CENTER FOR LARGE LANDSCAPE CONSERVATION
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Habitat Corridors & Landscape Connectivity: Clarifying the Terminology

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Over the past twenty years, conserving landscape connectivity has received increasing recognition as a key strategy to protect biodiversity, maintain viable ecosystems and wildlife populations and to facilitate adaptation for wildlife species in the face of climate change. Habitat corridors are the primary tool used to achieve connectivity in fragmented landscapes. However, confusion about how best to implement connectivity and employ habitat corridors on the ground stems in part from a generalized lack of clarity about what we mean when we talk about protecting 'corridors' and 'landscape connectivity.' We conducted a literature review to gain a better understanding of the terminology pertinent to landscape connectivity (Table 1). By attempting to synthesize the various uses of each term, we hope to add clarity to connectivity conversations.

Landscape Connectivity

'Connectivity' can be broken down into 'structural connectivity' and 'functional connectivity.' *Structural connectivity* refers to **the physical relationship between landscape elements** whereas *functional connectivity* describes **the degree to which landscapes actually facilitate or impede the movement of organisms and processes**. Functional connectivity is a product of both landscape structure and the response of organisms and processes to this structure. Thus, functional connectivity is both species- and landscape-specific. Distinguishing between these two types of connectivity is important because structural connectivity does not imply functional connectivity. In general, when we use the term 'connectivity' we are using the functional definition.

Habitat Corridor

Early definitions of habitat corridors approached the concept from a very literal perspective describing them as 'linear' or 'narrow' strips of land. But central to the rationale behind corridors is the capacity to facilitate movement, which occurs in different patterns and processes, and at different scales depending on the species or ecological process of interest. Thus, habitat corridors need not be linear or narrow and must be defined from the perspective of the organism or process being targeted for conservation.

More recent definitions reflect a broadened understanding of habitat corridors, which are now described as **components of the landscape that facilitate the movement of organisms and**

processes between areas of intact habitat. Implicit in this definition are two ideas: (1) corridors support the movement of both biotic processes (e.g. animal movement, plant propagation, genetic exchange) and abiotic processes (water, energy, materials); and (2) corridors are process- or species-specific (Jongman & Pungetti 2004). To help clarify the terminology on corridors that support biotic processes, Jongman and Pungetti (2004) distinguish between three different types:

Migration Corridor

Migration corridors are used by wildlife for annual migratory movements between source areas (e.g. winter and summer habitat). An example of a migration corridor is the Path of the Pronghorn in Wyoming.

Dispersal Corridor

Dispersal corridors are used for one-way movements of individuals or populations from one resource area to another. Dispersal is critical to the maintenance of genetic diversity within populations of species and to the persistence of fragmented populations which may require regular immigration to avoid local extinction.

Commuting Corridor

Commuting corridors link resource elements of species' home ranges to support daily movements including breeding, resting and foraging. As such, commuting corridors facilitate localized movements throughout the landscape important to daily survival and reproduction.

Linkage

Although the term is frequently used synonymously with corridor, 'linkage' technically refers to **broader regions of connectivity important to facilitate the movement of multiple species and maintain ecological processes**.

Matrix

Throughout the literature reviewed here, definitions of the 'matrix' were generally vague. Most commonly, the matrix is defined as 'non-habitat' and/or the portion of the landscape in which habitat patches and corridors are 'embedded'. This very black and white interpretation fails to capture the myriad land cover types and functional continuum that constitute the matrix. Precisely, the matrix is **a component of the landscape, altered from its original state by human land use, which may vary in cover from human-dominated to semi-natural and in which corridors and habitat patches are embedded**. In other words, the matrix may be anything from urban development to agricultural land to grassland or forest. Matrix lands have the potential to function as habitat as well as the capacity to be barriers to movement. Just as with connectivity, the role played by the matrix will depend both on its composition and on the unique behavioral response of the species under consideration.

Landscape Permeability

In contrast to landscape connectivity – which characterizes the capacity of individual species to move between areas of habitat via corridors and linkage zones – permeability refers to **the degree to which regional landscapes, encompassing a variety of natural, semi-natural and developed land cover types, are conducive to wildlife movement and sustain ecological processes**. Multi-scale, multi-stakeholder, sustainable land management strategies that not only target conservation areas like reserves and corridors, but also target the matrix, including areas of human development, are essential to achieving landscape permeability.

Scale

In the context of connectivity, scale refers to **the spatial and/or temporal dimension in which the conservation target (i.e. species or process) operates**. Since species and processes vary widely in the distances and timeframes at which they operate, identifying the appropriate scale(s) of the focal species or process is critical to designing successful connectivity management programs.

