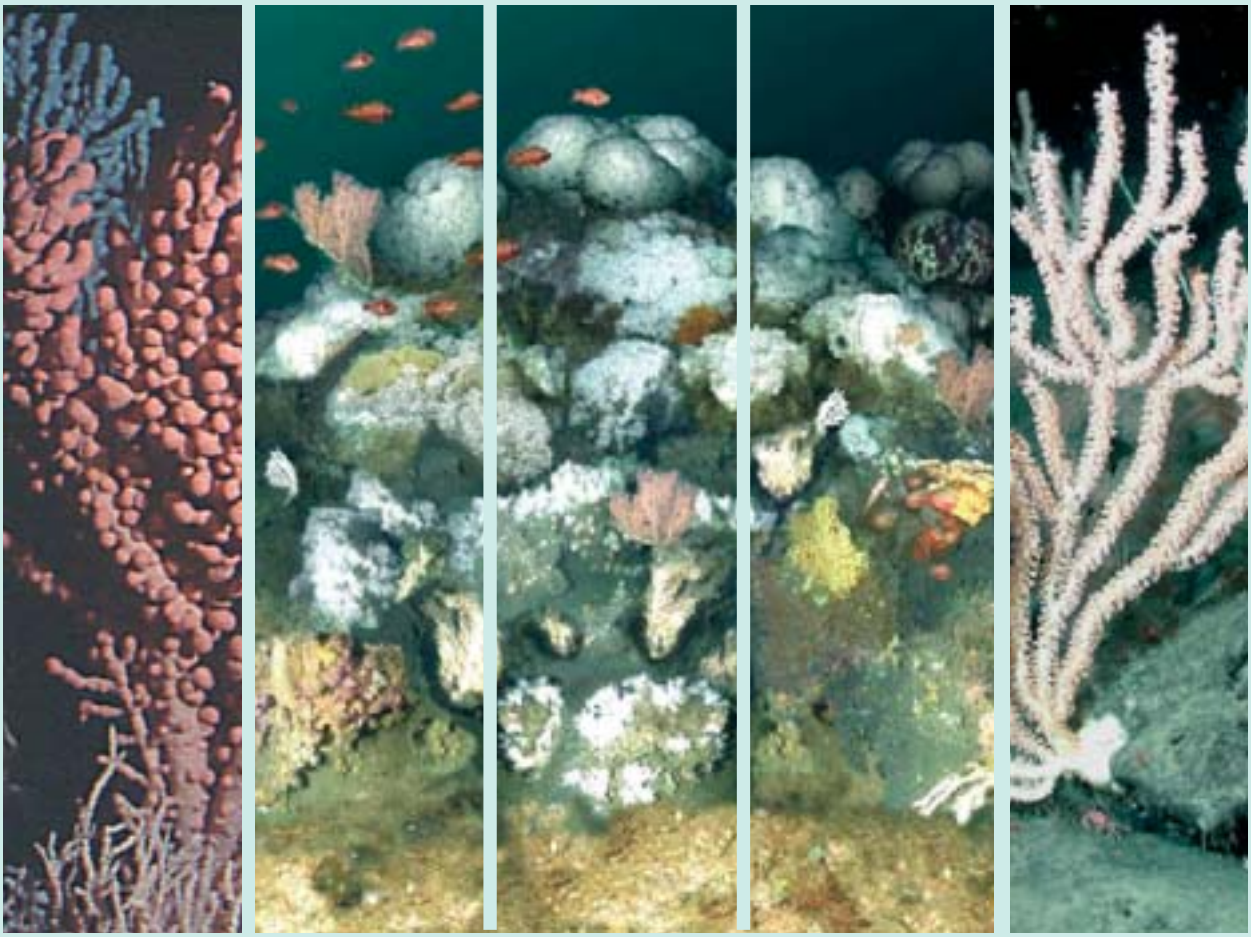
UNEP WCMC

defra
JOINT NATURE CONSERVATION COMMITTEE

MILJØVERNDEPARTEMENTET
Norwegian Ministry of the Environment

WWF

Cold-water coral reefs



Out of sight – no longer out of mind

André Freiwald, Jan Helge Fosså, Anthony Grehan,
Tony Koslow and J. Murray Roberts

