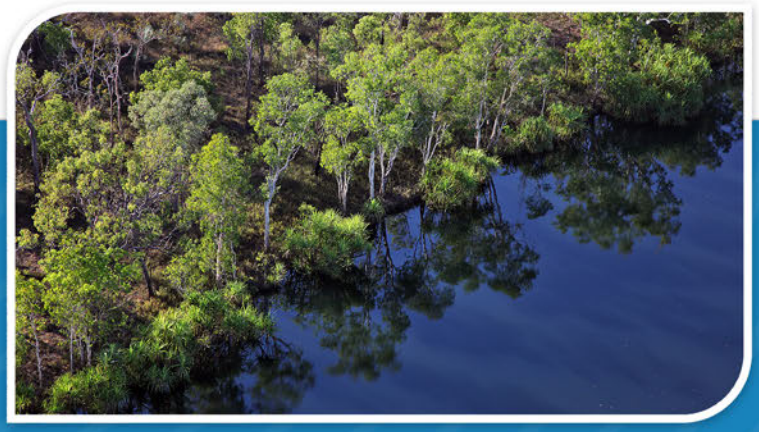

Northern Territory Marine Science

End-user Knowledge Needs Analysis - In Brief

NORTHERN TERRITORY GOVERNMENT

NAILSMA NORTH AUSTRALIAN INDIGENOUS LAND AND SEA MANAGEMENT ALLIANCE

Australian Government

AUSTRALIAN INSTITUTE OF MARINE SCIENCE

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CHARLES DARWIN UNIVERSITY

australian venture
CONSULTANTS PTY LTD

Northern Territory Marine Science

End User Knowledge Needs Analysis

January 2018

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Foreword

The Northern Territory's inhabitants are fortunate to enjoy life in one of the few remaining relatively intact tropical marine ecosystems in the world. In Australia, the Northern Territory marine environment is unique, in both its character and use. It has significant biological, ecological and cultural values, and hosts much of the industry in the Territory. However, this exceptional environment is facing increasing pressure from a broad range of human activities and demands, including climate change, resource use and development.

In the face of these pressures, government, regulators and industry are called upon to make policy, regulatory, strategic and operational decisions regarding human use of, and impacts on, the Northern Territory marine environment. In many instances, these decisions are not adequately informed by marine science knowledge and a poor decision can limit the prosperity and quality of life of the Northern Territory's people. As researchers and educators who work and live in the north, it is incumbent on organisations like ours to provide the knowledge that is needed to maintain marine ecosystems in a healthy state, so that all users can reap the benefits of the valuable resources without compromising their long-term sustainability. By assisting the decision-making processes of government, industry, community leaders and administrators with relevant marine science, our work can have a lasting impact on the future of the Northern Territory's precious ecosystems.

The Australian Institute of Marine Science (AIMS) and Charles Darwin University (CDU) are pleased to partner in the Northern Territory Marine Science End User Needs Analysis (NTMSEUNA). The NTMSEUNA provides us with a much stronger foundation from which to plan the marine research needed to protect the ecosystems of the Northern Territory and ensure the social and cultural values associated with the environment flourish. The NTMSEUNA identifies the marine science imperatives of all key stakeholders in the Northern Territory marine environment and includes a very comprehensive engagement with Indigenous communities regarding their aspirations and concerns for the marine environment. The NTMSEUNA brings to light the sheer volume and range of marine science that is necessary to ensure the environments are adequately preserved so that economic, social and cultural interactions can continue.

We thank Australian Venture Consultants and the North Australian Indigenous Land and Sea Management Alliance for their work in producing this comprehensive and important analysis and look forward to its implementation. We want to ensure that marine science research in the Northern Territory is applied and robust and focused on answering the important questions around marine ecosystem management and use, so that all stakeholders and end users enjoy the benefits for generations to come.

Dr Paul Hardisty

Professor Simon Maddocks

Traditional Aboriginal owners of land and sea *country* around Australia have never relinquished rights to our lands and waters. Our sense of belonging, identity and languages, our health, economy and futures are indelibly connected to our lands and seas.

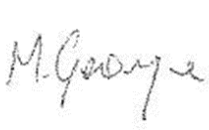
Today, many seek access to our *country* for many purposes; mining, tourism, the military, agriculture, conservation, Government agencies, research institutions and others. The pressures of this interest and development in north Australia more broadly, impact the health of our *country,* as they do us. We, as Traditional Owners, have a responsibility to care for our *country* and equally to grow up the next generations of kin to carry on this responsibility. It is not about 'protection' of environmental and cultural assets, but about active management and enhancement of these, about improved well-being and meaningful participation in wider economic activity.

Aboriginal people bring many valuable assets to the table: our *country*; local, historical and traditional knowledge; innovative thinking; permanently resident work force; and in the Northern Territory, strong land tenure and representation through statutory Land Councils. Our people have long participated in land and sea -based economic activity . . . from trade with Macassans, semi-industrial fishing during the Mission era, through to carbon farming and other ecosystem services, mining, arts and tourism and community based research. Our aspirations, experience and capabilities however, are relatively unrecognised in the development agenda.

Traditional Owners, like Governments and others, need to plan for development; make decisions about threats and opportunities; anticipate and monitor change; and manage and respond to impacts. For this we need good quality research and information, not just about environmental assets and issues relevant to development, but about proponents themselves, their outlook and interests. It's in our interests to drive and participate in research and development on our *country*: and it's in the quality of relationships amongst us and interested stakeholders that effective participation in a healthy and diverse northern economy can grow.

The NT Marine Science End User Needs Analysis (NTMSEUNA) has responded to this need for quality information by canvassing a broad range of stakeholders about their knowledge needs and research interests. This considerable effort and enormous compendium of information provides a unique and indispensable platform for better directed and better quality research, and importantly a positive step in engagement with the needs, interests and capabilities of Indigenous owners of land and sea *country*.

We look forward to building on respectful and productive relationships with the research community, and contributing to the application of wider and deeper knowledge to the many management challenges that face all of us in achieving prosperous and sustainable futures.



Melissa George

Chief Executive Officer

Peter Yu

Chair

North Australian Indigenous Land and Sea Management Alliance Ltd.

Summary of Findings

What is the Northern Territory Marine Science End User Needs Analysis?

The Northern Territory Marine Science End User Needs Analysis (NTMSEUNA) identifies the marine science imperatives of all key stakeholders in the Northern Territory marine environment.

Addressing these marine science imperatives will ensure that the important marine ecosystem services that the Northern Territory marine environment provides are optimally protected, the social and cultural values associated with that environment flourish and the industries operating within or intersecting with the Northern Territory marine environment achieves optimal levels of productivity and can operate with certainty.

The development of the NTMSEUNA has been funded by the Australian Institute of Marine Science and Charles Darwin University. The project has been overseen at arms-length by an independent Steering Group comprised of representatives of Northern Territory and Commonwealth Government policy makers and regulators, Aboriginal, industry and community interests in the Northern Territory marine environment, as well as marine science expertise. The analysis, consultation and drafting that has resulted in this report has been undertaken both separately and collaboratively by Australian Venture Consultants and the North Australian Indigenous Land and Sea Management Alliance Ltd.

