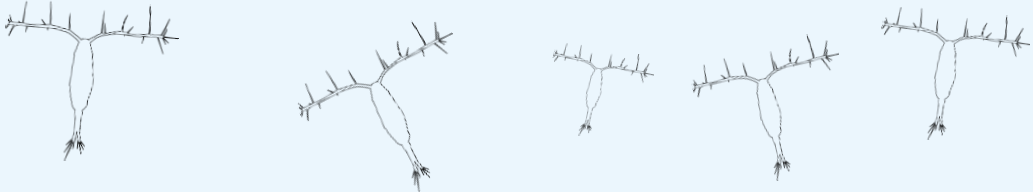


IMOS Australian Plankton Survey Newsletter - 2015

The Australian Continuous Plankton Recorder Survey & National Reference Stations



Directors report

2015 has been a busy year for us. I will just mention a few things here.

We released Plankton2015 on the 15th December – see the IMOS website for a copy: http://imos.org.au/fileadmin/user_upload/shared/Data_Tools/15-00245_OA_Plankton2015_20ppBrochure_WEB_151116.pdf. This is the inaugural assessment of the state of Australia's oceans using plankton as indicators of ecological change. Thank you to Ruth Eriksen and Wayne Rochester for their hard work on this, and Tim Moltmann and the IMOS office for their support. There was extensive media interest, including a 6-minute TV interview on ABC News 24 – who knew that plankton were so newsworthy! We will be producing the next plankton assessment in two years time.

We have had a couple of visits from staff of the Sir Alister Hardy Foundation for Ocean Science (SAHFOS) this year. Dave Conway came over to train us in zooplankton identification – we learnt a lot – thx Dave (and for helping paint my doors too!) Claire Taylor came over to exchange ideas – this provides a benchmark for us and helps us ensure we are adopting consistent and best practice in terms of our lab practices. It was great to have you here Claire! We were also lucky enough to gain some funding from CSIRO for travel, which helped support visits to SAHFOS. Mark Tonks did a CPR logistics course, Julian Uribe a zooplankton taxonomy course, and I visited and discussed continued scientific collaborations. Thank you SAHFOS for hosting us.

I would like to take this opportunity to congratulate Ysharda Clement, Jessica Savage, Vivian Yeung and Natsumi Nishikawa. All these students have used IMOS data and developed plankton expertise. Ysharda and Jessica did joint Masters projects between UQ, CSIRO, University of Florence and Université Libre de Bruxelles. Ysharda investigated the effect of climate variability and change on the zooplankton community

at the Port Hacking National Reference Station and found that the community has shifted from a cold-water to a warm-water one. Jessica investigated the effect of the extreme 2010/2011 heatwave in WA, where temperatures were up to 5°C above normal between December 2010 and March 2011. Jessica found that there was a significantly lower biomass of zooplankton at Rottnest Island and they were less abundant, but that the community composition was similar, suggesting that the warm-water had fewer zooplankton but similar species to what is normally present. You can read about Jessica and Ysharda's work later in the newsletter. Vivian Yeung did an Honours project at UNSW with Iain Suthers and Jason Everett investigating the size spectrum of zooplankton at the National Reference Stations on the east coast of Australia. She found that there was greater seasonality in size spectra off Tasmania, with higher biomass and mean size in Spring. Natsumi investigated the emergent zooplankton of the Great Barrier Reef and found that there were marked day/night differences. Well done everyone!

I also wanted to mention that the cutback in IMOS funding this year has been felt throughout IMOS and acutely for AusCPR. This has meant some tough decisions for us. I would like to thank the Team for maintaining a very positive, professional and flexible attitude during these challenging times. We also thank Tim Moltmann and the IMOS board for their continued support.

Finally, thanks everyone for your encouragement and collaboration this year. Hope you have a relaxing Christmas and a prosperous 2016. We will be producing our newsletter annually from now on, so watch out for it towards the end of next year.

Best
Anthony



Shipping Update

Mark Tonks

There have been several changes in shipping along the southern coast of Australia since our last newsletter, reflecting the high variability in the world economy in recent years, and the subsequent reductions in charter periods for ships operating around Australia. In early August CPR equipment was installed on a new vessel the *'Philadelphia'* in Sydney. This vessel is a 282m containership that is owned by the German company F. Laeisz. This vessel took over from the ANL *'Whyalla'* (formerly *'SCT Vietnam'*) that had been running the Sydney to Fremantle route for a number of years until February this year when it was taken off this service. Samples collected from this route were taken from the vessel in Fremantle and shipped to Brisbane towards the end of August, unfortunately this ship was removed from this service after this single tow. One again ANL were able to offer us the use of one of their ships; the ANL *Waratah*, which collected samples for us in early November. Unfortunately this ship will also only be servicing the route for a short period, so we are continuing to investigate other options. Earlier in the year, between February and June we contacted numerous ship agencies and companies who run freight in southern Australia hoping for assistance with the CPR however this proved difficult. In June we were encouraged by an offer of assistance by Wilhelmsen Ships Service and this resulted in a visit to the car carrier *'Tonsberg'* in July. Unfortunately, the configuration of their winching drums did not align well with a possible tow point location so we were not able to use this vessel or its sister vessel the *'Parsifal'*. Given the difficulties in sourcing ships we will investigate whether we can develop a tow point that works with the configuration of these ships.

Two Swires/ China Shipping Company vessels are continuing to tow CPRs along the east coast. The *'Island Chief'*, which was in dry dock from March to June 2015, is back running the Papua New Guinea Service and is collecting CPR samples north of Brisbane to Elusive Reef (southern Great Barrier Reef) and then between Brisbane and Melbourne when it returns to Australian waters from the Solomon Islands. The *'Kweichow'* has continued to sample the inner GBR between Brisbane, Gladstone and Townsville. However, due to a lack of market demand the *'Kweichow'* will no longer visit Brisbane after July 2015 but we will maintain sampling from Gladstone to Townsville.

Right: *Island Chief*

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Visit the AusCPR website at
<http://imos.org.au/auscpr.html>

Visit the NRS website at
<http://imos.org.au/anmnrs.html>

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<http://imos.org.au/australiancontinuousplanktonr6.html>



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Search IMOS Australian Plankton Survey or go to

