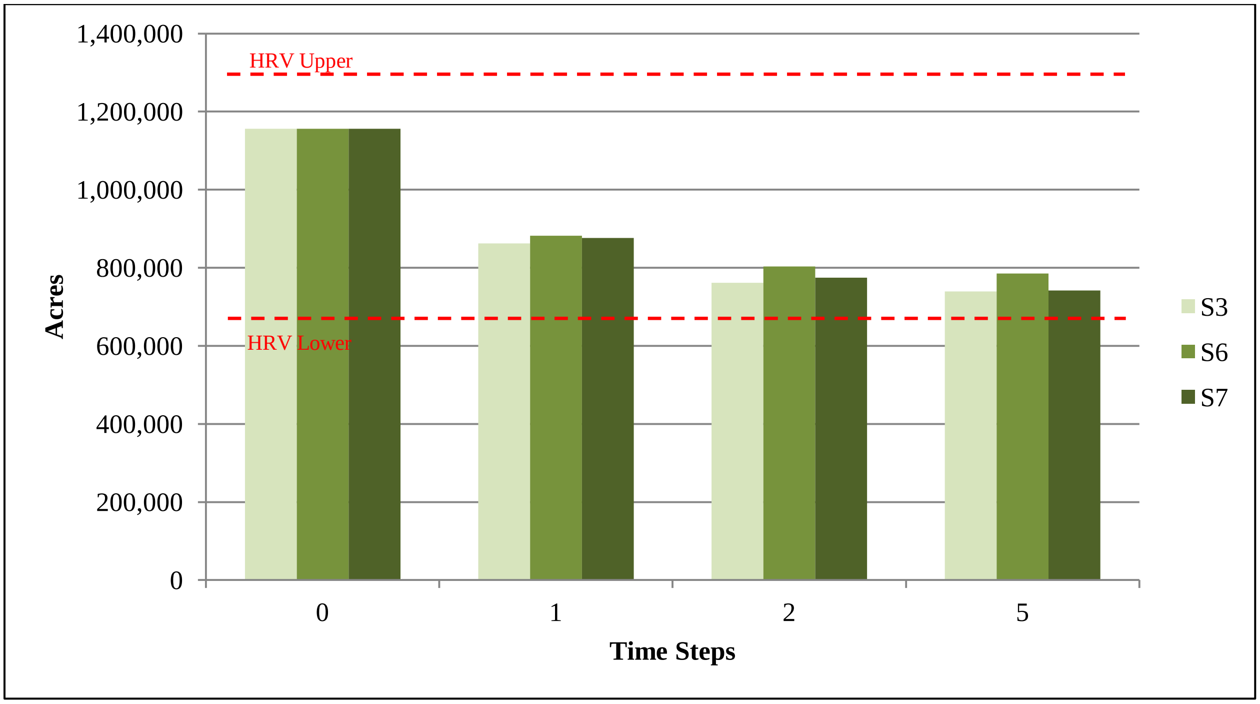

Figure 15 Existing and modeled levels of fisher habitat for the IPNF

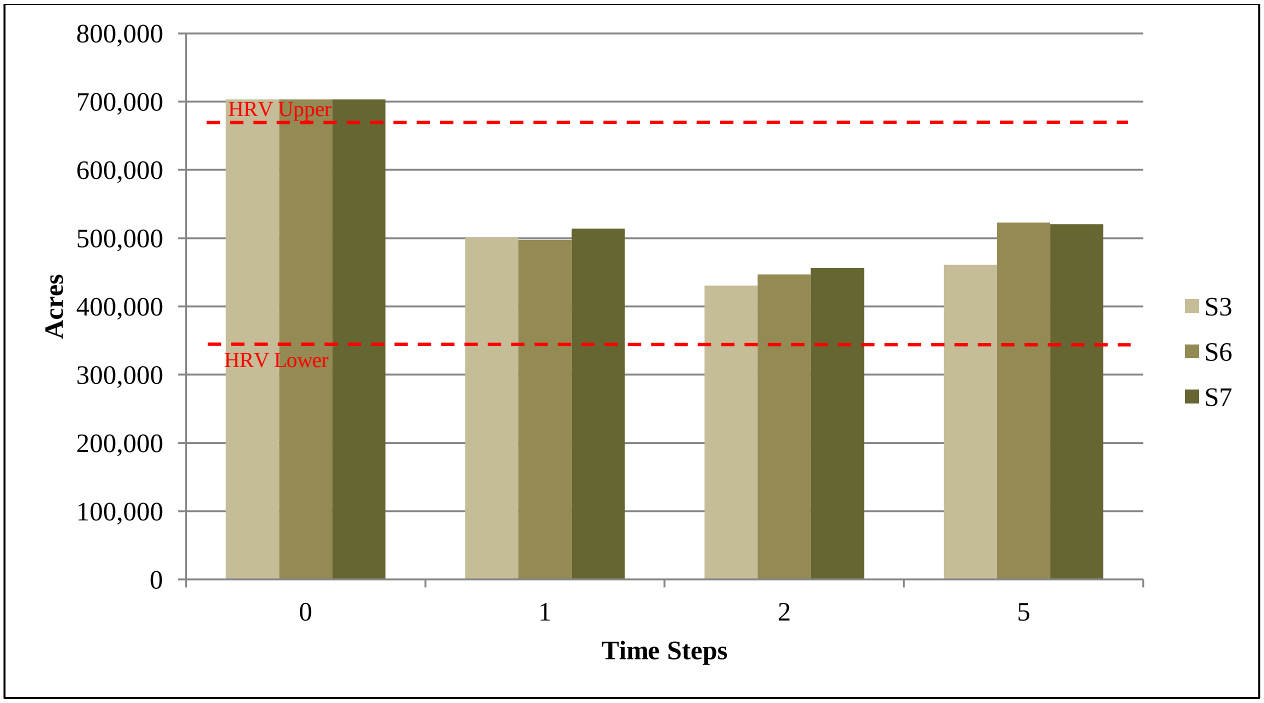

Figure 16 Existing and modeled levels of fisher habitat for the KNF

3.9 FLAMMULATED OWL

Modeled results show a modest decrease in suitable habitat on the IPNF by decade five. Conversely, there is a minor increase in suitable habitat on the KNF during that period. Potential habitat increases on both Forests under all scenarios.

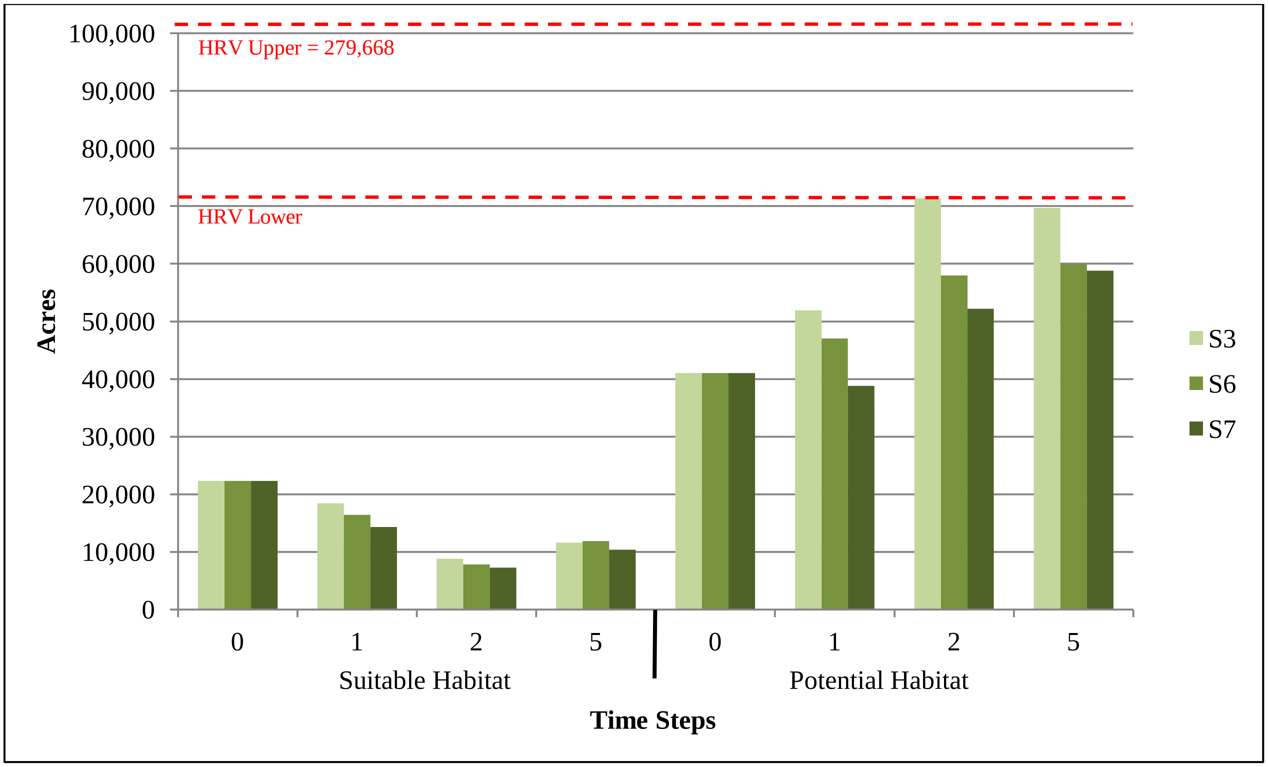

Figure 17 Existing and modeled levels of flammulated owl habitat for the IPNF

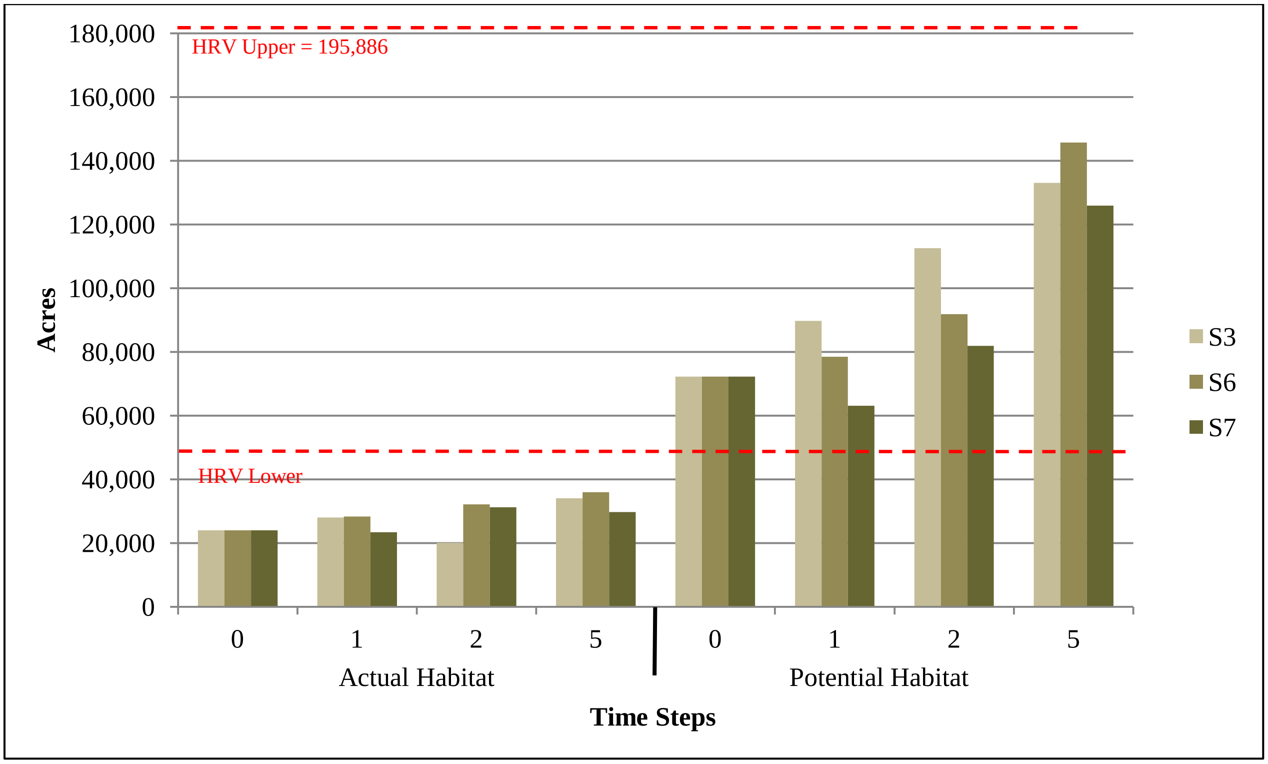

Figure 18 Existing and modeled levels of flammulated owl habitat for the KNF

3.10 PYGMY NUTHATCH

Habitat will increase substantially and remain within HRV on both Forests under all scenarios, although most dramatically under Scenario 3 (Figure 19 and Figure 20).

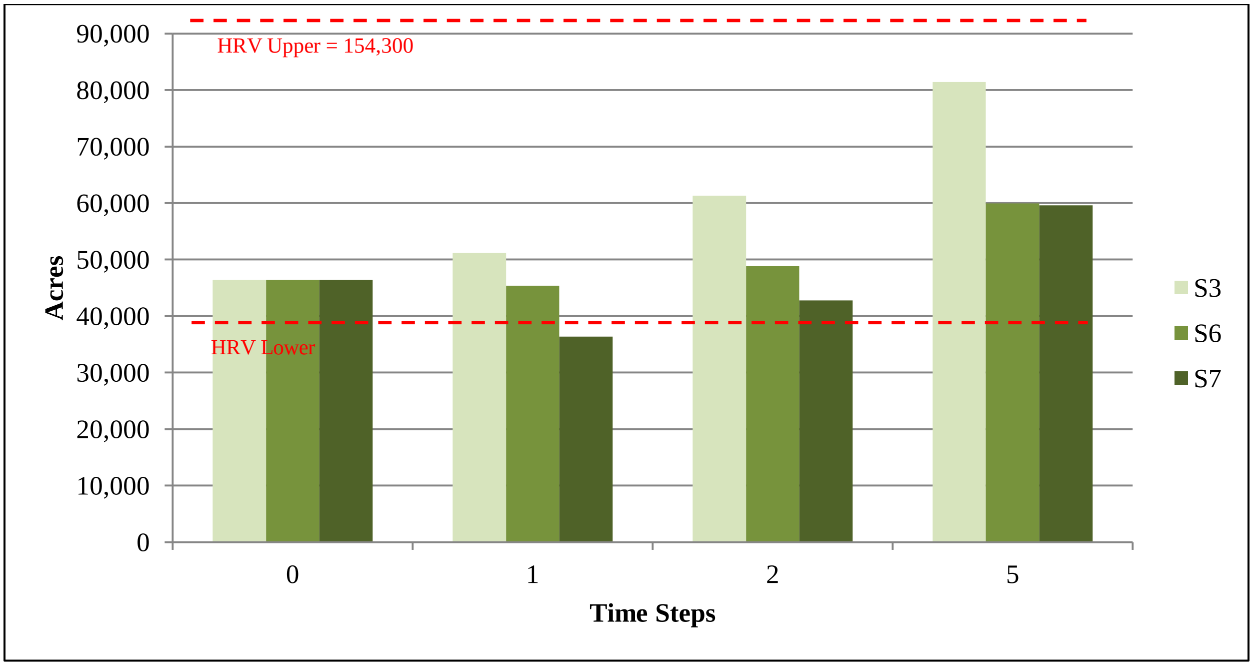

Figure 19 Existing and modeled levels of pygmy nuthatch habitat for the IPNF

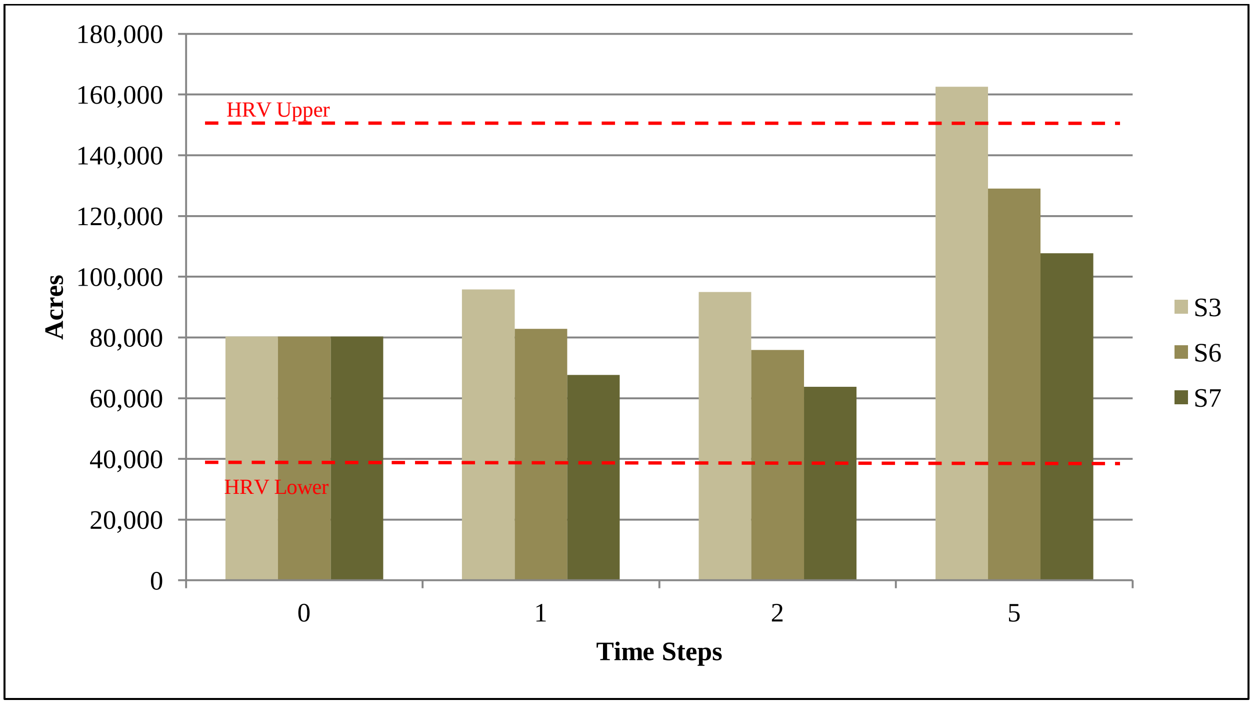

Figure 20 Existing and modeled levels of pygmy nuthatch habitat for the KNF

3.11 CHIPPING SPARROW AND DUSKY FLYCATCHER

The chipping sparrow and dusky flycatcher were combined due to their similar habitat preferences. Both species are dependent on relatively open, low to mid elevation forests. Habitat on the IPNF changes little over time, with Scenario 3 retaining the most habitat acres. By time step five, chipping sparrow and dusky flycatcher habitat was reduced on the IPNF by 9% under Scenario 6 when compared to Scenario 3. Conversely, on the KNF, Scenario 6 produced 6% more habitat than Scenario 3.

