



THE UNIVERSITY OF BRITISH COLUMBIA
Faculty of Forestry

October 5, 2024

Dear Dr. Collins:

We would be grateful for your consideration of our manuscript, “A four-step Bayesian workflow for improving ecological science,” for Concepts and Questions in *Frontiers in Ecology and the Environment*.

Given the increasing aims of forecasting and prediction today, many ecologists are using more complex models to leverage larger datasets (Anderson *et al.*, 2021; Muff *et al.*, 2022). Many in ecology—ourselves included—were not trained in best statistical practice for these approaches, which can lead to poor models and incorrect predictions and decisions.

To address this pressing gap, we outline a generalizable workflow that is built on fundamental scientific principles and new insights from statistics and data science. This approach moves away from a focus on null hypothesis testing, towards estimating effect sizes, using models calibrated and better understood through simulating data at multiple steps—using a number of skills more often associated with theoretical than empirical ecology. We conclude by highlighting how adopting this workflow has changed our science and how it may improve statistical and mathematical training in ecology, which could make model building, testing and forecasting more approachable for researchers, managers and policy-makers.

The manuscript is authored by an international and interdisciplinary group of ecologists, conservation biologists and statisticians. The workflow follows the basics of how authors EM Wolkovich, TJ Davies and WD Pearse approach model building and leverages the insights and skills of computational statistician M Betancourt who has developed fundamental statistical workflows for diverse scientific disciplines. We have designed it to be broadly generalizable and practical, including relevant examples of forecasting shifts in animals and plants over time.

We hope that you will find this perspective, which provides a road-map for the many different practitioners in ecology now building more complex models, suitable for publication in *Frontiers in Ecology and the Environment*. All authors contributed to this work, which is our original work and not pre-published, and we declare no conflict of interest (following ESA’s Code of Ethics). The manuscript is 2690 words plus 140 word summary and a 100-word in a nutshell; it has three figures and one glossary. It is not under consideration elsewhere.

Sincerely,

A handwritten signature in black ink, appearing to read 'E. Galimullin'.

Elizabeth M Wolkovich
Associate Professor of Forest & Conservation Sciences
University of British Columbia

References

- Anderson, S.C., Elsen, P.R., Hughes, B.B., Tonietto, R.K., Bletz, M.C., Gill, D.A., Holgerson, M.A., Kuebbing, S.E., McDonough MacKenzie, C., Meek, M.H. *et al.* (2021) Trends in ecology and conservation over eight decades. *Frontiers in Ecology and the Environment* **19**, 274–282.
- Grinsztajn, L., Semenova, E., Margossian, C.C. & Riou, J. (2021) Bayesian workflow for disease transmission modeling in stan. *Statistics in Medicine* **40**, 6209–6234.
- Muff, S., Nilsen, E.B., O’Hara, R.B. & Nater, C.R. (2022) Rewriting results sections in the language of evidence. *Trends in ecology & evolution* **37**, 203–210.
- van de Schoot, R., Depaoli, S., King, R., Kramer, B., Maertens, K., Tadesse, M.C., Vannucci, M., Gelman, A., Veen, D., Willemsen, J. & Yau, C. (2021) Bayesian statistics and modelling. *Nature Reviews Methods Primers* **1**.