CHAPTER 6.3. SOUTHERN OCEAN GELATINOUS ZOOPLANKTON.


The “Biogeographic Atlas” is a contribution to the SCAR programmes Ant-ECO (State of the Antarctic Ecosystem) and AnT-ERA (Antarctic Thresholds- Ecosystem Resilience and Adaptation) (www.scar.org/science-themes/ecosystems).

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, Helmholtz Centre for Polar and Marine Research, Bremerhaven)
Christoph Held (Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven)
Graham Hosie (Australian Antarctic Division, Hobart)
Falk Huettmann (University of Alaska, Fairbanks)
Alix Post (Geoscience Australia, Canberra)
Van Ropert-Coudert (Institut Pluridisciplinaire Hubert Curien, Strasbourg)

Published by:
The Scientific Committee on Antarctic Research, Scott Polar Research Institute, Lensfield Road, Cambridge, CB2 1ER, United Kingdom (www.scar.org).

Publication funded by:
- The Census of Marine Life (Albert P. Sloan Foundation, New York)
- The TOTAL Foundation, Paris.

The “Biogeographic Atlas of the Southern Ocean” shared the Cosmos Prize awarded to the Census of Marine Life by the International Osaka Expo’90 Commemorative Foundation, Tokyo, Japan.

Publication supported by:
- The Belgian Science Policy (Belspo), through the Belgian Scientific Research Programme on the Antarctic and the “biodiversity.aq” network (SCAR-MarBIN/ANTABIF)
- The Royal Belgian Institute of Natural Sciences (RBINS), Brussels, Belgium
- The British Antarctic Survey (BAS), Cambridge, United Kingdom
- The Université Pierre et Marie Curie (UPMC), Paris, France
- The Australian Antarctic Division, Hobart, Australia
- The Scientific Steering Committee of CAML, Michael Stoddart (CAML Administrator) and Victoria Wadley (CAML Project Manager)

Mapping coordination and design: Huw Griffiths (BAS, Cambridge) & Anton Van de Putte (RBINS, Brussels)
Editorial assistance: Henri Robert, Xavier Loréa, Charlotte Havermans, Nicole Moortgat (RBINS, Brussels)
Printed by: Altitude Design, Rue Saint Josse, 15, B-1210 Brussels, Belgium (www.altitude-design.be)
Lay out: Sigrid Camus & Amélie Blaton (Altitude Design, Brussels).
Cover design: Amélie Blaton (Altitude Design, Brussels) and the Editorial Team.
Cover pictures: amphipod crustacean (Epimeria rubrieques De Broyer & Klages, 1991), image © T. Riehl, University of Hamburg; krill (Euphausia superba Dana, 1852), image © V. Siegel, Institute of Sea Fisheries, Hamburg; fish (Chaenocephalus sp.), image © C. d’Udekem d’Acoz, RBINS; emperor penguin (Aptenodytes forsteri) G.R. Gray, 1844, image © C. d’Udekem d’Acoz, RBINS; Humpback whale (Megaptera novaangliae) (Borowski, 1781), image © L. Kindermann, AWI.

Online dynamic version:
A dynamic online version of the Biogeographic Atlas is available on the SCAR-MarBin / AntaBIF portal: atlas.biodiversity.aq.

Recommended citation:
For the volume:

For individual chapter:


This publication is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
6.3. Southern Ocean Gelatinous Zooplankton

Dhugal Lindsay¹, Elena Guerrero², Mary Grossmann³, Veronica Fuentes²

¹Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Yokosuka-shi, Kanagawa-ken, Japan
²Instituto de Ciencias del Mar (ICM-CSIC), Barcelona, Spain
³Okinawa Institute of Marine Science and Technology (OIST), Onna, Japan

