CSIRO

Marine National Facility


# Marine National Facility

## Year in Review 2023–24

Operated by CSIRO,
Australia's National Science Agency,
on behalf of the nation

## Citation

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## Important disclaimer



## Acknowledgements

The Marine National Facility (MNF) is funded by the Australian Government, including funding from the National Collaborative Research Infrastructure Strategy (NCRIS), and is operated by CSIRO, Australia's national science agency, on behalf of the nation.

CSIRO acknowledges the Traditional Owners of the land, sea and waters of the area that we live and work across Australia. We acknowledge their continuing connection to their culture and we pay our respects to their Elders past and present.

NCRIS National Research Infrastructure for Australia An Australian Government Initiative

This research is enabled by NCRIS.

SCIENCE AND INDUSTRY ENDOWMENT FUND

This research is supported by the Science and Industry Endowment Fund.

**Cover: RV *Investigator* and voyage co-chief scientists Benoit Legresy and Helen Phillips preparing the EM-APEX float for deployment. Image: Amelia Pearson**

# Contents


INVESTIGATOR
INVESTIGATOR

# About the MNF

The Marine National Facility (MNF) is Australia's dedicated ocean research capability, enabling world-class marine and atmospheric research across our vast marine estate. Funded by the Australian Government, including funding from the National Collaborative Research Infrastructure Strategy (NCRIS), it is operated by CSIRO, Australia's national science agency, on behalf of the nation.

The MNF includes the advanced ocean-class research vessel (RV) *Investigator*, a suite of scientific equipment, technical staff and expertise, and more than 40 years of freely available marine data. Operation of the MNF is overseen by an independent Steering Committee and sea time on RV *Investigator* is awarded by independent advisory committees through a competitive application process.

RV *Investigator* caters to the diverse and multidisciplinary research needs of Australian marine researchers and their international collaborators. It provides the capability for a broad range of oceanographic, biological, atmospheric and geophysical research. In addition, the vessel provides a vital catalyst for maritime education, outreach and training.

RV *Investigator* can accommodate a research team of 40 participants, stay at sea for 60 days, and cover 10,000 nautical miles per voyage.

The vessel can operate anywhere from the Antarctic ice edge to the tropics. With the delivery in 2020 of the 10-year strategy, *MNF 2030*, the MNF is fulfilling its mission to facilitate safe, efficient and excellent marine and atmospheric research that is aligned with national priorities and addresses challenges facing Australia's society, economy and environment. RV *Investigator* is funded for full year operations until 2026–27.

Image: Robert Strzepek

# From the Chair

It's been a great privilege for me to take on the role of Chair of the MNF Steering Committee (MNFSC) this past year and gain a fuller insight into the important work of the MNF. I'd like to acknowledge the previous Chair, Dr Sue Barrell, for her stewardship and immense contribution to the MNFSC over the past six years.

What a year it's been for the MNF and our collaborators, delivering outstanding marine science through this important infrastructure. The team undertook seven research voyages which supported a range of geospatial, atmospheric, oceanographic and biodiversity research that will improve Australia's understanding of our region, oceans and environment into the future.

As we reflect on the past year, I want to acknowledge how critical the MNF's partnerships with governments, universities and industries are to ensuring our infrastructure continues to enable world-class science and research to inform Australia's marine management and policy. As you'll read in this report, these close collaborations are allowing us to maximise the benefit from our national ocean research capability for all our stakeholders.

There are many research highlights featured throughout this Year in Review that showcase the breadth of science conducted on board RV *Investigator*. There have also been some amazing achievements which touched members of our Australian community in particular the identification of two shipwrecks, SS *Nemesis* and MV *Noongah*, that disappeared in separate tragedies off the coast of NSW many decades ago. This gave our MNF team and our partners the opportunity to provide closure to those who were deeply connected to the loved ones they lost. These experiences have touched our team and given us all the opportunity to reflect on the work we do to deliver national benefit.

The MNF Steering Committee (MNFSC) and its two assessment committees, the Research Advisory Committee (RAC) and the National Benefit Advisory Committee (NBAC), also had a productive year. There were some movements across our committees, with NBAC welcoming new members Ms Belinda Jago, and Dr Jodie Smith, and early career researcher (ECR) Member Dr Todd Bond.

