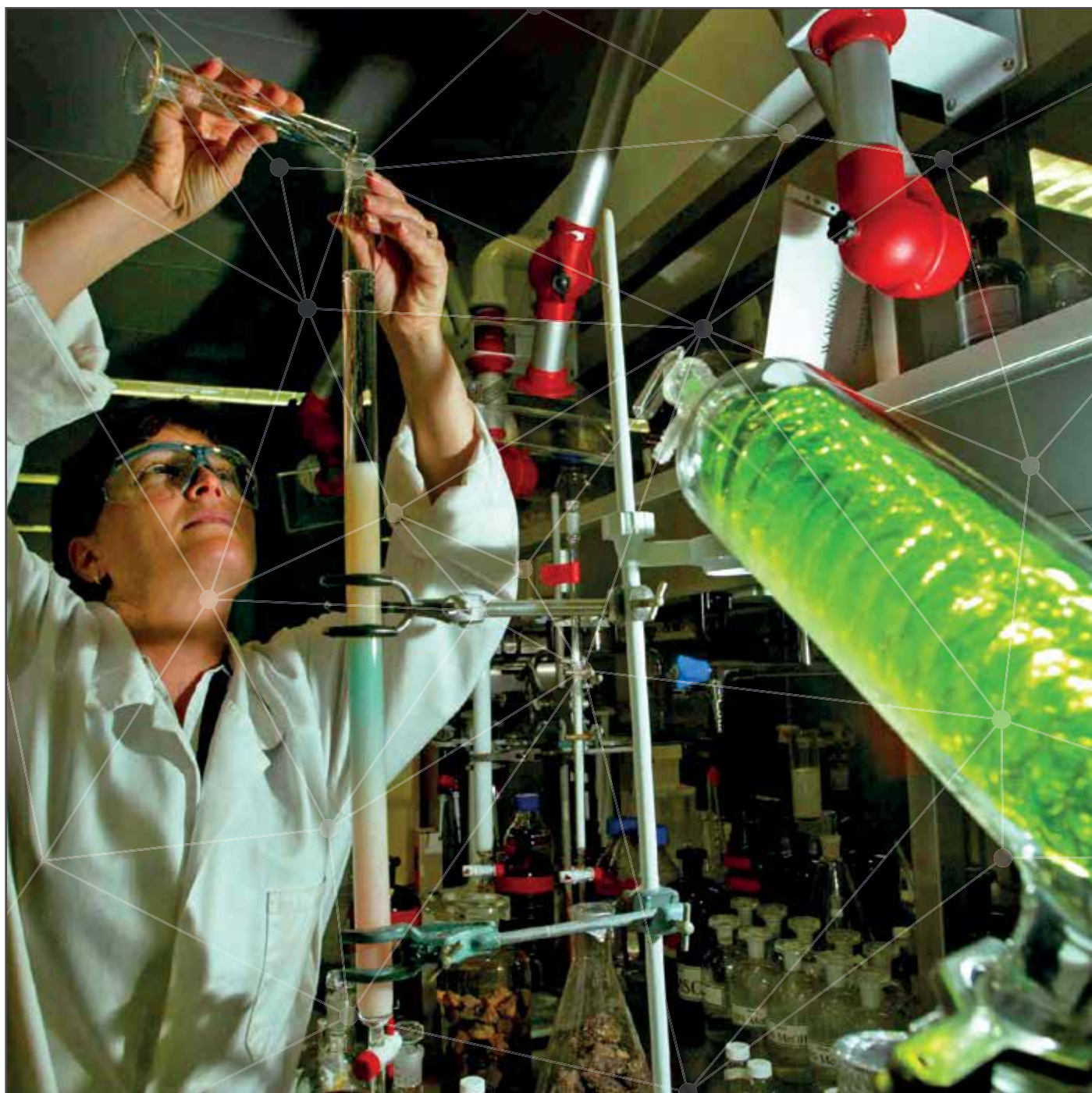




# capability statement of **LABORATORIES**



**AIMS: Australia's tropical marine agency.**



Australian Government



AUSTRALIAN INSTITUTE  
OF MARINE SCIENCE



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## 1. INTRODUCTION

AIMS is Australia's tropical marine research agency, established in 1972 to support the protection and sustainable of the marine environment through innovative, world-class scientific and technological research. Today AIMS operates from bases in Townsville, Perth and Darwin with extensive research activities across northern Australia, spanning two oceans and three regional seas.



To support AIMS broad activities and build research strength and capability, AIMS uses a set of advanced laboratories used by experienced scientists, postgraduate students, external collaborators, industry partners, and commercial clients alike. In addition, AIMS has recently opened its state-of-the-art marine aquarium facility, the National Sea Simulator (SeaSim), capable of supporting world leading research. These high levels of technology and support across the institute enables researchers, both nationally and internationally, to conduct research and analytical measurements at world class standards. AIMS is committed to continuously invest in developing research laboratories and capabilities to offer its scientists and stakeholders the best opportunity to enhance the quality of research output and maintain high national and international reputation.

