This document is totally open. Feel free to jot down notes, provide references, ponder theory, or anything else here.

The Theory of Ecological Communities Book Club open document

The publisher's page for the book:
http://press.princeton.edu/titles/10914.html

Twitter hashtag: #TOEC

Chapter 1: Introduction

One question the 6pm UTC Thursday group is going to think about as we read the book is which types of communities fit into this framework. Do all "horizontal" ones? Are there non-horizontal ones that would work?

And how far can we stretch the fundamental units of application? Do viruses count? Plasmids or genes? They have selection, speciation, and so forth. TOEC focuses mainly on processes, and has little focus on the nature and properties of units involved.

A few thoughts of will's after chapter 1:

1) I like Vellend's framework a lot but i'm conscious of what is missing from it. Using selection the way he does corresponds to evolutionary models that examine relative fitness but not absolute fitness. A host of other mechanisms can potentially pop up if you expand this framework.
2) This also makes me think of Sean Rice's book "Evolutionary theory". Sean argues that evolutionary theory's tendency to break down evolution into four mechanisms obscures some evolutionary forces that you can find from first principles. I apologize that the book is quite mathy.

After our discussion i am cautiously optimistic to the framework being applicable to other communities. Dispersal, speciation and drift clearly apply to any community. The real crux is selection. So far i'm concerned the concept of selection applies to any community (where selection is the change in the proportion of entities of type i in a community over time). The real challenge is that it can be hard to make meaningful statements about what selection will do in messy communities.

I'm adding my recommendation to Jim Mallet's paper which i've found so helpful.

Mallet, James. "The struggle for existence: how the notion of carrying capacity, K, obscures the links between demography, Darwinian evolution, and speciation." *Evolutionary Ecology Research* 14.5 (2012): 627-665.

Mark Westoby had what i thought was a question worth remembering, “Will ideas in this book change the way we present community ecology to savvy undergrads”.

I appreciated the recommendation of Lynch's book on genomes. I’ve procrastinated reading that but i’ll have to put it back on my list.

Chapter 2: How Ecologists Study Communities

http://www.ted.com/talks/eric_berlow_how_complexity_leads_to_simplicity?language=en

Chapter 3: A Brief History of Ideas in Community Ecology

Identification of 100 fundamental ecological questions

- Sutherland, W. J., R. P. Freckleton, H. C. J. Godfray, S. R. Beissinger, T. Benton, D. D. Cameron, Y. Carmel, D. A. Coomes, T. Coulson, M. C. Emmerson, R. S. Hails, G. C. Hays, D. J. Hodgson, M. J. Hutchings, D. Johnson, J. P. G. Jones, M. J. Keeling, H. Kokko, W. E. Kunin, X. Lambin, O. T. Lewis, Y. Malhi, N. Mieszkowska, E. J. Milner-Gulland, K. Norris, A. B. Phillimore, D. W. Purves, J. M. Reid, D. C. Reuman, K. Thompson, J. M. J. Travis, L. A. Turnbull, D. A. Wardle, and T. Wiegand. 2013. Identification of 100 fundamental ecological questions. Journal of Ecology 101:58-67.
- http://onlinelibrary.wiley.com/store/10.1111/1365-2745.12025/asset/jec12025.pdf;jsessionid=A863575BE3305D0AB6BAFF8F846F5BAC.f04t04?v=1&t=it4osb8q&s=03a62dda01a6bd5d3df479bb8e366e7a7c31e293

Unanswered questions in Ecology

- May, R. 1999. Unanswered questions in ecology. Philosophical Transactions of the Royal Society of London Series B-Biological Sciences 354:1951-1959.
- http://rstb.royalsocietypublishing.org/content/354/1392/1951.short

MW: The book’s stated aim in a nutshell: “theory that can help contain the mess”.

Similarly in Ch 4 “the smorgasbord of theory in community ecology can be reined in”. (Are smorgasbords delivered on animal-drawn sledges?)

