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Priority questions to shape the marine and coastal policy research agenda in the United Kingdom

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ABSTRACT

United Kingdom (UK) and European Union policy is rapidly developing to meet international targets for the sustainable use and protection of the marine environment. To inform this process, research needs to keep pace with these changes and research questions must be focused on providing robust scientific evidence. Thirty four priority research questions within six broad themes were identified by delegates who attended the 1st marine and coastal policy Forum, hosted by the Centre for Marine and Coastal Policy Research at Plymouth University in June 2011. The priority questions formed through this research are timely and reflect the pace and change of marine policy in the UK in response to international, European and national policy drivers. Within the data theme, the majority of questions seek to find improved procedures to manage and use data effectively. Questions related to governance focus on how existing policies should be implemented. The marine conservation questions focus entirely upon implementation and monitoring of existing policy. Questions related to ecosystem services focus on research to support the conceptual links between ecosystem services, ecosystem function, and marine management. Questions relating to marine citizenship are fundamental questions about the nature of societal engagement with the sea. Finally, the marine planning questions focus upon understanding the general approaches to be taken to marine planning rather than its detailed implementation. The questions that have emerged from this process vary in scale, approach and focus. They identify the interdisciplinary science that is currently needed to enable the UK to work towards delivering its European and international commitments to achieve the sustainable use and protection of the marine environment.

1. Introduction

The need to identify research priorities is important because a robust evidence base is critical to support informed policy change. However, it is a complex issue as national policy for the marine

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and coastal environment is not created in isolation and is driven, at least in part, by the need to meet international commitments. These include global treaties, such as the Ramsar Convention on Wetlands and the Convention on Biological Diversity, and regional agreements, such as the OSPAR Convention of the Protection of the North East Atlantic [1–3]. These policies provide a framework for both UK and European Union (EU) marine policy through the definition of important over-arching principles and criteria for species and habitat protection. The EU translates many of these principles into more concrete objectives through its directives and it is the responsibility of the member states to ensure the requirements of these directives are met.

Central to the management of the European marine environment are the Habitats Directive (92/43/EEC) and the Birds Directive (79/409/EEC) which together create a network of protected areas for a number of listed species and habitats native to member states in the terrestrial and marine environment. These directives require the designation of European Marine Sites as either Special Areas of Conservation (SACs) or Special Protection Areas (SPAs) and subsequently protection of these sites from harmful development [4]. More recently the Marine Strategy Framework Directive 2008/56/EC (MSFD) has been introduced to provide broader marine environmental protection in European waters [5]. This Directive, which constitutes the environmental component of the EU's Integrated Maritime Policy (IMP), aims to achieve good environmental status in all EU marine waters by 2020 while protecting the resource base for economic and social activities. This brings the marine environment in line with the EU's Water Framework Directive's (WFD) requirements for inland and coastal waters. In addition, the IMP, which advocates an integrated approach to governance of marine and coastal waters, has proposed the introduction of marine or maritime plans, working in close association with integrated coastal zone management.

To support the UK Government in meeting these international and European commitments and to achieve the Government's aim of 'clean, healthy, safe, productive and biologically diverse oceans and seas' [6], the Marine and Coastal Access Act 2009 (MCAA) [7], the Marine (Scotland) Act 2010 [8], and the forthcoming Northern Ireland Marine Bill 2012 are providing the framework to streamline the way the marine environment is managed in the UK. Along with developing legislation from the devolved administrations [9] these new provisions include the legal frameworks to develop Marine Plans (guided at a national level by the Marine Policy Statement [10]), provide powers to set licensing controls for development proposals in the marine area, and enable the designation of a new type of Marine Protected Area (MPA) called Marine Conservation Zones (MCZs).

The scale and pace of change in European and national policy presents challenges in managing the marine environment for its sustainable use. These changes in the governance of the marine environment place considerable demands on the marine community to work together to provide the necessary information and understanding to fulfill the set objectives. Decision makers need access to scientific evidence that is targeted to their needs [11,12]. To this end, academic research in the science-policy arena must be integrated and interdisciplinary. It must also be timely by framing research activities within the context of the general trends in that field [13,14]. Collaborative exercises to identify priority areas for research and management have demonstrated a methodology for identifying relevant areas of research to scientists, policy makers and practitioners [15–22]. However, none has focused on the interdisciplinary research requirements needed to achieve the sustainable use and protection of marine environment in the UK. To fill this gap in knowledge the aim of this study was to work with policy makers, practitioners and academics to identify priority questions to shape the marine and coastal policy research agenda in the UK.

