

# Do Corridors Have Value in Conservation?

by

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## Part I – Introduction and Review of Relevant Biology

In 2008, conservation groups filed petitions with the Supreme Court to stop the U.S. government from building a fence along the U.S.-Mexico border. The Court refused to consider the issue because of security threats. What was the environmental argument against the fence? While it was intended to control the flow of goods and people across the border, the fence would also restrict movement of endangered jaguars (*Panthera onca*).

Species that are endangered are found in very small numbers, often with very small geographic distributions. For an animal like the jaguar, which as an adult may weigh 45–115kg (100–250 pounds) and eats only meat, a large home range is necessary in order to locate sufficient food. They are known to move 2–3 km/day (1.2–1.8 miles), and even farther in the dry season. Conservation groups charged that building an 1127-km (700-mile) fence along the southern border of the U.S. would make it more difficult for jaguars to cover the ground they need. Besides restricting their movements in search of prey, a barrier could prevent jaguars finding each other in order to breed.

### Questions

1. Why is it more difficult for top carnivores to obtain sufficient energy resources than it is for animals lower on the food chain?
2. What sorts of genetic changes are more common in smaller populations than large ones? Are these problematic and, if so, how?
3. What term or concept is used to describe the population size of breeding animals (not the total population size)? What factors discussed above might reduce the number of breeding jaguars below the total number?
4. Is it important for people to try to protect endangered species?

Photo of US-Mexico border at Tijuana, Baja California, Mexico, by Wikimedia contributor Tomas Castelazo, [http://commons.wikimedia.org/wiki/File:Us-mexico\\_border\\_at\\_Tijuana.jpg](http://commons.wikimedia.org/wiki/File:Us-mexico_border_at_Tijuana.jpg), CC BY 3.0 license.

## Part II – Nature Preserves and Corridors

No one knows how many jaguars there are in the U.S. or Mexico, but it is doubtful there are enough to maintain a healthy population for long. And inbreeding and genetic drift make their population more susceptible to disease and environmental changes.

Obviously, nature preserves are ideal for protecting endangered species and their habitats. But it is not always possible to create adequate protected areas. As an alternative, environmentalists have suggested that elimination of barriers within the geographic ranges of endangered species might boost their survival through both greater habitat availability and increased genetic diversity. However, when there are no actual fences preventing species movements, there may still be human-made obstacles such as roads, urban sprawl, or agricultural areas. Exactly which of these might pose problems for a species depends on its particular needs.

Even when it is not possible to eliminate a fence, road, farm, or shopping mall, it may be quite easy to create a *corridor*, or area of habitat suitable for species to use in moving between natural areas. The importance of corridors has been widely reported in the conservation biology literature for decades now, and formed the basis of arguments in the case against the U.S. Border Fence.

### Questions

1. What does island biogeography theory suggest about the ideal design of a nature preserve? (Think of a preserve as a habitat island.)
2. What are some reasons why the number and size of nature preserves are limited? In your answer, consider what you know about both local and international pressures (social, economic, and political).
3. What are some examples of corridors that already exist where you live? They may not go by this name, but still serve the same function. Think about areas where typical land use changes. For example, if you live in a farming community, are there unfarmed areas that could serve as corridors? If you live in a city, which areas are not built up and could they be corridors?

## Part III – Experimenting with Corridors

From 1996 to 1998, Nick Haddad and several colleagues set about studying the effects of artificially created corridors within plantations of pine trees. The map below shows the 27 patches of open habitat the scientists created through the removal of trees. The patches are all  $128 \times 128$  m in size (this amounts to 1.64 ha, about 4 ac, or about twice the size of a baseball diamond). Some of them are connected by corridors that are 32 m wide, ranging from 64 to 384 m in length.

Whether these patches and corridors seem large or small to you, the important thing is whether they seem large or small to the species Haddad et al. studied. There are butterflies that do not move more than 128 m in their lifetime. There are mice with home ranges of about half a hectare. And then there are animals like jaguars that have home ranges of at least  $10 \text{ km}^2$  ( $4 \text{ mi}^2$ ). Obviously, butterflies would respond differently to the described study area than jaguars! Moreover, the type of habitat in the patches and corridors will only be suitable for certain types of organisms.

