Chapter 2. Conceptual Framework

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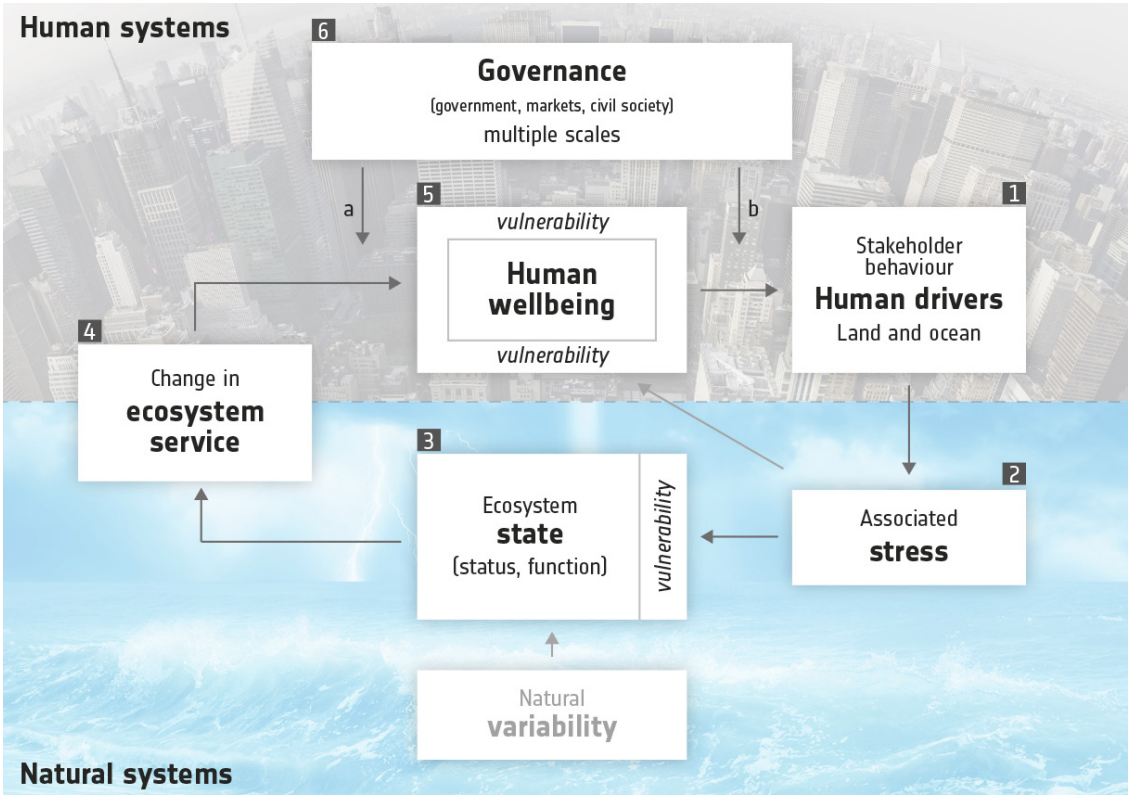
Conceptual Framework

2.1 Overall Conceptual Framework

The Conceptual Framework of the TWAP Open Ocean Assessment (similar to the TWAP LME assessment) displays the relationship between human and natural systems, to help identify why particular indicators are proposed and their relevance, where assumptions have been made, and where there are gaps in knowledge and data (Figure 1). The Framework draws on assessment efforts that focus on the idea of 'causal chains'. In short, human activities have associated stressors that in turn impact natural systems and this in turn affects the delivery (and value) of services to people (starting in Box 1 below and going clockwise). Ultimately the Open Ocean Assessment investigates how people are affected (Box 5 in bold), but these ultimate responses may not have easy indicators to develop and may take time, so there is value in having rapid 'early indicator' metrics that are earlier in the causal chain. Understanding and modelling this causal chain allows one to assess the relationship between indicators earlier in the causal chain while keeping in mind the ultimate goal.

Figure 2.1. Conceptual Framework for the Open Ocean Assessment, describing the relationship between human and natural systems from the point of view of ecosystem services and its consequences for people expressed as human well-being. Within TWAP this allows an identification of data sources and gaps, of assumptions made, of some factors peripheral to the central framework that may come into play, and of natural points of intervention for management.



