November 4, 2024 Theory Working Group Call

Attendees: Bilgecan Sen, Cole Brookson, Abby Lewis, Jody Peters, Jonathan Borelli, Caleb Robbins, Ruby Krasnow, Saeed Shafiei Sabet
Regrets: Freya Olsson, Shubhi Sharma

Agenda:

1. ESIIL working group proposal update (Cole, Shubhi, Abby, Caleb)

2. Paper discussion: times series jargon
    a. https://www.cell.com/trends/ecology-evolution/fulltext/S0169-5347(19)30087-4?dgcid=raven_jbs_etoc_email
    b. Like the main figure (fig 2) - but not sure how it helps Bilgecan's own research. But good figure for educational figure for going through time series.
        i. Coming from the trajectory point of view, the single event is harder to connect to, but think that will be very useful for education as people begin learning about time series.
    c. Like that they are equating temporal ecology with spatial ecology - it could be it's own field that has its own jargon. But problem is that we have been doing temporal ecology for a long time, e.g., population is commonly temporal ecology
    d. People have been thinking of temporal ecology for conservation for a long time.
    e. Is it useful to collect all the different parts of ecological studies under the 'temporal ecology' framework similar to what has been done for 'spatial ecology'
    f. Spatial ecology is term we have become accustomed to and comfortable throwing things in to a grab bag.
    g. Why are we okay doing this on spatial scale but not temporal scale. Doing stats spatially is hard. So whatever you are doing you bump up into the same challenges
        i. Think the analog is dealing with nonstationarity. Talk about why you expect to see trends/cycles. But the family of stats needed is the stats used for non-stationarity and that is not being done here.
        ii. If doing temporal study and dealing with non-stationarity you are in a small world, but if you are not dealing with non-stationarity then you don't have to worry about those stats
        iii. If your timeseries is stationary, then it doesn't matter what happens
    h. An analysis of time series data has not been neglected - it is foundational to ecology.
        i. But in-depth focus on lag effects, non-stationarity,
    i. Like the supplemental table on 60 key terms
        i. Abby agrees that people use related terminology
3. Instead of accounting for spatial autocorrelation, put random effect on and are all set.
    a. Do something similar in temporal realm - there are so many ways that fitting a single model can eat up temporal variation

        i. Sometimes it is okay and sometimes not
    b. Hard to get away from the statistical housing
        i. How do we form subfields in ecology?
            1. Sometimes associated with books. The book collects similar concepts. It is a synthesis
            2. E.g., Mike Dietze's Ecological Forecasting book
        ii. Spatial ecology is a lot of different tools and it makes sense to congrats them together
        iii. Are we at the point where it makes sense to collate to temporal ecology
            1. Even if it is just a statistical housing - should be included in education
4. Worth considering this from the academic lineage - what were people's background
    a. If we think of temporal ecology as population ecology, then think of population ecology was the intersection of people working from physics perspectives.
    b. ODE vs PDE application to population ecology
    c. Taking physics and applying it to ecology sometime happens
    d. Another argument for this: "Temporal ecology in the Anthropocene" https://onlinelibrary.wiley.com/doi/10.1111/ele.12353
    e. Would be interesting to compare how much of spatial ecology come from spatial disciplines vs time series analysis that is being done in different disciplines (economics, etc) - so the statistical methods can be more similar to what has been done in other disciplines
        i. Seems like ecologists have been leading the charge on spatial analyses/landscape analyses
5. How does this apply to predictability?
    a. Are we drawing from other fields when we talk about predictability? Or are we as ecologists leading the charge in this field?
    b. What is predictive ecology (what would go into the textbook/undergrad course)
    c. Are there basic principles of predictability that would lead to a coalescing of understanding around predictability?
    d. This paper applies some of the concepts from the Ryoo paper for predictability of phytoplankton blooms
        i. https://esajournals.onlinelibrary.wiley.com/doi/10.1002/fee.2376
        ii. Use hierarchy time series analysis to describe categories of phytoplankton blooms and what makes them more/less predictable
        iii. Here is Table that is a specific example: https://esajournals-onlinelibrary-wiley-com.libproxy.rpi.edu/action/downloadSupplement?doi=10.1002%2Ffee.2376&file=fee2376-sup-0003-TableS3.pdf
    e. This is a great example, but how do you take the next step and generalize past phytoplankton blooms.
6. Based on Table 3 How is intrinsic predictability or realized predictability assessed - analyze the patterns and relate to the predictability
    a. More ramps could mean more predictability - linear increase in general

7. Like starting with hypothesized food web mechanisms and move to what you expect predictability would be
8. Not sure what their definition of predictability is. Think they have simplified how the lake works into 3 components. Have to be willing to accept the simplified processes for it to work. This is hard when there is climate change and non-stationarity
9. Would it be possible to categorize some of the time series we think are important for the NEON Challenge, like they have in the phytoplankton paper?
    a. Don't need to go into the causality of the time series
    b. But can we categorize the NEON challenge time series
    c. Yes, could think through the categories.
        i. Think some of the chlorophyll would show similar patterns.
        ii. Ticks also have sporadic peaks in abundance
    d. Could also use similar metrics used in the table to break down the NEON challenge
10. Think across the scales from Table 2 of the Ryoo paper. Focus on characterizing forecast on time series level. But time series is composed of events (algal bloom, spring greenup)
11. There are multiple ways to analyze forecast performance and how to average performance over the whole time series.
    a. Think about how single events shape the time series
12. Additional discussion after Jody left the call
    a. Ruby shared about her work with EDMs
    b. While EFI typically focuses on assessing near term forecasts, it would also be interesting to look at long-term forecasts to assess how they did. For example, forecasts in the 1980s and 90s about pH in lakes could be analyzed as part of a compilation of long term forecast assessments

13. Other papers previously shared that Jody is including 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. The intrinsic predictability of ecological time series and its potential to guide forecasting; https://esajournals.onlinelibrary.wiley.com/doi/10.1002/ecm.1359
    c. Prediction in ecology: a first-principles framework; https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/eap.1589
    d. Fishing down the food web - https://www.science.org/doi/10.1126/science.279.5352.860
    e. 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/S030438002300292 2?via%3Dihub

f. EDM paper - https://www.pnas.org/doi/pdf/10.1073/pnas.1417063112
g. Pennekamp paper with weighted permutation entropy: https://esajournals.onlinelibrary.wiley.com/doi/10.1002/ecm.1359