The function and dynamics of corridors with respect to biodiversity and fire management: examples from forest and rangeland landscapes of North America

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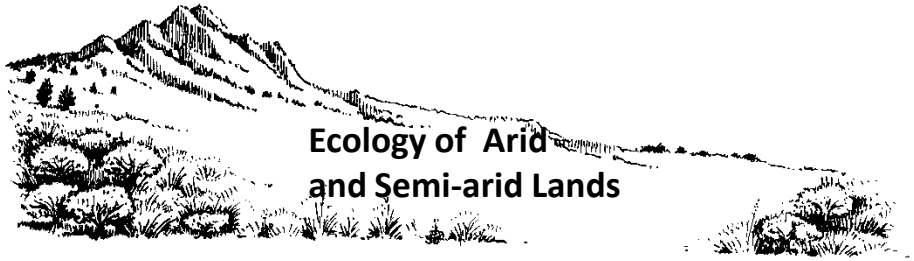


Natural vegetation often tend to occur as a heterogeneous mixture of many plant communities.

Northern Boreal Forest
Ontario, Canada
Source: Worldchanging.com

Sonoran Desert, Arizona, USA
Source: Conservation Lands Foundation

Northern Great Plains grassland, South Dakota, USA

Northern Great Plains grassland, South Dakota, USA

Northern Great Plains grassland, South Dakota, USA

1 mile
1 km

= Remaining grassland remnant

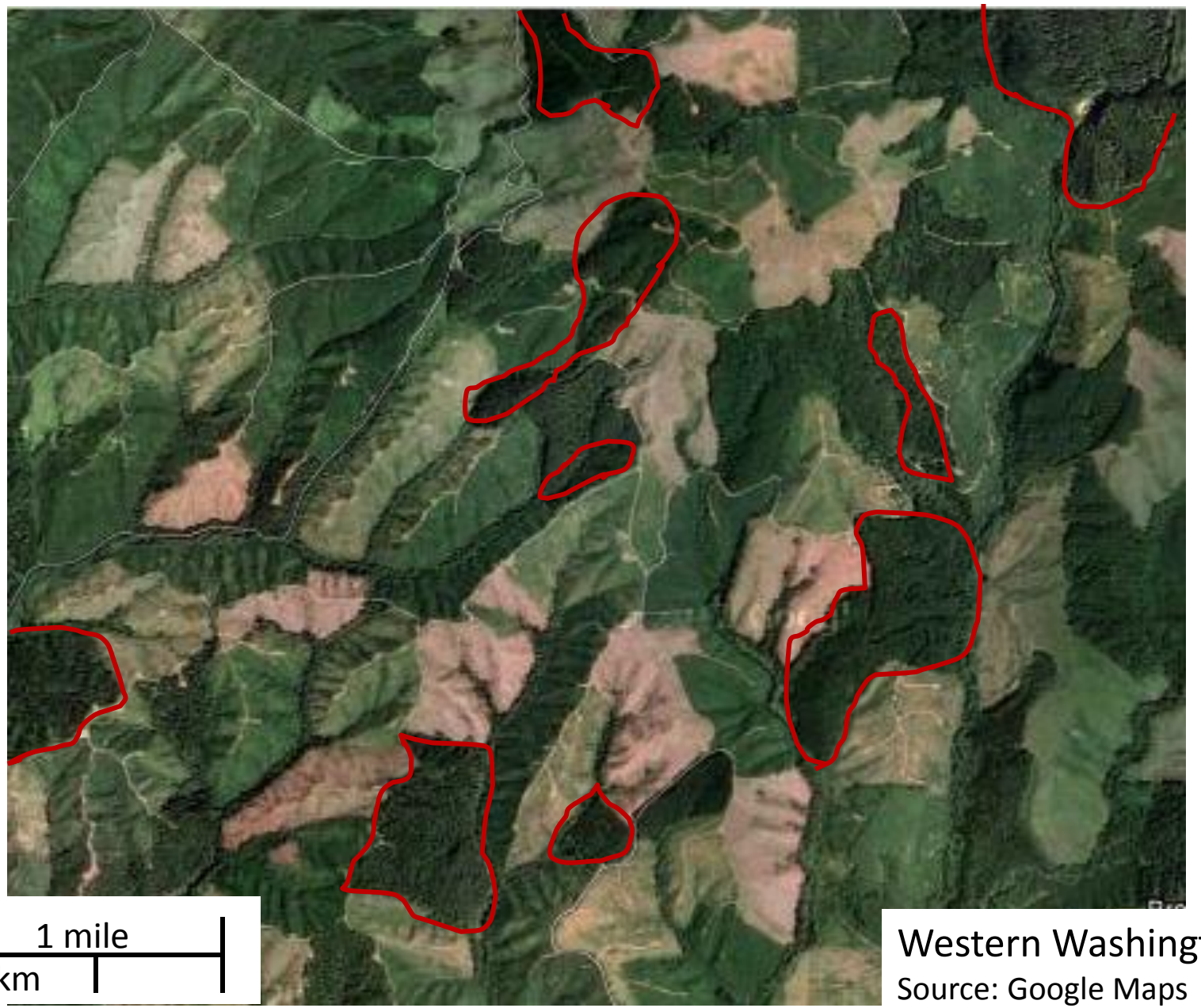
Source: Google Maps

Forest pattern resulting from wood harvesting

Western Oregon, USA

Source: marlimiller.com

Forest pattern resulting from wood harvesting



Western Washington, USA

Source: Google Maps

Natural processes can also influence habitat connectivity.

Sagebrush steppe /juniper woodland mosaic, southwestern Idaho, USA

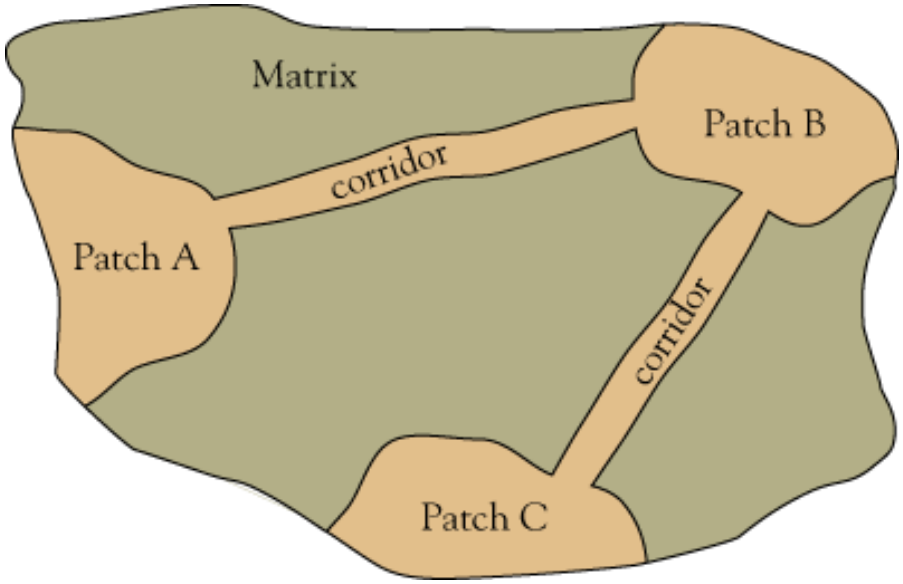
Sagebrush steppe habitat is declining reducing the amount and connectivity of habitat for sagebrush steppe obligate species.

Fragmentation has three recognized components:

1- Habitat loss

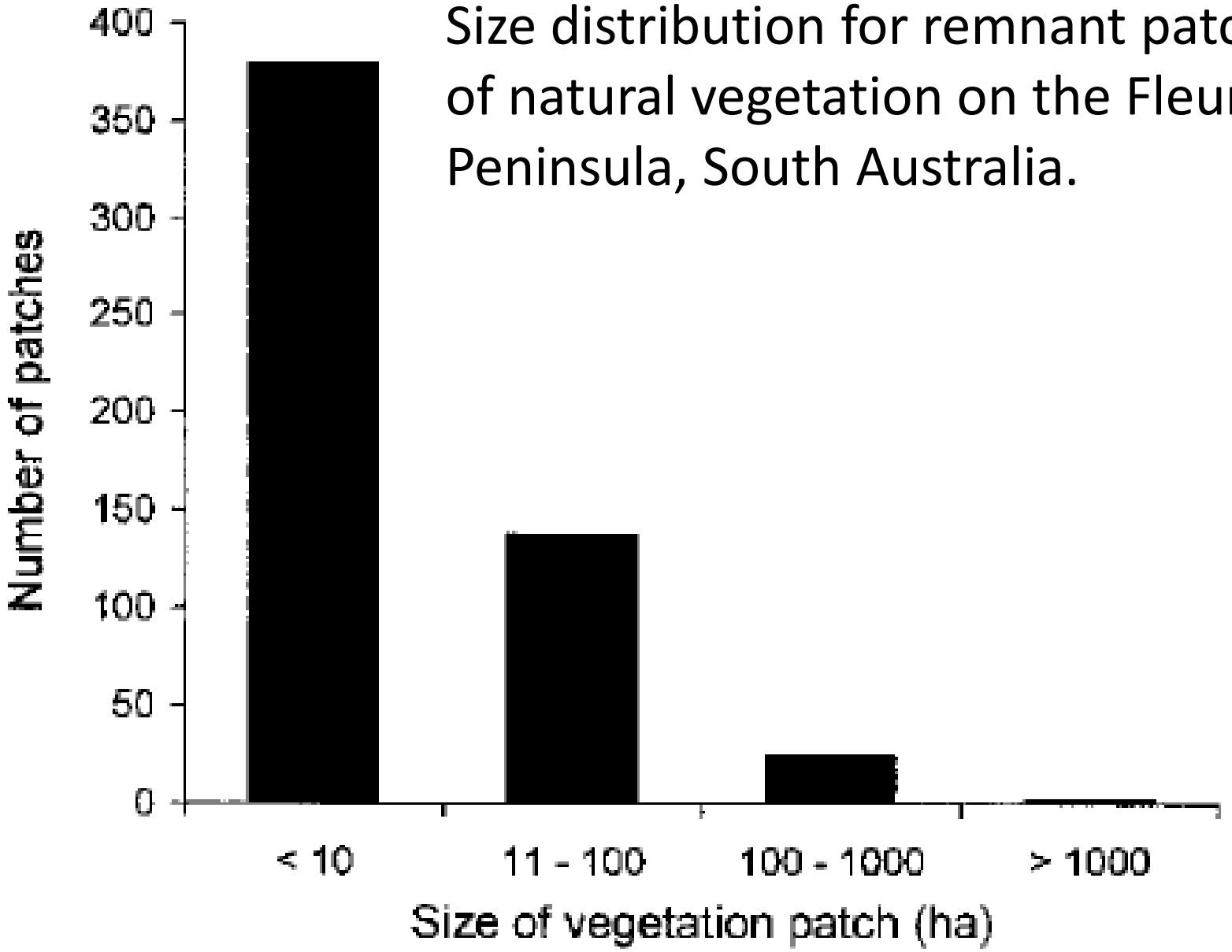
2- Reduction in the size of patches

3- Decreased connectivity between patches (habitat isolation)



Source: Barnes 2000

Size distribution for remnant patches of natural vegetation on the Fleurieu Peninsula, South Australia.



