MNF Voyage Summary

Voyage #:	IN2024_V03
Voyage title:	Untangling the causes of change over 25 years in the southeast marine ecosystem - Voyage 2
Mobilisation:	Hobart, Sunday 28 April 2024 – Tuesday 30 April
Depart:	Hobart, 0800 Wednesday 1 May 2024
Return:	Sydney, 0800 Friday 31 May 2024
Demobilisation:	Sydney, 0800 Friday 31 May 2024
Voyage Manager:	Stephen Thomas
Chief Scientist:	Dr Richard Little
Affiliation:	CSIRO
Principal Investigators:	
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Voyage Summary

Executive summary

The marine waters of southeast Australia are one of a series of global ocean hotspots. In this region, the East Australian Current is extending pole-wards, resulting in warming of the ocean surface at a rate four times the global average. Many species have extended their distributions southward, with potential changes in local abundance. In addition, extreme events, such as marine heatwaves, are leading to additional impacts. Projections show that these changes, and the associated biological responses, are expected to continue in the next century.

In this hotspot lies the Australian Commonwealth Southeast Marine Park Network (SE-MPN; Figure 4), which was established in 2012 to protect the region's marine ecosystems and biodiversity, contribute to the National Representative System of Marine Protected Areas and help ensure the long-term ecological viability of Australia's marine ecosystems. It is unclear whether the changes observed in the region have also affected the marine parks, or whether the network has mitigated them. Understanding this better would help improve the ability of the marine park network to protect Australian heritage in the future.

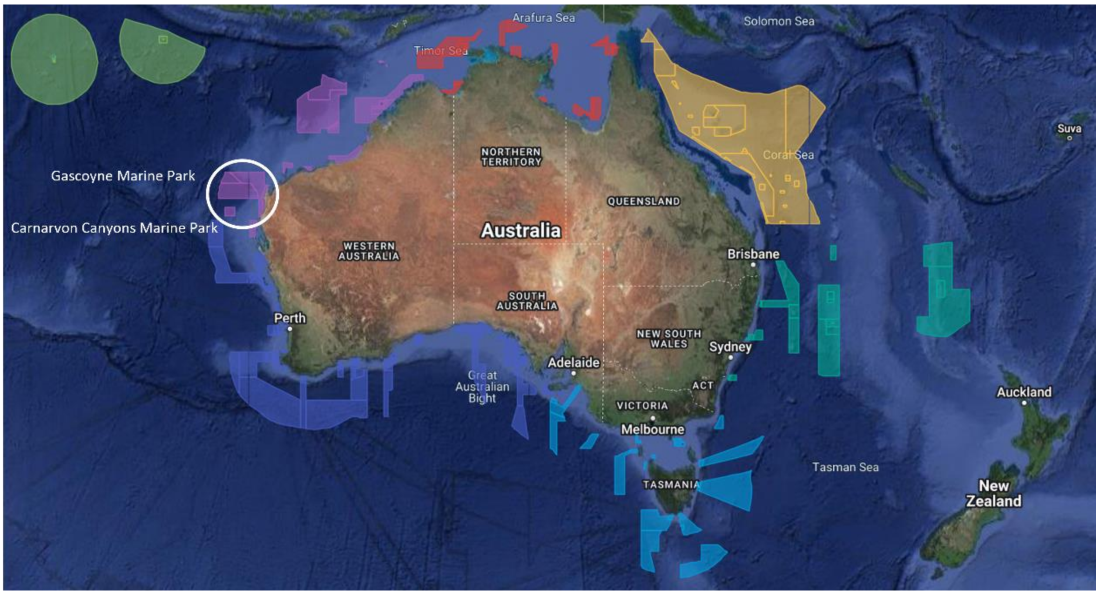


Figure 1 Australian Marine Park Network

In 2015, an expert scientific panel recommended an adaptive management approach for the Commonwealth marine reserve estate. It included the development of a research, monitoring and evaluation framework that supports robust evidence-based decision-making. It also recommended the establishment of baselines and development of early critical benchmarks in each Commonwealth marine reserve network, to enable a sound assessment for effective management. It recommended that this be done in partnership with the marine research community, under the recommendation in the National Marine Science Plan 2015– 2025 to 'establish and support a National Marine Baselines and Long-term Monitoring Program to develop a comprehensive assessment of our estate, and to help manage Commonwealth and State Marine Reserves'.

Also, in this hotspot lie important fisheries, providing the bulk of fresh fish to Melbourne and Sydney markets. The Commonwealth-managed Southern and Eastern Scalefish and Shark Fishery (SESSF) catches about 20,000t, valued at $87 million in 2018-19, and about 20% of the value of Australian Commonwealth-managed fisheries. The trawl sector, which accounts for roughly 15,000t, spans the marine waters in the hotspot. Observations from the SESSF over the past 20 years have indicated changes in the abundance and composition of the main finfish species, manifest as declines in commercial catch rates. Concurrent with these declines, has been unprecedented high levels of catches and catch rates of other species such as ocean jackets and latchet. Additionally, stocks that were historically over-fished have not responded as expected, despite active fisheries management and a reduction in fishing effort. A recent review concluded that physical and ecosystem factors are likely to be either directly affecting the main species, or indirectly affecting other species they compete with or rely on. The general view is that the marine ecosystem has experienced and is experiencing significant change. Several hypotheses have been proposed; none have been tested but they are broadly categorised as being climate-related, or fishing-related. What is clear is that fish species from which ecosystem changes have been inferred, represent only a small part of the ecosystem under pressure, and it is not well understood. Potential changes in the abundance of tropical picoplankton extending into southern Australian waters is possible for example, which would have cascading effects since they do not support the same fish biomass as those associated with cooler waters.

Scientific objectives

The South-East Australian Marine Ecosystem Survey (SEA-MES) seeks to answer 3 questions:

1. How much have habitats, fish assemblages and species abundances changed in the southeast ecosystem in 25 years?
2. How do any changes affect the multiple-use management of the region, particularly conservation and biodiversity management of Australian Marine Parks and the hive of activity from fisheries, oil & gas, and renewable energy sectors?
3. What are the implications for marine spatial planning and adaptive management in sectors that use the marine ecosystem and the managers that regulate it?

As a result, the core objectives are:

1. To determine changes in the assemblage structure (composition, abundances, distributions) of continental shelf and slope fishes (including focus on a suite of commercially important species) by comparing new survey data to historical baseline data.
2. To measure co-varying physical and biological properties of the regional ecosystem, especially metrics of changing ocean environment and exposure of benthic habitats to fishing.

3. To establish cause and effect by testing a series of hypotheses derived from a bio-physical model of the ecosystem, specifically created for the survey.
4. To establish a new baseline for future surveys.

It is also testing new monitoring techniques:

a. To measure fish presence and abundance using eDNA two sampling approaches, and how they compare to conventional sampling approaches.

b. To detect and count seabirds using deck mounted video camera.

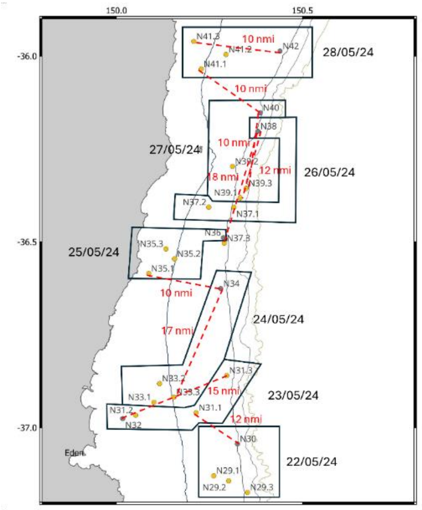
Voyage objectives

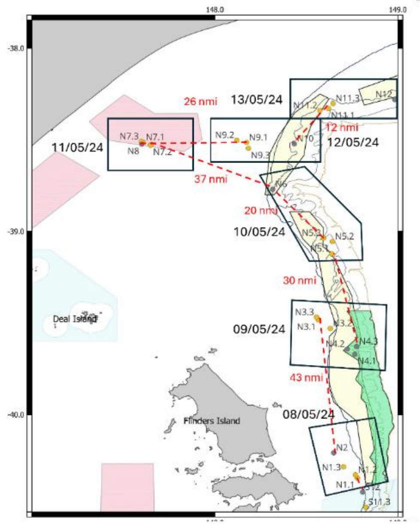
The scientific objectives are being addressed by the survey and subsequent analysis structured around three hypotheses (Figure 2) based on two impacts: (i) the physical impacts of the water column driven by changing ocean conditions (Climate Hypothesis) and (ii) impacts on benthic habitat driven by exposure to bottom-contact fishing (Habitat Hypothesis). These impacts work either directly on fish species abundances, or indirectly through the food web (Trophic Hypothesis). Our prime motivation has been on commercial fish species, but we are not limited to them.

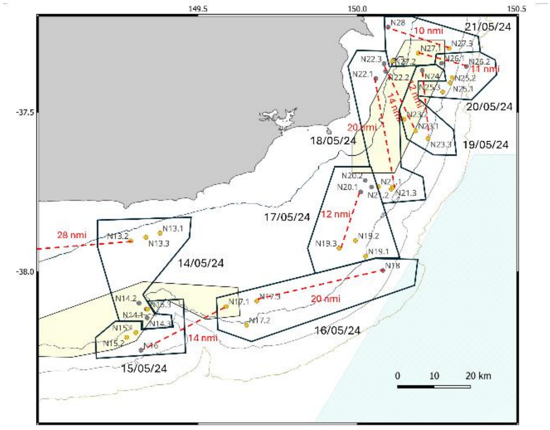
IN2024_V03 was the second of four monitoring surveys planned to help answer the above questions. The sampling schedule and locations were statistically designed for a range of sampling gear and included a weather contingency. The protocol was driven by the hypotheses and indicators derived from an ecosystem model. A program of investigating new data capture and monitoring techniques through the use of environmental DNA (eDNA) was also included in the voyage.