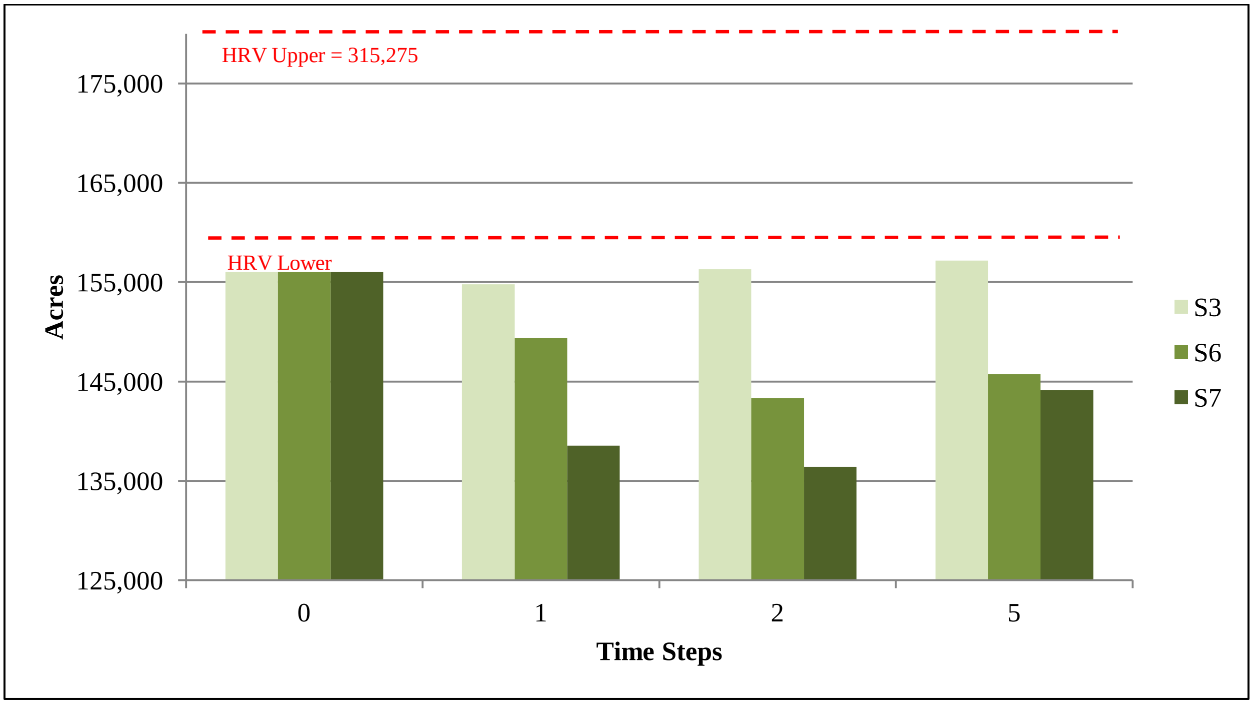

Figure 21 Existing and modeled levels of chipping sparrow and dusky flycatcher habitat for the IPNF

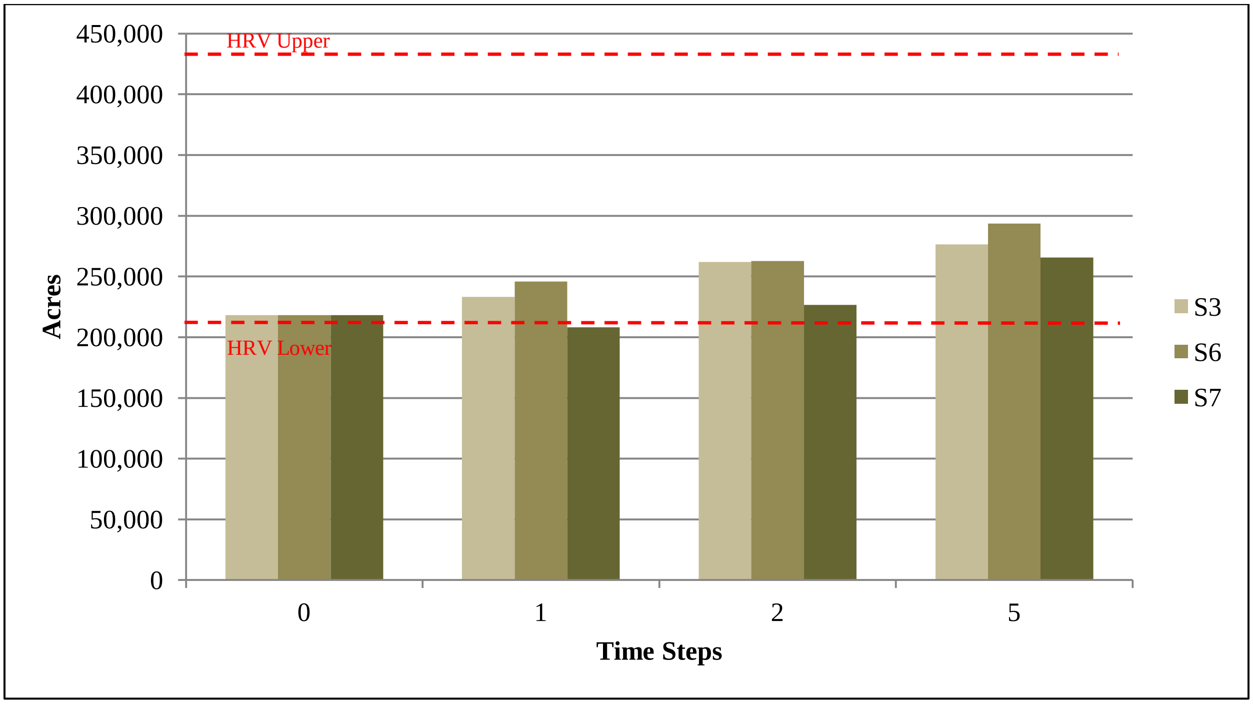

Figure 22 Existing and modeled levels of chipping sparrow and dusky flycatcher habitat for the KNF

3.12 HAIRY WOODPECKER

Hairy woodpecker habitat is abundant on both Forests. Habitat increases on the IPNF and KNF by the end of the 50-year period and there is little change by scenario.

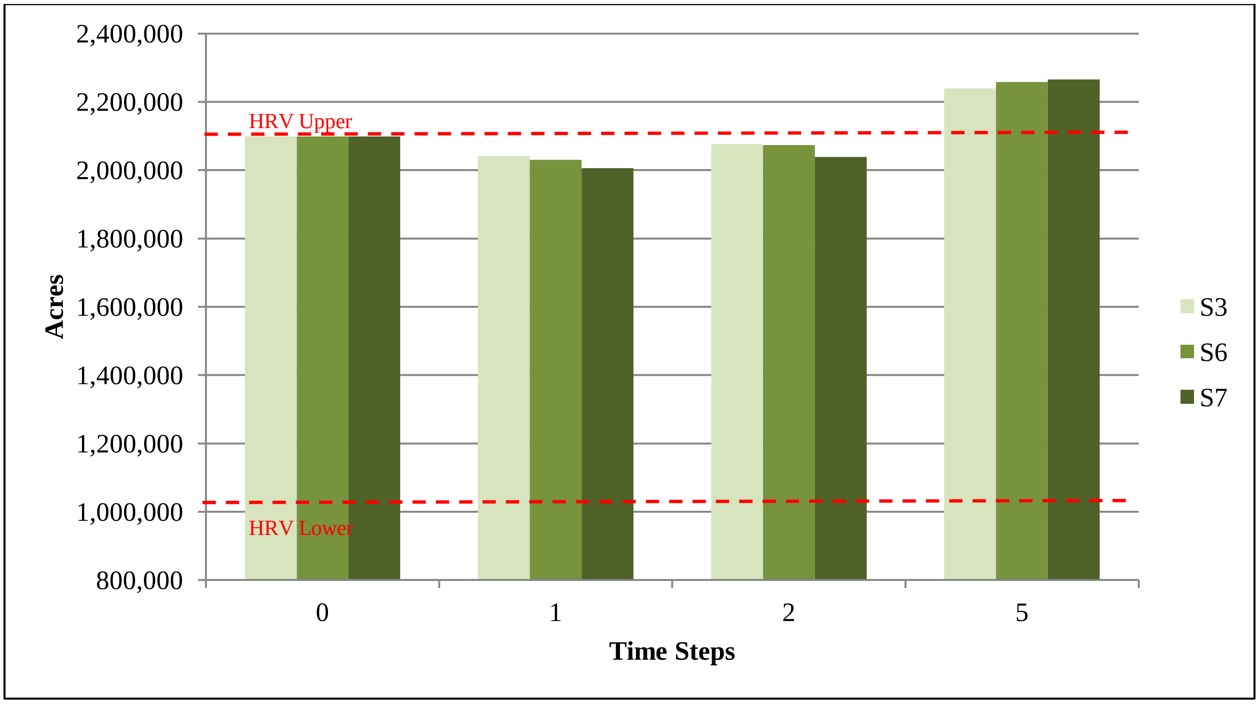

Figure 23 Existing and modeled levels of hairy woodpecker habitat for the IPNF

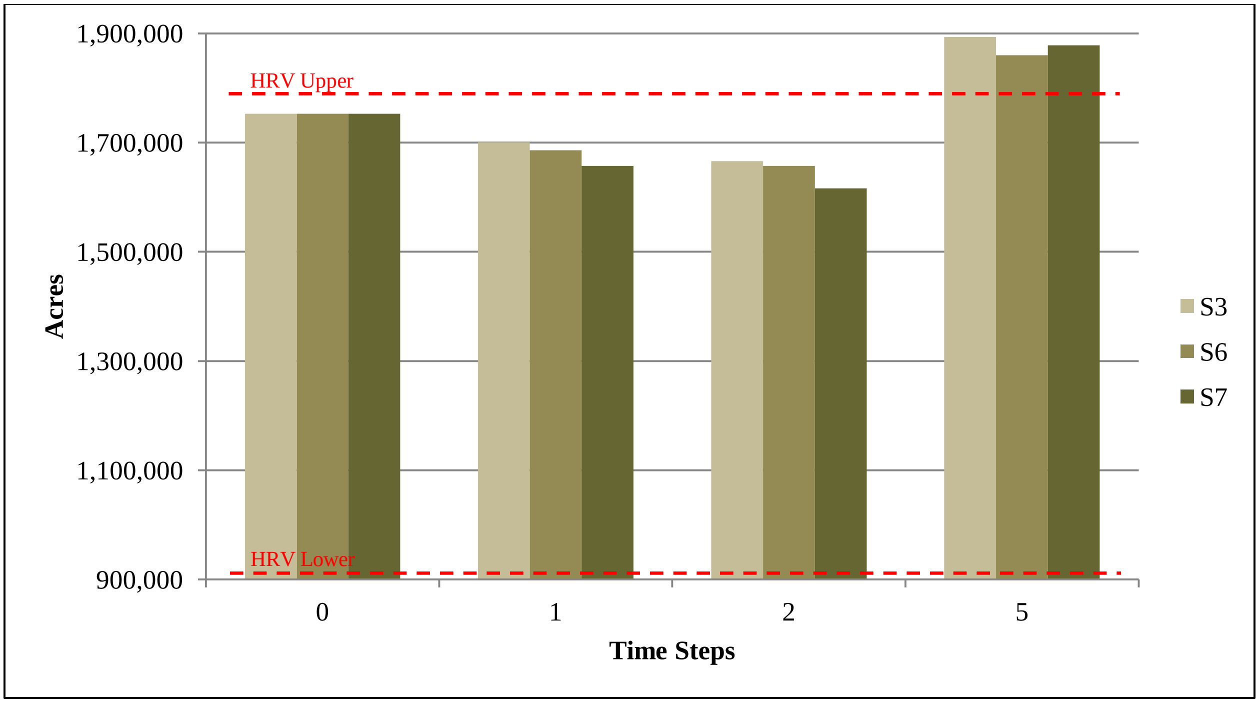

Figure 24 Existing and modeled levels of hairy woodpecker habitat for the KNF

3.13 HAMMOND'S FLYCATCHER

Hammond's flycatcher habitat increases under all scenarios on both Forests during the five decade period. There is little difference in resulting habitat between scenario, including no treatment and treatment.

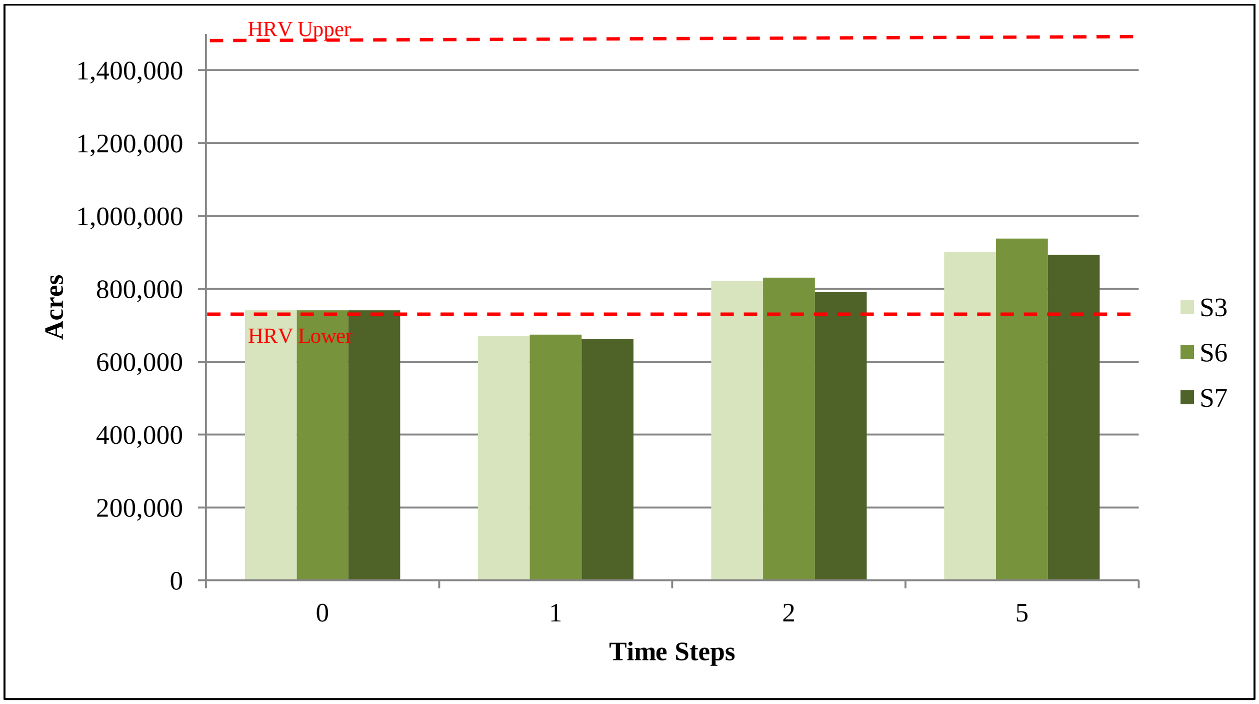

Figure 25 Existing and modeled levels of Hammond's flycatcher habitat for the IPNF

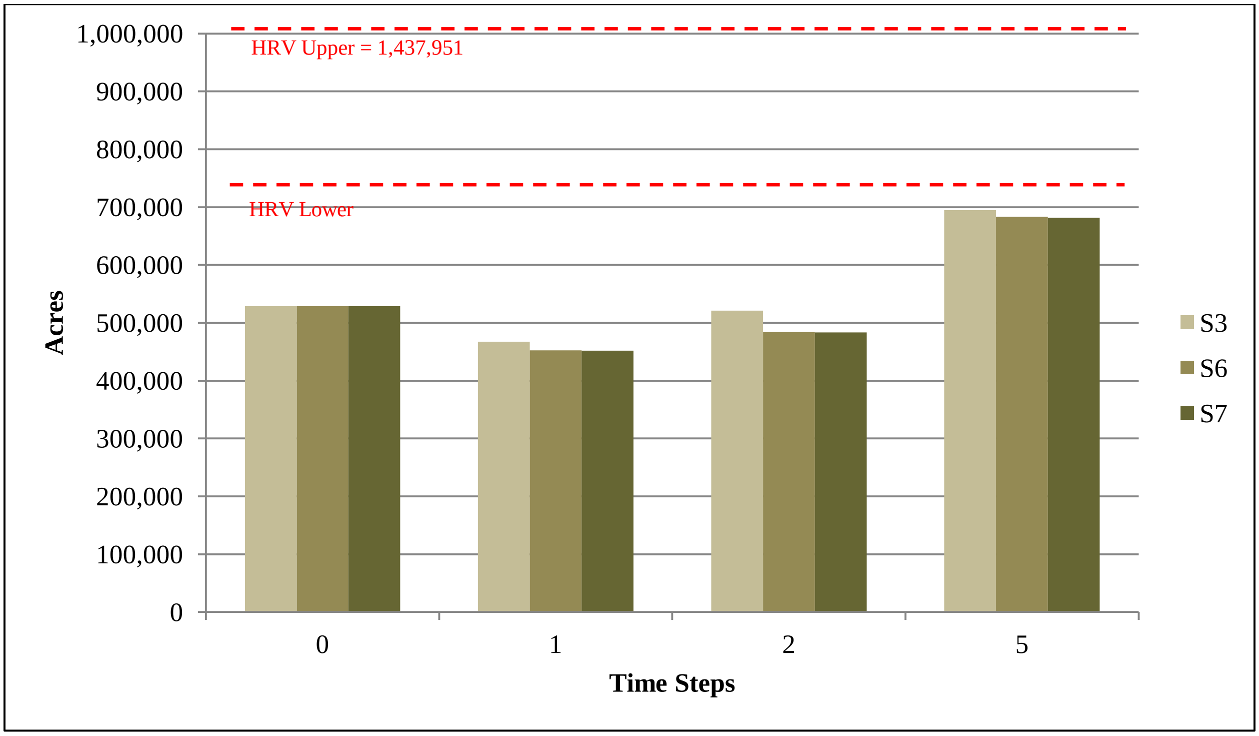

Figure 26 Existing and modeled levels of Hammond's flycatcher habitat for the KNF

3.14 OLIVE-SIDED FLYCATCHER

Olive-sided flycatcher habitat decreases on both Forests during the 50-year period although not dramatically. Scenario 6 produces slightly more habitat than either Scenario 3 or Scenario 7. Scenario 6 resulted in 2.2% more olive-sided flycatcher habitat at decade five on the IPNF, and 5.7% more on the KNF when compared to Scenario 3.

