—報告—
Report

Report on the Southern Ocean Continuous Plankton Recorder (SO-CPR) Standards Workshop 2018: SCAR SO-CPR Database Expert Group

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南極研究科学委員会の連続プランクトン採集器データベース グループワークショップ 2018 報告

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要旨: 2018 年 11 月 20–23 日にオーストラリア南極局にて「南極研究科学委員会，連続プランクトン採集器（以下 CPR）データベース専門家グループワークショップ 2018」を開催した．本ワークショップは 2 年に一度を目途に，南大洋 CPR 観測プロジェクト参加国の技術者を集め，各国間で統一された試料処理およびデータ管理を維持する目的で実施しており，今回は 2016 年に次ぐ開催であった．プロジェクトを主導する日本，オーストラリア，ニュージーランドの実務担当者の間で，動物プランクトンの種同定リストの更新，それに伴う具体的な分類カテゴリーの同定方法の確認を行った．特に亜南極域に出現するオキアミ類やカイアシ類について情報共有した．後半は観測データの品質管理，データ分析手法の再確認，また各国のマネージメントの状況を確認するとともに，今後の活動についての詳細な討議を行った．特に新規参入国へ向けた技術者育成ワークショップのための，分析手法マニュアル，および動物プランクトン種同定マニュアルの作成へ向けたロードマップを作製し，作業を開始することになった．

キーワード: 連続プランクトン採集器，モニタリング観測，動物プランクトン

Abstract: The “Southern Ocean Continuous Plankton Recorder (SO-CPR) Survey Standards Workshop” was held at the Australian Antarctic Division on 20–23 November 2018. This biennial workshop was last held in 2016. The participants were technicians from the three nations (Japan, Australia, and New Zealand) leading the project. The purpose of the workshop was to ensure that high standards of data quality were being

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maintained, in terms of species identification and methodology, among the main analysts of the SO-CPR survey, and to discuss future training methods and a future roadmap for the SO-CPR program. A range of topics was discussed including: taxonomic resolution issues (particularly for northern species of copepods and euphausiids), laboratory methods (setting of the CPR cassette, microplastic counting rules), training methods (SO-CPR processing manual and zooplankton counting rule book), data handling for database input, and future standards workshops, including comprehensive training workshops for emerging SO-CPR survey partners. We discussed and agreed on a future roadmap for making a SO-CPR processing manual and zooplankton counting rule book, for the purposes of current and new technician training.

Keywords: Continuous Plankton Recorder, monitoring, zooplankton

1. Background

The Continuous Plankton Recorder (CPR) is a useful monitoring tool for surface plankton species. It can continuously collect data over a distance of 450 nautical miles during a single tow as it is pulled behind a vessel with normal ship speed. CPR surveys have successfully been used to define geographical groupings of zooplankton species/taxa with similar patterns of seasonal, interannual, long-term, and spatial variation in plankton diversity.

The CPR prototype was invented and first trialled in the Southern Ocean by the marine biologist inventor Sir Alister Hardy during the *Discovery Investigations* of the 1920s. In 1991, the Southern Ocean CPR (SO-CPR) Survey commenced for the purposes of mapping spatial and temporal variations in zooplankton patterns and making use of the sensitivity of plankton to environmental change as an early indicator of the health of the Southern Ocean ecosystem (Hosie *et al*., 2003). The Scientific Committee on Antarctic Research (SCAR) recognised the importance and value of the SO-CPR data and established an Action Group in 2006. In 2008, we started the Expert Group on CPR Research (EG-CPR) to assist with the development and expansion of CPR research in the Southern Ocean and Antarctic waters. EG-CPR transitioned in 2016 to form the SO-CPR Database Expert Group to focus more on maintaining the quality control and assurance of data entered into the SCAR SO-CPR Database, as well as continue to develop the survey itself. At the SCAR Standing Scientific Group−Life Science (SSG-LS) business meeting in Davos, Switzerland in May 2018, the continuation of the SO-CPR Database Expert Group until the next meeting (August 2020) was recognized.