1. Introduction

The final years of the 19th century and the first few decades of the 20th century were perhaps the golden age for studies of Southern Ocean gelatinous zooplankton (Moser 1909, Browne 1910, Vanhöffen 1912, etc.) with only sporadic reports thereafter (Kram 1946, 1949, 1957) until samples taken by the USNS Eltanin were analysed and reported after the mid-1980s (Larson 1988, Alvariño et al. 1990, Navas-Pereira & Vannucci 1990). The vast majority of the occurrence data for gelatinous Antarctic zooplankton comes from the USNS Eltanin. Other data harvested from the Ocean Biogeographic Information System (OBIS) included a small taxonomic subset of easily recognizable species recorded in the Discovery data from the South African Oceanographic Centre (eroneogynous depth records not included) and Rectangular Midwater Trawl (RMT) data from the Australian Antarctic Data Centre, as well as a more taxonomically comprehensive dataset compiled from the literature, centering on high quality vertical distribution data produced by Francesc Pagès and others (Lindsay 2012), that are nevertheless unfortunately quite limited in their geographic range. Most Antarctic planktonic species are considered circumpolar in their distribution, so although the maps in the present Atlas seem to show limited geographical distributions, this is most likely an artefact of the sampling rather than a reflection of the true distributions. Furthermore, the southern hemisphere in general is vastly understudied and, as a result, although many of the occurrence patterns in the present Atlas seem to infer that distributions are confined to the Antarctic or sub-Antarctic, this may not actually be the case.

2. Biogeography and depth distribution

2.1. Generalities

Including undescribed species, approximately 12 species of ctenophores, 18 species of scyphomedusae, >30 species of siphonophores and >71 species of hydromedusae are known to inhabit the Antarctic and sub-Antarctic waters of the Southern Ocean. Their latitudinal ranges can be divided into several categories – coastal Antarctic endemics primarily concentrated close to the shelf or confined to the continental shelf, to cosmopolitan species, the range of which extends into Antarctic waters. In contrast to more mobile animals such as squids or fishes, gelatinous zooplankton, being planktonic, are more liable to be transported out of their “home” ranges and either into or out of Antarctic waters through horizontal advection. This is particularly true of the holoplanktonic groups such as siphonophores, trachymedusae, narcomedusae, ctenophores and the coronate scyphomedusae Periphylla periphylla (Pérón & Lesueur, 1810) and Atolla spp., and less true for those meroplanktonic species for which the origin of their medusa stage is from benthic polyps. The distributions of the planktonic stages are closely tied to the water masses that they inhabit and the depths of these water masses can change with latitude or indeed longitude. Unfortunately, much of the published data consists of records from nets that traversed multiple water masses but only depth of capture data was available for graphically presenting this data in map form.

The taxonomy of gelatinous zooplankton is still relatively undeveloped compared to many other groups of organisms, especially those in shells or other hard body parts. Indeed, one of the commoner polar siphonophores, Muggiaeae bargmannae Totton, 1954, was only described in 1954 and is therefore missing from the data from the early Discovery or Gauss expeditions, even though it certainly occurred — probably being misidentified as Dimophyes arctica (Chun, 1897) with which it shares many morphological features. Information on the various developmental stages of species is either non-existent or scattered through the literature in a variety of languages. Usually only the easily-recognizable polyclastic stage of siphonophore species is reported and, therefore, where the life history stage is not explicitly stated in the original reference, these records are plotted on the same map as the polyclastic stages, albeit with a different symbol. Failure to recognize younger stages can lead to apparent distributions that are quite different to the real distributions of a species. An example of this can be seen in the physocoept siphonophore Pyrostephos vanhoeffeni Moser, 1929, where its younger stages have apparently been misidentified as Bargmannia elongata Totton, 1954, giving an erroneous, apparent distribution for B. elongata including many points south of the Antarctic Polar Front but with very few records of P. vanhoeffeni in this area, where the younger stages of P. vanhoeffeni actually apparently predominate. An up-to-date taxonomic treatment of Southern Ocean gelatinous zooplankton is sorely needed to enable further biogeographic work to proceed with the correct species assignations.

2.2. Neritic Antarctic endemics

This group contains neritic animals presumably bound to the shallow coast due to the habitat of their benthic polyp stage. It includes species such as the ulmarid scyphomedusae Desmonema glaciale Larson, 1986 (Fig 1, Map 1) and Diplulmaris antarctica Maas, 1908. The anemomedusa Leuckartiara browni Larson & Harbison, 1990 would also seem to be in this group although the adult medusa stage has a lower epipelagic/upper mesopelagic distribution. Some holoplagic organisms, such as the beroid ctenophore Beroe compacta Moser, 1909 also appear to be confined to coastal waters close to the continent (Lindsay pers. obs.).
2.3. Antarctic species concentrated primarily close to the coast

