Applied Evolutionary Ecology Part 4: Road Ecology II

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Biol 417: Evolutionary Ecology

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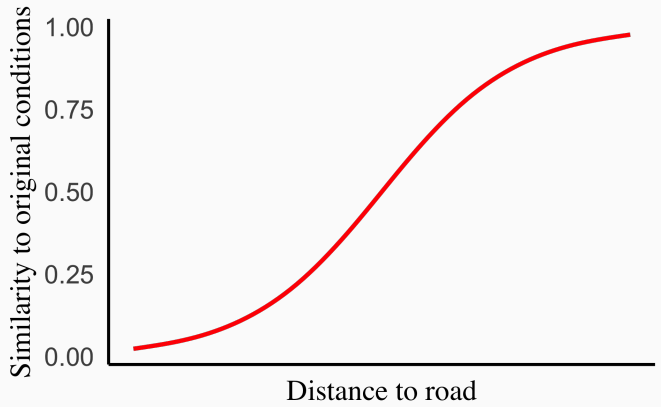
Review

Review

Last lecture we saw how road change the ecosystem in which they are placed to one that is high disturbance, high light, altered chemistry, and altered hydrology.

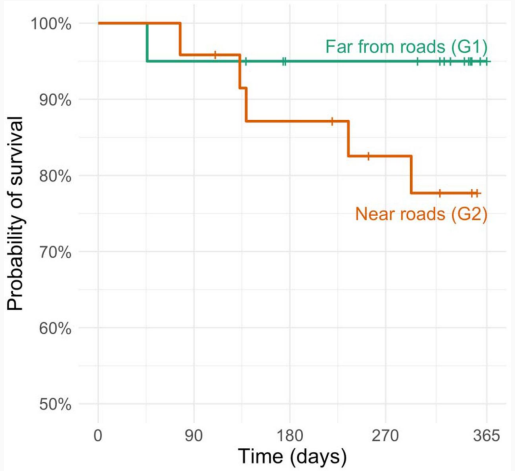
This results in a gradient of conditions when compared to the local ecosystem.



Roadside communities are likely to have substantially different composition from surrounding ecosystems.

Review cont.

Roads are also serious source of non-natural mortality for many animal species.



(Ascensão & Desbiez, 2022)

This can reduce population viability and drive species to change their behaviour or evolve adaptations to counter road-induced mortality.

Today we will focus on the impacts of roads on animal movement.

Road Characteristics and Animal Movement

Road Characteristics

Roads can be unpaved dirt or gravel, paved single lane straights, or large multi-lane highways.

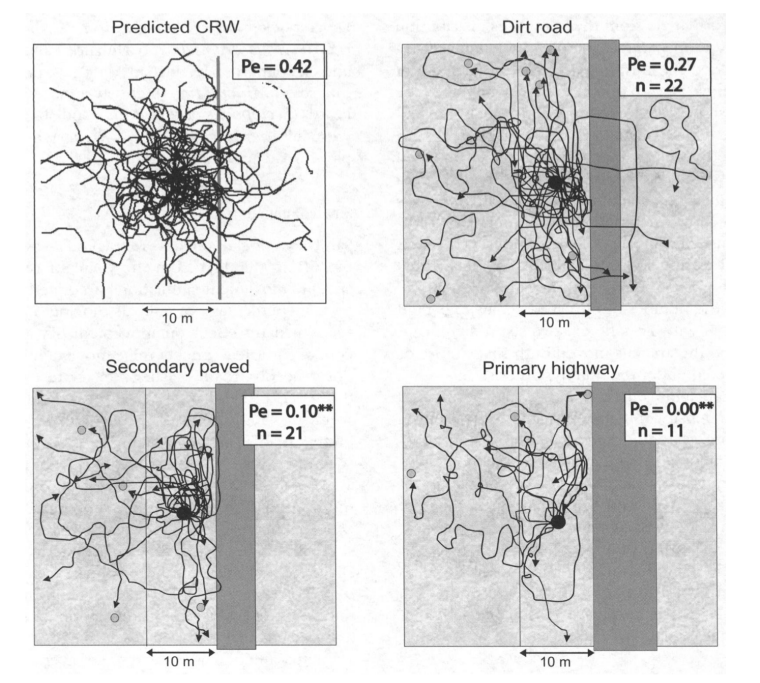
Road Characteristics

Unsurprisingly, wildlife responses to these different road characteristics are just as varied.

Road permeability

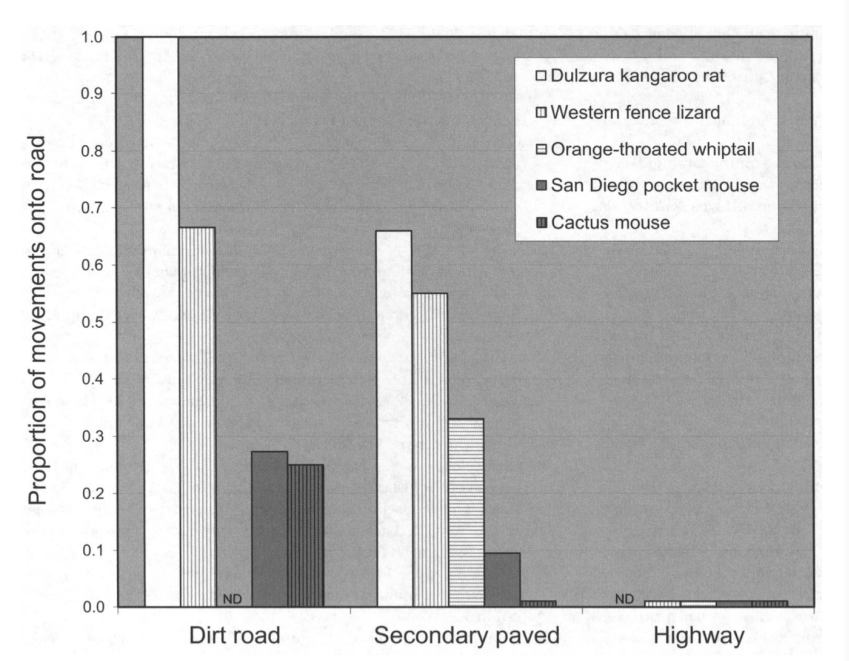
Brehme *et al.* (2013) studied the permeability of roads within the San Diego National Wildlife Refuge.

