



National Marine Science Plan
Science program to support **Decision-making**
**Establishing and supporting a
national marine baselines
and monitoring program**
Working Group Report

S U M M A R Y

NATIONAL
MARINE
SCIENCE
— COMMITTEE —

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CITATION

This document is a summary of:
Hedge P, Souter D, Jordan A, Trebilco R, Ward T, van Ruth P, Cowlishaw M, Lara-Lopez A, Barrett N, Thornborough K, Nichol S, Przeslawski R, Parr A, Kendrick A, Holmes T, Pattiaratchi C, Ferns L (2021) Establishing and supporting a national marine baselines and monitoring program. A report from the Baselines and Monitoring Working Group prepared for Australia's National Marine Science.

Front cover image: John Turnbull, www.marineexplorer.org;
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Acknowledgement of Country |

The National Marine Science Committee acknowledges the Traditional Custodians and Elders of the land and sea on which we work and observe, and recognises their unique connection to land and sea. We pay our respects to Aboriginal and Torres Strait Islander peoples past, present and future.

Summary |

Marine environments and ecosystem services are under threat.

A national approach to establishing marine baselines and monitoring is needed to:

- provide an evidence-based understanding of the status and trends in the health of marine ecosystems
- evaluate environmental risks
- assess the oceans' potential to provide resources
- evaluate the economic and social effectiveness of management actions
- better understand changes driven by natural variability
- improve seasonal and long-term climate prediction
- determine the effectiveness of conservation measures for marine protected areas and unprotected areas.

The National Marine Science Committee (NMSC) established a National Marine Baselines and Monitoring Working Group to provide advice on establishing and supporting a national program. The working group audited environmental social and economic baseline data describing Australia's marine estate and developed recommendations for the program.

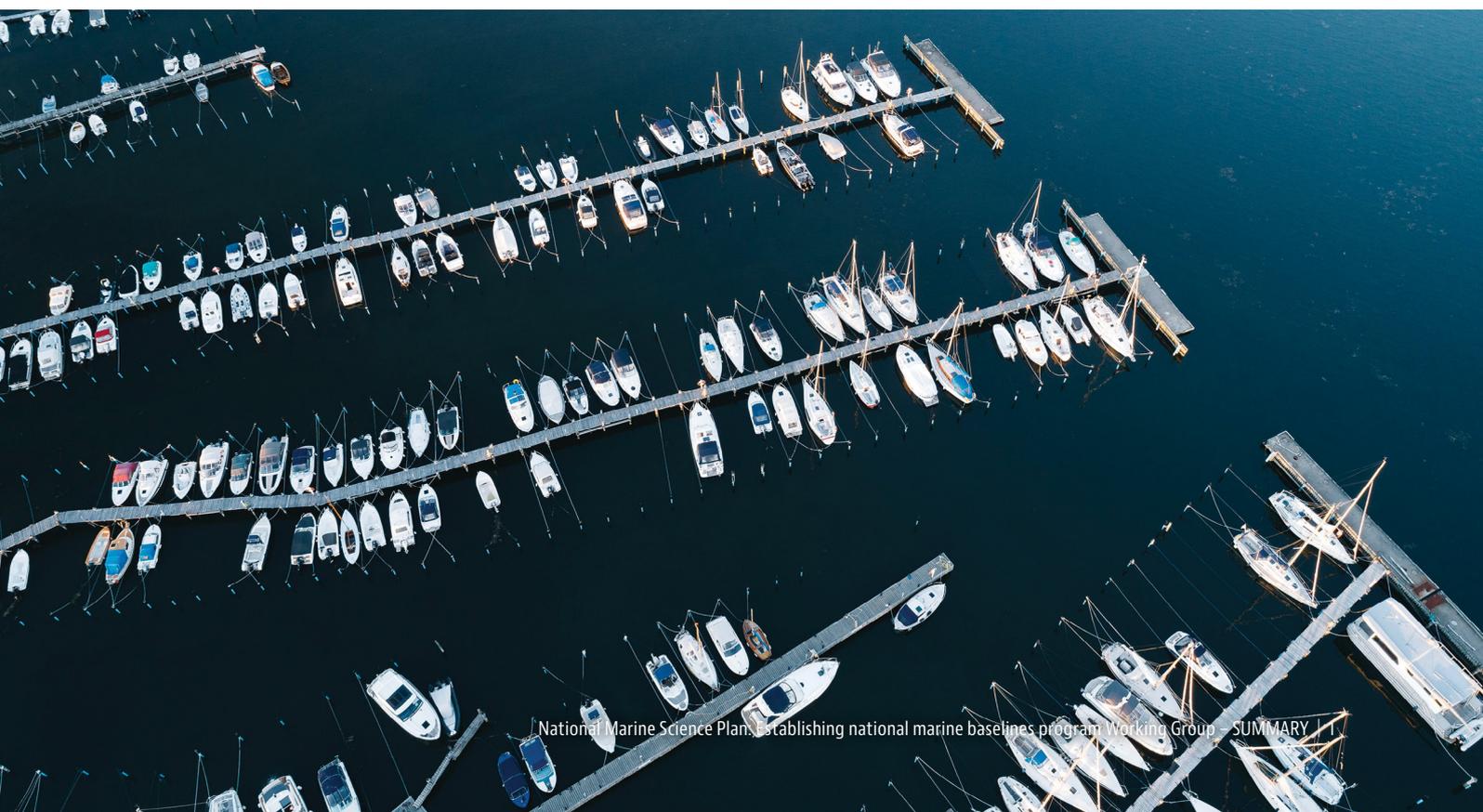
An effective national program needs a multi-decadal vision aligned with the needs and priorities of its partners, and secure funding. The program must be sufficiently flexible to respond to new pressures and priorities.

