



# Marine National Facility Capability Prospectus

Owned and operated by CSIRO,  
Australia's national science agency,  
on behalf of the nation.

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## Acknowledgements

The Marine National Facility (MNF) is funded by the Australian Government, and is owned and 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.



This research is enabled by NCRIS.



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

# Supporting, enabling and inspiring marine science for Australia

The Marine National Facility has an unrivalled record of delivering excellent marine research for national benefit.

We provide researchers with world-class ocean research capabilities, high quality marine data and expertise built up over more than 40 years.

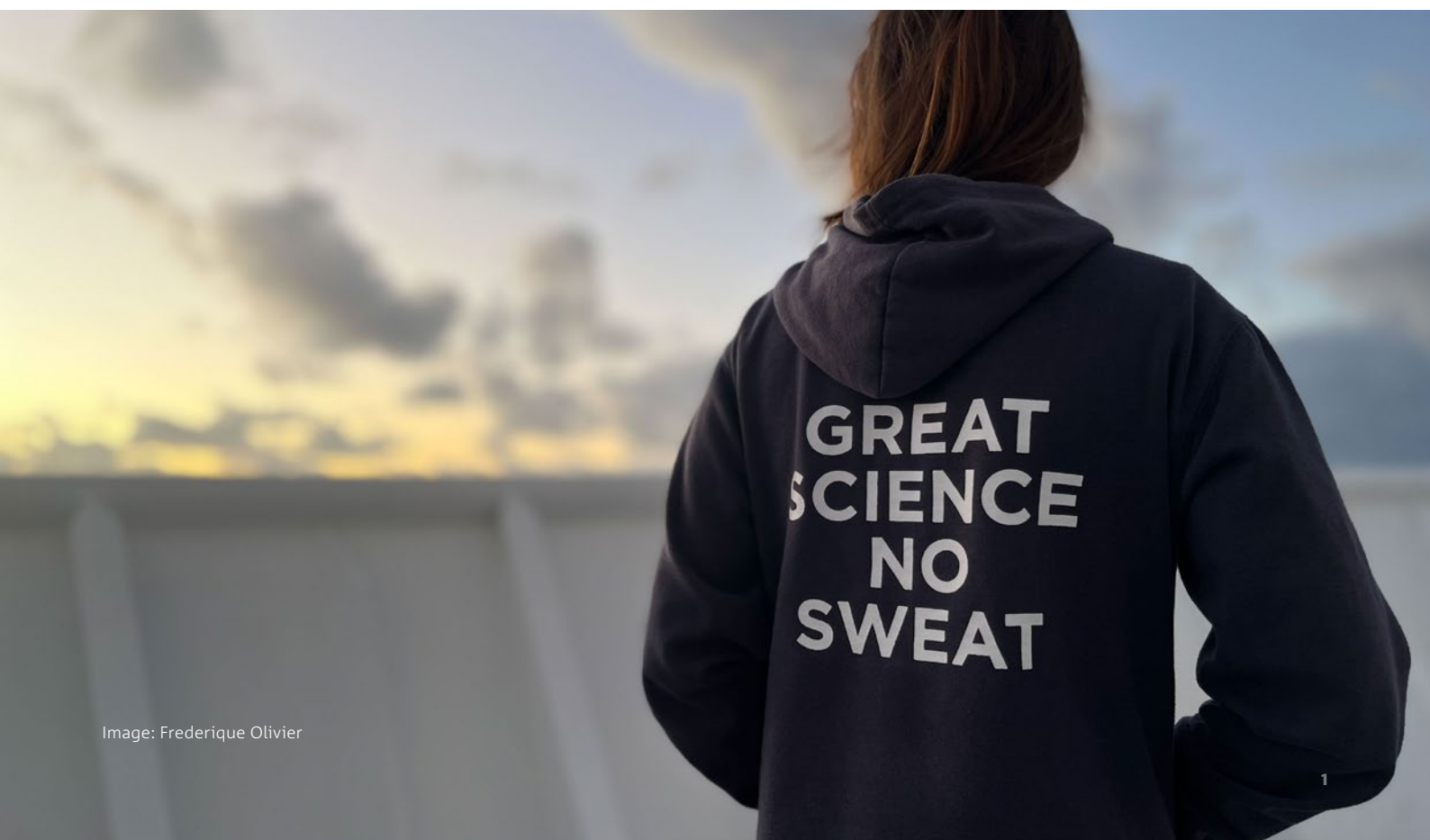
We are continuously looking to the future, enabling researchers to find solutions to our greatest challenges through innovative science and technology development.

## **Our goal**

To enhance the long-term prosperity of Australia's marine environment, industries and community by providing information that supports evidence-based decision making by government, industry and our community.

## **Our objective**

To deliver safe, efficient and excellent marine research that maximises the opportunities and benefits from our resources to ensure we provide the highest return on investment for the nation.



# About us

The Marine National Facility (MNF) was established in 1984 to provide Australia with a dedicated capability to conduct ocean research of national benefit across its vast marine estate. It is national research infrastructure funded by the Australian Government and operated by CSIRO, Australia's national science agency, on behalf of the nation.

The MNF includes:

- the multidisciplinary ocean-class research vessel (RV) *Investigator*
- a suite of advanced scientific instrumentation and equipment
- a collection of 40 years of marine data made freely available for the benefit of all
- world-leading expertise in vessel and voyage management, and technology development.

We are overseen by an independent steering committee which reports to the CSIRO Board.

Allocation of sea time on RV *Investigator* is managed through a competitive application process open to Australian researchers and their international collaborators. Project proposals are assessed for research excellence and national benefit by independent expert committees.

We strive to exceed our partner expectations in the delivery of excellent and efficient marine research.

Image: Matt Marrison





Image: Owen Foley

# Our research capabilities

Central to our capability is the advanced ocean-class research vessel (RV) *Investigator*. *RV Investigator* offers a capable and flexible platform for multidisciplinary marine research. It enables atmospheric, oceanographic, biological and geoscience research, as well as important education, outreach and training opportunities.

The vessel is technically impressive and opens avenues of discovery both within and across scientific disciplines.

