

# CEAMARC, the Collaborative East Antarctic Marine Census for the Census of Antarctic Marine Life (IPY # 53): An overview

Graham Hosie<sup>a,\*</sup>, Philippe Koubbi<sup>b,c</sup>, Martin Riddle<sup>a</sup>, Catherine Ozouf-Costaz<sup>d</sup>, Masato Moteki<sup>e</sup>, Mitsuo Fukuchi<sup>f</sup>, Nadia Ameziane<sup>g</sup>, Takashi Ishimaru<sup>e</sup>, Anne Goffart<sup>h</sup>

<sup>a</sup> Australian Antarctic Division, Department of Sustainability, Environment, Water, Population and Communities, 203 Channel Highway, Kingston, Tasmania 7050, Australia

<sup>b</sup> UPMC Université Paris 06, UMR 7093, Laboratoire d'Océanographie de Villefranche, BP28, 06234 Villefranche-sur-Mer, France

<sup>c</sup> CNRS, UMR 7093, LOV, BP 28, 06234 Villefranche-sur-Mer, France

<sup>d</sup> CNRS, UMR 7138, MNHN, Department Systematics & Evolution, UMR 7208, CP 26, 57 rue Cuvier, 75005 Paris, France

<sup>e</sup> Department of Ocean Sciences, Tokyo University of Marine Science and Technology, 4-5-7 Konan, Minato, 108-8477 Tokyo, Japan

<sup>f</sup> National Institute of Polar Research, 10-3 Midori-cho, Tachikawa, Tokyo 190-8518, Japan

<sup>g</sup> Muséum national d'Histoire naturelle, Department "Milieux et Peuplements Aquatiques", UMR 7208, CP 26, 57 rue Cuvier, 75005 Paris, France

<sup>h</sup> Laboratoire d'Océanologie, Mare Center, Université de Liège, Bat. B6c, Allée de la Chimie 3, B4000 Liège, Belgium

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## Abstract

The Census for Antarctic Marine Life (CAML, IPY Project 53) aimed to investigate the distribution and abundance of Antarctic marine biodiversity and how it will be affected by climate change. It was a major ship-based research programme in the austral summer of 2007–2008 involving scientists from 30 countries and 19 vessels. The Collaborative East Antarctic Marine Census (CEAMARC) was a multinational contribution to CAML involving scientists and students from several nations using three ships from Australia, Japan and France surveying the one area. This collaboration was a highly coordinated and comprehensive survey of the plankton, fish, benthos, oceanography and geophysical conditions of the waters north of Terre Adélie and George V Land of Eastern Antarctica. CEAMARC has provided a robust benchmark of the marine life in this poorly studied sector and will help to establish the monitoring of future changes in this region.

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## 1. Introduction

The Census of Antarctic Marine Life (CAML) set a challenge to understand the marine biodiversity of

the Antarctic, from virus to vertebrates, in all habitats, biomes and regions, and across all fields of study to strengthen our knowledge of ecosystem dynamics in this high latitude, ocean system. CAML aimed to determine what is known, unknown and probably unknowable about the Southern Ocean, and provide a better understanding of the diversity and status of

\* Corresponding author.

E-mail address: [graham.hosie@aad.gov.au](mailto:graham.hosie@aad.gov.au) (G. Hosie).

Antarctica's marine life that could be obtained only through a multi-scale level of investigation (Gutt et al., 2010; Schiaparelli and Hopcroft, 2011; Stoddart, 2011; [www.caml.aq](http://www.caml.aq)). The CAML was the first major programme since BIOMASS (Biological Investigations of Marine Antarctic Systems and Stocks, El-Sayed, 1994) to involve multiple nations and ships to study the Antarctic marine biodiversity in a comprehensive and integrated manner. Various surveys were conducted around Antarctica either as individual national projects or through consortia of nations.