The San Diego pocket mouse (*C. fallax*) moved across dirt roads, but not paved roads.



Brehme *et al.* (2013)

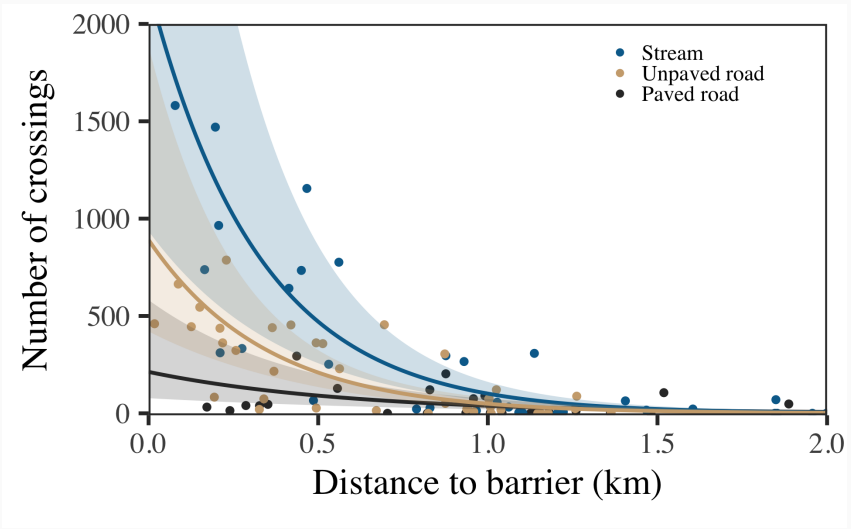
But permeability is species specific.



Brehme *et al.* (2013)

Road permeability cont.

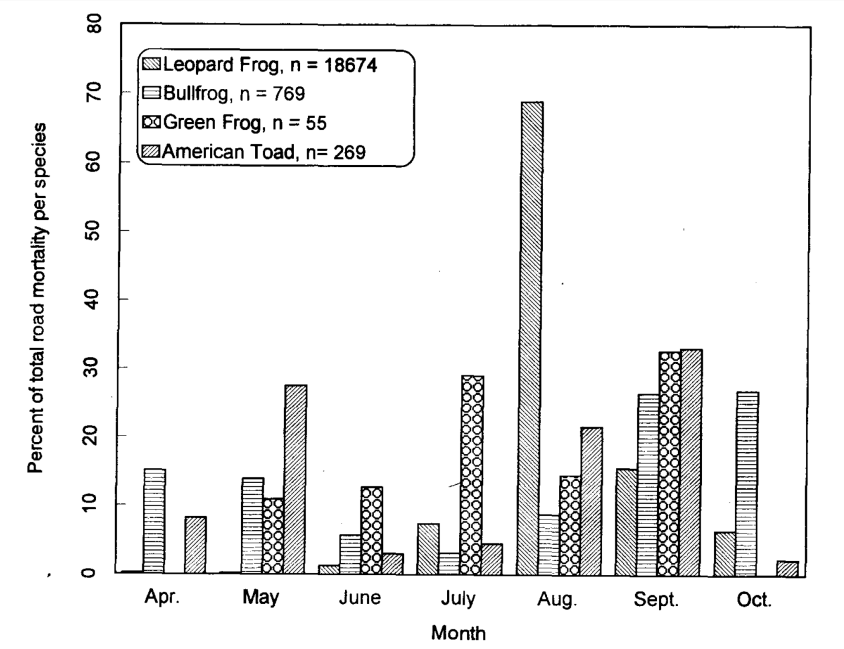
Noonan *et al.* (2021) found that giant anteaters crossed paved roads less frequently than unpaved roads, and both types of roads less than natural linear features (e.g., streams).



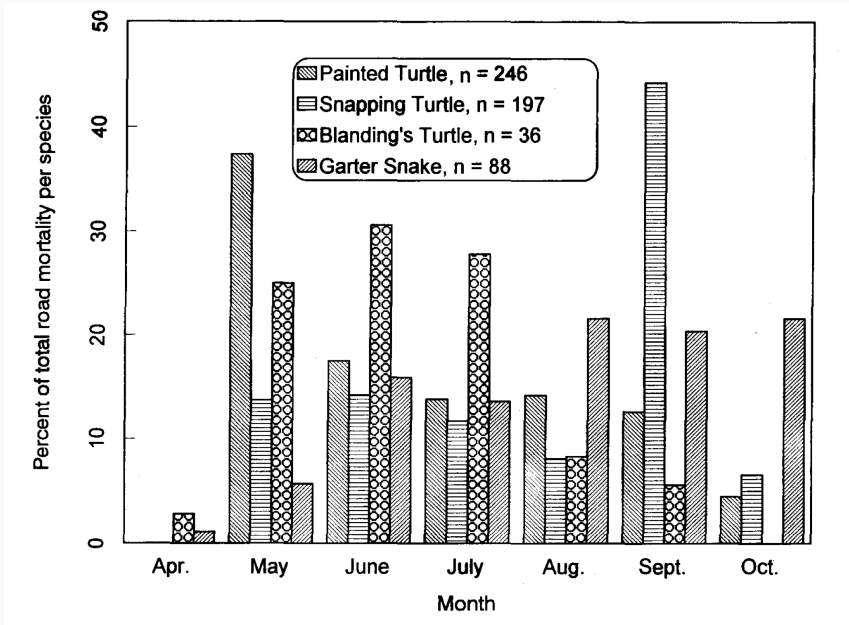
Noonan *et al.* (2021)

Road attraction

Paved roads with lower traffic rates can also attract ectotherms due to the higher temperatures (good basking).



