Issue 5, December 2012

IMOS Integrated Marine Observing System

Australian Government
Department of Sustainability, Environment, Water, Population and Communities
Australian Antarctic Division

IMOS Plankton Newsletter

The Australian Continuous Plankton Recorder Survey & National Reference Stations

A note from the IMOS plankton team directors…

Thanks once again for taking the time to browse through our fifth newsletter. We have renamed it the 'IMOS Plankton Newsletter' to better reflect the work we do, spanning both phytoplankton and zooplankton from the AusCPR and the National Reference Stations projects.

We would like to take this opportunity to announce a new route for AusCPR starting early 2013 – from Adelaide to the mid Great Australian Bight, some 450 nautical miles to the west along the 35°S line. This is in conjunction with a multinational oil company and helps spread our funding base. As most of you will know, IMOS funding is only currently guaranteed until June 2013. We have been actively engaged with the IMOS community to extend funding after that time and we have, together with other IMOS facilities, submitted an extension to the program, including revised budgets until Dec 2014, and submitted these to the Commonwealth Government. We expect to hear of the outcome very soon.

We have also been busy engaging with students and we would like to thank them for their contributions. Congratulations to Kate Picone (UTas), who has just been awarded 1st Class Honours for her thesis on "Seasonal, inter-annual and latitudinal changes in the zooplankton community composition along the East Australian Current: The AusCPR survey". She describes her work on p. 8 of the newsletter. We are also delighted to welcome three young passionate 'plankton enthusiasts' to the Ecosciences Precinct in Brisbane, as part of the CSIRO Marine and Atmospheric Research Vacation Scholarship and Visitor program.

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These are: Alex Coughlan, an undergraduate in Marine Studies student from UQ, who is working on phytoplankton from the CPR; Amelia Armstrong, who is working on zooplankton from the NRS; and Serena Burnett who is working on communications. Great to have you aboard and Serena describes their work in more detail on p. 7.

If you have any questions or comments about the IMOS Plankton work, then feel free to contact us directly