Complementing *RV Investigator* capability, we provide researchers with access to a suite of advanced scientific equipment and instruments, as well as expert technical and voyage planning support.

The research we deliver improves the national marine knowledge and helps power our growing Blue Economy.

## Useful links

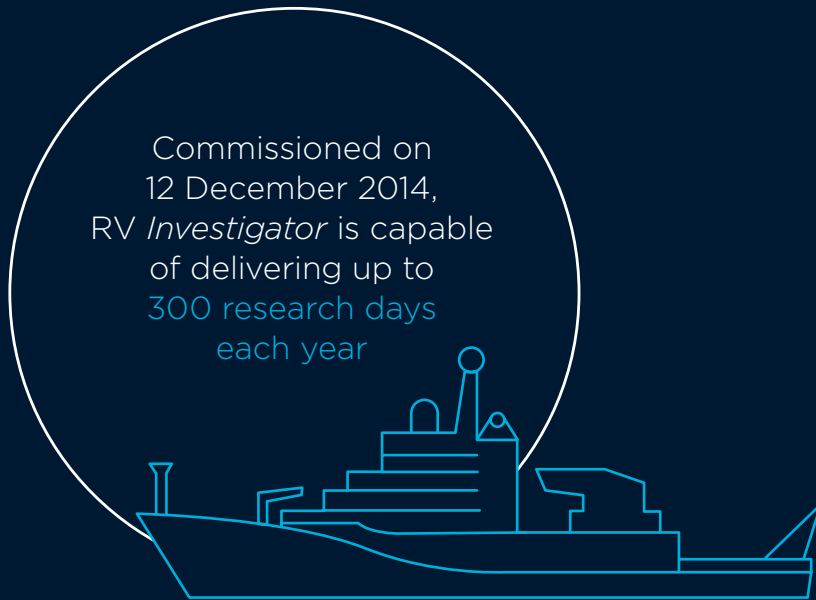
### **RVI specifications:**

[mnf.csiro.au/RV-Investigator](http://mnf.csiro.au/RV-Investigator)

### **MNF data portal:**

[mnf.csiro.au/MNF-Data](http://mnf.csiro.au/MNF-Data)

## RV *Investigator* specifications



Length 93.9 m

Beam (width) 18.5 m

Height (waterline to the top of the ship) 37 m

Draft (waterline to bottom of ship) 6.2 m

Gross tonnage 6082 t

10 internal storeys

12 on board laboratories

12 containerised laboratory spaces

20 ship crew

40 science and MNF technician berths

60 days endurance

10,000 nautical miles range (at cruising speed of 11 knots)

Home port Hobart, Tasmania

### Underway science

While underway, RV *Investigator* collects various atmospheric, oceanographic and geoscience data streams. Many of these data are accessible in near real-time via the Near Real-time Underway Data portal called NRUD: [www.marine.csiro.au/data/underway/](http://www.marine.csiro.au/data/underway/)

### Maximising capability

RV *Investigator* has been designed to an international maritime classification DNV-Silent-R. This classification ensures the vessel operates with low levels of radiated noise to maximise its acoustic system capabilities.

### Laboratory spaces

RV *Investigator* has 12 dedicated laboratory and other workspaces that offer flexible configuration to support diverse research. The vessel can also accommodate 12 containerised laboratories to support specific research needs.

## Laboratory summary

WORKSPACE	DESCRIPTION	FLOOR SPACE m <sup>2</sup>	BENCH SPACE m <sup>2</sup>
<b>Aerosol Laboratory</b>	A specialised laboratory equipped with various atmospheric research instrumentation and with a direct atmospheric air feed. Located on the foredeck at the base of the foremast.	15	3
<b>Air Chemistry Laboratory</b>	A specialised laboratory for underway atmospheric chemistry sampling taking atmospheric air from the aerosol sampling system after passing through the Aerosol Laboratory. Located at the forward end of the superstructure on the foredeck.	30	10
<b>Constant Temperature Laboratory</b>	A specialised laboratory available for temperature dependant experiments and storage. Temperatures can be specified from 2°C to 35°C and the laboratory entrance has an air lock. Located adjacent to the General Purpose Wet Laboratory (Clean).	19	9
<b>CTD Laboratory</b>	A specialised laboratory for the deployment of the CTD (conductivity, temperature and depth instrument) and collecting of water samples. Located on starboard side of vessel with a vertically opening hatch to outside to deploy CTD boom. It is adjacent to the Hydrochemistry Laboratory.	48	3
<b>Data Processing Laboratory</b>	A multipurpose workspace used for data processing and administrative purposes. Located adjacent to the Operations Room and IT Office.	35	14
<b>General Purpose Dry Laboratory (Clean)</b>	A multipurpose laboratory that can be set up for a wide variety of purposes. Located next to the General Purpose Wet Laboratory (Clean).	65	22
<b>General Purpose Wet Laboratory (Clean)</b>	A multipurpose laboratory where samples can be processed under clean conditions, and data recorded and analysed. Located between the General Purpose Dry Laboratory (Clean) and Constant Temperature Laboratory.	52	23
<b>General Purpose Wet Laboratory (Dirty)</b>	A multipurpose laboratory where samples, such as fish and plankton catches or sediment and geological samples, can be received from the working decks then sorted, subsampled and processed. Located next to the back deck with direct access to Sheltered Science Area and Preservation Laboratory.	68	24
<b>Hydrochemistry Laboratory</b>	A specialised laboratory for the analysis of nutrients, dissolved oxygen and salinity in seawater samples. Located adjacent to the CTD Laboratory and Underway Seawater Laboratory.	28	10
<b>Observation Station</b>	A multipurpose workspace used for marine mammal and seabird observation, as well as spotting research equipment on the sea surface. Located above the Bridge.	13	2.6
<b>Operations Room</b>	Control centre for all scientific operations and manned 24/7 while underway. Located on Main Deck adjacent to IT Office and Electronics Workshop.	50	13
<b>Preservation Laboratory</b>	A specialised laboratory equipped with an extra large fume hood, larger Hazchem lockers, and a camera stand for photography. Located adjacent to the Dirty Wet Laboratory.	15	5
<b>Sheltered Science Area</b>	A sheltered multipurpose workshop that extends over two decks with access to the aft main deck and starboard deck work areas.	40	4.5
<b>Underway Seawater Laboratory</b>	A specialised laboratory to accommodate permanently fitted instruments to measure seawater properties while the vessel is underway. Located adjacent to the Hydrochemistry Laboratory (no direct access).	12	5

## General equipment and capability

### A-Frame (back deck)

RV *Investigator* is equipped with a Triplex 20 t A-Frame to deploy large equipment. It has a height of 9.4 m, a width of 5.3 m and a 170° swing range.

