Dr. Tim CoulsonEditor-in-Chief, Ecology LettersDATE

Dear Dr. Coulson,

We are writing to submit the manuscript “Empirical abundance distributions are more uneven than expected given their statistical baseline,” by Renata Diaz, Hao Ye, and S. K. Morgan Ernest, as a Letter for your consideration. We note that this manuscript is currently posted as a preprint on bioRxiv at [bioRxiv/alink].

The species abundance distribution (SAD) is one of the most well-known patterns in ecology, exhibiting a nearly ubiquitous “hollow curve” shape with few abundant species and many rare species. This pattern has played a central role in the development and evaluation of ecological theories (McGill et al. 2007, *Ecology Letters*), but its utility has been questioned based in part on accumulating evidence that the hollow curve may be a statistical artefact that emerges from the mathematical process of dividing individuals into species (Locey and White 2013, *Ecology Letters*). However, even if the hollow curve is a statistical artefact, ecological processes may cause empirical SADs to deviate more subtly from the shapes that emerge mathematically and leave an ecological signal overlaid on this “statistical baseline”.

Here, we explore whether ecological SADs exhibit consistent deviations from their statistical baselines. We build on pioneering work by Locey and White (2013) by developing novel approaches to efficiently characterize the statistical baselines for 22,000 empirically sampled communities. We evaluate (1) whether observed SADs consistently deviate from their statistical baselines, and (2) how our power to detect such deviations differs for very small and large communities. We show that empirical SADs for large communities deviate consistently from their baselines, leaving a role for ecological process. However, we find that very small communities exhibit high variability in their baselines, greatly reducing our power to detect deviations.

This work highlights two novel avenues for understanding and interpreting the SAD, and macroecological patterns more broadly. First, our approach isolates the ecological signal in the SAD, which will allow the ongoing use of the SAD as a test of ecological theories. Second, we illustrate that while statistical baselines can be leveraged to disentangle ecological signals from mathematically generated patterns, this approach is sensitive to the size of the system being studied and may be of limited use for small systems.

Thank you for your time and consideration.

Sincerely,

Renata Diaz, Hao Ye, and S. K. Morgan Ernest

References:  
Locey, K.J. & White, E.P. (2013). How species richness and total abundance constrain the distribution of abundance. *Ecology Letters*, 16, 1177–1185.

McGill, B.J., Etienne, R.S., Gray, J.S., Alonso, D., Anderson, M.J., Benecha, H.K., et al. (2007). Species abundance distributions: moving beyond single prediction theories to integration within an ecological framework. *Ecology Letters*, 10, 995–1015.