

National Marine Science **Plan**
Science program to support **Decision-making**

**Implementing Integrated Ecosystem
Assessments (IEAs)** Working Group Report

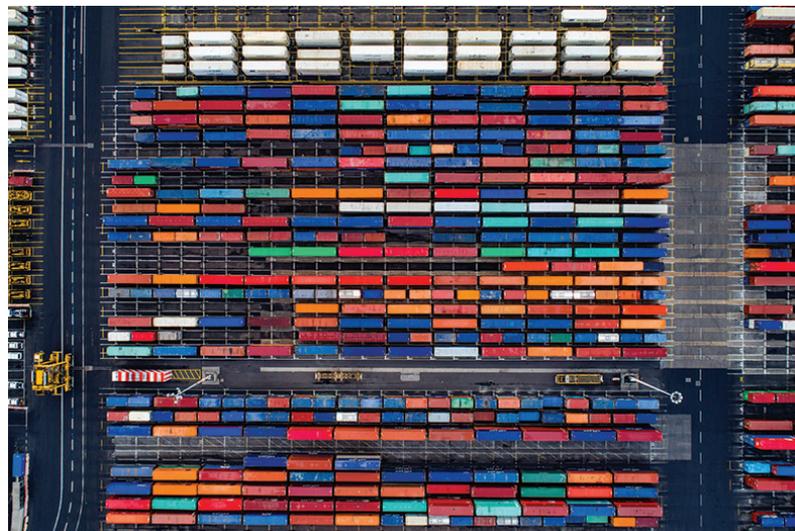
S U M M A R Y

NATIONAL
MARINE
SCIENCE
– COMMITTEE –



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CITATION

This document is a summary of:
Smith DC, Fulton B, Bax N, Boxshall A,
Dunstan P, Hayes K, Jordan A & Ward T (2021).
National Marine Science Plan science program
to support decision making: implementing
Integrated Ecosystem Assessment (IEA)
Working Group report, report to the National
Marine Science Committee, Australia.

Acknowledgement of Country |

The NMSC 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 |

The uses of ocean and coastal resources are expanding at a rapid, almost exponential rate. The multiple, sometimes conflicting, uses in an increasingly crowded marine environment make sustainable management of our oceans and coasts difficult.

Management decisions must balance the resource, economic, cultural and environmental needs and desires of many competing users. Such complexity in decision-making can be costly.

Integrated Ecosystem Assessments (IEAs) are emerging as the preferred process internationally to solve complex marine and coastal system management questions. The IEA approach is an interdisciplinary, policy-orientated, strategic planning process for combining, interpreting and communicating knowledge from diverse sources to inform and enhance decision-making.

IEAs do not replace other ways of marine planning and decision-making. They are an overarching tool that provides a broader scope to account for science and socio-economic considerations to avoid conflict.

IEAs have never been fully undertaken in Australia. However, several case studies contain elements of IEAs and these provide insights into what steps of the IEA process may work in the Australian context.

Four potential pilot projects, in the Spencer Gulf, Victorian coastline, NSW marine estate, and Northern Australia, could demonstrate that the IEA approach meets Australia's needs. An additional potential pilot (Westport) was suggested following the completion of this report. To progress the pilot projects, the next step in the IEA process is to start with manageable components of the larger problem in a staged manner.

While the IEA process can seem daunting, it provides an approach to managing crowded and stressed marine and coastal systems.

This document summarises the National Marine Science Committee *Implementing Integrated Ecosystem Assessments* report. The committee's report outlines an approach to Recommendation 5 of the National Marine Science Plan.



Background: National Marine Science Plan |

The National Marine Science Plan 2015-2025 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 provides a framework for marine science across Australia to address 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 *Implementing Integrated Ecosystem Assessments Working Group Report, 2021*, by David C. Smith and colleagues (available at www.marinescience.net.au). The Integrated Ecosystem Assessment Working Group has now been expanded to involve decision-makers, policymakers and resource managers to develop an implementation plan. The report and related activities are a response to the following National Marine Science Plan recommendation:

Recommendation 5. Develop a dedicated and coordinated science program to support decision-making by policymakers and the marine industry.

