

**Center of Independent Experts review of NOAA
Technical Memorandum, 'The State of Deep Coral
Communities of the United States'**

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Executive Summary

The Draft NOAA Technical Memorandum ‘The State of Deep Coral Communities of the United States’ provides a comprehensive, authoritative review of those communities. Following a consistent outline, the report covers the distribution and taxonomic composition of deep coral communities, their geological and oceanographic setting, apparent use by fishes and invertebrates, the impact of anthropogenic stressors, and the research priorities, region by region throughout the US EEZ. The initial chapter provides a valuable overview and synthesis of the regional chapters. For a multi-authored report of this magnitude, it shows remarkable consistency and continuity. The synthesis chapter and regional chapters are all of a uniformly high standard: accurate, thorough and balanced in bringing together and interpreting the available data and clearly articulating regional priorities in relation to management needs. Although the subject has engendered considerable controversy, the report provides a balanced review, pointing clearly to what is and is not known, and assessing further research priorities. The report is still in need of technical editing. However, with minor revisions, it should provide an authoritative assessment of our present state of understanding of these diverse communities in US waters, pointing the way clearly to future research and management directions.

Introduction

The NOAA Coral Reef Conservation Program has developed a draft report on the status of deep coral resources found within U.S. waters. The review by the CIE of this report is in partial fulfillment of the requirements set out in the Information Quality Act (IQA). The IQA requires independent review of influential Federal documents. The goals of the review are to evaluate whether the document presents a thorough review of the state of our knowledge regarding deep corals and their associated communities in U.S. waters that can support future deep coral management and conservation action, and to provide recommendations for improving the report. The document consists of an introductory chapter with a national summary, and seven regional chapters prepared by authors knowledgeable of deep coral communities. The report is approximately 240 pages in length, of which approximately 190 pages is 12 point, single spaced text, including references. The remaining 50 pages are photos, figures and tables.

Background

The *First International Symposium on Deep Sea Corals* was held from July 30 - August 3, 2000, in Halifax, Canada. Participants in the symposium identified several major points: 1) deepwater corals comprise significant habitat for commercial fishes; 2) biodiversity levels are higher in deepwater coral aggregations than in adjacent areas; 3) fishing gear, especially trawls, are damaging deepwater corals; 4) more research is needed on the distribution, life history (especially larvae), and taxonomy of deepwater corals; 5) individual deepwater corals reach ages measurable in centuries, and certain species, such as *Lophelia*, form reef-like structures that can reach ages measurable in millennia; and 6) these ecosystems are in need of conservation through the establishment of marine protected areas and the curtailment of trawl fishing on coral aggregations. Since this first symposium, there has been a rapid increase in both the number of studies aimed at understanding deep corals and the calls for their protection.

The President's Ocean Action Plan calls upon NOAA to produce a report detailing the state of our knowledge of deep coral communities in the U.S. Exclusive Economic Zone and to further the President's agenda to research, survey and protect deep coral communities. As fisheries and other human activities move into deep waters, it is important to understand the location of potentially vulnerable deep coral habitats, their importance to biological diversity and potential role as essential fish habitat. In U.S. waters, deep corals primarily occur in Federal waters rather than in state waters. As fisheries in Federal waters require permits, NOAA has an obligation to protect trust resources from overexploitation and base decisions regarding permitting on the best available science. The report on "The State of Deep Coral Communities of the United States" is designed to review current understanding of deep coral communities in U.S. waters and their role in ocean ecosystems, as well as serve as a baseline for future research and management activities.

Terms of Reference

The review is being conducted under the auspices of the Information Quality Act as required for a document deemed “Influential”.

The reviewers shall address all of the terms of reference listed below.

Overall:

- Is the report a cohesive document, or does it read as separate, individual, papers? If the latter, provide recommendations to make it more cohesive.
- Are the chapters balanced and the levels of information presented relatively consistent among chapters? If not, provide recommendations for improvement or areas where more detail is needed if it is available.
- Is the taxonomic information correct and complete with respect to current American Fisheries Society guidelines and current taxonomic understanding?
- Is the biogeographic information thorough and accurate? If not, report key gaps and provide key references.

Introduction and National Overview:

- Does the introductory chapter provide adequate background and context for understanding the regional chapters?
- Does the introduction accurately summarize the major threats to deep coral communities?
- Does the introductory chapter’s “National Overview” synthesize major trends and conclusions from the regional chapters that follow? Are important pieces missing from the overview?

