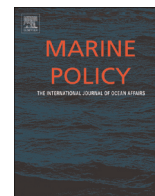




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Short Communication

What are the major global threats and impacts in marine environments? Investigating the contours of a shared perception among marine scientists from the bottom-up.



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ABSTRACT

Marine scientists broadly agree on which major processes influence the sustainability of marine environments worldwide. Recent studies argue that such shared perceptions crucially shape scientific agendas and are subject to a confirmation bias. Based on these findings a more explicit engagement with scientists' (shared) perceptions of global change in marine environments is called for. This paper takes stock of the shared understanding in marine science of the most pertinent, worldwide threats and impacts that currently affect marine environments. Using results from an email survey among leading academics in marine science this article explores if a shared research agenda in relation to global change in marine environments exists. The analysis demonstrates that marine scientists across disciplines are largely in agreement on some common features of global marine change. Nevertheless, the analysis also highlights where natural and social scientists diverge in their assessment. The article ends discussing what these findings imply for further improvement of interdisciplinary marine science.

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1. Introduction

A large body of scientific work has described the “litany” [14] of global changes that deteriorate the sustainability and resilience of marine environments, including habitat loss, global warming, ocean acidification, overfishing, coastal sprawl, eutrophication, species redistributions, etc. (e.g. [14,11,6]). Collectively, these impacts can be considered as a single “interlinked, higher-order syndrome of global marine change” that is constituted through

multiple mechanisms and feedbacks [6]. This syndrome of global (marine) change is historically unique because it is the largest environmental change that is primarily driven by anthropogenic factors. Several scholars now use the term ‘anthropocene’ [25] to mark this distinctive phase in earth’s historical development.

However, Duarte et al. [7] warn that the recital of marine environmental collapse associated with the anthropocene can become self-perpetuating and biased. The occurrence of new “ocean calamities” is too readily accepted into the above-mentioned litany, even when evidence for them is weak. This lack of (self-)criticism often stems from miscitations, selective citations and citation errors, which, according to the authors, are rooted in a confirmation bias, i.e. the human tendency to confirm prior beliefs and opinions

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([7], 136). This critique has already produced some counter-reactions,¹ which may hopefully lead to an interesting debate about the role of perceptions in performing and communicating scientific research.

Duarte et al.'s criticism lends support for more explicit focus on scientists' perceptions of global marine change and solutions to mitigate its impact (see also [20]). This resonates with many recent attempts that aim to distil 'major challenges' or 'big questions' from the marine scientific community directly through so-called bottom-up, participatory surveys or exercises [18,21,23,8,9]. A particular objective of these efforts is to take stock of the variety of perceptions and opinions of marine scientists from different academic disciplines to better understand research priorities.

Elucidating dominant and marginalized viewpoints can help to identify self-confirmation biases, and 'bandwagon fallacies' i.e. assuming things because most people do ('argumentum ad populum' or 'appeal to the majority'). Moreover, these exercises can also provide information if dominant perceptions cross disciplines. Indeed, awareness of the contours of dominant perceptions and priorities shaping current scientific agendas [19] can help to identify strengths and weaknesses that enable or impede the development towards greater interdisciplinarity [5].

The objective of this paper is to use a bottom-up approach to take stock of the shared understanding among leading marine scientists in academia of the most pertinent, worldwide threats and impacts that currently affect marine environments. Results from an email survey are used to identify a shared research agenda of global change in marine environments. The assessment is structured using two assumptions derived from Wilen [27] who suggests that natural scientists predominantly focus on symptoms while social scientists focus on causes of environmental change. These suggestions were reformulated into two assumptions: (a) because of a dominance of natural scientists in marine science a tendency exists to focus on investigating the symptoms of global change in marine environments instead of the causes that induce impacts; (b) natural and social academics in marine science likely differ in their focus on symptoms or causes of global marine change. To investigate the validity of these assumptions answers were needed to the following questions: (a) Do marine scientists emphasize symptoms or causes; and b) who mentions what? Do social scientists indeed mention causes more often than natural scientists?

2. Method and materials

To find answers to the above questions a survey was conducted under leading international academics in marine science. These scientists were identified from a literature search that included journals from the social and natural sciences that published marine science. To limit the number of potential respondents 10 target journals were selected with the highest five-year Impact Factor ranking from Thomson Reuters 2010 Journal Citation Reports (JCR) and containing more than fifty articles per year. Five journals were selected from the category 'Ecology' from the JCR Science Edition to represent academics from natural science disciplines; and another five from the category 'Environmental Studies' from the JCR Social Sciences Edition to represent the academics from social science disciplines (Table 1). For each of the selected journals, articles were extracted related to marine topics and published

Table 1

The top five journals in marine science for 'Ecology' in the 2010 JCR Science Edition and 'Environmental Studies' in the 2010 JCR Social Science Edition, their impact factors, and the number of authors per journal identified as marine scientists.

Category	Journal name	5-Year Impact Factor	Authors contacted
Ecology	Ecology Letters	14.261	429
	Frontiers in Ecology and the Environment	7.931	52
	Global Change Biology	7.814	216
	ISME Journal	6.813	32
	Trends in Ecology and Evolution	17.735	50
Environmental studies	Ecological Economics	3.232	90
	Ecology and Society	4.644	92
	Energy Policy	3.035	31
	Global Environmental Change	7.840	63
	Tourism Management	3.415	76

between 2007 and mid-2012. The list of academics in marine science who were asked to participate in the survey was compiled by extracting the names of the first and last authors of each of the selected publications. Through this exercise, a total of 1131 academics were identified as potential respondents. There were 352 authors identified from articles published in the category Environmental Studies (from now on referred to as 'social scientists'); 779 were identified as authors from articles published in the category Ecology (from now on referred to as 'natural scientists'). These academics were contacted through email with the request to identify what they considered the five greatest global impacts and threats in marine environments. The exact question was formulated as follows: "Could you tell us which five topics represent the greatest global threats or potential impacts in marine environments?" By phrasing the question in terms of 'threats' and 'impacts' it was left it open to respondents to focus on causes (which the authors associate with 'threats') or symptoms (which the authors associate with 'impacts').

A total of 45 responses from social scientists (a response rate of 12.78%), and 126 responses from natural scientists were returned (a response rate of 16.17%). Only the first five topics mentioned were included in the survey analysis, also for those instances when academics replied with more than five answers. The replies were categorized through integrative coding [1], an inductive coding process by which items were merged into subcategories (secondary level), and then further into seven main categories (first level) to arrive at a shortlist of topics that marine scientists consider significant for better understanding the impacts and threats associated with global change in marine systems (see Fig. 1).

3. Results

Our respondents listed "overfishing" (80.1%); "elevated temperature" (69.0%); "contamination and waste" (50.3%); and "ocean acidification" (49.7%) as major threats impacting marine environments (Fig. 2). These results indicate that a broad consensus exists among marine scientists, be they from the social or the natural sciences. The consensus is also visualized as a 'commonality cloud' (Fig. 3), highlighting the replies that were most often mentioned by the academics in our survey.

However, upon closer investigation the responses of natural and social scientists differ markedly on the following aspects. Firstly, social scientists more often mention "societal failures" than

¹ [7] are critical of the publishing practices of high-impact journals such as *Science* and *Nature*, which, as they say, tend to publish work that fits with the prevailing scientific paradigms. The editor-in-chief of *Nature* already responded to this charge (<http://www.nature.com/news/ocean-calamities-oversold-say-researchers-1.16714>).

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