



ENVEROS

ENVIRONMENTAL EDUCATION THROUGH
ROADKILL OBSERVATION SYSTEMS

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Environmental Education through Roadkills Observation Systems - EnVeROS

03. IMPACTS OF ROADS ON WILDLIFE



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LEARNING OBJECTIVES

At the end of this topic students should be able to:

- Summarize the impact of roads on wildlife.
- Explain the impact of roads on ecological patterns and functions.
- Identify the relation between road impacts and evolutionary processes.
- Relate real world examples with the impacts of roads on wildlife.



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Impact of Roads on wildlife

Ecological Patterns

- Roads impact species' abundance and distribution through both direct and indirect (secondary) effects.
- Direct Alteration of Species Abundance and Distribution.

The most obvious impact of roads on wildlife is mortality or injury through collision.



A car damaged as a result of a crash with a wild boar, Czech Republic.

(Photo: Generali)



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Impact of Roads on wildlife

Ecological Patterns

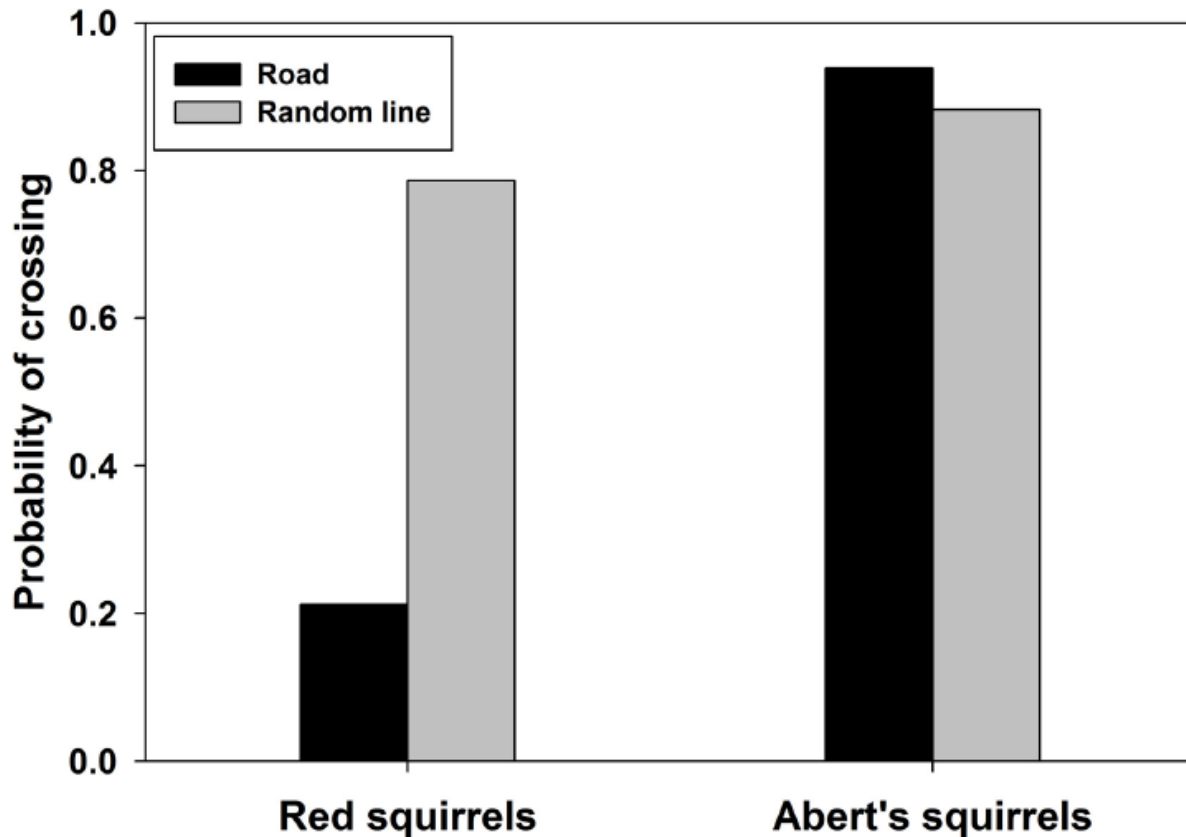
- **Roads impact species' abundance and distribution through both direct and indirect (secondary) effects.**

- Secondary Impacts.

