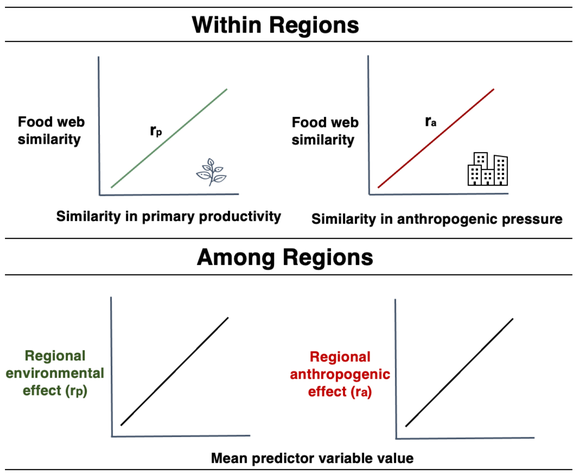
Food web network structure varies within and among regions as a function of productivity and anthropogenic pressure

Ann E. Finneran[1], César A. Uribe[2], and Lydia Beaudrot[1]
[1]Department of Biosciences, Rice University. Houston, TX USA
[2]Department of Electrical and Computer Engineering, Rice University. Houston, TX USA

Background

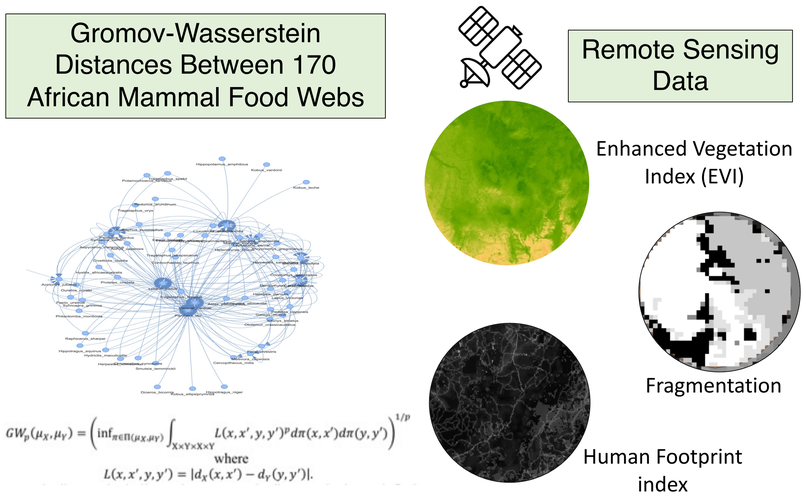
Food webs describe both the flow of energy moving through a system as well as the interactions among species by which energy is transferred. These mechanisms promote stability and maintain diversity in ecosystems. Energy for food webs begins with the primary productivity of the ecosystem, which varies depending on location and anthropogenic land-uses. **The extent to which productivity and anthropogenic impacts directly influence variation in mammal trophic structure within and among regions remains untested**. Understanding the drivers of food web structure in response to disturbances can contribute to our understanding of biodiversity maintenance and inform conservation strategies in disrupted landscapes.

Hypotheses



Methods

We measured difference in food web shape for 170 African mammal communities (Figure 1) using a novel quantitative approach tailored from engineering. We also collected variables describing primary productivity (EVI) and human impacts (fragmentation and human pressure index) from remotely sensed data. We ran partial mantel tests to look at independent effects of environmental and anthropogenic predictors on African mammal food web structure.



Results

- Within grassland and savanna regions (East Africa), food web similarity among sites was significantly correlated with differences in plant productivity among sites (r = 0.21, p = 0.028). Grasslands and savannas with more similar plant productivity had more similar food webs (Figure 2a).
- Within tropical rainforests, food web similarity among sites was significantly correlated with differences in anthropogenic impacts (r = 0.64, p = 0.001). Tropical forests with similar anthropogenic impacts had more similar food web structure (Figure 2b).
- Plant productivity more strongly predicted food web similarity among sites for regions with low plant productivity (Figure 3a, r = -0.82, p = 0.006) except for deserts.
- Human pressure was a stronger predictor of food web similarity among sites in biomes facing greater human pressure (Figure 3b, r = 0.96, p = 0.01).

