



ENVEROS

ENVIRONMENTAL EDUCATION THROUGH
ROADKILL OBSERVATION SYSTEMS

2018-1-CY01-KA204-046919

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Environmental Education through Roadkills Observation Systems - EnVeROS

02. EFFECTS OF ROADS ON ECOSYSTEMS



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LEARNING OBJECTIVES

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

- Describe the ecological effects of roads and highways.
- Identify the road impact zone.
- Recognize the main types of pollution that are related to road construction and function.
- Summarize how the habitat fragmentation due to road construction could affect biodiversity.

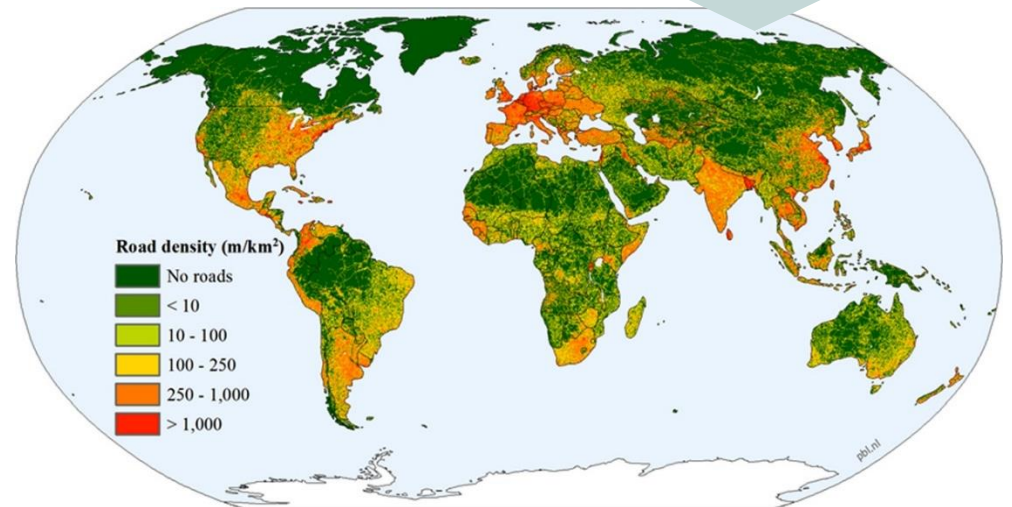
Increase of road length and density

- Despite the already high density of roads globally, road length, density and traffic volume still increase every year.

GRIP global road density map on 5 arcminute resolution representing the densities summed across the five road types.

E.g. in Europe:

- The length of the motorway network increased by 68% between 1990 and 2010.
- The number of passenger cars per thousand inhabitants increased 39% between 1990 and 2010.
- The number of kilometers driven by passenger cars increased by 22% between 1995 and 2010 (European Commission 2014).



(Source: Environ Res Lett)

Schematic representation of the six primary ecological effects of infrastructure:



- **Habitat loss**, **disturbance**, **barrier** and **mortality** effects usually refer to single infrastructure links, yet their long-term impact on **populations** and **ecosystem** depends on the type of infrastructure, landscape, or species considered.