(Ashley & Robinson, 1996)

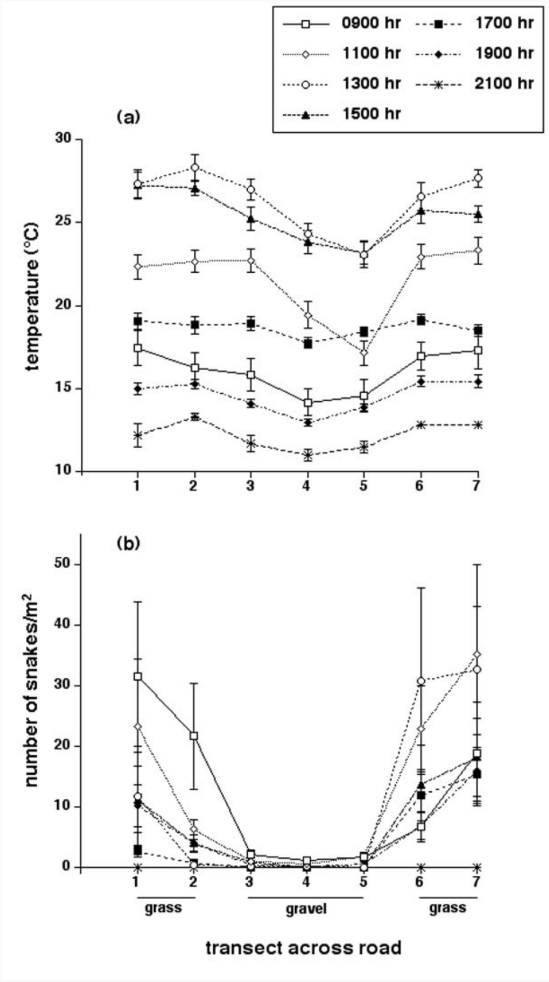


(Ashley & Robinson, 1996)

Road avoidance

But not all roads are equal. Shine *et al.* (2004) found that garter snakes (*T. sirtalis parietalis*) avoid gravel roads.

Source: Flickr



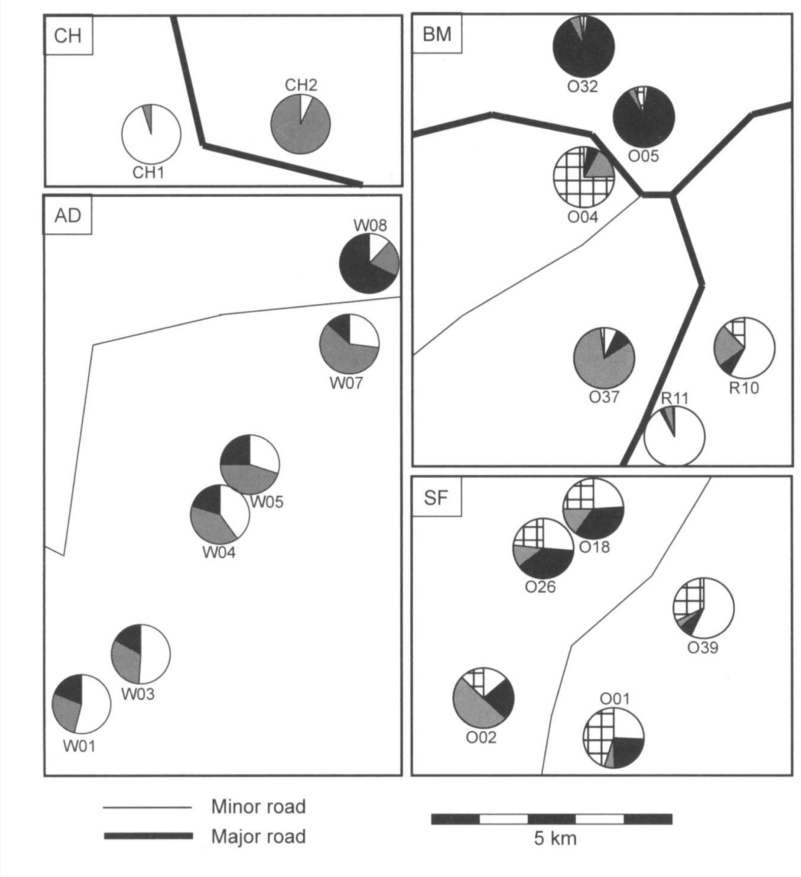
Shine *et al.* (2004)

Road Permeability

On average, roads tend to be less permeable than natural linear features. When this is the case, roads can interrupt dispersal, and alter genetic diversity.

Clark *et al.* (2010) studied the impacts of roads on gene flow in timber rattlesnakes (*C. horridus*).