<https://www.facebook.com/imosaustralianplanktonsurvey>



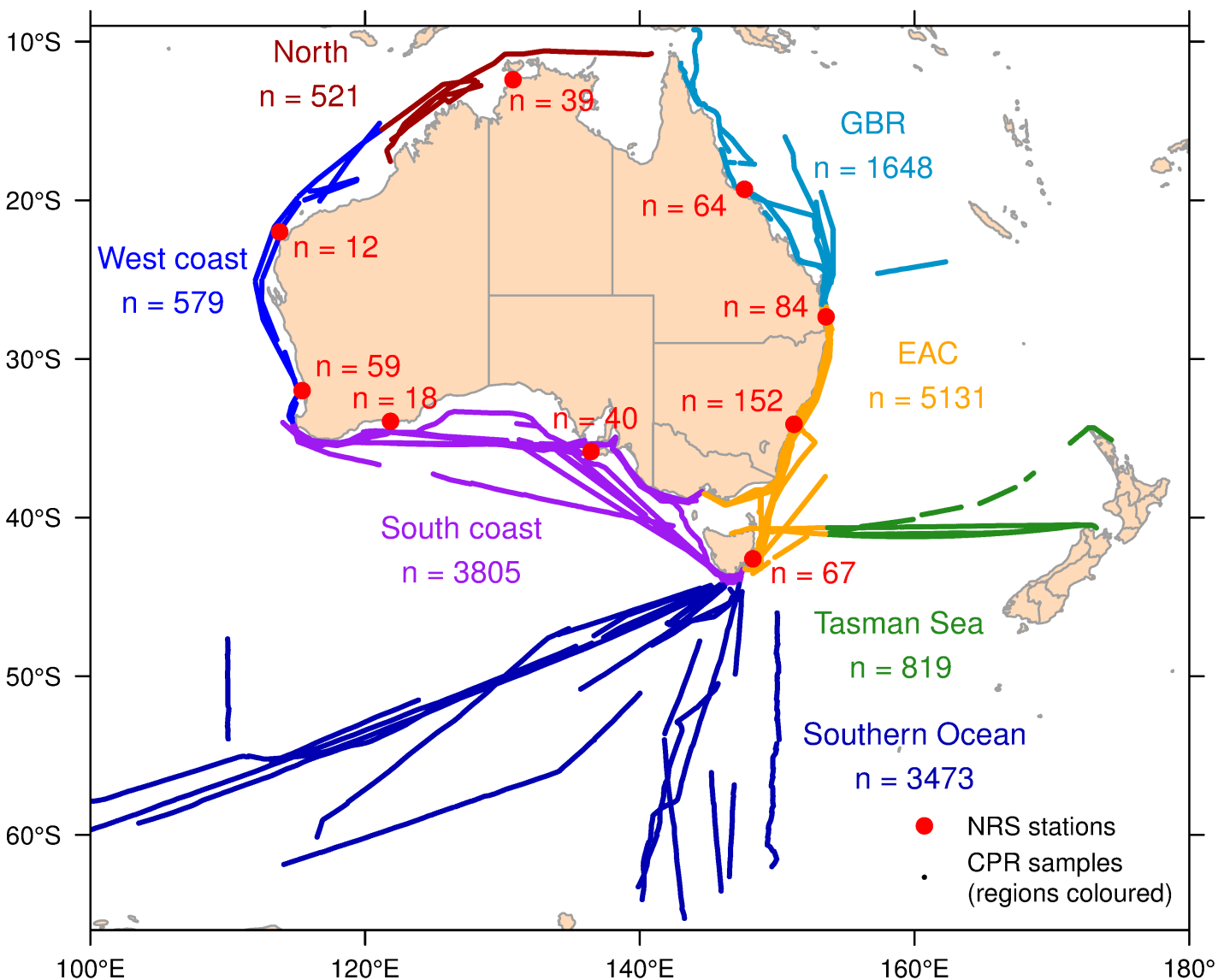
Integrated Marine Observing System (IMOS) Plankton Data 2007 – Nov 2015

Visit the AusCPR website at <http://www.imos.org.au/australiancontinuousplankton.html>

The **EAC route** is towed quarterly from Brisbane to Melbourne and follows the southward-flowing warm-water East Australia Current. This region is forecast to warm more than anywhere else in the Southern Hemisphere this century.

The **NRS** we sampled approximately monthly.

The **Tasman Sea route** is towed annually and extends from Burnie, Tasmania to Nelson, New Zealand. This is an important area for fisheries and our survey links in with the IMOS Bioacoustic Facility.



The **South Coast route** is towed quarterly from Melbourne to Fremantle. This route passes through a region of high endemism and is partly funded by the energy company BP.

The **Southern Ocean routes** below Australia are conducted by the SCAR SO-CPR Survey through the AAD and NIPR Japan, in conjunction with the AusCPR. Together with the EAC route, the Southern Ocean sampling provides an almost continuous transect running from warm tropical to polar waters.

Sample Progress – National Reference Stations

Stations	Pre Septem- ber 2008	2008				2009												2010												2011									
		S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	J	A	S	O	N	D			
Darwin																																							
Esperance																																							
Kangaroo Island																																							
Maria Island																																							
Ningaloo																																							
North Stradbroke Island																																							
Port Hacking		back to Feb 2002																																					
Rottnest Island																																							
Yongala																																							

Stations	2012												2013												2014												
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
Darwin	4						4				4							4				4								4				1			
Esperance																								site discontinued													
Kangaroo Island																								site discontinued													
Maria Island									2											2												2					
Ningaloo																								site discontinued													
North Stradbroke Island								2												2												2					
Port Hacking																					2																
Rottnest Island																						2												2	1	1	1
Yongala																																		1	1	1	1

Stations	2015											Total samples collected
	J	F	M	A	M	J	J	A	S	O	N	
Darwin		5										37
Esperance												17
Kangaroo Island												27
Maria Island												61
Ningaloo												13
North Stradbroke Island			2		2							79
Port Hacking												137
Rottnest Island						1						49
Yongala						2						58

- No sample planned
- No sample collected
- Sample collected
- Samples completed
- Historic Port Hacking samples

number in cell represents multiple samples from site for that month



Left: Mark Tonks and Julian Uribe Palomino dropping the plankton net at the North Stradbroke Island NRS station.

Update from Queensland

Frank Coman

In the Brisbane laboratory staff have been concentrating on collecting and analysing samples from both AusCPR and the NRS stations. Mark has also been working hard to get the CPR onto a new ship for the Sydney to Fremantle route, but there will be more on this in the Shipping News section of the newsletter.

In February, Anita, Frank, Mark, Julian, Alex and Anthony from Brisbane, along with James from Perth travelled to Hobart to join Claire, Felicity and Ruth in a phytoplankton identification workshop held at the IMAS building (see page 14 for the report). Julian attended a zooplankton workshop at SAHFOS, Plymouth in June (p.13) and went to the AMSA conference in Geelong to present on tintinnids collected from the IMOS plankton sampling program (p.15), both NRS and AusCPR. Ruth and Anthony also presented at the conference on data obtained from the IMOS plankton work. Both Anthony and Mark visited the SAHFOS laboratory. Anthony was working on some collaborative manuscripts and attended GACS, and Mark received training, especially from the workshop staff, at SAHFOS. Claire Taylor from SAHFOS visited the Brisbane laboratory in October to enhance the already strong interactions and collaborations between our two laboratories.

We have continued to have quite a few students working in our laboratory. Ysharda Clement has returned to work on data from Port Hacking NRS and historical samples, and we have also had Jessica Savage working on Rottneest Island NRS data and Larissa Perez working on *Trichodesmium* counting methods from NRS samples. Virginie and Audrey completed their internships in our laboratory, Audrey returned to France, while Virginie is undertaking another internship in South Africa. Ryan Downie, from CSIRO Hobart, spent some time in our laboratory using zooscan as part of his PhD, and Kate Burgess and Chris Rohner has also spent time in the laboratory investigating the diets of Manta Rays from Ecuador and the Philippines.

Sampling at the National Reference station at North Stradbroke Island has continued, and although we have managed 10 sampling trips this year, the timing has been affected by the weather, and we had 1 trip each in January and June and 2 in March and May to make up for unsuitable weather in February and April.

Mark Tonks, Julian Uribe and I are the regular crew, but we have also received plenty of help from students who have been visiting the laboratory and also Karl from the electronics laboratory. While we have not had any changes to the sampling procedures recently, we have seen some improvements in the boat, including the installation of 2 new motors and also a new stainless steel davit, both of which have improved the efficiency and safety of the sampling trips.

Update from Tasmania

Felicity McEnnulty

NRS

Maria Island NRS samples have been counted up to February 2015. Felicity put a photo on Facebook of some crustaceans .