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



Managing multiple ocean uses and users |

The uses of ocean and coastal resources are expanding at a rapid, almost exponential rate. Pressures on coastal and marine systems are increasing due to activities across multiple sectors such as fisheries, oil and gas, marine renewable energy, seabed mining, shipping, tourism, and urban and coastal development. Climate change, biodiversity loss and other environmental changes exacerbate these pressures.

Australia's marine industries are projected to contribute more than \$100 billion per year to our economy by 2025, with ecosystem services such as climate regulation, carbon dioxide absorption and coastal protection contributing a significant additional amount. The OECD estimates the value of the blue economy globally will grow to \$US 3 trillion by 2030.

However, the multiple, sometimes conflicting, uses in an increasingly crowded marine environment make sustainable management of our oceans and coasts difficult. Management decisions must balance the resource, economic, cultural and environmental needs and desires of many competing users.

The number of interactions involved in these complex systems presents challenges for those managing marine-related activities, given potential conflicts between users, pressure on marine systems and often contentious decision-making. This is exacerbated by current management processes that usually treat individual ocean uses separately, with fisheries, conservation, energy, shipping and coasts generally handled by different regulatory bodies and jurisdictions. Even related industries such as aquaculture and fisheries are often managed under different legislative arrangements.

Such complexity in decision-making can be costly. Environmental damage to marine ecosystems, including clean-up and lost resources, is estimated to cost US \$13 billion annually. Delays in decisions on whether developments can progress can cost industry tens to hundreds of millions of dollars a year in Australia.

While most marine industries have decision-support systems individually, Integrated Ecosystem Assessments (IEA) are emerging internationally as the preferred process to consider multiple sectors together to solve complex marine and coastal system management questions (Figure 1). However, while IEAs are starting to be investigated in some parts of Australia, they are not yet fully implemented, and aspects of the approach have only been operating recently.

“Management decisions must balance the resource, economic, cultural and environmental needs and desires of many competing users.”

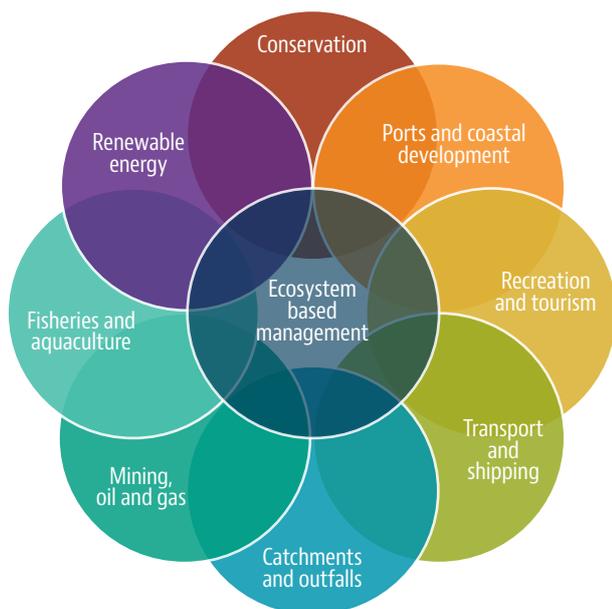


Figure 1: The IEA process focuses on multiple uses of the marine environment.

Integrated Ecosystem Assessments |

The IEA approach is an interdisciplinary, policy-orientated, strategic planning process for combining, interpreting and communicating knowledge from diverse sources to inform and enhance decision-making. While quantitative modelling may be a component, Integrated Ecosystem Assessments involve other components, some qualitative, in an iterative process.

The system-wide perspective of IEAs identifies trade-offs in the management of different marine industries and sectors, and explicitly considers uncertainty and cumulative impacts. IEAs encompass the natural world and its users, including social, cultural and economic considerations. They draw on information from many sources and involve transdisciplinary science, industry, regulatory bodies, First Nations people, non-government organisations, and community groups.

IEAs have mainly advised management in regional seas around North America and Europe. In particular, IEAs have been used to identify where the cumulative pressure from multiple activities could be leading to a breach of intended legislative objectives that a single sector evaluation would miss. This requires understanding the relationship between human activities and marine ecosystems, estimates of pressures and effects, and science-based advice on sustainable use and management options.

The IEA approach in Europe and the US has improved the handling of development planning and approvals in complex landscapes and in contested areas containing high biodiversity and cultural values. In particular, industry and agency decision-makers are better prepared to avoid, mitigate or offset risks to the region's environmental, economic, social or cultural values.