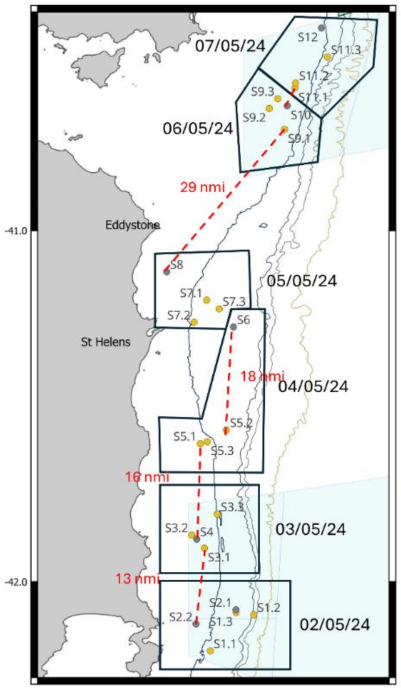
Right: NSW sampling stations

Below: Bass Strait sampling stations







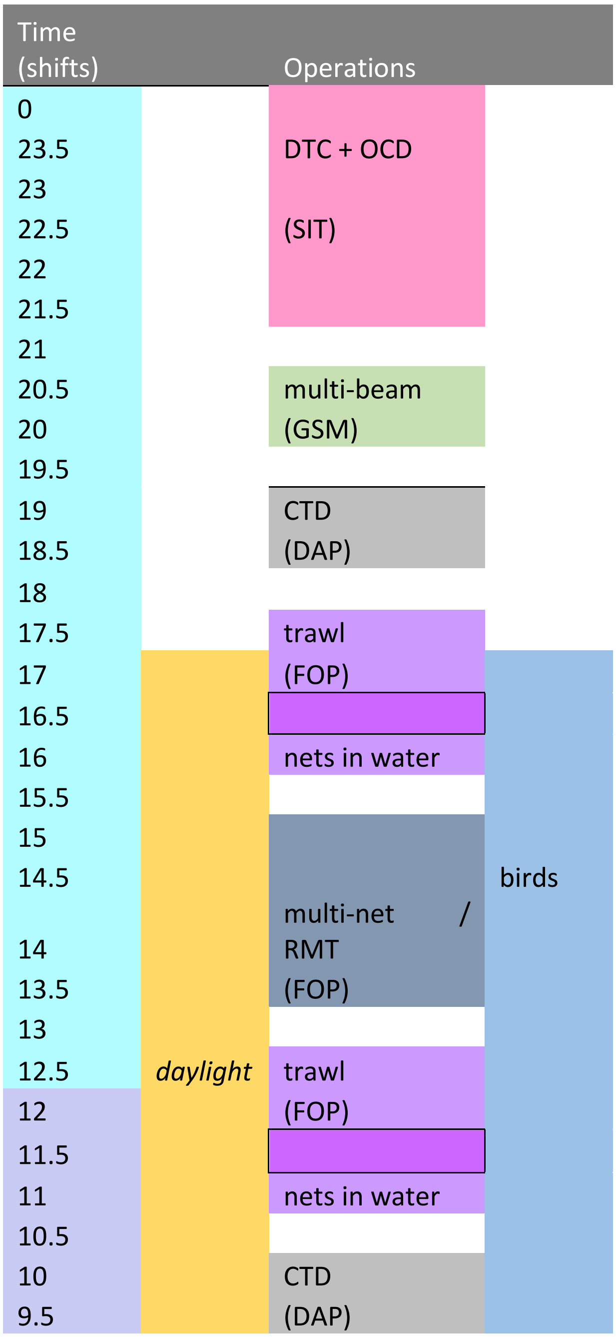


Left: TAS sampling stations

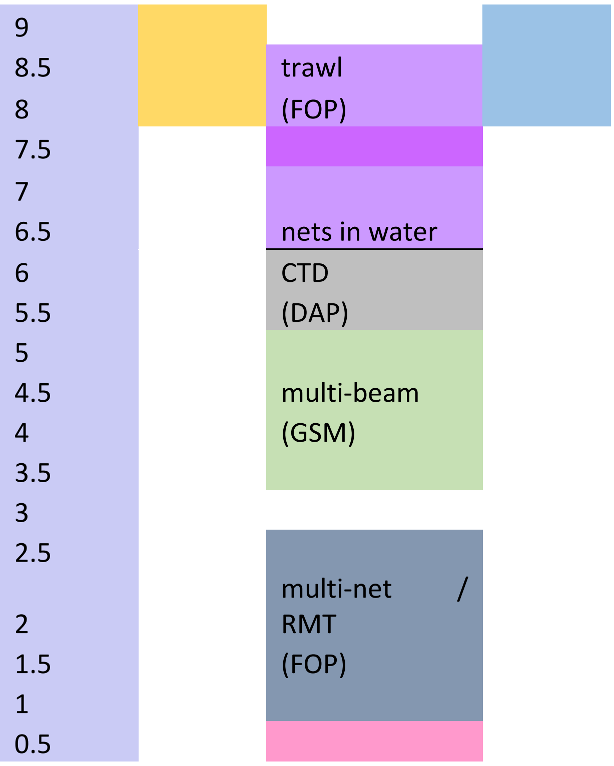
Above: VIC sampling stations

The geographical range of the study area, eastern Tasmania to southern NSW, encompassed the key area of operation of the SESSF where declines in fish abundances have been observed and where the ocean climate has, and is, changing rapidly. It is also the place where historical legacy data are located and where key stakeholders have interests (e.g. Flinders and Freycinet Australian Marine Parks).

Two 12-hour shift were scheduled to achieve these objectives. The morning shift (0000-1200) was responsible primarily for demersal fish trawl processing. The afternoon shift (1200-0000) conducted demersal fish trawl processing and habitat sampling using the Deep Towed Camera system. CTD were conducted throughout the day to record plankton samples, nutrients and for understanding the ocean dynamics, including climate variables. Mid-water trawl with the multi-net/RMT for estimating the plankton and micro-nekton prey fields.



Time (shifts)		Operations	
0			
23.5		DTC + OCD	
23			
22.5		(SIT)	
22			
21.5			
21			
20.5		multi-beam	
20		(GSM)	
19.5			
19		CTD	
18.5		(DAP)	
18			
17.5		trawl	
17		(FOP)	
16.5			
16		nets in water	
15.5			
15			
14.5			birds
		multi-net /	
14		RMT	
13.5		(FOP)	
13			
12.5	*daylight*	trawl	
12		(FOP)	
11.5			
11		nets in water	
10.5			
10		CTD	
9.5		(DAP)	



9			
8.5		trawl	
8		(FOP)	
7.5			
7			
6.5		nets in water	
6		CTD	
5.5		(DAP)	
5			
4.5		multi-beam	
4		(GSM)	
3.5			
3			
2.5		multi-net /	
2		RMT	
1.5		(FOP)	
1			
0.5			

An important part of our sampling was also directed toward collecting samples for eDNA analysis. The eDNA sampling approaches use:

1. CTD samples that are paired to demersal trawl samples during daytime hours. CTD samples for eDNA purposes thus are restricted to location and time of demersal trawl.
2. A passive sampler attached to the DTC.

Piggyback project

Seabird Detector

Principal Investigators: Rich Little (CSIRO), Carlie Devine (CSIRO), Geoff Tuck (CSIRO), Dadong Wang (CSIRO, Data61)

Test the feasibility of an automatic on-vessel seabird detector.

Planned activities include:

1. Installation of a camera, data storage for video, and processing unit into the RV Investigator electrical system prior to IN2024_V03.
2. During IN2024_V03 the camera, processor will operate while Investigator is underway. The system will be supervised by a member of the science team working with DAP support on the vessel. A daily report will be emailed to key personnel indicating the number of seabirds detected at specific time intervals throughout daylight hours.
3. The system will be uninstalled at the conclusion of IN2024_V03.

The expected outcome of this project is to bring together the hardware and software needed for an on-vessel seabird detector that will provide a running count of seabirds seen by a fixed camera over the course of a day on a sea-going vessel. Successful development of such a system will be the first step in providing more comprehensive and detailed baseline environmental data, at a fraction of the cost.

Results

Survey sampling achieved

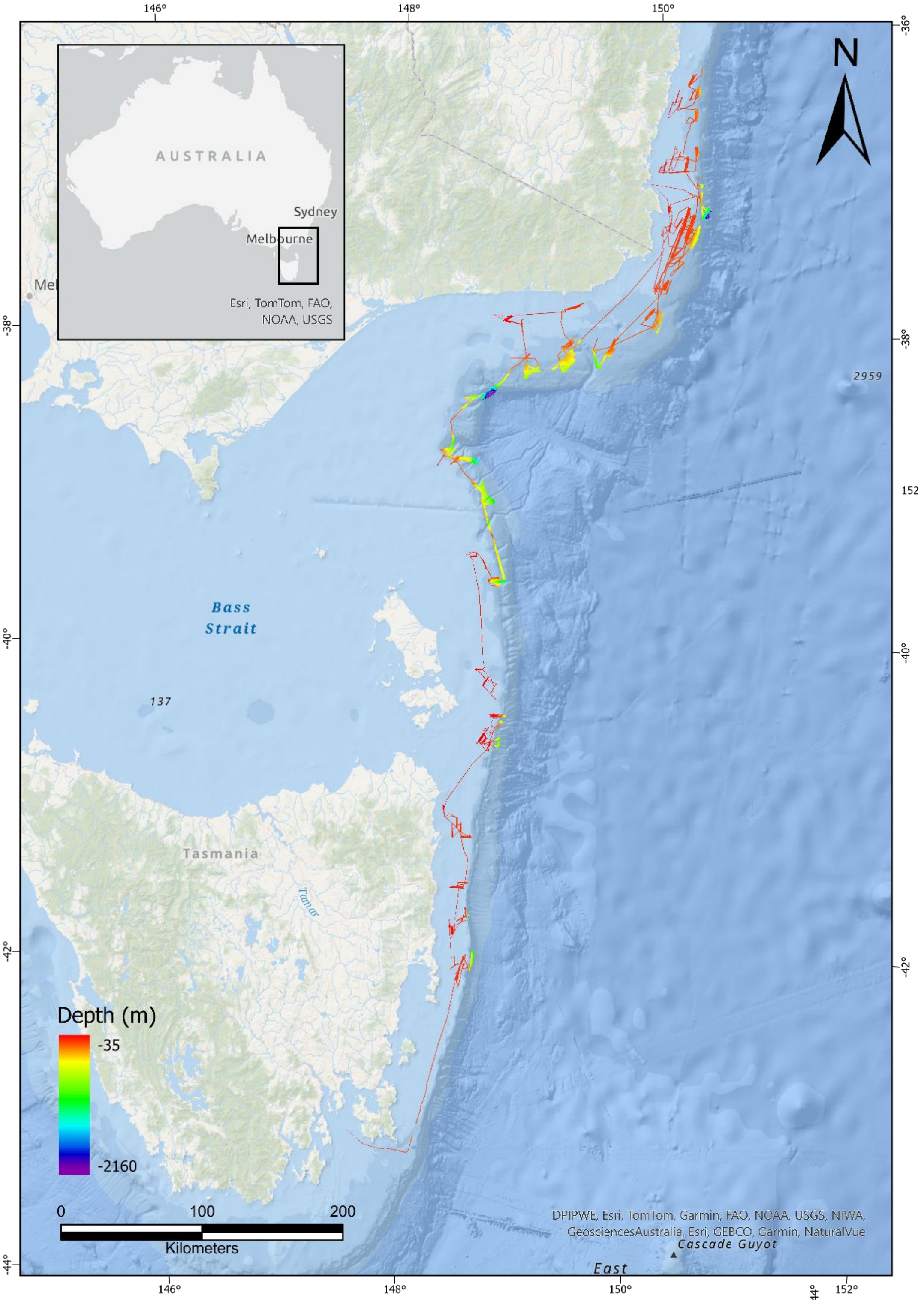


Figure 2 Vessel tracks for SEA-MES 2.

Table 1 Number of operations during SEA-MEs 1 and SEA-MES 2.

Operation	SEA-MES 1	SEA-MES 2*
CTD	62	83
Deep Towed Camera System	87	47
Mammoth / Hydrobios / Multinet	41	51
McKenna semi V-wing fish trawl	60	80
RMT	0	2
BRUV	2	0
Total	252	263

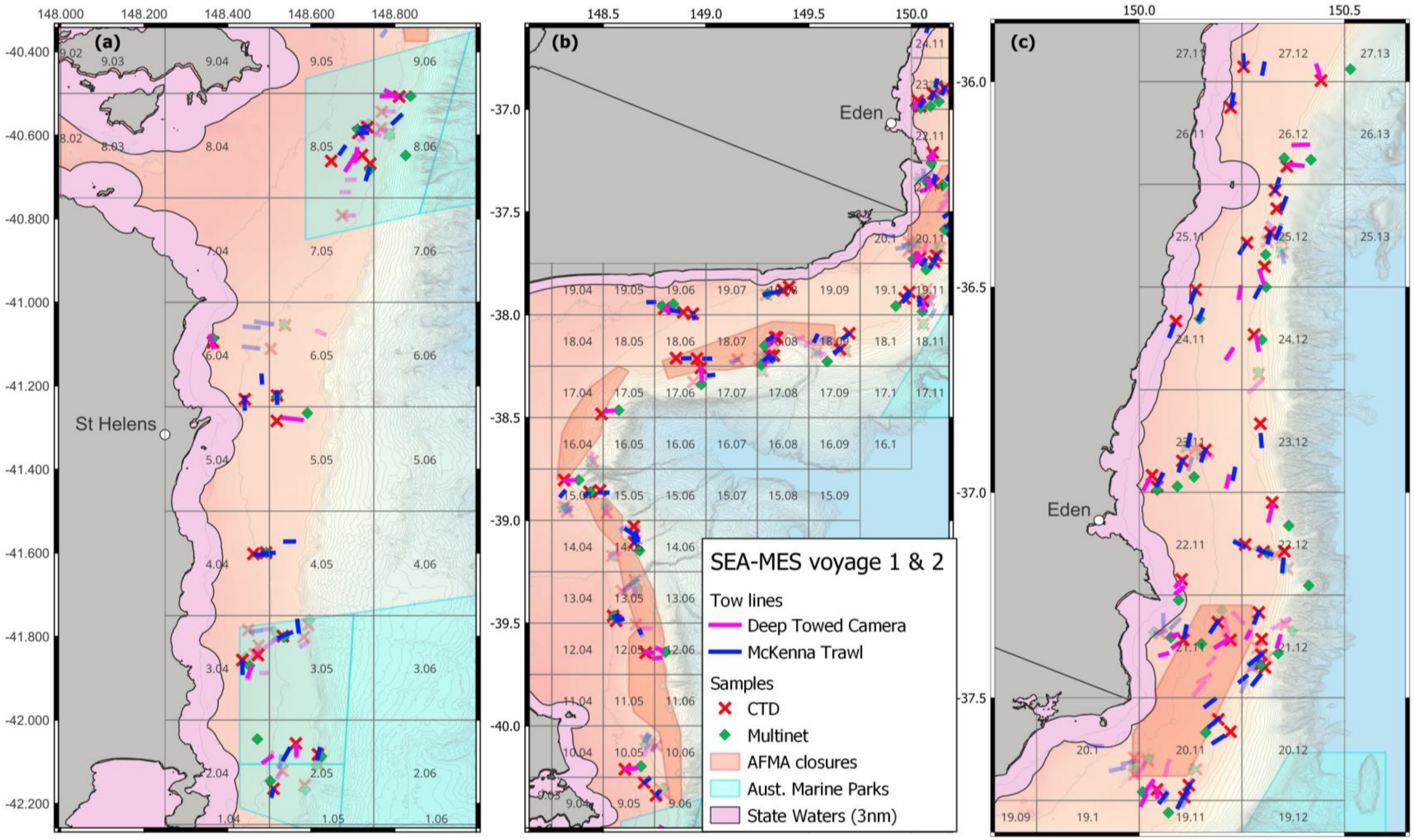


Figure 3 Samples locations from 2 SEA-MES voyages overlaid on the grid for (a) southern, (b) Bass strait, and (c) northern region. Samples taken on SEA-MES survey 1 are shown as semi-transparent.