2. Methods

In his taxonomy of horizon-scanning methods, Sutherland [16] identifies the methods used in this research as 'expert workshops' which "bring together experts to suggest possible future issues based on their own experience and knowledge" (p. 524). Sutherland identifies the advantages of this approach as the credibility provided by experts and that the iterative nature of the workshops draws out key issues and provides opportunities to refine the outcomes. The disadvantages are that the findings are always constrained by who was (or was not) involved in the workshops and by the precise process that was followed. The authors recognised these qualities in this study and specifically sought to minimise the disadvantages inherent to the method through the application of a rigorous research process described below, yet inevitably some effect will remain. Any variation in the methods used and in participation in the workshop would have resulted in a slightly different list of research questions; however, this is the case for all such processes.

The development of this research involved four stages (Fig. 1). The central focus for undertaking this research was the 1st marine and coastal policy Forum which was hosted by the Centre for Marine and Coastal Policy Research (MarCoPol) at Plymouth University, UK in June 2011.

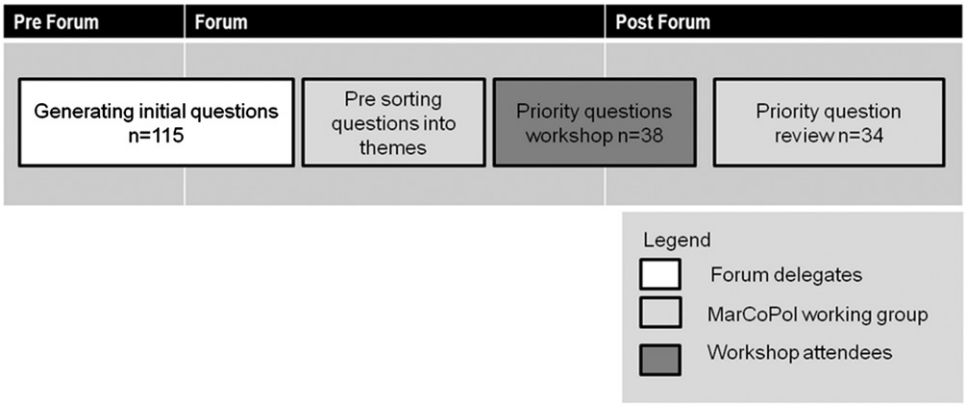

Fig. 1. Process diagram that shows the stages undertaken for developing the priority questions to shape the marine and coastal policy research agenda in the UK. n=the number of questions at each stage of the process.

Table 1
Delegates to the Marine and Coastal Policy Forum shown by sector.

Sector	Number of forum delegates
Consultant	12
Charity representative (e.g., National Trust, The Wildlife Trust)	12
Government advisory body (e.g., Joint Nature Conservation Committee)	6
Industry representative	3
Local government authority representative	3
Research institute member (e.g., University, Plymouth Marine Laboratory, Marine Biological Association)	52
Student (MSc and BSc)	6

2.1. Stage 1: Generating initial questions

Forum delegates were asked to identify the key questions that they felt were needed to be addressed by the research community to fully meet the challenges posed by recent policy developments to achieve the sustainable use and protection of the UK coastal and marine environment. Delegates were invited to submit questions by email prior to the Forum and during the first two days of the meeting. One hundred and fifteen initial questions were generated in total. Table 1 provides a summary of the sectors represented by Forum delegates. The majority of delegates to the Forum were representatives of research institutions within the UK, many of whom are experienced in providing research to support marine governance and policy decisions. In addition, there was representation from all key stakeholder sectors active in the UK's marine and coastal governance framework.

2.2. Stage 2: Pre-sorting questions and workshop

In order to make the best use of time available during the Forum meeting, the questions initially submitted were pre-sorted into thematic categories by a working group from the Centre for Marine and Coastal Policy Research. The thematic categories were: data, the ecosystem approach, human impacts, MPAs, marine spatial planning, policy, and social issues.