UNEP

UNEP WCMC

defra
Department for Environment, Food and Rural Affairs

JOINT NATURE CONSERVATION COMMITTEE

MILJØVERNDEPARTEMENTET
Norwegian Ministry of the Environment

WWF

Cold-water coral reefs

Out of sight – no longer out of mind

André Freiwald, Jan Helge Fosså, Anthony Grehan,
Tony Koslow and J. Murray Roberts

UNEP World Conservation Monitoring Centre
219 Huntingdon Road
Cambridge CB3 0DL
United Kingdom
Tel: +44 (0) 1223 277314
Fax: +44 (0) 1223 277136
Email: info@unep-wcmc.org
Website: www.unep-wcmc.org

Director: Mark Collins

THE UNEP WORLD CONSERVATION MONITORING CENTRE is the biodiversity assessment and policy implementation arm of the United Nations Environment Programme (UNEP), the world's foremost intergovernmental environmental organization. UNEP-WCMC aims to help decision makers recognize the value of biodiversity to people everywhere, and to apply this knowledge to all that they do. The Centre's challenge is to transform complex data into policy-relevant information, to build tools and systems for analysis and integration, and to support the needs of nations and the international community as they engage in joint programmes of action.

UNEP-WCMC provides objective, scientifically rigorous products and services that include ecosystem assessments, support for implementation of environmental agreements, regional and global biodiversity information, research on environmental threats and impacts, and development of future scenarios for the living world.

Citation: Freiwald, A., Fosså, J.H., Grehan, A., Koslow, T., Roberts, J.M. 2004. *Cold-water Coral Reefs.* UNEP-WCMC, Cambridge, UK.

URL: http://www.unep-wcmc.org/resources/publications/ UNEP_WCMC_bio_series/22.htm

A **Banson** production
UNEP-WCMC maps created by Corinna Ravilious, UNEP-WCMC

Printed in the UK by Swaingrove Imaging

Supporting organizations

Department of the Environment, Heritage and Local Government
National Parks and Wildlife Service
7 Ely Place
Dublin 2
Ireland
http://www.environ.ie/DOEI/DOEIhome.nsf

Norwegian Ministry of the Environment
Department for Nature Management
PO Box 8013
Dep. N-0030 Oslo
Norway
http://www.miljo.no

Defra
Department for Environment, Food and Rural Affairs
Nobel House
17 Smith Square
London SW1P 3JR
United Kingdom
http://www.defra.gov.uk

Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough PE1 1JY
United Kingdom
http://www.jncc.gov.uk

UNEP Coral Reef Unit (CRU)
c/o UNEP World Conservation Monitoring Centre
219 Huntingdon Road
Cambridge CB3 0DL
United Kingdom
Tel: (+44) 1223 277314
Fax: (+44) 1223 277136
http://corals.unep.org
http://www.unep-wcmc.org

WWF
Coral Reefs Advocacy Initiative
Global Marine Programme
WWF International
Avenue du Mont-Blanc
Gland 1196
Switzerland
http://www.panda.org/coral

Editors

Stefan Hain and Emily Corcoran
UNEP Coral Reef Unit

Authors

André Freiwald
Institute of Paleontology (IPAL)
University of Erlangen-Nuremberg
Loewenichstr. 28
91054 Erlangen
Germany
andre.freiwald@pal.uni-erlangen.de

Jan Helge Fosså
Institute of Marine Research (IMR)
PO Box 1870 Nordnes
N-5817 Bergen
Norway
jhf@imr.no

Anthony J. Grehan
Department of Earth and Ocean Sciences
National University of Ireland
Galway
Ireland
anthony.grehan@nuigalway.ie

J. Anthony Koslow
CSIRO Marine Research
Perth, Western Australia
Private Bag 5
Wembley, WA 6913
Australia
Tony.Koslow@csiro.au

J. Murray Roberts
Scottish Association for Marine Science (SAMS)
Dunstaffnage Marine Laboratory
Oban, Argyll, PA37 1QA
United Kingdom
murray.roberts@sams.ac.uk