Birds, small and large mammals, and amphibians appear to be markedly affected by fragmentation of habitat caused by roads; the open spaces associated with roads can represent barriers to movement, but also allow predators or alien species to invade habitats.

Alien species invasion

- Roads effectively fragmented the habitat of the endemic Mount Graham Red Squirrel (*Tamiasciurus hudsonicus grahamensis*) but increased habitat suitability for the introduced, edge-tolerant Abert's Squirrels (*Sciurus aberti*) (Chen and Koprowski 2016).



(Source: <https://doi.org/10.1371/journal.pone.0148121.g003>)



(Source: NPS -
<http://www.nps.gov/sagu/naturescience/abert-squirrel.htm>)

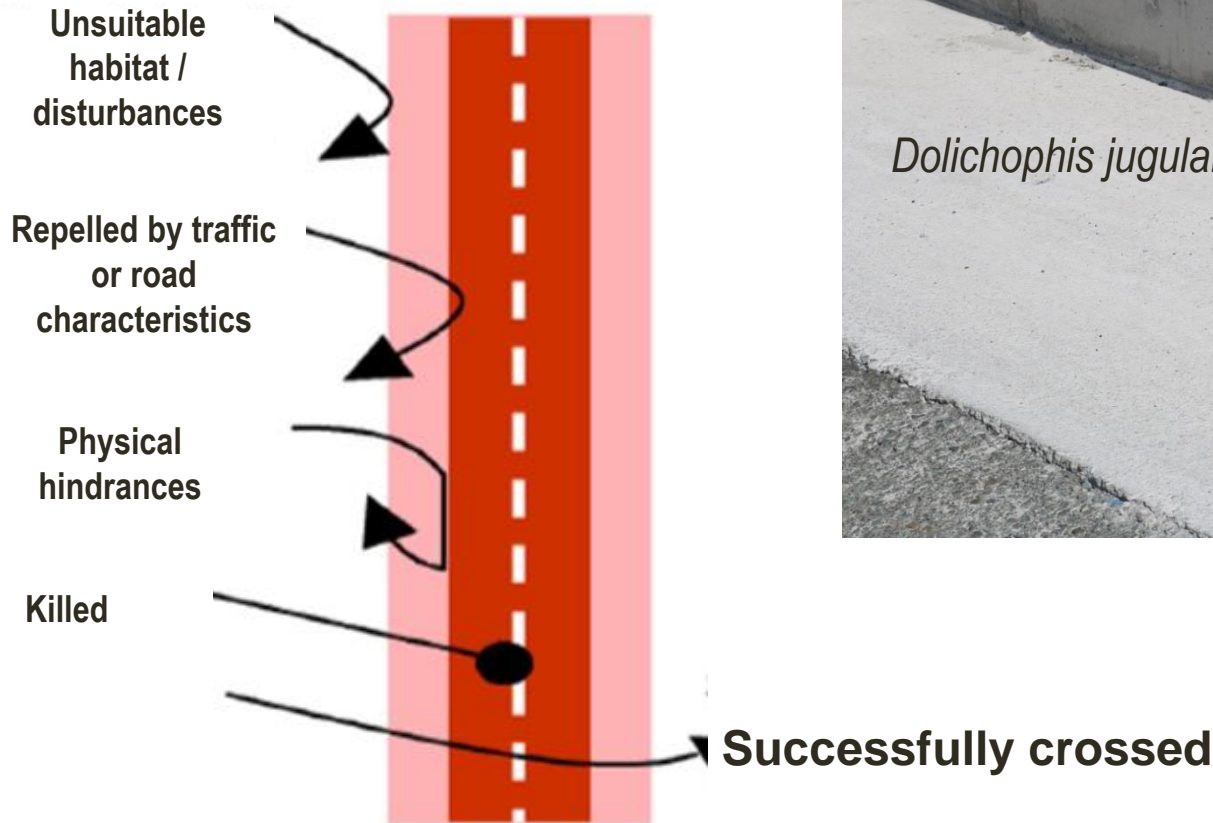


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Roads as barriers



(Source: Seiler, A., 2003; In COST (Vol. 341, pp. 31-50)



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Roads as barriers

Animal movement and roadkills could be highly frequent in areas where:

- Creeks and drainages intersect roads.
- Good habitat and forage near the roadside is present.
- Water source nearby the road.