Source: UNESCO-IOC and European Space Agency

The Framework tried to merge several existing conceptual frameworks: the Driving force-Pressure-State-Impact-Response (DPSIR) framework, indicator science, an emerging focus on ecosystem services, and cumulative impact modelling, all with a strong focus on governance and socio-economics - on how to manage the human-natural system interaction.

The top half of the diagram is the human system, the bottom half the natural system.

On the human system side, all the interactions between boxes were strongly mediated by socio-economic factors. Governance was defined broadly as including government, markets, and civil society, operating at global, regional, national, and local scales. Governance factors influence each other across scales, including through personal behaviour, and determine, for example, which people benefit from the delivery of ecosystem services (for example: equity) and what kinds of activities people engage in (regulations, social norms, etc.). One could reasonably and conceivably have indicators for any of these boxes, but the ideal indicators would connect directly to 'human well-being' (Box 5).

Effective governance is fundamental to achieving healthy ecosystems (inclusive of people), and in this context, should focus on sustaining ecosystem services (Box 4) in addition to other politically-negotiated goals. Governance affects the activities people pursue and with what intensity (Arrow b), and if or how value derived from natural systems reaches human communities and is or is not distributed equitably among community members (Arrow a).

On the natural system side, the framework concentrated on stresses associated with human activities (Box 2, which on the ocean side can come from both ocean-based activities like fishing and land-based activities like carbon emissions or plastics pollution), how they affect the state of the ecosystem under consideration (Box 3, modulated by the ecosystem vulnerability), which may lead to changes in the ecosystem services (Box 4, for example: fish catch). Finally, crossing the natural-human system boundary, the changes can lead to consequences for people, buffered or exacerbated by their vulnerability (surrounding Box 5). Natural variability, whether a regular seasonal change or more complex nonlinear interaction within the natural system, was evaluated separately from the interaction with the human system, so that the impact of a change in the human system - through a change in governance or

a particular GEF intervention, can be separately identified. It is also important to characterize natural variability in order to understand which ecosystem state changes require or can be subjected to management.

There are a few additional pathways depicted that were peripheral to this central framework, but should also be mentioned. Depending on the problem being examined, an associated stress may have a direct consequence for people without being mediated through an ecosystem service (Arrow connecting Box 2 to Box 5 directly), such as in the case of human-induced sea-level rise and its direct physical impact displacing populations.

While this conceptual framework identifies the protection of ecosystem services as the main pathway to mitigate consequences for people, under some other internationally-recognized value systems for management (protection of biodiversity, endangered species, natural heritage sites), the goal of management is not focused on sustaining ecosystem services but on directly conserving ecosystem state. In systems where thresholds might exist but uncertainty is *high*, and where future benefits are unknown, such a conservative approach has been politically negotiated.

2.2 Indicators in the Framework

The way that indicator science fits into this Framework is via the need to select indicators that serve specific prioritized needs'. Ultimately, the Open Ocean Assessment is aimed at improving human well-being, so that the long-term indicators that are assessed should focus on the human well-being and vulnerability box (Box 5). But all the preceding Boxes can give insights into likely outcomes for people, and often respond on much shorter time frames. Therefore, on the human system side, management goals and the reasons for wanting to track particular information was clearly articulated. Indicators were then, designed to meet these goals. Making clear all these assumptions and how directly or indirectly an indicator connects to the ultimate goal of the Open Ocean Assessment is critical so that there is a sense of the amount of uncertainty in how well indicator tracks the ultimate concern and whether the indicator is appropriately tracking a concern within the broader Framework.

The Framework allows and is useful for assessing the potential consequences of different management scenarios within a context of changing human activities and associated stressors (through the addition of new stressors and the changing intensity of existing stressors). A given management decision (or change in the intensity of a stressor due to other reasons) will lead to a changing suite of human activities and stressor intensities, which in turn will alter the attributes of the following boxes in the Framework. These changes can be predicted, and then monitored to test the validity of the predictions.

