**Energetic compensation**

*Defined*. When a decline in one species is offset by gains from other species, specifically in energy flux/resource use.

*Implications for the structure/processes in a system.* At least some sets of species have to be similar enough for other species to be able to access the vacant resources. Could be a kind of highly structured complementarity, or closer to effective neutrality. Associated with zero-sum dynamics: strong energetic compensation can be evidence that the species in a system are competing tightly for a shared pool of resources, such that resource availability imposes a strong constraint and populations of different species limit each other. Contrasts to a high degree of niche specialization, where species are so different that either they cannot access resources left unused, or other factors limit them preventing them from compensating even if the resources are available.

*Implications for how a system will respond to perturbation.* Energy flux will be more stable than species’ populations. At that scale, the system may be resilient to perturbations that result in the loss of some species (assuming the perturbation doesn’t also directly impact the resources available to the system).

Changes in context – either environmental or biotic – may modulate the degree to which species can functionally substitute for each other. Species may respond differently to environmental fluctuations, or shifts in the competitive network (or priority effects) may impose new limitations. This is especially the case when energetic compensation derives from (incomplete) niche overlap between subsets of species, rather than from neutrality.

Energetic compensation can arise endogenously from a community, if species coexisting in the community are similar enough to make the gains. However, perhaps in scenarios where highly similar species fail to coexist locally, it may also be facilitated via the metacommunity. If functionally similar species do not coexist locally but are able to colonize from the broader species pool, energetic compensation may occur via sequential functional turnover. Depending on the rate of dispersal, compensation may be subject to long time lags.

Energetic compensation may be an ephemeral and context-dependent effect, rather than a fixed attribute of an assemblage, and thus best understood within both temporal and metacommunity context. We combine long-term experiments with repeat implementations of the same experiments to test whether energetic compensation persists in an assemblage despite shifting conditions, and whether it is contingent on historical (legacy) effects.

The Portal Project has provided some of the most compelling evidence for energetic compensation. However, the conditions under which compensation occurred also suggest that it may be highly context-dependent, even within a single system. It took 18 years and required dispersal. This suggests that there’s a lot of niche stuff contributing to whether species can compensate for each other. And the compensating species is not a functional equivalent of a krat. It may be that, if shifting conditions modulate various species’ ability to access resources or impose limits on some species along other niche axes, compensation will be inconsistent over time because different traits are needed to compensate under different conditions. Or, it may be that the addition of PB means that there is sufficient overlap/complementarity in the system for compensation to now be a more reliable, endogenous feature of its dynamics.