A Summary of Conservation Evidence for Planted Corridors' Effects on Animal Movement

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Background Information

Planted corridor is the narrow landscape element built by planting trees and used by wildlife to travel from on habitat patch to another (Beier and Noss 1998, Soule and Gilpin 1991). The isolation problem has become a serious topic as the human activity increases in wildlife habitats, and corridor can conserve the connected and viable populations of species (Schultz 1998, Schultz and Crone 2005), thus the effectiveness of planted corridor is a crucial concern. Yet many corridor researches are lack of collaborative movement data of animals (Rosenberg et al. 1997), the difficulty of collecting movement data also lead to an absence of corridor effectiveness evaluation (Tewksbury et al. 2002). This summary collects some researches on planted corridors in different areas, and focuses on the results of corridor construction.

Reference:

Beier, P., and R. F. Noss. 1998. Do habitat corridors provide connectivity? Conservation Biology 12:1241–1252.

Soule, M. E., and M. E. Gilpin. 1991. The theory of wildlife corridor capability. Pages 3–8 in D. A. Saunders and R. J. Hobbs, editors. Nature conservation 2: the role of corridors. Surrey Beatty and Sons, Chipping Norton, Australia.

Rosenberg, D. K., B. R. Noon, and E. C. Meslow. 1997. Biological corridors: form, function and efficacy. BioScience 47:677–687.

Schultz, C. B. 1998. Dispersal behavior and its implications for reserve design in a rare Oregon butterfly. Conservation Biology 12:284–292.

Schultz, C. B., and E. E. Crone. 2005. Patch size and connectivity thresholds for butterfly habitat restoration. Conservation Biology 19:887–896.

Tewksbury J. J., Levey D. J., Haddad N. M. et al. (2002) Corridors affect plants, animals, and their interactions in fragmented landscapes. Proceedings of the National Academy of Sciences of the USA 99, 12923–12926.

1. Corridor in El Zota Biological Field Station

The author chooses El Zota Biological Field Station in northeastern Costa Rica as the research location. The study subjects are three primate species: the mantled howling monkey, the black handed spider monkey and the white-faced capuchin. The planted corridor is a result of the reforestation plan in El

Zota. Both native and exotic tree species are planted to build the corridor, the main tree species are *Gmelina arborea, Carapa guianensis, Hyeronima alchorneoides.* The trees are planted in a density of 82 trees per ha, and can produce edible fruits which may be eaten by primates. The researchers use a systematic observation schedule and attempt focal group follows to control bias. The researchers use scan sampling across all groups to get the primates' activity patterns and use trail maker to record the habitats. According to the study, the three primate species devoted more time to moving within the corridor, compared to other activities in the e corridor, indicating that the primates use the planted trees for movement or travel. Howling monkeys use 26% of time on moving, spider monkeys use 17% of time and capuchins use 16% of time.

Reference:

Jerimiah Luckett, Elizabeth Danforth, Kim Linsenbardt, Jill Pruetz "Planted Trees as Corridors for Primates at El Zota Biological Field Station, Costa Rica," Neotropical Primates, 12(3), 143-146, (1 December 2004)

2. **Corridor in Jasper National Park**

The studied corridor is the Athabasca Valley located in Jasper National Park, Alberta, Canada. The study specie is the wolves living in the studied area. The corridor was constructed through the forested center of a golf center in November 2001, ranging from 210m at the narrowest point to 450m. The corridor contains the gulf center's old fences, and a new wood-trail fence was designed for the carnivore movement and to exclude the elks from unnatural food resources. The researchers used track transects for wolf detection, including wolf movement, prey density and snow depth. When wolf tracks are detected, the researchers followed the tracks with GPS to collect further information. The researchers also recorded the human use of corridor by calculating the average number of human trails. 16, 36, 14 passages of wolves are recorded in year 2000-2001, year 2001-2002, year 2002-2003 respectively. Among these passages, 1%, 81% and 51% are within the corridor. The result shows that wolves shifted most movements to the corridor after the corridor was built, and the elk dispersed along the corridor and mountainside. The wolves prefer to choose area with high prey abundance, low elevations and low levels of human activity. The corridor provide wolves a high quality habitat and increases wolves' access to the elk at low elevations.