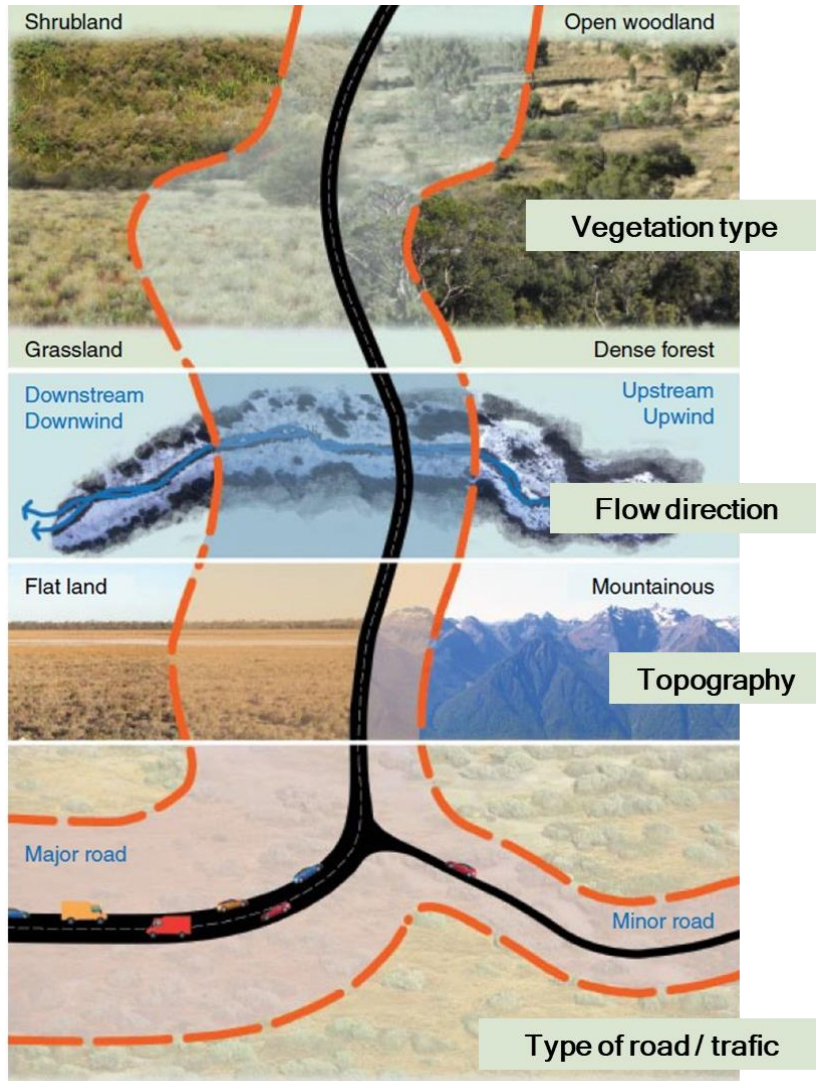
Road Impact Zone

The area affected directly/indirectly by the road and its traffic (Forman & Deblinger, 2000; Conservation biology).

The size of the road-effect zone is affected by a range of parameters – Main of them are:

- (1) Vegetation type
- (2) Direction of flows (wind and water)
- (3) Topography
- (4) Road and traffic characteristics

Sometimes the road impact zone is near 20 times larger than the natural area by the road itself !!!



(Source: Photograph by Zoe Metherell.)



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The size of the road-effect zone is determined by the characteristics:

Road (width, surface type, elevation relative to adjacent landscape)

Traffic (volume, speed)

Adjacent landscape (topography, hydrography, vegetation type, habitat quality)

Prevailing wind speed and direction

Species traits and their sensitivity to the impact.



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Ecological effects of roads and highways

- **Local effects**, such as on noise, water pollution, habitat destruction/disturbance and local air quality.
- **Wider effects** such as habitat fragmentation, ecosystem degradation/ habitat loss and road mortality.



(Source: Patrick T. Fallon/Getty Images)