The terms of reference for the SO-CPR Database Expert Group are to:

1. Continue to develop and maintain the SO-CPR Database and improve access for users
2. Ensure quality assurance and control of the data through regular training and standardisation workshops
3. Encourage other nations, especially developing Antarctic nations, to participate in the workshops, and thus improve the spatial and temporal coverage of CPR tows around Antarctica

The SO-CPR dataset is an important SCAR Business Product, and it is dependent on regular taxonomy and methodology standardisation workshops to maintain and ensure quality assurance and control of the data. At the time of the 2016 workshop in Hobart, we

agreed that there should be a workshop every two years to ensure that the high standards of the SO-CPR program are maintained (Takahashi *et al*., 2017).

2. Purpose of the workshop

The SO-CPR Standard workshop was organized to ensure the maintenance of high-quality data for zooplankton species analysis among the CPR analysts in each country. The main purpose of this meeting was to confirm that the three main analysts (from Japan, Australia, and New Zealand) are maintaining consistent high standards in relation to species identifications, methods, and data quality. A secondary aim of the workshop was to discuss future training methods, including the production of a SO-CPR processing manual, a zooplankton counting rule book, and a future roadmap for the SO-CPR program. This workshop followed on from the 2016 Hobart Standards Workshop (Takahashi *et al.*, 2017).

3. Workshop agenda and participants

Four participants from three countries attended the workshop (Table 1), including three CPR analysts (one from each country). The agenda for the workshop is shown in Table 2.

4. Workshop summary

4.1. Laboratory methods

We discussed the laboratory methodologies being used and checked some points in the laboratory (Fig. 1). We checked the processing procedure for each sample carefully based on the 2010 workshop report from Tokyo. In particular, we performed practice training for the setting of the CPR cassette in the laboratory. The processing methodologies will be further updated in a new SO-CPR processing manual.

4.2. Species list

During the previous workshop in 2016, we updated the species/taxa list of 260 categories (Takahashi *et al*., 2017). This time, one Amphipoda (*Hemityphis* sp.), one Siphonophorae (*Lensia* sp.), and 27 northern copepod species/taxa (*Acartia (Acartiura) tranteri*, *Acartia (Odontacartia) pacifica*, *Aetideus australis*, *Calanoides brevicornis*, *Calanoides* sp., *Calocalanus plumulosus*, *Calocalanus styliremis*, *Centropages furcatus*, *Clausocalanus arcuicornis*, *Clausocalanus ingens*, *Clausocalanus pergens*, *Clytemnestra*

Table 1. Workshop participant list.

Name	Position	Affiliation	Country
Kunio Takahashi	Assistant Professor, Director SO-CPR	National Institute of Polar Research	Japan
John Kitchener	CPR Senior Analyst, Co-Chair SCAR EG-CPR	Australian Antarctic Division	Australia
Karen Robinson	Plankton Analyst	National Institute of Water and Atmospheric Resarch	New Zealand
Graham Hosie	Emeritus Life Fellow, CPR Ambassador	Sir Alister Hardy Foundation for Ocean Science	Australia

Table 2. Agenda for the "SO-CPR Standards Workshop."

SO-CPR Standards Workshop "SCAR SO-CPR Database Expert Group" Agenda	
20 Nov.	
10:00-11:00	Background and purpose of workshop
	-Report of the SCAR business meeting in Davos, 2018
11:00-13:00	Up-to-date "SO-CPR taxonomic list"
	-Checking new species/taxa
	-Microplastic counting rule
	-Collation of taxonomic list
14:00-17:00	Database
	-Data handling for database
	-Double checking
21 Nov.	
10:00-12:30	Database
	-Data handling
13:30-15:00	Checking the publication list
15:00-17:00	Review of new identification and counting rules
22 Nov.	
10:00-12:30	CPR processing manual
	-Laboratory methodologies
	-Counting rule for copepods
14:00-17:00	CPR processing manual
	-Counting rule for euphausiids
	-Counting rule for other groups
23 Nov.	
10:00-11:30	Project fund and future workshops
	-Planning of the next workshop
	-Training workshop for India
	-Further larger workshop
11:30-12:30	Sample processing situation
14:00-16:00	Checking the laboratory methodologies
16:00-17:00	Workshop report

scutellate, *Farramula* sp., *Lucicutia flavicornis*, *Mecynocera* sp., *Mesocalanus* sp., *Nannocalanus minor*, *Oculosetella gracilis*, *Oithona atlantica*, *Oithona longispina*, *Oncaea mediterranea*, *Oncaea venusta typica*, *Paracalanus aculeatus*, *Paracalanus indicus*, *Rhincalanus nasutus*, *Sapphirina nigromaculata*, and *Scaphocalanus echinatus*) were added. The newest species list for the SO-CPR database was checked using the Taxon Match of the World Register of Marine Species (WoRMS: http://www.marinespecies.org/index.php) name validation tool (Costello *et al*., 2013). We updated the list to the latest version, which currently includes 289 species/taxa (Table 3).