The species in this group have distributions centered around landmasses south of the Polar Front but can also be found near land in the Sub-Antarctic Zone. These include species with polyps probably living in deeper waters such as the anthomedusa *Zanclonia weldoni* Browne, 1910 (Fig. 2, Map 2), as well as those with polyps probably occurring in shallower waters such as the anthomedusa *Heterotentacula mirabilis* (Kramp, 1957), and the leptomedusa *Cosmetirella davisi* (Browne, 1902). The distributions of the medusae, mostly off the continental shelf in the former species and over the shelf in the latter two species, probably mirror those of their benthic polyp stage. Younger stages of some species can be quite difficult to correctly identify, although records of *C. davisi* off southwest Africa and southern Patagonia seem to be valid. Some holopelagic organisms, such as the physconet siphonophore *Pyrostephos vanhoeffeni*, also seem to be associated with the coast/ice, not only around the Antarctic continent, and can be transported oceanwards of the coast as they mature (Fig. 3, Map 3).

![Map 2 Zanclonia weldoni](image1)

**Map 2** Distribution of *Zanclonia weldoni* based on available data, showing its coastal distribution over deeper water mostly within the Polar Front.

![Map 3 Pyrostephos vanhoeffeni](image2)

**Map 3** Distribution of *Pyrostephos vanhoeffeni* based on available data. At least a subset of the records of *Bargmannia elongata* by Alvariño (1990), such as those found within the Ross Sea, are assumed to actually be misidentified younger nectophores of *P. vanhoeffeni*. The paucity of records within the Polar Front suggests that this is where the majority of young colonies occur, maturing as they are advected northwards.

*Figure 2* Original line drawing of *Zanclonia weldoni* (Browne, 1910) (a), and photograph of an RMT net-caught specimen by DJL (b).

*Figure 3* Original line drawing of *Pyrostephos vanhoeffeni* Moser, 1925 (mature nectophore in upper view (a) and lower view (b), immature nectophore (c), photograph of a mature (d) and immature (e) nectophore from an entire colony by EG, line drawing of a mature nectophore of *Bargmannia elongata* Totton, 1954 (f) from Pugh (1999).
2.4. Sub-surface Antarctic endemics also found in the surface layer at or north of the Polar Front through upwelling

Species in this group tend to be associated with the Winter Water or are in any case usually confined to depths below the surface thermocline. Upwelling brings them into the surface layer at the Polar Front or in other upwelling regions. Examples of these species include the anthomedusa *Calycopsis borchgrevinki* (Browne, 1910) (Fig. 4, Map 4) and the polygastric stage of *Diphyes antarctica* Moser, 1925 (Fig. 5, Map 5a). The polyps of *C. borchgrevinki* presumably occur in the deeper waters of the continental slope and the medusa stage is unable to tolerate conditions in the surface layer, though it can often be found between the surface thermocline and 200 m depth — hence the "epipelagic" distribution in Map 4. *Diphyes antarctica* can tolerate conditions in the surface layer and remains there as it is advected northwards towards the Sub-Tropical Front. Its apparent absence in the epipelagic layer between 60° and 120°E appears to be an artefact due to a lack of taxonomic expertise rather than a real absence as many "siphonophore nectophores" were reported in the samples (AADC, 2013). The sexual (eudoxid) stage of *D. antarctica* appears to remain at lower epipelagic or mesopelagic depths as it is advected northwards (Map 5b).
2.5. Sub-Antarctic inhabitants of the epipelagic zone

Some species such as the calycophoran siphonophore *Eudoxoides spiralis* (Bigelow, 1911) occur predominantly to the north of the Antarctic Convergence, only rarely occurring closer to the continent and presumably having been transported there in some eddy or the like (Fig. 6, Map 6b) where they undoubtedly perish. This group also includes the calycophoran siphonophores *Eudoxoides mitra* (Huxley, 1859), *Sphaeronectes koellikeri* Huxley, 1859, the physonect siphonophore *Agalma elegans* (Sars, 1846), and the rhopalonematid trachymedusa *Rhopalonema velatum* Gegenbaur, 1857. Most of these species probably inhabit the entire southern hemisphere temperate zone but appear not to occur there due to the dearth of surveys to the north of the Sub-Antarctic Front.

2.6. Bipolar species concentrated within the Polar Front

The calycophoran siphonophore *Muggiaea bargmannae* Totton, 1954 (Fig. 7, Map 7a–b) and the cydippid ctenophore *Dryodora glandiformis* (Mertens, 1833) belong to this group. They are basically epipelagic or upper mesopelagic and although they can be subducted and advected outside of the Polar Front they cannot survive there. The bathypelagic records for *M. bargmannae* have a good possibility of being due to contamination from shallower layers (e.g. Pugh et al. 1997).

