The evolutionary biogeography of species interactions networks

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Abstract

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1 Why

In the most recent years, understanding the evolution of species interaction networks in space emerged as a challenging task [5], to some extent because of the lack of an integrative theory [9]. Yet, over the last fitfteen years, ecologists and evolutionists developped three bodies of litterature upon which such a theory can be based. First, we developped tools to analyse the structure of species interactions, in simple and complex communities. Second, we uncovered the mechanisms involved in species coevolution [7], including how coevolutionary dynamics should be affected by space and environmental heterogenetiy [8]. Finally, several contrasted hypothesis to explain species distribution patterns in space were proposed. As of now, there is still relatively little overlap between these three fields (Fig. 1). Here, we argue that while a theory for the evolutionary biogeography of species interactions can be built by increasing overlap between these three fields, there is more to in than that. We identify the need to more closely investigate mechanisms involved in species interactions and evolution at different scales of organization (individual, population, community), and ...

Despite the conceptual advance that this paper represents, it is still difficult to precisely outline what the theory will ressemble. Identifying patterns against which to match theoretical predictions is difficult, because as we show, there is a lack of dataset whose design would allow making inferences on the processes responsible for shaping the evolution of spatial networks. As we belive that, failing what it may be highly speculative, a theory allowing to make such predictions should be better grounded in data, we conclude this paper by proposing new ways to approach the sampling of species interactions, allowing a better understanding of the underlying evolutionary mechanisms.

2 Processes and mechanisms

In this section, we review processes and mechanisms belonging to the three bodies of litterature, likely to act in the evolution of SINs in space, and discuss which should be part of an integrative theory.

The first three paragraphs describe roughly what we know about each of the three theories, and how it relates to space / evolution. The last paragraph is essentially an appeal to

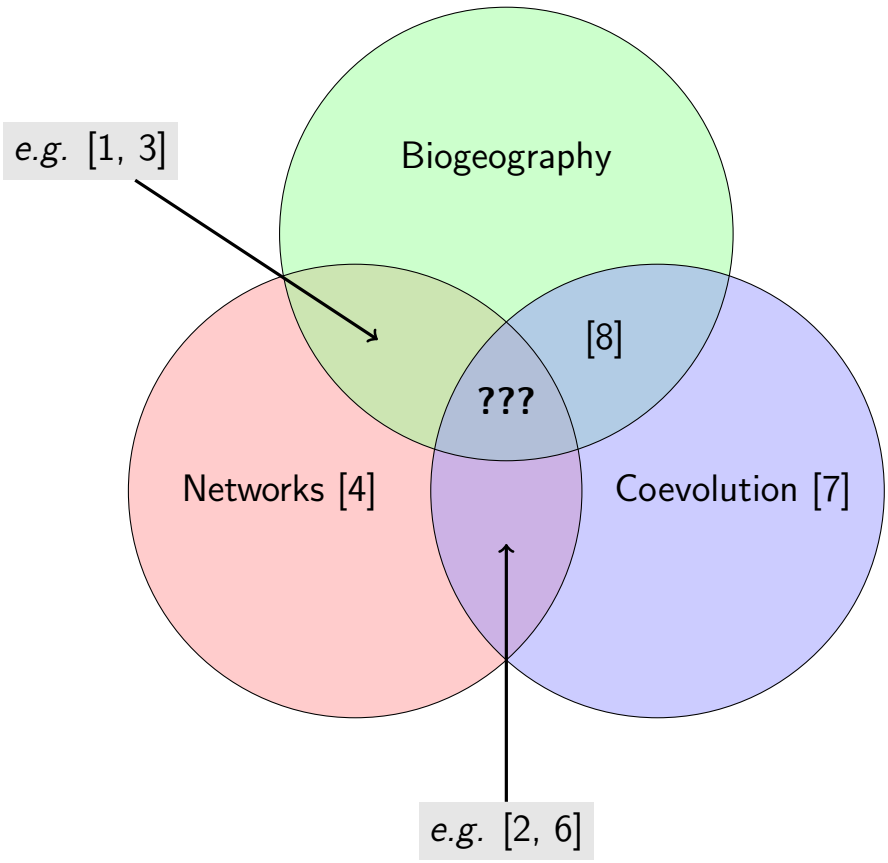

Figure 1: The integration between theories about species interaction, coevolution, and biogeography, is a required step to take in order to reach a biogeographic understanding of how species interaction network evolve over spatial extents.

make individuals / populations the relevant unit of observation and modelling. All the mechanisms acting at these scales provide a unification between both the theories and the scales of organization

- Current state of : networks theory
- Current state of : biogeography
- Current state of : coevolution
- (figure with arrows between similar mechanisms – tim)
- Right scale for the mechanisms
  - individual
  - trait
  - genetic architecture
  - provides the unification between scales of organization

3 Patterns

- How do patterns of interaction evolution scale from individuals to communities? Which patterns scale up, and which don't?
- not necessarily the same structure at different scales : which mechanisms will scale up ?
- do we have predictions for ecosystems (nutrient cycling, . . .)

4 What to do?

4.1 Data

The goal of this section is to outline what kind of data we need, and why

- Individual data with traits

- Genetic architecture
- Explicitely sampling different locations

4.2 Models

Phil (mostly) will compare different models and what they lack / have

- Box with the different models
- New methods for modelling 1
- New methods for modelling 2

5 Conclusions

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