Wildlife Corridor and Population Abundance：
Evidences from Experimental and Empirical Studies

Key Messages

- Positive effects of corridor connection on population abundance have been observed through controlled studies on experimental landscapes.
- Researchers believe that corridors can increase population abundance by increasing dispersal rates, reducing inbreeding, increasing home range available, and directing species movements.
- On real world landscapes, the effects of corridors in providing connectivity are less clear than their effects in providing extra habitat areas.
- Corridors can have a negative effect on species survival by increasing edge effect and risk of predation.

Background Information

Habitat fragmentation is widely believed to be a major threat to wildlife population, and the preservation or restoration of habitat patches is a commonly adopted conservation strategy to counter such threats (Rosenberg et al., 1997; Farig, 2003). In theory, corridors can have a positive effect on the abundance of wildlife population on both ends by facilitating colonization and genetic flow between habitat patches, increasing total available habitat area, and rescuing populations from extinction (Weldon, 2006; Tewksbury et al., 2002). Ecology studies conducted at large, landscape scale generally supported this theory by identifying positive correlation between habitat connectivity and population abundance (Beier & Noss, 1998; Pardini et al., 2005).

The effects of specific corridors on the population of specific species, however, deserves a closer examination, since corridors' effects on population may be mediated by factors like edge effect, habitat quality, and species-specific behavioral traits (La Polla & Barrett, 1993; De Lima & Gascon, 1999; Weldon, 2006). These topics have been studied by ecologists over a wide range of taxa both through controlling "corridor treatments" on experimental sites and by monitoring outcomes of restored or remnant corridors in real world landscapes. This essay summarized the findings of seven such case studies and highlighted the key lessons learned from them, in an effort to support evidence-based corridor design and restoration projects in the future.

Supporting Evidence from Individual Studies

1. Corridor increased butterfly density on experimental open-habitat patches

Haddad & Baum (1999) conducted an experimental test on the effect of habitat corridors on butterfly density at Savannah River Site, South Carolina. 27 equal-sized open patches of 1.64 ha that would serve as butterfly habitats were created by harvesting pine trees from the forest. Of the 27 patches, 19 were connected by cut corridors and eight were isolated. Butterfly surveys over two years found consistent evidences that butterfly density for three of the four surveyed species were significantly higher on corridor-connected patches after controlling for the effects of flowering plants. The authors identified three possible explanations for the observation: a) corridors increased movement rates; b) corridors increased non-edge habitats; and c) corridors acted as “drift fences” directing butterflies to connected patches (Haddad & Baum, 1999).

2. Corridor presence increased Meadow Vole density on experimental sites

La Polla & Barrett (1993) conducted an experimental test on the effect of corridor presence and width on Meadow Vole at an old field site in Ohio. A 3x3 randomized block was created by mowing the surrounding vegetation, making three pairs of patches connected by narrow 1-m corridor, three pairs of patches connected by wide 5-m corridor, and three pairs of unconnected patches. Vole population was surveyed by live traps and the results showed that both narrow and wide-corridor treatments had consistently higher mean vole density than controls. However, no difference in vole densities was evident between narrow and wide-corridor treatments. The authors concluded that the observed difference between treatments could be due to a) increased dispersal that facilitated colonization and reduced potential in-breeding, b) the additional habitat contributed by the corridor itself, or c) increased use of patches by voles for home range establishment (La Polla & Barrett, 1993).

3. Corridors didn't affected abundance but reduced nesting success for Indigo Buntings on experimental site

At Savannah River Site, South Carolina, Weldon (2006) conducted a study on the effect of corridors on Indigo Bunting. The study was done within eight experimentally replicated blocks of early-successional patches located within old pine matrix, which provided suitable breeding habitats for the species. Each block was composed of three unconnected habitat patches and two connected patches joined by a 150 x 25 m corridor. Breeding bird abundance and reproductive success of Indigo Bunting were monitored for a year at the experimental blocks. Neither the abundance of male and female birds, nor the abundance of nests differed among treatments. Daily survival rates, though, was significantly lower in connected patches than in unconnected patches. The authors believed that reduced nesting success was caused by an increase in predation risk resulting from edge effects incurred through the addition of the corridor (Weldon, 2006).

4. Landholder survey revealed wildlife increase on restored forest corridor in Australia

Community Rainforest Reforestation Program (CRRP) was a program in Queensland, Australia in which farm owners were encouraged to plant mixed native tree species on their properties. About 60% of the CRRP plantings formed part of a vegetation corridor network by connecting remnant forest patches to greater forest areas. 72 CRRP landholders in two counties were surveyed between 2000 and 2001. In the survey, 75% of the landholders covering 70% of the project area observed an increase in wildlife number in CRRP plantations, and 20% of the respondents (28% of project area) reported that wildlife number increased by "a lot more". These findings provided some evidence that the CRRP approach to restoration had some success in contributing to the conservation of biodiversity (Harrison et al., 2003).

