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BIOGEOGRAPHIC ATLAS OF THE SOUTHERN OCEAN

▶ CHAPTER 9.4. CONSERVATION AND MANAGEMENT.

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EDITED BY:
Claude DE BROYER & Philippe KOUBBI (chief editors)

with Huw GRIFFITHS, Ben RAYMOND, Cédric d'UDEKEM d'ACOZ, Anton VAN DE PUTTE, Bruno DANIS, Bruno DAVID, Susie GRANT, Julian GUTT, Christoph HELD, Graham HOSIE, Falk HUETTMANN, Alexandra POST & Yan ROPERT-COUDERT

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THE BIOGEOGRAPHIC ATLAS OF THE SOUTHERN OCEAN

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Edited by:

Claude De Broyer (Royal Belgian Institute of Natural Sciences, Brussels)
Philippe Koubbi (Université Pierre et Marie Curie, Paris)
Huw Griffiths (British Antarctic Survey, Cambridge)
Ben Raymond (Australian Antarctic Division, Hobart)
Cédric d’Udekem d’Acoz (Royal Belgian Institute of Natural Sciences, Brussels)
Anton Van de Putte (Royal Belgian Institute of Natural Sciences, Brussels)
Bruno Danis (Université Libre de Bruxelles, Brussels)
Bruno David (Université de Bourgogne, Dijon)
Susie Grant (British Antarctic Survey, Cambridge)
Julian Gutt (Alfred Wegener Institute, Helmoltz Centre for Polar and Marine Research, Bremerhaven)
Christoph Held (Alfred Wegener Institute, Helmoltz Centre for Polar and Marine Research, Bremerhaven)
Graham Hosie (Australian Antarctic Division, Hobart)
Falk Huettmann (University of Alaska, Fairbanks)
Alix Post (Geoscience Australia, Canberra)
Yan Ropert-Coudert (Institut Pluridisciplinaire Hubert Currien, Strasbourg)

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9.4. Conservation and Management

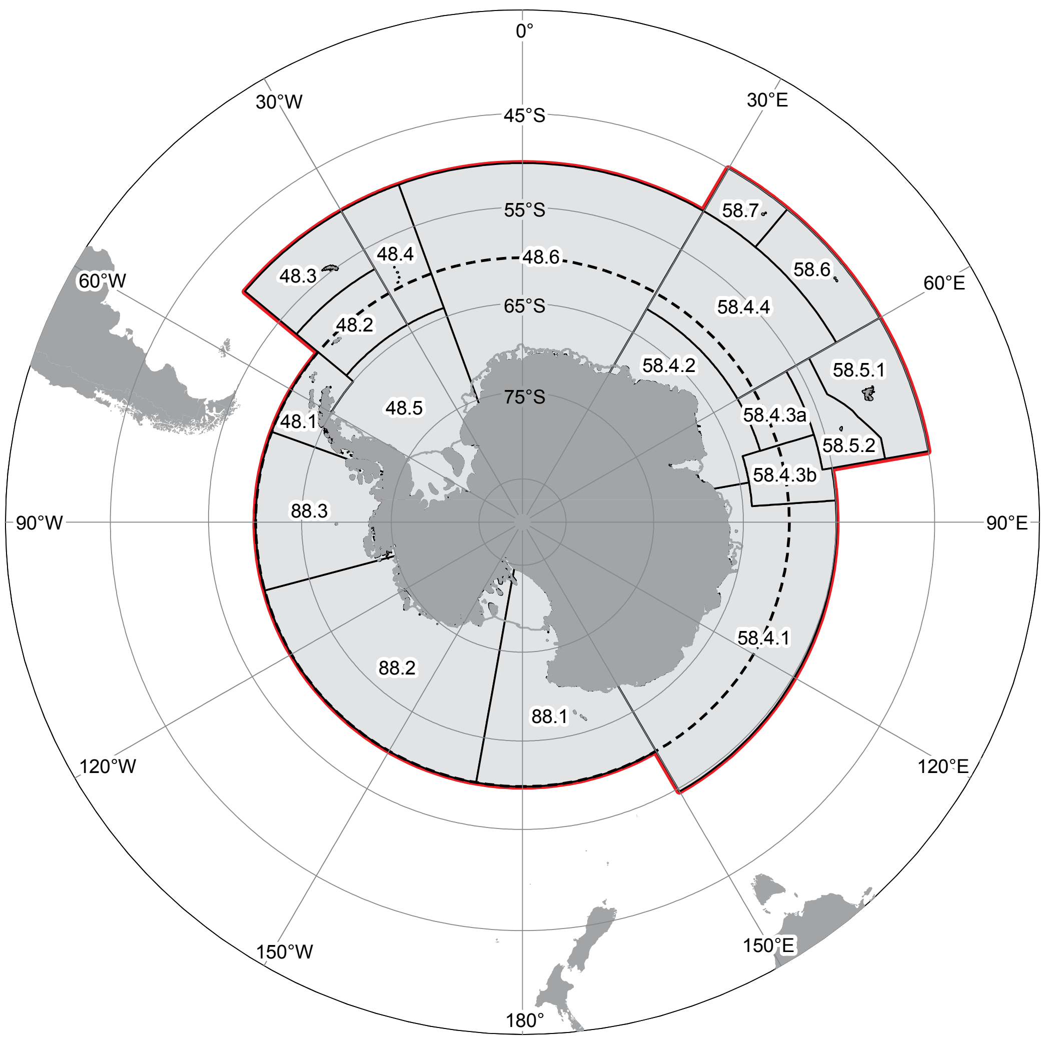
Susie M. Grant[1], Philippe Koubbi[2,3], Polly A. Penhale[4]

