IMOS Integrated Marine Observing System

ISSUE #16
October 2025

IMOS Australian Plankton Survey Newsletter

Included in this issue

Meet Sahan - our new Team member - p9

SEA-MES Voyages - p23

7th Zooplankton Production Symposium - p30

3D Zooplankton Modelling - p44

Our Achievements

Continuous Plankton Recorder:
36,074 Phytoplankton Colour Index Segments counted
8,194 Zooplankton Segments counted
11,731 Phytoplankton Segments counted
180,370 Nautical Miles towed
238 Trips Processed
1,011,897 Zooplankton counted
179,301 Phytoplankton counted

National Reference Stations:
1,096 Zooplankton Samples counted
1,016 Phytoplankton Samples counted
1,111 Biomass Samples counted
706,508 Zooplankton counted
454,663 Phytoplankton counted

Greetings from the IMOS Plankton Team

The past 2 years have been a period of remarkable activity for our team, marked by exciting scientific contributions, strengthened international partnerships, and revamped tools to support the plankton research community. As we reflect on this time, we are proud to share some of the highlights that have shaped our work and helped advance our collective understanding of plankton ecosystems.

One of the most significant events was the 7th ICES/PICES Zooplankton Production Symposium, held in Hobart in March 2024. This prestigious international gathering brought together hundreds of plankton researchers from around the world to discuss the latest advances in zooplankton ecology, production dynamics, and climate interactions. Our team played a central role in contributing to the symposium – including many presentations, posters and installations in the plankton art event at the symposium. It was a privilege to showcase Australian plankton research on a global stage while fostering new collaborations and ideas. The annual Australia Marine Science Association (AMSA) conference, also in Hobart, followed shortly after in September 2024. The plankton team ware again present co-leading sessions in modelling and microzooplankton and having a strong presence in the Integrated Marine Observing System (IMOS) session.

Our research output continues to grow, with several recent publications making important contributions to the field. A study expanding the BioTIME database (Dornelas *et al.* 2025, https://doi.org/10.1111/geb.70003) has provided a more comprehensive view of biodiversity time series, enabling researchers to track ecological change across diverse ecosystems with greater precision – including plankton data from Australia. We also contributed to another community driven paper exploring the immense value of plankton (Grigoratou *et al.* 2025, https://doi.org/10.1093/biosci/biaf049) and the potential of plankton as a climate solution. Continued next page ...

NCRIS National Research Infrastructure for Australia An Australian Government Initiative

Australia's Integrated Marine Observing System is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS). It is operated by a consortium of institutions as an unincorporated joint venture, with the University of Tasmania as Lead Agent.

PRINCIPAL PARTICIPANTS

University of Tasmania (Lead Agent) · Australian Government · Australian Institute of Marine Science · Australian Government Bureau of Meteorology · CSIRO · Government of South Australia · SARDI · The University of Western Australia · sims sydney institute of marine science · UTS · The University of Sydney · Macquarie University · UNSW Sydney

SIMS is a partnership invoving four universities

ASSOCIATE PARTICIPANTS

Curtin University · Australian Government Department of Climate Change, Energy, the Environment and Water Australian Antarctic Division · Australian Antarctic Program · Deakin University · The University of Melbourne

IMOS thanks the many other organisations who partner with IMOS, providing co-investment, funding and operational support, including investment from the Tasmanian and Western Australian Governments.

IMOS acknowledges the Traditional Custodians and Elders of the land and sea on which we work and observe, and recognise them as Australia's first marine scientists and carers of Sea Country. We pay our respects to Aboriginal and Torres Strait Islander peoples past and present.

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Cover Image: Detail of the compound eye of a Crab larvae, (megalopa stage) before becoming a juvenile. Collected and North Stradbroke Island, QLD.. By: Julian Uribe-Palomino

Publishing in the journal Science (Pigot *et al.* 2025, https://doi.org/10.1126/science.adq3278) we revealed macroecological rules that predict how biomass scales with species richness across terrestrial and marine species, including plankton data from IMOS. This work offers a new framework for understanding the functional role of biodiversity on Earth. Another study used inverse modelling to map global zooplankton grazing dynamics, highlighting spatial variability and improving our ability to model ocean carbon cycling (Rohr *et al.* 2024, https://doi.org/10.1029/2023GL107732).

Our team has been participating in the Southeast Australian Marine Ecosystem Survey voyages onboard the *RV Investigator*, with Claire, Felicity, Sahan, Mark and Frank all completing two of the four voyages. The voyages are investigating changes to ocean conditions over the past 25 years in a region where the oceans are warming at 4 times the global average. We are asking questions about how these changes are impacting productivity, marine species and habitats, and using the data we collect to inform policies around smarter fisheries and conservation management. Our involvement includes using a multi net to collect hundreds of depth stratified plankton samples, day and night, which will help us describe the secondary production dynamics across Southeast Australia and explain the impact a changing climate is having at the base of the food web.

In addition to research, we've made significant strides in data accessibility and visualisation through the Biological Ocean Observer platform (https://shiny.csiro.au/BioOceanObserver/). This work is led by Claire Davies and Jason Everett (UQ). With generous support from IMOS, the Biological Ocean Observer will be enhanced with new features, including the Southern Ocean Time Series mooring phytoplankton data, expanded zooplankton datasets, and improved plotting capabilities. These upgrades make the Biological Ocean Observer an increasingly valuable resource for researchers seeking to explore Essential Ocean Variables and bioindicators. Our collaboration with IMOS and the National Environmental Science Program (NESP) continues to ensure that the Biological Ocean Observer remains responsive to the needs of the scientific community and aligned with national and international monitoring priorities.

International engagement remains a cornerstone of our work. Claire Davies joined the Global Ocean Observing System (GOOS) Biology and Ecosystems (BioEco) Panel as a phytoplankton expert co-lead, participating in meetings in Sopot, Poland. This panel plays a key role in developing the resources around Essential Ocean Variables for use by the global community and supports the integration of biological data into broader ocean observing systems, including IMOS and GOOS. Claire's involvement reflects our commitment to contributing to global efforts to monitor and understand ocean health. GOOS is conducting a consultation on the Essential Ocean Variables (EOVs) and their associated specification sheets, you can participate here.

We're excited about the renewed momentum within the Global Alliance of Continuous Plankton Recorder Surveys (GACS). Under the leadership of Dr. Clare Ostle, GACS is advancing tools to harmonise global datasets, refine life trait analyses, and improve CPR methodologies. Our student Brian is actively contributing to the development of comparative data frameworks that will allow researchers to access and analyse global plankton data more effectively. These efforts are helping to build a more integrated and accessible global plankton monitoring network.

We also want to highlight that we have a rich plankton sample archive, which includes all the IMOS plankton samples over the past 16 years, as well as historical samples from the early 1970s. These samples offer a unique opportunity to explore long-term ecological trends and are available for collaborative research. We invite interested researchers to get in touch if they would like to work with this valuable collection.

Our team has also grown, with Dr. Sahan Jayasinghe joining us in mid-2024. Sahan brings a fascinating background in molecular genetics and astrobiology, including research on life in outer space. His interdisciplinary expertise is enriching our work and opening new avenues for exploration at the intersection of marine biology and planetary science.

Finally, we encourage everyone to explore the Plankton Manifesto (https://unglobalcompact.org/library/6242), a visionary document that outlines the critical role of plankton in global sustainability and ocean health. It serves as a rallying call for researchers, policymakers, and citizens to recognise and support the foundational role of plankton in Earth's systems. As we continue our work, we remain inspired by the manifesto's message and committed to advancing the science and stewardship of plankton ecosystems. Thank you for being part of our global plankton community. We look forward to continuing this journey of discovery, collaboration, and innovation with you.

Yours in plankton!
Anthony and Claire

The Team

Anthony Richardson

Position: Leader IMOS Australian Plankton Survey
Location: CSIRO, Brisbane, QLD
I manage the CPR project, I help secure funding, guide research directions and develop relationships with other plankton surveys. My research interests are climate change ecology, plankton ecology, pelagic ecosystem dynamics, conservation planning and ecosystem modelling. In my spare time I love to spend time with my family.

Anita Slotwinski

Position: Plankton Biologist
Location: CSIRO, Brisbane, QLD
I analyse CPR & NRS plankton samples. I also manage the project website, communication materials, the zooplankton species reference collection and contribute to developing Australian taxonomic material. My research interests are in marine plankton ecology, environmental change and species response. I also enjoy photomicroscopy and expanding our photographic catalogue of Australian zooplankton.

Claire Davies

Position: IMOS NRS BGC Coordinator
Location: CSIRO, Hobart, Tasmania
I lead the CSIRO National Reference Station Bio-Geochemical sampling project which is part of the IMOS Australian National Mooring Network facility and I am the BGC Steering Committee chair. I also manage the IMOS Biological Ocean Observer alongside my co-developer, Jason Everett. I also sit on the GOOS BioEco Panel as a Phytoplankton co-lead. These days, although I still count a few plankton samples, I am mostly involved with data science, creating products and running analyses to increase our impact.

Felicity McEnnulty

Position: Plankton Biologist
Location: CSIRO, Hobart, Tasmania
I analyse CPR and NRS samples, am involved in data collation and quality control and contributing to publications and presentations. My research interests include plankton ecology, deep-sea invertebrates, introduced marine species and Antarctic marine invertebrates and fishes.

Frank Coman

Position: Deputy Leader
Location: CSIRO, Brisbane, QLD
My role involves liaising with ships that tow the CPR, the management of the North Stradbroke Island NRS sampling, zooplankton sorting of IMOS NRS samples, and plankton analysis of CPR samples. I am interested in plankton biology and ecology, climate change impacts on marine ecosystems and aquaculture. In my spare time I play sport, enjoy fishing, camping and photographing Australian wildlife.

Julian Uribe-Palomino

Position: Plankton Biologist
Location: CSIRO, Brisbane, QLD
My role involves analyses of plankton samples, operational tasks, data collection and quality control and contributing to publications and presentations. I am interested in biological oceanography, environmental modelling, biogeography, remote sensing and GIS.

The Team

Karl Focey

Position: Technical Officer
Location CSIRO, Brisbane, QLD
I am helping the survey by working on the integration of marine instrumentation to CPR projects, data recovery and quality control, maintenance and repair of CPR units and technical advice. My research interests include underwater video systems, oceanographic instrumentation and AUV's gliders and other emerging technologies.

Ruth Eriksen

Position: Plankton Biologist
Location CSIRO, Hobart, Tasmania
I analyse CPR and NRS samples, and am involved in data collation and quality control and contributing to publications and presentations. My research interests are phytoplankton ecology and taxonomy, phytoplankton physiology and response to contaminants, tintinnid ciliates and temperate and sub-Antarctic phytoplankton community dynamics.

Luke Brokensha

Position: Phytoplankton Biologist
Location Australian Antarctic Division, Hobart, Tasmania
I am a phytoplankton taxonomist with the Institute for Marine and Antarctic Studies. My research is focused on the CPR program for the Southern Ocean (SO-CPR), funded by IMOS. This program samples the plankton found in the surface waters between the Australian and Antarctic continents, and my role focuses on phytoplankton taxonomy. The data set covers the last 30 years and is continuously growing in temporal and spatial scope. With this rich data set, we are able to track and map trends and changes to plankton communities through time and assess the impacts of climate change on the Southern Ocean.

Sahan Jayasinghe

Position: Plankton Biologist
Location: CSIRO, Hobart, Tasmania
I identify and count CPR & NRS samples, conduct field work at NRS MAI and contribute to publications. My research interests include phytoplankton taxonomy and ecology, molecular biology and astrobiology. In my spare time I like hiking, music and watching horror films.

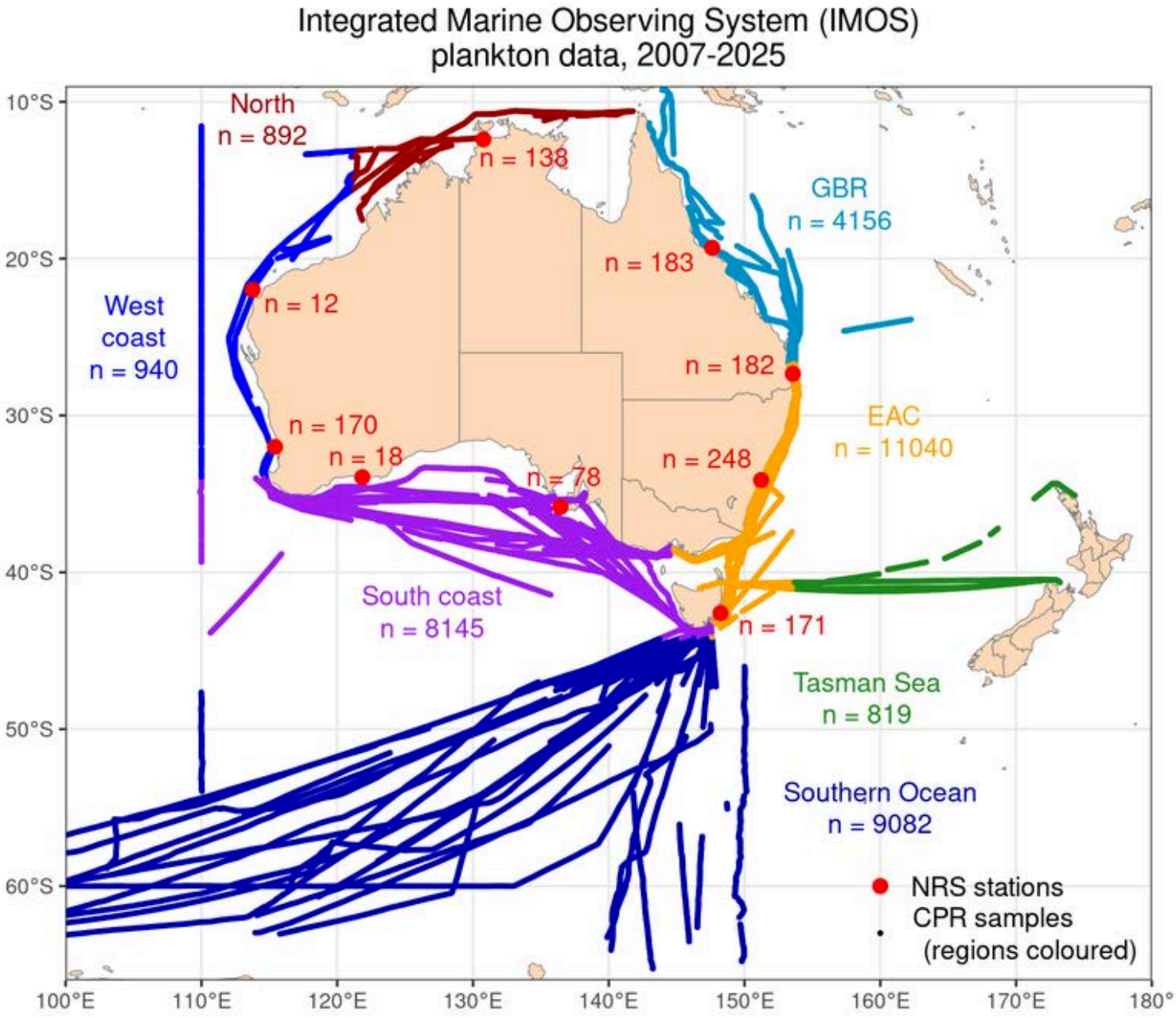
Mark Tonks

Position: Experimental Scientist
Location: CSIRO, Brisbane, QLD
My tasks include liaising with shipping companies, including owners, agents and crew to ensure that CPR sampling is maintained, and counting NRS and CPR zooplankton samples. I also have a coxswain's certificate and drive our research vessel to the NRS site where I then assist with plankton and water sampling. My research interests include plankton ecology, bycatch sustainability and fish and crustacean ecology. I also enjoy playing a variety of sports.

Wayne Rochester

Position: Quantitative Ecologist
Location CSIRO, Brisbane, QLD
I help the survey by the analysis of plankton data for ecosystem health assessment. My research interests are quantitative ecology, spatial ecology and natural resource management.

