



THE STATE OF DEEP CORAL ECOSYSTEMS OF THE UNITED STATES: 2007



PRODUCED BY THE NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION

NOAA TECHNICAL MEMORANDUM CRCP - 3



Citation for the entire document:

Lumsden SE, Hourigan TF, Bruckner AW, Dorr G (eds.) 2007. The State of Deep Coral Ecosystems of the United States. NOAA Technical Memorandum CRCP-3. Silver Spring MD

Citation for an individual chapter (e.g., Alaska Chapter):

Stone RP and Shotwell SK 2007. State of Deep Coral Ecosystems in the Alaska Region: Gulf of Alaska, Bering Sea and the Aleutian Islands. pp. 65-108. In: SE Lumsden, Hourigan TF, Bruckner AW and Dorr G (eds.) The State of Deep Coral Ecosystems of the United States. NOAA Technical Memorandum CRCP-3. Silver Spring MD 365 pp.

Cover illustration courtesy of Michael Peccini, NOAA

For more information:

For more information about this report or to request a copy, please contact NOAA's Coral Reef Conservation Program, 301-713-0299. NOAA/NMFS/OHC 1315 East West Highway, Silver Spring, Maryland 20910. Or visit <http://coralreef.noaa.gov/>

Disclaimer:

This publication does not constitute an endorsement of any commercial product or intend to be an opinion beyond scientific or other results obtained by the National Oceanic and Atmospheric Administration (NOAA). No reference shall be made to NOAA, or this publication furnished by NOAA, in any advertising or sales promotion which would indicate or imply that NOAA recommends or endorses an proprietary product mentioned herein, or which has as its purpose an interest to cause directly or indirectly the advertised product to be used or purchased because of this publication.

The State of Deep Coral Ecosystems of the United States

Report Editors:

S. Elizabeth Lumsden
Thomas F. Hourigan
Andrew W. Bruckner
Gabrielle Dorr

National Oceanic and Atmospheric Administration

October 2007

NOAA Technical Memorandum CRCP 3



United States Department
of Commerce

Carlos M. Gutierrez
Secretary

National Oceanic and
Atmospheric Administration

Conrad C. Lautenbacher, Jr.
Administrator

National Marine Fisheries
Service

William T. Hogarth
Assistant Administrator

Acknowledgements

Overall Report and Chapter 1: Introduction and Overview

The editors would like to thank Michael Peccini for developing GIS images and numerous others who provided photographs and images for use in this chapter. We would also like to thank the many reviewers for contributing considerable time and effort to provide constructive comments on this chapter. An independent external peer review of the full report was conducted by the Center for Independent Experts (CIE) at the University of Miami. Reviewers for the CIE review included Stephen Cairns – Smithsonian Institution, J. Anthony Koslow – Scripps Institution of Oceanography, and Pål B. Mortensen – Institute of Marine Research, Bergen, Norway. The report also benefited from additional external reviews by the South Atlantic Fishery Management Council, Western Pacific Fishery Management Council, New England Fishery Management Council, Peter Auster – NURC University of Connecticut, Andrew Shepard – NURC University of North Carolina, Wilmington, Chris Kelley – Hawaii Undersea Research Laboratory, Robert Y. George --George Institute for Biodiversity and Sustainability, John K. Reed – Harbor Branch Oceanographic Institution, Peter Etnoyer – Harte Research Institute, Texas A&M, John Warrenchuck and Santi Roberts – Oceana, Lance Morgan and Fan Tsao – Marine Conservation Biology Institute, Alberto Lindner – Smithsonian Institution, Brian Tissot – Washington State University. Internal NOAA reviewers included: NOS comments from Ed Bowlby – OCNMS, Mary Sue Brancato --OCNMS, Emma Hickerson – FGBNMS, G.P. Schmahl – FGBNMS, Roger Griffis and Kara Meckley --CRCP, Steve Gittings and Brad Barr – NMSP, Jeff Hyland – NCCOS, OAR Comments from NURP and OE, NMFS comments from Southeast Fisheries Science Center, Southeast Regional Office, Northeast Fisheries Science Center, Northwest Regional Office, Southwest Fisheries Science Center, Alaska Regional Office, Dwayne Meadows – Office of Protected Resources, Robert Brock – Office of Science and Technology. The Introductory Chapter was a collaborative effort with the authors from each of the regional chapters, and their input has greatly strengthened this section.

