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Ghoti

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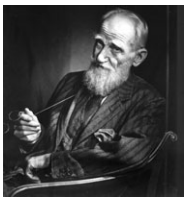

Ghoti aims to serve as a forum for stimulating and pertinent ideas. Ghoti publishes succinct commentary and opinion that addresses important areas in fish and fisheries science. Ghoti contributions will be innovative and have a perspective that may lead to fresh and productive insight of concepts, issues and research agendas. All Ghoti contributions will be selected by the editors and peer reviewed.

Etymology of Ghoti

George Bernard Shaw (1856–1950), polymath, playwright, Nobel prize winner, and the most prolific letter writer in history, was an advocate of English spelling reform. He was reportedly fond of pointing out its absurdities by proving that 'fish' could be spelt 'ghoti'. That is 'gh' as in 'rough', 'o' as in 'women' and 'ti' as in palatial.

A decision support tool for response to global change in marine systems: the IMBER-ADApT Framework

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Abstract

Global change is occurring now, often with consequences far beyond those anticipated. Although there is a wide range of assessment approaches available to address-specific aspects of global change, there is currently no framework to identify what governance responses have worked and where, what has facilitated change and what preventative options are possible. To respond to this need, we present an integrated assessment framework that builds on knowledge learned from past experience of responses to global change in marine systems, to enable

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decision-makers, researchers, managers and local stakeholders to: (i) make decisions efficiently; (ii) triage and improve their responses; and (iii) evaluate where to most effectively allocate resources to reduce vulnerability and enhance resilience of coastal people. This integrated assessment framework, IMBER-ADApT is intended to enable and enhance decision-making through the development, a typology of case-studies providing lessons on how the natural, social and governance systems respond to the challenges of global change. The typology is developed from a database of case-studies detailing the systems affected by change, responses to change and, critically, an appraisal of these responses, generating knowledge-based solutions that can be applied to other comparable situations. Fisheries, which suffer from multiple pressures, are the current focus of the proposed framework, but it could be applied to a wide range of global change issues. IMBER-ADApT has the potential to contribute to timely, cost-effective policy and governing decision-making and response. It offers cross-scale learning to help ameliorate, and eventually prevent, loss of livelihoods, food sources and habitat.

Keywords Appraisal, fisheries, global change, IMBER-ADApT, interactive governance, response, systems approach

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Introduction

Marine ecosystems face multiple challenges from global change, induced by natural and anthropogenic stressors, which affect their ability to function and deliver goods and services to humankind. Coastal areas in particular are most vulnerable given their proximity to the sea, and, because of their high population density, consequences of global change can be devastating, as witnessed in recent disasters caused by hurricanes, tsunamis and earthquakes. Stress and pressure occur daily in coastal areas, where heavy resource exploitation and rapid development take place to accommodate the rising global demand for capital, food, shelter, employment and enjoyment. At the same time, global change is occurring at a faster rate than predicted (Steffen *et al.* 2004; Brysse *et al.* 2013; Hay 2014), often with consequences far beyond those anticipated. The global changes induced by these challenges can result in widespread system degradation, undermining the functioning of the ocean and its provision of goods and services, including regulation of climate, nutrient cycling and assimilation of wastes. This condition creates hardship for local populations and businesses that depend on ocean services for food, livelihoods and well-being (Allison *et al.* 2009; Badjeck *et al.* 2010). For example, globalization of markets for several highly valued invertebrates (e.g. shrimp, sea cucumber) and an explosion in their demand have brought short-term gains to local fishers, but with consequent loss of habitat, biodiversity and livelihoods (Deutsch *et al.* 2007) and fishery collapses (Defeo and Castilla 2012). Fortunately, awareness about global change has risen and been accompanied by heightened concerns around the world, not only about the effect of these changes on society, but also about how to prevent or alleviate them.