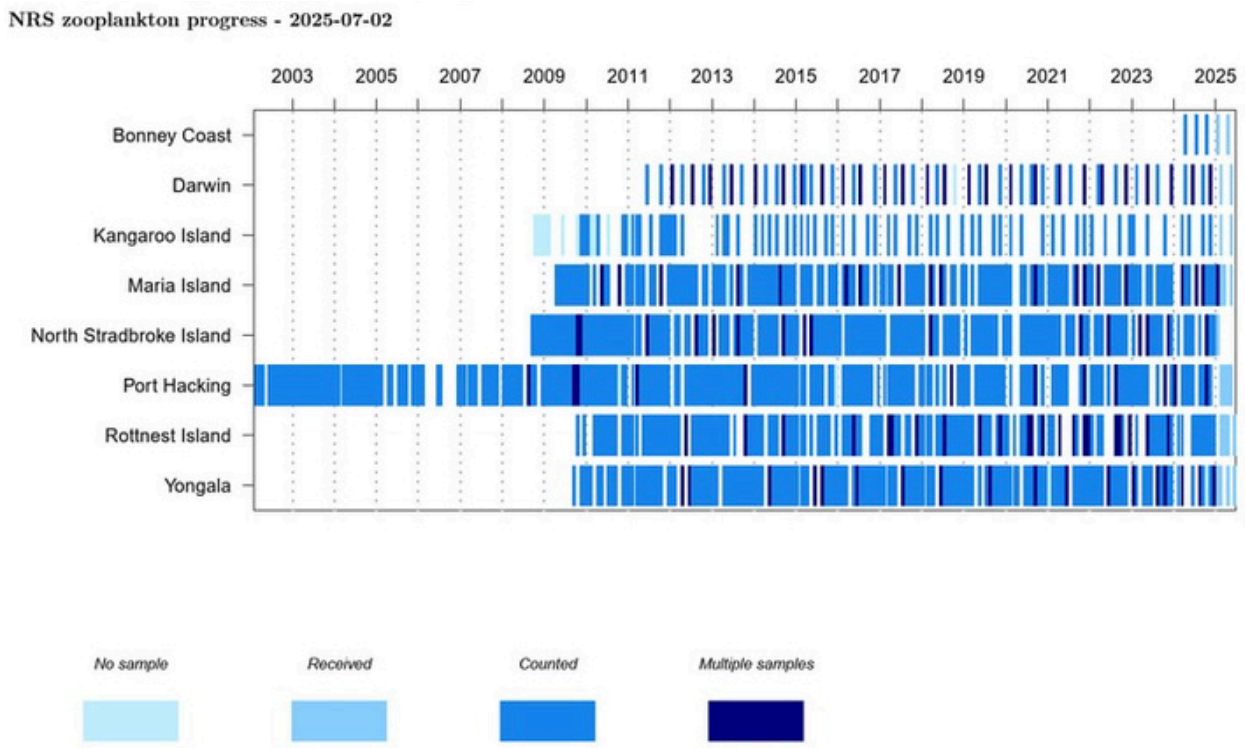
Sample Map



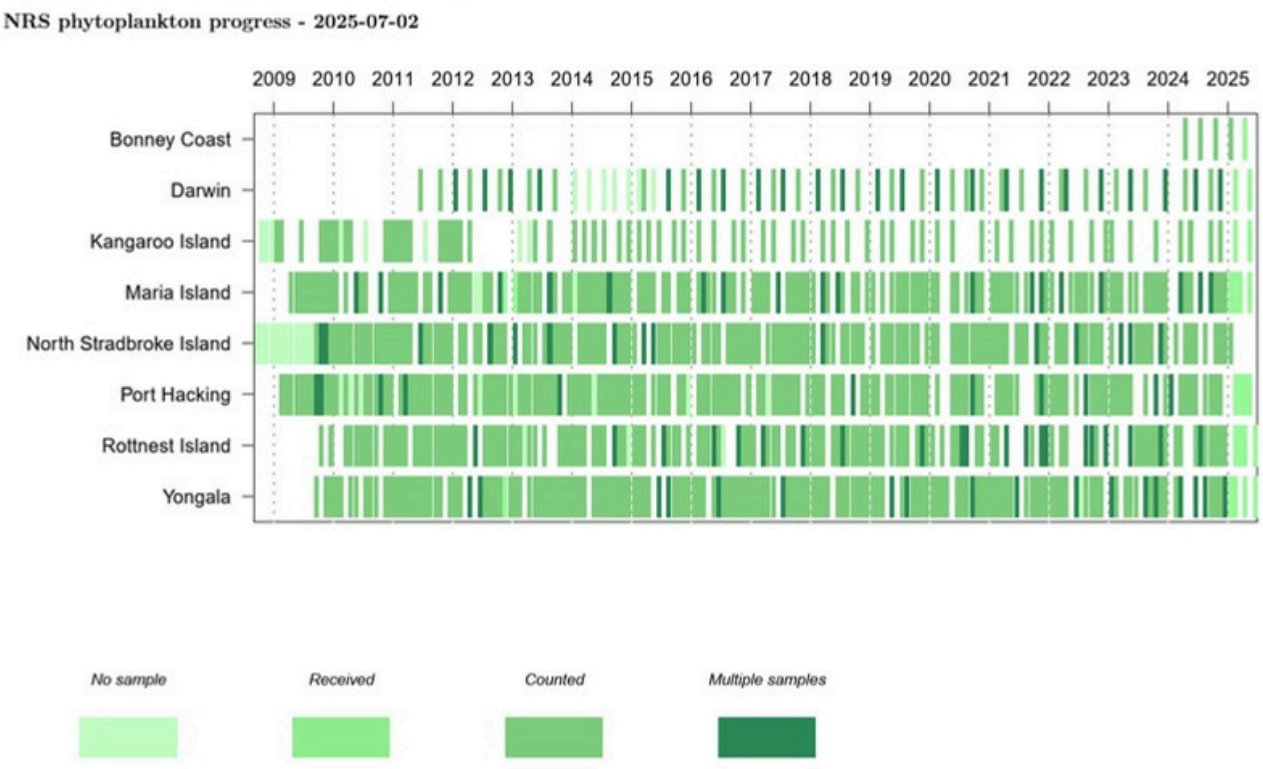
Explore our data further here:
https://shiny.csiro.au/BioOceanObserver/

Sample Progress

Progress in our National Reference Stations
Zooplankton Sampling and Counting



Progress in our National Reference Stations
Phytoplankton Sampling and Counting



Progress in Australian Continuous Plankton Recorder Sampling and Counting

Meet the Ships Working with Us

SHIP NAME	OPERATOR	LENGTH	DEAD WEIGHT
MV Tonsberg	Wallenius Wilhelmsen	265 m	41820 tonnes
MV Salome	Wallenius Wilhelmsen	265 m	43878 tonnes
RTM Wakmatha	Rio Tinto Shipping	236 m	89605 tonnes

Images: MV Tonsberg (Dexter), MV Salome (Mick Prendergast), RTM Wakmatha (all from www.marinetraffic.com). Thank you to all the ship operators that are working with us.

Welcome to our new Team member!

Can you tell us a little about yourself and your background?

Howdy! I joined the CSIRO-IMOS plankton team in July 2024 as a phytoplankton biologist. I will be involved in identifying and counting CPR & NRS samples, taking part in Maria Island NRS sampling trips, and contributing to writing papers and analyses. My primary research interests are in phytoplankton ecology and taxonomy, and molecular biology.

I initially joined CSIRO in February 2023 as a molecular research technician in the Australian National Fish Collection (ANFC). During my time in the ANFC I worked on projects focused on environmental DNA (eDNA) such as the SEA-MES Coupled eDNA experiment, and developing methods to extract genetic information from formalin-preserved and degraded specimens. Prior to that, I spent time working at Parks Australia as part of the team managing the Coral Sea Marine Park gaining experience in developing and implementing conservation strategies. I have also completed a PhD at the University of Tasmania in the field of astrobiology, where I studied polar extremophilic microbes (including phytoplankton & cyanobacteria) and the sea ice environment to explore the potential for life to exist elsewhere in our Solar System and beyond.

In my spare time I like to go hiking, play board games, play my bass guitar (badly) and listen to music (Claire can attest that I listen to every genre – currently going through a country-metal phase).

What inspired you to join the IMOS Australian Plankton Survey?

I was inspired to join the IMOS Australian Plankton Survey by the tremendous opportunity to contribute to a project that directly impacts our understanding of Australian marine ecosystems, and to work with a team of dedicated scientists making a real difference. It was a huge motivating factor, knowing that the data collected contributes to a valuable large-scale time series that allows us to track changes and trends over years and, provide crucial information for conservation and management decisions.

Why is studying plankton important to understanding the health of the ocean?

Plankton are the foundation of the marine food web – sustaining everything from tiny fish larvae to massive whales. Changes in plankton communities can have cascading effects throughout the entire ecosystem, indicating shifts in water quality, nutrient availability, and overall ocean health. By studying plankton, we can detect early warning signs of environmental stress and better understand the complex dynamics of our oceans.

Are there specific research projects or initiatives you're excited to be involved in?

I'm really looking forward to contributing to projects that involve modelling phytoplankton trends; phytoplankton taxonomy; and molecular studies that would supplement the plankton survey dataset such as the new IMOS eDNA facility.

What advice would you give to someone interested in working in ocean research?

Don't be afraid to ask 'stupid' questions. Seriously, the ocean's weird. And the only way to figure it out is by asking questions. Ocean research is a constantly evolving field, and new technologies and discoveries are constantly being made. Be prepared to be adaptable, willing to learn new things, and probably get a little bit wet.

What's something about plankton that most people don't know but should?

The earliest known diatoms only appeared in the fossil record in the Jurassic period (i.e 150 to 200 million years ago) – approximately 50 million years AFTER the first mammals! Before the rise of diatoms, the vast majority of Earth's oxygen was produced by cyanobacteria. In fact, cyanobacteria are responsible for the 'Great Oxidation Event', a period in Earth's history when atmospheric oxygen levels dramatically increased allowing higher forms of life to evolve.

Shipping

Mark Tonks

We continue to regularly tow CPRs from two Wallenius Wilhelmsen ships, the *Tonsberg* and *Salome*. Both vessels sample between Brisbane and south to offshore Adelaide. Since 2016, both vessels have now completed a combined 140 CPR tows covering more than 52,000 nautical miles.

In recognition of their long involvement (8 yrs) and continued support of the IMOS Australian Plankton Recorder Survey, the Master, Chief Officer and shipping agents of both ships were presented in mid-2024 with a plaque recognising their efforts.

Presentation of plaque to *Salome* crew, March 2024. (L-R) Chris Mathew (Agent, Wilhelmsen Port Services), Steven Edgar (CSIRO), Ganapathi Pandanda (Port & Cargo Operations Manager, Wallenius Wilhelmsen), Capt. Mariusz Wojs, Mark Tonks (CSIRO) and Chief Officer Chief Jijo Joseph

The Rio Tinto ship, *RTM Wakmatha* continues to tow CRPs along the inner Great Barrier Reef between Cairns and Gladstone. This ship travels fortnightly between Weipa and Gladstone carrying bauxite for Gladstone's alumina refineries. Since June 2018, 22 tows have been completed and over 8,700 nautical miles have been sampled. Mark and Frank visited the ship in Gladstone (February 2025) to swap out all sampling equipment, liaise with crew regarding sampling procedures and to present a plaque to the ship's officers recognising the 7 years they've supported our survey.

We are currently in discussions with Rio Tinto to establish another tow point on another one of their ships, which will provide flexibility if the *RTM Wakmatha* goes in for an extended refit period. We thank Rio Tinto and the ship's crew, particularly Captain's Mark Gunn and Yuriy Belogortsev, Chief Officer's Thiago F da Silva and Zak Miers and Max McColl (Ship Manager) for their assistance.

Aft view of the *RTM Wakmatha* in Gladstone Port, February 2025. Note the davit arm rear deck on starboard side used to tow the CPR.


Presentation of plaque to *RTM Wakmatha* crew, Feb 2025. (L-R) Chief Officer Thiago F da Silva, Capt. Mark Gunn, Frank Coman and Mark Tonks (CSIRO).

Brisbane Lab Update

Frank Coman

The last 12 months has seen a strong focus on sample analysis in the Brisbane laboratory with good progress being made with AusCPR samples, NRS zooplankton and phytoplankton samples, and samples collected from the first SEAMES voyage. Both the Wallenius Wilhelmsen ships, the *Salome* and the *Tonsberg* continued to collect samples between Brisbane and Melbourne for us. There were 5 voyages where samples were collected, 3 from the *Tonsberg* and 2 from the *Salome*. For the first 4 voyages of 2024 samples were collected while the ships were travelling from Fremantle to the east coast, but for the last voyage in November the *Tonsberg* travelled the more familiar route from East to west. Staff from Brisbane arranged for the delivery and pick up of the cassettes from the ships. The Rio Tinto ship, *Wakmatha*, also continued to collect samples along the Great Barrier Reef between Cairns and Gladstone. Samples were collected on 3 south bound, and one north bound voyage during 2024.

Sampling at the North Stradbroke Island National Reference station continued throughout 2024, but due to weather and unavailability of staff we only were able to sample in February, April, May, June, August, October, November and December and 2025 has started off with some difficulty due to the build up and eventual arrival of cyclone Alfred. We have continued to sample with *CSIRO 1* and as with recent years Mark Tonks, Julian Uribe-Palomino, Steve Edgar and Frank continue to be the regular crew on the sampling trips. We did however receive help from Rob Kenyon, Dean Kelk, Lauren Hardiman and Geoff Carlin who joined us on sampling when the regulars were not available. Steve Edgar and Margaret Miller have just attended the 2025 QA/QC summit held in Adelaide, along with Hobart team members Claire and Sahan.

Team members from Brisbane have continued to support several other projects, particularly with field work. Mark Tonks participated in the SEAMES voyage 2 in June, the Northern Prawn Fishery (NPF) survey in the Gulf of Carpentaria in July, and the last tropical rock lobster survey in November. Mark also spent time on Queensland's southeast coast as part of the effects of trawling project towed camera survey work. Julian travelled to Perth in January 2024 to work on a CAS (Chinese Academy of Science) collaborative project to develop automated plankton monitoring equipment. While in Perth Julian was also able to assist in getting CPR equipment loaded on one of our collaborating vessels.

SEAMES Voyage 4 Team (Image: Tegan Sime)

Frank Coman and Julian Palomino at the North Strabroke Island NRS Station.

Anthony has continued to have students working with our data during 2024 including Sandra Neubert and Kristine 'Tin' Buenafe. Hannah Moloney visited our laboratories on several occasions to process samples (with assistance from Davina and Jackie from UQ) and discuss analysis of her data for her PhD on Mantas at the Maldives. We also hosted a high school work experience student for a week in April.

Apart from these activities, the Brisbane staff have been busy with the usual administrative tasks including reviews of laboratory space, cleaning up storage areas, and attending first aid and other mandatory training courses and attending the local Environment mini symposium held at the University of Queensland.

Hobart Lab Update

Felicity McEnnulty

The Hobart team has been busy in the laboratory, identifying phytoplankton and zooplankton as well as settling samples and measuring biomass for the National Reference Station samples, Continuous Plankton Recorder samples, Southeast Australian Marine Ecosystem Survey voyage multinet and water samples and Southern Ocean Time Series samples the RV Roger Revelle voyage.

National Reference Station sampling

Sahan joined the Plankton team and jumped straight into participating in field sampling at Maria Island in his first week. We have had a good year of sampling managing 11 monthly samples in 2024 and 10 in 2023. In October 2024 we sampled during a bloom of *Noctiluca scintillans*, with the dinoflagellate accounting for 80% by abundance of the zooplankton net sample when analysed in the lab (see next page).

Claire has been busy managing the IMOS BCG NRS sampling program for Australia, organising and running the steering committee meetings and the QC summit each year. Thanks also to SARDI for hosting the summit, helping with all the preparations and ensuring all attendees were well looked after. She also attended IMOS APM and the IMOS AMSA data workshops presenting on and promoting the use of the Biological Ocean Observer for students and researchers.

Sahan on a NRS trip at Maria Island with a bloom of *Noctiluca scintillans* (Image: Matt Lansdell)

Bloom of *Noctiluca scintillans* (Image: Sahan Jayasinghe)

Plankton sample coloured from the bloom of Noctiluca scintillan (Image: Matt Lansdell)

Noctiluca scintillans under the microscope, in bloom it can account for 80% of the sample biomass (Image:s: Felicity McEnnulty).

The Marine National Facility (MNF) has continued to collect Continuous Plankton Recorder samples for us on *RV Investigator*. The MISO voyage in January 2024 towed the CPR down to the Southern Ocean Times Series (SOTS) mooring for us, on its way to Antarctica (see right).

This year, in March 2025 we deployed the CPR as part of the CAPSTAN (Collaborative Australian Postgraduate Sea-training Alliance Network) voyage and the students analysed silks for Phytoplankton Colour Index from both the east coast and west coast of Tasmania on the first circumnavigation on Tasmania by *RV Investigator* (see below).

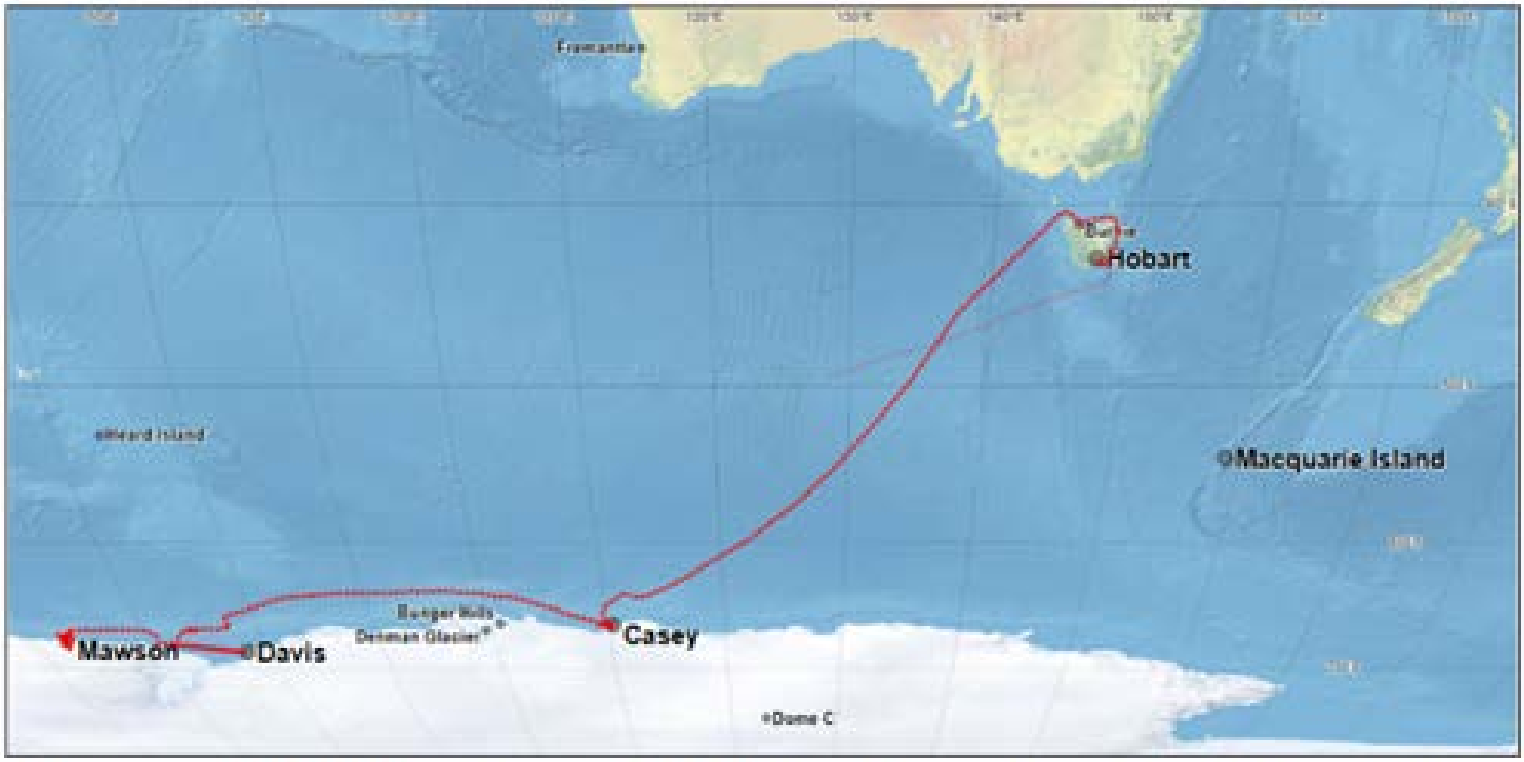
IN2024_V01 Multidisciplinary Investigations of the Southern Ocean (MISO) - CSIRO Jan - March 2024 (from MNF website)

IN2025_V01 CAPSTAN sea training voyage 04 - CSIRO March 2025 (from MNF website).

Felicity and Ruth gave the CAPTSAN students an introduction to the IMOS plankton observatory, the CPR program and other plankton resources as part of their pre-voyage training, and were delighted to receive a post-voyage articles by Rachel Wong and Catherine (Wren) Vally (see page 49).

The new Antarctic icebreaker, *RSV Nuyina* is now undertaking science voyages and the Southern Ocean CPR program at the Australian Antarctic Division collected CPR plankton samples from the Southern Ocean north of 47 degrees south on V3 from Hobart to Casey in February 2024 and Mawson to Hobart in March 2024 (see next page).

This summer season AAD has towed the CPR on V2 in December, starting at the north-west tip of Tasmania after bunkering at Burnie, which is the furthest north the AAD has deployed the CPR in all the years of the SO-CPR survey.