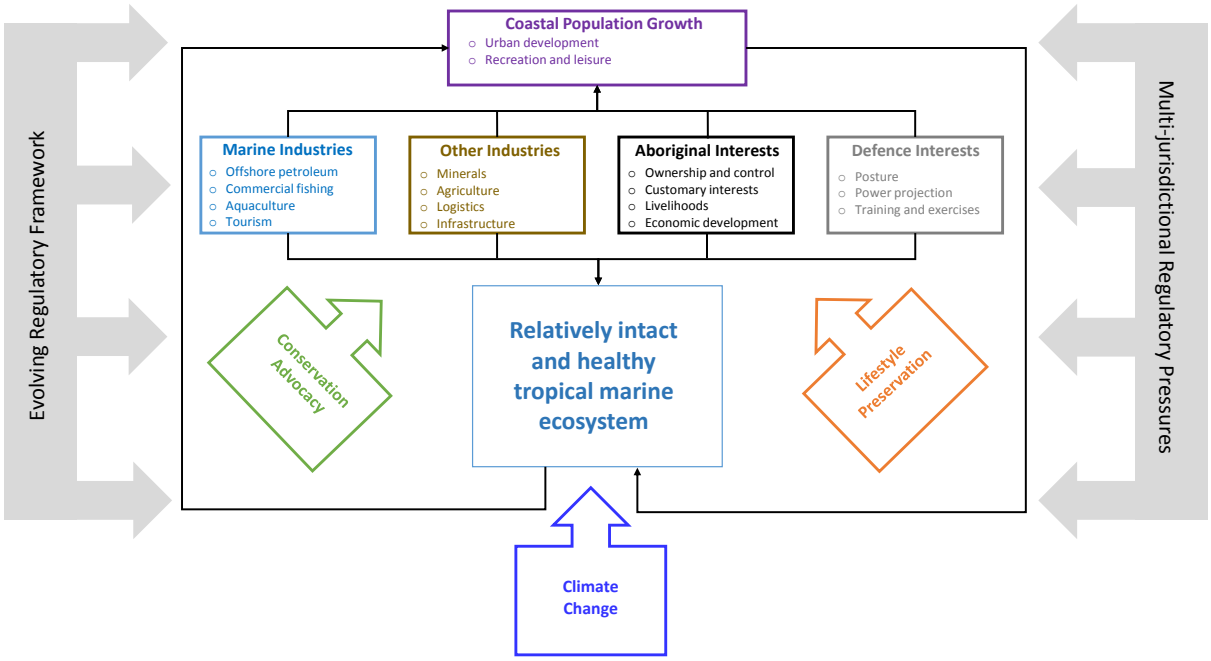
Why is the Northern Territory Marine Science End User Needs Analysis Necessary?

The Northern Territory marine environment is one of the few relatively intact tropical marine ecosystems in the world, particularly with respect to its coastal, littoral and shallow water zones. Extensive estuarine systems and the degree to which their source waters are almost unmodified by damming or diversion is globally unique. Extensive mangrove communities, seagrass meadows, reefs, shoals, islands, large bays and ria systems that are characteristic of the Northern Territory marine environment host globally significant marine ecosystems and biodiversity and provide both refugia and large areas of important habitat for several globally endangered species. The physical ocean environment provides important ecosystem connectivity and is a major determinant of regional climate.

Every day government, industry and community leaders and administrators make policy, regulatory, strategic and operational decisions pertaining to human interaction with the Northern Territory marine environment. In many instances, these decisions are not adequately informed by marine science knowledge. Ultimately, this results in decisions that reside on a continuum between those that knowingly place important marine ecosystem services at risk with the expectation of a significant public benefit and crude application of the precautionary principle, which can result in unnecessary loss of productivity and/or opportunity, or inadequate protection of key ecosystem services.

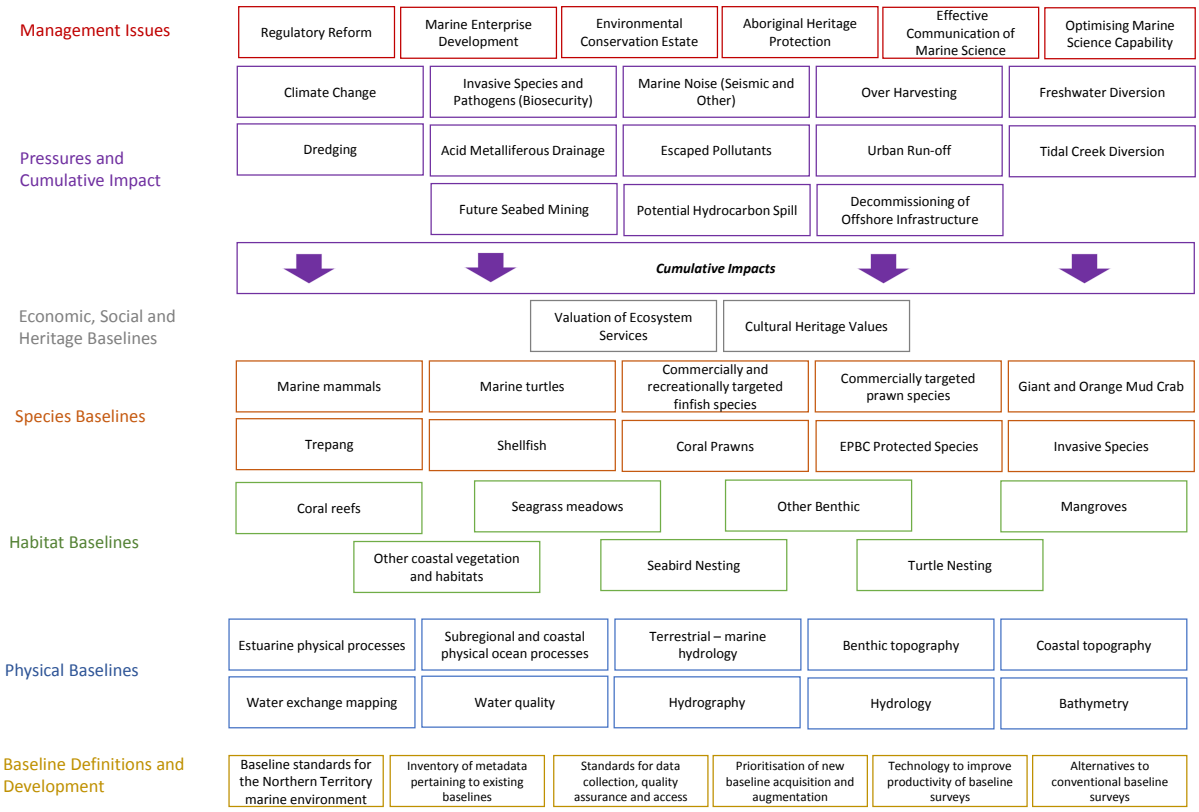
The Northern Territory is mainly a primary industry and tourism-based economy. While its growth will be subject to commodity price cycles, the longer-term trend toward increased economic development and coastal population growth are likely to continue. As this anthropogenic activity occurs, several socio-economic forces, together with global climate change are likely to shape the nature of the marine science knowledge needs that are required to facilitate optimal decision making with respect to the Northern Territory marine environment. This is

illustrated in the following figure and discussed in detail in Section 2 of this report.



What are the Key Outcomes from the Northern Territory Marine Science End User Needs Analysis?

