



Northern Australia
Environmental
Resources
Hub

National Environmental Science Programme



Economic values and Indigenous Protected Areas across northern Australia

Final report

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This report should be cited as:

Farr, M., Stoeckl, N., Esparon, M., Grainger, D., and Larson, S. (2016). *Economic values and Indigenous protected areas across Northern Australia*. James Cook University, Townsville.

Cover photographs:

Front cover: Ancestral wisdom © iStock.com/sebastianbourges

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This report is available for download from the NESP Northern Australia Environmental Resources Hub website: www.nespnorthern.edu.au

The Northern Australia Environmental Resources Hub is supported through funding from the Australian Government's National Environmental Science Programme. The NESP NAER Hub is hosted by Charles Darwin University.

ISBN 978-1-925167-79-5

December 2016

Printed by Uniprint

Executive summary

Indigenous Protected Areas (IPAs) are crucial components of Australia's National Reserve System (Section 2) and generate a large and diverse range of benefits – not just environmental and biodiversity benefits, but social, economic and cultural benefits as well (Section 3, Appendix 1). These benefits are valuable to a wide range of stakeholders (Section 3).

Some of the benefits associated with IPAs are relatively easy to quantify (e.g., the number of people employed through the IPA system) and some are relatively easy to assess in monetary terms (e.g. the incomes earned by rangers), but many of the benefits are intangible, which makes them difficult to quantify – particularly using money as a metric. A variety of different non-market valuation techniques exist that quantify a range of diverse benefits using monetary and non-monetary metrics, but different methods are good at assessing different things. Importantly, not all valuation methods can be used in each context (Section 4).

We undertook a systematic review of the empirical valuation literature relating to benefits associated with IPAs, revealing that some benefits are quantified in monetary terms more frequently than others, both in Australia and elsewhere. This does not mean that the quantified benefits are more important than other benefits. Instead it indicates that they are easier to quantify. As a result, there are substantive gaps in our understanding of numerous benefits – of their value to different people, in different contexts, in their entirety, and relative to other benefits (Section 5). Our research indicated that while a lack of price does not mean lack of value, it often means lack of ‘visibility’ or ‘presence’. So, vitally important non-market goods and services associated with IPAs may be overlooked, particularly by decision-makers who are driven by quantitative and/or economic data. It is important to find ways of highlighting the importance of those non-market benefits, so that resources can be directed in a manner that generates most benefit per dollar spent.

There are few quantitative valuation studies that have been undertaken in an Australian Indigenous context: we found only 18 studies that quantified the value of benefits associated with IPAs and most of these focused on provisioning services, such as the value of food or medicines obtained from country and the value of employment associated with ranger programs. There is relatively little quantitative research that focuses on other benefits, particularly those associated with spirituality and other intangible cultural values.

When prioritising research to fill the gaps and selecting the most appropriate valuation method for the task (whether it's one that uses money as a metric or something else), it is important to carefully specify the type of information required: *who needs the information?*, *on what?*, and *why?*. When asked by different stakeholders, these questions may require the use of different valuation methods. This is because different stakeholders will likely prioritise the assessment of different benefits, and different benefits require different assessment techniques. Links between potential questions and valuation approaches are provided in Section 6.

This project underscores the importance of truly transdisciplinary research that actively involves key stakeholders in the development and implementation of work.

Different people attach different meanings to the word ‘value’. Many people think of value in purely monetary terms (e.g. the price or cost of a good). Economists also often use money to assess value but tend to think of value more broadly, acknowledging that something is of value if it increases the wellbeing of an individual. In other social sciences, the word ‘value’ is not generally associated with money at all, and is instead linked to notions of individual and social norms. In this report, we use the word as economists most frequently do – noting that something is of value if it is important (and contributes to wellbeing) – but that value is not solely monetary.

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Acronyms

ACCSP	Australian Climate Change Science Program
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
CAR	Comprehensive Adequate Representative
CFC	Caring for Country
CICES	Common International Classification of Ecosystem services
CYPDA	Cape York Peninsula Development Association Inc
CYPLUS	Cape York Peninsula Land Use Strategy
DOGIT	Deed of Grant in Trust
FaHCSIA	Families, Housing, Community Services and Indigenous Affairs
GBR	Great Barrier Reef
ILC	Indigenous Land Corporation
ILUA	Indigenous Land Use Agreement
IPA	Indigenous Protected Area
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IUCN	International Union for Conservation of Nature
NAILSMA	North Australian Indigenous Land and Sea Management Alliance Ltd
NERP	National Environmental Research Program
NESP	National Environmental Science Program
NNTT	National Native Title Tribunal
NRM	Natural Resource Management
NRS	National Reserve System
NTRU	Native Title Research Unit
PBC	Prescribed Body Corporate
RHTU	Rural Health Training Unit
TEEB	The Economics of Ecosystems and Biodiversity
TO	Traditional Owners
TSRA	Torres Strait Regional Authority
WCC	World Conservation Congress

Acknowledgements

This project was supported through funding from the Australian Government's National Environmental Science Programme and led by the Northern Australia Environmental Resources (NAER) Hub. NESP is a multidisciplinary program delivering applied environmental science, particularly focussed on biodiversity and climate systems research.

We would like to acknowledge the steering group including Tom Holyoake (Kimberley Land Council), Julie Melbourne (Nyamba Buru Yawuru Ltd), Fiona Peek (Northern Land Council), Dean Yibarbuk (Wardekkenn IPA), Sharon Prior (Ewamian Aboriginal Corporation), Lynne McCarthy (Prime Minister and Cabinet), Emma Campbell (Department of the Environment) and David Hinchley (The Nature Conservancy) for consultations and for providing particularly useful insights, ideas, and reviews. We also acknowledge Melissa George (NAILSMA) and Ro Hill (CSIRO) for their significant support, useful insights and perspectives, and for linking this project to other IPA research being undertaken in the NAER Hub.

We wish to thank the reviewers for their time in providing feedback on our draft report. Their suggestions have been invaluable.

1 Introduction

1.1 The National Environmental Science Programme

Ecosystems worldwide are facing a multitude of threats (ABS, 2010). The Australian Government is committed to the long-term protection and maintenance of Australia's unique and diverse ecosystems (Department of Environment, 2015a). Aimed at increasing national capacity to better understand, manage and conserve Australia's exceptional environment, research into applied biodiversity and climate science is supported through the Australian Government's National Environmental Science Programme (NESP), currently funded with \$145 million for six research hubs and emerging priority projects from 2015 to 2021.

NESP builds on its predecessors the National Environmental Research Program (NERP) and the Australian Climate Change Science Program (ACCSP). Based on world-class science, NESP research is strongly focussed toward end-user delivery to support evidenced-based policy development and improved environmental management for Australia. NESP provides science for a range of stakeholders including government, industry and the community, and also aims to support public good outcomes.

Six research hubs were appointed, each with their own specific research priorities: Clean Air and Urban Landscapes; Earth Systems and Climate Change; Marine Biodiversity; Northern Australia Environmental Resources; Threatened Species Recovery, and Tropical Water Quality Hub (see the NESP website <http://www.environment.gov.au/science/nesp> for a detailed description of each hub). The research about which this report is written was undertaken as part of the Northern Australia Environmental Resources Hub, which addresses the sustainable development of the unique northern environments. This report is associated with the theme *Supporting Indigenous natural resource management in Northern Australia*, focusing predominantly on *Indigenous Protected Areas (IPAs)*.

1.2 Why focus on the value of Indigenous Protected areas (IPAs)?

Indigenous people are renowned for their strong connection to 'country'. Actively managing the land is an integral part of who they are. Land means life, not only for its ability to provide sustenance, but also because Indigenous cultural, social and spiritual identity is connected with it. It is a responsibility which has and continues to be passed on to future generations. Although it is something innate and part of culture, officially declaring the land or sea for protection is often required as a way to receive high levels of support from the Government.

Formally, Indigenous Protected Areas are Indigenous-owned land or sea where Traditional Owners have voluntarily entered into an agreement with the Australian Government to promote biodiversity and cultural resource conservation (Department of Environment, 2013). Seventeen years since the first IPA was declared, there are now more than sixty IPAs across 48 million hectares nationally (Figure 2). These are highly diverse, ranging from extremely large remote desert areas on Indigenous-owned lands to relatively small, rainforest multi-tenured sites where IPA co-exists with National Parks, lease-hold and privately owned lands (Hill et al., 2013). IPAs are pivotal in conserving Australian biodiversity and ecosystem services, constituting over 36% of the country's National Reserve System (NRS).

IPAs provide more than environmental benefits: they also protect cultural and community values that are vital to Australian societies and are of national significance. This means that it is not just Indigenous people who benefit from the establishment of an IPA, but the broader Australian and international community (Hill et al. 2016; Department of Environment 2013; Weir et al. 2011; Dudley et al. 2011). Moreover, communities receive numerous spin-off benefits such as health, education, employment and social cohesion. Despite the array of benefits generated by IPAs, relatively little is known about them. Hence the focus of this project.

1.3 Project aims and structure of report

This study is part of a larger project which is aiming to identify the research needs of IPAs in Northern Australia. This particular sub-component of the project focuses on the economic value of IPAs.

We set out to identify:

- a) Core social, economic and cultural benefits associated with IPAs;
- b) Methodological approaches suited to the estimation of value in these contexts;
- c) Gaps in our understanding of the economic value of those benefits; and
- d) Ways in which stakeholders could use information about the economic value of those benefits in decision-making contexts.

The above objectives were met by undertaking literature reviews and consultations with stakeholders across Northern Australia (i.e. IPA managers, government, non-government (NGO) and researchers).

First, we undertook a fairly broad review of land use and land tenure arrangements relevant to Indigenous people, and of Australia's National Reserve System to provide contextual background on IPAs (Section 2). We then reviewed literature discussing the numerous benefits associated with IPAs (Section 3 and Appendix 1, Objective A). We reviewed literature relating to frameworks for thinking about values, about valuation methods, and about the difficulties of undertaking valuation studies in Indigenous contexts (Section 4, Objective B). We searched for empirical studies in Australia and elsewhere which had explored (either quantitatively or qualitatively) the various benefits that have been associated with IPAs (Section 5, Appendix 1). We systematically analysed this literature, characterising studies according to the type of benefit assessed, and the method used to describe, quantify, or monetise it. This helped to highlight knowledge gaps (Section 5, Objective C). Finally, we used insights from the preceding reviews, and from consultations with Indigenous, Government and NGO stakeholders, to generate a non-exhaustive illustration of the way in which particular valuation approaches could be used to help fill (some) knowledge gaps, generating information that could be useful in specific decision-making contexts (Section 6, Objective D).

Key outcomes of this study are thus better understandings of:

- a) The multiple benefits of IPAs;
- b) Appropriate methods for assessing those benefits; and
- c) Stakeholder needs for information about the value of those benefits, and appropriate methods for assessing benefits to meet those needs.

2 Context

2.1 Indigenous Protected Areas (IPAs)

Australia is party to a number of international conventions and agreements relevant to the protection of biodiversity in protected areas, such as the Convention on Biological Diversity. The National Reserve System, founded in 1996 by the Natural Heritage Trust, is important to these conventions and agreements. The NRS comprises 10,000 protected areas of various sizes covering approximately 20% of Australia (Figure 1) (Department of Environment, 2015b). NRS development is guided by the CAR (Comprehensive, Adequate, Representative) objectives which emphasises large enough scale, sustainability of population and diversity of the ecosystem, respectively. In collaboration with the NRS, each state and territory government prepares a five-year budget and plan catering to their distinctive biodiversity needs.

Covering an area of more than 48 million hectares, IPAs account for around 36% of the country's NRS (Figure 2). There are currently 69 declared IPAs, the first of which (Nantawarrina in South Australia) was declared in 1998. They range in size from one square kilometre to 10.16 million hectares (in the Southern Tanami, Northern Territory) and protect a variety of ecosystem types, such as reefs, rainforests, mangroves and dunes. A few examples from Queensland include:

- The *Eastern Kuku Yalanji* IPAs are managed by the Native Title Prescribed Body Corporate (PBC) Jalunji-Warra under IUCN category VI. The intention being to conserve the rare flora and Great Barrier Reef (GBR) near the Daintree region.
- The *Kanju* IPA east of Coen, Cape York, conserves the river ecosystems under IUCN category V.
- The *Mandingalbay Yidinji* IPA is managed via the Djunbunji PBC for the region east of Cairns across the Trinity Inlet and aims to conserve the mangrove ecosystem.
- The *Warul Kawa* IPA covers vegetated dunes of Deliverance and Boigu Islands and is managed by the Torres Strait Regional Authority (TSRA).

These areas make a substantial contribution to the Government's international and national objectives, such as the National Strategy for the Conservation of Australia's Biodiversity. In 2008, the NRS became part of the Caring for our Country (CFC) initiative; the NRS being the 'cornerstone' of CFC to protect biodiversity across an Australia experiencing climate change.

There are various legal and practical reasons for the Australian Government to incorporate Indigenous customary interests into the broader Australian project of land, sea and resource conservation. Land and water subject to Indigenous ownership and governance constitutes a large proportion of the Australian continent, particularly in Northern and Central Australia. In Australia's Northern Territory, for example, Aboriginal people own over 50% of the land mass and over 80% of the coastline.