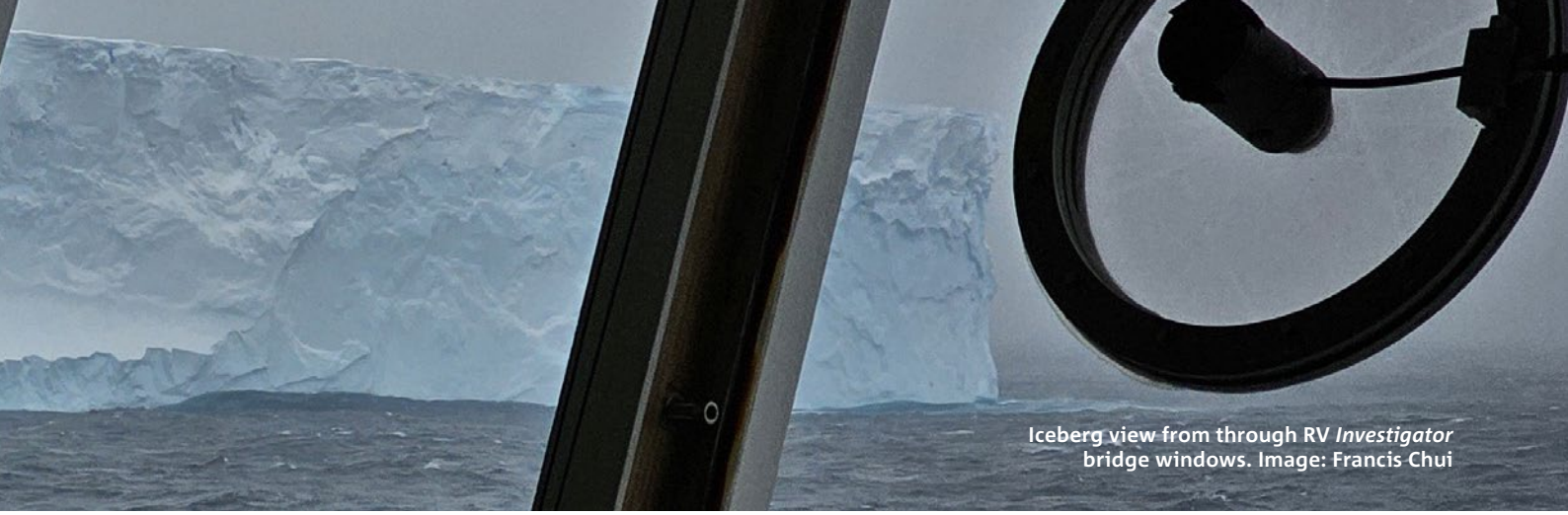
Two ECR members joined RAC, with Dr Pauline Latour and Dr Neil Malan participating in the 2024 review of applications.

We farewelled Dr Michele Allan AO and welcomed Prof Alex Brown into the CSIRO Board Observer role on the MNFSC and, also welcomed Dr Rhonda Bartley as Australian Antarctic Division (AAD) ex officio, Dr Lyndon Llewellyn as National Marine Science Committee (NMSC) ex officio, and Dr Beth Woods as a new independent member of MNFSC.

I'd like to express my gratitude for the contributions made by members of these committees and to the entire MNF team and our collaborators for your ongoing passion and commitment to our operations and research program.

Congratulations to all on another successful year of marine science.

**Ms Anne-Marie Lansdown**
Chair, MNF Steering Committee



Iceberg view from through RV *Investigator* bridge windows. Image: Francis Chui

# From the Director

The 2023–24 year was pivotal for the MNF as we focused on planning for a program of major upgrades and enhancements for RV *Investigator* as part of its middle of life refit. This will ensure the vessel continues to meet the needs of Australian marine researchers and their collaborators to deliver research that helps us better understand our oceans and climate into the future.

We hosted 226 researchers and 28 students onboard RV *Investigator*, collected more than 34 terabytes of data (made freely available to researchers and the public), and mapped approximately 358,000 square kilometres of seafloor. These are just a few highlights which hint at the breadth of what was achieved. I'd encourage you to dive into the case studies within this report to truly comprehend the impacts of the research program delivered this year.

In addition to our successful research program, the MNF team spent a significant part of the year preparing for the middle of life refit (Mid-Life Refit) project. This project, which is being initiated in the 10th year of vessel operations, will see a range of exciting scientific upgrades and enhancements delivered to RV *Investigator* over coming years. The Mid-Life Refit is designed to ensure RV *Investigator* continues to provide world-class scientific research capabilities for the next decade.

The past year hasn't come without its challenges, with the sustainability of MNF funding a major focus of our leadership team. We have worked diligently with our funders, CSIRO and the Australian Government's National Collaborative Research Infrastructure Strategy, to secure funding for full year operations of RV *Investigator* up until 2026–27. To set up the MNF for financial sustainability from 2027–28 and beyond, we will continue to investigate alternative funding options to operate the MNF at full capacity.