5. Linear remnants hosted viable population of small mammals and frogs in the Amazonia

De Lima & Gascon (1999) examined the conservation value of linear riparian remnant in the deforested Amazonian landscape of Brazil. Four linear streamside forest remnants 140-190 m wide and 700-1600 m long were studied by comparing their small mammal and frog richness and density with those of the adjoining continuous forest. They found no significant difference in species richness or abundance for either small mammals or frogs between linear remnants and continuous forests. Moreover, many frogs and small mammals were found to be reproducing and moving in the remnants. Findings from this study thus suggested that the linear remnant forests were able to function as corridors providing habitat connectivity for the species (De Lima & Gascon, 1999)

6. Vegetated roadside swale didn't increase reptile abundance in connected remnant patches

Williams et al. (2012) studied the effects of roadside swales as dispersal corridors for reptiles in Australia. Researchers compared reptile abundance between patches of remnant paddock dune habitats isolated by farmlands and paddock dunes connected to a conservation park through vegetated roadside swales. The roadside corridors were 20 km long and 5-30 m wide, and they traversed multiple patches of remnant vegetation, ideally providing viable dispersal habitats for reptile species. Results of the study, however, showed that reptile abundance were not significantly different between dunes connected by roadside swales and those that were not. Such a finding suggested that connectivity provided by roadside corridors was inadequate. They did not facilitate reptile colonization of remnant habitat patches within farmlands (Williams et al., 2012).

7. Rainforest birds increased inside planted corridor, but not at the connected habitats

A 1.5 km-long creek corridor was replanted to connect two rainforest national parks in Queensland. Bird surveys were conducted over a three-year period after the replantation at 14 census points: six in mature rainforests on the ends of the corridor; four in remnant forests connected by the corridor, and four inside replanted forest areas. Survey results showed no or little consistent change in bird communities over time at the "rainforest" or "remnant" sites, but significant changes took place at the "planting" sites toward more rainforest-like bird communities. Bird species that mainly occur in rainforest observed at "planting" sites increased from 0.7 ± 0.8 bird per count in 1996 to 4.3 ± 0.7 birds per count in 1998. Frugivorous birds, the main seed dispersers into the plantings, also increased significantly from 1.8 ± 0.9 in 1996 to 3.6 ± 0.8 birds per count in 1998 (Jansen, 2005). The finding suggested that the replanting was able to provide habitat for some bird species and facilitate further regrowth by facilitating seed dispersal. But a longer time might be needed for those corridors to develop enough to provide connectivity for rainforest only species.

Conclusions and Recommendations

Evidences from the case studies showed that the effects of corridors on wildlife abundance can be more complicated than suggested by theories. Simplified experimental studies on butterfly and Meadow Vole did show increased abundance on patches connected with corridors. Scholars proposed several possible explanations for the observation, including increased dispersal rate, increased habitat area created by the corridors, greater home range availability, and "drift fence" effects of the corridors (La Polla & Barret, 1993; Haddad & Baum, 1999).

As for the real-world cases, positive effects of corridors on wildlife abundance were mainly associated with increased habitats created by the corridors themselves, as the increases were mostly observed inside the corridor rather than on the ends (De Lima & Gascon, 1999; Harrison et al., 2003; Jansen, 2005). In the Williams et al. (2012) study, corridors were found to have no effect on the colonization of the patches they connect. From those studies, the effects of corridors in improving connectivity could not be easily distinguished from the effects in increasing habitat area (Fahrig, 1997). Another possible reason for the lack of evidence for the effects of connectivity might be that population abundance changes in real landscapes can take longer time to manifest and require harder efforts to monitor.

The Weldon (2006) study found the population of Indigo Bunting to be negatively affected by corridors due to increased nest predation. This finding warns us that the effects of corridors in improving the chance of survival for species cannot be taken as granted. By changing the spatial configuration of the landscape, corridors will interact with the species behaviors and inter-specific interactions to create complicated and unexpected outcomes for different species.

From my review of the studies discussed above, I propose the following recommendations for the design of future corridor studies and projects to better understand the effects of corridors on wildlife population abundance:

- Evidence for the positive effect of corridors on wildlife abundance is insufficient outside small experimental sites. **Baseline survey** and **continuous monitoring over a longer time scale** would be necessary in landscape-scale conservation corridor projects to gather more evidence for their effectiveness in promoting conservation.
- For longer-life-span species, a long time period might be needed before increased connectivity can translate into abundance change at the population level.
- Species of different taxa and from different ecological niches should be surveyed to examine the potentially differential effects of corridors on them.
- In future researches, abundance counts can be combined with other research methods on animal movement and genetic flow (e.g. radio-collaring, habitat use study, genetic tracking) to better understand the channels through which corridors affect wildlife population.

Supporting Studies

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