[1] British Antarctic Survey, Natural Environment Research Council, Cambridge, UK
[2] Laboratoire d'Océanographie de Villefranche, UMR CNRS 7093, Université Pierre et Marie Curie, Station Zoologique, Villefranche-Sur-Mer, France
[3] UMR 7208 BOREA, Université Pierre et Marie Curie, Muséum National d'Histoire Naturelle, Paris, France
[4] Division of Polar Programs, National Science Foundation, Arlington, VA, USA

1. Introduction

Effective conservation and management relies on the provision of the best available scientific advice to policymakers and managers. Increasingly, this includes a requirement for synthesized datasets that can be easily visualised, and quickly and effectively interpreted. Biogeographic data are particularly relevant in this respect, as they can provide insights into the distribution of species and communities ranging from local to circumpolar scales, in response to a range of scientific questions. The need for such data to be made available through GIS systems and web-based media is also increasing, especially in the context of internationally collaborative approaches to the development of scientific advice to inform policy through the instruments of the Antarctic Treaty System (ATS).

Well-defined routes exist within the ATS for the provision and interpretation of scientific advice, and its translation into internationally agreed policy on conservation and management. The focus on science as a major activity in the Antarctic region, the obligation to share scientific data, and the need for scientific advice to underpin conservation and management decisions are fundamental principles of two major components of the ATS: the Convention on the Conservation of Antarctic Marine Living Resources (CAMLR Convention) and the Protocol on Environmental Protection to the Antarctic Treaty. The Scientific Committee on Antarctic Research (SCAR) also plays an important role in providing scientific advice on specific questions of interest for the Parties to these instruments, and in coordinating research that has direct application in conservation and management.



Map 1 CCAMLR statistical areas and subareas. Boundary of CCAMLR Area shown in red; boundary of the Antarctic Treaty Area at 60°S shown as a dashed line.

2. Commission for the Conservation of Antarctic Marine Living Resources

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) takes a precautionary, ecosystem-based management approach to the conservation of Antarctic marine ecosystems. It aims to regulate the harvesting of resources in a sustainable manner, with consideration of the potential effects of fishing on other ecosystem components, particularly those which are dependent upon, or related to, harvested species (CAMLR Convention 1982: Article 2). CCAMLR employs a system of collection and assessment of scientific data through the input of Members into its Working Groups and Scientific Committee. Decisions made by the Commission are by consensus, and Conservation Measures giving effect to its objectives are formulated, adopted and revised on the basis of the best scientific evidence available (CAMLR Convention 1982: Article 9, and CCAMLR Resolution 31/XXXVIII, 2009). The CAMLR Convention defines the Convention Area, which is divided into statistical areas, subareas and divisions (Map 1). The subarea and division boundaries were selected taking into account general oceanographic conditions as well as biological characteristics, with the aim of grouping areas thought to contain relatively discrete populations of certain species. These areas and divisions allow for the reporting of fisheries data for individual stocks, and the implementation of management measures on a stock-by-stock basis (http://www.ccamlr.org/en/organisation/convention-area-technical-description).

Information on the distribution and ecology of fished species, as well as dependent and related species, has been gathered by internationally coordinated synoptic surveys such as the BIOMASS Experiments (El Sayed 1994) and the CCAMLR 2000 Synoptic Survey (Trathan *et al.* 2001) for krill (*Euphausia superba*), as well as surveys by individual Members (e.g. Kock *et al.* 2000, Jones *et al.* 2000), and reports from fishing vessels themselves (e.g. Hanchet *et al.* 2010, and summaries in the periodically reviewed Fishery Reports published on the CCAMLR website: http://www.ccamlr.org/en/fisheries/fisheries). The CCAMLR Scheme of International Scientific Observation is a critical source of scientific data required to assess the status of marine living resources and the impacts of fishing on these populations, as well as on dependent and related species (Sabourenkov & Appleyard 2005). Measures have been put in place so that a fishery cannot be opened without the extensive data collection effort required for a stock assessment and subsequent agreement by the Commission on a catch limit. Data or samples collected by fisheries observers can also be an important source of information for other studies, such as the genetic structure of populations (Rogers *et al.* 2006). Information on the status of predators is used by CCAMLR in assessing the relationship between harvested species and those species which are dependent upon or related to the same resources. The CCAMLR Ecosystem Monitoring Programme (CEMP) aims to detect significant changes in critical components of the Antarctic marine ecosystem, and to distinguish between changes due to harvesting and those due to physical or biological environmental variability (Agnew 1997, and http://www.ccamlr.org/en/science/ccamlr-ecosystem-monitoring-program-cemp).