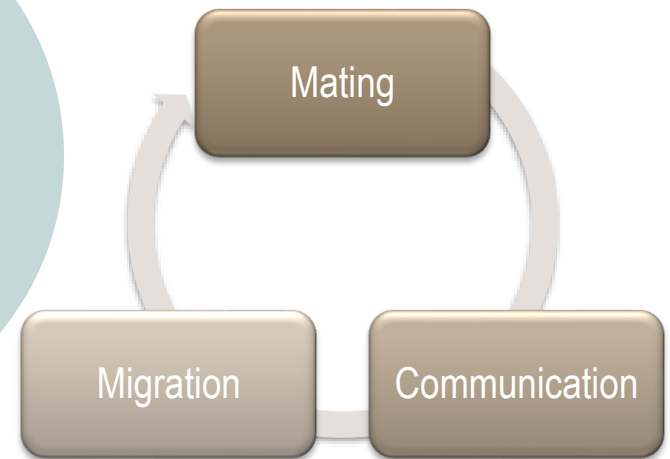
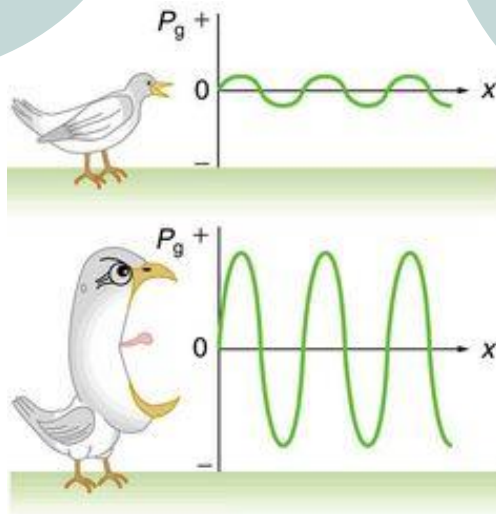
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Environmental effects of roads: Noise pollution

Noise can have a negative effect, particularly on birds.

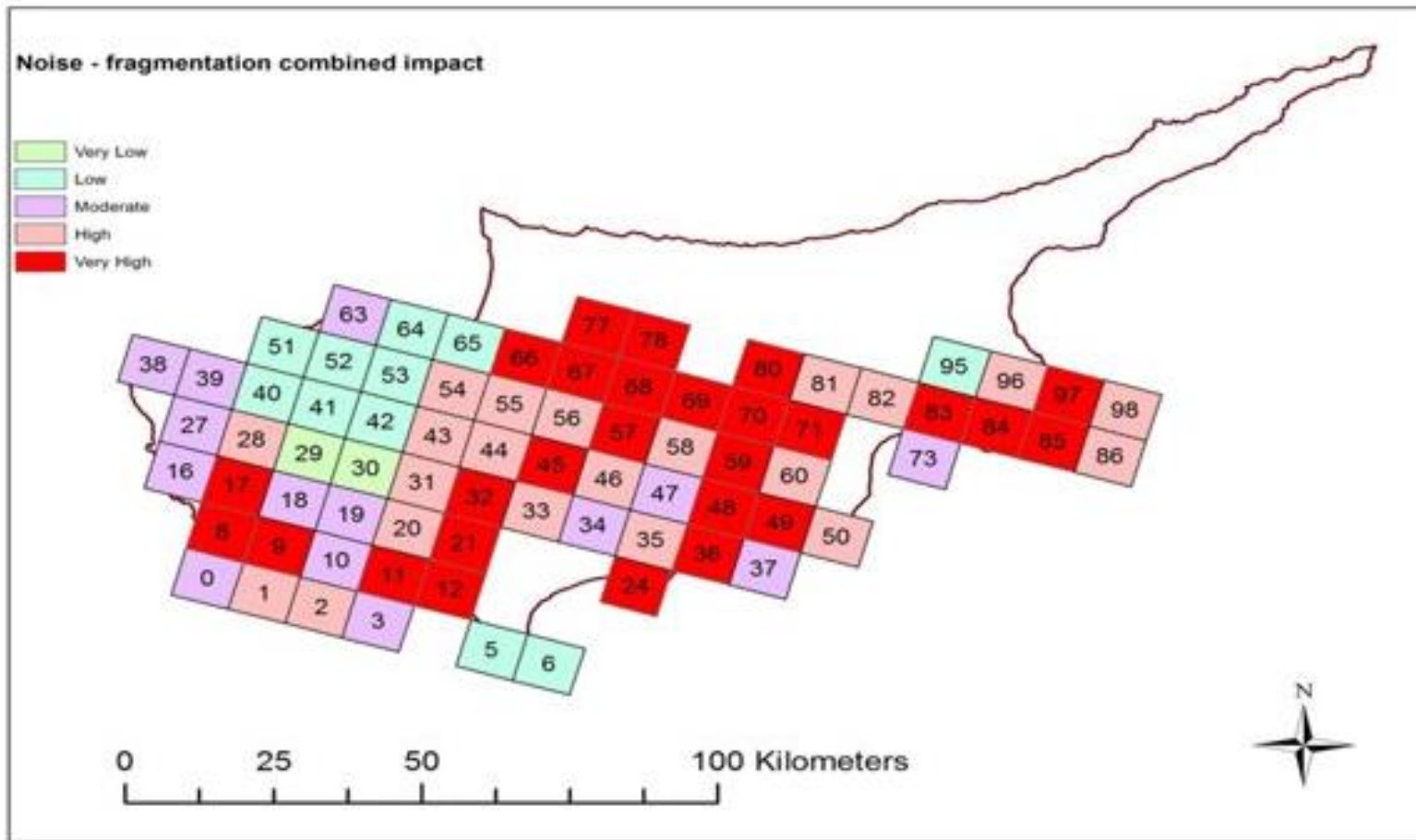
Species abundance around major roads due to noise.