Voyage track of the *RSV Nuyina* over the 10 weeks, from 13 November 2024 to 21 January 2025: (From: https://www.antarctica.gov.au/)

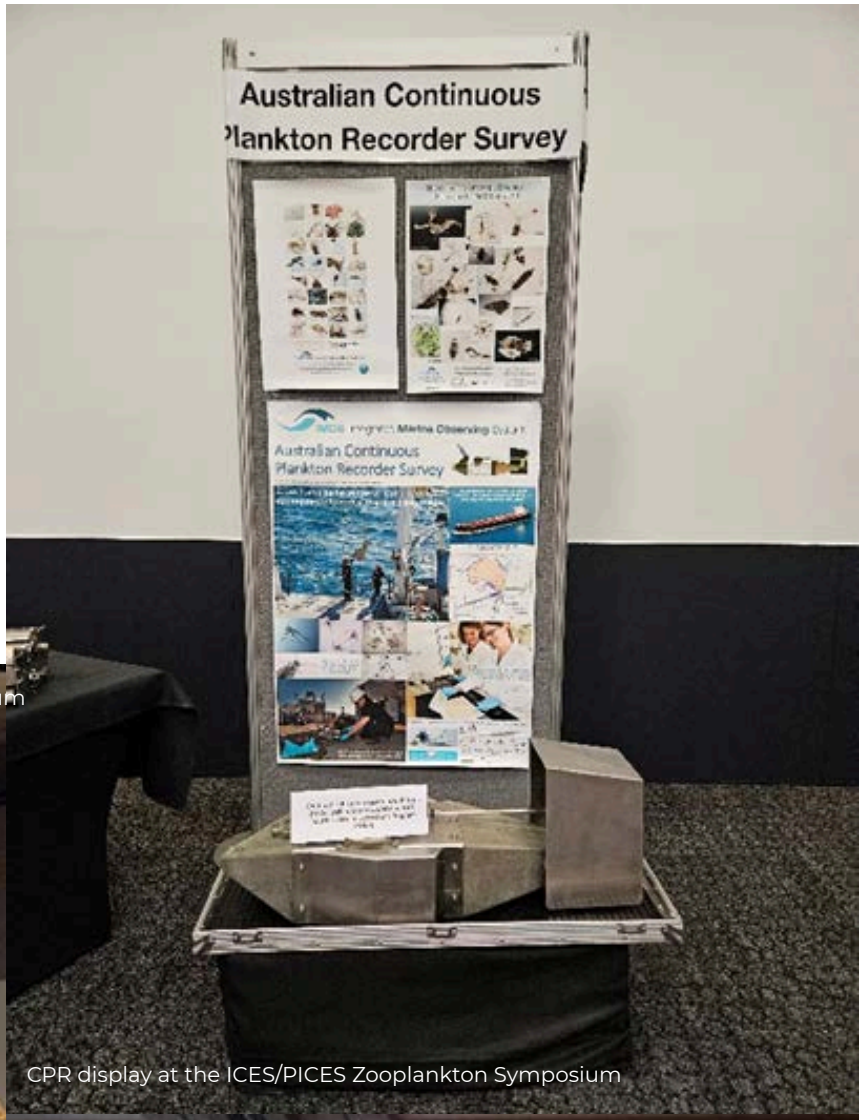
RSV Nuyina arriving in Hobart (Image: Felicity McEnnulty))

The Hobart team travelled to our Brisbane lab in October 2023 for a taxonomic workshop and plankton discussions.

We hosted larval fish identification expert Tony Miskiewiz in February and March 2024 hosted to go through CSIRO larval fish reference collections and transfer them to Australian Museum for registration and ongoing management.

The ICES/PICES Zooplankton Symposium was held in Hobart in March 2024 (see page 30).

Julian Uribe-Palomino at the ICES/PICES Zooplankton Symposium



CPR display at the ICES/PICES Zooplankton Symposium

Claire Davies at the ICES/PICES Zooplankton Symposium

Frank Coman at the ICES/PICES Zooplankton Symposium

Ruth Eriksen at the ICES/PICES Zooplankton Symposium

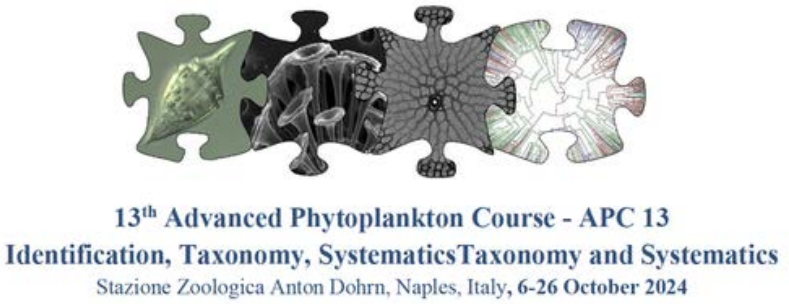
Claire and Jason Everett attended the Ocean Modelling & Observations workshop presenting on the Biological Ocean Observer and Trichodesmium:

Davies, Claire; Eriksen, Ruth; Dias, Albertina; Skerratt, Jenny; Van De Kamp, Jodie; Willis, Anusuya; Robson, Barbara. Trichodesmium – what we know from Australian observations, experiments and modelling. In: Ocean Modelling & Observations; 02 to end of 04 Jul 2024; Australian National University, Canberra. CSIRO; 2024.

Claire, Ruth and Sahan presented at the joint AMSA-NZMSS 2023 Conference (see page 38), and Sahan also presented at the Australian & New Zealand Environmental DNA Conference (February 2025) on the eDNA component of the first two SEA-MES voyages:

Jayasinghe, Sahan; Bessey, Cindy; Bodrossy, Lev; West, Katrina; Deagle, Bruce. ***The Coupled eDNA Experiment: Harnessing eDNA for Marine Biodiversity Observations from the South-east Australian Marine Ecosystem Survey (SEA-MES)****. In: 2nd Australian & New Zealand Environmental DNA Conference; Wellington, New Zealand. Southern eDNA Society; 18th to 21st Feb 2025.*

Ruth attended the 13th Advanced Phytoplankton Course in Identification, Taxonomy and Systematics in Naples, Italy (see page 46) October 4 – 28th 2024. She presented on Southern Ocean phytoplankton trends, and taxonomy with collaborators from UTAS, UTS and AAD.



Ruth also attended the launch of the SOOS/GOA-ON Ocean Acidification Regional Hub for the Southern Ocean at the Australian Antarctic Research Conference in Hobart.

Ruth took a science tour on the very impressive *RV Nuyina* as part of the Australian Antarctic Research Conference special session on the Denman voyage.

The SOOS Symposium Southern Ocean in a Changing World in August 2023 presentations include:

Eriksen, Ruth; Rigual-Hernández, Andrés S.; Scott, Fiona; Brokensha, Luke. ***"Coccolithophore communities in the Sub- Antarctic Zone: floristic diversity revealed through long-term sampling".*** This one won the poster prize!

Plasman, C; Hancock, A; Raymond, B; Fierro Arcos, D; Evans, K; Swadling, K; Henley, S; Halfter, S; Brokensha, L; Meiners, KlaKus; Jansen, J; ten Hoopen, P; Williams, J; Eriksen, R; Corney, I; Meijers, A; MacDonald, A; Walters, A; Henderson, A; Link, H; Schloss, I; Tattersall, K; Hill, N; Friscourt, N; Corney, S; Volzke, S; Gan, Y; Van de Putte, A. ***Designing Southern Ocean E(B)V workflows, from data collection to data products.*** *In: Towards a Distributed System for Essential Variables for the Southern Ocean Hobart Tasmania. Workshop report, Institute of Natural Sciences, Belgium; 2024. 2-16.*


Photo: Pete Harmsen

Our Australian Antarctic Research Conference, Hobart Tasmania in November 2024 presentations included:
.
Eriksen, Ruth; Latour, Pauline; Willis, Anusuya; Baker, Kirralee; Strzepek, Robert ***"Fragilariopsis yeti: A new, seasonally-recurrent, nano-planktonic diatom from the Southern Ocean Time Series"***

Fitzgerald-Lowry, Billy; Nielsen, Daniel Aagren; Theseira, Alyson; Eriksen, Ruth; Petrou, Katherina ***"Role of light in shaping community structure and physiology in the Sub-Antarctic Zone (SAZ): a study on silicon biomineralisation in Sub-Antarctic waters"***

Robert F. Strzepek; Philip W. Boyd; Anita Butterly; Pauline Latour; Delphine Lannuzel; Talitha Nelson; Brandon J. McNabb; Philippe D.Tortell; Andrew R. Bowie; Scott W. Meyerink; Ashley T. Townsend; Karen J. Westwood; Levente Bodrossy; Ruth Eriksen; Knut Heinatz; Brook L. Nunn; Joel Alroe; Kelsey Barber; Caleb Mynard; Erin Dunne; Emily B. Franklin; Ruhi S. Humphries; and Marc D. Mallet ***"Influence of marine plankton on cloud-seeding gases in the Southern Ocean: Insights from mesocosms".***

Ruth has joined the IMOS Science and Technology Advisory Committee, along with Mark Baird and Mark Underwood from CSIRO, and had her position in the "IOC Group of Experts on Climate Change and Global Trends of Phytoplankton in the Ocean (TrendsPO) : An IOC activity complementing the GOOS Bio-Eco Panel, OBIS and IOC-SCOR GlobalHAB" extended.

The specific objectives of TrendsPO are:
1. to continue to work on representative phytoplankton data sets in order to develop a more comprehensive scientific understanding of underlying processes and pressures mediating ecological change;
2. to better understand the connectivity of phytoplankton with environmental changes through interactions with other IOC sponsored programs and groups;
3. to engage with IPCC to examine phytoplankton variability in the ocean and coastal ecosystems under various climate change scenarios;
4. to train young career scientists under the mentorship of the Group's senior scientists.

Claire recently accepted a position on the GOOS BioEco Panel as the phytoplankton co-lead (https://goosocean.org/who-we-are/expert-panels/). The panel is a collaborative, international approach that strengthens data sharing and interoperability, enhances capacity building, facilitates technology transfer, and increases management options at all levels of government. IMOS is one of the GOOS Regional Alliances (https://goosocean.org/who-we-are/goos-regional-alliances/) and the aims of the panel align with the values of IMOS. Claire attended a face to face EcoPanel Workshop in Poland in February 2025. The workshops focussed on the development of specification sheets and implementation plans for each Essential Ocean Variable (EOV) (https://goosocean.org/what-we-do/framework/essential-ocean-variables/), best practice documentation and data management and the development of the BioEcoOcean project Blueprint for Integrated Ocean Science.

Claire and Jason received another 2 years of funding from IMOS to continue work on the IMOS Biological Ocean Observer. They released a new version in March 2025 which includes data from the newest NRS, at the Bonney Coast mooring. Other updates include significance data for the time series trends and some improvements in efficiencies in the back end. Check it out and let us know your thoughts, we are open to ideas for improvements and things that will help you use our data more efficiently - https://shiny.csiro.au/BioOceanObserver/

EcoPanel Workshop in Poland in February 2025 (Image: www.goosocean.org/).

Southeast Australian Marine Ecosystem Survey (SEA-MES)

SEA-MES, led by CSIRO Senior Scientist Dr Rich Little, is revisiting previous surveys of the Australian southeast continental shelf, and documenting changes in the 25 years since it was last examined. Find details on the series of voyages here: https://research.csiro.au/sea-mes/

Claire, Mark, Frank, Felicity and Sahan have participated in the Southeast Australian Marine Ecosystem Survey voyages on *RV Investigator* between Hobart and Sydney in July 2023, May 2024 and November 2024. The team has been responsible for collection stratified net samples using the Hydrobios Mammoth Multinet during the day and night, filtering water samples collected by niskin bottles on the CTD for flow cytometry, pigment, eDNA and phytoplankton analysis. The have also been involved in fish taxonomy, elasmobranch handling and invertebrate sorting from the fishing trawls. These voyages are investigating the causes of change over 25 years in the southeast marine ecosystem. Frank is going on the final voyage IN2025_V04 in June 2025.

The plankton multinet being deployed onboard the SEA-MES voyage 2 (Image: Claire Davies).

Claire, Ruth and Sahan presented at the joint AMSA-NZMSS 2024 Conference in September 2024 on plankton related topics from sampling on the first two Southeast Australian Marine Ecosystem Survey voyages (page 38).

Davies, Claire; Eriksen, Ruth; Sutton, Caroline; Fischer, Mibu; Langlais, Clothilde; Richardson, Anthony; Little, Rich; Pethybridge, Heidi; McEnnulty, Felicity. ***Green slime – Nuisance or productivity boom****. In: AMSA-NZMSS 2024 Conference; 15 to end of 20 Sep 2024; Hobart, Australia. AMSA; 2024. See page 39.*

Eriksen, Ruth; Davies, Claire; Sutton, Caroline. ***Greedy guts: diet of the salp Thetys vagina sampled during the SEA-MES voyage****. In: Australian Marine Sciences Association Annual Meeting 2024; 15 to end of 20 Sep 2024. See page 40.*

Sahan also presented at the joint AMSA-NZMSS 2024 Conference (September 2024) and the Australian & New Zealand Environmental DNA Conference (February 2025) on the eDNA component of the first two SEA-MES voyages:

Jayasinghe, Sahan; Bessey, Cindy; Bodrossy, Lev; West, Katrina; Deagle, Bruce. ***The Coupled eDNA Experiment: Harnessing eDNA for Marine Biodiversity Observations from the South-east Australian Marine Ecosystem Survey (SEA-MES)****. In: 2nd Australian & New Zealand Environmental DNA Conference; Wellington, New Zealand. Southern eDNA Society; 18th to 21st Feb 2025.*

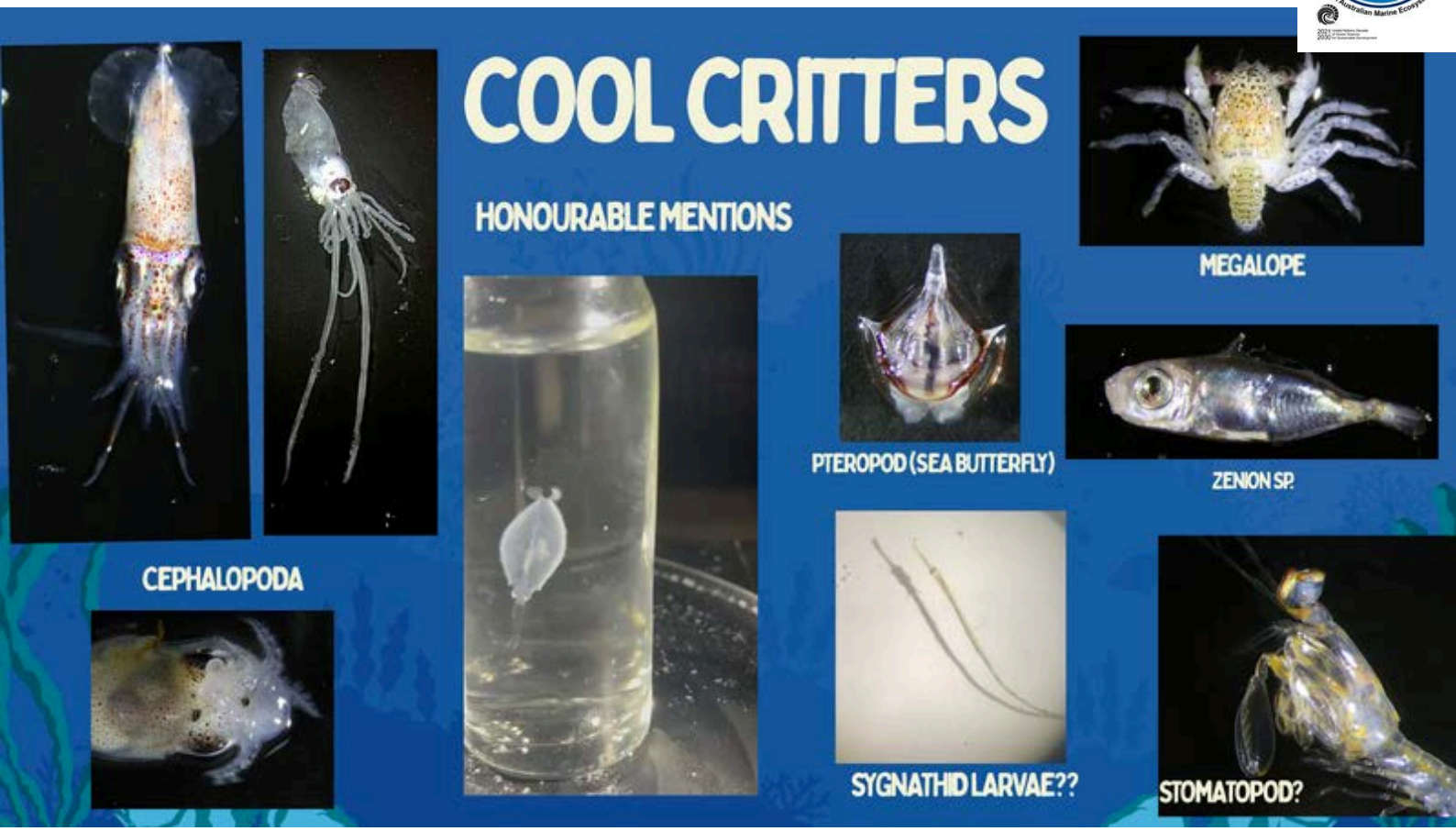
A birds eye view into the plankton multinet being deploed onboard the SEA-MES voyage 2 (Image: Claire Davies).

Snapshots of the plankton sampling and proessing onboard the SEA-MES voyage 2 (Felicity McEnnulty and Mibu Fisher).