Finally, I'd like to thank our team of passionate MNF staff and MMA ship crew who are critical to the success of our research voyage program. This team is committed to delivering safe and successful voyages for our science community, and I'm incredibly grateful to them for their dedication and achievements during the year.

Enjoy reading our MNF Year in Review.

**Toni Moate**
Director, Marine National Facility

# 2023–24 snapshot

**48,917**
km travelled

**298** (98%)
operational days
% target delivered

**358,146.57**
km² area mapped

**34.18**
terrabytes of data collected

**5** participating countries

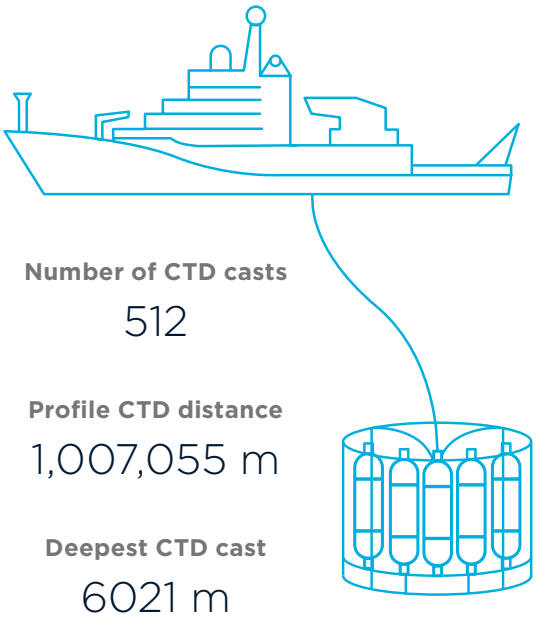
**28** participating students

**226** participating researchers

**54** journal articles
with publication date within the financial year

**9 datasets (external sites)**

**48 datasets hosted by MNF Information and Data Centre**



**Number of CTD casts**
512

**Profile CTD distance**
1,007,055 m

**Deepest CTD cast**
6021 m
IN2024_T01 at -38.93°, 126.97° on 15 March 2024


Waving off the 100th voyage. Image: Thomas Moore

# Research delivered and supported

The MNF's 2023–24 research voyage program was marked by many achievements, with RV *Investigator* travelling from ice edge to the tropics to support priority research areas identified in the *MNF 2030* strategy.

One of the significant highlights for the year was the delivery of the vessel's longest ever voyage of 60 days in January to March 2024 to conduct ocean and atmospheric research along the coast of Antarctica and in the Southern Ocean.

Before this, in October 2023, RV *Investigator* chased mesoscale eddies in the East Australian Current (EAC) system, which have become increasingly prevalent due to climate change and are driving ocean warming. Collaborative efforts like this are enhancing our understanding of eddy interactions and helping to improve ocean forecasting, ultimately benefiting all Australians and especially coastal communities.

The vessel delivered several important biodiversity and habitat surveys including the South-East Australian Marine Ecosystem Survey (SEA-MES) voyages I and II in July 2023 and May 2024. This multi-voyage project is documenting ecological changes and providing crucial insights for the effective planning and management of marine industries.

In February 2024, the MNF opened its 2026–27 Primary Application Call which invited Australian researchers and their international collaborators to apply for fully funded grants of sea time on RV *Investigator* to conduct excellent research of national benefit. The outcomes of this Application Call will be announced in early 2025.

# 10 years of RV *Investigator*

In 2024, we celebrate 10 years of RV *Investigator* supporting, enabling and inspiring marine science for Australia after it first arrived in its home port of Hobart in September 2014 and was commissioned into service in December the same year.


Let's look at some of the achievements of Australia's amazing science ship over the past decade!

- **110** voyages from ice to equator
- **516,592 km** travelled
- **1427** participants from 215 institutions
- **3,244,810 km²** seafloor mapped
- **112** new species described
- **6** shipwrecks discovered
- **3895 km** of CTD casts (end-to-end)
- **1st** mobile Global Atmosphere Watch station
- **1844** voyage publications