Roads can interrupt or interfere with the calls of song birds, and their instinctive calls associated with **three** activities:



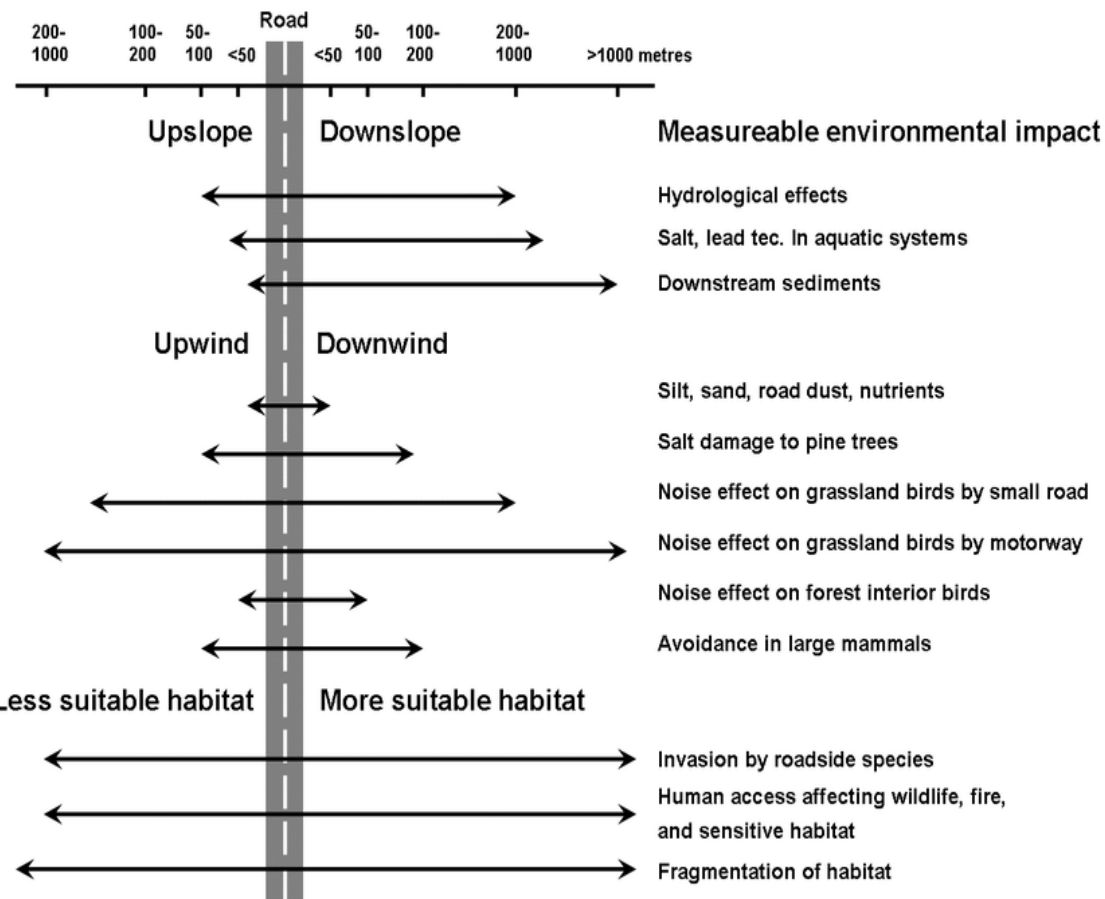


Combined impact of fragmentation and noise on avifauna





Environmental effects of roads: Impacts on Hydrology and Aquatic Habitats



Road construction:

- Alters the hydrology of watersheds through changes in **water quantity** and **quality**, **stream channel morphology** and **ground water levels**.