Interviews and workshops have sought input from Northern Territory and Commonwealth policy makers and regulators of the marine environment; Aboriginal interests in the Northern Territory Marine environment; the Australian Defence Force (ADF); the marine logistics, offshore oil and gas, commercial fishing, aquaculture, pearling, crocodile, minerals, irrigated agriculture and forestry industries; coastal communities; recreational fishing sector; marine conservation sector and scientific profession. This consultation has identified a total of 153 key issues requiring 246 specific marine science knowledge needs to be addressed. Collectively, these can be summarised based on the themes shown in the following diagram.



Aboriginal Interests in the Northern Territory Marine Environment and their Marine Science Knowledge Needs

A unique aspect of the Northern Territory marine environment is the extent of Aboriginal interests from both a geographical and breadth of rights perspective. In accordance with Commonwealth and Northern Territory legislation and case law, Aboriginal people are owners, managers, holders of resource rights and have wider stakeholder interests in the Northern Territory marine environment, including controlling access to approximately 85 percent of the intertidal zone along the Northern Territory coastline. There are also significant marine oriented Aboriginal cultural rights that are protected by law.

Historically, these rights have been mainly recognised as rights to occupy land and sea country at the exclusion of others, to use those resources to support livelihoods and to undertake customary practice. However, more recently, the legal and customary rights and interests held by Aboriginal people are being recognised by courts as encompassing certain commercial rights and interests. With a recognised need to address significant socio-economic disadvantage, this is serving as a catalyst for increased economic participation from coastal Aboriginal communities, with regions of interest to this study hosting an increasing number of community livelihood-oriented enterprises, as well as some of Australia's most successful Aboriginal owned and operated businesses.

Aboriginal people comprise a large portion of the population of the Greater Darwin Palmerston Area and the vast majority of the population in other Northern Territory coastal settlements.

Through Aboriginal Ranger Groups, Aboriginal communities along the Northern Territory coastline perform a range of marine conservation and resource management and

enforcement activities, including fee-for-service activities for government and industry, with demand for these services increasing.

There is a need to understand the role that conventional marine science plays in decisions made by Aboriginal people and to fully involve Aboriginal people in the process that generates marine science knowledge.

With respect to Aboriginal interests in the Northern Territory marine environment, this study has identified 34 key issues requiring 60 specific marine science knowledge needs to be addressed that revolve around the following key themes:

- Causes of coastal vegetation dieback;
- Knowledge to support sustainable harvests;
- Population baselines, pressures on key species and management frameworks;
- Habitat status, pressures and management frameworks;
- Biosecurity threats;
- Impacts of large anthropogenic disturbance;
- Adequacy of the marine conservation estate;
- Communication and governance of Aboriginal interests in the marine estate;
- Employment opportunities and enterprise development in coastal settlements; and
- Knowledge required to support the growth of the Aboriginal environmental services sector.

Aboriginal interests in the Northern Territory marine environment and their marine science knowledge needs are discussed in Section 3.

Northern Territory Marine Conservation Estate

The Northern Territory marine conservation estate includes a limited area of Northern Territory marine parks, coastal reserves and Indigenous Protected Areas (IPAs), and a relatively extensive network of Commonwealth Marine Parks. Different levels of access and activity are allowed on different areas of this marine conservation estate. The conservation estate portfolio is designed to protect specific threatened species and ecosystems, as well as important Aboriginal cultural values, and ensure the preservation of a connected network of ecosystems that are representative of those that are characteristic of the Northern Territory.

By protecting a range of representative ecosystems and bioregions representing breeding and feeding habitats for a variety of species, the North Network of Commonwealth Marine Parks aims to increase the resilience of the overall marine environment, reducing susceptibility to natural and anthropogenic pressures such as cyclones, climate change and potential hydrocarbon spills. The majority of these reserves are currently classed as 'multiple use zones', or Category VI under the International Union for Conservation of Nature (IUCN) protection schemes. This zoning is known as 'protected area with sustainable use of natural resources' and applies to ecosystems and habitats that are associated with cultural (usually traditional) values and usage, together with natural resources management systems that allow sustainable non-industrial use of resources. Priorities in management are the balancing of ecological, social and economic dimensions, with a focus on inter-generational security of livelihood for local communities.

The Northern Territory marine conservation estate also includes a few marine parks and coastal reserves managed under the jurisdiction of the Northern Territory Government, most of which also include a terrestrial component.

The final component of the Northern Territory marine conservation estate is comprised of IPAs. IPAs are areas of land and/or sea country voluntarily dedicated by Traditional Owners as non-legislated protected areas, recognised by all Australian governments as part of the National Reserve System of Protected Areas. IPAs are managed by Indigenous Rangers and partner organisations according to protected area guidelines of the IUCN.

The reserves that comprise the Northern Territory marine conservation estate are listed in the following table and discussed in Section 4, with the marine science knowledge needs of the managers of that estate discussed in Section 5.

Commonwealth Marine Parks in Northern Territory Marine Environment	Northern Territory Marine Parks and Coastal Reserves	Indigenous Protected Areas
▪ Oceanic Shoals ▪ Joseph Bonaparte Gulf ▪ Arafura ▪ Arnhem ▪ Wessel ▪ Limmen	▪ Limmen Bight Marine Park ▪ Garig Gunag Barlu/Coburg Peninsula National Park ▪ Casuarina Coastal Reserve ▪ Channel Point Coastal Reserve ▪ Shoal Bay Coastal Reserve ▪ Indian Island Conservation Area ▪ Charles Darwin National Park ▪ Tree Point Conservation Area ▪ Vernon Islands Conservation Area ▪ Melacca Swamp Conservation Area ▪ Djukbinj National Park ▪ Mary River National Park ▪ Kakadu National Park ▪ Barranyi National Park ▪ Finucane Island National Park	▪ Marri-Jabin (Thamurrurr) Stage 1 ▪ Djelk ▪ Dhimurru ▪ Laynhapuy ▪ Anindilyakwa ▪ Yanyuwa (Barni-Wardimantha Awara) ▪ Marthakal Stage 1 ▪ South East Arnhem Land

Regulators of the Northern Territory Marine Environment and their Marine Science Knowledge Needs

Adopted as a Territory from the State of South Australia in 1910, the Northern Territory was granted self-government in 1978 by the *Northern Territory (Self Government) Act 1978* (Cth). This Act functions in a similar manner to a State Constitution, but reserves some powers of government for the Commonwealth, including acquisition of land from the Territory and Indigenous land rights. In any event, the Northern Territory marine environment consists of waters that fall under the jurisdiction of both the Northern Territory and Commonwealth Governments.

The key Northern Territory and Commonwealth Government regulators of aspects of the Northern Territory marine environment are listed in the following table.

Fisheries Regulators	Marine Safety and Biosecurity Regulators	Environmental Regulators and Managers of the Marine Conservation and Heritage Estate
Northern Territory Government Agencies		
▪ Department of Primary Industries and Resources (Fisheries NT and Primary Industry Group)	▪ Director of Marine Safety and Regional Harbour Master – Department of Infrastructure, Planning and Logistics	▪ Environmental Protection Authority ▪ Department of Environment and Natural Resources ▪ Parks and Wildlife Commission ▪ Power and Water Corporation ▪ Aboriginal Areas Protection Authority
Commonwealth Government Agencies		
▪ Australian Fisheries Management Authority	▪ Australian Marine Safety Authority ▪ National Offshore Petroleum Safety and Environmental Management Authority ▪ Department of Agriculture and Water Resources	▪ Department of the Environment and Energy ▪ National Offshore Petroleum Safety and Environmental Management Authority

With respect to regulators of the Northern Territory marine environment, this study has identified 23 key issues that require 66 specific marine science knowledge needs to be addressed that revolve around the following themes:

- Species and habitat baselines, pressures and management frameworks;
- Immediate environmental pressures and management priorities;
- Knowledge to inform an evolving regulatory framework;
- Knowledge to inform commercial fisheries development; and
- Knowledge to inform safety and environmental impact of vessels and offshore infrastructure.