- ***AIMS has more than 20 specialised laboratories across Australia with over 100 experienced laboratory scientists and technicians.***
- ***We have secure sample storage, including large walk-in fridges and -20°C freezers in addition to several large freezers at -80°C and -150°C,***
- ***Our commitment to quality is not limited to physical sample storage. We have large data storage and efficient lab book monitoring and archiving across the laboratories.***



## 2. PC2 Laboratory

AIMS has established two certified Physical Containment Level 2 (PC2) Labs, equipped with advanced molecular biology capabilities. The PC2 laboratories are suitable for work with material likely to contain microorganisms classified as Risk Group 2 microorganisms. At AIMS, one of the PC2 labs is a quarantine certified premise (QC2) and is the core of quarantine activities in AIMS.



The capabilities in the PC2 Labs include:

### 2.1 Bio-Rad CEQ 8800 DNA Analyser and GeXP Software

This instrument involves capillary electrophoresis and is capable of DNA sequencing. It can also be used for microsatellite profiling and gene expression analysis.

### 2.2 Agilent Bioanalyser 2100

The Bioanalyser uses microchannel electrophoresis (electrophoresis 'on a chip') to provide sizing, quantitation and quality control of DNA, RNA and proteins.

- *The PC2 Labs advanced capabilities has attracted national & international collaborators.*
- *Strict safe work practices are implemented and adequate training, protective equipment and supervision are continuously provided.*
- *The PC2 lab is regulated by OGTR and DAFF. It enables numerous collaborative research projects.*

### 2.3 Corbett Quantitative Thermal Cyclers

Two quantitative thermal cyclers are available. Quantitative PCR (qPCR, also called real-time PCR) is used to amplify and simultaneously quantify a targeted DNA molecule. The quantity can be either an absolute number of DNA copies or a relative amount.

### 2.4 Corbett CAS1200 Liquid-handling Robot

This robot is used to prepare the samples mixtures required for qPCR and load them into the micro tubes used in quantitative thermal cyclers.



### 2.5 Perkin Elmer Victor Plate Reader

Microtitre plate readers are used for many tasks in the PC2 Lab, including quantitation of DNA/RNA in 96-well plate format. Able to read samples in high density 384 and 1536 well plates. This instrument can be automated to allow samples to be read in the absence of an operator.



- ***Microbial diversity and the study of the role of microbes in marine systems is one of the central themes of this lab.***
- ***The lab is also used for the study of the role of marine viruses in coral health and adaptation to climate change.***
- ***Members of the lab have experience in the study of marine invertebrates such as sponges, corals, and crown-of-thorns starfish.***
- ***The symbiotic algal partner of many marine invertebrates, Symbiodinium, is also studied in this laboratory.***

## 2.6 Beckman Avanti J-26XPI Preparative Centrifuge

The fixed-angle rotors we have for this refrigerated centrifuge can spin 8 x round-bottom, 50 mL tubes at 75,600g (max) and 6 x 250 mL bottles at 38 400g max. Both rotors are 'biosafe' *i.e.* they are designed to contain biohazardous material in the event of tube or bottle breakage.

## 2.7 Beckman Allegra X-15R bench-top Centrifuge

The swinging-bucket rotor we have for this refrigerated centrifuge can spin 15 mL and 50 mL conical-bottom tubes as well as 96-well plates. The maximal force is 5,250g for tubes and 4,060g for plates. Biosafe containment can be used for all tube and plate types.

## 2.8 Becton Dickinson FACSVerse Flow Cytometer

This is an analytical flow cytometer capable of detecting and counting viruses and other microbes. It is used primarily by the virus project.



- *The PC2 lab has been used to study the role of Vibrios in diseases of corals, crown-of-thorns starfish, and the tropical rock lobster.*
- *PC2 lab members have expertise in molecular phylogenetics, bioinformatics, and the evolutionary study of marine vertebrates.*
- *The development of microbial and molecular indicators (bioindicators) of pollution is a growing focus of the laboratory.*
- *AIMS possess bioinformatics resources to support molecular work carried out in the PC2 lab.*



### 3. Analytical Laboratory

The Analytical Laboratory at AIMS Townsville was established to support AIMS multidisciplinary field research activities. Its main specialities focus on carbon (organic & inorganic), nitrogen, alkalinity and nutrient measurements for solid and liquid samples. These analytical activities are performed by three experienced technical staff who produce data for internal users and external clients in a timeframe that meets their needs and that are scientifically valid, defensible, and of known and documented quality.