Chapter 2: Alaska Chapter

Jon Heifetz (AFSC) provided the overview on multi-beam mapping efforts in Alaskan waters and reviewed an earlier draft of this chapter. Jana DaSilva Lage and Rob Hansen (Fugro Pelagos, Inc.) provided helpful information regarding submarine telecommunication cable deployments in Alaskan waters. Amy Baco-Taylor (Woods Hole Oceanographic Institution), Peter Etnoyer (Texas A&M University), and Tom Shirley (Texas A&M University) provided information on coral distribution from the Gulf of Alaska seamounts. John Guinotte (Marine Conservation Biology Institute) provided helpful insights regarding the effects of ocean acidification on North Pacific corals. Jennifer Reynolds (University of Alaska Fairbanks) provided information about the submarine geology of the North Pacific Ocean. Cathy Coon (NPFMC) provided detailed information on fishing area closures in Alaskan waters and Jon Warrenchuk (Oceana) provided Figure 2.13.

Chapter 3: West Coast

Numerous agencies, institutions and individuals provided data and input to Chapter 3, including Mary Yoklavich (NMFS, Southwest Fisheries Science Center), Brian Tissot and Jennifer Bright (Washington State Univ. Vancouver), Milton Love (Univ. California, Santa Barbara), Ed Bowlby and Mary Sue Brancato (NMSP, Olympic Coast National Marine Sanctuary), Jeff Hyland (NOS, National Centers for Coastal Ocean Science), Jodi Pirtle (formerly at Washington State Univ. Vancouver), Dan Howard and Dale Roberts (NMSP, Cordell Bank National Marine Sanctuary), Erica Burton (NMSP, Monterey Bay National Marine Sanctuary), Mark Wilkins (NMFS, Alaska Fisheries Science Center), Lance Morgan (Marine Conservation Biology Institute), Peter Etnoyer (Aquanautix Consulting), Chris Goldfinger, Chris Romsos and Mark Hixon (Oregon State Univ.), Gary Greene (Moss Landing Marine Laboratories), Rikk Kvitek (California State Univ. Monterey Bay), Alberto Lindner (formerly with Duke Univ.) and Glen Jamieson (Department of Fisheries and Oceans Canada).

In addition to reviews by the Center for Independent Experts, additional reviews of all or portions of Chapter 3 were provided by Waldo Wakefield and Ewann Berntson (NMFS, Northwest Fisheries Science Center), Mary Yoklavich (NMFS, Southwest Fisheries Science Center), Ed Bowlby and Mary Sue Brancato (NMSP, Olympic Coast National Marine Sanctuary), Jeff Hyland (NOS, National Centers for Coastal Ocean Science), Frank

Lockhart (NMFS Northwest Regional Office), Steve Copps (NMFS, Northwest Regional Office) and Lance Morgan and Fan Tsao (Marine Conservation Biology Institute). We appreciate all their constructive comments.

Chapter 4: Hawaii

Much of the research reported in chapter 4: the Western Pacific Region: Hawaii and the US Pacific Islands, was supported by the NOAA Office of Ocean Exploration and the NOAA Undersea Research Program through the Hawaii Undersea Research Laboratory. Stephen Cairns and Dennis Opresko provided preliminary identifications and unpublished species lists to help us provide as complete a taxonomic inventory as possible. We are also grateful to Celeste Mosher, Deborah Yamaguchi and Ronald Hoeke who helped with tables and graphics.

Chapter 5: Northeast

The authors thank Beth Lumsden, Tom Hourigan, and other members of the Deep Coral Team for leading this effort and for editing and formatting our chapter. The authors would also like to thank reviewers Stephen Cairns, Pål Mortensen, and J. Anthony Koslow, as well as additional reviewers, for constructive comments and suggestions.

Chapter 6: Southeast

We thank the NOAA Office of Ocean Exploration, the U.S. Geological Survey, the South Atlantic Fishery Management Council (SAFMC), Environmental Defense, and the Minerals Management Service for helping to fund our deep coral research, which contributed to this review. Much of these data were collected as part of a team effort involving the authors, K.J. Sulak (USGS), E. Baird (NC Museum of Natural Sciences), C. Morrison (USGS) and A. Howard. Andy Shepard (National Undersea Research Center, UNC-Wilmington) facilitated several of our projects, including this report, and provided the *Oculina* photographs. We acknowledge the efforts of the SAFMC in leading the way toward better management of deep coral habitats. We thank A.M. Quattrin and M.L. Partyka for help with figures and data analysis. This chapter was partially supported by the NOAA Ecosystem Assessment Division.

Chapter 7: Gulf of Mexico

The authors would like to extend their appreciation and thanks for all the contributions from reviewers, which have greatly improved this chapter. A special 'Thank You' goes to Dr Steven Cairns (National Museum of Natural History) who helped us navigate the complexities of coral taxonomy, and to the staff of the Flower Garden Banks National Marine Sanctuary who generously shared their research with us'

Chapter 8: Caribbean

The authors would like to thank the following: Stephen Cairns, of the National Museum of Natural History, who's foundation work, advice, patience, and comments were invaluable; Nancy Voss, who helped us through the collections at the University of Miami's Invertebrate Museum; Loretta Burke, of the World Resources Institute, for our baseline bathymetry map; John Reed, Judith Lang, and Charles Messing, who provided first-hand accounts of lithoherms in the Straits of Florida; Daniel Opresko, who's expertise with deep water black corals brought us into the light; and many others. Support was provided by Marine Conservation Biology Institute and the University of Miami's Coral Reef Conservation Research Laboratory. Special appreciation goes to the late Peter Lutz, for advice, counsel, and support.