Source: Wikipedia

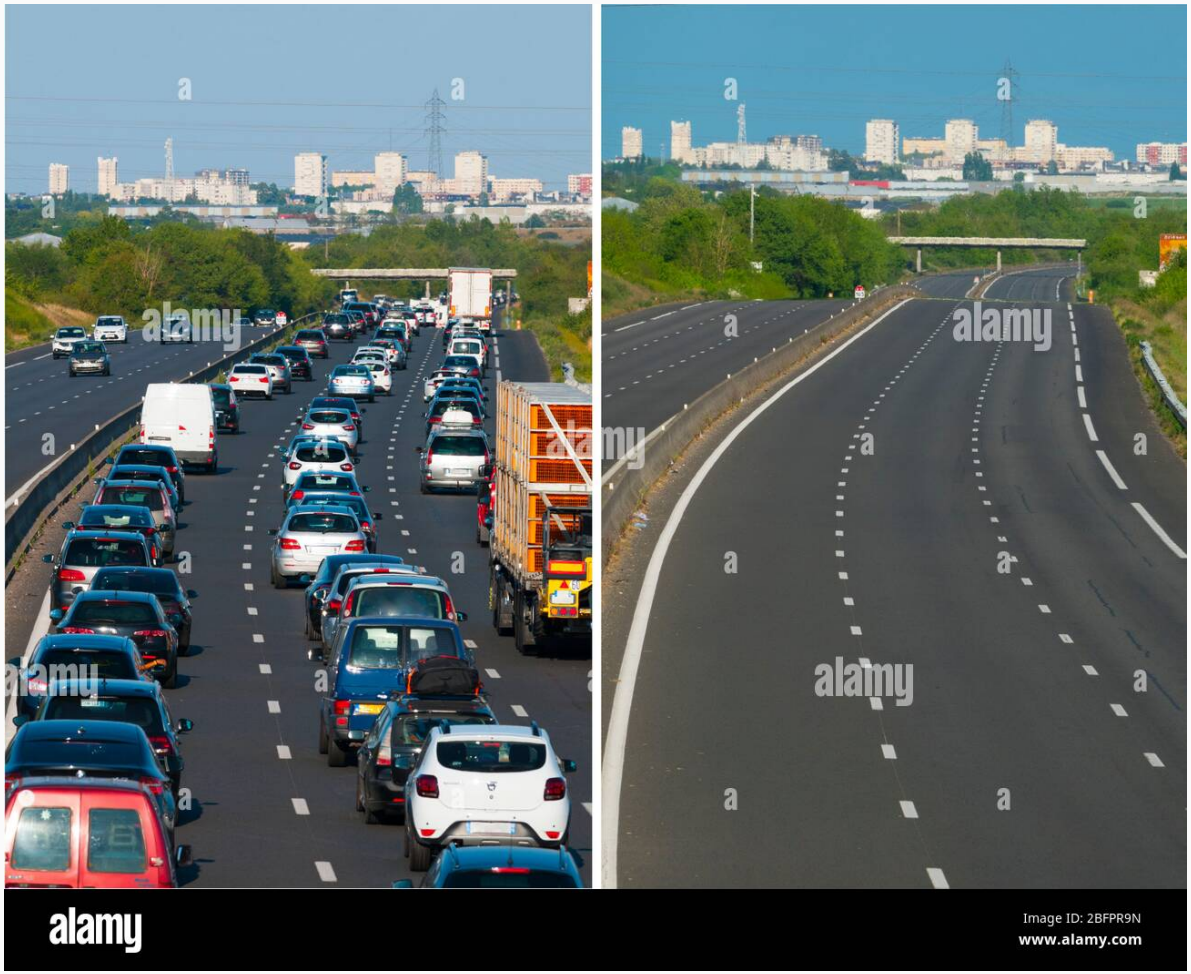


Clark *et al.* (2010)

Traffic Volume and Animal Movement

Traffic Volume

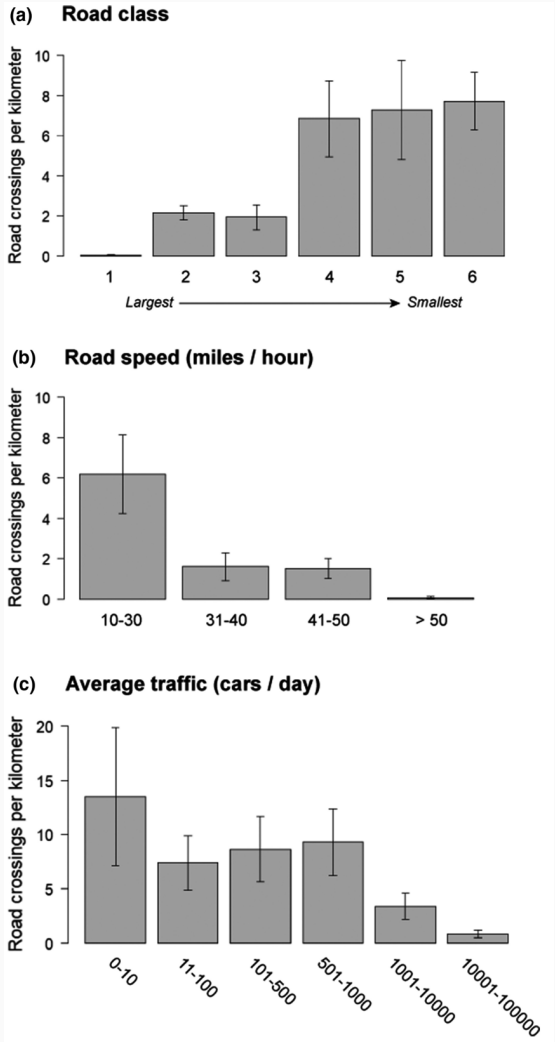
Traffic volume will also differ temporally and can impact the permeability of a road.



Traffic Volume cont.

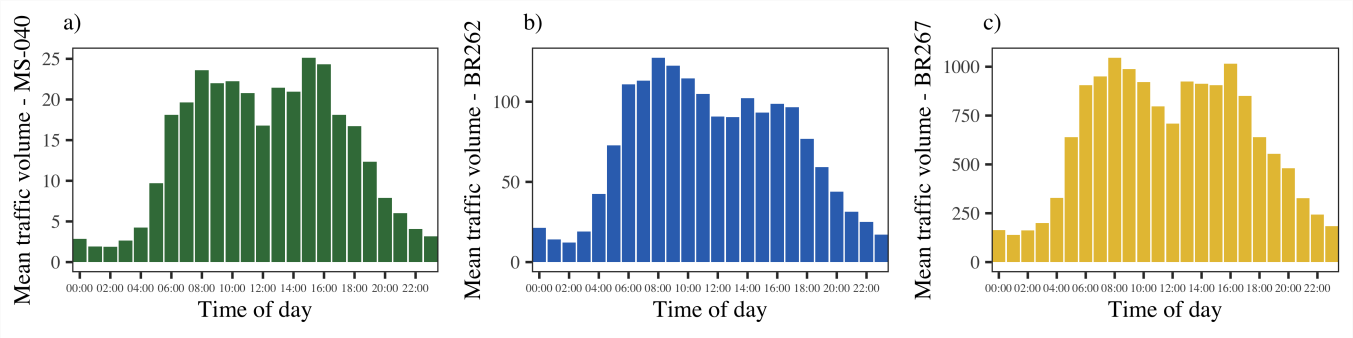
Traffic volume and vehicle speed influenced black bear crossings.

