Chapter 1
The Census of Antarctic Marine Life: The First Available Baseline for Antarctic Marine Biodiversity

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1.1 History of the Project

The Census of Antarctic Marine Life (CAML, www.caml.aq) was a 5-year long international project that focused the attention on the ice-bound oceans of Antarctica during the International Polar Year (IPY) in 2007–08, bringing together researchers from 30 different countries and more than 50 institutions. It was one of the fifteen IPY-endorsed biological projects devoted to Antarctica (Project #83) and coordinated field operations of 18 research voyages in Antarctica during IPY and/or within the CAML life-span.

CAML's main objectives were to study the evolution of life in Antarctic waters to determine how this had influenced the diversity of the present biota and to use these observations to predict how it might respond to future change.

CAML was also one of the fourteen projects of the international Census of Marine Life (CoML, www.coml.org) (Gutt et al. 2010), each focusing on specific geographic environments or subject areas, with the aim to understand marine

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biodiversity and set reference baselines to allow measuring change. CAML's sister project was the Arctic Ocean Diversity (ArcOD), devoted to the census of Arctic marine biodiversity. Thanks to strong interaction with this project, it is now possible to draw comparisons between differences in ecological structure and dynamics of the Arctic and Southern Oceans (Gradinger et al. 2010; Gutt et al. 2010).

1.1.1 The IPY Proposal

In considering its contribution as part of the "Evolution and Biodiversity in the Antarctic (EBA)" programme, the Scientific Committee on Antarctic Research (SCAR) accepted a proposal that a Census of Antarctic Marine Life be undertaken as a major activity during IPY and in July 2004 appointed an international Steering Committee to guide the project. The Committee held its first meeting following the SCAR meeting in Bremerhaven in October 2004 with the aim to shape the project and write an application through CoML to the Alfred P. Sloan Foundation, New York, for financial support to science coordination. The application was signed by Prof. M. Stoddart, CAML Chair, and Dr. C. Summerhayes, SCAR Executive Secretary. A grant was awarded and in early 2005 V. Wadley was appointed Project Manager with her first task being the coordination of an opening workshop (Brussels, June 2005). CAML was approved as IPY project in 2005.

While CAML received its core funding from CoML and the NAPs (in-kind support) researchers had to find institutional and/or national agency funds, to enable entire teams or individuals to participate in field and laboratory work.

CAML has been a very expensive project. Funds for coordination, including planning meetings, technical data analysis, taxonomic workshops, and salary for a Project Manager, were covered by the Sloan Foundation, under the CoML programme, for a total of ca. one and a half million USD between January 2005 and December 2009. SCAR provided additional funds during the duration of CAML. Specific research projects and travel were funded by national agencies.

1.1.2 CAML Organization

CAML has been chaired by Prof. M. Stoddart and led by V. Wadley (Australian Antarctic Division, Hobart/Institute for Marine and Antarctic Studies, University of Tasmania). The CAML Steering Committee appointed by SCAR comprised: C. de Broyer (Royal Belgian Institute of Natural Sciences, Brussels, Belgium), A. Murray (University of Nevada, Desert Research Institute, Reno, USA), Lúcia de Siqueira Campos (University of de Janeiro, Brazil), P. Rodhouse (British Antarctic Survey, Cambridge, UK), D. Rodriguez (Universidad Nacional de Mar del Plata, Argentina), A. Brandt (University of Hamburg, Germany). At its first

meeting in 2004 the SC co-opted several experts who had shown interest in the CAML, and all subsequent meetings included S. Schiaparelli (University of Genova, Italy), B. Danis (Royal Belgian Institute of Natural Sciences, Brussels, Belgium), H. Griffiths (British Antarctic Survey, Cambridge, UK), G. Hosie (Australian Antarctic Division, Hobart, Australia), R. Hopcroft (University of Alaska, Fairbanks, USA), J. Gutt (AWI, Bremerhaven, Germany) and many others.

