UNEP WCMC

United Nations Environment Programme
World Conservation Monitoring Centre

# Lessons Learned from the Regional Perspective

**UNEP-WCMC contribution towards the identification of Ecologically and Biologically Significant Areas (EBSAs) in open ocean and deep sea environemnts**

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## 1.0 Introduction

The United Nations Environment Programme – World Conservation Monitoring Centre (UNEP-WCMC) has played a lead role in the development and analysis of a regional case study which contributes to understanding how Convention on Biological Diversity (CBD) scientific criteria for marine areas in need of protection can be applied collectively and mapped in one area of the oceans. This multi-criteria analysis (MCA) was undertaken in the Ross Sea region of the Antarctic and was conducted in collaboration with a group of scientific experts led by David Ainley, Senior Ecological Associate, H. T. Harvey & Associates. This document illustrates the insights and lessons learned through undertaking the MCA and provides key recommendations aimed at informing subsequent analyses at the regional scale. We expect that further regional analysis, including a pilot study in the Pacific region, can build upon this experience.

### 1.1 Importance of the Regional Perspective

The focus on the application of the CBD criteria at the regional scale is important for a number of reasons. The first is that the biological and ecological significance of an area is governed by marine processes which take place at large scales, including the influences of ocean currents, patterns of biological productivity, dynamics of species life history patterns, and the implications of transboundary threats.

Secondly, there is significant variation between oceanic regions in terms of their biological and physical aspects as well as their governance regimes. This biological and physical variability has led to the development of a number of global biogeographic categorisations of marine areas, for example, the Large Marine Ecosystems developed by the UNEP Regional Seas Programme and the Marine Ecoregions of the World developed by WWF. There is also significant regional variation in seascape-level policies and management, with different oceanic regions varying significantly in their capacity to establish and manage protective measures in the high and deep seas.

Thirdly, it is vital to take into account the regional scale when considering the planning of networks to promote the ecological coherence of these significant sites. The IUCN/WCPA definition for networks of MPAs[1] relates closely to the Scientific Guidance for selecting areas to establish representative networks of of MPAs, found in Annex II of the CBD Decision VIII/24. The importance of connectivity and representativity in these documents is clear and these aspects can only be achieved through planning at the regional level.

These considerations illustrate the importance of exploring the application of the CBD criteria and the integration of scientific data at the regional scale. In addition to reviewing the application of criteria at local and global levels, or looking at criteria individually, a regional perspective allows for the inclusion of differences acorss the biological and political mosaic of the high and deep seas. As wide-ranging species and

[1] A collection of individual MPAs or reserves operating co-operately and synergistically, at various spatial scales and with a range of protection levels that are designed to meet objectives that a single reserve cannot achieve (IUCN/WCPA, 2008).

broad-scale oceanographic features incorporate large areas, so must the review of criteria application and ultlimately the implementation of management and political regimes as well as cooperation.

**1.2 The Application of the CBD Criteria to the Ross Sea**

The Ross Sea provides an excellent study area for an MCA of the EBSA criteria due to the relatively high level of data and information available compared with other oceanic regions and the fact that its properties relate to all the aspects considered by the seven EBSA criteria (see **Table 1**). While it is noted that the Ross Sea is located within a nearshore environment, the area is beyond national jurisdiction, it has deep sea habitat, and the lessons learned from this process are valuable in contributing to further developments.

It is recognized that the Ross Sea is managed under the auspices of the Antarctic Treaty System, which has in Annex IV of the Madrid Protocol for Environmetal Protection its own set of criteria for the identification of "Antarctic Marine Specially Protected Areas" and "Antarctic Marine Specially Managed Areas". Also, fisheries are regulated pursuant to the Convention on the Conservation of Antarctic Living Marine Resources. Thus this exercise is not seeking to abridge the competence of the Antarctic treaty system, but is rather trying to extract useful lessons learned that can inform the parties to the CBD.