There is an implicit temporal component to this framework, in that it takes time to move from Box to Box, and the time it takes will vary depending on which human activity and which ecosystem service is of interest. For political and practical reasons, GEF may need to focus primarily on attributes within this framework that respond more quickly, but it is important to keep the longer timeframe and relevant consequences in mind, particularly for the large and common spaces of the open ocean.

Within the context of the TWAP Assessment, indicators for all elements of the human and natural systems cannot be developed - as the systems and their interrelationships on different time and spatial scales are complex. In this context, the Framework has brought clarity to the TWAP regarding where data is available to be captured in an indicator, and what assumptions are required to link this indicator with human wellbeing and societal impacts or benefits. In many cases for the open ocean, data on the state of the natural ecosystem is localized or non-existent, and we may know more about the stressor (for example: fishing) than the state itself.

In the context of future GEF interventions, the full Framework could be useful in determining the main points of intervention in the human system to help manage a positive outcome via the environment (the natural system). These assumptions and scenarios will have to be scientifically tested and validated.

2.3 Inventory and characterization of the open ocean—assessment approach

2.3.1 Thematic approach

The TWAP open ocean assessment is thematic, primarily because governance and management arrangements for the open ocean are largely thematic (IOC-UNESCO 2012).

This differed from the traditional approach to an assessment methodology, which is to divide the surface of the area of the zone to be assessed into polygons, assess the same quantities in each, and do a comparative analysis. This was the approach taken by the other components of TWAP (rivers, lakes, groundwater, and LMEs). In the context of a web of regional, national and local management arrangements that are place-based, this type of geographic assessment unit makes sense.

For the open ocean, this approach made less sense, for a number of reasons. As mentioned above, the management of the open ocean is multilateral and largely global and thematic. The ocean is also relatively deep, harbouring very different surface pelagic and benthic ecosystems for example. While they have some links, they are very different and cover distinct regions, as a recent biogeographical mapping exercise for the world oceans (Global Open Oceans and Deep Sea-habitats [GOODS]) shows[6]. Previously, many different assessment units have been used for the open ocean, but these were often political and non-homogeneous: the FAO fishing areas, the Regional Fisheries Management Organizations, the IMO high seas regions, the UNEP and non-UNEP Regional Seas Conventions and Action Plans, the Assessment of Assessment regions; others are more geographical and based on ocean variables, such as the ocean basins, surface wind-driven gyres, and Longhurst polygons[7] that identify key pelagic ocean ecosystems. Each of these assessment units were developed for a different purpose, and none specifically for the purposes of TWAP. Therefore, the Open Ocean Assessment approach in TWAP was for a global governance solution in both time and space that was projected onto local impact and variability.

2.3.2 Identifying key areas of concern

The assessment as far as possible developed mapping approaches for visualization of key indicators and natural and human system vulnerabilities, which directs geographic interest toward areas with current or future problems. Where relevant, scientifically-based projections identified future consequences under relevant scenarios.

In order to speak to a high level with a simple, clear, but scientifically grounded voice, the assessment was based on a small number of indexes or indicators. On the natural system side these words were often interchanged, but to avoid confusion a few definitions guided the process: *indicators on the natural system side* were defined as key natural system or stress variables, averaged over spatial scales of relevance, which helped track the state of the natural system or the stress placed on it. If there were *reference levels* put on these indicators, they reflected natural features intrinsic to the ecosystem and its response to stress. *Indicators on the human systems side* are generally associated with societal goals, are also key social system variables or a combination of variables averaged over the scales of relevance. If there were *targets* for these indicators, they often reflected a political process that has decided a societal goal. An *index* for the open ocean TWAP was a combination of these indicators that exposed the central question being asked, linking as far as possible the human and natural systems.

6 Vierros, M., Cresswell, I., Briones, E.E., Rice, J., Ardron, J. (Eds.), 2009. Global Open Oceans and Deep Seabed (GOODS) biogeographic classification. International Oceanographic Commission, IOC Technical Series No. 84. UNESCO, Paris, 87 pp.