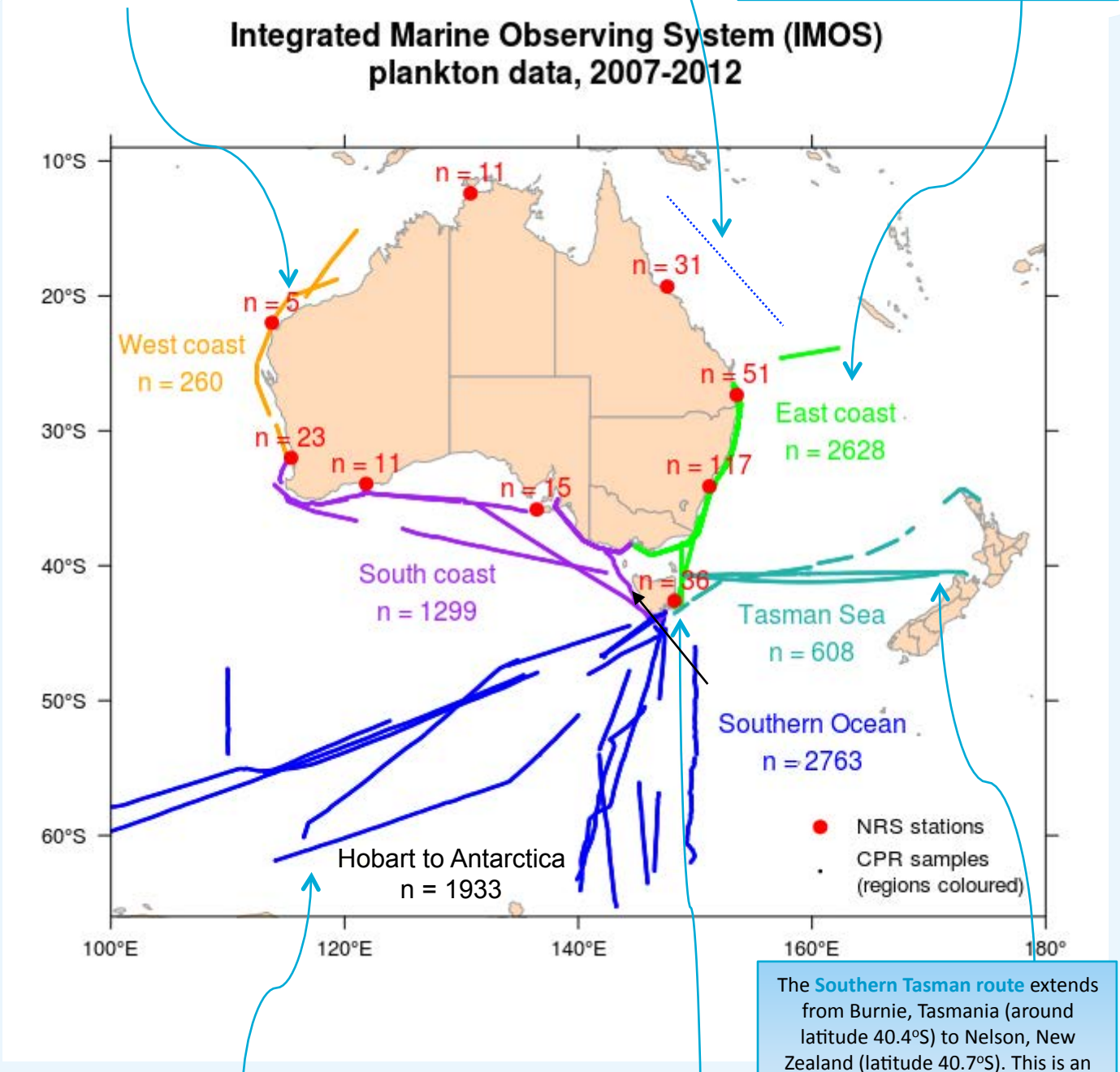
Best

Anthony J. Richardson *(below left)*
(anthony.richardson@csiro.au)
Graham Hosie *(below right)*
(graham.hosie@aad.gov.au

The new **WA route** runs between latitude 12.3°S to latitude 21.8°S down the Leeuwin Current . The north-west region has potential for strong development of industries such as gas and mining. We are working in collaboration with the Australian Institute of Marine Science (AIMS).

The **GBR route** extends from approximately latitude 14.3°S to latitude 23.4°S. The Great Barrier Reef is an area likely to be strongly affected by warming and ocean acidification. We will be working in collaboration with the Australian Institute of Marine Science (AIMS).

The **EAC route** extends from Brisbane (Queensland, latitude 27°S) to Adelaide (South Australia, latitude 34°S) down the east coast of Australia 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 **Southern Tasman route** extends from Burnie, Tasmania (around latitude 40.4°S) to Nelson, New Zealand (latitude 40.7°S). This is an important area for fisheries and our survey links in with an existing mesopelagic acoustic survey.

The **Southern Ocean** routes below Australia are conducted by the SCAR SO-CPR Survey through the AAD and NIPR Japan, with support of the AusCPR. These routes extends from just south of Australia to the sea-ice edge or the Antarctic continent. Together with the EAC route, the Southern Ocean sampling allows a almost continuous transect running between the warm tropical waters of QLD and the cold polar waters of the Antarctic.

The **TAS route** extends down the east coast of Tasmania, which is also subjected to the influence of the EAC. There is already some evidence of warm-water species moving southward.