**Table 1**

| **Criteria** | **Relevance to Ross Sea** |
|---|---|
| Uniqueness/Rarity | – Unique continental shelf system in Antarctic in terms of spatial extent, shallow water (250-1200m), and distinctive currents.<br>– Unique evolutionary history of predominant fish species (benthic and water column radiation); 327 Antarctic fish spp. (28,000 global), Southern Ocean is 10% of global seas; 104 are endemic.<br>– Endemic killer whale species are present.<br>– Meets World Heritage selection criteria[2] (# 9 of 10), if sites can be designated outside of national jurisdiction. |
| Special Importance for Life History Stages | – Contains significant proportions of bird and mammal populations (i.e. 38% of all Adelie penguins; 26% of Emperor penguins; 30+% of Antarctic petrels; 6% of Antarctic Minke whales; estimated 50% of Ross Sea killer whales.<br>– Species life history patterns (breeding, moulting, and foraging) linked to ice cover, circulation, and benthic/pelagic coupling influences on productivity.[3] |
| Vulnerability, Fragility, Sensitivity or Slow Recovery | – Pack-ice ecosystems are very sensitive to climate change and becoming significantly reduced in the Antarctic.<br>– The organisms of the Ross Sea are all slow to mature, slow to grow and long lived; certain benthic creatures likely live on the order of hundreds to thousands of years, large fish to 50 years, penguins and seals to 20 years.<br>– Vulnerability of some species to acidification (e.g. haptophytes). |
| Importance for Threatened, Endangered or Declining Species/Habitats | – Identified as potentially the last area on Earth having a pack-ice ecosystem under current global climate change trends.<br>– Southern Hemisphere westerlies control the rate of global deep ocean ventilation.<br>– Localised species extinctions have been projected for 2050.[4] |

[2] to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals
[3] Proffitt, K.M. *et al*. 2007.
[4] Cheung *et al*. 2009.

| | |
|---|---|
| Biological Productivity | – The summer Ross Sea phytoplankton bloom is the most intense in the Southern Ocean leading to extreme primary production and nutrient uptake.<br>– Circumpolar Deep Water has biological impacts resulting from circulation driven by density in the western Ross Sea.[5]<br>– Penguin energetic requirements are linked to areas with high prey availability.<br>– The significance of the Antarctic Convergence Zones. |
| Biological Diversity | – Contains the last, largely intact continental shelf food web on Earth, with all its top predators, including predatory fish.<br>– One of largest global concentrations of marine birds.<br>– Sea-ice habitat importance as nursery areas for krill and other organisms; basal tropic levels.<br>– Seasonality - whales exit Ross Sea in winter. |
| Naturalness | – Ranked as the stretch of ocean least affected by anthropogenic impacts on Earth.[6] |

**1.3 UNEP-WCMC's approach**

To conduct the MCA of the EBSA criteria, UNEP-WCMC undertook the following process:

- Scoping meeting hosted by UNEP-WCMC at the Cambridge office in March 2009 brought together Antarctic experts from the UK and Europe.
- Discussions of the Antarctic process continued from April to May 2009, exploring the feasibility of undertaking such an analysis and how it could coordinate with and build-on existing work being carried out in the region.
- Attendence at a Ross Sea workshop at the International Marine Conservation Congress (IMCC) in May 2009 where discussions were held on how the CBD scientific criteria could be applied to the Ross Sea.
- Compilation of Ross Sea data sources, coordinated by David Ainley and Grant Ballard, was carried out in June and some preliminary data cleaning and standardisation undertaken.
- Presentation of insights into the regional application of multiple CBD criteria at the *Scientific Collaboration Meeting on Identifying Analytic Approaches for the Application of the EBSA Criteria adopted by the Convention on Biological Diversity* held at Duke University, June 29 – July 2, 2009.

## 2.0 Key Insights

The process of undertaking a regional MCA in order to identify EBSAs in the Ross Sea was met with a number of challenges. However, as with any novel approach, evaluation of these challenges provide valuable insights and lessons learned which will serve to inform subsequent CBD criteria application activities at the regional level. This section provides discussion of the key insights and challenges which require consideration when undertaking a regional analysis. Key recommendations which emerge from this discussion can be found in section 3.0.

**2.1 Scale**

Key questions:

- At what resolution are these criteria optimal?
- Can they be applied at all scales?
- How do they compare across different regions?

An important first step to delineating EBSAs using the CBD criteria is to define the scale at which ecological and biological significance will be defined. Through carrying out the Ross Sea analysis, it became apparent

[5] Smith et al. 2007.

[6] Halpern et al. 2008.

that the EBSA criteria are applicable and have relevance at multiple scales, from fine-scale analysis through to regional and global scales. It was also concluded that the criteria have different meanings at different scales; for example, a species which is rare at the regional scale may be highly abundant at the local scale. It is also important to consider that a scale defined as meaningful in one region may not be so in another, due to differences in oceanographic processes and biodiversity measures. To identify cross-scalar patterns of ecological and biological significance, analysis at several hierarchical scales is required so that congruence between the outcomes at each scale can be examined.