Some of the information obtained for CCAMLR purposes on harvested and associated or dependent species is available through data portals such as SCAR-MarBIN/AntaBIF and this Atlas. Although detailed information on the location and distribution of catches tends to be less accessible due to proprietary issues in the commercial fisheries, these data can be requested from the CCAMLR Secretariat (which will then obtain authorisation from CCAMLR Members), as in the case of the synthesis on Fish written for this Atlas. Data collected specifically for stock assessment and fisheries management are an important component of biogeographic knowledge in the Southern Ocean, and could be enhanced by coordination with other sources of distribution data for these species.

In addition to data relating to harvested stocks, CCAMLR requires biogeographic information on a range of other species, communities and ecosystems to inform decisions related to spatial management and the development of protected areas. For example, CCAMLR has agreed a risk-management framework for the identification of vulnerable marine ecosystems (VMEs) (CCAMLR Conservation Measure 22-07), which are defined as including seamounts, hydrothermal vents, cold water corals and sponge fields (CCAMLR Conservation Measure 22-06). Conservation Measure 22-09 also provides for the protection of such areas to avoid significant adverse impacts from bottom fishing gear, in line with the requirements of the United Nations General Assembly Resolution 61/105. In developing these Conservation Measures, work to identify vulnerable taxonomic groups and to describe the distribution of potentially vulnerable taxa in the Ross Sea region used data extracted from SCAR MarBIN in addition to those collected by scientific observers on longline fishing vessels (Martin-Smith 2009, Parker & Bowden 2010). During 2007-08, the Collaborative East Antarctic Marine Census (CEAMARC) undertook a comprehensive survey of the biodiversity, oceanography and geophysical characteristics of the waters north of Terre Adélie and George V Land of Eastern Antarctica (Hosie *et al.* 2011). The survey identified two areas of deep coral-sponge communities as being of important conservation value due to their high biodiversity and unique benthos. Submission of this information to CCAMLR resulted in registration of the two 400 km^2 areas as VMEs, and the immediate implementation of conservation measures to protect them from bottom fishing (Post *et al.* 2010). This is an important example of how biogeographic data can be directly translated into fisheries management provisions through the CCAMLR framework

Areas of important biodiversity may also be given long-term protection as marine protected areas (MPAs). In 2004, CCAMLR agreed to address the topic of marine protected areas as a matter of priority (CCAMLR-XXIII, paragraph 4.13). It subsequently committed to work towards the development of a representative system of MPAs by 2012, with the aim of conserving marine biodiversity in the Convention Area (SC-CAMLR-XXVIII, paragraph 3.28). In accordance with CCAMLR Conservation Measure 91-04 (2011), MPAs may be designated to protect:

1) Representative examples of marine ecosystems, biodiversity and habitats;
2) Key ecosystem processes, habitats and species, including populations and life history stages;
3) Scientific reference areas for monitoring natural variability and long-term reference areas or for monitoring the effects of harvesting and other human activities;
4) Areas vulnerable to impacts by human activities, including unique, rare or highly biodiverse habitats and features;
5) Features critical to the function of local ecosystems;
6) Areas to maintain resilience or the ability to adapt to the effects of climate change.

The CCAMLR Scientific Committee has previously identified types of data and approaches that may be appropriate for use in the selection and design of MPAs. In recognising that comprehensive biological data are not available for the entire Southern Ocean, approaches have been developed to synthesise biogeographic patterns and processes into ecological, biogeochemical or physical regionalisations, with the aim of providing proxy information on the likely distribution of species and habitat types (this book, chapter 10). A representative system of MPAs aims to include examples of the full variety of biodiversity and habitats found within a region (Margules & Pressey 2000, Stevens 2002). The distribution of bioregions (physical and biogeochemical) or ecoregions (including species distributions) is therefore considered as part of the MPA planning process to provide an indication of how far each of these habitat types will be represented in the MPA system. Bioregions or ecoregions that are under-represented in existing MPAs might be considered for protection in additional locations in order to achieve representative protection across the Southern Ocean as a whole. Biogeographic classifications also have a range of other applications such as state of the environment reporting, risk analysis, ecosystem modelling, prediction of the potential spread of introduced species, and identification of key gaps in environmental knowledge (Grant *et al.* 2012).

The South Orkney Islands Southern Shelf MPA was established in 2009 (CCAMLR Conservation Measure 91-03) and remains the only such area to be designated by CCAMLR to date (Map 2). A systematic conservation planning process was employed in the development of the South Orkney Islands Southern Shelf MPA proposal (SC-CAMLR 2009), and has been endorsed by CCAMLR as one of a range of possible approaches to the selection of marine areas for protection. This process requires high quality, spatially resolved information on biodiversity and ecosystem characteristics (Margules & Pressey 2000), which must be available at scales that are appropriate to the scale at which MPA management occurs (Stevens 2002; Grant *et al.* 2013). The pelagic bioregions previously developed by CCAMLR (Grant *et al.* 2006) were used as one of a range of input datasets for the South Orkney Islands planning process, with the objective of protecting at least 20% of each of the four bioregions present in the region (SC-CAMLR 2009).

