December 14, 2021 Theory Working Group Call

Attendees: Elyssa Collins, Caleb Robbins, Cole Brookson, Abby Lewis, Jody Peters, Glenda Wardle, Christy Rollinson, Gerbrand Koren
Regrets: Mike Dietze, Jonathan Tonkin, Stephanie Brodie
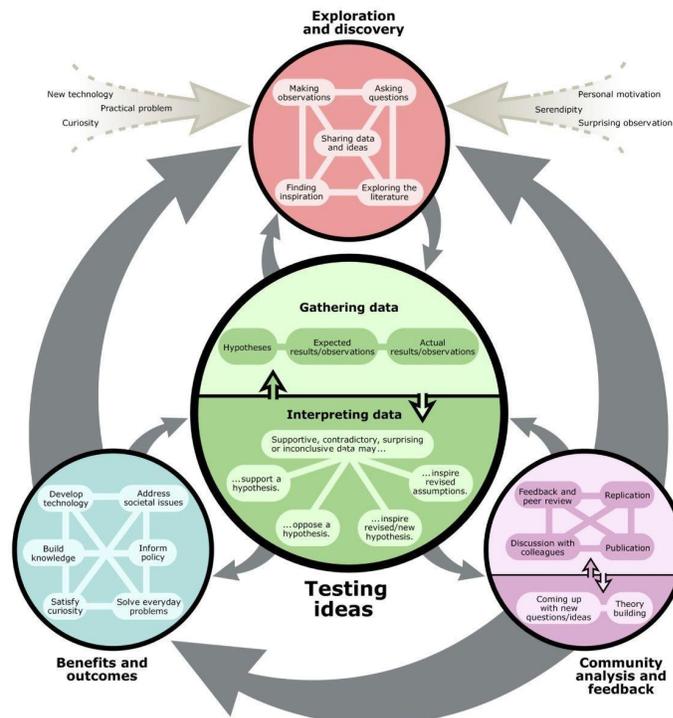

Agenda:

1. Discuss first section - forecasting uses prediction to advance prediction. Discuss the use of prediction in ecology and how forecasts contribute to that
    i. Figure 1
        1. 2 goals of forecasting Hypothesis (orange) testing and Decision Support (green)
        2. Empirical model doesn't necessarily translate to ecological understanding, but it can be used to create hypotheses
        3. Remove the number 1,2a, 2b, 3
        4. Can empirical model have an arrow directly to Hypothesis?
            a. You observe something about the empirical model that can then be used to refine your hypothesis
        5. Could make the two parts of the figure more circular and labeled A and B to refer to
        6. See Glenda's example - re-orient from top to bottom with the 2 circles.
        7. Go into how the empirical model→forecast→evaluation in more detail
            a. Could start with this to say how would forecasting help us to look at ecological theory differently and then go from there.
        8. If we want the arrow from empirical model to observation - want to find papers that show this. Or are people only using empirical models for decision support?
            a. Gelnda's example - boom in productivity when getting X amount of rain which then goes from plants to an eruption of small mammals. There is not management decision with it, but doing it for year, that this type of rain will give a rodent eruption within 6 months. They use the model to go back to the observation of the rodents - using it for the ecology. They are not using it for making management decisions about, for example removing rodents
            b. Raises the question of why is there that specific threshold. Whereas a mechanistic model
            c. Gives an example of an ecologist going back to observation in a cyclic way
        9. **To Do: Continue to read over this section and give comments and mock up edits for Figure 1**

b. Discuss Conclusion: Roadmap Section. Brainstorm - what is needed to use forecasts to advance theory. Why aren't people using forecasts to advance ecological theory questions

  i. Theory forecasts, particularly using field data - there is an emphasis on getting lots of good data. Need for comfort building and sharing preliminary. Be comfortable to fail faster. Learn from failed forecasts

  ii. Drawing out experiments and make them forecasts. Every year of experiment make a prediction for what you expect to find.

  iii. Think you need to have a long time series of data so you can make a forecast

  iv. Everything should be a forecast in ecology. You need to defend why you are not making a forecast in all your research. Want readers to think "Why aren't I forecasting?"

  v. Want to make a mind shift. Instead of thinking about forecasting - just think of it as ecology

  vi. How often are people studying past events in ecology and then discard forecasting. We have an event that happened in the past that we want to understand and then forget about the forecast toolbox. Applying methods that can be used for forecasting and they can also be used in hindcasting. Asking the question - could we have foreseen this?

    1. Alot of what we are talking about applies to hindcasting historical datasets and predicting next point in dataset as well as real-time forecast to make predictions of the future. And neither are commonly used at this point

  vii. Bringing in data and mathematical models into theory. How we learn about ecological theory predisposes you to the way you think about ecological theory that may not mesh with forecasting

  viii. Forecasting requires us to think about evidence and weights of evidence. Big emphasis on alternate hypotheses. This leads to thinking about our metrics for success.

  ix. Solving equations - you have a single equilibrium value that we won't actually see in the environment

  x. Thinking about uncertainty in a new way and quantifying different types of uncertainties

  xi. What is our thinking about the Bayesian approach?