Temporal scale is also an important consideration when assessing ecological and biological significance. Both long-term (e.g. a community's food regime) and short-term (e.g. iceberg scouring) processes need to be considered as well as the effects of seasonality and longer-term climate cycles. An assessment of the availability and use of time-series data can be used to inform whether some areas are more significant than others or where confidence in the analysis can be considered stronger

Once areas of ecological and biological significance have been identified, decisions on the mechanisms utilised to protect these areas will also be based largely on considerations of scale. For example, localised and static benthic areas will require a very different protection mechanism than dynamic, large-scale processes which may require a paradigm shift in relation to protective measures. For example, terrestrial protected areas and existing marine protected areas tend to follow a model of fixed boundaries and flexibility according to specific dates or seasons at most. In the future scenarios for large-scale marine protection, it is likely that predictable oceanographic features will shift in space and time, thus requiring flexible strategies for identifying and enforcing protection.

### 2.2 Benthic-Pelagic Coupling

Key questions:

- How are these realms incorporated?
- How are three-dimensional processes included in the application?

Although there is a large body of evidence of ecosystem coupling between benthic and pelagic systems, there was much debate during our regional discussions on whether the two systems should be treated seperately in a regional analysis or as a whole. There are significant differences between the two - the benthic system primarily being a much more static and stable environment than the dynamic and turbulent conditions at the surface. Due to oceanic currents and other oceanographic processes, changing conditions in pelagic systems may affect benthic ecosystems a substantial distance away from the original location and there is often a considerable time-lag between impacts on one system affecting the other. Therefore, not only will the CBD criteria apply differently to the benthic and pelagic systems but techniques for monitoring will also differ.

Due to the aforementioned issues, the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) published a bioregionalisation of the Antarctic region in 2006 based on physical parameters.[7] In their analysis, CCAMLR treated benthic and pelagic systems seperately in terms of the analysis and the end-goals identified. Although the value of this approach was recognised, it was still considered desirable to treat the benthic and pelagic systems as a whole in the process of identifying EBSAs. It was suggested that one way in which this could be possible would be to identify areas where pelagic and benthic knowledge overlaps and use these as an example of how the ecosystem can be analysed as a whole; however, spatial and temporal lags would still need to be taken into account.

When pelagic and benthic systems are considered together, there are also inherent challenges related to the visualation of the outcomes of the MCA in a way which will be meaningful for non-technical experts in the policy forum. Traditional visualisation tools which present two-dimensional mapping will not be able to convey the complexities of the coupled oceanic environment. Innovative tools will need to be developed in order to effectively convey the findings of any regional analysis. Three-dimensional mapping and analysis, which is underway in some spatial labs, is a positive new direction for dealing with this issue.

[7] Add reference here

**2.3 Threats**

Key questions:

- To what extent can threats be incorporated into the initial EBSA identification stage rather than in the subsequent planning and management stages?

The impacts of threats on the potential EBSAs being identified formed a critical part of the discussions at the Scoping Meeting held at UNEP-WCMC in March. Participants suggested adding two more columns to the CBD criteria table presented in Annex I of the CBD Decision VIII/24 to address: i) what the areas were in need of protection from; and ii) policy recommendations concerning protection and management for these areas. Threats in the open oceans and deep seas are often dynamic and transboundary, such as climate change and alien invasive species, and so will require protective measures which can be managed adaptively.

It was concluded that for this initial stage of identifying *EBSAs* rather than identifying potential sites for protected areas, all current and future threats, as well as potential high seas MPA designations and management types, should not hold bearing on this part of the analysis which should focus purely on the identification of significant areas. However, it was recognised that it will be important to consider these issues in the next stages of the CBD process.

**2.4 Data Considerations and Gaps**

Key questions:

- What data should we use?
- How do we account for confidence in the data?
- Can we apply proxies to the entire ocean?

To meaningfully identify EBSAs within a region, caveats in both the quantity and quality of data must be addressed. Scientifically informed decisions are needed to identify which of the available datasets most appropriately represent each of the criteria and how these seperate data layers can be combined to provide a cumulative, robust outcome.