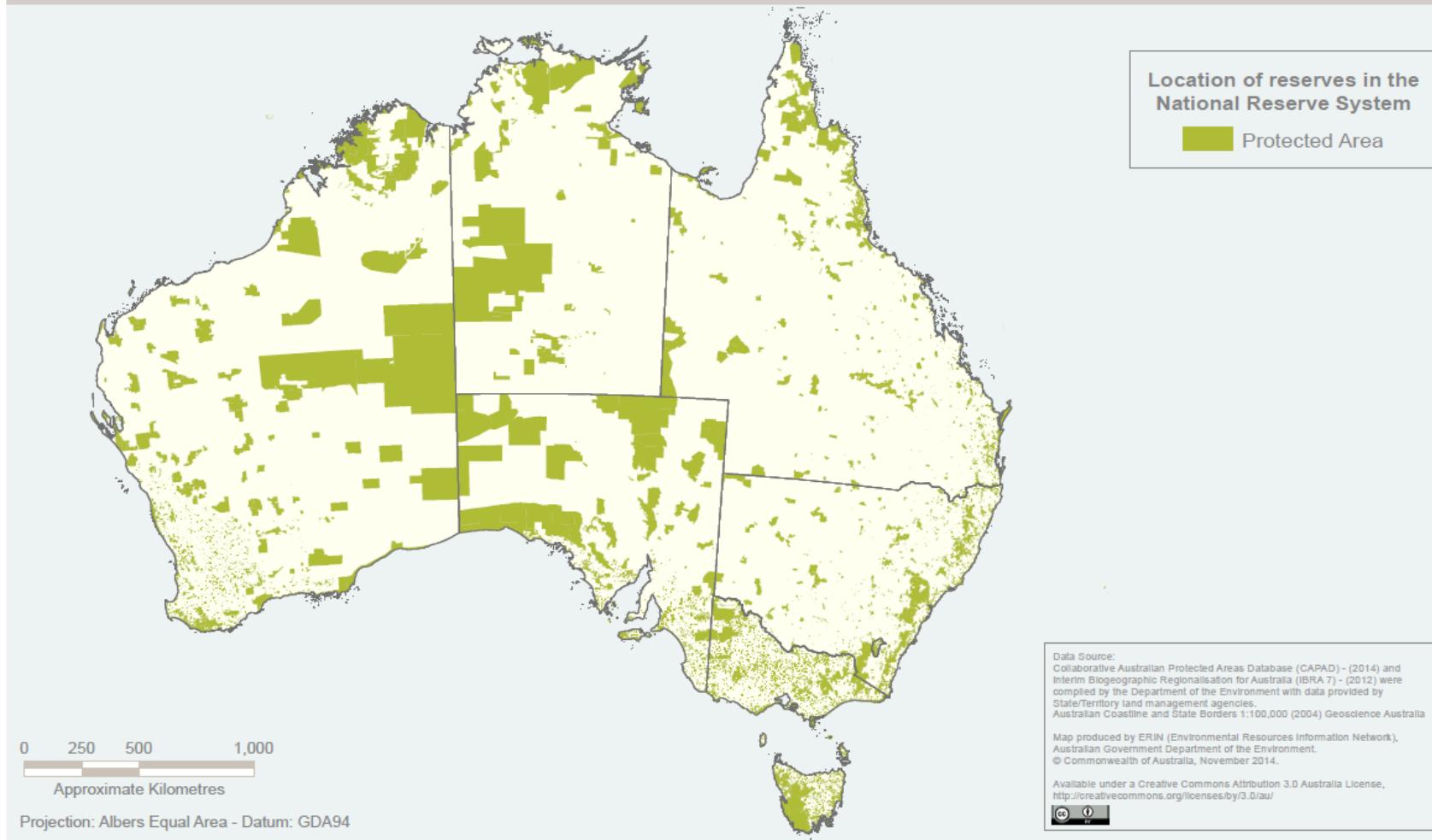
Collaborative Australian Protected Areas Database (2014)

National Reserve System



Location of reserves in the National Reserve System

Protected Area



Data Source:
Collaborative Australian Protected Areas Database (CAPAD) - (2014) and
Interim Biogeographic Regionalisation for Australia (IBRA 7) - (2012) were
compiled by the Department of the Environment with data provided by
State/Territory land management agencies.
Australian Coastline and State Borders 1:100,000 (2004) Geoscience Australia

Map produced by ERIN (Environmental Resources Information Network),
Australian Government Department of the Environment.
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Figure 1: The National Reserve System
(Source: Department of Environment, 2014)

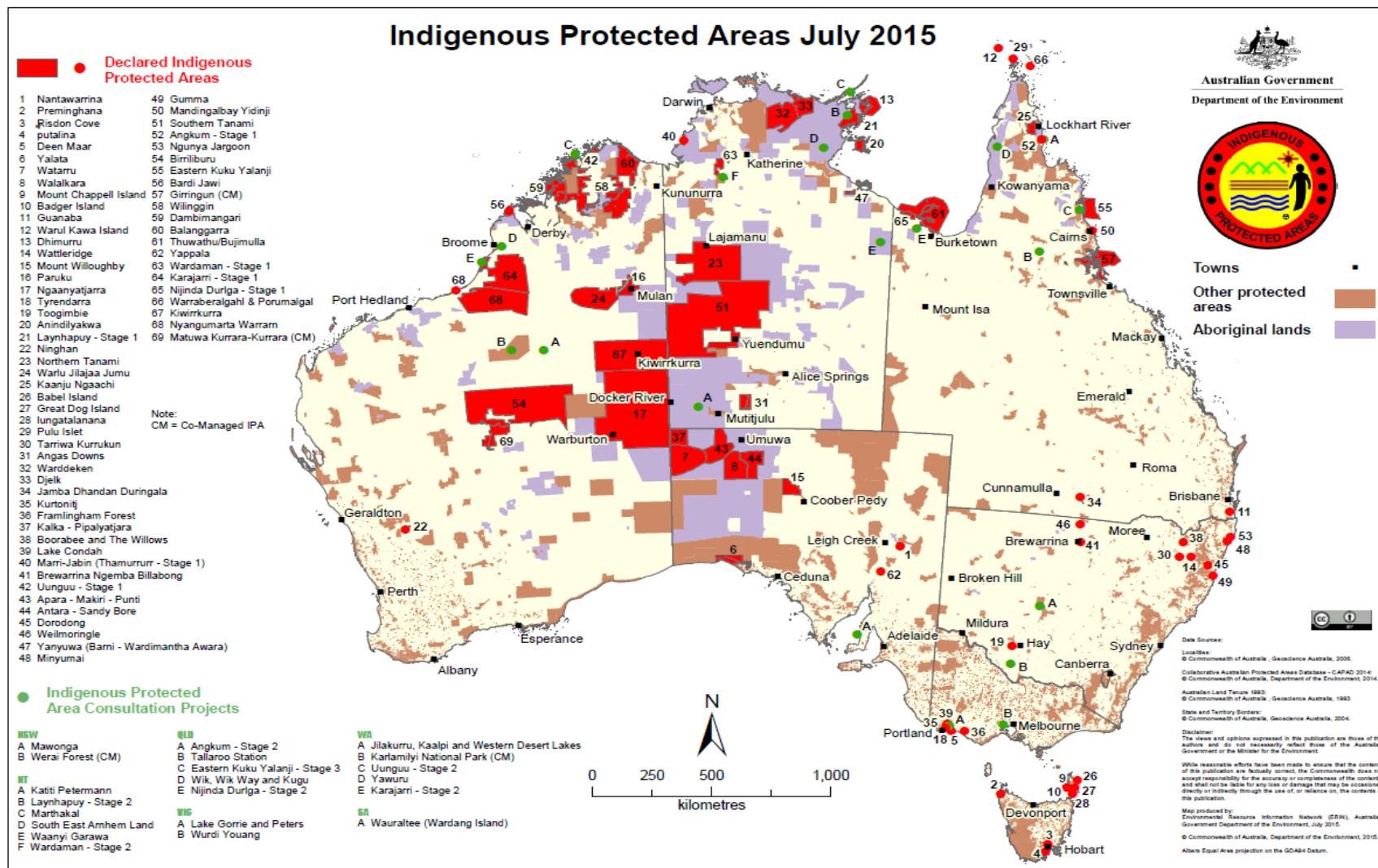


Figure 2: Declared IPAs and those under consultation (Source: Department of Environment, 2015c)

An IPA arises from a voluntary agreement entered into by traditional Indigenous owners to promote biodiversity and conserve cultural resources. Traditional Owners enter into a legally binding IPA commitment, via an Indigenous organisation, committing land title in perpetuity to the NRS purposes. These arrangements are made in line with international standards, namely the International Union for Conservation of Nature (IUCN), satisfying one or more of its six protected area management categories. Two of the six categories (V and VI) align most with the Indigenous peoples' wishes for recognition of their right to their lands, territories, waters, coastal seas and other resources, including their right to control and co-manage these resources (Beltrán, 2000):

IUCN Category V:

Protected area managed mainly for landscape/seascape conservation and recreation. Areas of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, cultural and/or ecological value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area. (Protected Landscape/Seascape).

IUCN Category VI:

Protected area managed mainly for the sustainable use of natural ecosystems. Areas containing predominantly unmodified natural systems, managed to ensure long-term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs. (Managed Resource Protected Area).

About 1/3 of Australian IPAs are nominated under IUCN Category V (Protected Landscape/Seascape); with 2/3 in IUCN Category VI (Managed Resource Protected Area), and several IPAs having more than one IUCN nomination (Hill et al., 2011). IPAs are only declared after a period of consultation. In its World Conservation Congress (WCC) *resolution 1.53*, the ICUN makes it clear that engagement of, and approval from, Indigenous people is required prior to an area of land being granted protected status. Furthermore, the rights of the Traditional Owners to use their lands and seas and equitably share benefits from them must be acknowledged and respected (Hill et al., 2011). The consultation process, which typically takes three to four years, facilitates positive changes in management and governance that ensure effective long term operation of these areas. Indeed, the IPA application guidelines stipulate evidence of Traditional Owners (TO) endorsement and the identification of a legal entity to receive grant funds (should the region be declared an IPA). Evidence of credible TO corporate governance and management capability must exist by the end of the IPA consultation phase.

Each IPA is actively managed by its TOs and overseen by an Indigenous organisation or land council. While most IPAs are governed by Indigenous people and local communities, co-governance arrangements have also been negotiated through different mechanisms. The TO community council is typically the relevant Indigenous organisation, given the relationships that are already in place between TO community councils and Government Natural Resource Management (NRM) authorities. The TO community council is mandated with local planning and development and, as such, has an interest in managing and protecting the economic value

of the land. Furthermore, the Caring for our Country approach aligns well with the IPA program (Szabo and Smyth, 2003).

There exists no consensus support by TOs across Australia for IPAs. In the broader socio-political context, the destructive impact of ‘passive welfare’ is well acknowledged (Altman, 2010) and in this light, IPAs may be seen to provide a part of the solution to passive welfare, as it is arguably an embodiment of Indigenous meaningful work. That is, IPAs typically create employment opportunities in new ranger type roles aligned with TO cultural interests. The ranger in the IPA setting is essentially an IPA manager.

More details are provided in Section 3 but suffice to say, rangers are an important part of the system. As IPA managers, their undertakings include the day to day running of these areas, safeguarding against weed and feral animal expansion, revegetating areas of deforestation, conducting interpretive tours for visitors, managing and maintaining visitor amenities, engaging in cultural history and language projects, including the protection of rock arts, and participating in research projects aimed at conserving fauna (e.g., crocodiles and threatened turtle population) and flora.

2.2 Other land use and land tenure arrangements relevant to Indigenous people

2.2.1 Native Title

Native Title is a type of property right that attempts to capture the complex connection of Indigenous people to their land (Department of Human Rights, 2015). It emerged out of the *Mabo vs Queensland (No 2)* (1992) High Court of Australia decision, which immediately led to the *Native Title Act 1993*. A poignant part of the Act defines the role of the Aboriginal and Torres Strait Islander Social Justice Commissioner who is charged with ensuring reasonable co-existence between Indigenous and non-Indigenous interests in land. Uncertainty existed over pastoral leases (which comprise 40% of Australia). In *Wik Peoples vs Queensland* (1996), the court found “statutory pastoral leases under consideration by the court did not bestow rights of exclusive possession on the leaseholder”. In short, Native Title rights are extinguished in part where explicit conflicting rights over land are encapsulated in freehold, mining or pastoral leases. Thus the push by Aboriginal and Torres Strait Islander people for freehold land rights that offers greater ownership and control over land (AIATSIS, 2015).

Importantly, Native Title is a precondition for Native Land Rights, whereby the former has been described as the non-exclusive ‘bundle of rights’ to enjoy land, and the latter conveying an exclusive freehold property right (Neate, 2010). The National Native Title Tribunal (NNTT) is responsible for advising the Federal Court of Australia to grant Native Title. To do so, the NNTT is required to deliberate upon two essential questions: (1) *is there a traditional connection to the area?* and, (2) *has this connection been either entirely or partially ‘extinguished’ by specific government actions?* The question of extinguishment is a sensitive one given that once Native Title is extinguished then it remains as such forever (Aurora, 2015).

Anthropologists provide the key forensic evidence to establish connection to land in “Land rights legal matters” (Altman, 2010). To this end, the Native Title Research Unit (NTRU) at the

Australian Institute of Aboriginal and Torres Strait Islander Studies “protects the Native Title and traditional ownership of Aboriginal and Torres Strait Islander people through research and policy advice”.

Upon recognition of Native Title, a Prescribed Body Corporate acts as trustee for the communal Native Title right. It is the PBC that is endowed with the right to negotiate land ownership matters with other interested parties on behalf of the Traditional Owner beneficiaries of the trust.

2.2.2 Indigenous Land Use Agreements and IPAs

Indigenous Land Use Agreements (ILUAs) are (simplistically) a co-management model that incorporates the interests and capability of Indigenous communities, and as such, are starkly different to the ‘Yellowstone model’. It has been argued that when the ‘Yellowstone model’ fails, it is because the model does not recognise the interests of Indigenous peoples in conservation, nor does it leverage the significant traditional knowledge in biodiversity conservation (Ross et al., 2009).

ILUAs are a pragmatic often used tool to guide land and sea management efforts with or without Native Title declared on these places. ILUAs are simply voluntary agreements between Indigenous peoples and other parties that outline future actions and facilitate sustainable co-existence of the parties. The terms of ILUAs become binding upon approval by the National Native Title Tribunal (NNTT) and are recorded in the Register of Indigenous Land Use Agreements. Three types of ILUAs exist: body corporate agreements, area agreements, and alternative agreements, each catering for Native Title determined lands, Native Title claims in waiting, and other arrangements, respectively (NNTT, 2015).

The benefit of ILUAs is that they avoid the long legal waiting times for Native Title determination and offer immediate certainty for all parties in the meantime. ILUAs also offer a flexible platform on which negotiations may take place whereby mining and other private development project to employ, compensate and recognise Indigenous people (Neate, 2010). ILUAs may be seen as an opportunity to emulate IPA-like agreements over lands that are not currently denoted as Indigenous freehold or protected areas (Ross et al. 2009).

However, two fundamental impediments have been identified in the negotiation of ILUAs. First is the lack of adequate supporting financial resources. Second is the lack of recognition of Indigenous conservation approaches (Hill, 2006). The IPA mechanism appears to at least partially address both.

2.3 Take home messages: IPA context

- Numerous land use and land tenure arrangements relevant to Indigenous People exist including, for example, Native Title, Indigenous Land Use Agreements and Indigenous Protected Areas (IPAs).

