SeaSim

AIMS: Australia's Tropical Marine Research Agency
AIMS was established near Townsville in 1972, in recognition of the importance of the Great Barrier Reef to Australia. Today, AIMS also operates from bases in Perth and Darwin to support research across northern Australia, spanning two oceans and three regional seas.

Australian Government

Australian Institute of Marine Science

THE NATIONAL SEA SIMULATOR

The National Sea Simulator (SeaSim) is a $35 million, cutting-edge, marine research facility operated by the Australian Institute of Marine Science (AIMS) at its Cape Ferguson headquarters, near Townsville, Australia. It enables multi-disciplinary, collaborative, national and international research in high priority areas such as climate change, pest management and intervention as well as coastal and industrial development impacts. Knowledge from research conducted within the SeaSim will help key stakeholders, including governments, industry and communities to predict, plan and manage likely changes to our marine estate to ensure its ongoing sustainable use and protection for future generations.

SeaSim provides researchers with a reliable, consistent supply of seawater and the capability to exercise precise control over environmental variables, such as temperature, light intensity, acidity and salinity.

Recognizing the potential for SeaSim to provide a quantum step in our understanding of the complex interactions between stressors on tropical marine ecosystems (e.g. climate change, ocean acidification, impacts of dredging, reduced water quality etc), AIMS is making up to 50% of the SeaSim capability available to scientists and research institutions from around Australia and the world to work on collaborative research projects with AIMS staff.

External collaborators will be required to co-invest to some of the costs of running projects within SeaSim in the form of bench fees (detailed later). AIMS will use an Advisory Panel to assist in judging the merits of project proposals to receive AIMS co-investment of facilities, fractional running costs and expertise. The Advisory Panel comprises

- Dr. Jamie Oliver, AIMS Research Director, (Chair)
- Dr. Lyndon Llewellyn, AIMS Program Leader, Data and Technology Innovation
- Prof. Morgan Pratchett, James Cook University
- Prof. Peter Steinberg, Director and CEO, Sydney Institute of Marine Science
- Prof. Denis Allemand, Scientific Director, Scientific Centre.

SEASIM SCIENCE

SeaSim is currently built around three research themes:

Future Oceans
Increasing atmospheric CO_2 both warms and acidifies our oceans. Whole-of-ecosystem understanding of how species will respond to these changes requires experiments with numerous species, including their different life history stages and under numerous scenarios.

Marine diseases and pests
Marine diseases and pests are increasingly being recognised as environmental and economic threats. Biosecure experimentation is required to investigate diseases and pathogens of marine organisms and their contributing environmental factors, and outbreaks of marine pest species to identify vulnerabilities at their different life history stages that can be exploited for intervention options.

Sediment and Pollution
Our coastal seas are experiencing increased long- and short-term impacts from sediment generated during dredging and extracted from the land by flooding rain and rivers. Chemicals are injected from farming, urbanisation and industry. Undersea resources (e.g. oil and gas) are being extracted exposing the marine environment to risks of leaks and spills of these hydrocarbons. The sensitivity of marine organisms to these potential insults is known only for a few species and for only some of their life stages. Their ability to recover is even less well known. Replicating exposures that marine animals experience in the real world will allow more informed decisions by resource managers and planners.

Core Capabilities

Integrating technology drawn from the industrial processing sector and large-scale commercial aquaria, SeaSim can:

- Precisely control complex combinations of environmental variables to accurately simulate both naturally occurring and human influenced water conditions.
- Undertake multi-organism experiments (particularly corals, sponges and seagrasses) in large-scale tanks.
- Develop model marine organisms, with the current focus on corals and coral reproduction.

Key Technologies

- pH manipulation of flowing seawater utilising industrial level controls and sensors. Key components of the system include ISFET pH probes, Liqui-cel membrane contactors and mass flow controllers.
- Heat exchanger systems enabling delivery of temperature controlled seawater with an accuracy of ±0.1°C.
- Advanced controls and monitoring systems enabling remote operation and monitoring of experiments.
- State-of-the-art data historian ensuring all data on experimental parameters are recorded and available at the experiment site or remotely in real-time.
- Large multi-species tanks for long term studies.

