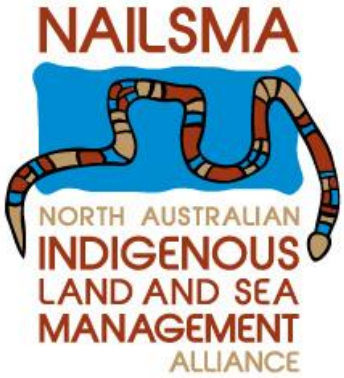

NORTHERN TERRITORY MARINE SCIENCE END USER KNOWLEDGE NEEDS ASSESSMENT - MEETING ABORIGINAL NEEDS

Indigenous Engagement Report Part A – Desktop Report

A report prepared by Rose Rutherford and Peter Whitehead for the joint North Australian Indigenous Land and Sea Management Alliance and Northern Land Council research project

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EXECUTIVE SUMMARY

In a nutshell:

- The Australian Institute of Marine Science and Charles Darwin University, with the financial support of the Northern Territory Government, are co-sponsoring an analysis of needs for better information for users of the Territory's marine environments. An important component of the study will be to understand Indigenous peoples needs and ways of securing Indigenous engagement in marine research.
- Aboriginal and Torres Strait Islander people are important end-users of marine science and science more generally.
- Western science is often used to complement customary knowledge and practise with the aim of ensuring healthy people and healthy country.
- Information needs range across many sectors and vary with biophysical and social context.
- There is often strong support to collaborate and engage with non-Indigenous researchers to address Indigenous information needs. Respectful, strong and equitable partnerships underpin successful projects.
- Addressing information needs must go beyond traditional science practise and communication to be effective.

Aboriginal and Torres Strait Islander people accept primary responsibility for the lands and seas with which they are associated. They embrace use of land, waters and resources to meet human needs while meeting long-established and fundamental obligations to care for country.

Changes in the ways sea country is used have created new challenges that also require new knowledge. To inform caring for country and managing, conserving and utilising natural resources in the contemporary Northern Territory, there is a need for western marine science and other disciplines to work together in support of Traditional Owners and managers, especially where others seek to use their land and seas.

Indigenous organisations have identified and documented a number of issues about which they require better information:

- caring for country and related opportunities to deliver environmental services, including:
    - establishing baselines and monitoring systems;
    - managing invasive species and improving biosecurity;
    - marine pollution; and
    - climate change.
- mainstream / orthodox industries and developments, including:
    - mining;
    - tourism

- port and urban development; and
- fisheries.

A key research interest was to understand impacts and threats to country from damaging natural and human made causes across all sectors. Research around opportunities to use natural resources in a way that can enhance the biocultural and biophysical health of lands and seas - while also providing social and economic opportunities - was a recurring theme.

However, accessible formal statements about research needs coming from Indigenous people and their organisations were clearly biased to products built around conservation goals, because support to prepare plans for use of country has been most readily available in these areas. To supplement these statements it is necessary to consider Indigenous submissions on policy and practice on socioeconomic matters that may not directly address marine research or knowledge needs but reveal broader aspirations, interests or concerns that may arise in regard to sea country as well as in other settings.

Key knowledge gaps sometimes related to absence of information at appropriate scales and of direct relevance to Indigenous interests. In other cases it was difficult to know whether apparent gaps resulted from poor accessibility or if additional new research was needed. The various sectors active in the marine environment gather and deploy research information that would be of use to Traditional Owners. However, much of this information may or may not be utilised due to issues of access and communication.

Federal and Territory law and policy in land and resource management do little directly to meet Indigenous knowledge needs. The *Environmental Protection and Biodiversity Conservation Act* 1998 (Clth) sets broad goals for participation of Indigenous people in land and resource management but does not translate these into meaningful actions for commercial participation. Federal and/or Territory government and NGO support for conservation planning has no parallel in development planning. National research priorities refer to Indigenous interests only in regard to health. Innovation and Science Australia's developing Strategic Plan focuses on "big" science. There has been no recent statement of NT government research priorities. Clearly there is a large Indigenous gap in Australia's and the Territory's research and innovation framework, including marine systems and issues.

Broader issues of communication, access, consent and intellectual property, scale and context, compensation, appropriate use of Indigenous knowledge and governance were considered in exploring what is best practise collaborative research. These issues highlighted that in the context of cross cultural research the partnerships underlying, and processes adopted in the conduct of projects are of critical importance.

Science research does not occur in a vacuum. In the absence of statements of needs and priorities from Indigenous groups, agendas will be determined by industry or researchers themselves. Adapting projects to encourage greater participation and deliver benefits to Indigenous people can be constrained by available time and funding. And without clear consent and reporting back to communities in a timely and appropriate manner, there may be no uptake of or benefit from research to Aboriginal and Torres Strait Islander people.

The continued growth of, and need for support of Indigenous-driven research currently and into the future is discussed as 'Next Practise', about how science needs and application may evolve. Contributions to greater capacity from communities to design, conduct and commission research as well as foster more Aboriginal and Torres Strait Islander researchers and scientists could do much to accelerate improvements in understanding of the land and seas of the Territory and the place of their people in them.

INTRODUCTION

BACKGROUND

Aboriginal and Torres Strait Islander peoples have lived with and cared for the biocultural and biophysical land and sea scapes of this country for millennia, continuing up to the present day. But since European settlement, governance and management systems across Australia and in the Northern Territory for using lands and seas have changed significantly.

Contemporary pressures, opportunities and information needs for a healthy coastal and marine environment are different from those to which traditional knowledge was previously applied. Rapid change in the complex interplay between human-made and natural processes means that both Indigenous knowledge and western science are needed to make informed decisions about conserving, managing and utilising country. As important end-users of western science, Aboriginal and Torres Strait Islanders recognise the need to apply these different knowledge systems collaboratively.

PURPOSE

This report aims to provide a brief overview of Indigenous research priorities for sea country in the Northern Territory identified by Indigenous organisations, based primarily on a desktop study of readily available written materials. It will be used primarily as background for consultations with a number of Indigenous groups to provide a more comprehensive view of priorities for marine research and options for engaging Indigenous individuals and their organisations in all aspects of research they consider relevant to their interests in marine and associated terrestrial environments.

This work is part of a broader project by the Australian Institute of Marine Science and Charles Darwin University titled “Northern Territory Marine Science End User Knowledge Needs Assessment” which is exploring knowledge gaps and strategies to address gaps for all marine science end users including government, industry and community.

STRUCTURE

Firstly, an overview of the context and key concepts is presented. Identified research issues are then summarised in a number of categories. A broad overview of the current science available relating to the identified categories is offered, set against Aboriginal interests and concerns. Finally, a discussion is presented on the broader issues that support genuinely beneficial, collaborative, just and equitable science research in the cross-cultural context. Aboriginal roles and obligations in all aspects of sea country management and resource use and conservation will be considered.

METHODOLOGY

These issues have been identified primarily from published land and sea country management plans and strategies framed by various Indigenous groups involved in caring for country in the Northern Territory. Because they cover a relatively small part of the Territory coast and mostly focus on sites where protected areas are being considered, other statements with no particular emphasis on research but indicating interests, aspirations and concerns have also been considered.

Taking into account that utilising only published plans and submissions may exclude groups without the capacity and resources to complete them, some additional supporting information is also presented. This includes published resources such as interviews and artwork of Traditional Owners to represent their interests in the marine science space. Further information will be gathered directly from Traditional Owners in the

consultation phase of this project, to ensure that representation of issues and priorities is as comprehensive and accurate as possible.

LIMITATIONS AND QUALIFICATIONS

Three important limitations must be acknowledged. First, such a desktop review creates an inevitable bias to the interests of groups who have the capacity to publish and make publicly available their information needs. Second, that capacity is influenced by the nature of support available to them, which has tended to focus on conservation and other environmental management issues. Third, the research issues and needs identified are unavoidably simplified representations of the great heterogeneity of interests, priorities and opinions among and within Indigenous groups with sea country. Fourth, while this report endeavours to present the available information in its original tone and intent, this report and many of the other reports drawn on have been written by non-Indigenous people. Where possible direct quotes and primary resources are presented to allow Indigenous voices to represent themselves, rather than be filtered through a non-Indigenous perspective.

Finally, it is acknowledged that the relatively small number of research-directed statements have required inferences about the desire or need for more research – as distinct from other more direct action – to advance aspirations or deal with concerns. Issues most relevant here include legal, policy and institutional barriers to active participation in resource management. These observations and suggestions require validation or rejection by Indigenous informants, which will be sought during consultations.

CONTEXT AND CONCEPTS

To understand this report several critical concepts must be established.

INDIGENOUS INTERESTS IN MARINE SCIENCE RESEARCH

Aboriginal people in the Northern Territory are custodians of sea country by Indigenous law and are also owners of, and controllers of access to, 85% of the coastline under Australian law (Brennan, 2008). They continue to assert ownership of sea country well beyond the low tide mark and have clearly and consistently identified themselves as end-users of science in order to inform their resource management decisions and practice. This is done with the over-riding aim of ensuring the best outcomes for people and country. The fragmentation and weakness of research in some areas has been identified by various groups as being a significant challenge in decision-making (Tiwi Land Council 2003; Dhimurru 2006).

Under various laws relating to development and infrastructure on Aboriginal and native title lands and waters, developers, government and researchers must consult with, or have consent from, Traditional Owners. Land rights law requires that landholders and communities understand the nature and purpose of developments, the effects the activities will have on their lands and seas and ways proposed to minimise adverse impacts. Without relevant and accessible information on benefits and risks, especially potential impacts on country, Traditional Owners cannot make fully informed decisions or give free, prior and informed consent to projects.

