Nina M. D. Schiettekatte  
EPHE-UPVD-CNRS, USR 3278 CRIOBE  
Université de Perpignan  
[nina.schiettekatte@gmail.com](mailto:nina.schiettekatte@gmail.com)

November 24th, 2020

Dr. Magdalena Skipper  
Editor-in-Chief  
Nature

Dear Dr. Skipper,

Please find our manuscript entitled “Global drivers and vulnerability of coral reef fish functions” for consideration as a research article in *Nature*.

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 proxies such as reef fish biomass or coral cover, we lack even basic information about the drivers and vulnerability of 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 global reefs, then we investigate the drivers and vulnerability of these five functions.

Our global analysis reveals a striking trade-off between different functions, challenging the classic, agro-economic 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 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; 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. As such, we believe it is ideally suited for the wide exposure granted by publication in *Nature*.

We wish to participate in the double-blinded peer review. Therefore, all required elements containing author information are added below. We also 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. Schiettekatte, on behalf of all co-authors

**Suggested reviewers:**

- Fiorenza Micheli ([micheli@stanford.edu](mailto:micheli@stanford.edu))

- Stuart Sandin ([ssandin@ucsd.edu](mailto:ssandin@ucsd.edu))

- Doug Mccauley ([douglas.mccauley@lifesci.ucsb.edu](mailto:douglas.mccauley@lifesci.ucsb.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))

**Author list:**

Nina M. D. Schiettekatte\*1,2, Simon J. Brandl3, Jordan M. Casey3, Nicholas A. J. Graham4, Diego R. Barneche5,6, Deron E. Burkepile7,8, Jacob E. Allgeier9, Jesús E. Arias-Gonzaléz10, Graham J. Edgar11, Carlos E. L. Ferreira12, Sergio R. Floeter13, Alan M. Friedlander14, Alison L. Green15, Michel Kulbicki2,16, Yves Letourneur2,17, Osmar J. Luiz18, Alexandre Mercière1,2, Fabien Morat1,2, Katrina S. Munsterman9, Enrico L. Rezende19, Fabian A. Rodríguez‐Zaragoza20, Rick D. Stuart-Smith11, Laurent Vigliola2,16, Sébastien Villéger21, Valeriano Parravicini1,2

\*Corresponding author

1PSL Université Paris: EPHE-UPVD-CNRS, USR 3278 CRIOBE, Université de Perpignan, Perpignan, France; 2Laboratoire d’Excellence “CORAIL”, Perpignan, France; 3The University of Texas at Austin, Marine Science Institute, Port Aransas, TX 78373, USA; 4Lancaster Environment Centre, Lancaster University, Lancaster, LA1 4YQ, UK; 5Australian Institute of Marine Science, Crawley, WA, Australia; 6Oceans Institute, The University of Western Australia, Crawley, WA, Australia; 7Department of Ecology, Evolution, and Marine Biology, University of California, Santa Barbara, CA, USA; 8Marine Science Institute, University of California, Santa Barbara, CA, USA; 9Department of Ecology and Evolutionary Biology, University of Michigan, Ann Arbor, MI, USA; 10Laboratorio Ecología de Ecosistemas de Arrecifes Coralinos, Departamento Recursos del Mar, CINVESTAV Unidad Mérida, AP73 Cordemex, CP97310, Mérida, Yucatán, Mexico; 11Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, TAS, Australia; 12Departamento de Biologia Marinha, Universidade Federal Fluminense (UFF), Niterói, the state of Rio de Janeiro (RJ), Brazil; 13Marine Macroecology and Biogeography Lab, Depto. de Ecologia e Zoologia, CCB, Universidade Federal de Santa Catarina, Florianopolis, Santa Catarina, Brazil; 14Department of Biology, University of Hawaii, Honolulu, HI, USA; 15Red Sea Research Center, King Abdullah University of Science and Technology, Thuwal 23955-6900, Saudi Arabia; 16Institut de Recherche pour le Développement, UMR UR-IRD-CNRS-IFREMER-UNC ENTROPIE, Nouméa, New Caledonia, France; 17Université de la Nouvelle-Calédonie, UMR UR-IRD-CNRS-IFREMER-UNC ENTROPIE, Nouméa, New Caledonia, France; 18Research Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, Australia; 19Departamento de Ecología, Center of Applied Ecology and Sustainability (CAPES), Facultad de Ciencias Biológicas, Pontificia Universidad Católica de Chile, Santiago 6513677, Chile; 20Laboratorio de Ecosistemas Marinos y Acuicultura (LEMA), Departamento de 12 Ecología, CUCBA, Universidad de Guadalajara. México. Carr. Guadalajara-Nogales 13 km. 15.5, Las Agujas Nextipac, Zapopan, C.P. 45110, Jalisco, 14, Mexico; 21MARBEC, Université de Montpellier, CNRS, IFREMER, IRD, Montpellier, France

**Acknowledgements**

We thank the staff at CRIOBE, Moorea for field support. We would also like to thank Jérémy Carlot, Beverly French, Titouan Roncin, Yann Lacube, Camille Gache, Gabrielle Martineau, Kailey Bissell, Benoit Espiau, Calvin Quigley, Kaitlyn Landfield and Tommy Norin for their help in the field, Sophie Schiettekatte for proof-reading the manuscript, and Guillemette de Sinéty and Jérémy Wicquart for their contribution to otolith analyis.

**Funding**

This research was funded by the BNP Paribas Foundation (Reef Services Project) and the French National Agency for Scientific Research (ANR; REEFLUX Project; ANR‐17‐CE32‐0006). This research is product of the SCORE-REEF group funded by the Centre de Synthèse et d’Analyse sur la Biodiversité (CESAB) of the Foundation pour la Recherche sur la Biodiversité (FRB) and the Agence Nationale de la Biodiversité (AFB). VP was supported by the Institut Universitaire de France (IUF) and JMC was supported by a Make Our Planet Great Again Postdoctoral Grant (mopga‐pdf‐0000000144).

**Data and code availability**

All data and code to reproduce figures are available online through GitHub (https://github.com/nschiett/global\_proc) and figshare (https://figshare.com/s/f789aec2c20492c4f0f9). All data on individual fish traits are available from the corresponding author on reasonable request.

**Author contributions**

NMDS and VP conceived the idea and NMDS, VP, SJB, and JMC designed methodology; NMDS, JMC, SJB, AM, FM, VP, KSM, JEA and DEB collected the data; All authors shared existing data. NMDS analyzed the data and led the writing of the manuscript. All authors contributed significantly to the drafts and approved the final version for publication.

**Competing interests:** None declared.

**Materials & Correspondence:** Nina M. D. Schiettekatte (nina.schiettekatte@gmail.com)

**Ethics statement:** All protocols related to the capture and handling of fish complied to the ethical standards of CRIOBE and EPHE, and the University of California Santa Barbara’s Institutional Animal Care and Use Committee (IACUC #915 2016-2019). Extraction and transport of samples were approved by the government of French Polynesia.