CPR

RV Investigator first scientific cruise to the SOTS mooring at the end of March collected a CPR sample for us on the way back from 46.5 to 44.5 degrees South.

RV Investigator also collected CPR samples during transit voyages from Hobart to Brisbane (May 2015) and Sydney to Hobart (June 2015). It will also be collecting samples across the Great Australian Bight in November and December.

We have been looking at CPR samples from Hobart to the Subantarctic Front collected by our collaborators the Australian Antarctic Division on RV Aurora australis in October 2014.

Claire has looked at some interesting CPR zooplankton samples from the mid-coast of eastern Australian which had a surprising number of cold water species in them.

Ruth has been super efficiently churning through a range of phytoplankton samples including NRS, CPR, the SOCPR samples and also some consultancy samples from NW Western Australia

Phytoplankton Workshop

In February, we had a very productive workshop in Hobart with all team members attending, hosted at the new IMAS waterfront teaching laboratory. Experts on hand were Professor Gustaaf Hallegraeff (IMAS), Dr Penny Ajani (UTS) and Dr Steve Brett (Microalgal Services) who provided us with some very handy tips on identifying those tricky phytoplanktons.

Trichodesmium Project

Larissa Perez

My name is Larissa Perez and I am an undergraduate student of Environmental Engineering from Brazil. I have had the opportunity to work as an intern in the CSIRO – Oceans and Atmosphere Flagship under the supervision of Anthony Richardson. My work is focused on Trichodesmium, which is a cyanobacteria species found mainly in oligotrophic waters. For the last 6 months I have been counting and observing samples collected in the National Reference Stations of Yongala – 53 samples collected between 2012 and 2014 - and Darwin – 13 samples collected between 2011 and 2014. The main objectives of this study are to develop a fast method of counting and to make a comparison between the accuracy of Trichodesmium samples collected using a mesh net and samples collected using Niskin bottles. After doing statistical analysis, the results I have observed from the Yongala samples show that subsampling, using a one minute timed count, proved to be an accurate method. The comparison between mesh nets and Niskin bottles, suggests the net samples are more efficient for catching Tricho filaments.



Above: *Trichodesmium*, from the Great Barrier Reef, QLD
Image: Larissaa Perez



Above: *Trichodesmium*, from Port Hacking, NSW
Image: Julian Uribe

Climate Change and Zooplankton Communities in Port Hacking, NSW

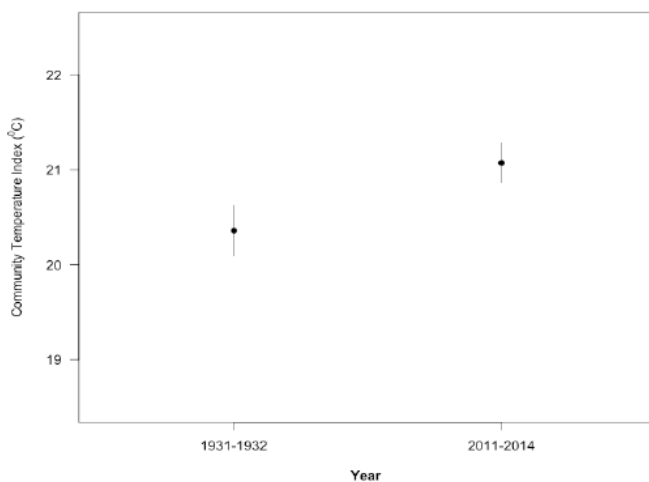
Ysharda Clement

I have investigated the effects of climate change and climate variability on zooplankton communities in Port Hacking, Sydney. Using the IMOS zooplankton dataset (2002-2013) I show how the present zooplankton community responds to changes in temperature and nutrients and how the community differs from the 1930's zooplankton community in terms of warm water and cold-water species. Findings suggest that the present day zooplankton community consists of more warm water zooplankton species in greater abundances than past communities and that seasonality and El Nino events influence the community. Increased flow of the East Australian Current in recent times has influenced the Port Hacking region and this creates a very interesting area to study how biological communities respond to environmental conditions. Zooplankton include a broad range of taxa from fish larvae to jellyfish to copepods and changes in their abundance and composition have important implications in marine food webs and climate regulation.

This project was being undertaken as a master's thesis project through a joint programme from the University of Florence, Université libre de Bruxelles, the University of Queensland and CSIRO.



Below: Mean community temperature indices \pm standard error for the historical data (1931-1932) and current data (2011-2014). Historical data was obtained from Dakin & Colefax (1940).



Zooplankton Communities at Rottneest Island

Jessica Savage, Erasmus Mundus MSc in Tropical Biodiversity and Ecosystems
 Supervisor: Prof Anthony Richardson

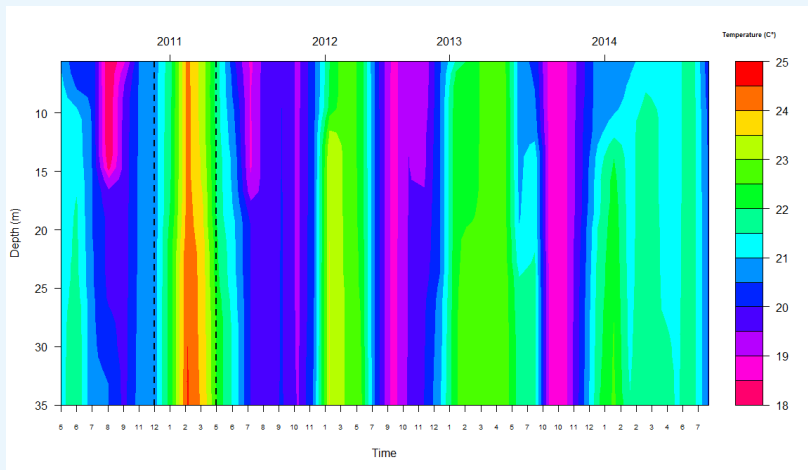
My project has investigated the responses of zooplankton communities at Rottneest Island to the 2010/2011 marine heat wave.



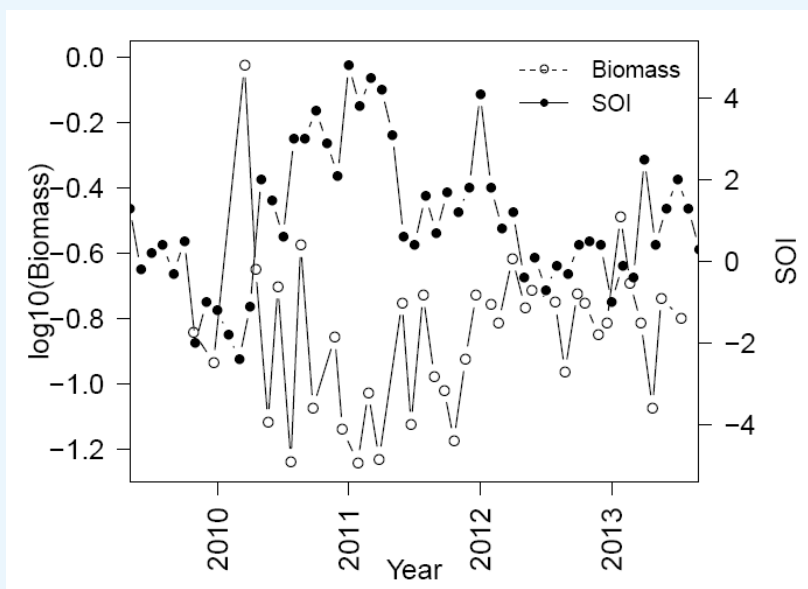
Rottneest Island (source: Wikipedia)

At the end of 2010 and in the early 2011, an extreme La Niña event caused the Leeuwin Current to accelerate, bringing warm tropical oligotrophic water down the coast of Australia. The temperatures rose above 5°C from average, resulting in fish kills, collapse of fisheries, and shifts in the range of megafauna (manta rays and whale sharks). The effects of the heat wave on plankton have not yet been studied. I used IMOS time series of monthly zooplankton biomass, abundance and diversity data from May 2010 to July 2014, along with physical and chemical parameters of the water body (such as temperature, salinity and nutrients) to determine what these effects were. The increased transport of Leeuwin Current suggested that the species composition of the zooplankton would change from temperate to tropical, inducing a decrease in biomass and abundance, as tropical zooplankton species tend to be smaller and less abundant. Linear models were used to investigate these hypotheses.