AusCPR Plankton data update

Route	Start	Ship	Freq	Dist (nm)	Tows	# PCI Samples	# Phyto samples	# Zoo Samples	Total phyto taxa	Total zoo taxa
Brisbane – Sydney	Jun 2009	ANL *Windarra*	2 monthly	5220	14	1044	247	248	107	400
Sydney – Melbourne	Jun 2009	ANL *Windarra*	2 monthly	6890	16	1378	337	336	95	386
Melbourne – Adelaide	Sep 2010	ANL *Windarra*	2 monthly	2395	3	479	101	65	47	175
Sydney – Hobart	Sep 2010	*Southern Surveyor*	ad hoc	410	1	82	20	20	19	121
Burnie – Nelson	Aug 2010	FV *Rehua*	annual	1140	1	228	57	57	30	101
Fremantle – Broome	April 2010	*Southern Surveyor*	ad hoc	910	1	182	48	31	60	227
Brisbane – Fiji	May 2010`	*Southern Surveyor*	ad hoc	280	1	56	14	14	19	85
Exmouth– Scott Reef	Nov 2011	*RV Solander*	quarterly	390	1	78	-	-	-	-
Nelson – Burnie	Jan 2012	FV *Rehua*	annual	940	1	188	47	47	19	107
Great Barrier Reef	April 2012	*RV Cape Ferguson*	quarterly	240	2	-	-	-	-	-
Auckland – Hobart	June 2011	*Southern Surveyor*	ad hoc	960	1	192	49	49	22	142
Australia – Antarctica*	Nov 2008	RSV *Aurora Australis*	spring to autumn	1515	43	3033	2901	3033	103	182

** This is a part of ~35,000 data records (175,000 nmiles) from 646 tows, for 240 zooplankton and 83 protistan taxa available from the SO-CPR survey that has been operating for the past 22 years.*

Above left: The *ANL Windarra* (Image: Les Blair www.marinetraffic.com).
Above right: The *RSV Aurora Australis* (Image: AAD).
Bottom left: The *FV Rehua* (Image www.action-engineering.co.nz).
Bottom right: The *RV Southern Surveyor* (Image: Edwina Hollander, CSIRO www.scienceimage.csiro.au).

National Reference Stations plankton data update

Station	Start date	Biomass samples	Total zoop taxa
Darwin	Jun 2011	7	87
Esperance	May 2009	11	132
Kangaroo Island	May 2012	9	162
Maria Island	Aug 2012	35	234
Ningaloo	Feb 2012	5	57
North Stradbroke island	Sep 2008	*48*	381
Port Hacking	Feb 2009	40	318
Rottnest Island	Nov 2011	23	213
Yongala	Sep 2009	30	232

Plankton Feature

The copepod *Sapphirinia stellata* from North Stradbroke Island in Queensland.

Update from Western Australia

Joanna Strzelecki and James McLaughlin

Western Australian IMOS had an annual meeting on 5 November 2012. Over 80 participants took part in a full day of marine science and oceanography talks followed by a short networking sundowner . The program was well received and participants felt it was a successful meeting. Ming Feng (CSIRO) presented analyses of the extreme warming event captured by instruments on IMOS moorings deployed at the Two Rocks, north of Perth, Western Australia. Peak surface temperatures 5 ^{o}C warmer than summer climatology were observed during 2 weeks in late February to early March causing widespread coral bleaching and fish kills. Dirk Slawinski (CSIRO) presented an overview of data from the Rottnest National Station, one of 3 stations positioned in key locations around the west Australian coast to provide long-term time series of physical and biogeochemical data. The Rottnest station time series is one of the longest starting in 1951. Craig Steinberg (AIMS) discussed observations from moorings on the North West Shelf. This region is part of the Indonesian Throughflow and Holloway Current that feeds into the Leeuwin Current. Charitha Pattiaratchi (UWA) further described the little known Holloway Current. Preliminary analysis of 6 months of data (February to August 2012) from north-west moorings added to the studies of this current by D'Adamo et al (2009). Surface currents (Jennifer Penton, UWA), internal waves (Florence Verspecht, UWA) and dense shelf water cascades (Thisara Welhena) further analysed physical features off the west coast of WA. Chari Pattiriatchi introduced the notion of peddies: smaller scale eddies, ~ 40km diameter, persisting for 2-3 days. They occur on the interface of the Leeuwin and Capes currents. A series of biological talks ranged from nitrogen fixing bacteria (Eric Raes, UWA), picoplankton (Paul Thomson, UWA, Christine Hanson, UWA), zooplankton (Joanna Strzelecki, CSIRO), corals, (Ben Radford, AIMS), to megafauna (Mark Meekan, AIMS), blue whales (Sasha, Gavrilov, Curtin University) and pygmy whales (Olga Bondarenko, UWA). Gary Kendrick (UWA) presented results from 3 years of monitoring marine habitats and dominant marine species using AUVs. The survey aims at detecting change in benthic habitats to inform management and planning. Luke Edwards (IVEC, IMOS) demonstrated access to publicly available marine data from multiple sectors including IMOS, State and Commonwealth Governments, universities, community groups and industry.

