

# IMOS Australian Plankton Survey Post

## The Australian Continuous Plankton Recorder Survey & National Reference Stations

Time flies – it's the start of a new year already. We have recently appointed a new member, **Dr Ruth Eriksen**. She is a phytoplankton expert based with Claire and Felicity in Hobart. Ruth will be helping us keep on top of our NRS and AusCPR phytoplankton samples. Welcome aboard Ruth! I'd also like to congratulate **Claire Davies** on her paper entitled "**Over 75 years of zooplankton data from Australia**". This paper compiles 98,676 abundance records of >1000 zooplankton taxa from unpublished research cruises, student projects, published literature, and IMOS datasets. This has been a great effort by the zooplankton research community, with 26 authors from 10 institutions involved. Congratulations also for **Asia Armstrong**, who has completed her Honours thesis at UQ and CSIRO entitled "Where can I find a decent meal? Foraging conditions at an aggregation site for reef manta rays on the Great Barrier Reef". She has just been awarded **1<sup>st</sup> class Honours**. Well done Asia!

I would also like to thank **SAHFOS** for hosting the **Global Alliance of CPR Surveys meeting** in Plymouth 24-26 September. This annual meeting harmonizes methods amongst CPR surveys, develops integrated products and cements collaborations. It was great to see everyone at SAHFOS once again and thank you for the hospitality.

We also have a number of **interns** at the moment. **Virginie Bornarel (Agrocampus Ouest, France France)** is describing the size spectra of zooplankton using Laser Optical Plankton Counter (LOPC) data and modelling in Matlab. This is a collaborative project with **Professor Iain Suthers** and **Dr Jason Everett** (both UNSW). **Audrey Laine (Agrocampus Ouest, France)** is looking at the food environment of manta rays. She has been using the ZooScan to describe the increased zooplankton densities that lead to manta ray feeding events. **Larissa Santeram (UMelb/Brazil)** is investigating the prevalence of the cyanobacterium *Trichodesmium*, which fixes atmospheric nitrogen in tropical waters. These data will be used to validate satellite algorithms for the identification of *Trichodesmium*. **Julia Ramos (UQ/Brazil)** is working on a database with **Dr Elvira Poloczanska**, updating our knowledge

of the rates and extent of the impacts of climate change on plankton and other marine life. **Sophie Horsfall (UQ)** is developing a database of jellyfish stings in Queensland based on data from Surf Lifesaving. **Elizabeth Claridge** is building a database summarizing newspaper reports on the impacts of jellyfish in terms of stings, fisheries and ingress events. Thanks to Julian, Frank, Tonka and Anita for making our students feel welcome.

I would also like to take this opportunity to highlight a recently funded **Australian Research Council (ARC) Discovery Project** entitled "**Linking phytoplankton to fisheries using zooplankton size spectra**" with **Professor Iain Suthers**, myself, **Dr Mark Baird** and **Dr Jason Everett**. This work will bring together gigabytes of LOPC and OPC data on zooplankton size spectra from around the world, and identify patterns in size spectra across a variety of systems (eutrophic to oligotrophic), latitudes (tropical to polar), and in the water column (surface to 100s of metres deep). A novel synthesis of the size structure of zooplankton communities, combined with phytoplankton estimates from satellites, will reveal critical ecosystem processes such as the export of carbon and fisheries production. This will inform environmental assessments and ecosystem sustainability, from water quality problems to fisheries, including the viability of super-trawlers in Australian waters. This project between UNSW, UQ and CSIRO will lever existing IMOS infrastructure.

Finally, I'd also like to thank Anita once again for putting the Newsletter together. She has also been doing a great job promoting IMOS and plankton research on our **Facebook page** ([www.facebook.com/imosaustralianplanktonsurvey](http://www.facebook.com/imosaustralianplanktonsurvey)). Take a look – there are many diverse articles, from using drones to study feeding of whale sharks on zooplankton to the most stunning plankton images you will see – and don't forget the free plankton posters!

Happy New Year to all our supporters.  
Anthony

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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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## Hobart Lab Update

We have been busy sorting samples from NRS and AUSCPR for zooplankton and phytoplankton.

We have also been on a steep learning curve looking at some drop net collected at the Southern Ocean Time Series (SOTS) mooring at 47degrees south in July 2012. The 3 day samples were fairly sparse (euphausiids, chaetognaths and a few copepods) and we had to sort the whole sample. But the night sample on the other hand was chockers of things, and almost every copepod was new to me (Felicity)!

Thanks to do The Australian Antarctic Division for collecting samples north of the Subantarctic Front for us this season, with *RV Aurora Australis* successfully deploying the CPR on V1 on the way to Davis in late October.

Frank and Claire went to sea on the new CSIRO vessel the *RV Investigator* as part of a trial voyage where they are testing the deployment of the CPR and assisting with other zooplankton sampling.