It is therefore essential that Traditional Owners influence the direction of research and the manner in which it is presented by being recognised as key end-users of science. Like all other land owners, Traditional Owners seek access to the best information available to foster and take up rewarding livelihoods and inform care for country. Better and more accessible information will facilitate sound and timely decision-making.

While Indigenous and non-Indigenous people share interests in, and needs for, high quality marine science information, the premise underlying these interests and needs may be different. This means the basis of all collaboration must be an awareness of different systems of knowledge and avoiding simplistic assumptions about shared understandings that may exist between groups. All collaboration must be grounded in a mutual respect for the different knowledge systems and values that coexist in this context.

Sea Country

"Let me tell you something, the sea, the saltwater, the waves, they are my mother, the sea is my mother, it is her Ancestral being. I know this, I have known this since I was small. Further I will tell you the sea has names, many names, names for the reefs, names for the sea grass beds, names for the sand bars and the sea has boundaries, we know these boundaries, they did not come here recently. From the time of the Spirit Ancestors and our human ancestors they have been there. Our songs and ceremony are also in sea, they are running through the sea both along the bottom of the sea and they also rise and travel on the surface of the sea. White people think the sea is empty that it has no Law, but the Law and the ceremony is there in the salt water, in the fish, in the sea birds, the dugong and the turtle, it is there and we knowledgeable people are holding it. " Dinah Norman Marrngawi, Yanyuwa Traditional Owner (Bradley and Yanyuwa Families 2007: 20)

"We do not make a distinction between land and sea the same way as Ngapaki (non-Indigenous people) do when talking about country; it is all country. While our rights to land were recognised by the Australian parliament in the mid 1970s the same rights we hold for sea country was ignored." Banduk Marika, Banul Munyarryun, Buwathay Munyarryun, Napunda Marawili and Wanyubi Marika (Altman and Kerins, 2012: 136)

Sea country refers to the Indigenous conceptualisation of the marine scape. It includes the biophysical aspects of the sea, islands and reefs, flora and fauna, as well as the cultural and spiritual aspects. The sea, as well as the land, contains evidence of events from the Dreamtime in its geographical features (Dhimurru, 2006). It contains song lines and sacred places, as well as kinship connections and totemic relationships for Aboriginal and Torres Strait Islander peoples with sea country (Smyth 2007; Morphy and Morphy 2006; Bradley and Yanuwa Families, 2007). Furthermore, parts of sea country may have a strong connection to a place, people or processes much further inland in the terrestrial landscape (Morphy and Morphy, 2006; see also the Yan-nhangu Atlas and Illustrated Dictionary of the Crocodile Islands (James and NAILSMA 2016)).

"The shark dreaming runs through the water and connects us to our neighbours and sea country" (Garawa 2014: 19)

Aboriginal and Torres Strait Islander peoples with sea country view it as integral to and inseparable from their estates and living cultural practise, not a separate and independent layer. Caring for sea country is essential to spiritual and physical wellbeing (Dhimurru, 2006). Land and sea must be cared for as a whole (Bradley and Yanyuwa Families, 2007).

In western literature and law, the understanding of Aboriginal concepts of and responsibilities for sea country has been slower than understanding of connection to land and view of customary practices in being narrowed to just cultural practices. In the Yanyuwa Sea Country Plan, Bradley suggests that early anthropologists such as Tindale, Warner, Rose, Bernt and others - in working with saltwater sea country people in the Northern Territory - must have sat on the beach and looked inland (Bradley and Yanyuwa Families, 2007: 21). The first references to sea country in the Northern Territory in western literature begin in the 1970s (see Woodward, 1973; Morphy 1977; Davis 1982, 1984; Palmer, 1983; Palmer and Brady, 1984). Aboriginal and Torres Strait Islanders have since generated numerous publications detailing the importance and characteristics of sea country (see Dhimurru, 2006; Isaacs, 2014; NAILSMA, 2004; James and NAILSMA 2016; Smyth, 2000), which has been followed by improved, but still incomplete, legal recognition.

Ranger Groups and Caring for Country

Across much of the north Ranger groups deliver a considerable amount of on ground activity for land and sea management, under the direction of Traditional Owners. As such Traditional Owners will be key end users of marine science to inform their land and sea country management. The groups looking after country grew organically as an Indigenous initiative as people got their land back under the ALRA (Smyth 2011). These

initiatives have successfully provided a range of environmental services (DPMC, 2015; 2016). They also provide social and employment outcomes and opportunities to individual rangers and Indigenous communities (Altman and Kerins, 2012; Smyth 2011).

Rangers also offer services that benefit Australia as a whole, such as bio-security surveillance and monitoring, as well as control of invasive species (DPMC, 2015; 2016). The area managed by Aboriginal and Torres Strait Islanders, areas under various tenures, sometimes called the Indigenous estate, makes up a significant part of Australia's reserve systems (Figure 1.). While much is done by ranger groups, other Traditional Owners and managers also contribute and influence the sort of work that is done and shape the methods used: to draw on traditional knowledge and accord with traditional practice.

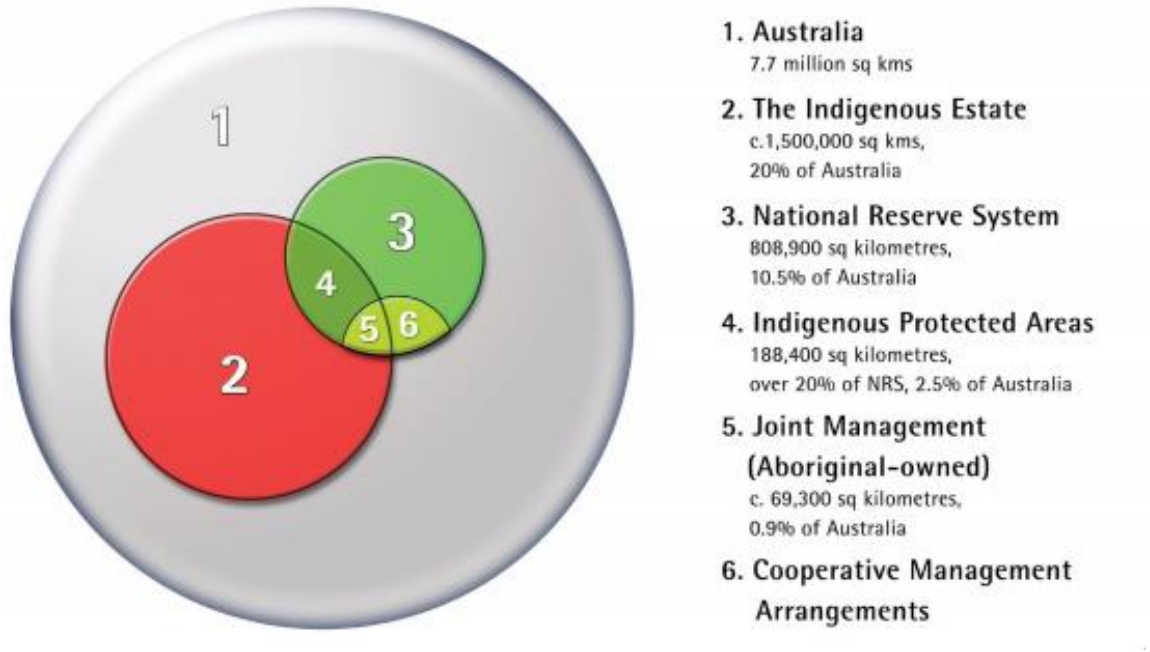

FIGURE 1 - THE OVERLAP OF THE INDIGENOUS ESTATE AND THE CONSERVATION ESTATE (ALTMAN, 2006)

Key policies and programs that currently support ranger groups include the Working on Country Program and the Indigenous Protected Areas program (DPMC, 2016). These provide structural and financial support to ranger groups. However, continued funding after 2018 is uncertain (Haxton, 2016).

LEGAL AND POLICY CONTEXT

Responsibility for management of marine environments is shared by the Federal and Territory governments. In general, the Territory has responsibility for management of waters within the coastal zone: from low water mark to about 5 kms to sea. Outside this zone within Australia's exclusive economic zone (up to 370 km to sea), the Commonwealth is responsible. In practice, governments have agreed to share management obligations to simplify arrangements. For example, the Commonwealth manages fisheries like the northern prawn fishery that extends across more than one state or territory. Where a fishery is largely confined to waters off a single state or territory, the local authority may have control, even if it extends outside the coastal zone. Specific agreements have also been reached in regard to resource (oil/gas and mineral) exploration and

extraction, so that in most cases the Territory will regulate and supervise these industries when they operate in coastal and near-coastal waters.

Overlying geographic separations of powers are many other Federal laws that apply everywhere and to some extent duplicate Territory laws. Examples of particular interest to Indigenous people include Commonwealth law in particular the *Environment Protection and Biodiversity Conservation Act 1999* covering migratory and marine wildlife like dugong and turtle, seabirds and waders. The Commonwealth also has responsibility for quarantine, human migration, customs and similar laws, but will often work in collaboration with the Territory to meet these obligations. Territory environmental assessment law has been accredited by the Commonwealth, so most activities (including minor or major developments or use of living resources on Aboriginal lands and waters) that require environmental assessment will be done under Territory law in ways that also satisfy federal obligations.

With the recognition of land rights in the *Aboriginal Land Rights (Northern Territory) Act 1976* (ALRA) and the *Native Title Act 1993*, Aboriginal and Torres Strait Islander peoples recovered rights and/or access to traditional lands down to the low tide mark.[1] However, practical recognition through settled claims was overwhelmingly directed to terrestrial areas. Subsequent cases around Croker Island and Blue Mud Bay furthered recognition of sea country under Australian law. These land rights laws and many other aspects of Aboriginal affairs are administered by the Commonwealth.