Voyage narrative

We surveyed a range of sampling stations (Figure 5) between 70m and 500m depth that complemented the stations collected in July 2023 on the SEA-MES 1 voyage (Table 1, Figure 6). At each site, one or more gear types were deployed to obtain samples of animals and record imagery of habitats and of animals in their natural habitats (Table 1). A typical day of operations over a 24h period consisted of a morning shift (0000-1200) responsible for mapping, demersal fish trawl processing. casting CTDs and conducting plankton tows with a Multi-net to estimate the plankton fields. The afternoon shift (1200-0000) was also involved with using the Deep Towed Camera (DTC).

An important part of our sampling was collecting samples for eDNA analysis, for comparative analysis to traditional sampling of demersal trawl and DTC. This was done by pairing CTD casts during the day spatially and either before or after trawl operations, and having a passive sampler attached to the DTC. CTDs were also used to record plankton samples, nutrients, and ocean dynamics, including climate variables.

Night-time Deep Towed Camera (DTC) seabed imagery (47 sites)

Seabed imagery was collected using the MNF Deep Tow Camera. Tows ranged between 70m and 450m. Procedures were used to process the collected video and stills imagery (e.g., linked with USBL data) for data management and upload into the Video Annotation and Reference System (VARS) annotation platform for on-board analysis.

On arriving at a DTC station, the *RV Investigator* would conduct a series of parallel transects using the Kongsberg EM122 (shallower sites) or Kongsberg EM710 (deep sites) multibeam echosounders (MBES) to produce a detailed ‘postage stamp’ of the seabed. The MBES data was used to generate high resolution bathymetric and backscatter maps of the seafloor which were used to inform DTC deployments. The DTC team would then interrogate these maps and identify suitable tow lines based on (1) backscatter features, (2) steepness of the seafloor, (3) presence of significant obstacles (e.g. sudden rises), (4) prevailing weather conditions and (5) the advice from the crew. The DTC tow lines were intended to sample a range of benthic habitats (e.g. reef, rock and sand) within the postage stamp. Two design approaches were applied to DTC tows. Firstly, we used the ‘hop’ method, whereby the DTC is towed for 1 km over the seabed and then hauled up slightly (approx. 50 m from the seafloor) to allow the DTC operator to rest. After approx. 15 mins or so (or 500 m) the DTC is lowered to the seafloor for another 1 km tow. This process is repeated until 3 x 1 km tows have been conducted. The ship may change direction slightly during the periods that the DTC is off the seafloor to allow different areas of the seabed to be sampled. The second method involved towing the DTC for 2-3 km in roughly a straight line. These longer tow lines are set in directions which offer the most heterogeneous seafloor. In either scenario the DTC is towed at between 1-1.5 knots at approx. 2 m above the seafloor.

Towed camera operations were viewed in real time in the operations room. A single observer collected information on the nature and quality of the tow, the benthic environment and key biota encountered.

Collected video and still imagery for each tow were post-processed to link the USBL and depth, altitude data. Stills imagery were used to identify and enumerate fishes and videos were uploaded to the Video Annotation and Reference System (VARS) for video annotation of physical and benthic habitat types.

Video annotation is achieved by viewing the video continuously, pausing to score only where a change in concept of the dominant categories; substrate, bedform, relief and/or benthic habitat type is observed in the field of view. A change in concept for each category is recorded only once the object of interest has passed the mid-line of the screen (Figure 7). For anthropogenic concepts, a label is added when the concept is first seen and 'start' entered as a comment, with an ‘end’ comment annotated for this concept when it moves out of the scoring window

During video annotation at sea a single observer collected data for the physical habitat (substrate, geomorphology, bedform) and benthic habitat. The latter category (benthic habitat) was specific to aggregations of sessile benthos which may or may not be dominated by a single faunal group. When aggregated stands of benthic fauna were present, additional modifiers of abundance and faunal relief were annotated. Annotated concepts follow the CATAMI schema with the addition of aggregate biota concepts, modifiers and selected anthropogenic concepts. The scoring method was developed to be comparable to annotation done for imagery collected in historical surveys of the region such as South-East Fishery habitat and Ecosystem study (SEFES – Bax & Williams, 2000).

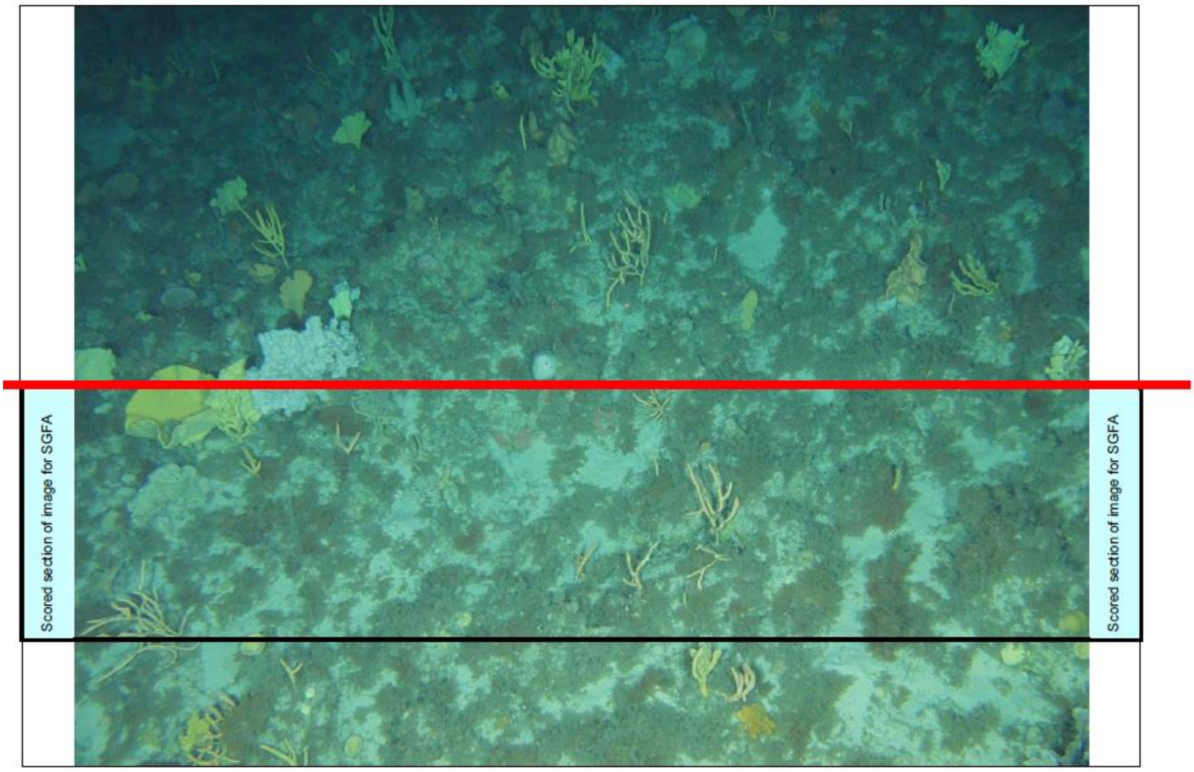
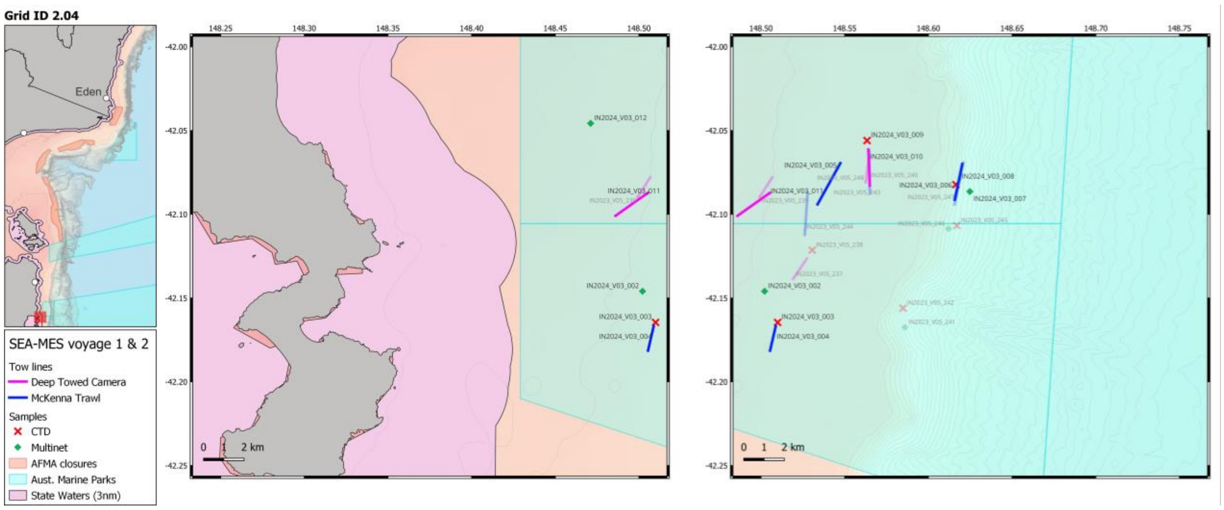


Figure 4 View of the annotation window during scoring indicating the area of the image scored (black box) and the mid-line of the window (red line).

Benthic habitat in Freycinet and Flinders AMPs

47 DTC tows were conducted. Here we show results for sites sampled in the Freycinet and Flinders Marine Parks. Annotation data at each site are depicted with maps showing the physical habitat descriptors overlaid on Multi-beam Echosounder (MBES) backscatter and benthic habitat descriptors overlaid on MBES bathymetry.

Operation 010 (Grid 2.05): Site S2, Freycinet Marine Park; 117-103 m.



Grid 2.04 Grid 2.05

Figure 5 Distribution of deployments (labelled with the operation numbers) taken on SEA-MES 2 (SEA-MES survey 1 sites are shown as semi-transparent) in Grids 2.04 and 2.05 (Figure 6). Inset shows the grid cell location (red box) in relation to the survey area.

This sample was conducted along flat bottom. The site was characterised by fine sand overlying biogenic gravel which is more exposed in places. Benthic habitat throughout were density variable; bryozoan dominated but including hydroids, sponges, ascidians and corals. Fishes were relatively rare, dominated by flathead and eels. Several gurnards, mackerel, sawtail catsharks, skates (*Dentiraja*), and a few ocean perch, pink ling and stingarees were also observed. Mobile invertebrates were dominated by hermit crabs which were common but not abundant, a few spider crabs and one starfish (*Asterodiscides truncatus*) was observed. A seal was present throughout the tow. A few detached pieces of macroalgae, one glass bottle and no apparent fishing gear marks were observed.

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Figure 6 Example images for operation IN2024_V03_010

Operation 011 (Grid 2.06): Site S2, Freycinet Marine Park; 111-90 m.

This sample was conducted slightly uphill, along undulating bottom and up onto a flatter plateau. The site was characterised by coarse sand with some bioturbation, a large rock slab and some boulders were present in the first 10 minutes. Benthic habitat throughout was characterised by a mixed assemblage of low relief sessile invertebrates including bryozoans, sponges, corals and tubeworms (polychaetes). Fishes were dominated by mackerel, a high abundance (>100) of Jackass Morwong were seen associated with the rocky reef. Eels and pearlfish were most abundant on the sandy substrates but ocean perch, catsharks, flathead, cucumber fish, morid cod, gurnards, stinkfish, gemfish and thetis fish were also observed. Mobile invertebrates were common; dominated by Baler shells and urchins (*Clypeaster*). Octopus, cuttlefish, lobster, spider crab and hermit crabs were also present. A few detached pieces of macroalgae were seen and two seals were present throughout the tow.