New staff – We also have Ruth Eriksen working with us part-time until end of June 2015 to identify the phytoplankton from the NRS backlog and CPR silks. Her expertise is very welcome.

Field sampling at the Maria Island NRS station has occurred as planned.

## IMOS Australian Plankton Survey Welcomes Dr Ruth Eriksen

Hi I am Ruth, I am working on the NRS and CPR samples, based in Hobart. I am a phytoplankton ecologist, and most of my work has been on temperate and sub-Antarctic communities. In the very distant past I was a hydrographic chemist. I am interested in understanding phytoplankton community dynamics and how phytoplankton respond to environmental change (natural and anthropogenic). I also work part-time at IMAS on a number of phytoplankton projects, and my new role at CSIRO is a perfect fit with my IMAS role. I'm particularly looking forward to working on tropical locations and learning more about warm water phytoplankton communities.



## Integrated Marine Observing System (IMOS) Plankton Data 2007 - 2014

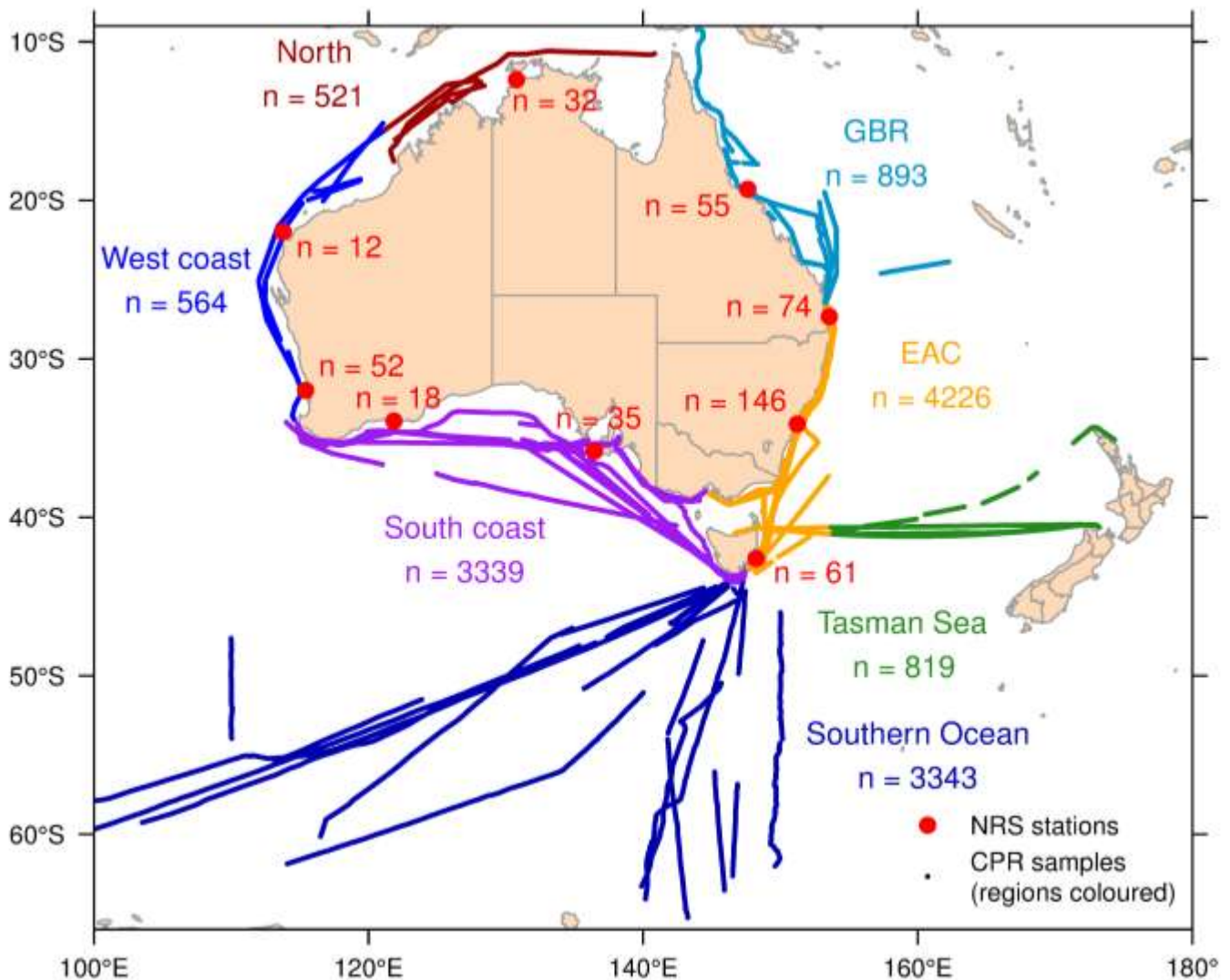
Visit the AusCPR website at <http://www.imos.org.au/australiancontinuousplankton.html>

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 **GBR route** is towed quarterly from Brisbane to Townsville. The Great Barrier Reef is an area likely to be affected by warming and ocean acidification.