4.3. Taxonomic resolution issues

Based on reports of past workshops (Takahashi *et al*., 2011, 2017), we checked a new

Fig. 1. Photographs showing verification of methods by technicians in the laboratory (left), and microplastic in the CPR samples (right).

counting rule. We also reviewed the previous reports to keep the same level of taxonomic identification of species at each technician. We checked the following points in particular.

- Copepods: The identification rules and counting points for the nauplius stages of *Eucalanus* and *Rhincalanus* species
- Euphausiids: The identification rules of northern species such as *Euphausia hanseni*, *E. lucens*, *E. similis*, and *E. spinifera*; the counting points for the larval stages including *Euphausia vallentini* and *E. frigida*
- Decapods: The identification rules for Zoea and Megalops stages
- Others: The minor identifying point of several species/taxa, such as *Vibilia* spp. (Amphipoda), Foraminifera, and Chaetognatha species

The taxonomic rules will be further updated in a new SO-CPR counting rule manual.

4.4. Microplastics on CPR samples

Marine plastic pollution has spread across the world's oceans, and recent findings have now demonstrated that microplastics have indeed reached the Southern Ocean (Isobe *et al*., 2017; Waller *et al*., 2017). To understand the sources and scale of this pollution, an internationally coordinated effort is needed with standardised identification techniques for microplastics. The CPR analysts from the Australian and New Zealand have been collecting a limited amount of data about microplastics alongside their primary research on CPR since 2008 (Fig. 1). In late 2016, there was a proposal for a common and appropriate counting methodology from the Global Alliance of CPR Surveys (GACS) community, which coordinated a global CPR program (Table 4).

Thus, we confirmed the counting rule for microplastics in CPR samples. We try to identify to three types of plastic: "Strand", "Bead", and "Flake". The "Strand" type is further classified into "Monofilament-type" or "Flat-fibre type". Each type is divided into seven colours (clear/transparent, black, blue, red, yellow, green, and other colours) and four size ranges ("Small" $\leq 300\,\mu$m, "Medium" $> 300\,\mu$m ≤ 2 mm, "Large" > 2 mm ≤ 5 mm, and "Extra Large" > 5 mm). We agreed to add the microplastics column into the latest data sheet and to count continuously.

*Table 3. Zooplankton species/taxa list for the SO-CPR Survey. C: Calyptopis stage, F: Furcilia stage. * Class; ** Phylum; *** Infraclass; **** Subphylum. +: New species /taxa added at this workshop. (1/3)*