The State of the Deep Coral Ecosystems of the United States

NOAA Technical Memorandum CRCP-3

Table of Contents

Acknowledgements	<i>iii</i>
Table of Contents	<i>v</i>
Preface	<i>vi</i>
Chapter 1: Deep Coral Ecosystems of the United States: Introduction and National Overview <i>Thomas F. Hourigan, S. Elizabeth Lumsden, Gabrielle Dorr, Andrew W. Bruckner, Sandra Brooke, Robert P. Stone</i>	1
Chapter 2: State of the U.S. Deep Coral Ecosystems in the Alaska Region: Gulf of Alaska, Bering Sea and the Aleutian Islands <i>Robert P. Stone and S. Kalei Shotwell</i>	65
Chapter 3: State of the U.S. Deep Coral Ecosystems in the United States Pacific Coast: California to Washington <i>Curt E. Whitmire and M. Elizabeth Clarke</i>	109
Chapter 4: State of the U.S. Deep Coral Ecosystems in the Western Pacific Region: Hawaii and the United States Pacific Islands <i>Frank A. Parrish and Amy R. Baco</i>	155
Chapter 5: State of the U.S. Deep Coral Ecosystems in the Northeastern United States Region: Maine to Cape Hatteras <i>David B. Packer, Deirdre Boelke, Vince Guida, and Leslie-Ann McGee</i>	195
Chapter 6: State of the U.S. Deep Coral Ecosystems in the Southeastern United States Region: Cape Hatteras to the Florida Straits <i>Steve W. Ross and Martha S. Nizinski</i>	233
Chapter 7: State of the U.S. Deep Coral Ecosystems in the Northern Gulf of Mexico Region: Florida Straits to Texas <i>Sandra Brooke and William W. Schroeder</i>	271
Chapter 8: State of the U.S. Deep Coral Ecosystems in the United States Caribbean Region: Puerto Rico and U.S. Virgin Islands <i>Steven J. Lutz and Robert N. Ginsburg</i>	307

PREFACE

This report represents the first effort by the National Oceanic and Atmospheric Administration (NOAA), in partnership with other federal, academic and non-governmental partners, to bring together available information on the abundance and distribution of structure-forming corals that occur in U.S. waters at depths greater than 50 m. It consists of an introduction, National Overview and seven regional chapters describing deep coral communities in U.S. waters off Alaska, the U.S. West Coast, Hawai'i and the U.S. Insular Pacific, the Northeastern U.S., Southeastern U.S., Gulf of Mexico, and U.S. Caribbean. This report reflects the tremendous increase in awareness of these communities that has evolved over the last few years as the result of increasing exploration and research to understand deeper regions of the oceans. In the U.S., NOAA is proud to serve as a leading partner in much of this work.

NOAA coordinated the development of this report, under the auspices of the Deep Coral Team of the NOAA Coral Reef Conservation Program. It reflects the work and dedication of writing teams from each region and these teams should be cited as primary authors of the regional chapters. The report also benefited from the comments and suggestions of numerous federal and external reviewers and a Data Quality Act peer review coordinated through the Center for Independent Experts.

An introductory chapter defines and provides background information on structure-forming deep corals and identifies major threats that they face. A National Overview explores general trends in these communities across the regions from a national perspective. Chapters 2 through 8, the regional chapters, were developed by authors considered experts in the field of deep coral research and management and those chapters represent the core of this report. The authors of each chapter briefly describe the region and geological and oceanographic features important to deep coral communities; identify the major deep coral taxa that structure habitats in the region and what is known about their distribution; provide information on the other species associated with coral habitat; describe the threats to these habitats; discuss management efforts developed to respond to these threats, and briefly outline regional information needs.. The report also includes unpublished data and observations collected during recent research expeditions.

This report fulfills a commitment made in the U.S. Ocean Action Plan as part of an overall effort to research, survey and protect deep coral communities. It reflects NOAA's growing understanding of the importance of these communities as hot-spots for deep-water biological diversity, and NOAA's commitment to ensuring their enhanced conservation. This report is also a central part of a broader NOAA effort to develop a National Deep Coral and Sponge Research, Conservation and Management Strategy. We hope that this first *Report on the State of Deep Coral Ecosystems of the United States* will stimulate additional research, surveys and protection, and hope that periodic future reports will document both increased understanding and protection of these unique and valuable ecosystems.