Ecological Network

The ecological network concept embodies several key elements: connectivity at the landscape scale, which is achieved through conservation areas and corridors; permeability at the landscape scale, which is achieved through buffer zones and sustainable use of the matrix; and incorporation of human cultural and/or socioeconomic factors with wildlife needs. Thus, we feel Bennett (2004) aptly defined ecological networks as **coherent systems of natural or semi-natural landscape elements configured and managed with the objective of maintaining or restoring ecological functions as a means of conserving biodiversity while also providing appropriate opportunities for the sustainable use of natural resources**.

TABLE 1: Review of connectivity terminology

Connectivity Science Terminology		
Functional Connectivity	Describes the ease with which individuals can move about within the landscape as a function of the organism's behavioral response to landscape elements and the spatial configuration of the entire landscape.	Kindlemann & Burel 2008
	The extent to which a species or population can move among landscape elements in a mosaic of habitat types.	Hilty *et al.* 2006
	Describes the response of individuals to landscape features and the patterns of gene flow that result from these individual responses.	Brooks 2003
	The degree to which the landscape facilitates or impedes movement among resource patches.	Taylor *et al.* 2003
	Describes the combined effects of (1) landscape structure and (2) the species' use, ability to move and risk of mortality in the various landscape elements, on the movement rate among habitat patches in the landscape.	Tischendorf & Fahrig 2000
	A species-specific characteristic determined by the interaction between the movement potential of each species and landscape structure.	Monkkonen & Reunnen 1999

	The functional relationship between habitat patches owing to the spatial contagion of habitat and the movement responses of organisms to landscape structure.	With *et al.* 1997
Structural Connectivity	Describes the physical relationships among habitat patches while ignoring the behavioral response of organisms to landscape structure.	Kadoya 2009
	A product of habitat amount, spatial configuration and condition across multiple scales.	Andersson & Bodin 2009
	Describes the shape, size and location of features in the landscape.	Brooks 2003
	The spatial contagion of habitat.	Monkkonen & Reunnen 1999
Corridor	A swath of land intended to allow passage by a particular wildlife species between two or more wildland areas.	Beier *et al.* 2008
	Any explicit spatial area designed, protected or managed to maintain connectivity for focal species or critical ecological processes.	Hoctor *et al.* 2007
	Any space identifiable by species using it that facilitates the movement of animals or plants over time between two or more patches of otherwise disjunct habitat.	Hilty *et al.* 2006
	Regions of the landscape that facilitate the flow or movement of individuals, genes and ecological processes.	Chetkiewicz *et al.* 2006
	Narrow, continuous strips of habitat that structurally connect two otherwise non-contiguous habitat patches.	Tischendorf & Fahrig 2000
	A linear landscape element that provides for movement between habitat patches, but not necessarily reproduction.	Rosenberg *et al.* 1997
	Linear landscape elements that connect two or more patches of natural habitat and function to facilitate movement.	Soule & Gilpin 1991
	Narrow strips of land that differ from the matrix on either side.	Forman & Godron 1986
Linkage	Connective land intended to promote movement of multiple focal species or propagation of ecosystem processes.	Beier *et al.* 2008
	Large conservation corridors containing significant areas of habitat while also facilitating connectivity between conservation areas.	Hoctor *et al.* 2007
Matrix	The rest of the landscape after exclusion of habitat patches consisting of patches of non-habitat elements.	Kindlemann & Burel 2008
	Collectively, the communities outside of the community type of special interest.	Hilty *et al.* 2006
	The area between habitable patches.	Debinski 2006
	The most extensive and connected landscape type.	Hess & Fischer 2001
	Nonhabitat surrounded by native habitat patches in a landscape.	Ricketts 2001
	The environment in which habitat an dlinear patches are embedded.	Rosenberg *et al.* 1997
Landscape Permeability	Characterizes the relative potential for animal movement between habitat patches at a regional scale.	Singleton *et al.* 2002
Scale	The spatial or temporal dimension of an object or process characterized by both grain and extent.	Chetkiewicz *et al.* 2006
Ecological Network	A set of nodes and links that simulates landscape suitability as perceived by different organisms.	Andersson & Bodin 2009

	The ensemble of environmental elements with heterogeneous physical and biological features that maintain their structural and functional heterogeneity regardless of human activity.	Blasi *et al.* 2008
	Interconnected systems of conservation lands.	Hoctor *et al.* 2007
	A coherent system of natural and/or semi-natural landscape elements that is configured and managed with the objective of maintaining or restoring ecological functions as a means to conserve biodiversity while also providing appropriate opportunities for the sustainable use of natural resources.	Bennett 2004
	Aim to provide the physical conditions necessary for ecosystems and species to survive in landscapes also exploited by economic activities.	James *et al.* 2000

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