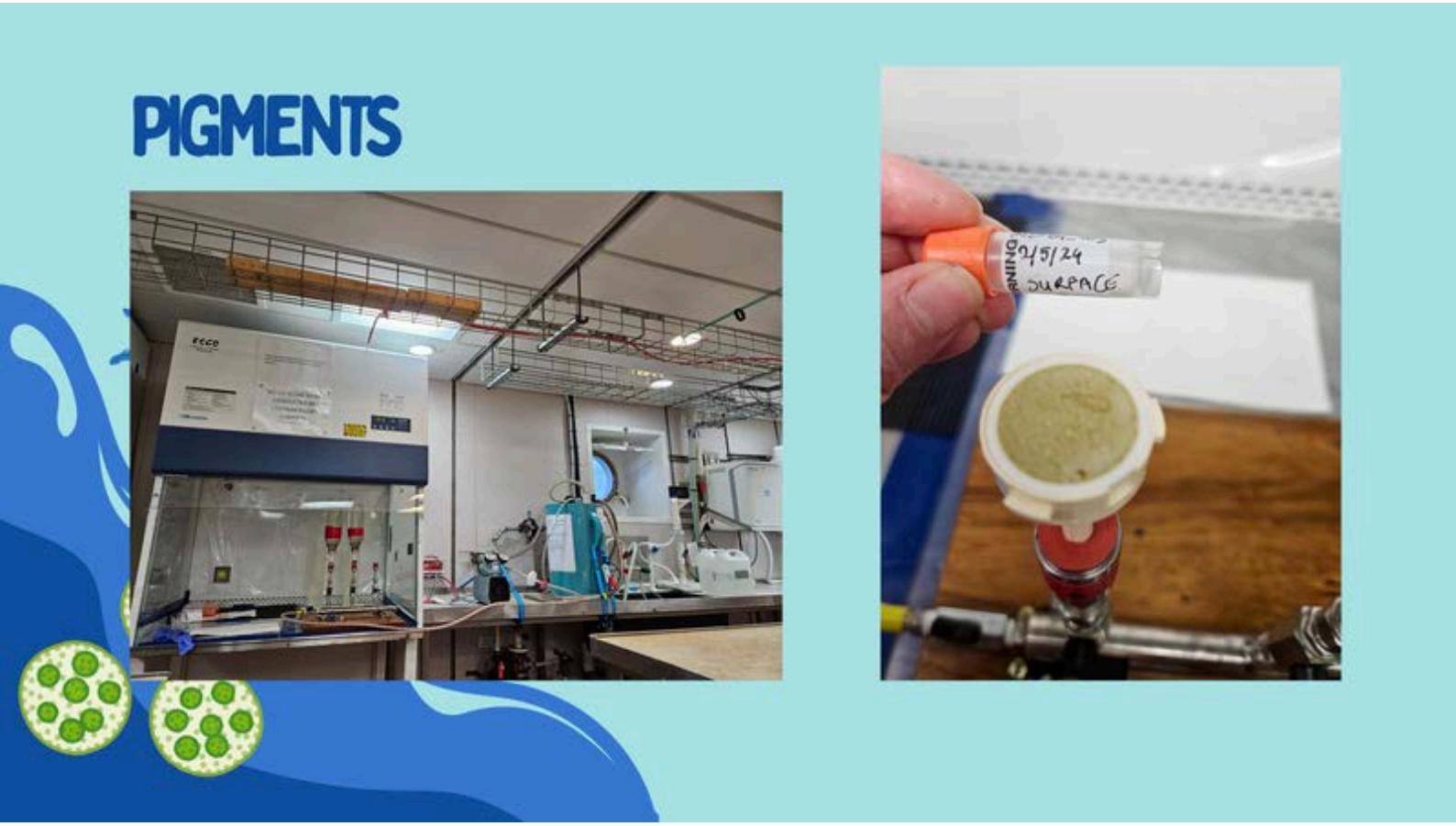
A selection of the diverse array of larval fish collected onboard the SEA-MES voyage 2 (Felicity McEnnulty and Mibu Fisher).

It was especially cativating to observe and collect these beauties onboard the SEA-MES voyage 2, Sea sapphires, belonging to the genus Sapphirina, are tiny copepods renowned for their stunning iridescence and remarkable ability to appear and disappear in flashes of color. (Felicity McEnnulty and Mibu Fisher).

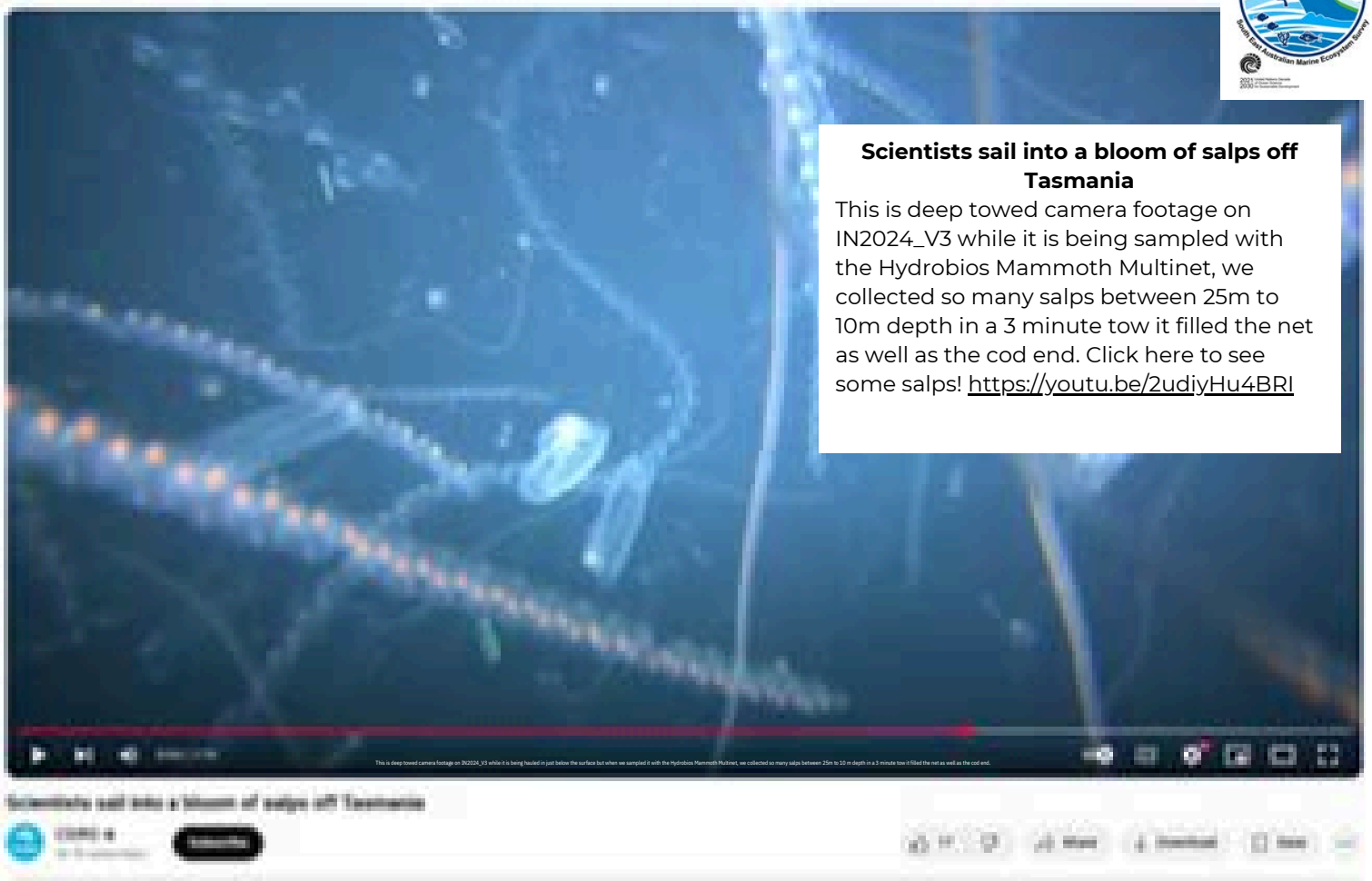
A selection of gelatinous ctenophores and amphipods collected onboard the SEA-MES voyage 2 (Felicity McEnnulty and Mibu Fisher).



A selection of gelatinous ctenophores and amphipods collected onboard the SEA-MES voyage 2 (Felicity McEnnulty and Mibu Fisher).



A selection of gelatinous ctenophores and amphipods collected onboard the SEA-MES voyage 2 (Felicity McEnnulty and Mibu Fisher).



Scientists sail into a bloom of salps off Tasmania

This is deep towed camera footage on IN2024_V3 while it is being sampled with the Hydrobios Mammoth Multinet, we collected so many salps between 25m to 10m depth in a 3 minute tow it filled the net as well as the cod end. Click here to see some salps! https://youtu.be/2udiyHu4BRI

Caroline Sutton and Mibu Fischer (top) Claire Davies onboard the SEA-MES voyage 3 processing plankton samples.

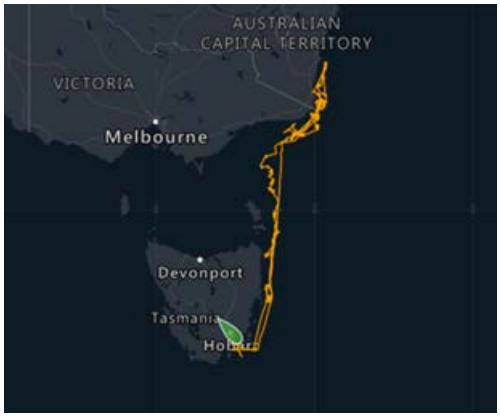
On SEA-MES voyage 3, Sahan and Claire teamed up with Hanuman Crawford from MNF's Scientific Instrumentation Team (SIT) to develop a tool to sample phytoplankton directly from CTD Niskin bottles.

The device, a light weight and manoeuvrable aluminium A-frame, holds a 10 um or 20 um plankton net over a graduated bucket. This enables us to measure the volume of water filtered through the net and to make quantitative assessments of the phytoplankton collected.

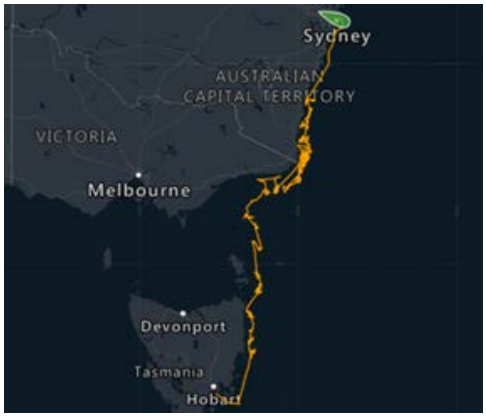
Following a naming competition aboard SEA-MES 3, the device was christened: Collecting and Harvesting Unbeknownst Microalgae By Using Cylindrical Kickass Experimental Tool (CHUM BUCKET) – a nod to the humble abode of the character Plankton from SpongeBob SquarePants.

The plan is to utilise CHUM BUCKET on future Investigator voyages. Ruth and Sahan will be analysing the phytoplankton samples in the coming months.

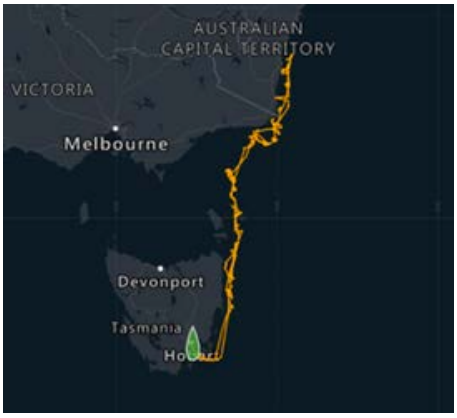
CHUM bucket in action onboard the SEA-MES voyage 2.



IN2023_V05 South-East Australian Marine Ecosystem Survey (SEA-MES) - Voyage I - CSIRO June-July 2023



IN2024_V03 South-East Australian Marine Ecosystem Survey (SEA-MES) - Voyage II - CSIRO April – May 2024



IN2024_V05 South-East Australian Marine Ecosystem Survey (SEA-MES) - Voyage III - CSIRO Nov – Dec 2024

Voyage number 4 is due back at the end of June 2025 - keep posted for results and interesting finds!

Jackson prior to boarding the RV Investigator

Jackson and the AM team painting up a storm

Exploring Ocean Colour: Pigment data from the SEA_MES Voyages

Jackson Griffin

In November–December 2024, I had the incredible opportunity to take part in the third SEA-MES (Southeast Australian Marine Ecosystem Survey) voyage aboard the *RV Investigator* (IN2024_V05). I joined as a University of Tasmania student volunteer, and for four weeks I found myself immersed in marine science; counting, weighing, and measuring fish, climbing onto the CTD rosette (carefully!), taking water samples, and sieving multi-net samples.

Of all the tasks, I found myself particularly drawn to the CTD and water sampling work. I enjoyed it so much that after the voyage, I was eager to stay involved and explore the dataset we had collected. During the voyage, presentations from Sahan and Claire sparked my curiosity about ocean colour and phytoplankton pigments, and, after some polite badgering, Claire kindly offered to support a project that could fit within my timeline, roughly a semester or two.

Thanks to that support, I'm now working with the pigment dataset collected from all three SEA-MES voyages (INV2023_V05, IN2024_V03, and IN2024_V05), expertly distilled by Albertina. The data provides insights into the composition and abundance of different phytoplankton groups, namely micro-, nano-, and pico-plankton, across time and space.

I'm currently in the exploratory phase of the project, looking for patterns in the data. Some of the key questions I'm asking include:

- Are there seasonal trends across the three voyages? How do the two winter voyages compare to the spring one?
- Are the pigment profiles significantly different between voyages?
- Can we detect simple correlations with environmental variables?
- Is there spatial variability? Such as differences from north to south?
- Do the proportions of micro-, nano- and pico-plankton vary seasonally or spatially?

Ultimately, I aim to compare the contemporary SEA-MES pigment data with those from the South East Fishery Ecosystem Surveys (SEFES) of the 1990s, to better understand long-term ecological change in this dynamic region.

This project has been a fantastic way to build on my experience at sea, learn new skills in data analysis, and stay connected with the fantastic community I met aboard the *Investigator*.

Contact Jackson for further information on jackson.griffin@utas.edu.au

7th ICES/PICES Zooplankton Symposium, Hobart, March 2024

Claire Davies

In March, the IMOS Plankton Team from CSIRO attended the 7th ICES/PICES Zooplankton Production Symposium. The 315 attendees, of which 161 were Early Career Ocean Professionals (>50%!), came from 38 countries. The 16 sessions covered every topic imaginable but those most relevant to our work were:

1) Applications of time series to track changes in zooplankton communities and impacts on ecosystem structure and function;

2) Improving zooplankton representation in models;

3) Advancements in zooplankton censusing and monitoring technologies; and 4) The role of microzooplankton in biogeochemical cycling and food webs.

There were some notable themes throughout the Symposium that ran through each of the sessions. The first was the value of data, especially well curated long time series. Data can be collected using many different methods, each having their strengths and weaknesses in answering a variety of questions. There was a feeling that rather than being substitutable, these methods are complementary. Taxonomy is still important. All methods add different information to the complex story. These different methods have also given rise to data being accessible as indices, size spectra and biomass products, which may be more accessible to users, including modellers. These data products are in high demand in the community. There was also a strong focus on some less well studied components of the zooplankton community and their roles in local ecosystems, including gelatinous zooplankton and microzooplankton.

Mark Tonks at our AuSCPR stand at the 7th ICES/PICES Zooplankton Production Symposium.

Data

Many researchers noting that only from long time series can we truly begin to understand the changes we see in our oceans. Anthony Richardson presented what may be the first observational evidence of a clear global decline in zooplankton biomass based on analysis of 90 years of historical biomass data from around the globe. This data has been painstakingly archived through efforts such as the Australian Zooplankton Biomass Database (McEnnulty *et al.* 2020) and the NOAA COPEPOD database compiled by Todd O'Brien. IMOS data were an important contribution to this analysis, as Australia was relatively devoid of zooplankton data in the past. However, research like Anthony's is only possible when data is made freely available and in useful formats. IMOS is doing comparatively well in this space for zooplankton research and Anita Slotwinski presented on how we maintain our taxonomic consistency and QC standards over the long term with multiple analysts and labs. Mark Tonks presented the Continuous Plankton Recorder and associated collecting materials at the Tuesday evening poster session and had a steady stream of interested attendees asking questions and looking over the physical components of where some of our data collection starts.

Data products

Long data sets and a variety of methods mean that time series analysis have gone beyond Latin names and counts. Size, biomass, indices, ratios, and assessment by functional role can give better insights into what is changing and why, and what its likely impact will be in the ecosystem and/or fisheries. Data standardization and interoperability are key to advancing the field of trait-based approaches and the massive potential of vast image databases. Frank Coman presented on a range of indices developed through the IMOS plankton data, EAC index, Community Temperature Index, and how these can aid our understanding of the overall ecosystem and how it is changing. All this information is difficult to decipher without visualisation tools, Claire Davies presented work on the IMOS Biological Ocean Observer and how this can increase uptake by making data more available and accessible. Data also needs to be presented in the accessible formats for uptake in models and Jason Everett presented on how to make model-ready products and use collections of local data on a global scale.

The importance of long-term data was made explicit in the official synthesis of the conference by Dr Sonia Batten, Head of PICES, who quoted Anthony's parting comment from his presentation: ***"Long after our papers will stop being cited, our data – that is collected and made freely available – will continue to increase in value."*** This also highlighted the need to ensure data is archived and curated so that it can continue to be accessible into the future.

7th ICES/PICES Zooplankton Production Symposium (Images: Sonia Batten).

Methods for measuring the zooplankton community
Another common thread introduced in Angus Atkinson's keynote and running through most sessions was that new technology and traditional methods should be seen as complementary, not replacements of each other. Morphological taxonomy, although slow and expensive, gives the most comprehensive community data and is very important especially for use in an integrative manner with other techniques, such as verification of molecular analysis. Whilst complementary approaches (molecular – morphological – imaging – acoustics – etc.) provide different views of the zooplankton community and are necessary for a complete understanding, bridging temporal and spatial scales.

Felicity McEnnulty and Julian Uribe-Palomino presented on how the IMOS plankton team are integrating new technologies into our work. The community felt that this complementarity is not appreciated by funding bodies who are often looking for a modern "silver bullet" technology that answers all questions. We have proposed a policy paper to highlight the relevance for the economy and the value for ecosystem services of integrating new technologies with more traditional morphological approaches. At the Symposium, 26 presentations were based, at least in part, around Continuous Plankton Recorder data, an old technology but the longest time series, which provides unparalleled value in understanding changes through time on large spatial scales.

Another common thread introduced in Angus Atkinson's keynote and running through most sessions was that new technology and traditional methods should be seen as complementary, not replacements of each other.

Left: Angus Atkinson at the 7th ICES/PICES Zooplankton Production Symposium (Image: Sonia Batten).

Attendees at the 7th ICES/PICES Zooplankton Production Symposium (Image: Sonia Batten).

