

Proposal of a New SCOR Working Group

1. Title: Deep-sea biodiversity Patterns of the South Atlantic Ocean

2. Background and Rationale

The deep sea is the largest continuous ecosystem of the planet, but also the least explored and understood. The traditional perception was that it comprised vast, remote, life-poor, and stable environments, isolated from other ecosystems and not affected by global-scale changes. However, it is now understood that deep oceanic waters can be diverse and productive. Some deep-sea habitats (especially ridge and seamount features) can host concentrations of commercial fish stocks, influence distribution of surface predators including tunas and whales, and may also contain minerals and resources with potential for seabed mining. Yet, studies have demonstrated that life in the deep ocean is vulnerable to the effects of climate change and human economic activities including fishing and mining. There is a pressing need to further describe, understand, and monitor such environments to determine human-induced and natural changes in the future.

Research under the umbrella of the Census of Marine Life (CoML) between 2000 and 2010 has highlighted that deep-sea habitats are not isolated, yet are connected in both horizontal space and dynamically linked to the water column (McIntyre, 2010). For example, seamounts in several areas of the world have similar faunal composition to ridges, canyons, and adjacent slope on continental margins (e.g. Rowden *et al.*, 2010; Menot *et al.*, 2010), although there is evidence that the structure and relative abundance of such communities may differ (e.g. McClain *et al.*, 2009). There can also be clear faunal breaks along mid-ocean ridges (Vecchione *et al.* 2010). These findings highlight the importance of understanding biogeographic patterns, and mechanisms of dispersal and connectivity whereby faunal communities in such habitats are linked across a range of spatial scales. Such understanding is an important input to aiding effective management of deep-sea resources to balance sustainable exploitation (fishing, mining, bioprospecting) and conservation of deep-sea ecosystems.

Oceans of the southern hemisphere have been much less researched and sampled than the northern hemisphere, especially the South Atlantic. The South Atlantic Ocean is the newest of all major oceans, formed by the separation of South America and Africa 175 – 90 million years ago, and is the only ocean basin to be directly connected to all of them (Levin and Gooday, 2003). It is also economically important as it sustains a large portion of the Atlantic pelagic (i.e. tropical tunas) and seamount fisheries. Despite its size and physical role in the world ocean ecosystem, our information about aquatic organism deep-sea diversity and distribution is scarce and mostly inferred by comparison with the North Atlantic.

Although the mid-ocean area is poorly known, there are a number of historical and very recent datasets that can contribute to a new analysis of biodiversity patterns in the region. In 2006 the South Atlantic MAR-ECO project was established to develop a strategy, based on the North Atlantic MAR-ECO (CoML) approach, to undertake a biological sampling program, spanning microorganisms to whales, capable of (a) collecting comprehensive new data on South Atlantic deep pelagic and benthic diversity, and (b) developing new understanding of the deep-sea habitats and biodiversity between South America and Africa. Based on such new information needs for conservation as well as sustainable use of its resources would be identified. A significant survey took place in November 2009 using the R/V Akademik Ioffe through a collaborative effort between the CoML project MAR-ECO and the Shirshov Institute of Oceanology (Academy of Sciences, Russia). During a 34-day cruise from Gran Canaria Island

(Spain) to Cape Town (South Africa), a team of scientists from Brazil, Uruguay, Russia and New Zealand conducted pelagic and benthic sampling events up to 4.7 km deep over areas of the southern Mid-Atlantic Ridge and the Walvis Ridge. Results are still preliminary and considerable effort is still required to process all biological samples. However provisional results indicate the survey collected approximately 1,120 records of organisms included in 175 fish taxa (Kobyliansky *et al.*, 2010), 50 cephalopods and over 200 benthic invertebrate species (Ascidiacea, Annelida, Porifera, Crustacea, Mollusca and other groups). Additional deep water diversity datasets from both South American and African continental margins and several seamounts have become available and were considered during a recent meeting of regional and international experts promoted by IOC-UNESCO (“Understanding deep-water biodiversity in the South Atlantic: options for conservation and sustainable use of resources in the high-seas”, 7-8 April, Paris, France). These include data from historical cruises conducted by Russia and France between the 1960s and 1980’s (e.g. IFREMER “Walda” and “Walvis” cruises in Southeast Atlantic) and more recent initiatives such as (a) the Brazilian REVIZEE and the Spanish ATLANTIS projects in the Southwest Atlantic continental margin, (b) the joint Spain-Namibia cooperation project and IFREMER’s Biozaire Project in the Walvis Ridge and Southeast Atlantic continental margin, and (c) the ongoing NOC Southampton deepwater camera survey in the Southern Mid-Atlantic Ridge (UK Atlantic Meridional Transect). Particularly important is the likelihood of acquiring new samples and information on midwater and benthic biodiversity of the seamount and ridges of the deep South Atlantic from new work planned by Brazil (e.g. MCT-III Commission of the R/V *Cruzeiro do Sul* to the Rio Grande Rise, June 2011) and other countries in 2011 and 2012.