- An IPA arises from a voluntary agreement entered into by traditional Indigenous owners to promote biodiversity and conserve cultural resources. Traditional Owners enter into a legally binding IPA commitment via an Indigenous organisation, committing land title in perpetuity to the NRS purposes.
- IPAs are only declared after a period of consultation which typically takes between 3 and 5 years, and which is intended to facilitate the development of management and governance systems to ensure effective long-term operation of the areas.
- IPA agreement is done in line with international standards, namely the International Union for Conservation of Nature (IUCN). About 1/3 of IPAs are nominated under IUCN Category V (Protected Landscape/ Seascapes); with 2/3 in IUCN Category VI (Managed Resource Protected Area); several IPAs have more than one IUCN nomination.
- Northern Australia is home to 30% of the total Indigenous population of Australia and contains more than 50% of the country's declared IPAs.
- IPAs play a major role in Australia's capacity to meet its conservation targets under national and international obligations.
- IPAs comprise a significant and growing part of the National Reserve System (NRS) – growth in IPAs accounts for nearly 70% of the total area of land that has been added to the NRS since its inception. IPAs range widely both in size and in ecosystem types protected.

3 Identifying the generic costs and benefits associated with IPAs

3.1 The cost (to government) of IPAs

Significant amounts of money have been spent on IPAs. The Indigenous Land Corporation (ILC), for example, in partnership with the Commonwealth Department of the Environment, invested \$7 million over three years, creating 10 IPAs (Commonwealth of Australia 2015). Further investment of \$20 million by business and individual donors led to the establishment of an additional 28 IPAs which covered more than 1.8 million hectares. In 2010/11, total IPA grant payments were in the order of \$11 million, with 40% of total IPA grant funding spent on the consultation process (Australian National Audit Office, 2012).

The Department of Environment estimates that the average funding allocated per (declared) IPA region is \$200,000 per annum (although the IPA terms of reference allow for the negotiation of finance for activities that lead to commercial opportunities, such as tourism developments, in addition to the government funding). Szabo and Smyth (2003) estimated that these recurrent costs were in the order of \$2 million per annum for 13.8 million hectares (about 14 cents per hectare). More recent estimates indicate that maintenance costs are closer to 30 cents per hectare (Australian National Audit Office, 2012).

To place these estimates in context: Adams et al. (2014) looked at farming enterprises in the Northern Territory, estimating marginal costs of on-farm conservation management (i.e. conservation costs which exceed routine land management costs) at $\approx \$2$ per hectare. Moreover, and as stated by Gilligan (2006):

“If we were to consider this issue in purely economic terms, the cost of dedicating long-term funding to an Indigenous peoples’ cultural and natural resource management employment program on country would be substantially cheaper than having to buy in external expertise and fly them in to (often) remote areas to undertake the necessary fire, feral and weed management activities needed to reduce the ongoing threats to biodiversity across the Indigenous estate” Gilligan (2006).

As noted in the Working on Country report (Australian Government, 2015), IPAs can help the government meet International and National Environmental targets at relatively low cost.

3.2 Benefits of IPAs

Documented examples of ecological and biodiversity benefits of IPAs are presented in Table 1.

Table 1: Examples of some of the ecological and biodiversity benefits of IPAs that have been noted in Australian Government, 2015

Reductions in feral animals:

Pests such as toads, feral cats, pigs, foxes, camels and horses were culled so as to reduce impacts on the threatened species and ecological communities. In Western Australia, for example, more than 7000 feral horses were removed from the Lake Paraku area. In South Australia, approximately 900 feral goats were removed from the Northern Flinders Rangers IPA, minimising the grazing of native plants to benefit rock wallabies. Poisonous cane toads threatening the northern quoll populations on Groote Eylandt were destroyed.

Reductions in weeds:

Several Weeds of National Significance (WONS) were destroyed, including parkinsonian, mimosa, olive hymenachne, lantana, boxthorn and gamba grass. In Tasmania, for example, rangers spent more than 100 days managing boxthorn on Bass Strait IPAs.

Reductions in illegal fishing:

In Northern Territory, 28 marine patrols were conducted by the *Djelk* rangers, spotting seventy vessels.

Reductions in greenhouse emissions:

Around 85% of ranger groups conducted fire management activities. Of the several fire management projects across the country, the West Arnhem Land Fire Abatement (WALFA) reported burning across 28,000km² of the Western Arnhem Land, using techniques such as early cool burns to reduce the extent of later wildfires. These techniques have contributed to lower greenhouse gas emissions over the years.

But there is growing recognition of the fact that IPAs are much more than a cost-effective means of meeting ecological and biodiversity objectives. Amongst numerous other things, they contribute to the Governments' "closing the gap" policy which aims to minimise disparities in health, education and employment between Indigenous and non-Indigenous Australians (Department of Prime Minister, 2015; Australian Government, 2009; Hunt, 2013; Auditor-General, 2011). Not only does the government benefit from IPAs, but so too do Indigenous people. Other than providing opportunities for employment (e.g., as rangers, wildlife officers, scientists, tour guides), training (e.g., as research assistants, for leadership), and economic development (e.g., providing access to facilities built for tourism or mining, such as roads, network coverage), IPAs provide a crucial means to conserve country and maintain culture. Getting out 'on country' (e.g., going hunting, eating fresh food from sustainable harvesting) generates documented improvements in mental and physical health and in social wellbeing (Burgess et al. 2005). Garnett and Sithole (2007), for example, found that Indigenous people who were working on country had lower body mass index (BMI), reduced risks of diabetes, lower blood pressure, and lower rates of kidney disease than did their city/urban bound counterparts. Partaking in land management may also help reduce substance abuse and violence in the communities, thus promoting cohesive families. Moreover, since many IPAs are located in regions of high unemployment, rangers and managers become role models (Department of Environment, 2015). Not only is this good for the self-esteem of rangers and managers, but societal/cultural constructs are also invigorated, which can lead to increased collective esteem and social cohesion (Burgess et al. 2005). Specific examples of the social,

cultural and economic benefits of IPAs are presented in Table 2 (based on Australian Government, 2015), while key values critical to the Indigenous people and communities are summarised in Table 3 (from Hill et al., 2011).

Eco-enterprises associated with IPAs also create employment for the Indigenous people and active involvement in other industry sectors such as mining and tourism, thus assisting in reducing welfare dependence (OIPC, 2006; Zander and Garnett, 2011). There is also evidence to suggest that both national and international visitors alike could be enticed into staying in Northern Australia for longer periods of time, if provided with more access to and information about Indigenous culture (Esparon et al., 2014). Ultimately, this would generate more revenues for the entire tourism industry.

The wider community (including non-Indigenous people) benefit from the environment/biodiversity outcomes from IPAs and from the knock-on benefits of improved social, economic and health outcomes in Indigenous communities (e.g., via reduced health costs (Hunt et al., 2009); or lower court costs (SVA Consulting, 2014)). IPAs also benefit the wider community through enhanced environmental services associated with, for example: the adoption of Indigenous fire management regimes which reduce wildfires and promote carbon sequestration; weed and feral animal control, biodiversity conservation, fisheries management and the restoration of wetlands (Berry et al., 2010; Hunt et al., 2009). Land and sea monitoring and reporting by rangers also helps protect Australia's border from, for example, domestic and foreign illegal fishing. Furthermore, the harvesting and cultivation of traditional bush foods, such as wattle seeds and bush tomatoes, provide others with the opportunity to benefit from foods they might not otherwise be able to access. Indeed, the consultation process leading up to formal listing of an IPA, and the ongoing consultation processes that continue after establishment create an opportunity to leverage the conjunction of traditional indigenous knowledge and modern science – generating a two-way flow of knowledge, and associated benefits (Department of Environment, 2015b).

Table 2: Specific examples of some of the social, cultural and economic benefits of IPAs that have been noted in Australian Government, 2015

Employment:

In 2013-2014, more than 2000 Indigenous Australians were employed on either full-time, part-time and casual basis, as part of the Working on Country (WOC) and IPA programmes. More specifically, there were 1612 WOC Indigenous positions (759 full time equivalent jobs) and 579 IPA Indigenous positions. 182 positions were held by non-Indigenous workers. Most of the employment was in Western Australia and Northern Territory where the larger IPAs are located. The employment retention rate is approximately a high 80%.

Increased capacities to manage land:

More than 60% of WOC and IPA projects facilitated training for employees. Around 400 employees gained accredited training, and around 950 obtained non-accredited training. Others gained experiences 'on the job'. Skills were enhanced in: conservation and land management, cultural heritage, business and financial management, work health and safety, leadership, mentoring, money management, fisheries compliance, coxswain licenses, firearms handing, crocodile hatchery management, and digital media to name a few.

New revenue streams:

In the Northern Flinders Rangers, South Australia, new tourism opportunities have developed. Rangers have constructed a number of tourism facilities to accommodate visitors to the IPA. Visitor fees collected are re-invested to further tourism and community projects.

Sustainable income streams from sustainable harvesting:

Aboriginal operators are able to earn money from the sustainable harvesting and processing of mutton birds on Babel and Big Dog Island IPAs.

Reviving languages:

In New South Wales, language classes were organised for the Gumma IPA rangers, contractors and intern students. They were able to learn the traditional language of the *Gumbaynggirr* people.

Connecting the community to country:

In Tasmania, a camp was organised to practise Aboriginal culture, connect the community with country and raise a sense of Indigenous land ownership. This was attended by around 90 people.

Job satisfaction and self-esteem:

Rangers were able to progress to higher roles such as senior ranger, supervisor and programme coordinator, engendering a sense of satisfaction and higher self-esteem. They are seen as role models and mentors in the community, encouraging young people to also care for country.

Gender equality:

There are more women employed as rangers now compared to 2010-2011 (20% and 27% respectively). Overall, 34% of WOC and IPA rangers are females. Better working conditions such as more flexibility to suit and balance other commitments (family and cultural) are in place.

Greater community engagement:

Several activities and festivals were organised. For example, at the Garma cultural festival in Northern Territory, the *Dhimurru* rangers displayed some of their works and organised cultural walks for more than 100 visiting youths.

Improved health and wellbeing:

70% of WOC and IPA projects reported an improvement in the health and overall wellbeing of their rangers.

Table 3: Examples of key values of importance to Indigenous people

Dreaming tracks and songlines;
Culture, law and activities associated with culture such as bush camps and trips;
Areas where people live, hunt, gather or fish;
Sites where Dreaming beings were active and formed landscape features;
Sites of historic importance to families including where individuals were born or where individuals were buried;
Areas where significant species are abundant or have essential phases of lifecycle;
Species that Indigenous groups identify as important, sometimes called 'iconic', 'cultural keystone', or 'collaborative' species;
Rare, threatened or endangered species or ecosystems;
Species or ecosystems of interest to scientists because of unique or interesting features, perhaps to do with their evolutionary history.

(Source: Hill et al. 2011)

In short, IPAs benefit different groups of people in many different ways. A list of these benefits is provided in Appendix 1 where studies that have focused on those benefits (using either quantitative or qualitative methods) are summarised (pages 66 and onwards focus on studies that have been undertaken in an Australian Indigenous context). Figure 3 synthesises that detailed list, showing the way in which broad groups of benefits accrue to different people.

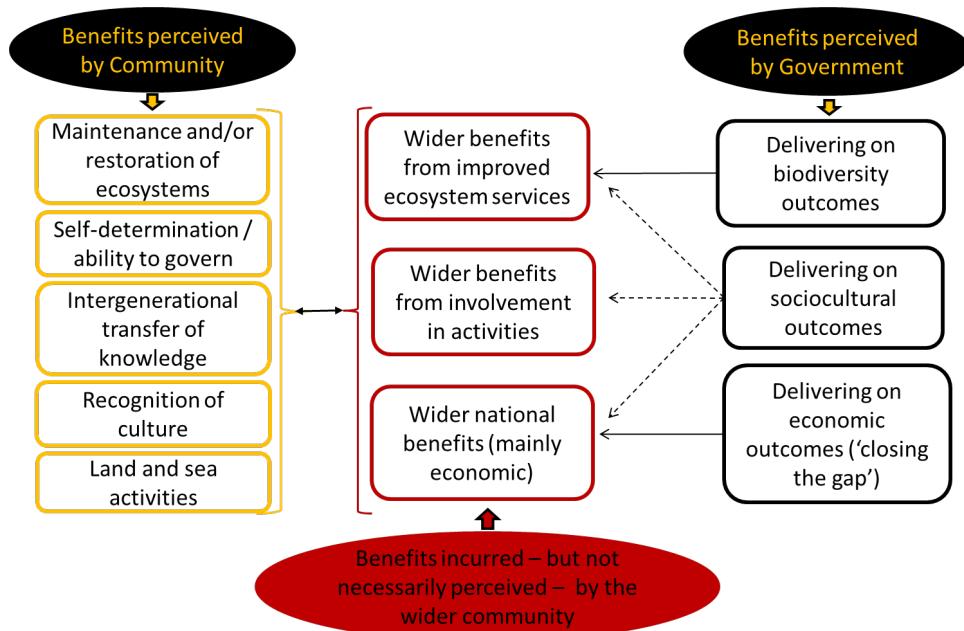


Figure 3: Broad groups of benefits and beneficiaries associated with IPAs

3.3 Take home messages: Core IPA costs and benefits

- Investment in IPAs is substantial: In 2010/11, total IPA grant payments were in the order of \$11million, or about \$200,000 per annum per IPA region. Some 40% of total IPA grant funding was spent on the consultation processes, deemed of crucial importance in both national and international best practice.
- The money invested in IPAs, however, at an estimated 14 - 30 cents per hectare, is small when compared to the estimated \$2 per hectare that some types of on-farm conservation practices cost.
- Most common examples of the ecological and biodiversity benefits of IPAs that have been identified include: reductions in feral animals, reductions in weeds, reductions in illegal fishing, and reductions in greenhouse emissions.
- In addition, IPAs create a wide range of social, cultural and economic benefits, including: employment, job satisfaction and self-esteem, increased capacities to manage land, new revenue streams, reviving languages, connecting the community to country, greater community engagement, and gender equality; all of which are resulting in improved health and wellbeing of both individuals and the communities.
- Benefits are perceived in different ways by different beneficiaries: individuals might see benefits of income, communities may instead focus on benefits associated with the maintenance of culture, while government may focus on benefits related to the delivery of wider biodiversity and socio-economic outcomes, including 'closing the gap'.
- The benefits of IPAs are thus diverse, complex, and contain many inter-related values.