- Increases runoff and storm discharges.
- Increases erosion.
- Sediment and nutrient delivery to streams and wetlands ➡ adverse impacts to aquatic habitats and species.

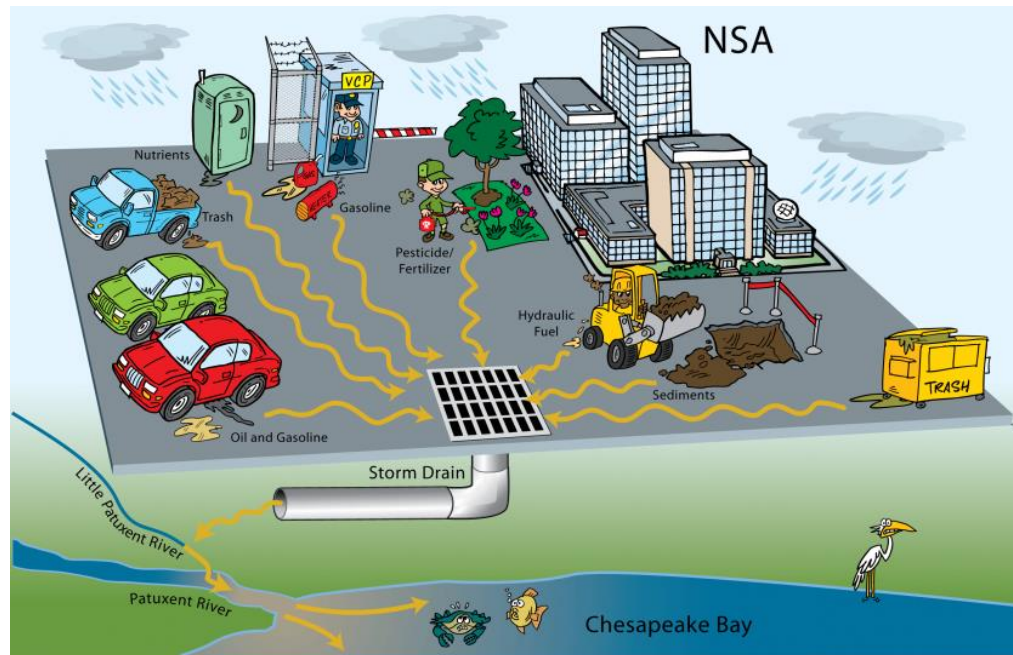
Disturbance effects spreading from a road into the surrounding landscape.

(Source: COST Action 341 Habitat Fragmentation due to Transportation Infrastructure – the European Review.)