# Map of 2023–24 voyages

# Voyages delivered

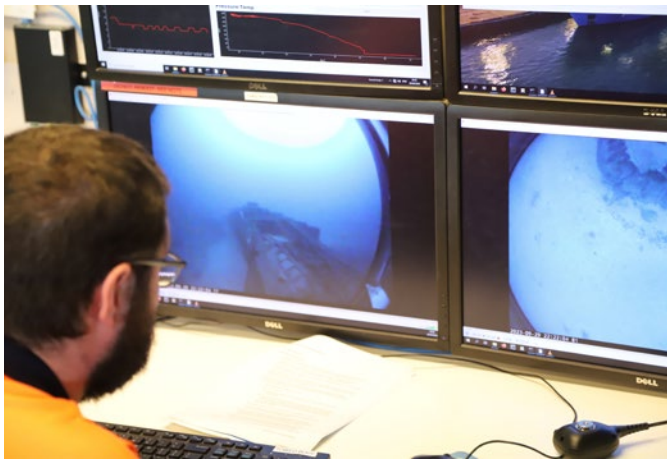


Image: Hugh Barker

## July 2023

### IN2023_V05 Multi-year: Untangling the causes of change over 25 years in the southeast marine ecosystem – Voyage I [Hobart to Hobart]

Led by CSIRO, this voyage departed Hobart on 28 June 2023 to conduct a repeat survey of the biodiversity and habitats of the marine waters of south-east Australia. This was the first of four voyages in a multi-voyage project called the South-East Australian Marine Ecosystem Survey (SEA-MES). This fishery and ecosystem assessment will compare current data with that collected on surveys in this region 25 years ago. The project is seeking to document ecosystem changes and establish new biological and environmental baselines. The knowledge generated will be essential for better planning and managing current and emerging industries and protecting important habitats and species throughout the region.

The voyage also commenced an innovative trial program to directly compare two traditional sampling methods – demersal trawl and deep towed camera – with two methods of environmental DNA (eDNA) collection to identify species present. An impressive count of 252 deployments were achieved during the voyage including 60 McKenna trawls, 87 deep towed camera runs and 62 conductivity, temperature, depth (CTD) casts.

## September 2023

### IN2023_E03 Sea trials and calibration voyage [Hobart to Sydney]

The MNF completed a sea trials and calibration voyage in September 2023, which was also used as an opportunity to reposition RV *Investigator* from Hobart to Sydney in preparation for its next research voyage.

During the voyage, an investigation of an unidentified shipwreck off the NSW coast was undertaken on behalf of Heritage NSW. The mapping data and video footage collected by CSIRO contributed to the identification of the wreck as the SS *Nemesis*, a steamship that sank in a storm in July 1904 with the tragic loss of all 32 lives on board.

Image: Linda Gaskell

Image: Amelia Pearson

## October 2023

### IN2023_V06 Understanding eddy interactions and their impacts in the East Australian Current [Sydney to Sydney]

Led by the University of NSW, a team of 35 science participants from eight institutions embarked on this 24-day research voyage to the East Australian Current (EAC) off Sydney to study mesoscale ocean eddies. These 'weather systems' of the ocean move heat, salinity, marine life and other materials around. In the eddy-rich EAC system, eddies are penetrating further south as the climate changes, driving ocean warming. Collection of mesoscale eddy data during the voyage, including satellite and in-situ ocean measurements, will help improve ocean forecasts and predictions of eddy interactions.

The voyage timing coincided with the pioneering high-resolution Surface Water and Ocean Topography, (SWOT) satellite operated by NASA, which provides highly accurate sea-surface height observations. Ocean and atmosphere measurements were also taken along transect lines off the coast of NSW in the EAC from shelf waters (100 m depth) to deep ocean (4600 m depth) increasing understanding and certainty of ocean and storm forecasting. This will benefit end users ranging from the Royal Australian Navy to those who live in coastal communities.

## November 2023

### IN2023_V07 SWOT-ACC: Smaller scales of the Antarctic Circumpolar Current in a meander south of Tasmania [Hobart to Hobart]

Led by CSIRO and the Australian Antarctic Program Partnership, this 36-day voyage into the heart of the Antarctic Circumpolar Current (ACC) investigated why the planet's strongest current, that helps keep the Antarctic frozen, is leaking warm water into the polar seas.
The primary aim of the voyage was to study a standing meander in the ACC, which is a hotspot of eddy activity, cross-front exchange, and energetic small-scale motions. The study used in-situ measurements to validate data from precise satellite measurements of sea surface height via the new SWOT satellite.

This voyage also supported the collection of a suite of aerosol, cloud, surface radiation and precipitation observations for the Bureau of Meteorology.

An additional unique objective was to recover a Biogeochemical (BGC)-Argo float that was deployed during IN2020_V08. In nearly three years of operation, the float collected valuable data on a range of seawater properties. This was the first recovery of a BGC-Argo float of this kind in the Southern Ocean, using our newly configured recovery net.

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Image: Lucinda Ross

## November 2023

### IN2023_T01 Transit voyage [Sydney to Hobart]

The objective of this voyage was to relocate RV *Investigator* in preparation for its next research voyage.

