

The Aim of this Review Paper

- One of a series of reviews (one from each Challenger 150 regional working group) the purpose of which is ultimately to be of use to identify data gaps to help prioritize future research and to inform management
- The Ocean Decade wants science to support sustainable development, thus these reviews need consider political and management based boundaries. Management is by political means, not ecological, thus this needs to be different from pure biological/ecological reviews
- Focus on biodiversity as Challenger 150 is a biology/biodiversity programme
- Need to focus on what is NOT known - gaps, rather than what we do know. Reviewing everything that is known about the North Atlantic is not possible!

Geographic Scope

Deep waters of the North Atlantic, Caribbean Sea, Gulf of Mexico

- Bounded in the North by the ridge that keeps Arctic waters out of the North Atlantic, i.e., a biological boundary
- Bounded in the South by a line from the entrance to the Mediterranean (the Mediterranean Sea is excluded) to the Southern boundary of the Caribbean, although including European island groups slightly to the south of this latitude (e.g., Madeira, Canaries, Azores).
- includes all ABNJ

A pragmatic (and potentially regional) approach can be taken to depth. Where there are very few data, those from the shelf break might be included, but where data are abundant, an upper slope threshold (e.g., 500 m) could be more appropriate.

A team (led by Kerry Howell's group, supported by Hanieh Saeedi) is prepping data for a spatial "gap analysis" drawing data from OBIS, GBIF, and DATRAS. Where data are in local databases, make contact with the data prep group to discuss the feasibility of inclusion. The best solution in all cases (where politically acceptable) would be to add these records to global databases to make them widely accessible. Data will be cleaned from 30 m depth downwards, as it has been for the South and Central Atlantic Review, but should be further filtered in different regions as noted above.

Outline paper Structure

1 Introduction

Aims and scope of review etc.

- Ocean Decade context, including origin, role and scope of Challenger 150;
- complementarity and role of other Ocean Decade programs such as Marine Life 2030;
- highlight challenges in approach, encourage use of standards for data management to enable periodic assessments

(repeat some of this in conclusion)

2 Geographic Setting

Include relevant maps, and place in a global context. Include an areal percentage representation of EEZ and ABNJ by nations?, i.e. E Caribbean SIDS have >65% water territory, most of it is deep ocean

2.1 Topographic setting

2.2 Oceanographic setting

Section should include deep ocean currents, sediment/bottom type, productivity, and potential carbon flux estimates

3 Historical Overview

From around 1850 onwards, so as to capture early expeditions such as Porcupine/Lightning and the discovery of Monterey Canyon etc.

3.1 Global / transatlantic expeditions

3.2 Eastern Atlantic expeditions

3.3 MidAtlantic Ridge expeditions

3.4 Western Atlantic expeditions

3.5 Caribbean expeditions

3.6 Gulf of Mexico expeditions

3.7 Summary of Effort

This would include heat maps to show where areas have been visited multiple times. Also might include effort maps versus available data to highlight areas where no open access data are available and to highlight the importance of Open Science.

4 Spatial analysis of research activities to date

(Need to agree data sources: include OBIS, GBIF, Datras, GRIIDC database (<https://data.gulfresearchinitiative.org/>). Other suggested databases include UNINMAR, UNIBIO, and CONABIO. Data team will liaise with others familiar with these databases to assess feasibility. Using DarwinCore is likely a prerequisite.

There is a need to capture several aspects of the available data – e.g., if assuming spatially represented by rasters, then number of individual expeditions per grid square, as well as number of biological records per grid square are important metrics. Suggested cell size is at minimum 10 km x 10 km. Data team can adjust to best fit/represent available data

4.1 Effort per grid square

4.2 Data per grid square

5 Summary of broad-scale biodiversity patterns and ecosystem function by feature

These need to be considered in a global context. I.e., esp. if the North Atlantic is globally significant for any given feature.

5.1 By Feature

- 5.1.1 mesophotic reefs
- 5.1.2 sandfalls
- 5.1.3 carbonate mounds
- 5.1.4 continental slopes
- 5.1.5 canyons
- 5.1.6 seeps
- 5.1.7 asphalt volcanoes
- 5.1.8 hydrothermal vents
- 5.1.9 organic falls (e.g., whale and wood)
- 5.1.10 seamounts
- 5.1.11 abyssal plains
- 5.1.12 trenches
- 5.1.13 mesopelagic
- 5.1.14 bathypelagic
- 5.1.15 abyssopelagic
- 5.1.16 hadopelagic
- 5.1.17 ridges (including MAR)

5.2 Temporal data

5.2.1 LTER (Long Term Ecological Research) Sites

For example, sites with >20 year observation; other time series (CARIACO, BATS, Cape Verde etc) (although many / most don't look at benthos organism)

5.2.2 Other temporal datasets

For example, areas that have been deliberately resurveyed after a considerable time gap and show biological change (e.g., the *Pheronema* field in the Porcupine Seabight)

6 Summary of human activities

[in the context of sustainable development and possibly unsustainable practices]

Since management tends to be sectoral, this section is arranged by activity rather than pressure. It is not intended to include any new analyses, rather simply review published literature. It should draw on, and point the reader towards, other reviews wherever possible so as to be concise. It is a "summary" of human activities only, and the size of the section should reflect that.

6.1 Fishing

- 6.1.1 Pelagic trawls
- 6.1.2 Long lines
- 6.1.3 Demersal trawls
- 6.1.4 Benthic trawls

6.2 Shipping

- 6.2.1 Noise
- 6.2.2 Introduction of pollutants

- 6.3 Mineral Extraction
 - 6.3.1 Oil & Gas
 - 6.3.1.1 *Seismic survey*
 - 6.3.1.2 *Installation and operation*
 - 6.3.1.3 *Spills and leaks*
 - 6.3.2 Deep-sea mining
- 6.4 Introduction of Substances
 - 6.4.1 Litter
 - 6.4.2 Deliberate dumping
 - 6.4.2.1 *Historical*
 - 6.4.2.2 *Ongoing*
- 6.5 Climate change
 - 6.5.1 Ocean acidification
 - 6.5.2 Temperature
 - 6.5.3 Deep Ocean currents
 - 6.5.4 Hypoxia
 - 6.5.5 Potential changes in productivity
 - 6.5.6 IPCC climate models

7 Existing conservation measures

7.1 National

Will need to do this nation by nation / EEZ.

7.2 Regional agreements

7.3 ABNJ

Remembering that seafloor can be EEZ, while water column is ABNJ at a particular location

8 Research priorities

This section will need a spatial focus for at least part of it, but also a focus on research needed for sustainable development.

- 8.1 ocean science infrastructures
- 8.2 human resources and capacity development
- 8.3 differential investment in ocean sciences
- 8.4 research priorities to support high-level management

This section needs to make clear why these issues are priorities and specifically how they will support conservation, management measures, and ultimately sustainable development. Critically important aspects include data management guidelines and standard data formats for different types of data. How do we manage (databases) and share data?

9 Conclusions

The conclusions (and thus the entire review) need to keep the focus on sustainable development as the main aim of the Ocean Decade.