

August 16, 2021 Theory Working Group Call

Attendees: Glenda Wardle, Andrew Allyn, Steph Brodie, Cole Brookson, Amanda Gallinat, Elyssa Collins, Jody Peters, Jono Tonkin, Abby Lewis

Regrets: Jaime Ashander, Mike Dietze

Agenda:

1. Poll for September-December calls.
2. Table 1 that compares forecasting with other modeling approaches. Abby's goal with the table is to directly outline what is uniquely powerful about near-term forecasts as a methodological approach, since this is something we have been dancing around in meetings and is a critical point of the paper. Please provide comments and suggestions, with a particular request to the "Transferability" subgroup to add suggestions for the table.
 - a. What are the strengths of forecasting vs traditional modelling framework?
 - b. What is the justification for greatest flexibility?
 - i. In contrast to ARIMA approach where you are limited by not having data at the timestep you are predicting. Example - predicting evapotranspiration
 - ii. Can we make the examples as close as possible. The drivers remaining the same but a model that relates leaf color to seasonal daily temps. So it is more comparable to forecasted environmental drivers. See example 3.1
 - iii. Want formula or model representation to show how each is different. Be explicit how the model structure is changing to accompany the description so people can see how what they are forecasting now related to the forecasting option
 - iv. This table is a really nice way to bring together the diversity of what we have been talking about
 - v. Differentiating between statistical forecast and mechanistic forecast. Here we are focused on statistical forecasting. Mechanistic models would be better at looking forward in time. Could add a 4th column that shows difference between stats and mechanistic model
 - vi. "Traditional" pushback. For now it is a good working word. We are trying to say we are different from that. But need to be clear what we are putting in the "Traditional" bucket.
 - vii. Want clarification about the predicted time step. This could be a phrasing question.
 - viii. Will come back to the table and articulate in the Intro of the paper
 - ix.
3. Framing/reframing conversation
 - a. Reorienting the abstract and paper around introducing the problem. What is missing from some of these "classical" approaches. What are the classical

approaches that we are saying aren't contributing what we need when we use forecasting.

- b. Many opportunities to define the approaches we are contrasting to forecasting. We need all hands on deck for this. Need clear language about the traditional/classical approaches.
- c. Abstract for the paper is set up as here is forecasting, here is what we think it will help inform ecological theory.
- d. Instead - identify the gaps in what we can address with ecological theory with the "classical approaches". What is missing and how ecoforecasting and fill those gaps and address eco theory in new ways
- e. How can we reframe around the gaps, what are the gaps.
- f. Approached this from a forecasters viewpoint and currently have 2 headings that come from a forecasting perspective.
- g. But if we come at it from the perspective of what is missing in ecological theory, wonder if the 2nd heading on transferability can be one way to test something fundamental?
- h. Alternative way of framing that could improve flow of paper and use content already present.
- i. 2 headers could be
 - i. There are gaps in our ability to test hypotheses in the interactive, adaptive way that is necessary for pre-emptive management of ecosystems. Iterative ability is huge benefit
 - ii. We can move beyond asking whether we can make predictions and move into why we can or cannot predict them. This is about parsing uncertainty and looking into why or why not we are good at this.
- j. Both of the questions then focus on testing questions in ecology. Both are unique to forecasting and allow us to draw in the content but lets us focus on theory
- k. Benefit is that it also lets us reach ecologists that do not already do forecasting
- l. Feedback from the group
 - i. All the material already developed will stay, but will change
 - ii. Connect to theory is the really exciting part of the paper
 - iii. How many people in ecology are working in theory? How many people read theory papers? It is stagnant. Doesn't bring people together. The theory part of ecology is in a stagnant/quiet phase. But forecasting as the ability to test hypotheses iterative aspect of it is really exciting for theory.
 - iv. Transferability is really exciting to point to generalization in ecology which is really exciting
 - v. Right now forecasting is for managing the environment. But if we set it up this way, it lets us look inwardly on ecology. Forecasting re-energizes what is exciting about ecological theory.
 - vi. Focus on what is exciting for ecology theory. Re-energize ecological theory. The ties between ecology theory and practice. Forecasting lets us

tie them back together.