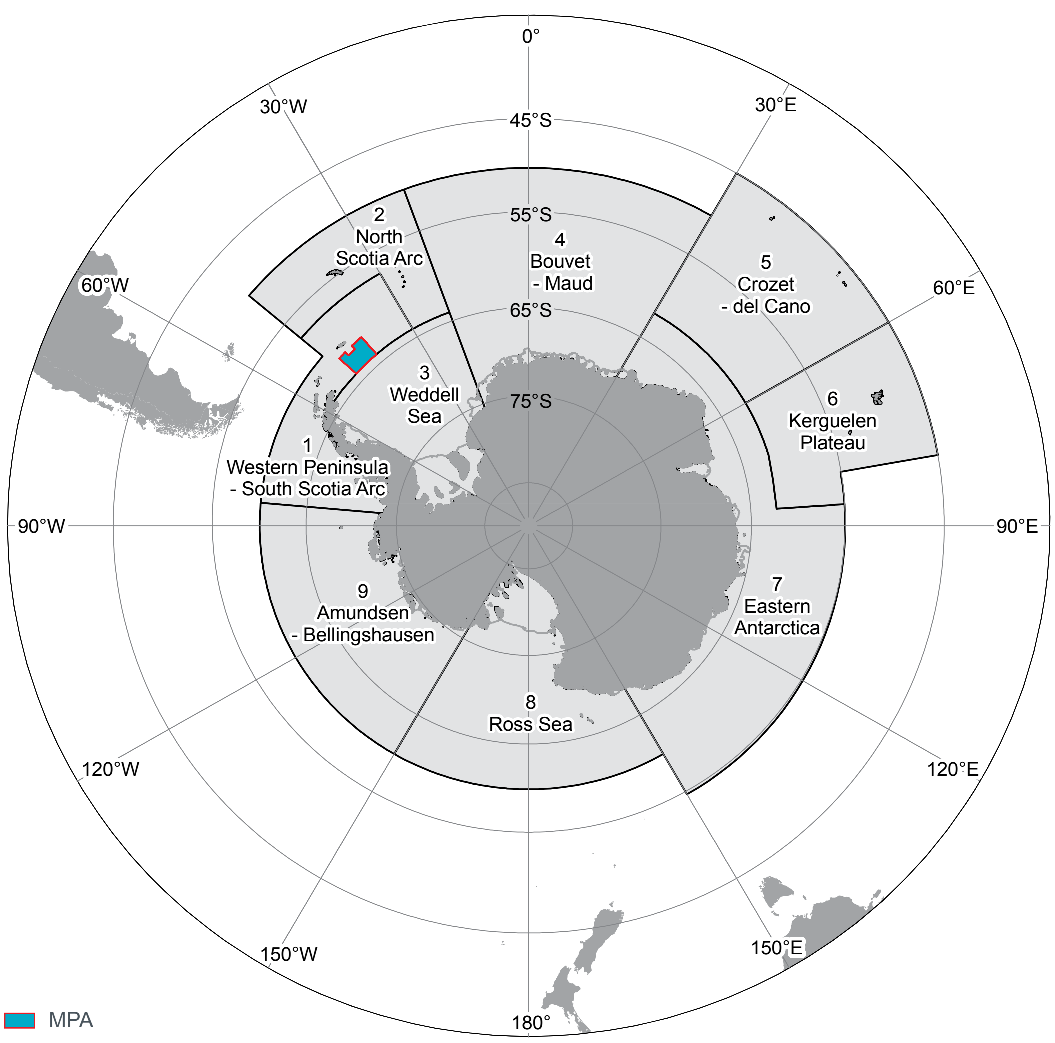
Following the establishment of this first MPA, CCAMLR defined 9 MPA Planning Domains across the Convention Area to allow for further work on the development of MPAs, as well as reporting on existing protected areas, to be regionally focused (Map 2). These Planning Domains may also provide a useful mechanism for future collation of biogeographic data into products specifically relevant to regional MPA planning processes.

Proposals have recently been developed for new MPAs to be established in the Ross Sea (CCAMLR 2013a), in East Antarctica (CCAMLR 2013b), and in areas exposed following the collapse of ice shelves in the Antarctic Peninsula region (CCAMLR 2012), and planning processes are also underway for the Western Antarctic Peninsula and Del Cano-Crozet regions (WG-EMM 2012a, b) and for the Weddell Sea (SC-CAMLR 2013). For the Del Cano-Crozet region, geostatistics, habitat and community modelling were used for predicting the potential distribution of species or communities in areas where there are few data available, including those that are unsurveyed. The representativeness of pelagic or benthic bioregions was used as proxy for biological communities. The CCAMLR Circumpolar Gap Analysis MPA workshop held in 2012 identified AntaBIF as a key resource for future MPA planning in areas where other types of data are less readily available, such as the Amundsen-Bellingshausen, Weddell Sea and Bouvet-Maud MPA Planning Domains (SC-CAMLR 2012). Caution must be exercised in the use of data that is likely to be heavily biased by sampling effort, however new modelling techniques using environmental and biotic data may help to generate predictive maps for selected taxa that will greatly assist in conservation planning (this book, chapter 2 for methods, chapters 5.25, 5.26 and this chapter for examples).