### Circulating clean seawater

Clean seawater is supplied to all laboratories.

### Deck seawater supply

A constant supply of seawater is supplied to the back deck, container spaces, deck Level 02 and the General Purpose Wet (Dirty) Laboratory.

### Container laboratories

#### Hazmat Locker

A specialised container for the bulk storage of toxic, corrosive and flammable chemicals. Substances that can be stored include concentrated acids, formaldehyde, formalin, ethanol and acetone.

#### Laboratory Clean Container

Specialised container for conducting trace metal work. It can be used for chemical and biological oceanography, atmospheric science and geoscience research.

#### Radiation Laboratory Container

Specialised container for use of low-level radioisotopes.

#### Trace Metal CTD Container

Specialised clean container for the storage of the trace metal CTD rosette.

#### Coring Facility Container

Container to store the long and short sediment core equipment.

### Cranes

#### Main working crane

The main working crane can lift 25 t at a reach of 12 m and 5 t at 20 m. Note that the main crane cannot be operated at sea.

#### Stores crane

Located on the forward deck, the stores crane is used to resupply the ship and is capability of lifting 5 t at 10 m.

#### Utility crane

Two aft deck utility cranes on each side of the ship are used for moving and deploying equipment.

### Drop keels

Two drop keels are located behind the gondola. The drop keels contain:

- 360° optical camera for monitoring scientific equipment and marine life
- Water intake to collect uncontaminated seawater samples
- EK60 with transducers working at 18 kHz, 38 kHz, 120 kHz, 200 kHz and 333 kHz
- Acoustic Doppler current profilers (ADCP) 75 kHz + 150 kHz
- Hydrophones.

### Walk in cool rooms and freezers

The vessel has a walk-in cool room, walk-in freezer and two -80° C freezers located on Main Deck. It also has a saltwater ice making machine and blast freezer. Liquid nitrogen storage can be accommodated.

### Dual axis Doppler log

A Skipper DL850 Doppler log is located in the gondola 1.2 m below the hull. It measures the speed of the ship through the water.

### Electronic balances

Various motion compensated electronic balances are available including:

- Light duty – 3 kg
- Medium duty – 20 kg
- Heavy duty – 80 kg.

### Fume cupboards and hazardous materials lockers

Fume cupboards and hazmat lockers are available for working with and storing hazardous materials. These are located in the General Purpose Wet Laboratory (Dirty), General Purpose Wet Laboratory (Clean), General Purpose Dry Laboratory (Clean), and Preservation Laboratory.

### Gondola

Underneath the bow is a hydrodynamically designed structure called a gondola. This sits 1.2 m below the hull and contains the vessel's advanced acoustic equipment including multibeam echosounders.



## Laboratory freshwater

Hot and cold freshwater is supplied to all laboratories and working decks.

## Laminar flow cabinets

Laminar flow cabinets provide a clean air environment for undertaking contamination sensitive analyses. Cabinets are present in clean laboratories and can also be installed in other laboratories for specific projects.

## Milli-Q systems

An ultra-pure filter for water used in laboratories. Systems available in Hydrochemistry Laboratory, Preservation Laboratory, General Purpose Wet Laboratory (Clean) and General Purpose Dry Laboratory (Clean) where trace metal analysis can be done.

## Portable capstan

A portable 1 t capstan is available for winding in ropes and wires. Used for the deployment and retrieval of equipment.

## Side towing booms (two each side)

Used for deploying, towing and retrieving equipment, with two located on the bow and two on the stern of the ship. These can be used to deploy atmospheric equipment. The forward booms can deploy equipment clear of the vessel wake.

## Stern gallows

These are used to deploy and retrieve nets and dredges. They are located either side of the A-Frame on the Back Deck.

## 12 kHz transducer

This transducer is a transmitting and listening device used to communicate with moorings and pingers to determine the distance that equipment is above the sea floor or from the ship.

## Ultra-short baseline (USBL) acoustic positioning system

The USBL system determines the position of instruments deployed off the side or the stern of the ship, reporting their position relative to the ship.

## Winches

### Coring winch

Located in the winch room with 8400 m synthetic rope and a safe working load of 20 t. It can be deployed through the A-Frame or the corer boom.

### CTD winches x 2

Both CTD (conductivity, temperature and depth instrument) winches have 7000 m of wire and can deploy CTD equipment from the CTD boom in the CTD Laboratory or the corer boom on the starboard side. These have conducting wires and can also be used for tow-yo operations.

### HOTS – Heavy Ocean Towing System

Located in the winch room, this system provides a fibre optic cable to allow fully instrumented deployments of heavy towed equipment down to 6500 m.

### Hydrographic winch

Located in the winch room, it has 6000 m of synthetic rope and is used for light sediment grabs, light grabs and as a general-purpose winch.

### Net drum

Located above the back deck on Level 02, this is an open drum that can be used for the deployment and recovery of nets, and to deploy and recover moorings.

### Towed body winch

Located in the winch room, it has 6000 m of fibre optic and conducting wire for towing the TRIAXUS, Multinet and towed camera systems. It is deployed through the A-Frame.

### Trawl winches x 2

Located underneath the gallows below the Back Deck, these provide 8400 m of steel cable for trawling and dredging operations.

### Utility winches – working decks

Utility winches are located underneath the net drum platform above the Back Deck.

### Working air systems

A compressed air system is available in all laboratories.