Reference:

D'Adamo et al 2009. Northern sources of the Leeuwin Current and the Holloway Current on the north-west shelf. Journal of the Royal Society of Western Australia, 92,53-66.

Database Update

Claire Davies

Over the past 6 months we have been busy collating all the zooplankton species data that we can uncover from the Australian region to build the 'Australian marine zooplankton: taxonomic guide and Atlas'. The taxonomic guide and atlas will be a major resource to plankton researchers, especially those interested in species distributions, range changes. We have involved many Australian zooplankton experts from outside AusCPR in this endeavour, including Dave McKinnon (AIMS), Kerrie Swadling (IMAS), Daniel Gaughan (WA Fisheries), who have made their data available to the Atlas.

We have currently loaded data from 26 projects containing 5748 samples. The Atlas currently consists of 390 zooplankton species, of which 344 are copepods and 46 are other zooplanktons, such as jellies, salps, cladocerans, appendicularians and chaetognaths.

Two of the major contributing surveys are AusCPR and the National Reference Stations (NRS). The NRS, part of the IMOS Australian National Mooring Network, include 8 stations around Australia where zooplankton is collected monthly and analysed in the AusCPR laboratory in Brisbane.

AusCPR includes data for 206 species from 3478 samples
NRS includes data for 207 species from 802 samples

The non-IMOS contribution comprises 1464 samples from 24 projects and includes data for 328 species. This data ranges from the early 1970's to the current date. This long time span will help determine if species range changes have occurred over the years.

And the most exciting news is that we have begun work on the Australian Phytoplankton Atlas. Vacation scholar, Alex Coughlan, is working with the AusCPR team and is currently compiling the phytoplankton species data from around Australia.

If you have any zooplankton or phytoplankton data that you would like to add to the Atlas please contact claire.davies@csiro.au. Data can be made freely available to the potential users or remain confidential.

Update from Tasmania

David McLeod

The laboratory in Hobart has been busy processing plenty of CPR samples collected from RV Aurora Australis during the 2011/12 season in the Southern Ocean. It is always interesting seeing the plankton communities change from '*warm-water*' species such as the calanoid copepod Temora turbinata, to '*cold-water*' communities including Antarctic krill Euphausia superba, along the same Hobart-Antarctica transect. We have also collected and processed two tows collected from the RV Southern Surveyor in July on its journey from Hobart (43ºS) to the Southern Ocean Time Series mooring at 47ºS and 140ºE. Not only are these tows going to add to the suite of measurements being taken at the mooring, but also help add some extra temporal coverage to our samples as winter samples in the Southern Ocean are rare.

Other samples collected from the RV Southern Surveyor include four tows (1800 nautical miles) between Hobart and Fremantle, and four more tows from Fremantle to Darwin. In, addition we also conducted repeat transects across the Tasman Sea to New Zealand from the FV Rehua. As always, we are extremely grateful for the assistance of the ship's captain, crew and other volunteers who assist in the successful deployment of the CPR.

