Habitat Corridors: what are they and what are they good for?

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Outline of remarks

1. Definitions of corridor
   a) Structural
   b) Functional
2. Effects of fragmentation
3. Advantages of corridors
   (metapopulation structure)
4. Potential disadvantages

Corridor definitions

- Corridors imply connections between entities, but how do we know if we have a wildlife corridor? And how do we know how to build one if we want one?
- Structural definitions are popular.
  1. Based on linearity in shape, physical connection between patches of same community-type, physiognomic distinctiveness from adjacent matrix, and especially visibility on aerial photos.
  2. May be continuous or stepping-stone.

Definitions, cont.

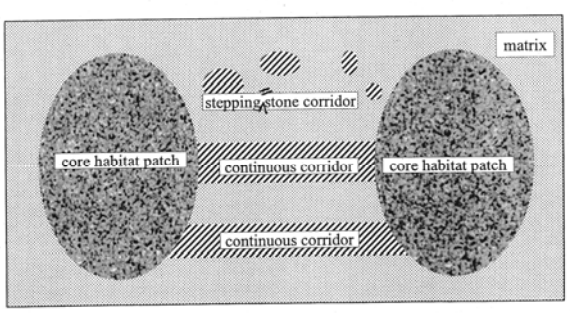
3. May be natural or man-made.

- Functional definition
  1. Does a presumptive corridor actually serve as a conduit for movement of organisms?
  2. A corridor must enhance movements beyond what is possible through adjacent matrix, or assist in crossing a barrier to movements.
  3. May not be visible in aerial photos, or may be visible, but not functional as corridor.

Definitions, concluded

- If a presumptive corridor is to be useful in conservation, it must function as a corridor, not necessarily look like one.
- It can be natural or man-made, or mixed.
- Such a functional definition means that corridors encompass a wide range of structures ranging from scent trails and culverts to huge swaths of natural habitat that connect similar communities on a continental scale.

Schematic representation of two habitat patches connected by two continuous corridors and a stepping-stone corridor

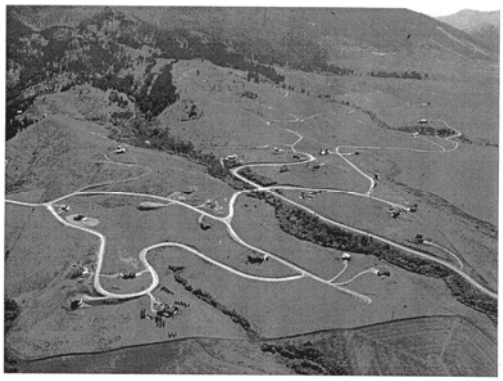


Ivory-billed Woodpecker, Cache River National Wildlife Refuge, Arkansas

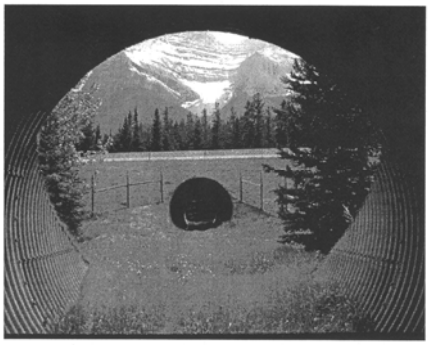
(Nature Conservancy 55(2): 21, summer 2005)

41,000 ac corridor connecting the Cache River and White River Nat'l. Wildlife Refuges established in early 1990's is claimed to be the single most important event favoring this species.

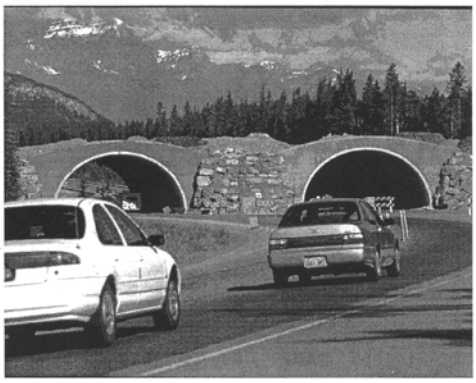
Riparian corridor in exurbian development, Bridger Mountains, near Bozeman, Montana



A culvert undercrossing, trans-Canada highway, Banff National Park; built in 1998