Image: Helen Fry


Image: Amanda Finn-NOAA

## January 2024

### IN2024_V01 Multidisciplinary Investigations of the Southern Ocean [Hobart to Fremantle]

Led by CSIRO and the Australian Antarctic Program Partnership, the longest RV *Investigator* voyage to date, at 60 days, departed Hobart and headed south to Antarctic waters to conduct the large and complex 'Multidisciplinary Investigations of the Southern Ocean' project. With 39 science participants from eight institutions, researchers on board aimed to characterise the properties of aerosols, clouds, radiation and precipitation over the Southern Ocean and investigate how they are shaped by interactions between the ocean, atmosphere and biosphere.

As RV *Investigator* made its way west along the Antarctic ice margin, the ship also occupied the southern margins of several hydrographic Global Ocean Ship-based Hydrographic Investigations Program (Go-SHIP) lines, as well as occupying the I09 GO-SHIP line on its way back to Fremantle, allowing researchers to study these rarely visited areas near the ice edge.

## March 2024

### IN2024_T01 Transit voyage [Fremantle to Hobart]

The primary objective of this voyage was to relocate RV *Investigator* ahead of its next research voyage. The transit provided an opportunity to deliver a variety of research, training and international exchange projects.

With 36 science party participants (including 12 students) from 8 institutions, the voyage collected a range of geoscience, oceanographic and biological data. A highlight was the deepest CTD cast ever conducted from RV *Investigator* enabling the field testing of new instrumentation to depths beyond 6000 m.

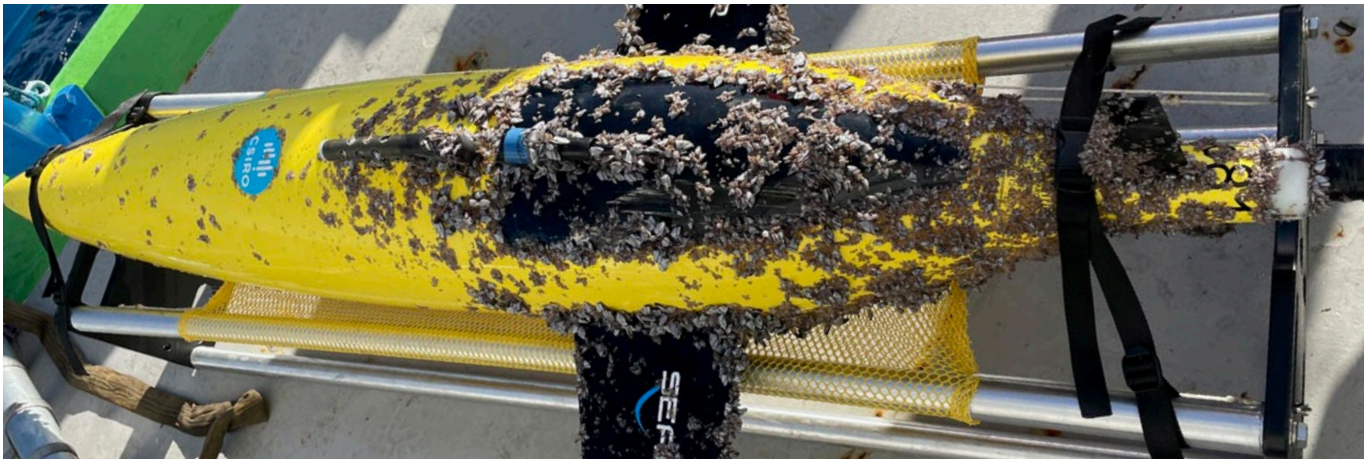


Image: Elizabeth Shadwick

## March 2024

### IN2024_V02 SOTS: automated moorings for climate and carbon cycle studies in the Southern Ocean [Hobart to Hobart]

Led by Australia's Integrated Marine Observing System (IMOS), this voyage maintained the deep-water Southern Ocean Time Series (SOTS) moorings, which sustain long time-series observations in a critical part of the Southern Ocean, where ocean interactions are most intense and least studied. The voyage recovered the existing SOTS moorings and deployed a new set of moorings to maintain this automated oceanic monitoring array.

During this voyage, the crew also retrieved an underwater glider which had been deployed in the Southern Ocean for more than two years collecting crucial climate data. These data will be used to validate the SWOT satellite data.

Four other opportunistic projects were undertaken on this voyage including a Flinders University study on the impact of microplastics on microbial and planktonic organisms; a CSIRO acoustic survey of basketwork eels; an oceanic latitudinal study of diatom silica production rates; and the acquisition of targeted seafloor bathymetry and towed magnetometer data.