Regulators of the Northern Territory marine environment and their marine science knowledge needs are discussed in Section 5.

Australian Defence Force and its Marine Science Knowledge Needs

Australia's key strategic defence interests are now clearly oriented toward the north of the Nation. Areas of most immediate importance to Australia are its borders and offshore territories, its strategic intersection with the interests of Indonesia, Timor-Leste, Papua New Guinea and various Pacific Island countries, as well as its maritime interests in South East Asia more generally. The economic importance of northern Australia and its offshore resources plays a significant role in current and future defence planning. This is a major aspect of ADF doctrine that has been further promoted in the most recent Defence White Paper that articulates ADF doctrine out to 2035.

In this contemporary defence landscape, the Northern Territory is playing an increasingly important role supporting the operations of the ADF from a posture and power projection, as well as training and exercise perspective. ADF presence and investment in Northern Australia will gradually increase over the next decade to support the needs of the more capable, high technology future force that the ADF will bring into service, as well as a more active defence posture. This will be supported by the existing ADF bases in the Northern Territory, namely HMAS Coonawarra, and other operations of Larrakeyah Barracks, Robertson Barracks, RAAF Tindal and RAAF Darwin.

Of relevance to this study is HMAS Coonawarra. HMAS Coonawarra is a critically important northern installation for the Royal Australian Navy (RAN). It is the base that supports border integrity operations and major international exercises in Australia's northern waters, with approximately 100 RAN and foreign naval vessels visiting the base and Darwin Harbour more generally each year. The 2016 Defence White Paper sets out a schedule of new asset acquisitions for the RAN. Prior to these assets being deployed, RAN bases across the north of Australia, including HMAS Coonawarra, will require significant upgrades.

The Northern Territory and the ADF installations play a key role in several domestic and international defence exercises. The main exercises are Talisman Sabre, Kakadu and Pitch Black, each of which interact with the Northern Territory marine environment to varying degrees.

The Department of Defence also has obligations under international conventions and Australian law to undertake and maintain hydrographic and oceanographic surveys of Australian waters. Significant areas of the Northern Territory marine environment are inadequately surveyed and, under a recently announced programme, the Department of Defence will endeavour to partner with industry and academia to cost- effectively address identified deficiencies in the Australian hydrographic and oceanographic survey data.

With respect to the needs of the ADF, this study has identified three key issues requiring three specific marine science knowledge needs to be addressed that revolve around the following themes:

- Marine science evidence that demonstrates the RAN's high standards of marine stewardship; and
- Development of survey data under the HydroScheme Industry Partnership.

The ADF's operation in the Northern Territory marine environment and its marine science knowledge needs are discussed in detail in Section 6.

Darwin Port and its Marine Science Knowledge Needs

As a place of trade, the general area around Darwin Port pre-dates European settlement, with the Larrakia people having conducted trade with South East Asia, particularly with Makassan Trepang fisherman from the southwest corner of Sulawesi, for thousands of years. Today, commodity ore exports, livestock exports, petroleum imports and bulk liquids, containerised import and export cargoes and specialised cargo is all handled through the multi-modal facility at East Arm Wharf, with the City Wharf area dedicated to cruise ship and limited defence needs. In 2015, the Northern Territory Government provided the People's Republic of China (PRC)'s domiciled company, Landbridge Holdings, with a 99-year lease to operate Darwin Port, retaining a 20 percent interest.

In 2015–16, the Northern Territory had merchandise exports of approximately $5.1 billion, equivalent to 22 percent of the Gross State Product (GSP). A significant portion of these exports were transported through Darwin Port including $444 million of live animal and $317 million of crude petroleum product. Darwin Port plays a critical role in the Northern Territory's export-oriented economy and will play an increasingly important role in supporting the economy of northern Australia more generally, particularly central and western northern Australia. Darwin Port is the only true multi-modal port in northern Australia, with direct rail connectivity through central Australia, to the southern, eastern and west regions of the Nation. Apart from the mineral and petroleum bulk commodity ports in Western Australia and Queensland, Darwin is

the busiest commercial port in northern Australia and has only been operating at this scale for the past five years.

Darwin Port's strategic location with respect to key Asian markets for Australian exports, proximity to northern Australian primary production areas, multi-modal connectivity to the wider Nation and expansion potentially renders it one of the most important pieces of economic infrastructure in northern Australia. This is particularly true with respect to its proximity to the current southeast Asian 'terminus' of the PRC's 'One-Belt-One-Road' international logistics infrastructure investment programme.

The current operational footprint of Darwin Port includes:

- East Arm Wharf and Logistics Precinct that incorporates a bulk liquids facility, container and common-user supply-base facility, bulk handling facility, multi-user barge ramp and common user area, several recreational boat ramps and the Darwin Business Park and Berrimah Freight Terminal;
- Hudson Creek Barge Facility that supports several coastal barge operations that service communities and industries along the northern Australian coastline;
- Darwin Wharf Precinct that incorporates the Stokes Hill and City Wharfs and is primarily a restaurant and tourism precinct supporting cruise ships and limited visiting naval vessel operations;
- Fisherman's Wharf that is the home port for local fishing and pearling operations, as well as additional coastal barge operations;
- Recreational marina facilities including Cullen Bay, Bayview and Tipperary Marinas
- HMAS Coonawarra;
- Darwin LNG, located on Wickham Point;
- Ichthys LNG, located on Bladin Point; and
- Channel Island Power Station.

Plans for the East Arm Wharf include:

- Expanding the refrigerated container park and strategic hardstand area;
- Harbour support vessel facility expansion;
- Quay-line container park expansion;
- Increased bulk commodity handling capacity; and
- Expansion of the marine supply-base.

Middle Arm has been identified as the site for a new industrial precinct that will focus on downstream gas processing and gas related industries, and other expansion plans in the Port area generally include a marine industry park, defence industry hub, transport industry precinct, cruiseliner facility and new fishing fleet marina.

From Darwin Port's perspective, this study has identified 11 key issues requiring 19 specific marine science knowledge needs to be addressed that revolve around the themes of:

- Water quality;
- Dredging; and
- Various other issues including predicting usage conflicts, managing biosecurity and the port-residential interface.

Darwin Port and its marine science knowledge needs are discussed in Section 7.

Commercial Fishing Industry and its Marine Science Knowledge Needs

The Northern Territory commercial fishing industry is comprised of fisheries that are managed either exclusively by the Northern Territory or exclusively by the Commonwealth, as well as those that are managed jointly by these jurisdictions, depending on whether a fishery operates exclusively in Northern Territory or Commonwealth waters or transects both.