Source: Bennett 2003

Corridor terminology

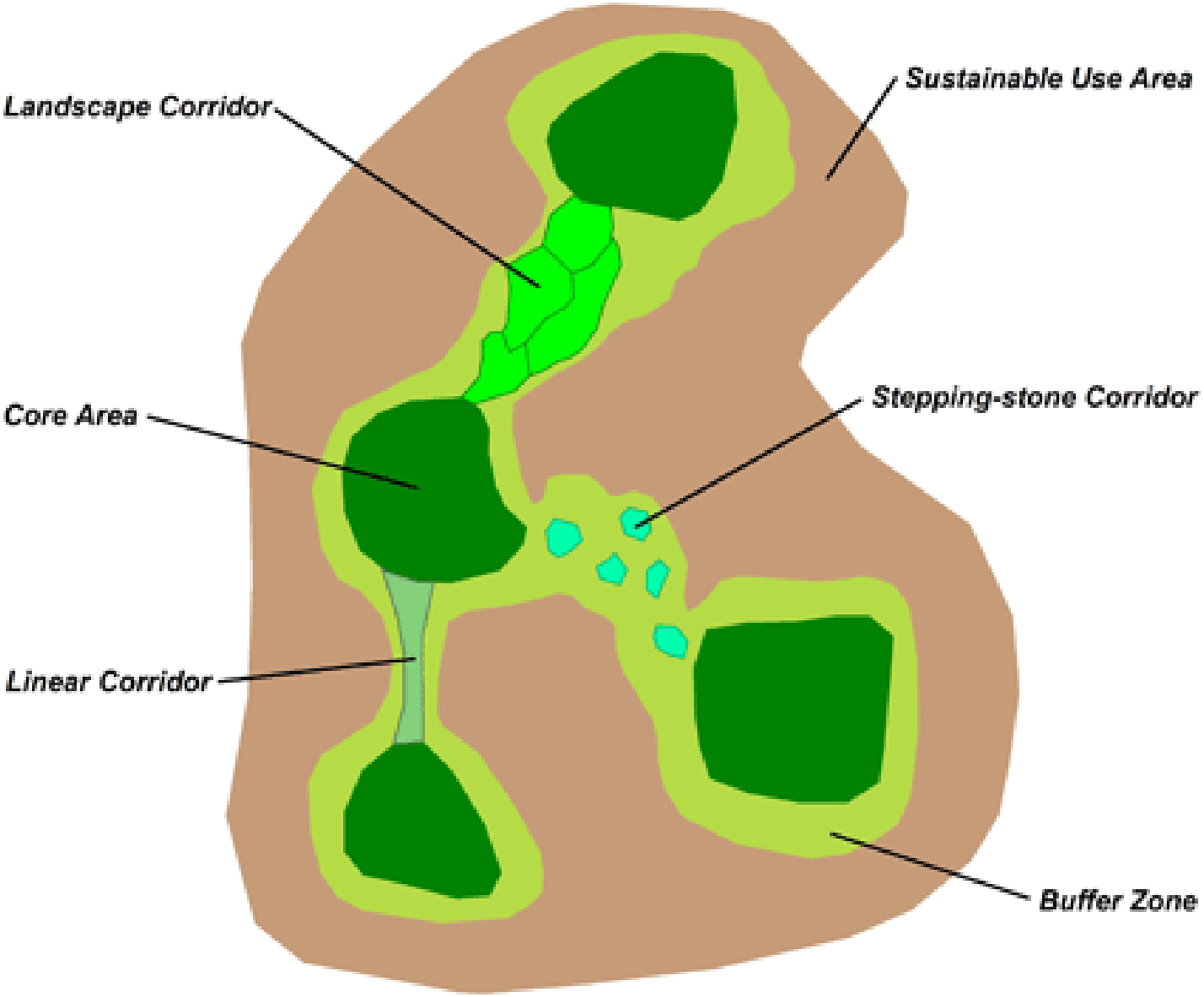
General definition: A corridor is a narrow linear strip of land that differs in structure from the surrounding matrix and facilitates movement of species and process between habitats

Similar terms: wildlife corridor, greenway, greenbelt, shelterbelt, buffer strip, landscape bridge, wildlife underpass

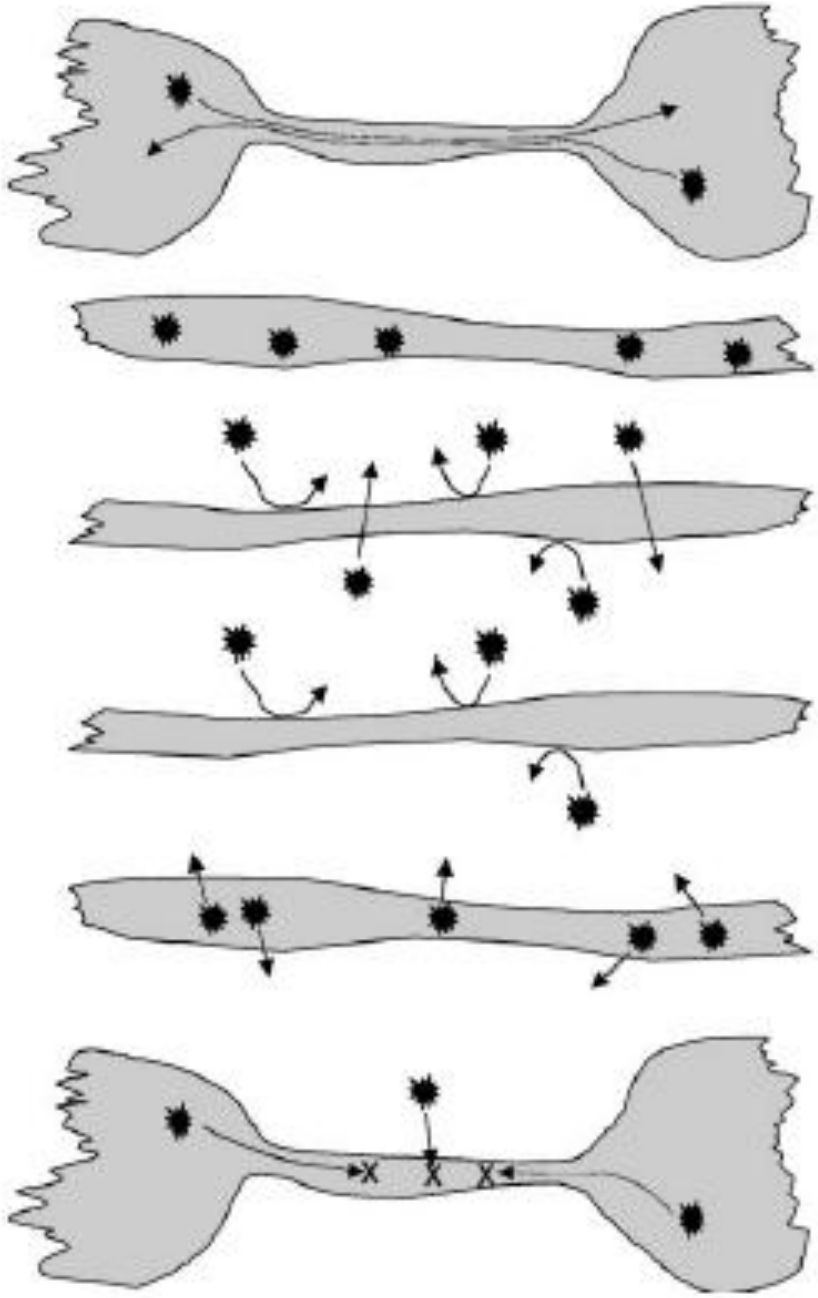
Functions can be related to:

Movement of species	**Biodiversity protection**
Gene flow	**Site recolonization of locally extinct species**
Movement of processes	
Water management	Enhancement of agroforestry production
Recreation	
Environmental modification	

Types of biodiversity corridors



Source: Asian Development Bank

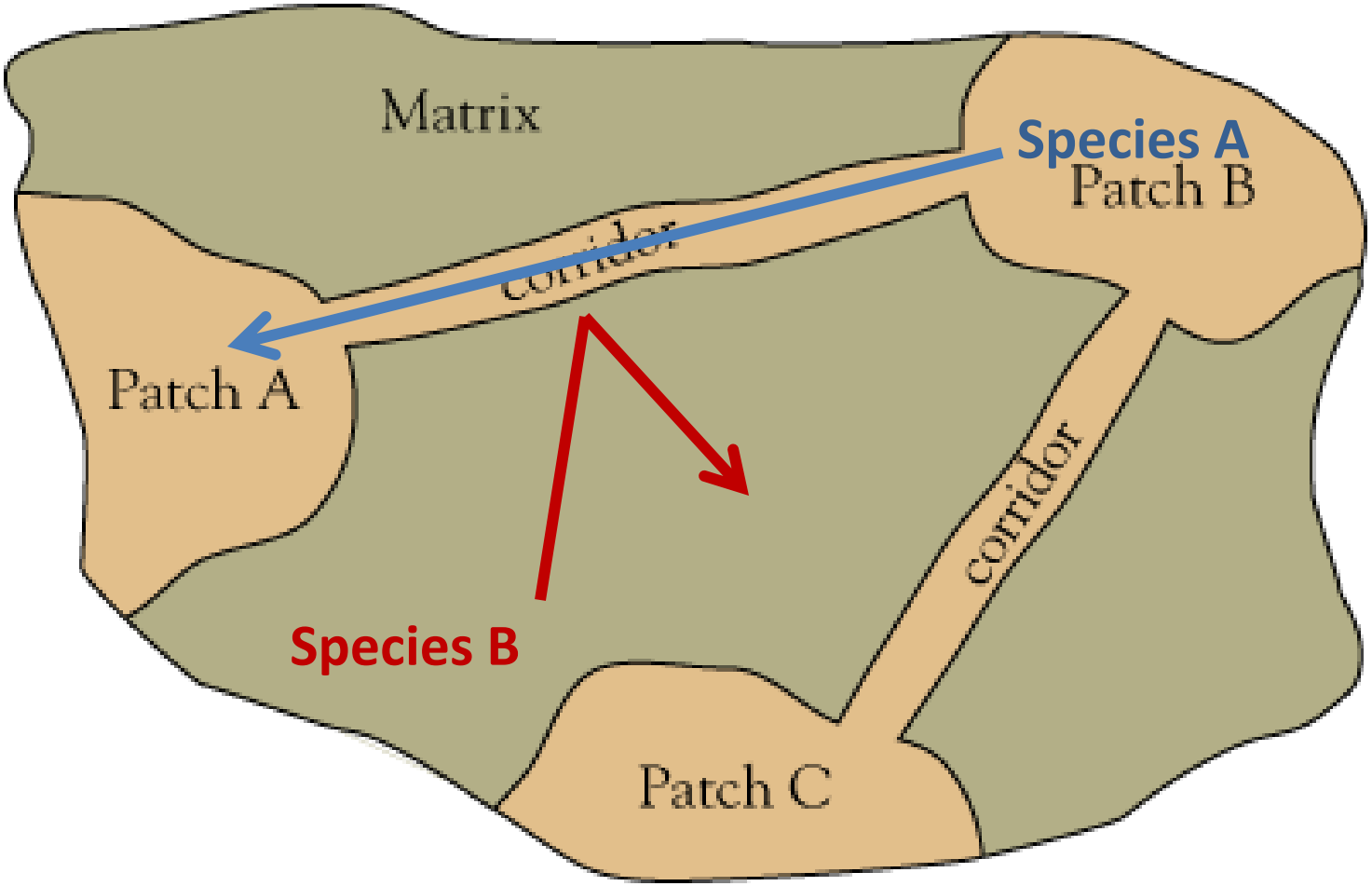


Corridors may function differently within the landscape with respect to movement.