It was found that the biomass and abundance did indeed decrease during the heat wave, and were related to warm temperature. The diversity indices (Shannon diversity index and Pielou's evenness) increased, implying a greater number of species, and fewer individuals per species.



Above: The graph represents the temperature over the time series. The heat wave is clearly visible (between December 2012 and May 2011) and is delimited by the two dotted lines.



Above: Zooplankton biomass at Rottneest island, showing the Southern Oscillation Index (SOI).

IMOS Plankton Data presented at the Australian Marine Sciences Association Conference 2015

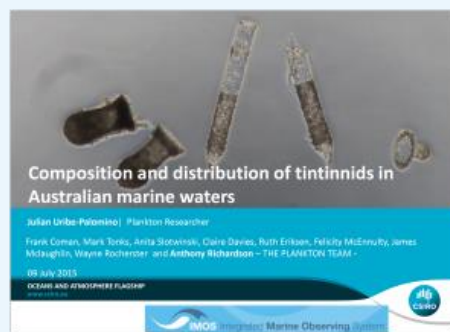
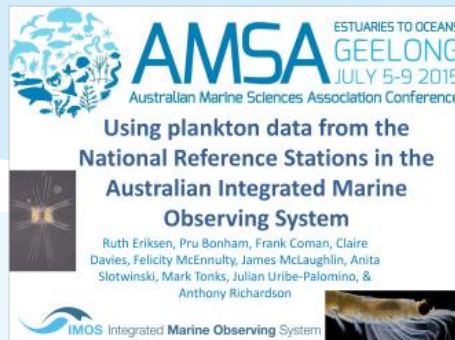
Julian Uribe-Palomino, Ruth Eriksen and Anthony Richardson

The IMOS-CSIRO plankton team participated with three presentations at the last Australian Marine Sciences Association (AMSA) conference held in Geelong this year. These three works highlighted the importance of using data from the Australian Integrated Marine Observing System (IMOS) database to produce useful results for the marine research community.

Dr Anthony Richardson, presented Plankton 2015: an assessment of Australia’s oceans using plankton as ecosystem indicators. This practical and useful product provides ecosystem indicators for climate change, ocean acidification, productivity supporting fisheries, biodiversity, and ecosystem health.

Dr. Ruth Eriksen explained the importance of the National Reference Stations as sources of very valuable biological and environmental data for the use of researchers, managers and policy makers interested in resource condition, and detecting and understanding the magnitude and time-scales of change in our marine environment.

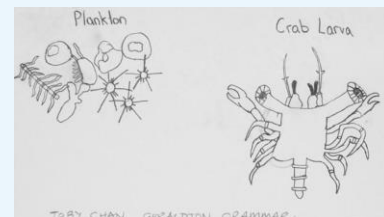
Finally Julian Uribe-Palomino presented preliminary results of a zooplankton group called tintinnids, the distribution and composition of this group have not been well studied in Australian marine waters. This study would not be possible without the information from the continuous plankton recorder and the National Reference Stations provided by the IMOS database.



Plankton Student Art

Anita Slotwinski

Our Integrated Marine Observing System - IMOS plankton images have recently been part of the Geraldton Community Coastal Biodiversity Exhibition in Western Australia. This has been designed by Angela Rossen, Artist in Residence Oceans Institute, The University of Western Australia. Our plankton images also formed the basis of a number of paintings and drawings made by children, some of which were included in the exhibition. The exhibition is on display in the Western Australian Museum - Geraldton and has attracted a lot of interest! A documentary was made of the project. Here is a link : <https://player.vimeo.com/video/127569580>
Thanks Angela for getting us involved.



Phytoplankton Training Workshop

Anita Slotwinski

The Plankton Team gathered together in Hobart during February 2015 for a 3 day intensive phytoplankton identification workshop, led by international plankton guru's Dr. Gustaaf Hallegraeff (University of Tasmania), Dr. Steve Brett (MicroAlgal Services) and Dr. Penny Ajani (University of Technology). The workshop was held at the new waterfront IMAS Labs in Hobart. The workshop was composed of both theoretical and practical components including:

- Temperate phytoplankton identification
- Tropical phytoplankton identification
- Identification of phytoplankton from the IMOS National Reference Station archive
- Identification of phytoplankton from the IMOS Australian Continuous Plankton Recorder Survey archive
- How does the CPR work?
- Phytoplankton time series presentation by Peter Thompson
- Identifying key features using fluorescence for pores and plates
- Identification from live cultures
- Identification of species in our photo database
- Phytoplankton Identification Sheet development and organisation systems
- Harmful Algal Bloom identification via light microscopy
- Changes to specimens upon lugols/formalin preservation
- Improving our NRS and AusCPR phyto identification and counting methodology
- Phytoplankton database

The Team would like to thank Gustaaf, Penny and Steve for donating their time and sharing their valuable skills and knowledge. We are excited to bring these new skills to the IMOS program.



Above: Julian Uribe-Palomino helping to collect a live plankton sample from the CSIRO dock.
Below: Workshop session in progress.



Below, from left: Anita Slotwinski, Mark Tonks, Alex Coughlan, Claire Davies, Ruth Eriksen, Felicity McEnnulty, Penny Ajani, James McLaughlin, ?, Anthony Richardson, Frank Coman, Steve Brett, Julian Uribe-Palomino, Gustaaf Hallegraeff



Zooplankton Workshop at Sir Alister Hardy Foundation of Ocean Science, Plymouth, UK

Julian Uribe Palomino

Earlier this year I attended a workshop on marine zooplankton identification held in Plymouth by the Sir Alister Hardy Foundation Organisation (SAHFOS) in June. There were people from 16 nations at the Workshop.

During my first day at SAHFOS, I had the opportunity to talk to SAHFOS and discuss the logistics of the Continuous Plankton Recorders (CPR) routes in the North Atlantic Sea. They took me step-by-step through the CPR components, the way it works, and their maintenance. I have never seen so many CPR units in my life! I also had a look at the laboratory where the CPR silks are analysed for counting and identification of phytoplankton and zooplankton organisms.

The workshop offered a variety of topics related to planktonic marine crustaceans such as copepods, euphausiids and decapod larvae. We covered generalities of these groups, also key points for their identification and the application of molecular techniques as a supportive tool for morphological taxonomy.

Though this training I had the opportunity to meet people with a lot of experience in the field of marine plankton such as Geoff Boxshall, David Conway, Alistair Lindley, Ruth Bottger-Schnack, Maria Grazia Mazzocchi, and Antonina Dos Santo. In particular, I enjoyed meeting Ann Bucklin whose area of expertise is molecular biology applied to marine organisms.