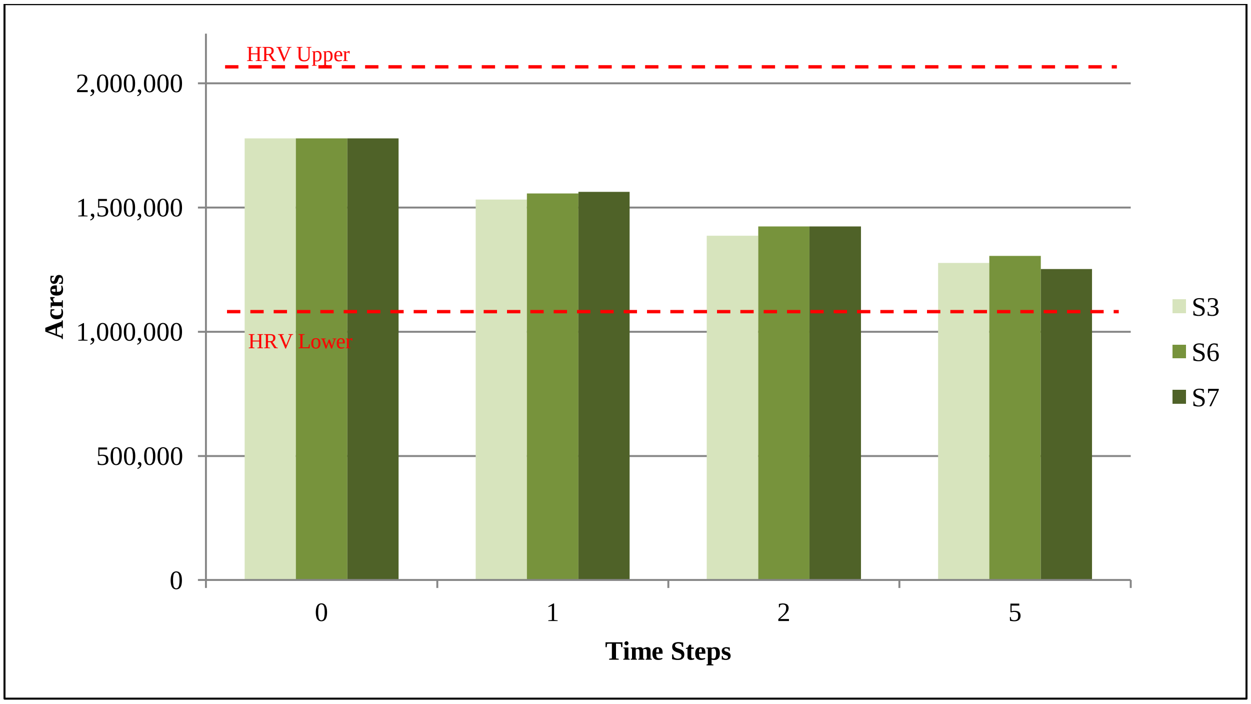

Figure 27 Existing and modeled levels of olive-sided flycatcher habitat for the IPNF

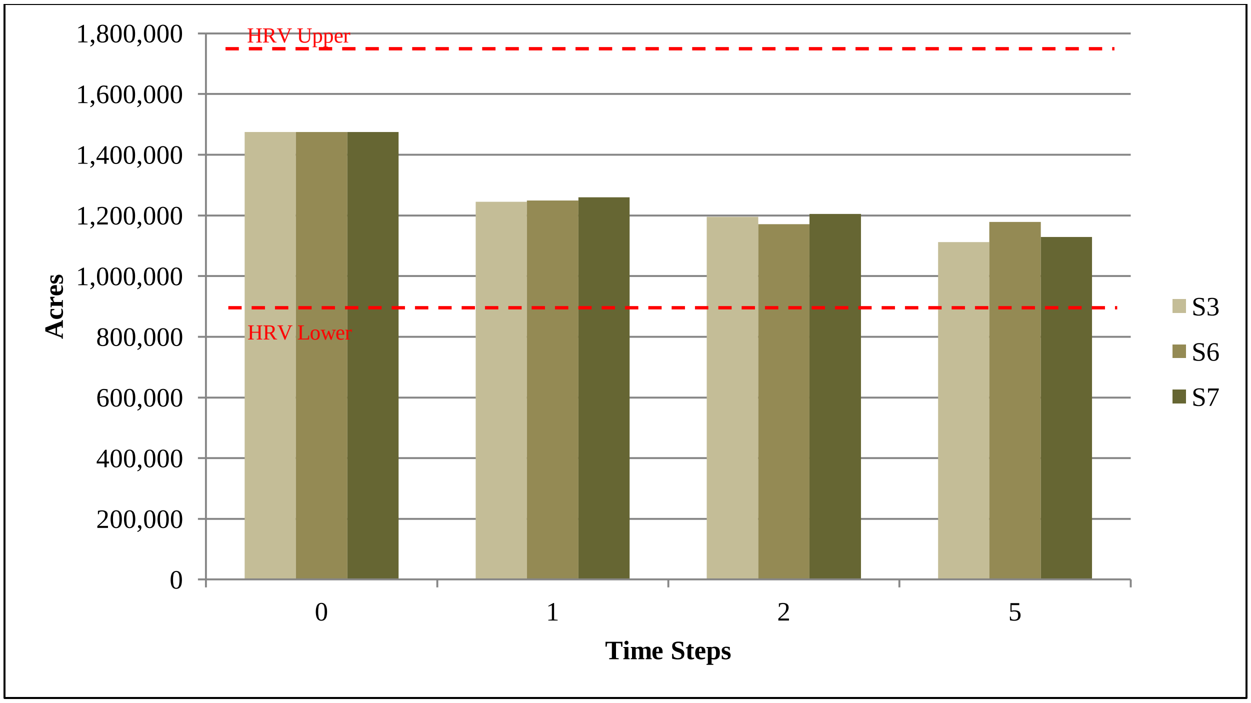

Figure 28 Existing and modeled levels of olive-sided flycatcher habitat for the KNF

3.15 AMERICAN MARTEN

All marten habitat was examined, and as a separate query, only mesic habitat was examined. Splitting all habitat and mesic habitat was performed to acknowledge the emphasis from Wasserman et al. (2010) of the preference found for western redcedar.

A consistent downward trend in mesic habitat occurs from present conditions to decade five on both Forests. Unlike the findings for mesic marten habitat, all marten habitat declines slightly but remains fairly stable over the five decade period on the IPNF and KNF. The no treatment scenario is slightly more beneficial for mesic habitat trends on both Forests during the five decade period, while treatment scenarios restore more all habitat acres on both Forests during that same timeframe.

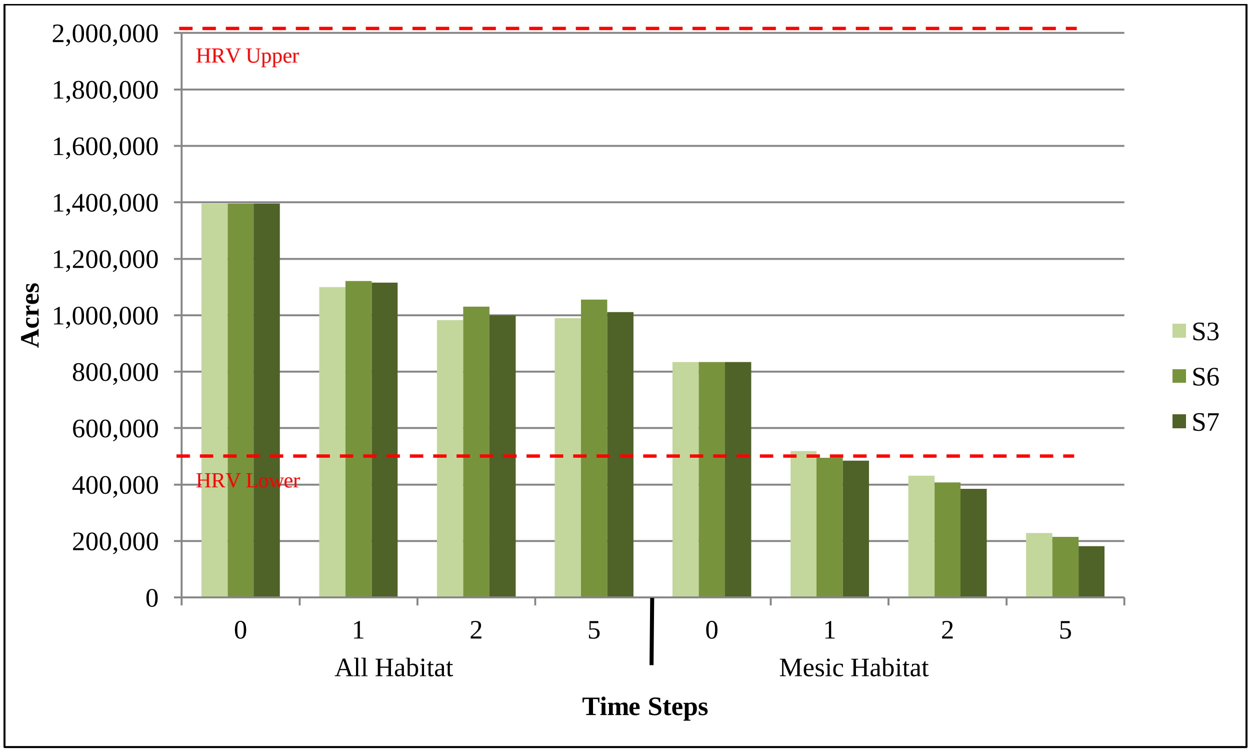

Figure 29 Existing and modeled levels of American marten habitat for the IPNF

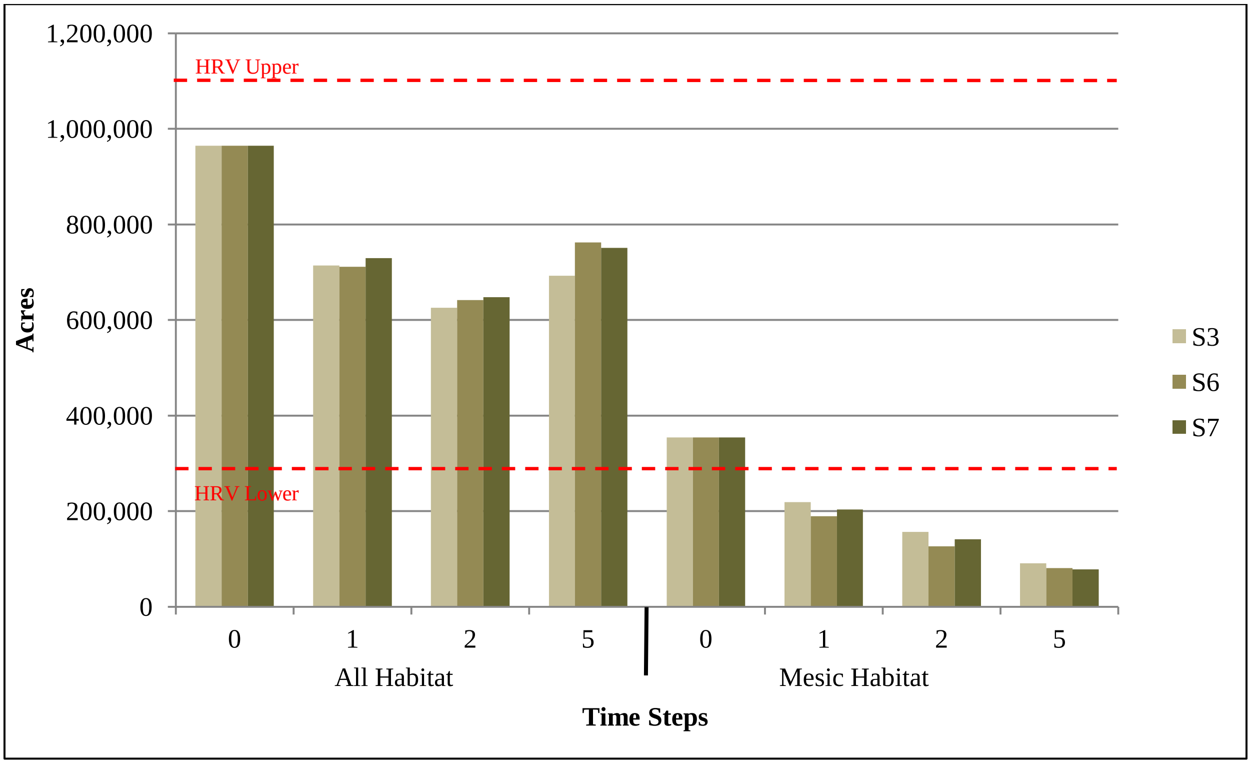

Figure 30 Existing and modeled levels of American marten habitat for the KNF

3.16 NORTHERN GOSHAWK

Northern goshawk habitat decreases on both Forests during the first time steps with habitat starting to rebound on the KNF by decade five. Scenario 6 produces the most acres, with 5.9% more northern goshawk habitat on the IPNF and 4.4% more on the KNF when compared to Scenario 3.

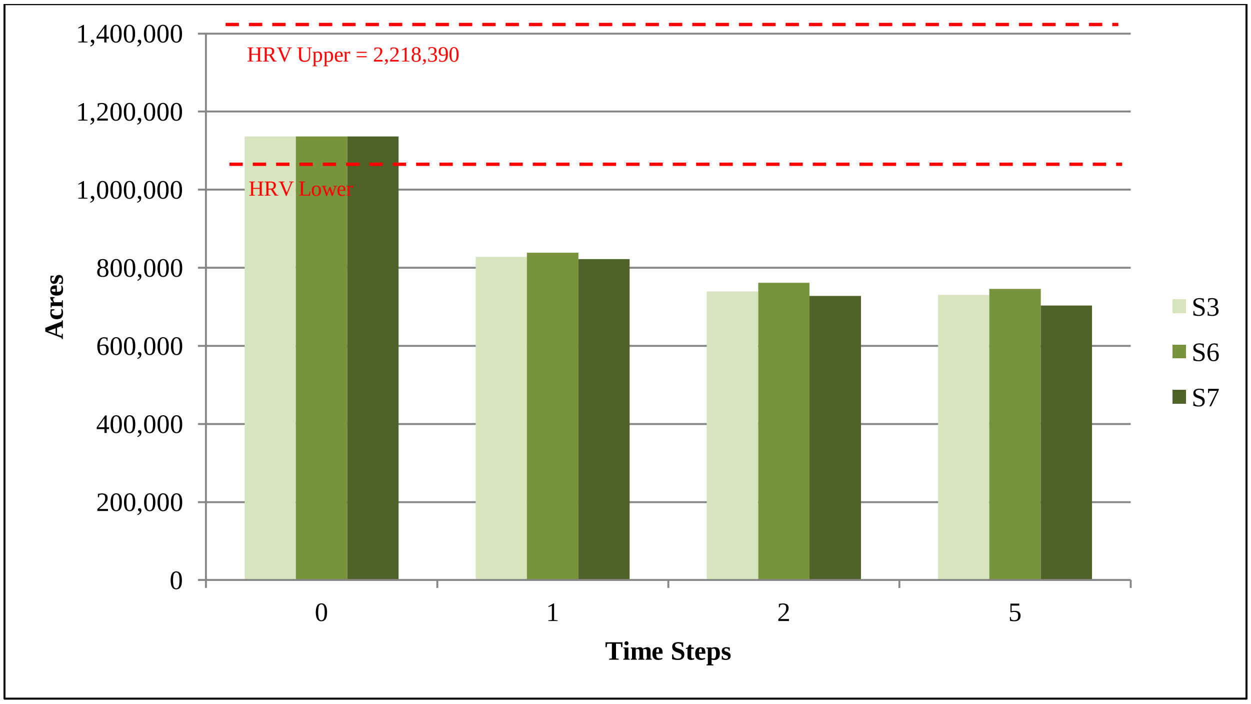

Figure 31 Existing and modeled levels of northern goshawk habitat for the IPNF

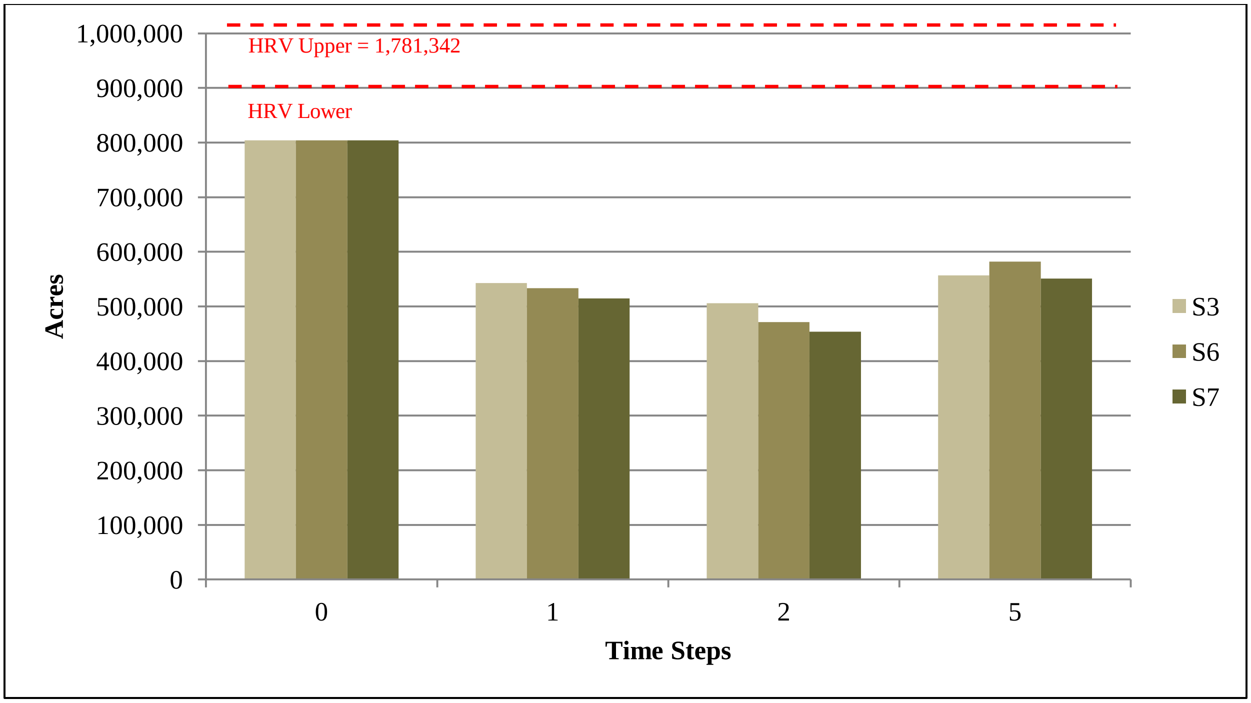

Figure 32 Existing and modeled levels of northern goshawk habitat for the KNF

The following figure presents distribution of northern goshawk habitat at decade five for Scenario 6. There are few if any 5,000 to 10,000 acre potential nest territories that lack sufficient nest habitat to be occupied.