Collectively, these fisheries produce a Gross Value of Product (GVP) of at least $55 million and up to $90 million, depending on the extent to which the catch of the Northern Prawn Fishery (which extends across northern Australia) is attributed to the Northern Territory. The commercial fishing industry is also a significant contributor to employment and a major component of the small-to-medium enterprise sector in the Northern Territory.

The following table summarises the commercial fisheries operating in the Northern Territory marine environment.

Northern Territory Managed Fisheries	Jointly Managed Fisheries	Commonwealth Managed Fisheries
▪ Barramundi ▪ Mud Crab ▪ Coastal Line ▪ Trepang ▪ Coastal Net and Other ▪ Aboriginal Coastal Licences	▪ Demersal ▪ Offshore Net and Line ▪ Spanish Mackerel ▪ Timor Reef ▪ Aquarium ▪ Squid Jigging	▪ Northern Prawn Fishery ▪ Western Tuna and Bill Fishery

Collectively, these fisheries target:

- A range of finfish species including Barramundi, King Threadfin, Threadfin, Blue Salmon, Red Snapper, Gold Band Snapper, Sweetlip Snapper, Emperor species, Cod species, Black Jewfish, Spanish Mackerel, Grey Mackerel, Trevally, Mullet, Baitfish, and various shark species including Black-tip Sharks, and Spot-tailed Sharks;
- Mud Crab;
- Trepang;
- Aquarium fish, coral, other invertebrates and 'live-rock'; and
- Banana, Tiger and Endeavour Prawns.

With respect to the commercial fishing industry, this study has identified 19 key issues requiring 33 specific marine science knowledge needs to be addressed across the following themes:

- Continued access to the fishery;
- Equitable allocation of the fishery resource;
- Productivity of the fishery; and
- Fishery development.

These marine science knowledge needs are consistent with the Fisheries Research and Development Corporation's National Fishing and Aquaculture Research, Development and Extension Strategy and are discussed in Section 8.

Pearling, Aquaculture and Crocodile Industries and their Marine Science Knowledge Needs

Marine oriented 'farming' industries in the Northern Territory produce an estimated GVP of approximately $48 million per annum. Aquaculture and pearling produce a GVP of

approximately $25 million, of which pearling operations account for 70 percent and the crocodile industry accounts for an estimated additional $23 million.

The pearling industry revolves around the production of the *Pinctada maxima* (or South Sea Pearl), which is highly valued in international jewellery markets. Production facilities are located on the Coburg Peninsula and in Bynoe Harbour.

Currently, a single Barramundi operation accounts for almost all the Northern Territory's aquaculture GVP. However, a planned large-scale Prawn farm producing Banana and Black Tiger Prawns may soon add significantly to the sector's GVP, with other smaller industries also in development including Trepang, Giant Clams and Tropical Black Lip Oysters.

The Northern Territory crocodile industry has been operating in the Northern Territory since the late 1970s and is currently comprised of eight farms located primary around the Darwin area. These operations produce a range of products from the native *Crocodylus porosus* (or Salt Water Crocodile) including skins, meat, teeth, feet, heads, skeletons and live animals. The Northern Territory crocodile industry accounts for approximately two-thirds of Australian crocodile skin exports.

With respect to the pearling, aquaculture and crocodile industries, this study has identified 11 key issues requiring 22 specific marine science knowledge needs to be addressed across the following themes:

- Ensuring biosecurity;
- Managing other external threats; and
- Improving industry productivity.

The needs of this sector are discussed in Section 9.

Offshore Petroleum Industry and its Marine Science Knowledge Needs

The offshore petroleum industry is a major driver of the Northern Territory economy. The Northern Territory offshore petroleum industry is currently comprised of:

- Two onshore LNG processing and export facilities located in Darwin Harbour and sourcing natural gas and condensate from production facilities in the Joint Petroleum Development Area in the Timor Sea and the Browse Basin in offshore Western Australia;
- Domestic gas supply from a production facility in the Joseph Bonaparte Basin;
- Exploration and development activity in the Timor and Arafura Seas; and
- A significant offshore oil and gas services sector based out of Darwin Port.

The ConocoPhillips operated Bayu Undan Field and associated Darwin LNG facility has been operating since 2006. With the Bayu Undan Field now approaching its end of life, the operator is assessing back-fill options to extend the operating life of the LNG facility.

The recent construction of the Inpex Ichthys LNG project has been a major stimulus for the Northern Territory economy. It is estimated that at peak production, the Ichthys project will add $4.5 billion to Northern Territory petroleum exports.

The offshore services industry based out of Darwin Port services the offshore infrastructure and operations of ConocoPhillips and other operators in offshore Northern Territory. It also is the main support base for Inpex's operations and Shell's Prelude project operating in the Browse Basin and Eni's Blacktip production facility operating off the Joseph Bonaparte Basin off the Kimberley coast of Western Australia.

With respect to the offshore petroleum industry, this study has identified 11 key issues requiring 31 specific marine science knowledge needs to be addressed across the following themes:

- Environmental baseline data;
- Infrastructure planning;
- Hydrocarbon spill response;
- Managing seismic noise; and
- Decommissioning of infrastructure.

These needs are discussed in Section 10.

Marine Tourism Industry

There are an estimated 1.7 million visitors to the Northern Territory each year, with approximately half of those visitors being holiday makers. Darwin is the focus of visitors with approximately three quarters of visitors to the Northern Territory only leaving Darwin for a day trip. Furthermore, the most popular tourism attractions in the Northern Territory are terrestrial experiences. Nevertheless, the Northern Territory's pristine tropical marine environment, marine-oriented Aboriginal culture and significant recreational fishing stocks render it a popular marine tourism destination.

The main aspects of tourism that intersect with the marine environment are cruise ships and fishing charters. Cruise ship visits contribute an estimated $54 million to the Northern Territory economy each year. The impact of cruise ship visitors on the Northern Territory marine environment is understood to be minimal and primarily confined to waterfront dining, cruises on the Adelaide River and water activities oriented around Cullen Bay.

The fishing charter sector is the most visible component of marine tourism in the Northern Territory with over 60 operators accounting for approximately 300,000 fishing days in total. Furthermore, this activity is more widely dispersed along the Northern Territory coastline, with an estimated 70 percent of the total fishing effort that occurs in regional areas derived from fishing charters.

This study has not ascertained key issues or marine science knowledge needs for the Northern Territory marine tourism industry. However, it is assumed that the fishing charter sector would have many common issues and marine science knowledge needs with the commercial and recreational sectors. This sector is discussed Section 11.

Minerals Industry and its Marine Science Knowledge Needs

The Northern Territory minerals industry is a major component of the Northern Territory economy, currently producing a GVP of approximately $3.0 billion and directly employing almost 6,000 people. While the industry produces at least a dozen mineral commodities, manganese, gold, zinc-lead, uranium and bauxite are the major drivers of production value.

Minerals operations intersect with the Northern Territory marine environment either through export operations or mine generated heavy metals and pollutants entering the marine environment either directly or through connectivity with river catchments. The main projects that have a significant intersection with the Northern Territory marine environment are:

- McArthur River Mine that is operated by Glencore and is the world's second largest zinc-lead mine. It is located near Borroloola, 900 kilometres southeast of Darwin and serviced by an export facility at Bing Bong;
- Gove Bauxite Mine that is operated by a wholly-owned subsidiary of Rio Tinto and located in northeast Arnhem Land, exporting bauxite ore; and
- Groote Eylandt Mining Company (GEMCO) that is a wholly-owned subsidiary of Latitude 32 mining and exporting manganese from an operation on Groote Eylandt.