The **West Coast route** is towed on an ad hoc basis.

The **North route** is towed on an ad hoc basis.



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.

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.

**National Reference Station Sample Progress**

Stations	Pre Septmber 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
Darwin																											
Esperance																											
Kangaroo Island																											
Maria Island																											
Ningaloo																											
North Stradbroke Island																											
Port Hacking																											
Rottne Island																											
Yongala																											

Stations	2012												2013												2014												Total samples collected
	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	A	S	O	N	D		
Darwin	4							4																											32		
Esperance																																			17		
Kangaroo Island																																			24		
Maria Island																																			56		
Ningaloo																																			13		
North Stradbroke Island																																			73		
Port Hacking																																			134		
Rottne Island																																			47		
Yongala																																			52		

- 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

**Australian Continuous Plankton Recorder Survey Sample Progress**

Routes	Pre 2009	2009												2010												2011											
		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	A	S	O	N	D	
ANL Windarra Brisbane-Sydney																																					
ANL Windarra Sydney-Melbourne																																					
ANL Windarra Melbourne-Adelaide																																					
Southern Ocean: phytoplankton and zooplankton	1 TOW																																				
Southern Ocean: zooplankton only	14 TOWS																																				
RV Southern Surveyor																																					
Great Australian Bight																																					
Tasmania to New Zealand																																					
RV Solander North West																																					

	2012												2013												2014												Total trips	Total samples
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D														
ANL Windarra Bris-Syd (ship removed from route Dec 2012)																													15	986								
ANL Windarra (Whyalla from Nov 2013) Syd-Melb																													22	1762								
ANL Windarra (Whyalla from Nov 2013)Melb-Adel																													12	986								
ANL Whyalla Adel- GAB																													5	432								
Tasmania to New Zealand																													4	863								
RV Southern Surveyor																													21	3679								
RV Solander North West																													4	285								
RV Cape Ferguson GBR																													4	105								
Southern Ocean: phytoplankton and zooplankton																																						
Southern Ocean: zooplankton only																																						
Kweichow Bris-Glad																													3	68								
Kweichow Glad-Towns																													4	146								
Island Chief Bris-Syd																													6	414								
Island Chief Bris-Glad																													4	177								

- no sample
- sample collected
- samples completed
- instrument problem
- ship problem
- PCI and phyto completed
- PCI completed

## Brisbane Lab Update

Since the most recent newsletter there have not been a lot of big changes in the Brisbane laboratory, with staff concentrating on collecting and analysing samples from both AusCPR and the NRS stations. The main news is that Anthony has managed to organise for Julian Uribe and Ruth Erikson have joined our group for the next year to help us with our analysis load. Julian is based in Brisbane and will mainly be counting zooplankton samples, while Ruth is based in the Hobart lab, where she will mainly count phytoplankton.

Julian and Mark recently gave a one day introductory zooplankton identification course in Sydney to a group which included staff from the Sydney water board and students from UNSW. Feedback from the course was positive, and preparing for the course was also great training for Julian and Mark. There will be a full report about the course elsewhere in the newsletter. Anthony was also away in September at the annual GACS meeting, and Frank, Mark and Julian were away for work in October. Frank (and Claire) went on the trial voyage of the new CSIRO ship the Investigator. Mark will be on the annual Torres Strait lobster survey and Julian visited Columbia, and spent some time giving an introductory course on plankton identification to university students.

Recently Claire was in Brisbane, and she stopped into the lab for a couple of days. Apart from meetings directly with our Team members, Claire also managed to catch up with a number of other people we have been collaborating with, particularly with regards to our database, and some interesting manuscripts which are arising from it. In the new year, the staff from Brisbane and Perth will be going to Hobart, where the whole team will be attending an in-house phytoplankton training workshop for 3 days. Felicity is taking the lead role in organising this. Recently we have also been trialling the use of ipads in the laboratory to store all our reference material. Mounts have been purchased to hold the ipads conveniently .

We have continued to have quite a few students working in our laboratory. Asia has just completed her Honours project, and Sarah has been able to resume some work in the laboratory, before she leaves for maternity leave. We have also had Virginie and Audrey doing internships in our laboratory from France, and just recently Natsumi has begun to spend more time in our laboratory for her Honours project.