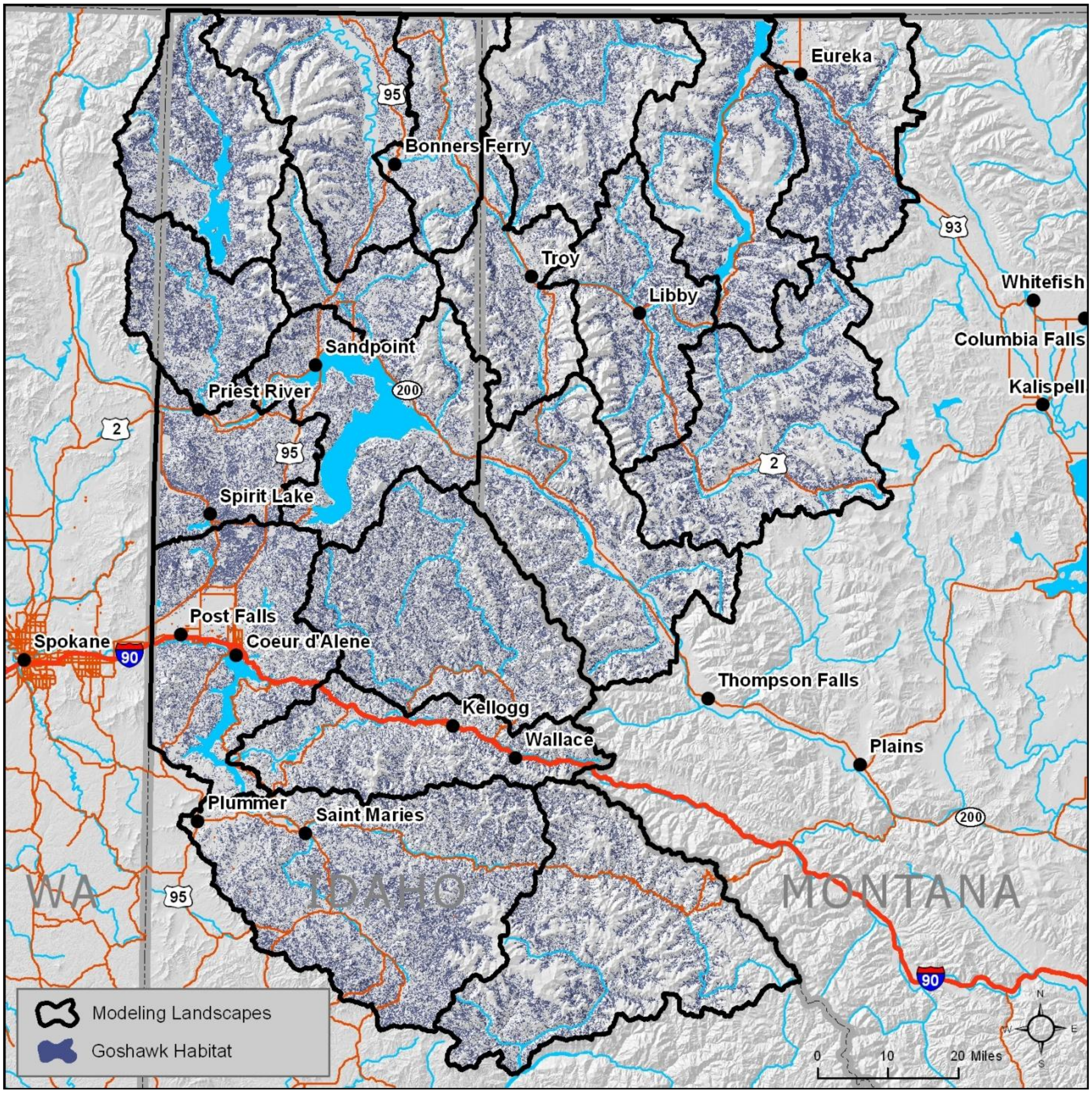

Figure 33 Northern goshawk habitat at decade five for Scenario 6

3.17 PILEATED WOODPECKER

Pileated woodpecker habitat remains fairly static on the IPNF under all scenarios by decade five. Habitat on the KNF increases moderately under all scenarios during the same period. Scenario 6 resulted in 2.8% more pileated woodpecker habitat on the IPNF and 1.2% more on the KNF when compared to Scenario 3.

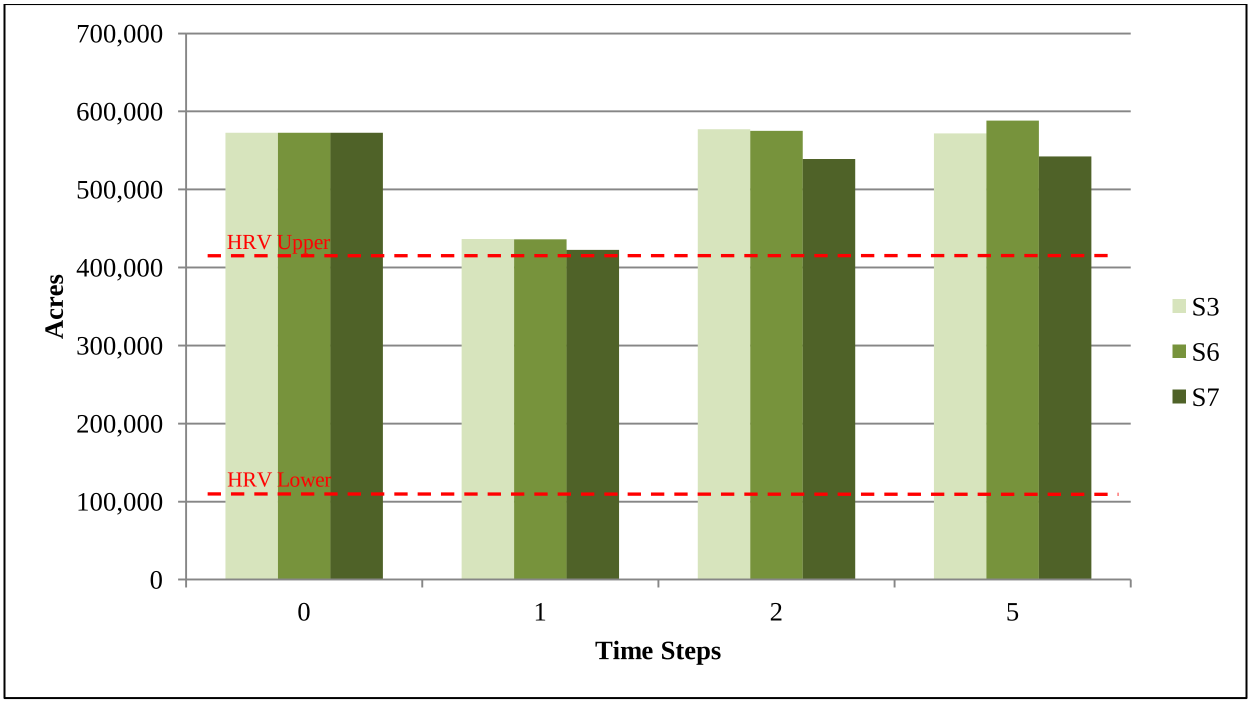

Figure 34 Existing and modeled levels of pileated woodpecker habitat for the IPNF

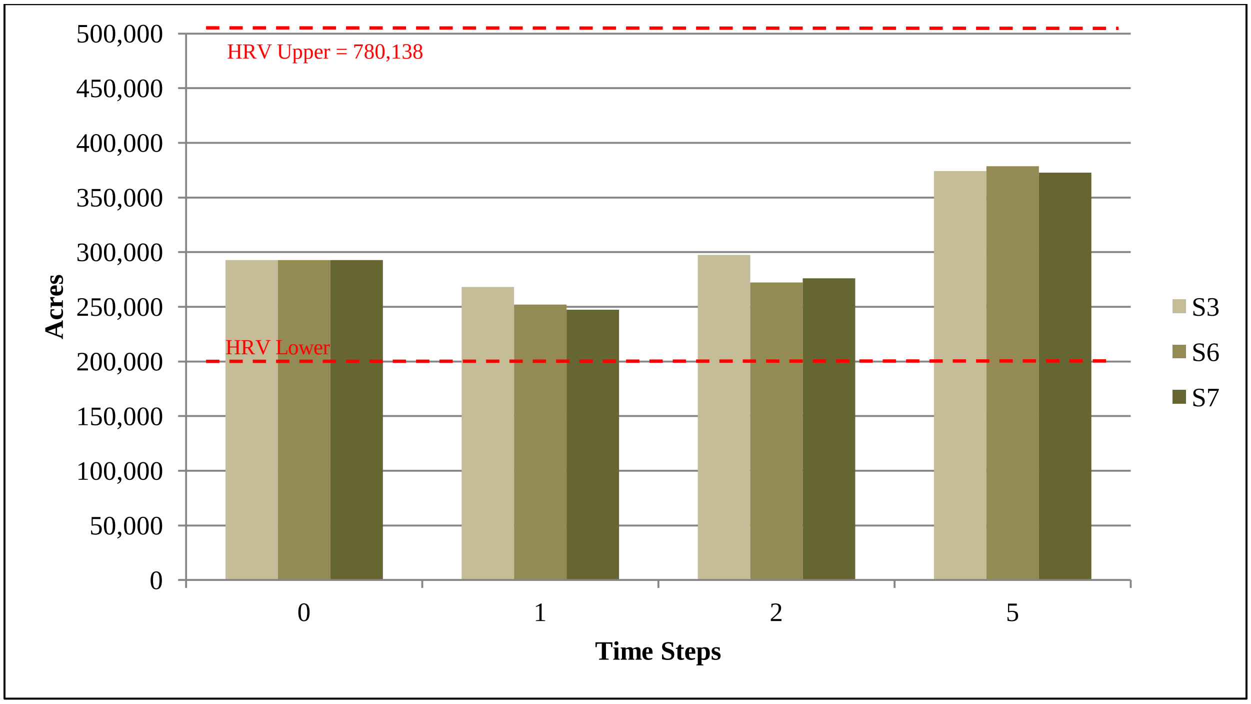

Figure 35 Existing and modeled levels of pileated woodpecker habitat for the KNF

3.18 HABITAT CONNECTIVITY

To assess long-term habitat connectivity, and to compare the benefits of permanent reserves versus areas where management actions would be allowed, all American marten habitat and potential flammulated owl habitat at year 2010 and 2060 were compared (see query designs described in Sections 2.10.5 and 2.10.11). American Wildlands (2008) corridors that were completely within the KIPZ were used for this analysis. The American Wildlands corridors were selected as the sample area for two reasons: 1) the acreage (643,694 acres) was substantial resulting in a large sample size; and 2) the locations in terms of cover type, elevation, and landform were comparable to other portions of the KIPZ. No attempt was made to assess whether or not the locations of the corridors were sufficient in size or locale to provide any genetic link to other landscapes. Rather, the analysis acknowledged that habitat connectivity is a well accepted biological requirement for mid-sized and large carnivores and that stands with large diameter stands are an important component of landscapes where those animals can move freely. Figure 36 and Figure 37 present the amount of American marten and flammulated owl habitat that was maintained, recruited, or lost from 2010 to 2060 for Scenario 3 and Scenario 5[4]. Habitat available at decade five

[4] This analysis was originally run with EIS Alternative B budget constrained. Alternatives B Modified have virtually identical outcomes for flammulated owls and martens, thus conducting the analysis using Alternatives B Modified was deemed unnecessary.

indicates that treatment performed better than no treatment in terms of recruiting and maintaining American marten habitat (see Section 4.20 for tabular results).

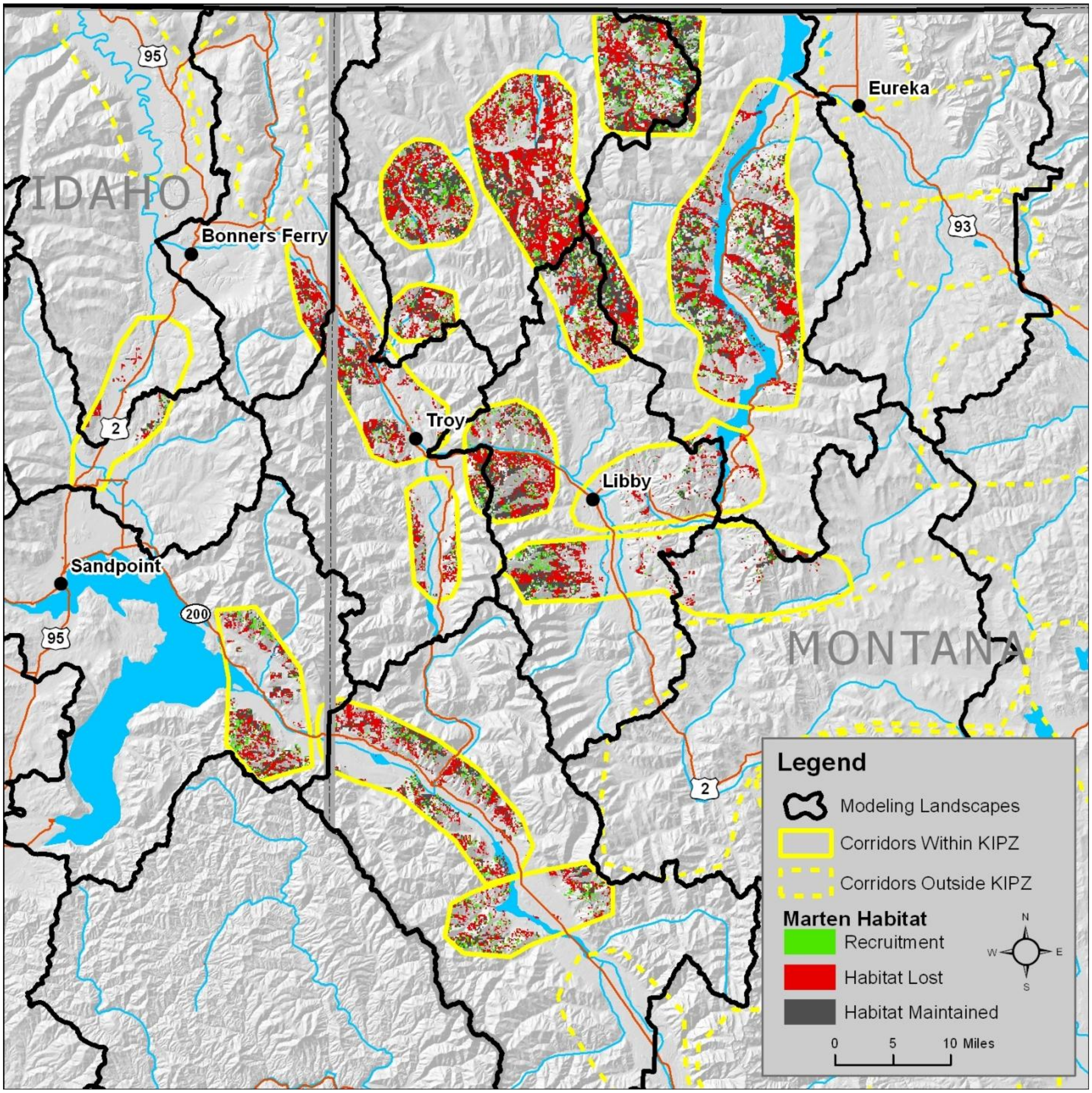

Figure 36 American marten habitat maintained, recruited, or lost from 2010 to 2060 for Scenario 3

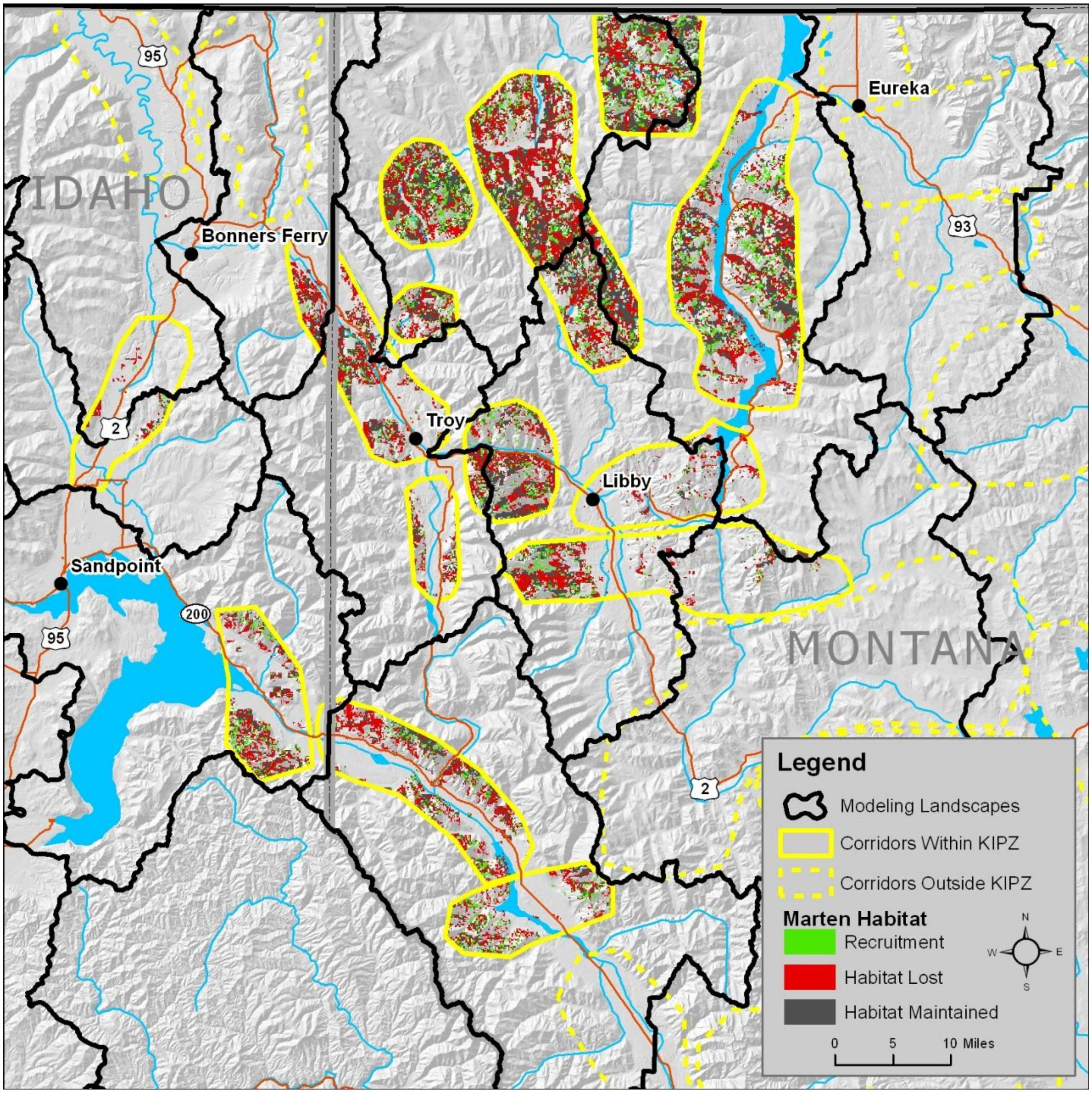

Figure 37 American marten habitat maintained, recruited, or lost from 2010 to 2060 for Scenario 5

4. DISCUSSION

This chapter summarizes the levels of habitat currently available on the KNF and IPNF and predicted for 50 years into the future for twelve wildlife species. Additionally, summaries are provided for whitebark pine and wildlife habitat connectivity. The habitat connectivity analysis is based upon comparisons by scenario of mid- and late-seral forest sustainability and recruitment over the 50-year period. While we modeled all of the alternatives described in the IPNF and KNF EIS, our discussion in this report is limited to Scenario 3, Scenario 6, and Scenario 7.