Source: Coastal Courier

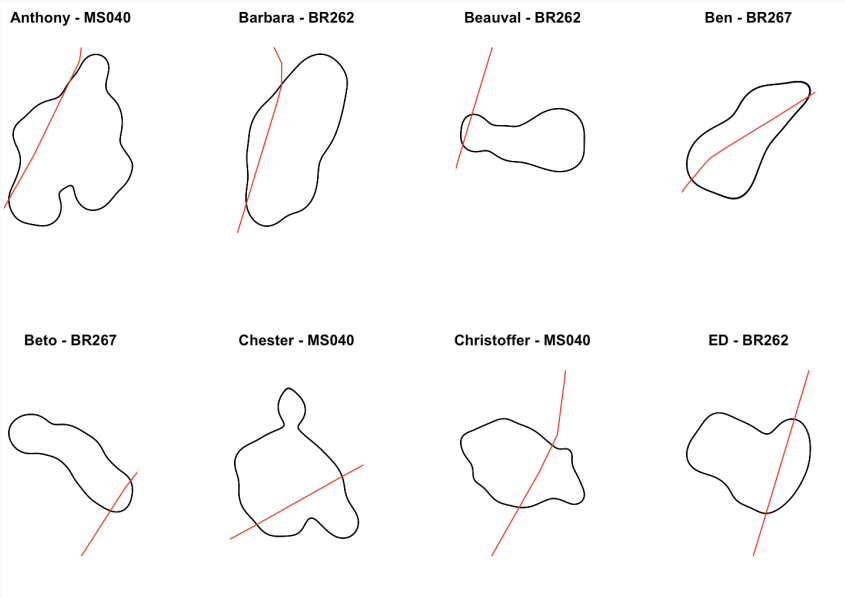


Zeller *et al.* (2021)

Traffic Volume cont.

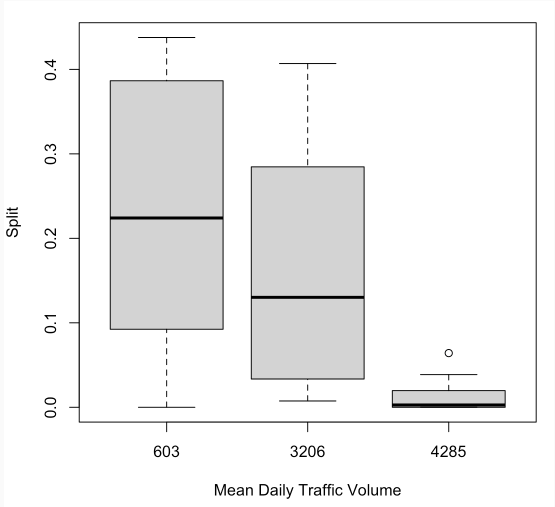


(Noonan *et al.*, 2021)



(Noonan *et al.*, 2021)

Traffic vol. infl. giant anteaters' ability to establish home ranges on both sides of highways.

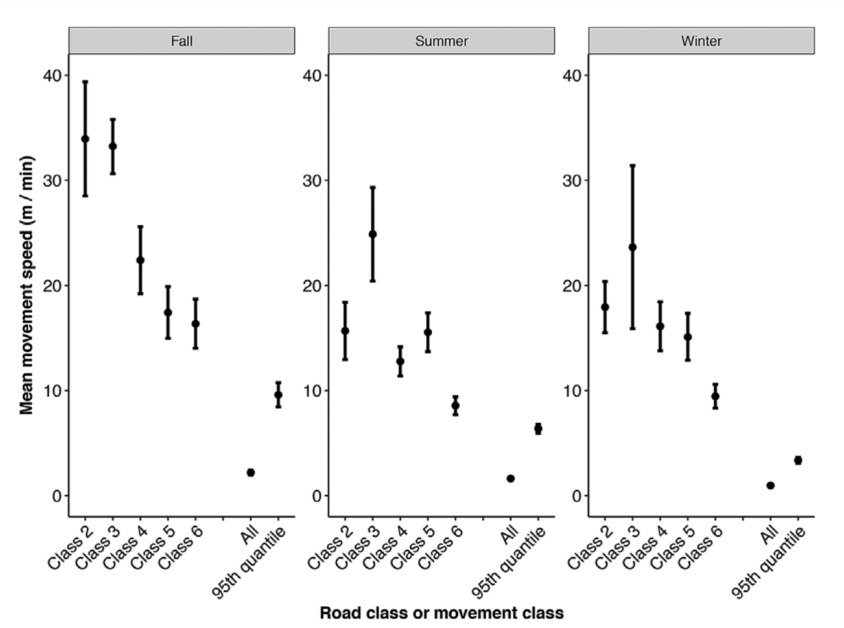


(Noonan *et al.*, 2021)

Traffic Volume cont.

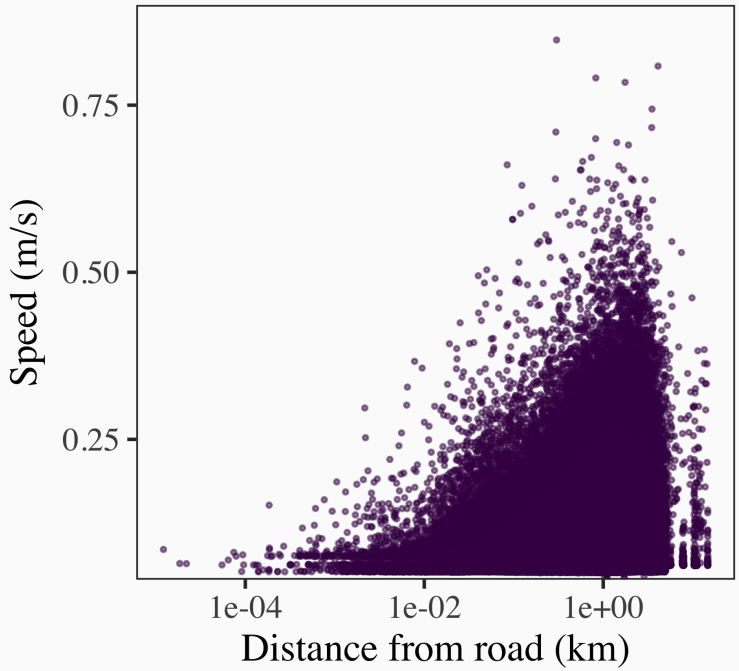
Animals also adjust their movement behaviour when approaching roads, but in species specific ways.