“ *The system-wide perspective of IEAs identifies trade-offs in the management of different marine industries and sectors, and explicitly considers uncertainty and cumulative impacts.* ”

Other approaches and processes use many components and tools of the IEA process. This experience will help with implementing IEAs in Australia. However, existing approaches are primarily based on single sectors where objectives identified relate only to one sector. The IEA process is more comprehensive and focused on assessing the impacts of multiple sectors with objectives across all sectors and potentially shared goals between sectors.

IEAs do not replace other approaches to marine planning and decision-making. They are an overarching process that proves a broader scope to account for science and socio-economic considerations to avoid conflict.

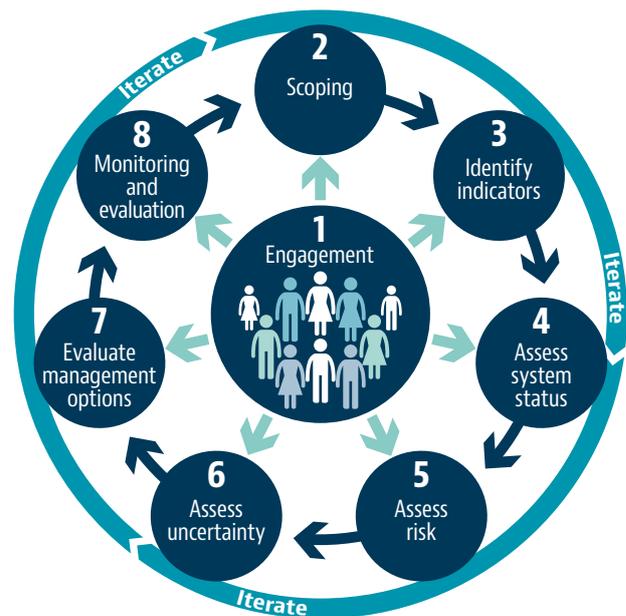


Figure 2: Integrated Ecosystem Assessment is an iterative process.

Steps in the IEA process

An Integrated Ecosystem Assessment is an interdisciplinary and policy-orientated process. The iterative steps in the process (Figure 2) are:

- 1 Engagement:** The first and most fundamental step in IEA is initial and ongoing engagement to keep participants informed, address needs and issues, reduce misunderstanding and build support for management actions. The transdisciplinary process brings together knowledge and perspectives from within and beyond the different scientific (biophysical, economic, social science) disciplines to include industry, regulators, traditional owners and other members of civil society. Engagement is not a one-off; it needs to occur throughout the process.
- 2 Scoping:** Identify, in consultation with stakeholders and experts, the context, including timing, geographic area, valued environmental, economic, social and cultural components of the system to be managed, and associated pressures and management objectives.
- 3 Indicator development:** Identify appropriate measurements that track the status and any changes in the system ecosystem and socio-economic components. They may be the status of a specific species (e.g., endangered), or more systemic (e.g., ocean colour), or calculated from another property (e.g., ocean health index). This step also identifies any gaps in available data.
- 4 Ecosystem assessment:** Integrate information across the set of indicators to assess the system's status and trends relative to historical conditions and the management goals.
- 5 Risk assessment:** Determine the likelihood that each indicator will reach or remain in an undesirable state, given the combined impact of existing pressures and proposed activities. The risk assessment method should include all relevant activities, identify the pressures and hazards that result in impacts, and then assess the likelihood of impact due to those stressors.
- 6 Uncertainty assessment:** Identify uncertainties associated with the risk analyses, indicator values, existing knowledge, different value systems, and the variability of natural systems. This includes uncertainty that arises through the vagaries of language, a limited understanding of natural systems, variability in the system, and decision uncertainty associated with our value systems and management.
- 7 Evaluating management options:** Translate the findings of the previous assessment steps to informally compare or formally evaluate the different options that can achieve management objectives.
- 8 Monitoring and evaluation:** Continued monitoring (involving the systematic collection of environmental, social and economic data) and assessment of indicators are required to demonstrate the effectiveness (or failure) of any implemented management actions.
- 9 Iteration:** IEAs are an iterative and adaptive process with the entire cycle, or parts of it, cycling through as needed. Revisiting the engagement step is essential to keep interested parties informed, reduce misinformation, and build support for management interventions.