Reference:

Shepherd, Brenda & Whittington, Jesse. (2006). Response of Wolves to Corridor Restoration and Human Use Management. ECOLOGY AND SOCIETY. 11. 10.5751/ES-01813-110201.

3. **Donaghy's Corridor**

Donaghy's Corridor is formed by 103 rainforest species in four blocks. The link is between 70m to 120m in width, and is bounded on either side by a 15-m forestry zone of Hoop Pine. The corridor links a 498-ha rainforest and an 80000-ha intact forest. The study subjects are Bush Rat (*Rattus fuscipes*) and Cape York Rat (*Rattus leucopus*), which are two native small mammals. The researchers used genetic analysis to monitor the re-connection of these two previously isolated species, and perform species-specific assessment for corridor usage. The genetic analysis includes quarterly trapping, ear clipping and laboratory analysis. The structure of data is latterly analyzed. As the genetic analysis result shows, 16 long-distance movements were identified in the corridor. The Bush Rat's use and occupation rate of corridor is higher than Cape York Rat's. 14 Bush Rats were identified as long-distance immigrants, among 74 samples, while only 3-4 Cape York Rats were expected to be immigrants among 69 samples. Long distance movements were most common immediately after habitat restoration, and dropped as the new habitat was colonized.

Reference:

Paetkau, David & Vázquez-Domínguez, Ella & Tucker, Nigel & Moritz, Craig. (2009). Monitoring movement through a newly planted rainforest corridor using genetic analysis of natal origin. Ecological Management & Restoration. 10. 210 - 216. 10.1111/j.1442-8903.2009.00490.x.

4. **Savannah River National Environmental Research Park, South Carolina**

The study site is located in Savannah River National Environmental Research Park. The researchers chose 5 blocks as experimental block. The study species is Old-field mice, which is the most common species in the study area. The researchers wanted to study both predator and corridor's effects on small mammals, so aside from small mammal trapping, predator(bobcat) urine is introduced as predator manipulation. in practice, bobcat urine was applied in a grid of dispensers 6.5m apart over entire trapping grid. The researchers also studied giving-up density to measure the foraging activity. The result indicated that interpatch movement rate was very low, only 4 individuals made interpatch movements. The mice showed no preference to patch type, and mice's density had no change with bobcat urine's presence. The foraging activity experienced decline after bobcat urine was applied. The foraging activity was also significantly positively correlated to connected patches. The foraging data shows that the corridor significantly affects the behavior of small mammals. The predator presence in the corridor will negatively affect small mammals' foraging activity.

Reference:

Brinkerhoff, Robert & Haddad, Nick & Orrock, John. (2005). Corridors and olfactory cues affect small mammal behaviour. JOURNAL OF MAMMALOGY. 86. 662-669. 10.1644/1545-1542(2005)086[0662:CAOPCA]2.0.CO;2.

5. **Corridor in Basque country**

The studied corridor is a forest protected area network in Basque country of northern Spain. The area is 7521 km^2, with 25% of natural forest, 28% of forest plantations, 18% pastures and meadows, 13% crops, 8% bushes, 6% urban areas and transportation infrastructures, 2% water bodies. In the study, the researchers used different median dispersal distances (1km, 5km, 10km, 25km) to represent medium and large forest mammals. The researchers' goal is to evaluate the highway defragmentation location's effect on connectivity restoration. The researchers used probability of connectivity index (PC) to quantify the connectivity of corridors. Overall 11 locations are evaluated and ranked. As the results show, the locations having most effective promotion to mammal dispersal are the areas in the central-eastern portion of Basque country, and between the nodes with large forest areas. An area's connectivity promotion decreases as the mammal's body size increases. The decreases of a corridor's effective distance are relatively higher in areas far from other alternative adequate wildlife crossing structures. The contribution of a location to the connectivity depends on its topological position, and is negatively related to the distance from habitat area, to the distance from defragmentation location to other existing alternative wildlife crossing structures, positively related to the amount of habitat connected by linkages.

