Connecting Technology and Biology: Wildlife Corridors

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Life 2.0 Research Paper
BIO 401- Senior Seminar
Wheaton College, Norton, MA, USA
December 1, 2014

Humankind has been influencing and changing the biological world for millennia, primarily through the use and implementation of technology. More and more, human technology is merging with various biological systems in ways that are irreversible and result in new, hybrid systems. One such hybrid technological-and-biological system that can be observed at both the organismal and ecological levels of biology is the introduction of wildlife corridors.

Wildlife corridors often function to connect previously separated habitats, and in the case of this paper, habitats that have been divided by roads in particular. Terrestrial wildlife corridors are built into the land itself, usually in the form of bridges or underpasses, and can be thought of as irreversible features in the landscape that have changed the pre-existing system in such a way that they create entirely new hybrid systems. Although defining what a wildlife corridor is exactly may differ depending on its function, the term 'corridor' is commonly defined as a broad, internally varied swath of habitat that allows for or directs the spread of organisms from one region to another (Barrows 2011). Recently, wildlife corridors have been constructed to allow organisms better opportunity to disperse and travel between habitats that had previously been disconnected by a barrier, such as a road. The technological structure of the wildlife corridor itself is most often designed as an overpass or bridge that crosses over a road, or an underpass or tunnel that creates a path underneath a roadway. Wildlife corridors can serve different functions, as shown in Figure 1, which illustrates their underlying complexity.

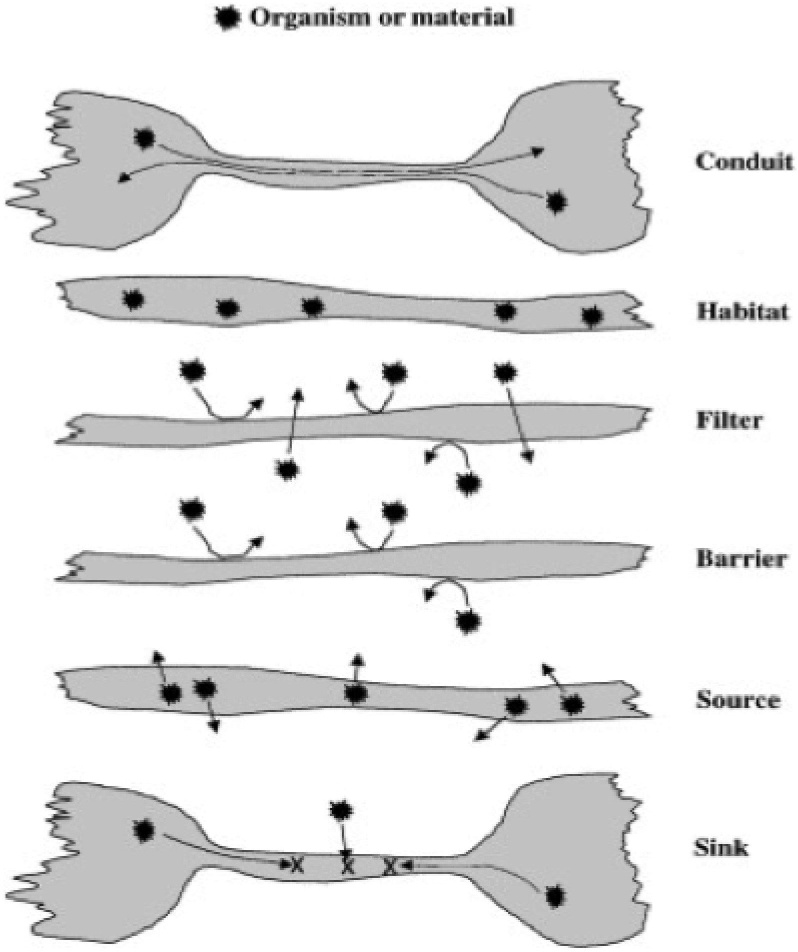

Figure 1: Corridor functions. In this figure, the gray area represents the corridor and arrows represent organismal movement, into and out of the corridor. "Conduit: organisms pass from one place to another, but do not reside within the corridor. Habitat: organisms can survive and reproduce in the corridor. Filter: some organisms or material can pass through the corridor; others cannot. Barrier: organisms or material cannot cross the corridor. Source: organisms or material emanate from the corridor. Sink: organisms or material enter the corridor and are destroyed," (Hess 2001). As the figure depicts, wildlife corridors can serve more than one function for the surrounding environment as well as the organisms that utilize these passageways.