Sampling at the National Reference station at North Stradbroke Island has continued, with Mark Tonks, Julian Uribe and myself going out most months, we have also received plenty of help from students who have been visiting the laboratory and also Karl and Brendon from the electronics laboratory. In

September, the North Stradbroke site began trial ichthyoplankton sampling as part of our monthly sampling. Samples are collected with a larger 500 micron mesh net, and will be sent to Iain Suthers' laboratory at the University of New South Wales for counting. Initially this sampling is only being conducted at a selection of the NRS stations, but hopefully this might be expanded in the future.

## Shipping Update

Since our last newsletter we have been we have continued to collect samples along from the ANL Whyalla and the Swires Shipping ships the Kweichow and the Island Chief. The Whyalla continues to collect samples between Sydney and Fremantle, travelling via the ports of Melbourne and Adelaide. We are now collecting two tows between Adelaide and Fremantle and have collected successful tows in June, September and December. The Island Chief and Kweichow have been collecting samples for us along the east coast, between Sydney and Townsville, and since the last report we have obtained samples from either or both ships for all months apart from October.

In November we were also lucky to conduct some tows from the new Marine National Facility vessel, the Investigator. The trial voyage was to test the deployment of sampling gear from the vessel and was conducted across the shelf off eastern Tasmania just north of Maria Island. Deployments of the CPR were successful and it would appear that the vessel will be a great platform to operate the CPR in the future.

Once again we would like to express our appreciation for the support of the company's managers, crews and Port Operations Officers who have enabled us to easily and effectively collect plankton samples and their associated spatial and temporal data.



Above: ANL ANL Whyalla

(source:[www.marinetraffic.com/ais/details/ships/shipid:730488/mmsi:565512000/imo:9295359/vessel:ANL\\_WHYALLA](http://www.marinetraffic.com/ais/details/ships/shipid:730488/mmsi:565512000/imo:9295359/vessel:ANL_WHYALLA))

### Do you have any phytoplankton data?

### Do you want to be part of a national data base project, collaborating and sharing data with researchers across Australia?

Recently the IMOS plankton team put out a call to all zooplankton researchers in Australia to contribute any data sets that they had from past research to the Australian Zooplankton Database. The IMOS plankton team also trawled through the CSIRO archives, student theses and literature to find as much zooplankton abundance data as possible. All this was collated into one database, converted to abundance/m3, the species names updated according to WoRMS, and with as much metadata as was found (sample depths, dates, net types and mesh sizes). The resulting data base, 98676 records, has been published in Ecology in November as a Data paper, with all data contributors as authors. Thank you to all contributors - this is a great example of collaboration in the marine research community.

Now we are wanting to put together all existing phytoplankton data and are looking for collaborations with phytoplankton researchers. We are looking for phytoplankton and Chla data from across Australia to build the Australian Phytoplankton Database. Many of you have already been asked, and a good number of you have responded with data. Thank you.

We will be collating phytoplankton species abundances in m3, presence/absence and chl a data and will require the following information. Please contact us if you would like to be involved; all contributors will be an author on the paper that describes the database.

Please do not hesitate to contact [claire.davies@csiro.au](mailto:claire.davies@csiro.au) with any questions or for more information.



### JeDI: The Jellyfish Database Initiative

JeDI is a scientifically-coordinated global jellyfish database housed at the National Center for Ecological Analysis and Synthesis (NCEAS), currently holding over 476,000 quantitative, categorical, presence-absence and presence only records on global jellyfish populations spanning the past two centuries. It can be accessed and searched at <http://jedi.nceas.ucsb.edu/>.

JeDI has been designed as an open-access database for all researchers, media and public to use as a current and future research tool and a data hub for general information on jellyfish populations. With this resource, anyone can use JeDI to address questions about the spatial and temporal extent of jellyfish populations at local, regional and global scales, and the potential implications for ecosystem services and biogeochemical processes. Using data from JeDI, the authors were able to show that jellyfish and other gelatinous zooplankton are present throughout the world's oceans, with the greatest concentrations in the mid-latitudes of the Northern Hemisphere. In the North Atlantic Ocean, dissolved oxygen and sea surface temperature were found to be the principal drivers of jellyfish biomass distribution. The IMOS plankton team were pleased to contribute all the jellyfish records from the National Reference Station counts and the AusCPR tows to the JeDI database.

Free Poster!

If you fancy a copy of this poster on your wall please email [Anita.Slotwinski@csiro.au](mailto:Anita.Slotwinski@csiro.au) for a digital poster file ready to print any size up to A0.

The poster features a collage of various jellyfish and gelatinous zooplankton species. At the top left is a large, colorful jellyfish with a green and blue pattern. To its right are several smaller, more transparent jellyfish. Below these are several other species, including a large, bell-shaped jellyfish and several smaller, more delicate forms. The bottom of the poster includes logos for the Integrated Marine Observing System (IMOS), the University of Queensland, and the National Reference Station (NRS).

