

Correspondence

Turning the tide of parachute science

Paris V. Stefanoudis^{1,2,*}, Wilfredo Y. Licuanan³, Tiffany H. Morrison⁴, Sheena Talma^{2,5}, Joeli Veitayaki⁶, and Lucy C. Woodall^{1,2}

Parachute science is the practice whereby international scientists, typically from higher-income countries, conduct field studies in another country, typically of lower income, and then complete the research in their home country without any further effective communication and engagement with others from that nation. It creates dependency on external expertise, does not address local research needs, and hinders local research efforts. As global hotspots of marine biodiversity, lower-income nations in the tropics have for too long been the subject of inequitable and unfair research practices¹. However, to date there has been little quantifiable evidence of this phenomenon in marine science. Here, we provide evidence through systematic literature searches and queries that parachute science practices are still widespread in marine research and make some recommendations to help change the current status quo.

We assessed the extent of parachute science in marine science using the field of coral reef biodiversity research as a test case and publication-related metrics as a proxy for effective scientist-to-scientist communication and engagement. We conducted a global analysis of scholarly articles in Scopus (covering 1969–2020) focusing on warm-water (tropical and subtropical) coral reef biodiversity-related research from shallow, mesophotic and deeper reef habitats (see Supplemental Information for search method details). Overall, we discovered that from the top 10 countries with the most publications in this field ('research output'; based on authors' institutional affiliations) (Figure 1A), only two (Mexico and Indonesia) are not classified as high-income nations (based on gross national income²). In addition, two (Germany and Canada) do not harbor any warm-water

coral-reef habitats within their Exclusive Economic Zones. Of note, there is a mismatch between research output and coral-reef habitat area per country (Figure 1B).

Focusing our bibliographic analysis on publications with fieldwork conducted in Indonesia (lower-middle-income), Australia (high-income) and the Philippines (lower-middle-income)² — the top three nations in terms of warm-water coral-reef habitat area globally (Figure 1B) — we found that approximately 40% of publications with fieldwork conducted in Indonesia or Philippines had no 'host nation' (the nation where field research was conducted) scientist included, whereas the respective figure for Australia was half that (Figure 1C). Similarly, 'research leadership' (defined as the number of publications for which host-nation scientists have a lead and/or senior authorship position) was higher in Australia (~66%) compared to

Indonesia (~30%) and the Philippines (~40%) (Figure 1C). Exclusion of host-nation scientists from publications (or inclusion of them as middle authors) was more common in the 1980s–1990s, and such practice was gradually reduced in the 2000s, although was still present in the 2010s (Figure 1D–F). Of note, during the 2010s in the Philippines (Figure 1F), and especially in Indonesia (Figure 1D), there was an increase in publications authored solely by host-nation scientists. In the case of the Philippines, there has been an increase in the number of operational marine stations, and local funding availability has also expanded the scope of reef research, going beyond taxonomic inventories and resource assessments to studies on reef restoration and impacts of climate change. In the case of Indonesia, recent government policy changes requiring Indonesian researchers to publish scientific papers for professional incentives (legislation

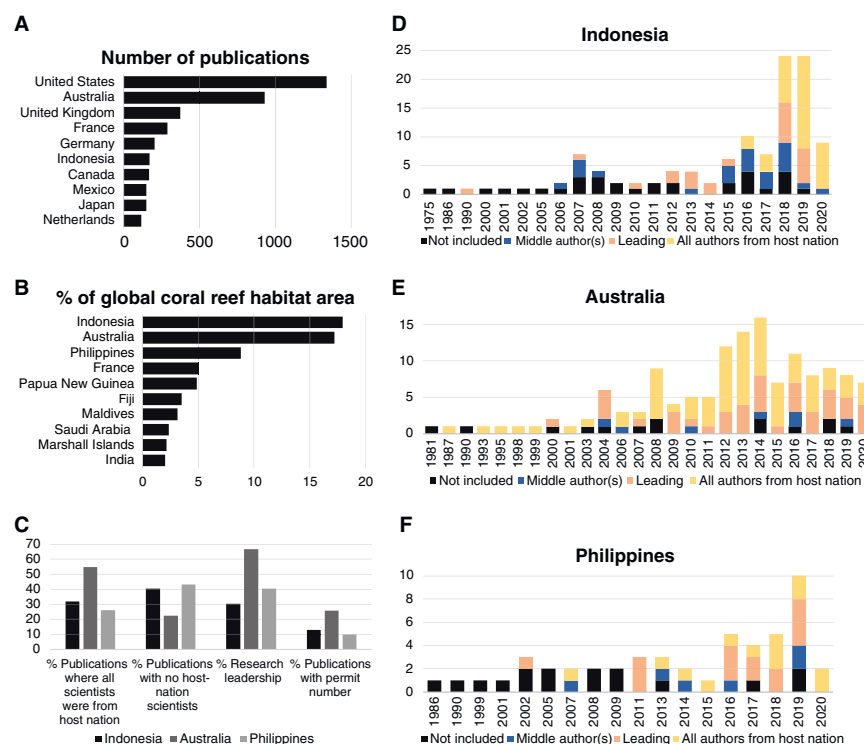


Figure 1. Results from the bibliographic analysis of coral reef biodiversity publications published between 1969 and 2020.