DTC_DSP_IN2024_V03_011_20240502T135256Z_00157

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Figure 7 Example images for operation IN2024_V03_011

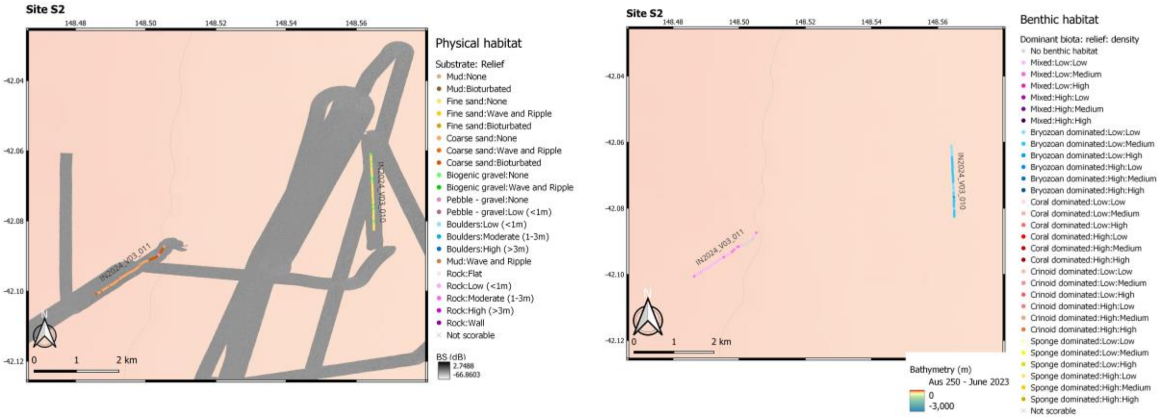
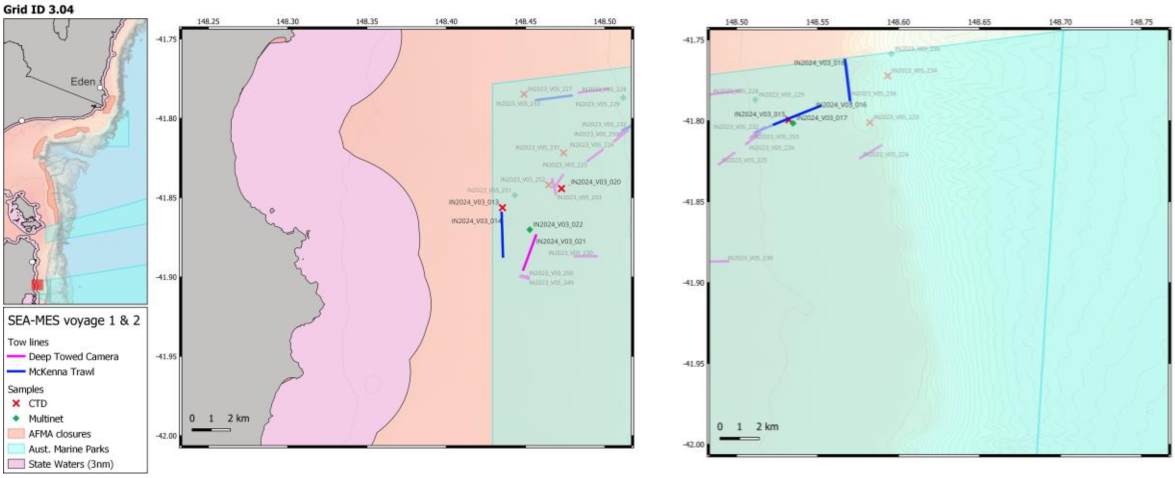


Figure 8 Ops 010 & 011 (Site S2) - Habitats: Distribution at 1s intervals of (left) physical habitat types overlaid on MBES backscatter, and (right) benthic habitat types characterised by its composition, relief and abundance overlaid on MBES bathymetry

Operation 020 (Grid 3.04): Site S4, Freycinet Marine Park; 81-81.2 m.



Grid 3.04 Grid 3.05

Figure 9 Distribution of the deployments labelled with the operation numbers (samples taken on SEA-MES survey 1 are shown as semi-transparent) in Grids 3.04 and 3.05 (Figure 6). Inset shows the grid cell location (red box) in relation to the survey area.

This sample was conducted across relatively flat, rugged bottom. The site was heterogenous with extents of rocky reef interspersed with bare, coarse sandy areas. Sandy substrates with bioturbation and wave and ripple bedform were present in places. Rocky substrates with mixed benthic habitat, including a variety of sponges, bryozoans, hydroids and corals were also present. Low relief rocks and outcrops were covered with veneer, whereas rocks of moderate to high relief had a higher density of benthos and a greater number and variety of associated fishes. Jackass morwong, a variety of perch (e.g. butterfly, orange), silver dory, shaw's cowfish and leatherjackets commonly were associated with these benthic habitats. Ocean perch, gurnards, flathead, stingarees, numbfish and eels were common in sandy areas. Mackerel were abundant along the length of the tow and three seals were observed hunting these fishes. Mobile invertebrates were dominated by hermit crabs and urchins (*Clypeaster*) but a few spider crabs, Baler shells, mantis shrimp, starfish and octopus were also seen.

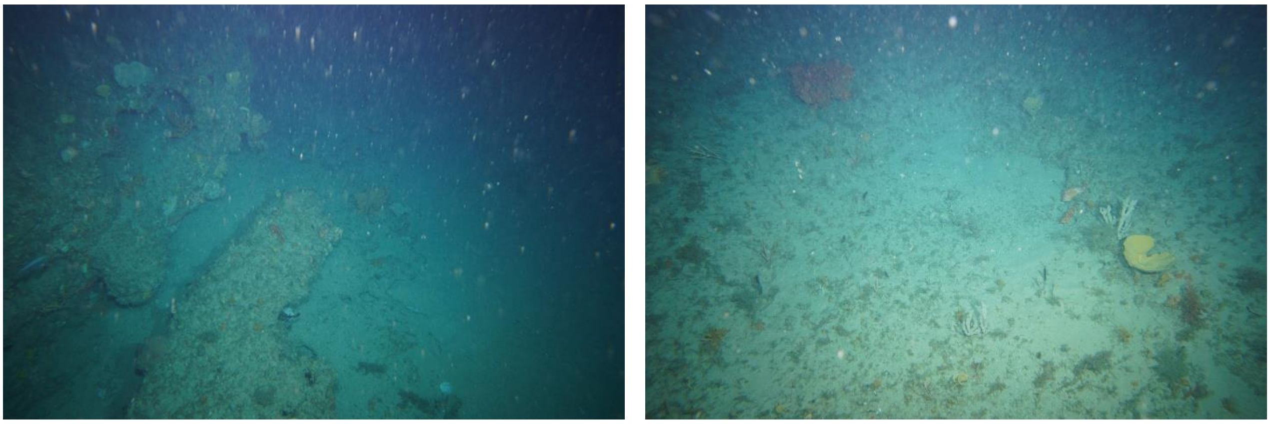


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Figure 10 Example images for operation IN2024_V03_020

Operation 021 (Grid 3.05): Site S4, Freycinet Marine Park; 80 m.

The sample was conducted North of Joe's reef along relatively flat bottom, uphill and onto an elevated feature. The site characterised by coarse sand with bioturbation and wave and ripple bedform in places, as well as biogenic gravel containing a high proportion of screwshells. Benthic habitat was present on the elevated feature, dominated by low relief Bryozoan turf. Fishes were dominated by mackerel, but cucumberfish, gurnards, ocean perch, numbfish, stingarees, skates and barred grubfish also common. Redbait, beaked salmon and pink ling were also seen. Mobile invertebrates were dominated by urchins (*Clypeaster*) and hermit crabs. Baler shells and mantis shrimp were also observed. Seals observed throughout the tow.

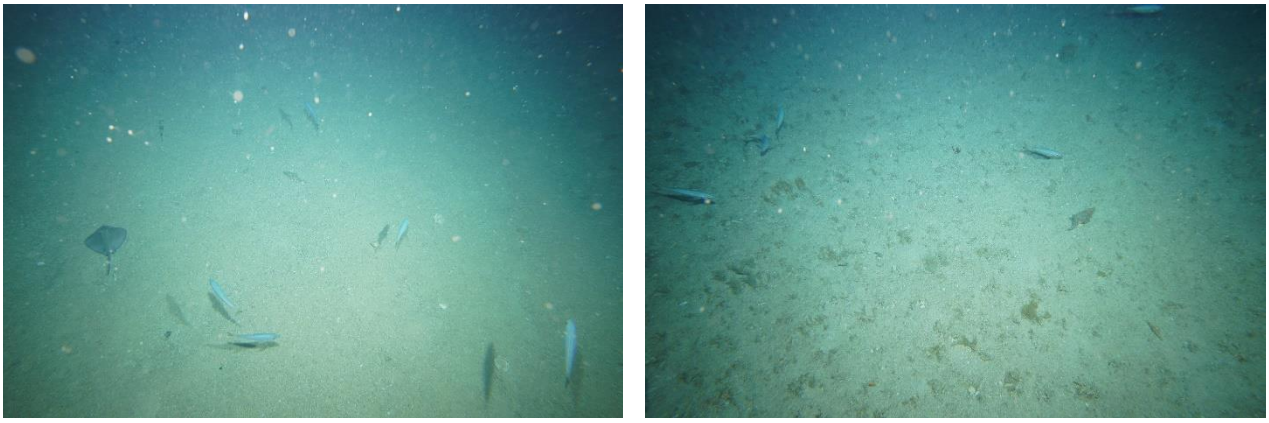

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Figure 11 Example images for operation IN2024_V03_021

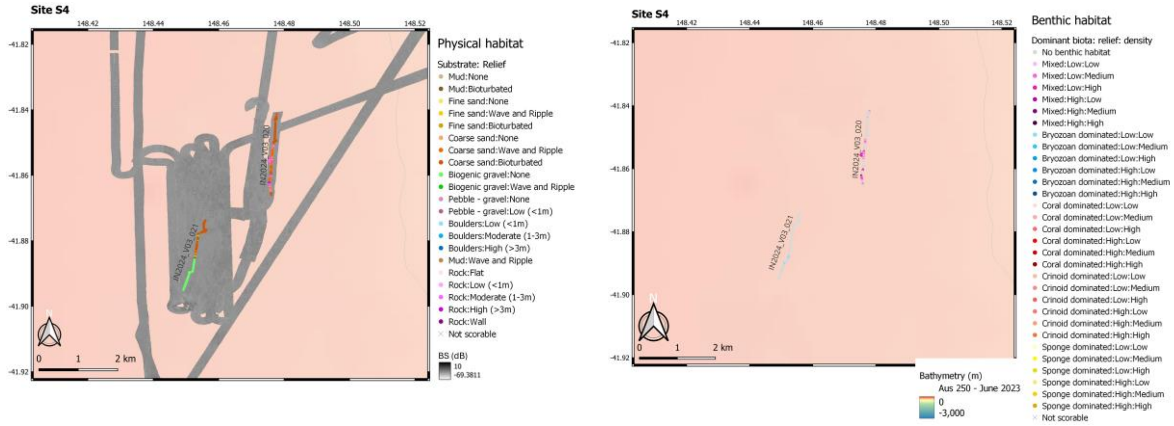
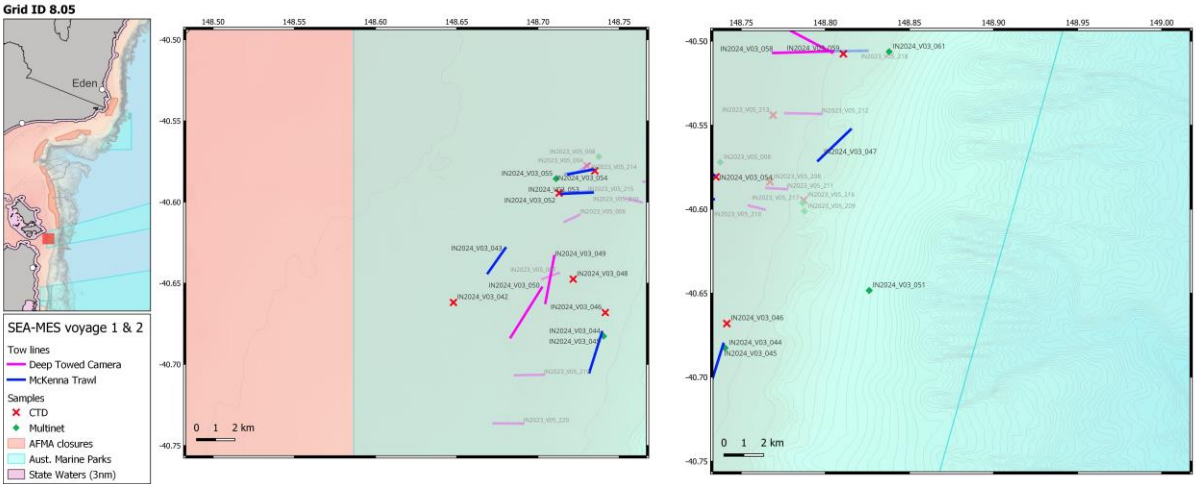


Figure 12 Ops 020 & 021 - Habitats: Distribution at 1s intervals of (left) physical habitat types overlaid on MBES backscatter, and (right) benthic habitat types characterised by its composition, relief and abundance overlaid on MBES bathymetry

Operation 049 (Grid 8.05): Site S10, Flinders Marine Park; 58-62 m.



Grid 8.05 Grid 8.06

Figure 13 Distribution of the deployments labelled with the operation numbers (samples taken on SEA-MES survey 1 are shown as semi-transparent) in Grids 8.05 and 8.06 (Figure 6). Inset shows the grid cell location (red box) in relation to the survey area.

The sample was conducted slightly uphill and along varied bottom. The site was characterised by biogenic gravel and coarse sand with a wave and ripple bedform in places. These gravel and sandy areas were interspersed with outcropping rock, of low relief and covered with a sediment veneer, as well as moderate relief rocky reef with crevices and ledges. Gravel sediments were generally bare, with no benthic habitat and very few fishes. Rocky substrates with a high density of benthic habitat were characterised by a mixed assemblage, including high relief sponges of varied forms, long whip corals, hydroids, ascidians and foliose and hard bryozoans. A high diversity and abundance of fishes associated with these habitats, including different species of perch and goatfish were often seen sheltering in and alongside sponges. Leatherjackets, cowfish, boarfish, striped trumpeter, pike, morwong (jackass and grey) and morid cod also associated with benthic habitat. Gurnards, ocean perch and stingarees common on gravel substrates and a small school of mackerel were present for most of the tow. Mobile invertebrates rare; an octopus, squid, starfish and a few hermit crabs were observed. Several large feather stars were seen on rocky ledges.