Fostering appropriate mitigation and adaptation to change requires timely, effective and coordinated responses from all involved parties, at all levels. However, identifying what the most appropriate response is for a given system remains a challenge. Experiences from around the world regarding how affected people respond to change and what their coping strategies are, whether taken by themselves or facilitated by government and non-government agencies, provide lessons that can lead to more effective future responses and to prevention in other areas, especially where financial resources and human capacity are limited. While a need for such a learning platform may be evident, currently, there is no framework to identify what coping strategies have worked elsewhere, the factors that have facilitated change, what preventative options are possible, and the conditions under which they are feasible. Such a framework would need to account for the effects of various stressors on the interconnected natural and human systems, and incorporate the

vulnerability of these systems, their adaptive capacity and the multitude of responses and their effectiveness. The framework would also require an interdisciplinary approach, drawing from the expertise of scientists across the natural and social sciences, local experts, resource users and community leaders. Ultimately, its results need to be relevant for the management and policy decisions.

In the context of climate change, adaptation is described as 'Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities' (Parry *et al.* 2007, p. 969). Scientific and policy interests in this new and evolving realm have led to a growing number of publications, research and policy arenas (e.g. European Climate Adaptation Platform, FAO-Adapt, Australia's Climate Adaptation Flagship, etc.). Additional resources are found on-line, with a bewildering plethora of web sites offering guidance on vulnerability and adaptation to climate change. Most of this advice is based on expert judgement of appropriate adaptation strategies to use, taking into consideration the complex interplay of vulnerability and risk tolerance on a case-by-case basis. Because the field is relatively young, it has not been possible to focus on the synthesis of responses or to integrate knowledge from past experience. Searching and sorting through these case-studies is also not easy. We argue that the absence of opportunity to learn from the experience of others may lead to ineffective governance responses and costly consequences. In fisheries, climate change is not the only challenge facing marine ecosystems and resource-dependent communities. In fact, it is often not considered the most important issue by resource users (Perry *et al.* 2010a; Bundy *et al.* 2013). This could be because resource-dependent communities are continually adapting to change, be it environmental, economic, social or governance derived. Yet, the limited understanding of responses and adaptive strategies to climate and other changes implemented by high-level institutions (state, regional councils) (Maury *et al.* 2013) or by local level stakeholders such as producers' organizations, firms or households, impedes the learning opportunity for other communities and decision-makers.

Thus, although there are many approaches available to explore aspects of global change, most do not assess the responses of stakeholders to global change issues, and there is little emphasis on applying lessons learned from one location to another. To address this gap, scientists from a wide range of disciplines have collaborated as part of the IMBER (Integrated Marine Biogeochemistry and Ecosystem Research, www.imber.info) global research program to develop an integrated assessment framework for decision support called the IMBER-ADApT (Assessment based on Description and responses, and Appraisal for a Typology) Framework.

The IMBER-ADApT Framework (simplified to IMBER-ADApT henceforth) is designed to enable decision-makers, researchers, managers and local stakeholders to: (i) make decisions efficiently; (ii) triage and improve their responses; and (iii) evaluate where to most effectively allocate resources to reduce vulnerability and enhance resilience of coastal peoples to global change. It is based on a global database of marine case-studies that have been impacted by global change and takes into account their interconnected natural and human systems. Specifically, it asks what can be learned from local and/or regional responses to global change, successful or not, and how can this information be used to direct decisions about adaptation and mitigation strategies to address current and future global change elsewhere. When completed, it will consist of a case-study template for practitioners to complete, a global database and a typology showing emergent classes of response situations. The framework is still under development; the case-study template has been developed (Appendix S1), the database is growing, and we present here a preliminary typology. IMBER-ADApT is ultimately intended to enable and enhance decision-making through the development of a typology of case-studies, linked to, and offering guided access to an underlying detailed database, providing instrumental lessons on how the natural, social and governance systems have responded to the challenges of global change.

The current focus of IMBER-ADApT is on wild and cultured fisheries, which are likely to suffer from multiple simultaneous pressures, such as rising temperatures and sea levels; decreased pH, changes in productivity, flooding and droughts; and increases in frequency and intensity of extreme weather events (FAO 2011; p. 5). The human consequences of these environmental factors are exacerbated by poverty, inequity and food insecurity, and in the case of fisheries, they are further compounded by over-exploitation, now

and in the past (Hall *et al.* 2013). As marine ecosystems are subject to a complex set of natural, social and governance drivers, and interactions at multiple levels and scales (Adger *et al.* 2009; Daw *et al.* 2009; Barange *et al.* 2010, 2014; Perry *et al.* 2010a), a thorough understanding of how humans interact with the marine environment can help address issues threatening security of food, shelter, livelihoods and human health (Adger *et al.* 2005; Allison *et al.* 2009; Perry *et al.* 2010b, 2011; Coulthard *et al.* 2011). By taking a broad perspective on interactions between human and natural systems, from biogeochemistry to governance, and recognizing interconnectivities and feedbacks, IMBER-ADApT addresses the complex nature of both marine ecosystems and of human responses in the context of change.