## IMOS Australian Plankton Team board the maiden CSIRO Investigator research voyage

During November, Frank and Claire were privileged to be part of the first scientific voyage to be conducted on the new Marine National Facility, *Investigator*. The voyage was led by Professor Iain Suthers from UNSW and was focusing on testing out the variety of biological and biochemical sampling equipment on board and writing up the safety procedures for their safe deployment. The cruise scientific team consisted of a mix of scientists and students from the universities of Tasmania, New South Wales, Adelaide, Macquarie and Southern Cross, the CSIRO, and the NSW Department of Environment. The voyage explored the shelf break along the east coast of Tasmania in the vicinity of Schouten and Maria Islands, looking for the effects of frontal eddies and evidence of incursion of the EAC.

On the first night, the Continuous Plankton Recorder, CPR185 successfully completed its maiden tow from its new home, *Investigator*. It was towed on a zig zag transect up the east coast of Tasmania covering the shelf, the shelf break and oceanic waters. It will be an interesting transect to count, hopefully demonstrating the differences in plankton communities either side of the shelf break and from the warmer EAC waters.

The CPR was also towed on the last night of the cruise. A transect from Schouten Island back to Hobart, representing a repeat transect similar to those from the Southern Surveyor on its return voyages to Hobart from the east coast.

Whilst at sea we also deployed:

- the Triaxus, a towed body using state-of-the-art computer technology and fibre optic telemetry for vehicle and sensor communication, armed with a Laser Optical Plankton Counter, to give underway data from down to 6000 m. The Triaxus was towed along the same transect as the CPR.
- CTD transects across the shelf to oceanic waters, with a 24 niskin bottle rosette followed by N70 net samples, a vertical haul net used by Thompson designed to capture large quantities of salps. The Niskin bottle water was used to test the hydrochemistry facilities and was also filtered for molecular analysis.
- Bongo nets (500  $\mu\text{m}$ ) for plankton tows to 200 m, transects across three sites, on the shelf, on the shelf break, and oceanic water
- The new EZ net (500  $\mu\text{m}$ ), designed to collect plankton at discrete depths, across the same three sites
- The rectangular mid water trawl net (1000  $\mu\text{m}$ ), as a neuston net to collect salps and lobster phyllosoma at surface at night, across the same three sites
- The Piccaro, an underway 13C sensor, was also running continuously during the voyage

Work now begins on counting samples, analysing data, and putting all the components together in a race to develop the first scientific paper to be published from research aboard the *Investigator*. Watch this space .....

The ship's crew and CSIRO MNF support staff deserve enormous thanks for their efforts and hard work over the last few months to get *Investigator* prepared, equipment ready and calibrated for the voyage. The voyage was a great success with all the equipment deployed safely and a lot of science completed. The MNF is a fabulous work platform and will be a significant asset to science in Australia for years to come.



## Honours Project: Where can I find a decent meal?

### Foraging conditions at an aggregation site for reef manta rays on the Great Barrier Reef

Asia Armstrong, UQ Honours Student 2014, 1<sup>st</sup> Class

Large tropical and sub-tropical marine animals must meet their energetic requirements in a relatively nutrient-poor environment. Ephemeral resource patches, resulting from a combination of environmental factors, can have broad biological impacts on higher trophic level animals, affecting the timing of reproductive events, migrations between habitats and animal survivorship. Understanding the drivers of this productivity is important, especially in aiding conservation efforts in threatened species. Large-bodied elasmobranchs that feed on zooplankton, such as whale sharks and manta rays, have thermal thresholds that prevent them foraging in nutrient-rich polar waters. Instead, they aggregate seasonally at predictable locations throughout tropical oceans where they are observed feeding.

Reef manta rays *Manta alfredi* aggregate year-round at Lady Elliot Island in the southern Great Barrier Reef, with their peak numbers observed during winter. My study investigated the foraging and oceanographic environment around Lady Elliot Island during the summer and winter of 2014. Zooplankton samples and oceanographic information were analysed in relation to manta ray behaviour, and compared to a long-term logbook of manta ray sightings from the island. Analysis involved the use of a high-resolution ZooScan system, which enabled detailed examination of the size structure and broad taxonomic groupings of the zooplankton community.

My results indicated that manta rays feed at Lady Elliot Island when zooplankton biomass and abundance are significantly higher than other times. Analysis suggests a critical prey density threshold is required to elicit feeding behaviour, however zooplankton size is not important. Visual inspection of the community composition (Figure 1) and size structure of the zooplankton shows no real changes irrespective of manta ray behaviour. Higher zooplankton biomass is observed during ebb to low tide scenarios and long-term logbook data confirmed that more manta rays are observed feeding during these tidal phases.

This was the first reported study to examine prey availability at an aggregation site for reef manta rays and the findings from this research have provided an indication of the food preferences and energetic requirements of these large charismatic animals. These findings are important to help identify critical habitat and drivers of migration for the conservation of this economically important, yet vulnerable species.