Scenario 3 provides a baseline for no treatment (no timber harvesting, prescribed fire, pre-commercial thinning, and tree planting) with a fire suppression strategy consistent with what the USFS currently performs, and is not the same as continuation of existing management ("no action") in the EIS. Scenario 6 is the equivalent of the EIS preferred Alternative B with budget constraints and Scenario 7 is the equivalent of the EIS preferred Alternative B without budget constraints.

As discussed in Chapter 2, this report uses the SIMPPLLE model to predict how those levels of habitat will change over the next 50 years from wildfires, disease, succession, and management. Much of the vegetative data used is based on R1-VMap. Satellite imagery data, including R1-VMap, is known to have errors in all major data classifications including cover type, size class, and crown closure. The conclusions presented here have considered those inherent errors and were compared against other broad-scale analyses based on different data. One of the options available to assess the inherent error within R1-VMap is to compare VMap-based results against other wildlife assessments that were based on FIA fixed plot data. Samson (2006b) provided a convenient FIA-based comparison for northern goshawk, flammulated owl, and pileated woodpecker. Samson also assessed the status of black-backed woodpeckers based on the presence of wildfire and insects from 2000 to 2003 and utilized FIA data to identify suitable habitat within those disturbed areas.

Another option for assessing R1-VMap error is to compare the species-by-species habitat criteria used to identify habitat based on R1-VMap against FIA summary data for the KIPZ (USDA 2006). By determining how many of the forested fixed plots met those criteria, we can compare those results against VMap-based SIMPPLLE modeled data for many of the 12 wildlife species.

Lastly, where species occurrence data were available, such as goshawk nests and flammulated owl reports, those occurrences were overlaid with VMap-predicted habitat to test the accuracy of the data and query design.

Thus the conclusions presented here include a "degree of certainty" based on such variables as whether or not species occurrence data supported the findings, (i.e. inventoried goshawk nests), whether or not the findings were similar to FIA data, or whether or not there was a high degree of decade-by-decade consistency in the results by scenario.

SUCCESSION AND DISTURBANCE PROCESSES

The discussion for natural disturbance processes is presented first since habitat fluctuations strongly correlate to disturbance trends.

4.1 SIZE CLASS COMPARISON WITH HISTORIC RANGE OF VARIABILITY

Large size classes (>15-inch DBH) represent a substantial percentage of forested acres on the KIPZ; which equates to 38% on the IPNF and 29% on the KNF. The percentage of large size classes increases slightly under all scenarios by time step five on both Forests. On the IPNF large size classes remain within HRV during all time steps, on the KNF however, the low range of HRV is not obtained until time step five for all scenarios.

Seedling/sapling (<5-inch DBH) stands are currently at a low level and decline slightly over time on both Forests. Modeled seedling/sapling acres by time step five are below HRV on both Forests.

Long term outcomes show little difference by scenario, including no treatment and treatment, for seedling/sapling and large size classes. Furthermore, the size class distribution trend for each decade is almost exactly the same for each scenario. This suggests that the amount of future wildfire on the landscape and regeneration treatments scheduled in the treatment scenarios are presumably at too low a level compared to the forest growth produced annually to make noteworthy differences in size class distribution at the Forest scale.

4.2 WILDFIRE

Figure 38 shows acres burned in the planning unit since 1830 (USDA 2011a; USDA 2011b). During the period from 1830 to 2010, approximately 80% of the 4.7 million acre planning unit burned. The period from 1830 to approximately 1930 represents the pre-fire-suppression period where wildfires may have burned at much higher severity due to fuels accumulated during the Little Ice Age (approximately 1280 to 1820). The timeframe from 1931 to 1987 represents the period where fire suppression was relatively successful. Lastly, 1988 to 2010 represents the current period where at a Region One scale, larger, higher severity wildfires have occurred attributable to both fuel accumulations and hotter, drier burning conditions.

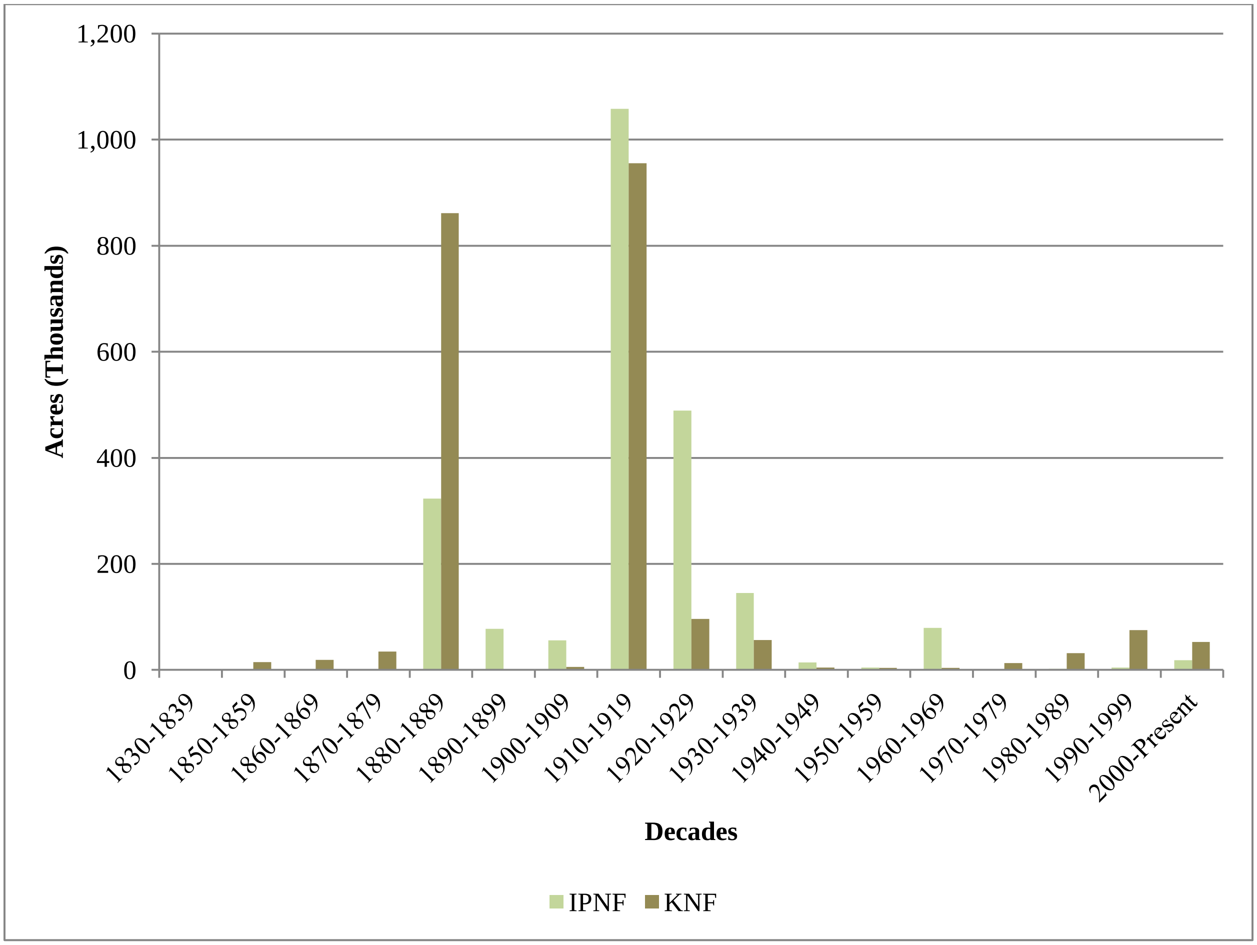

Figure 38 Wildfire history for the IPNF and KNF (acres burned by decade)

Results suggest that on the IPNF and KNF there is an increasing trend in wildfire during the 50-year period (see Section 3.2). Treatment scenarios reduce stand replacing wildfires on both Forests during all decades. Light and mixed severity wildfires are comparable under all scenarios during all decades, yet there is a slight reduction with treatment on both Forests.

Wildfire, root disease, and bark beetle outbreaks are the disturbances responsible for removing large diameter trees over time and for recruiting seedling/sapling stands. However, forest growth (young trees reaching large diameters over time) is occurring at a magnitude that is slightly greater than the loss from natural disturbances.

4.3 ROOT DISEASE

SIMPPLLE reflects the forest succession trend of increasing root disease in susceptible host species cover types. Species that are highly susceptible to root disease, Douglas-fir and true firs, lead to sharp increases in mortality across the landscape with rotating groups of trees having dense multi-aged stories and size classes as older and larger trees are killed and replaced by younger trees of the same susceptible species.

The trend continues as long as forest succession is not interrupted by wildfire or management activities (e.g., timber harvest or prescribed burns). For example altering species composition to more resistant host species (western white pine, western larch and ponderosa pine) reduces the hazard rating and impacts/severity of root disease.

Figure 6 indicates an increasing root disease probability of occurrence through each time step in each scenario. Large acreages are in the Douglas-fir and to lesser extent in grand fir cover types. Scenario 3 results in greater root disease acres than treatment scenarios due to lack of management activities. Root disease also increases over time in all scenarios as insufficient acres are treated to offset the increasing susceptible acres of infection due to forest succession.

4.4 INSECTS

The greatest modeled occurrence of MPB is in the lodgepole cover type, but infestation is also found in the Douglas-fir and spruce-fir cover types, indicating a presence of pine. Cumulatively, only 4% of the 4.4 million acre forested landscape of the KIPZ will be impacted by MPB by decade five. Widespread outbreaks of MPB are common in landscapes dominated by lodgepole pine, but given the relatively small amount of lodgepole pine across the KIPZ, MPB disturbances are kept at endemic levels (Hagle et al. 2003). Published data suggests that historically pole and medium sized classes would have been a much smaller percentage of the lodgepole cover type and that the uncharacteristic mix of pole and medium size classes is the result of wildfire suppression (Hessburg et al. 2005; USDA and USDI 2000). The moderate build up of MPB correlates with the uncharacteristic occurrence of pole and medium sized classes and dense lodgepole pine acreage during the first decade. The decreasing trend in MPB shows a relationship with the increasing trend in wildfire during the 50-year period. Scenario 6 provides the most reduction in MPB impacted acreage by decade five on both Forests.

WSB is the most widely distributed defoliator of coniferous forests in Western North America; hosts include Douglas-fir, all true firs, spruce, and larch (Hagle et al. 2003). At the KIPZ scale the modeled occurrence of WSB occurs in cover types including the aforementioned hosts. Less than 3% of the 4.4 million acre forested landscape of the KIPZ is affected by WSB under all scenarios and all time steps.

Across all scenarios and time steps, approximately 1% of the 4.4 million acre forested landscape of the KIPZ is impacted by DFB and the trend of acres affected decreases by decade five.

HABITATS

Comparisons of habitat available by Forest by decade by scenario follow.

4.5 CANADA LYNX

Two analyses for Canada lynx were used to assess their distinct habitat requirements: a stand initiation habitat analysis, and a multi-storied hare habitat analysis. Additionally, multi-storied habitat is stratified into potential habitat and suitable habitat.

4.6 STAND INITIATION

Lynx are associated with subalpine fir-Engelmann spruce forests. Lynx presence and productivity is directly related to the persistence of specific habitats in any given area. Lynx are intimately tied to their primary prey species, snowshoe hare. One of the habitat elements affecting lynx populations is the quantity and quality of snowshoe hare habitat. Winter snowshoe hare habitat is synonymous with dense regenerated seedling/sapling (stand initiation) forests where trees protrude above the snowline (Ruediger et al. 2000). The Northern Region Lynx Management Direction (USDA 2007a) provides highly prescriptive direction for the management of stand initiation-hare habitat as defined by Ruediger et al. (2000). Prescriptive direction includes: 1) standards limiting the amount of unsuitable (recently regenerated and not yet seedling/sapling size class) habitat within a LAU that can be created both within a decade (10% per LAU) and a maximum in any timeframe (30% per LAU); 2) standards precluding pre-commercial thinning within stand initiation-hare habitat with allowances for restoring rust-resistant whitebark pine; and 3) general emphasis but without targets for considering the need to recruit stand initiation-hare habitat when planning landscape-level management needs.

Interestingly, research by Squires et al. (2007) has consistently found (based on thousands of radio relocations) that south of the 49th parallel, lynx not only limit their foraging activity to multi-storied-hare habitat, but avoid stand initiation-hare habitat. As this research became available, the Northern Region Lynx Management Direction (USDA 2007a) added standards to protect multi-storied-hare habitat, but retained direction to protect stand initiation-hare habitat. Thus, the focus on lynx recovery in Region One has shifted from protecting stand initiation-hare habitat, although pre-commercial thinning is still not allowed in stand initiation-hare habitat, to protecting multi-storied-hare habitat.

4.6.1 Current Suitable Habitat and Projected Trends

Research conducted by Griffin and Mills (2007) on comparable habitats in the adjacent Lolo and Flathead National Forests shows that high density seedling/sapling stands of subalpine fir-Engelmann spruce should be abundant on the IPNF and KNF. However, modeled results indicate that there are currently only 1,032 acres of suitable (dense seedling/sapling stands dominated by subalpine fir-Engelmann spruce) stand initiation habitat occurring on the IPNF and slightly over 518 acres occurs on the KNF. These figures suggest that the model is not able to generate a reliable estimate for suitable stand initiation habitat. This is most likely because SIMPPLLE's suitable cover types regenerate at lower than 70% crown closure for seedling/sapling size classes.

4.6.2 Conclusions

Given the existing, highly prescriptive standards already in place for protecting stand initiation habitat and recent research (Squires et al. 2007) that indicates multi-storied habitat is more important for lynx recovery, the SIMPPLLE modeling logic was not adjusted to calculate stand initiation-hare habitat. Thus the emphasis for lynx related effects in this analysis will be placed entirely on lynx multi-storied-hare habitat.

4.7 MULTI-STORIED HARE HABITAT

These stands typically include older forests that provide lynx denning habitat and support dense coniferous understories that produce optimum cover and browsing opportunities for snowshoe hares at varying snow levels throughout the winter. These stands support trees with limbs that touch the snowline and provide dense, horizontal cover that offer excellent winter habitat and encourage high densities of snowshoe hares. Recent research (Squires et al. 2007) suggests that lynx use multi-storied-hare habitat almost exclusively over other stand size classes and structures.

4.7.1 Current Suitable Habitat and Projected Trends

This analysis defined suitable multi-storied-hare habitat as medium to very large stands of climax subalpine fir and/or Engelmann spruce with a canopy closure of 15–100%. Current suitable multi-storied-hare-habitat habitat equals 188,311 acres on the IPNF and 149,781 acres on the KNF. The spruce/subalpine fir cover types dominate this habitat category. This acreage represents slightly over 7% of the overall landmass managed by the two Forests.

The amount of suitable multi-storied-hare habitat from the current situation through decade five increases dramatically and on a consistent upward trend for all scenarios on both Forests (Section 3.5.2). The amount of suitable multi-storied-hare habitat roughly doubles in the 50-year period.

4.7.2 Current Potential Habitat and Projected Trends

Current potential multi-storied-hare habitat equals 239,836 acres on the IPNF and 263,572 acres on the KNF. Similar to suitable multi-storied-hare habitat, potential multi-storied-hare habitat also increases, but at a slower rate (Section 3.5.2). For example, at decade zero on the IPNF, suitable habitat represents 79% of potential habitat. By decade five, however, suitable habitat represents 91–94% of potential habitat, indicating that the percentage of subalpine fir-Engelmann spruce cover types in subalpine fir habitat types increased. The KNF exhibited the same percentage increase from a current ratio of 57% suitable to potential habitat, to 84–87% at decade five. Thus, not only will subalpine fir forests get larger over five decades to meet the medium to large size class requirement, but those forests will shift measurably from seral Douglas-fir-larch to subalpine fir-Engelmann spruce. In-growth and succession (climax subalpine fir replacing seral Douglas-fir) are recruiting suitable multi-storied habitat at a level greater than that lost to disturbance.