    1. From Abby's review paper of forecasts - almost all definitions of "forecast" include the need for quantifying uncertainty, but less than half of forecasts created in the review did not include uncertainty

      a. Forecasts that include uncertainty are important in these x,y, and z ways

      b. For its fullest usefulness forecasts will include uncertainty

      c. **Goes back to the idea of "we need to make forecasts, not that we need to make perfect forecasts". Don't let perfect be the enemy of the good. START OR END THIS SECTION WITH THIS IDEA**

xii. How do we get to this point? What is important?
1. Collaborations
2. Could poll EFI members/working groups. Could put something in a Slack channel
3. Thought experiment: if we changed the mind of the generation now, and we were to teach ecological theory, what would we teach, what would the examples be
   a. Set the thinking up when students first get thinking about ecology to draw out how forecasting sits within the idea of ecology
   b. Currently, it starts with mathematical theory at higher grad level. But instead of starting with "this is a distribution" - start with why you want to know.
4. Think about where you are trying to get. Instead of thinking of forecasting as a method to get there, rather the goal is to address a need, which can be a theoretical need.
   a. Forecasting as a disposition. Once you have the goal it causes you to change the way you do your science
xiii. Concrete steps already bulleted
1. Tools, computing power for making forecasts
2. Community driven best practices
3. More forecasts developed for the same systems and problems - e.g., forecasting challenge (this lets us understand the limits of predictability)
4. Could require a different definition of who the forecast user is. Could be used by basic researchers/theoreticians.
   a. Forecasts have had a very applied scope. But by being honest of the limitation of our forecasts can help to learn more about the ecology
   b. There is a history of doing this in physics, dynamical systems, etc. Making forecasts to understand your field
5. From Glenda: I had in mind the figure at this link The Bulletin of the Ecological Society of America, Volume: 98, Issue: 3, Pages: 211-226, First published: 30 June 2017, DOI: (10.1002/bes2.1330
6.

How science works

2. Timeline - aim to submit in early spring-ish (N. American time). For special issue. Review papers are of interest. The special issue will highlight that forecasts have utility to people outside of the usual "forecasting" field. The special issues is using this as an opportunity to grow the forecasting field across ecology, biology, evolution
    a. Goal is to have abstracts from everyone by the end of 2021 or early Jan 2022. Iterative process with editors to make sure everything is going to fit.
    b. Manuscript drafts by mid- to late-Q2 in 2022. **Shooting for April 2022**

3. Authorship Guidelines Discussion
    a. Current thinking on authorship - there are 5 ways to be involved with the manuscript and co-authors are expected to fulfill 2 of them
        i. Conceptual development through working group, slack, zoom meetings, etc
        ii. Writing the outline and text
        iii. Reviewing and editing drafts
        iv. Draft figures
        v. Supervision and administration

4. Spreadsheet to compile literature on forecasting papers that shed light on theory topics from the manuscript and non-forecasting papers on theory/ecology that are key for the manuscript
    a. Continue to add papers to the spreadsheet
    b. Need good examples - case studies that show it is clear that forecasting has been successful that we can learn from it. Showing by example how useful that can be.
        i. From Cole: examples of simpler forecasts too - there's so many great vingettes etc online of how to use basic statistical models that's great for folks just trying to learn GLMMs (or whatever) that don't need to be the GREATEST models, just examples for folks who've never even tried it before
    c. Don't have space for tons of examples, but would like to have 1-2 papers to highlight for each section.
    d. One simple example can be the NPN phenology examples are pretty simple. Don't do DA. Just update the weather
        i. Would this be useful for ecological theory?
        ii. Christy finds it useful for understand theory about edaphic and local adaptation
        iii. This plays into the idea that there are forecasts used for decision support, but because they play differently at different locations and this leads to a better understanding of predictability and transferability
        iv. Many of the models were not developed for decision support, but for public engagement
    e. Abby's paper - Rastetter 2017 - modeling efforts can be divided into 2 categories. Modeling for numbers (empirical modeling) more prediction oriented. Modeling for understanding is for thinking about relationships between organisms
        i. We confront models for understanding with data and get more information/understanding about the system

5. Action Items for Next Call
    a. Add comments to section 1 and the figure
    b. Any additional comments to section 2 also welcome
    c. Brainstorm any other roadmap items
    d. Abby added table to the bottom of the manuscript for co-author contributions. Fill in your contributions so Abby knows who to tap for different tasks coming up
    e. Continue to find examples
        i. Any other specific types of articles needed for the lit review?
            1. Papers that provide example of specific contributions that we talk about in the paper. E.g., hypotheses in section 2. If you find paper that talks about the limit of predictability or tries to understand the uncertainty to limit predictability

2. Would like co-author contributions to add lit citations to the manuscript