## Supporting long-term monitoring of the Southern Ocean

The vast Southern Ocean borders Australia's southern coast and plays a significant role in the global ocean system and climate, absorbing carbon dioxide and heat from the atmosphere while providing the foundations of ocean food webs and oxygen in return. The Marine National Facility provides the capability to sustain long-term ocean and atmosphere monitoring in this challenging region. This is through its partnership with IMOS to maintain the SOTS deep-water mooring array.

This project commenced on RV *Investigator* in March 2015 and SOTS has to date sustained the longest time series of Southern Ocean observations operated by any nation. The data collected by this facility is contributing to the global effort to understand ocean dynamics and their role in climate and responses to anthropogenic emissions.

Importantly, during the reporting period, research was published that provided the first ever measurement of an increase in the magnitude of the Southern Ocean's seasonal cycle of carbon dioxide. Improved understanding of our oceans and atmosphere is essential to enhance advice to the nation on climate variability affecting us now, assists in the development of future scenarios and impact assessments, and helps authorities make optimal decisions that will affect the nation's future.

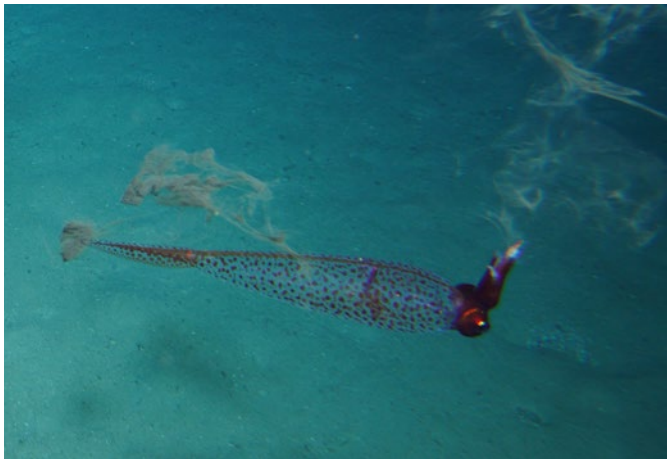



Image: Rich Little

## May 2024

### IN2024_V03 South-East Marine Ecosystem Survey (SEA-MES) Voyage II [Hobart to Sydney]

Led by CSIRO, this voyage departed Hobart to conduct a repeat survey of the biodiversity and habitats of the marine waters of south-east Australia. It is the second of four voyages in the South-East Australian Marine Ecosystem Survey (SEA-MES) Program (see IN2023_V05 entry above). The knowledge generated will be essential for better planning and managing current and emerging industries and protecting important habitats and species throughout the region. In addition, this voyage supported a pilot project to test an automatic seabird detector camera system.

An impressive operation count of 263 combined McKenna trawls, deep towed camera runs, CTD, Multinet and rectangular midwater trawl (RMT) deployments was achieved.

## June 2024

### IN2024_V04 East Australian Current canyons survey [Sydney to Brisbane]

Led by CSIRO, this voyage undertook detailed oceanographic, geophysical, and biological sampling in the East Australian Current. The studies were undertaken to investigate and detail the physical environment, the rate of turbulent mixing and upwelling of cool, nutrient rich water through the canyon, the benthic communities present within the canyons, and the use of the canyon environment by macrofauna such as whales and sea birds.

Indigenous Sea Country rangers participated in the voyage, providing marine mammal observations and valuable insight into scientific questions to be addressed from the perspective of Traditional Owners.

In addition, an investigation of an unidentified shipwreck off the NSW coast was conducted on behalf of Heritage NSW with the data collected helping to identify the wreck as MV *Noongah*.

# Collaboration for national benefit

Collaboration is integral to the success of the MNF.
In 2023–24, our research partners included:

- Australian Antarctic Program Partnership
- Australian Fisheries Management Authority
- Australian National University
- Bureau of Meteorology
- California Institute of Technology (USA)
- CSIRO
- Flinders University
- Griffith University
- Heritage NSW
- Integrated Marine Observing System
- Minderoo Foundation
- Monash University
- National Oceanic and Atmospheric Administration (USA)
- Parks Australia
- Queensland University of Technology
- Tasmanian Aboriginal Centre
- University of Melbourne
- University of New South Wales
- University of Queensland
- University of Tasmania
- University of Technology, Sydney
- University of Western Australia
- University of Wollongong
- University of the Sunshine Coast
- University of Southampton (UK)
- University of British Columbia (CA)
- University of Auckland (NZ)
- University of Utah (USA)
- Woods Hole Oceanographic Institution (USA)


**RV *Investigator* was lit up in rainbow colours ahead of the March 2024 Sydney Gay and Lesbian Mardi Gras parade to celebrate LGBTQIA+ staff and the organisation's commitment to acceptance, diversity and equality.**

# Connecting with Australians

A key commitment of the MNF is to deepen community understanding of marine and atmospheric science.