The biological systems into which wildlife corridor technology is brought have been negatively impacted by another human technology: roads. Although roads and the environments they run through may also be considered a hybrid system, for the purposes of this paper they will simply be considered to be the biological system in place prior to the introduction of wildlife corridors. These biological systems negatively affect wildlife, both directly and indirectly. Overall, there are several general effects that roads have on organisms: mortality from road construction and collision with motor vehicles, disturbance and modification of animal behavior, alteration of the physical and chemical environments, dispersal of exotic species, and increased use of areas by humans (Trombulak 2000). Perhaps the most deleterious effect of roads on wildlife, aside from direct mortality, is habitat fragmentation and destruction. Habitat fragmentation, which divides a larger habitat into several, smaller, separate patches of habitat, decreases biodiversity and can alter species composition. Specifically, roads have intensified forest fragmentation more than clear-cutting forests by dissecting large patches of habitat into smaller pieces and by converting typical interior habitat into edge habitat (Reed 1996). The technology of wildlife corridors has been introduced to these biological systems in order to connect previously fragmented habitats and help prevent vehicle mortality in animal species, and in doing so has created a new hybrid system of technology and biology.

When a technological wildlife corridor is introduced into the environment, it alters the preceding biology in such a way that results in a merged system. Before a wildlife corridor is constructed, the biological system operates in a certain way, typically wherein a road separates several patches of habitat; this can lead to more difficult, greater distances of travel between fragments for individuals in a population and could ultimately lead to the isolation of groups of animals, which could potentially endanger the survival of a species (Reed 1996). The implementation of wildlife corridor technology, however, can change the biological system so that, for example, underpasses allow for the passage of animals under roadways to prevent animal-vehicle collisions and provide connectivity between habitats separated by roads, thus enabling gene flow between animal populations and maintaining the undisturbed travel routes of those populations (Kleist 2007). In this way, the hybrid system that is created from the fusing of technology and biology is different from the preceding, problematic system.

This hybrid system, unlike others of its kind, is an intentional assimilation of a biological system and a technology, developed in order to counteract the negative effects of roads on wildlife. Various studies have shown that once introduced, wildlife corridors are utilized by numerous animal species, as is illustrated in Figure 2 with examples of underpasses in Florida.

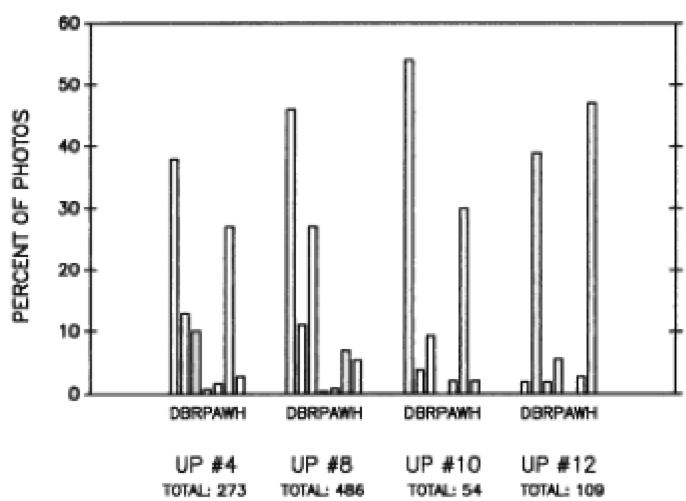

Figure 2: Corridor utilization. "Use of underpasses by wildlife at 4 underpasses (UP) monitored with infrared game counters and cameras in southern Florida, 1992. D = deer, B = bobcats, R = raccoons, P = panthers, A = alligators, W = wading birds, and H = humans," (Foster 1995). As shown in this figure, corridors are used by a variety of species, and these data support that wildlife corridors are true

mergers of biology and technology.