“ *Integrated Ecosystem Assessments (IEAs) are emerging as the preferred process internationally to solve complex marine and coastal system management questions.* ”



Image: John Turnbull, www.marineexplorer.org





IEAs have never been fully undertaken in Australia. However, several marine and coastal case studies, and terrestrial and freshwater management approaches, contain elements of IEAs. These case studies (Figure 3) are the best available Australian examples of assessments on the path to an IEA and provide insights into what works and what is required in the Australian context in relation to the individual steps of the IEA process.

GLADSTONE HARBOUR

Gladstone Harbour is one of Australia's largest multi-commodity ports and supports a range of diverse uses, including parks, fisheries, extensive urban areas, a major power station, heavy industry, and export terminals for inland mining and gas.

In response to a lack of best practice management and overly complex government oversight of the harbour, the Queensland Government established the Gladstone Healthy Harbour Partnership, with more than 20 partners across industry, Indigenous representatives, regulatory bodies, community groups and academia. The partnership has developed environmental, economic and social objectives and a monitoring regime for the harbour. It uses a range of tools to advise policy, management and regulatory agencies, industry and other stakeholders.

This case study shows a need to consider cumulative impacts because individual sector regulations, no matter how stringent, may not deliver. It offers transparency and engagement that are key to public acceptance and uptake of management decisions.

SOUTH-EAST AUSTRALIAN FISHERIES

The Alternative Management Strategies Project, for Australia's Southern and Eastern Scalefish and Shark Fishery, while focused on fishing, considered interactions and trade-offs between multiple fishery sectors with a range of management structures and covered many of the components of an IEA.

The project used different (qualitative and quantitative) methods to predict the consequences of alternative management scenarios. The qualitative stage used expert knowledge and based predictions on a whole-of-ecosystem model (Atlantis). The quantitative approach was influential in setting a new direction for the management of the fishery, and the qualitative approach had a greater influence on management changes and stakeholder uptake and action. This demonstrates that an IEA could occur without the need for developing new, complex quantitative models. It also highlights the value of a responsive and timely set of interactions with interested stakeholders who are motivated to act.

GREAT BARRIER REEF

The Great Barrier Reef was one of the first locations in the world to recognise the need to manage increasing human uses to avoid threatening a range of environmental, economic and socio-cultural values. Integrated planning of the GBR began with the gradual declaration of park boundaries and the creation of zoning plans.

A shared vision, which has evolved over time, was developed among stakeholder groups of what integrated management meant for the region. This process is an example of successful and strong consultative and participatory engagement that resulted in trusted relationships among participants. However, gaps remain in aspects of the ecosystem beyond the focus on reef habitat and water quality.

BIOREGIONAL ASSESSMENT

The Bioregional Assessments are a series of assessments of the potential cumulative impacts of coal seam gas and coal mining developments on water resources and ecosystems such as rivers, wetlands and forests in central and eastern Australia.

A lot may be taken from these terrestrial experiences around handling large-scale, cross-jurisdictional and cross-industry efforts and the associated uncertainties. However, the assessment does not provide monitoring and evaluation of its predictions and does not evaluate the effect of alternative management strategies. The assessment also does not account for the effects of climate change on the hydrological variables.

NINGALOO

The Ningaloo coastal region in Western Australia includes the 300 km Ningaloo Reef and has an economy that features fishing, mining, horticulture and livestock. Tourism also has a significant role in the region.

The Ningaloo Research Program provided information to assess and modify operations and management strategies to ensure the sustainability of marine resources and human communities. It created comprehensive assessment models, data sets and understanding for the region, and worked with stakeholders to identify information and processes required for effective integrated coastal management.