Acknowledgements

This report would not have been possible without the participation of many colleagues from the Institute of Paleontology, particularly Tim Beck, Jürgen Titschack and Max Wisshak. We are grateful to Mark Tasker (Joint Nature Conservation Committee (JNCC)) for reviewing the manuscript. Thanks also for additional material and input to Peter Etnoyer (Marine Conservation Biology Institute (MCBI)), Dorthea Hangaard (Living Oceans Society), Michael Hirshfield (Oceana), Beth Lumsden (National Oceanic and Atmospheric Administration (NOAA)), Elliot Norse (MCBI), Santi Roberts (Oceana), Caroline Turnbull (JNCC), Derek Fenton (Department of Fisheries and Oceans (DFO), Canada), Kristina Gjerde (IUCN–The World Conservation Union) and Martin Willison (Dalhousie University). For providing permission to reproduce or to use images, we are grateful to Allen Andrews (Moss Landing), Amy Baco (Woods Hole Oceanographic Institution), Lydia Beuck (Institute of Paleontology, Erlangen University), Andreas Beyer (Alfred Wegner Institute for Polar and Marine Research, Bremerhaven), Allan Blacklock (National Institute of Water and Atmospheric Research (NIWA), New Zealand), BP Plc, Sandra Dawn Brooke (Oregon Institute of Marine Biology), Stephen Cairns (Smithsonian Institution), the Conservation GIS Support Center (Anchorage), DNO Heather Ltd, Laure Fournier (IFREMER (French Research Institute for Exploitation of the Sea) Directorate), Donald Gordon (DFO-Canada), Jean-Pierre Henriet (University of Ghent), the JAGO-Team (Seewiesen, Germany), Cathy Kilroy (NIWA), Tomas Lundälv (Tjärnö Marine Biological Laboratory), Charles Messing (Oceanographic Center, Nova Southeastern University), Conrad Neuman (University of North Carolina), the NOAA Ocean Explorer staff, Olaf Pfannkuche (Institute for Marine Research-GEOMAR), Rebecca Reuter (National Marine Fisheries Service), the Rebikoff-Niggeler Foundation (Azores), John Reed (Harbor Branch Oceanographic Institution (HBOI)), Jim Reid (DFO-Canada), Geoffrey Shester, Joe Shoulak (MCBI), Tom Smoyer (HBOI) and Terje Thorsnes (Geological Survey of Norway (NGU)). The support of the International Gannet Association is appreciated.

This report was supported by the Governments of Ireland, Norway and the United Kingdom, as well as the World Wide Fund for Nature (WWF) and the United Nations Environment Programme (UNEP). The assistance of representatives of these organizations, Elizabeth Sides (Irish Department of the Environment, Heritage and Local Government), Mai Britt Knoph (Norwegian Ministry of the Environment), Charlotte Johnston (Joint Nature Conservation Committee, UK), Sian Owen, Simon Cripps and Charlotte Breide (WWF), Stefan Hain and Emily Corcoran (UNEP Coral Reef Unit), as well as constructive input from their colleagues, especially the marine and coral reef experts at the UNEP World Conservation Monitoring Centre (UNEP-WCMC), is also very much appreciated.

Messages

'The planet's life-support systems are the source of stability for all peoples, all nations. Cold-water coral reefs are emerging as a new piece in this vital web of life which now requires our urgent attention.'

Klaus Toepfer, Executive Director, UNEP

'Cold-water coral reefs form a remarkable and truly valuable ecosystem off our coasts which our nations must work together to protect.'

Minister Martin Cullen, Department of the Environment, Heritage and Local Government, Ireland

'Cold-water coral reefs are vitally important ecosystems, with immense biodiversity value; a treasure that must be preserved for future generations. The UK has secured a permanent ban on bottom trawling over *Lophelia pertusa* cold-water coral reefs in the Darwin Mounds through action at European Community level. However, further international cooperation is needed to conserve vulnerable marine ecosystems in areas beyond national jurisdiction.'

Elliot Morley, Minister for Environment and Agri-Environment, Defra, United Kingdom

'These reefs are underwater oases, biological treasures and important habitats for fish. It is amazing that such major new discoveries can still be made. The reefs are slow growing and extremely fragile, and must, as a matter of urgency, be protected from further damage.'