Regional Chapters:

- Evaluate the completeness of the information. Does each of the regional chapters reflect the most current data? Identify any major gaps or weaknesses in the reported information.
 - Are major known areas of deep corals in each region identified?
 - Does each chapter accurately characterize the state of research and knowledge to date? If not, provide specific recommendations for strengthening the information and associated references.
 - Are the maps and tables in each chapter clear, accurate and complete? Identify gaps and omissions in the maps and tables and provide key references for the missing information.
- Are the conclusions supported by the available evidence? If not, provide a detailed explanation and key recommended revisions.
- Evaluate the continuity of the regional chapters. Do they contain similar levels of information? Did the authors of the regional chapters follow the provided outline (see Appendix 2)?

Description of review activities

I received the report on 31 December 2006 and reviewed it over the first several weeks of January, in all, spending six days on the review. I reviewed no other materials specifically but carried out the review in the context of the global literature on deepwater corals and of potential anthropogenic impacts on them.

Summary of findings

Overall

Is the report a cohesive document, or does it read as separate, individual, papers?

The report is a remarkably cohesive document, given the large number of authors and their geographic spread. This was facilitated, no doubt, by the fact that the regional chapters followed a common outline and held to a similar length. The chapters were pitched at a similar and appropriate level.

However, there were minor technical but nonetheless jarring inconsistencies. Many of the chapters did not follow generally agreed stylistic conventions regarding capitalization and italics with regard to the names of species, genera, families, and so on. Species and generic names (e.g. *Lophelia pertusa*) were mostly italicized but not always (e.g. *L. pertusa* p 287, *Euminida picta* p 288, *Corallium lauuense* & *Corallium secundum* p 115, and so on). The names of families and orders are capitalized when the proper name is used (e.g. Family Macrouridae, Order Beryciformes) but not otherwise (e.g. there are x species of macrourids or octocorals) and never when common names are used (e.g. the blue corals (see p 323)). This was a particularly common problem in Chapter 3, but occurred sporadically throughout the report. And the names of families and orders are never italicized (it's Family Lithotelestidae, *not* 'family *Lithotelestidae*' (p 323)).

There were other stylistic issues fairly commonly throughout the report, such as lack of proper super-scripting (e.g. m²). Some references are missing, e.g. Husebo 2002 and Fautin and Romano 1997 from Chapter 1. Chapter 4 refers to 'Appendix ??,' which does not appear to be present. Chapter 8 suffers from formatting problems, with the font size changing sporadically; also, the last two paragraphs of the Introduction repeat material. There are sentences sprinkled throughout where words are missing. These are not major issues, but the report needs the services of a scientific and technical editor.

Chapter 8 (p 311-12) defines structure-forming and habitat-forming corals differently than in the first introductory chapter. (Chapter 1 treats the terms synonymously, whereas Chapter 8 distinguishes between them.) These definitions need to be uniform throughout the report, presumably following what is set out in the introductory chapter.

Are the chapters balanced and the levels of information presented relatively consistent among chapters?

The chapters generally struck the right balance between technical detail and readability. They followed the intended outline so the levels of information were relatively consistent among chapters.

Is the taxonomic information correct and complete with respect to current American Fisheries Society guidelines and current taxonomic understanding?

In general the report provides excellent reviews of the taxonomic groups found in the different regions. The only problem, as noted above, is the lack of consistent and proper use of taxonomic conventions in the nomenclature.

Is the biogeographic information thorough and accurate?

Information in the report on the distribution of the structure-forming corals seemed to be thorough, accurate and up-to-date.

Introduction and National Overview:

Does the introductory chapter provide adequate background and context for understanding the regional chapters?

For the most part the introductory chapter did a fine job of providing background information and context for understanding the regional chapters. However I believe several key points should be added.

- Although the report focuses on structure-forming corals, it would be useful to point out the overall diversity of deep, cold-water corals compared with warm, shallow-water corals. Cairns (1999, 2001), for example, points to the very similar number of azooxanthellate scleractinians relative to those with zooxanthellae that are restricted to shallow waters.
- It would be useful (though it may be beyond the scope of this report) to review the proportion of known species of deepwater corals found in US waters, at least for major groups for which there is good information.
- The Preface refers to an Executive Summary, which did not appear in my copy of the report.

Does the introduction accurately summarize the major threats to deep coral communities?

The review of threats to deep coral communities is thorough.

Does the introductory chapter's "National Overview" synthesize major trends and conclusions from the regional chapters that follow? Are important pieces missing from the overview?

The introductory chapter synthesizes the major trends and conclusions from the regional chapters. However the chapter does not address the overall biogeography of corals within the US EEZ. In particular, do the regions themselves, which correspond to US political entities and which correspond to biogeographic provinces? I am not aware of papers that address this specifically, although Alex Rogers (Institute of Zoology, Zoological Society of London) is examining the global biogeography of major coral groups and Les Watling (Zoology Department, University of Hawaii) has unpublished data on the biogeography of octocorals in the Atlantic Ocean. This work is unpublished but should (if possible) be incorporated in the report; the lack of a biogeographic overview is, I believe, a significant gap. The effort that underlies the report, which involved assembling available data on the

distribution of coral species and of types of coral habitats, provides the basis for such a synthesis as well. Perhaps this was beyond the scope of the report, but it seems that a valuable opportunity may have been missed.