Finally this participation opened the possibility to create new contacts with young people who are interested in marine plankton research in other parts of the world.



1. CPR units. 2. CPR zooplankton analyst stations. 3. DNA practical session. 4. SAHFOS zooplankton workshop attendees, organizers and professors.



Improving resolution of phytoplankton species in CPR samples

Ruth Eriksen

Examining phytoplankton in CPR silks presents some unique challenges for identification: cells may be presented in atypical orientations, and getting clear, consistent focus on cells can be difficult compared to traditional counting chambers or glass slides.

At our recent Phytoplankton training workshop (Hobart, February 2015), we discussed the limitations of phytoplankton identification on the CPR silks, and how we might improve our methods. Dr Steve Brett suggested that we add coverslips to the CPR silk to improve optics, and thus resolution of species present.

We trialed a couple of methods in the lab, and compared samples with and without coverslips. The results are a resounding success, and we now add two large coverslips (50 x 50 mm) to the filtering area of the silk prior to counting. The sample is kept moist with PGP, and this provides good optical properties for our LWD x63 objectives.

METHOD

A number of methods were trialed, with the most successful to date being:

- Prepare silk for counting as per usual method by laying silks open on glass plate
- Add PGP gently to the filtering silk, removing bubbles by gently stretching the silk flat on the glass with tweezers
- Add two 50x50mm glass coverslips, covering the filtering area of the silk (ie the area to be counted)
- Add more PGP with a pipette if large bubbles form under the coverslip
- Adjust the correction collar on the x63 objective for the best resolution
- Examine silk at x63, and count using the normal protocol of two diagonal transects of 10 replicate fields of view
- When the count is completed, remove each coverslip and gently rinse the underside (in contact with the silk) back onto the silk with a little PGP
- Fold the silk and return to packet, including any PGP that has accumulated on the glass plate

RESULTS

Using the coverslips results in improved resolution of key features for phytoplankton ID. For example,

It was possible to clearly see the vault formed by the upper setae, and spinose setae in species of *Chaetoceros* (Phaeoceros) Figure 1

Spines of *Thalassiothrix* could be resolved, thus improving separation from *Lioloma* and *Trichotoxon* Figure 2

Direction of striae in *Gyrosigma* could be used to distinguish cells from *Pleurosigma* (although not in all cells due to chloroplasts)

Morphology of claws on *Corethron* spines could be distinguished, allowing differentiation between *C. inerme* and *C. pennatum* Figure 3a-c

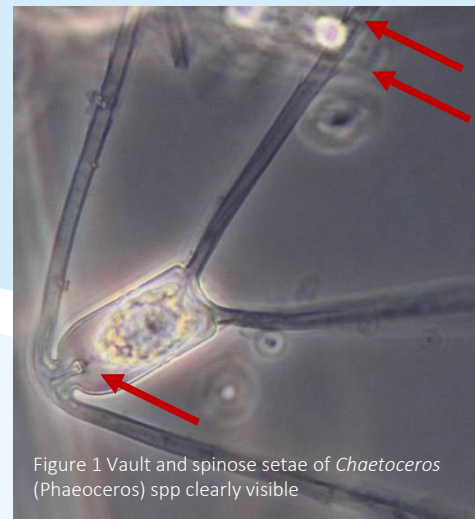


Figure 1 Vault and spinose setae of *Chaetoceros* (Phaeoceros) spp clearly visible



Figure 2 Absence of spines on long pennates distinguished *Trichotoxon* from *Thalassiothrix*



Figure 3a Morphology of claws on *Corethron* spines can be distinguished, improving ability to speciate



Figure 3b, c

Continuous Plankton Recorder Workshop, Plymouth UK Mark Tonks

Thanks to CSIRO, I was awarded Capability Development Funding to travel to Plymouth on the 23rd September to attend a Continuous Plankton Recorder (CPR) Workshop hosted by the Sir Alister Hardy Foundation for Ocean Science (SAHFOS). The course was run over a period of 11 working days. The purpose of attending the course was to improve and expand my knowledge of technical/ mechanical functioning of the CPR equipment in order to prevent loss of equipment, to maximise the success of plankton sample collection and to keep appropriate documentation to manage the integrity of equipment to satisfy liability issues.

The workshop covered an introduction to the SAHFOS plankton survey, the components of CPR equipment, servicing the internal cassette including fault detection, the preparation of silks to load into internal cassettes, examination of tow wires/ shackles, servicing of the CPR unit (including gearbox repairs) and fault finding, correct preservation techniques of plankton samples, documentation and logistics associated with equipment freighting and liaising with shipping companies. The greatest take home message from the course was the importance of taking precaution to safely protect, to the best of our ability, everybody involved in the survey from injury associated with CPR equipment and procedures. I was assessed on all of these components as SAHFOS are in the process of attaining accreditation for this course through the International Maritime Organisation (IMO).

Other than having a greater understanding of the mechanics, servicing and trouble shooting of CPR equipment I have an appreciation for the requirement to keep documentation (certificates and checks) of equipment that will fatigue and distort under load. This documentation can prevent over use of equipment or use of faulty equipment that can potentially lead to injury and the legalities associated with this. With respect to AusCPR survey there is a requirement to improve documentation of equipment use and fault checking procedures.

The SAHFOS Continuous Plankton Recorder workshop was comprehensive, interesting and informative. Over two weeks, the expert SAHFOS staff provided a supportive and enthusiastic environment in which theory and practical sessions were used to teach every aspect of the CPR Survey. As a result I feel more equipped to set up and service the CPR equipment in order to collect and store effective plankton samples and associated data. Even though I have experience with numerous aspects of the equipment I found it extremely useful and will definitely benefit the AusCPR team. I will establish new procedures regarding documentation and servicing that will safeguard against loss of valuable equipment/samples and also protect those deploying CPRs from injury as a result of equipment failure.



Above: Mark Tonks receiving his workshop certificate from Tanya Jonas.



Above: Eric Muxagata in the SAHFOS CPR workshop.



Above: Jules Morley, working on a CPR.

Zooplankton Workshop with David Conway

By Julian Uribe-Palomino and Frank Coman

Last October we, the IMOS-CSIRO plankton team, had the opportunity to improve our taxonomic skills through training offered by Dr. David Conway at the zooplankton laboratory in Brisbane.

Dr. Conway is author of several papers related to the study of zooplankton organisms. He has also used his professional experience working with zooplankton samples to compile four digital volumes of zooplankton, from the North Eastern Atlantic and other places of the world, that are freely available online. In addition to that, he has been analysing samples collected by the Continuous Plankton Recorder in the North Atlantic Sea at SAHFOS UK.

His expertise and willingness to share his knowledge makes him the right person to provide training to our plankton team.