# Atmospheric research

Image: Andrew Martini

RV *Investigator* is the first Australian research vessel with laboratories dedicated to analysing the interaction between the ocean and atmosphere. Its dedicated atmospheric research capabilities include a new generation weather radar, Air Chemistry Laboratory and Aerosol Laboratory, and space for two dedicated container laboratories on the Foredeck.

The 1.75 t C-band Doppler weather radar is mounted within a protective dome on top of the main mast. It sends and receives 800 microwave pulses per second, which collect information about the number, size, shape and movement of rain, hail, ice and snow. The vessel has an extensive suite of meteorological instruments on board to measure wind speed and direction, air temperature and humidity, rainfall, radiation and atmospheric pressure.

While at sea, a specially designed air sampling system on the foremast continuously draws air into the atmospheric research laboratories for analysis using the latest technology including:

- Atmospheric nephelometer
- Greenhouse gas spectrometers
- Multi-angle absorption photometer (MAAP)
- Nitrogen oxide monitor
- Ozone monitor
- Radon detector.

## Atmospheric research equipment and capability

### Air sampling system

This system starts with an air intake vent attached to the foremast, which collects clean air from the atmosphere, and pumps it to the Aerosol Laboratory and then onto the Air Chemistry Laboratory.

### Atmospheric nephelometer

This uses reflected light to measure suspended particles in the air. It provides continuous measurement of aerosol light scattering coefficient. A pump located near the Air Chemistry Laboratory draws air through the system.

### Black carbon Aethalometer

This measures the ability of particles to absorb light at 7 wavelengths.

### Cloud condensation nuclei counter

This analyses the ability of particles to nucleate cloud droplets by measuring the count and size of individual aerosol particles that can form droplets.

### Greenhouse gas spectrometers

Used to measure and analyse the atmospheric trace gases: CO<sub>2</sub>, methane, nitrous oxide, carbon monoxide and water vapour.

### Mobility Particle Size Spectrometer (MPSS)

The MPSS measures the size distribution (via electrical mobility) of particles in the range 10-800nm.

## Meteorological instrument suite

A range of meteorological data are captured via the following systems:

- RM Young 05106 propeller anemometer (propeller and vane type wind sensors)
- Gill Ultrasonic Wind Observer II ultrasonic anemometer (ultrasonic wind sensor)
- Temp Sensors are Rotronic HC2A
- RM Young 50203 siphoning rain gauge
- Optical Scientific ORG815 optical rain gauges
- Licor LI-190 PAR (photosynthetically active radiation) sensor
- Eppley Precision Infrared Radiometer
- Eppley Precision Spectral Pyranometer (ultraviolet radiation)
- Vaisala PTB330 Digital Barometer (atmospheric pressure)
- Eigenbrodt OceanRAIN Disdrometer
- Campbell Scientific CSAT3 3D Sonic Anemometer.

### Ozone monitor

Instrument to measure atmospheric ozone levels near the earth's surface.

### Particle count and size distribution

A suite of condensation particle counters, including Condensation Particle Counters and the Scanning Mobility Particle Sizer, which measure the total concentration of particles sized as small as 2.5nm.

### Radon detector

Instrument to measure the presence and amount of radon gas, an invisible, tasteless and odourless radioactive gas.

### Stabilised platform container

A motion compensated gimbal housed within a shipping container provides a platform for mounting a Cloud Radar or similar equipment. A fixed plinth provides a convenient mount for collocating a cloud lidar.

### Weather research radar

The dual-polarisation C-band Doppler weather research radar gathers precipitation data from 20 km over the ocean and a 150 km radius from the vessel.



## Biological research

Image: Museums Victoria–Robert French

*RV Investigator* offers marine biologists and ecologists an impressive capability to study life in our oceans. The vessel possesses advanced systems for quantifying biomass and collecting biological samples from anywhere in the water column and from the seafloor. Using the vessel's CTD (conductivity, temperature and depth) capabilities, researchers can collect water samples to depths of 6000 m to study phytoplankton and other biological parameters.

*RV Investigator* is fitted with the latest fish assessment sonar to measure biomass to depths of 3000 m. Towed camera systems are available to capture in real-time high-resolution imagery – both still images and video – of the seafloor to depths of 4000 m. Combined with the seafloor mapping technology, this offers researchers the ability to gather significant insights into marine biodiversity, seafloor habitats and ocean ecosystems.

The vessel possesses a wide range of sampling equipment, from small fine gauge surface nets to large ocean trawling nets and benthic sleds. These can be used to collect specimens down to 5000 m. Grabs and multi-corers can be deployed to collect sediment samples to study seafloor life. *RV Investigator* possesses incubation facilities to keep alive species, such as krill, for further studies or transportation to land-based laboratories. Refrigeration facilities are available onboard to store seafloor sediment samples.

## **Biological equipment and capability**

### **Bongo nets**

A very fine tubular mesh net to sample plankton.

### **Corer boom**

Located on the starboard side outside the Sheltered Science Area, this boom is used for deploying the long and short sediment corer, benthic grabs, bongo nets and other scientific equipment up to a load limit of 20 t.

### **Deck incubators**

The vessel offers 3 deck incubation units. Each unit has a 300 L tank and can maintain water temperatures between 2 and 34°C, depending on the ambient conditions. These can be used for conducting experiments and observations of phytoplankton activity.

### **Deep water camera systems**

Two submersible camera platforms are available to capture high quality video and still images of seafloor species, habitats and features. The deep tow camera is a towed system that can be deployed to 3900 m. The drop camera is a vertically deployed system with a maximum depth of 5000 m.

### **Dissecting microscopes**

Dissecting microscopes are available for general laboratory use.

### **Electronic fish measuring boards**

High resolution device used for measuring fish samples.

### **HydroBios multinet**

A system of multiple fine mesh nets and sensors that can be opened at different depths. System is towed behind the ship and used for sampling areas of the water column at various depths up to 1000 m.

### **Fish finding sonar**

Simrad SH90 fish finder used to detect fish and krill schools close to the surface and map their distribution. It can also be used to map rapid changes in depth while swath mapping.