The capabilities in the Analytical Laboratory include:

#### 3.1 Autoanalyser III (5 Channel – $\text{PO}_4$ , $\text{NH}_4$ , $\text{NO}_2 + \text{NO}_3$ , $\text{NO}_3$ , Si)

This instrument is a fully automated/computerised system for analysing nutrients in environmental waters. It is a five-channel segmented-flow continuous analyser consisting of a sampler, a pump, five-reagent mixing and reaction manifolds and five photometers to simultaneously measure dissolved inorganic nitrate, nitrite, ammonium, phosphate, and silicate at low  $\mu\text{M}$  levels. Detection limits offered by this state-of-the-art instrument fulfill the detection needs of researchers wishing to analyse oligotrophic (low nutrient concentration) seawater, while also providing the capability of analysing fresh and brackish waters, including soil water, sediment pore water, and groundwater.

- *The Analytical Laboratory recognizes the importance of Quality Assurance to enable superior data that is both accurate and precise being provided to users and clients.*
- *The Analytical Laboratory has documented a Quality Assurance Plan by which the laboratory operates and continue to review and update on a regular basis.*
- *The Analytical laboratory is committed to continuous improvement in methods and processes.*

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### **3.2 ICP Emission Spectrometer Iris Intrepid II XSP With Vapour Generation Unit plus autosampler**

This instrument works with Echelle polychromator optics and a CID semiconductor chip at wavelengths from 165 to 1050 nm. By axial or radial viewing of the plasma determination of high concentrations of traces of elements is possible. Solutions with up to 70 elements can be analysed simultaneously in a few minutes.

### **3.3 Atomic Absorption Spectrometer – includes Zeeman background-corrected Graphite Furnace (GFAAS), VP90 vapour generation system and HG90 mercury concentration system**

The Solaar M6 is a Dual Atomizer Zeeman AA Spectrometer with wide range photomultiplier. It is used for the quantitative determination of the elemental composition in both aqueous and non-aqueous matrices. Low detection limits, working ranges extending over several orders of magnitude and high daily throughput of samples make this a versatile and efficient atomic spectrometric analytical technique. The flame to furnace changeover can be fully automatic and take place unattended. The autosampler can accommodate up to 60 samples in the large carousel.

### **3.4 Total Organic Carbon Analyser TOC-V with solid sample module, nitrogen accessory and autosampler**

Combining the SSM-5000A with a TOC-V analyzer permits organic , inorganic, and total carbon and total nitrogen measurement of many solid samples.

### **3.5 Total Organic Carbon Analyser TOC-L with solid sample module, nitrogen accessory and autosampler**

A total organic carbon analyser (TOC) measures the carbon content of organic substances in water. An important capability for a TOC analyzer is the ability to oxidise organic carbon. The analyser can efficiently oxidise not only easily-decomposed, low-molecular-weight organic compounds, but also hard-to-decompose insoluble and macromolecular organic compounds. The Shimadzu TOC-L uses a unique combustion catalytic oxidation and nondispersive infrared (NDIR) method that permits measurements of all samples from ultrapure water to highly contaminated water. (Range of measurement is 4 µg/L to 25000 mg/L.)



- *Audits are performed annually to verify that laboratory operations continue to comply with the requirements of the Quality Assurance Plan.*
- *The Analytical Laboratory utilizes several layers of documentation to track samples from receipt through analysis.*
- *The sample storage environment will not affect the sample through the addition of any contaminants not originally present.*



### **3.6 Total Organic Carbon Analyser Vario TOC Cube (liquids & solids), with chemiluminescent nitrogen detector and autosampler**

High sensitivity analyser for the determination of organically and inorganically bound carbon in liquids, slurries and solids. This instrument measures automatically up to 100% carbon concentrations in any sample matrix. Oxidation of bound carbon by means of high temperature digestion and catalytic post combustion in a selectable range of up to 1200°C.

### **3.7 Truspec carbon/nitrogen elemental analyser**

Determine total carbon/nitrogen in solid samples. The system is based on the Dumas method of combustion, and provides a result within four minutes for all elements.

### **3.8 Seawater Alkalinity and DIC analyser VINDTA 3C**

High accuracy measurement of total inorganic carbon and titration alkalinity. The VINDTA 3C is a laboratory alkalinity titration system combined with an extraction unit for coulometric titration, which simultaneously determines the alkalinity and dissolved inorganic carbon content of a sample.

### **3.9 Algal Pigment Analysis**

The Algal pigment analysis capability has the capacity to quantitatively measure a wide variety of plant pigments, with a focus on microalgae. Identification of signature pigments from microalgae also enables the broad taxonomic description microalgae within samples (eg, diatoms, cryptophytes, dinophytes, and cyanobacteria). Two instruments are available for this measurement, a Waters Acquity Ultra Pressure Liquid Chromatography (UPLC) instrument and a Shimadzu High Pressure Liquid Chromatography (HPLC) instrument.



