**Proposal for a Contribution to the special issue on “Ecological and Evolutionary Insights from Very Long-Term Studies” to be published by *Ecology Letters* in 2024**

**Proposed contribution type: (Letter, Synthesis, Perspective, Viewpoint, or Method)**

Letter

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**Proposed title:** Long-term community change in kelp forest fish communities in relation to environmental factors

**Proposal (expected length < 300 words) which should (a) briefly describe the long-term dataset(s) that you are analyzing, including study site location, observations, experimental treatments if relevant, and the years involved, (b) succinctly explain why the proposed manuscript would be novel, important, and of general interest in ecology and (c) explicitly state the importance of very long-term data for this study.**

Predicting how communities respond to ongoing habitat change requires understanding how past environment variability has shaped species losses and gains, or community stability. In this study, we leverage a 23-year dataset (2000-2022) on fish communities (68 species) in nine giant kelp (*Macrocystis pyrifera*) forests from the Santa Barbara Coastal Long-Term Ecological Research site[1]. Fish have profound impacts on the structure of food webs and ecological functions maintained in giant kelp forests[2], yet are challenging to sample due to the nature of underwater surveys. Thus, to answer the question of how fish community stability is shaped by long-term environmental conditions, we first fit a state-space model (Bayesian hierarchical multi-species occupancy model[3]) that accounted for detection error in fish observations from 34 transects (662 transect-by-year combinations) that were repeatedly surveyed from July through October of each year. Using these estimates of corrected occupancy for each fish species in each site, we found that detection increased with dive visibility and average fish species size (βvisibility = 0.47; 95% BCI = 0.44-0.51; βsize = 1.86; 95% BCI = 1.77 - 1.96). Then, we generated estimates of species turnover (total turnover, losses, and gains) and beta diversity (compositional shifts) across subsequent years at each transect. Using Bayesian regression models, we plan to fit these ecological metrics to past[4] and current sea temperature and kelp productivity to understand how oceanographic variables related to fish physiology and resource availability shape community stability through time. Correcting for detection error prior to quantifying community stability is a novel approach that likely depicts more realistic estimates of extinction and colonization dynamics[5]. This combined with the long-term nature of this data is crucial to understanding the relevant time scales at which biodiversity responds to environmental variability.

[1]Reed et al. 2022. https://doi.org/10.6073/pasta/e0270d5a617339f91ae518c99eb67fda

[2]Vergés et al. 2016. *PNAS.* https://doi.org/10.1073/pnas.1610725113.

[3]Devarajan et al. 2020 *Ecography.* https://doi.org/10.1111/ecog.04957.

[4]Ogle et al. 2015. *Ecology Letters.* https://doi.org/10.1111/ele.12399

[5]Auger-Méthé et al. 2021. *Ecological Monographs.* https://doi.org/10.1002/ecm.1470.

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