The audit identified 371 marine baseline and monitoring programs. Approximately 9 per cent of programs were national, with 84 per cent state-wide, regional or local. Thirty per cent of data are open access.

The working group documented the physical, biogeochemical, biological, ecosystem and pressure variables measured by existing programs and assessed their readiness for incorporation into a national monitoring program. Among the 53 variables identified, 27 had high readiness and 9 had moderate readiness. These variables could form the basis of a national baselines and monitoring program.

The working group identified two options for establishing a national approach to marine baselines and monitoring. The first was a step-change approach that would require new funding. The second was an incremental approach that drew on collaboration and existing funds; or a combination of these two options. In addition, the report recommends six steps for establishing a national marine baselines and monitoring program.

This report provides a summary of the National Marine Science Committee report entitled *Establishing and Supporting a National Marine Baselines and Monitoring Program*. The committee's report outlines an approach to Recommendation 2 of the National Marine Science Plan.



Background: National Marine Science Plan |

The National Marine Science Plan draws together the knowledge and experience of Australia's marine research organisations, universities and government departments, including more than 500 scientists. It outlines the science needed to develop the knowledge, technology and innovation to support Australia's marine ecosystems and grow our blue economy.

The plan focuses on driving actions and investment to address seven interconnected grand challenges facing Australia's marine estate. These are: marine sovereignty, security and safety; energy security; food security; biodiversity conservation and ecosystem health; urban coastal development; climate variability and change; and resource allocation.

The National Marine Science Plan will ensure marine science across Australia addresses the grand challenges with cutting-edge research that integrates social and economic factors and is conducted at the scales required. To do this, Australia needs a coordinated, national approach that harnesses the collective capability of our marine science community working collaboratively with industry, government and community.

The plan sets out high-level recommendations for tackling the grand challenges to help Australia fulfil our blue economy potential and prosper as a marine nation.

This document summarises the National Marine Science Committee's *Establishing and Supporting a National Marine Baselines and Monitoring Program Working Group Report, 2021*, by Paul Hedge and colleagues (available at www.marinescience.net.au). It outlines an approach to fulfilling the following National Marine Science Plan recommendation:

Recommendation 2. Establish and support a national marine baselines and long-term monitoring program, to develop a comprehensive assessment of our estate, and to help manage Commonwealth and state marine reserves.

Access the National Marine Science Plan at: <https://www.marinescience.net.au/nationalmarinescienceplan>

Image: Bob Beattie, CSIRO



Benefits of a national approach |

Australia's coastal marine ecosystems have enormous economic, environmental and socio-cultural value. They are a key part of Australia's marine natural capital, with assets and services valued at tens of billions of dollars.