- *Analytical Technology assures quality by only accepting samples that do not create an unacceptable safety hazard*
- *All laboratory results and associated raw data are kept in confidence to the User or ECM.*
- *Maintains Standard Operating Procedures (SOPs) that accurately reflect all laboratory activities including protocols and personnel safety measures*

## 4. Chemistry Laboratory

AIMS Chemistry Laboratory was established to search for biologically interesting compounds from marine organisms for commercial uses. The laboratory capabilities also support research activities in the areas of chemical ecology and ecotoxicology, as well as developing methods for detecting pollutants within the marine environment. The laboratory houses several automated analytical, semi-preparative and preparative high performance liquid chromatography (HPLC) systems all with photodiode array and/or fluorescence detection for separation of compounds, as well as a polarimeter and a UV-visible spectrophotometer for chemical analysis.



Also available in the laboratory is standard equipment including

- Buchii rotoevaporators with chillers
- Dynavac FD12 freeze-drier
- Savant Speed Vac Plus with refrigerated vapor trap
- Sartorius balances (2, 4 and 5 figure)
- Hermle Z323K and Z233MK centrifuges
- Clayson oven
- Domnick Hunter nitrogen generator
- Spark-proof freezers and fridges for sample and chemical storage.

- ***Chemical diversity and the functional roles of these metabolites in marine organisms is a central theme of this lab.***
- ***Research is also focussed on identifying chemical markers that indicate early responses of organisms to environmental and anthropogenic stressors.***

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The capabilities in the AIMS Chemistry Laboratory include:

#### 4.1 UV Spectrophotometer

The Shimadzu UV 2550 spectrophotometer measures the UV absorption of liquid samples.

#### 4.2 Polarimeter

The automated Jasco P-1020 Polarimeter measures the optical rotation of optically active substances. Additionally, it can be used for quantitative analysis discrimination of D-optical isomer, L-optical isomer and other chiral analysis. Two cells sizes are available (3.5x50mm and 3.5x100mm).

#### 4.3 HPLC systems

The Chemistry Laboratory houses a number of HPLC instruments. The separation capabilities range from analytical to preparative scale and can be used to separate both small and large molecules.

- Five Shimadzu HPLC systems each consisting of a Shimadzu SCL-10Avp system controller, Shimadzu LC-10AT pump, Shimadzu SPD-M10Avp photodiode array detector, Shimadzu FRC-10A fraction collector and Shimadzu SIL-10A auto sampler operating with ClassVP software. One analytical Shimadzu HPLC system is coupled with an L-ECD-6A electrochemical detector and Varian 9070 fluorescence detector.
- Two Waters HPLC systems: one with a 600 Controller, 717 plus autosampler, 996 photodiode array detector, PCX 5100 post column reaction module and Fluor CC305 fluorescence detector, the other with a quaternary pump, 2487 dual wavelength absorbance detector and a Gilson FC204 fraction collector.
- One Agilent 1100 series HPLC system consisting of a degasser, a binary pump, an auto sampler, fraction collector a column oven, a fluorescence detector and a photodiode array detector.

#### 4.4 UPLC system

A Waters Acquity ultra performance liquid chromatography (UPLC) system is available with quaternary pump, autosampler and photodiode array detector. The higher flow rates and increased throughput offered by this system result in superior resolution and sensitivity while reducing separation time and running costs.



- ***Chromatography is a key technique used to isolate and purify metabolites of interest. One example is the isolation of compounds that initiate coral larval settlement and metamorphosis.***



## 5. Biomolecular Analysis Facility (BAF)

The AIMS Biomolecular Analysis Facility (an ANZMAGnet member) was established to determine the molecular structure of biologically interesting compounds isolated from marine organisms and the marine environment. The facility provides a one-stop-shop for chemical analysis and includes two nuclear magnetic resonance spectrometers (300MHz and 600MHz NMRs), two liquid chromatography systems each coupled to quadrupole ion-trap mass spectrometer (LCMS), a Fourier transform infrared spectrometer (FTIR) and a Fourier transform Ion-Cyclotron Resonance mass spectrometer (FT-ICR-MS). The built-in flexibility within the instrumentation means that there is some scope to undertake in-line hyphenated analysis. This facility is unique in Australia and represents a significant scientific asset for tropical marine science.



- *The BAF is well positioned to enable metabolomics-driven research by facilitating access, training, data acquisition, data analysis and data storage; providing the platform upon which challenging analytical problems can be addressed.*
- *Measurement of an organism's complete metabolite pool is impossible to achieve with a single analytical method. Applying multiple tools such as those in the BAF is providing such information.*
- *The Fourier Transform ion-cyclotron resonance mass spectrometer (FTMS) boasts superb resolution and mass accuracy.*

### 5.1 Bruker Fourier Transform Ion-Cyclotron Resonance Mass Spectrometry (FT-ICR-MS)

FT-ICR-MS is a highly sensitive technique for the detection of biologically important molecules at physiological concentrations ( $10^{-12}$  M). Built around a 4.7 Tesla super-conducting magnet which enables the trapping and manipulation of charged molecules (ions), the advantages of the FT-ICR-MS instrument are its remarkably high resolution capability and the ability to measure molecular mass accurately even with external calibration. The accurate mass measurement capability extends to fragment ions which are produced as a consequence of the tandem mass spectrometry procedure (MS/MS).