4.7.3 Effects of Management Scenarios – Suitable Multi-storied Hare Habitat

Scenario 6 provides slightly more habitat in all decades and on both Forests. The differences between scenarios, however, are small and do not compare to the magnitude of the decade-by-decade changes attributable to in-growth and succession. This lack of difference between scenarios suggests that the modest level of human disturbance (logging, prescribed burning) in the treatment scenarios along with continued wildfire suppression is comparatively minor.

4.7.4 Effects of Management Scenarios – Potential Multi-storied Hare Habitat

The effects of scenarios on potential habitat are similar between Forests, and like suitable habitat results, have little if any effect on the five decade outcome.

4.7.5 Comparison to Historic Range of Variability – Suitable Multi-storied Hare Habitat

The HRV on the IPNF is 70,585 acres (low range) and 283,707 acres (high range). The HRV on the KNF is 69,681 acres (low range) and 278,725 acres (high range). The current level of habitat on the IPNF is 188,311 acres. The current level of habitat on the KNF is 149,781 acres and represents the lowest level during the five decade period. At the end of decade five, habitat on both Forests will exceed the high range HRV under all scenarios.

4.7.6 Conclusions

Disturbances in multi-storied subalpine fir habitats are increasing but not at a magnitude or severity that encourages stand replacement. As a result, these habitats remain intact and increase over time due to moderate to low severity wildfires, forest growth, and succession that encourages climax subalpine fir, and multi-storied stand structures. These higher elevation habitats are wet and cool and have long wildfire return intervals relative to lower elevations on these Forests. These factors allow some potential habitats to convert into suitable habitat as previously discussed. Recognizing that the majority of both Forests are not lynx habitat (too low in elevation), the small portion of subalpine fir-dominated habitat that exists is well-suited to provide multi-storied-hare habitat. Tree growth occurs rapidly. Sites are productive allowing dense seedling/sapling subalpine fir understories to dominate the understories, even when overstories are dense (up to 100% crown closure).

Lynx remain threatened in the lower 48 states, and their recovery, largely due to the uncertainties of climate change, remains questionable. Only two reproducing lynx populations are found in the lower 48 (one in the Yaak drainage on the KNF, and the other in the Seeley Swan drainages on the adjacent Flathead and Lolo National Forests). According to Squires et al. (2007) the one habitat variable that best explains lynx occurrence within spruce-fir forests in those two populations is suitable (medium to very large, subalpine fir dominated) multi-storied-hare habitat. The current level of habitat is above HRV and will double during the next 50 years. The SIMPPLLE-modeled outcomes suggest all scenarios analyzed are fully compatible with recovery and clearly minimize risks to species viability to the degree that habitat availability affects lynx.

4.8 WHITEBARK PINE

Due to whitebark pine's dependence on wildfire for regeneration, we tracked wildfires in a whitebark pine probable layer with the assumption that these disturbances would have a high probability of regenerating whitebark pine stands. Simulated results used this whitebark pine probable layer as a 'footprint' to query for wildfires that had occurred in the previous time step. Thus all figures for whitebark pine in this assessment are not acres of whitebark pine cover type, but acres that had a high probability of whitebark pine establishment within the past ten years due to wildfire occurrence.

4.8.1 Current Habitat and Projected Trends

Whitebark pine trees occur on some of the higher ridges and mountain tops on the IPNF and KNF (USDA 2011a; USDA 2011b). Whitebark pine has declined severely in the planning unit due to white pine blister rust, competition from subalpine fir caused by long-term wildfire suppression, and attacks from MPB. Because of the long timeframe that whitebark pine has been under attack by blister rust, surviving mature whitebark pine likely exhibit some rust resistance and will provide a potential rust resistant seed source for the future.

KIPZ wildfire history data for the past ten years show 12,039 acres of wildfire within the whitebark pine probable area with the majority of that on the KNF (see Figure 38). Consequently, the level of high potential whitebark pine establishment declines substantially in decade one due to less wildfire occurrence and then increases steadily to near current levels at decade five. The trends are comparable for both Forests. The increasing habitat trend is equivalent to the trend of burned acres including all wildfire severity classes.

4.8.2 Effects of Management Scenarios

Prescribed burns occurring in the whitebark pine probable area would result in whitebark pine regeneration. Prescribed burns were only applied to the suitable base; whitebark pine probable areas were almost entirely out of the suitable base (98.8% on the IPNF and 99.2% on the KNF). Without prescribed fires in the whitebark pine probable area, all whitebark pine regeneration is attributable to wildfire alone.

On the IPNF, Scenario 3 provides more habitat than Scenario 6 or Scenario 7. On the KNF, however, treatment scenarios produce more habitat than Scenario 3. Regardless, upward trends under all scenarios suggest gradual long-term recovery.

Whitebark pine restoration typically involves protecting rust resistant adults by removing fuel accumulations, removing competing subalpine fir, creating nutcracker caching sites, and when budgets allow, planting rust-resistant seedlings. There is no logical reason why treatment scenarios should perform poorer than no treatment as the modeled results suggest on the IPNF. There are two possibilities why the modeled outcomes are inconsistent. It may simply be that the small number of acres involved on the KIPZ are overwhelmed by the “noise” in the model from random wildfire events (i.e. the sample is too small for the model to show conclusive outcomes). Also, the model logically tends to predict wildfires in the more volatile situations and predict acres burned as average events and whitebark pine sites are not typically volatile. In addition, wildfire in lower elevations may prevent wildfire from occurring in higher elevations.

4.8.3 Comparison to Historic Range of Variability

Given the lack of past data and because there is such a small amount of habitat occurring in the planning unit, comparisons to HRV are not feasible. Nonetheless, whitebark pine is clearly at risk in the planning unit and Northern Rockies. The recovery of western white pine provides a good approximation of what whitebark pine recovery will look like—natural rust resistance in surviving trees along with an increase in disturbance will provide conditions consistent with a slow recovery.

4.8.4 Summary Discussion

Although whitebark pine is at risk on the KIPZ and range-wide, measures in the treatment scenarios including prescribed burning and mechanical treatments to reduce subalpine fir competition, create seed caching sites, and reduce bark beetle mortality risk are fully consistent with reducing that risk over time.

4.9 BLACK-BACKED WOODPECKER

Black-backed woodpeckers are an obligate of recently burned forests. Given the recent wildfires in the area (i.e. 2007 Chippy Creek), high productivity of the planning unit in terms of forest growth, and the 100 years of wildfire suppression and associated increased fuel loads, it seems likely that the planning unit should have abundant black-backed woodpecker habitat.

4.9.1 Current Habitat and Projected Trends

Region One data collected on burned acres provides that the planning unit has approximately 44,000 acres of black-backed woodpecker habitat including 14,074 acres on the IPNF and 29,582 acres on the KNF (Figure 38). Based on modeled outcomes, the amount of habitat declines substantially in decade one to a low of 4,030 acres under Scenario 7 on the IPNF and to 5,600 acres under Scenario 7 on the KNF. Habitat increases steadily on both Forests to near current levels at decade five with 18,505 acres on the IPNF and 23,340 acres on the KNF under Scenario 3. The increasing trend matches predicted increases in burned acres through the five decade period.

4.9.2 Effects of Management Scenarios

The treatment scenarios measurably reduce habitat in each decade (Section 3.7) compared against Scenario 3, presumably through direct on-the-ground treatments that result in reduced burned acres and wildfire severity. The trends are comparable for both Forests. On the IPNF, Scenario 7 reduces habitat predicted under Scenario 3 for decade five from 18,505 acres to 12,209 acres (a 33% reduction). On the KNF, Scenario 7 reduces habitat from 23,340 acres predicted under Scenario 3 for decade five to 17,691 acres (a 24% reduction). These differences between no treatment and treatment scenarios for black-backed woodpeckers represent the most considerable differences of any of the 12 wildlife species in this analysis, and again are the direct result of actions taken to reduce burned acres and wildfire severity.

4.9.3 Comparison to Historic Range of Variability

The SIMPPLLE model was not used to estimate HRV for acres burned under a "no wildfire suppression" scenario. The closest run performed was Scenario 2, which was based on a "reduced wildfire suppression" setting. The KIPZ HRV data includes high and low estimates of dominance class, cover type, and size class, yet provides no estimates of acres burned. The KIPZ wildfire data does include fire history back to 1830 (Figure 38), although it is recognized by Forest staff that some wildfire occurrences are missing as the result of multiple burns, particularly those before 1900 which consumed trees having fire scars from previous fires. The low level of wildfire occurrence between 1930 and 1987 is presumably the result of successful suppression efforts. Hillis et al.(2002) hypothesized that the 1930 to 1987 period created a "habitat bottleneck" where wildfire suppression coupled with salvage may have placed black-backed woodpeckers at substantial risk. They also suggested, however, as did Samson (2006b) that research in the post 1988 period (Caton 1996; Hejl et al. 2000; Hitchcox 1996) found black-backed woodpeckers occurring in burns at high densities, suggesting they had survived any past habitat bottlenecks. Broad scale assessments of black-backed woodpecker habitat, (Ecosystem Research Group 2010; Hillis et al. 2002; Samson 2006b) have shown that fuel accumulations, and drier, more volatile burning conditions will lead to an increase in burned acres. This suggests that black-backed woodpeckers are at no risk region-wide. Again, that conclusion recognizes that black-backed woodpeckers are capable of migrating across forest boundaries to exploit wildfires (Hoyt 2000) and readily do so based on genetic relatedness (Pierson 2009).

4.9.4 Conclusions

The factors limiting black-backed woodpeckers are wildfire suppression and actions taken in the treatment scenarios to reduce burned acres and wildfire severity. Given that black-backed woodpeckers only make use of burned areas for six years, and that black-backed woodpeckers migrate across forest boundaries to exploit wildfires, it is essential that any objective analysis of black-backed woodpecker habitat evaluate both recent wildfires and predicted future wildfires at regional scales. Since 2000, wildfires at that scale have been substantial. Furthermore, fuel accumulations and insect outbreaks suggest an increase in activity at that regional scale. While the KIPZ planning unit is on the "cool, moist end" of the region in terms of fire severity, it too will provide substantial burned forest habitat as the SIMPPLLE-modeled outcomes indicate.

4.10 FISHER

High quality fisher habitat includes dense, mesic, mature and late-seral coniferous stands with high canopy cover found in low to mid elevation forests. Fisher are not as strongly tied to interior forests as are marten, yet fisher exhibit similar avoidance behavior to open areas with low canopy cover. This behavior may limit fishers' ability to expand into new areas when open areas dominate potential movement corridors.

4.10.1 Current Habitat and Projected Trends

Current habitat is abundant at 1,156,387 acres on the IPNF and 703,423 acres on the KNF. Fisher habitat will decline by over 377,013 acres in the best case scenario (Scenario 6) from decade zero to decade five on the IPNF (Section 3.8). The most noteworthy decline, however, occurs within the first decade when habitat declines from approximately 1.16 million to 882,046 acres under a best case scenario (Scenario 6). That trend represents a 24% decline over a single decade. The consistent downward trend flattens out after decade one with an overall decline from decade zero to decade five of 33%.

There is a slightly different trend on the KNF. Presently, the KNF provides fisher habitat at 703,423 acres (over 32% of the Forest). Habitat declines from 703,423 acres in decade zero to 513,986 acres in the best case scenario (Scenario 7) in decade one. This trend represents a 27% decline within the first decade. The decline in habitat starts to even out by decade two and habitat begins to increase slightly by decade five to 522,631 acres in the best case scenario (Scenario 6).

Habitat does not typically remain fixed in locations over the 50-year timeframe. On both Forests suitable habitat that was present in decade zero may not exist in that location by decade five, and conversely, habitat that not present in earlier decades occurs in future decades and is attributed to forest growth. By comparing modeled polygons of habitat at decade zero against future decades, declines or shifts in habitat can be identified. Then by overlaying the modeled polygons of disturbances (wildfire, insects, and disease), it can be determined which disturbance was responsible for that habitat change. On the IPNF, wildfires and root disease appear to be responsible for the five decade decline in habitat. On the KNF, the same disturbances are responsible, although root disease has less effect than wildfire.

4.10.2 Effects of Management Scenarios

Treatment scenarios have positive but minor effects on the five decade outcome. Scenario 6 provides the most fisher habitat at decade five with 785,040 acres on the IPNF and 522,938 acres on the KNF, while Scenario 3 provides 739,428 acres on the IPNF and 460,835 acres on the KNF. Scenario 6 consistently provides more habitat than other scenarios throughout the time period although the differences are minimal. The improved degree of habitat provided by treatment paralleled modeled reductions in acres burned and reduced wildfire severities, suggesting why those scenarios perform better.

4.10.3 Comparison to Historic Range of Variability

The HRV for fisher habitat on the IPNF is 652,018 acres at the low range and 1,304,037 acres at the high range. The HRV for fisher habitat on the KNF is 343,018 acres at the low range and 671,150 acres on the high range. Habitat on the IPNF is currently within the HRV at 1,156,387 acres and habitat on the KNF is currently above the HRV at 703,423 acres. The lowest modeled level of habitat on the IPNF (Scenario 3 at decade five) will still be within the low range HRV at 739,428 acres. Similarly, the lowest modeled level of habitat on the KNF (Scenario 3 at decade two) will be within HRV at 430,347 acres.

4.10.4 Conclusions

An increasing number of acres will experience disturbance over time and root disease and wildfire will have the most impact on fisher habitat. Regardless of the management scenario, fewer acres of dense, mature stands will be available to fisher on either Forest. Habitat losses stabilize on the IPNF and rebound on the KNF by decade five. Since available habitat stays within HRV throughout the 50-year period, there is no indication that any of the scenarios place fishers at risk from a viability standpoint.

4.11 FLAMMULATED OWL

Flammulated owls are strongly associated with dry, mature stands of ponderosa pine/Douglas-fir in montane forests with snags. Flammulated owls prefer ponderosa pine with open canopies of <40% (i.e. "suitable habitat" query for this analysis). Flammulated owls are frequently found within stands denser than 40% crown closure (Hayward and Verner 1994) although the literature (Wright 2000) also suggests flammulated owls, because of their foraging behavior may not be able to forage successfully within dense stands. Large, ponderosa pine/Douglas-fir stands 15–69.9% crown closure are designated "potential habitat" for this analysis, and represent both open and dense stands, the latter (with 40–70% crown closure) of which may be marginal due to excessive crown closures. It is assumed that dense potential habitat could be converted to "suitable habitat" with light disturbance such as low severity wildfire or restoration thinning.

4.11.1 Current Suitable Habitat and Projected Trends

Existing conditions for flammulated habitat are similar in acreage for both Forests with 22,286 acres of suitable habitat on the IPNF and 23,984 acres on the KNF. These figures represent about 1% of the total area for each Forest. Suitable habitat is limited to dry ponderosa and Douglas-fir stands with 15-inch DBH and crown closures less than 40%, which are relatively uncommon on both Forests; hence the resulting low existing acreage.

Existing suitable flammulated owl habitat declines by decade two on the IPNF then begins to recover by decade five. Nonetheless, habitat at decade five remains almost 50% below the current habitat conditions. Suitable flammulated habitat on the KNF increases over time from current conditions through decade five. The exception is a slight decline in decade two with no treatment under Scenario 3.

4.11.2 Current Potential Habitat and Projected Trends

Potential flammulated owl habitat is estimated at 41,017 on the IPNF and 72,265 on the KNF. The model uses similar habitat features and cover types for potential habitat but increases canopy cover ranges from the less than 40% used in the suitable habitat query to 15–69.9%.

4.11.3 Effects of Management Scenarios – Suitable and Potential Habitat

On both Forests, Scenario 6 provides more suitable habitat than either Scenario 3 or Scenario 7. Similarly, on the KNF Scenario 6 provides more potential habitat than either Scenario 3 or Scenario 7. On the IPNF potential habitat also increases under all scenarios during all time steps, yet no treatment outperforms treatment.

The increase in potential habitat indicates that increases in low and moderate severity wildfire and forest growth will increase the coverage of large and very large trees (>15-inch DBH) on both Forests. The mixed response in suitable habitat, however, suggests that most of the increase in large diameter ponderosa pine and Douglas-fir will be accompanied by dense stand structures (>40% crown closure) that are likely to be marginal for flammulated owls.

4.11.4 Comparison to Forest Inventory and Analysis Plots

Dominance types ponderosa pine and Douglas-fir, and size classes large and very large were considered suitable for nesting. Since flammulated owls nest in large snags in abandoned pileated woodpecker nest cavities within these dominance types and size classes, and since R1-VMap data does not include snag density data, the *Draft Comprehensive Evaluation Report for the Idaho Panhandle and Kootenai National Forest Proposed Land Management Plans* (USDA 2006) and the *Region One Vegetation Classification, Mapping, Inventory and Analysis Reports – Estimates of Snag Densities for Western Montana and Northern Idaho Forests in the Northern Region* (Bollenbacher et al. 2009a; Bollenbacher et al. 2009b) were assessed to ensure that stands meeting the SIMPPLLE model query had sufficient snags. FIA data summaries at the Hydrologic Unit Code 5 or larger scale provided statistically sound data on snag abundance.

On the IPNF the average number of snags with DBH 20 inches and larger is 1.4 snags per acre with a 90% confidence interval of 1.2 to 1.8 snags per acre (USDA 2006). On the KNF the average number of snags with DBH 20 inches and larger is 1.0 snag per acre with a 90% confidence interval of .8 to 1.2 snags per acre (USDA 2006). For western Montana, the average number of snags with DBH 20 inches and larger is 0.9 snags per acre with a 90% confidence interval of 0.8 to 1.1 snags per acre (Bollenbacher et al. 2009b). For northern Idaho the average number of snags with DBH 20 inches and larger is 1.6 snags per acre with a 90% confidence interval of 1.4 to 1.8 snags per acre (Bollenbacher et al. 2009a). The 2009 estimates of snag densities provide the more recent compilation of FIA data and are likely to be more accurate due to the larger sample size created by summarizing data at larger scales. Regardless of which dataset is used, snags are abundant and not limiting within the ponderosa pine dominance type and size classes used to estimate flammulated owl habitat.