Organism, material or process

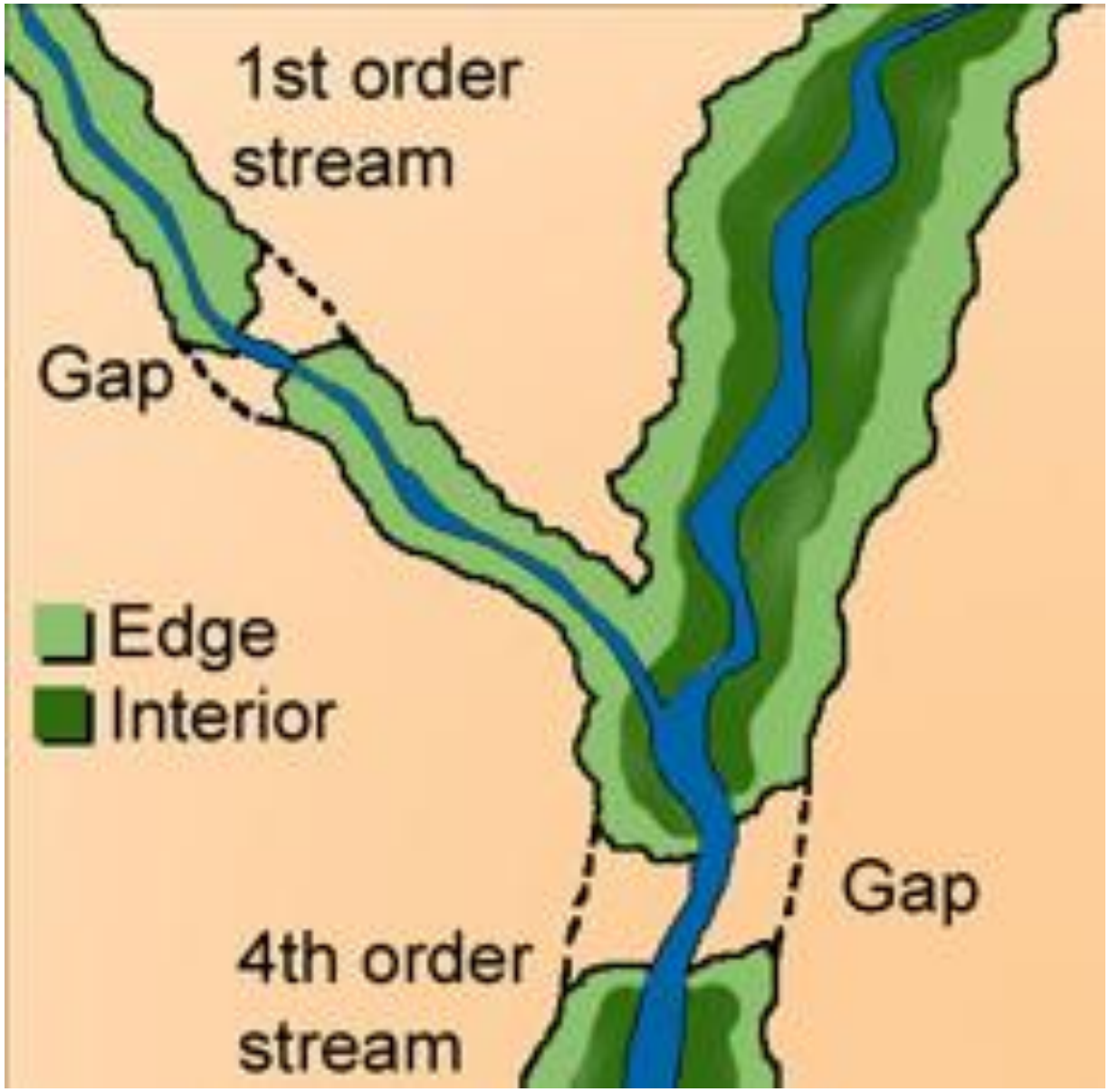
Source: Adapted from Hess & Fischer 2001

Corridors can be both conduits and barriers to the movement of species and processes