1.1.3 CAML Scientific Targets

The CAML SC compiled a Science Statement (www.caml.aq/education-outreach/documents/20061114_CAMLSciStatement_000.pdf) at the Brussels workshop in 2005. It was not intended as a work plan but, it established the main questions that needed to be asked about the Antarctic ocean in order to gain knowledge about its role in provision of ecosystem services to humankind, and how these are likely to be affected by climate and global change.

CAML's philosophy was to integrate knowledge of the *Known*, *Unknown* and *Knowable* diversity, and the abundance and distribution of marine life across regions, biomes and habitats. In particular, a specific set of scientific questions was proposed for each of the benthos, pelagos and top predators, virtually considering all size classes, from microbes to mammals.

By promoting collaboration between disciplines and international programmes, CAML intended to provide a legacy of knowledge for future generations and a baseline against which to measure future change in Antarctic marine diversity.

National plans for specific studies were presented and later coordinated by the SC, based on the available ship time provided by National Antarctic Programmes.

Beside new sampling activities and purpose-designed field studies, CAML utilised unemployed taxonomic collections and promoted data mining of historical data sets in collaboration with its sister programme, Marine Biodiversity Information Network (SCAR-MarBIN, www.scarmarbin.be), another IPY project.

Within this context, CAML's five main scientific goals were summarised as follows:

1. Undertake a species inventory of the Antarctic slopes and abyssal plains
2. Undertake an inventory of benthic fauna under disintegrating ice shelves
3. Undertake an inventory of plankton, nekton and sea-ice associated biota at all levels of biological organisation from viruses to vertebrates
4. Assess critical habitats for Antarctic top predators
5. Develop a coordinated network of inter-operable databases for all Antarctic biodiversity data

In addition to the above, CAML also promoted techniques of modern molecular biology to solve evolutionary and ecological questions, thanks to the agreement with the Barcode of Life Data System (BOLD http://www.boldsystems.org/) which provided facilities for the sequencing of samples from CoML projects.

All outcomes and cruise updates were constantly maintained by the Project Manager and made available to the wider public though the CAML website.

1.2 CAML Coordination Effort

One of the main goals was the coordination of international teams and programmes in 18 research voyages (Table 1.1) with sampling activities.

Coordination occurred at several levels during phases of voyages' organisation, ranging from endorsement letters for national funding agencies to organisation of symposia and workshops during which data sets were assembled or prepared for publication. For some activities, e.g. barcoding (see Sect. 1.3.3), it was necessary to select a coordinator (R. Grant, British Antarctic Survey) who would manage the high flow of data/sequences progressively fed from voyage activities.

Sampling guidelines were produced and protocols made available to the scientific community after the first CAML workshop (Brussels 2005) such as the protocol for benthic samples (www.caml.aq/benthos/documents/Benthos-Sampling.pdf) and for methodologies for sampling benthos of deep-sea basins and abyssal plains (www.caml.aq/benthos/documents/Benthos-Deep-Sampling.pdf).

1.2.1 CAML Main Expeditions

Some 18 expeditions had direct links and/or established expressions of interest with CAML activities. Although other voyages did not establish formal collaborations with CAML, they assessed geographical targets, or produced data for benefit of the CAML community. An example of the first case is associated to the Italian RV "OGS-Explora" (PI L. de Santis, OGS, Trieste). Although not part of CAML, it swath-mapped previously unknown areas and made the acquired high-resolution bottom topography available to CAML (Post et al. 2010); the latter was used to set sampling positions for the CAML-IPY voyage CEAMARC. Portions of the surveyed areas were declared Vulnerable Marine Ecosystems (VMEs) by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR, www.ccamlr.org) and closed to bottom fishing since 2008 (CCAMLR 2009a, b). Examples of the second type the "ANtarctic benthic DEEP-sea biodiversity: colonisation history and recent community patterns (ANDEEP)" voyages I–III in 2002 and 2005) in the Scotia and Weddell Seas (Brandt et al. 2004, 2007) which, although accomplished before, or in coincidence with the CAML beginning, brought a conspicuous series of scientific papers published in collaboration with CAML members and helped in setting the guidelines and protocols adopted during the main research IPY voyages.