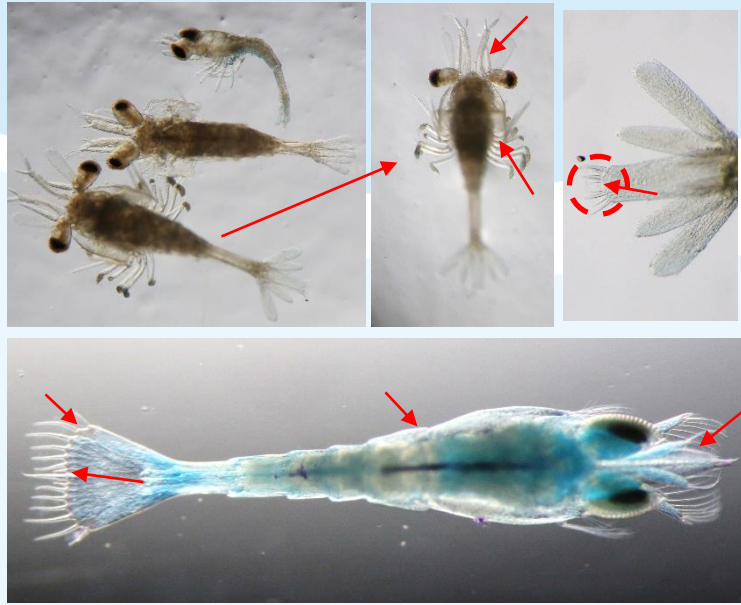
We gained new skills especially in the identification of larval stages from groups such as some crustaceans, echinoderms and molluscs. For instance, we feel more confident identifying decapoda larvae to infraorder level and in some particular cases to a family level. We have started to make distinctions of the different stages of echinoderms and assess the complexity of the larval stages and adult forms from the phylum mollusca.

In addition to this, we are refining our identification skills of cnidarians such as hydromedusae and siphonophores and planktonic polychaetes.

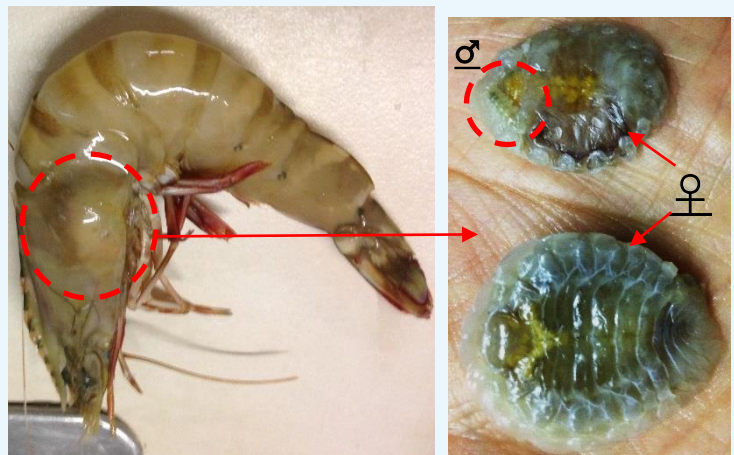
Felicity McEnnulty, who is a member of our plankton team, gave us a summary of her work identifying larval stages of euphausiids from samples collected at the Australian Southern Ocean.

Dr. Conway also presented some examples of parasitic marine planktonic organisms and the impact that they can have in populations of marine organism, the ecosystem and even the impact on the economy of some places.

The new knowledge that we are gaining plus the extensive collection of plankton images we have in our laboratory is being compiled in comprehensive charts and illustrated summary sheets. The team will be using these resources for the analysis of samples from the national reference stations and in samples from the continuous plankton recorder.



Above: Learning to identify different type of decapoda larvae (Infraorder: Caridea (top), Axiidea (bellow)).



Above: Adult isopod parasite (possibly *Hemiarthrus* sp.) found attached to the gills of king prawn (*Penaeus* spp.).

The participation in workshops such as the one we had with Dr. Conway helps to build a solid relationship to plankton experts and is a good way to improve the resolution and quality of the data that we produce for researchers who use the data from IMOS data portal.

Link to David Conway publications:

<http://www.mba.ac.uk/2015/04/09/the-complete-identification-guide-to-the-marine-zooplankton-of-southern-britain-is-now-available-to-download-for-free-from-the-mba-website/>

IMOS samples TrEnDing towards further identification

Tina Berry

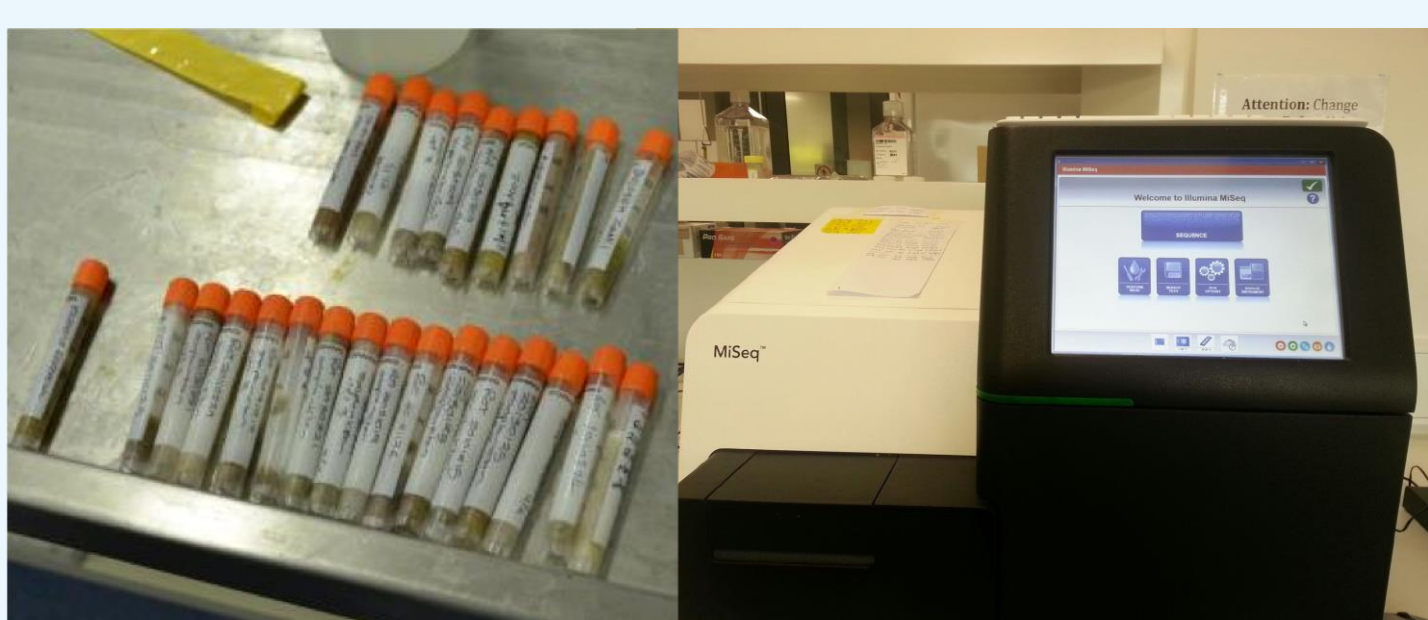
TrEnD Lab, Curtin University

The project is a collaboration between us, the TrEnD (Trace and Environmental DNA) Lab at Curtin University in Western Australia, and CSIRO in its role as a core partner in IMOS. Late in 2014 we were given the opportunity to subsample several plankton samples that had been collected by CSIRO from around Australia. The aim of this pilot project was to determine whether a next generation sequencing (NGS) approach could be used to complement existing methods by identifying genera or species that cannot be distinguished morphologically.

To be able to sequence DNA from the samples, primers are required. Primers are small pieces of DNA that are designed to adhere to, capture and reproduce (or amplify) larger pieces of “barcode” DNA. These barcodes are sections of DNA that are commonly used by researchers to identify a particular species or group of species. Unfortunately NGS primers sets for plankton were virtually nonexistent within the literature and so over twenty were designed as a part of the pilot project. Many of these primer sets have now been trialed with promising results. Thus the project has been expanded to include many more samples.