In November, the Hobart laboratory at the Antarctic Division hosted three international visitors who are involved in the initiation of CPR surveys. Erik Muxagata (Brazil), Lee Doo Byuol (Korea) and Philippe Koubbi (France) spent two weeks learning all aspects of the CPR process from maintenance and preparation of the units to analysing the samples.
AusCPR (Hobart and Brisbane) has also taken over the phytoplankton counting from the NRS stations in the second half of this year, following the retirement of Pru Bonham from CSIRO Hobart. The first few samples from the Maria Island station have been fairly sparse, but the October and November samples certainly increased dramatically in both abundance and diversity of phytoplankton largely due to a range of diatom species.

AusCPR was well represented at the AMSA (Australian Marine Science Association) conference in Hobart in July, with a poster outlining AusCPR's current projects and status and also an oral presentation by David McLeod on the range expansion the red-tide dinoflagellate, *Noctiluca scintillans*, which was published in the Journal of Plankton Research in April this year.

Left: A CPR unit being launched.

Plankton Toolbox Update

Wayne Rochester, Anthony J. Richardson

IMOS is an integrated, national observing system for monitoring the physical, chemical and biological state of Australia's marine environment. The key research infrastructure created by IMOS comprises data streams that are generated by the system and distributed by the IMOS Ocean Portal. The AusCPR and NRS data streams were established in 2007 and now have sufficient length and coverage for use in research and monitoring applications. With support from CSIRO, we have begun a number of research activities for answering ecological questions and evaluating the use of plankton data in sustained ecological monitoring. An outcome of these activities is a growing capability for analysing plankton data and integrating them with physical and chemical data from the IMOS portal and elsewhere.

We use plankton toolbox as a convenient shorthand for this capability because the capability comprises a growing collection of computing scripts, derived data views, and skills that we can apply to multiple projects. The toolbox supports the work of ourselves, our students and other AusCPR data users and helps us to choose analytical approaches that are more likely to be reusable by ourselves and others.
The scope of the toolbox includes data preparation, visualisation and mapping. Data preparation covers preparing plankton data for analysis and integrating physical/chemical data with the plankton data. The plankton Oracle database is complex because it must store all of the details of data collection that are needed to support the logistics of the program or might conceivably be needed for any future use of the data. For analysis, however, we need simple, specific subsets of the data, such as presence/absence datasets for particular species. Such views of the data can be implemented in the database for the AusCPR team's use, and, when more widely useful, exported via the IMOS portal for public use.

The software components of the toolbox are typically R scripts and Oracle database queries and views. However, a significant proportion of work, particularly with physical and chemical data, is performed with UNIX software on Linux desktops or the CSIRO Advanced Scientific Computing facility. In time, we hope to share appropriate tools (particularly data views and R scripts) with the wider IMOS community.
Recent and ongoing applications of the toolbox include the Australian Zooplankton Taxonomic Guide and Atlas (IMOS, CSIRO, UTas), the Plankton Ecological Assessment Report (IMOS, CSIRO Wealth from Oceans), a global ecological status report (Global Alliance of CPR Surveys), CSIRO Wealth from Oceans strategic research on sustained ecological observing, and support of student projects based on AusCPR data.
Note that the toolbox is not a simple software application that we could release for download, but please contact us for more information about it and how we might be able to use it to help with your use of AusCPR data.

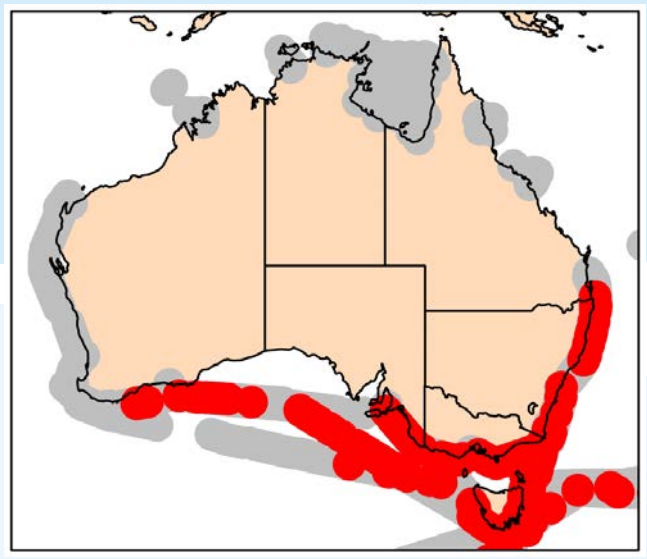


Figure 1. Sample atlas map of *Calanus australia* compiled from AusCPR, NRS and the AusCPR project's historical zooplankton database (red, present; grey, absent).

