3.3.2 Spatial Patterns - Management Indicator Habitats (MIH)

Overview of Spatial Pattern MIHs

The analysis of forest spatial patterns is primarily addressed in Chapter 3.2.2 – Forest Spatial Patterns Indicators 1-4. These indicators are described in more detail in that chapter and also in Appendix B. Appendix D Wildlife describes the age groupings and forest types used in this analysis. Wildlife species associated with these habitats are identified and associated impacts are briefly discussed. Some of this analysis in the Wildlife section is repeated because spatial indicators are very important factors affecting wildlife habitat.

Management-induced Edge Density Upland forest & Lowland forest (Indicator 11)

Indicator 11 (Vegetation Spatial Indicator 4) provides a measure of habitat fragmentation resulting from forest management intensity. It measures edge density (mile/mile^2) of young forest for uplands and lowlands.

This indicator allows evaluation of species of management concern that are benefited or adversely impacted by edge habitat.

Table WLD-11: MIH 11 - Upland Edge Habitat (management-induced): MIH 11 – associated wildlife species of concern

Superior	Chippewa
Heather vole, **Olive-sided flycatcher,** Deer, red fox, American robin, American woodcock, rose-breasted grosbeak brown-headed cowbird	**Olive-sided flycatcher,** Deer, red fox, American robin, American woodcock, rose-breasted grosbeak, brown-headed cowbird

Species in bold type are threatened, endangered or sensitive (TES)

Table WLD-11 displays species of management concern.

Amount of Mature/Old Forest Interior Habitat (Indicator 12)

Indicator 12 (Vegetation Spatial Indicator 3) is the amount of forest interior habitat. Forest interior habitat is used as an indication of habitat quality and the extent of large forest patches in a landscape (Sachs et al. 1998).

This indicator allows evaluation of species of management concern that are known or thought to benefit from environmental conditions associated with interior forest conditions.

Size and Amount of Large Forest Patches Mature/old (Indicator 13)

Indicator 13 (Vegetation Spatial Indicator 1), forest spatial patterns, is the size and amount of large (>300 acres) mature/old upland forest patches.

This indicator allows evaluation of species of management concern that are known or thought to benefit from environmental conditions such as interior forest, connected habitats, and patterns that emulate natural disturbances (Table WLD-12/13).

Table WLD-12/13 display species of management concern associated with Indicators 12 and 13.

Table WLD-12/13: MIH 12/13 - Interior Forest, Upland and Lowland; Large patches of Forest: MIH 12/13 –associated wildlife species of concern

Superior	Chippewa
goshawk, black-throated blue warbler, bay-breasted warbler, three-toed woodpecker, Connecticut warbler, boreal owl, lynx, goblin fern, triangle grapefern, ram's-head lady's slipper, fairy slipper, barren strawberry, Braun's holly fern, 4 species of lichens, Canada yew, Chilean sweet cicely, moschatel	**goshawk, black-throated blue warbler, goblin fern, bay-breasted warbler, spruce grouse, black-backed woodpecker, Connecticut warbler, red-shouldered hawk, four-toed salamander, northern bog lemming lynx, goblin fern, triangle grapefern, Goldie's woodfern, ram's-head lady's slipper, fairy slipper, 4 species of lichens, Canada yew**
pileated woodpecker, barred owl, blue-spotted salamander, spruce grouse, black-backed woodpecker, Blackburnian warbler, pine warbler, yellow-bellied flycatcher, northern waterthrush, bobcat, broad-winged hawk, white cedar	pileated woodpecker, barred owl, blue-spotted salamander, three-toed woodpecker, Blackburnian warbler, pine warbler, boreal owl, yellow-bellied flycatcher, northern waterthrush, bobcat, broad-winged hawk, white cedar

Species in bold type are threatened, endangered or sensitive (TES)

Analysis Area

Forest spatial patterns are assessed at various landscape scales and are described in detail in Chapter 3.2.2. Forest Spatial Patterns. The analysis area is the same as described earlier in this chapter.

.

3.3.2.a Affected Environment for Spatial Patterns MIHs

Fragmentation is the separation or isolation of similar types of habitat, either by natural events or human activities.

Within the context of the largely forested landscape matrix of the Chippewa and Superior NF, habitat fragmentation relates primarily to changes in the forest stand size, species composition, and age of stands. Limits on harvest size for even-aged management are tending to reduce stand sizes and increase fragmentation effects. Clear-cut harvests currently account for more than 90% of forest acres managed on the Superior or the Chippewa NF. This type of management tends to increase edge and favor occurrence of popular wildlife game species, such as deer. Conversely, it may tend to act against species requiring larger areas of continuous forest. A number of wildlife and plant species have been shown to be associated with conditions existing in the interior of relatively large patches of mature vegetation, or to be negatively affected by the proximity of early seral stage vegetation and associated edge (Morrison, et al., 1992, USDA Forest Service 1996a).