The contemporary context of land and sea country tenure, ownership and management is complex, with increased recognition of sea country leading to greater opportunities for Aboriginal control over access and opportunities for collaborations among industry, government and Traditional Owners. In many ways, however, this is yet to translate into tangible outcomes for custodians of sea country. Successive governments have urged traditional landowners actively to exploit their ownership of lands (and seas) to generate employment and incomes but offered little practical support, despite recognition of major challenges in creating viable businesses in remote, infrastructure-poor regions (NAILSMA 2014a).

Development policy

From a Commonwealth government policy perspective, northern development - as outlined in the 2015 White Paper - focuses on attracting external investors to large-scale projects. To realise advantage from the north's proximity to Asian markets and its abundant natural resources, the government proposes 'cutting red tape' and investing in large enabling infrastructure (Australian Government, 2015). With a focus on promoting agriculture and aquaculture as well as energy and mineral resources, the paper refers to the involvement of Indigenous Australians in educational and employment opportunities to be created by the government's development agenda. An obvious shortcoming of such an agenda is that it will at best help establish one or a few widely separated nodes of increased activity. But most importantly, it does not recognise Aboriginal and Torres Strait Islander landowners as having their own, distinct development aspirations and so includes no policy support to drive practical implementations of such aspirations (Yu 2016).

Proposals for Indigenous-led approaches to planning for economic development have been articulated in recent publications about development of an Indigenous Prospectus for participation in the sustainable development of northern Australia (NAIEP 2012, NAIEF 2012, NAILSMA 2013). Key elements are to:

- Set out Indigenous community aspirations to participate in and share the benefits of future developments in the north and the conditions under which they, as landowners may consider co-investment in the commercial use of their lands;

[1] In addition to two sea closures under the *Aboriginal Land Act* which extend two kilometres from the low tide. Note also recent extensions of land based IPAs into sea country around east Arnhem Land which extend into Commonwealth waters.

- Identify options for investment, and seek co-investment from industry, NGOs and governments, particularly in the agricultural, pastoral, fisheries, environmental services, tourism, arts and cultural sectors.

Serious pursuit of such an agenda will generate many questions requiring applied research in resource management and related social science, policy and law. Some of these questions are discussed later in this report.

Framing Research Needs

In the analysis to follow, we draw predominantly on direct references to marine research needs identified by Indigenous groups. But we consider it essential also to offer some context by reference to broader statements of aspiration and concern regarding management of lands, waters and resources, within the Indigenous estate and more widely.

In considering the following specific areas identified as research needs by Traditional Owners, it will important that they are interpreted against the background of those overarching themes.

Already identified research needs

In materials directly addressing research needs, items were varied and crossed disciplinary boundaries. Many identified research needs do not fall strictly within the disciplinary boundaries of marine science but their inclusion is useful to illustrate the nature of interests raised by Indigenous informants, most often in the context of sea country planning.

It is clear from these statements that communities firmly recognise the importance of western science information supporting and complementing Indigenous practice and law in caring for people and country. The issues identified reflect an intent to build independent and resilient societies with well managed natural resources used in ways that benefit Traditional Owners as well as other users (NAILSMA 2014).

Information needs are deeply embedded in place and context. They do not always refer to an identifiable industry sector or single issue. Nonetheless broad categorisations have been offered here to facilitate an overview of common issues. Issues on which research is sought are also crudely ranked according the relative frequency with which they were raised. Both the array of matters presented and their relative rankings are indicative only and expected to change based on direct input from Traditional Owners further in the consultation phase of this project.

Aspirations and concerns that may require research

The important themes identified above relating to Indigenous participation in northern development, barriers to participation and the conditions that Indigenous people seek to apply to development and resource use on their lands and seas cannot be expected to appear in lists mostly made for participation in conservation reserve management. So far as we are aware, Indigenous groups have not been supported in an equivalently systematic way with access to technical and operational advice, or to outline their information and research needs for participating in economic development. As a preliminary step to address this gap we have looked at statements made principally in response to the northern development Green Paper (Australian Government 2014) or related Senate Inquiry.

A full treatment of their content is outside the scope of this work. However, we note several outstanding policy-related discussions - conducted by Indigenous organisations through exhaustive consultation over the last decade or so - that reveal central themes that are directly relevant to marine systems and appear to warrant further research. Among the more significant of these are:

- Effective mechanisms for real Indigenous influence on the way that resources on Indigenous lands and seas are accessed and used, including Indigenous land, sea and resource-use planning (NAILSMA 2012b, 2013a)
- Determining Indigenous-specific resource allocations for both commercial and non-commercial (including customary) purposes (NAILSMA 2009a, b; NAILSMA 2012a)
- Ways of localising decision-making so that traditional owners can be satisfied that they are meeting their obligations to country and to their communities (NAILSMA 2012, 2013, Martin 2011)
- Monitoring and evaluation arrangements for development and conservation that track Indigenous values, benefits and concerns (NAILSMA 2013b, Robinson et al 2016).

Finally, motivation to engage in research relevant to Indigenous lands, waters and the resources they support is not confined solely to greater focus on values important to Indigenous people, although change to address them properly is essential. Indigenous landowners have been active participants in research and management to advance goals - like reduction in greenhouse gas emissions - that sit outside traditional obligations and experience (Russell-Smith et al. 2009). They are eager to deploy assets, skills and practices to problems important to others members of Australian society, especially where delivery of those external goals can contribute to meeting customary obligations to country. Additionally, Indigenous people are aware that the way research is done and choice among methods to meet non-Indigenous goals can affect rights and obligations in regard to issues like customary use of wild plants and animals. There are likely to be no or few areas of research relevant to land, sea and resource management in which Indigenous people are entirely disinterested.

Documented research interests

Land and Sea Management and Environmental Services

In this broad category we include issues related to impacts of land and resource use practice on important values, status of living resources, and approaches to measuring and reporting status of values.

Baseline Information and Monitoring

Traditional Owners are worried about the lack of a coordinated, independent and systematic effort to monitor the impacts, threats and opportunities to sea country (Dhimurru, 2006). There is a desire to develop and implement effective management strategies for issues such as invasive plants and animals as well as quarantine and soil erosion. Comprehensive information is critical to inform these strategies and management plans. The research needs identified in the documents assessed related to baseline information and monitoring are in Table 1. Some of these statements are a decade old or more, but given the limited resources available to address the issues they raise, they remain highly relevant today.

Table 1. Baseline Information and Monitoring Issues

Most shared	Cross-disciplinary research on dugongs and marine turtle species including population status, pressures, threats and habitat (sea grass meadows) degradation (Anindilyakwa, 2016; Dhimurru, 2006; Djelk Rangers 2015; Garawa, 2014; Bradley and Yanyuwa Families, 2007) Record and catalogue baseline data including topography, soils, flora, fauna and water resources. Particular emphasis on culturally and environmentally important species such as shellfish, stingrays and sharks (Anindilyakwa; Dhimurru; Djelk; Garawa; Tiwi Land Council 2003; Yanyuwa)

	Develop capacity for rangers to carry out surveying, data collection and monitoring (Dhimurru 2015; Djelk; Garawa; Yanyuwa, Layhnapuy Homelands Aboriginal Corporation 2013)
Often shared	Threats and potential impacts of increased erosion and siltation of waterways to sea country. Including contributing factors such as overgrazing, feral animals and inappropriate fire regimes (Djelk; Garawa; Tiwi)
Unique or less frequently shared	Population surveys of migratory species (Djelk) Information on dieback in vegetation communities (Dhimurru) Fresh water quality tests (Djelk; Garawa) Survey population of long neck turtles (Djelk) Survey of crocodile eggs (Djelk) Crocodile monitoring (Garawa) Information on the declining populations of small native mammals (Dhimurru; Djelk)

"We believe our wellbeing and turtle (miyapunu) wellbeing are inseparable. To put it another way, we belong to turtles and turtles to us; we sustain them and they us. As custodians and managers of sea country we have responsibility to work with others to manage turtles. We regularly record green, hawksbill, olive ridley and flatback turtles and we are the custodians of internationally significant rookeries of these four species." (Dhimurru 2015 – 06: 25)

Available Research

Overall from a Traditional Owner perspective there is a lack of comprehensive data on the biodiversity and other salient features of coastal and marine areas of the Territory. This includes a lack of ongoing monitoring of key habitats and species.

Communities and Indigenous organisations with the capacity to engage with researchers and commission work have done so, such as the 2013 survey of fauna in the Dhimurru Indigenous Protected Area (IPA) (Vanderduys *et al*., 2013). Most Indigenous groups with sea country do not have this capacity and are reliant on information and research carried out by government or external academic and research institutions for their own purposes.

Systematic presentation of baseline environmental information overall is lacking, with the Northern Territory as the only state or Territory not producing a State of the Environment report (SoE, 2017). However, useful foundational research includes decades of work by Woinarski and colleagues doing biological surveys to standardised techniques across much of northern Australia, including coastal regions and islands (e.g. Woinarski et al 2001, 2007, 2011). Extensive baseline surveying work by Chatto in the 1990s and 2000s (see Chatto, 2000, 2001) focused particularly on the coasts, recording distribution and status of various fauna species including nesting marine turtles, colonial breeding sea birds, shore birds and water birds around the coast and coastal wetlands. Some of the most systematic work involved regular aerial surveys of dugong, magpie geese, and feral animals (see summaries in Whitehead et al 2000) but these have now ceased or are run over small areas for particular purposes. Crocodile surveys from boats continue to be run in most major river systems as they are required to support management programs for commercial use of the saltwater crocodile in particular (Fukuda et al. 2011, 2015).