4 Frameworks and methods for assessing benefits associated with IPAs

In principal, all of the costs and the benefits (hereafter, termed simply benefits') associated with IPAs could be classified as being economic, social, cultural or environmental, although there are complex interactions and connections between them. It can thus be useful to use a 'framework when thinking about those benefits, to help organise thoughts, and clarify connections.

4.1 Frameworks for thinking about benefits

There are different frameworks that try to portray the relationships between nature and people, but one which popularised the notion of what is termed *ecosystem services* was that of the Millennium Ecosystem Assessment (MEA). This framework highlights the dependence of human wellbeing on natural assets, and the consequences of degradation of ecosystems for human wellbeing (MEA, 2005). It helped bring to the fore the longstanding work undertaken in the field of environmental economics, and served as a solid foundation for the development of subsequent related initiatives such as The Economics of Ecosystems and Biodiversity (TEEB) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) – both of which highlight that ecosystems and environmental resources are forms of natural capital, and thus, like any other type of capital, have value (Varcoe et al., 2015).

The link between people and nature is, however, complex. Ecosystems are multi-faceted systems, composed of non-linear, inter-dependent components (Koch et al., 2009), and many ecosystem services are inter-related; they are often overlapping and thus are difficult to separate from one another (Fu et al., 2011). The Common International Classification of Ecosystem services (CICES) is one framework for trying to think about various ecosystem services in a systematic manner, thus minimising potential problems that may arise by effectively '*double counting*' overlapping values. Using the MEA as a starting point, CICES categorises ecosystem services hierarchically, with 'sections' as the highest level, followed by a nested series of 'divisions', 'groups' and 'classes'. The three most recognised categories of ecosystem services are: provisioning, regulating and maintenance, and cultural (Haines-Young and Potschin, 2013) (Table 4). A fourth category of ecosystem service – '*supporting*' or '*intermediate*' services – is also included in the CICES, and accounts for services that are necessary for the production of all other ecosystem services, such as soil formation and nutrient cycling. Unlike prior classification systems, under CICES, supporting services are separated from the 'final outputs' from ecosystems. This is particularly important when linking ecosystems and economic valuations so as to help reduce the risk of double counting.

Table 4: CICES ecosystem service classification

Section	Division	Group
<i>Provisioning Services</i>	Nutrition	Biomass Water
All nutritional, material and energetic outputs from living systems.	Materials	Biomass, Fibre Water
	Energy	Biomass-based energy sources Mechanical energy
<i>Regulation & Maintenance Services</i>	Mediation of waste, toxics & other nuisances	Mediation by biota Mediation by ecosystems
All the ways in which living organisms can mediate or moderate the ambient environment that affects human performance.	Mediation of flows	Mass flows Liquid flows Gaseous / air flows
	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection Pest and disease control Soil formation and composition Water conditions Atmospheric composition and climate regulation
<i>Cultural Services</i>	Physical and intellectual interactions with ecosystems & land-/seascapes	Physical and experiential interactions such as tourism and recreation Intellectual and representative interactions
All the non-material, and normally non-consumptive, outputs of ecosystems that affect physical and mental states of people.	Spiritual, symbolic & other interactions with ecosystems & land-/seascapes	Spiritual and/or emblematic Other cultural outputs

(Source: Adapted from Haines-Young and Potschin, 2013)

While frameworks such as these help to highlight the importance of the environment, and the ecosystem services provided to humans, they do not explicitly acknowledge the importance of knowledge, behaviours, institutions and governance in enabling (or preventing) the transaction that generates benefit. To give an example: one way in which people are able to benefit from nature is if they have access to it (i.e. if they are able to drive into, or walk around, or live on their country), which helps explain why ecosystem benefits are unevenly distributed with winners (those with access) and losers (those without) across the landscape (Daw, 2011). People can also benefit from nature without accessing it, and economists have long recognised the importance of things such as bequest and existence values. Indigenous people are also likely to benefit from bequest and existence values, but establishing a legal right to country is vitally important (as evidenced through activities of the native title tribunal). Indeed for some

Indigenous people, this type of legal access may be a necessary (although perhaps not sufficient) condition for them to be able to derive full benefit from their country. In other words, access can be affected through, for example, legal, technological, knowledge or economic means (Hicks, 2013; Ribot and Perusoe, 2003), and it is important to recognise that issue when thinking about ecosystem services and the benefits of IPAs (since IPAs influence access).

The IPBES Conceptual Framework (Figure 4) builds upon frameworks that think only of ecosystem services, recognising the key role of anthropogenic assets, institutions, governance systems and other drivers. This integrated approach, particularly the recognition of knowledge systems other than western science, has been promoted as a better way for stimulating new thinking and better policy making for all stakeholders (Diaz et al., 2015).

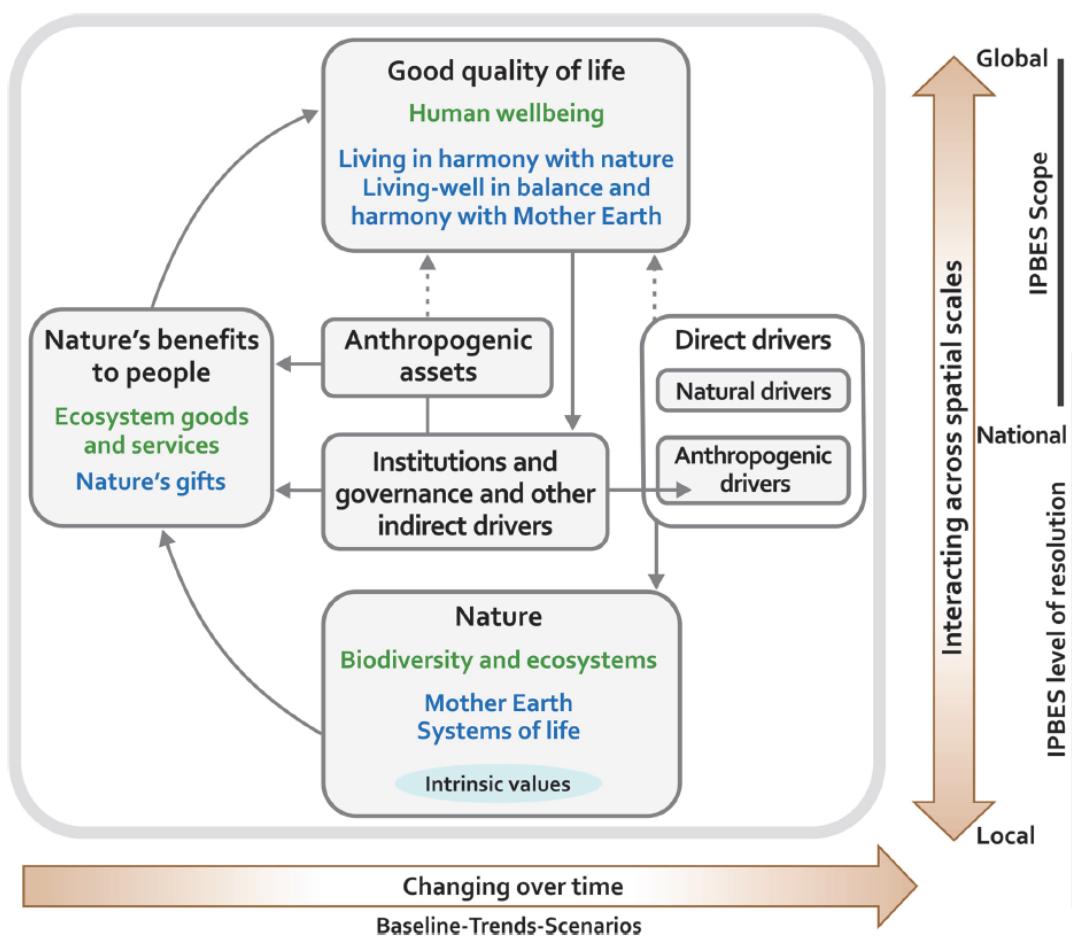


Figure 4: The IPBES conceptual framework

The relationships between nature and people are denoted by six main factors (highlighted in bold in the grey boxes, with examples of categories used in western science (green) and their equivalent counterparts (i.e. other knowledge systems) (blue)). Solid grey arrows show influence between elements; the dotted arrows denote important links, but which are not the main focus of the Platform. The thick, coloured arrows indicate that the interactions between the elements vary over time (horizontal bottom arrow) and space at different scales (vertical arrow). See Diaz et al. (2015) for a more detailed description. (Source: Diaz et al., 2015)

In the context of IPAs, this framework allows for explicit recognition that IPAs provide anthropogenic assets and altered institutional arrangements which enable people to promote and protect biodiversity and ecosystems. At the same time, this framework also highlights that IPAs can also help provide better access to ecosystem and other services (not necessarily related to the ecosystem). The benefits of IPAs are thus diverse, complex, and contain many inter-related values.

Despite the increasing acceptance of the conceptual structure of the CIES and IPBS models, economists who undertake valuation exercises often categorise benefits differently: they use the Total Economic Value (TEV) framework (Pascal et al., 2010). The TEV framework facilitates valuation by dividing services according to the way in which they generate benefits. These are: *direct use values*, examples of which include provisioning services as well as some cultural services such as recreation and aesthetic beauty; *indirect use values*, examples include many regulation and maintenance services; and *non-use values*, which are largely comprised of cultural services including existence values and people's desire to bequeath nature to future generations. On occasion, another category of benefits (*option values*) is included – although there is some debate about whether these values are a separate category, or can be thought of as types of both use and non-use values.

The option value issue illustrates the important point that not all benefits can be neatly categorised, so the TEV framework is perhaps best thought of as highlighting the continuum of diverse values. As one moves along the continuum from direct, to indirect, to non-use values, the link between benefits and markets becomes increasingly tenuous and the valuation task becomes increasingly complex.

4.2 Economic valuation methods

Over the years, economists have developed a variety of valuation techniques to estimate the benefits and costs associated with the environment and other non-market goods and services in monetary terms (Getzner et al., 2005; Bateman et al., 2002) (Table 5). Not all methods can be appropriately applied in all settings, so when selecting a valuation method, it is crucial to identify carefully which values need to be assessed and to understand the culture and broader context in which, and for which, valuation is being undertaken before selecting a valuation tool.

Cost Benefit Analysis (CBA) and assessments of the Social Return on Investment (SROI) are sometimes referred to as non-market valuation methods. Strictly speaking, they are not. Rather, they are structured ways of aggregating monetised data about benefits and costs – weighting them against each other according to specific rules (e.g., including discount rates). The Australian Government is committed to ensuring comprehensive evaluation of projects using the CBA methods by setting up specific guidelines which include: specifying the set options; deciding whose costs and benefits count; identifying the impacts and selecting measurement indicators; predicting the impacts over the life of the proposed regulation; monetising (attach dollar values to) impacts; discounting future costs and benefits to obtain present values; computing the net present value of each option; performing sensitivity analysis; and reaching a conclusion (Department of Prime Minister and Cabinet 2016; Boardman et al. 2010; NSW Treasury 2007). Setting guidelines is common practice for governments around the world, although specifics vary: the UK government, for example, recommends the use of

weights if working in regions where there are significant income disparities – the intention being that weights help compensate for income-biases introduced by some valuation methods (HM Treasury, 2003) More will be said about this important issue later.

A rigorous CBA or SROI analysis should include monetised estimates of all benefits and all costs associated with the project/program being evaluated. We note, however, the difficulty of even identifying, let alone assessing the value of (in monetary terms) all costs and benefits. Since many benefits and costs are not directly associated with the market, both CBA and SROI require researchers to undertake non-market valuation exercises (using techniques like those listed in the table below) to generate estimates of relevant costs and benefits, for use in the wider analysis. CBA and SROI studies thus often entail numerous non-market valuation activities, with ‘value’ estimates aggregated into a single value (e.g., the net benefit, or the ‘return’ on investment).¹

¹ See Costa 2013, Emerson et al. (2000) and Ryan and Lyne (2008) for further details on SROI. See Baker and Ruting (2014) for CBA.

Table 5: Overview of traditional valuation approaches that seek to ‘monetise’ benefits

General approach	Specific examples	Comments
Valuation techniques that use market prices: Market prices exist only for goods which are bought and sold. So these techniques are only able to provide information about ‘use-values’ which are traded in the market and cannot quantify many of the non-use values associated with IPAs such as cultural, existence and bequest values.	Change in the value of output (increase or decreases in earning)	This technique simply estimates the extra earnings (or losses) associated with an environmental good or service (e.g., comparing farm production on soils with varying biodiversity to draw inferences about the value of biodiverse soil – Pascal et al., 2010).
	Preventative expenditures (damage avoided)	This technique looks at how much people spend to prevent damages from occurring to draw inferences about the ‘value’ of an ecosystem service that does the same job (e.g., by estimating how much would be spent on constructing sea walls to prevent beach erosion and storm damage, one can estimate the ‘value’ of fringing coral reefs or mangroves which provide similar protection (World Resources Institute, 2009)
	Replacement cost or Expected cost	These approaches look at how much it costs (or is expected to cost) to replace damaged items (e.g., the cost of repairing buildings and businesses after storm surge provides an estimate of the (regulating) value of wetlands which reduce storm surge damage (Barbier, 2015).
Valuation techniques that use surrogate markets: Revealed preference approaches do not require the goods that one wishes to value to be exchanged in the market, but they require a strong connection between that good and the market (e.g., house prices and ‘views’; salaries/wages and workplace safety). If one cannot establish a connection between the intangible good to be valued and the market then one cannot use these techniques. This is most likely to be the case for intangible benefits associated with IPAs such as spiritual/cultural, bequest and existence values, suggesting that these techniques cannot be used to monetise those benefits.	Hedonic pricing (including wage differential and property or land value approaches)	This technique assumes that multiple things contribute to the value of a house (or car, or job) – some of which are associated with the environment. Essentially, it is as if it compares the value of two houses which are identical in all respects (e.g., number of bedrooms, bathrooms) except for one: proximity to an urban park. The difference in house price between that which is near the park and that which is not, gives an indication of the value of the park – everything else constant (Czembrowski and Kronenberg, 2016).
	Travel cost	This technique notes that even if there is no monetary entry fee to a park, people must spend money travelling to and from it. The money spent travelling can be used to draw inferences about the value of a park, an activity related to the park (Prayaga et al., 2010), or the value of parks that are of different environmental ‘quality’ (e.g., people will travel further and spend more to visit a well-maintained park than a degraded one).