Theoretical development of IMBER-ADApT

IMBER-ADApT has two fundamental theoretical bases: (i) it is rooted in a systems thinking approach about the linkages and interactions between people and their environments and (ii) it is premised on interactive governance theory (Kooiman *et al.* 2005) which places a strong emphasis on understanding the interactions that occur between human and natural systems. Central principles of a systems approach, such as social–ecological systems (Berkes and Folke 1998; Folke *et al.* 2005, 2010; Perry *et al.* 2010b,c; Berkes 2011), human-environment systems (Turner *et al.* 2003) or coupled human and natural systems approaches (Liu *et al.* 2007a,b), are (i) the explicit recognition that the delineation between human and ecological systems is artificial and arbitrary (Berkes and Folke 1998) and (ii) that the relationship between humans and the environment is complex, bi-directional and occurs at different, but interrelated, spatial and temporal scales. Interactive governance theory argues that it is within these interactions where governability of issues, such as climate change, are situated, but it is also where solutions and opportunities to address governance challenges may be found. Because of this perspective, IMBER-ADApT is designed to assess and classify interactions between entities and across scales.

There are several tools already developed for a system-oriented approach, such as social network analysis (e.g. Knoke and Yang 2008), ecological network analysis (e.g. Wulff *et al.* 1989) and transdisciplinary network analysis (e.g. Bodin and Tengö 2012). Network analysis identifies and conceptualizes the links (interactions) between different nodes in a system and can be used to identify the number of nodes and links, the strength of the linkages and the robustness to perturbations of the systems. While excellent for studies of specific coupled natural and social systems, they are less useful for a broad comparative approach that seeks to identify commonalities among locations and events, the way that IMBER-ADApT does.

A simpler, descriptive approach that defines the relationships between different components of the system is the Driver–Pressure–State–Impact–Response (DPSIR) causal framework, which links the social, economic and cultural forces that drive human activities, including government policies and societal needs, to pressures on the environment (Burkhard and Müller 2008). DPSIR aims to identify the pathways connecting pressures to impacts and responses, which can then be summarized using a range of indicators. The approach taken in IMBER-ADApT builds on this together with interactive governance theory (Kooiman *et al.* 2005), which is nonlinear and less deterministic than the DPSIR approach, allowing for a full exploration of system properties that may contribute to response decisions and their effectiveness.

In contrast to the DPSIR approach, which focuses on driving forces, the interactive governance approach begins with an examination of the characteristics or properties of the system-to-be-governed and the governing systems (Chuenpagdee *et al.* 2008; Chuenpagdee and Jentoft 2013). The system-to-be-governed comprises both the natural and social systems, with their corresponding bio-physical, ecological or human elements. The governing system includes institutions, organizations, communities and individuals responsible for setting rules, norms and legislations for the governance of the natural and social systems.

Core to interactive governance theory is the concept of 'governability', which considers the qualities of the system-to-be-governed and the governing system in relation to how likely they are to be successfully governed (Kooiman 2003; Kooiman and Chuenpagdee 2005; Chuenpagdee 2011). The recognition that there are limits to how governable a system is, and to the level of governability that can be achieved (Jentoft 2007) is a central premise of IMBER-ADApT. In the global change context, the governability concept

explores what aspects of the natural and social systems make them vulnerable to change, what capacities of the social system and the governing system will enable them to respond to change, what factors contribute to the effectiveness of these responses, and what interactions can be fostered to improve mitigation and adaptation strategies (Chuenpagdee and Jentoft 2013). The integration of the interactive governance and DPSIR approaches into IMBER-ADApT is depicted in Fig. 1. It helps to explain what aspects of the governing system and the system-to-be-governed may foster or inhibit the capacity of these systems to respond in a timely and cost-effective manner.