### **Laboratory incubators**

The vessel has two 300 L Steridium incubators that can be located in laboratories. These are controlled light and temperature incubators.

### **Multibeam scientific and fisheries echo sounder system**

The Kongsberg/Simrad ME70 is a fish biomass sonar system located in the gondola. It spreads a signal in a fan shape to 120°, collecting data to 500 m depth and 3000 m wide.

### **Multi-frequency scientific split-beam echo sounders**

The Simrad EK80 echosounder is utilised for biomass estimation within the water column. The narrow-band system can operate in 6 frequency bands: 18 kHz, 38 kHz, 70 kHz, 120 kHz, 200 kHz and 333 kHz. This system is permanently mounted in the drop keel.

### **Sherman sleds**

An epibenthic sled used to sample benthic organisms over rough areas of seafloor such as seamounts.

### **Side scan sonar**

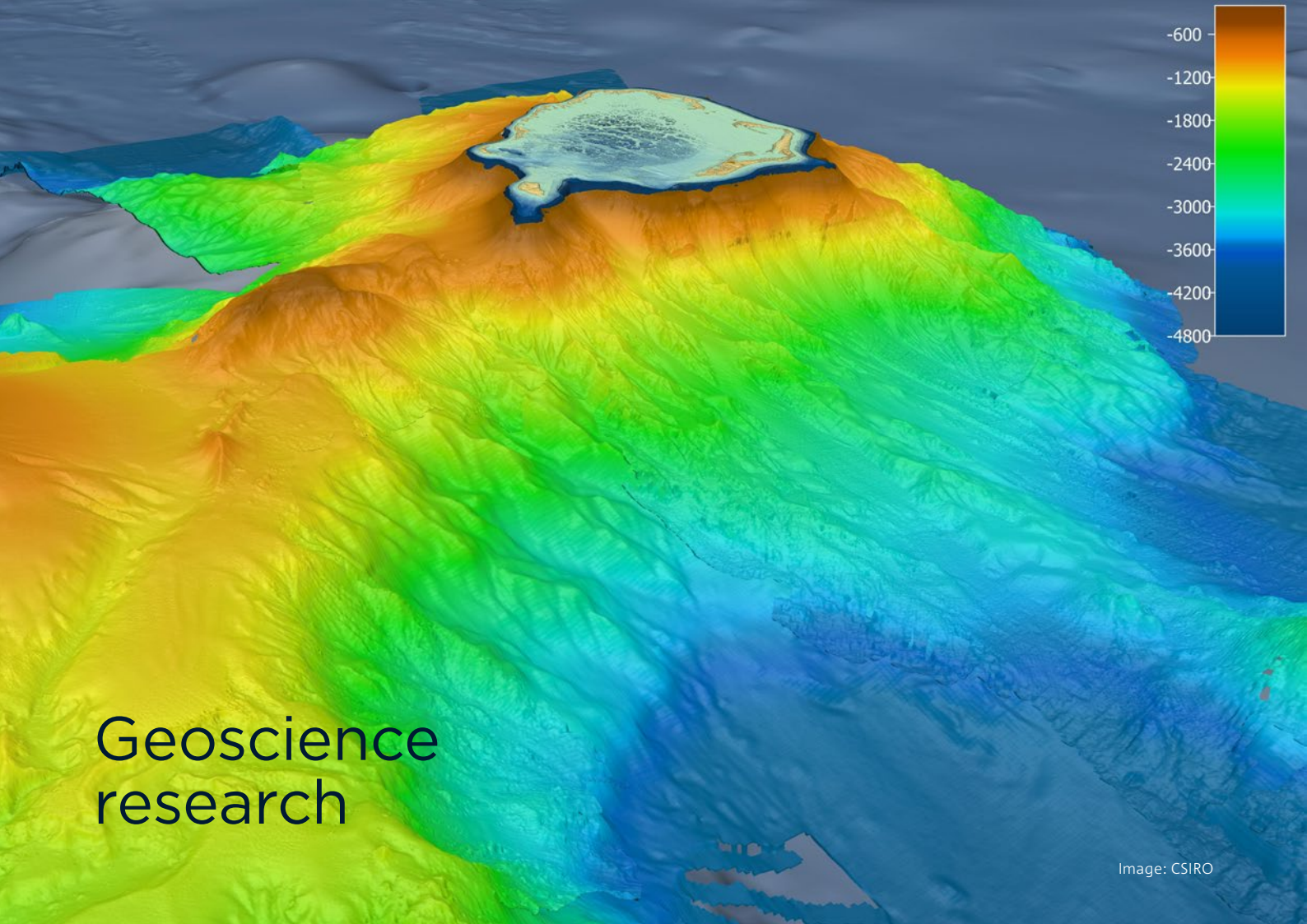
An Edgetech 4200FS multipurpose scan sonar with hydraulic winch is available by negotiation with Geoscience Australia. This can be used for detailed seafloor habitat and biomass mapping.

### **Trawl mensuration and monitoring systems**

A device to assist in the collection of data associated with the trawl net. Used to ascertain the height, width and depth of the mouth of the net.

### **Trawl nets**

The MNF has access to benthic beam, pelagic, demersal, and rectangular midwater trawl nets. These can be deployed to sample habitats from the sea floor to near surface waters. A Midwater Open-Close (MIDOC) system with six cod ends can be used with pelagic trawls to perform stratified sampling.



## Geoscience research

Image: CSIRO

Australia has the third largest ocean territory in the world but less than 15 percent of the seafloor in our Exclusive Economic Zone has been mapped to modern standards. *RV Investigator* provides researchers with the capability to map, sample and investigate the seafloor anywhere in our region. This includes the capability to deploy seafloor sampling equipment, such as sleds, dredges and corers, to depths of over 6000 m. The vessel's giant piston corer can collect sediment samples up to 24 m long at depths to 6500 m.

Our geoscience capabilities are built around 3 advanced multibeam echosounders that can map to full ocean depth. A fourth system can be added to the drop keels to enhance high resolution mapping capabilities in shallow waters. These systems allow high resolution mapping from coastal regions to the deep ocean, revealing seafloor structure and features. This capability offers maritime archaeologists the ability to locate shipwrecks and other submerged cultural heritage.