Table 5: Overview of traditional valuation approaches that seek to ‘monetise’ benefits

General approach	Specific examples	Comments
	Acceptance of compensation	This technique considers how much people have been awarded, in the courts, as ‘compensation’ for damages – using those estimates as a proxy for value (Kallis et al., 2013).
Stated preference techniques: In principal, these techniques are capable of estimating the monetary value of anything, including use and non-use values. People are asked how much they would be ‘willing to pay’ if a market did exist. The quality of the estimate is only as good as the quality of the experiment designed to elicit the value – and there is a substantive body of literature that provides guidance on how best to describe the market and conduct the experiment. These techniques thus require the use of complex survey design, often draining to the respondents and requiring the use of sophisticated analytical procedures (Bateman et al., 2002; Day et al., 2012).	Contingent valuation Choice Modelling	Contingent Valuation (CV) involves the construction of ‘hypothetical’ markets. Individuals are asked to indicate their willingness to pay for, for example, improved water quality/clarity to enjoy swimming, snorkelling or diving (Awatere, 2008). Choice modelling (CM) ² differs from CV, in that respondents are asked to choose between alternatives, rather than asked if they are willing to pay a price. CM involves the construction of numerous different ‘choice-sets’, each with different characteristics (e.g., differently levels of environmental amenity) and different prices. Individuals are asked to indicate which choice-set is preferred, and these preferences are used to draw inferences about the value of the different characteristics described in the choice-sets (Kerr and Swaffield, 2012; Kragt et al., 2007; Rolfe and Windle, 2003).

² Also referred to as Choice Experiments or Conjoint Analysis

Valuation techniques that use market prices (e.g., changes in the value of output, replacement cost approach) are not able to provide information about the ‘value’ of goods and services if those are not traded in the market. Consequently, market-based approaches cannot be applied to estimate cultural, existence and bequest values. Revealed preference (RP) approaches do not require goods to be exchanged in the market, but they require a connection between the environmental good or service of interest and the market (e.g., house prices and views of the ocean). If this connection cannot be established, one cannot apply these techniques.

There is a substantive and rapidly growing body of literature on methods for estimating non-use values, many of which require the use of complex survey design and data analysis procedures (particularly choice modelling – Bateman et al., 2002; Day et al., 2012). Contingent valuation (CV) and Choice experiment (CE) are arguably the most widely used (Yao and Kaval, 2007). However, research indicates that the decision-makers who are interested in ecosystem services are more inclined to use ecological indicators than information from non-use valuation studies (at least partially) because of the difficulty they have in understanding these complex methods and an associated low level of trust in them (Marre, 2014).

Not all of these methods can be validly applied in all settings. In particular, practitioners attempting to estimate numerous related values at once (e.g., value an entire ecosystem) cannot simply estimate each value individually (using these techniques) and add unless each value can be shown to contribute to welfare (utility) in an additively separable manner (Carbone and Smith, 2013; De Groot et al., 2002)³. Problems can also arise if there is a lack of substitutability between goods and services and when there are collective (rather than individualistic) views of ownership and value (Venn and Quiggin, 2007; Adamowicz et al., 1998) (a particularly important problem in Indigenous contexts, as discussed below). Moreover, the process of discounting future costs and benefits can be problematic when dealing with costs and benefits that accrue over time⁴. Valuation can thus be a challenging task, particularly within Indigenous communities. Table 6 provides a succinct summary of other approaches that have been used to assess the importance of various environmental goods and services in Indigenous contexts (which, like the traditional non-market valuation approaches, are imperfect). The following section discussing some of the valuation problems in more detail.

³ Non-market valuation techniques, simplistically, are best suited to the task of generating estimates of the monetary worth of individual goods (say, of a fish) to an individual person. If wishing to estimate the monetary value of an entire ecosystem, one needs to determine the aggregate value of numerous goods and services, to numerous individuals. But the value of the whole is rarely equal to the sum of the parts. Problems can arise if the value of one good is dependent upon another (the value of a left shoe, for example, is substantially diminished without a right shoe). Problems can also arise if an individual’s assessment of the value of a good or service depends upon the presence (or absence) of another person (the value of food for example, may be greatly enhanced if shared with a loved one on a special occasion).

⁴ Valuation practitioners sometimes choose to discount future costs or benefits, in recognition of the adage that *a bird in the hand is worth two in the bush*. This practice, in essence assumes that costs or benefits borne by future generations are worth less than those borne by the current generation.

Table 6: Overview of alternative non-monetary approaches

General approach	Specific examples	Comments
Techniques that use subjective wellbeing measures: This approach attempts to assess the value of the environment, by asking respondents to indicate how satisfied they are with life overall on a quantifiable scale. These life satisfaction (LS) scores are then regressed against a range of variables known to affect LS, in addition to variables capturing environmental quality. Some studies use coefficients from equation to estimate the income-compensation that would be required to keep LS constant should environmental quality reduce. The technique avoids many of the strategic biases associated with stated preference approaches, but determining which factors should be included in the LS equation and controlling for the complex interrelationships between those factors has the potential to introduce significant statistical biases.	Life satisfaction	Larson et al (2014) assessed the importance of various ecosystem services of the Great Barrier Reef (GBR) to residents' LS. Jarvis et al (forthcoming) estimated the value, to residents, of various (non-use) cultural services provided by the GBR. Orru et al (2016) assessed the impact of ambient air pollution on individual's LS. Similar studies include those of MacKerron and Mourato (2009) which examined the effects of nitrogen oxide on residents' LS.
Techniques that use psychometric measures in spatial landscape analysis: These approaches seek to assess psychological (i.e. nonmonetary) values at specific locations by for example, asking people about the emotions they experience when doing different things in different parts of the landscape. This information can assist people when land use planning by identifying land use opportunities (e.g. conservation, or production) to suit population preferences. Although these approaches help assess land-use preferences at a population level they say nothing about <i>why</i> these preferences exist (Carlson, 1995; Swaffield and Foster, 2000).	Place perceptions (human-landscape relationships)	Brown and Reed (2000) asked Alaskan residents to discuss what they think, feel and do in different parts of the landscape in the Chugach National Forest– responses reflecting psychological values. This allowed them to examine the relationship between attitudes toward forest management actions and those psychological values.
	Landscape values	Beverly et al (2008) asked people to identify the reasons they value the landscape (e.g. for recreation, production, aesthetic, spiritual) and then mapped those values (reasons) across a 2.4million ha study area in the province of Alberta, Canada.
Techniques that use multi-metric measures: These approaches ask individuals to respond to numerous questions about their attitudes, feelings and perceptions of the environment on a Likert scale. Responses are combined into a scale which can be used to assess environmental values and to identify groups of individuals that share similar values. This approach allows one to consider a wide range of attitudes from a diverse range of stakeholders (Gregory et al 2011) although care must be taken to avoid biases related to order, scale and halo-effects (Podsako et al. 2003), and when analysing and interpreting data (Jahedi and Mendez, 2013).	Subjective scaling	Turner and Loewen (1998) measured the value of the cultural aspects of Indigenous plant exchanges (be it plant resources or products manufactured from plants, e.g. dried edible seaweed, basket materials) and examined the relationships across communities that might be harmed if these exchanges is not maintained.

Table 6: Overview of alternative non-monetary approaches

General approach	Specific examples	Comments
Techniques that use deliberative participatory measures: These are ‘bottom up’ approaches which ask respondents to talk about environmental values, often in an open discussion at first, to get their perspectives on what is/is not important (rather than determining that from the ‘top-down’). This is often used as a first step to gauging what is perceived to be valuable/important, with respondents also participating in decisions about the best method of assessing or measuring those values (e.g. researchers can use subjective scales, or to tell stories, or to do cognitive mapping).	Stakeholder workshops	Pert et al (2013) ran workshops to determine the best way to incorporate social values into a conservation planning exercise in the Mission Beach Area. They developed interactive GIS maps which allowed people in real time, vary weights relating to biodiversity importance, threat level, and current level of protection, and also vary formula based attributes.
Techniques that attempt to understand relationships between values: These techniques are used to leverage knowledge to improve understanding and problem solving, particularly relating to the interconnectedness between values. They can be used to (e.g. visually) illustrate the relationships between concepts/values so as to better understand, interpret and attribute meaning to these values. Although they provide information about what relationships exist between values, they do not tell about the relative importance of those values, or about why those values exist.	Statistical methods (including, but not limited to Principal component analysis (PCA))	Esparon et al (2015) used PCA to identify separable groups of reef-related benefits elicited from tourists visiting the GBR catchments. PCA was used to identify values that grouped together (i.e. similar values) as perceived by respondents.
	Cognitive mapping	Delisle et al (2015) used cognitive mapping to examine the sharing of dugong meat, turtle meat and other seafood between Torres Strait Islanders who live in the Torres Strait (TS) and those living on the mainland.

4.3 Valuation challenges which are particularly pertinent in the Indigenous context

4.3.1 Income disparities

Most traditional (neoclassical) non-market valuation techniques seek information from the market (e.g., prices) and thus rely on observed expenditure patterns to provide information about preferences. When no market exists, practitioners construct hypothetical markets (as is done with choice modelling and contingent valuation), asking about people's 'willingness to pay' (WTP). But expenditure patterns and willingness to pay do not just reflect preferences – they also reflect income or wealth (Adler and Posner, 1999). All else constant, a rich person will be both willing and able to pay more for the goods and services which he/she enjoys than his/her poorer counterparts. So, price-based valuation techniques can potentially give greater voice to the preferences of the rich, than to the preferences of the poor (Baker, 1975; Blackorby and Donaldson, 1990; Georgiou et al., 1997).

A handful of governments endorse the use of 'weighted measures' within cost-benefit analyses to correct the income disparity (e.g., HM Treasury, 2003), though this practice is largely limited to developing economies, where income inequalities are often extreme (Hanley and Barbier, 2009). While on some measures, Australia is more 'unequal' than the majority of OECD countries (notably, the income gap between Australia's richest and poorest 10% of households (Hoeller et al., 2012)), the Commonwealth of Australia discourages the use of distributional weights in cost-benefit analyses (Commonwealth of Australia, 2006). Indigenous Australians are at a significant socio-economic disadvantage compared with other Australians (Altman, 2009, Hunter, 1999; Venn and Quiggin, 2007). Thus, despite such general recommendations against the use of weights in Australian cost-benefit analysis, it may be important to do so if comparing price-based values estimated from within Indigenous communities, with those estimated from non-Indigenous communities.

4.3.2 'Value' and culture

Cultural benefits are very significant for Indigenous people because "they represent an important part of contemporary cultural practice that links people to their country" (Gray, Altman, and Halasz, 2005). However, studies that use traditional neoclassical valuation methods to value cultural services – as defined in the CIES – are limited (see Section 5 later). This is likely because of the difficulty of valuing these benefits, and because it is only relatively recently that researchers have begun to focus attention on them, seeking to further refine and develop appropriate methods to do so. Some difficulties arise because cultural services include both direct use values (e.g., recreation) and non-use values (e.g., bequest and existence), researchers seeking to value cultural services must thus address both the issue of inseparability (discussed in Section 4) and tenuous or non-existent links to market prices (Daniel et al., 2012). Moreover, cultural values are inherently social, whereas traditional non-market valuation methods, by design, seek to assess value at an individual level, so may struggle to adequately value these benefits

In theory, stated preference techniques (such as choice modelling or contingent valuation) are capable of measuring all aspects of environmental value (including those associated with culture). Nonetheless, it is not uncommon for researchers to note that it is either unfeasible or

inappropriate to convert all types of values into a single monetary metric (Driver and Burch, 1988); moreover it seems that by doing so, one may underestimate those benefits and values (The Allen Consulting Group, 2011).

In addition, there is debate over the use of monetary metrics within Indigenous cultures (Andersen, Kerr, and Lambert, 2012). Awatere (2005, 2008), notes that stated preference techniques are inappropriate in the Indigenous context because indigenous values are usually considered to be sacred and intangible, thus, cannot and indeed should not be subject to monetisation (Steenstra, 2009; Venn and Quiggin, 2007).

"Valuation techniques for non-marketed goods may simply be inappropriate if indigenous peoples' valuation of land is non-utilitarian...It may make as little sense to ask an indigenous person their WTA (i.e. willingness to accept compensation) for the loss of access to traditional living areas from which they derive ceremonial/religious values as it would be to ask a devout Christian how much they would need to be compensated in monetary terms to forswear any practice of their religion. It is not that the estimation is difficult – in the conventional sense of problems with estimating values in contingent markets – but that the entire idea of forswearing for monetary compensation is simply nonsensical" Godden (1999, p. 18).

Whether or not it is appropriate to express cultural values in dollar metrics, or whether one should instead use other approaches, is thus an important topic for debate (Chee, 2004; Norton and Noonan, 2007; Spash, 2008). Rather than using money, some researchers have used psychometric measures (Brown, 2004), qualitative research methods (Buijs, 2009) and/or a mix of methods (Cortese, 2003; Sneddon et al., 2002; Taylor and Douglas, 1999). Interestingly, these non-monetary metrics also get around the problem of income inequality (discussed in Section 4.3.1) and have also been used when dealing with inseparable benefits (Section 4.3.3).

4.3.3 (In)separability

Gilligan (2006) argues that monetary measures of the environmental values provided by IPAs are elusive, as are the socio-economic benefits (e.g., relating to wellbeing, social capital, health and culture), which are invariably interconnected (The Allen Consulting Group, 2011). Traditional valuation methods will thus likely struggle to produce the comprehensive measures of benefits, suggesting a need for more holistic assessments (Barber, 2015). This is because traditional valuation approaches often require one to be able to identify (and subsequently monetise) the value of individual benefits (e.g., the value of an ice-cream, the value of a car). It is only appropriate to add values if each good being valued, enters the utility function in an additively separable manner. The importance of separability of values has long been acknowledged in the literature associated with systems of demand for market goods (Elger and Jones, 2008, Moschini, 2001); it is a more recently recognised problem in the environmental/ecological literature, where it is more often referred to as the overlapping values problem (Balmford et al., 2011).

Numerous researchers have noted that the benefits associated with IPAs are frequently interdependent and overlap (Altman and Whitehead, 2003; Gray, Altman, and Halasz, 2005).