Order	Taxa	Order	Taxa
Amphipoda	Amphipoda indet	Calanoida	*Calanoides acutus*
Amphipoda	*Brachyscelus crusculum*	Calanoida	*Calanoides brevicornis* +
Amphipoda	*Cyllopus lucasii*	Calanoida	*Calanoides* sp. +
Amphipoda	*Cyllopus magellanicus*	Calanoida	*Calanus australis*
Amphipoda	*Dairella californica*	Calanoida	*Calanus propinquus*
Amphipoda	*Hemityphis* sp.+	Calanoida	*Calanus simillimus*
Amphipoda	*Hyperia* sp.	Calanoida	*Calanus* sp.
Amphipoda	*Hyperia spinigera*	Calanoida	*Calocalanus plumulosus* +
Amphipoda	*Hyperiella antarctica*	Calanoida	*Calocalanus* sp.
Amphipoda	*Hyperiella dilatata*	Calanoida	*Calocalanus styliremis* +
Amphipoda	*Hyperiella* sp.	Calanoida	*Candacia bipinnata*
Amphipoda	Hyperiidae indet	Calanoida	*Candacia cheirura*
Amphipoda	*Hyperoche medusarum*	Calanoida	*Candacia falcifera*
Amphipoda	*Hyperoche* sp.	Calanoida	*Candacia maxima*
Amphipoda	*Phronima* sp.	Calanoida	*Candacia* sp.
Amphipoda	Platysceloidea indet	Calanoida	*Centropages aucklandicus*
Amphipoda	*Primno macropa*	Calanoida	*Centropages bradyi*
Amphipoda	*Scina* sp.	Calanoida	*Centropages furcatus* +
Amphipoda	*Themisto australis*	Calanoida	*Centropages* sp.
Amphipoda	*Themisto gaudichaudii*	Calanoida	*Clausocalanus arcuicornis* +
Amphipoda	*Themisto* sp.	Calanoida	*Clausocalanus brevipes*
Amphipoda	*Vibilia antarctica*	Calanoida	*Clausocalanus ingens* +
Amphipoda	*Vibilia armata*	Calanoida	*Clausocalanus laticeps*
Amphipoda	*Vibilia* sp.	Calanoida	*Clausocalanus pergens* +
Branchiopoda*	Branchiopoda indet	Calanoida	*Clausocalanus* sp.
Chaetognatha**	Chaetognatha indet	Harpacticoida	*Clytemnestra scutellata* +
Phragmophora	*Eukrohnia hamata*	Harpacticoida	*Clytemnestra* sp.
Aphragmophora	*Pseudosagitta gazellae*	Hexanauplia*	Copepoda indet
Aphragmophora	*Pseudosagitta* sp.	Hexanauplia*	Copepoda nauplius indet
Aphragmophora	Sagittidae indet	Calanoida	*Ctenocalanus citer*
Aphragmophora	*Solidosagitta marri*	Calanoida	*Ctenocalanus* sp.
Choreotrichida	Tintinnina indet	Cyclopoida	Cyclopoida nauplius indet
Cirripedia***	Cirripedia cyprid	Calanoida	*Drepanopus* sp.
Cirripedia***	Cirripedia nauplius	Calanoida	*Euaugaptilus* sp.
Diplostraca	*Evadne* sp.	Calanoida	*Eucalanus hyalinus*
Diplostraca	*Podon* sp.	Calanoida	*Eucalanus* sp.
Siphonophorae	Abylidae indet	Calanoida	*Euchirella rostrata*
Siphonophorae	*Chelophyes* sp.	Calanoida	*Euchirella rostromagna*
Cnidaria**	Cnidaria indet	Calanoida	*Euchirella* sp.
Siphonophorae	*Lensia* sp. +	Harpacticoida	*Euterpina* sp.
Siphonophorae	Siphonophorae nectophore	Cyclopoida	*Farranula* sp. +
Siphonophorae	Siphonophorae sp.	Calanoida	*Haloptilus oxycephalus*
Narcomedusae	*Solmundella bitentaculata*	Harpacticoida	Harpacticoida indet
Calanoida	*Acartia (Acartia) danae*	Calanoida	*Heterorhabdus austrinus*
Calanoida	*Acartia (Acartiura) tranteri* +	Calanoida	*Heterorhabdus lobatus*
Calanoida	*Acartia (Odontacartia) pacifica* +	Calanoida	*Heterorhabdus* sp.
Calanoida	*Acartia* sp.	Poecilostomatoida	*Heterorhabdus spinifrons*
Calanoida	*Aetideus australis* +	Calanoida	*Lubbockia* sp.
Calanoida	*Aetideus* sp.	Calanoida	*Lucicutia flavicornis* +