The role of forgotten zooplankton groups

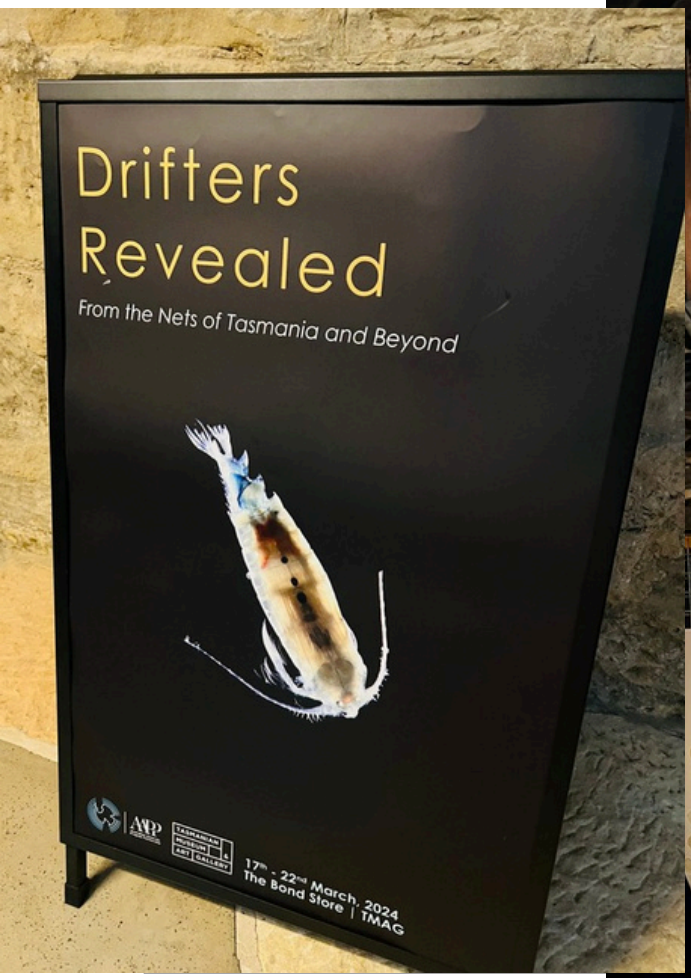
Gelatinous zooplankton and microzooplankton are recognised for their importance in ecological and biogeochemical dynamics and interest in studying in these areas has increased. Claire Davies and Ruth Eriksen both presented information on the behaviour of Tintinnids that generated a lot of interest. Based on a global ecosystem model ZooMSS (Zooplankton Model of Size Spectra) Jason Everett highlighted that larvaceans were a globally important group – especially in oligotrophic gyres - that had been overlooked. This was supported by extensive global sampling using the Underwater Video Profiler (UVP) in a talk by Fabian Lombard, who found that inverse trophic pyramids (thinner at the base than at the apex) were common in marine systems.

Community Outreach

The Symposium art exhibition **"Drifters Revealed: From the Nets of Tasmania and Beyond"** (see page 36) run adjacent to the Conference Venue at the Bond Store basement at the Tasmanian Museum and Art Gallery, had a full house of 200 people on opening night, and over 1000 members of the public visited over the week. The exhibition highlighted the beauty and mystery of zooplankton and its diversity via art. The arts are an important medium for increasing awareness and conveying science to the public by providing information and sparking interest. IMOS was well represented with works by Julian Uribe-Palomino ("A Silver Lining in the Darkest Seas"), Anita Slotwinski ("Silent Villages") and artist Lori Waters ("Phylogenetic Tree of Major Zooplankton Groups") who was directly inspired by an Australian Plankton Survey IMOS Publication.

Summary

Getting together as a zooplankton community after so long, the last symposium was in 2016, has reinvigorated collaborations, given a space for early career researchers to share their work and for us all to continue to learn. Who knew that swarming copepods are noisy and sound like rice bubbles? That a Chinese research vessel has a manned sub that can be used for collecting plankton samples at 3000m!



The Symposium art exhibition "Drifters Revealed: From the Nets of Tasmania and Beyond" (Images: Anita Slotwinski).

7th ICES/PICES Zooplankton Production Symposium Presentations from the IMOS Plankton Team:

The diversity and power of zooplankton indicators for assessing ecosystem state and trends
Frank E. Coman[1], Claire H. Davies[2], Ruth S. Eriksen[2], Jason D. Everett[1,3,4], Felicity R. McEnnulty[2], Wayne Rochester[1], Anita Slotwinski[1], Mark L. Tonks[1], Julian Uribe-Palomino[1], Anthony J. Richardson[1,3,4]
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[2]CSIRO Environment, Hobart, Tasmania, Australia
[3]School of the Environment, The University of Queensland, Brisbane, Australia
[4]Centre for Biodiversity and Conservation Science (CBCS), The University of Queensland, St Lucia, Queensland, Australia

Microzooplankton and their associations with other plankton
Claire H Davies[1], Ruth S. Eriksen[1], Luke Brokensha[2], Anthony J. Richardson[3,4,5], Frank E. Coman[3], Felicity R. McEnnulty[1], Anita Slotwinski[3], Mark L. Tonks[3] and Julian Uribe-Palomino[3]
[1]CSIRO Environment, Hobart, Tasmania, Australia. E-mail: claire.davies@csiro.au
[2]Institute for Marine and Antarctic Studies, University of Tasmania, Australia
[3]Commonwealth Scientific and Industrial Research Organisation (CSIRO) Environment, Queensland Biosciences Precinct, Australia
[4]School of the Environment, The University of Queensland.
[5]School of Mathematics and Physics, The University of Queensland

Microzooplankton distribution and trends from long-term surveys around Australia
Ruth S. Eriksen[1,2,3], Claire H. Davies[1], Luke Brokensha[2], Frank E. Coman[3], Jason D. Everett[4,5,6], Felicity R. McEnnulty[1], Anita Slotwinski[4], Mark L. Tonks[4], Julian Uribe-Palomino[4], Anthony J. Richardson[4,5,6], Elizabeth Shadwick [1,2], and Kerrie Swadling [1,2]
[1]Commonwealth Scientific and Industrial Research Organisation (CSIRO) Environment, Hobart, TAS, Australia. E-mail: ruth.eriksen@csiro.au
[2]Australian Antarctic Program Partnership (AAPP), University of Tasmania, Hobart TAS, Australia
[3]Institute of Marine and Antarctic Studies, University of Tasmania, Hobart TAS, Australia
[4]CSIRO Environment, Queensland Biosciences Precinct, Brisbane QLD, Australia
[5]School of the Environment, The University of Queensland, Brisbane QLD, Australia
[6]School of Mathematics and Physics, The University of Queensland, Brisbane, QLD, Australia

Integrating modern techniques with traditional plankton taxonomy
Felicity R. McEnnulty[1], Anthony J. Richardson[2,3,4], Claire H. Davies[1], Frank E. Coman[2], Ruth S. Eriksen[1], Jason D. Everett[2,3,4], Anita Slotwinski[2], Mark L. Tonks[2] and Julian Uribe-Palomino[2]
[1]Commonwealth Scientific and Industrial Research Organisation (CSIRO) Environment, Hobart, Tasmania, Australia. E-mail: felicity.mcennulty@csiro.au
[2]Commonwealth Scientific and Industrial Research Organisation (CSIRO) Environment, Queensland Biosciences Precinct, St Lucia, Queensland, Australia
[3]School of the Environment, The University of Queensland, St Lucia, Queensland, Australia
[4]Centre for Biodiversity and Conservation Science (CBCS), The University of Queensland, St Lucia, Queensland, Australia

Developing products to aid taxonomic consistency and rigour in plankton microscopy
Anita Slotwinski[1], Luke Brokensha[2], Frank E. Coman[1], Claire H. Davies[2], Ruth S. Eriksen[2], Felicity R. McEnnulty[2], Wayne Rochester[1], Mark L. Tonks[1], Julian Uribe-Palomino[1],Anthony J. Richardson[1,3,4]

A new species of copepod of the Family Pseudiaptomidae from the Great Barrier Reef and discussion of the species diversity and distribution of this family.
Julian Uribe-Palomino[1], Chad Walter[4] and Anthony J. Richardson[1,2,3].
[1]Commonwealth Scientific and Industrial Research Organisation (CSIRO) Environment, Queensland Biosciences Precinct, Australia. Email: julian.uribepalomino@csiro.au
[2]School of theEnvironment, The University of Queensland, Australia
[3]Centre for Biodiversity and Conservation Science (CBCS), The University of Queensland, St Lucia, Queensland, Australia
[4]Smithsonian Institution. Washington, DC, USA

Global zooplankton trends over the past 80 years

Anthony J Richardson[1,2,3], Frank Coman[2], Claire H Davies[4], Ruth S Eriksen[4], Jasmine Fowler-Morrow[1], Felicity R McEnnulty[4], Todd D. O'Brien[5], Julian Palomino-Uribe[2], Sarah Pausina[2], Wayne Rochester[2], Anita Slotwinski[2], Mark L Tonks[2], William Venables[2], Jason D Everett[1,2,6]
[1]School of the Environment, University of Queensland, St Lucia, Brisbane, QLD, Australia. E-mail: a.richardson[1]@uq.edu.au
[2]Commonwealth Scientific and Industrial Research Organization (CSIRO), Environment, Brisbane, QLD, Australia
[3]CBCS
[4]Commonwealth Scientific and Industrial Research Organization (CSIRO), Environment, Hobart, TAS, Australia
[5]NOAA Fisheries –Office of Science and Technology, Silver Spring, Maryland, USA
[6]Centre for Marine Science and Innovation (CMSI), The University of New South Wales, Sydney, NSW, Australia

Timeseries, indices & tools lead to understanding

Claire H. Davies[1], Anthony J. Richardson[2,3,4], Frank E. Coman[2], Ruth S. Eriksen[1], Felicity R. McEnnulty[1], Anita Slotwinski[2], MarkL. Tonks[2], Julian Uribe-Palomino[2] and Jason D. Everett[2,3,4]
[1]CSIRO Environment, Hobart, Tasmania, Australia.E-mail: claire.davies@csiro.au
[2]Commonwealth Scientific and Industrial Research Organisation (CSIRO) Environment, Queensland Biosciences Precinct, Australia
[3]School of the Environment, The University of Queensland.
[4]School of Mathematics and Physics, The University of Queensland

The Biological Ocean Observer: An online portal for the visualisation of IMOS data

Jason D Everett[1,2,3], Claire H Davies[4], Anthony J Richardson[1,3]
[1]The University of Queensland, Brisbane, QLD, Australia. E-mail: Jason.Everett@uq.edu.au
[2]Centre for Marine Science and Innovation (CMSI), The University of New South Wales, Sydney, NSW, Australia
[3]Commonwealth Scientific and Industrial Research Organization (CSIRO), Environment, Brisbane, QLD, Australia
[4]Commonwealth Scientific and Industrial Research Organization (CSIRO), Environment, Hobart, TAS, Australia

Model-ready data products: Taking discrete zooplankton observations from the local to the global scale

Jason D Everett[1,2,3], Ryan F Heneghan[4], Claire H. Davies[5], Anthony J Richardson[1,3]
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[2]Centre for Marine Science and Innovation (CMSI), The University of New South Wales, Sydney, NSW, Australia
[3]Commonwealth Scientific and Industrial Research Organization (CSIRO), Environment, Brisbane, QLD, Australia
[4]School of Environment and Science, Griffith University, Nathan, Brisbane, QLD, Australia
[5]Commonwealth Scientific and Industrial Research Organization (CSIRO), Environment, Hobart, TAS, Australia

Plankton Art Exhibition, '*Drifters Revealed: From the Nets of Tasmania and Beyond*' at the 7th ICES/PICES Zooplankton Symposium, Hobart, March 2024

Julian Uribe-Palomino and Anita Slotwinski

The 7Th International Zooplankton Production Symposium not only offered a unique opportunity to learn about plankton research by researchers around the globe; it also allowed some artists and scientists to exhibit creative works inspired by these mostly microscopic organisms.

Julian was fortunate to collaborate with six professional and passionate divers from different parts of the world, who contributed images or videos from zooplankton in their natural environment. The resulting project, "***A Silver Lining in the Darkest Sea***," revealed these creatures as they appear and behave while alive.

The contributors—Linda Ianniello (South Florida), Frida Yolotzin, Pedro Valencia, Robert Standsfield (Cozumel, Mexico), Jones Wayne (Anilao, Philippines) and Ryo Minemizu (Japan)—opened a window onto this fantastic and almost invisible world. With each dive and every shot, they captured details that plankton researchers cannot obtain from fixed laboratory samples.

In a series of interviews that was part of the same exhibition, we heard from Ryo, Linda, Pedro and Frida about how their passion for 'Black Water Diving' developed while reflecting on the importance of their citizen science contributions to the general public and plankton researchers around the world by sharing their work in social media platforms.

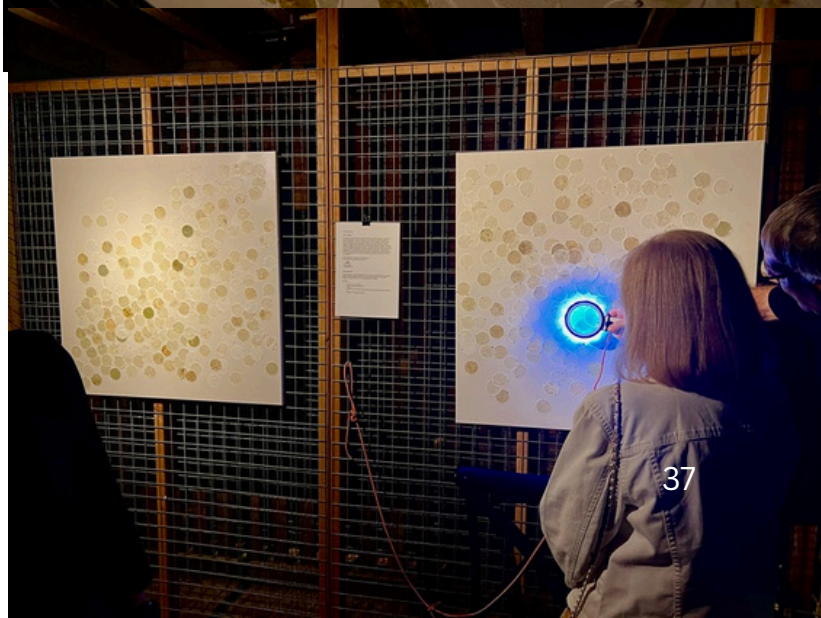
Anita presented a tactile piece '***Silent Villages***': highlighting the work of our IMOS Australian Plankton Survey Team which has been monitoring plankton communities around Australia for the past 15 years.

The piece highlighted that changes in plankton biomass (how much) and abundance (how many) can have significant impacts on the functioning, dynamics, and structure of entire marine ecosystems and invited viewers to explore the textured piece more closely.

The tiny circular samples in the piece represent the 'silent villages' of plankton that exist beneath the ocean's surface.

Each circle was created by filtering seawater collected monthly from different National Reference Station locations around Australia. The filters were dried to a constant weight and then measured to estimate the amount of living material present in each sample. Variations in colour and texture between the circles revealed the complexity and diversity of these microscopic communities.

The piece questioned: What can these silent villages tell us about the health and future of our oceans? Visitors were encouraged to pick up the accompanying magnifying glass and take a closer look. It was also noted that data from these stations could be explored further at https://shiny.csiro.au/BioOceanObserver/



'Silent Villages' art piece (Images: Anita Slotwinski).

58th Australian Marine Science Association Conference

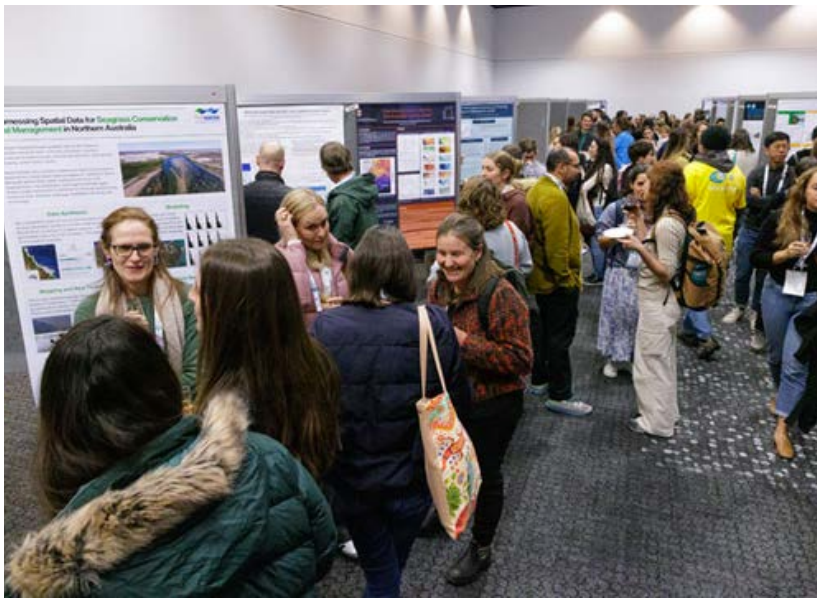
Anita Slotwinski

The 2024 joint conference of the Australian Marine Sciences Association (AMSA) and the New Zealand Marine Sciences Society (NZMSS) convened from September 15–20 at the Hotel Grand Chancellor in Hobart, Tasmania. Under the theme "**Navigating Uncertainty for a Future Sustainable Ocean**," the event brought together over 900 delegates from across Australia, New Zealand, and the Indo-Pacific, marking it as the largest marine science conference ever held in Australia! Attendees included marine scientists, policymakers, Indigenous leaders, and early-career researchers, all focused on addressing the pressing challenges facing our oceans amid climate change and environmental uncertainty.

Claire and Ruth presented on plankton related topics from sampling on the first two Southeast Australian Marine Ecosystem Survey voyages:

Davies, Claire; Eriksen, Ruth; Sutton, Caroline; Fischer, Mibu; Langlais, Clothilde; Richardson, Anthony; Little, Rich; Pethybridge, Heidi; McEnnulty, Felicity. **Green slime – Nuisance or productivity boom**. See page 39

Eriksen, Ruth; Davies, Claire; Sutton, Caroline. **Greedy guts: diet of the salp Thetys vagina sampled during the SEA-MES voyage**. See page 40.



Sahan presented on the eDNA component of the first two SEA-MES voyages:

Jayasinghe, Sahan; Bessey, Cindy; Bodrossy, Lev; West, Katrina; Deagle, Bruce. **The Coupled eDNA Experiment: Harnessing eDNA for Marine Biodiversity Observations from the South-east Australian Marine Ecosystem Survey (SEA-MES).**

Anita presented on how we have progressed plankton research in Australia IMOS over 15 years by combining traditional taxonomy with modern tools like ZooScan, EcoTaxa, FlowCam, and genetic techniques, developing standardised resources and open-access data to support large-scale, long-term marine ecosystem analysis. Slotwinski, Anita; Brokensha, Luke; Coman, Frank E.; Davies, Claire H.; Eriksen, Ruth S.; McEnnulty, Felicity R.; Rochester, Wayne; Tonks, Mark L.; Uribe-Palomino, Julian; Richardson, Anthony J. **Enhancing impact of Australian Plankton Surveys – Integrating tradition** See page 41.

Green Slime

Productivity boom or bust?

Claire Davies[1]

Ruth Eriksen[1,2,3], Mibu Fischer[1], Clothilde Langlais[1], Felicity McEnnulty[1], Heidi Pethybridge[1], Anthony Richardson[4], Caroline Sutton[1], Rich Little[1]

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[3] Institute of Marine and Antarctic Studies (IMAS), University of Tasmania, Australia. [4] School of the Environment, The University of Queensland, St Lucia, Queensland, Australia

ENVIRONMENT
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Large phytoplankton blooms off South East Australia are common and produced when cold, nutrient rich water is uplifted from the continental slope (Hallegraeff & Jeffery 1993). These blooms, of entirely oceanic primary production, should result in good food availability for microzooplankton but several voyages report that during blooms zooplankton is scarce and grazing is minimal (IN2016_V04, IN2017_V04, Bax *et al* 2001).