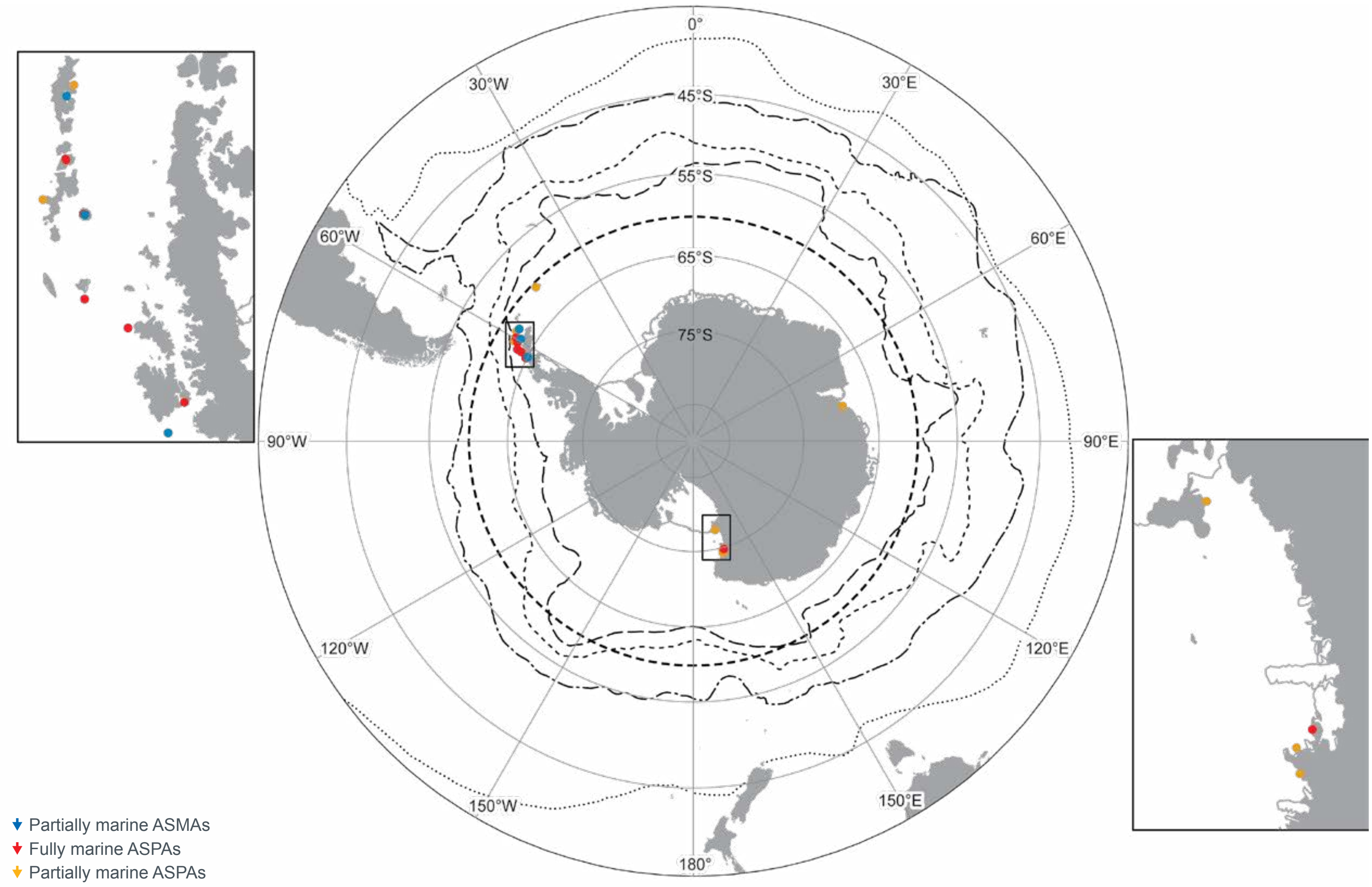
In 2012 and 2013, the Commission failed to reach agreement on the establishment of any new MPAs, with some of the proposals challenged partly on the basis of questions surrounding whether the supporting data are sufficient (CCAMLR 2012, paragraph 7.65). Comprehensive data repositories such as the Dynamic Biogeographic Atlas might help to minimise such problems in the future by providing a clearer indication of the extent of available data. However, this relies on the willingness of all scientists and national programmes to make their data available and to maintain timely updates. A special inter-sessional CCAMLR meeting in 2013 was convened solely for the purpose of considering MPA issues and making decisions on two MPA proposals (CCAMLR 2013c). However consensus could not be reached on establishing these areas at the special meeting, nor at the annual meeting of the Commission later in the same year (CCAMLR 2013d).