All available NT information on flora and fauna, including coastal and some marine species, has been aggregated in a geo-coded database which can be accessed across the web. Whilst this provides a most useful tool for preliminary studies, outside a few heavily surveyed areas data are too sparse to be used for assessing trends in populations or changes in distribution at most locations (Whitehead and Oliver 2014). Arguably,

crocodile surveys are the only regularly-conducted surveys that could be used without local supplement to provide meaningful indices of responses to land or wildlife population management actions.

Land condition monitoring programs using a mix of remote sensing and on-ground assessments at fixed points are run by government on pastoral leases. In its annual reports, the Pastoral Land Board reports regional summaries of the conditions of sites assessed during the year. For example, in 2014/15 the Board reported that the condition of many sites in the Gulf of Carpentaria was poor (PLB 2016), indicating soil instability. However, more useful information (e.g. on specific sites and potential influences on nutrient and sediments entering rivers and streams) is not routinely released to the public. It is therefore difficult to make judgments about effects of poor management on riverine or estuarine values.

It follows that specific monitoring programs will often need to be designed and implemented to answer local questions about effects of existing or changed land use or condition of particular species or phenomena about which Indigenous landholders have concerns.

Invasive Species and Biosecurity

Invasive plant and animals can have a large impact on sea country. They also introduce issues of biosecurity. Pigs are degrading and damaging wetland, coastal and marine species and habitat by, for example, consuming turtle eggs and contributing to increased turbidity in the waterways. Their presence on coasts increases risks of entry and spread of exotic animal disease. Weeds can also lead to a decline in native vegetation, change fuel loads and limit access to important places (Dhimurru, 2015). Compromised fire management can result in greater erosion (Russell-Smith et al 2006). A large amount of the time and effort by ranger groups is spent managing and controlling invasive species. This is significant work for the biosecurity and ecosystem heath of the entire country as rangers are working to control weeds of national significance and hyper invasive fauna, such as the yellow crazy ant. Relevant research issues are presented below in Table 2.

Table 2. Invasive Species and Biosecurity Research Issues

Most shared	• Threats and impacts of feral animals and plants to inform management and control strategies of pigs and buffalo* (Anindilyakwa 2016; Dhimurru 2006,2015; Djelk Rangers 2013; Garawa 2014; Tiwi Land Council 2003 ;Layhnapuy Homelands Aboriginal Corporation 2013)
Often shared	• Yellow crazy ants (Anindilyakwa; Dhimurru, Yirralka)
Unique or less frequently shared	• Information to inform management strategies of weeds including the rubber plant, hyptis and annual mission grass (Yirralka) • Information on biosecurity issues of ports e.g. bilge water from ships (Yanyuwa, Dhimurru)
*Buffalo has historically and currently been a source of conflicting management decisions from Traditional Owners. It can serve as a food source but is also destructive. All documentation surveyed highlighted the excessive numbers of buffalo and the need to control them.	

Although some of these expressions of concern are obviously terrestrial in focus, they illustrate a desire to deal with exotic species issues in general and to recognise and manage “downstream” effects of terrestrial impacts on waters, including marine systems.

Available Research

It is very much in the national interest to have up to date information on invasive species and biosecurity issues. For species recognised as threatening or invasive under the EPBC Act there is extensive research and recommendations provided by the federal Department of the Environment and Energy on invasive species (2017a), feral animals (2017b), marine pests (2013) and weeds (2011).

Further collaborative and localised research, such as the work by Ens et al. (2017) is needed to adequately meet and communicate Traditional Owners knowledge needs at a local level. It is particularly important that local people are engaged in work on impacts of exotic species so that they can assess the relative costs and benefits of active management (Robinson et al. 2005). However, serious systematic study of impacts is rare and assessments are mostly anecdotal, making it harder to justify investments in control.

Marine pollution

Marine pollution is of significant concern to Traditional Owners as carers for sea country (Table 3). Marine debris and ghost nets are particularly prevalent and dangerous to species such as marine turtles and dugongs, as well as damaging to significant ecological habitats on the coast. A substantial part of sea ranger work is devoted to monitoring or managing marine debris and ghost nets.

Table 3. Marine Pollution Issues

Most shared	• Information to inform management strategies for marine debris and ghost nets (Anindilyakwa; Dhimurru 2006, 2015; Djelk; Garawa; Yirralka)
Often shared	• Litter from visiting tourists (Dhimurru; Djelk; Garawa)
Unique or less frequently shared	• Dumping of oils and pollutants (Dhimurru) • Impacts of burning of illegal (confiscated) vessels (Dhimurru)

Concerns about other serious but less direct “upstream” sources of marine pollution appear under other headings (e.g. feral animals and mining).

Available Research

The impact of plastic debris and ghost nets on Australian marine life is increasingly studied (Ceccarelli, 2009; Hardety et al., 2014; Reisser et al., 2014).

There is also a significant amount of research on marine debris and ghost nets in the Northern Territory thanks to the ongoing work of sea country rangers, conservation volunteers and research organisations such as the Commonwealth Science and Industrial Research Organisation (CSIRO). The Indigenous organisation Ghost Nets Australia plays a significant role bringing communities and researchers together to address the issues of marine debris in sea country (Ceccarelli, 2009, Wilcox et al., 2014; Wilcox and Hardesty, 2016). As sea country ranger groups and communities have been ongoing contributors to this research it is much more likely this information is accessible and understood by Traditional Owners in the Northern Territory.

Research has also shown the majority of marine debris and ghost nets washing up and injuring marine life, particularly in the Gulf of Carpentaria, is of foreign origin (Edyvane and Penny 2017; Wilcox and Hardesty, 2016). Thus, as the knowledge gap is being filled, there is a greater focus on managing the issue, domestically and internationally.

Pollution issues such as the impact of authorised burning of boats seized for illegal fishing or people smuggling and impacts of port developments are issues that need further research.

Climate change

Information on the current and potential impacts of climate change are of critical interest across all sectors. Understanding of how anthropogenic climate change will affect sea country in the Northern Territory is a research priority identified by Traditional Owners (Table 4). Information needs are particularly acute given the potential for sea level rise to change the intertidal zone, already a contentious space, and threaten sacred sites. The direct reliance of some Aboriginal and Torres Strait Islanders on the intertidal environment for sustenance and obligations of ensuring the health of country and people make the information needs in this context all the more critical.

Table 4. Climate Change Issues

Most shared	• Information to identify, describe and assess potential climate change impacts (Anindilyakwa 2014; Dhimurru 2015; Djelk Rangers 2013; Garawa 2014; Seed 2017)
Often shared	• Issues of sea level rise and protection of marine and costal sacred sites (Dhimurru; Anindilyakwa)
Unique or less frequently shared	• Potential changes to the intertidal zone (Martin, 2011)

Although not raised in the documents examined, recent AIMS reports of coral bleaching in the Darwin area may also be expected to attract interest, whether attributed to climate change or not.

Available Research

Research into potential climate change impacts is often at a broad scale and has varying degrees of certainty. At an international level, the Assessment Reports by the Intergovernmental Panel on Climate Change (IPCC) provide a strong foundational understanding of current climate change science and modelling at a global level (IPCC, 2014).

At a national level reports such as the State of the Climate (e.g. BoM and CSIRO 2016) provide national overview of issues and offer some regionally relevant information and predictions for northern Australia, such as a higher sea level rise than in southern Australia and the predictions of tropical cyclones of decreased frequency but increased severity. These broad scale reports may not offer information at a level localised enough to be of use to Traditional Owners.

Nonetheless, various online hubs of climate change knowledge may be of use to Traditional Owners including: Climate change in Australia (https://www.climatechangeinaustralia.gov.au/en/) and Terra Nova (https://terranova.org.au/). Both provide regional interactive information and predictions that are aimed at decision makers and natural resources managers. Drawbacks of these resources for some Traditional Owners and communities may be their necessity for high quality, consistent internet connection as well as strong literacy in Information Technology (IT), formal science and English.

At a species or ecological community level in marine science, there is research into commercially important fish species and the seafood industry impact of climate change. While mostly at a national level (Department

of Climate Change, 2008; Flemming et al, 2014) there are also studies focussed on the Northern Territory (Welch et al., 2014).

For information on species or ecological communities of identified interest to Traditional Owners there are various studies related to the potential impacts of climate change on sea grass meadows (Campbell, 2006; Connolly, 2012) and marine turtle species (Butt et al., 2016) in the Australian context. As above, some of these are more applicable to the Northern Territory context than others. Most are published in academic journals, only some of which are open access. Furthermore, the technical nature of some of the reports (for example Campbell 2006) mean this information would most likely not be accessible to the majority of Traditional Owners in the Northern Territory.

Interestingly in a recent paper on *Climate Knowledge Needs for NRM Planning in Australia's Monsoonal North and Rangelands,* natural resource managers were interviewed and conveyed their difficulty in utilising climate change science, data and modelling to inform their management plans and practise (Capon 2015a). The reasons identified for this included that information:

- Lacked regional specificity
- Was highly uncertain
- Was technically complex
- Lacked committal language in reports
- Was very top down
- Had little consideration of how to be fit for purpose
- Lacked formats that were culturally sensitive and catered to an array of literacy levels and languages backgrounds

It is apparent science institutions and researchers are attempting to bridge these knowledge gaps and make climate change science more applicable and better communicated. An example of this is the *Climate Change Impacts for Aboriginal people in Northern Australia* document, which usefully communicates in a clear and straight forward manner what can generally be expected for communities (Capon, 2015b). A more comprehensive report by the Department of Climate Change and Energy Efficiency (2009) may also be of use to Traditional Owners who have the capacity to engage with it.