Marine environments and ecosystem services are under threat. Pressures include sea-level rise, acidification, ocean warming and marine heatwaves, tropical cyclones, unsustainable fishing, wildlife disturbance, habitat loss, and plastics and other pollution.

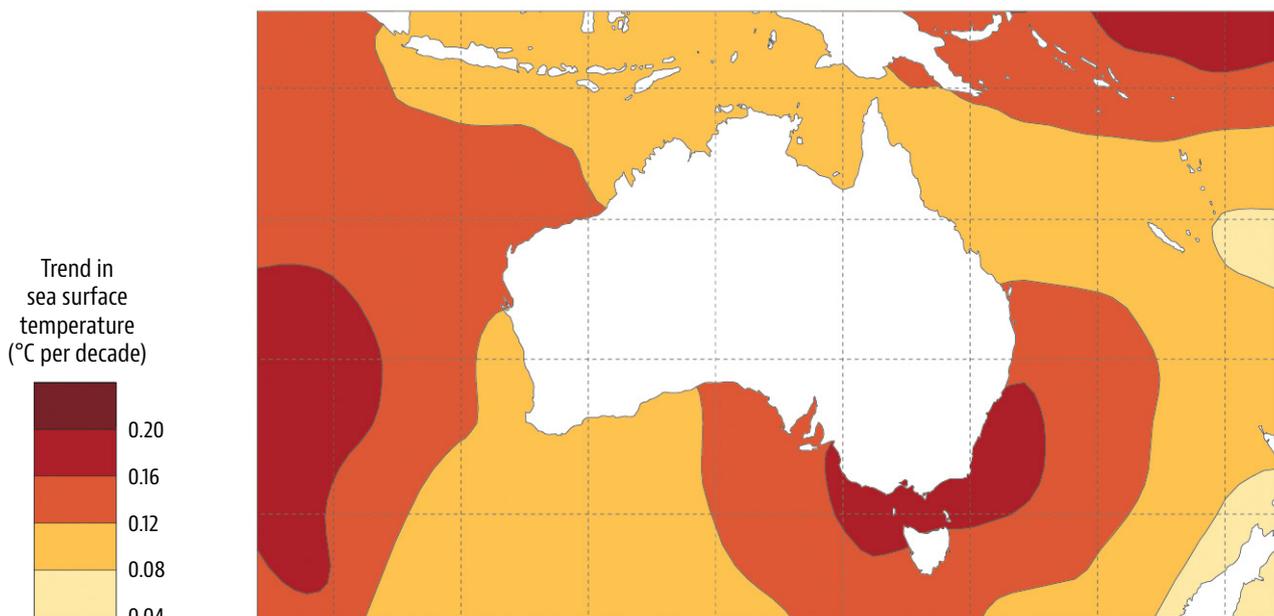
A national approach to establishing marine baselines and monitoring is needed to:

- provide an evidence-based understanding of the status and trends in the health of marine ecosystems
- evaluate environmental risks
- assess the oceans' potential to provide resources
- evaluate the economic and social effectiveness of management actions
- better understand changes driven by natural variability
- improve seasonal and long-term climate prediction
- determine the effectiveness of conservation measures for marine protected areas and unprotected areas.



Image: John Turnbull, www.marineexplorer.org

“An effective national program needs a multi-decadal vision aligned with the needs and priorities of its partners, and secure funding.”



The ocean surface around Australia has warmed, with more rapid warming in oceans to the southeast.

Source: Bureau of Meteorology

National marine baselines and long-term monitoring program |

The objective of a national marine baselines and monitoring program is to aggregate social, economic and environmental data sets held by government agencies, universities and industry, and establish methods and standards for environmental baselines and long-term monitoring.

The NMSC established a National Marine Baselines and Monitoring Working Group to provide advice on establishing and supporting a national monitoring program. The working group focused on two goals:

1. Undertake a systematic audit of environmental, social and economic baseline data describing Australia's marine estate
2. Establish a national marine system monitoring program to track changes in the marine estate.

A national program would complement sector, national and state-based programs and meet requirements of national reporting, such as those associated with the State of the Environment and State of the Climate reports. The program would better support reporting against international agreements and commitments, including the UN Sustainable Development Goals, and Convention of Biological Diversity targets.

