Determining landscape factors influencing tropical amphibians using a multi-species occupancy model

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INTRODUCTION

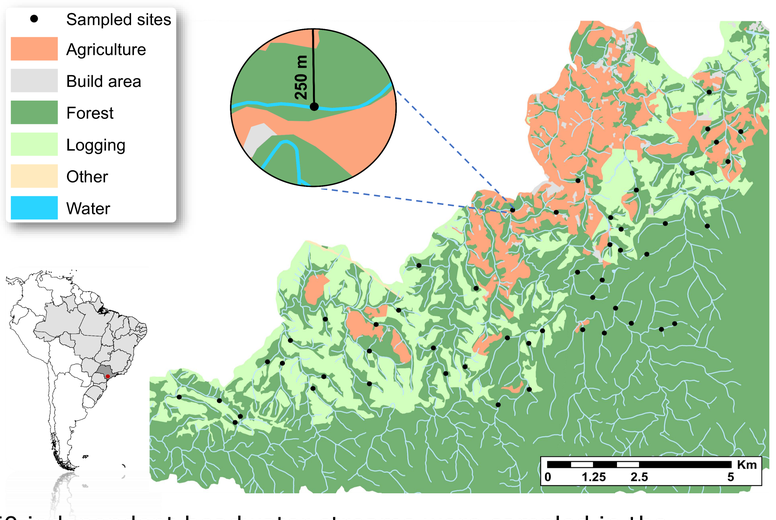
- Nearly one-third of amphibian species are designated as endangered or extinct; habitat loss is the greatest threat.
- Landscape features, such as stream density, land cover type, and topography, can influence amphibian occurrence.
- The Brazilian Atlantic Forest has high diversity and endemism of amphibians, but little is known about the response of many of these species to landscape characteristics.
- Understanding the effect of multiple landscape factors on tropical amphibian species and communities is necessary for biodiversity conservation decisions.

GOAL

Our goal was to quantify the response of amphibians to landscape characteristics at both species- and community-levels.

We developed a hierarchical multi-species occupancy model to investigate the influence of landscape composition on amphibian occupancy for individual species and the entire community observed in Brazilian Atlantic Rainforest streams.

STUDY AREA



50 independent headwater streams were sampled in the Brazilian Atlantic Forest – São Paulo State, Brazil.

AMPHIBIAN SURVEY

- We surveyed during the rainy season (Oct 2015 – Mar 2016).
- We used two sampling methodologies:

- Standardized Acoustic and Visual Transect Sampling (100 m).

- Automated Acoustic Recorders.

MULTI-SPECIES MODEL

- We built a hierarchical multi-species occupancy model.
- We modeled the occurrence and detection probabilities of each species as Bernoulli random processes.
- Covariate effects were included through logit link functions.
- We fit our model in a Bayesian framework using MCMC.

Occupancy model:

Occupancy ~ Forest cover + Agriculture cover + Catchment area + Stream density + Slope

Detection model:

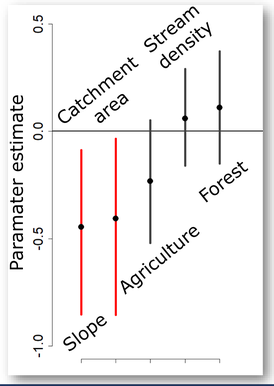
Detection ~ Methodology + Date (linear and quadratic) + Daily rain

RESULTS

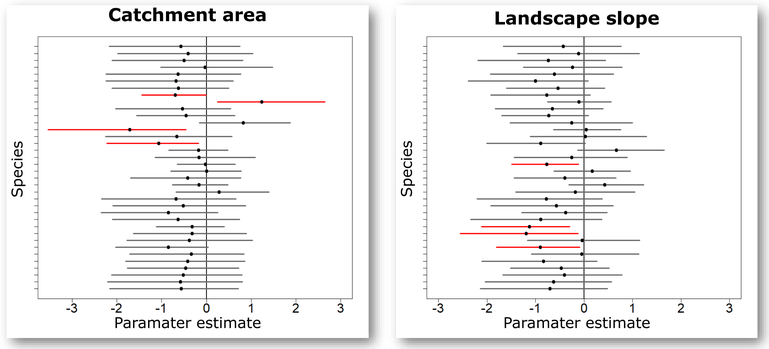
We observed 36 amphibian species, but our model estimated richness as 51 species (95% CI: 38-81).

Community-level response of amphibian occupancy probability

The slope, catchment area, and agriculture cover had negative effects on amphibian occupancy probability at the community level, while stream density and forest cover positively influenced species occurrences overall.

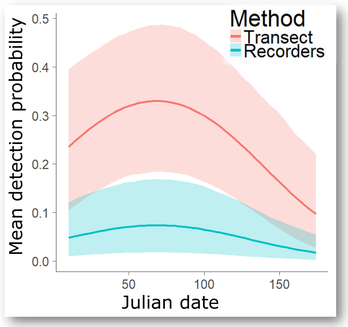


Species-level responses of occupancy probability



Forest cover and stream density positively influenced occupancy probability for most species. Agriculture cover had a negative effect on most species' occupancy, but the credible intervals overlapped zero for all species (except one; results not shown).

Effect of date and sampling method on community-level detection probability



Species' detection probabilities were influenced by Julian date, with peak community-level detection occurring during the middle of the rainy season. Transect sampling was a more effective method for sampling than acoustic recorders.

CONCLUSION

- Small catchments (i.e. small streams) and flat landscapes positively affect species- and community-level occurrences.
- Forest cover and stream density have positive effects (although insignificant) on tropical amphibian communities.
- Agriculture cover negatively impacts amphibian occupancy.

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