(A) Top 10 countries (based on authors' affiliations) in terms of number of publications. (B) Top 10 countries in terms of coral reef area, expressed as a % of the global coral reef area (data obtained from Spalding *et al.*³). (C) Publication metrics comparison between Indonesia, Australia and Philippines. (D–F) Publications metric trends over time for Indonesia (D), Australia (E) and Philippines (F). Figures (A–B) and (C–F) are based on results from 3,667 and 305 publications, respectively (see Supplemental Information for details).

passed in 2017³) is likely driving some of the recent enhanced research output.

Overall, the number of studies providing a research permit number or exemption notification, both prerequisites to conduct fieldwork and sample collection in any marine setting), was between 10% and 25% (Figure 1C). Although the absence of a permit number does not necessarily indicate that unethical activity took place, based on our experience this will have been the case in some of those publications. It is clear from the above results that the extent of parachute science is more prevalent in lower-middle-income nations and less so in high-income nations.

Recently, the United Nations General Assembly proclaimed the Decade of Ocean Science for Sustainable Development (A/RES/72/73), whose mission statement includes building capacity, developing scientific knowledge, building and sharing infrastructure and fostering partnerships between member states for a sustainable and healthy ocean⁴. We argue that this will only be achieved by adopting a research culture that is more ethical and equitable, and where partnerships, knowledge-exchange activities, mutual trust, and respect between researchers from host nations and international researchers are the rule and not the exception. This must include the elimination of the practice of parachute science. Indeed, truly collaborative research practices will be critical to building the local adaptive capacity of reef-dependent peoples as they face the urgent challenges of the Anthropocene⁵.

Below are some recommendations to help stop parachute science. Similar sets of recommendations have been provided for the field of paleogenomics⁶, but here we focus specifically on the field of marine research. These recommendations are addressed to scientists conducting research overseas and research publishers. However, other sectors must also change their practices, including academic and research institutions, ethics committees, and funding bodies.

Find academic collaborators: start with host-country institutions with a national reach or scope. Online databases (Scopus, Web of Science) can help locate individuals and their work. Articles published in host-country

journals (including university in-house journals) provide insights on potential collaborators' expertise. An in-country visit and/or webinar early on in a project would help identify the most appropriate collaborators and are thus recommended.

Liaise with government funding bodies of the host nation: these can connect suitable collaborators, especially those with a track record for delivering on research grants.

Develop a joint research agenda: once appropriate collaborators have been identified and before fieldwork takes place, an extensive consultation with host-nation stakeholders is necessary so the research agenda is jointly framed and addresses local research needs.

Engage with the next generation of researchers: we strongly encourage the establishment of internship and exchange programs between partnering institutions for promising early-career researchers and/or co-supervision of students. This will not only provide enriching experiences for all parties involved but also, and most importantly, will help build and develop local talent and leadership that in time will be less reliant on foreign expertise.

Share academic literature: scientists from a high-income country working with colleagues in lower-income nations are encouraged to share copies of key papers from their personal collections, and where possible, make such personal collections available to local universities.

Know the regulatory landscape: many countries are very wary of specific research themes (for example, bioprospecting⁷). Regulatory bodies and agencies therefore have guidelines to vet applicants and applications. Partnerships are key in order to navigate requirements and provide useable information. Finally, many institutions also require better host-country engagement as part of research ethics approvals.

Transparency in publishing: journals should make it mandatory for authors to provide research permit and research ethics permit number(s). Editors and reviewers should confirm the existence of these or agree on a justification as to why one was not needed, in the same way that studies conducting experiments using animals require

ethical approval, and which is clearly communicated in published articles.

SUPPLEMENTAL INFORMATION

Supplemental Information includes one table, experimental procedures, and author contributions and can be found with this article online at <https://doi.org/10.1016/j.cub.2021.01.029>.

A video abstract is available at <https://doi.org/10.1016/j.cub.2020.12.025.#mmc2>.

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¹University of Oxford, Zoology Research and Administration Building, Oxford OX1 3SZ, UK. ²Nekton Foundation, Begbroke Science Park, Begbroke Hill, Begbroke, Oxfordshire OX5 1PF, UK. ³Br. Alfred Shields FSC Ocean Research Center and Biology Department, De La Salle University, 1004 Manila, The Philippines. ⁴ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, QLD 4811, Australia. ⁵Ministry of Environment, Energy and Climate Change, Victoria, Seychelles. ⁶University of the South Pacific, Suva, Fiji.

*E-mail: paris@nektonmission.org