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Viewpoint

Support for improved quality control but misplaced criticism of GBR science. Reply to viewpoint "The need for a formalised system of Quality Control for environmental policy-science" by P. Larcombe and P. Ridd (Marine Pollution Bulletin 126: 449–461, 2018)

Britta Schaffelke[a,*], Katharina Fabricius[a], Frederieke Kroon[a], Jon Brodie[b], Glenn De'ath[a], Roger Shaw[c], Diane Tarte[d,e], Michael Warne[f,g], Peter Thorburn[h]

[a] Australian Institute of Marine Science, PMB 3, Townsville MC, QLD, 4810, Australia
[b] Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, QLD 4811, Australia
[c] Reef Independent Science Panel, Graceville Q 4075, Australia
[d] Marine Ecosystem Policy Advisors, Redland Bay Q 4165, Australia
[e] Mackay-Whitsunday Healthy Rivers to Reef Partnership, Australia
[f] Centre for Agroecology, Water and Resilience, Coventry University, CV1 5FB Coventry, UK
[g] Queensland Department of Environment and Science, Dutton Park, Brisbane, Queensland 4001, Australia
[h] CSIRO Agriculture and Food, Brisbane, QLD 4067, Australia

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ABSTRACT

This is a response to the published Viewpoint by Larcombe and Ridd (2018). We agree with Larcombe and Ridd (2018) that scientific merit goes hand in hand with rigorous quality control. However, we are responding here to several points raised by Larcombe and Ridd (2018) which in our view were misrepresented. We describe the formal and effective science review, synthesis and advice processes that are in place for science supporting decision-making in the Great Barrier Reef. We also respond in detail to critiques of selected publications that were used by Larcombe and Ridd (2018) as a case study to illustrate shortcomings in science quality control. We provide evidence that their representation of the published research and arguments to support the statement that "many (…) conclusions are demonstrably incorrect" is based on misinterpretation, selective use of data and over-simplification, and also ignores formal responses to previously published critiques.

1. Introduction

Over the past years, shortfalls in the reproducibility of research results and other quality control criteria have been debated in the biomedical sciences, and this has led to constructive changes, e.g. in editorial procedures.[1] In their recent Viewpoint, Larcombe and Ridd (2018) argue that systemic failings occur in the quality control in environmental sciences, especially in what they call "policy-science", which they define as science used to inform government policy. In a case study, they examine nine journal publications selected from the extensive[2] literature on the condition of the Great Barrier Reef (GBR) and its responses to environmental and human pressures. The authors conclude that some of the GBR "policy-science" appears to be invalid, driven by an ideological agenda, and overstating the pressures and observed declines in ecosystem condition. Based on this, they question the effectiveness of quality control processes for research results that have informed policy.

We fully support the view that stringent quality control procedures are key to the responsible conduct of research, in particular the need for transparency, rigorous peer review, better and explicit representation of uncertainty, avoidance of over-simplification, and sharing of data and statistical code for analyses. We welcome critical assessment and re-appraisal of scientific publications as this is part of the scientific method. However, we contend that Larcombe and Ridd (2018) make a series of points that warrant rebuttal. First, we outline that for the GBR, formal and effective science review, synthesis and advice processes are

* Corresponding author.
E-mail address: b.schaffelke@aims.gov.au (B. Schaffelke).

[1] For example: https://www.nature.com/articles/nmeth.2471 (viewed 11 December 2017).

[2] A simple search in Web of Science (www.webofknowledge.com, accessed 10/12/2017) using the keywords 'Great Barrier Reef', 'impact', 'water quality', 'condition', 'decline' resulted in ca. 1000 publications during 2003–2013 (the same period selected in the case study of Larcombe and Ridd (2018).

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in place and do in fact support policy and decision makers. Second, we question the value and validity of Larcombe and Ridd's (2018) proposed concept of "policy-science", as it disregards the boundary that separates science and policy. And last, we comprehensively rebut their criticisms of the publications they believe underpin "*much government policy and spending*" on the GBR. We argue that their critiques demonstrate biases, misinterpretation, selective use of data and over-simplification, and also ignore previous responses to their already published claims. We acknowledge that Larcombe and Ridd (2018) is a "Viewpoint" rather than an original study. Nevertheless, scientists expect any article published in a scientific journal to pass the same stringent quality controls as those so strongly advocated in Larcombe and Ridd (2018).

2. Review and synthesis processes for GBR science

Understanding large, complex and interconnected ecosystems like the GBR is challenging. However, the knowledge base, including large-scale observational datasets, constantly evolves and advanced statistical and process models are increasingly developed and applied. Models, such as the new eReefs[3] suite of models, have improved the ability to e.g., predict system responses, analyse and attribute spatio-temporal changes, and include estimates of uncertainty.

Compared to many other tropical marine ecosystems, the GBR is relatively well studied, and its management and policies are supported by a comprehensive body of science, generally published in the peer-reviewed, international scientific literature. While we acknowledge that peer-review processes could be improved, it is our opinion and that of the French Academy of Sciences, the German Leopoldina and the UK Royal Society (Catlow, 2017) that peer review should remain the cornerstone of the evaluation of science quality.