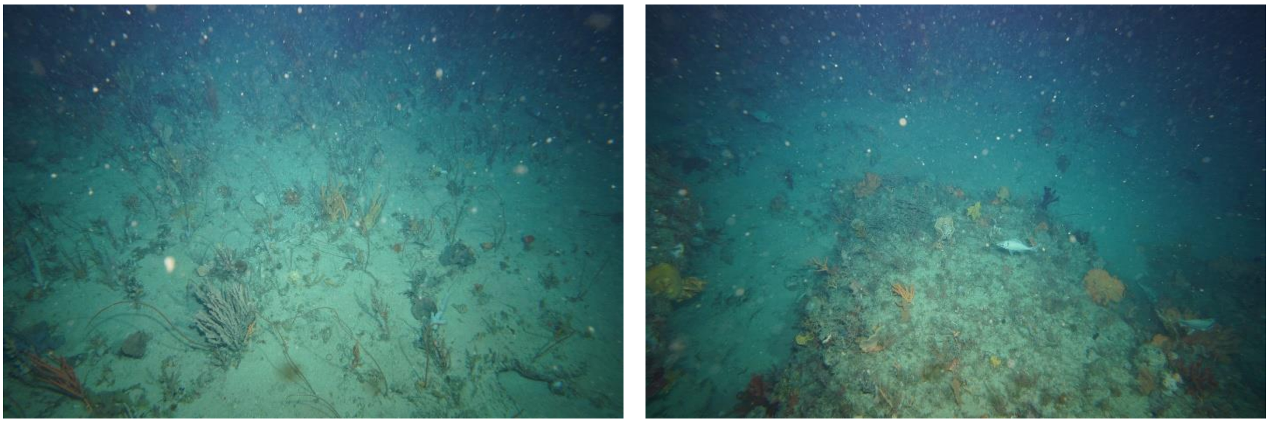


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Figure 14 Example images for operation IN2024_V03_049

Operation 050 (Grid 8.06): Site S10, Flinders Marine Park; 66-63 m.

The sample was conducted in a circular hole and uphill onto an elevated ridge. The site was characterised by areas of biogenic gravel with no benthic habitat, as well as sandy substrates with a distinct wave and ripple bedform in places. There were also areas of outcropping rock, covered with a sediment veneer and one patch of rocky reef. Sandy substrates with patchy benthic habitat were dominated by sponges. Rocky substrates with a high density, were mixed benthic assemblage including a variety of sponges, bryozoans, corals and ascidians. Gurnards, cucumberfish, ocean perch, eels, stingarees and flathead were common on the bare sandy and gravel substrates. Benthic habitat had a different assemblage of fishes; a variety and high number of perch, were often seen sheltering in and alongside sponges. Goatfish, leatherjackets, shaw’s cowfish, thetis fish, boarfish, sandpaperfish, morwong (jackass and grey) and several port jackson sharks were associated with benthic habitat. A small school of mackerel and redbait were present for most of the tow. Mobile invertebrates dominated by squid and cuttlefish; a few hermit crabs were also observed. Several large feather stars were seen on rocky ledges.

DTC_DSP_IN2024_V03_050_20240506T132841Z_00552.JPG DTC_DSP_IN2024_V03_050_20240506T133432Z_00727.JPG

Figure 15 Example images for operation IN2024_V03_050

Operation 058 (67-99 m): Site S11, Flinders Marine Park

Both camera tows were conducted along varied bottom and down a rocky ridge of high elevation onto a deeper sandy plain. The site was characterised by biogenic gravel and sandy substrate (coarse, fine) with no bedform or light bioturbation in places. There were also outcropping rocks of low relief covered with a sediment veneer, as well as large boulders and rocks of high relief (>3 m), particularly at the edge of the cliff where the drop off occurs. Sandy sediment was generally bare but there was patchy benthic habitat in places, characterised a mixed assemblage including a variety of sponges, hydroids, bryozoans, ascidians and corals, including soft and solitary hard, cup corals. Rocky substrates with a similar assemblage but generally a higher density of benthos had feather stars and ophiuroids also seen. These rocky reefs were also associated with a high diversity and abundance of fishes including redfish, morwong (jackass and grey), sandpaper fish, leatherjackets, boarfish, morid cod, and perch of different kinds which tend to shelter in and alongside sponges. A small school of mackerel were present for part of both tows. Gurnards, silverside, bellowsfish, stingarees, spikey dogfish, thetis fish, ocean perch, numbfish, eels and flathead were observed on sandy substrates. Mobile invertebrates relatively rare; a few squid, an octopus, urchins and hermit crabs were observed. Gear marks were seen on the sandy plains above and below the ridge and a length of old wire also observed on high relief rock during both operations.

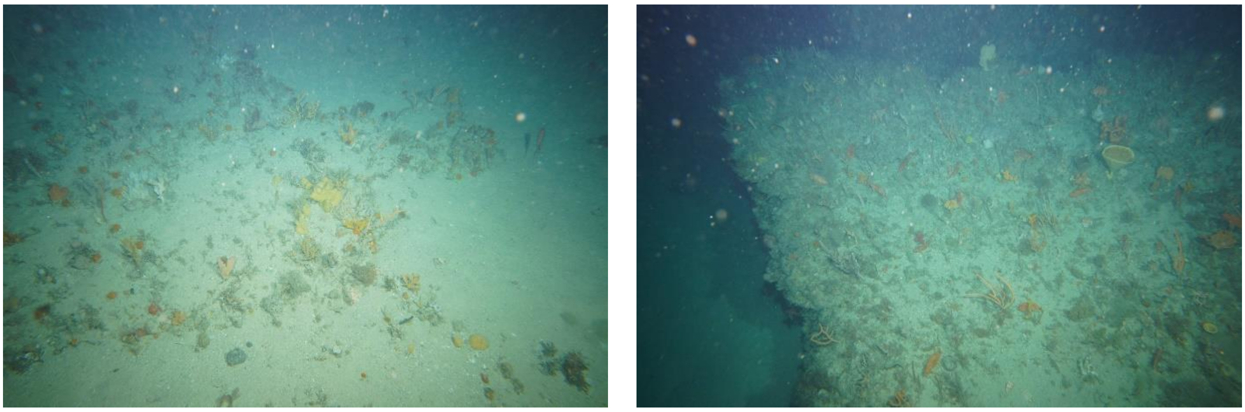

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Figure 16 Example images for operation IN2024_V03_058, 060

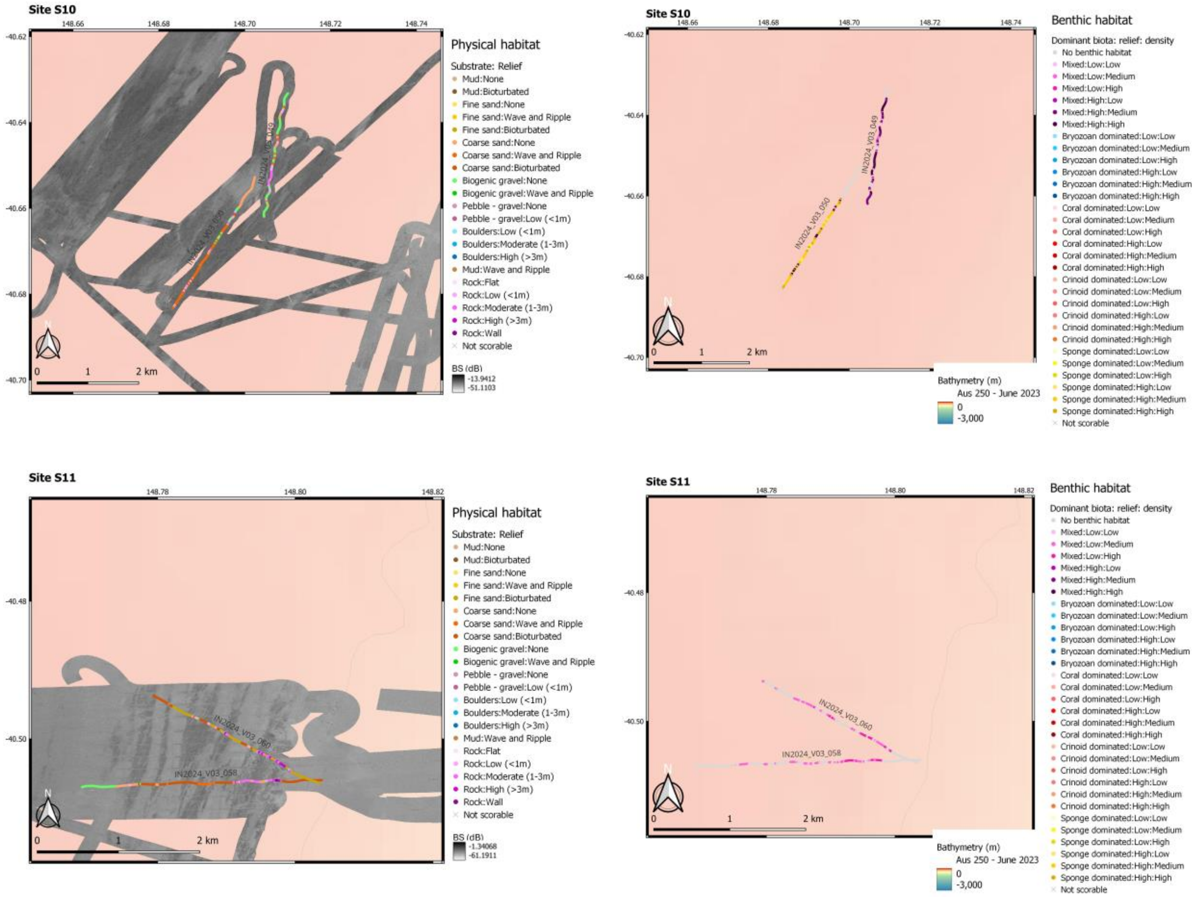


Figure 17 Ops 049, 050 (top) 058,060 (bottom) - Habitats: Distribution at 1s intervals of (left) physical habitat types overlaid on MBES backscatter, and (right) benthic habitat types characterised by its composition, relief and abundance overlaid on MBES bathymetry

Passive eDNA DTC sampler

A novel eDNA collection method (passive eDNA; Figure 21) was deployed for comparative analysis with video and stills imagery, and results from conventional CTD eDNA collection. The method relies on collection of eDNA from water passing through a sampling device affixed to the DTC frame. The device was opened upon reaching the target tow camera depth. This allowed water to flow over a coarse mesh filter during the length of the tow, thereby collecting an integrated eDNA sample. The collection device was closed prior to camera ascent to prevent contamination from other depths.

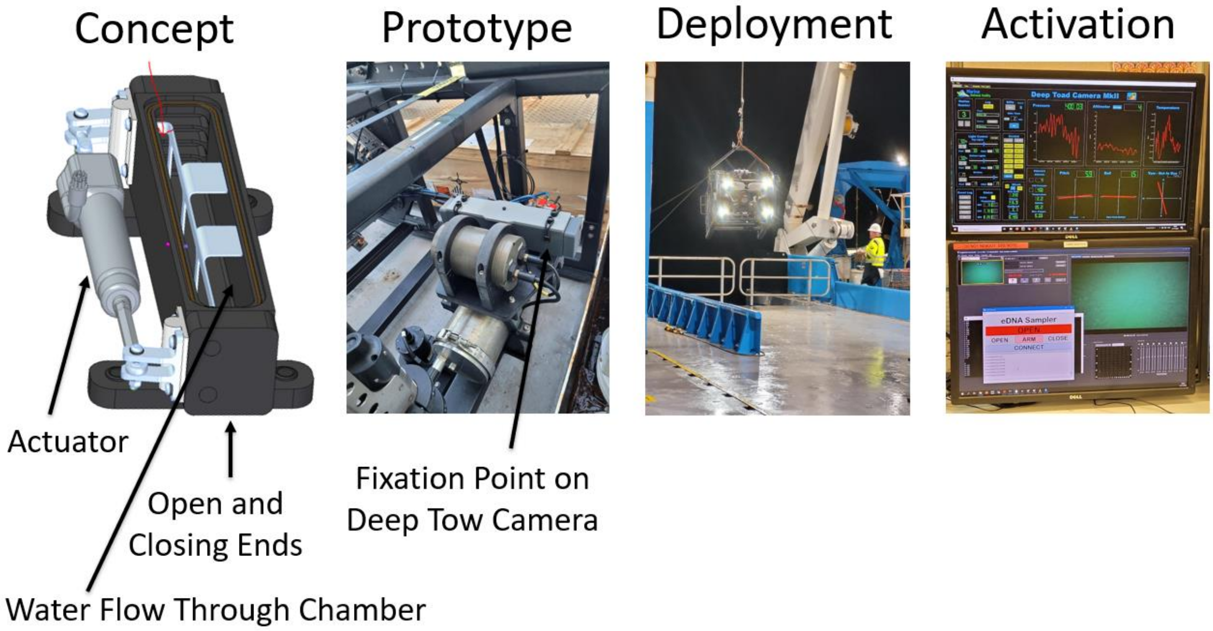


Figure 18 The passive eDNA deep tow camera (DTC) sampling device affixed on the deep tow frame, deployed alongside the DTC video and imagery capabilities, and activated on board to open and close the device at the depth of the tow only.

