

December 30th, 2020

Dr. Jeremy M. Berg  
Editor-in-Chief  
Science Journals

Dear Dr. Berg,

We are pleased to submit our manuscript entitled “Biological trade-offs underlie coral reef ecosystem functioning” for consideration as a report in *Science*. Understanding the processes that underpin ecosystem functioning is paramount to preserving healthy ecosystems for future generations. Coral reefs support the livelihoods of 500 million people worldwide, but they are threatened by a host of anthropogenic stressors. Beyond static proxies such as reef fish biomass or coral cover, we lack even basic information about the drivers and vulnerability of dynamic ecosystem functions on coral reefs.

In our paper, we provide the first quantification of five key ecosystem functions across coral reefs worldwide. Specifically, we examine how nitrogen cycling, phosphorous cycling, biomass production, herbivory, and piscivory vary across the world’s reefs, what underpins their performance, and how vulnerable each function is to dominant anthropogenic stressors. Our global analysis reveals a striking trade-off among different functions, challenging the classic, agroeconomic view that ‘healthy’ ecosystems can maximize all functions. Furthermore, across different locations, each function is dominated by a few key species. Yet, no species consistently performs a key role across regional or global scales, thus challenging the applicability of conservation practices founded on the concept of keystone species. Finally, we reveal the vulnerability of several functions to two major anthropogenic stressors, overfishing and coral loss.

Using a novel, integrative approach across the world’s coral reefs, our paper 1) provides the first global analysis of ecosystem functioning on reefs (beyond biomass as a proxy); 2) identifies the key drivers of coral reef functioning, and 3) challenges the traditional management paradigm in which all ecosystem functions are maximized. Thus, our paper offers a bold new perspective on biological conservation in a time when maximizing ecosystem functioning is heralded as a primary management objective. In light of the fundamental importance of coral reefs for humanity, we believe this study will be of great interest to a wide array of scientists, policy makers, conservation practitioners, and the general public.

No related manuscripts or materials presented in the paper are currently under consideration or published and no colleagues have provided comments on the manuscript. All collections were performed in accordance with ethics and collection permits listed in the paper. All data and the code necessary to replicate the paper are accessible via figshare (<https://figshare.com/s/f789aec2c20492c4f0f9>). We provide a list of potential reviewers for our manuscript below. Thank you for your consideration. We look forward to your response.

Kind regards,

Nina M. D. Schittekatte, on behalf of all co-authors



**Suggested reviewers:**

- Fiorenza Micheli ([micheli@stanford.edu](mailto:micheli@stanford.edu))
- Aaron MacNeil ([a.macneil@dal.ca](mailto:a.macneil@dal.ca))
- Camilo Mora ([cmora@hawaii.edu](mailto:cmora@hawaii.edu))
- Jarrett Byrnes ([jarrett.byrnes@umb.edu](mailto:jarrett.byrnes@umb.edu))
- Mary O'Connor ([oconnor@zoology.ubc.ca](mailto:oconnor@zoology.ubc.ca))
- Daniel Pauly ([d.pauly@oceans.ubc.ca](mailto:d.pauly@oceans.ubc.ca))
- Maria Dornelas ([maadd@st-andrews.ac.uk](mailto:maadd@st-andrews.ac.uk))
- Patricia Balvanera ([pbalvane@oikos.unam.mx](mailto:pbalvane@oikos.unam.mx))