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Action: Building Overpass or Underpass on roads

Effect studied: Population Abundance Change

Summary:

- Road border fences prevent animal mortality, but can disrupt habitat connectivity especially without adequate overpasses or underpasses
- A barrier wall-culvert system can reduce animal mortality by up to 93%
- Overpass/underpass corridors can mitigate the population disturbance of building new roads
- Driver-oriented measures like speed reduction and warning signs can reduce animal mortality impacts of roads

Key Messages:

- One before-and-after study in Florida found that a barrier wall-culvert system on a road reduced total animal mortality by 65% and by 93.5% for animal mortality excluding tree frogs. Another before-and-after Florida study found that a drift fence installation in conjunction with an existing culvert reduced turtle mortality from 11.9/km/day to 0.09/km/day.
- One study in California showed that barrier fences along roads can reduce desert tortoise mortality, but can increase fragmentation if the animals fail to use culverts or other means of connectivity.
- One study in Australia found that construction of a corridor leading to two tunnels allowed male pygmy possums to disperse to female breeding areas, after which the population structure and survival rate changed to match that of the undisturbed study area. One 24 year study in the Netherlands showed tunnels mitigated the fragmentation and mortality from roads, as badger risk of mortality stayed the same despite increased road construction and road use.
- One study in Tasmania suggested that road improvement led to extirpation of local quoll population and reduction by 50% of local Tasmanian devil population. Mitigation measures such as slowing driver speeds, increased driver awareness, wildlife reflectors, and pipes and ramps to encourage escape allowed the quoll population to rebound to 50% of former levels and allowed Tasmanian devil population to increase.

Introduction/Background Information:

Roads, while important infrastructure for human communities, often disconnect critical animal habitats and cause animal mortality. One proposed solution are overpasses and underpasses, human constructions intended to allow animal passage over the roads. They attempt to restore habitat connectivity by allowing animals to move freely between divided habitat areas. They strive to reduce animal mortality by reduction of dangerous road crossings by providing a safer alternative. Habitat connectivity and mortality levels are critical to survival and growth of threatened animal populations, making underpasses and overpasses important components of a conservation plan.

This study analyzes existing literature that investigates the impact of overpasses and underpasses on population abundance to better understand their effectiveness and what factors might influence it.

I chose to focus on studies with field data on population abundance, rather than population models, to provide conservation planners with concrete evidence on the function of overpasses and underpasses. Many field studies on overpasses and underpasses measure the corridor usage rather than population because it's easier to measure, and population is influenced by a lot of factors. I sought studies that studied animal populations before and after the introduction of the corridor. While these studies are relatively rare due to their difficulty, they contain valuable information for conservation planners.

Individual Papers:

1. Dodd et al. (2004) *Biological Conservation*

In Alachua County, Florida a research team studied animal road mortality for a year before and after the construction of a barrier wall-culvert system. They found that excluding treefrogs, 158 animals were killed after installation of barrier wall-culvert system compared to 2411 killed before installation, resulting in a 93.5% reduction of mortality excluding treefrogs, 65% reduction including treefrogs. Approximately 73% of the non-treefrog mortality occurred in the 400m section of road beyond the end of the barrier wall. They found 51 vertebrate species using the 8 culverts, as opposed to 28 species using the 4 culverts before construction, and capture success in culverts increased 10-fold after construction. Breaches of the wall were due to overhanging vegetation, or lapses in fence integrity.

2. Vink et al. (2008) *Lutra*

In a 24 year study on badger populations, analysis of population dynamics suggested that tunnels increase the lifetime of reproducing badgers and allow them to disperse to new habitats. Tunnels have allowed the mortality rate to stay more or less constant despite increasing road traffic in the area.

3. Boarman et al. (1997) *New York Turtle and Tortoise Society*

The study found that barrier fences can reduce road mortality of desert tortoises, but may serve to increase population fragmentation without proper corridors like overpasses and underpasses.

4. Mansergh and Scotts (1989) *The Journal of Wildlife Management*

In an Australian study, researchers found that construction of a corridor leading to two tunnels filled with the habitat scree of mountain pygmy-possums, allowed male

pygmy possums to disperse to female breeding areas. After construction, the population structure and survival rate changed to match that of the undisturbed study area.

5. Aresco (2010) *The Journal of Wildlife Management*

A Florida researcher installed a drift fence along a road by Lake Jackson to work with an existing culvert, and studied the effects for 2.5 years. A total of 10,229 reptiles and amphibians of 44 species were studied: 8,842 turtles, 838 frogs, 363 snakes, 152 lizards, 32 alligators, and 2 salamanders. Along a 0.7km stretch, the drift fence and intensive monitoring reduced turtle mortality from 11.9/km/day to 0.09/km/day. Pre-fence data suggested that at least 98% of turtles crossing the 4-lane highway were killed.

6. Jones (2000)

A study in Tasmania was triggered by a road improvement that extirpated the local eastern quoll population after 17 months and halved the local Tasmanian devil population due to road-kills from the increased vehicle speed. They implemented driver-oriented mitigation measures of slowing traffic speed with slow points, increased driver awareness, and wildlife-oriented measures such as wildlife reflectors to deter crossing, and pipes and ramps to encourage animal escape off the road. The animals used the ramps and pipes, and their mitigation measures allowed the quoll population to re-establish up to 50% of its former level after 2 years, and produced signs that Tasmanian devil population is increasing.

Conclusion:

If a road is built, or road traffic is increased, through an area with wildlife, there will be negative effects on population abundance through mortality and habitat fragmentation. Culverts and overpasses can be used to allow safe animal passage across a road, and barrier walls or fences can be used to prevent dangerous animal road crossings, mitigating the effects of roads. Barrier fences without adequate corridors, however, will result in population fragmentation. In addition, driver-oriented measures to slow driver speed and increase awareness can prevent wildlife mortality. While construction of roads generally have negative effects on population abundance, they can be mitigated through culverts, overpasses, barrier fences, and reducing driver speeds.