Moose speed up when approaching roads.



(Wattles *et al.*, 2018)

Giant anteaters slow down as they approach roads.

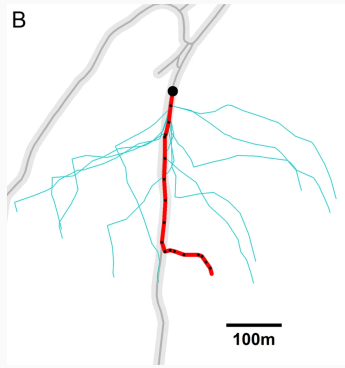


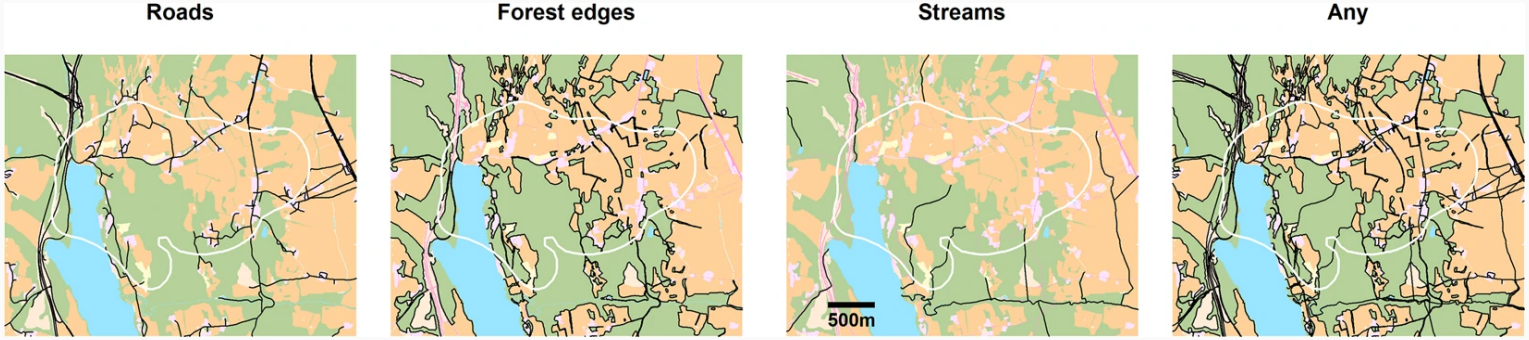
(Noonan *et al.*, 2021)

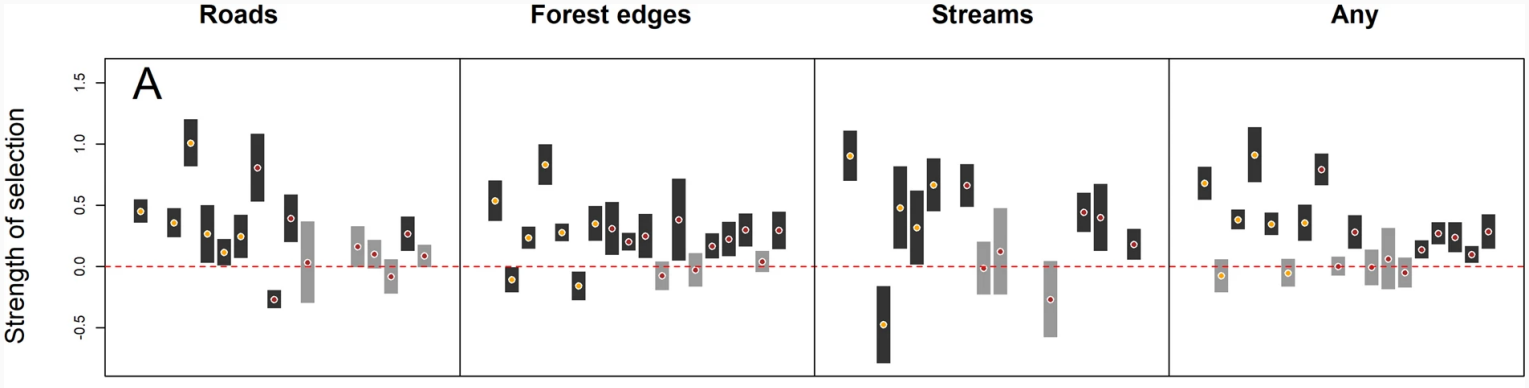
Roadways Enhancing Movement

Linear movement

Bischof *et al.* (2019) used GPS data to study red fox movement with respect to linear features.





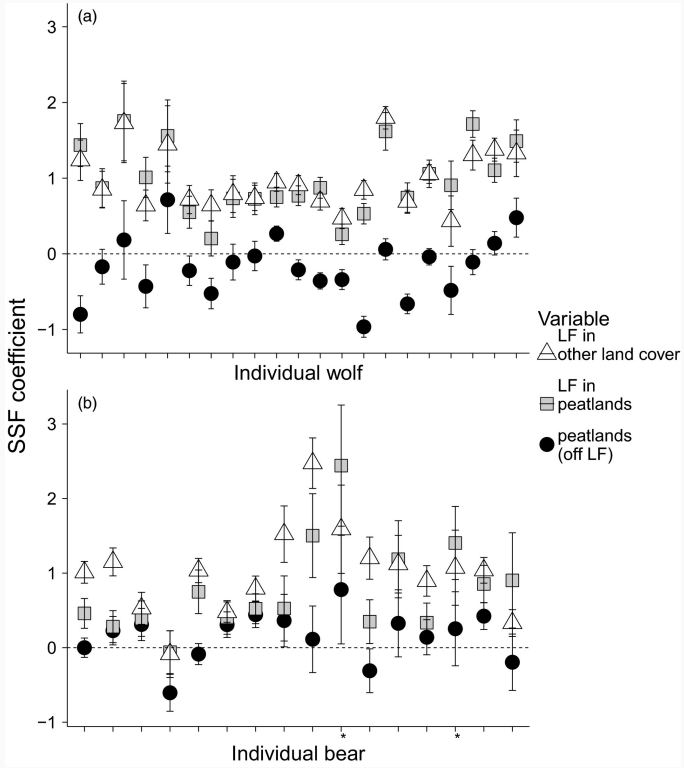


Linear movement cont.