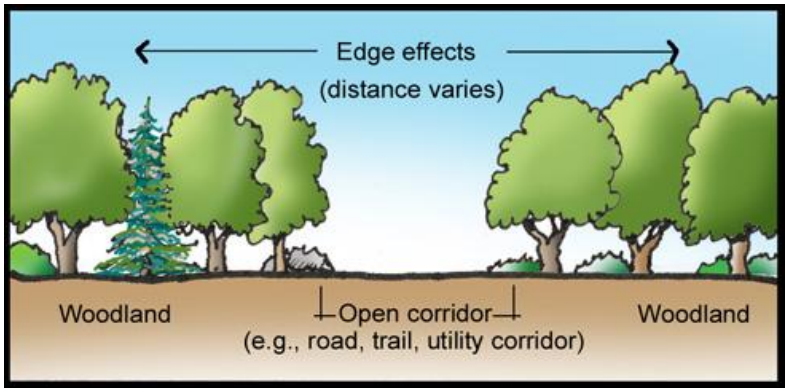
Source: Barnes 2000

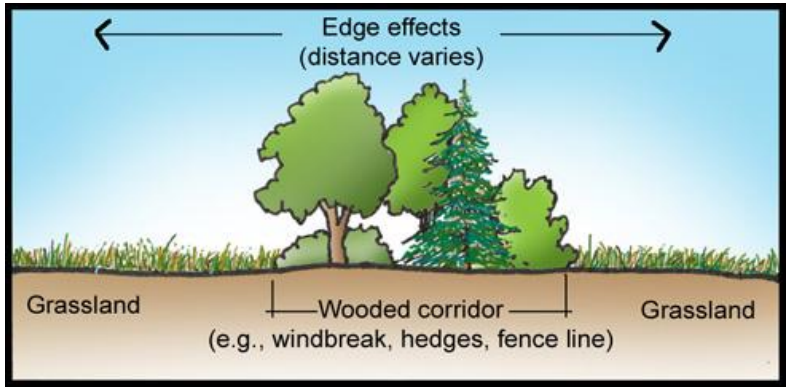
Gaps in corridors

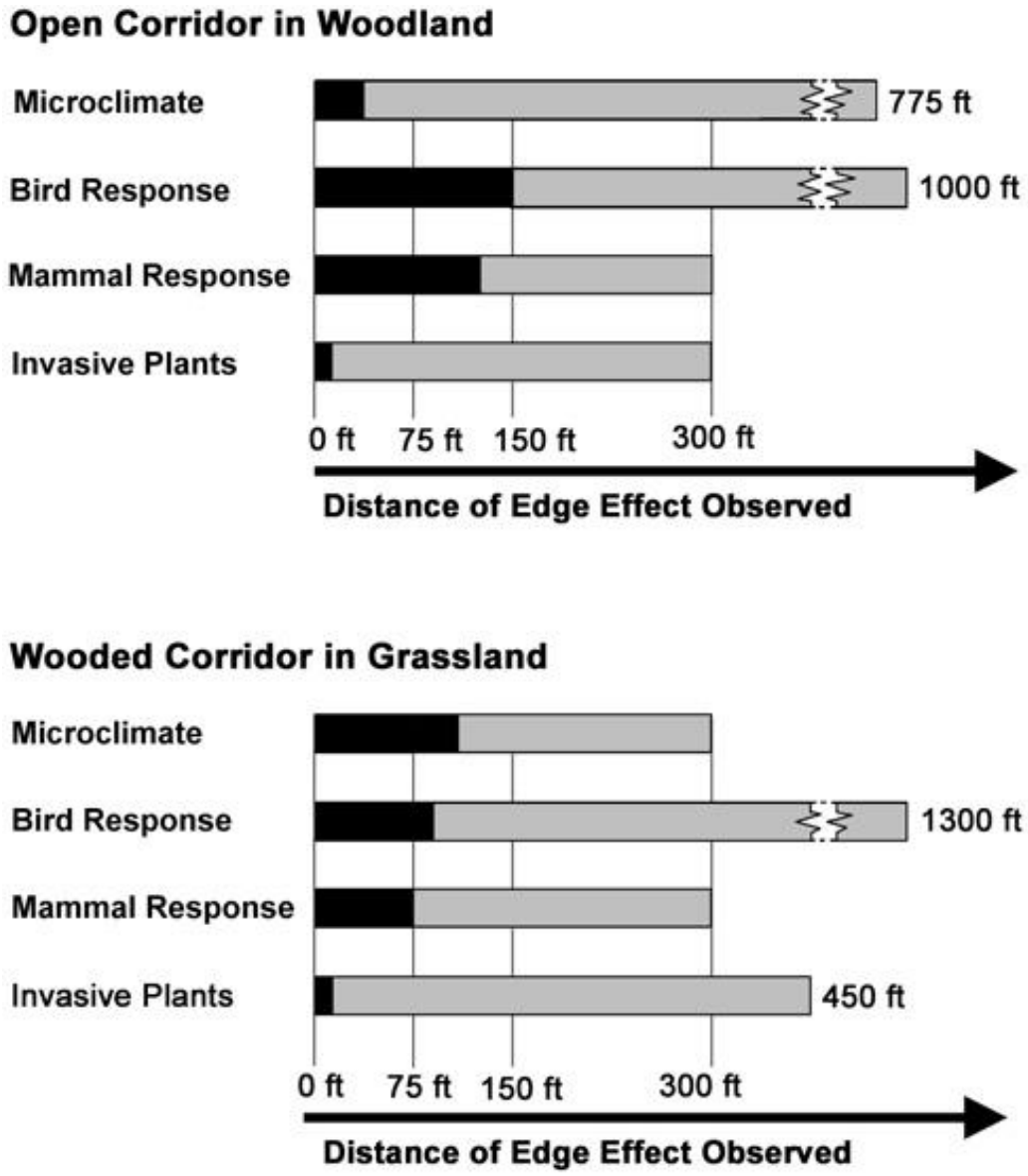


Source: Bentrup USDA FS GTR SRS-109 2008

Corridor width

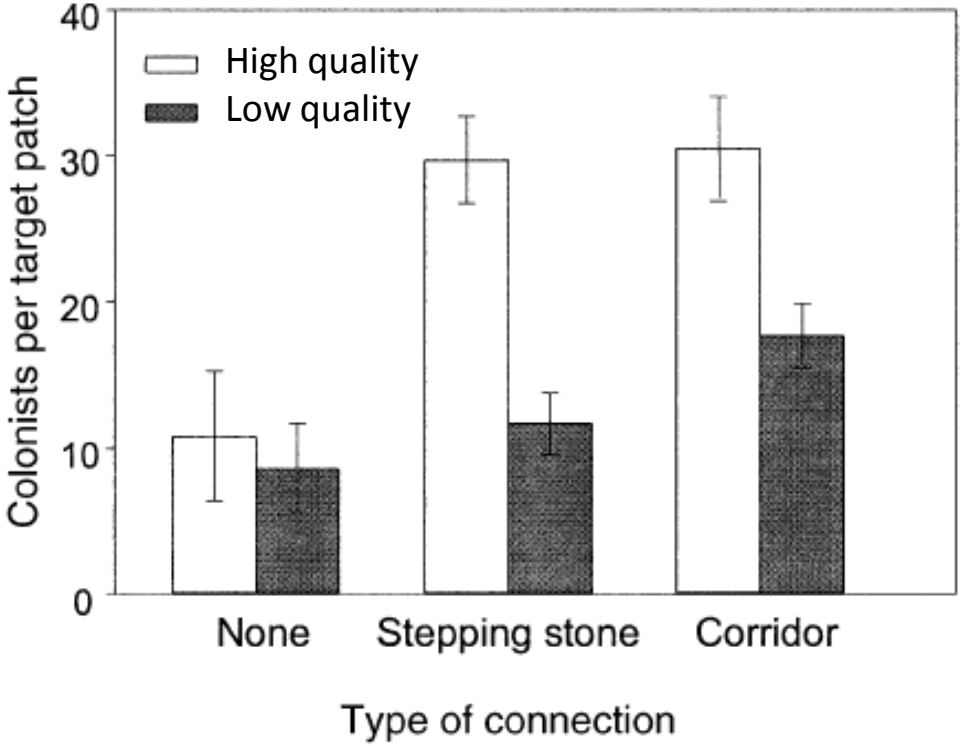






Source: USDA National Agroforestry Center

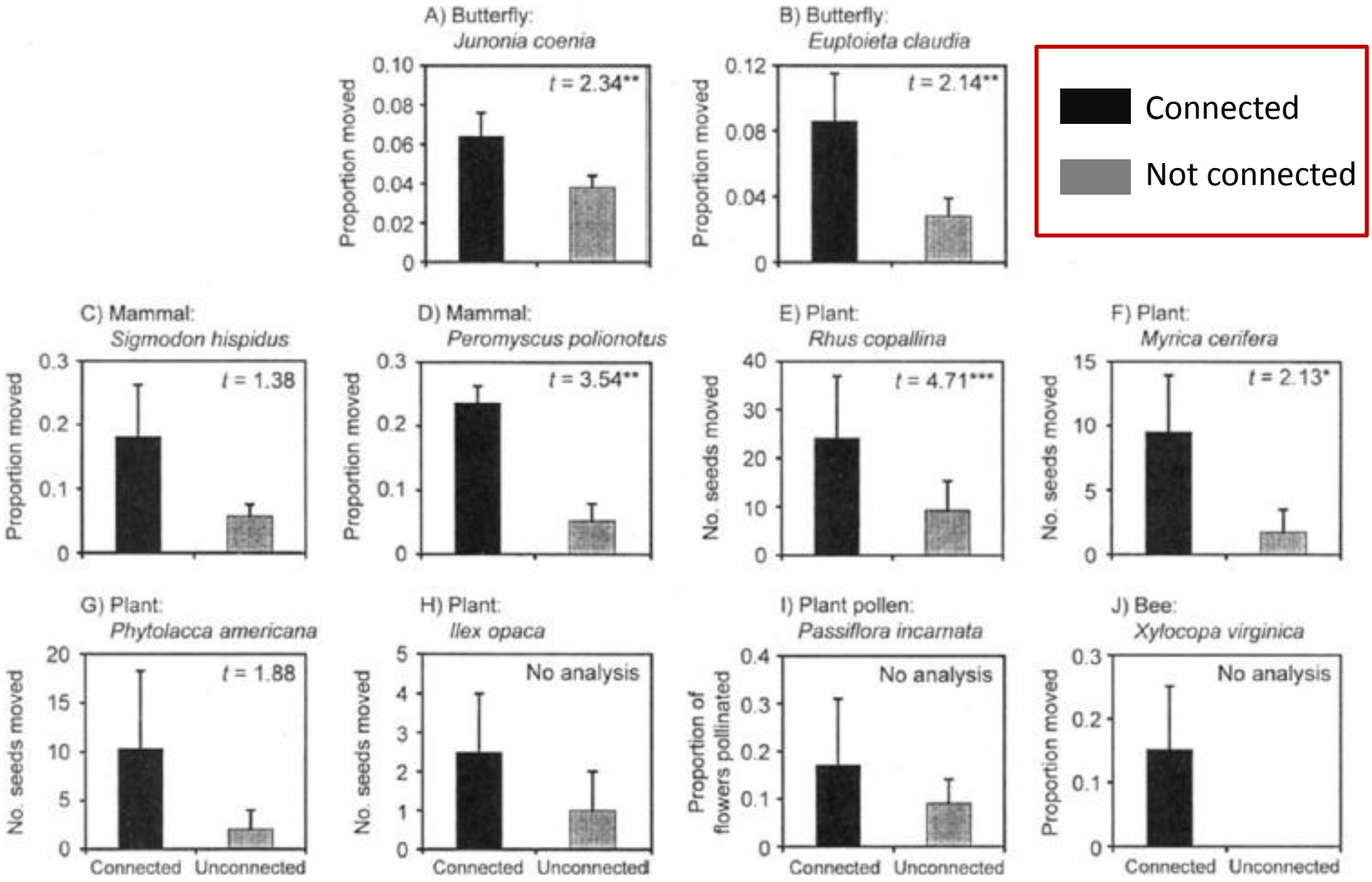
The habitat quality of the surrounding matrix matters.



Total number of planthopper colonists (mean ± 1 SE) in target patches over a 7-day period.

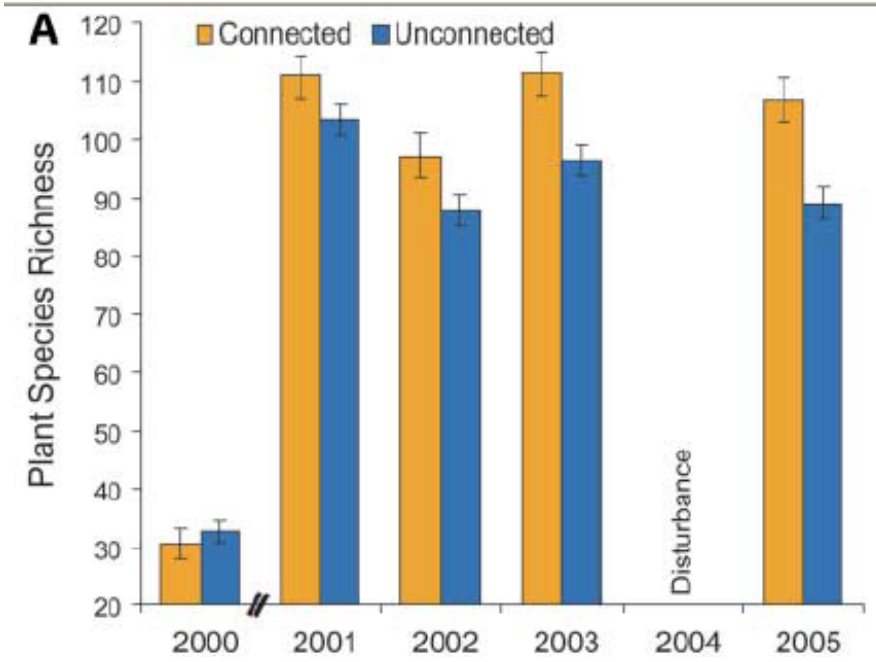
Sources: Upper left - USDA National Agroforestry Center
Lower left - Alberta Riparian Habitat Society
Right- Baum et al. 2004

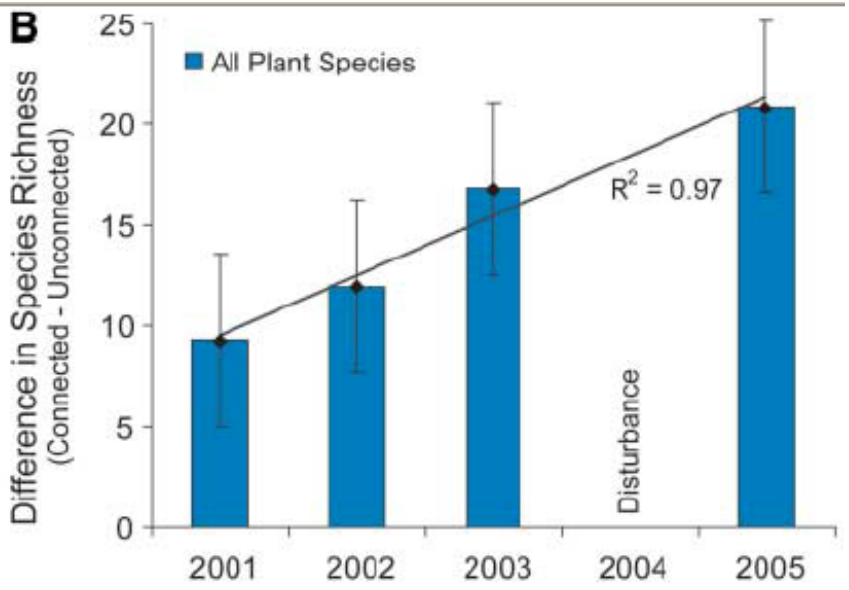
Corridors effectively increase organism dispersal

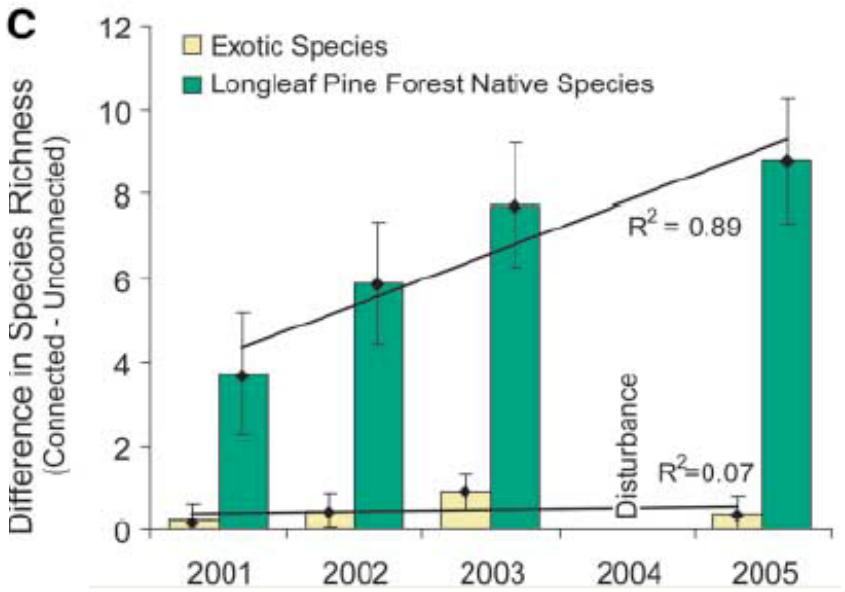


Source: Haddad et al. 2003

Corridors and Plant Species Richness





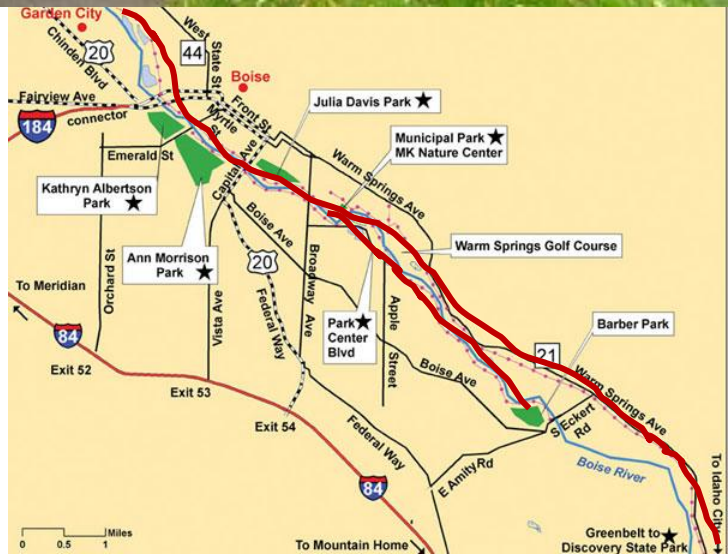


Native plant species richness increased over time within both connected and unconnected patches (A). The difference in species richness became greater over time (B). However, exotic species richness did not increase more on unconnected patches (C).

Source: Damschen et al. 2006

Corridors may have primary objectives other than biodiversity conservation

Urban greenbelt in Boise, Idaho, USA
35 km in length, includes 12 city parks, parallels the Boise River



Corridors as fire breaks

Oak savanna, Indiana, USA

Source: Savanna Oak Foundation

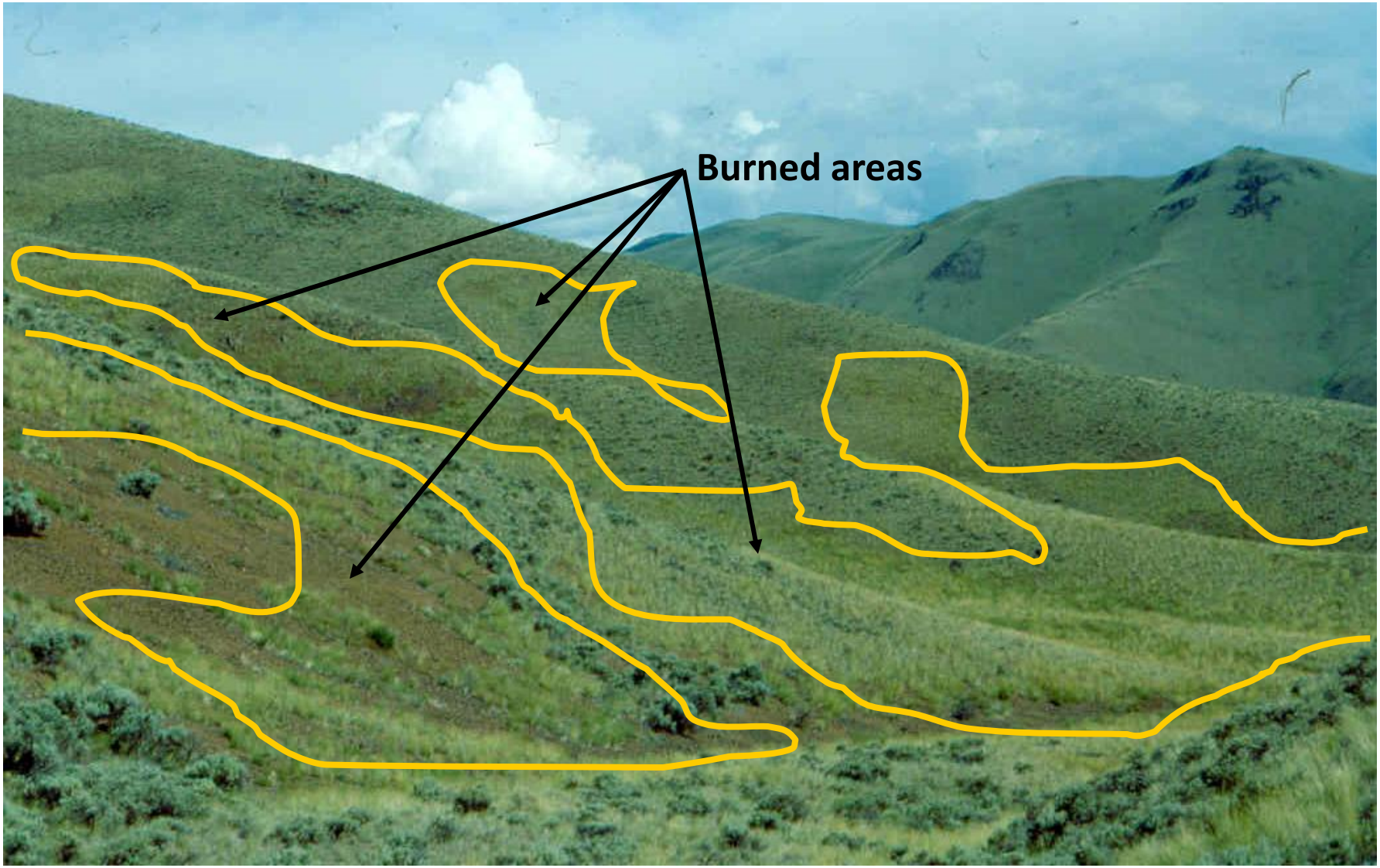
Argyll And Butte, Great Britain

Source: Geograph

Corridors as fire conduits

Riparian vegetation acts a fire conduit in semi-arid areas.