The program would include data collected by Indigenous programs, recognising that Aboriginal and Torres Strait Islander organisations are becoming increasingly interested and skilled in establishing monitoring programs focused on culturally important habitats and species, and the pressures that affect them. It would also build on established and emerging citizen science initiatives that have national (e.g. Reef Life Survey, RedMap) or regional (e.g. Seagrass-Watch) scales. An effective national program needs a multi-decadal vision aligned with the needs and priorities of its partners, and secure funding. The program must be sufficiently flexible to respond to new pressures and priorities.

What are baselines?

Baselines are the initial or background conditions against which changes over time or the impacts of activities such as resource extraction, natural or anthropogenic disturbances or environmental protection measures can be compared. Baseline values for variables such as sea surface temperature, sea level, oxygen and nutrient concentrations, pH, fish abundance and distribution, species extraction, and the amount of marine debris and pollution are commonly considered when assessing the health of the oceans.

By regularly monitoring these variables, scientists can track changes in ocean health. This allows assessment of the effectiveness of management activities, such as those designed to combat overfishing or reduce plastics entering the ocean.

Systematic collection and reporting of priority marine baseline and monitoring data are critical for effectively managing Australia's marine resources and iconic ecosystems.

Image: John Turnbull, www.marineexplorer.org

Australia's baselines and monitoring programs |

Monitoring of Australia's marine estate extends back to the First Peoples. Insights from monitoring are embedded in the traditional knowledge and cultural practices of Australia's Aboriginal and Torres Strait Islanders.

Since colonisation, there has been monitoring of some variables in the marine environment and its resources. Some of the national reference stations operated by the Integrated Marine Observing System (IMOS) have been collecting data for over 70 years.

An audit of Australian marine baseline and monitoring programs identified 371 programs. Most focused on biological, chemical and physical attributes. Approximately 9 per cent of programs were national, with 84 per cent state-wide, regional or local. Most do not employ common national standards. Only 30 per cent of Australia's marine baseline and monitoring data are open access while 50% are either restricted or confidential.

The Australian Ocean Data Network (AODN) is the central repository for a standards-based approach to managing Australia's marine physical, biogeochemical and biological data.

Readiness for national-scale monitoring

The audit of marine baseline and monitoring programs identified 53 physical, biogeochemical, biology, ecosystem and pressure variables for which data were collected by existing monitoring programs. Pressure variables represent system stressors, such as pollution, species extraction, oil spills and ocean acidification.

The readiness of these variables to be incorporated into a national-scale monitoring program were assessed based on criteria such as whether there was a national need and agreement on how they should be sampled, monitored and reported. This assessment identified 27 variables with high readiness and 9 variables with moderate readiness that could form the basis of a national program of baselines and monitoring (Table 1).

Table 1: Variables measured in existing monitoring programs and their states of readiness for incorporation into a national-scale monitoring program.