Aktürk Pilanci



Left: Mouflon (*Ovis orientalis Ophion*) trying to cross the road. Photo: A. Pilanci

Right: Roe deer (*Capreolus capreolus*) killed during AVC, Czech Republic. Photo: Jiří Kasina.



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- **Avoidance:** Some species of wildlife avoid the road-effect zone due to traffic disturbance and/or habitat degradation, resulting in a reduction of habitat or a barrier to movement.
- **Attraction:** Roads and roadsides can attract some species by providing resources or enhanced opportunities.

Reptiles

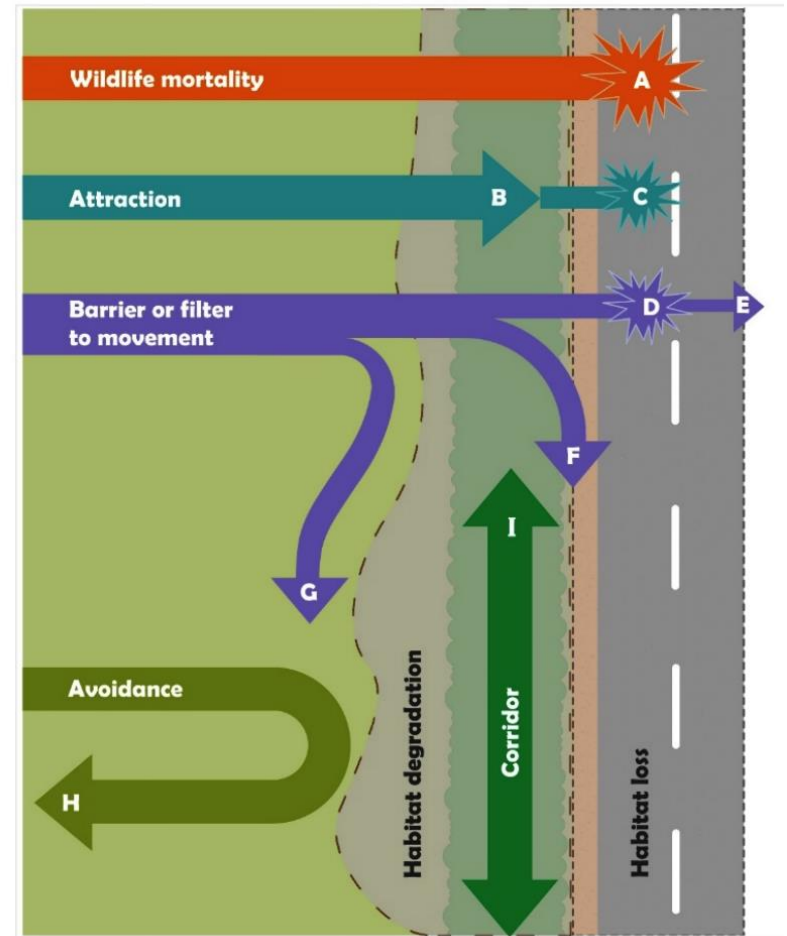
- May bask on the warm surface of the road

Herbivores

- May forage on the enhanced plant growth on roadsides

Scavengers

- Can be attracted to feed on roadkill



(Connecting Habitat Across New Jersey,
Source: CHANJ)



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Ecological function

- **Altered primary production**

Roads are corridors in ecosystems with resources that include:

- runoff water from road surfaces,
- spillages of grain and food discarded by travelers,
- fresh and decomposing roadkill,
- dust and inputs of carbon dioxide and nitrogen from motor vehicles, creating more productive (although also more polluted) patches than the surrounding habitat.



Impact of Roads on wildlife

Ecological function

- **Predation and Scavenging**

- Animals killed on the roads, provided they are freshly killed, provide easily accessed nutrition for scavengers and predators.
- Feeding on roadkill requires minimum energy, although competitive interactions between scavengers may be costly.



