

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

This work is released by its authors under a CC-BY 4.0 license



Last revision: *September 19, 2022*

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 built 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 if two groups of individuals *can* interact or if they *will* interact. This impacts the spatial, temporal, and taxonomic scaling of interaction probabilities, thus enlightening the need to properly define them in their ecological context.

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

1 **Intro/Background**

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

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

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

11 **Overview of Probabilities**

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

14 **Probabilistic Metawebs**

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

17 **Ecological Context of Probabilistic Interactions**

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

24 **Scaling**

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

28 empirical example figure

29 **Concluding Notes**

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

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

33 Be careful how we define probabilities. Be sure to be explicit about these things/think about it carefully.

34 Also, different interpretations imply different scaling, and different ways to manipulate these numbers.

35 *Maybe mention/thinking about workflow from metaweb to realisation*

36 Scores vs probabilities

37 **References**