MINING

Many operational and legacy mines, as well as resources exploration activities, on Aboriginal land and seas have the potential to impact, or currently impact, on sea country. Despite recent improvements in openness (see references below), driven by independent monitoring and reporting, Traditional Owners have identified an information deficit of up to date, independent and relevant information on the potential and current impacts of mining on country, including effects on marine environments (Table 5).

Arguably the previous history of denial of problems, and with-holding of relevant information about problems once acknowledged, has contributed to distrust of government and industry exemplified by the public reaction to "fracking".

Table 5. Mineral and petroleum/gas extraction Issues

Most shared	• Consistent and independent information and monitoring of the potential and actual impacts of mining. This includes but is not limited to information on: a) broader marine ecosystem impacts of contamination from pollutants leaching through waterways to the sea b) impacts on threatened species downstream of active and legacy mines c) information of the impacts of fracking on ground water resources (Anindilyakwa 2016; Dhimurru 2006,2015; Djelk Rangers 2013; Garawa 2014; Smyth 2004; Seed 2016)
Often shared	• Information on bioaccumulation of pollutants in fish and other aquatic resources (Dhimurru; Garawa)
Unique or less frequently shared	• Information on sea bed mining and potential damage to the sea bed, destruction of sacred sites and severing of song lines (Anindilyakwa)

Although not raised specifically in the documents considered**,** social and cultural impacts of competition with other land use associated with ramifying infrastructure for unconventional oil and gas extraction may also arise in consultations. Implications for continued access, land (fire) and resource management in exploration and extraction areas are likely to be of particular interest.

Available Research

Some research is available on well established mines and mining practises that have been operating for some time, or are legacy mines in the Northern Territory (Altman and Martin, 2009; Scambary, 2013; Laurecont 2013; NTEPA 2013, 2014; Wollard; 2014). Key issues are Traditional Owners' access to information that is localised and up to date in order to make informed decisions about mining projects on their country and ensuring best practise in operation and rehabilitation. The quote below illustrates the nature of some of the concerns.

"Most recently, at the end of 2013, volatile pyrite iron sulphide was dumped onto a waste rock pile at the mine (McArthur River Mine) and caused spontaneous combustion. The waste rock pile continues to burn, sending toxic smoke into the air and contaminating the water systems. An independent environmental report assessing data from Glencore and the NT Department of Mines has reported on a number of serious issues. These included high levels of lead in nine out of ten fish caught in nearby Barney Creek; an increase in dust levels around the site; and the potential for waste rock pollutants to spill into nearby water systems, including seeping of sulphuric acids. Glencore has been asked to carry out an Environmental Impact Statement to respond to the problem, but this may take up to two years to complete[2]. For people living in Borroloola, fishing is their livelihood and the McArthur River is the lifeblood of the community. We continue to support our people and neighbours in pushing for Glencore to be transparent and accountable for the impacts caused by current pollution." (Garawa, 2014: 40).

Independent monitoring at McArthur River mine has revealed elevated metal levels (lead and zinc) in samples of fish and molluscs from a number of sites (ERIAS 2016). Cattle exposed to lead have been destroyed.

Another significant knowledge gap is the environmental and social impacts of unconventional oil and gas production. For example, ongoing research in the United States has found a significant increase in methane emissions. However, Australia does not have the baseline data for a standard to measure against (Lafleur et

[2] The Environmental Impact Statement for overburden management was lodged in March 2017.

al., 2016). Methane is a green house gas that has a global warming potential about 30x higher than carbon dioxide (IPCC, 2014).

In the Northern Territory there is currently an inquiry into hydraulic fracking, with background information outlined in an issues paper (Northern Territory Government, 2017). Information on unconventional oil and gas production will be particularly important to Traditional Owners if (when) the moratorium on fracking in the Territory is lifted (Dias, 2016).

Tourism and other local livelihoods

Many Traditional Owners in the Northern Territory want to explore opportunities in tourism and other local initiatives that utilise or otherwise depend on healthy natural resources. There is a particular emphasis on creating employment opportunities and supporting people to be on country (Table 6).

Table 6. Tourism and local livelihoods

Most shared	• Information on impacts and opportunities of tourism including pressures on coastal and marine environment (Anindilyakwa, 2016; Cobourg Peninsula Sanctuary and Marine Park Board of Management 2011; Dhimurru 2006, Djelk, Garawa; Tiwi)
Often shared	• Identify and quantify potential impacts and opportunities for use of natural resources across a range of sectors, which are consistent with the protection and maintenance of cultural and environmental values (Anindilyakwa; Garawa; Tiwi)
Unique or less frequently shared	• Support for creating information for tourists on cultural sites and values (Garawa) • Information on Indigenous business and employment opportunities in local tourism industries (Garawa) • Identify potential impacts associated with heritage, cultural and ecotourism ventures (Andindilyakwa) • Information on erosive nature of visitor pressure e.g. vehicle traffic (Dhimurru)

Whilst issues documented in sea country plans are dominated by present experience with tourism, other small scale enterprises (e.g. in sale of bush tucker) that are often associated with tourism can also be expected to arise.

Available Research

As the environmental impacts of mines are better understood and they reach the end of their economic lives, there is recognition of the need and opportunity for Traditional Owners to diversify their economic options (Altman, 2014). Tourism is an important option which is already taken up in many locations and there has been some research on developing opportunities in Indigenous tourism (e.g. Buultjens et al 2010).

There is a particularly large knowledge gap in identifying what other industries and development opportunities are available that place Aboriginal and Torres Strait Islanders as actors in this space. Useful future research would build on scoping studies for livelihoods (NAILSMA 2012a) and the West Arnhem Land Regional Economic Development Scoping Study (CentreFarm 2014). Additional areas of research raised by these and other studies of local livelihood opportunities are discussed in more detail in later sections of this report.

Opportunities need to be evaluated in ways that recognise and value interdependencies between different economic activity undertaken by Indigenous people in remote and regional areas (Altman, 2005; Russell, 2010).

Ports and urban development

Most of the Territory coast and offshore environments are relatively undeveloped, with substantial urban concentrations on the coast only at Darwin and Nhulunbuy. It is unsurprising then that concerns about changes associated with port development and operation and urban development are confined to groups whose lands are occupied by such developments. Concerns appear well-founded, being based on experiences with spills of mining-related pollutants and fuels at both centres and the Bing Bong port facility near Borroloola. During 2016 there were recommendations from the NT Department of Health that fish from sites associated with the McArthur River mine not be consumed due to metal contamination.

Recent environmental concerns identified in relation to Darwin Harbour include: *E. coli* (bacteria) outbreaks, spills of copper concentrate and oil, clearing of mangroves for urban development, industrial and port development, fishery trawling, overfishing, seabed disturbance, by catch issues, sea level rise, and climate change. http://www.topendcoasts.org.au/resources

Table 7. Ports and urban development

Often shared	• Information on threats from port and urban development (Larrakia, Dhimurru)

Available Research

Water quality in Darwin Harbour has been summarised annually in the form of a Report Card (since 2009). Aquatic pest, dolphin and beach monitoring is also undertaken. http://www.denr.nt.gov.au/water/darwin-harbour/reportcards.

Inpex, operators of the Ichthys LNG Project in Darwin Harbour, undertake environmental monitoring including water quality and subtidal sedimentation, intertidal sedimentation and mangrove community health, coral, seagrass, marine pest, recreational fishing and fish health, coastal dolphin, turtle and dugong. http://www.inpex.com.au/our-projects/ichthys-lng-project/ichthys-commitments/environment/monitoring-the-environment/

Some Larrakia Traditional Owners have expressed concerns relating to the safety of eating shellfish from particular waters in the harbour which has led to a research collaboration which will analyse metal trace levels and microbial populations in shellfish and other marine invertebrates collected near sewage outfalls and industrial areas compared to samples collected from reference locations. https://riel.cdu.edu.au/news/2012/none/keeping-bush-tucker-healthy

Fisheries

The coastal and marine areas of the Territory support significant habitat and fisheries populations that enable commercial, recreational and Indigenous fisheries alike. Fishing has been an essential part of life for sustenance, trade and culture and ceremony for as long as Aboriginal and Torres Strait Islanders have lived in coastal and marine areas in Australia.

International trade for trepang (sea cucumber) with the Macassans occurred for centuries before European settlement and there are estimates of its equivalent contemporary economic value being as much as $100 million annually (C-AID consultants, 2010). There was also significant involvement of Aboriginal and Torres Strait Islanders in commercial fisheries during the 1960s and 1970s. This declined following the introduction of stricter regulation and licencing in the 1980s, which made it prohibitively expensive to enter and operate within the commercial fisheries sector in the Territory (C-AID Consultants, 2010t; Department of Primary

Industries and Fisheries, 2003, 2004) Thus, there is a traditional and contemporary interest of Traditional Owners in fisheries and its effects on sea country. Specific research issues are outlined in Table 7.

Table 7. Fisheries Issues

Most shared	• Impacts of commercial and recreation fishers including information on: a) Threats to marine sacred sites b) Overfishing and by-catch, especially in feeding and breeding areas c) Impact of on habitat, e.g. vessel damage to sea grass beds (Anindilyakwa 2016; Dhimurru 2006; Garawa, Living on Saltwater country; Tiwi Islands)
Often shared	• Impacts and opportunities in aquaculture (Dhimurru 2006, C-AID doc., Anindilyakwa, 2016).
Unique or less frequently shared	• Fish population surveys (Djelk) • Fisheries compliance monitoring (Garawa) • Collect information on Indigenous fisheries to support inclusion of Indigenous fisheries in resource sharing and management (Garawa)

Effects of large scale aquaculture on water availability and quality and risks of exotic disease have been raised by the proposed Project Sea Dragon, and can be expected to attract future interest.