The spatial configurations of the coarse filter (patch size, interior forest, and edge) are important considerations in National Forest planning. Some species require or benefit from specific spatial arrangements; these may include large patches of contiguous habitat, linkages of habitat patches through the juxtapositions of patches with specific composition or structure (USDA Forest Service 2000c). Edges created by forest management activities cause physical and biological changes that affect habitat suitability for some plant and animal species (Chen et al. 1999, Matlack 1993). Many ecosystem processes essential for sustainability of ecosystems operate at large spatial scales.

A landscape dominated by natural disturbances has a greater range of patch sizes with more larger patches and patches with more complex shapes than young, managed forest (Mladenoff et al. 1993). The result is a landscape matrix that maximizes both forest interior habitat and connectivity of patches.

Recent trends in landscape spatial patterns show a 50% decrease in average patch size (Host and White 2003), a reduction in patches of mature conifer forest, a reduced number of large patches (>500 ha), reduced connectivity of patches, increased edge density, and reduced forest interior habitat in managed portions of the forest landscape (Wolter and White 2002).

3.3.2.b Environmental Consequences for Spatial Patterns MIHs

Effects Common to All Alternatives

Earlier in this chapter (3.3), laws, regulations, policy and forest plan direction and implementation are outlined that affect wildlife and wildlife habitat. Forest plan direction and implementation applicable to forest spatial patterns is outlined in Chapter 3.2.2. Forest-wide desired conditions, objectives, standards, and guides have been developed to address long-term and short-term management direction.

Standards and guides for forest spatial patterns generally set minimum patch numbers, acre numbers, or within-patch conditions for large mature upland forest patches. On the Superior, spatial zones are used to provide a context for large patch numbers and acres, provide for ecosystem representation, and account for the BWCAW in forest spatial patterns. Standards and guides also address the amount, number, and condition of mature or older red and white pine forest patches.

While most of the management direction that affects forest spatial patterns deals with coarse-filter habitat conditions, direction was also developed for individual species. These fine filter protections and mitigations also have an effect on forest spatial patterns. These include nest site protective buffers, plant colony protective buffers, and minimum habitat parameters for rearing young.

Direct and Indirect Effects for Spatial Pattern MIHs

Alternatives B, D, and F

On the Chippewa, these alternatives project similar decreases in Upland Young management induced edge from existing condition in the short-term (Table FSP-5). In the long-term Alternatives F, B, and D, in this order, produce decreasing amounts of edge. At most, Alternative F produces 50% of the Upland Young edge density than currently exists. This indicates a notable decrease in the effects related to management induced edge (such as predation rates to ground nesting birds, and physical changes), an increase in spatial diversity, and an increase forest stand size. Habitat conditions for species like deer, American robin, or the cowbird decrease from existing condition by the second decade and continue to decrease through all decades examined.

In Alternatives B and F Lowland Young edge density increases from 160% to 300% from existing, depending on the decade. Habitat conditions for some lichen species that require large patch mature forest conditions would be decreased over current conditions.

Alternative D, for all decades, produces less than half the Lowland Young edge density than currently exists. Alternative D is the only alternative that produces less Lowland Young edge density than currently exists.

On the Superior, Alternatives B and D project similar short-term decreases in Upland Young edge density from existing condition. Edge density is reduced 56% by the end of the second decade. Over the long-term Alternative D shows a greater decrease in edge density than Alternative B at 79% and 46% respectively. Alternative F reduces edge density 27% in the short-term and 17% in the long-term. Habitat conditions for species like deer, American robin, or the cowbird decrease from existing condition by the second decade and continue decrease through all decades examined.

The reduction in edge density favors species that need more interior forest conditions and larger patch sizes such as the goshawk and black-throated blue warbler. Physical changes resulting from edge are also reduced

and habitat conditions improve for the goblin fern and ram's-head lady's slipper.

Edge density of Lowland Young forest on the Superior shows similar increases as on the Chippewa. Edge density of Lowland Young is greater in all decades than currently exists. Alternative F projects as much as 112% more Lowland Young edge density than currently exists. Alternative B projects as much as 82% more Lowland Young edge density than exists.

Alternative D produces no Lowland Young edge in the long-term. This alternative is the only one that, for all decades, produces less Lowland Young edge density than currently exists.