For species data, decisions need to be taken on the level of data used. For example, there are over 8,500 species known to exist in the Antarctic, thus, should we study each individually or should we group them to the community level? This decision may differ depending on the criteria being applied or the specific question being asked. Temporal variations in both physical and biological data need to be taken in account, i.e. seasonal variations in productivity or life-history stages of migratory species. Data which is representative of annual variability and preferably longer time-scales is necessary for understanding these dynamics, and anecdotal or historical data should also be sought to increase the reliability of the MCA.

Biological datasets for the open ocean and deep seas are plagued by data gaps and disparities in sampling efforts which significantly impact confidence levels. Knowledge is highly disproportionate; for example, the most complete datasets are available for shallow species whereas many benthic and deep-sea species are still being discovered. Life history data is often patchy, benthic life history data is practically non-existent, and in some instances only seasonal data is available; this is especially true for the Southern Hemisphere where data collection takes place typically only in summer. Resolution of datasets vary significantly: habitat data is often available only as coarse resolution and datasets such as species migratory movements are of too fine a scale to reliably generalise behavioural patterns. These differences in resolution make the cumulative analysis of different data layers difficult.

Sampling effort emerged as one of the most important considerations of dataset interpretation and analysis. The majority of the open oceans and deep seas have not been sampled for biological data and most datasets represent only species presence rather than both presence and absence, an important factor in reliability of information. Some localised areas have been subject to a significant amount of sampling, e.g. in the locality of a designated research station, and so a large amount of data is available for a relatively small area. These highly sampled areas can disproportionately increase the apparent ecological significance of an area even though it is  merely a result of the confounding impacts of sampling effort.

Data gaps can be illustrated fairly simply, and this will be a vital part of the presentation of the MCA in order to provide meaningful and robust recommendations. Communication with the orginal data providers will be imperitive to thoroughly understanding the datasets being analysed and therefore being able to accurately convey the results.

Due to the vastness of the open ocean and the significant gaps that exist in our knowledge, it is necessary to extrapolate from what we do know and develop proxies of ecological and biological significance. It is vital that these proxies are as robust as possible to ensure well-informed decision making and caution should be taken in their development. Challenges include the need to define threshold levels of what is significant and what is not, and the need to consider non-intuitive patterns, for example oceanography or behaviour,  which will not be detected through the modelling process. To overcome some of these challenges the best available scientific data must be used and models should be able to be continuously updated as new information comes to the fore. The validation of proxy models through ground-truthing, modelling and other means should also be undertaken. It is likely, due to the inherently variable state of the ocean that "one proxy cannot fit all" and that  a proxy which is suitable in one region is not in another, or that the significance threshold of the proxy will need to be redefined.

It is also interesting to note that, once developed, the proxies themselves also have inherent gaps in coverage. These can be exemplified by examining existing proxy methodologies. For example, bioregionalisation does not include data on biodiversity, biogeography lacks coverage abundances, models of community structure have poor taxanomic resolution and biases based on bycatch, and details of habitats, key species, and processes are often absent. Therefore, when applying the EBSA criteria, there is a great need to combine these techniques into a holistic, ecosystem approach in order to provide as complete an understanding as possible to best inform decision making.

### 2.5 Collaboration is critical

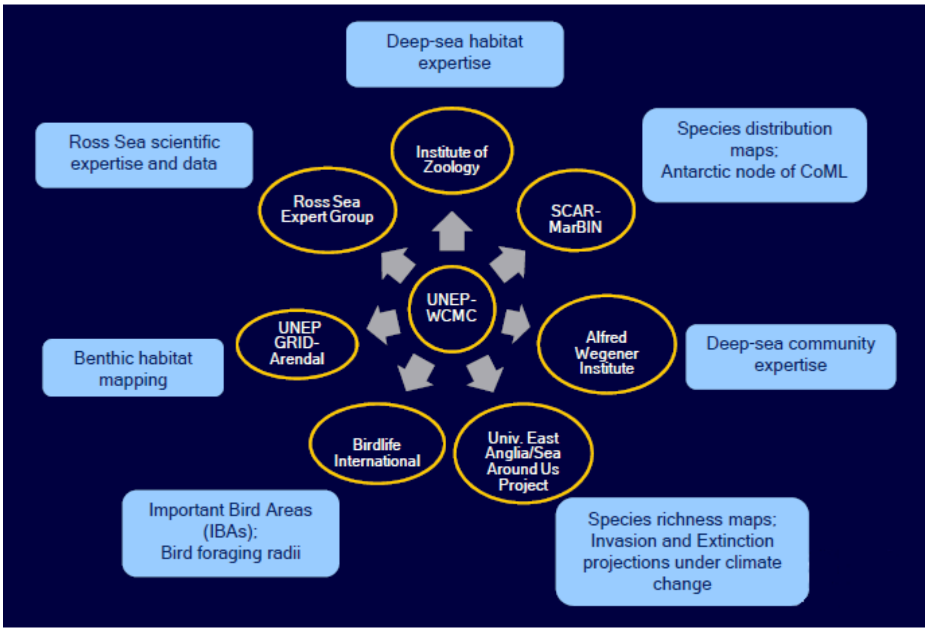
Key questions:

- Who are the partners that we should engage in this process?
- How do we access critical information which is unavailable for various reasons?

There are a number of actors across a wide range of sectors to whom the CBD criteria and guidance has relevance. However, for this first stage of using scientific criteria in order to *identify* EBSAs, there is little need to engage with those organisations which will be more involved with the management aspects of the subsequent stages, for example, the fishing and shipping lobbies. At this first stage, collaboration with scientific experts, managers of regional databases, individuals with understanding of the region's political landscape, and with representatives of those organisations who are already conducting similar work within the region, is critical from the outset in order to ensure the process is scientifically-led and that it complements and coordinates with existing activities as much as possible to ensure resources are used with optimum efficiency. **Figure 1** illustrates the range of partners UNEP-WCMC have worked with whilst undertaking the Ross Sea MCA.

Data inaccessibility is another key issue which must be considered. Satellite derived physical datasets, such as sea surface temperature and productivity, are often widely available in various spatial resolutions and temporal bins. In contrast, biological datasets such as fisheries data or satellite telemetry of migratory species movements are often not easily accessible. This can be for a range of reasons, for example political sensitivity - as in the case of fisheries data – or because it has not yet been published by the scientists who manage it. This inaccessibility can form a significant obstacle to the completion of the MCA, negatively impacting both the reliability of the outcomes and the resources required. Collaboration with scientists is often key to accessing these datasets, demonstrating how the process will be mutually beneficial by adding value to the dataset, perhaps by undertaking analysis that the data provider doesn't have the time or resources to do themselves, whilst also fully acknowledging the data provider's participation. In addition to these collaborative efforts, it is also important to promote the need for data sharing and the mechanisms which can facilitate this, such as the online data facilities managed by the Census of Marine Life's Ocean Biogeographic Information System (OBIS) and the Duke Marine Geospatial Ecology Lab and data visualisation tools such as the High Seas Viewer currently under development by UNEP-WCMC.

**Figure 1: Schematic of collaborations undertaken through the Ross Sea multi-criteria analysis**




## 2.6 Project Timeframe

<u>Key questions:</u>

- What is the optimum timeframe for undertaking a multi-criteria regional analysis?
- How do the results differ if the analysis is carried out rapidly as opposed to more comprehensively in the longer term?

Lack of time and resources represented one of the key hindrances we experienced in attempting to undertake a multi-criteria analysis in the Ross Sea. Due to the issues of data inaccessibility described above, the time required for sourcing data for the analysis should not be underestimated as it often requires the development of new relationships with individuals and organisations with which one has not previously worked. Once a dataset is in-house it needs to undergo a significant period of cleaning and processing so that it can be combined with other datasets from disparate sources with differing resolutions in a single MCA. This process requires the dedication of a skilled individual(s) for a number of weeks and will almost certainly require ongoing dialogue with the data provider. Following this stage of dataset preparation, statistical analysis then needs to be employed to take account of sampling effort and any data gaps as discussed in Section 2.4. Again, this will require input from the data provider and may also require the time of a specialist statistician to ensure accurate data interpretation.

The undertaking of the MCA following these data preparation stages also represents a lengthy process requiring significant resources. As the datasets originate from a range of sources which represent very different variables, complex algorithms and modelling will be required in order to create interoperability between the datasets so that they can be meaningfully overlaid and conclusions developed regarding areas of ecological and biological significance. This process may require outsourcing to a specialist data modelling group with the experience and software needed to carry out such a task.