The range of samples collected offered a selection of potential projects. We are however particularly interested in conducting a longitudinal study using samples collected from one site in WA (Rottneest Island) over five years (including a marine heat wave) and later a spatial study examining the diversity of plankton communities across Australia and over three years. It will be interesting to discover whether the change in water temperatures affected diversity in the plankton communities at Rottneest and to look at the similarities and differences in plankton diversity around Australia.

We are very excited to continue our collaboration with CSIRO and IMOS and hope that this project will provide a valuable supplement to the tremendous amount of work already undertaken morphologically by CISRO Hobart.



Above: Plankton samples for subsampling.

Above: Illumina MiSeq; Next Generation DNA sequencing machine.

Australia 2015 – SAHFOS Visits Brisbane

As part of GACS (the Global Alliance of CPR Surveys) we invited Claire Taylor from SAHFOS (the Sir Alister Hardy Foundation for Ocean Science who has run a CPR survey for the past 70 years) to visit, to standardize methods between surveys and for us to learn from each other.

Some words from Claire Taylor, Deputy Lab Manager and Plankton Analyst, SAHFOS, UK...After a long old couple of flights, I was met by a familiar face at Brisbane International airport (thank you Anthony) and taken to what was going to be my home for the next couple of weeks. The following day began early (though for me it was evening) with a 1½ hour drive to a local National Park where the rest of the AusCPR (both from Brisbane and Hobart) team, along with Dave Conway, had set up camp. After a good walk, spectacular views and good company it was back to my hotel in an attempt to get my head around the time difference.

I managed to easily navigate my way to the Ecosciences precinct the next day and went straight into my first meeting. As the Tasmanian team were up visiting too, it was an ideal opportunity for a get together and we spent much of the first week thrashing out flow charts, taxonomic summary sheets and naming protocols. I also gave a well received presentation to the team regarding SAHFOS past and present, our methodologies and procedures, explaining the differences between the two Surveys. My evenings were spent popping down to the South Bank (very beautiful), visiting a nearby island, eating lots of scrummy Chinese/Vietnamese food or looking for an elusive wallaby in Anita's garden!

The next week was focused on being in the laboratory. I began by assisting Frank with unloading and cutting of silk and the entering of ships data. Julian then showed me some National Research station (NRS) samples. It was great to see tropical net hauled specimens and I soon developed an appreciation of just how small tropical zooplankton can get. This led onto Frank running through both AusCPR Phytoplankton and Zooplankton counts; it was comforting to see we both find the same things difficult to speciate and have nicknames for some things we just don't know what they are!

I had a thoroughly enjoyable couple of weeks and learnt a lot. I hope I have also given the AusCPR team a few ideas too. Many thanks to Anthony for the opportunity but also to Claire, Ruth and Felicity from Hobart and to Frank, Anita, Mark and Margaret in Brisbane, for making me feel so welcome. I would love to come back one day.....!



Above: Claire Taylor from SAHFOS in the IMOS Brisbane Lab

Noctiluca blooms in Tasmania – these sparkly sea organisms are an eerie omen of Climate Change

Michael Slezak, New Scientist (Source:

<https://www.newscientist.com/article/dn27565-these-sparkly-sea-organisms-are-an-eerie-omen-of-climate-change/#.VWuuW8-qpBd>)



Above: Milky Bioluminescence. Image: Jo Malcomson

“All I can say is wow, just freakin wow!” says Lisa-Ann Gershwin from Australian Marine Stinger Advisory Services in Launceston, Australia. This river in Southern Tasmania seemed to come alive this week as a bloom of *Noctiluca scintillans* – a type of bioluminescent plankton, also known as “sea sparkle” – washed into the region.

When it’s disturbed, the organism produces light in its cytoplasm, the gel-like substance inside its single cell.

As news of the bloom spread, hundreds of people came to see the spectacle, says Gershwin. “People turned out in droves, rolled up their pant legs and danced, ran, splashed, stomped, tiptoed, you name it, people played! It was incredible!”

But there is a dark side to this impromptu festival of light. “The displays are a sign of climate change,” says Anthony Richardson from the CSIRO, Australia’s national science agency in Brisbane.

Until 1994, *Noctiluca* had not been seen in Tasmania. But global warming has been strengthening the East Australian current, which pushes warm water south towards Tasmania. “As the Southern Ocean warms, it will be warm enough for *Noctiluca* to survive,” says Richardson.

What’s more, these particular plankton have more direct impacts too. “*Noctiluca* is a voracious feeder on diatoms, which is the food for krill in the Southern Ocean,” says Gustaaf Hallegraeff from the University of Tasmania in Hobart. Dense blooms like this can therefore starve other organisms, he says. They can also kill fish through oxygen depletion and gill irritation.

“As wondrous and entertaining as *Noctiluca* is, it is also a species infamous for causing fish kills,” says Gershwin. But what the outcome will be from this particular bloom remains an unresolved question, adds Hallegraeff. “Blooms can disappear within days, leaving essentially no trace.”



Plankton on the cover of Science!

Using the research vessel Tara, the Tara Oceans expedition sampled plankton ecosystems around the world and collected associated oceanographic data. The wet part of the expedition was accompanied by an integrative analysis on land, incorporating DNA sequencing and bioinformatics, microscopic imaging, and network analysis.

Read the issue here <http://scim.ag/sci0522>

See pages 841, 865, 870, and 873.

Photos: C. Sardet/CNRS/Tara Oceans/Plankton Chronicles/Plankton: Wonders of the Drifting World

Phytoplankton Image Gallery

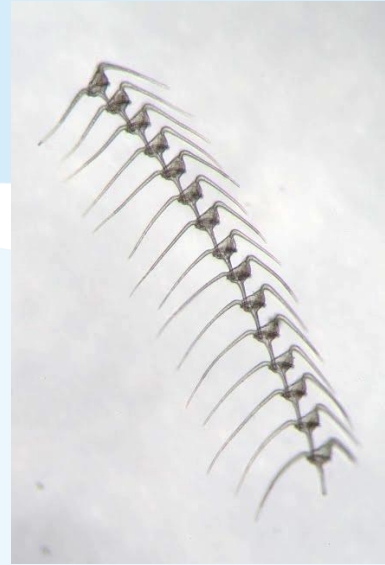
Images by Julian Uribe-Palomino & Ruth Eriksen



