**Cover letter**

Dr. Tim Coulson

Editor-in-Chief, Ecology Letters

DATE

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.

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’ is actually a statistical artefact that emerges from simply dividing individuals into species (Locey & White 2013, *Ecology Letters*). While the primary hollow-curve form of the SAD may be a statistical artifact, ecological processes could still shape more subtle aspects of the SAD, providing an empirical signal of ecological processes overlaid on the statistically generated hollow-shaped curve.

In this paper, we develop novel methods to explore whether ecological SADs exhibit consistent deviations from their expected statistically-generated shapes that reflect ecological processes. We build on pioneering work by Locey and White (2013, *Ecology Letters*) by developing novel approaches to efficiently characterize the full distribution of shapes that would emerge from statistical processes for 24,500 empirically sampled communities, and evaluate (1) whether observed SADs consistently deviate from these statistical baselines, and (2) how our statistical capacity to detect deviations between observations and the baseline, differs between very small and very large communities. We show that empirical SADs for large communities deviate consistently from the SADs that emerge from strictly statistical processes. However, we find that very small communities exhibit high variation in their statistical baselines, which greatly reduces our power to detect deviations between observed SADs and the statistical expectation. 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, while we can leverage statistical baselines in macroecology to isolate ecological signals from statistically generate patterns, we illustrate that this approach is sensitive to the size of the system being studied and will therefore be more useful in larger communities with high abundances and larger numbers of species.

Thank you for your time and consideration.

Sincerely,

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. *Ecol Letters*, 10, 995–1015.