

October 8, 2025 Theory Working Group Call

Attendees: Jon Borrelli, Ruby Krasnow, Caleb Robbins, Abby Lewis, Freya Olsson, John Foster, Marcus Lapeyrolerie, Jody Peters, Joseph Savage, Saeed Shafiei Sabet
 Regrets: Bilgecan Sen

Agenda:

1. Announcements:
 - a. [EFI2026 Conference](#) in Toronto on August 4-7. Working groups and workshops will take place on August 4. More details to come.
 - b. Find a pre-print of a manuscript describing the cyberinfrastructure behind the Forecast Challenges at <http://doi.org/10.22541/essoar.175917344.44115142/v1>
2. Predictability of Nature synthesis - discuss challenges and opportunities in predictability.
 - a. Request for input on this table compiling predictability papers Predictability papers
 - b. Especially interested in papers people know of or have cited as you think about predictability. This is not meant to be an all encompassing list. Just things that people are aware of
 - c. Will use this to develop figures and summary table
 - d. Understand the reason behind not doing an systematic search for papers, but will need to consider how to address reviewers who may want a systematic search
 - i. Abby shared her lit review process for her
 - e. "ecological predictability" turns up 1,198 results in web of science
 - f. Are there other things of predictability that we would want to include for search terms (adaptability, transferability)
 - g. Goal is for the paper to be a Trends Perspective - here are papers that fit in the topic, here is how they fit in the framework for forecasting.
 - h. Paper argument - we need to be studying predictability. It is a useful concept. Want to argue that the lit search helps identify papers that support this point and pull out a few as case studies
 - i. Two questions to think about:
 - i. Are any papers in the table useful as case studies on how people think about predictability or quantified it?
 - ii. Find cases where people have quantified intrinsic predictability and used that to develop forecasts
 1. Freya cares about intrinsic predictability to make her forecasts better. But can't think of specific examples
 2. People have mapped where forecasts are not doing well because there is lack of intrinsic predictability.
 - j. Going back to the aggregation paper example in the table - are we forecasting the wrong thing. Perhaps it is targeting different aggregation or different time horizons to get improved forecasts

- i. Also can think about this with picking drivers for an empirical forecast.
 1. Predictions of Chla do well if you know phosphorus concentration, but really hard to predict phosphorus concentration
 2. When people do model forecast development, you don't see ones that didn't work. They didn't publish it because it was terrible.
 3. Worth talking about intrinsic predictability to say we can do things in a more quantitative way and the importance of talking about failed models.
 4. Metrics of intrinsic predictability shouldn't be interpreted as the maximum capability of the forecast
 5. Intrinsic predictability tells you how good the forecast can be if you only have the time series - gives approximation of what you know with the time series. So if you bring in other covariates you will get more information.
 6. Permutation entropy tells you pattern of the data and better pattern recognition algorithms may be able to better forecast that.
- k. How does a synthesis or review papers fit into the table - how to fill out all the variables in the table.
 - i. Example paper: <https://onlinelibrary.wiley.com/doi/abs/10.1111/ele.12443>
 - ii. Put in qualitative data about the paper.
- l. How does this connect with management decisions
 - i. Put in argument for working with decision makers early on in the forecasting process.
 - ii. Motivation for baseline accuracy lets people go into discussions with manager informed to talk about what is possible.
- m. Is permutation entropy the gold standard for intrinsic predictability?
 - i. They are similar to any time series model that can be used to assess the system
 - ii. Doing one is not enough - being able to compare values is useful.
 1. What does a permutation entropy value of 0.7 mean - need to get metrics for multiple time series so you can see the patterns
- n. What does it look like to reverse the process - if you know seasonality or constancy of your variable, does that influence your discussions with managers.
 - i. All speculative without concrete examples of people doing this.
- o. Another example - when you don't have the right model to do the forecast
- p. Seems speculative to put anything in the paper about intrinsic predictability for forecast development
 - i. Talk about it as next step/open question
 - ii. Instead talk about how intrinsic predictability is how you can assess how well your forecast does
- q. Figure 2 updates
 - i. Case studies for model building, assess your forecast, use those to evaluate hypotheses about predictability

- ii. Bilgecan took out the cycle. But think including it as something to aim for is nice to shoot for. Keeping the idea that it is the potential for these feedbacks is a goal.
 - 1. Could have dotted line from predictability patterns back to model building
 - 2. Have caption say we can't find concrete examples of this yet, but it is the next step
 - iii. Use the table to identify the prediction
 - 1. Forecast horizon
 - 2. Environmental drivers/species interactions
 - 3. Scale and aggregation
 - r. Want to get people excited about the gradients of predictability in ecosystems with a figure that is similar to the figure in Dietze et al. 2024. <https://www.nature.com/articles/s41558-024-02182-0>
 - i. Picture of ecosystem today - is clear and picture of ecosystem in the future that grays/fuzzes out some things that are hard to understand
 - ii. Maybe something like the figure in this article <https://www.science.org/doi/10.1126/science.aba4658>
 - iii. It is difficult with the figures because they are static and want to capture the time series
 - iv. Keep thinking about ideas for this type of figure. These types of papers see to have these kind of conceptual figures to help convey the concept
- 3. Papers previously discussed/shared during the 2024 calls. Included here for reference
 - a. Discussed on 10-7-24 call. Nonlinear population dynamics - <https://www.nature.com/articles/s41559-019-1052-6>
 - i. See notes from the call here
 - b. Discussed on 11-4-24 call. Basic principles of temporal dynamics
 - c. The intrinsic predictability of ecological time series and its potential to guide forecasting; <https://esajournals.onlinelibrary.wiley.com/doi/10.1002/ecm.1359>
 - d. Prediction in ecology: a first-principles framework; <https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/eap.1589>
 - e. Fishing down the food web - <https://www.science.org/doi/10.1126/science.279.5352.860>
 - f. Discussed on 1-14-25 call. Error metrics - the choice of error metrics can influence your overall conclusions. Ideas in this paper could feed into the synthesis and what metrics to use. Not relevant for forecasting specifically, but useful frameworks <https://www.sciencedirect.com/science/article/pii/S0304380023002922?via%3Dihub>
 - g. EDM paper - <https://www.pnas.org/doi/pdf/10.1073/pnas.1417063112>
 - h. Pennekamp paper with weighted permutation entropy: <https://esajournals.onlinelibrary.wiley.com/doi/10.1002/ecm.1359>

- i. Came up in the 11-4-24 call. Temporal ecology in the Anthropocene
<https://onlinelibrary.wiley.com/doi/10.1111/ele.12353>
- j. Came up in the 11-4-24 call. Forecasting phytoplankton blooms
<https://esajournals.onlinelibrary.wiley.com/doi/10.1002/fee.2376>
 - i. Here is the Supplemental Table with the specific example:
<https://esajournals-onlinelibrary-wiley-com.libproxy.rpi.edu/action/downloadSupplement?doi=10.1002%2Ffee.2376&file=fee2376-sup-0003-TableS3.pdf>