Regional Chapters:

Evaluate the completeness of the information. Does each of the regional chapters reflect the most current data? Identify any major gaps or weaknesses in the reported information.

The regional chapters are written by recognized experts in each region, and they follow the agreed outline. As a result the chapters are all of a very high quality and reflect the current state of knowledge. The major known areas of deep corals in each region are identified, and the maps and tables in each chapter are clear, accurate and complete. However I noted a few areas where there might be improvement. Chapter 5 (Northeastern USA) does not treat non-fishing stressors (and potential stressors) to deepwater corals in that region. If mining, oil and gas exploration and development, cable laying, etc are not significant threats, this should be stated, if only to maintain consistency with the other chapters. On the other hand, this chapter seems to make too much of the introduced species, *Didemnum*, given that it is presently restricted to relatively shallow water.

Are the conclusions supported by the available evidence?

The report is well-balanced in its conclusions and treatment of the available data. The authors are careful to delineate the limits of the data available about deep coral communities for the different regions, and their conclusions do not go beyond the data available.

Evaluate the continuity of the regional chapters. Do they contain similar levels of information? Did the authors of the regional chapters follow the provided outline?

The general style of the chapters and their levels of information are consistent and similar. All followed the agreed outline with a few minor exceptions stated above.

Conclusions

Written by recognized experts within each region, ‘The State of Deep Coral Communities of the United States’ provides a valuable, authoritative review of the present state of knowledge regarding these communities in US waters and assessment of research priorities in order to meet the needs of science-based management. Though multi-authored, the report chapters consistently follow an agreed outline and display a consistent style and level of detail. The reviews are thorough, accurate and up-to-date and show consistent, high levels of scientific rigor and balance in their interpretation of the typically limited data available. Although the report still stands in need of minor revision—and of strong scientific editing, in particular—it should provide an invaluable guide to future research needs to meet the growing consensus on management objectives for these communities.

References

- Cairns S. D. 1999. Species richness of recent Scleractinia. *Atoll Research Bulletin* 459:1-46.
- Cairns S. D. 2001. A brief history of taxonomic research on azooxanthellate Scleractinia (Cnidaria: Anthozoa). *Bulletin of the Biological Society of Washington* 10:191-203.

Appendix 1

Statement of Work

Consulting Agreement Between the University of Miami and Tony Koslow Statement of Work

CIE Review of report on “The State of Deep Coral Communities of the United States”

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available science. The report on “**The State of Deep Coral Communities of the United States**” is designed to review current understanding of deep coral communities in U.S. waters and their role in ocean ecosystems, as well as serve as a baseline for future research and management activities.

CIE Review

The CIE shall provide three reviewers with nationally and internationally recognized expertise in the following fields.

- Deep coral biology/taxonomy - Expertise in the distribution, biology, taxonomy or ecology of deep-water (cold-water) corals (e.g., deep-water stony corals, octocorals, black corals and stlyasterid corals).
- Biogeography – Expertise in the biogeography of deep coral communities as well as associated fauna and flora.
- Fish ecology/deep sea biology - Expertise in the distribution, abundance and biology of deep sea fishes or other deep sea marine organisms and their interaction with the environment.
- Marine conservation biology - Expertise in the protection, restoration and sustainability of marine biological diversity, and the science necessary to achieve such goals.
- Fisheries management - Expertise in the conservation and management of marine fisheries species, especially deeper-water demersal fishes and the impacts of fishing gear on marine habitats.

Knowledge of marine ecology, taxonomy and deep coral biology, as well as a familiarity with the mandates governing deep coral conservation are highly desirable. All of the reviewers must have a common thread of expertise in the field of deep corals.

Each reviewer’s duties shall occupy a maximum of 6 workdays (i.e., a few days for document review and a few days to prepare a Review report). The reviewers shall review the report and deliver recommendations for individual chapters and the overall report. Each reviewer shall develop an individual review report that addresses all the terms of reference. See Appendix 1 for further details on report contents.

By January 22, 2007, the reviewers shall submit their individual reports to the CIE for review¹. The CIE reports shall be sent to Dr. David Die, via e-mail to ddie@rsmas.miami.edu and to Mr. Manoj Shivilani via e-mail to mshivilani@rsmas.miami.edu.

Terms of Reference

The review is being conducted under the auspices of the Information Quality Act as required for a document deemed “Influential”. The resulting reviews, including the

¹ All reports will undergo an internal CIE review before they are considered final.

names and affiliations of the reviewers, will be posted at www.doc.gov in compliance with the Information Quality Act.