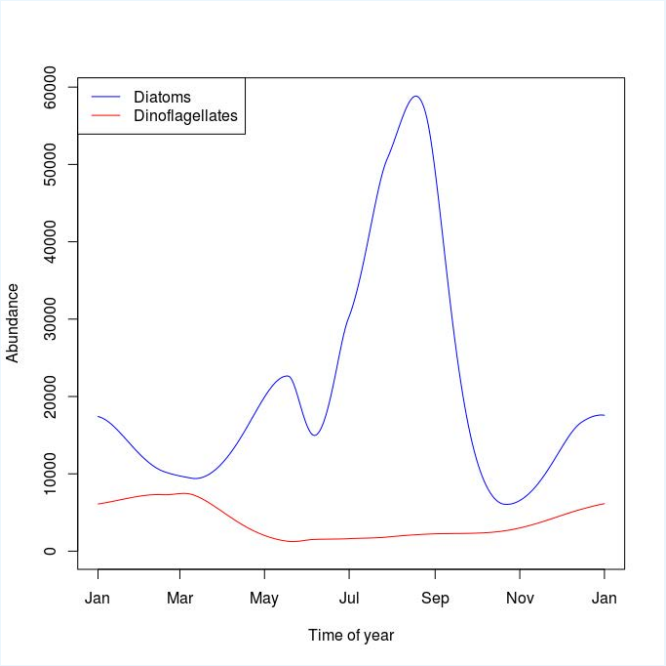


Figure 2. Average seasonal abundance of diatoms and dinoflagellates on the Sydney–Melbourne AusCPR route from 2009 to 2011.

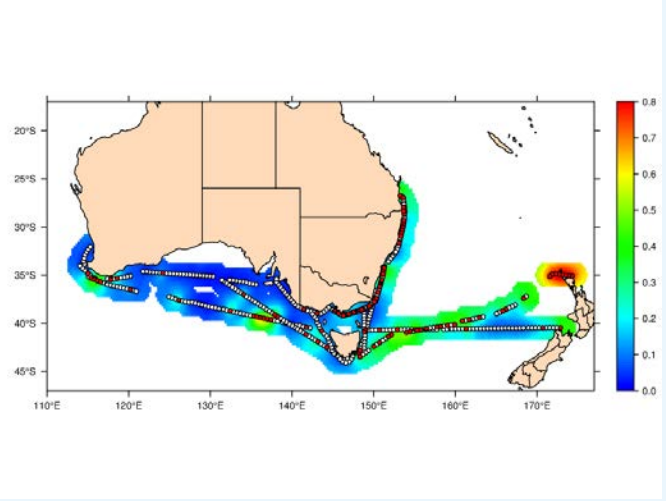


Figure 3. AusCPR records of microplastic pollution (red and white dots for presence and absence) and a simple spatial interpolation of microplastic frequency (colours).

Students in the Brisbane Plankton Lab

Serena Burnett, Anthony J. Richardson

This month the IMOS Plankton Team is delighted to welcome three young passionate 'plankton enthusiasts' to the Ecosciences Precinct in Brisbane, as part of the CSIRO Marine and Atmospheric Research (CMAR) Vacation Scholarship and Visitor program.

Amelia Armstrong, a third year Marine Studies student from The University of Queensland (UQ) will be working with ZooScan. The innovative instrument images zooplankton, creates a size spectrum and identifies them to basic taxonomic level using a neural classifier.

