Updated: August 18, 2021

Working Title: Isotopic niche space, predator body size, prey composition, and prey trophic positions between high- and low-productivity habitats

Baby: Habitat productivity can shape the structure of food webs. Increased habitat productivity can increase food chain lengths as habitats support more species or as increased resources increases the ability of organisms to take advantage of different resource pools (e.g. Young et al. 2013, other food chain length studies). Something with Layman et al. papers related to niche breadth with resource availability as well.

Werewolf: While it has been established that habitat productivity can increase food chain length, we don’t know what the mechanism(s) is/are.

Silver Bullet: There are multiple mechanisms by which this could occur:

1. Top predators shift their diet by either:
   1. Predators may shift to new resources at higher trophic levels (niche space stays the same but shifts location).
   2. Or, predators may become more general and feed across broader trophic groups (niche space expands beyond its current span)
2. Prey become more omnivorous

*For idea one*, multiple lines of evidence may help us understand how and why these niche shifts take place:

1. Predator niches may expand or shift in isotopic niche space (either N or C)
2. (*this feels a bit like a non-sequitur – is it necessary?*) Predators may become larger in size to access different resource pools or in response to more available resources
3. What prey items we detect in top predator diets may shift in preference for different prey in different environments.

Answers to idea one mechanisms:

1. Does predator niche space either shift in space or expand in habitats with higher productivity? *Yes, it shifts up and slightly more terrestrial in high productivity environments; however, it does not expand to suggest a broader pool of resources*
2. Are predators larger in some locations than other, providing a mechanism or response to changes in niche space? *No, and higher trophic level does not equal higher niche, see recent paper sent by An from Ecology (August 2021)*
3. Can DNA diet items from DNA metabarcoding provide evidence of the resource pools that predators shift to-from across environmental contexts? *Resource pools are ~similar suggesting that shifts in diet are happening not for top predators, but rather somewhere else in the food chain.*

*For idea two*, we can look at the common prey we detect in the DNA diet data and examine their isotopic signatures across environments:

1. Prey items shift their diets, suggesting that the increases in food chain length happen because of increased omnivory at lower trophic levels as opposed to top predators getting more predatory.

Answers to idea two:

1. Do prey items shift their isotope values along the gradient, suggesting that lower trophic levels are seeing the productivity boon, rather than the top predator? *It seems that omnivorous prey do become more enriched with N15 in higher productivity environments*
2. Is there room here for prey of prey from DNA? (could potentially compare organisms collected in *Cocos nucifera* versus *Pisonia grandis* for both Dermaptera (*Euborellia annulipes*) and Araneae (*Neoscona theisi* and *Keijia mneon*))

Thoughts from co-authors May 2021:

Dan – could increases in food chain length happen at lower trophic levels, not the top trophic level?

Common prey items for which we have isotope data:

Diptera - 2009\_Palmyra\_Insect\_Amphipod\_Isopod\_Isotopes

Hempitera - 2010\_Palmyra\_Insect\_Isotopes

Lepidoptera - 2009\_Palmyra\_Insect\_Amphipod\_Isopod\_Isotopes

Araneae - 2010\_Palmyra\_Day\_Spider\_Isotopes.xlsx & 2012\_Palmyra\_Day\_Spider\_Isotopes.xlsx

Orthoptera - 2010\_Palmyra\_Insect\_Isotopes

Could I also incorporate the DNA data from more spiders + the potential prey items I picked up somehow to answer these questions? Maybe top predators aren’t shifting their diets all that much but food chain length is increasing in the middle of the food web?

- this is challenging because i only have prey items from a few islands, and not at the ends of the spectrum.

Austen:

compare isotope and DNA dissimilarity via Mantel test?

dist(isotopes) ~ dist(diet) + dist(spider\_phys)