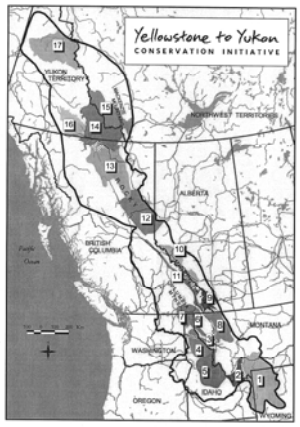


Wildlife overpass across trans-Canada highway, Banff National Park, Alberta



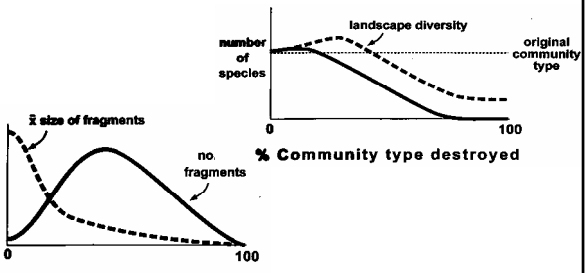
Yellowstone to Yukon Conservation Initiative:

connecting the Rocky Mountain spine with 17 critical core and corridor areas

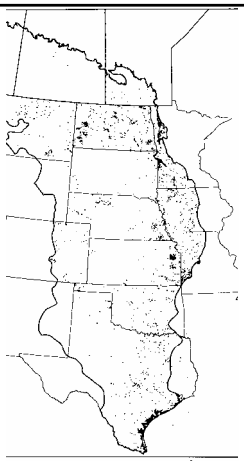


Fragmentation

- Fragmentation leads to decreasing sizes and numbers of remaining habitat patches and to declining biodiversity.



Documented occurrences of natural habitats in the Great Plains of the United States (extension into Alberta has been cut off to fit on to page).

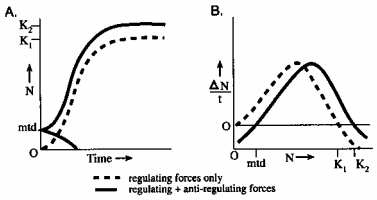


Fragmentation, cont.

- Small fragments generate small populations of the organisms living in the patches.
- Decreasing fragment size and increasing irregularity of shape increase edge effects

Fragmentation, cont.

- Small populations are at high risk of extinction for demographic, genetic, and stochastic reasons.
  - Demographic factors: anti-regulating factors ("Allee Effect"), leading to minimum threshold densities; patch quality (carrying capacity); social incompatibilities; strong density fluctuations (seasonal, multi-annual).



Fragmentation, cont.

- Genetic factors: loss of balanced polymorphism; inbreeding depression; fixation of deleterious mutations; reduced genetic variability leading to inability to respond to new conditions; effective population size can be much less than the actual size (non-reproductives, variation in reproductive output, sex ratio inequality, temporal variation in population size, inbreeding); outbreeding depression.

Risks of extinction in small populations, cont.

- Stochastic factors: deleterious mutations, catastrophes, strongly biased sex ratio; new forms of mortality such as a predator wandering by or human disruptions; severe decline in effective population size.

❖ The magnitude of these risk factors is strongly influenced by the nature and extent of the matrix, namely, the communities that are adjacent to the patch containing the small population.

- The matrix may increase or decrease the possibility of movements among fragments (both immigration and emigration).
- It may also change the effective size of a patch through edge effects, and introduce new mortality factors such as predation, parasitism, or competition.

Advantages of corridors

❖Connecting such fragments through corridors or other means produces a metapopulation structure which has a much improved chance for sustainability.

❖Metapopulations are assemblages of separate populations (demes), variously connected by movements among them (dispersal). Arrays of demes not connected by dispersal, move inevitably toward extinction unless one or more deme is very large.

Metapopulations and metacommunities

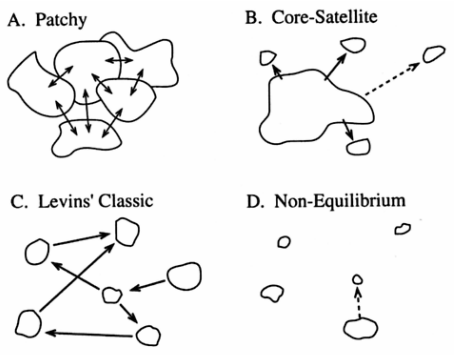
❖ Persistence of metapopulations (and hence metacommunities) depends on two things.

1. Risk of demic extinction (population in a fragment) = mortality rate.
2. Rate of colonization of empty fragments = birth rate

❖ Births (colonizations) must exceed or equal deaths for persistence of metapopulation.

❖ ***Movements among patches*** influence both death and birth rates, and so are critically important in this equation. They also influence genetic and social structure of demes.

Four types of metapopulations



Potential disadvantages of corridors

- Disadvantages are less well understood than the advantages.
- While advantages generally exceed the disadvantages, understanding the possible negative consequences of corridors can help us to avoid them.
- Artificial or heavily human modified corridors are more likely to suffer negative effects than natural corridors. A culvert that helps mountain lions cross a freeway may not meet its objectives if it simply leads the lions into a suburban area.

What are some potential disadvantages?

1. Edge effects
   a. Since corridors are often narrow, they may be largely or entirely edge in character.
   b. There is thus an increase in the total amount of edge in a given area.
   c. Edges may not be suitable for dispersal of interior species (those that avoid edges), and may increase the impact of predators, parasites, or competitors that either are attracted to edges or penetrate patches from the matrix.
2. Community drift – changes in the community composition within the connected patches because of differential use of corridors
   a. Change in community-type over time
   b. Disruption of strong coactions may lead to cascade of extinctions.