SEA-MES voyages

During the first South-East Australian Marine Ecosystem Survey (SEA-MES) in July 2023 we collected pigments, carbon and zooplankton data to investigate the primary and secondary production in this region (Figure 1). During the voyage we encountered a large phytoplankton bloom which we sampled extensively using a zooplankton multinet. Similar to other surveys in this region the bloom was identified as *Thalassiosira partheneia* and it contributed significantly to the plankton biomass sampled.

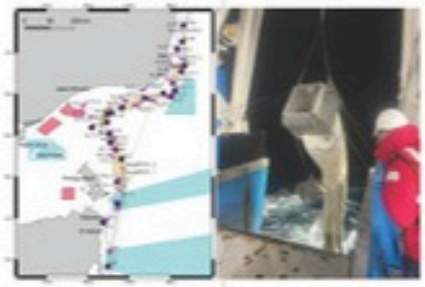

Figure 1: SEA-MES sample sites and zooplankton multinet

Thalassiosira partheneia

This centric diatom, 8-13 µm diameter, lives in gelatinous tubes which pack tightly together to form large aggregates (Figure 2 & 3). Whilst the resulting biomass is potentially good food for grazing zooplankton the irregular gelatinous masses can be difficult for zooplankton to process. The threads and aggregations increase the sinking rate which leads to high carbon export as opposed to the classic theory that small cells are almost entirely remineralised within the microbial loop.

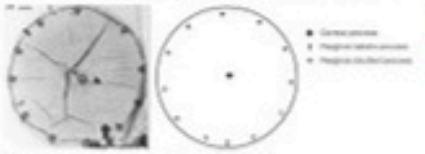

Figure 2: *Thalassiosira partheneia*

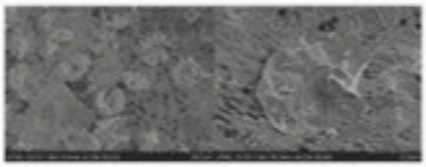

Figure 3: *Thalassiosira partheneia* cells

AusCPR: *Thalassiosira* data

To further understand the dynamics of phytoplankton blooms in this region we used the IMOS Australian Continuous Plankton Recorder Survey (AusCPR) data. AusCPR has been sampling in South East Australia for 15 years and confirms that large blooms of *Thalassiosira*, <20 µm in size, occur frequently between July and August. The highest densities of *Thalassiosira* are typically found off the South East coast (Figure 4) when the temperature is ~14°C.

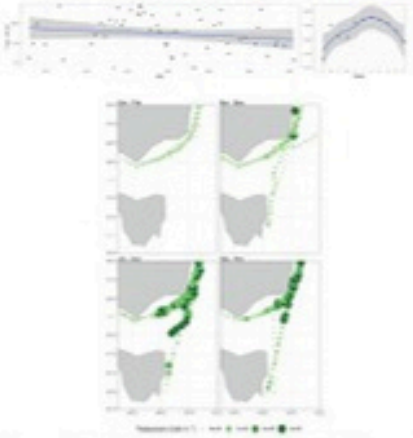

Figure 4: Time series and distribution of *Thalassiosira*

Results

The SEA-MES voyage found plankton biomass was greatest off the South East coast where the *Thalassiosira* bloom was most evident (Figure 5). The measured biomass is a combination of phytoplankton from the bloom and the target zooplankton. The plankton samples with the greatest biomass had the highest zooplankton abundance and the highest concentration of chlorophyll and fucoxanthin, the pigments associated with diatoms. Both the SEA-MES survey and a detailed study in 1994 (Bax *et al* 2001) found cool, nutrient-rich water was being injected onto the continental shelf during the bloom. Stable carbon isotope values of particulate organic carbon indicated that the source of the primary productivity was temperate marine phytoplankton and was ~3‰ lower during the SEA-MES voyage.

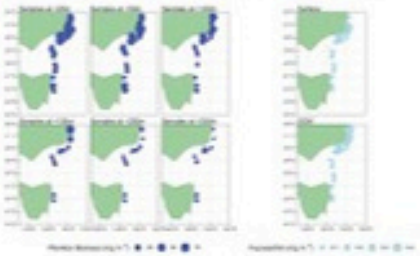

Figure 5: Total plankton biomass and fucoxanthin concentrations

Zooplankton grazing

In both surveys the grazing indicator pigments, astaxanthin and phaeophorbide, were rarely detected. This led to the conlusion in 1994 that grazing was minimal, but our zooplankton samples, using a 100 µm mesh net, gave us direct evidence of grazing potential. The zooplankton composition was dominated by small, herbivorous micro - zooplankton such as copepods, nauplii and tintinnids. Microzooplankton are often overlooked and under-sampled but are important trophic intermediaries being major grazers of primary productivity, good food for larger zooplankton and hence contributors to nutrient recycling.

Discussion

Whilst we encountered a *Thalassiosira partheneia* bloom in similar oceanographic conditions to earlier surveys, using a fine mesh net to collect zooplankton allowed us to demonstrate that zooplankton grazers were abundant during the SEA-MES bloom. Grazing potential from abundant microzooplankton was highest when fucoxanthin and chlorophyll pigment concentrations peaked.

Acknowledgment & Reference

We acknowledge the use of the CSIRO Marine National Facility (https://ror.org/01mae8353) in undertaking this research.

Bax, NJ., Burford, M., Clementson, L., Davenport, S., 2001. Phytoplankton blooms and production sources on the south-east Australian continental shelf, *Mar. Freshwater Res.* 53, 451-462.

Hallegraeff, GM., Jeffrey, SW., 1993. Annually recurrent diatom blooms in spring along the New South Wales coast of Australia, *Aust. Mar. Freshwater Res.* 44(2) 325 - 334.

Multinet image: Curt Chalk, TEM image: Haste, GR. 1983. The marine, planktonic diatoms *Thalassiosira. Oceanica* sp. nov. and *T. partheneia*, J. of Phycol. 19, 220-229. SEM photos: Ruth Eriksen.

Greedy guts!

Diet of the twin-sailed salp *Thetys vagina* from the SEA-MES voyages

Ruth S. Eriksen [1,2,3] , Claire H. Davies [1] and Caroline Sutton 1

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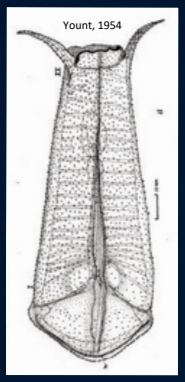
2. CSIRO Australian National Algae CultureCollection(NCMI)HobartTasmaniaAUSTRALIA
3. Australian Antarctic Program Partnership,InstituteofMarineandAntarcticStudiesHobartTasmaniaAUSTRALIA



Gut content analysis can determine dietary preferences in a wide range of organisms. During the South-East Australian Marine Ecosystem Survey(SEA-MES) voyages in2023 & 2024, salps(gelatinouszooplankton) wereanotable component of trawls. We present a summary of the taxa identified in guts of solitary *Thetys vagina* as part of understanding the ecology of salps, their place in the food web and trophic implications for SEA-MES ecological models and hypotheses.

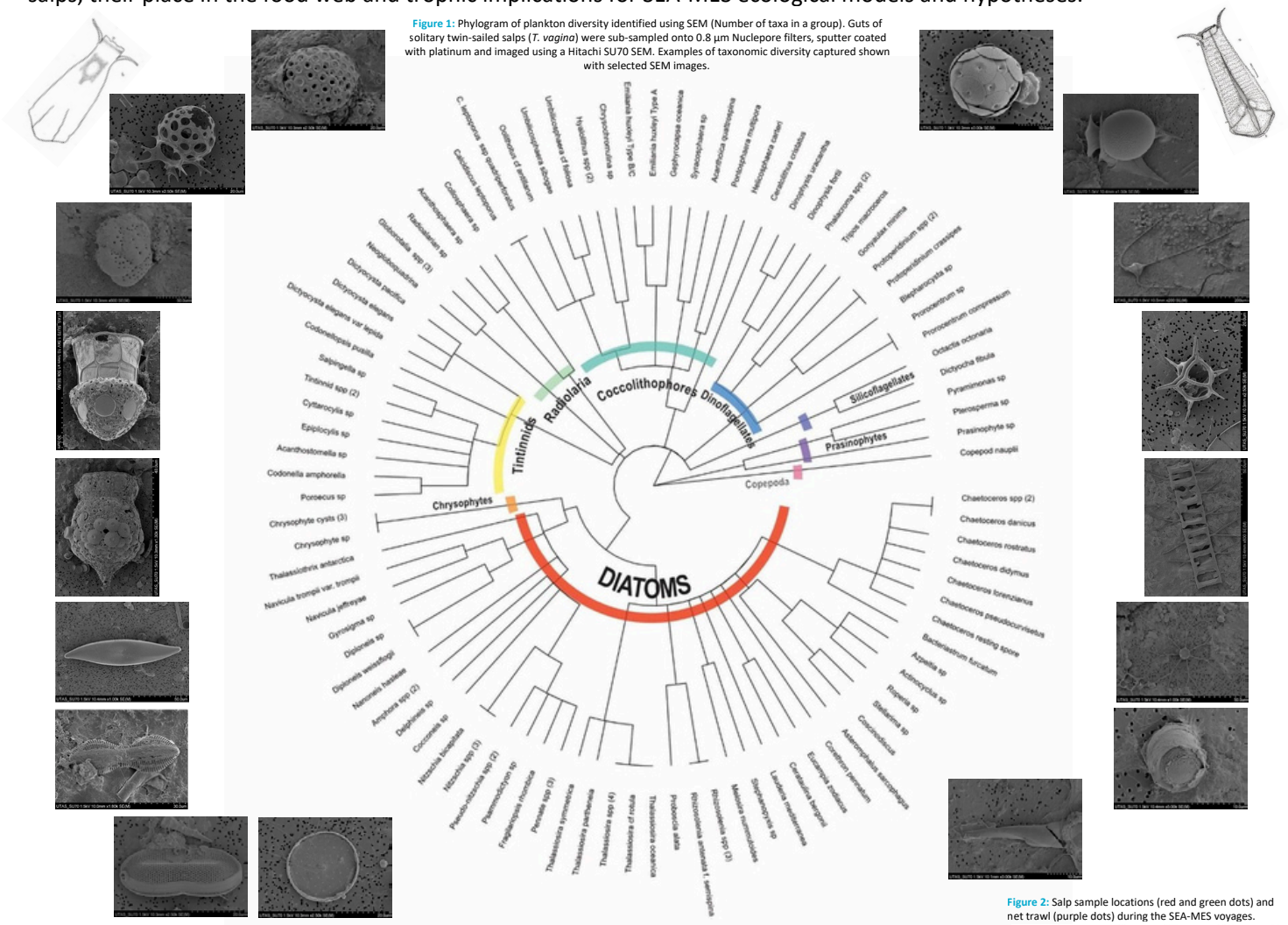


Figure 1: Phylogram of plankton diversity identified using SEM (Number of taxa in a group). Guts of solitary twin-sailed salps (*T. vagina*) were sub-sampled onto 0.8 µm Nuclepore filters, sputter coated with platinum and imaged using a Hitachi SU70 SEM. Examples of taxonomic diversity captured shown with selected SEM images.

Efficient, non-discriminatory feeders

- salpscatcha wide range ofparticle sizes(~1 - 1000 µm) via a mucous net. Swarms are linked to nutrient-rich upwelling events or slope-water intrusions (Henschke et al, 2016).
- we identified 115 taxa in the guts of *T. vagina* (Fig. 1) from 3 Kingdoms, 9 Phyla, 13 Classes, 51 Families and > 70 Genera. Diatoms were dominant, comprising 50% of taxa
- salps from the 2023 voyage (Fig. 2 sampled in winter) had fewer taxa than salp guts from the 2024 voyage (sampled late autumn, and further south)
- results are biased towards taxa with hard components (diatom frustules, tintinnid lorica or dinoflagellate theca) and/or identifiable remnants (scales, liths or skeletons)
- more information on diet of twin-sailedsalps canbe obtained by using stable isotope analysis, pigment analysis and molecular approaches applied to gut samples.

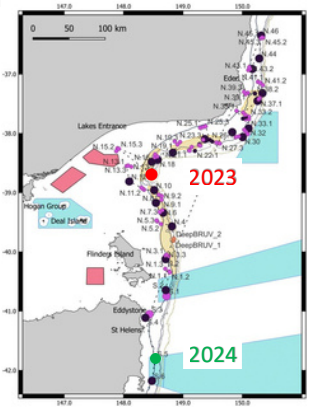
Swarms contribute significantly to carbon export

- vialarge, rapidly-sinking carcasses andfaecalpellets,especiallyduring blooms (Henschke et al, 2016). The relative role of gelatinous taxa like salps is expected to change in response to pressures on marine systems such as climate change, eutrophication and over-fishing. Many gaps in knowledge of basic salp ecology compound predictions, but it is possible that salp numbers will benefit from an increase in the proportion of small phytoplankton that is likely to occur as oceans warm (Finkel et al, 2010).

Building a picture of Thaliacean ecology

- there are limited dietarystudies on*Thetys* inAustralian waters, largely due to their fragile nature and tendency to be destroyed during sampling. This leaves a knowledge gap as salps are nutritionally important for more than 200 marine species, and may outcompete other planktivorous zooplankton during blooms
- studies on *Salpa fusiformis* and *Thalia democratica* caught in SE Australia showed preferences for prey species that were not common in phytoplankton samples (Ahmad Ishak et al, 2017). Next, we plan to compare salp gut contents with water-column pigment and eDNA samples collected at the same time as the SEA-MES trawls to explore this relationship in twin-tailed salps.

Figure 2: Salp sample locations (red and green dots) and net trawl (purple dots) during the SEA-MES voyages.



FOR FURTHER INFORMATION

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Finkel et al (2010) Phytoplankton in a changing world: cell size and elemental stoichiometry J. Plankton Research 32(1)
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ACKNOWLEDGEMENTS

We thank Drs S. Feig and K. Goemann (CSL, University of Tasmania) for SEM support. We acknowledge the use of the CSIRO Marine National Facility (https://ror.org/01mae9353) in undertaking this research. Special thanks to Felicity McEnnulty and everyone involved in sampling on SEA-MES voyages IN2024_V03 and IN2023_V05.

Enhancing impact of Australian Plankton Surveys – Integrating traditional taxonomy with contemporary methods

AUTHORS

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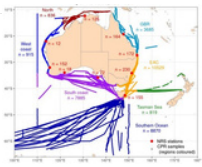
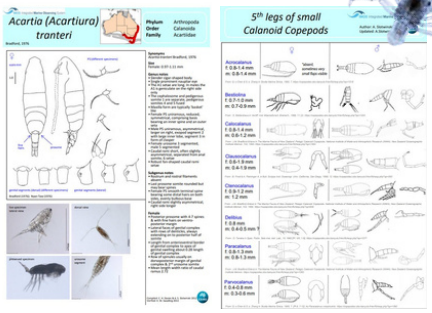
Over 15 years, our work withintheIntegrated Marine Observing System (IMOS) has significantly advanced plankton researchin Australia via the National Reference Stations (NRS) andthe Australian Continuous Plankton Recorder (CPR) Survey. Historically, plankton observations were localized and short-term, lasting no longer than three years. We have developed a suite of taxonomic products (Species Identification Sheets, Genus and Family Summary Sheets) and utilise tools such as Interactive Keys, an Image Database and Distribution Mapping to maintain and improve our data quality and consistency across multiple laboratories. This ensures our data, freely available on the Australian Ocean Data Network portal, can support long-term, large-scale analyses and are reliable and robust. As traditional taxonomic identification to species level requires specialist skills and can be time consuming, we are exploring technological advances and new techniques of data acquisition and interpretation that may be used to complement classical approaches. Advances in data visualisation allowed the development of the IMOS Biological Ocean Observer. We are exploring modern image-based technologies like Zooscan, Ecotaxa and Flowcam, are trialing Micro CT scanning for 3D zooplankton models, as well as genetic techniques and linkages to global databases and bioacoustics. We strive to merge traditional expertise with contemporary methods for sustained, high-quality plankton data collection and analysis.



15+ years
1,136 net samples
312,849 km of ocean towed
1,634,993 zooplankton identified
593,421 phytoplankton identified

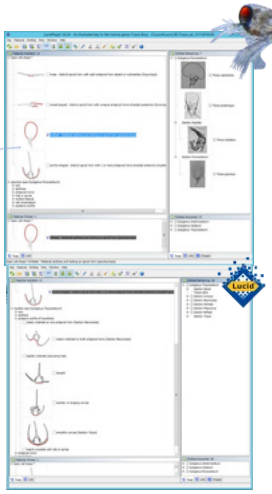
Species Identification & Summary Sheets

The development and use of Species Sheets has been an excellent initial learning tool, beneficial in summarising historical and newly collected information in a quick and easy-to-access way when in the laboratory. Species Sheets are also a vital part of ensuring consistency among multiple analysts and are key resources used for training new analysts. Species Sheets are developed on an on-going basis, we use the World Register of Marine Species (WoRMS) for taxonomic verification and they are reviewed by taxonomic experts. Species Sheets are compilations of published information and diagrams, diagnostic tips, as well as images and sizes sourced from our samples collected in Australian waters. Species Sheets cover both phytoplankton and zooplankton, detailing key species, genus and family differences. Analysts have found these to be essential parts of our laboratory 'tool-kit', that significantly speed up the identification of specimens in particularly complex or taxonomically diverse groups. The information compiled via Species Sheets will also be used to develop interactive taxonomic keys using Lucid Software.



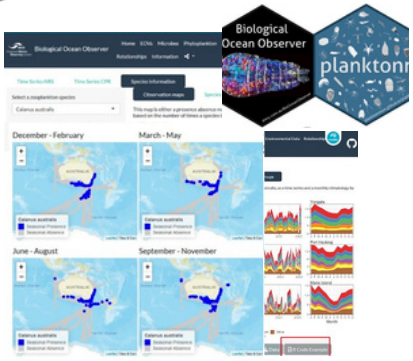
Interactive Keys

Lucid provides digital tools for the development of matrix and dichotomous keys, and the production of associated fact sheets and media for keys (www.lucidcentral.org). We are developing information, data and media that we have collected into Lucid keys and fact sheets, to streamline identification of specimens in particularly complex or taxonomically diverse groups via tablets adjacent to microscopes. Keys and factsheets will be available for free online once published.



Data Visualisation

We have designed and developed an R-Shiny app – the IMOS Biological Ocean Observer – and an R package – planktonr – that brings the biological data to life at your fingertips! You do not need to be an R user, just curious about plankton. By selecting options from drop-down boxes and filters, you see visualisations, such as time series of important indices, and download the code, the plot and/or the data used to create the graphic. All the National Reference Station (NRS) and Continuous Plankton Recorder (CPR) Survey data are integrated with physical and chemical parameters behind the scenes, so the biological response to physical parameters can be explored, graphed and downloaded. Explore the data here for free https://shiny.csiro.au/BioOceanObserver/



From Davies, Claire H., Everett, Jason D., Ord, Louise (2022) Integrated Marine Observing System IMOS) Biological Ocean Observer - Shiny APP. v9.3. CSIRO. Service Collection.