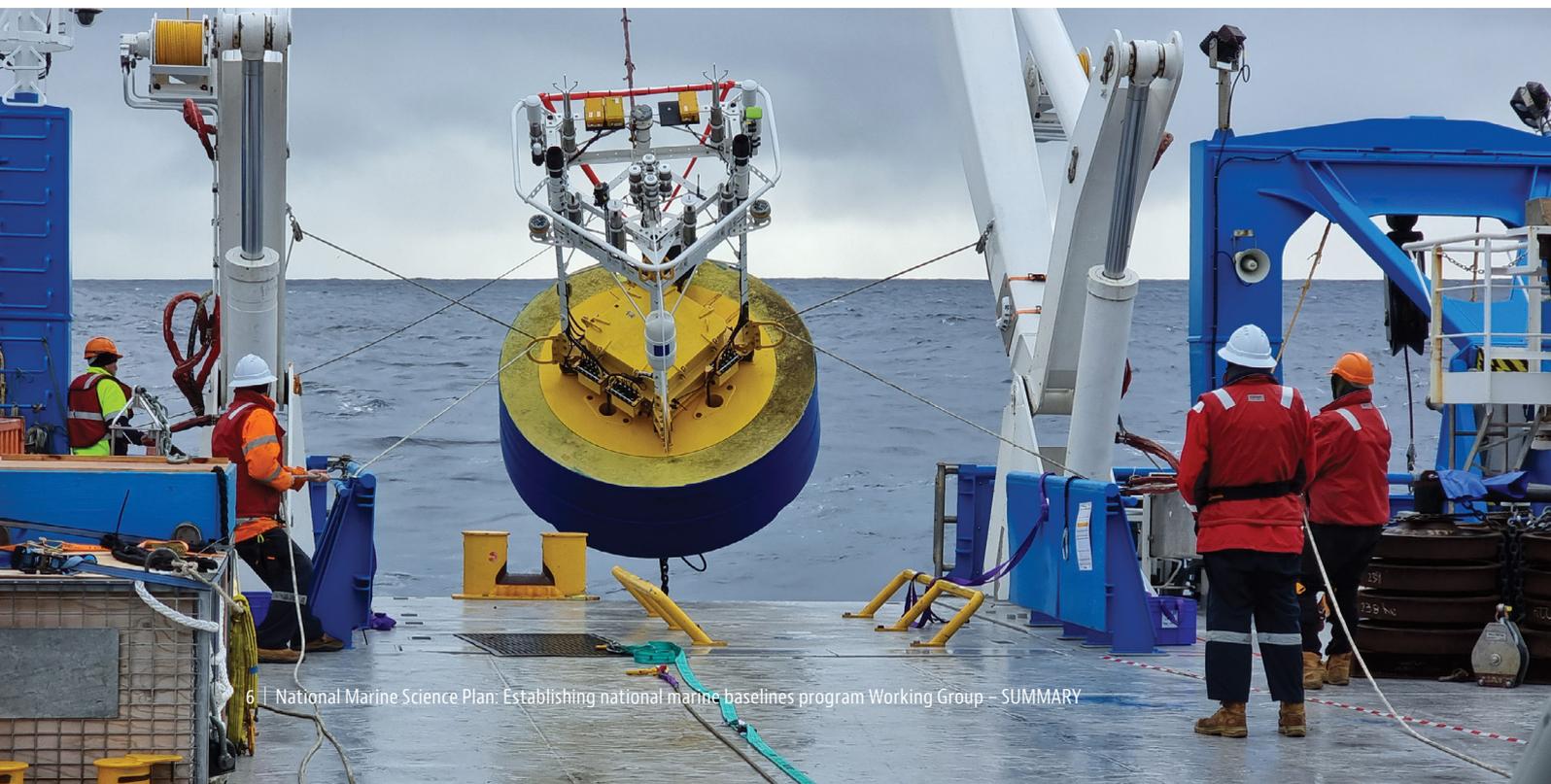
Readiness	Variable type		
	Physical	Biogeochemical	Biology and ecosystem
High	Sea state Ocean surface stress Sea surface height Sea surface temperature Subsurface temperature Surface currents Subsurface currents Sea surface salinity Subsurface salinity Ocean surface heat-flux Bathymetry Sediments	Oxygen Nutrients Inorganic carbon Particulate matter	Plankton biomass and diversity Zooplankton biomass and diversity Fish abundance and distribution (fishery dependent) Fish abundance and distribution (fishery independent) Microbe biomass and distribution
Moderate	None identified	None identified	Marine birds abundance and distribution Marine reptiles abundance and distribution Marine mammals abundance and distribution Hard coral cover and composition Seagrass cover and composition Macroalgal canopy cover and composition Mangrove cover and composition
Low	None identified	None identified	Invertebrate abundance and distribution
To be advised	Sea ice	Transient tracers Nitrous oxides Dissolved organic carbon Stable carbon isotopes	

Table 2: Pressure variables measured in existing monitoring programs and their states of readiness for incorporation into a national-scale monitoring program.

Readiness	Pressure variable
High	Oil/chemical spills Species extraction Outbreaks of disease Ocean acidification Sea level rise Altered ocean currents
Moderate	Storm activity and extreme events Incidental catch of species of conservation concern
Low	Outbreaks of pests Marine debris Seafloor habitat damage Wildlife disturbance Vessel strike Noise pollution Light pollution Physical habitat disturbance
To be advised	Contaminants Sediment run-off Nutrients and organic matter



Image: David Flynn, CSIRO



Insights from national and international initiatives |

The Global Ocean Observing System (GOOS) provides a potential approach for an Australian national baseline and monitoring program. Established in 1991, GOOS coordinates global oceanic observations of climate, operational services and marine ecosystem health.