Environmental effects of roads: Water pollution / Chemical Pollution

Urban runoff from roads and other impervious surfaces is a major source of water pollution

- Rainwater and snowmelt running off of roads tends to pick up gasoline, motor oil, heavy metals, trash and other pollutants (**Chemical pollution**).
- De-icing chemicals and sand can run off into roadsides, contaminate groundwater and pollute surface waters.
- Road salts can be toxic to sensitive plants and animals.
- Sand can alter stream bed environments, causing stress for the plants and animals that live there.



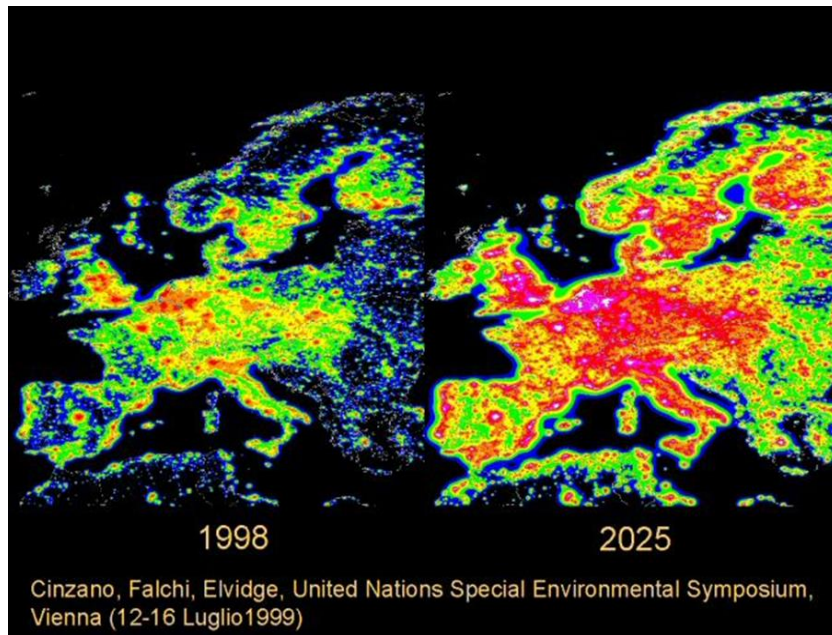


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Environmental effects of roads: Light pollution

Artificial Lights Disrupt the World's Ecosystems:

- Radically alter the nighttime environment of nocturnal animals.
- Disturbs predator-prey interactions.
- Some species lost their orientation with fatal consequences (e.g. sea turtles, migratory birds).



(Source: Flickr)



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Environmental effects of roads:

Local air quality

Air pollution from fossil (and some biofuel) powered vehicles can occur wherever vehicles are used and are of particular concern in congested city street conditions and other low speed circumstances.

- Near the road there are greater respiratory health effects from concentrations of air pollutants than at some distance away from the road.
- Road dust kicked up by vehicles may trigger allergic reactions.
- Motor vehicle emissions are an important contributor to the growth of CO₂ concentrations in the atmosphere and therefore to **global warming**.



(Aab Pasadena Highway Los Angeles.jpg)



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Environmental effects of roads: Habitat Fragmentation

All roads cause Edge phenomenon.

They create conditions along the edge of the road that differ from those inside a biotope.

These conditions favors some species while leading other to extinction.