More specifically, the experimental capabilities that exist within the SeaSim includes:

Controlled Environment Rooms

- 8 controlled environment rooms ranging in size from 6 x 7 m to 4 x 7 m.
  -3 of the 8 rooms have gantries to enable gravity fed systems
- Constant air temperature in each room with less than ±0.5 °C variation
- Sophisticated control system
  - Monitoring and logging of environmental parameters, accessible remotely
  - Automated alarms with messaging sent via SMS
  - Process controls of parameters such as pH, temperature and lighting
  - Automation of process functions
  - Simple user interface for monitoring and adjusting experimental parameters
- Extensive services provided to each room
  - Ambient temperature filtered seawater
  - Ambient temperature unfiltered seawater
  - 22 °C filtered seawater
  - 36 °C filtered seawater
  - Freshwater
  - 15 °C Seawater
  - 40 °C Seawater
  - High pressure air

  - CO_2 gas lines
  - Mixed CO_2/air
- Ability to control experimental seawater to any given temperature between 22°C and 36°C with an accuracy of ±0.1°C, including ability to set daily or seasonal profiles
- State of the art LED lighting systems with control of periodicity and intensity
- 2 rooms set up for advanced ocean acidification research
  - CER 2 Rm 3: 4x pH, 4x Temp, 3 x rep (48 tanks)
  - CER 2 Rm 6: 3 x pH, 4 x Temp, 3 x rep (36 tanks)
- 1 room set up with advanced sediment delivery system

The following three spaces have all of the above listed services plus the following:

1. **Controlled environment rooms for out of season spawning of marine organisms**
   - 3 controlled environment spaces to enable manipulation of environmental parameters such as temperature, lighting and moon light cycles to shift the natural spawning cycles of model marine organisms such corals and crown of thorns starfish
   - Larval rearing and early life stage nursery facilities

2. **Interior Open Plan Experiment Area**
   - 350 m2 of air-conditioned open plan space with artificial lighting for long term, large tank multi-species studies under tightly controlled conditions
   - State of the art plasma and multi-chip LED lighting
   - Advanced experimental system for studies investigating sediment/dredging plumes
3. **Exterior Open Plan Experimental Area**
   - 400 m^2 of open plan space with ambient temperature and lighting allowing for long term, large tank, multi-species studies under ambient conditions
   - Full temperature control of seawater if required
   - Area is covered in state of the art acrylic sheeting allow for the penetration of full spectrum sunlight, including ultra violet

Additional services

- Live feeds may be provided on request and after discussion with SeaSim staff to determine feasibility
- Propagated corals of various species (Eg Acropora millepora)
- Larval Pocillopora acuta (formally damicornis) for periods of the year

Support Facilities

Laboratories with chemical and bioanalytical capability, data management facilities, engineering workshops, extensive microscopy facilities, organic geochemistry and radioisotope laboratories, and research vessels.

Pricing

Individual controlled environment rooms

	Dimensions (m)	Number available	Weekly bench fee ($)
Small	3 x 7	2	1,450
Medium	4 x 7	3	2,200
Large	6 x 7	3	2,900
Extra Large *	6 x 12.5	3	1,700

*These rooms can be combined by removal of partitions

Open plan experimental spaces

The following spaces are large, open plan and the price will be determined on a pro rata basis depending on the proportion of floor space that the project will required (e.g. if the project needs 20% of the available floor space, then the bench fee will be 20% of the stated weekly bench fee)

	Floor space (m^2)	Weekly bench fee ($)
Open plan (Interior)	350	6,500
Open plan (Exterior)	400	8,500

PhD student projects conducted under the AIMS@JCU, North Australia Marine Research Alliance or the collaboration between AIMS/CSIRO/UWA, will be eligible for a 30% discount on the project bench fees.

Longer projects will be eligible for a further discount on the bench price of:

Project duration	% discount
12-26 weeks	2.5
26-52 weeks	5
>52 weeks	10

Specialist equipment

Specialist aquarium systems or tailor-made instrumentation will be produced at cost with full consultation with external users.

SeaSim

To visit SeaSim or for more information about the facility: Please contact either

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Australian Government

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