- Majority of steps complete
- Major component missing
- No / little progress

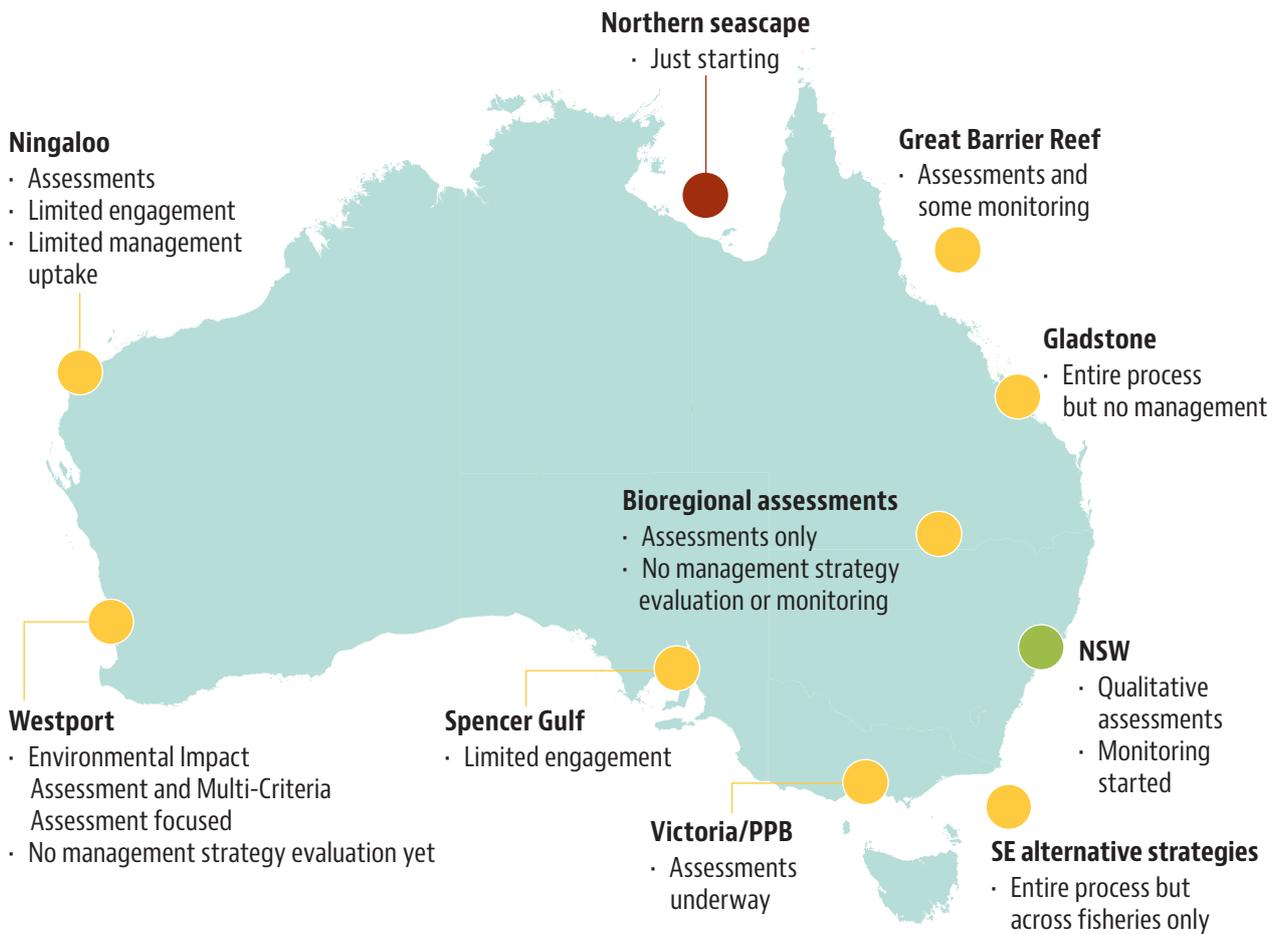


Figure 3: Location of historical case studies and ongoing pilot projects on which IEA approaches can be built.

“ These case studies are the best available Australian examples of assessments on the path to an IEA and provide insights into what works and what is required in the Australian context in relation to the individual steps of the IEA process.

PILOT PROJECTS



Four potential pilot projects were suggested to evaluate whether the IEA approach meets Australia's needs. The pilot projects (Figure 3) cover a range of locations, different spatial extents and represent areas of differing user complexity, including competing objectives, needs and uses, and different levels of data and knowledge. The four potential pilots could ensure the IEA approach meets Australia's needs. An additional potential pilot (Westport) was suggested following the completion of the report.