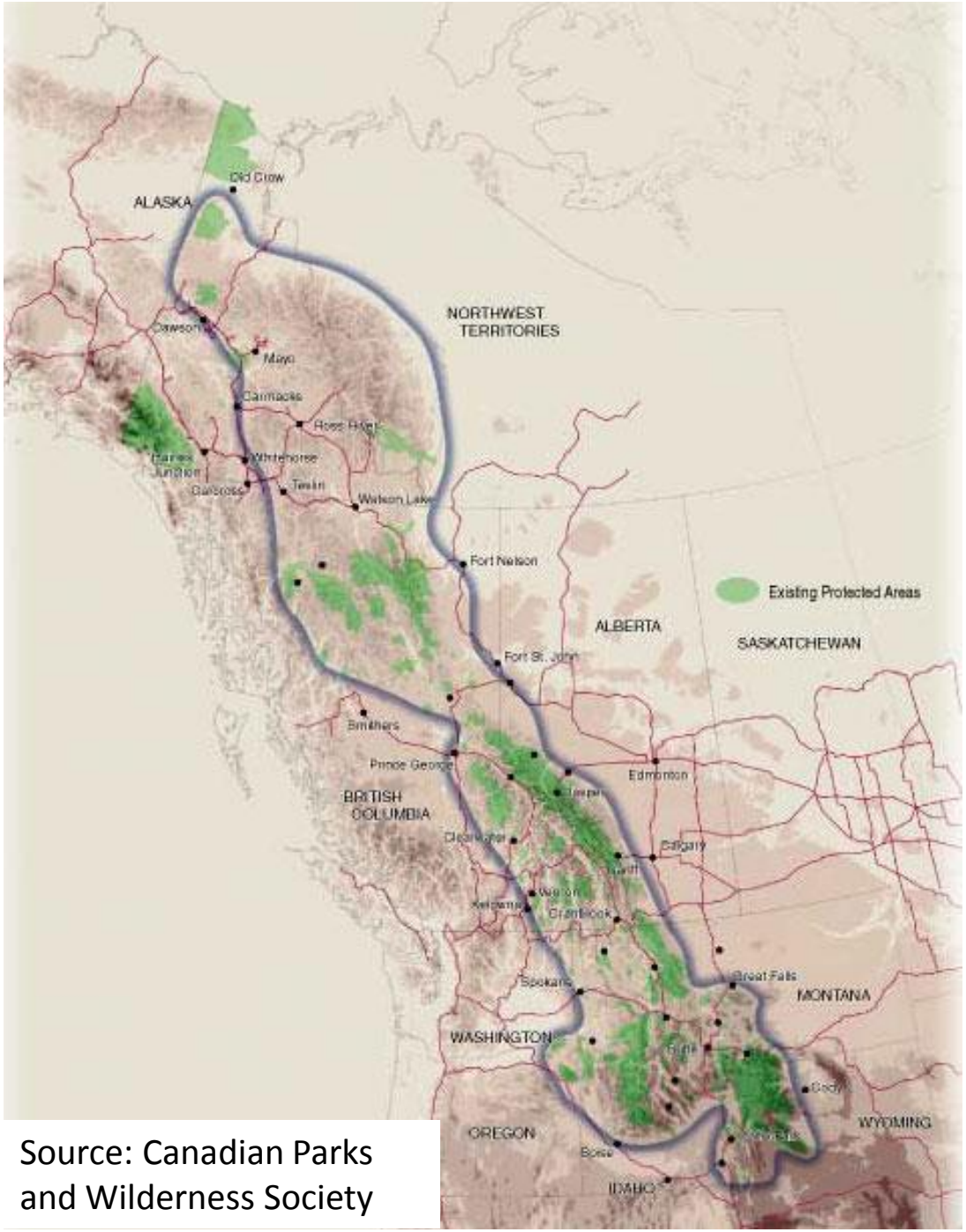
Fire corridors- sagebrush steppe



Broad-scale example: Yellowstone to Yukon Conservation Initiative

Note scale some way.

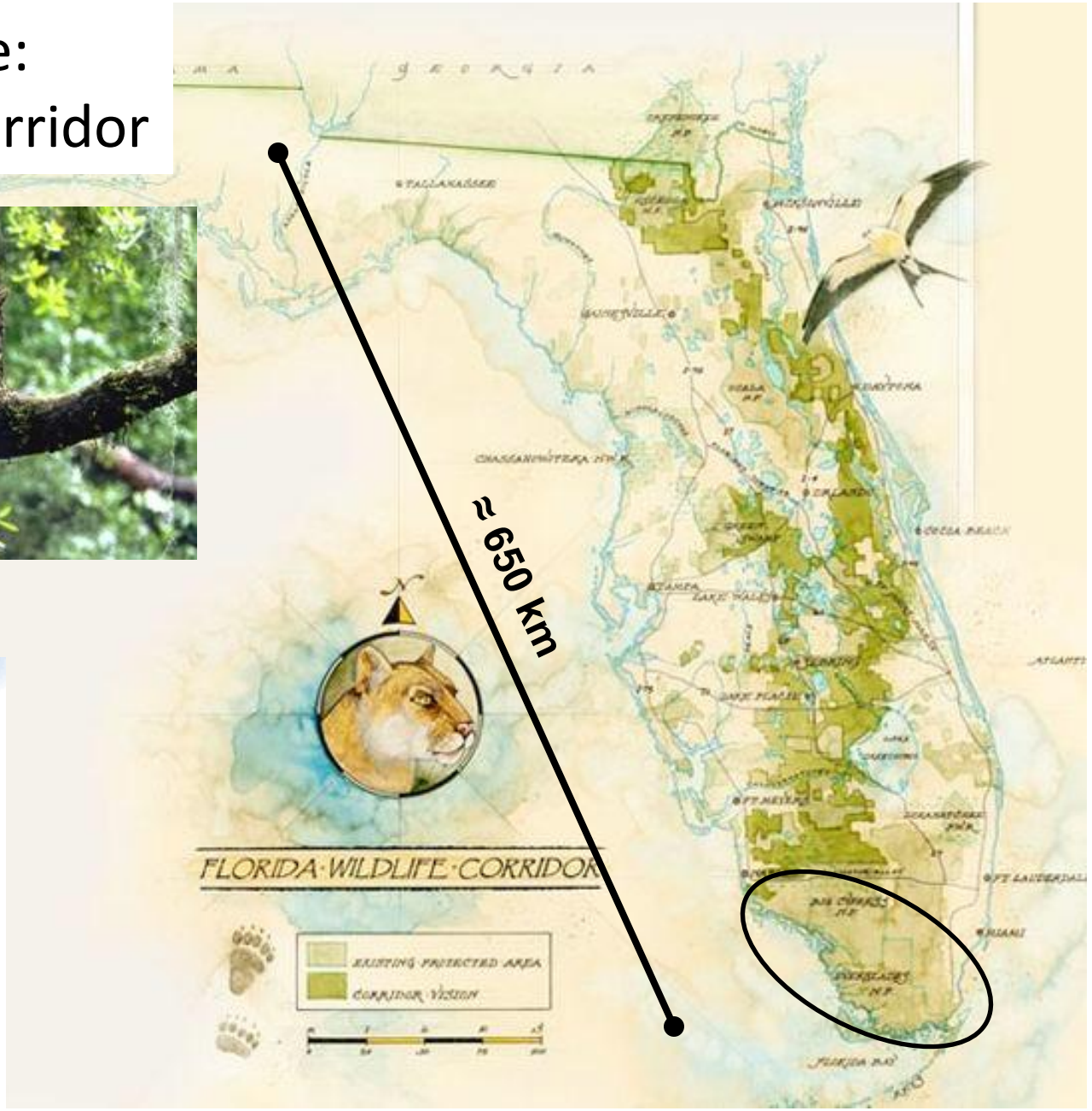
Source: Visions of the Wild



Source: Canadian Parks and Wilderness Society

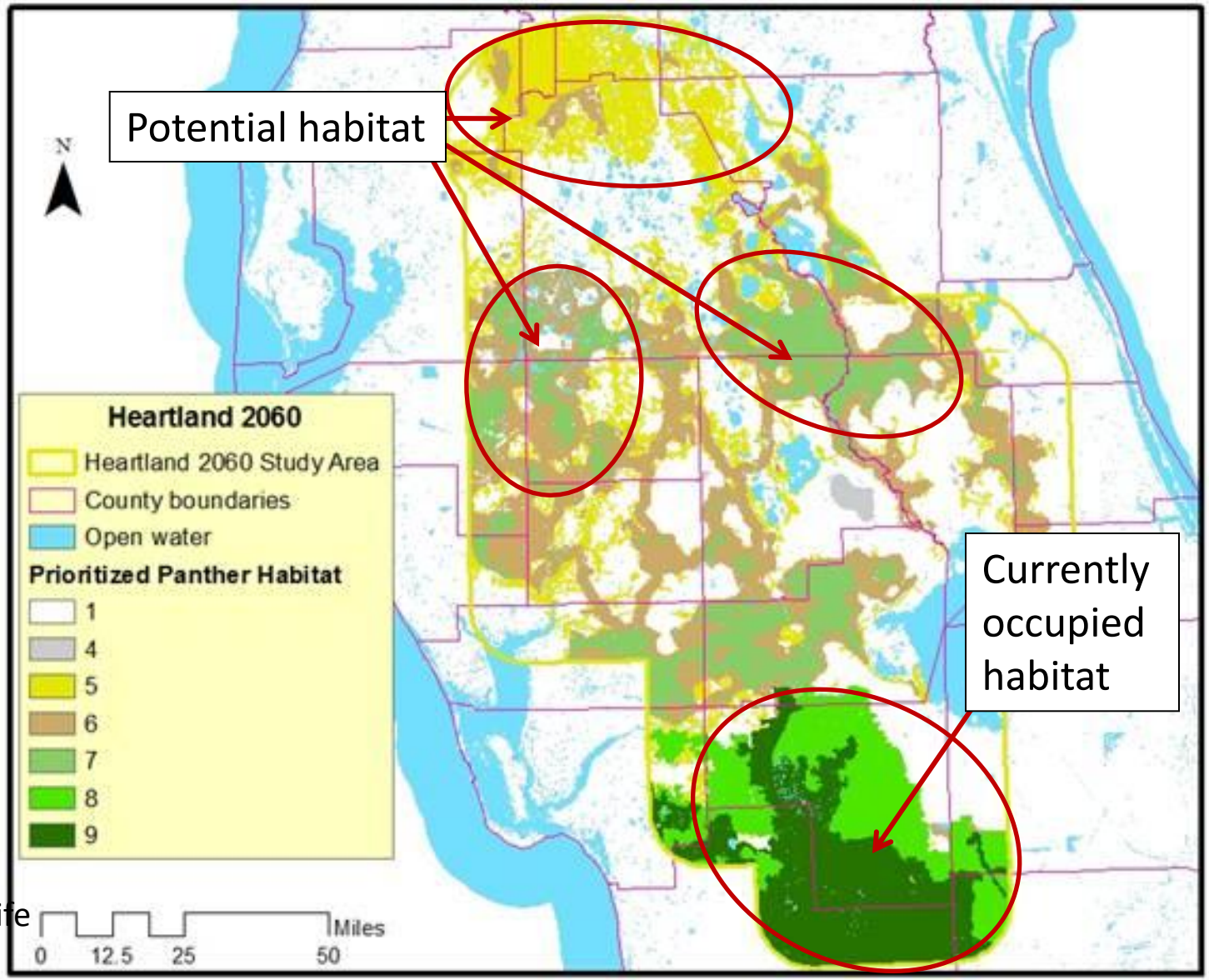
Mid-scale example: Florida Wildlife Corridor