Peer review by itself does not facilitate the use and application of research outcomes (Elliott et al., 2017). To regularly provide science updates to policy makers and GBR stakeholders such as Traditional Owners, industry sectors, and the broader community, publications are regularly[4] reviewed, synthesised and interpreted by scientists in collaboration with natural resource managers (most recent major syntheses: Great Barrier Reef Marine Park Authority, 2014a; Hairsine, 2017; Waterhouse et al., 2017). In addition, multidisciplinary groups of scientists are regularly requested to provide specific advice to policy makers (for example: Great Barrier Reef Water Science Taskforce, 2016).

The current overarching policy framework for the management of the Great Barrier Reef is the Reef 2050 Long-term Sustainability Plan (Commonwealth of Australia, 2015), which incorporates the Draft Reef 2050 Water Quality Improvement Plan (The State of Queensland, 2017) that was recently updated for the third time since its initial release in 2003 (The State of Queensland and Commonwealth of Australia, 2003). Core principles of these plans are adaptive management and decision-making based on best available science (Great Barrier Reef Marine Park Authority, 2014b, 2014c). The adaptive management strategies for the GBR, like for most other natural resources, includes the monitoring, reporting and assessment of the resource condition and of success or failure of adopted policies. An important component of this are various, peer-reviewed, annual report cards that synthesise observational and modelled data for ecosystem health and socio-economic indicators, extending from the upper catchment to the outer GBR.[5] Adaptive management and decision-making is also supported by several formal independent advisory bodies,[6] chaired by eminent Australians, providing publicly reported scientific advice by recognised experts in their field, review of developing policy and cross-sectoral stakeholder input.

Larcombe and Ridd's statement "*that there appears to be no effective mechanism of robust technical scrutiny of policy-science regarding the GBR*" does not reflect existing processes. Based on the above we argue that review and synthesis processes for GBR science are in line with good practices to provide science for evidence-based decision making (Elliott et al., 2017), including peer review, effective dissemination and fit-for-purpose interpretation.

3. Maintaining a distinction between science and policy

The concept of "policy-science" as proposed by Larcombe and Ridd (2018) is misleading. Scientific studies are, and should remain conducted and reviewed based on their scientific merit, not their policy relevance or conformation with current hypotheses, paradigms or policies. We argue that science that may be used to inform policies, guidelines and management decisions is no different from any other scientific research. Results of such studies are generally published in the international scientific literature, and the requirements for rigour in experimental design, execution, analysis, interpretation and peer review are exactly the same as for studies that may not inform policy. Larcombe and Ridd's argument might lead to indiscriminately questioning the rigour of any science that underpinned policies - such as research identifying man-made ozone-depleting substances (that led to their ban under the Montreal Protocol), research on the toxicology of pharmaceuticals and pesticides (e.g. that led to the ban of persistent organic pollutants under the Stockholm Convention), or research identifying the emission of greenhouse gases as the dominant cause of observed warming (that underpins the climate change policies of many nations, including the Paris agreement).

For the GBR, and elsewhere, the effective use of science in policy development and implementation is based on the consideration of multiple lines of evidence from a broad range of studies, whether carried out in response to an articulated policy-relevant knowledge gap or not. Scientific hypotheses and theories as well as regulations, legislation and policy are rarely, if ever, based on the findings of a single publication. The multiple-lines-of-evidence approach permits ALL relevant science to be used in setting policy.

Application of science in policy development benefits from timely access to information, synthesis and contextualisation of information and knowledge, including the interpretation of seemingly contradictory results, and from diverse expert advice. The challenge of managing complex ecosystems, such as the GBR, in a future of intensifying multiple and cumulative pressures, is often considered a "wicked problem" (e.g. Chapman, 2017); partly because it requires the resolution of "conflicting human wants or needs", but also because future states can only be predicted with high uncertainty. Resource management under these circumstances requires the integration of knowledge from social and biophysical science with socio-economic and cultural aspirations and political considerations (Chapman, 2017; Batie, 2008) - exactly what is in place for supporting the use, management and conservation of the GBR.

4. Clarifying some quality control issues

Very few scientists would argue with the call by Larcombe and Ridd (2018) to improve quality control procedures. But these authors make a series of points that warrant rebuttal. Larcombe and Ridd (2018) argue that a major failing of quality control procedures is that studies

[3] http://ereefs.org.au/ereefs, https://research.csiro.au/ereefs/.

[4] For a history of syntheses related to GBR water quality see: http://www.reefplan.qld.gov.au/about/history/.

[5] http://www.reefplan.qld.gov.au/measuring-success/report-cards/; http://healthyriverstoreef.org.au/report-card-results/; http://riverhealth.org.au/report_card/ehi/; http://ghhp.org.au/report-cards/2016.

[6] For example: Independent Expert Panel, Reef Advisory Committee: http://www.environment.gov.au/marine/gbr/reef2050/advisory-bodies; Independent Science Panel: http://www.reefplan.qld.gov.au/about/committees/science-panel/.