Available Research

While there has been substantial research into fisheries, it has emphasised commercially managed species, such as prawns, for many decades (Burford, 2010; Somers, Crocos and Hill, 1987) The most recent Fisheries' Status Report by the Department of Primary Industries and Fisheries (DPIF) provides an overview of the most recent data and information on several managed commercial species (DPIF, 2014).

There is a lack of research into Indigenous fisheries. Until 2010, there had only been one survey conducted on Indigenous fisheries practise by Henry and Lyle as part of a nation-wide study of recreational and fishing practises (2003). While an extensive and comprehensive study, it has also been criticised by Traditional Owners as misrepresenting fishing practises (Dhimurru, 2006).

The most recent and only other published survey into customary fishing was by Saunders and Carne on Groote Eylandt (2010). Providing insight into the catch of culturally and ecologically significant species on the island, it stands out as an example of successful collaborative research. This study will be further explored later in the report.

AIMS has done relevant research on opportunities in "low tech" aquaculture in which populations of commercially valuable marine organisms (e.g. sponges: Duckworth and Wolff 2007) grown in natural systems may be artificially supplemented or protected from predation. The Darwin Aquaculture Centre is conducting applied research on a number of species, including trepang.

Thus, there are large information gaps when it comes to Indigenous fisheries that must be addressed. This is particularly important within the context of government, commercial and recreational fishers and Aboriginal communities negotiating fisheries access and management following the Blue Mud Bay decision (Case study 1). Obviously there are also issues around the potential for Aboriginal people to take up larger roles in

commercial fisheries (DPIF 2012). Related issues around resource allocations are considered in other parts of this paper.

Case Study 1. The Blue Mud Bay Decision

In July 2008, the High Court of Australia upheld the decision that the Northern Territory government could not grant access to waters covering Aboriginal Land (*Northern Territory of Australia & Anor v Arnhem Land Aboriginal Land Trust & Ors (2008) HCA 29).* This means the Department of Primary Industries and Fisheries does not have the power to issue commercial and recreational fishing licenses over the majority of the intertidal zone, where much fishing activity in the Territory take place (DPIF, 2014). Access to these waters requires the permission of Traditional Owners.

Since 2007 Traditional Owners have been negotiating with the Northern Territory government, and other fisheries stakeholders, through the relevant Land Councils on how best to address this issue of access. A delegation of various stakeholders including representatives of government and commercial, amateur and Indigenous fisheries interests' also travelled to New Zealand to learn from the example of Maori fisheries management (Calogeras and Sarneckis, 2009). Extensive consultations have taken place since the decision (C-AID Consultants, 2010; Martin, 2011) and more recently (NLC LES).

While the initial government position of seeking "enduring and certain access…without individual access permit or access fee" has evolved as a result of Traditional owners voicing their concerns and aspirations around protection of country and sacred sites there is frustration over the slow process of negotiations (La Canna, 2017).

Traditional Owners views in the Blue Mud Bay consultations have been consistent with the view expressed over the course of numerous Indigenous fisheries and sea country consultations over the past decades such as:

- Desire for genuine engagement, inclusion and ability to influence fisheries management
- Greater powers of surveillance and enforcement for sea rangers
- General desire to keep a permit system, despite logistical and administrative challenges, in order to protect sacred sites, generate economic opportunities, and reinforce recognition of Aboriginal ownership.
- Frustrations and cross cultural communication issues over the limited recognition of sea country rights – sea country extends far beyond the intertidal zone and in Yolngu (the lingua franca of Arnhem land) there is no singular word for the intertidal zone
- The need for long term collaboration between Traditional Owners and NTG that is inclusive of transfer and transparency in information, including science around local catch effort and local knowledge of which licencees or other fishing access is occurring
- Strong desire for fisheries resources to be enjoyed by the next generation in as good a condition, if not better, than present
- Demand for better ways for government, industry and Traditional Owners to interact to give expression to and achieve policy responses to the large stake that Aboriginal people have as owners and custodians of lands and waters and their resources.

The Northern Territory Government has, since the Blue Mud Bay decision, released various frameworks and strategies with the aim of addressing Aboriginal roles in fisheries management in the Territory. These include the Indigenous Fisheries Development Strategy 2012-14, and the Northern Territory Fisheries Resource Sharing Framework 2013. Neither has resulted in major change in approaches to commercial and recreational fisheries management and little traction to enhance TOs roles in fisheries management and decision making processes.

More recently however, through NLC processes to resolve access arrangements in its jurisdiction, the paradigm is shifting to position Traditional Owners in determining their interests to control access and manage sea

country from the previous negotiation processes based on compensation for permit free access. The NLC is working to secure a participatory planning process to empower local decision making on fishing access and management arrangements.

ADDITIONAL RESEARCH NEEDS

EMERGING AND UNDOCUMENTED ISSUES

We have noted that the specific issues documented by Indigenous organisations came from a small subset of coastal regions and focused on matters associated with establishment of protected areas.

Some Aboriginal organisations have also put statements of interests in particular development options. Often they are offered in response to promptings from external interests like researchers or government agencies: in other cases assembled by local Aboriginal organisations. The summary to follow is dominated by studies done by TopEndFarm / CentreFarm under contract to the Northern Land Council from 2012 to 2014 (Centrefarm 2014). This work appears to be the most comprehensive assemblage of systematically gathered Aboriginal views of favoured forms of development in the NT.

Areas of expressed interest, in approximate order of frequency raised, include:

- tourism;
- land management, often identifying Ranger work;
- horticulture, often small scale;
- pastoralism, often small scale;
- wild harvest, especially of feral animals;
- fisheries, including a few references to aquaculture;
- various minor construction and maintenance services, especially fencing and roadworks;
- forestry, usually around harvesting of natural stands rather than establishing plantations;
- manufacturing only in regard to furniture-making and minor processing of bush products;
- mining *per se* was infrequently raised, and most around construction and maintenance services to mines or small scale quarrying to provide gravel and sand; and
- a couple of references to cropping are about hay production.

Most of these options involve working on country, and using renewable resources present on country. Unsurprising, frequently-raised options appear to be those in which informants have direct experience, because they are or have been in the past available in the remote areas in which they live. And options to which people have direct exposure are mostly of low intensity, like extensive pastoralism or tourism.

For more intensive uses like horticulture, experiences are often small scale. Informants raising horticulture often referred to small domestic gardens used to meet local domestic needs or service local markets. Benefits from these options are most often expressed in terms of local employment, especially for the young, rather than incomes (royalties) for landholders. Frequent references are made to connecting activities to each other, often placing land and sea Rangers at the centre.

There has as yet been no opportunity to “test” these preferences in detail with communities. Nor have people been asked to identify knowledge and research needs connected with them. But the requirement for better information and for systematic interactions between landowners and external informants with detailed knowledge of these activities in other, contemporary settings is illustrated by the observation that options identified by Aboriginal informants often differed from those thought plausible by the consultants recording their views.

Approaches to searching, collaborative examinations of these and other options and the research issues they raise are considered in the next section.

ECONOMIC AND SOCIAL POLICY, GOVERNANCE AND LEGAL ISSUES

Our examination of a set of statements from Indigenous organisations and groups regarding issues in Indigenous economic participation and northern development suggest several areas where targeted research may be useful. In making this assessment we have interpreted research to include investigation and analysis for applying existing knowledge, as well as activities generating entirely new knowledge.

The topics to follow consider recurring emphases in these statements about land (and sea) access, economic development and related policy that may have implications for both the choice of research questions and design of programs and strategies.

ACCESS TO INDIGENOUS LANDS AND SEAS

> "... any approach on Indigenous land and waters that does not properly recognise and respect traditional ownership .. (whether or not that ownership is fully recognised at law) will only lead to ill feeling, project uncertainty and delay."
>
> "... development on Aboriginal land and waters will only be successful and sustainable where Indigenous people are provided with the opportunity to be partners in development ..." (Expert Indigenous Working Group advising the CoAG Senior Officers Working Group (SOWG 2015) on land administration and use)
>
> "Indigenous rights and interests in land and waters must be respected, and rights holders should be able to make choices about how they use their land." (CoAg Senior Officers Working Group 2015).

Submissions to and from government and industry prior to the high level reviews from which the statements above are taken often sought reduction of rights to make development decisions, including government takeover of development on Aboriginal lands (e.g. NTG 2014). More equitable and productive approaches to gaining access to Aboriginal lands and waters will involve genuine partnerships. Developing models for such partnerships and the governance systems to support them could be an important focus for research, along with the processes and tools for sharing information for timely and sound decision-making.