SPENCER GULF, SOUTH AUSTRALIA

The Spencer Gulf is a region of high economic and cultural importance. Management of Spencer Gulf is delivered through at least 15 different South Australian Government Acts, with limited cross-referencing between different pieces of legislation, despite many having broadly similar objectives. Management decisions are often made without fully considering the region's overall social, economic and ecological status. Cumulative impacts are not considered explicitly. There is also no clear basis for assessing trade-offs between different uses of the environment.

Marine Innovations Southern Australia (MISA), established in 2005, is a collaboration of South Australia's key government agencies responsible for natural resource management and industry development, peak seafood industry organisations, universities and marine research institutions. The involvement of industry, government and researchers in MISA makes it an excellent vehicle to trial the implementation of IEAs in Australia.

Much of the preliminary work needed to support an IEA of Spencer Gulf has already been done. Available data have been collated and a range of decision support tools established. A series of field surveys have tested the tools to make sure they are making reliable predictions that provide meaningful inputs to planning and decision-making.

The next step is to conduct a full IEA, which would need to renew the focus on engagement with key government and industry stakeholders, and consolidate the collated datasets into a smaller subset of indicators to monitor the status of Spencer Gulf and evaluate the impacts of future activities. The cost of undertaking a full IEA of Spencer Gulf would be approximately \$2-3 million.

WESTPORT, FREMANTLE, WESTERN AUSTRALIA

Fremantle Harbour has been an important port for Western Australia for over 100 years. It is a gateway to the west, essential both as a trading port and for the population of Perth's growing urban development.

The Western Australian government's development and modernisation of Kwinana, the outer harbour, is taking an integrative, evidence-based and inclusive approach. This is in line with an IEA and is considered critical for the area given the drop in resilience in the region over the past 60 years due to increasing urbanisation, recreational pressure and industrial traffic. There is a desire to recognise, plan for and mitigate or offset any impacts to the local environment associated with the development. This way of thinking about the issues and the links across interested parties, topics and the full supply and value chain is in line with an IEA.

The Western Australian Marine Science Institution (WAMSI) is leading the research program for the development and planning processes. This program will provide baselines for ongoing monitoring, inform mitigation and management strategies and provide simulation and decision support tools. By the end of the program, many of the steps of a full IEA will be partially complete. A modest investment of approximately \$500,000 would be required to take this through to a full IEA.

“ *The pilot projects cover a range of locations, different spatial extents and represent areas of differing user complexity, including competing objectives, needs and uses, and different levels of data and knowledge.* ”

VICTORIAN COASTLINE

There are two distinct geographic options for a Victorian site in a broader national pilot study of IEA:

- Port Phillip Bay, one of Australia's busiest ports and Victoria's most used body of water, has recreational and commercial fishing and aquaculture. The surroundings are home to 70 per cent of Victoria's population.
- State-wide (the Outer Coast), including the entire Victorian marine environment, has different industry and fisheries drivers than Port Phillip Bay. One important benefit of the Outer Coast being considered for an IEA pilot study is the new Marine Spatial Planning Framework, designed to enable decision-making to resolve cross-sectoral conflicts over use in the Victorian marine environment.

Port Phillip Bay or the Victorian coast presents an opportunity for a large-scale pilot IEA to be done relatively quickly, as the Victorian Commissioner for Environmental Sustainability is required to deliver a State of the Marine and Coastal Environment for Victoria in the coming years.

An IEA pilot in this region would require an investment in the range of \$3-4 million.

NSW MARINE ESTATE

The NSW marine estate is one of the most significant natural resources in NSW. It includes around one million hectares of estuary and ocean, with over 1,750 kilometres of ocean coastline. Over six million people live within 50 kilometres of the coast, including the people of eleven coastal Aboriginal nations intimately connected to their Land and Sea Country.

The Marine Estate Management Authority (MEMA) brings together the heads of the NSW Government agencies with key marine estate responsibilities, advising the NSW Government on policies, priorities and the direction of management of the marine estate. Components that could contribute to an IEA approach include results of a threat and risk assessment of the entire marine estate, a description of the region's environmental assets and evaluation of the threats to these assets, the identification

and categorisation of the benefits that communities gain from the marine estate and the threats and risks to those benefits, management objectives actions, and measurement and reporting processes. The social, cultural and economic component is being evaluated through a community wellbeing framework.