3. Committee on Environmental Protection

The Protocol on Environmental Protection to the Antarctic Treaty establishes the Committee on Environmental Protection (CEP), which formulates advice on environmental issues to the Antarctic Treaty Consultative Meeting (ATCM). Unlike CCAMLR, the CEP does not have formal scientific working groups, however scientific input is provided through the work of individual Parties and inter-sessional contact groups, as well as the advice of SCAR, CCAMLR and other non-governmental entities. The CEP's focus is on assessing the environmental impact of human activities, designation of specially protected and managed areas, protection of fauna and flora, prevention of pollution



Map 2 CCAMLR MPA Planning Domains (1–9), with the only currently designated CCAMLR MPA (South Orkney Islands Southern Shelf MPA) shown in blue.



Map 3 Marine and partially marine Antarctic Specially Protected Areas (ASPAs) and Antarctic Specially Managed Areas (ASMAs). Fully marine ASPAs are shown in red, partially marine ASPAs (those also containing a terrestrial component) in yellow, and partially marine ASMAs in blue. Boundary of the Antarctic Treaty Area at 60°S shown as a dashed circle. Antarctic Protected Areas Data source: Environmental Research & Assessment (2011).

or other disturbances, the impacts of climate change, and introduction of non-native species. Underlying all of these topics is a requirement for comprehensive, accessible and up-to-date information on the distribution and characteristics of Antarctic biodiversity, particularly in relation to how species might respond to human-induced or naturally occurring changes. The Protocol on Environmental Protection applies to both marine and terrestrial areas, although it does not consider fisheries so its work on human activities is largely confined to areas on land.

At a joint meeting of the CEP and the CCAMLR Scientific Committee in 2009, it was agreed that CCAMLR should be the 'lead body' on work to establish marine protected areas (CEP XII Report). However, the CEP also has its own mechanism by which it can designate marine areas for special protection or management, with the approval of CCAMLR where relevant (ATCM Decision 9, 2005). Antarctic Specially Protected Areas (ASPAs) and Antarctic Specially Managed Areas (ASMAs) can be designated anywhere south of 60°S, including in any marine area. There are currently six entirely marine ASPAs, and a further seven ASPAs which contain both marine and terrestrial components (Map 3). CCAMLR Conservation Measure 91-02 (2012) lists ASPAs and ASMAs with marine components for which management plans have been approved by CCAMLR in accordance with ATCM Decision 9 (2005).

The Environmental Protocol requires that ASPAs should be designated within a 'systematic environmental geographic framework' (Annex V, Article 3.2). This framework has been defined by Morgan *et al.* (2007) as a method of classifying or organising subsets of environmental and geographic characteristics such as different types of ecosystem, habitat or terrain into different regions, each of which is distinct from other regions but may have characteristics in common. In theory, the establishment of ASPAs within such a framework corresponds to the concept of a representative system of protected areas, similar to that required by CCAMLR. However in practice, despite the requirements of the Environmental Protocol, the present system of established ASPAs is neither systematic nor representative. It is often the case that the ASPA designation has related more to national activities and expertise in the vicinity of existing research stations than to adoption of an objective assessment process at continental scale (Hughes & Convey 2010). The geographic coverage of marine ASPAs is limited, with all sites located in either the Antarctic Peninsula or Victoria Land (Ross Sea) regions, and the majority are small coastal areas (Grant *et al.* 2012). Antarctic Specially Managed Areas (ASMAs) can also be designated in marine areas to coordinate human activities and minimise environmental impacts. ASMAs are located in areas where multiple human activities occur, as a means to plan and coordinate the activities in order to avoid potential conflicts and minimise environmental impact. While protection of biodiversity is not a sole reason for the designation of an ASMA, biogeographic data may still be useful in determining appropriate boundaries and management provisions for such areas.

Efforts to improve the scope and representative coverage of terrestrial ASPAs are underway, and a new biogeographic classification scheme for conservation planning has been developed by Terauds *et al.* (2012), which incorporates biodiversity as well as environmental data. Although currently focused on the terrestrial environment, this approach could be adapted or extended for marine conservation planning, particularly in coastal waters. Nearshore benthic biogeography is often closely linked with the ecology of coastal ice-free areas (Terauds *et al.* 2012) and further development of the marine ASPA system would benefit from a comprehensive focus on biogeographic differences between regions. ASPAs may be more suitable than other tools for the achievement of specific objectives such as the protection of scientific reference areas or locally biodiverse coastal waters, and could therefore be developed in harmony with existing CCAMLR MPA processes to ensure comprehensive protection for Southern Ocean biodiversity.

4. Adapting conservation and management to change

The acquisition of baseline biodiversity information is critical to achieve an understanding of how populations or habitats may change over time. Few Antarctic localities have complete species lists for all flora and fauna known to occur there, and this may impede efforts to monitor change, or to detect the establishment of non-native species. A complete estimate of marine faunal biodiversity has been compiled for the South Orkney Islands archipelago (Barnes *et al.* 2009), and a full marine fauna and flora species list has been established for Deception Island (Barnes *et al.* 2008); however such information is not currently available for any other Antarctic marine sites. Estimates of biodiversity for specific locations provide an important basis for effective monitoring. For example, Deception Island is one of the only marine sites at which it may now be possible to assess with relative certainty whether non-native species have become established, based on the presence or absence of species from the existing baseline (Grant *et al.* 2012).

