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# Spatial determinants of habitat use, mortality and connectivity for elephant populations across southern Africa

by

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# Spatial determinants of habitat use, mortality and connectivity for elephant populations across southern Africa


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## Dedication

I dedicate this thesis to my dad, Jerry Roever.

## Abstract

Southern Africa contains 58% of the world's savannah elephant population, yet 72% of their range occurs outside of protected areas. It is, therefore, important to develop management guidelines that satisfy the needs of both elephants and people while maintaining environmental heterogeneity and ecosystem processes. Managing elephants as a metapopulation may provide the solution. The goal of this thesis was then to use a habitat-based approach to identify landscape characteristics which could contribute to the functionality of a metapopulation for elephants.

Using resource selection function models, I identified habitat suitability for elephants across southern Africa and used these models to evaluate whether current habitat configurations allow for the assumptions of connectivity and asynchronous population dynamics required by a metapopulation. I found that water, tree cover, slope, and human presence were important predictors of elephant habitat selection. Furthermore, functional responses in habitat selection were present across space and time for water and tree cover, showing the adaptability of this generalist species to resource heterogeneity.

Using habitat selection along with circuit theory current flow maps, I then found a high likelihood of connectivity in the central portion of our study area (i.e. between the Chobe, Kafue, Luangwa, and Zambezi cluster). Main factors limiting connectivity were the high human density in the east and a lack of surface water in the west. These factors effectively isolate elephants in the Etosha cluster in Namibia and Niassa clusters in Mozambique from the central region. Models further identified two clusters where elephants might benefit from being managed as part of a conservation network, 1) northern Zambia and Malawi and 2) northern Mozambique.

Incorporating information on elephant mortalities in northern Botswana into habitat selection estimations, I found that source habitats for elephants occurred within the central Okavango Delta region and sink habitats were associated with periphery of the study area where human use was highest. Eighty percent of elephant mortalities occurred within 25 km of people. The protected designation of an area had less influence on elephant mortality than did the locations of the area in relation to human development. To exacerbate human-elephant conflicts, people tended to settle in areas of high-quality elephant habitats, creating resource competition between elephants and people. Consequently, elephant mortality near humans increased as a function of habitat suitability, and elephants responded by using less suitable habitats. While humans occupied only 0.7% of the study area, mortality and behavioural effects impacted 43%.

Based on the habitat factors examined here, elephants in southern Africa could be managed as a metapopulation if (1) connectivity is maintained and encouraged and (2) spatial heterogeneity in resources and risks serves to stabilize elephant demography. This habitat-based system of management could serve to alleviate unstable elephant populations in southern Africa and create more natural, self-sustaining regulatory mechanisms.

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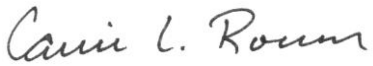
## Disclaimer

This thesis contains four manuscripts (Chapters 2-5), prepared for submission to different peer-reviewed journals. Chapter 2 has been published in *Ecography* (2012; 35, 972-982), and Chapter 3 has been published in *Biological Conservation* (2013; 157, 128-135). For consistency, styles and formatting for all Chapters follow the requirements for the journal *Biological Conservation*. I hereby declare all the work to be my own and that I have acknowledged all those that helped me and contributed in producing this thesis.



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