NCHRP 25-25, Task 113

ROAD PASSAGES AND BARRIERS FOR SMALL TERRESTRIAL WILDLIFE SPECIES

SUMMARY CONSIDERATIONS FOR BARRIER STRUCTURES

Prepared for:

AASHTO Committee on Environment and Sustainability

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DISCLAIMER

BARRIERS FOR SMALL ANIMAL SPECIES

This document summarizes considerations for using barriers to exclude small animal species from roads and to funnel animals to both designated and/or non-designated crossing structures. This summary is based on the literature review, survey report, and knowledge and experience of the authors. The literature review and survey report are available as separate documents produced for this project (NCHRP 25-25, Task 113).

GENERAL CONSIDERATIONS

General considerations include the design and operation and maintenance issues associated with barriers that are implemented along roads for animal species that are smaller than a coyote (*Canis latrans*). These barriers are generally referred to as exclusion fencing, guide-walls, or barriers. The primary purpose of the barriers is provide exclusion or a barrier to animals that attempt to move onto the road while also guiding animals to designated or non-designated crossing structures.

These barriers should only be considered when designated or non-designated crossing structures are also available for safe animal crossings. In some cases, road-kill may have been so high that the local population of the target species has substantially declined. In such cases, it may be essential to stop the road mortality immediately, and barriers may be installed prior to installation of crossing structures. However, it is important to provide critical habitat needs on both sides of the road and to follow through with crossing structures soon after.

In some cases, less permanent or temporary fencing is used during assessment and exploratory studies. For example, temporary funnel fencing and guide-walls may be installed to assess the use of non-designated structures by different small animal species (e.g., Aresco 2005; Collinson et al. 2017) or to assess road-kill reductions to provide a case for a more permanent barrier. In this document, considerations for temporary fencing are not discussed but the focus is more on durable permanent barrier designs, although some components are also applicable to temporary barrier design.

Characteristics

Barrier Type: Permanent barriers are meant to persist in the landscape with minimal maintenance; however, the life span of these barriers is largely unknown and varies with the type of materials used, installation procedures, site conditions, and maintenance. The main types of permanent barrier materials are wood, plastic, concrete, metal or aluminum sheeting, chain-link, and hardware cloth. Design specifications include height, buried depth, and inclusion of a top lip or extension to deter animals from climbing and burrowing underneath the barriers.

Mesh size and wire thickness, commonly termed gauge, are considerations for hardware cloth and chain-link. Mesh and perforations allow for water permeability, but if animals can see through the barrier evidence suggests that the animals will spend more time at the fence and attempt to escape, and may therefore be less likely to find a crossing structure that provides safe passage to the other side of the road (Peaden et al. 2017; Milburn-Rodriguez et al. 2018).

Often a permanent barrier is more easily installed along new or upgraded roads, e.g., twinning expansions and widenings when the adjacent terrain and road features should be considered alongside the design of the barrier. When selecting a barrier design, the following primary components must be evaluated to assess the type of barrier that will be effective:

- Behavior and physiology of the target species
- Terrain slope
- Vegetation
- Continuity of barrier, e.g., presence of driveways and access roads
- Drainage from road
- Presence of existing features such as guiderails
- Presence of subsurface rock
- High water levels of existing wetland and drainage features
- Motorist safety considerations
- Mowing requirements
- Budget

Location: Barriers should encompass the entire habitat that is bisected by the road, as well as an additional 'buffer' to prevent fence-end road-kill. In some cases, the habitat may be homogeneous and extensive and occur for more than several miles alongside a road. In this situation, if barriers cannot extend along the entire habitat, they should extend alongside known animal crossing areas or where road-kill is expected more than chance, commonly termed hotspots. In addition, the known daily movement distances (or home range) of the target species can inform decisions about functional barrier length along roads. The number and placement of crossing structures will also inform barrier location and length.

Maintenance: All barrier materials are subject to "wear and tear" maintenance concerns such as holes, burrowing, wash-outs, erosion, vegetation overgrowth, falling trees, vandalism, tampering, car crashes, and damage from mowing and snow removal. More durable materials, careful and robust installations, along with educating maintenance workers will help optimize routine maintenance procedures and maximize effectiveness in reducing road-kill.

Species-specific Considerations

Behavioral criteria of the target species include the ability for an animal to move, jump, swim, climb, or dig. Physical characteristics include an animal's tolerance to extremes in abiotic climates, such as dehydration, overheating, and freezing. In all cases, barrier designs must integrate the safety and well-being of the animal as well as the behavioral adaptation when interacting with the barrier.

Snakes: Snakes vary greatly in body thickness by species and when growing from hatchling to juvenile and adult. Snakes can poke and move through small openings and may often become stuck. Openings in mesh and separation of material where panels join are examples of openings that snakes can use to access the road.

Some larger snakes (e.g., eastern foxsnake) can climb considerable heights (up to 3.2 feet [1 meter]); therefore, taller barriers are required but may compromise the sturdiness of an upright barrier.

Therefore, an "outrigger" or perpendicular extension, sometimes termed a "lip," are often used to compensate for increased height or to prevent climbing animals from accessing the road (Figure 1). Smoother plastic smooth surfaces may also be used to prevent snakes from climbing barriers (Figure 2).

Figure 1: *Top lip made from chain link fence and metal outriggers from top of fence. Photo Credit: Kari Gunson.*

Figure 2: *Plastic solid Animex fence with top lip and smooth surface to prevent climbing. Photo Credit: Ausable Bayfield Conservation Authority.*

Mammals: Digging mammals can burrow under an exclusion barrier and create tunnels that permeate from the inside to the roadside of the barrier. These tunnels can then be used by all animals that are able to move freely through the dug-out tunnels to access the road. Often, a bottom outrigger or buried lip/apron is used to deter tunneling by animals. Some smaller mammals can easily jump or scale a barrier; therefore, taller chain link fences are often used with both outriggers or "floppy tops" and buried aprons.

Turtles, Amphibians, and Aquatic Mammals: Barriers are generally installed near or adjacent to wetlands for aquatic or semi-aquatic animals. Barrier height should be above the high-water mark along the length of the barrier to prevent animals from swimming over and accessing the road. Drainage is an issue, especially when the barrier material is non-porous and water needs to flow through or past the structure. When there is not appropriate water drainage, wash-outs can occur or the barrier will fail and fall to the ground.

Tortoises and Lizards: A recent study by Peaden et al. (2017) observed tortoises pacing along galvanized wire mesh fence, which can lead to extremely high or lethal carapace temperatures. Another controlled experimental study by Ruby et al. (1994) showed desert tortoises spent more time following mesh fencing than a solid fence. Shade structures (e.g., shrubs along any barriers) should be provided for shelter especially during longer stretches with no available crossing structures. A solid barrier with a smooth surface may be more suitable for tortoises and other climbing reptiles such as turtles and lizards in terrestrial habitat.

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