Driver et al. (1996), for example, note that plants and animals do not exist independently but they are parts of interrelated and complex ecosystems and dependent completely on those ecosystems. Gray, Altman, and Halasz (2005) argue that the benefits of using wild resources (including, but not limited to that of an improved diet, material for arts and crafts, employment, self-esteem, pride in customary practice and greater social cohesion) are essentially inseparable. Similarly, Bradley (1997) (for the Yanyuwa people) and Delisle (2013) (in Torres Strait), describe the complex socio-economic and cultural values associated with the customary use of dugong and marine turtle and the interconnections between those values. For the Yanyuwa people, dugong and marine turtles are not only a source of food but they are considered to be ‘food sources of *wurrama*’ or “authority” (Bradley, 1998, p. 134) which is vital for survival of Yanyuwa people physically (health/provisioning benefits) and spiritually (cultural). There are also links between the natural environment and Indigenous Health. In their study, Campbell, Davies, and Wakerman (2008, p.5) refer to ‘treatment of the whole person’: noting that through traditional knowledge and labour inputs, Indigenous people ‘receive a range of biophysical health benefits (such as through exercise) and psychosocial health benefits (such as enhanced self-esteem through recognition by others of the value of their knowledge and effort)’. Clapham, O’Dea, and Chenhall (2007) argue that ‘solutions to Indigenous health’ (p.272) should come from many other areas because of all the ‘...meanings attached to Aboriginal holistic health’ (Lutschini, 2005) which include 23 interrelated elements (e.g., social, cultural, physical, emotional, community, spiritual, physical environment/infrastructure, mental, family etc.).

The key point is that many of the benefits associated with IPAs (like those listed in Table 1, Table 2 and by SVA (2013)), are likely to be interdependent and potentially overlapping, which makes the valuation exercise particularly challenging. That said, valuation is not always impossible: examples of alternative approaches exist, a subset of which are summarised below:

- Boyd and Banzhaf (2007) proposed that researchers should simply record the value of nature’s services in terms of quantity (i.e. how much we have) and weight (i.e. how important the components are to utility). Whilst this framework proved difficult to apply in practice, Chan et al. (2011) noted that one could ‘use information from value elicitation to relate people’s responses to high-level categories like overall well-being’ (p.216). They also suggested that one could quantify many of non-use values related to cultural ecosystem services through spatial landscape analysis. Their valuing approach ‘facilitates integration with output from other biophysical and economic service models. Such integration is essential for ensuring that cultural services and non-use values are considered on equal footing with other services and biodiversity when making land management and policy decisions. Expanding the set of mapping and valuation tools represents an important frontier for research and conservation practice’ (Chan et al., 2011, p.226).
- Chan, Satterfield, and Goldstein (2012, p.15), argue for the use of multi-metric approaches because they allow one to incorporate preferences ‘through the use of subjective scaling when necessary (i.e. because no scale for that value exists)’ (see also Chuenpagdee et al., 2006 and Naidoo and Adamowicz, 2005). These scales ‘enable the assigning of value, ordinal ranking, or numeric tag to what are in large part

intangible properties (such as ‘awe’ in reference to spiritual value)’ (Chan et al., p.15). In addition one can explore the causal links between benefits facilitating a more nuanced understanding of the environment, situation and settings (Barber, 2015).

- Delisle (2013) demonstrated a method for firstly eliciting (community-defined) benefits of Traditional Dugong and Turtle hunting (in the Torres Strait), and then using cognitive mapping to identify separable groups. She then used subjective rankings of those preferences, to determine which separable groups of benefits were considered, by respondents, to be most (least) important to their overall quality of life. Delisle (2013) was then able to combine those rankings with market information (the replacement value of the separable group of benefits relating to meat) to draw inferences about the minimum value of other separable groups of benefits (in this case, cultural values). Similarly, Stoeckl et al. (2014) used various statistical techniques, including principal components analysis, to identify separable groups of reef-related benefits elicited from residents of the Great Barrier Reef catchments. They then ‘benchmarked’ (separable) market-related benefits (in this case, those relating to jobs and incomes associated with the tourism industry), to draw inferences about the minimum monetised ‘value’ of non-market benefits.

4.3.4 Community versus Individual values

Values can be held at the level of individuals or groups (Chan, Satterfield, and Goldstein, 2012, p. 11), but most traditional economics valuation techniques derive from values expressed at the individual level (Brown, 1984; Wilson and Howarth, 2002). Indigenous people often accumulate knowledge and wealth at the community, rather than at the household or individual level (Venn and Quiggin, 2007). Values associated with ‘cultural integrity and continuity’ (Chan, Satterfield, and Goldstein, 2012, p. 11), for example, are mostly determined at the community or group level. Community members hold dynamic traditional knowledges, practices and beliefs that evolve over time and that are transmitted from generation to generation over thousands of years (Johnson and Ruttan, 1993; Berkes, 2008; Adams et al., 2014). Therefore, it may be entirely inappropriate to assume that one can seek individual expressions of these values and then add to generate estimates of total community value (the value of the whole may not equal the sum of the parts).

Instead, it may be preferable to assess some benefits or values at the community level rather than at the individual level, using group or deliberative approaches (Gregory, Lichtenstein, and Slovic, 1993; Wilson and Howarth, 2002) – ideally recommended, and driven by the communities themselves (Sithole et al., 2008).

4.3.5 Literacy

Low levels of literacy are a systemic problem in many societies. For example, the 2006 Australian Bureau of Statistics’ Adult Literacy and Life Skills Survey used an internationally recognised five-level assessment of literacy, finding that between 46 and 73% of Australian’s were in the bottom two bands (people with ‘very poor literacy skills, or people who can read, but are only able to do so with material that is simple, clearly laid out and which does not involve complex tasks’) (Australian Bureau of Statistics, 2006 (reissued 2008); Australian Council for Adult Literacy, 2009).

Low literacy is particular problem in Indigenous communities. The OECD's Program for International Student Assessment report 2012, for example, showed that there is a 2.5-year gap between non-Indigenous and Indigenous literacy rates in Australia. More recently, the Closing the Gap report 2015, indicated that statistically, there has been no significant improvement between 2008 and 2014 for Aboriginal and Torres Strait Islander students at or above the national minimal standard in reading and numeracy across the eight measures (Indigenous Literacy Foundation, 2016). Poor attendance rates are a key factor to the lack of literacy, but so is the low literacy of the parents – the parents often left school without basic literacy and numeracy skills (Creative Spirits, 2016).

It can be difficult for researchers to use non-market valuation techniques in such contexts. This can be particularly problematic when assessing non-use values. As noted in table 5, current research trends have researchers solving problems associated with separability, 'inattendance to attributes' (a problem when respondents do not seem to consider all parts of a hypothetical choice set appropriately), and social desirability bias, to name just a few, with complex survey designs that can be cognitively draining on respondents (Bateman et al., 2002; Day et al., 2012) – even those with high literacy rates. This markedly reduces the reliability of final estimates, since one cannot be sure that the answer given to questions which are not understood will accurately reflect respondent views. Current research trends seem to be towards adding more and more complexity to valuation studies; if this trend continues unabated, it will become more and more difficult to apply traditional non-market valuation techniques in communities (Indigenous and other) with low literacy rates.

4.4 Take home messages: Methodological approaches

- There are different frameworks that try to portray the relationships between nature and people. These different frameworks use different approaches and group benefits in different 'themes':
- Some frameworks go beyond ecosystems and acknowledge and include key drivers of the system outside of the ecosystem, such as anthropogenic assets, institutions, and governance systems: drivers very relevant in the IPA context.
- Economic valuation methods are many: importantly, not all methods can be appropriately applied in all settings. It is therefore crucial to carefully identify which values need to be assessed (and why) before selecting an appropriate valuation method.
- Several well-acknowledged challenges with the valuation methods are particularly pertinent in the Indigenous context and thus cannot be ignored, for example:
 - Income disparities: Price-based valuation techniques effectively give greater voice to the preferences of the rich, than to the preferences of the poor.
 - (In) separability: Benefits are frequently interdependent and overlap.
 - Value and culture: Monetary valuation methods might be inappropriate in the Indigenous context.
 - Values can be held at the level of individuals or groups; hence, it may be preferable to assess some benefits or values at the community and some at the individual level.
 - Low literacy rates, which limit the ability to use complex survey designs (a characteristic of, for example, choice modelling)

- In an Indigenous context, alternative approaches, such as the life satisfaction approach, the recording values of 'end products'; multi-metric approaches using subjective scaling; cognitive mapping; and 'benchmarking' using separable market-related benefits, might be more suitable than traditional neoclassical approaches.

5 Synthesis of relevant knowledge from published literature

5.1 Examples of valuation studies from the international literature

We looked for examples of applied international studies where researchers had sought to monetise benefits similar to those identified as being associated with IPAs (Section 3, Table 1, Table 2 and Table 3). Note that this did not restrict our search to only research within IPAs – similar benefits occur in many settings.

We grouped the benefits into broad categories using the CICES (Table 4) and added two additional categories entitled *Health* and *Employment & Enabling* (intended to capture changes in anthropogenic assets, institutions, governance and other factors associated with IPAs but not necessarily mediated through the environment). Even at this broad level (and in line with expectations given the (in)separability problem discussed in Section 4.3.3), numerous studies considered more than one type of benefit and, in such cases, we list more than one group.

This review (see Appendix 1 for details) is neither definitive nor exhaustive but panel (a) of Figure 5, which counts the number of studies identified for each category, clearly shows that some types of benefits are assessed using quantitative approaches much more frequently than others. The majority of the quantitative studies identified in our literature review focused on provisioning services (e.g., fishing and hunting, harvesting plants for medicine). The quantitative studies investigating cultural services, focused on just a subset of cultural services; those involving ‘interaction with nature’ and related to recreation and tourism. Other cultural services – particularly those associated with spiritualism – are rarely quantified. This is not to say that tourism, and provisioning services are more ‘valuable’ than other ecosystem services, merely that they are easier to directly implement using well-established methods such as: the Travel Cost method (TCM) (Knoche and Lupi, 2007; Fleming and Cook, 2008; Nillesen, Wesseler, and Cook, 2005); the Replacement Cost approach (Haener et al., 2001; Skewes et al., 2005; AFMA, 2007); Choice Experiments (Robinson, Clouston, and Suh, 2002; Bell, Yap, and Cudby, 2009); and Contingent Valuation (Tapsuwan, Burton, and Perriam, 2010; Awatere, 2005).

In contrast, research on (non-tourism related) cultural services (King and Goff, 2006; Garnett and Sithole, 2007; Davies, LaFlamme and Campbell, 2008) or on combinations of cultural and provisioning services (e.g., aesthetics, cultural identity, arts and crafts, traditional ecological knowledge) (Barber, 2005; Steenstra, 2009; Farrier and Adams, 2011) is dominated by qualitative methods, or by a mix of qualitative and quantitative methods, where, for the most part, the quantitative part of the investigation focuses on provisioning services (e.g., monetary equivalent value of bush meat) whilst the qualitative considers cultural services (Bliege Bird and Bird, 1997; SVA Consulting, 2014). This reflects the difficulty (discussed in Section 4.2) of monetising these values.

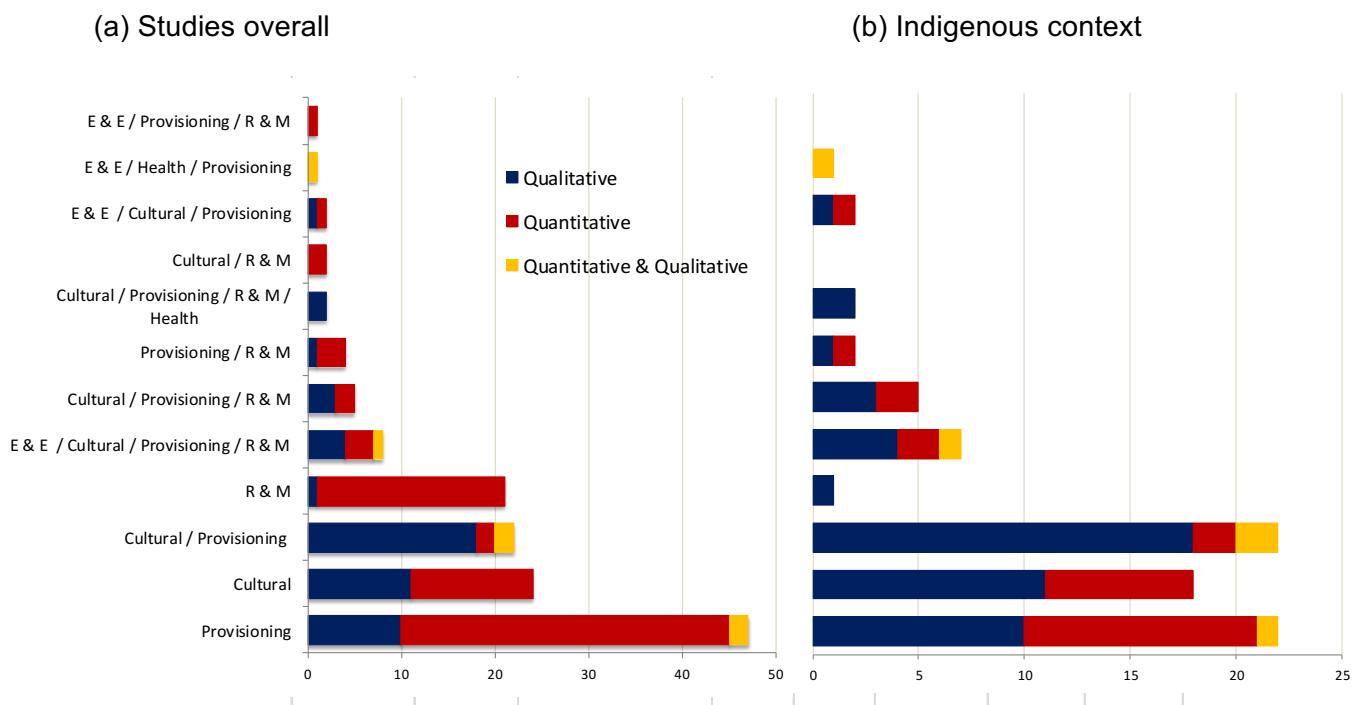


Figure 5: Number of international studies referring to the 'value' of different types of benefits (e.g. cultural, provisioning), by general methodological approach (Quantitative, Qualitative or both).