Three components of the IMBER-ADApT

IMBER-ADApT is comprised of three inter-related components: description, appraisal and typology. 'Description' provides the detailed information necessary for 'appraisal', and together they contribute to the 'typology', the classification of case-studies into different 'types'. The 'descriptive' component is based on Fig. 1 and examines the ecological, social and governing systems impacted by stresses and global change, what the impacts are, and identifies their responses to governance at different institutional and governance levels (Ostrom 1990; Chuenpagdee 2011). The second component, 'appraisal,' is the key to the learning component of IMBER-ADApT; it evaluates how successful these responses are in mitigating the impacts, what factors affect the outcomes of these responses and what some of the risks and uncertainties are involved in their implementation. Together these two components have guided the development of the case-study template. The typology is developed from the case-study template and classifies different case-studies into representative 'types'. It is the gateway for end-users to access the information in the IMBER-ADApT database. It also facilitates learning and provides guidance for timely responses with respect to the natural, social and governing systems and the global change issues to which they are responding.

Data collection to inform the three components

IMBER-ADApT relies on the use of contextualized, place-based case-studies, which, as proposed by Turner *et al.* (2003), are selected strategically to cover a wide range of geographical locations such as tropical and temperate, many types of fisheries including pelagic fish in the high-seas, coastal shellfish, and everything in between, and a variety of issues, for example whether the system is bio-physically or anthropogenically driven. The case-studies

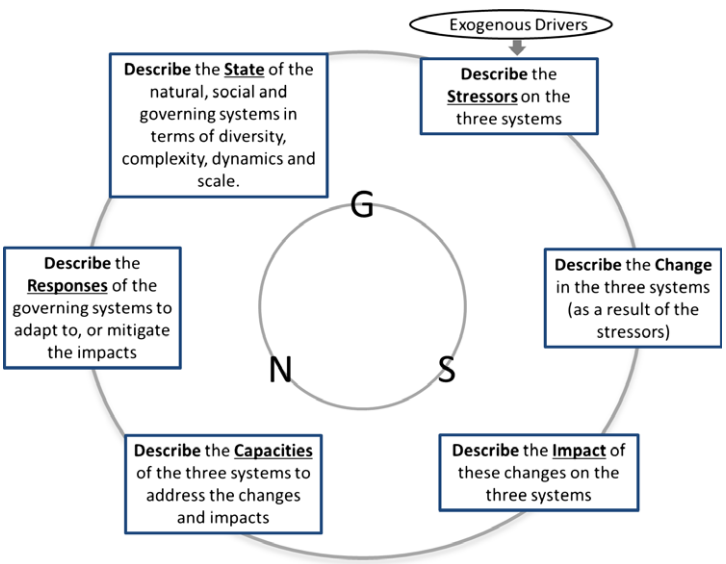

Figure 1 Outline of the different steps for the Description and Response component of IMBER-ADApT. (N) is for the Natural System, (S) for Social System and (G) for Governing Systems. Stressors may be anthropogenic or natural. The outer circle represents a continuous cycle, which can be entered at any point, and the inner circle indicates that each component of the Description should be applied to the natural, social and governing systems.

include the following key features of the system: (i) geography (tropical/temperate regions, north/south); (ii) oceanography (nearshore, continental shelf and open sea/offshore); (iii) coastal type (beach, estuary, lagoon, cliff, fjords); (iv) habitats (gravel, mud flat, mangroves, seagrass, submerged aquatic vegetations, reefs); (v) fisheries (types, sizes and gears); and (vi) other uses. Drivers and pressures affecting the systems come from various sources and are of a different nature. Also, degree of vulnerabilities and livelihood dependency on the marine systems are likely to differ from place to place. IMBER-ADApT captures these by including case-studies from countries in all categories of the 'human development index' (http://hdr.undp.org/en/statistics/hdi/, accessed 7 October 2013). From the governing system perspective, the case-studies include areas governed by all possible modes, such as hierarchical, co-governance and self-governance (Kooiman *et al.* 2005), and involve various formal and informal institutions such as rules, regulations and norms (Chuenpagdee and Song 2012). Further, actual governing responses and consequences, as appraised from the case-studies, are captured as the final component in the classification system.