The increases in lowland edge on both forests under Alternatives B and F are indicative of greatly increased edge effects including physical changes of forested sites adjacent to edges, hydrological changes of sites that may influence reforestation, and vegetative changes that may affect rare species (USDA Forest Service 2004e [Biological Evaluation] planning record, Chen et al. 1999, Matlack 1993).

On the Chippewa, Alternatives B, D, and F are the only alternatives that increase acres in Indicators 12 and 13 from existing condition by the second decade.

On the Superior, these alternatives show decreases in Indicator 13 by the second decade. These decreases are the smallest among all alternatives. Alternative B is the only alternative that shows an increase in Indicator 12 by the end of the second decade. Alternative D shows a slight decrease from existing conditions and Alternative F shows a considerable decrease from existing conditions.

Table WLD-11 and WLD-12/13 outlines species that would benefit from large mature upland patches and from interior forest conditions. On the Chippewa Alternatives B, D, and F would benefit species as varied as the goshawk, black-throated blue warbler, goblin fern, four-toed salamander, and ram's-head lady's slipper.

On the Superior, impacts as a result of a decrease in Indicators 12 and 13 from existing condition decrease suitability for the species outlined in Table WLD-12/13 and would increase risk to maintaining viability of TES species. This risk is comparatively small and management direction has the potential to eliminate decreases and impacts in the short term. In the long-term, these alternatives increase these habitat attributes.

Alternative G

This alternative makes long-term improvements in habitat for species such as northern goshawk, black-throated blue warbler, and others listed in Table WLD-12/13. In the short-term habitat condition, decrease from existing conditions and increase risk to maintaining these species.

On the Chippewa, this alternative shows considerable decreases in Indicator 11-Young Upland edge, a decrease in Indicator 12-Interior Forest in the first decade, and substantial short-term decreases in Indicator 13-Large mature upland patches. Long-term, interior forest and large mature upland patches increase by more than 60% from the existing condition. Edge effects would be reduced considerably from existing condition on Upland Forest. Habitat for deer, American robins, and cowbirds would be less than currently exists.

On the Superior, this alternative shows decreases in Indicator 11-Young Upland edge over all decades, while Indicators 12-Interior Forest and Indicator 13-Large mature upland patches decrease from existing conditions during the first and second decade. Indicators 12 and 13 are increased measurably from existing condition in the long-term. Habitat for deer, American robins, and cowbirds would be less than currently exists.

Reductions of Indicator 11-Young Upland edge on both forests in this alternative reflect the reduced amount of even-aged harvest projected.

The increases in Indicator 11-Lowland Edge on both forests under this alternative are indicative of greatly increased edge effects including physical changes of forested sites adjacent to edges, hydrological changes of sites that may influence reforestation, and vegetative changes that may affect rare species such as some lichens ((USDA Forest Service 2004e [Biological Evaluation] planning record, Chen et al. 1999, Matlack 1993).

Modified Alternative E

This alternative makes marginal short-term and long-term improvements on the Chippewa and sustained decreases until the 10th decade on the Superior in habitat for species such as northern goshawk, black-throated blue warbler, and others (Table WLD-12/13). Decreases from existing conditions increase risk to maintaining viability of these species on both forests.

On the Chippewa, this alternative shows measurable increases in Indicator 11-Young Upland edge, a increase in Indicator 12-Interior Forest in the first and second decades, and a net but marginal increase by decade 2 in Indicator 13-Large mature upland patches. Long-term, interior forest and large mature upland patch area increase by 74% and 59% respectively from the existing conditions. Edge effects would be reduced from existing condition on Upland Forest. Habitat for deer, American robins, and cowbirds would be less than currently exists.

On the Superior, this alternative shows a marginal decrease of Indicator 11-Young Upland edge that is sustained over all decades. Indicators 12-Interior Forest and Indicator 13-Large mature upland patches decrease by 9% and 19% respectively by the second decade from the existing condition. Indicators 12 and 13 remain below existing condition until the 10th decade of decades examined. Habitat for deer, American robins, and cowbirds would be equivalent to existing amounts.

The increases in Indicator 11-Lowland Edge on both forests under this alternative are indicative of greatly increased edge effects including physical changes of forested sites adjacent to edges, hydrological changes on sites that may influence reforestation, and vegetative changes that may affect rare species such as some lichens or moisture sensitive species ((USDA Forest Service 2004e [Biological Evaluation] planning record, Chen et al. 1999, Matlack 1993).
.