Chapter 4: The Pursuit of Generality in Ecology and Evolutionary Biology

- What potential 5th process would incorporate within-species variation (e.g. traits)? Or is this covered by Speciation, Dispersal, Drift and/or Selection? (p 44) Or is it simply covered by the evolutionary synthesis (which acts in concert with the ecological processes)?

    - We (Thurs group) talked about this, too. Within-species variation affects both selection (i.e. fitness differences) and speciation. Perhaps the consequences of intraspecific variation would be something that would be an add-on to Vellend's 4-process framework.

- Does most ecology fall under the study of Selection processes? Maybe dispersal is a close second, with relatively fewer ecologists studying drift or speciation processes?
- When aiming for generality, distinguish high vs. low level processes (low level likely system-specific, thus not very general) and high-level consequences for community properties (richness, abundance, structure, composition; I think there are probably also system-specific low-level consequences, that would also not be very useful in a general context, but perhaps very useful for specific applications).
- Thurs group noted that TTOEC might apply equally well to communities that aren't so clearly defined by species. e.g. bacterial communities that use OTUs, a community where genotypes are ecologically distinct and important, ...

MW: Filter metaphor works OK for dispersal and abiotic, but not for biotic, where the process is one of interactions not of screening by something external.

MW: Very interesting is the comparison between ecology and population genetics -- he's right to say there's a strong difference in self-confidence. Maybe this is because pop gen is overconfident just as much as because ecology is underconfident?
(In particular, pop gen doesn't try to generalise much about actual real-world selection pressures.)

MW: Fig 4.4 only represents one possible way of representing the difference between pop gen and ecology. On the left hand side, all four of competition, predation, food webs and niches are populaion-interaction entities and typically are treated that way in textbooks. And why doesn't scale appear on the right hand side?

Chapter 5: High-Level Processes in Ecological Communities

Population Genetics	**Community Ecology**	**Plain English Description**	**Potential Community Consequences**
mutation	speciation	Origination of new things	Increase species richness. Increase beta diversity.
migration/gene flow	dispersal	Movement from one place to another place	Increase species richness (decrease via emigration), alter species relative abundances (if already exist in the community). Decrease beta diversity.

Genetic drift	drift	Stochastic sampling from one time period to another time period	[stochastic/random] fluctuations of species relative abundances (which ultimately may have consequences for richness, composition, and evenness) [can still be driven by non-random demographic events occurring to individuals within a species]
Natural selection	selection	Processes that favor things that can successfully survive and reproduce in a place and are relatively better at these tasks than the other things in that place	Changes the relative abundances of species in a community (composition) and potentially presence/absence of species in that community. These changes may be 1) constant, 2) negatively frequency dependent or 3) positively frequency dependent. *There are many well-studied low-level processes that drive this consequence.

Drift

- Drift is often discussed in a neutral context (ecological equivalency), but doesn't need to make this assumption to be an influential process.
- Drift seems different from these other processes in that it's a thing that happens, but doesn't necessarily have a low-level process underlying it. A model could incorporate drift or not, but it's a binary thing, rather than selection, dispersal, and speciation, which can all be given rates and varied in different ways.
- Although Vellend makes an impassioned argument for randomness (p. 52), it seems like a bigger stretch for communities vs. populations. It's much easier to conceptualize an stochastic event happening to an individual of a species independent of a particular allele (e.g. a big storm kills a random butterfly, without regard for whether the butterfly has a yellow phenotype or a blue phenotype), but it's harder to think about a stochastic event happening to a random individual in a community without regard to its species identity. Perhaps this relates to why the TTOEC applies just to "horizontal communities," where individuals of different species are more "equivalent" in some way.

Selection

- Absolute individual fitness: expected # [or quantity, as in spp that we can't delineate individuals well] offspring produced by an individual per unit time [assuming survival of the individual itself]
- Relative species fitness: average fitness across individuals within a given species, and standardized across species in a community (divide average species fitness by average community fitness or by absolute species fitness of the fittest species)
- Note: if we think of abundance as not just "Number" but "quantity" it allows the theory to work across even more theories and organizational schema - e.g. biomass/body size studies, things that we can't count individuals well or reliably, things where we might be more interested in size or energetic units and dynamics.
- Magnitude and direction of selection can vary on: 1) current properties of the community, 2) space, and/or 3) time.