In Alberta cutlines are used to give vehicles access to remote regions for oil and gas exploration.

(Wattles *et al.*, 2018)

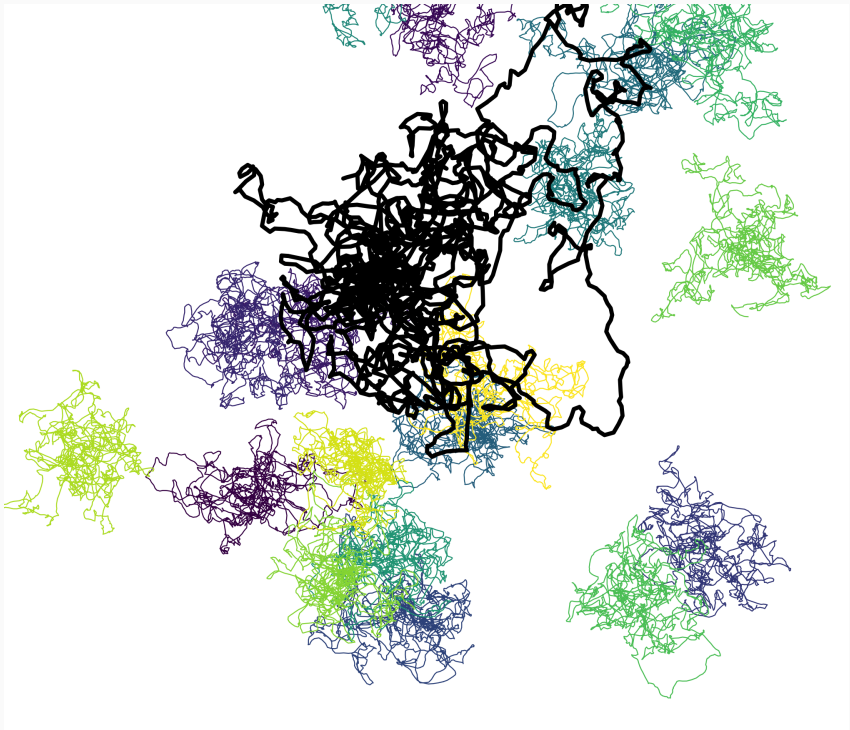
DeMars & Boutin (2018) found wolves and bears used roads to move into previously avoided areas, which increased predation pressure on caribou.

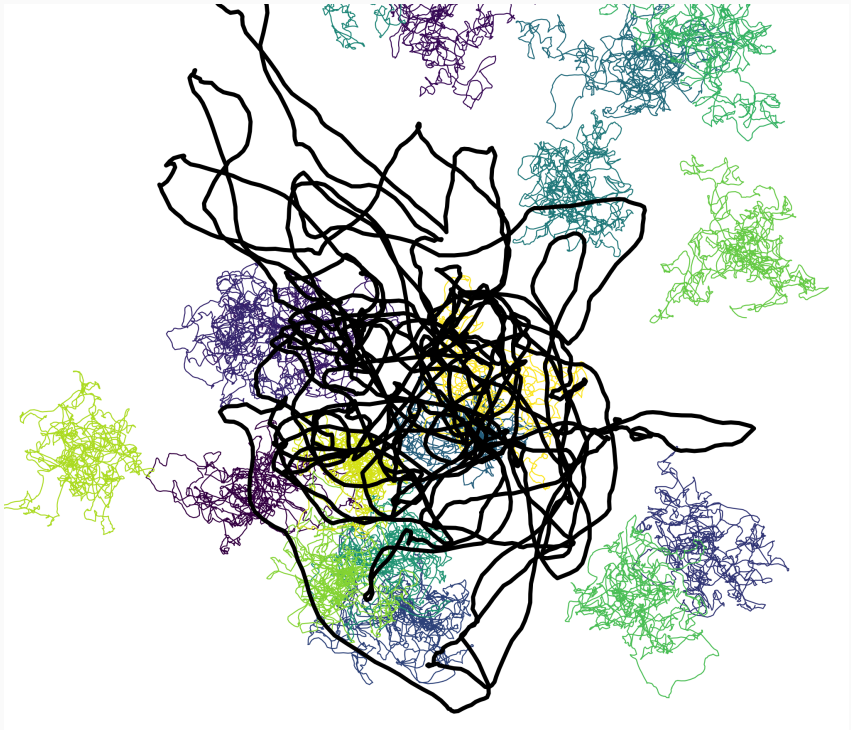


(DeMars & Boutin, 2018)

Linear movement and Encounters

All else being equal linear, ballistic motion increases encounter rates with prey vs. more diffusive motion (Bartumeus *et al.*, 2008).





By allowing more efficient movement, roads can alter predator prey dynamics (Dickie *et al.*, 2017).

Mitigation

Linear movement and Encounters

Roads are important for socio-economic growth, so we can't simply remove roads.