During the past year, we delivered a range of activities and events to engage the community with our science, collaborators and infrastructure.

Outreach highlights included Storytime from a Science Ship, a ship tour and virtual book reading for school students from aboard RV *Investigator* for National Science Week; a public open day on RV *Investigator* while in Sydney (in collaboration with Australian National Maritime Museum); national launch of the INVESTIGATE immersive marine science exhibit; ship tours for media in Hobart and Sydney; and public presentations at the memorial event for the 50th anniversary of the loss of MV *Blythe Star*.

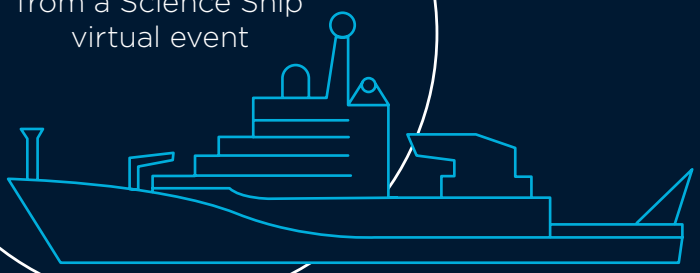
**MV *Blythe Star* talk. Image: Ben Arthur**

**28.5 million**
traditional media audience reach

**4.6 million**
social media impressions

**71,451**
MNF website page views

**8713**
school students and teachers who joined Storytime from a Science Ship virtual event



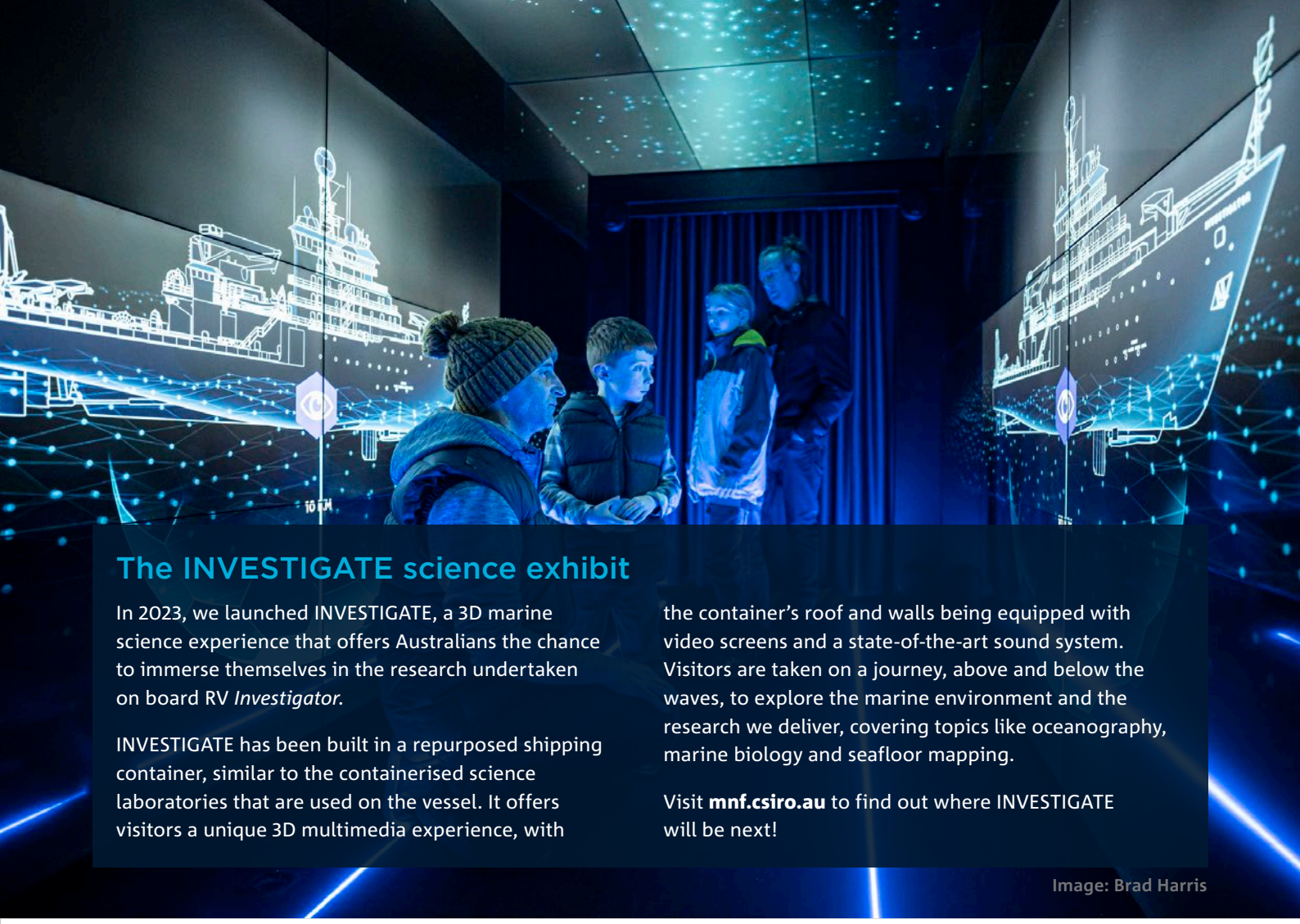
**5300**
visitors to MNF's new INVESTIGATE exhibit