ID	*Number of Sites*	*Richness*	*Site Min Spp.*	*Site Max Spp.*	*Site Mean EVI*	*Site Mean Fragmentation PC1*	*Site Mean Human Footprint*
✦	14	108	49	62	3961	0.92	2.80
◆	15	123	42	80	3655	-1.16	9.95
✖	10	120	47	67	3449	0.02	5.22
■	12	56	8	37	1262	1.43	4.22
▲	22	69	37	54	2707	0.35	6.42
✖	6	79	30	51	2094	0.31	7.01
●	28	129	49	73	2686	-0.26	7.51
▼	51	123	27	72	3013	-0.34	4.89
✚	10	67	17	50	1048	0.29	3.97

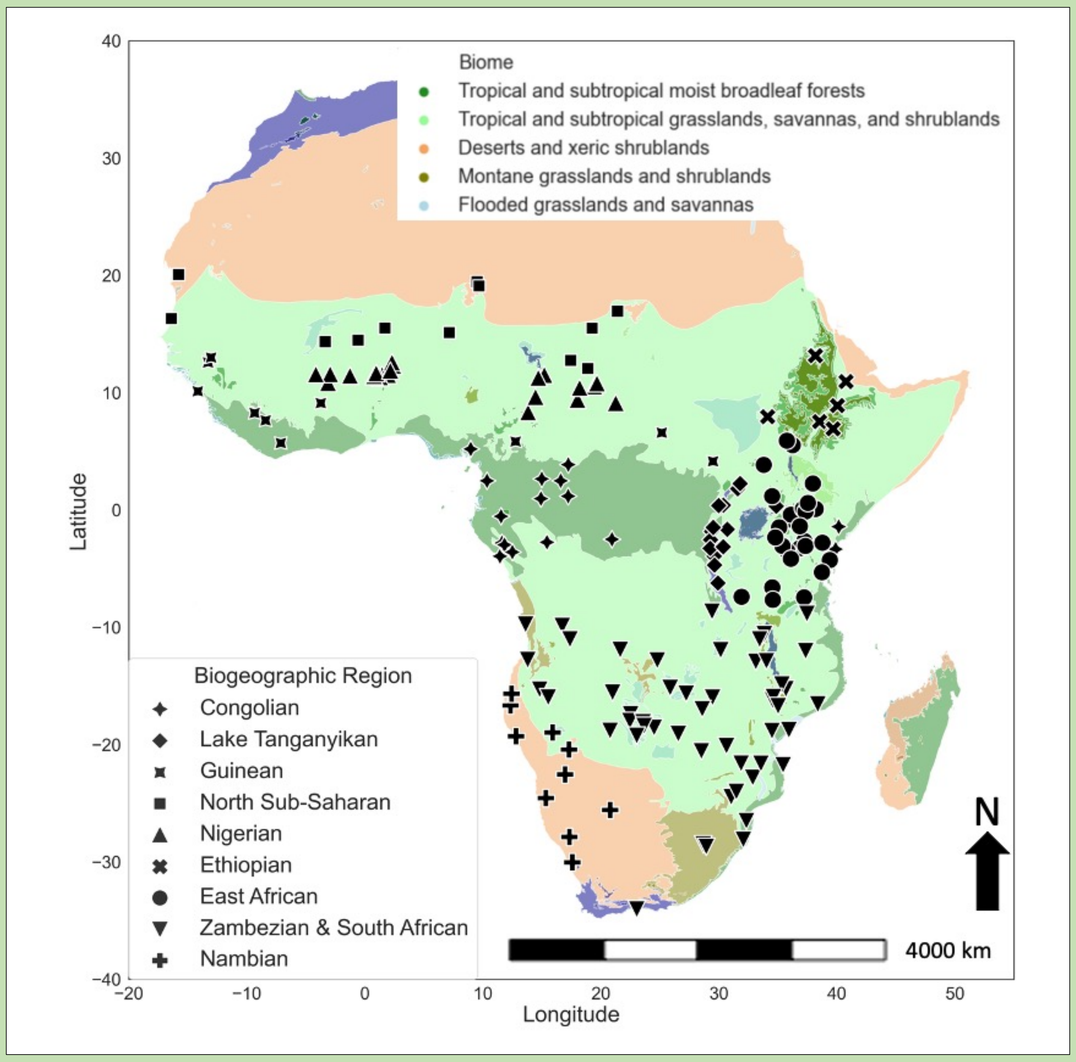


Figure 1.

