

Kelowna, December 20, 2022

Dear Editors,

We are pleased to submit our manuscript entitled “Rethinking the Road Effect Zone: The Probabilistic Effect of Roads on Ecosystems” for consideration as a Note in *American Naturalist*.

Roads are important for human socio-economic growth, yet, while the area that roads occupy might be small, they carry substantial ecological impacts. The impacts of roads are so marked that they have spurred entire sub-disciplines of theoretical, ecological, and conservation research. Roads can cause a broad range of ecological impacts, but their effects are usually considered strongest with increasing proximity to the road surface. This relationship between the strength of effect and proximity to the road forms the basis for the concept of the ‘Road Effect Zone’, which is now a foundational theory in road ecology research. Ecologists and conservation practitioners regularly quantify road effect zones for different species, which are then used to make conservation recommendations. Although the concept of the road effect zone has proven useful in measuring patterns of biodiversity loss, it is a static measure that does account for the dynamic effects animal movement and species interactions. This is a noteworthy limitation. For instance, the effects of road mortality on highly vagile animals might decrease nutrient transfer, prey densities, and/or grazing pressure hundreds or even thousands of kilometers away from the road, yet these effects would not be captured within the current Road Effect Zone framework.

In this short note we re-frame the road effect as a joint probability of independent events and introduce a more mechanistic probabilistic road effect that describes the broader ecological impacts that the mortality of an animal might have on the landscape. Our framework provides ecologists and conservation practitioners with a dynamic metric for quantifying the ecosystem-wide impacts of roads, and/or the benefits of management strategies. Using movement data from giant anteaters occupying roadside habitats in Brazil, we have demonstrated how this framework can be used in practice to understand the ecological impacts of a road, and help inform species management. Notably, this framework builds straightforwardly off of home-range estimation and requires no specialized data collection protocols, allowing researchers to easily quantify the potential ecological impacts of roads for a variety of taxa.

We also note that the R scripts required to reproduce these analyses and estimate the probabilistic road effect from animal tracking data are openly available at https://github.com/NoonanM/Road_Effect_Zone. The Giant anteater tracking data are also openly available on MoveBank (MoveBank ID: 1574830796). However, to ensure anonymity during the double-blind peer-review process, we do not list these in the submitted manuscript. We are happy to provide them though should they be required,

Our manuscript provides a new theoretical framework for studying the effects of roads on ecosystems. We believe that this work is well suited as a Note in *American Naturalist* as road ecology research is a broad and impactful topic that will appeal to the readership of your journal.

We look forward to your response.

Kind regards,

Prof. Michael Noonan on behalf of all co-authors