The future prospect of subsea mining in the Northern Territory will obviously have a significant intersection with the Northern Territory marine environment.

With respect to the minerals industry, this study has identified 11 key issues that require 22 specific science knowledge needs to be addressed across the following themes:

- Wider-scale cumulative impacts of direct interactions with the marine environment;
- Impacts of acid and metalliferous drainage and escaped pollutants on the marine environment; and
- Efficient regulation of the mining industry's interface with the marine environment.

The needs of this sector are discussed in Section 12.

Irrigated Agriculture and Forestry Industry and its Marine Science Knowledge Needs

Agriculture more widely is a significant component of the Northern Territory economy producing a GVP of approximately $500 million. The beef cattle sector typically accounts for approximately two-thirds to three quarters of Northern Territory agricultural GVP each year.

The horticulture sector producers various fruit, vegetables and nursery and cut flower products, and the mixed farming sector produces various field crops from groundwater fed irrigation systems. Estimates of the value of irrigated agriculture production in the Northern Territory range from $133 million to $245 million. Horticulture operations are concentrated in the Litchfield, Katherine/Mataranka, Central Australia and Douglas-Daly River Regions.

In addition, there is approximately 50,000 hectares of irrigated and un-irrigated forestry production in the Northern Territory, rendering it the second largest production land user after beef cattle. This is comprised of Black Wattle plantations on the Tiwi Islands, African Mahogany plantations in the Douglas-Daly River Region and Sandalwood plantations in the Douglas-Daly River and Katherine Regions.

There are plans to expand the Ord River Irrigation Area into parts of the Northern Territory and several areas of the Northern Territory have been identified as suitable for supporting irrigated agriculture, particularly around the Roper and Wildman River areas. This could include forestry, horticulture, field crop and/or stand-and-graze cattle production.

All current irrigation operations source from groundwater resources. However, for the industry to grow there will likely need to be some off-stream harvesting of peak-flows upstream from floodplains where topography is suitable for storage.

With respect to the irrigated agriculture and forestry industries, the main theme is understanding the resilience of potentially affected marine ecosystems to changes in timing and volume of freshwater ingress to identify optimally sustainable levels of freshwater harvest for the industries. This study has identified five key issues pertaining to this theme, requiring six specific marine science knowledge needs to be addressed. These are discussed in Section 13.

Coastal Communities and their Marine Science Knowledge Needs

The vast majority of Northern Territorians live in cities, towns or settlements that are on or near the coast, with almost 60 percent of the population residing in the Greater Darwin Area and an additional 18 percent residing in Local Government Areas (LGAs) with a coastline.

The Darwin City CBD and built waterfront occupies a large portion of the Darwin peninsula. The majority of usage of the marine estate stems from the retail, restaurant, high density residential and tourism precinct in the Darwin Wharf Area, as well as Cullen Bay, Kitchener Bay, Tipperary Waters and Bayview Marinas. The current Darwin Master Plan contains numerous proposals to develop and increase utilisation of the coastal estate, including waterfront parks, releasing waterfront land for residential and commercial development and rerouting and upgrading road and public transport links. In particular, the plan calls for significant reclamation activities involving landfill, seawalls and other related stabilisation works to reclaim a significant portion of the northwest shoreline of East Arm, opposite the Charles Darwin National Park.

Most of the coastal population that resides outside of the Greater Darwin Area is Aboriginal and is concentrated in the coastal settlements along the Northern Territory coastline and on its islands. There are at least 20 such settlements that range in population from 200 to 4,000, with many of these settlements supporting additional communities and outstations. Because there are numerous island settlements and many of the coastal mainland settlements are inaccessible by land during the wet season, they are heavily reliant on coastal barge operations for regular supply and servicing.

With respect to coastal communities, this study has identified 17 key issues requiring 31 specific marine science knowledge needs to be addressed across the following themes:

- Stormwater run-off from the Darwin CBD;
- Predicting and managing coastal inundation;
- Destruction and diversion of tidal creeks; and
- Stormwater and public health.

Section 14 discusses the needs of this sector.

Recreational Fishing Sector and its Marine Science Knowledge Needs

Recreational fishing is a major pastime in the Northern Territory, incorporating many social and cultural values. The sector is estimated to have a significant multiplier effect on the local economy through fishing retail (bait and tackle), recreational vessel hire and purchase, fuel, and ancillary services such as hospitality and accommodation associated with extended fishing trips, with an estimate of total impact of up to $100 million per annum.

The recreational fishing effort in the Northern Territory is coastally oriented. While an estimated 22 percent of the non-Indigenous population of the Northern Territory participate in recreational fishing once a year, around 20 percent of those account for 60 percent of the total recreational fishing effort. The vast majority of the recreational fishing effort is boat and line based and occurs between April and November. Approximately 50 percent of the recreational fishing effort is concentrated in the wider Darwin Harbour Area, with less than 9 percent focused on the Arnhem and Gulf of Carpentaria coastlines.

The main species that are targeted by recreational fishers in the Northern Territory are Barramundi and Snapper, with a large portion of fish caught on a ‘catch-and-release’ basis. Mud Crabs are also an important recreational species.

With respect to the recreational fishing sector, this study has identified 8 key issues requiring 12 specific marine science knowledge needs to be addressed across the following themes:

- Understanding the current and future impact of the sector on the fishery resource;
- Accurately defining the sector's contribution to the economy and social fabric of the Northern Territory; and
- Maintaining the sector's social licence to operate.

These are discussed in Section 15.

Northern Territory Marine Science Capacity

This study also identifies and discusses the various Commonwealth, Northern Territory and other scientific organisations operating in the Northern Territory that have marine science capability and capacity. The capacity is discussed based on the organisations, collaborations and specific industry sector scientific capabilities listed in the following table.

Commonwealth Organisations	Northern Territory Organisations	Collaborations	Industry Sectors with Marine Research Capability
▪ Australian Institute of Marine Science ▪ Commonwealth Scientific and Industrial Research Organisation (CSIRO) Oceans and Atmosphere Business Unit ▪ Integrated Marine Observing System ▪ Department of Environment and Energy ▪ Bureau of Meteorology	▪ Department of Primary Industry and Resources (NT Fisheries) ▪ Department of Environment and Natural Resources ▪ Charles Darwin University ▪ North Australian Indigenous Land and Sea Management Alliance Ltd	▪ Northern Australia Environmental Resources Hub ▪ Northern Australia Cooperative Research Centre ▪ Aboriginal Research Practitioners Network ▪ Northern Australia Marine Research Alliance	▪ Offshore petroleum ▪ Commercial fishing ▪ Aquaculture and pearling

Compared to capacity that resides elsewhere in Australia, the individual Northern Territory marine science capacity and capability of many of the organisations listed in the above table is relatively limited. However, this capacity can be significantly enhanced through greater collaboration around strategic marine science knowledge needs and by better harnessing the national resources of some of the larger research organisations and industry.

