Connectivity

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 E.O. Wilson in his seminal book *The Theory of Island Biogeography* posits that larger areas and habitats with greater connection to similar habitats have greater species richness than smaller isolated areas. Smaller disconnected areas can also experience greater species extirpation because of reduced genetic diversity and inbreeding. Connecting smaller areas to other similar habitat with secure corridors expands island sizes and presumably fortifies species survival. This awareness drives an interest in secure connections across landscapes for wildlife, particularly for those species listed under the Endangered Species Act. Numerous practical questions related to species needs, habitat management, and designation of connectivity areas and corridors remain for the Lolo National Forest.

 Species habitat connectivity across larger landscapes depends on 3 factors: unobstructed passage through connectivity corridors; appropriate habitat in the connectivity corridor especially for species with longer transit time or likely with young; and security in the connectivity area from predators/humans and other disturbance.

**Unobstructed Passage**

A classic example of obstructed passage is a road culvert that prevents fish passage. The Lolo Forest must be credited with engaging the Montana Department of Fish, Wildlife, and Parks and non-profit groups to eliminate such barriers on a consistent basis in the past. Objectives FW-CON-OBJ 01 and 02 commit to continue this work, and we hope these objectives are a minimum.

The initial connectivity assessment provided in the Revised Assessment indicates that some of the most significant passage obstacles for terrestrial species are related to highways and associated development. Although these landscape features are not generally controlled by the Forest Service, we recommend an approach below for Forest involvement in this issue.

**Connectivity Habitat**

The most complex connectivity features to analyze and manage are the habitat requirements within connectivity areas or corridors. The Lolo National Forest like much of western Montana is noted for its variety of species supported by a variety of habitats. The need for connectivity between these habitats will vary by species as discussed in the Revised Assessment analysis of connectivity, but the overarching principle remains: this variety of species must be supported by a variety of habitat configurations

Because of the number of species, a presumed analysis of habitat and connectivity needs requires the use of a broad-scale (coarse filter) habitat analysis for groups of similar species and additional analysis for individual at-risk species. This approach would simplify the analysis process because analyzing for each of hundreds or thousands of species is not feasible or required by the 2012 Planning Rule.

The Revised Assessment proposes using a coarse-filter connectivity modelling process pioneered by the Custer-Gallatin Forest. Species are to be divided into groups depending on combinations of the following characteristics:

* 4 habitat associations: closed canopy forest, open canopy forest, non-forest, habitat generalist;
* 2 types of response to human activity: sensitive and neutral; and
* 2 maximum dispersal distances: 10 kilometers and 50 kilometers.

 Combinations of these factors results in an analysis matrix of 16 categories of wildlife species: (4 habitat classes) times (2 disturbance response classes) times (2 dispersal classes).

Even this simplified analysis is challenging. As reported by the Revised Assessment (page 150), “At the time of writing this Assessment, only initial results for closed-canopy species are available with the full connectivity analysis ongoing. Initial results for closed-canopy species are presented in Figure 24.” It is worth noting that of the species of concern on the Forest only the fisher is a closed canopy species. The connectivity needs of closed-canopy species are likely the most difficult to satisfy on the Lolo because of the desired forest structural characteristics that are indicated by the natural range of variability on the Forest and the degree of canopy manipulation envisioned by the Proposed Action.

 The Revised Assessment provides no findings or conclusions from the maps presented in Figure 24. Fundamental questions remain for these closed-canopy species. How many corridors/connectivity landscapes are needed? How big? Where? How is the habitat configured?

And most fundamentally this 16-matrix analysis cannot answer the basic question: how are the habitat and connectivity needs of individual species associations to be balanced against the needs of others species. I believe that the connectivity needs of different species association and the tradeoffs between them will only be resolved by applying the basic principle: the viability of the variety of species on the Lolo, requires a variety of habitat conditions in core areas and connectivity areas. This distribution of conditions must be guided by an ecosystem management approach that considers the natural range of variability.