Monitoring of changes in biodiversity and biogeographic distributions is particularly important in the context of protected area management, and forms a major part of the systematic conservation planning process (Margules & Pressey 2000). Ongoing collection of information on the biodiversity contained within a protected area, and the responses of this biodiversity to natural or human-induced changes, allows for adaptive management to be undertaken as required. New data on biodiversity patterns may necessitate the agreement of revised conservation objectives for a particular area, and the review of boundaries, zoning or management provisions to achieve these objectives. Such management should be a dynamic process, and will be greatly enhanced by the availability of up-to-date biodiversity information resources.

Recognising the importance of this process, CCAMLR has set out a requirement for research and monitoring plans to be adopted for designated MPAs, giving details of the scientific research to be undertaken pursuant to the objectives of the MPA, and monitoring to ascertain the degree to which these objectives are being met (CCAMLR Conservation Measure 91-04, paragraph 5). In addition to this ongoing monitoring process, and unless otherwise provided for, conservation measures designating CCAMLR MPAs must undergo review every 10 years, including an evaluation of whether the MPA objectives are still relevant and are being achieved (CCAMLR Conservation Measure 91-04, paragraph 8). Biogeographic information, particularly in the context of climate change, will therefore be equally important in the process of reviewing MPAs as in their initial development.

There are undoubtedly practical difficulties in acquiring baseline information on species and habitats across the full range of Antarctic and Southern Ocean ecosystems, and this will influence the ability of scientists to provide relevant advice to policymakers. However, the consequences of conservation inaction can be substantial, and decisions must therefore be based on the tools and data available at the present time (Hughes & Convey 2012, Terauds *et al.* 2012). New in situ sampling methods such as remote data collection via autonomous underwater vehicle (AUV) instrumentation can improve spatial coverage in an efficient manner. Methods such as satellite remote-sensing and broad-scale characterisation of physical habitats may be employed to predict the characteristics of areas that have not been studied or sampled directly, and improved modelling techniques will further enhance the extent of biogeographic understanding. With further work on all aspects of marine conservation and management, and particularly on Southern Ocean MPAs, likely to be a major focus for CCAMLR and the CEP in the coming years, it will be critical to ensure that the best available biogeographic data are easily accessible.

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THE BIOGEOGRAPHIC ATLAS OF THE SOUTHERN OCEAN

Scope

Biogeographic information is of fundamental importance for discovering marine biodiversity hotspots, detecting and understanding impacts of environmental changes, predicting future distributions, monitoring biodiversity, or supporting conservation and sustainable management strategies.

The recent extensive exploration and assessment of biodiversity by the Census of Antarctic Marine Life (CAML), and the intense compilation and validation efforts of Southern Ocean biogeographic data by the SCAR Marine Biodiversity Information Network (SCAR-MarBIN / OBIS) provided a unique opportunity to assess and synthesise the current knowledge on Southern Ocean biogeography.

The scope of the Biogeographic Atlas of the Southern Ocean is to present a concise synopsis of the present state of knowledge of the distributional patterns of the major benthic and pelagic taxa and of the key communities, in the light of biotic and abiotic factors operating within an evolutionary framework. Each chapter has been written by the most pertinent experts in their field, relying on vastly improved occurrence datasets from recent decades, as well as on new insights provided by molecular and phylogeographic approaches, and new methods of analysis, visualisation, modelling and prediction of biogeographic distributions.

A dynamic online version of the Biogeographic Atlas will be hosted on www.biodiversity.aq.

The Census of Antarctic Marine Life (CAML)

CAML (www.caml.aq) was a 5-year project that aimed at assessing the nature, distribution and abundance of all living organisms of the Southern Ocean. In this time of environmental change, CAML provided a comprehensive baseline information on the Antarctic marine biodiversity as a sound benchmark against which future change can reliably be assessed. CAML was initiated in 2005 as the regional Antarctic project of the worldwide programme Census of Marine Life (2000-2010) and was the most important biology project of the International Polar Year 2007-2009.

The SCAR Marine Biodiversity Information Network (SCAR-MarBIN)

In close connection with CAML, SCAR-MarBIN (www.scarmarbin.be, integrated into www.biodiversity.aq) compiled and managed the historic, current and new information (i.a. generated by CAML) on Antarctic marine biodiversity by establishing and supporting a distributed system of interoperable databases, forming the Antarctic regional node of the Ocean Biogeographic Information System (OBIS, www.iobis.org), under the aegis of SCAR (Scientific Committee on Antarctic Research, www.scar.org). SCAR-MarBIN established a comprehensive register of Antarctic marine species and, with biodiversity.aq provided free access to more than 2.9 million Antarctic georeferenced biodiversity data, which allowed more than 60 million downloads.

The Editorial Team

Claude DE BROYER is a marine biologist at the Royal Belgian Institute of Natural Sciences in Brussels. His research interests cover structural and ecofunctional biodiversity and biogeography of crustaceans, and polar and deep sea benthic ecology. Active promoter of CAML and ANDEEP, he is the initiator of the SCAR Marine Biodiversity Information Network (SCAR-MarBIN). He took part to 19 polar expeditions.