Reference:
Saura, Santiago & Gurrutxaga, Mikel. (2013). Prioritizing highway defragmentation locations for restoring landscape connectivity. Environmental Conservation. 41. 10.1017/S0376892913000325.

6. **Corridor in western Qinling Mountains**

The studied corridor is a 400km^2 area along the Xushui River Valley(XRV) in Qinling Mountains, China. The corridor links the Huangbaiyuan, Changqing and eastern Niuweihe Nature Reserves with approximate 60 giant pandas and Western Niuweihe Nature Reserve with approximate 20 giant pandas. The researchers want to evaluate the landscape options for corridor between giant panda reserves. Researchers conducted passive infrared cameras and sign plot to detect giant panda activity, and used obtained data for corridor modeling (least-cost model and circuit model). The first step was to construct species occupancy model to identify occupancy covariates and habitat suitability. The second step was to use habitat suitability map to construct least-cost model and circuit model to predict giant panda's potential dispersal pathways. The third step was to assess different variables' effectiveness. The result shows that occupancy rate is higher in low elevation, less steep slope area with abundant bamboo and/ or primary forest. Being close to residence and roads have negative effect on occupancy probabilities. The researchers predicted 3 potential pathways using least-cost model and circuit model. The result of alternative pathway analysis indicates that, The dispersal cost user forest/bamboo restoration is significantly lower than that in current corridor, while dispersal cost under residence relocation scenario is not significantly lower. The study indicates that both natural and anthropogenic factors affect giant pandas' distribution. Human infrastructures (road, residences, etc.) have significant negative effects. The factors that affect corridor's connectivity are elevation, slope, forest age, bamboo presence, distance to road, and distance to large residences.

Reference:
Wang, Fang et al. "Evaluating landscape options for corridor restoration between giant panda reserves." *PloS one* vol. 9,8 e105086. 18 Aug. 2014, doi:10.1371/journal.pone.0105086

Conclusions and Recommendations

Overall, planted corridor has a positive effect on increasing the connectivity between habitats, as given researches indicated. The proportion of studied subject's movements within corridor increases (Jerimiah et al. 2004, Shepherd et al. 2006). The effect of planted corridor diminishes as the body size of mammal increases, (Paetkau et al. 2009, Saura et al. 2013). The predator 's presence will have significant negative effect on corridor's connectivity for a specific specie (Brinkerhoff et al. 2005), while the targeted specie's prey's abundance will have positive effects on the connectivity (Shepherd et al. 2006). The elevation also has significant effect on the effectiveness of corridor (Shepherd et al. 2006, Wang et al. 2014), the slope of correlation depends on the target specie's and its prey's preference. The planted corridor's effectiveness is commonly more obvious after corridor is built (Shepherd et al. 2006, Paetkau et al. 2009), and decreases as the corridor is colonized (Paetkau et al. 2009). The human activity has significant negative effect on planted corridor, as the connectivity drops when there is road or human residence nearby (Shepherd et al. 2006, Wang et al. 2014). The recommendation for selecting potential planted corridor is to choose corridor at appropriate elevation and slope for target species and preys, with relatively low predator density, far from human residence and roads, and close to alternative wildlife crossing structures. The biodiversity of corridor plants is also need to be consider, all the studied corridors used various native plant species to ensure the quality of corridors.

Reference:

Jerimiah Luckett, Elizabeth Danforth, Kim Linsenbardt, Jill Pruetz "Planted Trees as Corridors for Primates at El Zota Biological Field Station, Costa Rica," Neotropical Primates, 12(3), 143-146, (1 December 2004)

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Saura, Santiago & Gurrutxaga, Mikel. (2013). Prioritizing highway defragmentation locations for restoring landscape connectivity. Environmental Conservation. 41. 10.1017/S0376892913000325.

Wang, Fang et al. "Evaluating landscape options for corridor restoration between giant panda reserves." PloS one vol. 9,8 e105086. 18 Aug. 2014, doi:10.1371/journal.pone.0105086