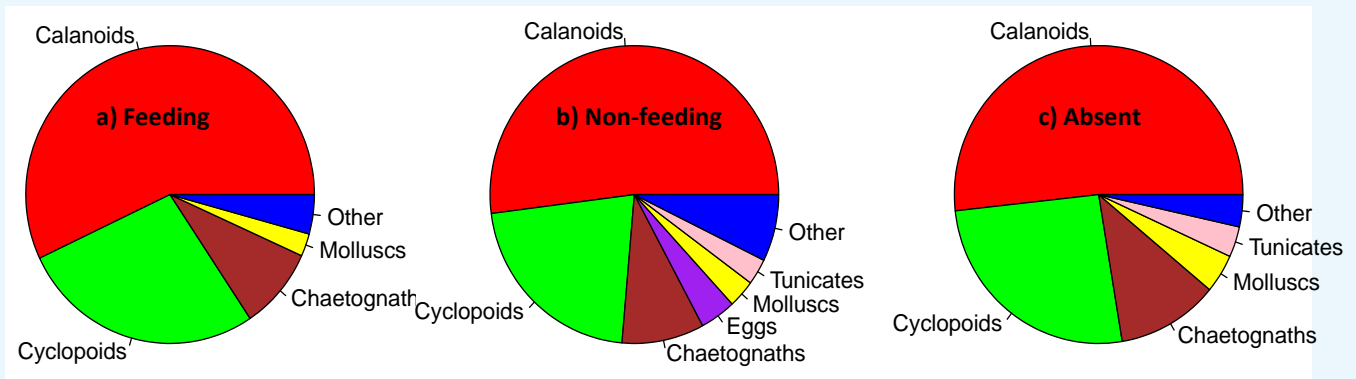


Figure 1: Community composition of zooplankton at Lady Elliot Island in relation to manta ray behaviour: Taxonomic composition when manta rays were a) feeding (n=17), b) non-feeding (n=12), and c) absent (n=21). "Other" includes cnidaria, polychaetes, echinoderms, bryozoa, fish larvae, salps and various classes of arthropods.

Below: *Manta alfredi*

Right: Lady Elliot Island





## Characterising the missing link in marine ecosystem management: Using zooplankton size spectra to link primary production and fisheries

Virginie Bornarel

Over the past two years, I have been studying agronomy first at Montpellier Supagro, (Montpellier, France). Then the Agrocampus-ouest (Rennes, France) in February 2014 to start a specialization in fisheries and marine ecology. I am now doing a gap year to do several placements in order to gain experience with quantitative marine ecology, currently based at CSIRO through the Integrated Marine Observing System (IMOS). My project is investigating the size spectra of zooplankton and is jointly supervised by Anthony J. Richardson (CSIRO/UQ) and Iain Suthers and Jason Everett (UNSW).

We know little about the zooplankton that links the ocean's phytoplankton and fisheries. Moreover, available data on zooplankton rates are unequal across the world depending on the region and the season. This project aims at analysing optical plankton counter (LPC) data from Australian Seas. Plotting normalized biomass size spectra (NBSS) relating to zooplankton will give us the opportunity to determine vital rates of pelagic ecosystems, thanks to mathematical theories. As a result, zooplankton size distribution associated with phytoplankton estimates will provide us with ecosystem processes, oceanic features, and especially fisheries production since zooplankton drive the production of our fisheries.

As a first step, I have been analysing raw OPC data from cruises off SE Australia to get a general idea of the distribution of zooplankton. I used the software Matlab to plot and map the abundance and biovolume of zooplankton along the different transects as well as the oceanic features like the salinity, the temperature, the fluorescence and the density in order to correlate the presence of zooplankton with these last parameters. Jason Everett, the postdoctoral researcher I'm working with, has been very helpful in teaching me Matlab. Matlab was useful to interpolate data where none were available between the SeaSoar tracks. Below is an example of one of those six transects mentioned above. This one is the Lord Howe Island transect where a positive correlation between the abundance/biovolume of zooplankton and the fluorescence (phytoplankton) is noticeable.