The passive eDNA sampler was deployed at 23 sites to enable the comparison of fish and habitat composition at each site and between different collection methods (Table 2). Molecular work has commenced with all DNA extractions on schedule to be completed by August 2023.

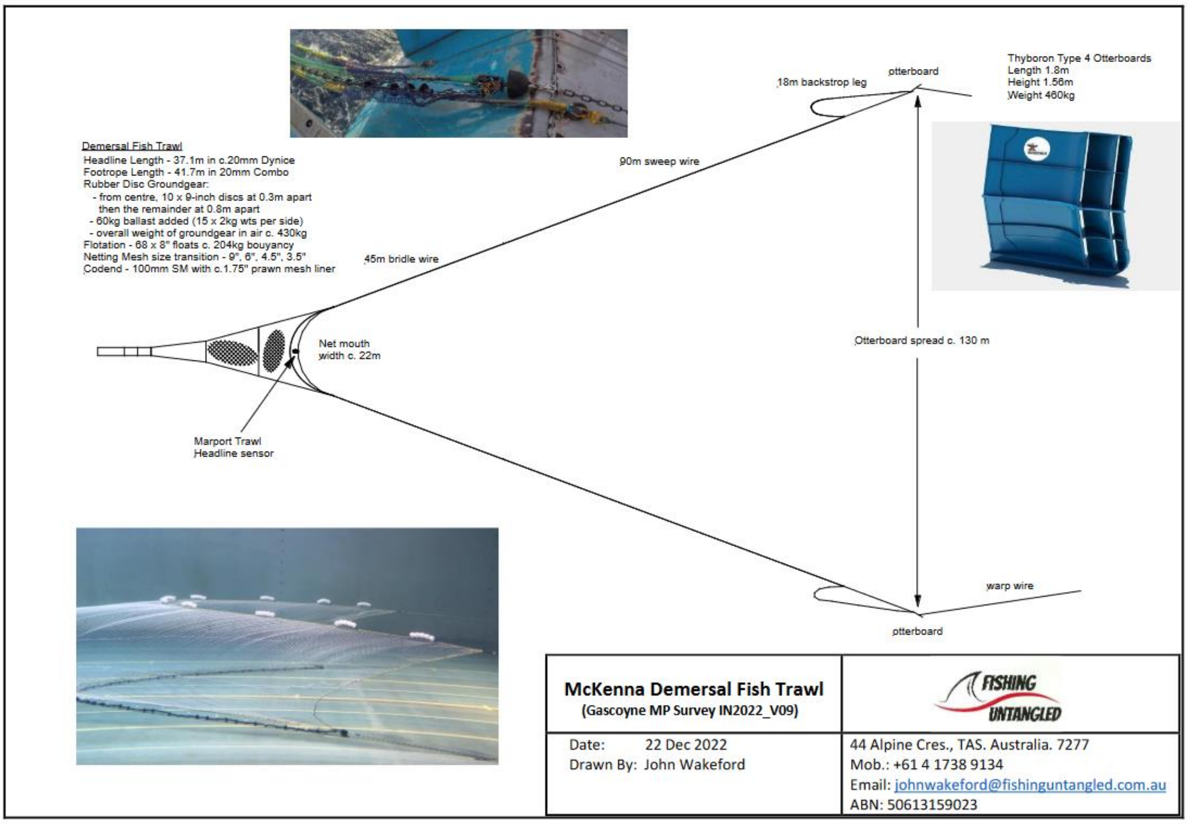
Table 2 Passive eDNA sampler comparisons by site.

		Sampler Comparison		
Site	Depth	Passive eDNA	CTD Filtration eDNA	DTC Imagery
N10.1	190	✓	✓	✓
N14.3	390	✓	✓	✓
N34.2	140	✓		✓
N38.1	110	✓		✓
N44.1/N44.2	150	✓	✓	✓
N46.3	400	✓	✓	✓
N42.1/N42.3	100	✓	✓	✓
N36.3	280	✓	✓	✓
N35.2/N35.3	130	✓	✓	✓
N35.6	100	✓		✓
N32.1/N32.3	300	✓	✓	✓
N28.1	475	✓	✓	✓
N38.1	115	✓		✓

N38.11	110	✓		✓
N38.12	110	✓		✓
N22.1	230	✓	✓	✓
NewS2.2	100	✓	✓	✓
NewS2.1	100	✓	✓	✓
S5.1new	100	✓	✓	✓
S5.4new/S5.2	100	✓	✓	✓
S6.2	110	✓		✓
S6.1	110	✓		✓
CathsReef	80	✓	✓	✓

Demersal trawl (80 sites)

Demersal trawl sampling using a McKenna semi V-wing fish trawl net was conducted at 80 sampling stations. 193 species of teleost or elasmobranchs were seen. Biological samples were taken from 32. The voyage caught 20. 63t of teleosts and elasmobranchs compared to 30.45t on the previous voyage SEA-MES 1. The 20 most commonly caught species in SEA-MES 1 are shown in Table 3 in comparison to the catches on SEA-MES 2, and vice versa, the 20 most common species on SEA-MES 2 are shown in Table 4 compared to the catches taken on SEA-MES 1.



Demersal Fish Trawl
Headline Length - 37.1m in c.20mm Dynice
Footrope Length - 41.7m in 20mm Combo
Rubber Disc Groundgear:
- from centre, 10 x 9-inch discs at 0.3m apart then the remainder at 0.8m apart
- 60kg ballast added (15 x 2kg wts per side)
- overall weight of groundgear in air c. 430kg
Flotation - 68 x 8" floats c. 204kg bouyancy
Netting Mesh size transition - 9", 6", 4.5", 3.5"
Codend - 100mm SM with c.1.75" prawn mesh liner

Thyboron Type 4 Otterboards
Length 1.8m
Height 1.56m
Weight 460kg

McKenna Demersal Fish Trawl
(Gascoyne MP Survey IN2022_V09)

Date: 22 Dec 2022
Drawn By: John Wakeford

44 Alpine Cres., TAS. Australia. 7277
Mob.: +61 4 1738 9134
Email: johnwakeford@fishinguntangled.com.au
ABN: 50613159023

Table 3 Biological samples collected from the McKenna demersal trawl.

Spcode	Scientific Name	Common Name	Measured Total	Site Count	Min Length (mm)	Max Length (mm)	Gonad	Otolith	Muscle	Stomach
37258003	*Centroberyx affinis*	Redfish	36	9	92	291	29	30	16	0
37337062	*Pseudocaranx georgianus*	Silver Trevally	57	18	89	204	0	0	16	0
37337002	*Trachurus declivis*	Common Jack Mackerel	2318	62	73	270	521	572	254	951
37445005	*Seriolella brama*	Blue Warehou	61	11	145	327	31	50	31	3
37445006	*Seriolella punctata*	Silver Warehou	329	24	119	351	85	97	69	142
37377003	*Nemadactylus macropterus*	Jackass Morwong	1337	43	23	413	267	266	234	11
37264002	*Cyttus australis*	Silver Dory	98	25	111	360	0	0	0	0
37345001	*Emmelichthys nitidus*	Redbait	762	30	108	236	0	0	92	241
37439002	*Rexea solandri*	Gemfish	737	29	92	624	176	172	101	272
37227001	*Macruronus novaezelandiae*	Blue Grenadier	197	5	255	699	0	0	43	0
37465006	*Nelusetta ayraud*	Ocean Jacket	102	12	174	488	51	90	27	0
37465005	*Meuschenia scaber*	Velvet Leatherjacket	877	41	75	276	0	0	102	0
37122002	*Lampanyctodes hectoris*	Hector's Lanternfish	50	6	38	75	0	0	0	0
37228002	*Genypterus blacodes*	Pink Ling	54	24	327	1072	52	52	40	1
37120001	*Paraulopus nigripinnis*	Blacktip Cucumberfish	2543	64	83	344	2	2	196	2
37296001	*Platycephalus richardsoni*	Tiger Flathead	1201	63	176	588	457	454	321	576
37287093	*Helicolenus barathri*	Bigeye Ocean Perch	422	14	78	451	0	0	64	0
37287001	*Helicolenus percoides*	Reef Ocean Perch	1204	42	42	301	0	0	129	321
37330014	*Sillago flindersi*	Eastern School Whiting	851	15	130	256	114	114	113	0
37017008	*Galeorhinus galeus*	School Shark	8	2	459	725	0	0	0	0
37017001	*Mustelus antarcticus*	Gummy Shark	20	8	466	980	0	0	0	0
37440002	*Lepidopus caudatus*	Frostfish	2	2	603	715	2	2	1	0
37288003	*Lepidotrigla vanessa*	Butterfly Gurnard	491	21	90	298	0	0	0	0
37288006	*Pterygotrigla polyommata*	Latchet	451	38	166	461	0	0	90	0
37288007	*Lepidotrigla modesta*	Cocky Gurnard	1961	51	89	251	0	0	91	3
37288008	*Lepidotrigla mulhalli*	Roundsnout Gurnard	3172	52	22	1961	0	0	169	593
37038014	*Trygonoptera imitata*	Eastern Shovelnose Stingaree	17	5	272	735	0	0	0	0

37038007	*Urolophus viridis*	Greenback Stingaree	460	25	154	465	0	0	0	0
37038001	*Urolophus bucculentus*	Sandyback Stingaree	216	30	140	729	0	0	0	0
37038004	*Urolophus paucimaculatus*	Sparsely-spotted Stingaree	902	38	115	450	0	0	66	331
37038002	*Urolophus cruciatus*	Banded Stingaree	436	40	99	417	0	0	0	0
37264004	*Zeus faber*	John Dory	82	22	214	476	60	60	22	0

Table 4 The 20 most common species caught on SEA-MES 1 and compared to SEA-MES 2 (red text indicates species that were not in the list of 20 most common species caught on SEA-MES 2).

	Species name	Common name	SEAMES 1 catch (kg)	SEAMES 2 catch (kg)
83	*Trachurus declivis*	Common Jack Mackerel	17048.09	6539.44
86	*Emmelichthys nitidus*	Redbait	2627.47	188.47
42	*Macruronus novaezelandiae*	Blue Grenadier	831.2	653.37
104	*Scomber australasicus*	Blue Mackerel	794.7	723.01
38	*Paraulopus nigripinnis*	Blacktip Cucumberfish	762.02	1956.57
102	*Rexea solandri*	Gemfish	628.86	292.69
106	*Seriolella punctata*	Silver Warehou	614.65	197.96
71	*Platycephalus richardsoni*	Tiger Flathead	593.45	497.64
70	*Lepidotrigla mulhalli*	Roundsnout Gurnard	508.01	477.9
22	*Dentiraja confusa*	Longnose Skate	382.19	566.77
28	*Urolophus bucculentus*	Sandyback Stingaree	303.89	312.86
30	*Urolophus paucimaculatus*	Sparsely-spotted Stingaree	264.75	706.41
101	*Thyrsites atun*	Barracouta	243.8	250.33
58	*Helicolenus percoides*	Reef Ocean Perch	217.96	349.72
59	*Neosebastes scorpaenoides*	Common Gurnard Perch	215.36	181.09
32	*Urolophus viridis*	Greenback Stingaree	200.05	256.88
121	*Allomycterus pilatus*	Australian Burrfish	189.88	259.55
68	*Pterygotrigla polyommata*	Latchet	187	96.21
53	*Zeus faber*	John Dory	180.3	49.76
52	*Zenopsis nebulosa*	Mirror Dory	175.62	377.96

Table 5 The 20 most common species caught on SEA-MES 2 compared to SEA-MES 1 (green text indicates species that were not in the list of 20 most common species caught on SEA-MES 1).

	Species name	Common name	SEAMES 1 catch (kg)	SEAMES 2 catch (kg)
83	*Trachurus declivis*	Common Jack Mackerel	17048.09	6539.44
38	*Paraulopus nigripinnis*	Blacktip Cucumberfish	762.02	1956.57
104	*Scomber australasicus*	Blue Mackerel	794.7	723.01
30	*Urolophus paucimaculatus*	Sparsely-spotted Stingaree	264.75	706.41
42	*Macruronus novaezelandiae*	Blue Grenadier	831.2	653.37
94	*Nemadactylus macropterus*	Jackass Morwong	114.54	605.86
22	*Dentiraja confusa*	Longnose Skate	382.19	566.77
71	*Platycephalus richardsoni*	Tiger Flathead	593.45	497.64
70	*Lepidotrigla mulhalli*	Roundsnout Gurnard	508.01	477.9
52	*Zenopsis nebulosa*	Mirror Dory	175.62	377.96
58	*Helicolenus percoides*	Reef Ocean Perch	217.96	349.72
69	*Lepidotrigla modesta*	Cocky Gurnard	118.27	341.68
28	*Urolophus bucculentus*	Sandyback Stingaree	303.89	312.86
102	*Rexea solandri*	Gemfish	628.86	292.69
7	*Asymbolus rubiginosus*	Orange Spotted Catshark	11.14	284.56
82	*Sillago flindersi*	Eastern School Whiting	62.79	261.59
121	*Allomycterus pilatus*	Australian Burrfish	189.88	259.55
32	*Urolophus viridis*	Greenback Stingaree	200.05	256.88
101	*Thyrsites atun*	Barracouta	243.8	250.33
4	*Cephaloscyllium laticeps*	Draughtboard Shark	102.79	218.72

In terms of changing abundance from SEA-MES 1 to SEA-MES 2 (CPUE: kg per standardised trawl) the 20 most abundant species in each are shown Table 5 and Table 6, including the number of samples each species, and the relative change in one year.