That challenge was taken up by Australia, France, Japan and Belgium, brought together during CAML in 2007/08 to conduct the Collaborative East Antarctic Marine Census (CEAMARC). The survey focussed on the continental shelf, slope and oceanic waters north of Terre Adélie and George V Land, studying the plankton, fish, and benthos, together with oceanographic processes and the assessment of geomorphology and substratum of the underlying seabed. All four collaborating nations have previously conducted biological, oceanographic, and geological research in the region, indicating it to be an area of rich and interesting biodiversity over diverse habitats.

The CEAMARC survey area extended eastward from 138°E, just west of the French station of Dumont d'Urville, to the Mertz Glacier Tongue at approximately 146°E, and northward from the coast to 62°S. The continental shelf extends 120–130 km from the coast with a shelf break located at depths of 500–550 m. The continental slope reaches 2000 m and has a complex network of submarine canyons extending across the shelf and over the shelf break (Carburlotto et al., 2006). On the shelf there are two major banks shoaling to about 200 m, the Adélie Bank and Mertz Bank, which alternate with very deep inner-shelf depressions of 500 m to more than a 1000 m depth. Some of these depressions are large, notably the George V and Adélie Basins but there are other smaller glacial basins (Beaman and Harris, 2003, 2005; Post et al., 2010, Fig. 1).

A previous geological survey by Australia of the continental shelf of the region, included an assessment of the geomorphology of the seafloor and substrate type, and led to an initial classification of the benthic habitats and biotypes (Beaman and Harris, 2003, 2005). More extensive geomorphological and habitat assessment during CEAMARC (Post et al., 2010, 2011), indicated that gravelly sediments only occur along the continental slope whereas muddy and sandy sediments dominate respectively over depressions and banks. The seabed was shaped by past glacial ice sheet which has created basins but also moraine on banks.

Much of the seabed in this area is less than 440 m depth and therefore subject to regular scouring by icebergs calved from glaciers along the coast, which has consequences on benthic assemblages and fish (Beaman and Harris, 2005; Causse et al., 2011; Gutt et al., 2007; Koubbi et al., 2010; Post et al., 2011).

At the time of CEAMARC, the eastern edge of the area was bordered by the Mertz Glacier ice tongue which extended northward more than 80 km from the coast. Immediately to the west of the ice tongue, and positioned over the George V Basin, is the Mertz Glacier Polynya (Smith et al., 2011). This is a region that remains as open water throughout the year because of the combination of strong offshore winds, prevailing westerly flowing currents and the shelter provided to the east by the ice tongue. The constant contact between cold air and the sea surface in winter produces vast quantities of sea-ice which is blown northwards out of the polynya. As the sea-ice forms it rejects heavy more saline water (Lacarra et al., 2011; Marsland et al., 2004) which sinks to become deep flowing Antarctic Bottom Water. It was anticipated that at some stage the Mertz Glacier ice tongue would detach and would have an immediate physical impact on the seabed, as well as the biological communities in general through altered oceanographic conditions and current flow. The ice tongue broke off in February 2010 producing iceberg C28 approximately 80 × 40 km in size (Young et al., 2010).

Since 2004, France with the support of Belgian, Italian and Australian researchers have been conducting series of plankton and fish surveys of the continental shelf area. The ICOTA (Coastal Ichthyology in Terre Adélie) programme primarily focused on fish larvae and juvenile and adults of demersal fish. Later, the ICO<sup>2</sup>TA (Integrated Coastal Ocean Observations in Terre Adélie) programme extended the pelagic work focussing more on the Antarctic silverfish *Pleura-gramma antarcticum* and incorporating plankton studies, especially the euphausiid *Euphausia crystallorophias*, which along with *P. antarcticum* are key prey species of predators foraging on the shelf. Both the ICOTA and ICO<sup>2</sup>TA programmes have provided further indication that the topography and hydrology of the shelf affect the distribution of fish, larvae of fish and euphausiids and plankton (Koubbi et al., 2009, 2011; Vallet et al., 2009). The programmes were the foundation for CEAMARC itself, and provide the data which allow time-series analyses of the fish and plankton in the region, included in this special issue.

The CEAMARC area corresponds with Area C of Japanese Antarctic Research Expedition STAGE

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