Ms Armstrong will be using ZooScan to analyse the archive of plankton samples from the nine IMOS National Reference Station (NRS) locations around Australia. She will assess how properties of the zooplankton size spectrum vary in relation to latitude, season, and environmental conditions. The ZooScan work has been kindly supported by Tim Lynch.

"ZooScan provides novel descriptive information to better characterise zooplankton community composition. It is a revolutionary tool that will enable us to process large samples quickly and store them forever in image archives." Ms Armstrong said. On completion of Ms Armstrong's project, these data will be available to the research community through the data portal.

Alex Coughlan, also an undergraduate Marine Studies student from The University of Queensland, will spend the summer consumed with phytoplankton fervor.

With the help of Steve Edgar, Tony Rees and Claire Davies, and Gustaaf Hallegraeff at Utas. Ms Coughlan is building a database of tens of thousands of phytoplankton samples from AusCPR, NRS, and the historical and recent literature.

"We're thrilled, because the taxonomy of tropical phytoplankton is poorly documented, and this database may have the power to detect range shifts and assess how climate variability influences phytoplankton communities." Ms Coughlan said.

If you have records that you would like to contribute to the phytoplankton database, please contact Alex at AusCPR (Alex.Coughlan@csiro.au).

Our third vacation student is Serena Burnett, who is currently working in communications. She has enthusiastically and professionally penned several articles about our work for the shipping and fishing industries and for the broader community.

The team at AusCPR would like to take this opportunity to thank CSIRO for organizing the three studentships and the three dynamic young researchers themselves for their hard work and enthusiasm.

From left: Alex Coughlan, Serena Burnett and Amelia Armstrong.

Update from the QLD team

Mark Tonks

The IMOS Plankton Team have been continuing with our monthly NRS sampling north of Stradbroke Island and processing zooplankton samples from the various NRS stations around Australia. Continuous Plankton Recorders (CPRs) have been deployed in the East Australian Current (EAC), the Leeuwin Current (Western Australia) , the Tasman Sea (Burnie to Nelson) and in waters between Brisbane and Fiji. Collaborations between ourselves and ships of opportunity are continuing to be relatively successful and we are investigating the potential of a new collaborator that could tow within the Great Barrier Reef lagoon.

In addition, we've also begun to take on the phytoplankton cell counts from each of the NRS stations. Pru Bonham (CSIRO Hobart) was responsible for this, however due to her imminent retirement, we've assumed this role. To assist with the transition, we hosted Pru in Brisbane where she spent a week in July training us in cell count methodology and taxonomic identification.

We've also seen the addition to the team of a few University of Queensland students who were successful in obtaining vacation scholarships and an industrial Trainee position. Amelia Armstrong is working with Zooscan and analysing zooplankton samples from the Maldives; Alex Coughlan is assisting in the development of an Australian phytoplankton database by sourcing and entering historical data, and Serena Burnett is producing articles for magazines that relate to our AusCPR work. Both Amelia and Alex are likely to continue next year with the team and do a project with us for their Honours degree.

Finally, we were lucky recently to have a world jellyfish expert, Dr Lisa Gershwin (CSIRO Hobart), spend a few days with us where we were trained in the finer points of jellyfish taxonomy and ecology.

AusCPR Honours Student

Kate Picone

Over the past 9 months, I have completed my Honours thesis at the University of Tasmania through the Institute of Marine and Antarctic Studies, supervised by Kerrie Swadling (Institute of Marine and Antarctic Science) and Anthony Richardson (CSIRO, UQ). I was awarded 1st Class Honours and am now busy writing up my work as a paper. My project, entitled "Seasonal, inter-annual and latitudinal changes in the zooplankton community composition along the East Australian Current: The AusCPR survey", focussed on zooplankton dynamics in the East Australian Current (EAC), and examined how zooplankton communities change annually, seasonally and under different environmental conditions. Zooplankton data were obtained from the EAC route spanning the timeframe from June 2009 to December 2011, and were analysed in conjunction with freely available environmental data for the region. I also measured zooplankton biomass for the first time at any CPR survey, developing a protocol to wash off the plankton from CPR silks, dry it in an oven for 24 hrs, and then weigh it. This procedure will be continued at the survey in the future.