- Are there any reasons that assuming “perfect” heritability could be problematic? Are there any taxa or scenarios that this might not apply to (e.g. hybridization)?
- How should we count fitness operationally? Is it just number of offspring? What if you’re in a place where your offspring can’t survive? (e.g. all your seeds get blown into the ocean and never germinate)

Dispersal

- Primary vs. secondary effects of dispersal (or any of the 4 processes?)
- Where does seasonal migration fall into Vellend’s structure of community theory?
    - He says it doesn’t. p. 58 “Dispersal is … , as distinct from seasonal animal migration”
- In chapter 4, the example of dispersal is *only* immigration. In chapter 5 he makes it clear that dispersal includes emigration. But then he doesn’t discuss that further at all. Because organism emigration can cause species extinction (at a local patch), it seems important. Perhaps the lack of attention to emigration in the book is due to Vellend’s expertise in plant systems, where emigration of adult individuals doesn’t happen.

Speciation

- Extinction is a consequence, not a process
- Consider in a more detailed way than as the probability of a random change (Hubbell modeled speciation [v] similarly to genetic mutation rates.

How does this 4-process structure inform our understanding of scaling community properties and processes (e.g. beta diversity and regional patterns in S, N, Evenness, and composition)? Table 5.1

Could each of us couch our own research themes/theories in the structure Vellend presents? Which of the 4 high-level processes does the study address and what high-level consequences are of interest?

Chapter 6: Simulating Dynamics in Ecological Communities

Official online materials (annotated R code):
http://mvellend.recherche.usherbrooke.ca/TOEC.html

R code on GitHub for Chapt 6 figures: https://github.com/aammd/ecotheory

During our conversation about the use of density- vs. frequency-dependence in the models presented here, I mentioned a couple of papers that discussed how empirical tests of ‘modern coexistence theory’ use the concepts. These are those papers:

> http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2435.2008.01456.x/abstract
> http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2435.2008.01462.x/full

Chapter 7: The Nature of Empirical Evidence

Chapter 8: Empirical Evidence: Selection

We talked about scaling up again this week. Specifically, I think the conversation came to the point where we discussed whether or not it would be possible to apply Vellend’s predictions in this chapter to any of various scales at which ecological studies are conducted. Can selection (sensu Vellend) operate at local, regional, and continental scales? And what happens when we bump up against the limits? I mentioned that scale transition theory might be an approach that links multiple scales and could be useful to think about.

The papers below (thanks to Emily Schultz, a grad student at Rice who works on scale transitions, for pointing these out) focus on population dynamics, but I think the theory applies to communities, too. Here's a short description: "[s]cale transition theory shows that the most important changes in dynamics at the larger scale can be attributed to interactions between local-scale nonlinear population dynamics and spatial variation in either population density or the physical environment.

Melbourne, B. A., & Chesson, P. (2005). Scaling up population dynamics: Integrating theory and data. Oecologia, 145(2), 179–187.
Melbourne, B. A., & Chesson, P. (2006). The scale transition: Scaling up population dynamics with field data. Ecology, 87(6), 1478–1488.

https://drive.google.com/file/d/0B2DOOC8VLKFhTnVaT3JOdFZFLUE/view?usp=sharing
https://drive.google.com/file/d/0B2DOOC8VLKFhb3FqdzlJS1RGOEE/view?usp=sharing

Or, if you're looking for a blog discussion:
https://dynamicecology.wordpress.com/2012/10/15/scaling-up-is-hard-to-do/

Chapter 9: Empirical Evidence: Ecological Drift and Dispersal

Chapter 10: Empirical Evidence: Speciation and Species Pools

Chapter 11: From Process to Pattern and Back Again

Chapter 12: The Future of Community Ecology

Notes that are not chapter-specific