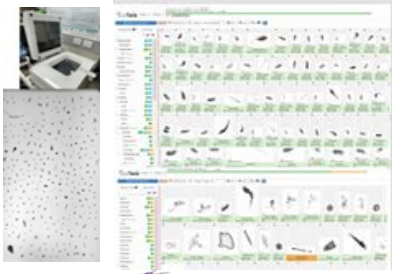
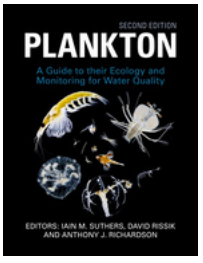


Image Analysis

We are using and trialing imaging systems and analysis platforms such as Zooscan, Ecotaxa (zooplankton) and Flowcam (microzooplankton and larger phytoplankton) to develop size-based data products such as community composition, biovolume and size spectra. Specialist taxonomic knowledge via our plankton analysts is required to validate the processed results of these technologies.

Taxonomic Publications

TheAustralian ZooplanktonAtlasproduced in collaboration with zooplankton experts, contains our Species Identification Sheets. Guides are available for free download www.imas.utas.edu.au/zooplankton. We authored an identification chapter in the revised edition of Plankton: A Guide to their Ecology and Monitoring for Water Quality (2019), and have contributed to several reviews of phytoplankton groups (Tripos, Dinophysoids).



Describing New Species

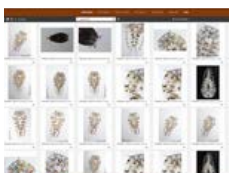
The samples we collect provide the opportunity to find and describe new species. This has included two species of tiny full-grown jellyfish (~2 mm diameter) described in 2018. *Paralovenia yongalensis* was found in samples collected at the Yongala National Reference Station (NRS) and *Melicertissa antricharsoni* was found in Moreton Bay samples.

A new species of copepod from the Pseudodiaptomidae family, found in Great Barrier Reef waters is currently being described in collaboration with Chad Walter from the Smithsonian Institution.

Lateral view of the two new species of micro-medusae. *Paralovenia yongalensis* (top) *Melicertissa richardsoni* (bottom) from Uribe-Palomino J, Pausina S, Gershwin L-A (2018) Two new species of Hydromedusae from Queensland, Australia (Hydrozoa, Leptothecata). ZooKeys 783: 17-36.

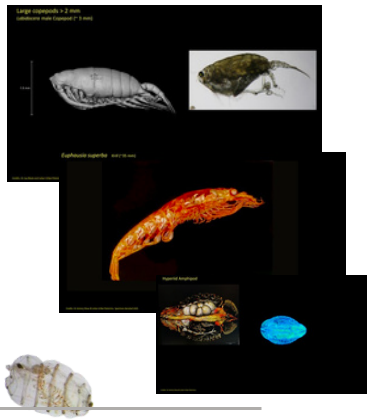
Image Database

A digital image reference collection is continuously maintained for National Reference Station (NRS) and Continuous Plankton Record (CPR) Survey phytoplankton and zooplankton species via an internal Extensis (www.extensis/portfolio) Image Database. This contributes to consistency between analysts and ensures data quality control. We also maintain a physical collection of zooplankton specimens.



MicroCT Scanning

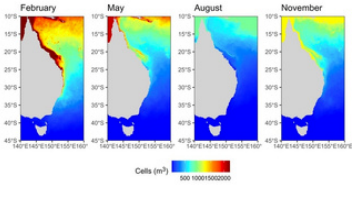
We are trialing ways to digitalise and visualise specimens in high-resolution via Computed Tomography (CT) scanning, leading to the possibility of using 3D models and a virtual digital collection for morphological and taxonomic purposes. Research has the potential to enhance future digital collections, virtual reality and AI applications as well as open up lines of research in animal anatomy & physiology, integrated taxonomy, systematics and evolution, biomechanics, bioengineering, nanotechnology and robotiocs.



Distribution Mapping

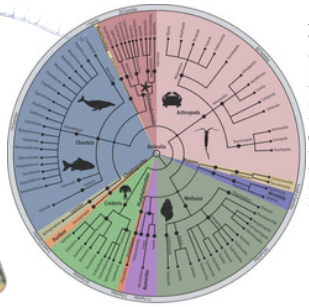
Thedate andlocationofeachphytoplankton and zooplankton species identified via National Reference Station (NRS) and Continuous Plankton Record (CPR) Survey sampling is recorded in a database. Database QC checks and mapping allow us to find 'spurious' entries. Over 15 years of data collection this has allowed us to develop range maps across Australian waters for all recorded species. As of August 2024 we have identified **2,228,414 specimens**!

Distribution maps of Trichodesmium thiebautii on the East Coast of Australia



Molecular Studies

We are co-developing molecular techniques for species-level identification in collaboration with Professor Cynthia Riginos (University of Queensland) and Marc Koh (James Cook University). The aim of this initial stage of the project is to obtain barcodes for common copepods, decapod larvae, amphipods and monstrilloid copepods, building a verified molecular library to be used in future metabarcoding and e-DNA projects. We have worked with Tina Berry (Curtin University) applying our long-term collection of bulk plankton samples to test the capacity of DNA metabarcoding to characterize the spatial and seasonal patterns found within a range of zooplankton communities, and to investigate links with concurrent abiotic data collected as part of Australia's IMOS programme.



Total Animalia detected in DNA extracted from 90 bulk IMOS plankton samples using multi-assay metabarcoding. From: Berry TE, Coghlan ML, Saunders BJ, Jarman S, Power M, Richardson AJ, Davies C, Berry O, Burice M (2023) A 3-year plankton DNA metabarcoding survey reveals marine biodiversity patterns in Australian coastal waters. Diversity and Distributions 29: 862-878. https://doi.org/10.1111/ddi.13699

FOR FURTHER INFORMATION
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Data were sourced from Australia's Integrated Marine Observing System (IMOS) – IMOS is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS)
www.imos.org.au

Dr. Clare Ostle (MBA), Chair of the Global Alliance of CPR Surveys (GACS)

At the end of 2024, I was honoured to take on the role of Chair of GACS, succeeding Professor Anthony Richardson, who has done a sterling job leading the group. I'm also incredibly grateful for the support of Claire Davies (CSIRO), who has been instrumental during the handover and will continue to play a key role moving forward. With such a strong foundation, I'm genuinely excited about what the GACS community can achieve together.

Our current focus is on consolidating GACS datasets to produce global outputs - ranging from data products to global studies - with a best practices paper also in development. The CPR Survey has a rich legacy, not only in generating invaluable data, but in offering a scalable and accessible platform for environmental monitoring. This work is powered by an international network of dedicated individuals, and we take pride in the global knowledge exchange it fosters. Being part of this community, and now helping to support its growth and collaboration, is a true privilege - that I intend to fully embrace in this role.

Looking ahead, a key priority is to energise and expand our global partnerships and technical abilities - especially in underrepresented regions - to ensure that the CPR Survey truly reflects global ocean health. A great example was the new route set up between Brazil and South Africa through the Horizon 2020 AtlantECO project (see picture right from Lance Gregory (CPR Operations Manager, MBA) who ran a training course in Cape Town to initiate this new route). We're exploring new funding opportunities, fostering training initiatives, and building capacity to make participation more accessible and sustainable for all. By amplifying the collective voice and capabilities of GACS, we hope to elevate the visibility and impact of CPR data in tackling global marine challenges.

Dr. Clare Ostle (MBA), Chair of the Global Alliance of CPR Surveys.


Training course in Cape Town, South Africa for the new route set up between Brazil and South Africa through the Horizon 2020 AtlantECO project (Image: Lance Gregory (CPR Operations Manager, MBA).

Modelling the Ocean's Tiny Giants: New Research to Unlock Plankton's Role in Ocean Carbon Cycling

Kieran Murphy

Dr Kieran Murphy joins the Mathematical Marine Ecology Lab to improve how we model zooplankton in marine ecosystems.

When we think about marine life, charismatic megafauna often come to mind. But some of the ocean's most 'gigantic' players are invisible to the naked eye. Zooplankton – tiny drifting animals ranging from microscopic copepods to jellyfish – make up an estimated 40% of all marine biomass and play a crucial role in the ocean's carbon cycle. Despite their importance, zooplankton remain poorly represented in most ecosystem models, limiting our ability to predict how marine ecosystems will respond to climate change.

A New Approach to Ocean Modelling

Dr Kieran Murphy, who recently joined The University of Queensland's Mathematical Marine Ecology Lab, is working to change this. As part of an Australian Research Council Discovery Project, Kieran is leading efforts to improve how we model these vital organisms through continued development of the Zooplankton Model of Size Spectra (ZooMSS).

"Zooplankton are incredibly diverse, with different species playing very different ecological roles," explains Kieran. "This diversity is often oversimplified in current models."

Unlike traditional approaches, ZooMSS captures the incredible diversity of planktonic life by organising species by size and feeding behaviour. "Size is a fundamental organising principle in marine ecosystems," says Kieran. "Generally speaking, bigger animals eat smaller ones, but the details matter enormously for understanding energy flow through the food web."

The research team may also explore different versions of ZooMSS using mizer, a dynamic size spectrum modelling R package specifically developed to explore the effects of fishing on marine ecosystems.

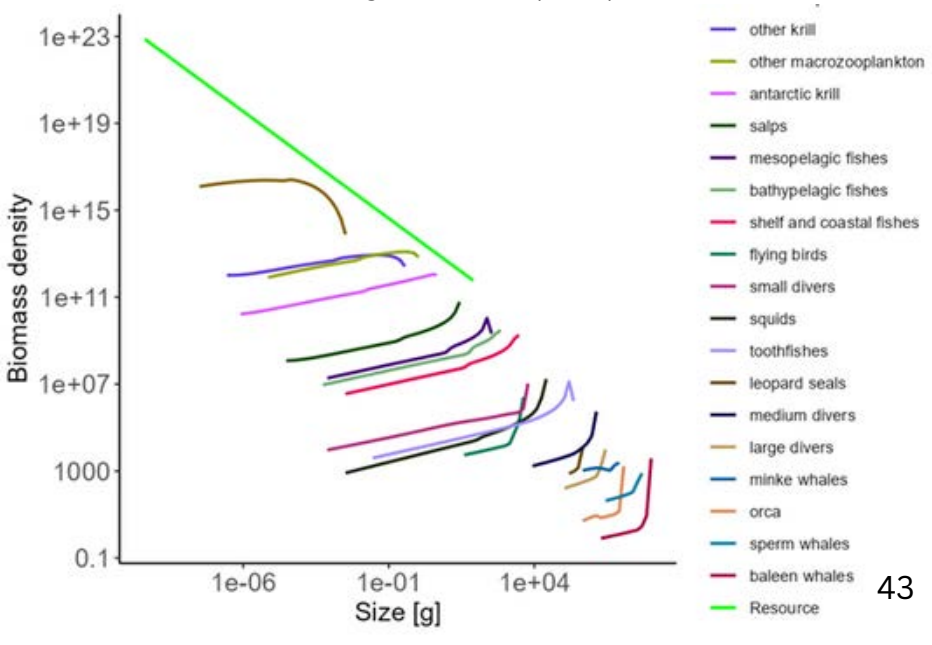
Real-World Validation

A crucial aspect of Kieran's work involves using IMOS plankton data to validate and improve the model. "IMOS provides an incredible resource of high-quality plankton observations from around Australian waters," notes Kieran. "We're planning to use this resource to validate our models and ensure they accurately represent real-world plankton communities."

This validation process helps researchers build confidence in their projections and guides improvements to make models more realistic. Broader Implications.

The improved understanding of zooplankton dynamics has far-reaching implications for climate projections and fisheries management. Better models can help predict how climate change might affect the ocean's ability to absorb carbon dioxide and improve forecasts of fish populations that depend on zooplankton for food. "Understanding zooplankton is really about understanding the ocean's engine room," says Kieran. "These tiny organisms drive so many of the processes that make marine ecosystems work."

As climate change continues to alter marine environments, this research becomes increasingly vital. By combining cutting-edge modelling with comprehensive observational data like that provided by IMOS, researchers are building a more complete picture of how our



Playing with Technology and Looking into the Future

Julian Uribe-Palomino

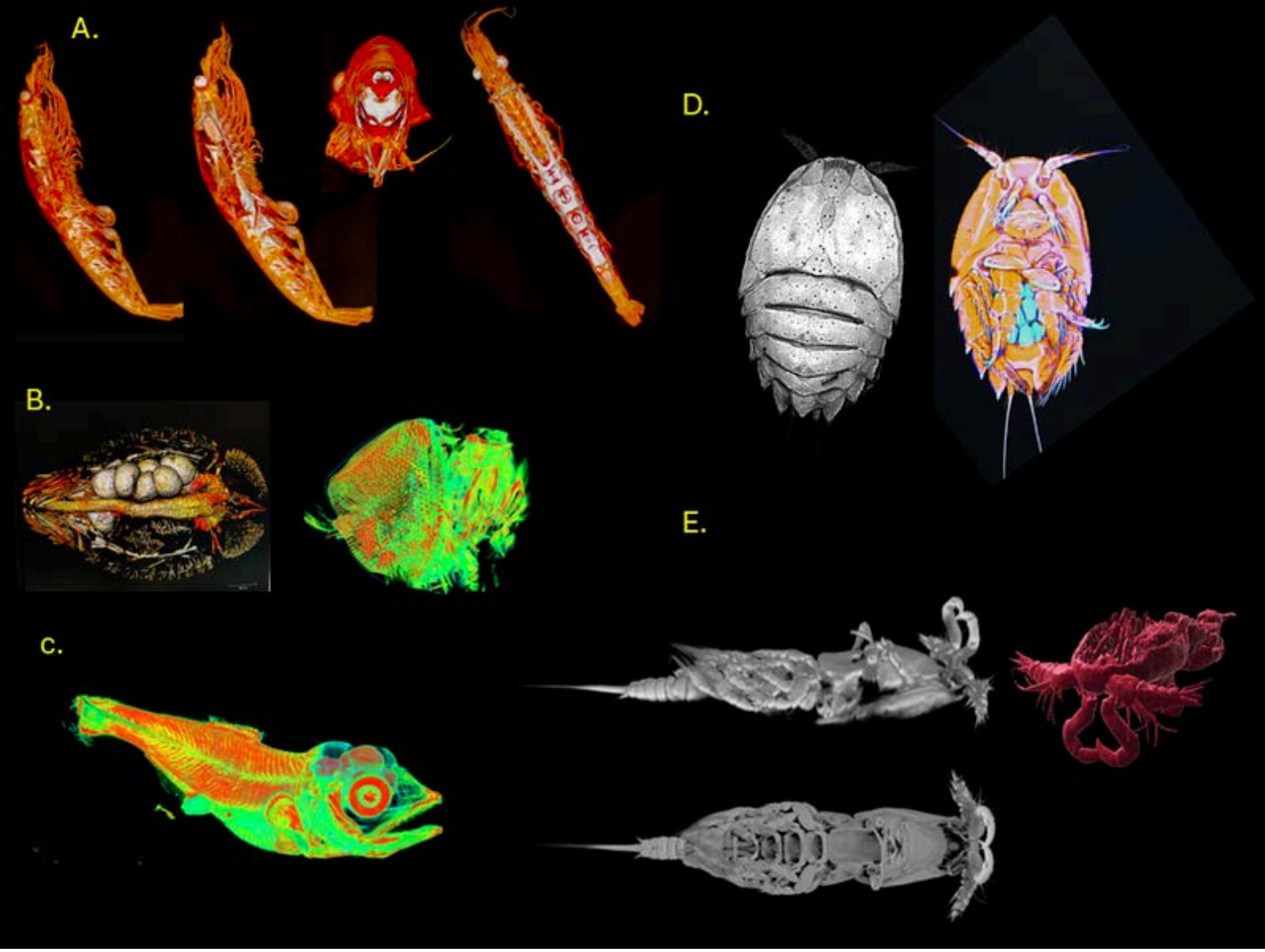
It is not much that we know about the internal anatomy of many very small planktonic organisms; most of our knowledge comes from drawings and not from direct observations inside the specimens because of their size and delicate body structure.

It is here that technology long applied in human medicine - such as Computational Tomography (CT) is giving us the opportunity to use X-rays to see inside a variety of hard structures from rocks and fossilised bodies, to animals from natural history reference collections such as: birds, reptiles, fish or even some insects.

Last year I was able to explore the limits of getting 3D models from different zooplankton specimens, assessing the ability of this technology to scan very small bodies such as those from copepods and soft bodies from gelatinous zooplankton. This experience was possible by using a Micro CT scanner from the University of Western Australia under the direction of Dr Jeremy Shaw. Results of this projects supported by CSIRO – Labs of the Future initiative - were presented and the 6th International Conference on Copepoda (Hiroshima -Japan) and at the 7Th International Zooplankton Production Symposium in Hobart (Australia).

In addition to this technology, I also had access to a Spinning Disc Confocal Microscope, from the Institute of Molecular Biosciences at the University of Queensland under the Direction of Dr Nicholas D. Condon. This microscope produces high resolution products from the external anatomy of very small specimens that might be challenging to process with the Micro CT scan alone. Participation in another project related to Phytoplankton, gave me the opportunity to use a FlowCam, a device designed to capture images of very small particles (phytoplankton or detritus) from a large sample volume, that could take several hours of an analyst's time to get it done. The aim of this project was to generate enough data to train a machine learning-AI system that could speed up the analysis of samples from the field.

Micro CT scan from the University of Western Australia (UWA) (Image: Julian Uribe Palomino).



Examples of different products from Micro CT scan (A. Euphausiid, B. Amphipod Hyperiid, C. Fish Larvae) and Spinning Disc Confocal Microscope (D. Copepod Peltidiidae, E. Copepod Ergasilidae) Image credits: Julian Uribe-Palomino, Dr Jeremy Shaw , Dr Nicholas Condon.

There is not a single method that provides all the information we require from the plankton samples. Nevertheless, these different techniques complement the direct analysis we perform on the samples, as we still require of human supervision of the products from the technologies mentioned above.