2.3. Stage 3: Priority questions workshop

Twenty three delegates attended the Forum workshop, during which they were asked to work in small groups to review the initial, themed, pre-sorted questions. Delegates were asked to keep the following criteria in mind when writing, reviewing, and combining research questions. The criteria, adapted from Sutherland et al. [16], were that each question should:

a) be answerable through realistic research design;
b) be SMART (specific, measurable, attainable, realistic and timely);
c) allow a factual answer that does not depend on value judgements; and
d) be of relevance to the UK.

Each group was moderated by a facilitator who kept the group to task and recorded the process through which decisions were made, primarily in order to maintain a clear audit trail between the initial questions generated by the wider Forum delegates and the refined questions identified by delegates at the workshop. The outcome of the workshop was 38 priority questions to take forward to the next stage.

2.4. Stage 4: Priority question review

A working group from the Centre for Marine and Coastal Policy Research undertook a final review of the priority questions in order to remove duplication and validate the audit trail between the initial questions and the final set of priority questions. This process resulted in the removal of four duplicated questions. A final set of 34 priority questions was agreed.

3. Results

The research questions were grouped into the following six broad categories: marine conservation, marine planning, marine citizenship, ecosystem services, data and governance. The questions were divided into these categories in order to provide a coherent structure for presentation. However, it should be recognised that an individual question may have relevance under one or more categories. The final 34 questions are not ranked. The results are presented and discussed according to their categories.

3.1. Data

1. What are the minimum data requirements (range of datasets and quality thresholds) for effective marine planning?
2. What lessons have been learned from the recent Marine Conservation Zone (MCZ) process to improve the incorporation of scientific and stakeholder data into marine conservation planning?
3. What elements are required to coordinate a national data collection and monitoring framework to support marine management?
4. How can confidence in stakeholder sourced data be assessed?

The need for a robust evidence base to inform marine decision making is apparent in questions 1–4. All four questions are forward thinking and, ultimately, aim to identify ways in which the collation and provision of data can be improved to support marine environmental management. Questions 1 and 4 reflect upon the development of the UK MPA network, in particular with regard to improving the incorporation and quality of data into the decision making process (question 1). Data initiatives such as the Ocean Biogeographic Information System (OBIS), and the Marine Environmental Data and Information Network (MEDIN), have developed in response to the fragmented nature of marine environmental data holdings in the UK and have worked to increase the availability of marine environmental data to end-users. Yet lack of data has been cited as a common impediment to progress in conservation, especially in offshore environments [23]. The questions posed here recognise the extent of data gathering (consolidation of ecological data and gathering of social and economic data) required to determine the location of MCZs (question 2) and support the development of marine plans (question 1). Question 3 also identified that the development of a central data body, monitoring framework and a protocol for the assessment of stakeholder sourced data (question 4) could serve to support robust policy delivery.

3.2. Ecosystem services

5. What are the links between marine ecosystem function and ecosystem services?
6. How can marine ecosystem services (e.g., climate regulation) be incorporated into marine management?
7. What are the research priorities to improve our understanding of marine ecosystem services?

Marine ecosystems provide a number of essential ecosystem services, such as the provision of food and climate regulation, which are essential to maintain human wellbeing [24–26]. The development of descriptors [24] to translate the complexity of marine ecosystem functions into marine ecosystem services has broadened the inclusion of marine ecosystem services into policy and planning [27,28]. As such, the consideration of economic, social and ecological values in decision making (the ecosystem approach) via defining ecosystem services has become integral to marine conservation planning and policy in the UK [5,7,10,29]. The questions raised under the category of ecosystem services (questions 5–7) demonstrate that greater understanding is needed of the concept, particularly with regard to the links between ecosystem functions and the delivery of ecosystem services (question 5), in order for it to be used in a management context (question 6). As this is a broad area of research it is suggested that setting research priorities within the subject area may improve its practical application (question 7).

3.3. Governance

8. How can marine heritage priorities (e.g., wrecks) be integrated into coastal and marine policy?
9. How can the current marine and coastal policy framework adapt to drivers of change?
10. Can the current marine and coastal policy framework in the UK be streamlined and duplication reduced?
11. How do sectoral interests (e.g., fisheries, conservation, energy) influence marine and coastal policy at different scales?
12. How does the current marine and coastal policy framework enable the sustainable management of the marine environment?
13. To what extent is the Marine Policy Statement effective and how can this be assessed?
14. To what extent is the national capacity for marine and coastal governance appropriate for the scale of the challenge(s)?