Our experiences suggest that the completion of an MCA needs to be a viewed as a long-term goal which requires a significant amount of dedicated resources. Of course, we recognise the values of the precautionary approach and the urgent need for action to be taken with the best available data;however, as our knowledge and work in this area builds, it will be ciritical to look at the variations in results between short-term, rapid analysis and a more thorough, longer-term analysis. Where possible,we feel that enough time and resources should be made available to provide the most robust recommendations possible.

## 3.0 Recommendations

Through the evaluation of our experiences in undertaking the Ross Sea regional MCA described above, we have identifed key recomendations which will play a valuable role in informing subsequent regional applications of the EBSA criteria.

1. **Perform the MCA at a hierarchy of scales within the region being studied**. This will provide insights into the relevance of each of the criteria at different scales, the confounding influences of scale upon the results, and also insight into which areas are consistently identified as ecologically and biologically significant irrespective of scale effects.

2. **Consider the complexities of representing benthic and pelagic systems as a singular ecosystem in terms of analysis and visualisation.** Explore the possibilities of using well known examples of areas with benthic-pelagic coupling to inform the MCA in the interim between more scientific knowledge being made available. These case studies can also be used to inspire novel techniques for displaying the results of the MCA which takes into account the three-dimensional nature of marine ecosystems and the potential spatial and temporal lags that exist between the benthic and pelagic systems.

3. **Focus this initial stage of the process on *identifying* EBSAs rather than trying to incorporate data on threats and specific management needs.** The CBD criteria make a distinction between 'Ecologically and Biologically Significant Areas' and 'protected areas' and experts should not allow their knowledge of threats and policy or management challenges to influence the scientific process of identifying EBSAs. These outside considerations will form an important component of the second stage of the process when the feasibility of protecting the identified EBSAs is examined.

4. **Dialogue with data providers is vital to ensuring accurate representation of information.** Due to the inherent gaps in open ocean and deep seas datasets, and the disparities in methodologies and sampling effort, communication with the original data providers is necessary to ensure the accurate representation of the data in the final analysis.

5. **Validation of data and models must be carried out where possible.** To overcome some of the above described challenges concerning confidence in the data and the subsequent models, validation through ground-truthing, modelling and other available means is necessary. When available, time-series datasets which account for annual and seasonal variability, as well as anecdotal or historical data, should be used to assess the validity of data and model ouputs. Models should also be built flexibly so that the new, more robust datasets can be easily incorporated as they become available.

6. **Develop proxies and indicators for ecological and biological significance which can be adapted to account for scale and regional variability.** There are a number of possibilities for creating proxies and indicators from data which is currently available. For example, prey species occurence can be extrapolated as an indicator for species higher in the food-chain or the presence of ocean fronts, data from genetic barcoding may act as a useful proxy for marine genetic diversity, or species habitat preferences can be used to model predicted distributions. When developing these proxies, it will be necessary to consider the need to adapt to changes in scale and regional variability, i.e. by creating a dynamic threshold at which the proxy is defined as representing ecological and biological significance.

7. **Collaboration at an early stage is critical to inform approaches for the MCA, leverage of data and information, and coordination with existing activities to ensure optimal resource use**. We recommend that a regional workshop which brings together scientific and policy experts, data managers, and organisations conducting environmental protection work in the region, is held at an

early stage in the MCA process. This provides the opportunity to explain the wider, political context of the work in relation to the CBD and to foster collaborative partnerships. A number of smaller, more focused, technical meetings may also be required throughout the MCA process.

8. **The timeframe of the project needs to be realistic in terms of the end-goals to be achieved.** Conducting a scientifically rigorous MCA for the regional identification of EBSAs will require a significant amount of time and resources for a number of reasons including the inaccessibility and disparate nature of the data, the complexity of the analysis due in no small part to the inherent complexity of marine ecosystems, and the extensive collaborative links that need to be made. It is therefore important to establish sustainable funding streams and allocate a realistic time-frame in which to conduct the analysis.

## 4.0 Acknowledgements

UNEP-WCMC would like to thank those participants who have contributed to the workshops and discussions during this regional analytical process. The United Nations Environment Programme kindly provided supplementary funds to allow the time to consolidate the lessons learned from this process to date. We also acknowledge Defra for their financial support to participate in meetings and the development of products which are relevant to the Convention on Biological Diversity's work in marine protection of the open oceans and deep seas. Lastly, the partners in this collaborative project who have provided valuable insights throughout the process include IUCN, Marine Conservation Biology Institute, the CBD Secretariat, and the Duke University Marine Geospatial Ecology Lab.