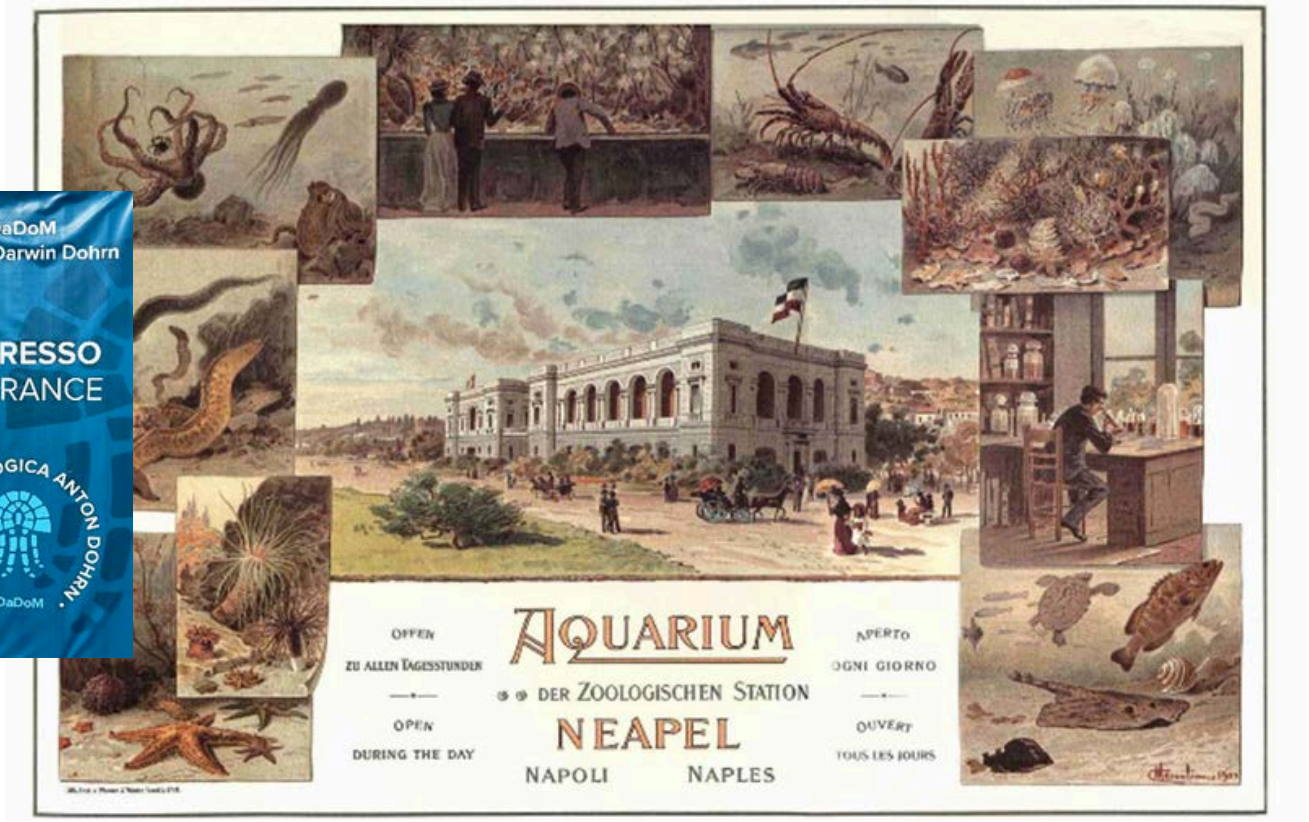
The use of Machine learning and AI is increasing, and we look forward to applying these tools to the products we have generated with the Micro-CT scan and the FlowCam in the near future.

FlowCam at the Indian Ocean Marine Research Centre – UWA (UWA)
(Image: Julian Uribe Palomino).

13th Advanced Phytoplankton Course, Naples Italy

Ruth Eriksen

In October 2024, I travelled to Naples, Italy to spend a month studying phytoplankton taxonomy and systematics at the Stazione Zoologica Anton Dohrn (SZN). The course was jointly organised by SZN, the UNESCO/IOC Science and Communication Centre on harmful Algae, and the Station Biologique de Roscoff, with the support of UNESCO/IOC project office for IODE and partners.



I joined 21 other, very excited phytoplankton taxonomists as part of the 13th Advanced Phytoplankton Course, which is run every 4 years or so since 1976. A total of 240 participants from 50 countries have attended the APC training, and this is reflected in the literature on phytoplankton taxonomy and ecology.

It was a very hectic and full schedule, with long days and classes 6 days a week, combining lectures with hands-on microscopy sessions. Over the duration of the course, we looked at more than 250 cultures and permanent slide preparations on the microscope. We were able to examine living cultures from the Naples SZN collection, the Norwegian Culture Collection of Algae, the University of Oslo, the Natural History Museum of Copenhagen, and Station Biologique de Roscoff. The teaching faculty shared their permanent slides collections and images. Zeiss provided microscopes for the course, and the course was delivered through the Ocean Teacher Global Academy platform.

Eight of our teachers were former participants of the early APC courses; Adriana Zingone, Carina B. Lange, Diana Sarno, Jacob Larsen, Marina Montresor, Nicolas Chomerat and Wenche Eikrem. Ian Probert, Nina Lundholm, Bente Edvardsen and Daniel Vaulot and Urban Tillman joined the APC teaching faculty to provide expert tuition in all the major marine phytoplankton groups.

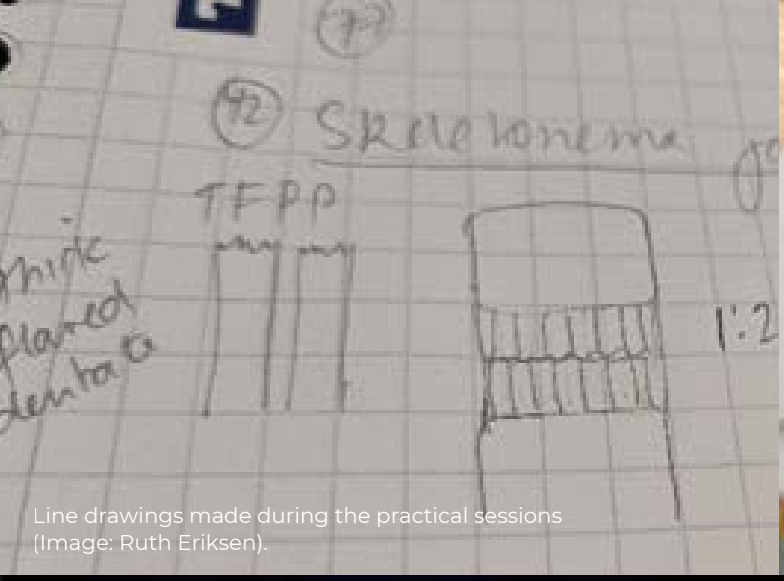
For each major taxonomic group covered, the focusing was on understanding diversity through both molecular and morphological lenses. Sometimes these lines of evidence align beautifully, although its often not the case!. With 16 countries represented, most of the attendees were from the northern hemisphere, but it was great to have the company of Tamsyne Smith-Harding from Microalgal Services in Melbourne, and Penny Harrison from the Cawthron Institute in New

Lectures and live microscopy of cultures with experts Jacob Larsen, Urban Tillman and Nicolas Chomerat (Image: Ruth Eriksen).

Zealand. Several participants had interests in Antarctic phytoplankton taxonomy so there was much comparison of species lists and images from various research voyages and long-term monitoring stations to keep me happy. I did a presentation on the IMOS plankton observatory and some of the tools and compilations we have published and made available over the past 15 years of data collection. There was great interest in our sampling methodologies, identification resources, image database, and the IMOS Biological Ocean Observer website. Like all good courses, we rounded out the experience with an exam – extremely daunting after all the information covered in the previous weeks.

Stazione Zoologica Anton Dohrn was established in 1872, and has operated from the same site at Villa Comunale in Naples to the current day. Anton Dohrn's work was shaped by meetings with Ernst Haeckel, who introduced him to the theories of Charles Darwin. There is a magnificent library and museum, dedicated to taxonomy and the collaborations between Anton Dohrn, Charles Darwin and researchers that based themselves at the Stazione for works on the marine life of the region. Fishermen were paid to collect specimens from the local area, and there were either displayed in the public aquarium, or prepared as museum specimens and distributed to collections around the world. Both these activities raised much needed funds for the operation of the research station. There is a magnificent taxonomic display of some of the species prepared for museum collections in the main meeting room at SZN.

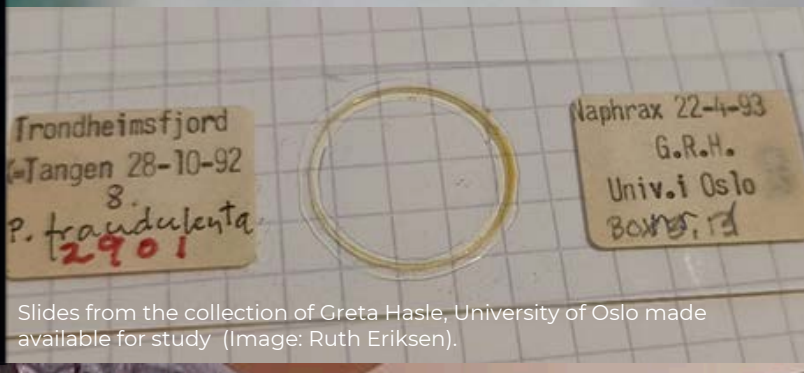
Stazione Zoologica at the 13th Advanced Phytoplankton Course (Image: Ruth Eriksen).



Line drawings made during the practical sessions (Image: Ruth Eriksen).

Live cultures from various algal culture collections, donated to demonstrate taxonomic principles (Image: Ruth Eriksen).

Diatom bicycle viewed under the light microscope, by Klaus Kemp; the "Wall of Taxonomy" specimens from the Bay of Naples, collected for distribution to museums around the world (Image: Ruth Eriksen).



Slides from the collection of Greta Hasle, University of Oslo made available for study (Image: Ruth Eriksen).

Graduation day outside the museum (Image: Ruth Eriksen).

CAPSTAN jumpstarts Students ability with CPR

by Students on the CAPSTAN Voyage

In early March, 21 students from across Australia came together for the CSIRO's CAPSTAN program and learned about deploying equipment and collecting data while at sea aboard the *RV Investigator*. Two of the students, Rachel Wong and Catherine Vally (both of UTAS), got an insight into AusCPR through CAPSTAN and this is what they learned.

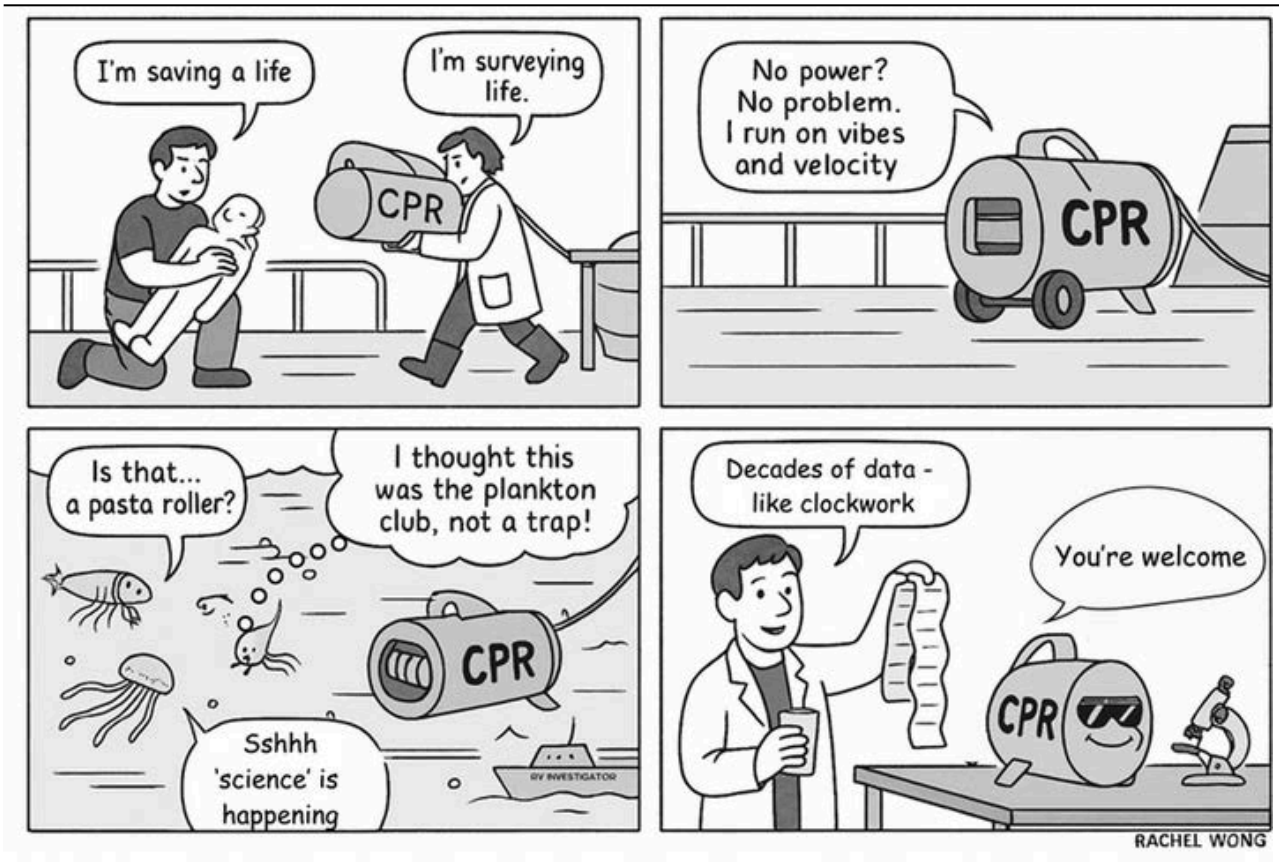
CPR: The pulse of life (Rachel Wong)

Most people associate "CPR" with cardio-pulmonary resuscitation. For biological oceanographers, CPR stands for *Continuous Plankton Recorder* - less of a tongue twister, but equally vital. Both CPRs track the pulse of life, one in humans, the other in the ocean. The marine CPR surveys both phyto- and zooplankton, the microscopic powerhouses that support the entire marine food web.

Deploying the CPR is delightfully low-fuss. Built like an armoured tank, it needs no power or delicate electronics. It's the oceanographic equivalent of a robot vacuum: small, self-sufficient, and it gets the job done. The CPR is towed behind the vessel, passively collecting plankton over vast distances. Inside, it works like a pasta roller - trapping unsuspecting plankton between two layers of fine mesh silk.

Of course, like your robot vacuum, it doesn't do corners too well. In ocean terms, that means it samples only the surface mixed layer and mostly traps mid-size plankton active in the water column. So, anything hanging deeper or migrating vertically might be missed.

But where it shines is scale. Few tools in oceanography offer the CPR's blend of simplicity and reach. It traces the ebb and flow of plankton across time and space, revealing patterns that stretch across oceans and changing climates. It may not be fancy, but it is quietly brilliant at keeping an eye on the ocean's vital signs.



Peeking at Plankton (Catherine Vally)

My first impression of the Continuous Plankton Recorder (CPR) was its seemingly simple design. At its core it filters ocean water across a silk mesh, trapping any plankton for later study. Scientific fields are often characterised by specilised instruments and steep learning curves, the CPR remains refreshingly straightforward. Although my research does not concentrate on plankton, I quickly understood the CPR's purpose and functionality, highlighting its clear-cut design.

In my time utilising the CPR during the CAPSTAN 2025 voyage, it was a perfect example of a tool that can be used in conjunction with other scientific research without requiring constant oversight. Towed behind the ship, it is the type of equipment that can be set up and left to operate, quietly and efficiently working in the background while other research takes place.

This concept highlights an important aspect of science in the field, especially at sea - the necessity of utilising research methods that can be integrated smoothly with other methods. Given the time and space constraints on research expeditions, equipment that can 'hitch a ride' without disrupting other methods are invaluable. The CPR is an excellent example of this symbiosis. It does not require a constant dedicated team, or extensive training, simply it requires a vessel, a tow point and time.

Another interesting fact about the CPR is the minimal change in its design since its creation around 90 years ago, on top of adding to one of the longest running marine biological programs in the world. In an era of continuous technological advancements, the CPR represents a principle of "if it isn't broken, it doesn't need fixing". Its continuous presence in the scientific field is a testament to the robustness of its original concept - simple, effective and reliable for decades.

What impressed me the most was the accessibility of the CPR as a scientific tool. Scientific equipment is typically specialised and can be challenging to interpret without training and time. However, the CPR is surprisingly user-friendly. Even the Plankton Colour Index (PCI), which formed part of the post-sampling analysis by observing mesh colour to estimate phytoplankton abundance, is performed visually and is an intuitive process.

In many ways, the Continuous Plankton Recorder acts as a reminder that science can be meaningful without being overly complex. It operates quietly, gathering essential ocean health, biodiversity and climate trend data. More importantly, it encourages a broader participation in marine science through its simple and hands off use. Isn't that what science should be, accessible, inclusive and quietly brilliant?

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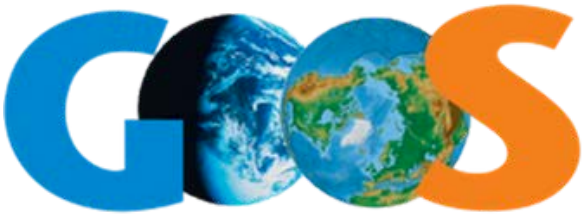

The Global Ocean Observing System

Open Consultation on Biology and Ecosystems Essential Ocean Variables

The Global Ocean Observing System (GOOS) is conducting a consultation on the Biology and Ecosystems Essential Ocean Variables (BioEco EOVs) and their associated specification sheets.

The GOOS Biology and Ecosystems Expert Panel has identified a set of BioEco EOVs using the Drivers, Pressures, State, Impact, and Response (DPSIR) framework, combined with feasibility and impact assessments. These BioEco EOVs represent the core biology and ecosystems observations needed to inform our understanding of ocean health and to provide baselines against which the impacts of human pressures and climate change can be measured and reported. To date, 12 BioEco EOVs have been recognised by GOOS, with Zooplankton & Phytoplankton (biomass and diversity) being two of these EOVs. A detailed draft specification sheet has been developed for the EOV to serve as a practical guide for contributing relevant observations to the global system. It describes key phenomena and processes, outlines the essential measurements, and defines the spatial and temporal scales and observing approaches required to monitor the EOV effectively. The information contained within is by design focused on basic observations that can be applicable globally, regardless of place-based capability and capacity.

This is an opportunity for the plankton research community to have their say on the content of the draft specification sheet, helping ensure it meets the needs of researchers, observers, and decision-makers alike. You can fine more information on this open survey here.

The Zooplankton biomass and diversity specification sheet can be found here.

The Phytoplankton biomass and diversity specification sheet can be found here.

Thank you for reading!

NCRIS National Research Infrastructure for Australia
An Australian Government Initiative

Australia's Integrated Marine Observing System is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS). It is operated by a consortium of institutions as an unincorporated joint venture, with the University of Tasmania as Lead Agent.

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SIMS is a partnership invoving four universities

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Australian Government Department of Climate Change, Energy, the Environment and Water Australian Antarctic Division
Australian Antarctic Program
Deakin University
The University of Melbourne

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IMOS acknowledges the Traditional Custodians and Elders of the land and sea on which we work and observe, and recognise them as Australia's first marine scientists and carers of Sea Country. We pay our respects to Aboriginal and Torres Strait Islander peoples past and present.

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