Paired with this equipment is the capability to probe the structure of the seabed below using the vessel's sub-bottom profiler and small-scale seismic acquisition system. *RV Investigator* also possesses a gravity meter to study large geological features in the earth below our oceans. Equipment can be towed behind the vessel, such as magnetometers and side scan sonars, to collect additional geophysical data. Deep tow and drop camera systems can also be deployed to capture still and video imagery of the seafloor.

## Geoscience equipment and capability

### Corer boom

A starboard boom for the deployment of equipment from the side of the vessel, with a load limit of 20 t. It can be used for deploying equipment including long and short sediment corers and benthic grabs.

### Full ocean depth multibeam echosounder (MBES) system

The Kongsberg/Simrad EM122 is a deep-water 3D seafloor mapping system capable of working to full ocean depth.

### Gravity meter

The Lacoste and Romberg L and R Air-Sea Gravity System is a gyroscopically stabilised instrument used to measure variations in the Earth's gravitational field.

### Kasten Corer

The Kasten corer provides core sample for sampling (up to 4 m) on board and as a site selection aid for the Piston Corer.

### Long and short sediment coring system

A complete sediment coring and winch system that collects cores up to 24 m in length. The corer is deployed by winches and a dedicated handler on the starboard side of the main deck. It can be deployed as a piston or gravity corer.

### Magnetometer

A SeaSPY Marine Magnetometer can be used to survey the Earth's magnetic field. Available by negotiation with Geoscience Australia.

### Multicorer

The multicorer takes multiple sediment samples in a single deployment to a depth of 600 mm capturing sediment and bottom water below seafloor.

### RapidCast system

The Teledyne rapidCAST system is utilised primarily to provide sound velocity corrections to the vessel's seafloor mapping echosounders.

### Rock dredges

Rock dredges can be used for sampling larger rocks on the seafloor.

### Rock saws

A suite of rock saws provide onboard sampling of rock samples.

### Seismic acquisition system

The seismic acquisition system is used to acquire seismic reflection information of the seafloor. Use of the seismic system triggers additional technical resources in permitting, personnel (including Marine Mammal Observers to be supplied by the science party), time and logistics. Note that seismic acquisition operations can only be undertaken during daylight hours.

### Shallow water multibeam echosounder (MBES) system

The Kongsberg/Simrad EM710 is a high-resolution seafloor mapping system with a flexible configuration for acquiring bathymetry and back scatter data down to 2000 m.

### Smith McIntyre grab

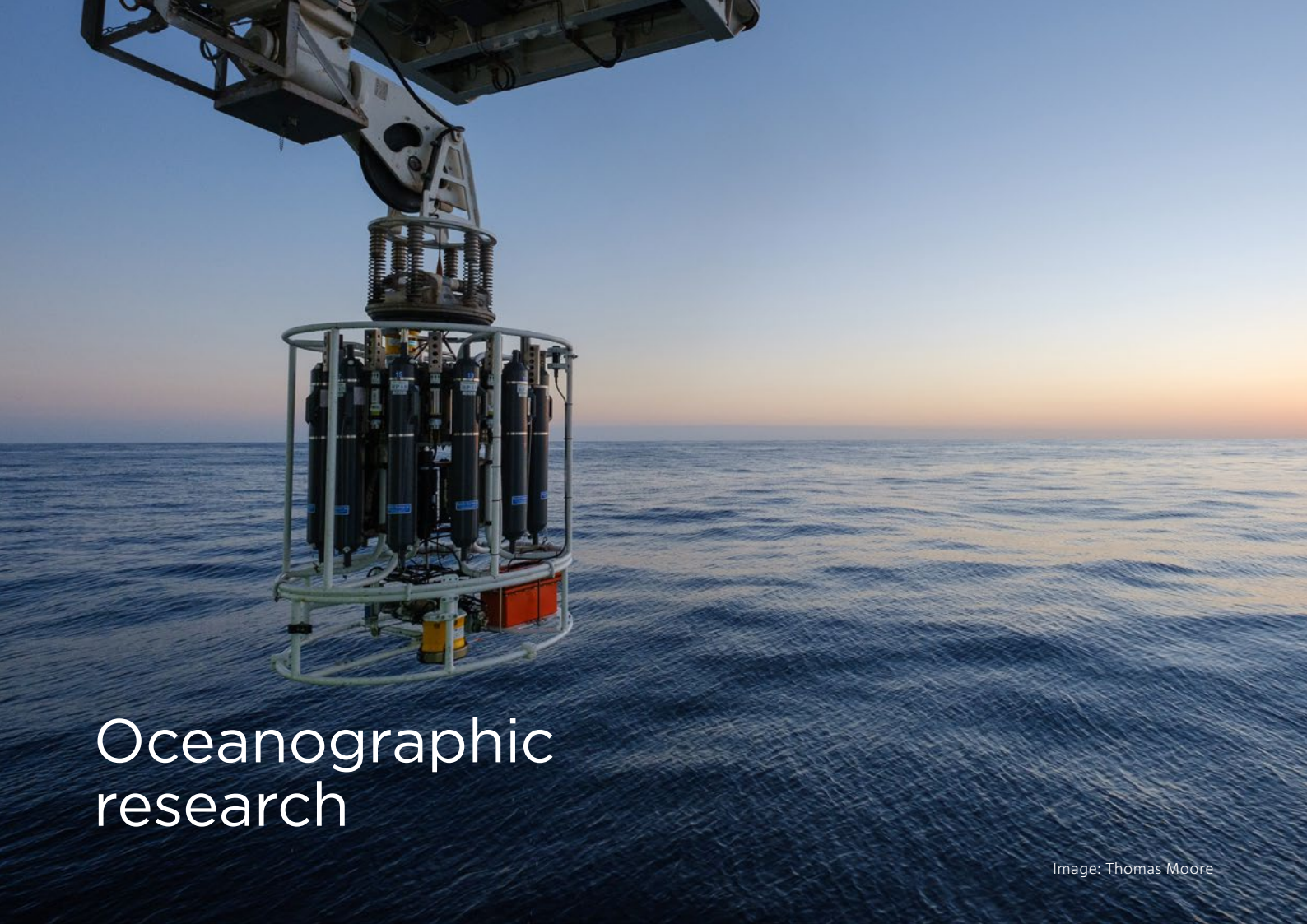
A sediment sampling device that uses bucket-like jaws to collect seafloor sediments from a target area.