Source: SFWMD.GOV



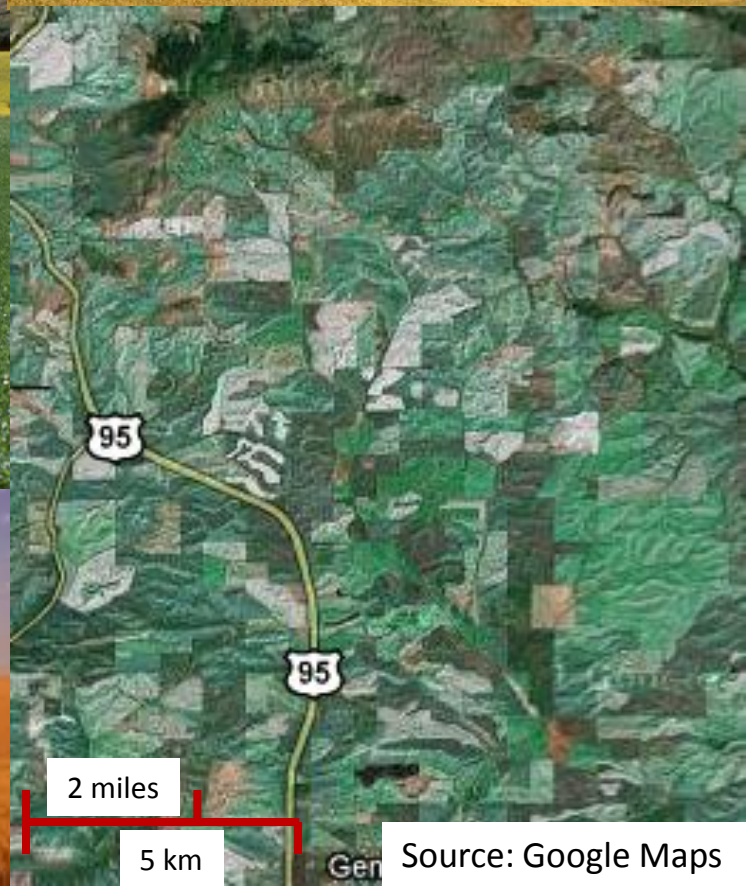
Source: The Florida Wildlife Corridor Initiative

Potential Florida panther corridor system connecting currently occupied habitat with large areas of potential habitat.

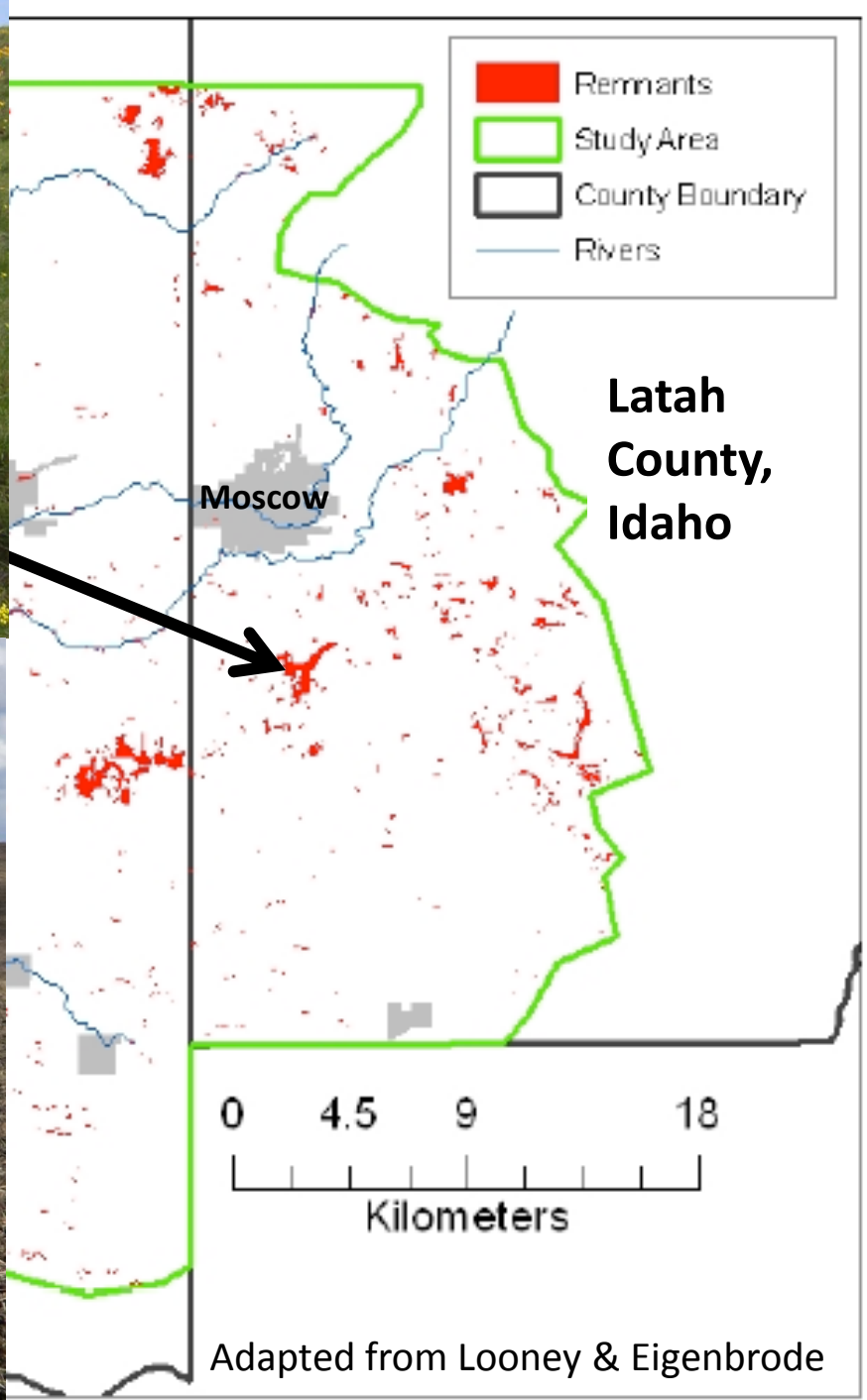


Source: The Florida Wildlife Corridor Initiative

Fine-scale example:
Latah County, Idaho



Source: Google Maps



Adapted from Looney & Eigenbrode

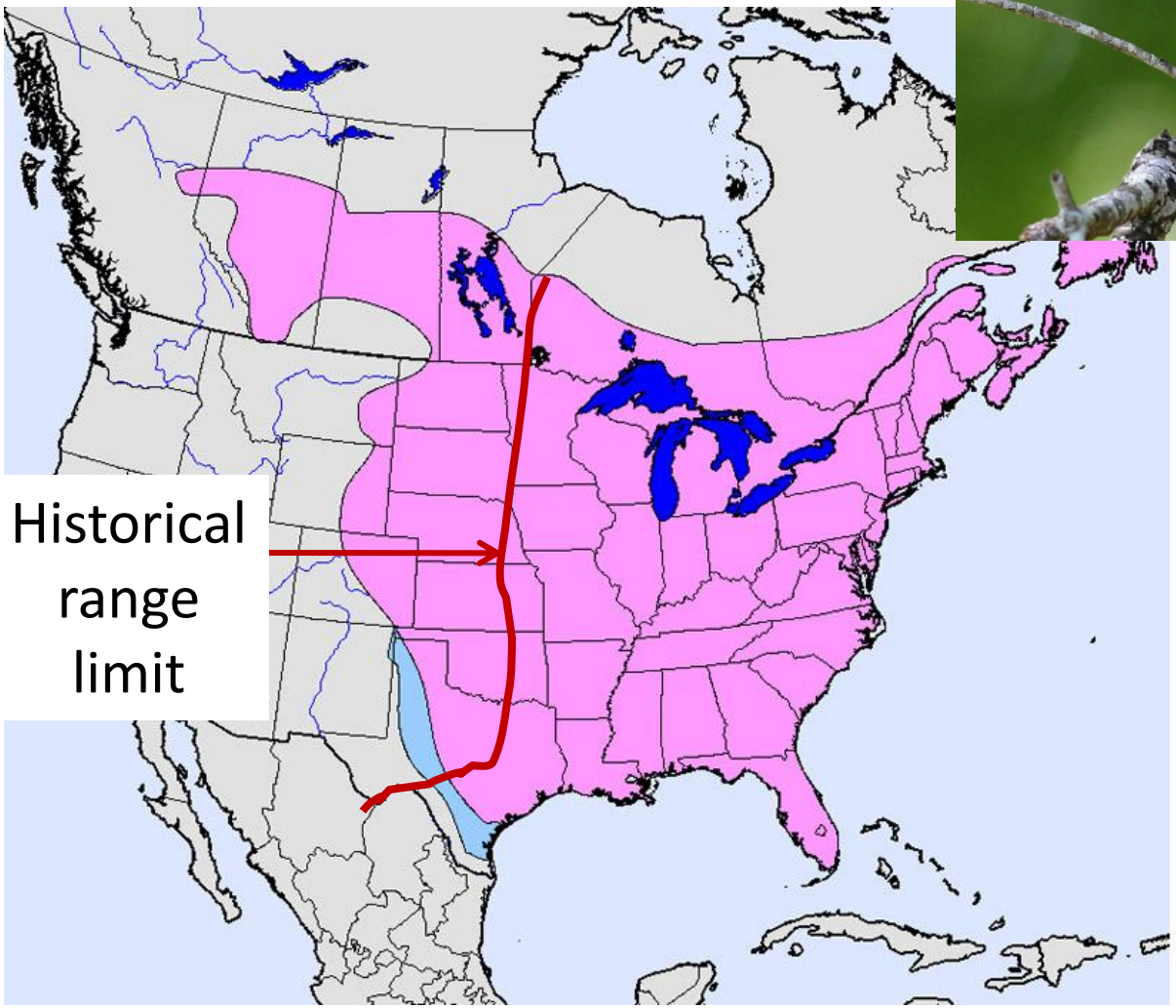
Landscape corridors can enhance connectivity

Landscape configuration	Fine-scale (1 -10 km)	Mid-scale (10-100s km)	Broad-scale (100-1000s km)
Habitat corridor	Hedgerows, streams, forest corridors	Rivers & associated riparian vegetation, broad linkages between reserves	Major river systems, mountain ranges
Stepping stones	Patches of native vegetation, small wetlands	Series of small reserves, woodland patches	Wetlands along flight paths, alpine habitats
Habitat mosaic	Patchy vegetation in farmland, mosaics of gardens, parks and natural areas	Mosaics of regenerating forest in forest blocks, patchy vegetation resulting from frequent disturbance	Regional soil mosaics supporting different vegetation communities

Adapted from Bennett 2004

Current range of the northern blue jay (*Cyanocitta cristata*)

Source: Ken Blackwell (flickr)



Source: sdakotabirds.com

Increased woodlands on the Great Plains

Platte River

Source: US Geological Survey

North American Great Plains Grassland

Source: US Dept of State

More frequent wildfire has resulted in more extensive grassland, and thus even more fire.