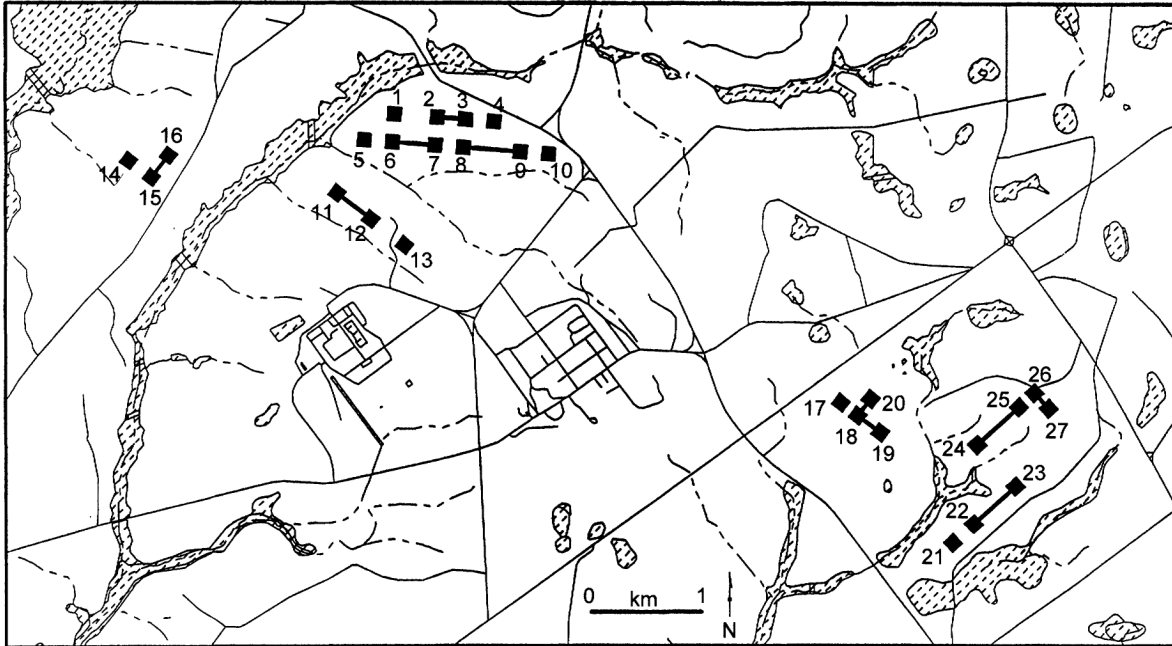


FIG. 1. Corridor experiment at the Savannah River National Environmental Research Park, South Carolina, USA. Black areas show patches ( $128 \times 128$  m, numbered 1–27) and 10 corridors (32 m wide, varying in length from 64 m to 384 m). Solid lines show roads, and stippled areas are ponds and streams.

### Questions

1. How and why might animals move between habitat patches?
2. How and why might plants move between habitat patches?
3. As Haddad et al. point out, we often think of forests as “good” habitat (ideal for corridors), when they could be a barrier. What sorts of species might Haddad and colleagues be studying for which pine forest can serve as a barrier?
4. What can you predict about the species Haddad and colleagues wanted to study, based on the size and vegetation of the habitat patches and corridors they used?
5. Examining habitat patches 14, 15, and 16, can you predict the type of comparison Haddad and his colleagues would make to determine whether corridors were important to the species studied? Specifically, what type of data would you collect, and in which patches, to determine whether corridors had an influence on the species of interest?

### Reference

Haddad, N.M., D.R. Bowne, A. Cunningham, B.J. Danielson, D.J. Levey, S. Sargent, and T. Spira. 2003. Corridor use by diverse taxa. *Ecology* 84 (3): 609–615.

## Part IV – Methods and Results of the Study

Haddad and colleagues studied the movements of two species of butterfly, two small mammals, one bee species, four bird-dispersed plants, and the pollen of an additional plant. In each case, they determined whether the individuals were more likely to move via corridors; in other words, were they more often found in patches that were connected or unconnected to the center patch?

To collect data on these diverse organisms, they had to use a number of different techniques:

- Butterflies and bees were captured and individually marked; attempts were made to recapture them later.
- Hispid cotton rats were captured from locations 13 km or further from the experimental area, radio-collared, released within habitat patches, and radio-tracked.
- Old-field mice were eliminated from three blocks of three patches; then marked mice were introduced to the center patch (e.g., patch 15) and attempts were made to recapture them in traps set in all nine patches.
- For two species of plants, members of that species already present were removed from the peripheral patches (e.g., patches 14 and 16) and any seeds found subsequently were assumed to have been brought by birds from the center patch.
- In the other two plant species, plants were not removed, but the seeds in the center patch were marked with fluorescent microspheres; these microspheres followed the same ingestion/excretion path as the seeds and allowed researchers to identify which seeds located in the peripheral patches were from plants in the center patch.
- For the pollination study, flowers in the center patch were dusted with fluorescent powder and presence of powder was observed on flowers in the peripheral patches. The single bee species observed pollinating 90% of these flowers was also marked and recaptured (as described in the first point above).

Below are the data. Note that the statistical results are printed in the corner of each graph. Where it says “no analysis,” there were insufficient observations of movement to conduct a statistical test.

