Census of Antarctic Marine Life (CAML)

DRAFT Uniform Sampling Protocols – Pelagic Realm

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The current draft is based on a draft prepared during February 2006. By end March 2006 the draft will be posted on the CAML website (in the Members' secure area) for comment and reference by the Scientific Steering Committee (SSC).

Aim

The uniform sampling protocols are being prepared by the SSC to provide a baseline of minimum acceptable standards in projects coordinated by CAML. These uniform protocols are provided as a guideline for the various researchers, vessels and locations included in the CAML project. They are not intended to be prescriptive; rather they provide the baseline of a minimum standard for the publication of metadata on the SCAR-MarBIN data portal to OBIS. Where the protocols cannot be met, for example where a non-standard net is fitted following damage to standard gear, this should be noted as an exception to the uniform protocols.

For some realms, there will be overlap in the sampling protocols. For example, demersal fish are included in the pelagic realm for convenience, however many may occupy the benthic habitat. Microbes may be pelagic; however they are cross-referenced in a separate set of protocols.

Introduction

The pelagic realm is always moving, forming part of a dynamic oceanographic system. The system is subject to climatic and ocean variability. This drives the variability in sea ice cover, which in turn determines the structure of the pelagic ecosystem in the Antarctic. The geostrophic currents, and the frontal systems separating them into different water masses, are important aspects of the environment of pelagic organisms.

Historically, human impact on the Antarctic has been greatest in the pelagic realm. Currently continues human impact in the pelagic and affects adjoining ecosystems, for example seals impinging on tussock grass habitats. The epipelagic and mesopelagic communities support the top predators - whales, seals, fish and seabirds - that have been the subject of huge exploitation in the past and are still impacted by commercial fisheries and their bycatch. Together with the "top down" impact of whaling and fisheries, the "bottom up" impact of global climate change is shaping the pelagic ecosystems that we see today in Antarctica. These affect the extent and timing of the annual sea ice cycle, the ecology of the pelagic ecosystem and the ecosystem services from Antarctica to the global ocean system.

Collection data should include the date, time (GMT) and georeference of the sample, together with relevant information on the depth and duration of a tow. Tissue samples should be accompanied by the genus and species of the organism, with the author and date of the description and location of voucher/type specimen. This information is often indicated by a species code, with a relational link to another database. In the frequent situation that an organism is undescribed, reference to a voucher specimen is imperative.

In the pelagic realm, description of the geographical location of sampling requires careful consideration. Georeferencing of the sample pinpoints the location of the sample, however additional information in relation to fronts, upwellings and other oceanographical phenomena may be highly relevant.

1. Main groups of organisms in the Antarctic pelagic realm

Microzooplankton
Passively moved by a current.
Size 20–200 µm

Mesozooplankton
Passively moved by a current or limited mobility against currents.
Size 0.2–2.0 mm

Macrozooplankton
Passively moved by a current or limited mobility against currents.
Size 2–200+ mm

Micronekton
Capable of swimming against a current.
Size 10–100 mm

Nekton
Capable of swimming against a current.
Size > 100 mm

Demersal (as sampled in daytime)
Capable of swimming against a current.
On or near the bottom; may migrate vertically into the water column at night and may include merozooplankton. Included in the pelagic realm for convenience, although some organisms may be oriented more to the seafloor than the water column.

2. Methods of collection
For the purposes of CAML sampling, collection from the pelagic realm has been grouped according to the sampler employed. First, we list the conventional samplers such as nets with specified mesh size, yielding a *quantitative sample*. These samples are comparable between different areas, times and vessels of deployment. Second, the additional methods of gathering information, yielding useful but not necessarily quantitative data. The various methods may

provide a window on more than one group of animals. There is overlap in the organisms sampled by the various gears. For example, bongo nets may occasionally capture micro nektonic fish as a bycatch of the target zooplankton.

Key to abbreviations

LHPR	Longhurst Hardy Plankton Recorder (Cod end can be attached to RMT IKMT or semi rigid net – not commonly used)
RMT	Rectangular Midwater Trawl
IKMT	Isaacs-Kidd Midwater Trawl (previously a common alternative to the RMT for krill and macro zooplankton; RMT used in CCAMLR protocols.
CPR	Continuous Plankton Recorder
WP2	Probably the most common conical net.
Norpac	North Pacific Net
ORI	Ocean Research Institute
MOCNESS	Multiple Opening/Closing Net and Environmental Sampling System
IYGPT	International Young Gadoid Pelagic Trawl
AGASSIZ	Agassiz Trawl

2.1. Conventional quantitative samplers

Basic common systems are highlighted in bold text

Group	Gear Type	Comments
Microzooplankton	Water bottles – Niskin Water pumps Ice cores Umbrella nets	Suitable for fragile organisms Overlap with microbe protocols Sea ice micro zooplankton
Mesozooplankton	Multinet (Multiple Plankton Sampler)	Depth-stratified samples during vertical tows.
Zooplankton	Bongo nets – as WP2 or Norpac Plankton nets – WP2, Norpac, ORI RMT 1+8 IKMT LHPR CPR Light traps Umbrella nets	Duplicate samples Vertical tow Stratified oblique* and horizontal tows – overlap with CCAMLR-IPY Krill survey protocols Oblique and horizontal tows Horizontal tows See separate protocols Under ice sampling Under ice sampling
Micronekton	LHPR RMT 1+8 IKMT	