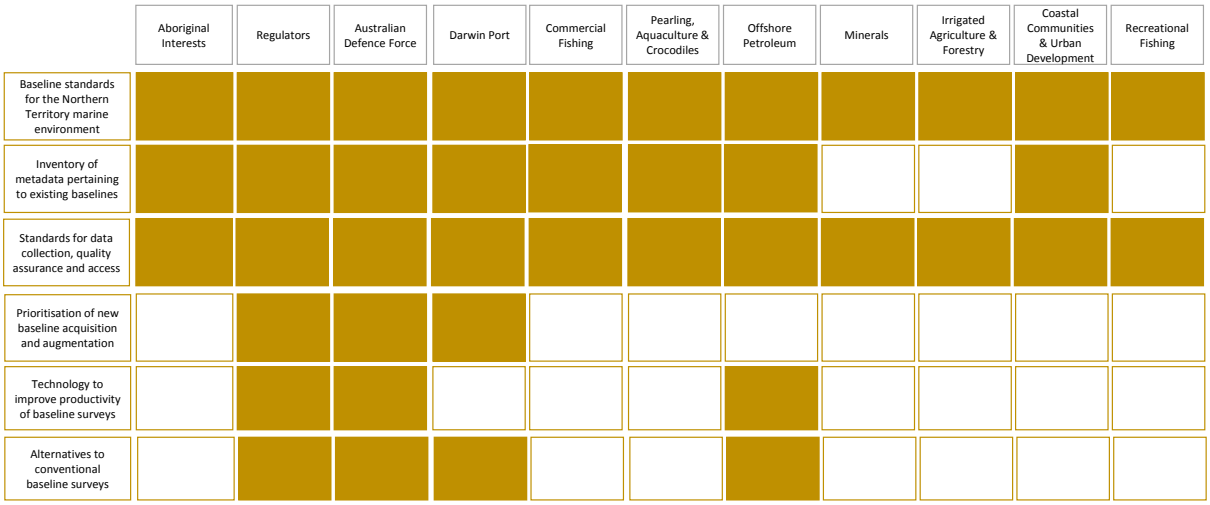
Given limited and often contracting resources in research organisations, it is important to access local and Indigenous knowledge of marine systems and their dynamics, as well as the scientific capacity of Aboriginal communities. To achieve this, the research sector will need to continue to develop its ability to effectively engage with Aboriginal communities in the design, development and delivery of marine science research outputs.

Common Marine Science Knowledge Needs

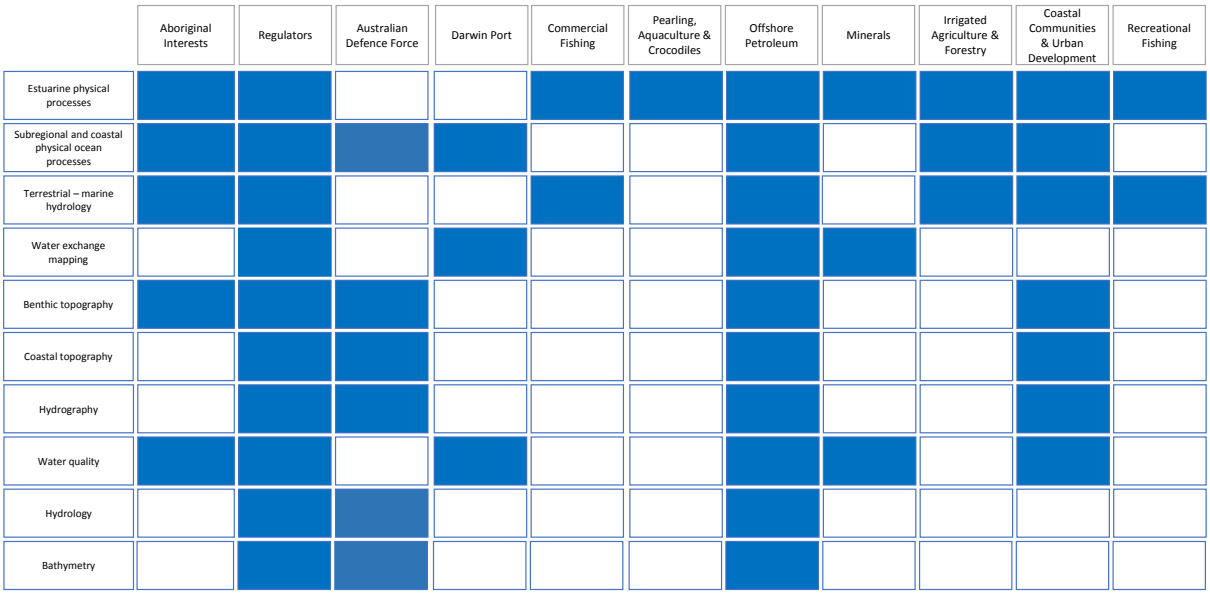
A key output of this study is the identification of marine science knowledge needs pertaining to the Northern Territory marine environment that are common to multiple stakeholders and interests in the Northern Territory marine environment. This serves as the basis for greater collaboration and co-investment in the acquisition of priority marine science knowledge.

These common interests are summarised in the following figures.