2.7. Discontinuously-distributed boreal deep-water inhabitants
extending south to the edge of the continental shelf

Some species are distributed in boreal waters of both the northern and southern hemispheres and penetrate into the deep water up to the Antarctic continental shelf. The anthomedusa *Pandea rubra* Bigelow, 1913 (Fig. 8, Map 8) has an asexual polyp stage that grows only on the shells of a certain species of pelagic snail, thought to be an epipelagic, cold-water species of the genus *Clio* (Lindsay et al. 2008).

Gelatinous Plankton Map 7 Distribution of polygastric stages of *Muggiaea bargmannae* based on available data, suggesting that it is subducted into the mesopelagic layer as it is advected northwards.

Gelatinous Plankton Map 8 Distribution of *Pandea rubra* based on available data, showing its meso-bathypelagic distribution.
2.8. Deep-water inhabitants extending south to the edge of the continental shelf

Species that occur in deep waters worldwide can be entrained in southward-flowing deep water and can penetrate to the Antarctic continental shelf break. Some species such as the rhopalonematid trachymedusa *Pantachogon haeckeli* Maas, 1893 (Fig. 9, Map 9) and the calycophoran siphonophore *Vogtia serrata* (Moser, 1925) are confined to upper mesopelagic layers at their shallowest extent, while others such as the calycophoran siphonophore *Rosacea plicata* Bigelow, 1911 (Fig. 10, Map 10) and the coronate scyphomedusa *Periphylla periphylla* (Péron & Lesueur, 1810) can penetrate the epipelagic (Fig. 11, Map 11), although only when surface temperatures are cold in the case of the latter. Other species inhabit the lower mesopelagic with their distributions becoming deeper as they approach the Antarctic continent. They include species such as the calycophoran siphonophores *Gilia reticulata* (Totton, 1954) (Fig. 12, Map 12a) and *Clausophyes moserae* Margulis, 1988, and the halicreatid trachymedusa *Botrynema brucei* Browne, 1908. The sexual eudoxid stages of *G. reticulata* have yet to be reported from epipelagic waters (Map 12b).

![Figure 9: Original illustration of *Pantachogon haeckeli* Maas, 1893 (a), and photographs by DJL of individuals in various stages of development (immature: b, c; mature: d, e) [not to scale].](image)

![Map 9: Distribution of *Pantachogon haeckeli* based on available data, showing its meso-bathypelagic distribution encroaching on the Antarctic continent.](image)

![Figure 10: Original line drawing of *Rosacea plicata* Bigelow, 1911 with N2 nectophore in lateral view (a), and lower view (b), N3 nectophore in lower view (c).](image)

![Map 10: Distribution of *Rosacea plicata* Bigelow, 1911 based on available data, showing its mesopelagic distribution around the Antarctic continent and its epipelagic distribution north of the Polar Front where it is upwelled and is advected northwards with surface water up to the Sub-Tropical Front.](image)
Gelatinous Plankton Map 11 Distribution of *Periphylla periphylla* based on available data, showing its bathypelagic distribution and encroachment on the Antarctic continent.
2.9. Southern Hemisphere extending south of the Polar Front

Some species such as the rhopalonematid trachymedusa *Crossota brunnea* Vanhöffen, 1902 (Fig. 13, Map 13) and the cydippid ctenophore *Bathyctena chuni* (Moser, 1909) seem to originate/flower in the Deep Water of the Southern Ocean and penetrate northwards to replenish their populations in the Southern Hemisphere. *Crossota brunnea* is not synonymous with *C. rufobrunnea*, its northern hemisphere counterpart, contrary to the assertion of Navas-Pereira & Vannucci (1990).

---

Figure 12: Original line drawing of anterior nectophore of *Gilia reticulata* (Totton, 1954) in lateral view (a), photograph of a fresh specimen from Pagès et al. 2006 (b), line drawings of upper (left) and lateral (right) views of a eudoxid bract from Pugh & Pagès 1995 [scale bar 0.5 mm] (c), and a photograph of a eudoxid bract in lateral view by MMG (d).