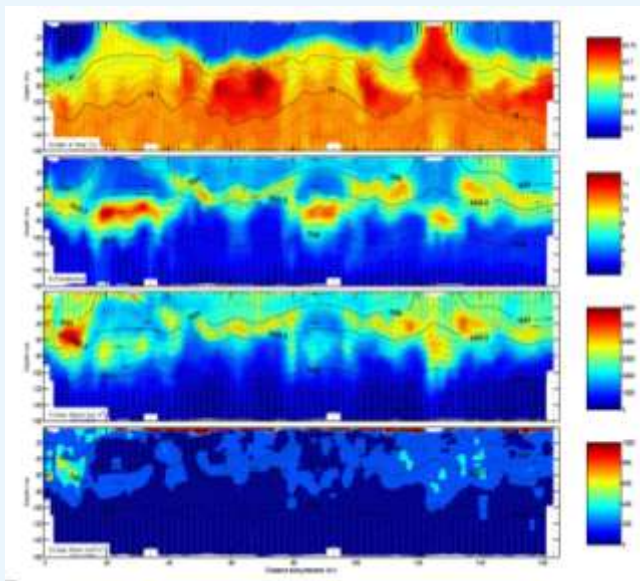


Figure 1: Lord Howe Island transects. A) Salinity & Temperature, B) Fluorescence, C) Zooplankton abundance(ind.m-3), D) Zooplankton bio volume(mm3.m-3)

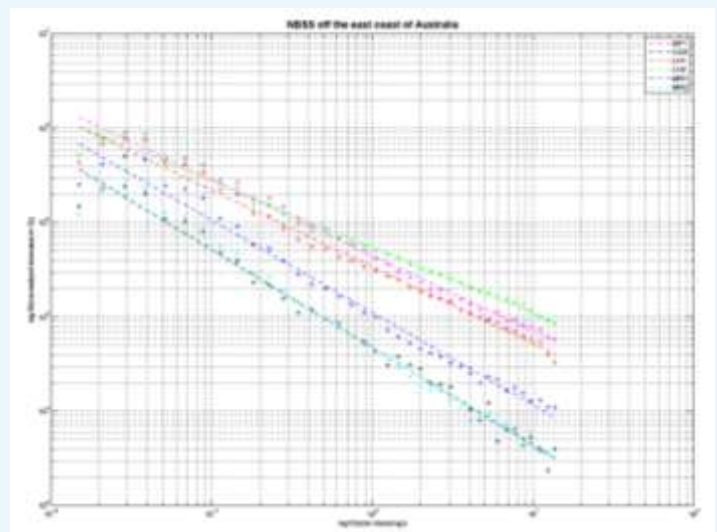


Figure 2: Bio volume spectra (+) and linear regression (-) in six different locations offshore of the east coast of Australia

A linear regression has been made to calculate subsequently the slope and the total biomass for each location. This work aids understanding of how environmental parameters and climate variability affect zooplankton communities and is thus a first step in studying large-scale zooplankton distribution.

## Zooscan

Audrey Lainé

I am doing an internship at the CSIRO for 5 months with Anthony J. Richardson and the Plankton Team. This internship is part of my study as I have to do a training period in an English-speaking country for my second year of higher education at Agrocampus Ouest, a French Engineering School which trains students in the field of Agronomy and Food Sciences. I do want to specialize in fisheries and aquatic sciences because I have a strong interest in marine life and environmental issues, that is why I am really happy to work here.

In the laboratory, I am learning how to use ZooScan thanks to Julian Ulribe. I am using 25 zooplankton samples which belong to Asia Armstrong. They are part of her project "Project Manta" and they have been collected in Lady Elliot Island. ZooScan is a scanner with a very high resolution imagery (cf. Figure 1). It scans subsamples of zooplankton and generates photos (cf. Figure 2). Then it separates each organism of photos in vignettes and the software "Plankton Identifier" identifies the groups (cf. Figure 3). At the end of the process, each sample has folders by groups of zooplankton. Moreover, "Plankton Identifier" is not totally autonomous, I have to check if each vignette is in the right folder. In this way Julian has also taught me how to recognize the main groups that we can find in the zooplankton samples. I am focus on the copepods and in particularly the orders of Calanoida, Cyclopoida and Harpacticoida (cf. Figure 4). When all vignettes will be sort out, I could calculate the percentage of zooplankton groups by sample and study their impact on the feeding of ray mantas. Indeed, the primary food source for the manta rays is plankton. They open their mouth and filter the water with their gills to trap plankton. The samples have been collected close to manta rays with an open mouth and close to manta rays with a close mouth. So, we could see in which situation, the manta rays feed themselves.



Below: Image generated by ZooScan



Below: Groups Classified from ZooScan





### IMOS Plankton Team Teaches Zooplankton ID

On the 16th October, Julian Uribe and Mark Tonks from the IMOS Plankton Team provided a 1-day zooplankton identification workshop to staff from the Sydney Water Corporation and the Sydney Institute of Marine Science (SIMS). The workshop was held at Sydney Water, West Ryde NSW.

This opportunity arose because Sydney Water Monitoring Services were looking to further develop their identification of zooplankton in the marine pelagic environment. Traditionally, Sydney Water has monitored the composition of benthic marine and freshwater biota in relation to water quality. In doing so, they have been able to successfully develop a significant list of bio-indicator species for these environments.