LAND USE PLANNING / ECONOMIC DEVELOPMENT PLANNING

> " ... in addition to law reform, Indigenous people need to be supported and resourced to fulfil their potential and engage with the mainstream economy". (Expert Indigenous Working Group advising the CoAG Senior Officers Working Group (SOWG 2015) on land administration and use)
>
> "The ... approach of the Indigenous Experts Forum requires that policies:
>
> - support local, bottom up planning for generating incomes from Indigenous land
> - link Indigenous rights in resources, including commercial use, to ownership of land and water". (NAIEF 2012)
>
> "To drive the implementation of the Indigenous empowerment policy on the ground, each region will need to establish development agendas" (Empowered Communities Steering Committee 2015)
>
> " The (Northern Australia Indigenous Experts) panel proposes an Indigenous Prospectus for Northern Development ... set(ting) out the benefits that Indigenous investors seek from their lands and waters; the ways that co-investors can also benefit; the conditions under which investments will be sought and accepted; ... and the strategies and plans needed to realise national benefits from full Indigenous participation in northern development". (NAILSMA 2013)

Effective partnerships depend on all parties understanding the opportunities at stake, the risks involved, realistic appraisal of benefits and cost, and the best methods of achieving them. In short, they depend on

planning. At present most Indigenous landowners lack the systems needed to aggregate and interrogate available data for robust land use planning. Designing and testing systems of support, including tools suited to and usable by landowners in remote setting will be an important area for applied research. Exploring the biophysical and socioeconomic implications of new options will be a rewarding and essential component of that research in all settings, including marine.

Resource access and allocation

> "The ability for Indigenous people to fully utilise their property rights to create wealth and prosperity is critical (and) ... "law and policy needs to be amended to enable this". (Expert Indigenous Working Group advising the CoAG Senior Officers Working Group (2015) on land administration and use)
>
> "We urge governments to ... to enable the equitable participation of the Indigenous owners of Australia in the development of policies, setting of allocations, and management of regulatory schemes" (NAILSMA 2012b)
>
> "Any water allocation plan in tropical Australia must, irrespective of historical allocation, include an equitable Indigenous allocation from the consumptive pool for commercial purposes" (NAILSMA 2009a).

These statements reinforce obligations to redesign policy instruments to provide for more equitable Indigenous access to resources, and ways of managing change in management regimes in productive (non-disruptive and mutually beneficial) ways. There are presently no agreed formulae for working out how to add Indigenous allocations to existing resource management regimes, which is especially challenging where they have been fully or even over-allocated without considering Indigenous landowners rights and expectations. Negotiations over such issues must be underpinned by high quality research and analysis of the biophysical and socio-economic implications. Redesign of management systems and the legal and related instruments for implementing them to provide the predictability sought by both industry and landowners will be challenging and will benefit from independent review and analysis.

The Fisheries Resource and Development Corporation Indigenous Reference Group has identified research, development and extension priorities for fishing an aquaculture with cultural allocations identified as a priority.

Community-based and/or co-management of natural resources

> "... Sustainable Livelihoods ... (require):
>
> - responsive and participatory planning and implementation
> - activity focused partnerships
> - outcome-based monitoring and evaluation .." (NLC 2014)
>
> "... various governments have raised options for devolution of powers in some areas of natural resource management ... arrangements need to go well beyond the more or less tokenistic consultative mechanisms that operate in areas like commercial fisheries" (NAILSMA 2012)
>
> "... relevant laws should be amended to establish co-management as the preferred approach to managing sustainable use and conservation of wild plants and animals of significance to Indigenous people" (NAILSMA 2014b)
>
> " all management programs for wildlife important in the customary economy or valued for other reasons should be developed jointly with Indigenous interests and implemented at regional and local scales with or entirely though local Indigenous experts." (NAILSMA 2014b)

> "Neither traditional knowledge nor orthodox science needs or seeks validation in terms of the other, but skilled practitioners jointly seek the best solutions to management problems" (NAILSMA 2014b)

One of the strongest and most consistent messages from Traditional Owners of sea country is that they lack the influence needed to discharge their obligations under traditional law. Respect for traditional knowledge is urged mostly rhetorically in treatments of research and resource management policy. The best way of showing respect will be to develop systems for Indigenous custodians to apply such knowledge. Co-management or community-based management of marine resources has been an area of active research and experimentation in other nations for decades. Opportunities should be taken to frame and test new models in an adaptive management environment, perhaps using action research techniques.

Measuring benefits and costs

> Each (plan) "should also identify indicators used to measure progress ... and how each party is meeting its responsibilities". (Empowered Communities Steering Committee 2015)

> "Success in joint management will be indicated as much by its social outcomes as its biophysical" (NAILSMA 2014b)

> " ... consultation results show significant continuity of core values, aspirations and views amongst Indigenous people across the savannas, not-withstanding important local and regional differences. There is, as expected, little continuity of actual monitoring of these foundational values or indicators derived from them to date. This research shows that a number of other indicator sets and sources of monitoring exist across the Indigenous land management sector – some more useful than others. Perhaps the most useful are those developed by locality based land manager corporations ..." (NAILSMA 2012)

Research on ways to embed Indigenous views of important values and outcomes from management is in its infancy (Robinson et al. 2016). Much more study is required on design to demonstrate achievement consistent with traditional norms and obligations and to foster active participation in measuring, interpreting, reporting and responding to outcomes of changed policy and practice.

Cumulative and off-site environmental impacts

> "Our fish, creeks and waters are slowly being poisoned by mining companies. Our river's been diverted ... They made a huge rock pile too. And that's full of toxic waste that's gonna slowly leak acid into our waterways. On top of this we got the fracking mob turning up" (Jack Green in Kerins and Green (in review))

> "... it is uncertain to what extent wider scale water dependent opportunities are achievable and sustainable. This uncertainty is heightened when water access is evaluated with regard to the critical issue of maintaining water flows required to protect cultural and environmental values on Indigenous-held land" (Indigenous Land Corporation 2014)

Local capacity to deal with complex issues such as cumulative impacts - of multiple exposures to multiple on and off-site effects - is rudimentary. Increased risk of additive or synergistic effects is an inevitable consequence of accelerated development and new forms of land use. As discussed in regard to planning, Indigenous people presently have little or no access to the tools necessary to reveal risks of cumulative impacts, let alone provide quantitative or even ranked qualitative assessment of risk and options for risk treatment. There is an urgent need for development of improved tools for analysis and presentation of such effects.

Policy review and law reform

> "Key shifts in policy for Indigenous development in northern Australia must include:

- serious, integrated planning processes that:
    - instead of setting up competing development and conservation plans, treat both together
    - deploy economic development as a solution to improve and sustain environmental quality and address social problems
- "... match(ing) government programs of all sorts to deeper understanding of local context and aspirations" (NAIEP 2012)

Recurring themes in assessments of government policies and programs in Indigenous affairs are that they are disconnected, discontinuous and sometimes in conflict. Despite centralisation, mismatches across portfolios are common (e.g. NAILSMA 2015). Recent formal audits have revealed severe problems of design and delivery of core programs, with damaging effects on competent local organisations (ANAO 2017) on which local development will depend. There is an ongoing need for independent review of programs to reveal problems and promote greater coherence. Bringing policy goals around northern development and Indigenous socio-economic advancement into alignment is an obvious candidate for serious work, at both an overarching conceptual level and in the elements discussed elsewhere. Opportunities and obligations to make productive advances in the marine environment have been opened up by the Blue Mud Bay decision.

Emerging commercial opportunities

- "... (too) little consideration of emerging economic opportunities, including carbon and other offset industries." (NLC 2014)
- "... planning to include thorough examination of new options for ... payment for ecosystem / environmental services originating on Indigenous lands" (NAILSMA 2014b)
- "Explicit incorporation of commercial environmental services in procurement policies to favour Indigenous providers can provide an essential bridge to routine engagement with other aspects of the mainstream economy, at low or no additional public cost" (NAILSMA 2015)
- Fishing – ACLs, holding commercial licences

The northern development focus has been on large scale interventions to promote orthodox industry with benefits expected to "trickle down" to north Australia's resident populations. However, numerous analyses have shown that little benefit reaches remote and Indigenous people through favoured industries, even when large developments occur on their lands. There is an obvious need for smaller scale activities that are better matched to the present interests and skills of Indigenous residents of regional and remote areas. AIMS and other research organisations have looked at opportunities in "low tech" aquaculture and governments have sought participation in small scale local wild catch fisheries. A few options, especially those deploying traditional knowledge in land and sea management, may be commercially viable in isolation, but many more could form part of a viable mix. However, such inter-dependent "hybrid" enterprises can be complex and fragile. There is great scope for research to identify new opportunities and in particular to develop management, financial and governance systems capable of dealing with such complexity. The existing Ranger systems offer working models that often depend on multiple incomes from disparate sources. Research to apply lessons from existing successes that incorporate Indigenous governance principles matched to local context is a potentially rewarding area of study.

Implications

The issues discussed above illustrate only a few of many areas of applied research applicable to Indigenous roles in use and management of the marine environment and its resources. Levels of interest in pursuing these issues and others will be determined in consultations.

Many of the research questions they raise straddle elements of traditional descriptive or hypothesis-driven research in the biophysical sciences; social and community development; planning theory and practice; design

of effective resource management policy instruments; and political science. They are inherently complex and often difficult, but if not addressed, the impacts of ignorance on management effectiveness and the well-being of Indigenous landholders and their communities may be profound.

Engagement of Indigenous people in these and other research activities may be achieved through action research methods. Stringer (2007, p. 1) describes action research as "a systematic approach to investigation that enables people to find effective solutions to problems they confront in their everyday lives". It focuses on localised solutions rather than necessarily seeking generalisations. Such an approach obviously differs strikingly from the way most biophysical research is conducted, where capacity to generalise is treated as an essential feature of good research design. The approach demands much more from researchers than technical skill.

Research protocols developed by Indigenous organisations often embody aspects of the action research orientation. For example, in NAILSMA (2007) guidelines it is indicated that research "should:

- address community landholder goals and aspirations
- promote Indigenous management and control and protect Indigenous rights under Indigenous law
- promote and support natural and cultural resource-based enterprise and economic activity, especially when linked to customary practice
- increase respect, understanding and use of traditional knowledge and skills and
- assist Indigenous people to be active on country."