The UK marine and coastal governance framework mediates policy derived from a number of scales into tangible actions, usually at the national, sub-national, or local level. The priority research questions developed related to governance all address specific issues related to the implementation of current policy, either as standalone policy themes or through integration with other policy frameworks. The coastal and marine governance framework has been the subject of on-going debate in the UK for the last five years during the development of new marine legislation, therefore many of the questions about what the legislation should contain have been resolved. The emphasis in questions 8–14 reflects this evolution; they are directed at assessing the suitability of the current policy framework to deliver overarching policy objectives. Given that the questions refer to a system which has very recently been developed and not yet fully implemented, this can be read as the participants' observation that there is both an opportunity and need to build in mechanisms for review and adaption of that system as the challenges of implementing the policy become apparent. Questions are posed as to whether current policy is adaptive to drivers of change (question 9), whether duplication can be reduced between policies (question 10) and whether current policies incorporate all sectors fairly (questions 8 and 11).

3.4. Marine citizenship

15. How are people's perceptions of the marine environment influenced by media?
16. What are the barriers to engaging the public with the marine environment and how can these be overcome?
17. What is the role of the 'Big Society' in the marine environment?
18. What public behaviours could be encouraged to change in order to improve the health of marine ecosystems?
19. What role do retailers and consumers play in the use and management of marine resources?

Questions 15–19 all relate to aspects of marine citizenship, the emerging paradigm that encompasses an individual's responsibility to make informed choices about their impact on the marine environment [30]. In common with other citizenship principles, marine citizenship recognises that individual members of society have a responsibility to contribute to solving marine environmental problems through their personal behaviour, particularly related to everyday consumer and lifestyle choices [31–33]. Multiple factors, including knowledge, values and experience, can influence public engagement with environmental issues [34] and the relationship between the public and the marine environment is also likely to be influenced by similar factors [35]. Better understanding of these factors, and the channels through which information about the marine environment flows will support future action to increase the level of marine citizenship in a target population (questions 15 and 16). Elements of marine citizenship and the UK's 'Big Society' (the current Government agenda of greater individual involvement in civic activity in policy areas where Government has reduced or retracted direct support) are potentially aligned, therefore question 17 is significant, but potentially UK specific. At present, the desirable individual pro-environmental behaviours that might be considered as expressions of marine citizenship in order to reduce human pressures on marine environmental health are uncertain, hence question 18. Finally, question 19 focuses on the role retailers can play in influencing the choices of consumers and therefore indirectly contributing to the governance of marine resources. These questions highlight the potential of marine citizenship as an emergent policy channel in the UK, but also identify some of the challenges which need to be overcome in order to support its realisation.

3.5. Marine conservation

20. What are the impacts (social, economic and ecological) and extent of recreational fishing within UK seas?
21. How can ecological change in the UK MPA network be monitored from a baseline to demonstrate performance against conservation objectives at varying scales?
22. Can non-statutory management measures deliver the conservation objectives of the UK MPA network?
23. To what extent do the conservation objectives of the UK MPA network help achieve wider good environmental status for UK seas as defined in the EU MSFD?
24. What are the relationships between socio-economic and ecological change in the MPA network?
25. What are the socio-economic impacts of the UK MPA network and how can they be monitored?
26. What are the thresholds and criteria for implementing statutory management measures in an MPA?
27. Does the size, shape and number of MPAs influence their social, ecological and economic effectiveness?
28. What are the relative costs and benefits of statutory and non-statutory management and enforcement measures for marine management?
29. How can the conservation needs of highly mobile marine species be addressed within the current policy framework?

The UK administrations are tasked to substantially complete an ecologically coherent network of MPAs by 2012 [10]. Recommendations for MCZs in English and offshore Welsh waters

were published in September 2011 [36–39]. These recommendations have been reviewed by an independent scientific advisory panel and the statutory nature conservation agencies. Final recommendations will be put forward to Government in 2012. Questions 20 to 29 all relate to this policy development and delivery. The questions identified under this category recognise that in order to improve decision making a greater understanding is required of the human impacts on marine resources e.g., does recreational angling have a significant impact on marine resources (question 20). At present, the future management of activities within the MPA network is under review, based on the statutory conservation objectives for each site. As such, questions 22, 26 and 28 highlight the need to assess the suitability of different management measures to deliver the conservation gains for which the MCZ network was designed and to set thresholds for the management of activities to be reviewed. In addition, the priority questions identify a need to make provisions to monitor and manage the network of MPAs from a baseline economic, social and ecological perspective (questions 21, 24, 25 and 27) against which the success of the MPA in delivering conservation objectives both locally, regionally and internationally can be reviewed. Question 29 specifically addresses the provisions for the conservation needs of highly mobile marine species within the current marine conservation policy framework.