Alternative A and C

These alternatives increase Indicator 11-Management induced edge density on the uplands and the lowlands in the short-term and in the long-term. This reflects the long-term increased harvest levels projected in these alternatives, decreases in Indicator 13-Large mature forest patches, and decreases in Indicator 12-Interior forest. While these alternatives greatly increase edge habitat that would favor deer, the American robin, and the cowbird, they would greatly increase the risk to maintaining viable populations of species that require interior forest and large forest patches. Some TES species or habitats would be lost within each National Forest.

Alternative A reflects management direction of the current forest plan for the Chippewa and Superior National Forests. Management direction affecting forest spatial patterns includes a 40 acre limit on even-aged regeneration harvests on the Chippewa and a 200 acre limit on the Superior; a harvest adjacency requirement that promotes small patches; and vegetation objectives that emphasize young aspen forest.

Alternative C on the Chippewa maintains 40% fewer Indicator 13- Large Mature Upland patches than currently exist, and is among the lowest at representing large patches within the forest's capability among all alternatives. On the Superior, this alternative causes the greatest short-term decrease in Indicator 13-Large Mature Upland Patch acres and patch numbers among all alternatives.

On the lowland forest on the Chippewa, in the short-term there is a 440% increase in Indicator 11-Lowland Young edge density in Alternative A and a 521% increase in Lowland Young edge density in Alternative C. In the long-term Alternative A eventually has 30% less edge than exists today. Alternative C reduces management intensity in lowlands through time but still results in 203% more edge than exists today.

On the Superior uplands, these alternatives increase edge in the short-term and the long-term at a similar rate. Alternative C has greater increases in the short-term (25%), while Alternative A increases edge 29% over what currently exists. On lowland forest (lowland conifer), Alternative C increase young forest edge 651% in the short-term. Alternative A shows a 214% increase in the short-term.

Cumulative Effects for Spatial Patterns MIHs

Host and White (2002, 2003) and Wolter and White (2002) examined changes over different time periods in forest landscape structure using Landsat TM data and other information (such as aerial photos). These works provide trend information during those time periods and define current spatial patterns for the landscape inclusive of all ownerships. The percent ownership of the DLP Section and the NSU Section, by Landscape Ecosystem, is provided in Appendix G.

For purposes of this analysis, the effect of National Forest-wide vegetation management strategies (that is, alternatives) on forest spatial patterns are compared to the existing conditions and trends on all forested lands within the appropriate ecological Section. The information can be used to evaluate how individual alternatives for National Forest land contribute to the overall conditions across the ecological Section.

Ownership patterns, current and predicted disturbance rates on forested lands, and the relationship to RNV, recent trends, and desired conditions of landscapes helps to place into context foreseeable effects to landscape patterns, species populations, and habitat trends for these species.

Chippewa and the DLP Section

Alternative B, D, and F

These alternatives make the greatest short-term and long-term changes in the spatial diversity within the forest and work towards the desired conditions for DLP section to a greater degree than other alternatives. These alternatives would compensate for higher amounts of fragmentation and smaller patch sizes due to interspersed ownership patterns. In relation to RNV (Chapter 3.2.1), these alternatives begin to move forest composition and age structure toward this reference point. Combined with any similar efforts on other ownerships, this would result in greater representation section-wide of ecosystem structure, processes, and functions that were once more common. Reductions in disturbance rates (Wolter and White 2002, p.149) would begin to change recent past effects on forest spatial patterns more quickly than other alternatives.

Alternative G

This alternative makes noteworthy long-term increases in the spatial diversity within the forest. During the implementation period of the plan, projected drops in large patches and interior forest would be limited by management standards and guidelines. These, along with management objectives to increase patch sizes and interior forest, would allow this alternative to work towards the desired conditions for DLP section. This alternative compensates for interspersed ownership patterns by using management area (MAs) allocations that would result in larger patches of mature or older forest.

Modified Alternative E

This alternative would make some short-term and long-term increases in the spatial diversity within the forest and would maintain current conditions of some spatial elements. During the implementation period of the plan, the projected first decade drop in large patches would be limited by management standards and guidelines. These, along with management objectives to increase patch sizes and interior forest, would allow this alternative to work towards the desired conditions for DLP section. This alternative has fewer management area allocations that would result in larger forest patches of mature or older forest. As a result, it has a lower ability to compensate for interspersed ownership patterns. Maintenance of disturbance rates similar to recent levels combined with other factors listed above would perpetuate recent downward trends to forest spatial patterns in the region (Host and White, 2002).

Alternative A and C

These alternatives continue recent downward trends in changes to forest spatial patterns. Rates of disturbance predicted combined with landscape trends would limit these alternatives to maintain species that require interior forest or large mature upland forest patches. Edge species would have ample habitat.