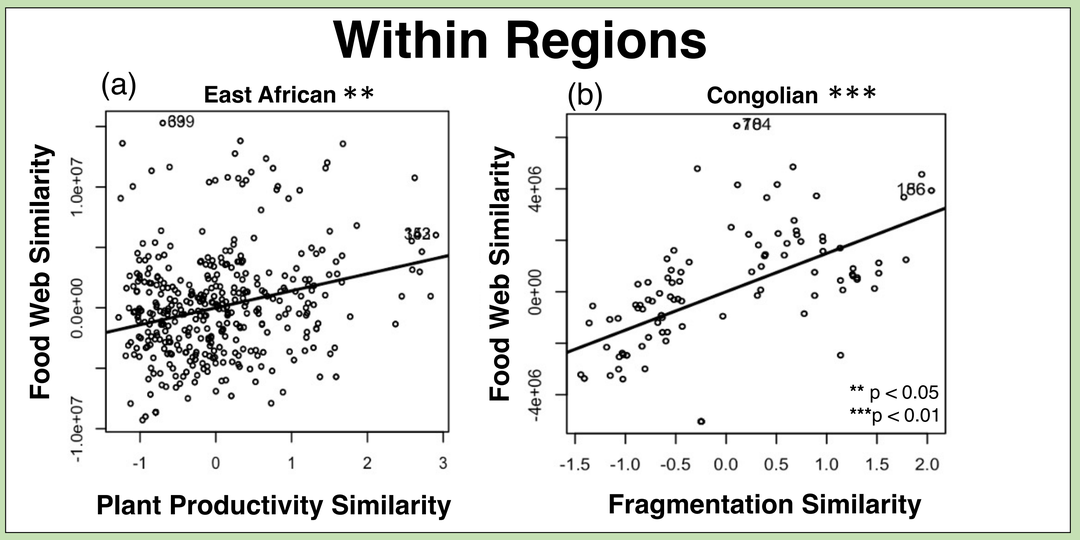


Figure 2.

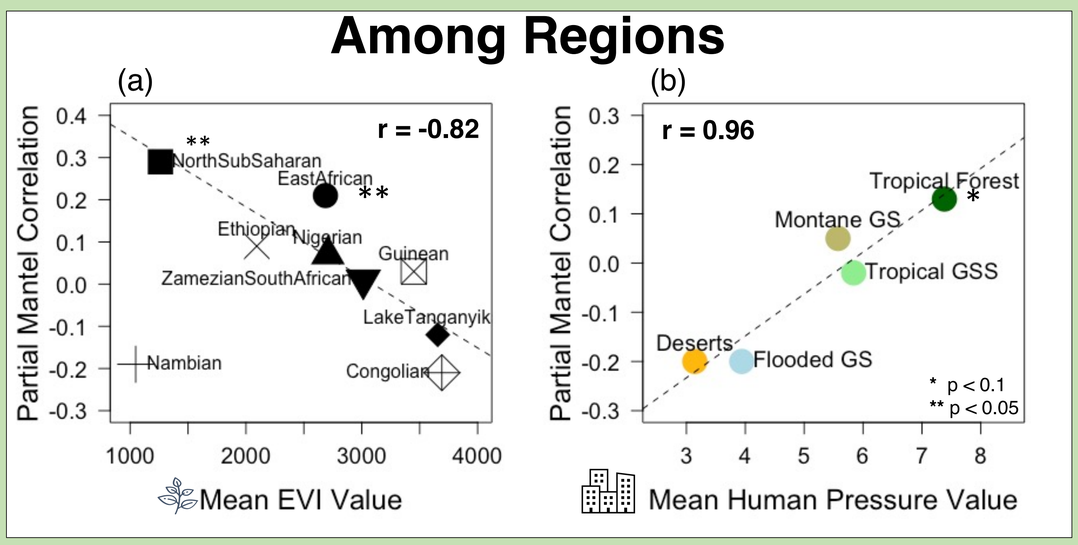


Figure 3.

Conclusions

- Regions with low primary productivity exhibit bottom-up control of food web structure.
- Regions with high primary productivity appear to experience top-down control from human pressure impacts.
- Deserts food webs surprisingly differ from the overall trend among regions.
- Understanding how habitat loss and other anthropogenic disturbances alter food webs can provide scientists with a toolkit for predicting the consequences of conservation decisions on a community.

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CONTACT

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