(a) We undertook a non-exhaustive search for studies where researchers had sought to monetise benefits associated with protected areas ($N = 139$). We classified studies according to the type of benefit considered, using CICES. These services include: provisioning; regulation and maintenance (R&M); and cultural benefits. We added two additional categories entitled Health and Employment & Enabling (E&E), (intended to capture changes in anthropogenic assets, institutions, governance and other factors associated with the protected areas but not necessarily mediated through the environment). When studies considered more than one type of benefit, we list all. (b) We then narrowed our search from (a) to focus only on valuation studies undertaken in an Indigenous context (the subset had $N = 82$). Details of the studies reviewed, are provided in Appendix 1. (R&M = regulation and maintenance)

Second, we narrowed our focus to consider only the subset of valuation exercises undertaken in Indigenous contexts (in Australia and elsewhere in the world); a particularly complex task given the multiple issues discussed in Section 4.3. If one compare panel (a) with panel (b), it is apparent that in Indigenous contexts, most studies have been descriptive/qualitative (Figure 5, panel b, and Appendix 1). We did, nonetheless identify several studies that had attempted to estimate values of different components of Indigenous cultural heritage using some of the price-based techniques outlined in Table 5 (Melnyk and Bell, 1996; Haener et al., 2001; Boxall, Englin and Adamowicz, 2003; Adamowicz et al., 2004). Some studies examined Indigenous heritage and cultural values (Janke, 1998; Zeppel, 2000), with a few applications of the replacement cost technique (Altman, 1987; Asafu-Adjaye, 1996). Only a few studies considered marginal values – i.e. looking at the way in which changes to one part of the system might generate an impact elsewhere (e.g., commercial utilisation of wildlife creating more economic benefit, development of skills creating more employment opportunity) and these change studies were, for the most part, descriptive (Gray, Altman, and Halasz, 2005; Buchanan et al., 2009; Altman and Fogarty, 2010).

Third we focused on Australian studies that considered at least some of the benefits associated with IPAs, identifying 62 studies (quantitative, qualitative, or both) that had been conducted

with or within Indigenous communities. Less than one-third (only 18) of these studies quantified the value of benefits and most of these focused on provisioning services, such as: the importance of dugong and marine turtles as a food source (Berson, 2004; Morris and Lapwood, 2002; Bliege Bird and Bird, 1997), the benefits of native medicinal plants (Brown, 1992) and improved diet and health benefits from being on country (O'dea, 1984). Employment benefits were also frequently quantified (e.g., Department of Prime Minister and Cabinet, 2014). Figure 6 summarises these Australian Indigenous quantitative studies, listing methodological approaches on the axis, and differentiating 'counts' (of the number of studies) by the benefit considered. Reflecting the information portrayed in panel b of Figure 5, provisioning services are valued most frequently – in this context, using the replacement cost/value method (most appropriate when the provisioning services that are valued are not bought/sold in a store) and other methods that simply count services (e.g. numbers employed) Further details of valuation studies in Indigenous context in Australia are presented in Appendix 1.

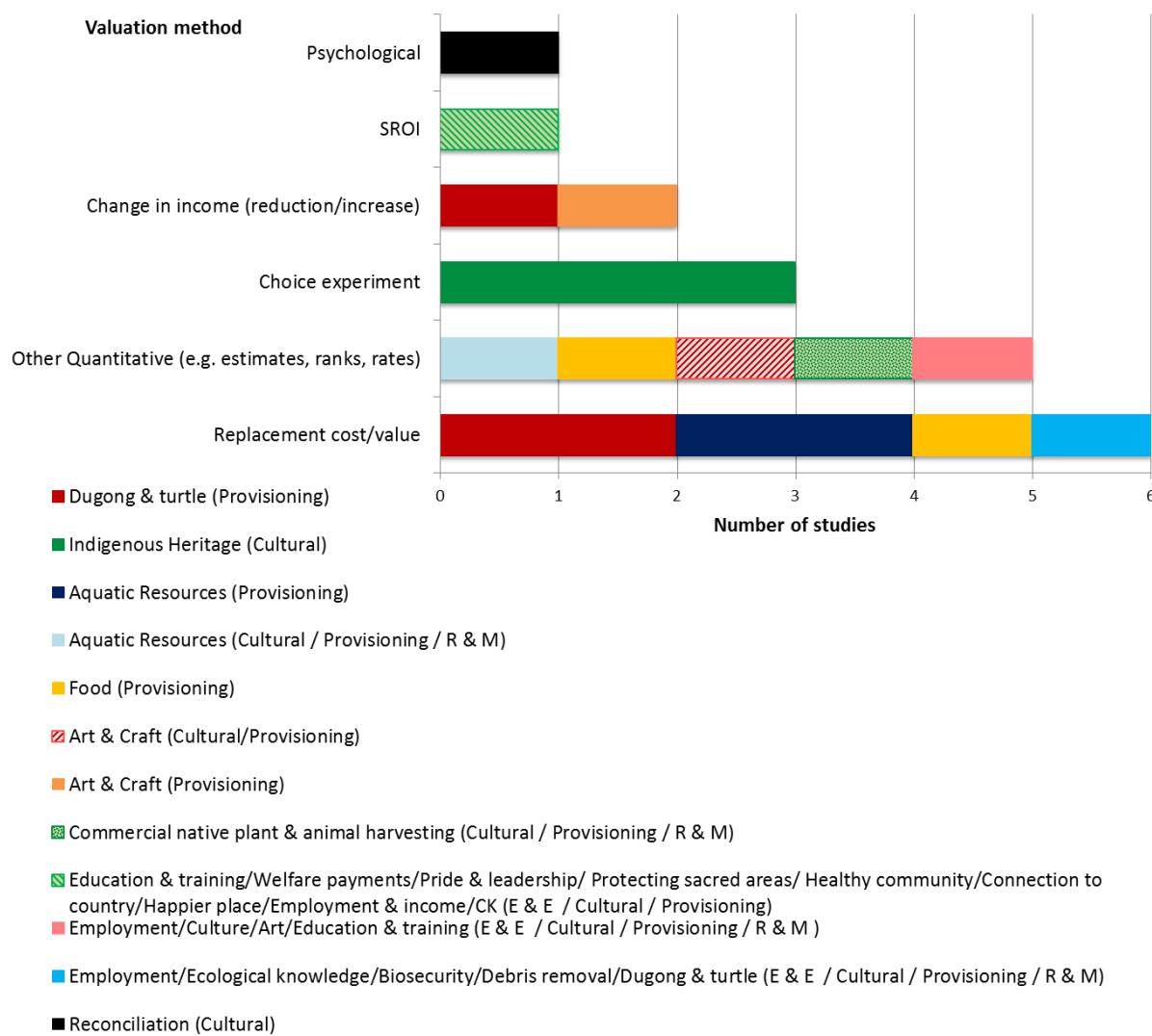


Figure 6: Number of quantitative Australian studies undertaken in an Indigenous context, referring to the 'value' of different types of benefit, by methodology and type of benefit

We further narrowed our search (from panel (b) Figure 5) to focus only on quantitative valuation studies undertaken in an Australian Indigenous context ($N = 18$). Studies were classified according to the type of benefit and the value of the benefit which is disintegrated based on the quantifying methodological approach used.

Relatively little research that highlights the importance of other (non-provisioning) benefits has been done, notable exceptions being the work undertaken by Social Ventures Australia (SVA) (2014), with new projects starting during 2015 in four IPAs across Australia. We have given this project its own method in our summary charts, but note that the total value arrived at in the SROI assessment is calculated by adding several individual values, and these individual values are estimated using a variety of different methods. Most of the non-market valuation methods used within the SROI are ‘indirect’ market-based approaches (e.g., using the average pay of professors to estimate the time value of TOs; using reductions in court costs used to estimate some of the value of getting people working on country). Studies of Cultural/Provisioning benefits including fishing and special ceremonial events such as weddings and funerals (Farrier and Adams, 2011); of Cultural benefits such as Art and Crafts (Garnett and Sithole, 2007; Davies, LaFlamme and Campbell, 2008) and of Indigenous cultural heritage and tourism (Janke, 1998; Zeppel, 2000; Windle and Rolfe, 2003; Gray, Altman, and Halasz, 2005) have also been undertaken – but these all rely on market prices that are relatively easily observed or inferred. Benefits that are much more loosely, or not at all, associated with the market are, for the most part, left unquantified. Future research could thus usefully explore these, including, but not limited to, explorations of the benefits associated with Indigenous culture, knowledge, and the (inseparable) value of connections between land/people and culture. This could involve investigations of the value of:

- Spirituality
- The maintenance/preservation of language
- The preservation and transfer of knowledge (both traditional and western)
- Undertaking traditional land management practices
- Getting (Indigenous) people back on country (i.e. improving access)
- Empowering Indigenous people/increasing autonomy

5.2 Take home messages: Gaps in our understanding

- Numerous studies consider more than one type of benefit but do not always differentiate between them. This is appropriate since many benefits are inseparable.
- Some types of benefits (provisioning services and a subset of cultural services that are associated with tourism), are assessed using quantitative approaches much more frequently than other services. This does not indicate that the quantified benefits are more important than other benefits; rather it indicates that they are easier to measure using existing valuation methods; further development of methods able to capture these other benefits is an important topic for future research.
- Research focusing on (non-tourism) cultural services or investigations of benefits that encompass both cultural and provisioning services (e.g., aesthetics, cultural identity, arts and crafts, traditional ecological knowledge) is dominated by qualitative methods – reflecting the difficulty of monetising these values.
- Very few studies have looked at the way in which changes to one part of the system influence a change in the value of an ecosystem.

- There are few quantitative valuation studies that have been undertaken in an Australian Indigenous context: we found only 18 studies that quantified the value of benefits associated with IPAs and most of these focused on provisioning services, such as the value of food or medicines obtained from country and the value of employment associated with ranger programs. There is relatively little quantitative research that focuses on other benefits, particularly those associated with spirituality and other intangible cultural values.

6 The importance of matching information needs and valuation methods

If researchers hope to influence policy, then they need to understand the type of information that is required by communities and other stakeholders when conducting valuation projects. Otherwise, their chosen techniques may not be capable of producing information that is useful in a given decision-making context.

For example, some researchers seek to generate estimates of total value of a good or service (e.g., the total money earned by rangers and/or the value of a recreational area). These types of estimates are particularly useful if seeking to describe the current state of affairs (for example, determining how much regional income is generated by ranger programmes, or how much a recreational area is worth). This can help highlight the value of such programmes or areas, for example, the wider community. Total value estimates are also useful if trying to assess the impact of starting (or, much less likely, stopping) programmes or of setting up, or removing a recreational area. It is an all or nothing (with/without) assessment, that requires one to, for example, estimate the value of an entire program, or an entire area. But managers are not always faced with all or nothing choices (100 rangers or no rangers; recreational area or no area) so may not need information about total values. They may, instead, need information about marginal values that helps answer questions such as: what would happen (to costs and/or benefits) if I altered the way in which ranger programmes were managed, or if I expanded the size of existing recreational areas? Is it better to use ranger programmes, or are other Indigenous land management programs better able to meet my needs? This different type of question requires subtly different valuation approaches. In the former (all or nothing, total value) case, it is sufficient to simply generate estimates of, or value, the existing situation. In the other cases, one needs to compare the value of the existing (or projected) situation with a relevant counterfactual. So the valuation exercise is someone more complicated if managers need information to help them answer these more complex questions – they need to understand the current situation, and the proposed one.

Not only does one need to consider the key policy/manager question being asked of decision-makers (is it an all or nothing type problem, or one assessing change?), but one also needs to understand the context, before designing a valuation study and selecting an appropriate method (a hammer is particularly good if wishing to drive nails into timber, but not usually the best tool for repairing windows). Table 7 provides a list of four questions, relating to IPAs that could potentially be asked by decision-makers in Indigenous communities or in government. For each question, a non-exhaustive list of methods that could be used to generate data to help answer those questions is provided alongside. This highlights that even for a single question, a diverse range of methods could be employed; each generating different types of information that will likely have different utility for communities and government. For example, both people from an Indigenous community and people from government might be interested in knowing if it is better to use IPAs or to instead use some other type of Indigenous Land Management Program. But the Indigenous community will likely have different views about what constitutes better than government employees (the former might focus on a holistic and varied range of benefits such as those in Table 3, while the latter might instead need information about the cost-effectiveness of different programmes in delivering biodiversity or outcomes relating to closing the gap – See also Figure 3, which highlights the different types of benefits likely to be perceived by different groups). As noted previously, different valuation

approaches are required to assess different types of benefits (Table 5, section 4.2). Subsequently, it may be necessary to use several different valuation methods to answer the single question: which is better?

Table 7: Linking the policy/management question to the valuation method

Potential questions	Potential valuation approach/Study design
How do we increase awareness of the benefits of IPAs?	<p>Estimate the value of some of the benefits (beyond those assessed by the SROI project to avoid duplication), using a variety of valuation approaches. These could include, but not necessarily be limited to techniques discussed in Sections 4.2 and 4.3 – crucially seeking to use methods suited to the Indigenous context. Community workshops and focus groups could also help highlight community perspectives and identify appropriate valuation method(s), likely to require a blend of traditional non-market valuation methods and deliberative community-based approaches which recognise collectively held values and do not all rely on money as a metric</p> <p>Use quantitative macroeconomic models which trace the flow of benefits (monetary and other) associated with IPAs: e.g., Input/Output. NB: study like this would be unlikely to capture much more than one or two benefits beyond those associated with the market.</p>
If we were going to expand the IPA system, what, if anything, should we do differently?	<p>Seek to identify the characteristics of IPAs which generate most benefit using broad and/or in-depth approaches.</p> <p>BROAD: collate data from ABS and elsewhere; use statistical techniques to assess the impact (benefit) of IPAs. Data permitting, one could test if the IPAs with different characteristics seem to have different impacts. If using these approaches, the investigation would be restricted to thinking about benefit using readily available data (likely things such as income, employment or vegetation but it might also be possible to assess impact on other indicators of biodiversity, or on indicators of health and crime if available). As such, this type of analysis would likely omit many crucially important benefits.</p> <p>IN DEPTH: Undertake within-community assessments of change – capturing impressions of impact on community-defined values of concern. Data permitting one could compare differences in noted impacts by IPA characteristics (requires data to be collected from different communities, to control, where possible, confounding factors)</p>
Which types of ILMPs (including, but not limited to IPAs) seem to generate most benefit in which contexts?	Seek to identify the characteristics of Indigenous Land Management Programs (ILMPs) which generate most benefit using broad and/or in-depth approaches – similar to those above (but focusing, more broadly on ILMPs, not only on IPAs).
Which ILMPs are most economically efficient (i.e. generating most benefit per dollar spent) ⁵	Compare the benefits of different ILMPs (assessed using approaches like those above) per dollar spent on them. Benefits need to all be measured in the same unit, to facilitate comparison, but not necessarily in dollars. Indeed it may be necessary to use non-dollar metrics since, as is apparent from the foregoing discussion, we have not yet developed methods to adequately measure the value of some benefits in monetary terms (and even the non-monetary methods are imperfect, requiring research to further refine and develop).