### 5.2 Bruker Esquire 3000<sup>+</sup> LC-MS

The quadrupole ion-trap mass spectrometer complements the FT-ICR-MS with the addition of automation and higher throughput capabilities. Equipped with an Agilent 1100 series HPLC front end, including a diode array detector and a Gilson 215 liquid handler, the instrument is capable of chromatographic separation and detection-based fraction collection.

### 5.3 Bruker Avance 300 MHz Nuclear Magnetic Resonance Spectrometer

The  $^1\text{H}/^{13}\text{C}$  two channel 300MHz NMR spectrometer with z-gradients is the work horse of the facility and has the capability to provide one and two dimensional NMR data for the structure elucidation of small molecules where the amount of sample is not the limiting factor. Additionally, a 24 tube sample changer (CASE) enables the instrument to be run in unattended fashion to enable data acquisition for a suite of experiments on a number of samples without operator intervention.

### 5.4 Bruker Avance 600 MHz Nuclear Magnetic Resonance Spectrometer

The  $^1\text{H}/^{13}\text{C}/^{15}\text{N}$  three channel 600MHz NMR spectrometer with z-gradients is the centre piece of the BAF. Intended principally for the structure elucidation of biologically important small molecules, the instrument also enables determination of the three dimensional solution structures of proteins of modest size. Equipped with a cryogenically cooled probe, the instrument provides the sensitivity required for the analysis of low microgram amounts of compound. Samples can be introduced into the magnet in the traditional tube format (1.7 – 5mm), or can be introduced from a robotic sample handler (BEST) capable of handling vials or 96 well plate formats via a 60 $\mu\text{L}$  flow-cell.



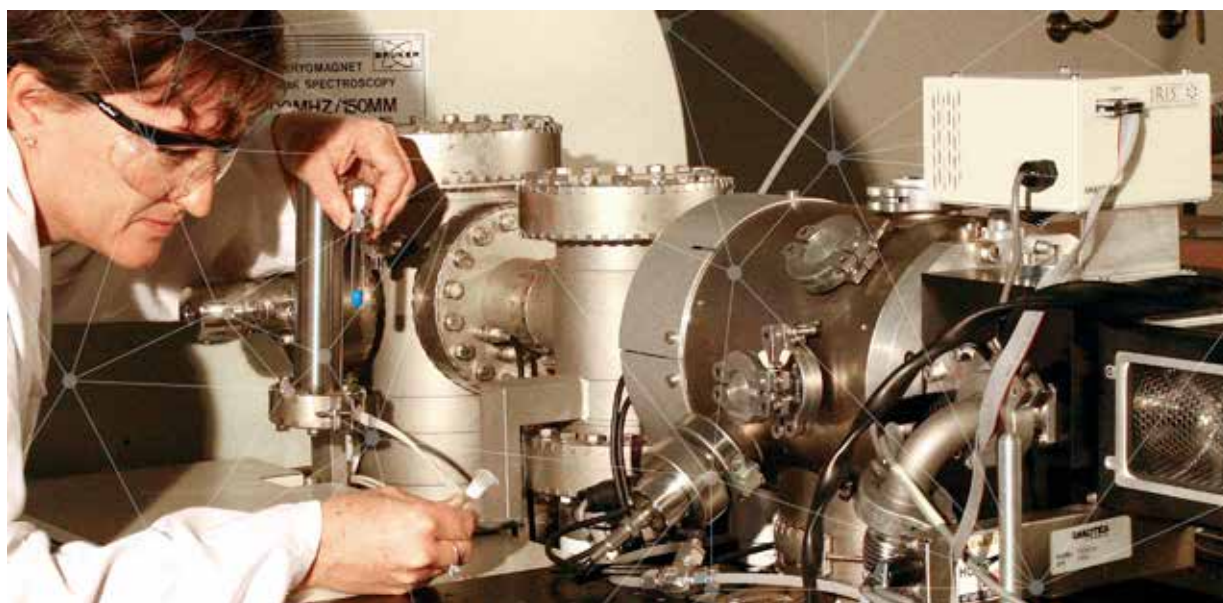
- *The LC-MS couples chromatography with mass spectrometry. It can resolve different components of a mixture and provide information on the mass of each of these.*
- *Nuclear magnetic resonance spectroscopy (NMR) is one of the most versatile analytical platforms for complex mixture analysis.*

## 5.5 LC-MS-SPE-NMR

A post-column robotic solid phase extraction (SPE) system provides an interface between a Bruker Esquire 3000 quadrupole ion-trap mass spectrometer (LCMS) and the 600MHz NMR configured with the flow cell (LC-MS-SPE-NMR). HPLC fractions can be trapped on the basis of UV or MS response, subsequently dried to remove the protonated LC solvents and then transferred using deuterated solvents for NMR measurement. In the case where a particular bio-active compound is present in microgram amounts, sufficient NMR data may be generated from a single chromatographic analysis to enable the unambiguous determination of the structure of the compound without further purification. This is routine for known compounds, and can be extended to determine the structure of new compounds.