In Alternative A, high rates of disturbance along with a 40 acres limit on harvest size perpetuate trends in forest fragmentation (Host and White 2002, Wolter and White 2002) of small patches, decreasing interior forest, and high amounts of edge. There is a corresponding decrease in mature or older upland

forest and large patches of forest in these age classes. A high degree of ownership interspersion, especially non-industrial private land, will limit opportunities to increase the patch size or increase interior forest within the DLP section.

Alternative C is similar to Alternative A in its management intensity and trend away from RNV with regard to forest composition and age. This alternative has a greater potential than Alternative A to increase the grain (the distribution of patch sizes to include more large patches) of the landscape by increasing the size of young forest patches up to 1000 acres.

Superior and NSU Section

Wolter and White (2002) showed that management as affected by ownership (such as private industrial vs. federal, etc.) strongly influences landscape patterns in the NSU in northeastern MN. This work shows an overall trend toward less interior forest area and decreased connectivity (increased fragmentation) across the managed forest landscape in northeastern MN. By contrast, the Boundary Waters Canoe Area Wilderness, considered unmanaged forest in this study, remained relatively constant with regard to these same measures of spatial patterns. The wilderness is a dominant feature in the NSU and some LEs are well represented in the wilderness.

Alternative B, D, F, and G

These alternatives make the greatest long-term changes in the spatial diversity within the forest and work towards the desired conditions for NSU section to a greater degree than other alternatives. All of these alternatives would contribute in the short-term to recent trends in the NSU section of increased forest fragmentation, but at a lower rate than current levels. Management area (MAs) allocations that would help to maintain larger forest patches help to moderate these predicted short-term trends. All of these alternatives would compensate for higher amounts of fragmentation and smaller patch sizes due to interspersed ownership patterns. Reductions in disturbance rates (Wolter and White 2002, p.149) would begin to change recent past effects on forest spatial patterns more quickly than the other alternatives. With the BWCAW, these alternatives implement an effective coarse filter that is at least as effective as currently exists (Alternative G) to that which has greatly increased over existing (Alternative B) for maintaining species that require interior forest or large mature upland patches.

Modified Alternative E

Rates of disturbance predicted in this alternative combined with landscape trends may limit the ability of an ecosystem coarse filter to maintain some species or habitats. This alternative has fewer management area allocations that would result in larger forest patches of mature or older forest and may result in a lower ability to compensate for interspersed ownership patterns. Spatial management zones would direct where on the forest mature or older forest patches would be maintained or increased. Spatial Zones 1 and 2 are zones where the objectives would compel the Forest Service to achieve maintenance or increases of large mature or older patches. These zones are also the areas of the Superior with the highest interspersion of other ownerships, perhaps mitigating the positive effects of achieving these objectives.

During the first and second decades of the plan, projected drops in large patch acres and interior forest would be limited by management standards and objectives for Spatial Zones 1 and 2. Forest-wide, inclusive of all spatial zones and the wilderness, recent downward trends to forest spatial patterns in the region would be perpetuated and would result in an overall decrease in spatial diversity in the NSU section during the first 2 decades of the plan and beyond. Habitat connectivity and distribution of habitat on the forest adjacent to the wilderness in Spatial Zone 3 will be influenced by objectives that emphasize meeting age class and composition objectives and that allow decreases in spatial elements such as large patches and interior forest. The effects of interspersed ownerships are the lowest in Spatial Zone 3. Consequently, management impacts to spatial patterns would be predominantly a result of Forest Service actions (that is, forest plan implementation) in this zone.

Alternative A and C

These alternatives continue recent downward trends in changes to forest spatial patterns. Rates of disturbance predicted combined with landscape trends would limit these alternatives to maintain species that require interior forest or large mature upland forest patches. Edge species would have ample habitat. The BWCAW

would continue to contribute considerably to spatial patterns in that portion of the forest. Areas outside of the wilderness would continue in the downward trend in spatial diversity.

Alternative A continues recent trends in changes to forest spatial patterns. High rates of disturbance along with a 200-acre limit on harvest size perpetuate trends in forest fragmentation (Wolter and White 2002) to small patches, decreasing interior forest, and high amounts of edge. There is a corresponding decrease in mature or older upland forest and large patches of forest in these age classes. Ownership interspersion, especially non-industrial private land, will limit opportunities to increase the patch size or increase interior forest within some sub-sections of the NSU section.

Alternative C is similar to Alternative A in its management intensity and trend away from RNV with regard to forest composition and age. This alternative has a greater potential than Alternative A to increase the grain (the distribution of patch sizes to include more large patches) of the landscape by increasing the size of young forest patches up to 1000 acres.