### Sub-bottom profiler integrated with 12 kHz multibeam

The Kongsberg SBP120 is a sub bottom profiler used to investigate composition below the sea floor. It can be operated with both the EM710 and EM122 multibeam systems.

### XBT system

XBT (expendable bathythermographs) launch and data retrieval system using Deep Blue XBT. XBT can be launched by hand (singly) or using the XBT launcher. Deployed to collect water temperature profiles to allow calculation of sound velocity data.



# Oceanographic research

Image: Thomas Moore

We offer a wide range of physical, biological and biogeochemical oceanographic research capability. *RV Investigator* has a suite of advanced oceanographic instrumentation as well as the capacity to deploy a range of ocean monitoring equipment, such as TRIAXUS instrument and autonomous underwater vehicles. The vessel's deck capacity means it can recover and deploy multiple large ocean moorings on a single voyage.

*RV Investigator's* oceanographic capabilities include a CTD (conductivity, temperature, depth) rosette in 24 and 36 water sampling bottle configurations (12 L per bottle). The CTD can be fitted with a variety of instruments measure ocean properties and can collect water samples to depths of 6000 m. The vessel's drop keels are fitted with acoustic Doppler current profilers (ACDP) – high (150 kHz) and low (75 kHz) frequency – to measure water current velocities. One drop keel can also be fitted with voyage-specific equipment.

The vessel provides researchers with the capability to accurately study trace elements in seawater. Facilities to support these studies include containerised cleanroom laboratories, a separate trace-metal-clean CTD system for collecting water samples, and a trace-metal-clean pump to bring surface seawater onto the vessel with the least possible contamination. We also have MilliQ water suitable for trace metal analysis. There are several dedicated oceanographic laboratory spaces including the Hydrochemistry Laboratory and Underway Seawater Laboratory.



## Oceanographic equipment and capability

### Hydrochemistry Laboratory

A dedicated hydrochemistry laboratory which specialises in measurement of macro-nutrients, dissolved oxygen and salinity.

### CTD

An instrument used to profile the conductivity, temperature and depth of the water column, to a depth of 6000 m. Extra sensors can be added to measure other variables such as phytoplankton, oxygen fluorescence and turbidity.

### 24 bottle carousel and frame

A cluster of 24 water sample bottles (12 L per bottle) and sensors that is attached to a Seabird 911 CTD.

### 36 bottle carousel and frame

A cluster of 36 water sample bottles (12 L per bottle) and sensors that is attached to a Seabird 911 CTD.

### CTD Laboratory

The CTD Laboratory is a complete system for CTD deployment and recovery. It includes a boom that extends from the starboard side of the vessel via a vertically opening door.

### TRIAXUS

Triaxus is a remotely piloted towed vehicle capable of carrying a variety of instrumentation. Constant depth towing or undulating profiles are possible. Typically, undulations from the surface to 200 m are possible at 8 kts, with slower speeds for deeper profiles and faster for constant-depth towing. Maximum achievable depth is typically 350 m at vessel speed 6kts.

### Trace Metal Systems

#### Trace metal CTD system

A specialised clean system that includes a trace metal clean winch and 12 bottle trace metal CTD. The Hydrographic winch provides for deployment to 6000 m depth. Two Trace Metal Clean Containerised Laboratories are available for sampling and analysis.

#### Trace metal in-situ pumps (ISP)

These are specialised water sampling instruments deployed using the Hydrographic Winch. It filters large volumes of sea water (1000 L over 1–2 hours) to capture particles. Filters are then analysed for trace elements, as well as other marine particles such as organic carbon and phytoplankton.

### Underway seawater supplies

RV *Investigator* has four science seawater pumps and associated pipework to suit a variety of requirements. Water is drawn from a single titanium intake for the Underway Instrument Clean, Circulating Clean and Trace Metal Clean systems on the Port Drop Keel, from which dedicated pumps and pipework deliver seawater to the instrumentation.

### Underway instrument clean seawater

120 litres per minute is provided to the Underway Seawater Laboratory and CTD Laboratory, primarily for the MNF's dedicated underway seawater instrumentation suite.

### Circulating clean seawater

Similarly, 120 litres per minute is supplied to the majority of labs and workspaces on the Main Deck for use by voyage specific and guest instrumentation.

### Trace metal clean seawater

An air driven Teflon piston pump supplies up to 100 litres per minute of seawater via metal-free pipework to the labs and workspaces on the Main Deck for use by voyage specific and guest instrumentation.

### Raw seawater

This is not part of the clean seawater systems. Seawater is drawn from machinery cooling sea chests and supplied to the majority of labs on main deck and incubation tanks on O2 level.

### Underway seawater analysis Instrumentation

#### Sea surface temperature (SST) radiometer

This instrument is located on the Bridge Wing and uses infrared radiation measurements to accurately determine the temperature of the sea surface or skin.

#### Sound velocity probe

The sound velocity probe is an integral part of the seafloor mapping sonar systems. It is mounted in the Drop Keel and used to measure the speed of sound in water.

#### Sea surface temperature probe

This is mounted in the Drop Keel to take accurate measurements of the sea temperature (mix layer) just below the vessel hull.

#### Thermosalinograph

Continually measures surface temperature and salinity along the track of the ship using the underway seawater system originating in the drop keel. This is located in the Underway Seawater Lab on Main Deck.

#### Fluorometers

Fluorometers measure fluorescein, from which an estimate of the chlorophyll concentration can be inferred. This is located in the Underway Seawater Lab on Main Deck.

#### Oxygen optode

This measures the oxygen concentration in the water. This is located in the Underway Seawater Lab on Main Deck.