## 5.6 FT-IR ATR

The FT-IR spectrometer is used for chemical fingerprinting, characterisation, identification and quantification. The technique of attenuated total reflectance (ATR) enables fast sampling of liquids and solids with minimal sample preparation, easy cleaning, reproducibility and excellent quality data.



- *The cryoprobe associated with the 600 MHz NMR provides a dramatic increase in sensitivity by a factor of 3-4 in tube operation mode.*
- *LC-MS-NMR combines chromatography with nuclear magnetic resonance & mass spectrometry for full structural elucidation of sensitive and unstable or low concentration compounds.*
- *The attenuated total reflectance (ATR) technique on the FT-IR offers a convenient alternative to thin-film or KBr pellet.*



## 6. Arafura Timor Research Facility (ATRF)

The ATRF is based in Darwin and is one of AIMS' major national research facilities. Here, scientists conduct multidisciplinary research activities integrating ecology, biochemistry, coastal oceanography using physiological, molecular and genetic techniques.

The facility house advanced capabilities such as:

### 6.1 Electrochemistry system

This system comprising Autolab PGSTAT128N potentiostat / galvanostat, Metrohm 663 VA stand, Metrohm rotating disc electrode and Ace Glass photo-oxidation apparatus. This system is primarily used to measure the concentrations (total, bio-available, organically bound) of metals (e.g., copper, lead, zinc, aluminium) in seawater. It can also be used to determine metalloids (e.g., arsenic) and non-metals (e.g., oxygen, sulfide, iodate) provided that they can interact with the electrode.

### 6.2 Isotope Ratio Mass Spectrometer

This instrument is equipped with a Thermo Fisher Delta V Advantage Isotope Ratio Mass Spectrometer, Elemental Analyser 1112HT O/H-N/C and a Finnigan Conflo III. It measures the isotope ratios of carbon, nitrogen, hydrogen and oxygen. Stable isotope data is used to track specific elements in the environment, revealing their cycle paths in the environment and other ecological information.

### 6.3 HPLC system

Shimadzu LC10 gradient HPLC system comes with autosampler, column oven, and fluorescence detectors. A universal and integrated liquid chromatography system applicable to organic and inorganic solutes.

### 6.4 Gilson Gel Permeation Chromatography System

This flexible prep-scale chromatography system comes with autosampler and UV-VIS detector that can be used for size-exclusion chromatography and fraction collection.

### 6.5 Automatic Total Mercury Analyser

The LECO AMA254 system takes solid samples, combusts in furnace, traps mercury on Au trap and volatilises for AAS detection.

- *The ATRF main laboratory is a fully equipped general space to accommodate a range of marine scientific experiments and is colocated with a experimental aquarium facility.*
- *Stable isotopes have become a popular method for understanding aquatic ecosystems.*



## 7. General Purpose Laboratories

Four general purpose laboratories have been established to provide workspace and expert support for scientific staff, students and collaborators undertaking a wide range of analytical and technical tasks. Each laboratory is available for research activities such as: the calibration and maintenance of field-going instrumentation, the preparation of hazardous chemical reagents for field work, the preservation, preparation and analysis of water, sediment, marine fauna and flora samples. Each laboratory has access to facilities such as water purification systems, dedicated chemical storage areas, acid-wash areas for cleaning glassware, fume cupboards, compressed air and clean multi-purpose bench-top space.

Laboratory users have access to a wide range of general laboratory equipment including calibrated balances, centrifuges (both swinging bucket and fixed angle rotors are available to spin from 1.5 ml to 50 mL tubes as well as microplates), homogenisers, hotplates, drying ovens, high temperature ovens (1100°C), vacuum filtration equipment, compressed air guns, refrigerators and freezers (-20 and -80°C), cryogenic dewars, static water baths and circulating water baths.

Across the laboratories there is also a range of more specialised instrumentation available, including:

- a High Performance Liquid Chromatography (HPLC) system with fluorescence detection;
- a flow cytometer
- two BioTek plate readers (one which can measure absorbance and the other a high end multi-mode instrument capable of absorbance, fluorescence and luminescence that has injectors for assays such as flash luminescence)
- a high precision salinometer
- microscopes (compound, dissecting and fluorescent)
- a high precision colorimetric pH instrument
- UV-visible spectrophotometers
- floor standing shaker/incubators (with lights for algal growth)
- benchtop fluorometers (for analysis of phytopigments, ammonia and rhodamine tracers)
- limited marine aquaria facilities for small scale experimental projects working with live organisms.