3.6. *Marine planning*

30. How can the net environmental impact of marine planning be measured?
31. What are the mechanisms and criteria (ecological, economic and social) for identifying and negotiating trade-offs between human activities in marine planning?
32. How can the representation of stakeholders be quality assured in participative marine management?
33. How can marine planning integrate with the existing policy framework and management processes at varying scales?
34. What are the implications of applying a precautionary approach to marine planning?

Marine spatial planning is considered to be a critical step to implementing an ecosystem based approach to managing the multiple uses of the marine environment [40]. The EU IMP [41], the EU MSFD 2008/56/EC, the UK MCAA (2009), the Marine (Scotland) Act (2010), and the UK Marine Policy Statement have collectively set the course for delivering marine plans in the UK. This policy impetus has shaped the development of the priority research questions 30–34. Question 30 identifies the need for developing methods to determine the net environmental impact of marine planning and one reason for this could be to determine the impact of the planning process itself on our use of the marine environment. It is possible that the introduction of marine planning will increase human impacts on the marine environment or facilitate better protection, and such a study would enable the impacts to be assessed and compared with the goals of the Marine Policy Statement. It is recognised that decision making within this ecosystem based context of marine planning requires trade-offs to be made between multiple users [42,43]. Therefore, questions 30 and 31 require the identification of these activities, potential trade-offs, and a mechanism to review the net environmental impact of the marine plans to deliver broader marine resource use objectives.

The representation of stakeholders in the decision making process is addressed by question 32. The task of ensuring that appropriate representation is maintained may be more challenging for offshore areas, than for example for estuaries or terrestrial environments where user groups are more easily defined, as there could be a lack of democratic representation, given that it is remote to the general population. Questions 33 and 34 require an overview of the policy and to identify whether the objectives can be integrated with other concurrent polices and management (question 33), including those existing at sea and those on land, and if the application of the precautionary approach should be reasserted (question 34). A lack of data is particularly acute in offshore areas [23] but there is a need to provide plans in the immediate future. Where insufficient data exists to make informed choices the precautionary principle requires that there is a presumption in favour of environmental protection. This is relatively straightforward when considering new activities but can be more challenging when reviewing and approving existing activities which may be causing harm and determining their future maintenance or growth. Hence, exploring the application of the precautionary principle to marine planning offers many interesting research questions particularly with regard to balancing social and economic factors within a precautionary approach.

4. Discussion

This research priority setting process was focused on the needs of marine and coastal policymakers in the UK; therefore the questions form an explicitly applied research agenda largely specific to the UK. It is anticipated that policymakers will benefit from the development of a research agenda that supports their information needs [22] and which therefore underpins the development of policy. The questions that emerged from this process varied in scale, approach and focus, which potentially reflected the interdisciplinary nature of marine and coastal research [44] and the mix of participants in the process (e.g., the notable lack of questions relating to coastal processes) [22]. The balance of questions between each category varied, with an emphasis towards marine conservation, governance, and marine planning. However, as topicality is an important influence in the selection of questions, this is unsurprising, as the development of an MPA network within a marine planning framework are the central developments in the UK's current marine and coastal governance framework.

The specific nature of the questions presented under each category broadly reflected the stage of that theme or topic in the policy cycle (Table 2). The number and composition of each stage in the cycle varies, but a typical policy cycle includes the following stages: (1) identification of a policy challenge; (2) evidence collection to understand the characteristics of the policy challenge; (3) analysis of the evidence in order to understand the cause and effect relationships involved in the policy challenge; (4) identification of potential policies to address the policy challenge; (5) selection of favoured policies; (6) implementation of favoured policies; and (7) monitoring of implemented policies to evaluate success and consider the need for policy adaptation. Table 2 broadly summarises the approximate connection between the question categories and stages of the policy cycle.