This is the most mature of the four pilots, with most IEA components completed. The components that require further attention include Uncertainty Assessment (which would benefit from a quantitative analysis) and Evaluation of Management Options (which has been partially completed). Completing these would provide greater certainty regarding potential future management options and trade-offs and could be undertaken for less than \$500,000.

NORTHERN SEASCAPES, NORTHERN AUSTRALIA

Northern Australia has significant and new opportunities for economic development and a landscape with environmental and cultural values of global, national, regional and Indigenous significance. However, some aspects of the system's content and function, as well as detail on the benefits provided by the system's values, are poorly understood or articulated. An IEA is the best means of addressing potential hurdles.

The Northern Integrated Environmental Assessment project, undertaken by the Australian Government's National Environmental Science Program (NESP) research hubs, aims to develop and demonstrate the value of an IEA approach. The project documents the available information, data needs, analysis and risk management approaches, and governance settings required for undertaking an IEA and associated decision-making, to articulate and demonstrate the value of undertaking an IEA.

While it is a work in progress, this provides an opportunity to initiate an IEA before many industries have sunk costs that can make it uneconomic to explore more integrated approaches. Additional funding to complete this IEA would be around \$2 million.



Next steps |

Based on the case studies and pilot projects, criteria identified for completing an IEA or progressing it include:

- **A clearly articulated need** where the IEA assists managers and industry to deliver sustainable outcomes effectively and transparently, maintains community support, reduces sovereign risk to investors, and provides significant resource and cost savings through better decision-making and less controversy.
- **Enabling elements** (such as policy, governance and long-term funding) to help legitimise the process and ensure implementation of resulting recommendations.
- **Effective, truly participatory and broad stakeholder engagement** through the entire process.
- **A socioecological focus** that captures social and economic as well as bio-physical dimensions.
- **Plenty of available data** across multiple industry and science domains and scales that can be drawn together in a useful and accessible way.
- **A staged manner**, such as collating data and assessing risk as a first step.
- **An ensemble approach** with multiple analyses and tools used together to allow the best handling of uncertainties, use of available resources, and opportunities for communication tailored to audience needs.
- **Clarity on spatial extent and scale** appropriate to the sectors and interest groups involved.
- **A governance framework** to help resourcing and legitimise and implement outcomes.
- **Positioned within an adaptive management context** that provides an ongoing commitment from management and industry to collect data and evaluate the effectiveness of management activities.

To complete, or progress, the pilots, the next step in the IEA process is to start with manageable components of the larger problem. The IEA process includes several distinct stages, and there are significant advantages to using a staged approach to complete each step. The first (often qualitative) iteration can advance prioritising actions, identifying gaps in knowledge, and bringing together the scientific community and other sectors. Further iterations may refine the information, but the individual steps have value in progressing understanding, synthesising data critical to decision making and bringing stakeholders together in a dialogue around expectations, objectives and possible actions.

Completing an IEA will also benefit other national and international activities. For example, maximising sustainable development benefits while minimising degradation is at the heart of the UN Sustainable Development Goals. Assessing cumulative impacts is also central to the UN Decade of Ocean Science for Sustainable Development.

While the IEA process can seem daunting, it is a process that is increasingly seen as the only way to manage crowded, stressed and changing marine and coastal systems. Starting or progressing an integrated decision-making process is cheaper, less risky and more robust than none at all. Without understanding how to complete such a process effectively, significant tension or conflict, economic loss and environmental degradation will continue.

Conclusion and recommendations |

Although Australia has pockets of capability for integrating decision-making in marine and coastal systems, these are dispersed across the country. We lack a national, coordinated and consistent approach to deliver these processes at a scale that would enable more effective decision-making.

The following recommendations are provided to address this gap:

1. **Support IEAs** as the preferred way to provide a dedicated and coordinated science program to support decision-making by policymakers and the marine industry.
2. **Undertake a national trial** of the potential pilots and evaluate the process and results of these pilots to develop a set of IEA guidelines for implementation across Australia.
3. **Adopt the criteria and considerations** identified in this report to ensure the effectiveness of future IEAs.



Scientists lower a PLAOS system over the side of RV Investigator.
Image: CSIRO



NATIONAL MARINE SCIENCE – COMMITTEE –

NATIONAL MARINE SCIENCE PLAN
Implementing Integrated Ecosystem Assessments (IEAs)
Working Group Report

SUMMARY

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

www.marinescience.net.au