As shown in the graph, even just a few underpasses can be used to avoid roads and connect habitats for a number of species, which would have otherwise been vulnerable to vehicle collision if they attempted to cross the road, or isolation from other members of their respective species if they stayed away from the road entirely (Foster 1995). Wildlife corridors can also be useful during certain seasons, if for example, there are species of animals whose migratory routes run through areas divided by roads. The seasonal usage of a specific wildlife corridor site over several years can be seen in Figure 3.

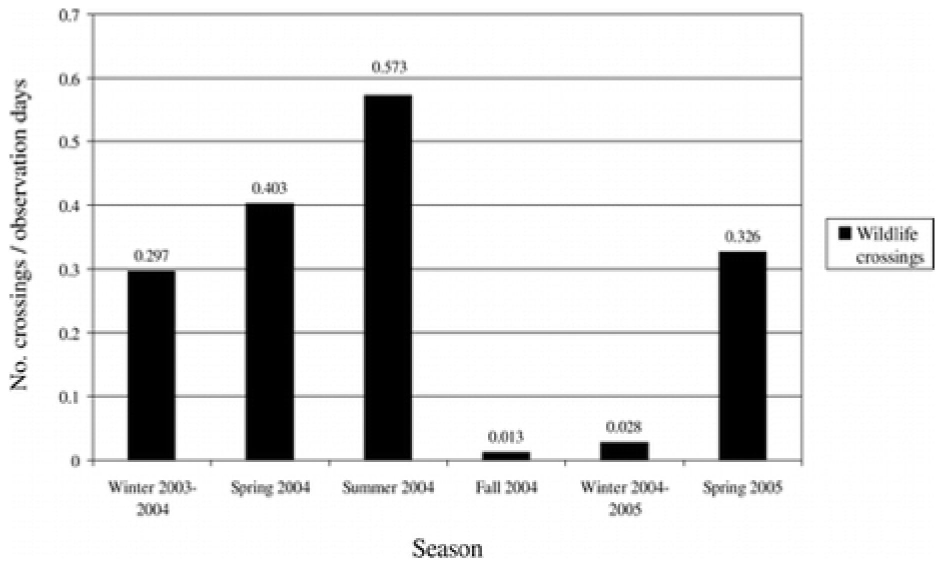

Figure 3: Crossings by season. "Number of wildlife crossings observed in the sample of video data per days recorded by season at the New Hope Creek underpass from December 2003 through May 2005, Durham County, North Carolina, USA," (Kleist 2007). This figure illustrates how the use of this wildlife corridor is highly correlated to the physical season, with a greater number of crossings occurring during the spring and summer than the fall and winter. These data may be helpful in predicting when certain organisms will be utilizing the wildlife corridor, which could be beneficial when considering any potential conservation efforts.

Although there are many benefits to the wildlife corridor hybrid system, there are also some potential negative effects. It has been argued that corridors might encourage the spread of diseases, catastrophic disturbances, whether natural or anthropomorphic, and exotic species into the areas connected by corridors, or could pull animals into spaces, including the corridors themselves, where they might potentially experience higher mortality than they would have without the corridor (Beier 1998). While these concerns are valid, a greater number of long-term studies would need to be done in order to better understand the probability of these dangers becoming reality. Skeptics of wildlife corridors have also objected to the financial cost of this technology, but as many conservation efforts are expensive, this criticism has no unique relevance to, or bearing on, corridor projects specifically, which can be much cheaper than various alternatives (Beier 1998). While wildlife corridors have become more popular in the past few decades, the question of where this technology is headed in the future remains.

As more studies on the impacts and benefits of wildlife corridors are undertaken, it will be important to consider where this technology and hybrid system will go in the future. Hopefully, in the decades to come, more and more wildlife corridors will be constructed to connect fragmented habitats and allow animals to avoid crossing dangerous roadways. As the structural design of wildlife corridors can influence which organisms utilize them, future research and industry might be able to tailor corridor design to better fit certain species and ensure their use (Kleist 2007). However, it is abundantly clear in the world today that the infrastructure of human civilizations, such as roads, can have distinct, negative effects on the world and its organisms. Wildlife corridors are simply one type of technological-biological hybrid system that can help to minimize the damage caused by human activity and improve the state of the world for future generations of organisms to inhabit and enjoy.

Literature Cited

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