Figure 13: Original line drawings of *Crossota brunnea* Vanhöffen, 1902 (lateral view (a), ventro-lateral view (b)).

---

**Map 12a** *Gilia reticulata*
- Polyastral stage
- Epipelagic (0-200 m)
- Mesopelagic (200-1000 m)
- Bathypelagic (>1000 m)
- Indeterminate depth

**Map 12b** *Gilia reticulata*
- Eudoxid stage
- Mesopelagic (200-1000 m)
- Bathypelagic (>1000 m)

**Gelatinous Plankton Map 12a** Distribution of polyastral stages of *Gilia reticulata* based on available data, showing its mesopelagic distribution in the offshore waters of the Antarctic continent and its epipelagic distribution north of the Polar Front where it is upwelled and is advected northwards with surface water up to the Sub-Tropical Front.

**Map 13** *Crossota brunnea*
- Epipelagic (0-200 m)
- Mesopelagic (200-1000 m)
- Bathypelagic (>1000 m)
- Indeterminate depth

**Gelatinous Plankton Map 13** Distribution of *Crossota brunnea* based on available data, showing its predominantly bathypelagic distribution in the offshore waters of the Antarctic continent and occurrence north of the Sub-Tropical Front.
2.10. Cosmopolitan extending to south of the Polar Front

The calycophoran siphonophore Dimophyes arctica (Chun, 1897) is probably the only member of this group (Fig. 14, Map 14a). It occurs at both poles, mostly in epipelagic and upper mesopelagic waters, and in mesopelagic to bathypelagic waters worldwide. The sexual eudoxid stage seems to be distributed deeper than the polygastric stage when mapped (Map 14b) and some layered net samples have also reported that although habitat depth ranges largely overlap, population peaks for the eudoxid are deeper than the polygastric stages (e.g. Grossmann 2010).

3. Conclusions

In the majority of cases the distribution type of various gelatinous zooplankton species is unclear, due to a combination of limited taxonomic expertise and sampling artefacts. The sizes of life history stages are also seldom recorded through both depth distributions and environmental niche preferences could well vary according to these factors. Small calycophoran siphonophores slip through the mesh of large aperture nets such as the Rectangular Midwater Trawl (RMT) commonly used for plankton studies in the Southern Ocean and soft-bodied forms such as ctenophores are often destroyed to the point where species identification is impossible, if indeed any tissue remains at all. Although the ctenophores Callianira antarctica Chun, 1897 and large pink or brown Beroe species are conspicuous inhabitants of the Southern Ocean, their distributional type is not yet determined. Studies on gelatinous zooplankton in the Southern Hemisphere outside of the Southern Ocean are even fewer than within it, and as a result the true endemcity of many species has yet to be conclusively proven. In fact, the “endemic” species Leuckartiella brownei and Heterotentacula mirabilis have also been reported in recent years from the Mediterranean Sea (Pagès et al. 1999, Bouillon et al. 2000)! New species continue to be described from the Southern Ocean and its surrounding waters (e.g. Grossmann et al. 2012). The study of the gelatinous zooplankton fauna of the Southern Ocean would benefit greatly from the collection, photographic recording, and preservation for taxonomic study of pristine specimens of many of the species, preferably with some tissue preserved for DNA analyses and the voucher specimen fixed and preserved in buffered 4% formalin-seawater solution. The use of imaging technologies such as remotely-operated vehicles (ROVs) and in-situ photographic devices such as the Visual Plankton Recorder (VPR) or Underwater Video Profiler (UVP) would greatly augment the more traditional approach of SCUBA diving with a camera — still an invaluable tool for increasing our knowledge on this fragile but important component of the planktonic fauna of Antarctic seas.

4. Data Source


Acknowledgments

We greatly thank Denise Navas-Pereira and Enlilma M. Araujo for the digital data they provided on Hydromedusae and Siphonophorae, respectively. This data made it possible to include much important information in the distribution maps. The final versions of these maps were kindly prepared by Dr. Huw Griffiths, British Antarctic Survey. Ingo Arndt, Dr. Ricardo Giesecke and Dr. Russell Hopcroft graciously provided photographs of live animals. We acknowledge the support of the TOTAL Foundation (SCAR-MarBIn grant) for the building of the database. Thanks are also due to the University of Alaska Fairbanks for permission to use Dr. Hopcroft’s images. This is CAML contribution # 132.
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) 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.

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 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) 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 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) 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.