7 Longhurst, A.R., 2006. Ecological Geography of the Sea, 2nd edition. Academic Press, NY, 560 pp.

Due to a lack of data about the natural systems in the open ocean, the assessment also pointed to gaps in observations, in scientific knowledge linking human stressors to changes in ecosystem state and services, and in the governance of human interaction with the open ocean. These allowed for a bridging between scientific exactitude and a management desire for simplicity, highlighting gaps in knowledge and uncertainty, and helped to define whether effective environmental management is possible based on the current state of knowledge.

The assessment was also based, for a number of themes and sub-themes, on expert assessment of the scientific literature. Some issues identified by the open ocean working group experts have *high* uncertainty but potentially *high* impact, with potential ecosystem thresholds, or in the case of governance issues, subjective judgments, and the only way to assess these was through expert judgment.

With the GEFs desire to identify the results of their interventions over time using repeat assessments – the approach used for the Open Ocean Assessment will to some extent help in doing this, but will be complicated by the fact that there are likely to be many actors in the management of the open ocean. Future assessments will have to respond directly to the question of the impact of particular GEF interventions by trying to identify specifically the indicators best suited to this purpose among those proposed here. Future elaboration of the Conceptual Framework will help with this.

2.3.3 Priority issues

The Open Ocean Assessment focused on four major themes, and two cross-cutting aspects on governance and the adequacy of observations and research:

- Climate change and variability in the global ocean, and global and local impacts, related to:
  - changes in temperature, stratification, and sea ice and their impacts on extreme weather, corals, and primary productivity,
  - rainfall and drought changes on land linked to the oceans,
  - ocean deoxygenation,
  - the fate of continued ocean CO_2 uptake,
  - ocean acidification.

- Ocean ecosystems, habitats, and biodiversity, in particular related to:
  - chlorophyll changes due to climate change and their downstream impact,
  - zooplankton changes,
  - pteropod changes (representative of polar ecosystems)
- Open-ocean fisheries
  - as a stress, including bottom fishing,
  - its sustainability, looking at the marine trophic index and projected catch potential, and tuna fishing trends
  - and its equity by looking at the distribution of fish catch value in the high seas.
- Pollution as a stressor of the marine environment, with indicators for
  - ship traffic as a proxy for ocean-based pollutants and stress,
  - plastics, focused on the convergent subtropical gyres,
  - and a clear need for a scientific literature-based assessment to address high uncertainty potentially high-impact issues.
- A cross-cutting governance assessment that looks at the policy cycle at the global level, and its links with regional and national arrangements.
- Underlying all: how adequate are the observational, understanding, and management/governance capabilities? This aspect of the assessment is of key value to the Intergovernmental Oceanographic Commission and the global ocean observing system.

In a thematic approach, the priority ordering of issues for the open ocean was not immediately evident at the commencement of the Assessment. This was addressed by tools for assessment of cumulative impact, which can geographically pinpoint estimates of the stresses on open ocean ecosystems (see Section 8).

2.3.4 Linking knowledge of human and natural systems for management

Ultimately, identifying where interventions should take place will depend on good monitoring and knowledge of the natural system side as well as the human system side. GEF is part of the human system and its interventions will be focused there - on improving governance to mitigate human activities that cause stress to key natural systems, and improving the resilience of human systems to reduce vulnerability. Both of these however will require a good understanding of the interactions and assumptions embodied by the conceptual model, which in turn will require scientific information and knowledge of both the natural systems and social systems.

The TWAP Open Ocean Assessment sought above all to interpret natural and social science with clear and understandable messages that will spark action for management of the environment.

The understanding of the human and natural systems are unavoidably imperfect, but taking a pragmatic approach, the results improve this understanding through scientific monitoring. The open ocean is under-observed and under-explored, and its full impact on present and future human society imperfectly known. However, this should not prevent GEF and others from acting despite this lack of information, as imperfect scientific information can still point to key concerns and management needs, and management goals can be refined iteratively as scientific understanding from research and monitoring improves. The governance of the open ocean is generally poor, and action is needed to prevent adverse consequences to people, and to the environment that provides key ecosystem services.

For the open ocean, a robust scientific support enterprise will continue to be needed to help GEF and others to have confidence that they are directing resources and energy correctly.

References:

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