(Source: reddit)



Ecological function

- **Predation and Scavenging**

- No energy is expended in capturing prey, but there is energy expenditure in searching for road-killed animals, and there are some risks associated with feeding on items in the road.
- Roadkill that is less than fresh may also offer lowered nutrient content, and for the consumer there is an unknown risk of disease from toxic organisms, including fly larvae, microbes and fungi.



(Source: Marzluff et al., 2001, Kluwer academic Press, norwell, Ma.)

Evolutionary processes

- **Genetic Effects**

- A large and emerging body of genetics research across taxa confirms a loss of genetic diversity in small populations isolated by roads.
- However, long-term impacts on the fitness of affected populations through the reduction in genetic diversity is not yet clear.

- **Roads Exerting Selective Pressure on Populations**

- A study conducted in Poland found that, unlike predators, which remove individuals that are weak or in poor condition, roads “predate” birds randomly (Bujoczek et al. 2011; *Biological Conservation*).

Evolutionary processes

- **Roads Exerting Selective Pressure on Populations**
 - Thus, “fitter” birds are removed through roadkill, whereas predators consistently remove weaker individuals from the population (Genovart et al. 2010; *PLoS One*).
 - The evolution of morphological adaptations in birds living on roadsides is known only for one species. The majority of road-killed Cliff Swallows (*Petrochelidon pyrrhonota*) adjacent to roadside nesting sites in southwestern Nebraska were found to have relatively longer wings than the ‘population at large’ (Brown et al. 2012).



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What makes a species susceptible to road impacts (Forman et al. 2003; Road ecology: science and solutions. Island press.)

Characteristics	Mortality	Habitat loss	Reduced connectivity
Attraction to habitats next to roads	X		
Inability to avoid cars	X		
specialists	X		
generalists	X		
Multiple survival needs	X		X
Large area requirements	X	X	X
Low reproductive rate	X	X	X
Behavioural road avoidance			X



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Roadkill turtle in
Crittenden County,
(Arkansas
Thomas R Machnitzki)

https://commons.wikimedia.org/wiki/File:Turtle_roadkill_2012-06-17_004.jpg

WILDLIFE BEHAVIOURAL RESPONSE	IMPACT	SPECIES EXAMPLES
Non - responders	These animals fail to detect or take avoidance behavior to oncoming vehicles and will continue to try cross the road. The likelihood of a successful crossing decreases with an increase in traffic. These species are vulnerable to populations reductions and fragmentation effects.	Invertebrates Frogs Some snakes Livestock
Pausers	These species detect the danger oncoming traffic poses to them but respond by stopping. The longer they stop or pause, the greater the risk of them being hit by the oncoming vehicle. High traffic volume presents a complete barrier to these species.	Snakes Turtles Western Leopard Toad
Speeders	These species flee from danger but may flee directly into an oncoming vehicle. Shy species may be at risk from a barrier effect and population fragmentation.	Antelope Guineafowl
Avoiders	These species will only cross when traffic volumes are fairly low. Generally these species experience the lowest mortality rates but may suffer from population fragmentation depending on how often traffic volumes are low.	Carnivores



Frog roadkill in
California
(Paul Souders/Corbis)
<https://www.smithsonianmag.com/smart-news/changes-californias-roadkill-linked-states-drought-180954926/>



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Summary

- Roads:
 - impact species' abundance and distribution through both direct and indirect (secondary) effects.
 - alter ecological functions (e.g. predation and scavenging).
 - impact evolutionary processes.
- Special characteristics (e.g. behavior, area requirements) define species susceptibility to roads.



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Selected references

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- Meijer, J.R.; Huijbregts, M.A.J.; Schotten, K.C.G.J.; Schipper, A.M. Global patterns of current and future road infrastructure. *Environ. Res. Lett.* 2018, 13, 064006.
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Activities & self assessment exercises:

- Give 2 examples of Roads impact on species' abundance and distribution through indirect (secondary) effects.
- Explain why roads and roadsides can attract some species.
- What do you understand when you read that “Roads Exert Selective Pressure on Populations”?
- Regarding wildlife behavioral response on/near roads, what is a “pauser”, what is a “spreader” and what an “avoider” species?