- ***The general purpose laboratories provide well equipped, professional workspaces for researchers focussing on sustainable practices for coastal ecosystems and industries in tropical Australia.***
- ***Host research activities in marine science especially those involving anthropogenic impacts to water quality, coral reef health, and plankton, invertebrate and vertebrate assemblages.***
- ***Laboratory users are encouraged to follow world's best practice with regard to safety and quality control. Experienced supervisors are available to provide advice.***

## 8. Chromatography Laboratory

The AIMS Chromatography Laboratory was established for the separation and identification of organic compounds. The laboratory hosts a broad range of research activities such as nutritional ecology, chemical toxicology and organic geochemistry.

Placing a major focus on lipids, lipid classes, fatty acids and hydrocarbons, the chromatography laboratory is well equipped with a range of automated analytical equipment, including:



### 8.1 Agilent 6890N network Gas Chromatography

Uses advanced electronic pneumatic control modules and high performance temperature control to provide optimal chromatography and outstanding retention time repeatability.

### 8.2 Agilent 7890B Gas Chromatography System

Leading edge technology of Gas Chromatography with advanced separation capabilities, powerful new productivity enhancements, and real-time self-monitoring instrument intelligence. This device features a direct two-way communication system between the 5977A MSD and itself, enhancing vent times by 40% and backflushing capabilities that increase the throughput and reduce the cost per sample.

### 8.3 IATROSCAN MK-6s

Combines thin layer chromatography and a flame ionization detector. It can be used across many different field application such as forestry, fishery, the crude oil and carbon industry, carbon products, biochemistry, biotechnology, and environmental pollution.

- *Gas chromatography – mass spectrometer system provides high quality assurance for a low- cost.*
- *Gas chromatography uses less expensive carrier gases with eco-friendly sleep/wake modes.*
- *Combination of FID and FPD Improves quantification and reproducibility, enabling a wealth of analytical information.*

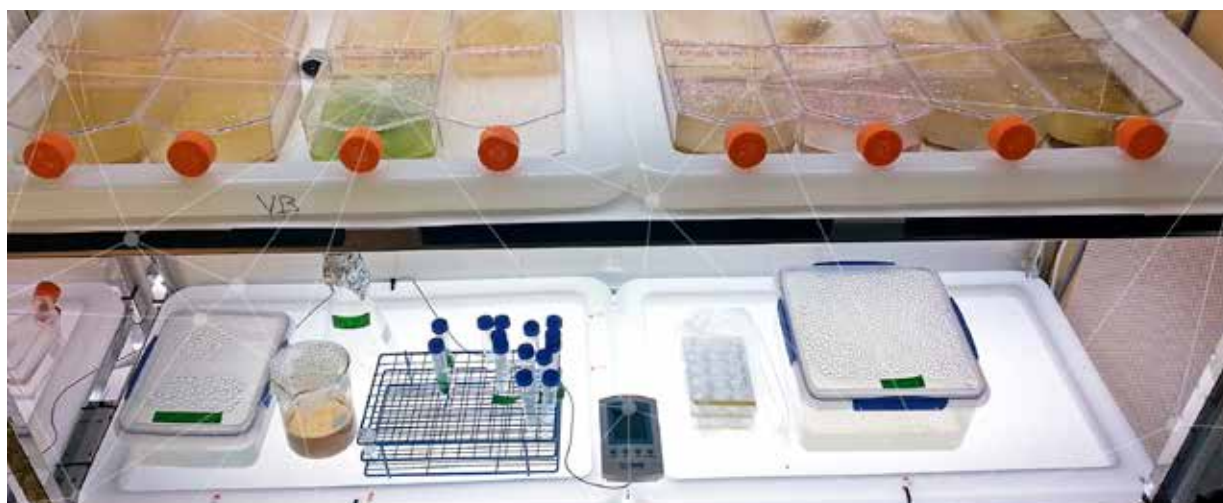


## 9. Symbiont Culture Facility (SCF)

The Symbiont Culture Facility was established to maintain, identify and provide axenic zooxanthellae cultures from different genetic background to AIMS and more recently to external institutions through a material transfer agreement. This involves the development and adaptation of novel culture techniques, especially for those strains that are ecologically important but for which *in vitro* studies are limited due to their inability to survive and reproduce in synthetically formulated media. There is a further necessity to maintain the diversity of the cultures/fresh isolates through systematic cryogenic studies.

The infrastructure of the SCF allows the manipulation of several temperature and lighting regimes in order to accommodate the growing cultures and also for direct experimentation. The laboratory is equipped with several chlorophyll fluorometers including iPAM, diving-PAM and mini-PAM. In order to manipulate and transfer cultures, the SCF is equipped with a Class II Biological Safety Cabinet that allows working under sterile conditions. The lab also has access to micromanipulation equipment and inverted fluorescence microscopes in order to isolate single cells. All artificial environments are under constant surveillance and light and temperature records can be readily accessed.