Table 1.1 List of research voyages with research targets specifically linked to IPY #53 (CAML) and #83 (SCAR-MarBIN)

Country	Vessel	Date	Area	Project or voyage name (IPY proposal)
Au, F, J	*Aurora Australis*	11/07–01/08	TA, GLC	CEAMARC, CCAMLR, CASO
Br	*Ary Rongel*	02/07	KGI	MABIREH (IPY#156)
Br	*Ary Rongel*	11/07–12/07; 11/08–03/09	SA, WS, BeS, AB	SOS-CLIMATE; SASSI; CRAC-ICE; ICED-IPY; CASO (IPY# 911)
Dk	*Vaederren*	08/06–03/07	BS; AP	GALATHEA 3
F, Au, J, Be	*L'Astrolabe*	12/07–01/08	TA, GLC	CEAMARC
G	*Polarstern*	11/06–01/07	WS	ANT XXIII/8
G	*Polarstern*	11/08–02/09	SA	ANT-XXIV/2; ANDEEP-SYSTCO (IPY#16, SCACE; IPY#111)
J	*Umitaka Maru*	12/07–01/08	SR; TA; GLC	STAGE, NIDR
J, Au, F	*Umitaka Maru*	01/08–02/08	TA, GLC	CEAMARC
NZ	*Tangaroa*	01/08–03/08	RS	IPY-CAML (TAN0802) (CPM IPY#343)
Pe	*Humboldt*	01/06–02/06; 12/06–01/07; 01/07–02-07; 01/08–02/08	AB	ABBED; MABIREH (IPY#156)
Pe	*Humboldt*	01/08–02/08, 01/09–02/09	SubA; DP; BS; AB; EI	
Po	*Polar Pioineer*	01/06; 03/07–04/07	SS, KGI, AB	
RF	*Akademik Fedorov*		Haakon VII Sea	SASIE (IPY#818)
UK	*James Clark Ross*	02/06–04/06; 02/08–04/08	ScS; BeS; AS; WS	BIOPEARL I (JR147) & II (JR179) (IPY#417, ICCED; IPY#949)
USA	*Yuzhmorgeologia*	02/08–03/08; 02/09–03/09	SOI	CCAMLR + CAML
USA	*Gould*	01/06–02/06; 01/07–02/07; 01/08–02/08; 04/07–05/07	CSI; PS	NSF polar programs (IPY#77)
Ve	*Oyarvide*	02/08–03/08	KGI	First Venezuelan Antarctic expedition

Whenever possible, information about voyage data report or web sites is reported. Countries: *Au* Australia; *Be* Belgium; *Br* Brazil; *Dk* Denmark; *F* France; *G* Germany; *J* Japan; *NZ* New Zealand; *Pe* Peru; *Po* Poland; *RF* Russian Federation; *UK* United Kingdom; *USA* United States; *Ve* Venezuela. Sites: *AB* Admiralty Bay; *AP* Antarctic Peninsula; *AS* Amundsen Sea; *BeS* Bellingshausen Sea; *BS* Bransfield Strait; *CSL* Cape Shirreff Livingston; *DP* Drake Passage; *EI* Elephant Island; *GLC* George V Land Coast; *KGI* King George Island; *PS* Palmer Station; *RS* Ross Sea; *SA* South Atlantic; *SR* Syowa Region; *ScS* Scotia Sea; *SS* South Shetlands; *SubA* Sub-Antarctic; *TA* Terre Adélie; *WS* Weddell Sea

