Preregistration

The effects of wolves on moose presence and abundance in central Sweden.

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Study Information

Title	The effects of wolves on moose presence and abundance in central Sweden.
Description	Predator-prey interactions often have strong effects on the lower trophic levels in a given environment. For example, upon the re-establishment of wolves in a national park in North America, aspen trees saw markedly increased recruitment (Ripple et al., 2014). Apex predator reintroduction is often considered to benefit ecosystems by limiting the consumption of lower trophic levels by grazers, and by providing meals for scavengers (Ripple & Beschta, 2004). However, most research on the effects of predator reintroduction has been conducted in natural areas minimally affected by human activities (Kuijper et al., 2016). Due to climate-driven relocation and controlled reintroduction programs, modern and future predator populations may become established in areas of strong anthropogenic influence. Thus, when

predicting future effects of predators, it is important to conduct research in areas with nearby human activity, to discern how it may affect predator-prey interactions (Kuijper et al., 2016).

Recent studies in Europe have found that wolf reintroduction does not impart biodiversity benefits to lower trophic levels, contrasting observations made in American National Parks. For example, Gicquel, Sand, Månsson, Wallgren, & Wikenros (2020) reported that wolf reintroduction slightly increased moose browsing damage to Scots Pine trees in Sweden, as did Ausilio, Sand, Månsson, Mathisen, & Wikenros (2021). By surveying moose pellets, Ausilio, Sand, Månsson, Mathisen, & Wikenros (2021) also found that wolf presence and wolf territory establishment had slightly positive effects on moose presence and abundance. Other factors, including distance from roads (an indirect measure of human activities), had much stronger effects on moose populations than wolves (Ausilio, Sand, Månsson, Mathisen, & Wikenros, 2021).

Future populations of predators will continue to establish themselves in areas of anthropogenic influence. It is important to critically investigate the effects that they may, or may not, have on prey populations and lower trophic levels in these areas. To increase certainty in their paradigm-questioning results, we will replicate Ausilio, Sand, Månsson, Mathisen, & Wikenros (2021)'s research, conducting parallel analyses on areas that are just north of the original study area.

Hypotheses

We hypothesize that:

1) Wolf presence and wolf territory establishment will moderately increase the probability of moose presence, and overall moose abundance.
2) 'Distance from roads' will effect moose presence and abundance more strongly than wolf presence or wolf territory establishment.

Design Plan

Study type

The study type is a replication of the original paper by Ausilio et al. entitled *Ecological Effects of Wolves on Anthropogenic Landscapes: The Potential for Trophic Cascades is Context-Dependent.*

Study design

Our proposed study maybe could be classified as two-group, between-subjects study with repeated measures? I.e. plots where wolves are established and plots where wolves are not established are observed (via moose pellet counts) over time? Unsure on this..

Upon further research I think this study would be better-classified as **a regression analysis**. The data we will use could be classified as secondary data (i.e. we did not collect it specifically for this study). We could add a short description of our predictor/response variables and direct readers to more thorough definitions below.

Data collection

The study will be conducted using data retrieved from various government and private sector institutions (Table 1) between 2003 and 2016, as is consistent with the original study by Ausilio et al. The study area will be the northern range of south-central Sweden's breeding range of wolves, distinct from the region assessed in the original study. The predominant trees in this landscape are Scots pine, Norway spruce, and birch. The average moose winter density in the study range is approximately 1.3 per km² (Zimmermann, Nelson, Wabakken, Sand, & Liberg, 2014). Variables to be collected include: moose pellet counts, tree cover, roads, and wolf presence and time since wolf territory establishment. The sample size will be determined by the data available within the study region. (number of surveyed plots??)

Variables

Variable data will be collected within the study area of south-central Sweden. Data sources will be consistent with those used in the original study in order to maintain as close a replication study as possible. Seven variables will be use in statistical analysis of the effect of wolves on the presence and abundance of moose.

1) *Moose pellet counts:* Moose pellet counts will be used to gather presence and absence data on moose. Yearly surveys are conducted between the months of May and September throughout south-central Sweden (Fridman et al., 2014). The data source for this variable is the Swedish National Forest Inventory.
2) *Forest age stages:* There are four forest age stages considered when moose pellet count surveys are conducted. These stages classified as clear-cut, young, thinned, and mature. The data source for this variable is the Swedish National

Forest Inventory.

3) *Pine proportion:* Sample plots, the same as those used for moose pellet count surveys, will be surveyed to assess tree cover. The cover (m^2) of lodgepole pine and Scots pine, as a proportion of all tree cover, will be generated as an index of food availability. The data source for this variable is the Swedish National Forest Inventory.
4) *Distance to the nearest forest road (km):* Distance (km) between each plot and the nearest forest road, as classified by the database, will be calculated as a proxy representing human influence on the landscape. The data source for this variable is the Swedish national road database from the Swedish Transport Administration.
5) *Distance to the nearest main road (km):* Distance (km) between each plot and the nearest main road, as classified by the database, will be calculated as a proxy representing human influence on the landscape. The data source for this variable is the Swedish national road database from the Swedish Transport Administration.
6) *Wolf presence:* Presence or absence of a wolf territory, as determined by monitoring obtained by snow tracking, DNA-samples, and GPS locations of collared wolves. A buffered radius will be used based on the average wolf territory size in Scandinavia (Liberg et al., 2011). The data source for this variable is the National wolf-monitoring system from County Administrative Boards.
7) *Time since wolf territory establishment:* A continuous range from 1 year to 27 years since establishment, as noted by annually conducted surveys. The data source for this variable is the National wolf-monitoring system from County Administrative Boards.

Analysis Plan

Statistical models

Enter your response here.

Transformations

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The original authors describe a few data transformations in their methods, like standardizing continuous predictors. We could propose we do the same, and offer the same reasoning (eliminating collinearity and improving interpretability). Could propose that we will test VIF / tolerance values, as the original authors did.

Exploratory analyses (optional)

Enter your response here.

Other

Other (Optional)

Enter your response here.

References

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