Greater sage-grouse
(*Centrocercus urophasianus*)

Source: US National Park Service

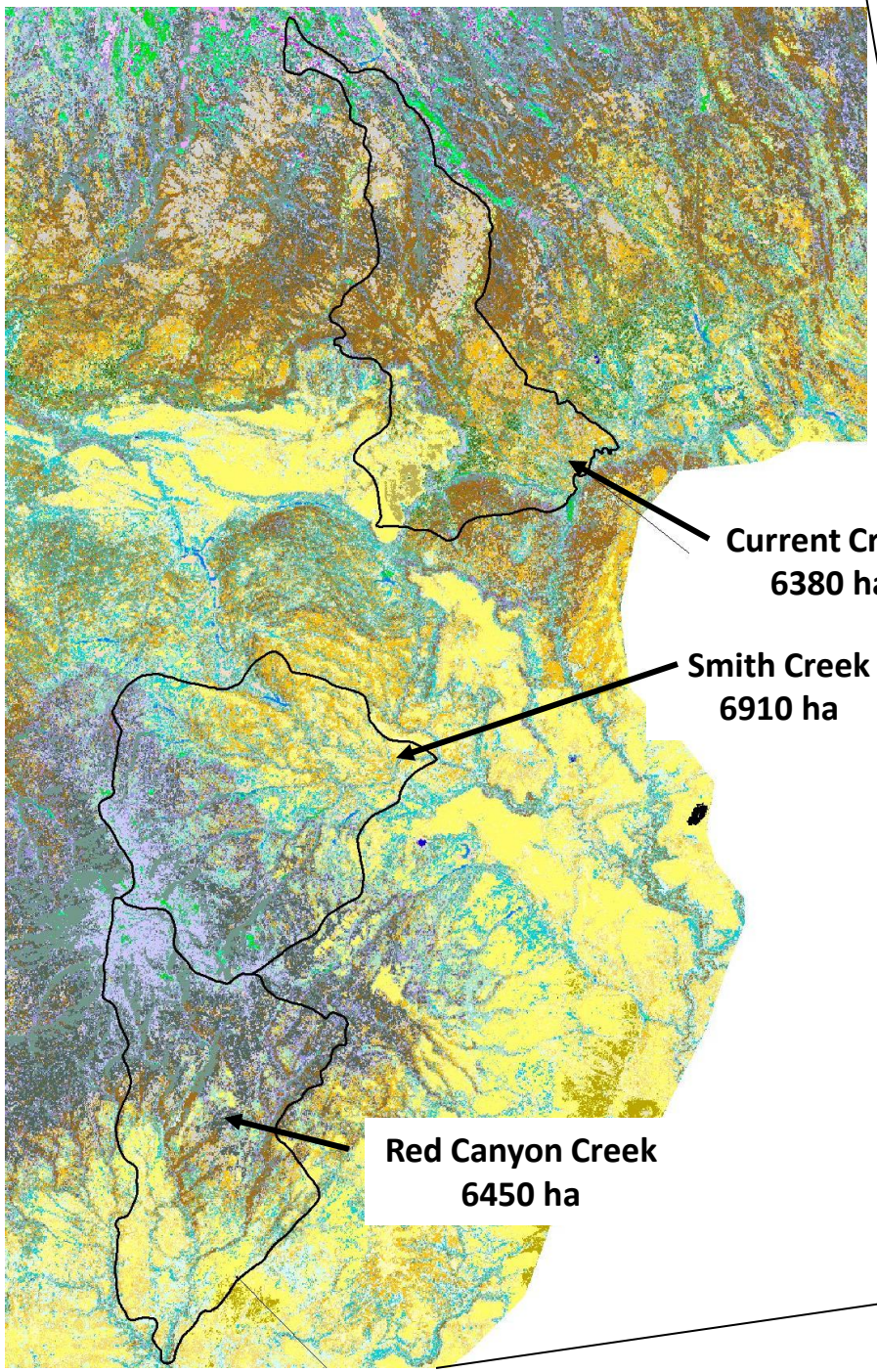
Long-billed curlew
(Numenius americanus)

Source: Idaho Department of Fish and Game

Firebreaks, referred to as “green strips”, have been established in sagebrush steppe to aid in fire control efforts.

Landscape Dynamics in Sagebrush Steppe-Western Juniper Woodland Ecosystems

Vegetation of Current Creek, Smith Creek and Red Canyon Creek Watersheds



There has been a general increase in juniper woodland area over the past 150 years in the western US.

(Tausch & West 1995, Miller & Rose 1999, Tausch & Nowak 1999)

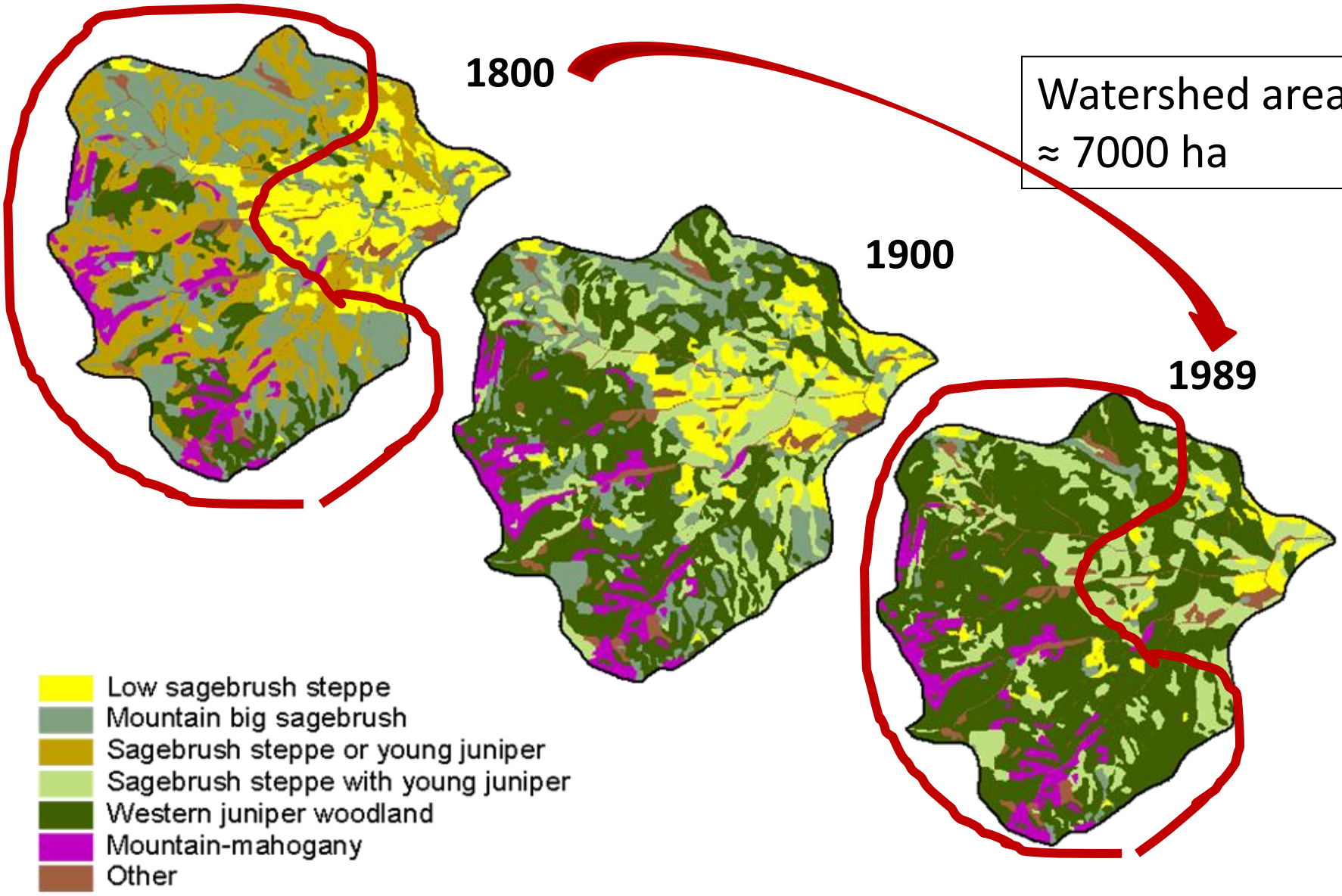
The increase has been credited to changes in:

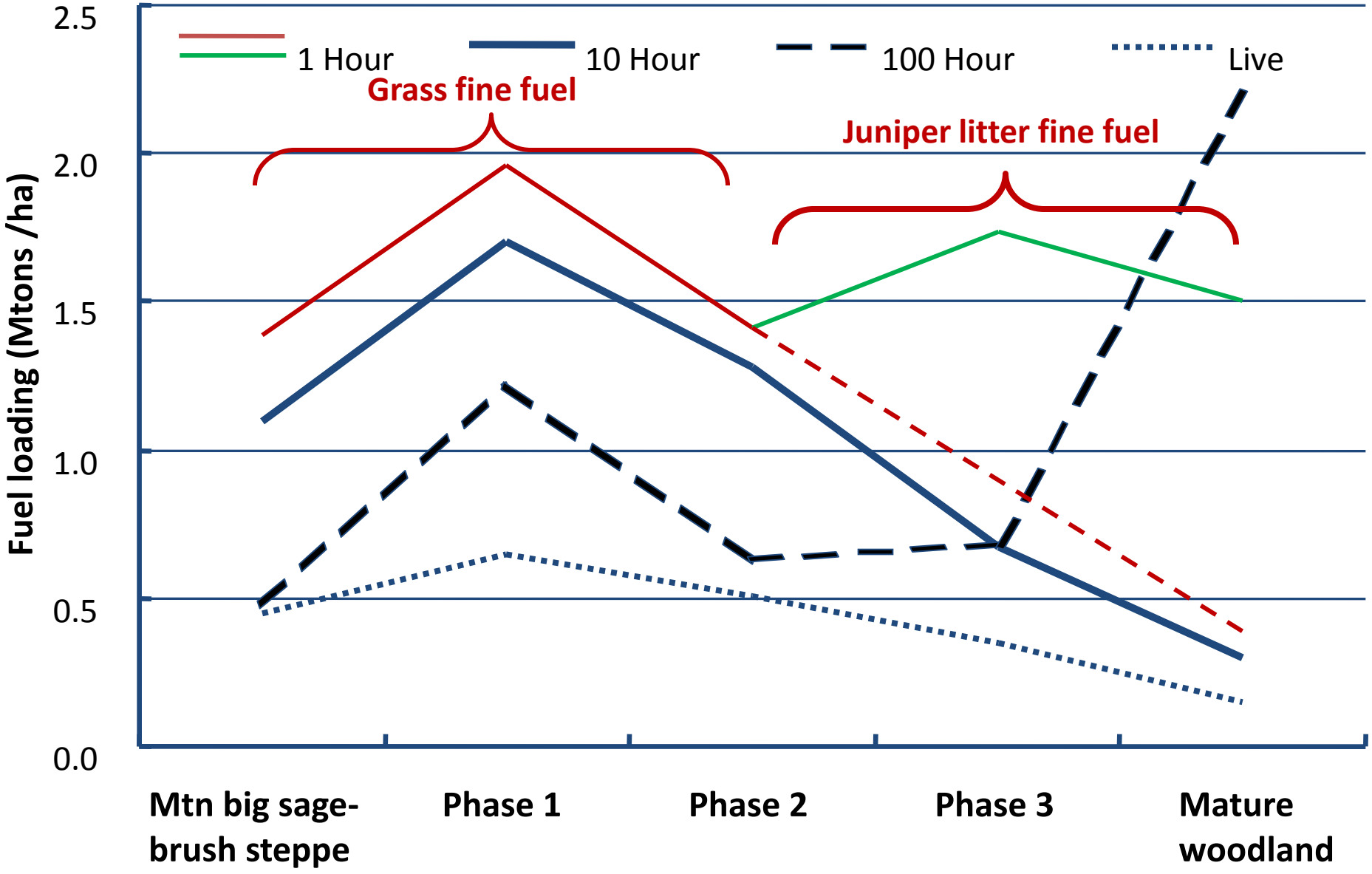
- Fire regime (Burkhardt & Tisdale 1976, Miller et al. 2001, 2003)
- Herbivory regime (Burkhardt & Tisdale 1976, Miller and Rose 1999)
- Climate (Pohl et al. 2002, Soule' et al. 2004)
- Atmospheric CO_2 levels (Knapp and Soule' 1996, Soule' et al. 2001)

