

The biological interpretation of probabilistic ecological networks

Francis Banville^{1,2,3,‡}, Tanya Strydom^{1,3,‡}, Timothée Poisot^{1,3}

¹ Université de Montréal; ² Université de Sherbrooke; ³ Quebec Centre for Biodiversity Science

‡ These authors contributed equally to the work

Correspondance to:

Francis Banville — francis.banville@umontreal.ca

1: Community ecologists are increasingly shifting from a binary thinking of ecological networks (e.g., do species interact?) to a more probabilistic perspective (e.g., how likely are species to interact?). Assuredly, the benefits of representing ecological interactions as probabilistic events are numerous, from a better assessment of the spatial variation of interactions to an increase capacity to reconstruct networks from sparse data.

2: However, probabilities need to be used with caution when working with ecological networks. Indeed, depending on the system at hand and the method used to build probabilistic networks, probabilities can have different interpretations that imply different ways to manipulate them. This is rarely discussed in the literature, thus impeding our ability to use data on probabilistic interactions appropriately.

3: At the core of these differences lie the distinction between assessing the likelihood that two groups of individuals *can* interact and the likelihood that they *will* interact. This impacts the spatial, temporal, and taxonomic scaling of interaction probabilities, thus further enlightening the need to properly define them in their ecological context.

4: With these challenges in mind, we propose a general approach to thinking about probabilities in regards to ecological interactions, and call for better definitions and conceptualizations of probabilistic ecological networks, both at the local and regional scales.

Keywords:

ecological networks
metaweb
probabilistic networks
spatial scale
species interactions
temporal scale

1

Intro/Background

Why it is useful think about interactions as probabilistic event An interaction is probabilistic since two species ‘meeting’ does not mean that an interaction will occur e.g. a lion crossing paths with a gazelle does not mean predation will happen but is contextual on the physiological state of both the lion and the gazelle. Also, two species co-occurring does not mean there’s gonna meet (think of species relative abundances)

Aim: Although it makes sense to think about interactions as probabilities it is not without challenges. This paper aims to outline some of these challenges/limitations of interpreting these probabilities

probably a dope conceptual figure [‘scale’ up a the nodes from and individual to population to taxo group how would how we interpret these probabilities change]

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Overview of Probabilities

How are we defining (in the literature) what the probability of interaction is (there are many ways to slice this cake)? Weighted Networks??? It might not be as intuitive as you would think/assume

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Probabilistic Metawebs

What does a probability in the context of a metaweb mean? Can we turn this into a local network realisation that is also probabilistic and intuitive? Bayesian vs frequentist

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Ecological Context of Probabilistic Interactions

A cautionary tale of how we define probabilities? Environmental context, local abundance context Talk about individual scale and the population scale (probability at the individual level vs the species level) Taxonomic scale ['scale' up the nodes from an individual to population to taxo group how would we interpret these probabilities change. How does the aggregation change the interpretation? Does it?] How is it analogous to spatial and temporal scaling (basically, all kinds of scaling are just different ways to aggregate individuals/nodes).

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Scaling

Note scaling can refer to both space and time Regional can inform local but can local inform regional? Network area relationships (Ontario lakes?? Or Alaska) Why probabilistic realised networks scale with area but not probabilistic metawebs

empirical example figure

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Concluding Notes

Non-ecological Networks: What can we learn from other systems/fields e.g. social networks, probabilistic graph theory?

What even are the probabilities? What is the probability that we will ever know the answer to that?

Be careful how we define probabilities. Be sure to be explicit about these things/think about it carefully. Also, different interpretations imply different scaling, and different ways to manipulate these numbers. *Maybe mention/thinking about workflow from metaweb to realisation*

Scores vs probabilities

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References