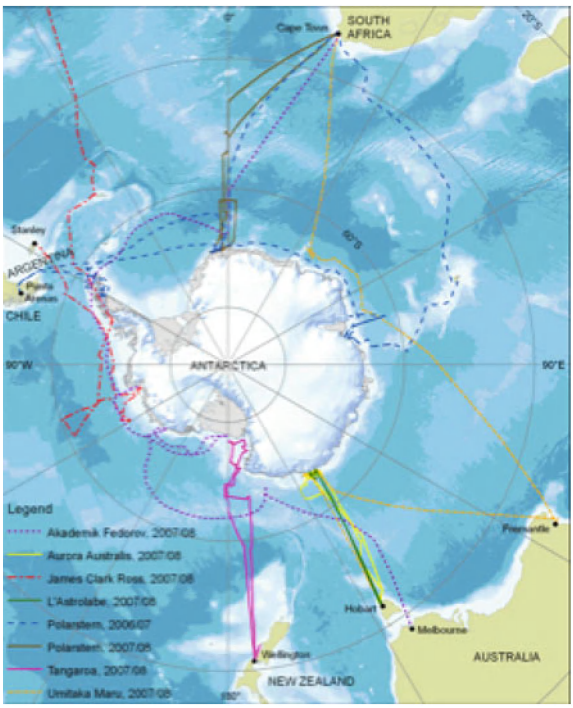

Fig. 1.1 Tracks of main research voyages under the CAML umbrella in the 2006–2008

This report only lists the voyages undertaken in the CAML framework (Table 1.1) and show the routes of the major ones (Fig. 1.1). Other information about smaller research projects can be found in the CAML web site.

1.3 CAML Main Results

1.3.1 Distributional Records

In 2010, immediately after the end of CoML, over 1 million distribution records, representing over 5,200 species (validated by taxonomic experts) were present in the SCAR-MarBIN information systems (Griffiths 2010, Fig. 4). More data sets are continuously added with the completion of specific studies and will increase our spatial coverage of sampling stations around Antarctica giving to end users updated information about species distributions and state of the art.

This impressive number of records is the largest repository of Antarctic marine georeferenced biodiversity information ever compiled and is freely available through Internet (De Broyer et al. 2012c; www.scarmarbin.be).

1.3.2 Coordination with SCAR-MarBIN

In parallel with CAML, SCAR-MarBIN was born in the framework of the International Polar Year (IPY) (De Broyer et al. 2012c). The project's objective is clear-cut: to offer free and open access to Antarctic marine biodiversity data, and provide a means to manage data arising from CAML's exceptional sampling effort.

SCAR-MarBIN was inspired by the Antarctic Treaty (Art. 3.1.c): "In order to promote international cooperation in scientific investigation in Antarctica [...] Scientific observations and results from Antarctica shall be exchanged and made freely available."

SCAR-MarBIN was quickly adopted by SCAR as its marine biodiversity information network. Based in Brussels, the project has been mainly funded by the Belgian Science Policy Office since 2005. SCAR-MarBIN's mandate was to build a web portal offering a single access point to Antarctic marine biodiversity data, providing a thematic information Node for global networks, such as the Ocean Biogeographic Information System (OBIS, www.iobis.org), or the Global Biodiversity Information Facility (GBIF, www.gbif.org).

Thanks to a shared vision, and an extremely tight collaboration, SCAR-MarBIN grew as a successful tool, serving the SCAR community and beyond. As a tangible result, SCAR-MarBIN has built the first dynamic Register of Antarctic Marine Species (RAMS) (De Broyer et al. 2012a), which builds the taxonomic backbone to the information system and is maintained by an international board of specialists, as well as a biogeographic data system, giving access to hundreds of datasets which used to be scattered all over the world. For the first time, scientists have direct access to raw data on biodiversity, which, before SCAR-MarBIN, was only available from the researchers who gathered it; the data were stored on their computers and the only public mention of it was in papers they wrote.

Based on this, many projects are being developed, ranging from the new Antarctic Biodiversity Information Facility (ANTABIF, www.biodiversity.aq), harmonising the access to marine, terrestrial and limnetic biodiversity data (Danis et al. 2012c), to data-derived products (such as the Antarctic Field Guides, http://afg.biodiversity.aq, Danis et al. 2012a) or the Biogeographic Atlas of the Southern Ocean (http://atlas.biodiversity.aq, De Broyer et al. 2012b).