Table 6 The 20 abundant species by CPUE, and number of trawls in which they were caught, in SEA-MES 1 compared to SEA-MES 2 and the proportion change (red text indicates species that were not in the list of 20 most abundant species in SEA-MES 2).

Species	Common name	Avg SEAMES_1 CPUE (kg/shot)	SEAMES_1 shots	Avg SEAMES_2 CPUE (kg/shot)	SEAMES_2 shots	1 year change
Trachurus declivis	Common Jack Mackerel	846.06	44	227.59	64	0.27 ↓
Emmelichthys nitidus	Redbait	169.88	33	15.51	29	0.09 ↓
Macruronus novaezelandiae	Blue Grenadier	138.53	12	472.32	3	3.41 ↑
Scomber australasicus	Blue Mackerel	76.17	23	42.87	37	0.56 ↓
Neosebastes scorpaenoides	Common Gurnard Perch	49.13	10	23.47	19	0.48 ↓
Rexea solandri	Gemfish	39.68	33	22.46	28	0.57 ↓
Kathetostoma canaster	Speckled Stargazer	38.76	10	5.25	5	0.14 ↓
Paraulopus nigripinnis	Blacktip Cucumberfish	36.52	44	67.43	64	1.85 ↑
Foetorepus calauropomus	Common Stinkfish	32.13	12	34.19	12	1.06 ↑
Nelusetta ayraud	Ocean Jacket	30.2	10	10.48	12	0.35 ↓
Platycephalus richardsoni	Tiger Flathead	29.65	43	17.85	62	0.6 ↓
Seriolella punctata	Silver Warehou	29.13	45	17.47	25	0.6 ↓
Spiniraja whitleyi	Melbourne Skate	27.54	10	27.47	16	1
Lepidotrigla mulhalli	Roundsnout Gurnard	26.6	42	20.34	53	0.76 ↓
Parequula melbournensis	Silverbelly	24.37	4	9.61	9	0.39 ↓
Urolophus bucculentus	Sandyback Stingaree	24.31	29	23.44	31	0.96 ↓
Zenopsis nebulosa	Mirror Dory	23.79	16	46.47	18	1.95 ↑
Sphoeroides pachygaster	Balloonfish	23.5	13	2.32	20	0.1 ↓
Cephaloscyllium albipinnum	Whitefin Swellhark	22.98	10	7.45	2	0.32 ↓
Callorhinchus milii	Elephantfish	22.06	12	8.92	4	0.4 ↓

Table 7 The 20 abundant species by CPUE, and number of trawls in which they were caught, in SEA-MES 2 compared to SEA-MES 1, and the proportion change (green text indicates species that were not in the list of 20 most abundant species in SEA-MES 1).

Species	Common name	Avg SEAMES_1 CPUE (kg/shot)	SEAMES_1 shots	Avg SEAMES_2 CPUE (kg/shot)	SEAMES_2 shots	1 year change
Macrurонus novaezelandiae	Blue Grenadier	138.53	12	472.32	3	3.41 ↑
Trachurus declivis	Common Jack Mackerel	846.06	44	227.59	64	0.27 ↓
Paraulopus nigripinnis	Blacktip Cucumberfish	36.52	44	67.43	64	1.85 ↑
Dipturus gudgeri	Bight Skate	11.25	9	52.09	7	4.63 ↑
Zenopsis nebulosa	Mirror Dory	23.79	16	46.47	18	1.95 ↑
Bathytoshia brevicaudata	Smooth Stingray	9.57	9	43.32	3	4.52 ↑
Scomber australasicus	Blue Mackerel	76.17	23	42.87	37	0.56 ↓
Urolophus paucimaculatus	Sparsely-spotted Stingaree	20.87	29	42.81	38	2.05 ↑
Asymbolus rubiginosus	Orange Spotted Catshark	1.66	14	41.95	15	25.29 ↑
Sillago flindersi	Eastern School Whiting	13.75	10	38	15	2.76 ↑
Thyrsites atun	Barracouta	19.43	27	35.18	17	1.81 ↑
Foetorepus calauropomus	Common Stinkfish	32.13	12	34.19	12	1.06 ↑
Nemadactylus macropterus	Jackass Morwong	18.78	14	33.57	42	1.79 ↑
Myliobatis tenuicaudatus	Southern Eagle Ray	18.23	19	32.33	10	1.77 ↑
Squatina australis	Australian Angelshark	10.76	9	31.27	4	2.91 ↑
Cephaloscyllium laticeps	Draughtboard Shark	10.11	24	30.73	18	3.04 ↑
Lepidoperca pulchella	Eastern Orange Perch	0.56	1	28.43	3	50.55 ↑
Chimaera ogilbyi	Ogilby's Ghostshark	7.77	8	28.09	7	3.62 ↑
Spiniraja whitleyi	Melbourne Skate	27.54	10	27.47	16	1
Trygonorrhina dumerilii	Southern Fiddler Ray	18.37	6	26.22	4	1.43 ↑

SEA-MES demersal fish community composition

Demersal fish species and sampling station site comparison over the two SEA-MES voyages so far were similar (Figure 22).

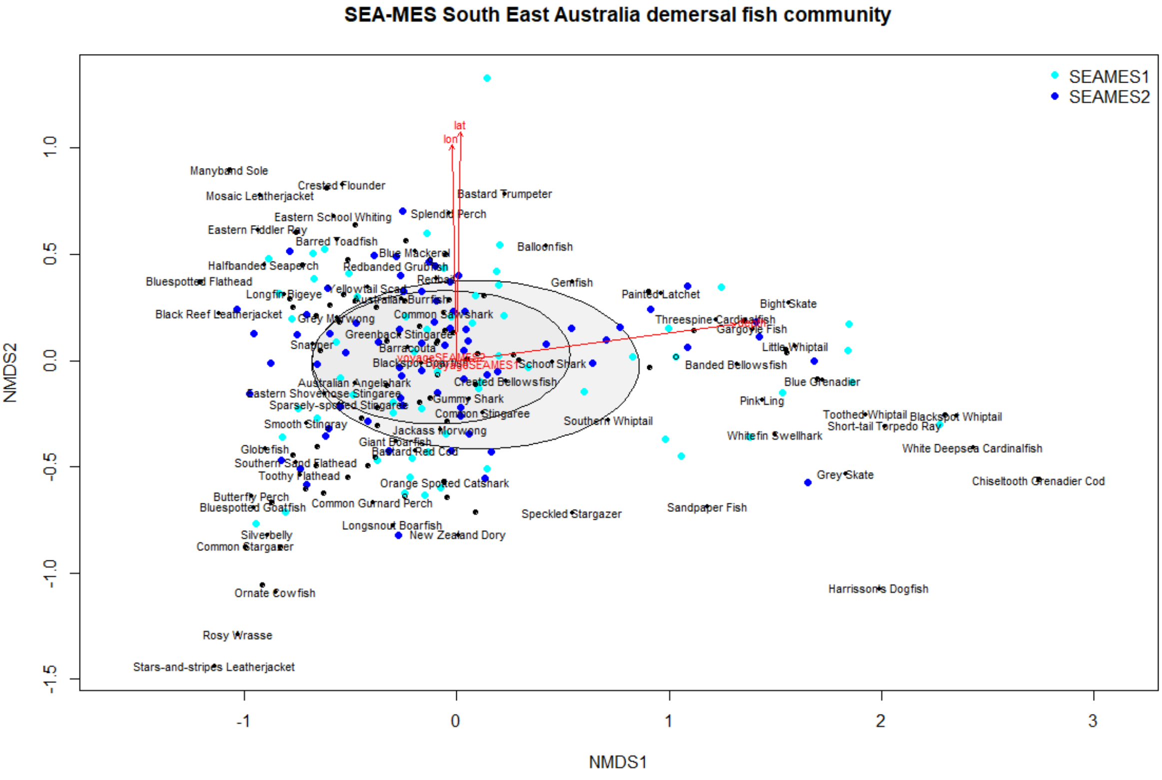


Figure 19 Demersal fish community species composition over two SEA-MES voyages.

Outreach, education and communications activities

Project communication to the public and stakeholders can be seen on the website:

https://research.csiro.au/sea-mes/

On the voyage there were **102 media items** and a **measured audience of 229,287**.

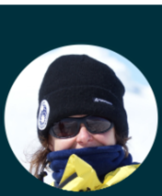
Green Slime

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]

1) CSIRO Environment, Castray Esplanade, Hobart, TAS 7000, Australia, 2) CSIRO NCMI, Castray Esplanade, Hobart, TAS 7000, Australia
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
www.csiro.au

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.

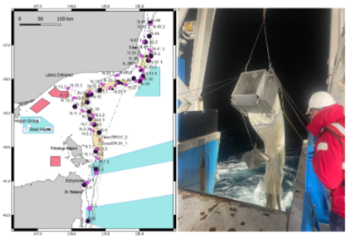


Figure 1: SEA-MES sample sites and zooplankton multinet

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.

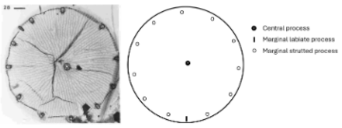


Figure 2: *Thalassiosira partheneia*

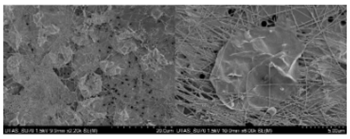


Figure 3: *Thalassiosira partheneia* cells

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.

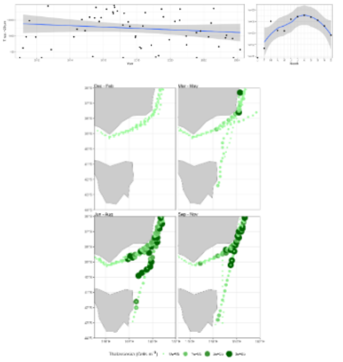


Figure 4: Time series and distribution of *Thalassiosira*

Results

The SEA-MES voyage found plankton biomass was greatest off the South East coast where the *Thalassosira* 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.

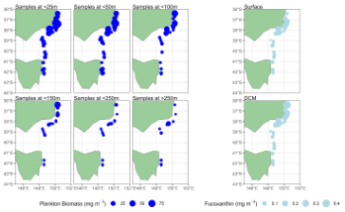


Figure 5: Total plankton biomass and fucoxanthin concentrations

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.

IMOS
Integrated Marine Observing System

SEA-MES 2023-2026
South East Australian Marine Ecosystem Survey

Acknowledgment & Reference

We acknowledge the use of the CSIRO Marine National Facility (https://ror.org/01mae9353) in undertaking this research.

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Multinet image: Curt Chalk, TEM image: Hasle, 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

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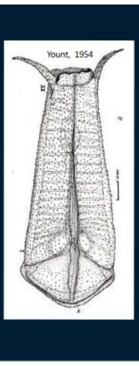


Gut content analysis can determine dietary preferences in a wide range of organisms. During the South-East Australian Marine Ecosystem Survey (SEA-MES) voyages in 2023 & 2024, salps (gelatinous zooplankton) were a notable component of trawls. We present a summary of the taxa identified in guts of solitary *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.