Børge Brende, Minister of the Environment, Norway

'At last, advanced science and world leaders recognize that the oceans' resources are finite and now require thoughtful stewardship and intelligent management. We call upon government and industry leaders to take urgent action to conserve the spectacular and unique ecosystems of cold-water coral reefs.'

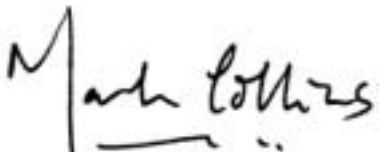
Dr Claude Martin, Director General, WWF International

Foreword

Only in the last 20 years has the sea given up one of its deepest secrets. Far beneath the sunlit surface corals thrive, close relatives of the species found along tropical shores and familiar to scuba divers the world over, but adapted to cold, dark, deep water. Found in all the world's oceans, almost from pole to pole, they form physical structures, even reefs that rival in size and complexity those in warmer, shallower waters. These cold-water reefs are usually far beyond the reach of divers and require specialized submersible vehicles to collect samples, to photograph and study the ecology of the corals themselves and the dazzling array of animals that depend upon them.

Undoubtedly this is why cold-water corals have been outside our consciousness for so long. Remote from the daily lives of most people, only a few scientists have studied them, and we are grateful to the five leading members of this community for their efforts in preparing this report on 'Cold-water coral reefs'. Through their work and that of others we now know that cold-water coral reefs are important and ancient reservoirs of marine biodiversity and are essential nursery habitats for many commercially important fish species. We are also now aware that these reefs are within the reach of one of the most destructive human activities in deep waters, bottom trawling, and so are at serious risk.

The gaps in knowledge are also brought to our attention by this report. We do not yet know how much coral reef covers the deep ocean floor, or even where reefs occur outside a few well-studied locations. While we do understand the threats to cold-water reefs, policy makers do not yet have all the necessary regulatory tools to protect them. I therefore welcome the recommendations made by the authors. As a result of their work, cold-water corals – for so long out of sight – will no longer be out of mind.



Mark Collins
Director
UNEP-WCMC

Executive summary

Over the last few decades the exploration of deep-water environments using new technologies has revealed insights into parts of our planet that challenge conventional wisdom. Coral reefs, once thought to be restricted to warm shallow waters in tropical and subtropical regions, have been found found in dark, cold, nutrient-rich waters off the coasts of 41 countries so far. They occur in fjords, along the edge of the continental shelf and around offshore submarine banks and seamounts in almost all the world's oceans and seas. To date, most studies have been carried out in high latitudes, where cold-water reefs occur at depths of hundreds of metres to just 40 metres. However, cold-water corals are increasingly being observed in the tropics, where they thrive at greater depths.