#### pCO<sub>2</sub> system

The concentration of dissolved CO<sub>2</sub> is continually measured, with regular calibration provided by a suite of reference gases. This is located in the Underway Seawater Lab on Main Deck.

# Information technology and data capabilities

## VSAT system

Our standard VSAT bandwidth is 6 Mbps down/4.5 Mbps up. Internet access is provided to all voyage participants via vessel Wi-Fi network. Prioritised access to network can be arranged for critical activities.

## Video broadcasts

The vessel can support high quality video broadcasts for live media, education and outreach activities. These can be delivered via a variety of platforms. A dedicated video conference room is available on board.

## Video streaming

RV *Investigator* has a continuous live stream (broadcast to MNF website) from the vessel's deck Level 05 external camera. Additional live streams can be broadcast simultaneously from other cameras, including feed from deployed camera systems such as the deep towed camera.

## Data accessibility

The vessel offers a centralised voyage archive, 400 TB of onboard storage and live dashboards of all core underway data feeds (available to participant smart devices). Bulk data transfers via CSIRO's public FTP site can be facilitated for onshore collaborators.



# Promoting innovation in marine research

With the increasingly rapid rate of technological change and growth in partner demands, focusing on developing technology and stimulating innovation has never been more critical.

We seek to match the pace of emerging technologies and research needs. Our Streams of access provide a pathway for collaborative research aimed at value-adding capability to enhance our ability to manage our marine environment and grow the Blue Economy.

Our goal is to play an active role in promoting and adopting innovation in marine technology.



Image: Mark Horstman, AAPP

# Fostering education and training

We are committed to developing the next generation of marine scientists and experts. We seek to actively foster education and training opportunities through targeted programs, as well as encourage ongoing participation on every voyage.

We acknowledge and respect the Aboriginal and Torres Strait Islander people, our nation's first scientists and the Traditional Owners of the land and sea country of Australia. Our objective is to actively partner with Indigenous peoples to embed their participation in the research, management and prosperity of Australia's marine environment.



Image: Huw Morgan

# Applying for sea time

Researchers can access fully funded grants of sea time to conduct research on RV *Investigator* through the Granted Voyage program. This program is funded by the Australian Government.

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**Indicative value of grants of sea time (2023–24): \$130K/day**

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Applications for grants of sea time can be made by Australian researchers and their international collaborators via three pathways:

## Primary Applications

A Primary Application call is used to build the primary voyage schedule for each financial year. This is an annual call made two years in advance of the start of the available period.

Successful applicants are generally announced at least 18 months prior to delivery of voyages.

## Supplementary Applications

A Supplementary Application call is used to fill unused capacity in the Primary Voyage Schedule built from the Primary Application process. This is an annual call made approximately one year in advance of the start of the available period.

Supplementary Applications are generally invited at the time the Primary Voyage Schedule is announced.

## Piggyback Applications

A Piggyback Application call is used to fill any remaining capacity in the Voyage Schedule or where projects of national benefit, that require little or no additional resourcing, can be incorporated.

Piggyback Applications can be discussed with the Marine National Facility at any time.

## Apply here

To apply for sea time, you must first register for an account in our online application portal, MFP – Marine Facilities Planning system. Applications can then be made through one of five access Streams.

For more information visit [mfp.csiro.au](https://mfp.csiro.au)



Image: Cass Erbs

## Streams of access

There are five Streams of access to sea time on *RV Investigator*. These support the selection of research to meet national priorities and the diverse needs of our research community.

**Stream 1:** Policy-driven research, for proposals that directly inform and influence critical public policies and programs, where the identified policy driver and appropriate end-user co-design the project and pathways to impact.

**Stream 2:** Discipline-driven research, for proposals with the primary purpose of advancing scientific knowledge that do not directly address policy-driven priorities while still delivering national benefits.

**Stream 3:** Strategic partnerships with national publicly funded programs or institutions that rely on regular access to MNF capabilities to support data and sample collection in the national interest.

**Stream 4:** Technology and innovation projects, for proposals to develop and test innovative technology.

**Stream 5:** User-funded research, for proposals that are in the national interest and rely on *RV Investigator's* specific capabilities.

## Awarding sea time

The Marine National Facility seeks to maximise the utility and benefit from all its resources.

Primary and Supplementary Applications are competitively assessed by independent committees who consider the research quality and national benefit of the proposed project. Collaboration, student training, Indigenous participation and public outreach are highly regarded in proposals.

Piggyback proposals (prior to an application being made) are considered directly by the Marine National Facility in consultation with the relevant Chief Scientist and other voyage partners.

# Our return on investment

## Achieving our mission

Our research is driven by national research priorities and seeks to solve the greatest challenges through innovative science and technology. We strive to deliver science with impact and connect our end-users – government, industry and community – with the knowledge to inform evidence-based decision making about our marine environment and industries.

At the forefront of all our work is an unwavering commitment to the health, safety and wellbeing of our people and the environment.

We seek to go the extra nautical mile to enable, deliver and ensure the success of your research.

## Delivering national benefit

*RV Investigator* is a valuable element of research infrastructure for Australia's people and economy. The research we deliver provides significant insights about our oceans, weather and climate, marine geology and marine ecosystems.

Importantly, our research partners are expected to help promote and raise public awareness of their research and Australia's incredible marine environment. This is in addition to important obligations for reporting their research outputs and outcomes to the Marine National Facility.

The uptake of this new knowledge has matured the nation's situational awareness and furnished evidence-based data for improved resource and ecosystem management, as well as policy development and planning that affects the marine environment. Furthermore, *RV Investigator* provides both important capability development opportunities for students and a platform for the development of innovative marine technologies.

Independent economic impact analysis conservatively estimates the Benefit-to-Cost Ratio (BCR) of the Marine National Facility at 3.3–7.3. That is, for every \$1.00 invested in the Marine National Facility, benefits worth at least \$3.30–\$7.30 are returned to the nation.



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CSIRO is solving the greatest  
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#### **Mailing list**

Subscribe to receive news and updates from the  
Marine National Facility, including when calls are  
made for applications for sea time on RV *Investigator*.  
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