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Order	Taxa	Order	Taxa
Calanoida	*Lucicutia* sp.	Calanoida	*Scaphocalanus echinatus* +
Calanoida	*Mecynocera clausi*	Calanoida	*Scaphocalanus farrani*
Calanoida	*Mecynocera* sp. +	Calanoida	*Scolecithricella minor*
Calanoida	*Mesocalanus* sp. +	Calanoida	*Scolecithricella* sp.
Calanoida	*Mesocalanus tenuicornis*	Calanoida	Calanoida indet (small)
Calanoida	*Metridia gerlachei*	Calanoida	*Stephos longipes*
Calanoida	*Metridia lucens*	Calanoida	*Subeucalanus longiceps*
Calanoida	*Metridia* sp.	Calanoida	*Subeucalanus* sp.
Calanoida	*Microcalanus pygmaeus*	Calanoida	*Sulcanus conflictus*
Harpacticoida	*Microsetella norvegica*	Calanoida	*Temora turbinata*
Harpacticoida	*Microsetella rosea*	Poecilostomatoida	*Triconia antarctica*
Harpacticoida	*Microsetella* sp.	Crustacea****	Crustacea nauplius indet
Calanoida	*Nannocalanus minor* +	—	Nauplius indet
Calanoida	*Neocalanus gracilis*	Ctenophora**	Ctenophora indet
Calanoida	*Neocalanus tonsus*	Cumacea	Cumacea indet
Harpacticoida	*Oculosetella gracilis* +	Decapoda	Decapoda (natant) indet juv
Cyclopoida	*Oithona atlantica* +	Decapoda	Decapoda megalopa indet
Cyclopoida	*Oithona frigida*	Decapoda	Decapoda nauplius indet
Cyclopoida	*Oithona longispina* +	Decapoda	Decapoda phyllosoma indet
Cyclopoida	*Oithona similis*	Decapoda	Decapoda zoea indet
Cyclopoida	*Oithona* sp.	Decapoda	*Munida gregaria*
Poecilostomatoida	*Oncaea curvata*	Decapoda	*Nematocarcinus longirostris*
Poecilostomatoida	*Oncaea mediterranea* +	Decapoda	Sergestidae indet
Poecilostomatoida	*Oncaea* sp.	Stomatopoda	*Squilla* sp.
Poecilostomatoida	*Oncaea venusta typica* +	Noctilucales	*Noctiluca scintillans*
Calanoida	*Onchocalanus* sp.	Echinoidea*	Echinoidea larvae
Calanoida	*Paracalanus aculeatus* +	—	Egg indet
Calanoida	*Paracalanus indicus* +	—	Egg mass
Calanoida	*Paracalanus* sp.	Euphausiacea	*Euphausia crystallorophias*
Calanoida	*Paraeuchaeta antarctica*	Euphausiacea	*Euphausia crystallorophias* calyptopis
Calanoida	*Paraeuchaeta barbata*	Euphausiacea	*Euphausia crystallorophias* furcilia
Calanoida	*Paraeuchaeta biloba*	Euphausiacea	*Euphausia frigida*
Calanoida	*Paraeuchaeta exigua*	Euphausiacea	*Euphausia frigida* calyptopis
Calanoida	*Paraeuchaeta* sp.	Euphausiacea	*Euphausia frigida* furcilia
Calanoida	*Paraheterorhabdus farrani*	Euphausiacea	*Euphausia hanseni* furcilia
Calanoida	*Paralabidocera antarctica*	Euphausiacea	*Euphausia longirostris*
Calanoida	*Pleuromamma abdominalis*	Euphausiacea	*Euphausia longirostris* calyptopis
Calanoida	*Pleuromamma borealis*	Euphausiacea	*Euphausia longirostris* furcilia
Calanoida	*Pleuromamma gracilis*	Euphausiacea	*Euphausia lucens*
Calanoida	*Pleuromamma piseki*	Euphausiacea	*Euphausia recurva*
Calanoida	*Pleuromamma robusta*	Euphausiacea	*Euphausia similis*
Calanoida	*Pleuromamma* sp.	Euphausiacea	*Euphausia similis* furcilia
Calanoida	*Pleuromamma xiphias*	Euphausiacea	*Euphausia spinifera*
Calanoida	*Rhincalanus gigas*	Euphausiacea	*Euphausia spinifera* calyptopis
Calanoida	*Rhincalanus gigas* nauplius	Euphausiacea	*Euphausia spinifera* furcilia
Calanoida	*Rhincalanus nasutus* +	Euphausiacea	*Euphausia superba*
Calanoida	*Rhincalanus* sp.	Euphausiacea	*Euphausia superba* C1
Poecilostomatoida	*Sapphirina nigromaculata* +	Euphausiacea	*Euphausia superba* C2
Poecilostomatoida	*Sapphirina* sp.	Euphausiacea	*Euphausia superba* C3

*Table 3. Zooplankton species/taxa list for the SO-CPR Survey. C: Calyptopis stage, F: Furcilia stage. * Class; ** Phylum; *** Infraclass; **** Subphylum. +: New species /taxa added at this workshop. (3/3)*