As indicated earlier, we do not suggest that only research overtly adopting action research methods will be of interest to Indigenous people. However, researchers seeking to engage with Indigenous groups should be aware of the expectation that work will - in one way or another - address practical local problems and thereby help contribute to improvements in well-being. Some of the issues this raises are considered next.

Best Practice and Next Practice

'Best Practice' - Meeting End User Needs

Aboriginal and Torres Strait Islanders' research needs as end users are distinctly different to others in that they will not be solved by simply conducting more conventional marine science.

For example, a recent study published on mangrove dieback in the Gulf of Carpentaria (Duke et al., 2017) would very likely be of interest to Traditional Owners in that region. Published in a scientific journal, this article is accessible via a paid subscription. Thus, the primary source is only available to an audience that has the financial means (or the institutional affiliation) to access such publications and the technical capacity to engage with a scientific report presented in this way. On both accounts, Indigenous communities are disadvantaged. Naturally, independent, comprehensive science requires funds and comparative standards. However, this example highlights the importance of additional targeted science communication and that in this cross-cultural context of meeting end user needs, the knowledge needs of Aboriginal and Torres Strait Islanders cannot simply be addressed by publishing more papers.

This provides challenges and opportunities to meet information needs that embrace a more interdisciplinary and transdisciplinary practice of science. Creative and innovative science communication strategies will need to be further explored. To accurately present the end user needs of Aboriginal and Torres Strait Islanders in marine science there must be a consideration of what knowledge is missing or needed, as well as how research is conducted, presented and of its outcomes.

For meeting research needs for Traditional Owners as end users of marine science there must be a consideration of broader issues including:

- **Scope** - Mechanisms are required to ensure that Indigenous interests have real opportunities to participate in framing research questions, and design and implementation of research programs and projects that directly address their values, concerns and interests. The obligation to achieve real engagement also extends to areas that Indigenous people have not identified as high priority, but acknowledge to be important to others and that have the potential to influence policy and/or practice affecting lands, waters and resources in which they have actual or potential customary or commercial interest.
- **Communication** – Cross cultural communication be a challenge between Indigenous and non-Indigenous people researchers and communities, particularly if all consultation, research and study outputs are in English. Consultation, collaboration and research outputs must consider how to be culturally sensitive and cater for varying levels of English and literacy.
- **Access** - As identified, available science relating to the information priorities was in some cases, only available via subscription access academic journals and databases. As such, there is a current large lateral gap in knowledge. Consideration must be given as to how current knowledge can be shared more effectively and how future research can be provided back to communities in an appropriate and timely format.
- **Consent and intellectual property** – Free, prior and informed consent must be negotiated prior to research and intellectual property rights recognised in the publishing of reports and materials (Ens, 2015).
- **Scale and context/recognition of localised interests and issues** – Indigenous knowledge is held in place, and therefore not generally regarded by its custodians as directly applicable to other locations. Non-Indigenous researchers must be aware of working at scales applicable to Indigenous interests and showing how work from other places and situations is relevant.
- **Compensation** – In the case of collaborative research driven primarily for a non-Indigenous research agenda, researchers should negotiate agreed compensation with Aboriginal and Torres Strait Islanders as participants of, or contributing knowledge to, a research project.
- **Use of Indigenous knowledge** – Care must be taken to ensure an equitable collaboration without the appropriation of Indigenous knowledge out of context to simply inform the western research agenda (Barbour and Schesinger, 2012). Also, there is some knowledge that cannot be shared publicly (Figure 2).
- **Governance** – Science research exists within broader political, environment, political and historical contexts. Consultation fatigue can be an issue as Land Councils and Traditional Owners continue to provide information and explanations to changing government and research bodies in an uncertain and erratically shifting policy and funding landscape.

MARGARET ORR

In the middle of the painting is a Council meeting. Grey people (U) are seniors, the old people. Brown U are the community members. White U are the visiting research workers. The meeting gives permission for visiting researchers to go out and talk to the community. One group of community people talk into tape recorders (U with rectangle above). They can decide if their stories are OK to share or if they are private and confidential. Other people talk and the researchers write down what they say (white books). The people are OK for the researchers to take their words away for the research, but they have to give a copy to the community people. Another group talks up strong to the visiting researchers and gives them good ideas but says the stories are confidential (brown books), and the researchers can't write them down.

FIGURE 2 HTTP://WWW.NINTIONE.COM.AU/RESOURCE/ABORIGINAL-KNOWLEDGE-AND-IP-PROTOCOL-COMMUNITY-GUIDE-BOOKLET-A5.PDF - CLC BOOKLET P. 20

An example of a successful recent research collaboration between government, researchers, sea rangers and communities is of the shark and stingray survey on Groote Eylandt (Figure 3.) A key element of the project's success was recognised as the underlying partnership between community and researchers (Saunders and Carne, 2010).

Case study 2 – Survey of Customary Fishing of Sharks and Stingrays: Groote Eylandt

Recognising the cultural and ecological importance of sharks and stingrays and the lack of information on Indigenous fishing practices, this report aimed to address what is a successful method for collecting information on shark and ray harvesting by Indigenous people.

The four phases of the project were:

1. Consulting and forming a partnership
2. Developing the survey
3. Identifying a method to sample a broad section of the community (engagement)
4. Implementing and conducting the survey

Acknowledging that current research practices had not been successful in obtaining information, a key consideration of the study was the survey framework and design. Anindilyakwa sea rangers and researchers worked together for eight months to produce a survey that was culturally appropriate and easy to use.

The final survey design was a poster with images of the species to be surveyed as well as their common, scientific and Anindilyakwa names (Figure 4). Thus, the survey supported the use of Anindilyakwa language and could easily be placed in a prominent place in the home. Images also helped identify species better.

Extensive consultation on how to involve participants lead to the survey being conducted at two local schools in the communities of Angurugu and Umbakumba and imbedded into the curriculum.
Participation was high and survey information was collected on blacktip shark, speartooth shark, giant shovelnose ray, cowtail stingray, roughskin stingray, barramundi and mud crab, green turtle and dugong species. Survey sheets were completed weekly at schools for a six month period.

Figure 3 - survey poster used by school students (Saunders and Carne, 2010: 20)

Species other than sharks and rays were included at the request of the Anindilyakwa sea rangers and the Department of Resources in order to support ranger work and other research projects. This project has in turn lead to various community benefits, such as engaging school children in learning and creating junior rangers employment opportunities. The Anindilyakwa sea rangers will continue to carry out and expand on the survey in phase II of the project.

This case study highlights the opportunities and challenges of collaborative research in the marine space. From the beginning of the project researchers recognised the need to create a project design that was contextually and culturally appropriate. As a result of the innovative research method, there was successful community engagement as well as social, educational and employment benefits.

Limitations of the project and future improvements are acknowledged and suggested in the report. Recognising these, this report still stands out as a useful example of how marine science research may be conducted in a collaborative and culturally sensitive manner. The study contributed to greater understanding of Indigenous fishing practices (a knowledge priority identified in this study) and had a net benefit to the community more broadly.

'Next Practice' - Indigenous-Driven Research

As previously stated, the capacities and contexts of Indigenous communities with sea country in the Northern Territory are diverse. As communities continue to build up their capacity to engage with the western science community on their own terms there is growing research, which is the result of two-way collaboration driven by Indigenous interests and actions (James and NAILSMA 2016; Dhimurru, 2013; Ens, 2012, 2017). This marks a growing change that will continue to expand, away from research projects primarily being founded on only non-Indigenous actors, interests and priorities.

With Aboriginal and Torres Strait Islanders as stronger stakeholders, researchers and scientists in this space, the role and practice of non-Indigenous scientists and researchers may also evolve. For example, researchers in North East Arnhem land recently published a paper exploring how an Indigenous research methodology can support and inform western academia (Wright et al., 2015).

A key issue will be how research is conducted and approached in different contexts. For example, how to encourage Indigenous-driven research in terms of realising Traditional Owners' research priorities for communities who have information needs but not the capacity to act on them. As well as supporting communities to engage with, commission and/or conduct research for themselves where appropriate, and building their capacity to do so.

This further highlights the heterogeneity of interests and capacities between community groups and of the critical importance of context in prioritising and designing research. It also presents the opportunities available moving forward to conduct new and original marine science research.

Conclusion

This report has endeavoured to present the knowledge needs of Indigenous people as end users of marine science in the Northern Territory to the extent that those needs have been identified in the literature. As customary and legal owners of much of the land and sea in the Northern Territory, Aboriginal and Torres Strait Islander people have information needs that are critical to supporting informed decisions on how to care for, develop and utilise sea country.

The review identifies key sectors of interest and a broad overview of available research in each of those sectors is offered. Relevant policy and programs have also been presented. Consideration is given to research needs relevant to Indigenous economic participation in northern development and takes in economic and social policy, governance and legal issues, including resource access and allocation concerns. This report has gone on to highlight the broader considerations that must be taken into account when conducting research in this context such as communication, access, consent and intellectual property, scale and context, compensation, appropriate use of Indigenous knowledge and governance.

Aboriginal and Torres Strait Islander peoples' research interests go beyond informing external conservation and development agendas. These interests are not limited to informing western biophysical science or providing others with the 'social licence' to operate on their estates. The social and environmental obligations of government and industry can only be met through recognition of the underlying rights and interests of Indigenous people to conserve, manage and use natural resources, including marine resources.

It is in the interests of all to ensure Australia's coastal and marine environments in the Northern Territory are better understood so that they can be better managed and cared for. Seriously addressing the research issues and approaches outlined here will support Traditional Owners' interests in creating increasingly resilient societies of healthy people on healthy country.

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