

## Do Wildlife Corridors Have a Downside?

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Since the dawn of conservation biology in the 1970s, wildlife corridors—strips of land to connect otherwise isolated habitat patches—have been promoted as a means to reconnect fragmented landscapes, protect biodiversity, and maintain population integrity. Ecological studies have often investigated corridors' positive attributes, such as their role in the preservation or enhancement of genetic diversity. Highway overpasses that allow for grizzly bear movement and remedy reproductive isolation are a classic example.

Negative impacts of corridors have received less attention. A corridor's connectivity may also aid the spread of unwanted guests, including disease, fire, predators, invasive species, domestic animals, and poachers, as was articulated by Daniel Simberloff and James Cox in 1987 in *Conservation Biology*. Recently, scientists began examining the potential downside of corridors. Despite this growing body of research, more questions than answers remain.

North Carolina State University's Nick Haddad and his colleagues conducted a 2014 meta-analysis evaluating 33 papers addressing the negative effects of corridors, published in *Conservation Biology*. They found no consistently negative effects but highlighted mixed evidence that corridors give unwanted predators, parasites, competitors, and pathogens a helping hand and may synchronize population cycles (a risk factor for local extinction). Corridors typically have a high edge-to-interior ratio, and "edges inevitably exert some effect on corridors and the patches they connect." The authors noted that wider corridors with "softer edges" are preferable but that there is a dearth of studies evaluating how wide is wide enough. The ideal width for one species may be ineffective for another. The composition of the surrounding

landscape matrix matters too, adding further complexity.

In a study published in the August 2014 issue of *Ecology*, the University of Florida's Julian Resasco and his colleagues, including Haddad, looked at the use of corridors by an invasive species. At South Carolina's Savannah River Site, they used eight replicate landscapes, "each with connected and unconnected patches the size of football fields," says Resasco, to compare invasive fire ant densities in habitat patches with and without corridors. Fire ants (*Solenopsis invicta*) are a noxious invasive species in the southern United States and are spreading globally. Fire ants have two distinct social forms. The polygyne (multiple-queen) form causes more ecological damage but typically has inferior dispersal ability compared with the monogyne (single-queen) form. In landscape replicates where the polygyne (dispersal-challenged) fire ants were present, corridors increased their densities, and as a result, lowered diversity of native ant species. This effect may be short term, and poor dispersal is an unusual trait for invasives, but such traits are useful for predicting when corridors may contribute to the spread of invasive species, say the researchers.

Even when corridors do give undesirable species a helping hand, the knock-on effects might be both positive and negative. Marit Wilkerson, of the University of California, Davis, investigated the use of corridors by invasive plants. In agricultural hedgerows and ditches of the Central Valley, many bees use invasive mustard species for food, "so that is a positive effect facilitated by a corridor taken over by an invasive," she says. Asked whether there are examples of corridors where the negative effects outweigh the positives, she said that was not known; few studies

have matched the effects of corridors with their original goals. Assessing the net effects is clouded further by the fact that most corridor studies have focused on one or a handful of species, rather than community-level effects. What is still missing from virtually all studies, argues Haddad, is an assessment of how corridors affect the long-term persistence of populations, something also highlighted in a 2014 *Conservation Biology* paper coauthored by Northern Arizona University's Paul Beier. He and his colleagues are seeking out half-century-old habitat corridors to answer the seemingly simple yet unanswered question: Do they work to promote gene flow and demographic movement?

Nowadays, corridors are touted as a strategy to help species forced into climate-induced range shifts. Though he applauds Haddad's work, Simberloff argues that its small-scale nature makes it difficult to scale up their findings. A quarter-century after his often-cited paper, Simberloff still worries about corridor impacts. Since then, many corridors have been constructed. But, he says, "we don't know what would have happened if they had *not* been constructed." Beier is more optimistic, explaining that, historically, natural habitats "were very well connected, and both the things we care about, and the diseases, were able to move freely across the landscape." He says, "Nobody is proposing to connect two areas that have naturally been isolated," adding that we are just trying to conserve enough of this remnant connectivity to maintain the benefits.

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