These commons embody the continuation of the Census of Antarctic Marine Life, in the form of an electronic ecosystem involving researchers, institutes, data, computers, networks and databases. At the moment of writing these lines, CAML-generated data is still flowing in this ecosystem.

Further details about the Antarctic Biodiversity Information Networks can be found in a dedicated chapter "Connecting biodiversity data during the IPY: the path towards Polar Science" in this book series (Danis et al. 2012b).

A full list of CAML-related datasets can be consulted on the ANTABIF data portal (http://data.biodiversity.aq).

1.3.3 DNA Barcoding

CAML aimed to collate DNA barcode sequences for as many Antarctic marine species and Antarctic research expeditions as possible, in order to maximise the taxonomical and geographical coverage of obtained sequences.

This large-scale effort was a CAML priority, given the potentially great extent of environmental change in polar region under climate-driven fluctuations, which might lead to severe extinctions, and to the fact that, before CAML, a reference baseline of barcode sequences was substantially lacking for Antarctica (Grant and Linse 2009).

Thanks to the collaborations with the Marine Barcode of Life project and the Canadian Centre for DNA Barcoding, it was possible to start large-scale DNA barcoding projects for many of the major CAML voyages.

Under the CAML umbrella, material obtained in the framework of different expeditions was studied in a coordinated fashion, by focusing on gaps, setting priorities for most important taxa and avoiding any loss of resources deriving by potentially duplicated collecting effort in similar regions by different research groups (Grant et al. 2011).

In this way, large collections of organisms and sequences have been achieved and several researchers were able to collate data sets with thousands of sequences (e.g. Hemery et al. 2012).

1.3.4 Published Results and Journal Special Issues

Several journal special issues have appeared in the last years entirely or only partly dedicated to specific CAML voyages or to national Projects linked to CAML. Here we report the main references concerning special issues related (entirely or partially) to CAML-related data, in order to address the reader to the information. Tens of other CAML-related papers have been and are being published in many journals but it is not possible here to give an account about all these.

An Antarctic Science special issue (Antarctic Sci 20, Special Issue 3) dedicated to the project "Biodiversity, Phylogeny, Evolution and Adaptive Radiation of life in Antarctica (BIOPEARL)", managed by the British Antarctic Survey, appeared in 2008 (Linse 2008b). This project had two voyages, one in the Scotia Sea in 2006 (BIOPEARL I) and one in the Amundsen Sea in 2008 (BIOPEARL II). The special issue includes eleven papers: Linse (2008a); Griffiths et al. (2008); Linse et al. (2008); Strugnell et al. (2008); Rock et al. (2008); Barnes (2008); Barnes et al. (2008); Kaiser et al. (2008); Pearce (2008); Allen and Smellie (2008).

In 2010, a special issue of Polar Science (Volume 4, Issue 2), "Antarctic Biology in the 21st Century—Advances in and beyond IPY", assembled papers presented at the 10th SCAR International Biology Symposium, Hokkaido

University, Sapporo 2009 (Fukuchi and Conlan 2010; Stoddart 2010). Of the 22 contribution, 13 are on marine themes: Coppola et al. (2010); de Pascale et al. (2010); Jadwiszczak (2010); Koubbi et al. (2010); Lautredou et al. (2010); Massom and Stammerjohn (2010); McLeod et al. (2010); Naito et al. (2010); Russo et al. (2010); Sato-Okoshi et al. (2010); Takahashi et al. (2010); Toda et al. (2010); Vallesi et al. (2010).