Within the data category, the majority of questions sought to find improved procedures to manage and use data effectively rather than focus on what data is needed or how it should be collected. These questions were concerned with the implementation of data policy, which perhaps reflects data management as a long-standing concern in the UK. Similarly, the questions related to governance reflected the advanced stage of governance issues within the policy cycle, and focused on how existing policies should be implemented. The marine conservation questions demonstrated the furthest progression through the policy cycle as they were, in general terms, focused entirely upon implementation and monitoring of existing policy. These questions were

Table 2
The relationship between question category and policy cycle stage.

	Policy cycle stage	Question category					
		Marine conservation	Marine planning	Marine citizenship	Ecosystem services	Data	Governance
1	Identification of policy challenge			■	■		
2	Evidence collection			■	■		
3	Analysis of evidence			■	■		
4	Identification of potential policies		■				
5	Selection of favoured policies		■				
6	Implementation of favoured policies	■				■	■
7	Monitoring of implemented policies	■				■	■

also rather specific, targeting existing gaps in knowledge that, if filled, would support the delivery of existing policy, rather than the development of new policy. In contrast, the questions related to ecosystem services were much more fundamental in nature, focused on conceptual links between ecosystem services, ecosystem function, and marine management. The current policy framework related to ecosystem services reflects the need to understand the issues surrounding how ecosystem service ideas could be formulated and applied to the marine environment and its management. The questions related to marine citizenship illustrated a similarly early position in the policy cycle as they related, in general terms, to fundamental questions about the nature of marine citizenship rather than its implementation or monitoring. Finally, the marine planning questions reflected a mid-stage in the policy cycle by focusing upon understanding the key approaches to be taken to marine planning rather than focusing upon its detailed implementation.

It was notable that although all questions were intended to be focused on the UK, some of the questions, if successfully answered, would provide insight into issues at other geographic scales. For example, answers to the question 'What are the mechanisms and criteria (ecological, economic, and social) for identifying and negotiating trade-offs between human activities in marine planning?' (question 31) would also be of benefit at the European scale, to inform the implementation of the European Roadmap for Maritime Spatial Planning [45–47] and in more general terms as a contribution to the delivery of the European IMP [48]. In addition, recent studies focused on the Mediterranean and the Black Sea highlight data needs for the integration of science into policy [49]. The development of research related to those questions derived under the marine conservation theme would benefit from international collaborations with scientists in countries where networks of MPAs are more advanced (e.g., [50–52]) or where studies on MPA impacts are already in effect (e.g., [53,54]).

That the potential usefulness of the answers to some questions extends beyond the UK highlights that some questions transcend national boundaries and are potentially salient questions applicable to other countries, to regional seas, or globally. Given the influence of the EU in particular on UK marine and coastal policy, the applicability of certain questions at a variety of scales was perhaps to be expected. The observed interdependence does highlight the potential for the development of a European or even global collaborative research agenda that is tailored to answering specific questions of shared relevance.

The impact of research priority setting exercises such as this one is discussed by Sutherland et al. [22], who make the point that the connection between science and policy is sometimes slow and ambiguous, making impact rather difficult to determine. However, it is also noted that in previous exercises of a similar nature [16,17,19–21], policy makers have been keen to engage and the exercises have been successful in encouraging discussion and debate, as has this process.

5. Conclusion

The priority questions formed through this research reflect the pace and change of marine and coastal policy in the UK in response to international, European and national policy drivers. They also represent a 'to date' snapshot of issues pertinent to the science-policy research community. By using a collaborative process to identify priority questions the results will enable scientists to be more effective and efficient at delivering policy focussed science [15]. The results will also encourage collaborations between sectors and academic fields. The questions have identified the science that is currently needed to inform policy that will enable the UK to deliver its European and international commitments to achieve sustainable use and protection of marine environment.

Identifying questions that are pertinent to the UK does not however exclude a wider European and international audience from engaging with this research. Answers to some of these questions are local in nature but others, including ecosystem service questions, have global relevance (e.g., carbon sequestration), and research must be focussed at an international scale. With a global trend towards integrated approaches to managing ecosystems at appropriate scales [55], the sustainable management of the oceans requires science to be integral to current policy requirements. Developing priority questions to focus research is not a static process. To maintain relevance within this fast-moving subject base, the science-policy research community would benefit from regular revisions of this process and the inclusion of a broader sample group. Developing priority questions is therefore an iterative exercise and one which must (like policy) reflect the trends, values and needs of society.

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