The three most abundant species over the sampling period were the copepods *Temora turbinata* and *Oncaea venusta,* and the cladoceran *Penilia avirostris.* Throughout 2010, zooplankton abundance and biomass were generally higher than in 2009 and 2011 (Fig. 1), and there was a shift in community composition, towards dominance of cladocerans, particularly *P. avirostris.* These high zooplankton abundances in 2010 were associated with the strong La Niña climatic conditions observed along the east coast of Australia. Seasonal abundance was higher in autumn, with large blooms along the Victorian coastline (Fig. 2), while the most abundant organisms per season remained relatively similar. This study identified a transition zone at ~32°S where the northern and southern water masses met and produced a highly complex and diverse zooplankton region. This work aids understanding of how climate variability influences zooplankton communities, and represents the first examination of large-scale zooplankton distribution along the EAC. We aim to publish the main findings of this thesis in the coming months.

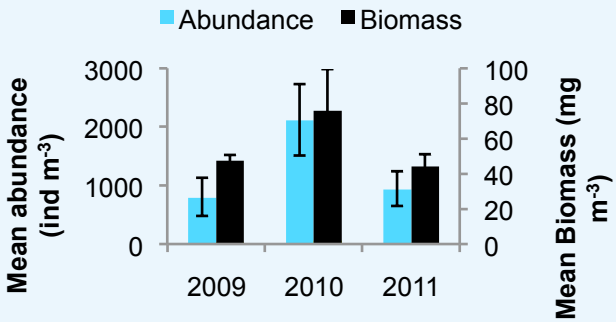


Fig. 1: Annual mean abundance (individuals m^{-3}) and biomass (mg $^{-3}$) per year. Standard error bars are shown

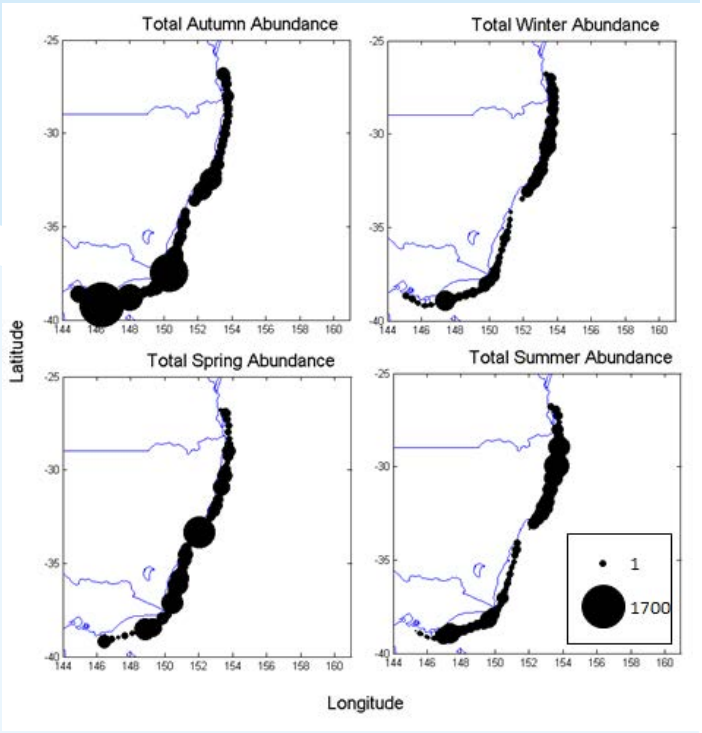


Fig. 2: Distribution of zooplankton seasonal abundance (measured in individuals m^{-3}).

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 Anita.Slotwinski@csiro.au

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IMOS
Integrated Marine Observing System

IMOS is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative

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

Visit the NRS website at http://imos.org.au/anmnnrs.html

Further team contact details can be located at http://imos.org.au/australiancontinuousplanktonr6.html

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