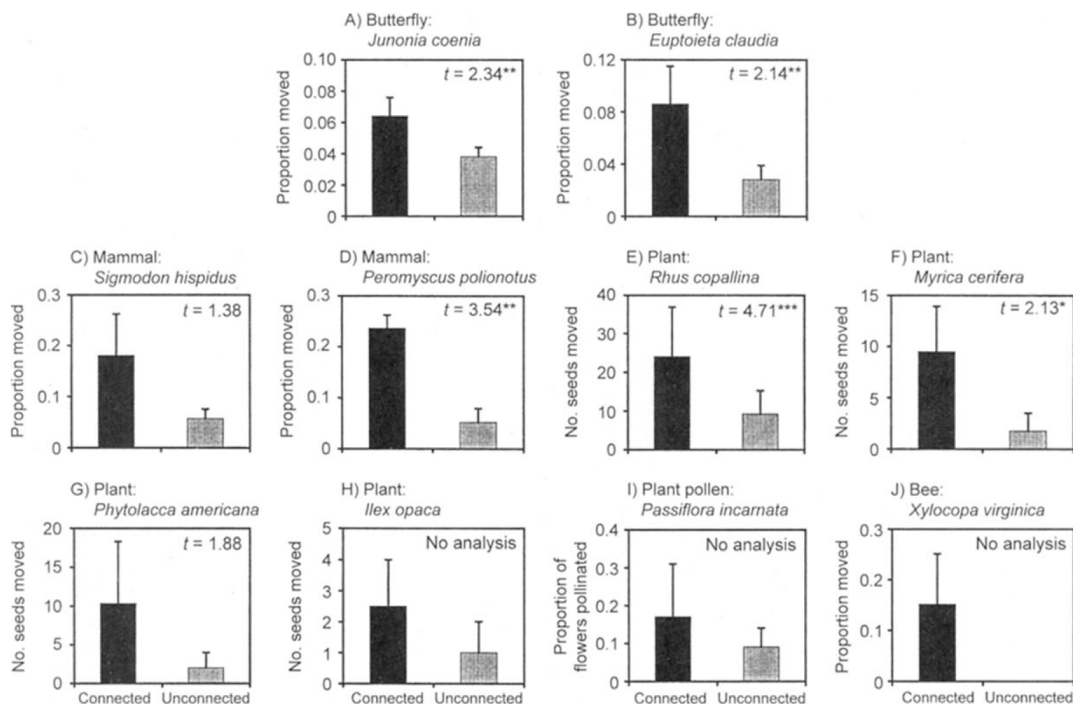


FIG. 2. Plant and animal movement between connected and unconnected patches. Panels (A)–(D) and (J) show the mean (+1 SE) proportion of individuals that were marked in one patch and moved to a connected or unconnected patch. Panels (E)–(H) show the mean (+1 SE) number of bird-dispersed seeds that moved from center patches to connected or unconnected patches. Panel (I) shows the mean (+1 SE) proportion of flowers in connected or unconnected patches with fluorescent powder. Data for butterflies are adapted from Haddad, N. M. 1999, Corridor and distance effects on interpatch movements: a landscape experiment with butterflies, *Ecological Applications* 9:612–622. Asterisks indicate significance levels: \* $P < 0.10$ ; \*\* $P < 0.05$ ; \*\*\* $P < 0.01$ .

## Questions

1. Briefly describe the overall pattern you see in the data.
2. For which species are the results significant?
3. Does your answer to Question #2 suggest any patterns among species types? For example, are plants different from animals or are butterflies different from bees? Describe the patterns and try to explain them according to the characteristics of the taxa involved.
4. Haddad and colleagues conclude that “In our study, we lack data on population viability and genetic diversity, and our dramatic increases in movement to connected patches strongly suggest, but do not demonstrate, the value of corridors.”
  - (a) Do you think this statement (“suggest, but do not demonstrate”) is a fair assessment of their study? Explain your answer.
  - (b) What other data are the researchers suggesting they need to conclusively demonstrate the importance of corridors? Do you think they are right? For example, does knowing the level of genetic variability answer questions about long-term population survival?
  - (c) How could researchers collect these data? Give suggestions for several of the species in their study.
5. Based on what you know from the Haddad et al. study, what would be the effects of a border fence on the population of jaguars mentioned in Part I? Explain your thinking. Specify any additional information you need in order to make sound predictions.



Figures 1 and 2 and accompanying captions were reproduced with permission of Ecological Society of America, from “Corridor use by diverse taxa” by Haddad, N.M., D.R. Bowne, A. Cunningham, B.J. Danielson, D.J. Levey, S. Sargent, and T. Spira, in *Ecology* 84(3), 2003, pp. 609–615. Case copyright held by the [National Science Teaching Association \(NSTA\)](#). Originally published May 25, 2011. Please see our [usage guidelines](#), which outline our policy concerning permissible reproduction of this work.