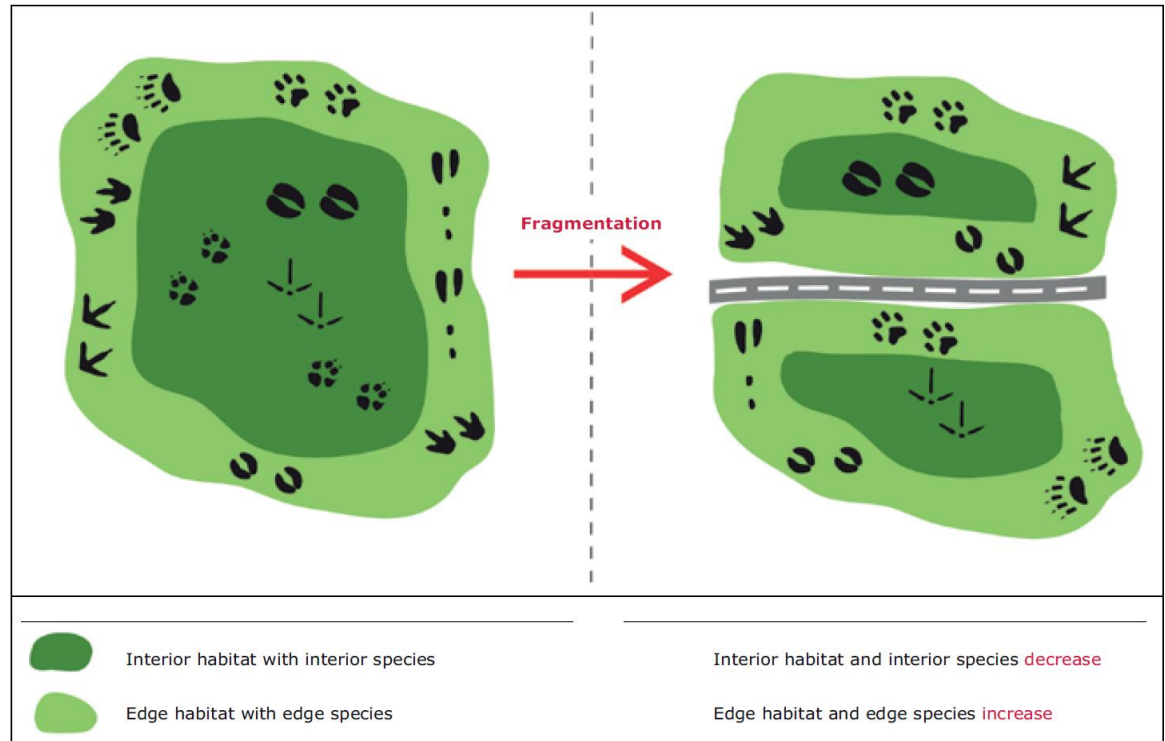


Illustration of the loss of core habitat (or interior habitat) caused by road construction cutting through a patch of habitat (EEA 2011)

Environmental effects of roads: Road Mortality



(Source: Robin Loznak/[ZUMApres.com](https://www.zumapress.com/)/Corbis)



(Source: Capt. Michael Kellems/LaPorte County
Sheriff's Office via AP)

'Sometime during the last three decades, roads with vehicles probably overtook hunting as the leading direct human cause of vertebrate mortality on land' Forman and Alexander (1998)



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Summary

- Despite the already high density of roads globally, road length, density and traffic volume still increase every year.
- Roads cause local (e.g. noise) and wider environmental effects (e.g. fragmentation).
- Road impact zone is the area affected directly/indirectly by the road and its traffic.
- Light, noise and chemical pollution as well as roadkills are typical effects of road impacts to the environment.



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Selected references

- Coffin, A. W. (2007). From roadkill to road ecology: a review of the ecological effects of roads. *Journal of transport Geography*, 15(5), 396-406.
- Daigle, P. (2010). A summary of the environmental impacts of roads, management responses, and research gaps: A literature review. *Journal of Ecosystems and Management*, 10(3).
- Seiler, A. (2001). *Ecological effects of roads: a review*. Uppsala: Swedish University of Agricultural Sciences.
- Van Der Ree, R., Smith, D. J., & Grilo, C. (2015). *Handbook of road ecology*. John Wiley & Sons.



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Activities & Self Assessment Exercises:

- Which are the main ecological effects of infrastructure?
- Which are the main characteristics that affect the size of the road impact zone?
- Make a list with the top 10 countries in the world with the highest road density. Is your country in this list?
- Name local and wider ecological effects of roads and give 3 representative examples.



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