**1100**
visitors to the ship open day in Sydney

**200**
guests at Blythe Star memorial presentations

**35** students visited CSIRO Marine Laboratories, Hobart for the Working on Water Program and 30 Students for the Beacon Foundation Work-based Learning Program

**9** MNF Virtual Work Experience Program students



## The INVESTIGATE science exhibit

In 2023, we launched INVESTIGATE, a 3D marine science experience that offers Australians the chance to immerse themselves in the research undertaken on board RV *Investigator*.

INVESTIGATE has been built in a repurposed shipping container, similar to the containerised science laboratories that are used on the vessel. It offers visitors a unique 3D multimedia experience, with the container's roof and walls being equipped with video screens and a state-of-the-art sound system. Visitors are taken on a journey, above and below the waves, to explore the marine environment and the research we deliver, covering topics like oceanography, marine biology and seafloor mapping.

Visit **mnf.csiro.au** to find out where INVESTIGATE will be next!

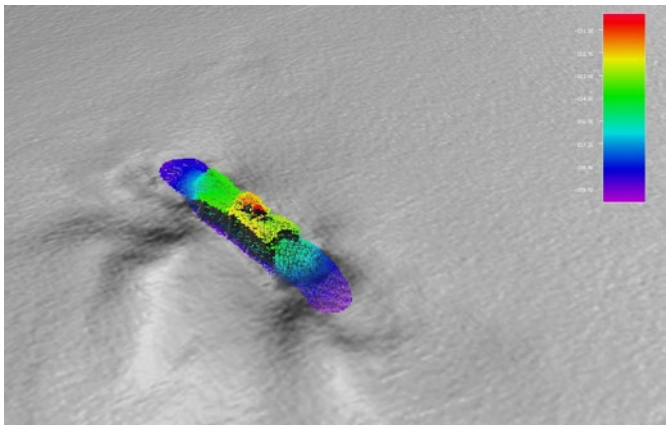
Image: Brad Harris

# Identifying and protecting underwater heritage

While delivering its research program, RV *Investigator* contributed to two significant shipwreck identifications during 2023–24. In September 2023 while on a transit voyage from Hobart to Sydney, an investigation of an unidentified shipwreck off the NSW coast was conducted for Heritage NSW. This led to the identification of the wreck of SS *Nemesis*, which sank in 1904 with the loss of all 32 lives on board.

In June 2024, an investigation of an unidentified shipwreck off the NSW coast was conducted during a research voyage. This was a collaborative project between CSIRO, Heritage NSW and The Sydney Project. The data and imagery collected led to the identification of the wreck as MV *Noongah*, which sank in 1969 with the loss of 21 of the 26 crew aboard.

These discoveries deliver important outcomes for the nation. Finding and analysing a shipwreck can help us understand the circumstances that led to these tragedies. It can also help provide closure to affected communities whose loved ones were lost at sea. Knowing the current state of the shipwreck is important for heritage professionals and agencies who manage and protect the sites. Some shipwrecks are at risk of creating environmental damage such as fuel or oil leaks, so having data on them is vital for managing those risks.



Seafloor mapping of SS *Nemesis*.

Through the application of the impressive survey and scientific capabilities of RV *Investigator*, we are making an important contribution to maritime heritage work in Australia.

As Australia's national science agency, CSIRO is solving the greatest challenges through innovative science and technology.

CSIRO. Creating a better future for everyone.

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