These existing datasets, and the further planned sampling opportunities, create a new basis to address a number of scientific questions about deep-sea biodiversity patterns of the South Atlantic, including:

- Are the faunal communities of the Mid-Atlantic Ridge and seamounts related to and part of broader deep South Atlantic environments?
- Is the mid Atlantic ridge fauna different from that of continental margins?
- What are the environmental drivers of faunal composition and abundance (e.g. is there a relationship between surface production and abundance; do the physical ridges in the South Atlantic provide linkages or obstacles to faunal communities)?
- Is the MAR different from other ridge systems in the southern hemisphere?

Addressing these questions will fill critical gaps of knowledge on the deep South Atlantic Ocean, its biodiversity patterns and connectivity with other deep areas of the southern hemisphere. The results of this work will also be relevant to activities and processes carried out in the South Atlantic by (a) regional fisheries management organizations, principally SEAFO (Southeast Atlantic Fisheries Organization) and ICCAT (International Commission for the Conservation of Atlantic Tuna), (b) other international fora such as CBD (Convention on Biological Diversity), ISA (International Seabed Authority), FAO (UN Food and Agriculture Organization), and (c) international scientific initiatives such as INDEEP (International Network for Scientific Investigation of Deep-sea Ecosystems).

SCOR promotes international and multidisciplinary collaboration towards oceanographic research, and a comprehensive biodiversity study in the South Atlantic would be timely and relevant. There are significant science gaps to be filled. Furthermore, the South Atlantic Mid-oceanic ridge and related seamount chains are prominent structures of the deep seafloor that lie mostly outside EEZs of coastal countries, implying that commercial exploration, conservation

and research initiatives have essentially been multinational and/or international enterprises. While the South Atlantic will be the location focus of the proposed working group, concepts and ideas that result will be applicable and comparable with other southern hemisphere mid-ocean ridges and deep-sea habitats.

3. Terms of Reference

- 1) To synthesise existing data on biodiversity of mid-ocean environments (associated with ridges and seamounts) in the South Atlantic Ocean.
- 2) To identify knowledge gaps and promote networking activity to explore opportunities for research of South Atlantic mid-ocean habitats.
- 3) To analyse and update descriptions of biogeographical patterns in the deep South Atlantic Ocean using new mid-ocean data, comparisons with continental margins and deep basins, and existing data from other southern hemisphere systems.
- 4) To coordinate the process of entry of existing and future South Atlantic data into the Ocean Biogeographic Information System (OBIS) and other appropriate databases (e.g., FAO VMEs (Vulnerable Marine Ecosystems), GOBI EBSAs (Global Ocean Biodiversity Initiative - Ecologically and Biologically Significant Areas), and Geology of the South Atlantic Ocean – GIS).
- 5) To provide appropriate information products to aid management of resources in the South Atlantic.

4. Timeline for activities:

Year 1:

Collate and synthesize existing biodiversity data
Identify gaps in data and knowledge
Identify priorities for new studies

Product: Report on available data, gaps and priorities.

