# Landscape Pattern & Habitat Connectivity

As part of the land management plan revision process, the 2012 Planning Rule requires updated land management plans to include components that will "maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area," and "maintain or restore structure, function, composition, and connectivity" (36 CFR 219.8(c)(1)).

Key considerations in creating these components include:

1. Accounting for the interdependence of terrestrial and aquatic ecosystems.
2. Acknowledging the broader landscape context of the plan area.
3. The critical role of system drivers such as forest succession, wildland fire, and climate change.
4. Recognizing the importance of scale, both spatial and temporal, in defining connectivity.

Further interpretation of the 2012 Rule includes USDA memo 1077-004, which calls for including ecological connectivity in consideration of wildfire risk analyses and promoting efforts that "foster increased biodiversity, enable wildlife migration, and enhance habitat integrity and resilience."

**Figure 1. Habitat connectivity is a scale-dependent concept. It looks very different from the perspective of a grizzly bear compared to an Idaho giant salamander.**

## What is Connectivity?

The 2012 Planning Rule defines connectivity as: "Ecological conditions that exist at several spatial and temporal scales that provide landscape linkages that permit the exchange of flow, sediments, and nutrients; the daily and seasonal movements of animals within home ranges; the dispersal and genetic interchange between populations; and the long-distance range shifts of species, such as in response to climate change" (36 CFR 219.19).

Broadly speaking, connectivity can be defined as either *structural* or *functional*. While inter-related, the two represent different management priorities.

Structural connectivity has been described as the physical relationship between patches of habitat and ecosystems ((Haber and Nelson 2015). It is strongly influenced by landscape pattern and is best represented by the distribution of biophysical attributes across a landscape. For example, the distribution of old growth forest, riparian areas, or ridgelines are examples of structural connectivity.

**Figure 2. Clark's nutcracker perched on a whitebark pine.**

## Why do we care about connectivity?

The 2012 Planning Rule directs the Forest Service to manage key characteristics of ecosystems in order to maintain ecological integrity, and a key component of ecological integrity is connectivity (36 CFR 219.19). While the specific attributes of connectivity will vary depending on the species, community or process being considered, connectivity is a foundational principle for biodiversity conservation and the protection of ecosystem function.

Some examples of key ecological processes that connected landscapes support include the daily movement of an animal around its territory to find food and escape predation, the seasonal movement of migratory wildlife, the dispersal of seeds or juvenile animals into new areas, or the exchange of genetics between isolated populations.

To highlight the importance of connectivity in ecological planning, a review of 22 years of recommendations for managing biodiversity in the face of climate change found that improving landscape connectivity is the most frequently recommended strategy for allowing biodiversity to adapt to new conditions ((Heller and Zavaleta 2009).

## How does landscape pattern influence connectivity?

The structure of a landscape can be described as the arrangement, connectivity, composition, size and abundance of a particular resource or landscape element within a particular area over a given timeframe. This can be broad categories such as forest type or seral stage, or more specific resources such as big snags or pockets of colder water.

The degree to which physical connectedness of these elements is required depends on the species or process. Both marten and goshawk use patches of older forest; however, their ability to move between disconnected patches is significantly different.

There are situations where physical connectedness may be undesirable as well. Natural heterogeneity in landscape or vegetation conditions can act as a limit to the spread of disturbances such as wildfire or disease. It is therefore important to recognize that connectivity is a nuanced concept, and historic patterns of seral stage or forest type provide an informed starting point for future forest planning.

## What are examples of connected versus fragmented landscapes?

A connected aquatic landscape is one where the flow of energy, water, and nutrients is uninhibited. These systems can be fragmented through dams, incorrectly sized or installed culverts, removal of streamside vegetation, or natural events such as rockslides or stream channel erosion.

**Figure 3. Rock Creek on the Lolo National Forest**

Riparian systems support the flow of energy from upland areas into aquatic systems, they protect aquatic systems from erosion and other external influences, and they create microclimates used by many at-risk species. Riparian networks provide fine-scale connectivity for a variety of wildlife but can be fragmented by disturbances such as fire or windthrow, vegetation management, or development.

Upland connectivity can take many forms, from elk migration corridors to wetland systems that support migratory birds. Depending on the function a corridor serves, it can be broken by roads, fence lines, wildfire, logging, or development.

**Literature Cited**

Haber, J., and P. Nelson. 2015. Planning for connectivity: A guide to connecting and conserving wildlife within and beyond America's national forests.

Heller, N. E., and E. S. Zavaleta. 2009. Biodiversity management in the face of climate change: A review of 22 years of recommendations. Biological Conservation 142:14-32.