4.11.5 Comparison to Historic Range of Variability – Potential Habitat

The KIPZ HRV data includes historic ranges of dominance class and size class by VRU category (USDA 2011a; USDA 2011b). When individual species' habitats can be defined by those variables, the comparison of current levels of modeled habitat to HRV is a straightforward mathematical comparison. When, however, a certain range of crown closure is also a habitat requirement, the lack of historic data on crown closure makes comparisons difficult. For that reason, comparisons of SIMPPLLE-modeled flammulated owl habitat to HRV were made using potential flammulated owl habitat (ponderosa pine/Douglas-fir within VRUs 1–3, and size class >15-inch DBH), not suitable flammulated owl habitat (the aforementioned variables but further limited to 15–40% crown closure). The potential flammulated owl query is also limited by an upper crown closure (70%) but according to the FIA summary data, crown closures within dry ponderosa pine/Douglas-fir sites in VRUs 1–3 are all less than 70%, even after nearly a century of wildfire suppression. Those VRUs are presumably too dry to produce enough biomass to reach a crown closure of 70%. Thus, any bias from comparing SIMPPLLE-modeled data that uses crown closure data against HRV data that lack crown closure data is avoided.

The HRV for potential flammulated owl habitat on the IPNF is 70,993 to 279,668 acres and 48,432 to 195,886 acres on the KNF. Modeled outcomes suggest that current potential habitat on the KNF is within the HRV and will remain so at decade five for all scenarios. Potential habitat on the IPNF increases steadily throughout the 50-year period but remains below or at the low range HRV.

Yet it should be noted that there is a discrepancy between suitable and potential habitat. On the IPNF only about 3% (roughly 12,000 acres out of 300,000 acres) of potential habitat will provide preferred suitable foraging habitat (i.e. crown closures less than 40%). On the KNF, that percentage is roughly 10%, but still only constitutes a small percentage of potential habitat acres. This could be the result of a minor problem with the SIMPPLLE logic pathways allowing low and moderate severity wildfires, and/or treatments (thinning from below, prescribed burning, etc.) to correctly predict open forest conditions. Or, the treatment scenarios may simply not provide enough activities in the low elevation, dry forest habitats to restore historic stand structures.

4.11.6 Conclusions

Potential habitat for flammulated owls defined as large trees in dry ponderosa pine or Douglas-fir cover types increases throughout the five decade period on both Forests. The low acres of suitable habitat, the predicted decline from decade zero to two, and the slight increase to decade five, suggests further actions to reduce crown closure might be warranted. Given the predicted increases in low and moderate severity wildfires, the improvement in suitable habitat should be more pronounced than what is predicted in the model. For that reason, the level of certainty for the predicted outcomes is likely low for this species.

4.12 PYGMY NUTHATCH

Pygmy nuthatches are an obligate of late seral ponderosa pine forests with large ponderosa pine snags. Their distribution matches the distribution of ponderosa pine across the west with nuthatch populations highest in national forests that are ponderosa pine dominant. National forests with only modest percentages of ponderosa pine may contribute genetic connectivity but likely provide less long-term viability than those ponderosa pine dominated forests. The lack of pure ponderosa pine-dominated stands and habitat potential suggests the IPNF and KNF contribute little to the viability of the species, regardless of habitat conditions on those limited acres.

4.12.1 Comparison to Forest Inventory and Analysis Plots

Ponderosa pine size classes large and very large were considered suitable for nesting. Since pygmy nuthatches require large snags within theses size classes, and since R1-VMap data does not include snag density data, the *Draft Comprehensive Evaluation Report for the Idaho Panhandle and Kootenai National Forest Proposed Land Management Plans* (USDA 2006) and the *Region One Vegetation Classification, Mapping, Inventory and Analysis Reports – Estimates of Snag Densities for Western Montana and Northern Idaho Forests in the Northern Region* (Bollenbacher et al. 2009a; Bollenbacher et al. 2009b) were assessed to ensure that stands meeting the SIMPPLLE model query had sufficient snags. FIA data summaries at the Hydrologic Unit Code 5 or larger scale provided statistically sound data on snag abundance.

On the IPNF the average number of snags with DBH 20 inches and larger is 1.4 snags per acre with a 90% confidence interval of 1.2 to 1.8 snags per acre (USDA 2006). On the KNF the average number of snags with DBH 20 inches and larger is 1.0 snag per acre with a 90% confidence interval of .8 to 1.2 snags per acre (USDA 2006). For western Montana, the average number of snags with DBH 20 inches and larger is 0.9 snags per acre with a 90% confidence interval of 0.8 to 1.1 snags per acre (Bollenbacher et al. 2009b). For northern Idaho the average number of snags with DBH 20 inches and larger is 1.6 snags per acre with a 90% confidence interval of 1.4 to 1.8 snags per acre (Bollenbacher et al. 2009a). The snag densities indicate that snags are abundant and not limiting within the ponderosa pine dominance type and size classes used to estimate pygmy nuthatch habitat.

4.12.2 Current Habitat and Projected Trends

Existing habitat on the KIPZ is comprised of 46,372 acres on the IPNF and 80,313 acres on the KNF. Habitat will increase substantially on both Forests during the 50-year period under all scenarios, although most noticeably under Scenario 3. Disturbances responsible appear to be a combination of increased low and moderate severity wildfires with some losses from high severity wildfires, and in-growth of larger, ponderosa pine size classes. Since ponderosa pine is fire dependent, the general increase in habitat is not unexpected.

4.12.3 Effects of Management Scenarios

Although habitat increases over time, treatment scenarios produce less by decade five on both Forests when compared to no treatment. This is inconsistent with the research. For instance, the Interior Columbia Basin Ecosystem Management Project (USDA and USDI 2000) predicted that large diameter ponderosa pine communities would decline substantially in the coming decades due to high severity wildfire without substantial treatments to reduce fuel accumulations. Conversely, the SIMPPLLE-modeled outcome suggests wildfires will predominately be low to moderate severity and that treatment scenarios would have a negative effect on the recruitment of large diameter ponderosa pine.

4.12.4 Comparison to Historic Range of Variability

The KIPZ HRV data includes historic ranges of dominance class and size class by VRU category (USDA 2011a; USDA 2011b). The habitat query for pygmy nuthatch is limited to dominance class ponderosa pine and large trees >15-inch DBH with no upper limit on crown closure. While this comparison suggests that habitat is sufficient and increasing over five decades, largely from forest growth, the analysis ignores the question of long-term snag durability. It has been suggested that snag durability in ponderosa is strong correlated to large trees, slow growth, and pitch build-up from periodic exposure to non-lethal wildfires (Smith 2000). While the modeled results indicate an increase in large ponderosa pine, and thus it can be assumed large snags, the complexity of questions surrounding snag durability suggest further finer-scale analyses might be useful.

The HRV on the IPNF ranges from 39,168 to 154,299 acres. The HRV on the KNF ranges from 39,118 to 155,983 acres. On the IPNF the lowest habitat amount (36,379 acres) occurs under Scenario 7 at decade one and is slightly below the low range HRV. On the KNF the lowest habitat amount (63,705 acres) occurs under Scenario 7 during decade two, and is well within HRV. The modeled outcomes clearly indicate that pygmy nuthatches are not at risk on either Forest, regardless of the scenario selected.

4.12.5 Conclusions

The condition of ponderosa pine on the planning unit likely has little relevance to pygmy nuthatch viability range-wide. Nonetheless, increased wildfires are likely to benefit fire dependent communities like ponderosa pine and ponderosa pine-associated species like pygmy nuthatches (USDA and USDI 2000).

4.13 CHIPPING SPARROW AND DUSKY FLYCATCHER

The dusky flycatcher and chipping sparrow were combined due to their similar habitat preferences. Both are dependent on relatively open, low to mid elevation forests.

4.13.1 Current Habitat and Projected Trends

Chipping sparrow and dusky flycatcher habitat is present on 156,004 acres of the IPNF and 218,218 acres of the KNF. Through the 50-year period habitat on the IPNF stays roughly the same with 157,158 acres under Scenario 3, 145,743 acres under Scenario 6, and 144,163 acres under Scenario 7. Habitat on the KNF marginally increases by decade five for all scenarios.

Recognizing that chipping sparrows and dusky flycatchers are open forest-dependent, it appears that the effects of increasing low and moderate severity wildfire on the KNF, which results in more open stand conditions, is responsible for most of the increase over time. The lack of any increase in habitat on the IPNF seems to be the result of a combination of improved habitat from low and moderate severity wildfire and a loss of habitat from continued root disease.

4.13.2 Effects of Management Scenarios

On the IPNF treatment scenarios result in less habitat acres than Scenario 3, whereas on the KNF, Scenario 6 consistently provides more habitat than no treatment. Conversely, on the KNF, Scenario 7 provides less habitat acres than no treatment.

4.13.3 Comparison to Historic Range of Variability

HRV data provide historic ranges of dominance types and size classes, but no hard data on historic crown closure. Because chipping sparrows and dusky flycatchers occur in most dominance classes and medium and large size classes, the availability of open forests may be the most limiting factor. Since data on historic crown closure is lacking, we can only surmise about the historic availability of open forests.

According to the KIPZ vegetation data (USDA 2011a; USDA 2011b), including the distribution of suitable warm, dry VRUs (1–3), and historic distribution of suitable size classes (medium and large), the HRV for the IPNF is 159,492 acres to 315,275 acres, and the HRV for the KNF is 220,592 acres to 436,282 acres. These HRV ranges may be an overestimate of historic habitat since some acres may have lacked sufficient openness to support chipping sparrows and dusky flycatchers. Habitat on the IPNF is currently slightly below HRV at 156,004 (98% of HRV). Habitat on the KNF is also slightly below HRV at 218,218 acres (99% of HRV). Since the habitat trends over five decades are either flat (IPNF) or improving (KNF), and habitat is at or very near the lower range of HRV, there is no indication that either species is a risk in terms of long-term viability.

4.13.4 Conclusions

The comparison to HRV has some uncertainty because of the lack of historic crown closure data. For instance, it may have ignored habitat created by mid elevation mixed severity wildfires, which on occasion create open forest conditions. More typically, however, mixed severity wildfires in mesic habitats result in a mosaic of burned openings and unburned dense forest (Fischer and Bradley 1987).

Thus, if anything, HRV may be lower than modeled, making the modeled future outcomes within rather than near HRV. Either way, there are no indications that either species is at any risk from a long-term viability standpoint.

4.14 HAIRY WOODPECKER

Hairy woodpeckers are dependent upon forests that produce small to large snags. Unlike pileated woodpeckers, hairy woodpeckers occur in all cover types from low elevation ponderosa pine to high elevation subalpine fir.

4.14.1 Current Habitat and Projected Trends

Current hairy woodpecker habitat equals 2,098,871 acres on the IPNF and 1,752,715 acres on the KNF. Habitat increases slightly on both Forests under all management scenarios during the 50-year period.

4.14.2 Comparison to Forest Inventory and Analysis Plots

Medium, large, and very large size classes and all dominance types except for whitebark pine were considered suitable for nesting. Since hairy woodpeckers require medium and large snags within these dominance types and size classes, and since R1-VMap data does not include snag density data, the *Draft Comprehensive Evaluation Report for the Idaho Panhandle and Kootenai National Forest Proposed Land Management Plans* (USDA 2006) and the *Region One Vegetation Classification, Mapping, Inventory and Analysis Reports – Estimates of Snag Densities for Western Montana and Northern Idaho Forests in the Northern Region* (Bollenbacher et al. 2009a; Bollenbacher et al. 2009b) were assessed to ensure that stands meeting the SIMPPLLE model query had sufficient snags. FIA data summaries at the Hydrologic Unit Code 5 or larger scale provided statistically sound data on snag abundance.

On the IPNF the estimated average number of snags per acre on all forested lands with DBH between 10 inches and 20 inches is 10.4 snags with a 90% confidence interval of 9.2 to 11.8 snags per acre (USDA 2006). The average number of snags with DBH 20 inches and larger is 1.4 snags per acre with a 90% confidence interval of 1.2 to 1.8 snags per acre (USDA 2006). On the KNF the estimated average number of snags with DBH between 10.0 inches and 20 inches is 10.0 snags with a 90% confidence interval of 8.3 to 11.7 snags per acre. The average number of snags per acre with DBH 20 inches and larger is 1.0 snag per acre with a 90% confidence interval of .8 to 1.2 snags per acre (USDA 2006).

For western Montana, the average number of snags with DBH 20 inches and larger is 0.9 snags per acre with a 90% confidence interval of 0.8 to 1.1 snags per acre (Bollenbacher et al. 2009b). The average number of snags with DBH 15–20 inches is 2.9 snags per acres with a 90% confidence interval of 2.6 to 3.2 snags per acre (USDA 2009). For northern Idaho the average number of snags with DBH 20 inches and larger is 1.6 snags per acre with a 90% confidence interval of 1.4 to 1.8 snags per acre. The average number of snags with DBH 15–20 inches is 4.0 snags per acre with a 90% confidence interval of 3.6 to 4.0 snags per acre (Bollenbacher et al. 2009a). Both datasets suggest that snags are abundant and not limiting within the dominance and size classes used to estimate hairy woodpecker habitat.

4.14.3 Effects of Management Scenarios

The differences between scenarios are slight and the effects of no treatment versus treatment are mixed (Section 3.12). Since hairy woodpeckers use a wide range of small to large sized snags including most species of snags, and because the planning unit will be subject to extensive root disease, insect outbreaks, and wildfires, it appears that effects from natural disturbances outweigh any effects on snags from treatment scenarios.

4.14.4 Comparison to Historic Range of Variability

Acres of habitat present in decade five represent 85% of planning unit. The HRV on the IPNF is 1,076,427 to 2,128,390 acres. The HRV on the KNF is 901,402 to 1,781,342 acres. On the IPNF the lowest level of habitat occurs during decade one under Scenario 7 at 2,005,917 acres. On the KNF the lowest level of habitat occurs during decade two under Scenario 7 at 1,616,302 acres. This implies that there is no shortage of medium to large stands capable of producing snags, and as a result habitat on both Forests is within HRV under all scenarios.

4.14.5 Conclusions

Hairy woodpeckers have a wide range of suitable habitats due to the ability to utilize multiple snag densities and size classes. The high productivity of the KIPZ, which results in rapid forest growth and recovery following disturbances, and the periodic disturbances resulting in snag recruitment, strongly suggest hairy woodpeckers are not at risk regardless of scenario selected.

4.15 HAMMOND'S FLYCATCHER

Hammond's flycatchers prefer dense, mature coniferous and mixed forests including both warm, dry and cool, moist forests. Hammond's flycatchers are aerial foragers that require openings in the canopy.

4.15.1 Current Habitat and Projected Trends

Existing Hammond's flycatcher habitat is 740,899 acres on the IPNF and 528,684 acres on the KNF. Habitat trends within the KIPZ include a minor loss of habitat from present conditions to decade one; habitat is lowest at 662,841 acres on the IPNF and 451,743 acres on the KNF with both amounts occurring under Scenario 7. A consistent upward trend, 27–29% respectively, occurs following decade one through decade five for all scenarios. Since Hammond's flycatchers utilize a wide range of suitable cover types, the adverse effects of wildfire and root disease are offset by forest growth.

4.15.2 Effects of Management Scenarios

There are only minimal differences between the effects of treatment and no treatment scenarios on the KIPZ. On the IPNF the treatment scenarios provide more habitat acres by decade five. Conversely, on the KNF Scenario 3 provides marginally more habitat than the treatment scenarios.

4.15.3 Comparison to Historic Range of Variability

The KIPZ HRV data includes historic ranges of dominance class and size class by VRU category (USDA 2011a; USDA 2011b). The Hammond's flycatchers habitat query includes stands with size class >15-inch DBH and crown closures >40%. Since the KIPZ HRV data lack historic estimates on crown closure, comparing SIMPPLLE-modeled habitat to HRV could overestimate the amount of habitat that was historically available.

The HRV for Hammond's flycatcher habitat on the IPNF is 758,392 acres at the low range and 1,492,319 acres at the high range. The HRV for the KNF is 729,707 acres at the low range and 1,437,951 acres at the high range. Current acreages of Hammond's flycatcher habitat are below the low range of HRV on both Forests. Habitat on the IPNF is currently at 2% below the low range of HRV and habitat on the KNF is 28% below the low range of HRV. Hammond's flycatcher habitat on the IPNF increases to a level within HRV by decade five. Habitat on the KNF increases to a level at decade five that is approximately 7% below the low range of HRV for all scenarios. This suggests that none of the scenarios constitute any risk to Hammond's flycatchers from a viability standpoint (Mehl et al. 2009).

4.15.4 Conclusions

Hammond's flycatchers are often considered an "old growth species" and therefore potentially at risk where timber harvests are conducted. On the KIPZ, however, where tree growth is rapid and timber harvests are well below the biomass produced annually, the model suggests no conflict with any of the scenarios for Hammond's flycatchers.

4.16 OLIVE-SIDED FLYCATCHER

Olive-sided flycatchers are an obligate of dense, mature forests with openings. Given the mesic, highly productive characteristics of the KIPZ and past logging history which created a lot of openings within dense forested areas, it was hypothesized that there would be abundant olive-sided flycatcher habitat.

4.16.1 Current Habitat and Projected Trends

The KIPZ currently has approximately 3.25 million acres of olive-sided flycatcher habitat, including 1,777,479 acres on the IPNF and 1,474,772 acres on the KNF representing approximately 69% of the planning unit (see Section 3.14). The amount of habitat declines steadily on both Forests through the five decade period to approximately 2.4 million acres or 51% of the planning unit. Disturbances responsible for this decline appear to be an increase in low, moderate, and high severity wildfire during the period (Section 3.2), and particularly on the IPNF an increase in root disease.

4.16.2 Comparison to Forest Inventory and Analysis Plots

FIA summary data indicates >15-inch DBH late seral forest, that is not segregated by crown closure or cover type, represents 29% of the forested acres in the planning unit. By adding the mid seral range of >9-inch DBH to late seral forest, the percentage increases to 70%. Thus, the aforementioned current levels of SIMPPLLE-modeled habitat across the planning unit appear consistent with fixed plot data.

4.16.3 Effects of Management Scenarios

Treatment scenarios outperform Scenario 3 on both Forests in terms of maintaining habitat for olive-sided flycatcher, but the benefits are not substantial, especially when compared to the decade-by-decade changes resulting from wildfires, insects, and root disease.