A case-study template was developed to capture the Description and Appraisal characteristics (Appendix S1). It uses a common set of questions to standardize across the case-studies providing comparable information for the typology. This overcomes the problems outlined by other authors where there is a mix of approaches and assumptions (Preston and Stafford-Smith 2009), and provides a rigorous, systematic basis for comparison. The questions in the case-study template address the components of IMBER-ADApT as outlined below.

Description and response

To capture the intricacies of the effects of global change on marine social and ecological systems, and the consequent challenges to governance, description of at least six elements is required: state, stressors, change, impact, adaptive capacities and responses of the natural (N) and social (S) systems that are affected by the change, and the governing (G) system (Fig. 1). This description process is circular, but the logical entry point is the global change issue, the stressor, central to the case-study. The inner circle highlights the importance of looking at the six elements always in the context of the inter-related natural and social system-to-be-governed and the governing system. When describing a case-study, we are interested not only in the global change issue, when it occurs and where, but also in how it affects the ecological, social and governing systems. The case-study template (Appendix S1) identifies relevant scales and differentiates the scale at which the issue occurs, whether it is local, regional, national or international. The underlying assumption is that responses may be different depending on the scale affected by the issue.

Governance responses, short or long term, can occur at various levels of governance, and by a range of actors including governments, non-governmental organizations, donors, development agencies, producers' organizations, and research and academic institutions. The external agencies often provide formal responses, with clearly defined objectives, accompanied by strategies and implementation plans. However, formal responses take longer to develop, and fast moving changes, such as development of new global markets for products, may outpace the ability to develop an appropriate response (Berkes 2011). In a self-governance system, however, responses can be part of an internal process, which can be formal or informal and led by key members of the communities. What these different responses are, the process by which they come to be, factors that may foster or prohibit their success, as well as any lessons from hindsight, are important details captured in IMBER-ADApT, recognizing the different spatial and temporal scales and different institutional levels of action. Whether the responses are formal or informal, short or long term, their outcomes will determine the ability of the human–ocean system to deal with change, which in turn may affect other levels of the natural, social or governing system, with potential feedbacks (Turner *et al.* 2003). Ultimately, the choice of response depends on the characteristics of the systems and their adaptive capacities.

Appraisal

Building infrastructure for mitigation and adaptive capacity are usually part of the response program. What is often not included, however, is a formal system of monitoring and evaluation to assess the effectiveness of the chosen responses, although its importance is recognized (Lamhauge *et al.* 2012), both before and after the response. For

IMBER-ADApT to be useful, an appraisal component is essential as without this, a user has no means to determine the effectiveness of responses, and therefore no basis to make a decision regarding their suitability.

In accordance with the overall theoretical structure, the appraisal component considers the natural, social and governing systems to account for all aspects of the response. The main focus of IMBER-ADApT is on response effectiveness, which needs to be judged on a case-by-case basis, using pre-defined criteria (Preston and Stafford-Smith 2009). We use a simple result-based-management approach (OECD 2002) for the appraisal component, which focuses on performance and achievement of outputs and outcomes to establish pre-defined criteria. Outputs are short-term effects related to response objectives and are achieved if the objectives of the responses for the natural and social system-to-be-governed and the governing systems are met; the outcomes are longer term effects that are achieved if the main global change issue was addressed. Specific questions in the case-study template have been designed to elicit this information. To account for the time lags between responses and outputs and outcomes, these questions are asked for the short- and the long-term time horizons. Additional questions are designed to elicit further details about conditions that led to success, or to lack of success, and what constraints may have interfered with the response (see Appendix S1 for further details).

Typology

The third component of IMBER-ADApT is the development of a typology to translate and interpret the rich detail provided in the case-study template into a format useful for decision-makers. We use a multivariate statistical approach to develop the typology and classify the case-studies into groups of similar systems and responses. Specifically, the answers to key questions from the template are coded to categorical variables, to which multiple factor analysis (MFA), which is similar to Principal Components Analysis but appropriate for categorical variables, is applied to derive the typology. Here we use MFA from the R package FactoMineR (Husson *et al.* 2014).