	MOCNESS Bongo nets	Depth-stratified sampling*
Nekton	RMT 1+8 RMT 25 IYGPT IKMT AGASSIZ Commercial trawls Squid Jigs or similar	Overlap with CCAMLR-IPY krill survey protocols (See also Benthic Protocols)
Demersal	Epibenthic sleds Commercial bottom trawls Longlines	Cameras may be fitted Special dispensation required (See also Benthic Protocols)

* Stratified depths need to be defined but for the RMT it is likely to be 0–200 m, 200–500 m, 500–1000 m and 1000–2000 m (or deeper, depending on the winch capability). The latter is based on discussions with Evgeny Pakhomov and other Antarctic zooplankton biologists.

2.2. Additional methods of gathering information

CTD-Bottle rosettes
Provides basic oceanographic profiles of salinity, temperature, as well as oxygen, light profiles and fluorometry to help explain horizontal and vertical distribution patterns. The CTD also provides a platform for water bottles for sampling protist and nutrients and also serve as a platform for camera/video systems.

Acoustics
Passive acoustics monitor the activities of whales, using hydrophones, moorings and acoustic curtains. Active acoustics assess the stocks of pelagic species eg. CCAMLR surveys of krill using split-beam echosounders with 38, 120 and 200 kHz and EK500 (can be quantified in a relative framework).

Moorings and drifters
Passive acquisition of data eg. AUDOUS. Images may be collected this way.

Images and video identification systems
Important for gelatinous zooplankton that cannot be properly captured or preserved by conventional techniques. Provides information on function and movement.

Remotely Operated Vehicles
Vehicles gather data and images, may have pumps and arms to grab specimens. *ROV Isis* deployed to provide information on vertical migration of scattering layer with diel cycle.

Higher Predators
Body parts of prey in the stomachs of their predators indicate trophic pathways and energy flow in the ecosystem. For example, squid beaks from whale, seal and seabird stomachs; fish otoliths seal and seabird stomachs. Barcoding of tissue may be used to identify stomach contents, by reference to a library of known organisms.

Detection of aggregations
Organisms in the pelagic zone may aggregate with oceanographic phenomena. Aggregation patterns may be detected by satellite information and location of fishing vessels. Nutrient data indicates highly productive areas, sometimes shown by sea surface colour and temperature. Aggregations of seabirds indicate feeding areas. The distribution of sea ice is visible on NOAA synthetic aperture radar.

Biologgers
Biologger packs and cameras on seals and whales provide data eg. CTD thermal structure of the water column. Areas inaccessible by ships can be sampled, eg. under permanent pack ice.

Commercial fishing vessels
Commercial gear may sample species that are not caught by other methods. Intensive and repetitive sampling in a location may yield rare species. Catch per unit effort data assists in stock assessment. Fisheries and CCAMLR surveys eg. ground fish surveys at South Georgia, Kerguelen, and Heard Island provide abundance and distribution data, possibly stock assessment. Historical records of the exploitation of whales, seals, seabirds and krill indicate the level of human disturbance of the pelagic ecosystem.

Tourist vessels
Observations may assist on some projects eg. seabird distribution, whale movements.

Parasites
The identity and distribution of parasites on their pelagic hosts provide population-level information and elucidate trophic pathways. See separate protocols promised by Eric Hochberg.

Tissue samples
Samples of tissue from pelagic organisms provide information on gene sequence (barcoding using Coenzyme 1), stable isotopes, heavy metals, lipids, fatty acids, calcification (erosion due to ocean acidification), UV effects.

Swath mappers and bathymetric data
Bathymetrical data show dropoffs and canyons that may be important for the distribution of pelagic organisms. For example, eggs and larvae may be located in relation to canyons.

3. Processing Protocols - handling and processing of samples on ship – *work in progress*
   - 3.1 Protists/microzooplankton, possibly as defined by microbe group
   - 3.2 Meso-, macrozooplankton (non-gelatinous) and krill. – Hosie, Pakhomov and Siegel
   - 3.3 Continuous Plankton Recorder – Hosie
   - 3.4 Special protocols to be established
     Gelatinous zooplankton – Russ Hopcroft
     Nekton
     Fish – Philippe Koubbi or Dick Williams
     Cephalopods – Paul Rodhouse, Uwe Piatkowski, Victoria Wadley

4. References – *work in progress*

BIOMASS protocols
CCAMLR protocols
MARECO protocols ICES Zooplankton Methodology Manual

Perissinotto R. (1995) Marine Productivity. In : Encyclopedia of Environmental Biology. Volume 2. Academic Press, pp. 507-521.

Lenz J. (2000). Introduction. In: ICES Zooplankton Methodology Manual. Academic Press, pp. 1-32.

For further information:
Molecular analysis – see separate barcoding protocols
Demersal organisms – see separate benthic protocols
CPR – see separate protocols by Graham Hosie