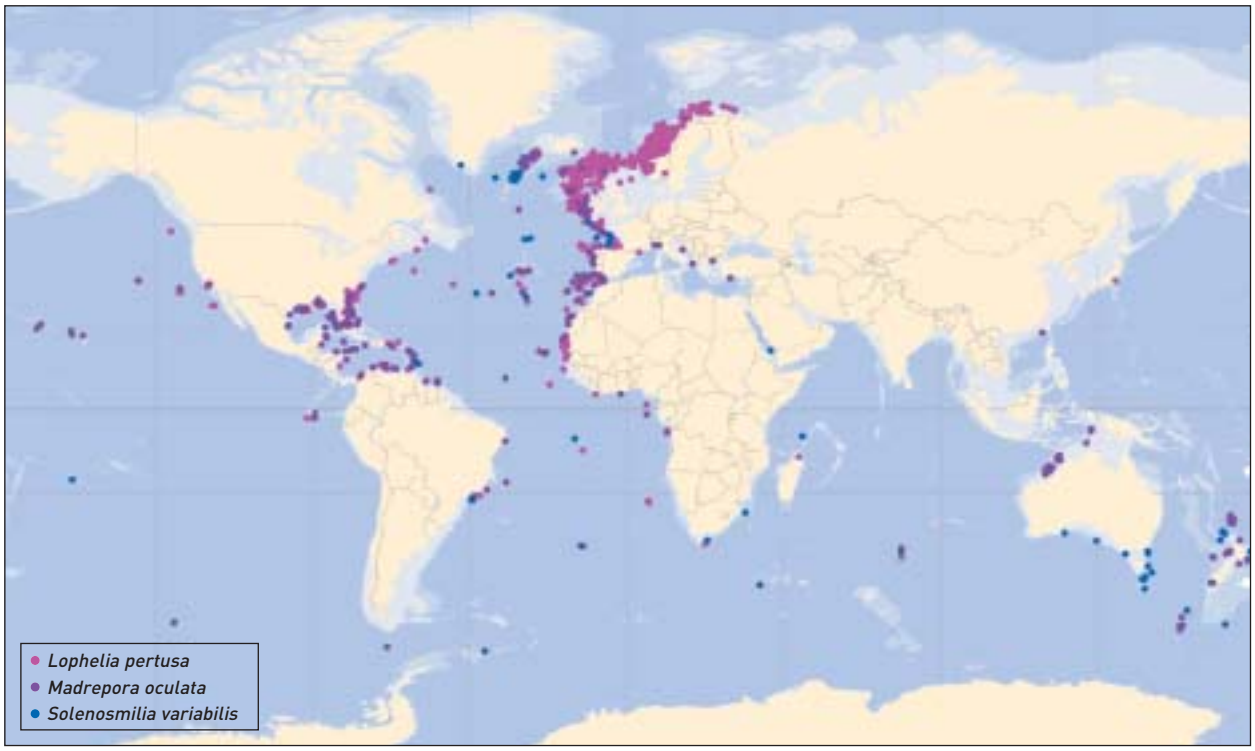
Reef-building and habitat-forming corals in cold waters are derived from several systematic groups. The most important of these are the colonial stony corals (Scleractinia), true soft corals (Octocorallia), black corals (Antipatharia) and calcifying lace corals (Hydrozoa). Several species of these groups create reefs and three-dimensional, forest-like structures on the sea floor, comparable to their warm-water cousins in size and complexity. These cold-water reefs and structures act like islands in the normally flat, featureless and muddy surroundings and harbour a distinct and rich ecosystem, providing niches and nursery grounds for a variety of species, including commercial fish species.

Cold-water coral ecosystems are long lived, slow growing and fragile, which makes them especially vulnerable to physical damage. Regardless of the depth at which these reefs occur, the impact of human activities is evident in almost every survey undertaken. Bottom fisheries, especially using trawls and heavy gear, have already destroyed or scarred several reefs, and represent one of the major threats to cold-water corals. Other documented and potential sources of impact are hydrocarbon and mineral exploration and production, cable and pipeline placement, repair and dumping.

We are still only beginning to understand the principal ecological aspects of cold-water corals, including the environmental factors (temperature, salinity, nutrition) and biological processes (reproductive biology, molecular genetics, predation, parasitism and bioerosion) which regulate their life and distribution. It is

Fosså et al., 2000

A model of a cold-water reef



Global distribution of cold-water coral reefs: points on the map indicate observed reefs of varying size and stages of development, but not the actual area covered. The high density of reefs shown in the North Atlantic most probably reflects the intensity of research in this region. Further discoveries are expected worldwide, particularly in the deeper waters of subtropical and tropical regions

UNEP-WCMC, sourced from A. Freiwald, from various sources

evident that there are large gaps in our knowledge of cold-water coral reefs which need to be closed by further mapping and integrated, multidisciplinary research including modelling of distribution, geology, biology, ecology and the assessment of human impact.

However, already the scientific results and findings clearly demonstrate that cold-water coral ecosystems are important biodiversity hotspots and a biological resource with intrinsic and socio-economic other high-seas habitats are starting to appear on political agendas and to influence political decision making. Various countries and regional bodies have adopted, or are in the process of establishing, regulations and measures for the protection and management of vulnerable deep-water habitats, including cold-water coral reefs. These range from the use of fisheries regulations to requirements for environmental impact assessments and the development of specific management plans and regulations, including