Year 2

Update and incorporate new biodiversity data
Biogeographic analyses (South Atlantic deep habitats comparison)

Product: Report on initial biogeographic analyses
Plan for future analyses and publication of results (e.g. journal special issue)

Year 3

Update and incorporate new biodiversity data
Biogeographic analyses, both South Atlantic and other oceans of the southern hemisphere

Product: Final entry of new data into international databases (e.g., OBIS)

Year 4

Final synthesis of knowledge

Product: Set of scientific publications synthesizing biodiversity patterns in the South Atlantic. Provision of scientific advice to environmental and resource management bodies

5. Working Group Composition

Proposed Full Members

Name	Affiliation	Country	Expertise
José Angel Alvarez Perez <i>(proposed chair of the group)</i>	Universidade do Vale do Itajaí	Brazil	<ul style="list-style-type: none"> • Chair of the South Atlantic MAR-ECO project Steering Group • Cephalopod taxonomy and biology • Deep-water fishery
Andrey Gebruk	Shirshov Institute of Oceanology	Russia	<ul style="list-style-type: none"> • Benthic invertebrates • Biogeography
Irene Cardoso	Museu Nacional do Rio de Janeiro	Brazil	<ul style="list-style-type: none"> • Crustacean taxonomy
Luís Abellán	Instituto Oceanográfico Español	Spain	<ul style="list-style-type: none"> • Seamount ecology • Deepwater crustaceans
Tone Falkenhaug	Institute of Marine Research	Norway	<ul style="list-style-type: none"> • Zooplankton ecology
Malcolm Clark	National Institute of Water and Atmospheric Research	New Zealand	<ul style="list-style-type: none"> • Member of the INDEEP Steering Group • Seamount ecology and fisheries • SW Pacific deep-sea habitats
Rudi Cloete	National Marine Information and Research Centre	Namibia	<ul style="list-style-type: none"> • Member of the Scientific Committee of SEAFO • Deep-sea fisheries
Wayne K. Florence	Iziko South African Museum	South Africa	<ul style="list-style-type: none"> • Marine Invertebrates • Bryozoan Systematics • SABIF (local GBIF node) steering committee member
Ricardo Serrão Santos	Universidade dos Açores	Portugal	<ul style="list-style-type: none"> • Seamount, island and ridge ecology • Deepwater Fish
Claudia Silvia Bremec	Instituto Nacional de Investigación y Desarrollo Pesquero	Argentina	<ul style="list-style-type: none"> • Benthic invertebrates, • Biodiversity

Provisional list of Associate Members

Name	Affiliation	Country	Expertise
André O.S. Lima	Universidade do Vale do Itajaí	Brazil	<ul style="list-style-type: none"> • Microbiology and Bioprospection
Alexey Orlov	Russian Federal Research Institute of Fishery and Oceanography	Russia	<ul style="list-style-type: none"> • Deep-water fish
Débora Pires	Museu Nacional do Rio de Janeiro	Brazil	<ul style="list-style-type: none"> • Deep-water corals
David Billet	National Oceanography Center	UK	<ul style="list-style-type: none"> • Deep-sea ecology • ISA LTC member
José Henrique Muelbert	Federal University of Rio Grande	Brazil	<ul style="list-style-type: none"> • Ichthyoplankton • Physical-Biological Oceanographic Processes
Luiz Fernando Loureiro Fernandes	Universidade Federal do Espírito Santo	Brazil	<ul style="list-style-type: none"> • Zooplankton
Odd Aksel Bergstad	Institute of Marine Research	Norway	<ul style="list-style-type: none"> • Demersal fish ecology • Mid-ocean ridges
Tim O'Hara	Museum of Victoria	Australia	<ul style="list-style-type: none"> • Lead of INDEEP biogeography working group • Brittle star taxonomy and ecology
Dylan T. Clarke	Iziko South African Museum	South Africa	<ul style="list-style-type: none"> • Marine Fishes / Invertebrates • Polychaete Systematics • Large Pelagics Fisheries
Patricio Arana	Universidad Católica de Valparaíso	Chile	<ul style="list-style-type: none"> • Deepwater fisheries • Seamount ecology
Alex Rogers	University of Oxford	UK	<ul style="list-style-type: none"> • Deep-sea ecology • SW Indian Ocean biodiversity
Natalia Venturini	Universidad de la Republica	Uruguay	<ul style="list-style-type: none"> • Benthos diversity and ecology
Luciano Fonseca	Intergovernmental Oceanographic Commission	France	<ul style="list-style-type: none"> • South Atlantic high-seas research and conservation

6. References

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