Order	Taxa	Order	Taxa
Euphausiacea	*Euphausia superba* calyptopis	Thecosomata	*Clio* sp.
Euphausiacea	*Euphausia superba* F1	Gymnosomata	*Clione limacina antarctica*
Euphausiacea	*Euphausia superba* F2	Gymnosomata	*Clione* sp.
Euphausiacea	*Euphausia superba* F3	Gastropoda*	Gastropoda indet
Euphausiacea	*Euphausia superba* F4	Thecosomata	*Limacina* sp.
Euphausiacea	*Euphausia superba* F5	Gastropoda*	Pteropoda indet
Euphausiacea	*Euphausia superba* F6	Gymnosomata	*Spongiobranchaea australis*
Euphausiacea	*Euphausia superba* furcilia	Teuthida	Teuthida indet
Euphausiacea	*Euphausia triacantha*	Isopoda	Isopoda indet
Euphausiacea	*Euphausia triacantha* calyptopis	Bivalvia*	Bivalvia larvae
Euphausiacea	*Euphausia triacantha* furcilia	Mysida	Mysidae indet
Euphausiacea	*Euphausia vallentini*	Ostracoda*	Ostracoda indet
Euphausiacea	*Euphausia vallentini* calyptopis	Chordata**	Pisces egg
Euphausiacea	*Euphausia vallentini* furcilia	Chordata**	Pisces larvae
Euphausiacea	Euphausiidae calyptopis indet	Myctophiformes	Myctophidae indet
Euphausiacea	Euphausiidae furcilia indet	Perciformes	*Pleuragramma antarctica*
Euphausiacea	Euphausiidae indet	Myctophiformes	*Protomyctophum* sp.
Euphausiacea	Euphausiidae metanauplius indet	Phyllodocida	Alciopidae indet
Euphausiacea	Euphausiidae nauplius indet	Phyllodocida	Iospilidae indet
Euphausiacea	*Nematoscelis megalops*	Phyllodocida	Lopadorrhynchidae indet
Euphausiacea	*Nyctiphanes australis*	Phyllodocida	*Maupasia* sp.
Euphausiacea	*Nyctiphanes australis* calyptopis	Phyllodocida	*Pelagobia longicirrata*
Euphausiacea	*Nyctiphanes australis* furcilia	Phyllodocida	*Phalacrophorus pictus*
Euphausiacea	*Thysanoessa gregaria*	Phyllodocida	*Phalacrophorus* sp.
Euphausiacea	*Thysanoessa gregaria* calyptopis	Polychaeta*	Polychaeta indet
Euphausiacea	*Thysanoessa gregaria* furcilia	Polychaeta*	Polychaeta larvae
Euphausiacea	*Thysanoessa macrura*	Phyllodocida	*Tomopteris carpenteri*
Euphausiacea	*Thysanoessa macrura* C1	Phyllodocida	*Tomopteris* sp.
Euphausiacea	*Thysanoessa macrura* C2	Phyllodocida	*Travisiopsis levinseni*
Euphausiacea	*Thysanoessa macrura* C3	Phyllodocida	*Travisiopsis* sp.
Euphausiacea	*Thysanoessa macrura* calyptopis	Phyllodocida	*Typhloscolex muelleri*
Euphausiacea	*Thysanoessa macrura* F1	Phyllodocida	*Vanadis antarctica*
Euphausiacea	*Thysanoessa macrura* F2	Phyllodocida	*Vanadis longissima*
Euphausiacea	*Thysanoessa macrura* F3	Radiozoa**	Radiozoa indet
Euphausiacea	*Thysanoessa macrura* F4	Appendicularia*	Appendicularia indet
Euphausiacea	*Thysanoessa macrura* F5	Doliolida	Doliolidae indet
Euphausiacea	*Thysanoessa macrura* F6	Copelata	*Fritillaria* sp.
Euphausiacea	*Thysanoessa macrura* furcilia	Copelata	*Oikopleura* sp.
Euphausiacea	*Thysanoessa macrura* metanauplius	Pyrosomatida	Pyrosomatidae indet
Euphausiacea	*Thysanoessa* sp.	Salpida	*Salpa fusiformis*
Euphausiacea	*Thysanoessa* sp. furcilia	Salpida	Salpidae indet
Foraminifera**	Foraminifera indet	Salpida	*Salpa thompsoni*
Rotaliida	*Globigerina bulloides*	Salpida	*Soestia zonaria*
Rotaliida	*Globigerinita uvula*	Salpida	*Thalia* sp.
Rotaliida	*Globorotalia* sp.		
Rotaliida	*Neogloboquadrina incompta*		
Rotaliida	*Neogloboquadrina pachyderma*		
Rotaliida	*Turborotalita quinqueloba*		
Thecosomata	*Clio pyramidata*		

Table 4. Microplastic counting rules from GACS program.