Ornithocercus steinii



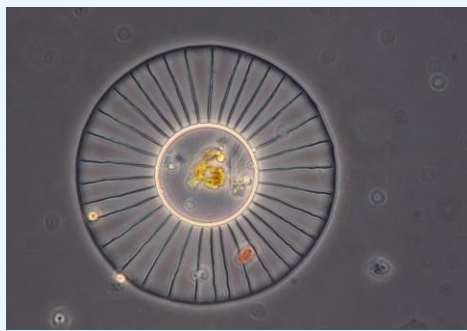
Bacteraistrum delicatum



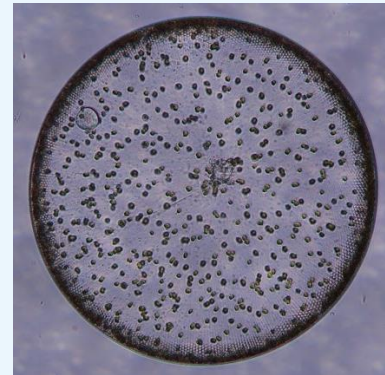
Tripos vultur



Chaetoceros decipiens



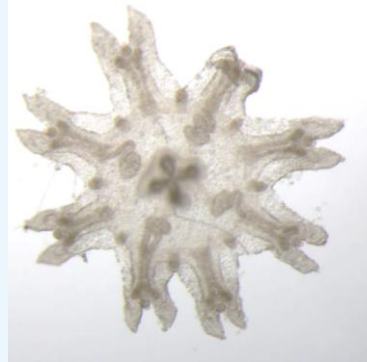
Planktoniella sol



Coscinodiscus gigas



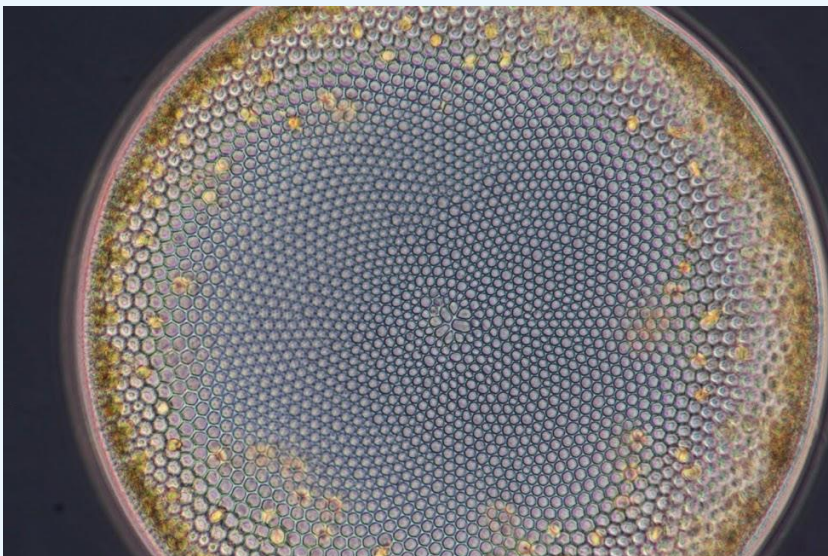
Ornithocercus splendidus



Medusa efira larva



Chaetoceros coarctatus and Vorticella oceanica



Coscinodiscus cf. granii



Prismatic Life, Sapphirina – 2015 New Scientist Eureka Prize for Science Photography IMOS Team member Julian Uribe Palomino receives high commendation

(Source: <http://australianmuseum.net.au/image/prismatic-life-sapphirina-eureka-prizes>)

Prismatic Life, Sapphirina
 Julian Uribe-Palomino
 IMOS - CSIRO Plankton Team
 Oceans and Atmosphere Flagship

Sapphirina is the name given by science to this beautiful micro-crustacean (subclass Copepoda) which produces a metallic blue colouration when light strikes the animal's body at a certain angle. This male specimen was collected near North Stradbroke Island in Queensland.

Julian Uribe-Palomino's striking image shows how the microscopic structure of the exoskeleton gives this animal the amazing ability to reflect light in a beautiful composition of colours.

See more at: <http://australianmuseum.net.au/image/prismatic-life-sapphirina-eureka-prizes#sthash.a65enins.dpuf>

Well done Julian !!

Free digital poster giveaway!

To celebrate our recent milestone of reaching 500 Facebook likes we have a free digital poster to give away, featuring the beautiful plankton we find off North Stradbroke Island, QLD, Australia

To receive your digital copy, please email Anita.Slotwinski@csiro.au



IMOS is a national collaborative research infrastructure, supported by Australian Government. It is led by University of Tasmania in partnership with the Australian marine and climate science community.



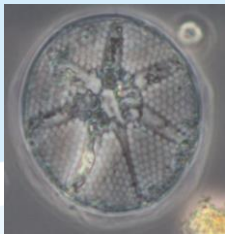
Images by: Anita Slotwinski and Julian Uribe-Palomino
 IMOS Australian Plankton Survey

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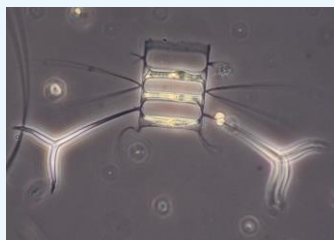
Snapshots from the Hobart Lab

Felicity McEnnulty

Asteromphalus is a diatom. It has an areolated surface with smooth rays that give it a star-like appearance. It is found in temperate waters and extends to the Southern Ocean. This one was in our September sample from Port Hacking in New South Wales. It was identified and photographed by Ruth. They are 42-175 micrometers diameter. I love it.



This is not a robot! It is a phytoplankton from the tropical waters of the North-west Shelf off Western Australia. This chain forming diatom was identified and photographed by Ruth, our phytoplankton expert. It is *Chaetoceros messanensis*.



Sometimes we get fish larvae in our samples. There's a few different sorts here from Tasmanian waters. Possibly Scorpaenids, Platycephalids, Clupeids and some others... To identify fish larvae, you need to count the myomeres (muscle bands) along the body, look for early developing pelvic fins, whether it has pigment and whether the gut is stripey, along with other key features.



Copepods

Claire Davies

Here are a few interesting facts about copepods in our samples. In our NRS and AusCPR plankton samples we find, as do most analysts, that copepods are the dominant group. In the NRS they account for 70% of taxa identified and 67% in the AusCPR samples.

They are also the group that has traditionally received the most attention from taxonomists and are therefore the best described group. They are robust and preserve well so the specimens are still in good condition once they get to the microscope.

We identify our copepods to species wherever possible and we routinely identify 232 different species. Calanoids account for 50% of all the copepods that we count; Poecilostomatoids 22%, Cyclopoids 15% and Harpacticoids 13%. Calanoids are also the most diverse group, of the 232 species that we identify, 134 of them are calanoids.

For information on how we identify our copepods please visit

http://www.imas.utas.edu.au/_data/assets/pdf_file/0009/396477/AtlasAustralianZooplanktonGuide_Introduction.pdf and <http://www.imas.utas.edu.au/zooplankton>

Female copepods are more common in the plankton samples than males, 71% of the adult copepods that we sex are female. Is this a real ratio or is it an artefact of sampling? There are a few notable exceptions, in the CPR samples we frequently see blooms of *Temora turbinata* and *Oncaea venusta*, these blooms are often 50% male, 50% female. In our samples 20% of the copepods we count are juveniles.

We use a 100 micron mesh in our drop net, this is a compromise between catching the smaller fraction copepods and the potential of the net clogging if a smaller mesh size were used.

We have also identified intersex copepods, they are 0.1% of our counts. These copepods are from the Paracalanidae and Clausocalanidae families. The intersex copepods can be identified as they have a female genital pore and an immature male leg, they can often be mistaken for juveniles. Does this mean that copepods have the ability to change sex?

Are the high ratio of female copepods and the potential ability for copepods to change sex related? Interested? Why not read more, similar findings have been reported from other studies. Felipe Gusmao, who spent time working as part of the IMOS plankton ecology lab, has published on this topic (Gusmao & McKinnon 2009).

Reference: Gusmao, F., McKinnon, A.D., 2009. Sex ratios, intersexuality and sex change in copepods, *Journal of Plankton Research*, 31(9):1101-1117



Image: Intersex copepod, *Acrocalanus* sp.
Credit: Luiz Felipe Mendes de Gusmao

PLANKTON 2015

Plankton 2015 is an assessment of the state of the oceans around Australia using plankton as indicators of ecological change.

The Plankton 2015 report from CSIRO and based on data from the Integrated Marine Observing System (IMOS) looks at why plankton are important to the health of our oceans and Australia's future prosperity.

Please download and share... http://imos.org.au/fileadmin/user_upload/shared/Data_Tools/1500245_OA_Plankton2015_20ppBrochure_WEB_151116.pdf

<http://imos.org.au/imosdatatools.html>