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- Evaluate the continuity of the regional chapters. Do they contain similar levels of information? Did the authors of the regional chapters follow the provided outline (see Appendix 2)?

Submission and Acceptance of Reviewers' Reports

The CIE shall provide via e-mail the final reports of all reviewers by February 5, 2007 to the COTR, Dr. Stephen K. Brown (Stephen.K.Brown@noaa.gov), for review and approval, based on compliance with the requirements of this Statement of Work. The COTR shall notify the CIE via e-mail regarding acceptance of these reports. Following the COTR's approval, the CIE shall provide the COTR with pdf versions of the final reports.

Appendix 1: Contents of Reviewer Reports

1. The reports shall be prefaced with an executive summary of findings and/or recommendations.
2. The main body of the reports shall consist of a background, description of review activities, summary of findings, conclusions/recommendations, and references.
3. The reports shall also include as separate appendices the bibliography of all materials provided and any papers cited in the Reviewer's Report, along with a copy of the statement of work.

Please refer to the following website for additional information on report generation:
http://www.rsmas.miami.edu/groups/cimas/Report_Standard_Format.html

Appendix 2: Regional Chapter Outline

I. Introduction

1. Summary of regions covered by this chapter
2. Historical information
3. What is in chapter

II. Geological Setting

1. Brief general description of major geological features of importance to deep corals (e.g., shelf and slope, geomorphology, canyons, seamounts etc.)
2. Brief identification of geological or biogeographical subregions as applicable

III. Oceanographic Setting

1. Brief general intro of oceanographic features of importance to deep corals
2. Subheadings by geological or biogeographical subregions discussing oceanography in each region

IV. Structure-forming deep corals and the spatial distribution of deep coral communities

1. General Introduction - If a particular class is not known to be in the region then state but do not remove the heading. Include unique information about the corals in the region, including number of species, only one ever found. If something unique is known about the biology in the region then include:
 - a. *Stony corals* (Class Anthozoa, Order Scleractinia)
 - b. *Black corals* (Class Anthozoa, Order Antipatharia, Families Cladopathidae and Schizopathidae)
 - c. *Gorgonians* (Class Anthozoa, Order Gorgonacea)
 - d. *True soft corals* (Class Anthozoa, Order Alcyonacea)
 - e. *Pennatulaceans* (Class Anthozoa, Order Pennatulacea)
 - f. *Stoloniferans* (Class Anthozoa, Order Stolonifera)
 - g. *Gold Corals* (Class Anthozoa, Order Zoanthidea)
 - h. *Hydrocorals* (Class Hydrozoa, Order Anthothecatae, Suborder Filifera)
2. Spatial Distribution of Coral Species and Habitat
 - a. Introductory sentences
 - b. Organize subregions by geological setting if applicable

V. Species Associations with Deep Coral Communities

3. General intro sentence
4. Separate into regional geological sections as appropriate, then discuss fish then invertebrates.
5. Comment on critical habitat as possible.

VI. Stressors on Deep Coral Communities

6. Introduction
7. Fishing effects
 - a. Bottom trawling

- b. Scallop dredges
- c. Deep Gill Nets
- d. Bottom Long-lines
- e. Other (e.g. traps)
- 8. Non-Fishing Effects
 - a. Oil and Gas Exploration and Extraction
 - b. Deployment of Gas Pipelines and Communication Cables
 - c. Sedimentation
 - d. Pollution
 - e. Coral Harvest (e.g. black or precious corals)
 - f. Mineral Mining
 - g. Climate Change
 - h. Invasive Species

VII. Management of Fishery Resources and Habitats

- 1. Introduction
- 2. Management of Fishery Resources and Habitats
- 3. Mapping and Research
- 4. Directed Harvest
- 5. Minerals Management Service
- 6. Fishery Management Councils
- 7. National Marine Sanctuaries
- 8. Planned or anticipated activities

VIII. Regional Priorities to Understand and Conserve Deep Coral Communities

- 1. Introductory sentences – Given limited funds these will help develop strategic plans.
- 2. Mapping? Name specific areas
- 3. Research? Be specific about gaps

IX. Conclusion

- 1. General statement on how much deep coral habitat may be found in the region.
- 2. What factor is most important in the region for deep coral development?
- 3. What are the unique features in the region?
- 4. Specific statements (re: fish or inverts) that rely on DSC or are they opportunistic structures
- 5. Are there specific areas impacted by the threats – known coral areas
- 6. Condition of areas examined
- 7. Unique assemblages
- 8. Areas in critical need of protection

X. References

- 1. References are in the Coral Reefs format. Please use this format for any additional included references.