

CH-1 - Maintenance of community function through compensation breaks down over time in a desert rodent community.

segue

For the first chapter, we'll be taking a deep experimental, natural-history informed look at how ~~changes in species composition, the size structure, the competitive dynamics, species interactions, and whole-state habitat conditions~~ ~~modulate how ecological communities~~ and why community-level properties respond to perturbations, and how these

~~changes in~~ responses change over time. This work is currently in rev. ^{Ecology preprint & cycle: X}

As a field, ecology is v. specifically, ~~we're~~ interested in how community function ~~is~~ - such as the total biomass produced in a system, or the total amount of ^{food} ~~energy~~ resources

motivate
from -
perturbation

being processed by a group of organisms as metabolic flux - will respond to the types of perturbations ~~we often see in~~ we often see in community dynamics, ^{such as} ~~including~~ species loss, ^{species mass} ~~changing species~~ mortality events, or climate change, ~~interactions, or shifts in environmental conditions~~

These are both questions about basic ecology, and about how we expect ecological systems to respond to global change ~~data~~ in the Anthropocene.

Here, we'll ~~use a classic experimental desert rodent~~ ^{classic} to focus on how community function is affected by the loss of ecologically significant species, and how this response changes over long periods of time. ~~desert rodent community is made up of many species~~

here we
#1

Generally when ~~on~~ species are lost from a community, whatever contributions they made to overall community function - their biomass, or their resource uptake - is also lost. So species loss, on its own, should ^{automatically} result in a decline in function. However, ~~if there are species~~ ~~remaining in the community that are able to perform the same functions as the species that were lost, we can see a phenomenon called compensation or compensatory dynamics~~ function may be

Compensation

resilient to species loss if there are other species still present in the community that are able to "take up the slack" or compensate for the decline in function that was caused directly due to species loss. When we're talking about function measured in terms of resource use or standing biomass, this means that there are species remaining in the system that are able to exploit the resources that were made available ~~there~~ due to the loss of some species. Once the original species are gone, those remaining species may increase in abundance to take advantage of these resources, and restore community-level function, in terms of biomass or energy use, to match what it was before those species were lost. This is called compensating dynamics or compensation.

one way for compensation to occur is for ~~we can see compensation occurring either~~ because all species are identical, capable of using all the same resources equally well under whatever contexts — this is a scenario we ~~see in~~ ~~refer to as~~ complete "niche neutrality," and it is perhaps most strongly associated with theoretical dynamics. Or, compensation can occur ~~also~~ in a niche structured system through what's called "functional redundancy." Functional redundancy is when there are subsets of species in a community that may not be identical in every respect, but share similar enough traits and environmental requirements that they can perform similar functions ~~under some~~ under some conditions. ~~So, two species of grasses may be measurably~~

FR

context dep.

When we see compensation achieved through functional redundancy, it's contingent on a few things. First, the right species, with the right traits, have to be present in the system. Second, they have to be capable of performing similar functions under the

contingency

particular set of environmental conditions being experienced in that system at that time. This is esp. relevant! because functionally ^{within the assemblage} redundant species are likely to be competitors, and one of the ways we see similar but nonidentical competitors coexist is for them to respond differently under different conditions. ~~Both of~~

Temporal dimension

Both of these contingencies in compensation through functional redundancy introduce an ~~also~~ important temporal dimension to compensation. ~~As the set of species over time~~, we can see the set of species available in an assemblage change due to colonization ^{temporal} from the regional metacommunity. We can also see ~~long-term~~ ~~changes~~ fluctuations in environmental conditions modulate the amount of functional redundancy ~~is~~ between similar, but not identical, competitors.

Long term experiments

So there is solid theoretical logic for the expectation that ~~the~~ the ~~ext~~ extent to which community function is robust to species loss should be context dependent and change over time, through either changes in species composition or through changes in the competitive dynamic ~~between species~~ within the same set of species. However, it's very difficult to evaluate these effects empirically, because observational data don't provide enough information to ~~distinguish compensation~~ detect compensation & attribute it to specific processes ~~in the system~~. Experiments can give us that information, but experiments are time and labor intensive, and a short term (3-5 yr) experiment can't give us the temporal breadth to watch these dynamics change. So this is a moment where we're really looking for long-term experimental evidence to tell us how the response of community function to species loss has changed over time and provide clues as to why it's changed that way.

Here we turn to the Portal Project
long term manip. of desert
rodents to study how
community function responds
to the loss of key species,
kangaroo rats.

System of experimental
plots. "Controls" w/ KR;
"Excl" from which KR
removed. Rodents censused monthly
& weighed.
Compare again EE v CC to
see how KR removal affects it
Long term (40 yr) monitoring
reveals how these responses have
 Δ d due to different types of
 Δ s to community dynamics.

This site has experienced major
transitions in rodent
community composition & habitat
over the years, w/ potential to
affect compensation. Specifically,
rodent community shifts ~1996,
2015; long term grass \rightarrow shrub
~~long term grass \rightarrow shrub~~

We use the TS of the PP to
examine ~~specifically~~ how these
 Δ s modulate the ~~of~~ impact
response of spp. loss on Δ time.

Stat. methods:

break TS into chunks

calculate TER,
compensation,
PB, dipo

Compare time periods using
GLS / autocorr.

Repeated shifts in $\frac{E}{P}$ TER
response and imputation.

1st is PB arrival

2nd is PB decline