4. Toy model - Elyssa has been working on this
 - a. Second section - not just can we predict ecological systems, but why can or can't why and how does transferability fit into that
 - b. Figure 1 with 1b shows different sources of uncertainty, but then it will be great to have another figure in to show frontier for showing the uncertainty
 - c. Transferability figure - want to show this in the figure: what does the dominant source of uncertainty in the model indicate about the transferability of the model to a new location
 - d. Source of uncertainty is part of the figure and then how dependent is that on the novelty of the new environment (will still need to define what "novelty" means)
 - e. On left hand have dominant source of uncertainty (driver, process, initial condition) and on bottom have increasing novelty
 - f. Elyssa and Abby have been working on developing logistic growth model using data from the Dietze GitHub repo - dummy data from 30 years from 10 sites
 - g. Does the forecast tell us about the theory about transferability or that this is informing us about the logistic growth model and the theory behind the logistic growth model?
 - i. Can you transfer a model based on the dominant sources of uncertainty
 - ii. And what does the transferability of forecast tell us about the novelty of a system.
 - iii. Think it might go both ways.
 - iv. Think about transferability tied to generality in ecology. This would be a broader ecological concept that this sheds light on. It can be useful to apply forecasts to new locations to try to see whether the equations we understand govern a process in one location governs those same processes in another location
 - v. Also want to tie to uncertainty - still working through that part
 - vi. This figure will be very instructive for bringing together our thinking and will be very important for the paper
 - vii. What is wrong with the way ecologists do hypothesis testing right now?
 1. There are lots of alternatives, but there isn't a good way to test the alternative
 2. Another way is that we test hypothesis one place/one way and then go on. Whereas when we use the iterative process then we stay in one place
 3. Would be useful to provide more concrete examples of theory we are trying to test.
 4. What are the most popular theories in ecology? Then can we come up with a toy example that addresses those theories
 5. Play with it in a sort of hindcast way. An iterative hindcast with a timeseries
 - a. Could draw on previous published lit

- b. Be clear in the manuscript about what specific ecological theory forecasting can advance. Be clear about example. Perhaps with a box
 - c. Wonder if it would be useful to include some ecological examples on left hand of Elyssa's figure. Give an example that would apply along with the theory example that are given
 - d. Concrete examples - cover a broad range of
 - e. Relationship of species and their environment is a focus
6. Suggestion from Cole. Doing DA and forecasting can get your parameters back with tighter estimate. Illustrate the difference in CI - see how this approach gets us something compared to other approaches

5. Wrap up

- a. With the reframing - how much will the manuscript be the concrete example vs drawing on other literature
 - i. Paper will be structured as a short perspective piece. So won't provide comprehensive lit review and won't do an in-depth analysis
 - ii. We don't need to identify the methods like we would in a methods piece. So can make the point that forecasting can energize the field of ecological theory. And can use figures to demonstrate that rather than demonstrating the method
 - iii. Scheiner 2010 Articulating a theory forces us to provide clear definitions of concepts that have often been in dispute. Theories can evolve through a change in our understanding of a principle, without changing the way the principle is worded (e.g., our understanding of the concept of
 - iv. What I think we can use from that is that forecasting forces us to articulate the sources of uncertainty in ways that are helpful for advancing our understanding/
- b. Next steps
 - i. Abby to restructure the outline with the reformatting/reframing
 - ii. Abby will flag people individually to look at the outline or fill in the outline. Or will potentially think about writing short paragraphs.
 - iii. Abby will continue to flag people. But wants to make sure there is an opportunity for everyone to participate even if she doesn't think of you for a particular section. Will continue to use the #theory Slack channel.
 - iv. If you are interested in specific section, reach out.
- c. Abstract is due at the end of the month to Christy and she will share it with the selection committee. This will be the way for the selection committee to see if it fits
- d. Outline for special issue will be due in mid-fall. Then manuscript submissions are due next spring. (These seasons are in reference to the northern hemisphere).

6. Abstract for Methods in Ecology and Evolution Special Issue. The abstract is due at the end of the month.
7. Revised manuscript outline. Please take a look and add comments or be ready to discuss during Monday's meeting.