Broadly, there are two strategies for mitigating the impacts of roads on animal movement:

Fencing

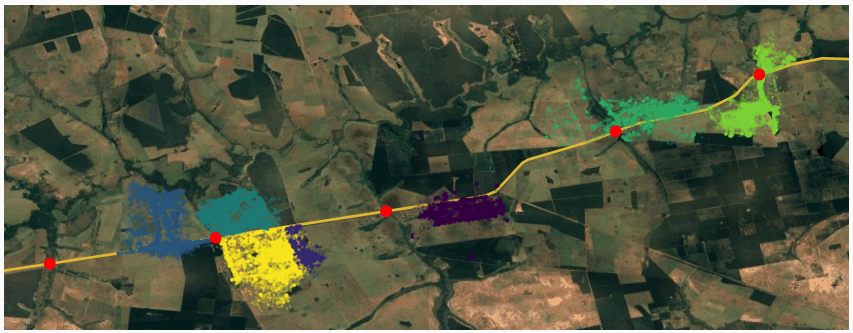
Crossing Structures

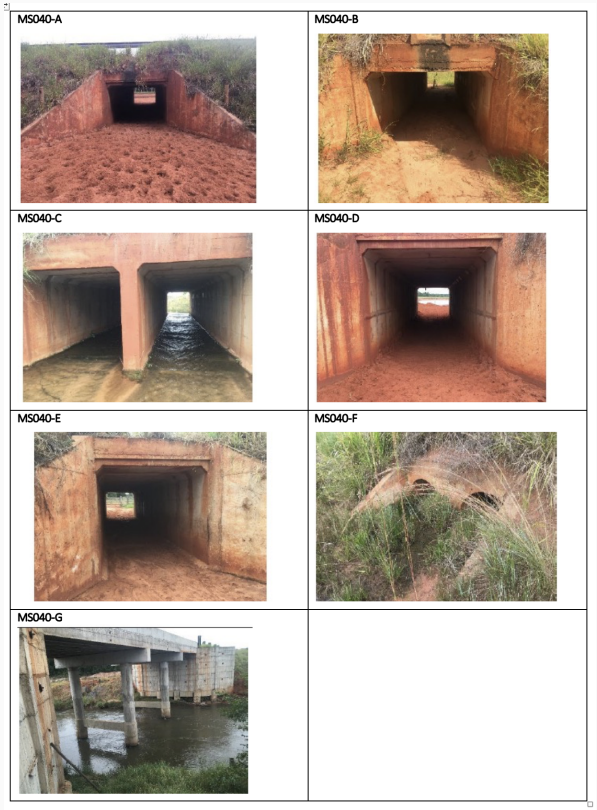
Crossing Structures

The theory behind crossing structures is that they punch holes into an otherwise impermeable surface to increase connectivity

...but to work animals need to use them.

Noonan *et al.* (2021) found that only 19 of >1,700 crossings occurred via a crossing structure.

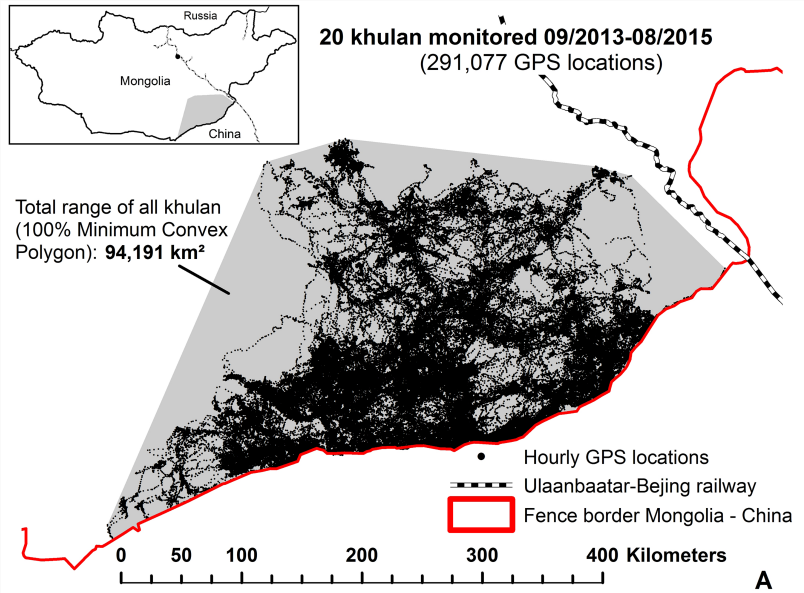




Fences

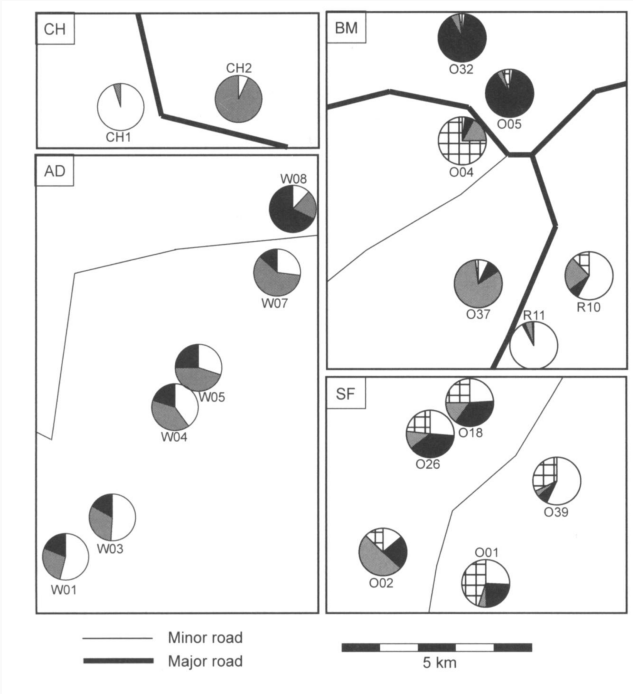
The theory behind fences is that by keeping animals off of roads we reduce road mortality

..but at a cost of reduced permeability



Linnell *et al.* (2016)

and reduced gene flow.



Clark *et al.* (2010)

Road Take Homes

Roads are important for socio-economic growth. ...but roads can hinder species' capacities to disperse and redistribute.

Road characteristics and traffic volume will dictate the permeability of roads, but they do so in a species specific way (there's no 'one-size-fits-all' approach).

Because linear motion is more efficient, many species make use of roads and this can alter community-level dynamics.

Because responses to roads are so variable between species, the best management strategy is a combination of crossing structures (to increase permeability) and fences (to reduce mortality and non-natural mobility).

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