Effects of this landscape change

- Reduced shrub cover (Burkhardt & Tisdale 1969, Miller et al. 2000, Roberts & Jones 2000)
- Reduced herbaceous cover (Bunting et al. 1999, Miller et al. 2000)
- Increased soil erosion and runoff (Wilcox et al. 1996, Davenport et al. 1998, Pierson et al. 2003)
- Reduced species diversity (Bunting et al. 1999, Bates et al. 2000)
- Altered nutrient cycles (Doescher et al. 1987, Josaitis 1990, Klemmedson & Tiedemann 2000)

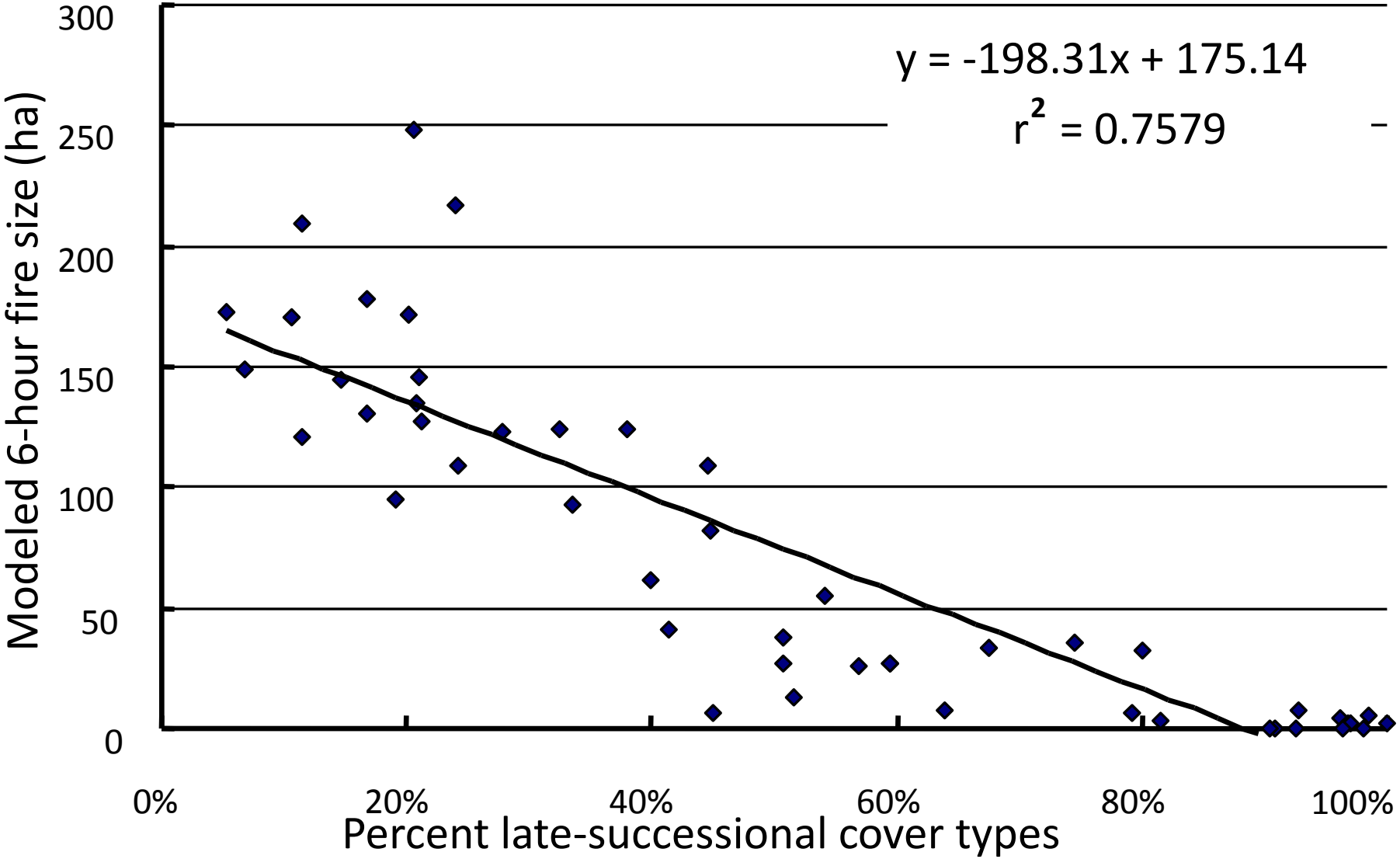
Changing composition of Smith Creek Watershed





Mountain big sagebrush fuel loading by cover type

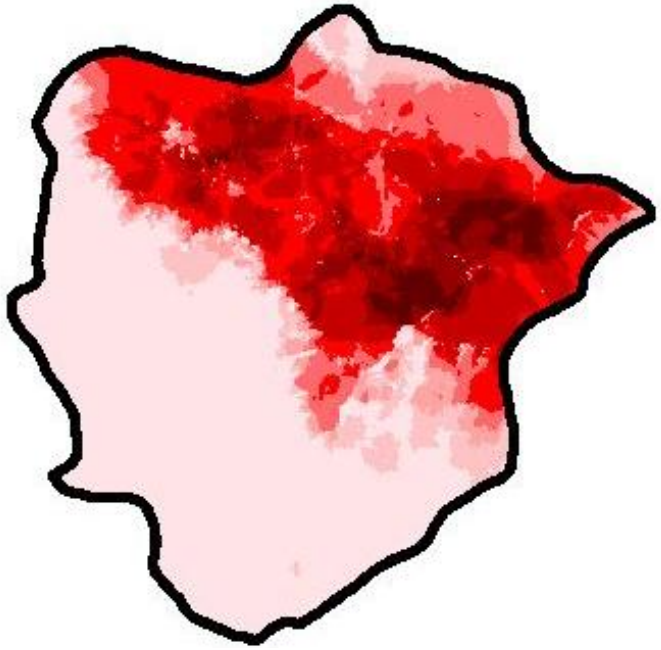
Yanish 2002



Decreasing fire size with increasing proportion of late seral vegetation

Yanish 2002

Fire occurrence



Vegetation

- ARAR R3B
- ARAR TABLE
- ARAR W1
- ARAR W2
- ARAR W4
- ARAR W5
- ARTR R3B
- ARTR W1
- ARTR W2
- ARTR W4
- ARTR W5
- ASPEN
- BROADLEAF
- CELE
- MEADOW
- MNT SHRUB
- ROCK

Fire occurrence

- 0 - 2
- 3 - 4
- 5 - 6
- 7 - 8
- 9 - 10
- 11 - 12
- 13 - 14
- 15 - 17

Results of 100 simulated wildfires. Fire area modeled using Farsite.

Roth, Bunting & Strand 2011

Landscape pattern is important

Analysis indicated that landscape structure had little influence on fire behavior when the landscape was dominated by early successional stages (sagebrush steppe).

However, landscape metrics such as patch density, patch size and landscape diversity were significantly related to burned area when dominated by late successional stages (juniper woodland).

Roth, Bunting & Strand 2011

Habitat corridors are likely to be more effective means of promoting landscape connectivity:

- Where a large part of the landscape is modified and inhospitable to native species
- For species that are habitat specialists or have obligate dependence on undisturbed habitats
- For species with limited dispersal distances
- Where the goal is to maintain continuity of populations between habitats
- Where maintenance of ecosystem processes require continuous habitat for their function

Adapted from Bennett 2003

Other observations about the functionality of landscape corridors include:

- No single corridor vegetation structure serves all species equally well and some landscape patterns may actually serve as a barrier to species movement.
- The function of corridors is dynamic as landscapes change through time responding to disturbances and succession.
- Corridors may enhance the movement of invasive species.
- The movement of wildfire within the landscape may be either enhanced or restricted by corridors.
- In some cases, landscape structure has been specifically modified to serve other purposes (e.g. fire breaks, flood zones, walkways, greenbelts) and may or may not be effective as biological corridors. In some cases minor modifications can make them more effective biological corridors.

Considerations in the design and management of conservation corridors

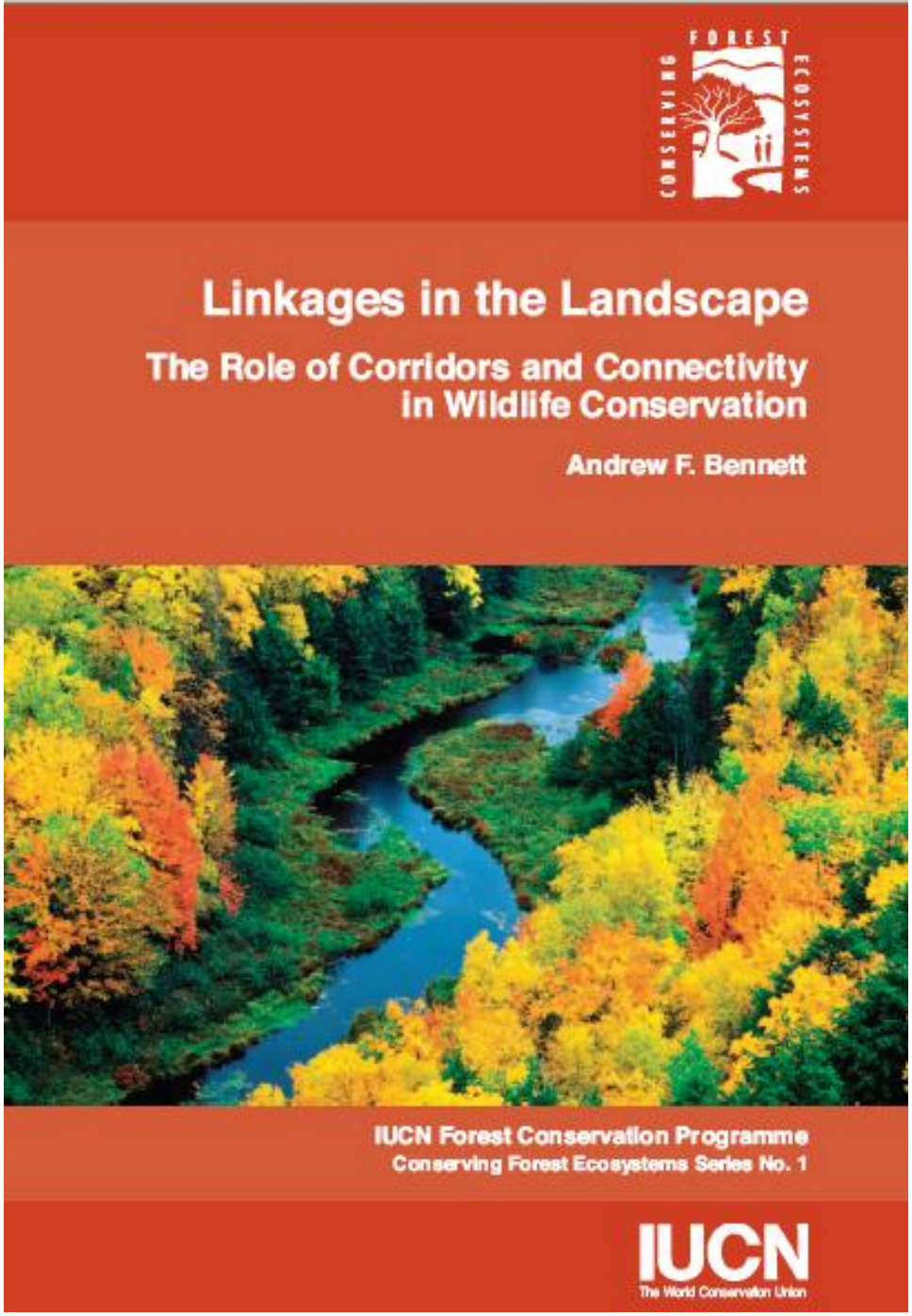
Biological issues

Biological purpose
Behavior and ecology of species
Structural connectivity
Quality of surrounding habitat
Quality of corridor
Corridor width and edge effects
Location
Monitoring capability

Socio-political issues

Status and tenure of land
Management responsibility
Adequacy of resources
Support from local communities
Integration with other land management programs
Community education and awareness
Strategic approach to planning
Most efficient use of conservation funds

Adapted from Bennett 2003



Bennett, A.F. 2003. Linkages in the landscape: The role of corridors and connectivity in wildlife conservation. IUCN, Gland, Switzerland and Cambridge UK. xiv + 254p.

http://app.iucn.org/dbtw-wpd/edocs/FR-021.pdf

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