Huw GRIFFITHS is a marine Biogeographer at the British Antarctic Survey. He created and manages SOMBASE, the Southern Ocean Mollusc Database. His interests include large-scale biogeographic and ecological patterns in space and time. His focus has been on molluscs, bryozoans, sponges and pycnogonids as model groups to investigate trends at high southern latitudes.

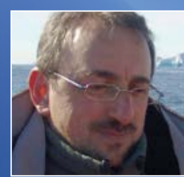
Cédric d'UDEKEM d'ACOZ is a research scientist at the Royal Belgian Institute of Natural Sciences, Brussels. His main research interests are systematics of amphipod crustaceans, especially of polar species and taxonomy of decapod crustaceans. He took part to 2 scientific expeditions to Antarctica on board of the *Polarstern* and to several sampling campaigns in Norway and Svalbard.

Bruno DANIS is an Associate Professor at the Université Libre de Bruxelles, where his research focuses on polar biodiversity. Former coordinator of the scarmarbin.be and antabif.be projects, he is a leading member of several international committees, such as OBIS or the SCAR Expert Group on Antarctic Biodiversity Informatics. He has published papers in various fields, including ecotoxicology, physiology, biodiversity informatics, polar biodiversity or information science.

Susie GRANT is a marine biogeographer at the British Antarctic Survey. Her work is focused on the design and implementation of marine protected areas, particularly through the use of biogeographic information in systematic conservation planning.

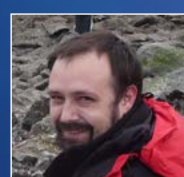
Christoph HELD is a Senior Research Scientist at the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Bremerhaven. He is a specialist in molecular systematics and phylogeography of Antarctic crustaceans, especially isopods.

Falk HUETTMANN is a 'digital naturalist' he works on three poles (Arctic, Antarctic and Hindu-Kush Himalaya) and elsewhere (marine, terrestrial and atmosphere). He is based with the university of Alaska-Fairbank (UAF) and focuses primarily on effective conservation questions engaging predictions and open access data.



Philippe KOUBBI is professor at the University Pierre et Marie Curie (Paris, France) and a specialist in Antarctic fish ecology and biogeography. He is the Principal Investigator of projects supported by IPEV, the French Polar Institute. As a French representative to the CCAMLR Scientific Committee, his main input is on the proposal of Marine Protected Areas. His other field of research is on the ecoregionalisation of the high seas.

Ben RAYMOND is a computational ecologist and exploratory data analyst, working across a variety of Southern Ocean, Antarctic, and wider research projects. His areas of interest include ecosystem modelling, regionalisation and marine protected area selection, risk assessment, animal tracking, seabird ecology, complex systems, and remote sensed data analyses.



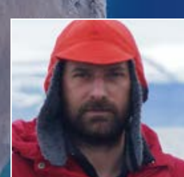
Anton VAN DE PUTTE works at the Royal Belgian Institute for Natural Sciences (Brussels, Belgium). He is an expert in the ecology and evolution of Antarctic fish and is currently the Science Officer for the Antarctic Biodiveristy Portal www.biodiversity.aq. This portal provides free and open access to Antarctic Marine and terrestrial biodiversity of the Antarctic and the Southern Ocean.

Bruno DAVID is CNRS director of research at the laboratory BIOGÉOSCIENCES, University of Burgundy. His works focus on evolution of living forms, with and more specifically on sea urchins. He authored a book and edited an extensive database on Antarctic echinoids. He is currently President of the scientific council of the Muséum National d'Histoire Naturelle (Paris), and Deputy Director at the CNRS Institute for Ecology and Environment.

Julian GUTT is a marine ecologist at the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Bremerhaven, and professor at the Oldenburg University, Germany. He participated in 13 scientific expeditions to the Antarctic and was twice chief scientist on board Polarstern. He is member of the SCAR committees ACCE and AnT-ERA (as chief officer). Main focii of his work are: biodiversity, ecosystem functioning and services, response of marine systems to climate change, non-invasive technologies, and outreach.

Graham HOSIE is Principal Research Scientist in zooplankton ecology at the Australian Antarctic Division. He founded the SCAR Southern Ocean Continuous Plankton Recorder Survey and is the Chief Officer of the SCAR Life Sciences Standing Scientific Group. His research interests include the ecology and biogeography of plankton species and communities, notably their response to environmental changes. He has participated in 17 marine science voyages to Antarctica.

Alexandra POST is a marine geoscientist, with expertise in benthic habitat mapping, sedimentology and geomorphic characterisation of the seafloor. She has worked at Geoscience Australia since 2002, with a primary focus on understanding seafloor processes and habitats on the East Antarctic margin. Most recently she has led work to understand the biophysical environment beneath the Amery Ice Shelf, and to characterise the habitats on the George V Shelf and slope following the successful CAML voyages in that region.



Yan ROPERT COUDERT spent 10 years at the Japanese National Institute of Polar Research, where he graduated as a Doctor in Polar Sciences in 2001. Since 2007, he is a permanent researcher at the CNRS in France and the director of a polar research programme (since 2011) that examines the ecological response of Adélie penguins to environmental changes. He is also the secretary of the Expert Group on Birds and Marine Mammals and of the Life Science Group of the Scientific Committee on Antarctic Research.

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