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sDiv working group meeting summary "sNiche"

Expanding Neo-Chessonian coexistence theory towards a stochastic theory for species rich communities

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The general objective of the two sNiche workshops is to synthesize recent coexistence theories by focusing on the role of stochasticity in promoting biodiversity. Our starting point is the dilution hypothesis that states that interactions between species may become "diluted" and less predictable if the variability in the biotic neighborhood of individuals becomes larger.

We aim to approach a new stochastic coexistence theory that should allow for deterministic fitness differences and stabilizing mechanisms, but include stochasticity as a key mechanism that further promotes coexistence and that can lead to biodiversity patterns similar to those predicted by neutral models.

The participants contributed expertise on spatial pattern analysis, stochastic modeling, Neo Chessonian coexistence theory, and spatially explicit simulation modeling. Diverse career stages were represented, including PhD students, post docs, early career researcher, senior scientists and faculty. The group was also diverse in terms of gender and geographic origins, with participants from Germany, the US, Australia, and China. The presentations and discussions during the first workshop covered four broad areas:

1. Background on spatial point pattern analysis of fully stem-mapped plots of plant communities to quantify spatial patterns in the biotic neighborhood of species. Discussion on how spatial analysis of field data and simulated data allows testing the dilution hypothesis and how it can provide hints on the nature of the new coexistence theory.
2. Discussion of the different types of stochasticity in community dynamics, different axes of complexity and complex dynamics, and how stochasticity may influence coexistence.
3. Background on contemporary coexistence theory, its limitations under high species richness, and first brainstorming on how the new stochastic coexistence theory might look.
4. Background on spatially explicit simulation model of community dynamics and the design of simulation experiments to understand results of spatial analysis and test new theory.

For subsequent discussions we divided the overall goal into smaller themes to better understand operation of stochasticity and its consequences for coexistence:

1. Operation of stochasticity fundamentally alters community dynamics and the conditions for coexistence. We also discussed the different types of stochasticity that occur in community dynamics.
2. What can be pulled out of spatial neighborhood patterns? We identified mechanisms or processes that are expected to produce spatial structures in biotic neighborhoods. We developed ideas on how to use spatially explicit and individual-based simulation models to generate virtual census data (with analogous structure to "real" census data") to test if spatial statistics is able to recover the signal of the known processes.
3. We discussed if and how community dynamics may differ with diversity and how we can quantify this. We also discussed the evolution of coexistence mechanisms.
4. How can models (data analyses) consider more realistic higher-order interaction structures, and how sensitive coexistence may be to changes in interaction functions?

Several possible outputs, mostly journal articles, were defined and several ideas for joined analyses discussed. Possible output included concepts/synthesis papers on biodiversity theory and stochasticity, and studies that use census data generated by simulation models to (i) see if the assumed pattern - process link holds, (ii) explore if species richness changes the dynamics and spatial patterns of communities, (iii) to mimic the analysis protocol of Neo Chessonian coexistence theory, and (iv) to check the importance of higher order interactions.

We scheduled only few background presentations of participants, and the balance between work on outputs/ general brainstorming - information exchange / participants presentations was roughly 30%/45%/25%. sNiche was very inspiring for all participants. The research ideas developed during the workshop were beyond what we had hoped before the workshop. The general working atmosphere was exceptionally positive and constructive, and concentrated. Despite a rather large group of 21 participants there was a sense of full dedication throughout the workshop. Besides the good composition of the workshop group the support of sDiv was absolutely key for the success of the workshop.

First sNiche workshop, 18-20 01. 2016 at iDiv, Leipzig. Participants from left to right: Jonathan Chase, Lauren Sullivan, Stan Harpole, Juliano Sarmento Cabral, Tiffany Knight, Sebastian Lehmann, Karin Frank, Chengjin Chu, Felix May, Thorsten Wiegand, Stefan Kupers, Grigoris Kylafis, Janneke Hille-Ris Lambers, Margie Mayfield, Lauren Shoemaker, Aubrie James, Karen Abbott, Nathan Kraft, Xugao Wang, Sean Satterlee, Andreas Huth

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