Type	Color	Size	Split-strands type
Strand	clear/transparent black blue red yellow green other	S = Small (≤ 300 µm) M = Medium (> 300 µm ≤ 2 mm) L = Large (> 2 mm ≤ 5 mm) X = Extra-large (> 5 mm)	Mono = Monofilament-type strand Flat = Flat-type strand
Bead	clear/transparent black blue red yellow green other	S = Small (≤ 300 µm) M = Medium (> 300 µm ≤ 2 mm) L = Large (> 2 mm ≤ 5 mm) X = Extra-large (> 5 mm)	
Flake	clear/transparent black blue red yellow green other	S = Small (≤ 300 µm) M = Medium (> 300 µm ≤ 2 mm) L = Large (> 2 mm ≤ 5 mm) X = Extra-large (> 5 mm)	

4.5. Database

The SCAR SO-CPR Database is registered with the Australian Antarctic Data Centre (AADC) and can be accessed via: http://data.aad.gov.au/aadc/metadata/metadata.cfm?entry_id=AADC-00099. We checked the data handling for database input. From there, it is distributed to various international agencies and databases/portals including, but not limited to:

- GACS (http://globalcpr.org/)
- SOOS (Southern Ocean Observing System; http://www.soos.aq/)
- OBIS (Ocean Biogeographic Information System; https://obis.org/)
- GBIF (Global Biodiversity Information Facility; https://www.gbif.org/)
- SCAR's BIODIVERSITY.AQ (http://www.biodiversity.aq/)
- Atlas of Living Australia (https://www.ala.org.au/)
- CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources; https://www.ccamlr.org/)
- IGMETS (International Group for Marine Ecological Time Series; https://igmets.net/)

5. Future directions

5.1. Status Report

As a product of the Action and Expert Group on CPR research, we are continuing to work on a special report to SCAR on the Status and Trends of Southern Ocean zooplankton. This report will bring together all information derived over 25 years into the SO-CPR Survey. This report will also identify any trends (seasonal or long-term) in relation to

changes in abundance, shifts in distribution, timing of events, or changes in composition and community composition (Takahashi *et al*., 2017). The second workshop on a special report was conducted in May 2018 at the National Institute of Polar Research Japan. The purposes of the workshop were to summarize the SO-CPR Survey activities during the first 25 years, and to advance the task of writing the special report. This report involves a review of more than 50 publications, including peer-reviewed papers, proceedings, reports, and theses. We have already finished about 90% of the draft and will hold the final workshop for completing the report in May 2019.

5.2. Future conferences

The next "SCAR Business Meeting and Open Science Conference" will be held in Hobart, Australia in August 2020, and the "SCAR Biology Symposium" will be held in Christchurch, New Zealand in 2021. We will encourage high-level attendance by participants in our project, and a SO-CPR Database Expert Group meeting to discuss the development of our CPR program will be held in association with the symposium.

5.3. Future training and standards workshop

The SO-CPR Survey involves several countries with shipping activity in the Southern Ocean. Issues that were identified through this workshop include inconsistencies in taxonomic skill and identification across different laboratories and the lack of technicians with high-quality standard techniques. One important future task for maintaining high-quality data is therefore developing and enhancing the skills of current and new technicians. We will plan a larger standardisation workshop in 2020 to maintain the high standards for procedures and identification for quality control and assurance among the different laboratories around the world. Countries interested in joining SO-CPR will be encouraged to participate in our workshops. We also discussed ways to improve future training such as the making of a SO-CPR processing manual and zooplankton counting rule book. The new counting rules and taxonomic list will be further described in the new procedures manual. Furthermore, to expand the program, we are planning a training workshop for 2019 to help India initiate Southern Ocean CPR work. We have had discussions with scientists at the Goa National Centre for Polar and Ocean Research (NCPOR) about running a CPR from Goa to Antarctica during the annual resupply of India's Antarctic station. To achieve this, we will need to provide the necessary training to participants.

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