Four of the sections from the case-study template (Appendix S1) are used to develop the typology: vulnerability, governance, response and appraisal. The information provided in the template is generally qualitative and in text format, which enables the rich detail required for decision-making, but makes objective analysis more challenging. Thus, qualitative responses are transformed and recoded into semi-quantitative responses on a 5-point nominal scale. The MFA is conducted using the coded responses from the vulnerability, governance and response questions, and then, the coded responses to the appraisal questions are mapped onto the resulting typology. A useful feature of the MFA is that it enables the analysis of variables both as individual variables (the questions in our case) and as groups of variables (here vulnerability, governance, response and appraisal).

An illustrative typology is provided using six case-studies from the authors of this paper (Table 1, Appendix S2). These case-studies include the major ocean basins, low and mid-latitude, and coastal and oceanic ecosystems and the issues range from mass mortalities of shellfish to distribution changes to industrialization and overfishing. The six case-studies separate into three clusters on the first two dimensions of the MFA (Fig. 2a), which account for 50% of the variance in the data

Table 1 List of case-studies used to develop the illustrative typology.

Case-study	Abbrev	Location	Species	Issue	Author
Bourgneuf Bay	BB_oyst	France	Oysters	High mortalities on oyster farms	P. Guillotreau
La Coronilla-Barra Del Chuy	Ur_clam	Uruguay	Clams	Mass clam mortalities	O. Defeo
US Pacific NW	US_oyst	USA-Pacific	Oysters	Ocean acidification	S. Cooley
Southern Benguela	BU_pela	Southern Africa	Small pelagic fishes	Distribution change	M. Isaacs
Tokyo Bay	TB_shrm	Japan	Shrimp	Industrialization	M. Makino
Spermonde Archipelago	In_reef	Indonesia	Coral reef	Overfishing	B. Glaeser

See Appendix S2 for more details.

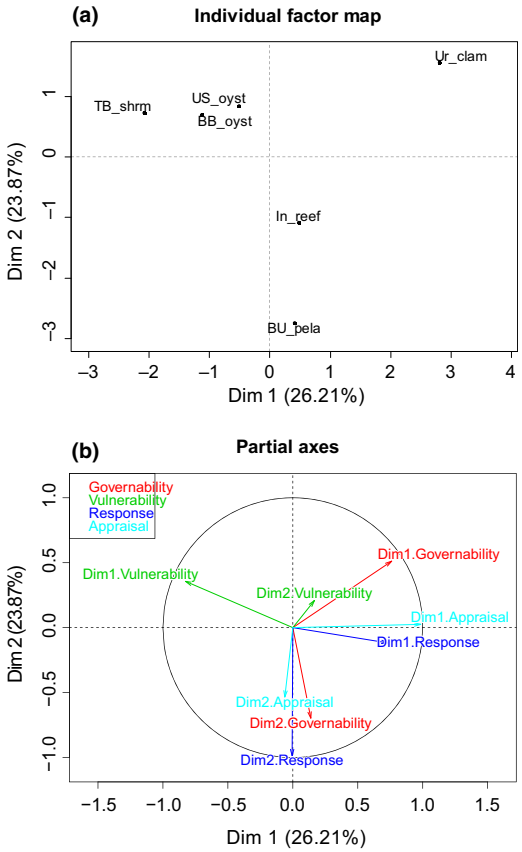

Figure 2 Multiple factor analysis (MFA) of six case-studies as an example of how a typology can be constructed which identifies groups of case-studies with similar features of vulnerability, governability, response and appraisal: (a) 3 clusters of case-studies represented in two dimensional space and (b) association of the 4 classes of questions (governability, vulnerability, response, appraisal) with the 2 dimensions of the MFA. Abbreviations identifying the six case-studies are defined in Table 1.

