Do more diverse predator guilds display more evidence for compensatory dynamics?

**Ecological theories generally predict that complex speciose food webs with many weak trophic linkages, such as those found on continental shelves, are buffered from dramatic trophic cascades driven by changing predator abundances (Strong 1992)**. Thus predator diversity is associated with resource control. Ecosystem models driven from the bottom up tend to have more linear and therefore predictable dynamics, in addition to being less susceptible to community-scale responses to fishing/exploitation.

In general, the mechanism by which predator diversity buffers systems from consumer control is niche redundancy. That is, **individual predator populations have a relatively small impact on the total natural mortality of the prey populations, so major changes in a single predator population are unlikely to cascade through the food web.** For this to occur, the different predator populations cannot vary synchronously. Although fish populations often respond similarly to large-scale environmental influences (citation), a lack of synchrony could be due to the dominance of more local-scale processes, and slightly different niches among populations (Stachura et al. 2014).

**There is some evidence in marine ecosystems that increasing predator diversity is more associated with resource/bottom-up control (Boyce et al. 2015)**. However, they use correlation between predator and prey biomass as evidence for trophic control, a contentious metric (Pershing et al. 2015), and, more importantly, the mechanism was not closely explored.

**Compensatory dynamics occur in diverse assemblages of similar species that have complementary responses to the environment (Gonzalez & Loreau 2009)**.In other words, total predation (or any other metric) remains less variable than we would expect because one population *compensates* for decreases in another. “Less variable than expected” is subject to interpretation, and may not mean mere statistical independence. Because of this, there are several papers on developing proper neutral or null models for compensatory dynamics (e.g., Loreau et al. 2008). I think it’s all about interpretation and hypothesis testing is dumb in this case.

**Compensatory dynamics are often detected by negative summed covariances (also known as asynchrony)**. One common metric is the ratio of community variance to the sum of all species variances. If species are oscillating statistically independently, this ratio is always one (i.e., sum of covariances is zero). **Another approach to detecting synchrony in time series data is dynamic factor analysis (Ouellet et al. 2016).** In this case, consistently high loadings for trends across species would indicate synchrony. (Is it this simple? Probably not.)

Lindegren et al. (2016) focused on the Southern California Current and found asynchrony across different functional groups, including predatory fish, and hypothesized that these compensatory dynamics increased resilience and stability of the food web there. However, without a comparative approach, it is unclear how the diversity of species contributed to this asynchrony versus other factors structuring the ecosystem.

**Different diets and consumption rates across predators is rarely accounted for when quantifying predator synchrony.** That is, measuring synchrony of the entire community above some threshold trophic level is not necessarily related to whether one prey population experiences dampened variability in predation, if all predation in fact comes from a single predator population. This would be particularly important for wasp-waist ecosystems where the impact of predation is funneled through a small number of mid-trophic level species, and their “perspective” on predation is crucial.

In this study, we take a unique comparative database of multispecies abundances across Northern Hemisphere large marine ecosystems to examine patterns of variation in predator assemblages. We combine these abundance data with coarse information on diet and consumption compiled in Ecopath models. From the perspective of different prey populations, we seek to quantify the relationship between predator diversity and the variance factor (metric of synchrony). Variability in the predator assemblage relative to its component populations could decrease with increasing predator diversity for one of two reasons: 1) if a diversity-stability relationship is simply due to averaging of more statistically independent populations, synchrony will stay constant as diversity increases, and 2) if increasing predator diversity actually increases the utilized niche space and populations vary asynchronously, we consider that evidence of compensatory dynamics. If stability decreases with predator diversity, we consider that evidence that predators respond similarly to a shared environmental driver; adding predators magnifies this effect.

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