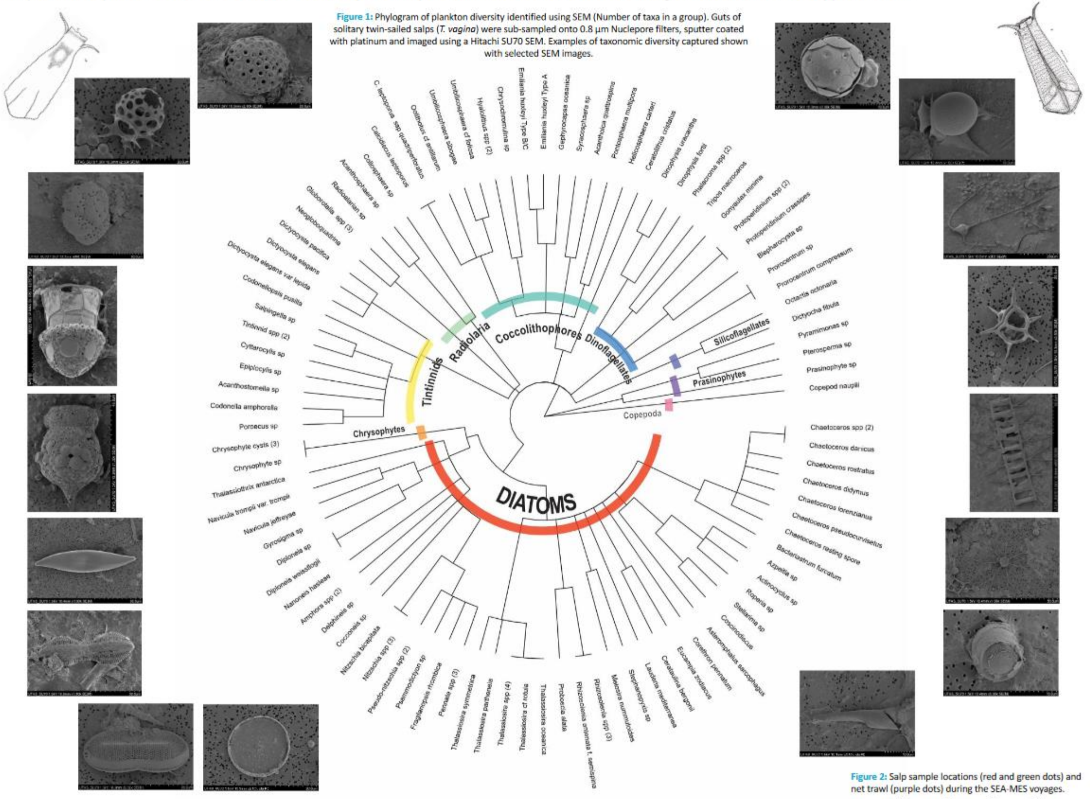
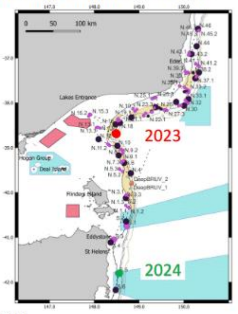


Figure 2: Salp sample locations (red and green dots) and net trawl (purple dots) during the SEA-MES voyages.



Efficient, non-discriminatory feeders

- salps catch a wide range of particle 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-sailed salps can be obtained by using stable isotope analysis, pigment analysis and molecular approaches applied to gut samples.

Swarms contribute significantly to carbon export

- via large, rapidly-sinking carcasses and faecal pellets, especially during 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 dietary studies on *Thetys* in Australian 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.

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FOR FURTHER INFORMATION
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The Coupled eDNA Experiment: Harnessing eDNA for Marine Biodiversity Observations from the South-east Australian Marine Ecosystem Survey (SEA-MES) (#182)

Sahan Jayasinghe [1] , Cindy Bessey [2] , Levente Bodrossy [1] , Katrina West [2] , Bruce Deagle [1]

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A vast range of methods are applied to measure marine biodiversity to provide critical scientific data for environmental management. In recent years, environmental DNA (eDNA) has emerged as a powerful tool for biodiversity assessment, offering a non-invasive and efficient method for detection and monitoring species from across the tree of life. In this project, we evaluated eDNA monitoring approaches in offshore marine surveys, focussing on relatively well characterised fish fauna. eDNA samples were collected throughout the water column, via CTD Niskin bottles and filtering as well as via a passive eDNA sampler, aboard the *RV Investigator* at sites from Tasmania to NSW, including sites within the South-East Marine Park Network, to establish a new baseline and provide a unique eDNA-based perspective on biodiversity in the south-east marine region. The eDNA data generated by the different water filtering protocols were compared spatially (between sites and depths). Biodiversity data was also collected in parallel using a suite of conventional methods (i.e trawl nets and deep towed-cameras) allowing direct comparisons to be made between eDNA methods and traditional surveying approaches. The evaluation of different eDNA sampling methods will provide guidance for designing effective and scalable bio-monitoring tools for Australian marine ecosystems.

Untangling the causes of ecosystem change with the South-East Australian Marine Ecosystem Survey (SEA-MES) (#352)

Richard Little [1] , Alan Williams [1] , Jeff Dambacher [1] , Scott Foster [1] , John Keesing [2] , Karen Evans [1] , Ben Scoulding [1] , Ian Knuckey [3] , Caroline Sutton [1] , Matt Lansdell [1]

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- The marine waters of SE Australia are in a global warming hotspot where the East Australian Current is extending pole-wards, warming the ocean at more than four times the global average. Anecdotal evidence from the Southern and Eastern Scalefish and Shark Fishery (SESSF) that operates in the region indicates that the ecosystem has changed but the reasons are unclear. The South-East Australian Marine Ecosystem Survey (SEA-MES) is revisiting a survey conducted 30 years ago to understand what is driving the changes being seen and why, with a focus on climate change, and bottom contact fishing (trawling).
- SEA-MES is a comprehensive multi-year biophysical research project on *RV Investigator*, Australia's multi-purpose oceanographic research vessel. Sampling methods consist of demersal and mid-water trawl, deep-towed video, and physical analysis of the water column. Prospective technologies are also being tested.
- The ecosystem is a busy and valuable place, containing industries such as oil and gas, shipping and a developing offshore wind sector. It also holds important cultural heritage in the Australian Southeast Marine Park Network, and proposed indigenous Sea Country such as the tayaritja Sea Country IPA. Understanding the pressures on it, what has changed and why, is important for protecting environmental and cultural heritage.

Observations of sub-mesoscale frontal instabilities: a pathway for nutrient supply in South-east Australia (#482)

Clothilde Langlais [1] , Claire Davies [1] , Heidi Pethybridge [1] , Sahan Jayasinghe [1] , Caroline Sutton [1] , Yann-Treden Tranchant [2] , Benoit Legresy [1] , Richard Little [1]

1. CSIRO, Hobart, TAS, Australia
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- Continental shelves host 20-30% of global primary production and 90% of the global fish catch, with South-East Australia providing the bulk of fresh fish to Melbourne and Sydney markets. However, this region is a hotspot of global ocean-warming with the intensification of the East Australian Current (EAC). CSIRO's SEA-MES project aims to understand changes in fish assemblages and species abundances through a comprehensive bio-physical assessment of the shelf slope.
- Our July 2023 RV Investigator voyage revealed an offshore EAC eddy near the Bass-Strait entrance, creating a very sharp thermal and density front along the shelf edge that facilitated strong ageostrophic vertical transport and cross-shelf exchanges, resulting in: (i) injection of cool, low O2 and salinity, high nutrient water from deep ocean layers of the Tasman Sea onto the shelf at 100-200m and (ii) export and cascade of dense , high O2, shelf Bass Strait water off the continental shelf towards a 300-500m deep layer. Observations of sub-mesoscale fronts and associated ageostrophic vertical transport are rare and highlight efficient pathways for vertical exchange between the surface and deep ocean. Our findings suggests that the intensification of the EAC poleward extension may increase the occurrences of these sub-mesoscale nutrient pathways.

Plans and progress in developing an edge AI seabird detector and enumerator in an autonomous marine surface vehicle (#410)

Carlie Devine [1] , Richard Little [1] , Muhammad Saqib [2] , Jingyu Zhang [2] , Ella Pietraroia [3] , Andrew Filisetti [4] , Geoff Tuck [1] , Dadong Wang [2] , Roshni Subramaniam [1] , Jam Graham-Blair [1]

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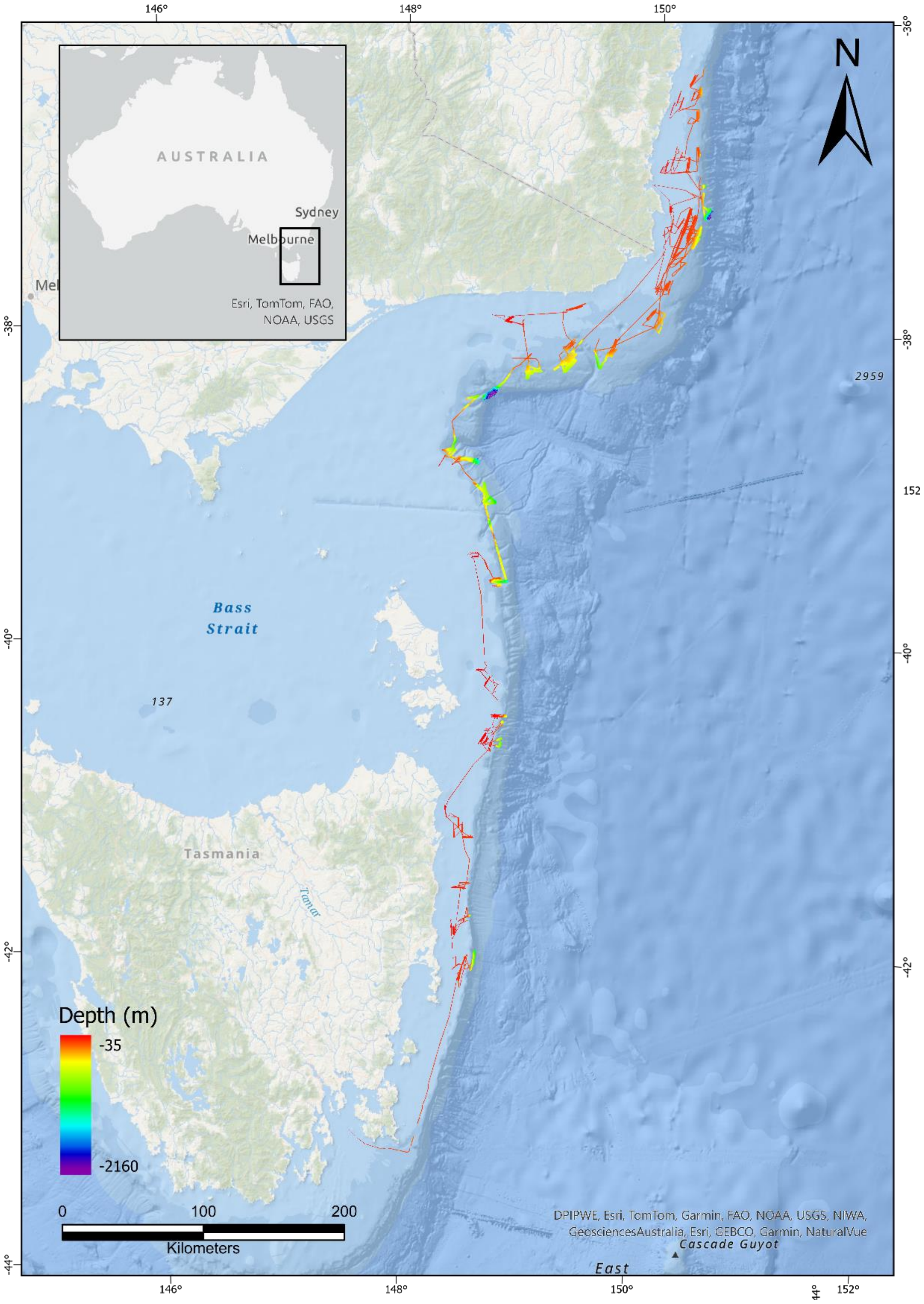
3. National Collections & Marine Infrastructure, CSIRO, Hobart
4. Mineral Resources, CSIRO, Hobart

- Continuous real-time or near-real-time species identification and automatic counting in marine imagery is increasingly being viewed as a future method for managing the marine environment. Currently, automated detection and classification require imagery to be stored and then processed in a lab-based, cloud system on land. Edge computing and processing of marine imagery in the field is the next step in obviating the need for storing and moving large amounts of data ashore. The last step is integrating the system into an autonomous vehicle to perform continuous monitoring of relevant areas.
- We are currently developing an edge detection system for seabirds on *RV Investigator* as part of the CSIRO led South East Australia Marine Ecosystem Survey (SEA-MES). This could allow deployment to a range of crewed vessels including commercial fishing vessels. A system deployed to an autonomous vehicle however would be more flexible, and cost-effective, and offer a means of collecting data for offshore wind developments and marine environmental regulators. This talk will outline our current plan and progress in a project that is developing an edge AI system integrated into an autonomous *Maritime Robotics Otter*, surface vehicle.

Track Chart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Kilometers
DPIPWE, Esri, TomTom, Garmin, FAO, NOAA, USGS, NIWA, GeoscienceAustralia, Esri, GEBCO, Garmin, NaturalVue
Cascade Guyot
East

Links to Further Data and Information

NCMI Information and Data Centre (csiro.au)

Data Trawler (csiro.au) – Data Extraction tools for Voyage Data

MNF Reporting (csiro.au) – Publications and reports from research on vessels run by the Marine National Facilty

Marlin3 - Marlin - CSIRO Oceans and Atmosphere Metadata Catalogue

Open Access to Ocean Data (aodn.org.au)

AusSeabed (ausseabed.gov.au)

CAAB - Codes for Australian Aquatic Biota (csiro.au)

Ocean Biodiversity Information System - Australia (obis.org.au)

Atlas of Living Australia (ala.org.au)

CSIRO Data Access Portal (data.csiro.au)

Global Biodiversity Information Facility (GBIF) (gbif.org)

Signature

Your name	Richard Little
Title	Chief Scientist
Signature	
Date:	18/07/2025