4.16.4 Comparison to Historic Range of Variability

Habitat on the IPNF and KNF is currently within the HRV, with 1,076,427 to 2,128,390 acres and 901,402 to 1,781,342 respectively. The lowest level of habitat on the IPNF occurs during decade five under Scenario 7; although the decrease to 1,252,343 acres is still within the HRV. The lowest level of habitat on the KNF occurs at decade five under Scenario 3 and the decrease to 1,111,837 acres is also within the HRV. Recognizing the modeled increases in wildfire and root disease and decrease in available habitat over time, the planning unit will still provide abundant dense, mid-to-late seral forest, amidst forest openings at a level within HRV through the five decade timeframe. This clearly indicates no risk to species viability over time (Mehl et al. 2009).

4.16.5 Conclusions

The decline in olive-side flycatcher habitat is attributed to a century of wildfire suppression resulting in accumulating fuels and aging mid-to-upper elevation forests, the loss and conversion of seral western white pine and western larch from disease and succession to root disease-prone Douglas-fir and grand fir, and wildfires occurring through the five decade period. The conclusion that treatment scenarios have little modeled positive or negative effect can be explained as follows: treatments may reduce acres burned thus protecting olive-sided flycatcher habitat; however, those same treatments remove suitable habitat by either reducing crown closure or by the use of thinning or removing mid and late-seral stands via regeneration logging. The decline in olive-sided flycatcher habitat on the KNF and IPNF is within HRV. The return to a more natural mix of disturbances, cover types, and age classes, while slightly negative for olive-sided flycatchers, has substantial benefits to other forest health resources.

4.17 AMERICAN MARTEN

American marten are considered interior forest species. Marten prefer forests with medium to large trees with moderate to high canopy cover located at mid to high elevations. In addition to the preference for large patches of mid to late seral forests, martens prefer high densities of snags and CWD in forest stands that offer complex structure near ground level.

Two approaches were used for the query design. All marten habitat was examined, and as a separate query, only mesic habitat was examined. Splitting all habitat and only mesic habitat was performed to acknowledge the emphasis from Wasserman et al. (2010) of the preference found for western redcedar.

4.17.1 Mesic Habitat and Projected Trends

A consistent downward trend occurs from present conditions to decade five on both Forests. For example, the IPNF currently provides 833,636 acres of mesic marten habitat and that figure drops the least to 228,433 acres under Scenario 3 by decade five. The KNF currently provides 354,050 acres of mesic marten habitat and that level drops the least to 91,072 acres under Scenario 7 by decade five.

4.17.2 All Current Habitat and Projected Trends

All marten habitat currently occurs on 1,396,267 acres on the IPNF and 964,849 acres on the KNF. Unlike the findings for mesic marten habitat, all marten habitat declines slightly but remains fairly stable over the five decade period. On the IPNF all marten habitat declines the least under Scenario 6 from 1,396,267 acres at decade zero to 1,011,032 acres at decade five. On the KNF all marten habitat declines the least under Scenario 6 from 964,849 acres to 762,059 acres by decade five.

4.17.3 Effects of Management Scenarios – Mesic Habitat

Scenario 3 provides more mesic habitat than either treatment scenario by decade five on the IPNF. On the KNF, however, Scenario 7 treatments result in more mesic habitat by decade five. Regardless of the management scenario, the levels of mesic habitat decline throughout the period. This is likely explained by the increasing level of wildfire which is converting climax grand fir-redcedar cover types back to Douglas-fir or larch. While this is a plausible explanation, it is the opposite of what is predicted in high elevation lynx multi-storied hare habitat where there is a slight increase in climax subalpine fir (Section 3.5.2). Yet this is reasonable since modeled assumptions include fires starting and burning hottest at low elevation areas containing heavy fuels.

4.17.4 Effects of Management Scenarios – All Habitat

Treatment scenarios provide more all marten habitat on the IPNF by decade five when compared to Scenario 3. On the KNF, conversely, Scenario 3 provides more all marten habitat by decade five when compared to treatment Scenarios 6 and 7. Overall, the effects of scenarios are minor when weighed against changes by decade occurring from wildfires, root disease, insects, forest growth, and succession.

During this timeframe, mesic grand fir, redcedar cover types are being converted by disturbance back to other seral, non-mesic cover types including larch and Douglas-fir. Hence the abrupt decline in mesic habitat and increased percentage of all inclusive marten habitat.

4.17.5 Comparison to Historic Range of Variability – All Habitat

The HRV for all inclusive marten habitat on the IPNF is 510,576 acres at the low range and 2,017,399 acres at the high range. HRV on the KNF is 279,862 acres at the low range and 1,110,839 acres at the high range. All inclusive marten habitat on both Forests is within the HRV and remains so throughout the five decade period, regardless of management scenario or decade. Based on Mehl et al. (2009) this suggests that viability is not at risk.

4.17.6 Conclusions

The decline in mesic habitat under all scenarios is a possible concern. According to Wasserman et al. (2010) mesic habitats are twice as valuable as all inclusive marten habitat. However, since Wassermann's finding is unique among the broad body of research including another local paper (Tomson 1999b), and because all inclusive habitat remains within HRV, there is still no likely risk to viability.

4.18 NORTHERN GOSHAWK

Nesting habitat is probably the most limiting factor for the northern goshawk. Northern goshawks typically select for size classes over 10-inch DBH and prefer trees larger than 14-inch DBH with canopy cover of greater than 40%; although nest sites have been located in areas with smaller trees and/or more open canopies.

4.18.1 Current Habitat and Projected Trends

Nesting habitat for northern goshawks is currently abundant at 1,136,237 acres on the IPNF and 804,074 acres on the KNF. Over the five decade period, habitat declines by approximately 35% on the IPNF and 28% on the KNF. The amount of habitat decline is similar under all scenarios, yet Scenario 6 retains the most habitat acres on both Forests.

Reasons for the habitat decline are similar to those for previously discussed species. An increase in natural disturbances removes some habitat over the five decade period (Section 3.2 and Section 3.3). Forest growth adds habitat over time, but does not fully compensate for the losses from inevitable disturbances.

4.18.2 Comparison to Forest Inventory and Analysis Plots

FIA summary data indicates >15-inch DBH late seral forest, that is not segregated by crown closure or cover type, represents 29% of the forested acres in the planning unit. By adding the mid seral range of

>9-inch DBH to late seral forest, the percentage increases to 70%. Thus, the aforementioned levels of goshawk nesting habitat appear consistent with fixed plot data.

4.18.3 Effects of Management Scenarios

There are minimal differences between no treatment and treatment scenarios on either Forest. Scenario 6 produces more acres of northern goshawk nesting habitat on both Forests, presumably due to reductions in burned acres and wildfire severity.

4.18.4 Comparison to Historic Range of Variability

The KIPZ HRV data includes historic ranges of dominance class and size class by VRU category (USDA 2011a; USDA 2011b). The northern goshawk habitat query includes stands of any dominance class, size class >15-inch DBH, and crown closures >40%. Since the KIPZ HRV data lack historic estimates on crown closure, comparing SIMPPLLE-modeled habitat to HRV could overestimate the amount of habitat that was historically available.

Currently there are 1,136,237 acres of nesting habitat on the IPNF and 804,074 acres on the KNF. The HRV for goshawk nesting habitat on the IPNF is 1,076,427 acres at the low range and 2,128,390 acres at the high range. The HRV for goshawk nesting habitat on the KNF is 901,402 acres at the low range and 1,781,342 acres at the high range. The lowest level of habitat on the IPNF is 703,093 acres under Scenario 7 at decade five and this represents 65% of the low range HRV. The lowest level of habitat on the KNF occurs at decade two under Scenario 7 and the habitat amount of 453,648 acres represents 50% of the low range. According to Mehl et al. (2009) neither comparison to HRV suggests any significant risk to northern goshawks from a viability standpoint.

A factor that is more important to northern goshawk densities than total habitat availability is the distribution of habitat. Northern goshawks are fiercely territorial and defend huge territories of 5,000 to 10,000 acres. Since nest stands can be small, on the order of 30 acres, the amount of nesting habitat within each 5,000 acre landscape can be a small percentage of that landscape and still support northern goshawks at maximum density. If habitat is well distributed, i.e. each Hydrologic Unit Code 6 has substantial habitat, northern goshawks are likely to occur at maximum densities based on territoriality. Figure 33 shows northern goshawk nesting habitat at decade five for Scenario 6. There are very few, if any, 5000-acre landscapes that do not contain nesting habitat.

In summary, the habitat available at decade five, estimated at below HRV, may be closer to HRV than disclosed for two reasons. First, local data corroborates that northern goshawks are adept at finding suitable nest trees within stands that are too small or too open at the stand scale to be considered suitable. Secondly, modeled habitat at decade five is well distributed. Therefore, species territoriality rather than available habitat is much more likely to limit population density.

4.18.5 Conclusions

The decline of nesting habitat on the KIPZ does not place northern goshawks at risk. An increase in open foraging areas, anticipated by the increase in wildfires may influence higher nesting success which may provide compensating dynamics to the overall situation. In addition, based on what northern goshawks are actually utilizing, including many stands that are much smaller or more open than the habitat query used in the analysis, the findings are very conservative, i.e. habitat is strongly underestimated based on actual local goshawk nest selection.

4.19 PILEATED WOODPECKER

Pileated woodpeckers are an obligate of low to mid elevation forests where large diameter ponderosa pine, western larch, or Douglas-fir snags are present.

4.19.1 Current Habitat and Projected Trends

Pileated woodpecker habitat is present on 572,687 acres on the IPNF and 292,644 acres on the KNF (Section 3.17). The amount of habitat stays roughly the same on both the IPNF and KNF over the 50-year period. Disturbances responsible for habitat fluctuations are wildfire, root disease, and insects, which are offset by forest growth.

4.19.2 Comparison to Forest Inventory and Analysis Plots

Western larch and ponderosa pine dominance types within the large and very large size classes were considered suitable for nesting. Since pileated woodpeckers require large snags within these dominance types and size classes, and since R1-VMap data does not provide snag density data, the *Draft Comprehensive Evaluation Report for the Idaho Panhandle and Kootenai National Forest Proposed Land Management Plans* (2006) and the *Region One Vegetation Classification, Mapping, Inventory and Analysis Reports – Estimates of Snag Densities for Western Montana and Northern Idaho Forests in the Northern Region* (Bollenbacher et al. 2009a; Bollenbacher et al. 2009b) were assessed to ensure that stands meeting the SIMPPLLE model query had sufficient snags. FIA data summaries at the Hydrologic Unit Code 5 or larger scale provided statistically sound data on snag abundance.

On the IPNF the average number of snags with DBH 20 inches and larger is 1.4 snags per acre with a 90% confidence interval of 1.2 to 1.8 snags per acre (USDA 2006). On the KNF the average number of snags with DBH 20 inches and larger is 1.0 snag per acre with a 90% confidence interval of .8 to 1.2 snags per acre (USDA 2006). For western Montana, the average number of snags with DBH 20 inches and larger is 0.9 snags per acre with a 90% confidence interval of 0.8 to 1.1 snags per acre (Bollenbacher et al. 2009b). For northern Idaho the average number of snags with DBH 20 inches and larger is 1.6 snags per acre with a 90% confidence interval of 1.4 to 1.8 snags per acre (Bollenbacher et al. 2009a). The aforementioned snag densities indicate that snags are abundant and not limiting within the dominance and size classes used to estimate pileated woodpecker habitat.

4.19.3 Effects of Management Scenarios

On both Forests, Scenario 6 outperforms Scenario 3 by decade five but less so in decades one and two. Scenario 6 resulted in 2.8% more pileated woodpecker habitat at on the IPNF and 1.2% more on the KNF when compared to Scenario 3. Scenario 7 consistently produces less habitat acres than Scenario 3. Regardless, the effects of scenarios are minute compared to inevitable changes over time from wildfire, root disease, insects, and in-growth.

4.19.4 Comparison to Historic Range of Variability

The HRV for pileated woodpeckers represents a large amount of acres due to the combined historic presence of either ponderosa pine or western larch dominance types and large diameter trees required for nesting. The HRV on the IPNF is 105,007 acres to 406,803 acres. The HRV on the KNF is 200,526 acres to 780,138 acres. Habitat on the IPNF (572,687 acres) currently exceeds the high range HRV and stays above the level during all time steps for all scenarios. Current habitat on the KNF (292,644 acres) is within HRV and increases under all scenarios by decade five.

4.19.5 Conclusions

Habitat remains fairly static on the IPNF during the 50-year period under all management scenarios. Habitat on the KNF increases under all scenarios during the same period. Although there is little difference between scenarios in terms of resulting acres, Scenario 6 produces more acres on both Forests.

4.20 HABITAT CONNECTIVITY

The 12 wildlife species addressed in this habitat assessment are highly specialized in that they utilize certain cover types, size classes, or crown density closures, and/or require large blocks of habitat. The comparison to HRV provides some assurance that habitats occur in sufficient quantity so that habitat isolation is unlikely given the relative mobility of the 12 species analyzed.

A strategy for maintaining habitat connectedness that has become popular involves designating corridors (American Wildlands 2008). This approach advocates that corridors for animal movement be designated and permanently protected. The strategy often emphasizes the protection of late seral stands based on the assumption that late seral stands are more limited than other size classes.

Such strategies have merit in locales (Amazonia, coastal temperate rain forests) where disturbance regimes result in vegetation communities that remain static over long periods of time. For instance, within coastal temperate rain forests, trees (Sitka spruce, coastal Douglas-fir) tend to be very long-lived and wildfire return intervals are equally long, often spanning millennia in time (Franklin et al. 1989). Intermediate disturbances are typically limited to individual tree blow-down that has little effect on size class distribution or patch sizes. In such situations, a high percentage of the landscape may persist for centuries in a very stable, late seral condition (Franklin et al. 1989). Thus, protection of such communities from logging or other development may provide a logical way to sustain large unbroken patches of late seral forest as animal movement corridors.

Conversely, in the Northern Rockies, reserves designed to retain large patches of late seral forest are more questionable because of the presence of shorter-lived trees (interior Douglas-fir, lodgepole pine) and a higher frequency of wildfire and other disturbances. Unlike coastal temperate rain forests, interior forests are typically not static and change dramatically decade-by-decade. For a no treatment reserve strategy to be logical in the Northern Rockies, it should meet two criteria: 1) late seral stands currently present should persist at a higher percentage into the future than scenarios emphasizing managed stands; and 2) the recruitment of late seral stands should be higher than scenarios emphasizing managed stands.

Advocates of designated corridors often cite the lack of human disturbance and associated road development as desirable attributes of designated corridors. This analysis did not consider any effects related to roads.

4.20.1 Current Habitat and Projected Trends

To test the relative merits of no treatment and treatment scenarios on habitat connectivity, the SIMPPLLE model was utilized to compare Scenario 3 and Scenario 5[5] potential flammulated owl habitat and all marten habitat within American Wildlands corridors (Figure 36 and Figure 37).

These habitats were chosen because martens require large trees and occupy cool/moist forests and flammulated owls are associated with mature xeric ponderosa pine/Douglas-fir stands. Scenarios were compared in order to assess: 1) which late seral stands within the designated American Wildlands corridors on national forest lands persisted (i.e. did not succumb to wildfires or other disturbances) over the 50-year period; and 2) how much late seral forest was recruited based on in-growth during that same time period (Table 15 and Table 16).

Table 15 Late Seral Persistence and Recruitment Comparison using American Marten Habitat

Marten Habitat	Scenario 3 Acres	Scenario 5 Acres
Time Step 0 Total Habitat	267,267	267,308
Time Step 5 Total Habitat	160,472	188,471
Habitat Lost	158,274	139,434
Habitat Retained	108,993	127,874
Habitat Recruited	51,478	60,597

[5] This analysis was originally run with Alternative B budget constrained. Alternatives B Modified budget have virtually identical outcomes for flammulated owls and martens, thus conducting the analysis using Alternatives B Modified was deemed unnecessary.

Table 16 Late Seral Persistence and Recruitment Comparison using Flammulated Owl Habitat

Flammulated Owl Habitat	Scenario 3 Acres	Scenario 5 Acres
Time Step 0 Total Habitat	31,233	31,266
Time Step 5 Total Habitat	49,710	55,339
Habitat Lost	13,325	12,584
Habitat Retained	17,908	18,682
Habitat Recruited	31,802	36,656

4.20.2 Effects of Management Scenarios

Table 15 and Table 16 show the loss of late seral stands over the five decade period due to a combination of disturbances. The level of recruitment from forest growth is considerable. Flammulated owl habitat increases under both scenarios by decade five yet more habitat is retained and recruited under Scenario 5. With no treatment (Scenario 3) only 51% of marten habitat remains by the end of decade five and with treatment (Scenario 5) that percentage increases to 68%.

4.20.3 Conclusions

This analysis suggests that in the planning unit where disturbances from wildfires, insects, and root disease are pronounced, large-tree-dominated stands are lost, even when fire suppression is performed at the current level. The analysis suggests that the recruitment of large-tree-dominated stands resulting from forest growth is interrupted by those same disturbances at substantial levels. Thus applying the same criteria for delineating good corridors at a point in the future will result in different identifications of “best corridors”.

The analysis shows that management actions reduce insect and disease impacts, and acreages burned to the extent that measurably more acres of large-tree-dominant stands persist over five decades, and more acres of large-tree-dominated stands are recruited during that timeframe. This finding is consistent with the overall effects of management actions on fire severity and acres burned. Not only is less habitat loss with treatment, but more habitat is retained and recruited and this indicates that treating some timber stands disrupts and/or decreases the influence that wildfires, root diseases, and insects would have on habitat fragmentation.

Armillaria and other root pathogens affect forest species composition, structure, successional trajectories, and often maintain stands in early seral stages (USDA 2010b). Consequently, root disease will lead to permanent non old growth on many sites, and managing patterns including patch size should be deliberate and compatible with disturbance—this is when management plays a key role. Even in areas without a moderate or high hazard rating for root disease, or where trees grow more slowly, management approaches are required to diminish the likelihood that desired objectives (e.g. old growth management areas) are not entirely compromised by random events (Klenner et al. 2000).

This analysis solely focused on the persistence and recruitment of large-tree-dominated stands. No doubt, there are many other variables that make some areas important as habitat connectivity. This analysis in no way infers that the persistence and recruitment of large-tree-dominated stands are the only pertinent variables in habitat connectivity. Nonetheless, debates over habitat connectivity do tend to focus on the protection of large-tree-dominated stands within disturbance-prone landscapes where large-tree-dominated stands are anything but permanent. Therefore, this analysis is a useful analytical tool to define that debate based on science-based, modeled outcomes.

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