The SCF also provides symbiont genotyping through DNA comparison of conventional markers such as the ITS1. In line with this, several monoclonal cultures have been generated and further genotyped using DNA fingerprinting technology. Finally, high throughput screening of growth and mortality of symbionts in culture has been adapted and validated using 96 well plates.



- ***SCF also curates valuable scientific information such as specific strains growth conditions, DNA sequences, and microphotographs to support its culture collection.***
- ***SCF is capable of photosynthesis performance under varied but controlled conditions.***
- ***SCF continues to generate monoclonal cultures genotyped using DNA fingerprinting technology.***

## 10. Radiation Laboratories

AIMS has three dedicated radiation laboratories. The densitometer lab is dedicated to a coral densitometry which is used to measure coral density banding patterns. The X-ray lab houses an X-ray unit for detection of coral banding patterns related to climate and environmental changes. Finally, AIMS has a lab dedicated for the use of unsealed sources and contains bench space, basic laboratory instrumentation and scintillation counters.

### 11.1 Coral densitometer

Custom built densitometer houses a  $^{241}\text{Am}$  source for the production of gamma rays. Attenuation of gamma rays through coral slices allows for coral banding patterns to be measured.

### 11.2 Ecoray Orange 1060HF and 1040HF X-ray units

These are portable veterinary X-ray units that have been permanently roof mounted for the analysis of coral sections. Maximum output is 100kVP at 60mA and 40mA.

### 11.3 Benchtop centrifuges

Various centrifuges used for sample preparation

### 11.4 Filtration manifolds

Filtration manifolds for sample analysis including radioligand binding experiments. Plate adapters and 25mm filter adaptors are available.

### 11.5 Microbeta scintillation counter

The Microbeta Scintillation counter is a unique scintillation counter than can count samples in 96-well plates. this accelerates the sped of analysis and reduces the use of radiochemicals and scintillation fluids.

- ***Custom built densitometer enables the measurement of coral density banding which directly related to climate conditions.***
- ***X-ray analysis of coral sections provides a unique insight to growth patterns in massive corals.***
- ***Radioactive tracers enable high sensitivity detection of and are utilised in measurements including primary productivity, mineral cycling and enzymatic reactions.***



## 11. Laboratories at Sea

AIMS laboratory capabilities extend to the ocean, with two large purpose-built research ships - the RV *Cape Ferguson* and the RV *Solander* - helping AIMS scientists undertake field research across the diverse tropical marine habitats of GBR and northern Australia, from inshore reef work to open ocean explorations.

RV *Solander* is 35m long and can carry 18 people. The vessel has 21m<sup>2</sup> of dry laboratory space and 12m<sup>2</sup> of wet laboratory space as well as a dry scientific office. The RV *Solander* laboratory includes bench space served by 240V power, a fume hood and a walk-in freezer for increased frozen sample storage capacity.

RV *Cape Ferguson* is 24m long with accommodation for up to 14 people with access to wet and dry labs as well as scientific office space. The laboratory includes a small fume hood, under bench freezer and a lab bench served by 240V power.

Both ships are equipped with a hydrographic A-frame mounted on the side of the vessel for oceanographic instrumentation.

The AIMS vessels traverse the Great Barrier Reef, the North West Shelf, and other prominent northern Australian locations like Ningaloo Reef and Darwin Harbour, and their laboratories enable experiments and analyses to be conducted at sites far from the coast.





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Instruments frequently taken on board for scientific measurement include:

### 11.1 Accuri C6 Flow Cytometer

A small, portable benchtop flow cytometer used to sort and count cells. With two lasers, two scatter detectors and four fluorescence detectors, it can handle most common assays.

### 11.2 Turner 10 AU and Trilogy fluorometers

Highly sensitive, small benchtop fluorometers with interchangeable modules for analysis of chlorophyll a, low level ammonia in seawater and turbidity.

### 11.3 Shimadzu 1800 UV-Vis Spectrophotometer

Scanning, dual beam spectrophotometer with a range of cells from 1cm to 10cm pathlength.

### 11.4 Millipore portable ultra high purity water systems

Benchtop units capable of producing high quality water from distilled water.

### 11.5 Field going water filtration manifolds with filter funnels and 20L reservoirs

Portable, self-contained filtration kits designed for collecting particulate material from seawater onto 25mm or 47mm filters.

### 11.6 Niskin water samplers

Specialised collection vessels capable of taking water samples at discrete depths from throughout the water column

### 11.7 Cryogenic dewars

A range of cryogenic vessels and dry shippers (10 to 38L) that can be used for preservation and transport (including air freight) of samples collected at sea



*AIMS ships are versatile allowing them to support a variety of other platforms such as:*

- ***instruments can be temporarily deployed on the underside of the hull via their internal moon pools, a feature unusual to vessels of this size, to take measurements and sample water at sea.***
- ***underway water quality measurements of near-surface water temperature, salinity, chlorophyll (fluorescence) and turbidity (NTU) during scientific operations as part of the IMOS Ships-of Opportunity Program.***



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