The international project "Cooperative East Antarctic Marine Census project (CEAMARC)", was conducted by a consortium of 3 ships from Australia, France and Japan, and scientists/students from several nations. Eighteen contributions from this project were published in a special issue of Polar Science (Vol 5, Issue 2) (Hosie et al. 2011): Amakasu et al. (2011a, b); Causse et al. (2011); Cherel et al. (2011); Dettaï et al. (2011a); Giraldo et al. (2011); Koubbi et al. (2011a, c); Lacarra et al. (2011); Mayzaud et al. (2011); Moteki et al. (2011); Ono et al. (2011); Smith et al. (2011); Swadling et al. (2011); Takahashi et al. (2011); Vallet et al. (2011a, b).

ANtarctic benthic DEEP-sea biodiversity: colonisation history and recent community patterns—SYSTem COupling (ANDEEP-SYSCO), was the prosecution of the ANDEEP I-III expeditions, aimed at defining responses of the abyssal benthos to seasonal and longer-term changes in primary productivity (Brandt et al. 2011b). Ten papers were published in a special issue of Deep Sea Research II (Vol 58, Issues 19–20): Brandt et al. (2011a); Brenke et al. (2011); Flores et al. (2011); Göcke and Janussen (2011); Janussen and Rapp (2011); Pawlowski et al. (2011); Veit-Köhler et al. (2011); Wilmsen and Schüller (2011); Würzberg et al. (2011a, b).

In 2009, the South American Consortium on Antarctic Marine Biodiversity, (LA CAML), organised a LA CAML/BioMAntar/COMARGE Integrated Workshop on Antarctic-South America interactions. Ten papers were published in a special issue of Oecologia Australis (Campos et al. 2011; Vol 15, Issue 1), "Antarctic—South American Interactions in the Marine Environment (ASAI)" [www.oecologiaaustralis.org/ojs/index.php/oa/issue/view/29 (Aguayo–Lobo et al. 2011; Costa et al. 2011; Da Rocha Fortes and Absalão 2011; de Moura Barboza et al. 2011; di Prisco and Verde 2011; Gutt and Arntz, 2011; Ivar do Sul et al. 2011; Krüger and Petry 2011; Rodrigues et al. 2011; Verde et al. 2011)].

Major achievements were presented in the CAML Final Symposium "Diversity and Change in Southern Ocean Ecosystems", hosted by the Italian National Antarctic Museum, Genova 2009. From the 42 presentations, 25 were assembled in a special issue (Schiaparelli and Hopcroft 2011) of Deep Sea Research II, Vol 58, Issues 1–4: Allcock et al. 2011; Arango et al. 2011; Bowden et al. 2011; De Broyer et al. 2011; Dettaï et al. 2011b; Díaz et al. 2011; Eléaume et al. 2011; González-Wevar et al. 2011; Griffiths et al. 2011; Gutt et al. 2011; Hardy et al. 2011; Havermans et al. 2011; Kaiser et al. 2011; Koubbi et al. 2011b; Mühlenhardt-Siegel 2011; Nakayama et al. 2011; O'Driscoll et al. 2011; O'Loughlin et al. 2011; Olguín and Alder 2011; Post et al. 2011; Rapp et al. 2011; Schrödl et al. 2011; Siciński et al. 2011; Strugnell et al. 2011; Würzberg et al. 2011c.