GOOS has multi-tiered governance, identifies essential ocean variables, maintains sustained observations, encourages data sharing and includes regular evaluation. A framework for ocean observing within GOOS details requirements and assesses observation technology and the usefulness of data and products.

Australia's IMOS has operated since 2006, undertaking long-term observations of physical, chemical and biological variables at ocean-basin and regional scales. IMOS has benefitted from related investments in remote sensing, vessel operation, marine data management, and ocean and coastal modelling. The observing system has grown in response to changing national priorities. IMOS observations are guided by peer-reviewed science and planning undertaken by the marine and climate science community in consultation with industry, government management agencies, and research institutions.

Other relevant programs include the:

- Reef 2050 Integrated Monitoring and Reporting Program (RIMReP), which was announced in 2015 by the Australian and Queensland Governments to track progress toward targets articulated in the Reef 2050 Long-term Sustainability Plan
- New South Wales Marine Integrated Monitoring Program which advises the NSW Government on policies, priorities and management of the marine estate.

These four initiatives coordinate a range of existing and developing baseline and monitoring programs to meet the needs of users. The common elements across the four programs provide insights into how to establish and support a national marine baseline and monitoring program for Australia. These elements include:

- Mandate for observing and monitoring
- Oversight committee(s)
- Expert committee(s) to provide advice
- Principles to guide decision-making
- Priorities for coordination and investment
- Strategy for developing programs
- Framework for promoting coordination (language, logic and processes)
- Distributed networks
- Standards for data collection and management
- Reporting products
- Projects to develop and expand the program.

Image: Jakob Weis, University of Tasmania



Conclusion and recommendations |

There is considerable support for a national approach to marine baselines and monitoring. Australia has considerable experience and numerous programs to build on. An effective mandate and oversight arrangements will be critical to establishing a national approach.

There is the need for a limited set of national monitoring priorities designed to meet the requirements of data users. The national approach must accommodate societal needs, prioritised variables, national monitoring networks and clearly define program outputs and reporting.

The working group identified two options for establishing a national approach to marine baselines and monitoring. The first was a step-change approach that would require new funding. The second was an incremental approach that drew on collaboration and existing funds. A combination of these two options could also be used.

The Working Group recommended the following steps to develop a national marine baselines and monitoring program:

1. **Discuss and agree on the preferred mechanism for establishing an explicit mandate to advance a national approach.** Ideally, the mechanism extends beyond the National Marine Science Plan to capture parties such as state and territory government agencies, Indigenous organisations and industry.
2. **Discuss and agree on a preferred governance model.**
3. **Establish an ongoing NMSC subcommittee with terms of reference, a chair and secretariat and a call for members.**
4. **Propose a set of principles and common framework to guide decision-making and promote coordination.**
5. **Consider the two options (step change program and incremental collaboration) and determine the NMSC's support for one or both.**
6. **Consider options for promoting the establishment of a national marine baselines and monitoring program, such as establishing a brand, regular symposia and a virtual roadshow.**

Image: John Turnbull, www.marineexplorer.org



IMOS Integrated Marine Observing System



IMOS undertakes systematic and sustained observing of Australia's marine estate.



Operates a portfolio of platform-based Facilities to acquire ocean observations.



Plans its operations through internationally peer-reviewed science processes.



Engages with users across universities, governments, and industries to drive uptake and impact.

Our Facilities include

Deep Water Moorings



Ships of Opportunity



Satellite Remote Sensing



Ocean Radar



Ocean Gliders



Autonomous Underwater Vehicles

National Mooring Network



Animal Tracking #1 Acoustic Telemetry

Argo Floats



Animal Tracking #2 Animal Tagging



Marine Microbiome Initiative



New Technology Proving



Australian Ocean Data Network

IMOS is enabled by





NATIONAL MARINE SCIENCE – COMMITTEE –

NATIONAL MARINE SCIENCE PLAN
Establishing and supporting a national marine
baselines and monitoring program
Working Group Report

SUMMARY

The full technical report, and a PDF of this summary,
are available at

www.marinescience.net.au