Disadvantages, cont.

3. Invasion of exotic species
   a. Access through corridor, from the edge, or from the matrix
   b. Spread among patches
4. Invasion of deleterious native species
   a. Access to patch facilitated for predators, parasites, and competitors that negatively impact target species within the patch that may be too few or too unhealthy to withstand their impact
   b. Virulence of pathogens may increase with connectedness.
5. Demographic impacts
   a. Spillover predation or parasitism
   b. Corridors as demographic sinks
   c. Synchrony among patches increases chances of metapopulation extinction
   d. Connected patches may support predators or parasites which could not persist if patches were isolated.
   e. Increased exposure to human depredations: humans are edge creatures themselves and hunt preferentially in corridors.

Disadvantages, cont.

6. Social impacts
   a. Corridors may be inadequate for dispersal of social groups.
   b. Social fence effect of residents living in corridors.
7. Genetic impacts
   a. Outbreeding depression
   b. Loss of local adaptation
   c. Hybridization between taxonomic units
   d. Genetic “swamping” of rare species by invading exotic
8. Conflicting scientific objectives
   a. Corridor projects must be clear about objectives, priorities, and realistic possibilities, egs. provision of habitat or conduit; target species; land acquisition realities.

Disadvantages, cont.

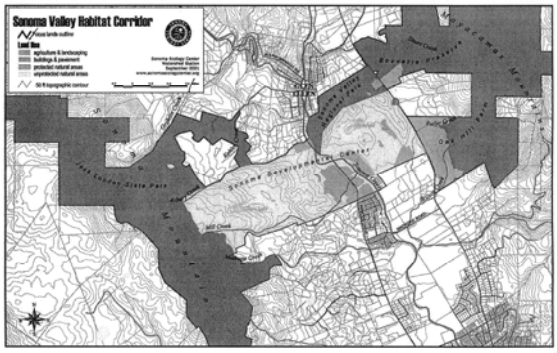
b. Target species requirements vs metacommunity conservation

c. Urgent short-term objectives versus long-term sustainability

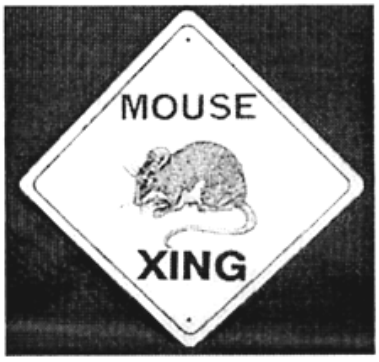
d. Alternative conservation strategies (corridors, matrix improvements, translocations)

9. Economic impacts
   a. Costs of acquisition and construction
   b. Costs of maintenance
   c. Costs of monitoring
   d. Lost opportunity costs
   e. Unforseen negative impacts on adjacent matrix
   f. Benefits generally ignored (education, aesthetics, research, increases in quality of life, biodiversity conservation, recreation, ecosystem services, employment opportunities)

Sonoma Valley Habitat Corridor (connecting Myacamas and Sonoma Mountains)



Future road sign – if we are successful in increasing public acceptance of habitat corridors.



Road sign signaling seasonal road closure to allow newts to cross a major park road to reach a breeding stream; Tilden Park, Contra Costa Co., Calif.

Conclusions

1. Corridors are major tools for conservation planning as they provide many advantages in increasing the viability of species trying to survive in our fragmented world.
2. In doing this, they help us to conserve biodiversity, and hence our own life support system.
3. There are, however, many potential disadvantages to corridors that need to be addressed in any real planning situation.
4. Read all about this in our book Corridor Ecology.

Corridor design, planning, and implementation

- Chapter 7 Design objectives
- Project attributes
  - SCALE (spatial and temporal)
  - GOALS (target or focal species, landscape context, social context, institutional missions)
  - HABITAT REQUIREMENTS
  - DISPERSAL CONSIDERATIONS
  - GENERALISTS VS SPECIALISTS (sensitivity to corridor filtering)
  - SOCIAL AND BEHAVIORAL FACTORS
  - SENSITIVITY TO HUMAN ACTIVITIES
  - PHYSICAL LIMITATIONS OF FOCAL SPECIES

- CHAPTER 7, cont.
- Corridor quality
  - Physical aspects
  - Habitat quality
  - Landscape context
- Restoring existing corridors
- CHAPTER 8 – Identifying, prioritizing, and assessing corridors
  - Collaborative process
  - Address scale
  - Identifying sites (conservation or restoration)
    - Six steps in process (p. 212)
    - 4 important components of the planning process
  - Prioritization
  - Selecting indicator taxa

Chapter 9 – protecting and restoring corridors

- Seven point strategic strategy
- Voluntary efforts by landowners (suitably educated)
- Buying land
- Conservation agreements
- Conservation concessions (purchasing leases)
- Restoring land
- Lessons from past projects