Table 1.2 CAML main workshops and events

Location	Date	Topic
London (UK)	1–4 Oct 10	CoML Final meeting Presentations by all field programs
Rio de Janeiro (Brazil)	3–4 Nov 09	Antarctic-South American Interactions in the Marine Environment (ASAI)
Genova (Italy)	**17–20 May 09**	**CAML Final Symposium**
Villefranche sur Mer (France)	13–16 May	Polar synthesis macroscope
Long Beach, California (USA)	17–21 Feb 09	CoML all program meeting
Valencia (Spain)	9–10 Nov 08	Meeting of CAML Steering Committee
Durham, North Carolina (USA)	26–28 Oct 08	Polar Synthesis Macroscope
St Petersburg (Russia)	08–11 Jul 08	SCAR-IASC Open Science Conference
Bonn (Germany)	19–30 May 08	European Conference of Parties, Biodiversity Conference
Bialowieza, Poland	**4–8 Jun 07**	**CAML Scientific Steering Committee and Invited Experts meeting**
Tokyo (Japan)	11–12 Oct 06	CAML Top Predators Working Group
Concepcion (Chile)	Aug 06	Oficina Latinoamericana para el Census of Antarctic Mar Life (OLA-CAML)
Hobart (Australia)	15 Jul 06	Southern Ocean Observation System (SOOS) Workshop
Hobart (Australia)	11 Jul 06	Workshop: Processes of Colonisation and Dispersal—how they shape the Biodiversity of Antarctic Marine Ecosystems and CAML Scientific Steering Committee meeting
Brussels (Belgium)	**27–30 May 05**	**First CAML workshop**

In *bold* are the major events, where guidelines (Brussel, 2005), coordination between cruises and targets (Bialowieza, 2007) and final results (Genova, 2009) were discussed

1.3.5 Workshop Organisation

The milestone workshop for CAML was that held in Brussels in May 2005. The draft Science Plan was produced and finalised in September, after consultation with the SC. This Plan was circulated within nations and marine Antarctic science organisations to obtain encourage involvement in CAML and to help national projects to get funded by national institutions/funding agencies. In other workshops, partial results were discussed and/or data set organised (Table 1.2). The CoML Final Meeting with presentations by all field programmes was the last formal meeting of CAML, which ended in December 31st, 2010.

1.4 The CAML Legacy

The CAML scientific legacy can be summarised in four main points:

- Legacy sampling sites (identifiable by GPS) from which biodiversity data have been obtained and that can be re-sampled at intervals in the future in order to track changes in marine biodiversity.
- Collections of marine specimens that may be used for biological research for many years to come.
- Publication of data sets that can be freely accessed (so far, 66 data sets relating to CAML are available at http://data.biodiversity.aq (last search in April 10th, 2012).
- Baseline of Antarctic DNA barcodes (COI) that enabled and will enable to answer important questions regarding marine genetic diversity and distribution of species and their links with areas outside the Polar Front.

Moreover, CAML facilitated the establishment of regional networks of Institutions that worked at the national level in a similarly coordinated way. This is the case of the Latin America CAML (LA CAML), where seven Latin-American countries (Chile, Peru, Ecuador, Brazil, Argentina, Venezuela, Uruguay) operated together in order to maximise gaining Antarctic biodiversity data. Twenty-five projects were run by LA CAML researchers (www.caml.aq/news/la-caml-projects.html).

After a meeting in Hobart (July 2006), following the Open Science Conference, SCAR began establishing the Southern Ocean Observing System (SOOS, http://www.scar.org/treaty/atcmxxxiii/ATCM33_ip050_e.pdf). SOOS was established in 2010, with a SC reporting to SCAR and to the Scientific Committee on Ocean Research (SCOR), to coordinate multi-disciplinary pan-Antarctic long-term monitoring systems which will help to assess the impacts of global change on Southern Ocean ecosystems. A Secretariat has been established at the Institute for Marine and Antarctic Studies at the University of Tasmania, for 2010–2015.

1.5 Concluding Remarks

During its five-year time span CAML generated considerable interest in Antarctic marine biodiversity, with press releases, television and radio interviews given by CAML scientists. It appeared in CoML press releases and publicity. Based on the biological complexity reported by CEAMARC, CCAMLR declared two areas off Terre Adélie as "Vulnerable Marine Ecosystems" that, while not formally protected, should be avoided by bottom fishers. As an important catalyst for the launch of SOOS, and as the major data-provider for SCAR MarBIN, CAML's greatest legacy has been the renewed interest in Antarctic marine biodiversity. It is to be hoped that SCAR and other influential bodies are able to build on its

achievements and further understand the biological complexity of the vast circum-Antarctic Southern Ocean, particularly as climate change is expected to bring about significant changes in the decades ahead.

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