Common Interests in Baseline Definition and Development

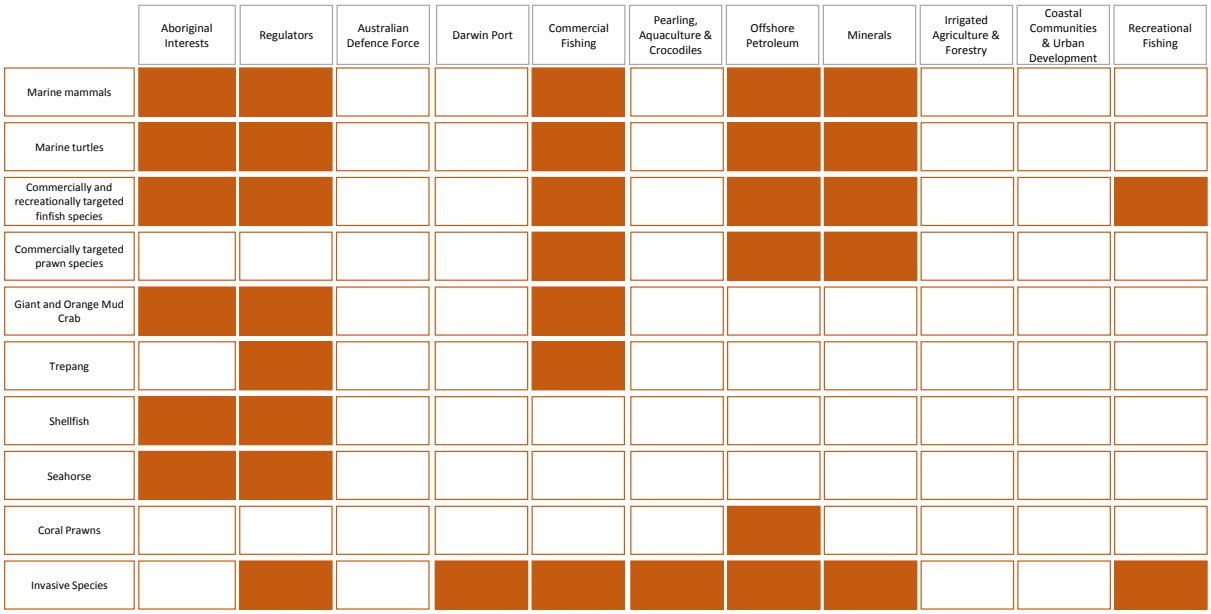


Common Interests in Physical Marine Baselines

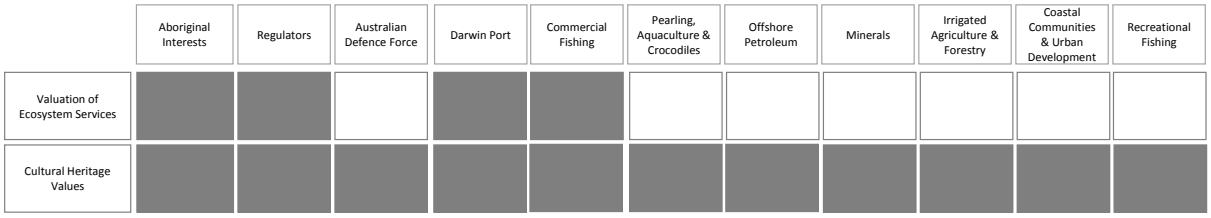


Common Interests in Marine Habitat Baselines

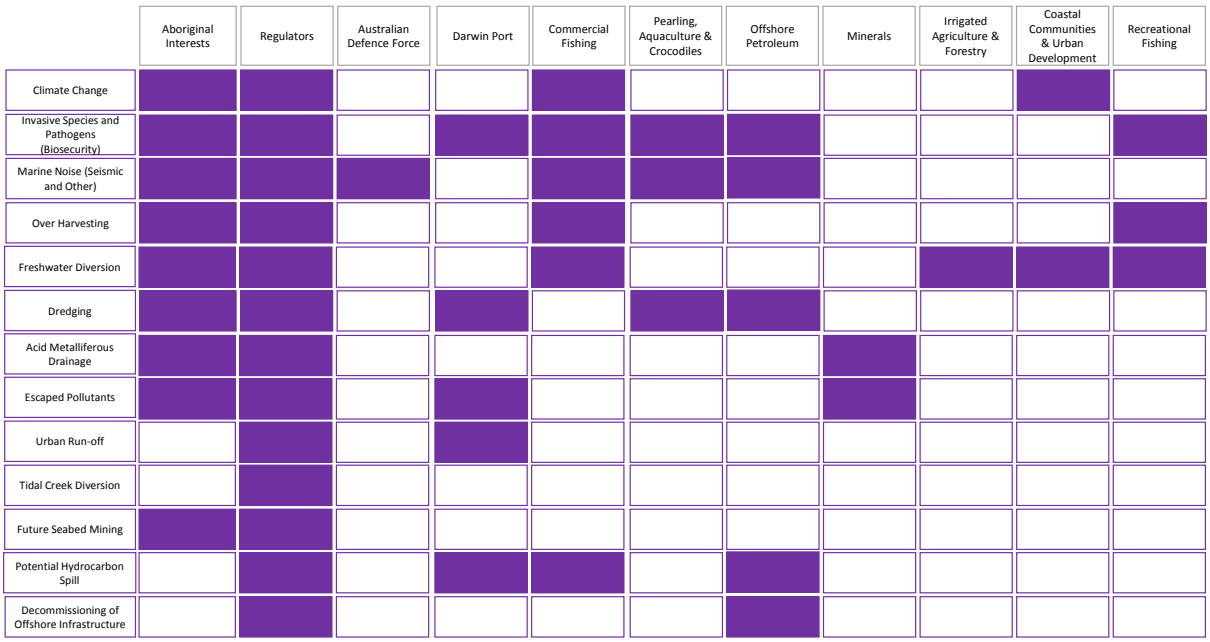
Common Interests in Species Baselines



Common Interests in Economic and Heritage Baselines



Common Interests in Cumulative Pressures



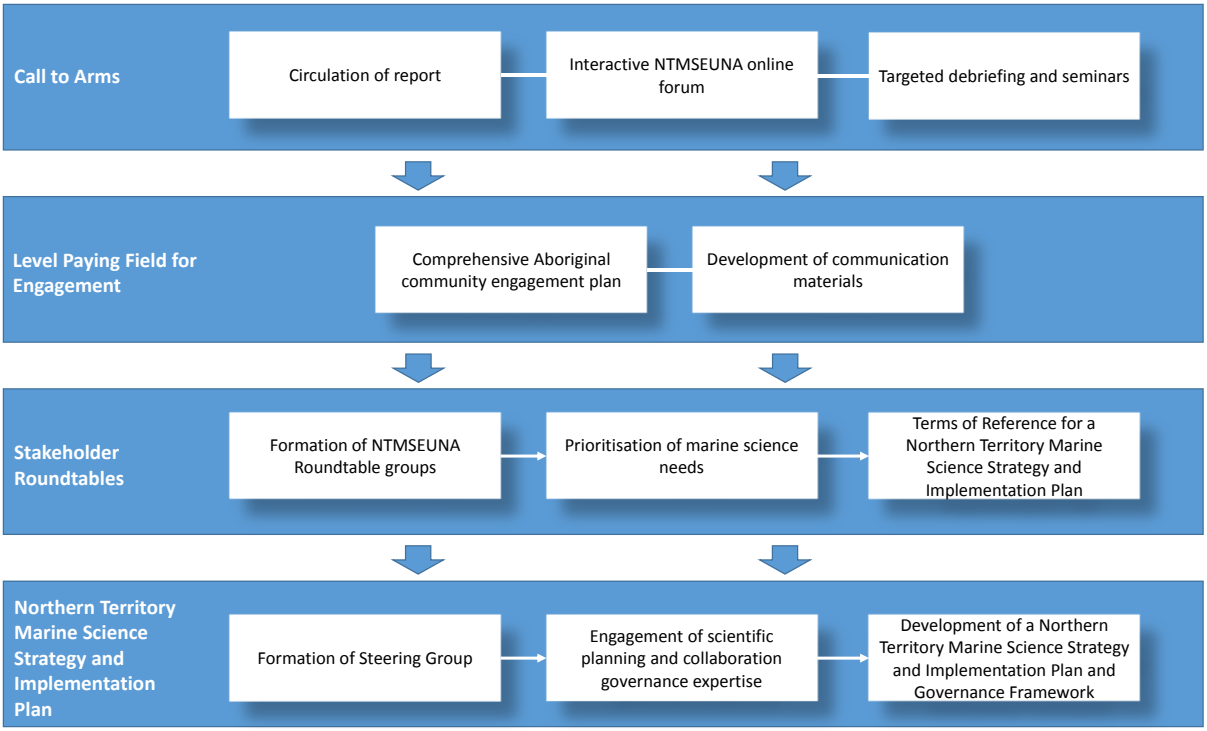
Common Interests in Management Issues

Toward a Comprehensive Northern Territory Marine Science Strategy

This report stops short of developing and presenting a comprehensive, end user driven marine science strategy and implementation plan for the Northern Territory. There are certain limitations with respect to comprehensive coverage of stakeholders, particularly with respect to the diverse Aboriginal interest in the Northern Territory marine environment, specific prioritisation (including only a limited basis for geographical prioritisation) and detailed local marine science capability assessment that restrict this report's ability to achieve this.

However, the report does set out a clear and achievable pathway to develop what is a critically necessary collaborative strategy to ensure that the many marine science knowledge needs that are required to better inform policy, regulatory, strategy and operational decisions

pertaining to the Northern Territory marine environment are better informed by marine science are acquired effectively and efficiently. This process is summarised in the following diagram.



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