The purpose of the Workshop was to provide attendees with the ability to identify free-living zooplankton to at least the taxonomic level of Order. We also provided information about how to go about identification to family and species level. It was an interactive workshop that included theory followed by practical microscopy sessions using preserved zooplankton samples collected from IMOS National Reference Stations. A considerable part of the Workshop focused on identifying micro-crustaceans (particularly copepods) and gelatinous plankton such as jellyfish, arrow worms, pelagic tunicates and the barrelled shaped doliolids and salps.

The feedback provided by the attendees was very positive. Participants felt that their identification of marine pelagic zooplankton improved substantially and has therefore enabled them to provide a more holistic service to stakeholders. Sydney Water has indicated a desire to continue developing their marine zooplankton taxonomic capability. Discussions are under way for the IMOS Plankton lab in Brisbane to host Sydney Water marine analysts for several days in 2015. During this visit it is intended that they experience pelagic zooplankton sampling and identification techniques associated with the IMOS National Reference Stations. The fostering of plankton taxonomic skills by IMOS – needed for provision of plankton time series – has enabled these skills to be passed onto a wider community.



## When Australia meets the Caribbean: Teaching marine copepod ID in the Colombian Caribbean

Julian Uribe

Marine copepods are one of the most important components of trophic webs in the oceans worldwide, however there is a dearth of people trained to explore the diversity of copepods from many parts of the world, including the Caribbean and Pacific Colombian territorial seas. There has been little research on copepods from Colombian waters, and what has been published, is difficult to access and has been written mostly in Spanish.

As a plankton researcher in Australia, and with a Latin-American background with knowledge of the history of copepods in Colombia, I saw the opportunity to pass some of my experience in marine copepod identification to a group of professionals and students who are interested in these important organisms.

The Workshop was held over an intense three days at the University Jorge Tadeo Lozano in Santa Marta- Colombia. A total of 14 people attended the Workshop, from universities and institutions in Santa Marta and from sites dispersed throughout Colombia. A few students were from the Jorge Tadeo Lozano University (UJTL), a couple of professors from The Universidad del Magdalena (UNIMAG), a student from the Industrial University of Santander (UIS), and a group came from the Marine and Coastal Research Institute INVEMAR.

We covered aspects of the identification of copepods, from general morphology, developmental stages, orders and families, to the use of specific resources that the IMOS-CSIRO plankton team in Australia has developed.

We identified species from samples from near shore-waters off Santa Marta and also I had the opportunity to see, for my first time, a few copepods collected at in deep water (~450 m depth), collected by INVEMAR. These copepods were "huge", close to 7 mm in total length, and have not previously been reported from Colombian Caribbean waters.

The evaluation of the course was positive, attendees were very pleased with the information delivered during and after the workshop, and they have asked for a follow-up course in the near future to involve more students and professionals from Colombia.

If you would like to join the Friends of the IMOS Plankton Team mailing list and receive newsletters and updates on research and developments please email  
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- Below: 1. Strategic location of Colombia in between the Caribbean sea and the Pacific Ocean.
- Colombian Marine territory. It is as large as the Colombian landmass. <http://www.scielo.cl/fbpe/img/gayan/v67n2/f1diaz.jpg>
- Attendees from the first Marine Copepod identification Workshop.
- Workshop attendees learning about IMOS, SAHFOS and the Continuous Plankton Recorder.
- Deep-water parasitic cyclopoid from the Family Pontoeciellidae
- Two big copepods (approx. 7 mm) from deep water.
- Detail of one of the deep water copepod calanoids from the Family Megacalanidae.
- Detail of the opal-like colours from one of the deep water copepods.



## Into the Imbra

Earlier in the year the Brisbane IMOS Plankton Lab hosted scientist and artist Julia Bennett from the University of South Carolina, Columbia, Sc. Julia photographed many beautiful images of the plankton from our IMOS National Reference Stations. Julia has since returned to the United States and has exhibited some of the images in an exhibition entitled 'Into the Imbra' at The University of South Carolina. The images will be housed in a permanent space at the University McKissick Museum. Please visit <http://www.julialbennettphotography.com/> for more information.

*Into the Imbra - "There exists a historic and profound relationship between humans and the ocean, its processes and inhabitants having long been a source for awe, curiosity, and inspiration. It was in the volatile, primordial chemical "soup" of the early seas that the first life on Earth emerged. Since these times, visual representations of scientific discoveries in the marine environment have allowed accessibility to complex processes and structures, and have informed the scientific landscape by creating space to contemplate new and ever-changing interpretations regarding the nature of life.*

*These images, captured in-microscope, invite the viewer to observe samples of plankton within an abstract visual framework, and consider the means by which, through both scientific and artistic processes, we are able to create the world we seek to observe. By deconstructing the context in which the images exist, framing them in a way that references outer space, it is my goal to initiate a conversation about the extent of our knowledge of oceanic processes in a time when human interactions with the marine environment are particularly fragile."*