Although the connectivity and general habitat needs of most species across the Forest can be accommodated with a broad-scale/coarse filter ecosystem approach it is clear in discussions of connectivity that the proverbial “elephant in the room” is the grizzly bear and its secure connectivity needs. The Lolo is defined as a critical link between the Cabinet-Yaak; the Flathead NF and Glacier NP; and the Bitterroot ecosystems. The connectivity and habitat needs of the grizzly bear will garner the greatest public and agency attention and judicial oversight.

In terms of biological and structural habitat requirements species like the grizzly bear, lynx, and wolverine are adapted to varied conditions, including early seral conditions like brush fields, young forests, and insect-and rodent-laden coarse woody debris on the forest floor of older forests. These varied conditions will also accommodate a very high percentage of all species on the Lolo National Forest. Maintaining these varied conditions will require some management. As noted in the Proposed Action (FW-VEGF-DC-10), the Forest should be working toward a desired condition of less medium-sized closed canopy forest overall as well as disaggregation of this condition and increased landscape-level ecosystem diversity and heterogeneity; in short, more old forest and more young forest in patches of varying size. As a side note, the Flathead National Forest Plan envisions managing grizzly bear core habitat (and presumably connectivity habitat) for a similar variety of habitat conditions and forest age classes. I believe this approach on both the Flathead and the Lolo National Forests is warranted.

I concede that working for less closed canopy forest may work against the interest of the fisher, but an ecosystem management approach does not and cannot maximize any single interest or species. Ecosystem integrity implies a balance of many parts that approximates a natural range of variability. And with insistent repetition I recall the basic principle: maintaining a variety of terrestrial species requires a variety of forest conditions in connectivity areas and elsewhere.

**Secure Connections**

Providing access to critical habitat areas to increase “landscape-level ecosystem diversity and heterogeneity” (FW-VEGF-DC-10) often challenges managers. It requires access, often motorized. The third critical element in well-functioning connectivity corridors is security from human incursion and disruptive activities affecting security-sensitive species such as grizzly bears. This security concern is often seen as a barrier and hindrance to management access. Maintaining a balance between access and habitat security requires careful analysis of the actual utility of the existing road network, eliminating unneeded roads, and limiting new road installations. We cannot accept carte blanc that more system roads are always necessary for functions like fire suppression and vegetation management. More frequent use of temporary roads, more robust closure of existing closed roads, and more diligent monitoring of closed roads can reduce the security issues.

**Recommendations:**

1. Provide a variety of habitats in connectivity corridors and across the Forest to provide for a variety of terrestrial species.
2. To address the habitat security issue, the Forest plan should more aggressively advocate the use of temporary roads for management in critical habitats. Practice has shown that well-considered and designed temporary roads can be less expensive than constructing and maintaining permanent system roads. Such temporary roads could allow access to otherwise inaccessible areas to accomplish a variety of management goals and objectives and desired conditions on the landscape.
3. Emphasize the reduction of road density in recently acquired lands.
4. Continue to remove barriers such as culverts that interfere with aquatic species passage, especially to spawning areas.
5. Provide plan components that reflect the best science on the ecological effects of varied habitat in connectivity corridors and balance security requirements on the landscapes with the overall need to provide diverse ecological conditions.
6. Work with State and Federal highway agencies and State and Federal wildlife agencies to identify the best potential wildlife highway-crossing areas considering the quality of species habitat adjacent to the highway and the presence of natural wildlife travel ways. Advocate for installation of overpasses and underpasses or other means to direct wildlife to safer crossing locations.

And last I note some vacillation in the Forest Plan in reconciling the benefits and the challenges of connectivity between forest conditions such as old growth or refugia. At times the Proposed Action seems to endorse a maximalist approach to connectivity, and at other times the Proposed Action and the Revised Assessment and Appendix 3 of the Proposed Action acknowledge the possible difficulty posed by too much connectivity of vegetative conditions because of the risk of extreme contagion in disturbance events like fire and insect outbreaks. More effort is needed to acknowledge and reconcile these perspectives and provide clear direction in the plan components addressing the connectivity issue.