(a 3rd dimension (not shown) accounts for another 20%). Cluster 1 (comprised of Tokyo Bay shrimp (*Oratosquilla oratoria*), U.S. Pacific Northwest oysters (*Crassostrea gigas*) and Bourgnef Bay France oyster (*C. gigas*) case-studies; see Table 1) is separated from cluster 2 (Uruguay clams, *Mesodesma mactroides*) along dimension 1, and clusters 1 and 2 are separated from cluster 3 (Indonesian coral reef and southern Africa pelagic fishes) along the second dimension. Analysis of the groups of questions on these dimensions indicates that governance and response are associated with positive values of the 1st dimension and negative values of the 2nd dimension. Vulnerability is associated with negative values of the 1st dimension and negative values of the 2nd dimension (Fig. 2b). When the appraisal questions are mapped onto these results, they are associated most strongly with the 1st dimension (Fig. 2b) and attributes of governance and response.

Such a typology can also be used to examine which questions separate the clusters and, therefore, which may be of use to decision-makers. Cluster 2 is characterized by the global change issue being relevant at the local scale, increased participatory management and stronger co-management institutions with increasing numbers of rules, high productivity but some loss of species and with a variety of factors contributing to successful results in the long and short term. In contrast, cluster 1 is associated with the global change issue being relevant at the national scale, degraded systems with low productivity, some increase in number or diversity of key rules, some informal rules but no identifiable factors contributing to successful results. Cluster 3 is strongly associated with negative values on the 2nd dimension related to governance (informal rules, some coercion between different sectors, both input and output measures used to achieve management objectives and structural changes in the governing organizations), poor ecological status and limited short response with no long-term response.

These results demonstrate that the IMBER-ADApT case-studies can be grouped into different 'types', that is, a typology, which provides a first-order entry point to compare marine social–ecological resource crises to identify solutions which may, or may not, have worked elsewhere, and why. We recognize that six case-studies are far too few to fully develop the typology, but the brief results presented here are to demonstrate the concept and show emerging trends. In reality, as the typology is a statistical representation of the information provided in the case-studies, it will change somewhat as more case-studies are added, and become more robust, stabilizing at some future point, thus enabling end-users to easily identify a group of systems with characteristics similar to their own, from which they can derive guidance for their particular global change issue. We welcome additional case-study contributions to accelerate the development of the typology.

Links to decision-making and policy

IMBER-ADApT is designed to examine past decision-making choices and policy with a view to

advising future actions. It is not intended to be prescriptive, or encompass all possible responses, but offers stakeholders, decision- and policymakers a framework that will enable them to compare the challenges they face with respect to global change in their location and specific circumstances, with the lessons learned from other case-studies. A database of global case-studies with key system characteristics, responses, outcomes and key lessons is being developed as an open-access web application to help policy and decision-makers and stakeholders make hard choices and trade-offs in response decisions. The typology acts as a guide to the database, sorting through the case-studies, highlighting those that are similar to the case of the user and then crucially linking the user to the more detailed information in the database. A necessary step in the development of IMBER-ADApT is consultation with end-users to determine whether the database and decision-making components of the framework will meet their needs. However, as noted by Weichselgartner and Marandino (2012), knowledge production is not the challenge. Rather the use of the knowledge, and turning it into decisions and actions that lead to successful responses to global change, is the hard part. To this end, it may require involving end-users also as case-study providers to check that IMBER-ADApT is providing the information required. This level of engagement also implies the high potential that these stakeholders have to influence policy and decision-making. Ultimately, the utility of IMBER-ADApT is its contribution to timely and cost-effective policy and governing responses, as well as its offer of cross-scale learning for affected communities to help ameliorate, and eventually prevent, loss of livelihoods, food sources and habitat.

Conclusions

Although intended for global application, IMBER-ADApT does not gloss over heterogeneities in ecological, social or cultural context, governance or geography. Indeed, this diversity is essential to understand what conditions can lead to successful responses to global change. It approaches the question of how to best respond to global change from the perspective of the people experiencing the change, and synthesizes this knowledge into a learning platform (Weichselgartner and Marandino 2012). Critically, it includes an appraisal of responses, which generates knowledge-based solutions and lessons that can be applied to other situations. IMBER-ADApT will improve the information upon which future decisions are based and facilitate better learning from case-studies addressing issues related to fisheries at various scales and types of social and ecological systems. As outlined here, the focus of IMBER-ADApT is on fisheries; however, it has the capacity to be applied to a wide range of global change issues in both the terrestrial and marine realms.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Case study template for IMBER-ADApT.

Appendix S2. Case Studies used to develop the illustrative typology.