⁵ The term efficiency is often confused with effectiveness. A program is effective if it successfully achieves a particular task or goal. Efficiency does not just consider the benefit of achieving a goal, but also the cost of achieving it (formally, the most efficient programme is that which achieves the maximum (marginal) benefit per dollar invested). Importantly, the social welfare literature clearly establishes that the when assessing efficiency, one needs to consider a broad range of costs and benefits – and that researchers should also consider distributional/equity issues since individuals, and society in general have been shown to be negatively impacted by inequality.

6.1 Take home message: Aligning information needs with methods

- A variety of valuation methods could be used to fill different information gaps associated with the benefits of IPAs.
- Resources are insufficient to fill all gaps, requiring one to prioritise information needs.
- It is important to start the prioritisation process by carefully identifying a policy/management question that could be more easily addressed if more information were available.
- Determining what information is needed, by whom, to inform which particular decisions, can help determine which valuation approach/es is/are likely to generate information that is most useful to decision-makers.
- Similar questions, asked by different stakeholders, may require the use of different valuation methods. This is because different stakeholders will likely prioritise the assessment of benefits differently, and different benefits require different assessment techniques.

7 Conclusion

Indigenous Protected Areas (IPAs) are crucial components of Australia's National Reserve System and generate a large and diverse range of benefits – not just environmental and biodiversity benefits, but social, economic and cultural benefits as well. These benefits are valuable to a wide range of stakeholders. Most of these benefits do not have an associated market price but this doesn't mean that these benefits lack economic value: numerous studies have shown that these benefits improve human wellbeing. The knowledge gap that remains relates to the fact that many benefits have only been described in qualitative terms and have not been formally quantified or valued.

Economists have long recognised that value is not synonymous with price and from the early 1900s, growing recognition of the importance of non-priced goods and services to human wellbeing inspired the burgeoning field of environmental economics. This has led to the identification of a variety of different benefits associated with the environment including, but not limited to recreational, bequest and existence values. Identification of these diverse benefits has, in turn, led to the development of different methods for estimating the value of those benefits. The last 50 years has seen rapid development of methods and tools that are designed to highlight the importance of non-market values, most often employing techniques that seek to measure value using money. Importantly, these valuation methods have all been developed under the assumption that an individual's wellbeing cannot be measured directly, so the focus has been on dollar estimates, which, simplistically, seek to determine how much money would need to be given to an individual to keep their welfare constant, if a good or service were taken away from them⁶.

In recent decades, some economists have begun to argue that it may be possible to measure individual welfare directly (Barberis 2013), implying that one can also directly measure the contribution that environmental goods and services make to an individual's wellbeing. Estimating value in this way overcomes some of the problems associated with traditional valuation methods, but still entails considerable empirical hurdles and still remains individualistic. They help to clarify the value of goods and services to individuals, but like traditional non-market valuation approaches, these approaches remain ill-equipped to quantify socially constructed benefits, such as the socio-cultural benefits so apparent in Indigenous contexts.

The challenges faced by valuation practitioners when assessing some types of goods and services are found throughout the literature. Our review of empirical valuation papers that focus on goods and services related to IPAs revealed that some goods and services (e.g. provisioning and recreation) are valued much more frequently than others (particularly cultural values). Evidently, some types of benefits are routinely omitted from valuation studies. While lack of price does not mean lack of value, it often means lack of visibility or presence. This is not always a problem, but some decision-makers are driven almost exclusively by quantitative and/or economic data, seeking wherever possible to select the most 'efficient' programmes

⁶ Or how much money an individual is willing to give up (pay) to obtain a good or service – the underlying assumption being that this will maintain overall wellbeing/utility.

(i.e. those that generate most benefit per dollar spent). If benefits that are difficult to assess, or cannot be assessed using existing valuation methods are routinely omitted, then decision-makers risk selecting programmes that generate the most quantified benefits per dollar spent, rather than selecting programmes that generate the most benefit *per se*. This may lead to underinvestment in IPAs or other land management programs which generate numerous, difficult-to-quantify benefits. Additional research is therefore needed to improve both our measurement and our methods of measuring these benefits.

No single method of assessing benefits is suitable in all situations, so one is likely to need to use multiple methods to assess the multiple values associated with IPAs. In most situations, resources are simply too scarce to adequately value all costs and benefits, so difficult choices must be made about which information gaps to fill. At least in part, this will depend on the specific socio-economic, political and decision-making context, highlighting the need to include policy/decision-makers when designing research projects. Having made choices about which gaps to fill, one must determine which methods are most appropriately used. Those choices need to be informed by researchers with a broad range of skills (not only non-market valuation experts) and by the communities in which the valuation is occurring. This highlights the importance of truly transdisciplinary research programs which actively involve key stakeholders in the development and implementation of research (compared to inter or multidisciplinary research, which can policy/decision-makers and local communities during the research planning stages of work).

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Appendix 1: Valuation studies from the international and Australian literature

Australian or Elsewhere	Indigenous or Non-Indigenous	Qualitative or Quantitative	Valuation Method	Type of benefit	Details of benefit considered	Example	Source
Elsewhere	Non-Indigenous	Quantitative	Choice experiment; Travel Costs; both	Cultural / R & M	Biodiversity/Amenities	Environmental amenities	Adamowicz, Louviere, & Williams (1994)
Elsewhere	Non-Indigenous	Quantitative	Hedonic Pricing	Provisioning	Amenities	Coastal amenities	Anderson & Edwards (1986)
Elsewhere	Non-Indigenous	Quantitative	Estimates	Provisioning	Plants for medicine	Plants material used in traditional medicine	Balick & Mendelsohn (1992)
Elsewhere	Non-Indigenous	Quantitative	Production function	R & M	Wetland	Tropical wetland resources	Barbier (1994)
Elsewhere	Non-Indigenous	Quantitative	Production function	Provisioning	Fisheries	Change in mangroves area on fishing	Barbier (2007)
Elsewhere	Non-Indigenous	Quantitative	Production function	Provisioning	Fisheries	Change in mangroves area on fishing	Barbier & Strand (1998)
Elsewhere	Non-Indigenous	Quantitative	Travel Cost	Provisioning	Recreation	Recreational values	Beal (1995)
Elsewhere	Non-Indigenous	Quantitative	Expenditure	E & E / Cultural / Provisioning/ R & M	Education and training/Research; Gas and climate regulation	Cognitive development (education and research); Food, Leisure, recreation, Gas and climate regulation provided by marine biodiversity	Beaumont et al. (2008)
Elsewhere	Non-Indigenous	Quantitative	Contingent Valuation	Provisioning	Recreation	Recreational value of wetlands	Bergstrom et al. (1990)
Elsewhere	Non-Indigenous	Quantitative	Choice experiment	Cultural / R & M	Biodiversity/Amenities	Nature conservation and scenic amenity	Bienabe & Hearne (2006)
Elsewhere	Non-Indigenous	Quantitative	Dynamic ecological model	R & M	Carbon sequestration	Logging on carbon sequestration	Boscolo & Vincent (2003)
Elsewhere	Non-Indigenous	Quantitative	Choice experiment, Contingent Valuation	R & M	Biodiversity	Environmental improvement	Boxall et al. (1996)
Elsewhere	Non-Indigenous	Quantitative	Choice experiment	R & M	Wetland	Wetland restoration	Carlsson et al. (2003)

Australian or Elsewhere	Indigenous or Non-Indigenous	Qualitative or Quantitative	Valuation Method	Type of benefit	Details of benefit considered	Example	Source
Elsewhere	Non-Indigenous	Quantitative	Choice experiment; Contingent Valuation	R & M	Biodiversity/Protecting species	Biodiversity attributes, Biodiversity enhancements	Christie et al. (2006)
Elsewhere	Non-Indigenous	Quantitative	Choice experiment; Benefit Transfer	R & M	Soil condition	benefits of reducing soil erosion	Colombo, Calatrava-Requena, & Hanley (2007)
Elsewhere	Non-Indigenous	Quantitative	Replacement cost/value	R & M	Wetland	Wetland protection	Farber (1987)
Elsewhere	Non-Indigenous	Quantitative	Travel Cost	Provisioning	Recreation	Recreational values	Fleming & Cook (2008)
Elsewhere	Non-Indigenous	Quantitative	Travel Cost	Provisioning	Recreation	Recreational values	Greig (1973)
Elsewhere	Non-Indigenous	Quantitative	Travel Cost, Value added; Donations	E & E / Provisioning / R & M	Tourism; Employment and Income; Biodiversity	Recreation/Tourism	Hein et al. (2006)
Elsewhere	Non-Indigenous	Quantitative	Travel Cost; Contingent Valuation	Provisioning	Recreation	Recreational values	Herath & Kennedy (2004)
Elsewhere	Non-Indigenous	Quantitative	Cost Benefit Analysis; Impact	Provisioning	Fisheries; Tourism	Logging induced sedimentation in watershed on marine fisheries and tourism	Hodgson & Dixon (1988)
Elsewhere	Non-Indigenous	Quantitative	Contingent Valuation	Provisioning	Recreation	Recreational values	Imber, Stevenson, & Wilks (1991)
Elsewhere	Non-Indigenous	Quantitative	Cost Benefit Analysis	R & M	Biodiversity	Forest and forested watershed conservation	Kaiser & Roumasset (2002)
Elsewhere	Non-Indigenous	Quantitative	Travel Cost	Provisioning	Recreation		Kerr & Greer (2004)
Elsewhere	Non-Indigenous	Quantitative	Choice experiment; Q method	Provisioning	Water	Water quality and clarity	Kerr & Swaffield (2012)
Elsewhere	Non-Indigenous	Quantitative	Travel Cost; Contingent Valuation	Provisioning / R & M	Fishing; Recreation; Water quality	Fishing	Kerr, Sharp, & Leathers (2004)
Elsewhere	Non-Indigenous	Quantitative	Travel Cost	Provisioning	Terrestrial hunting	Hunting as ecosystem service provided by agricultural land-	Knoche & Lupi (2007)

Australian or Elsewhere	Indigenous or Non-Indigenous	Qualitative or Quantitative	Valuation Method	Type of benefit	Details of benefit considered	Example	Source
Elsewhere	Non-Indigenous	Quantitative	Contingent Valuation	Provisioning	Recreation	Recreational values	Lockwood & Tracy (1995)
Elsewhere	Non-Indigenous	Quantitative	Contingent Valuation; meta-analysis	R & M	Protecting and enhancing species	Rare, threatened and endangered species	Loomis & White (1996)
Elsewhere	Non-Indigenous	Quantitative	Replacement cost/value	Provisioning	Food	Forest food	Melniky & Bell (1996)
Elsewhere	Non-Indigenous	Quantitative	SROI	Provisioning	Health	Health and social care	Millar & Hall (2013)
Elsewhere	Non-Indigenous	Quantitative	Travel Cost	Provisioning	Recreation	Recreational values	Nillesen, Wesseler, & Cook (2005)
Elsewhere	Non-Indigenous	Quantitative	Production Function	R & M	Biodiversity	Biodiversity conservation	Norton and Southey 1995
Elsewhere	Non-Indigenous	Quantitative	Hedonic Pricing	Provisioning	Amenities	Access to amenities	Parsons & Wu (1991)
Elsewhere	Non-Indigenous	Quantitative	Contingent Valuation	R & M	Biodiversity	Environmental improvement	Randall, Ives, & Eastman (1974)
Elsewhere	Non-Indigenous	Quantitative	Life Satisfaction	R & M	Protecting species	Species diversity	Rehdanz (2007)
Elsewhere	Non-Indigenous	Quantitative	Discrete time model, a spawner-recruit model	Provisioning	Fisheries	Coral reef habitat support of marine fisheries	Rodwell et al. (2002)
Elsewhere	Non-Indigenous	Quantitative	Hedonic Pricing	Cultural	Recreation; Aesthetics	Access to outdoor recreation areas; scenic quality	Sander & Haight (2012)
Elsewhere	Non-Indigenous	Quantitative	Hedonic Pricing	Cultural	Recreation	Access to outdoor recreation areas	Sander & Polasky (2009)
Elsewhere	Non-Indigenous	Quantitative	Hedonic Pricing	Cultural	Recreation; Aesthetics	Access to outdoor recreation areas; scenic quality	Sander et al. (2010)
Elsewhere	Non-Indigenous	Quantitative	Production function	Provisioning / R & M	Fisheries; Carbon Sequestration	Wetlands deforestation on fisheries	Sathirathai (1998)
Elsewhere	Non-Indigenous	Quantitative	Contingent Valuation	R & M	Debris removal	Controlling marine debris	Smith, Zhang, & Palmquist (1997)
Elsewhere	Non-Indigenous	Quantitative	Contingent Valuation	Provisioning	Recreation	Recreational values	Tapswan, Burton, & Perriam (2010)

Australian or Elsewhere	Indigenous or Non-Indigenous	Qualitative or Quantitative	Valuation Method	Type of benefit	Details of benefit considered	Example	Source
Elsewhere	Non-Indigenous	Quantitative	Cost Benefit Analysis	Cultural	Biosecurity	Biosecurity	Turner et al. (2004)
Elsewhere	Non-Indigenous	Quantitative	Contingent Valuation	R & M	Biodiversity	Biodiversity conservation	Turpie (2003)
Elsewhere	Non-Indigenous	Quantitative	Travel Cost	Provisioning	Recreation	Recreational values	Ulph & Reynolds (1981)
Elsewhere	Non-Indigenous	Quantitative	Bio-economic model	R & M	Biosecurity	Plant and animal biosecurity	Waage & Mumford (2008)
Elsewhere	Non-Indigenous	Quantitative	Bio-economic model	R & M	Biosecurity	The value of excluding a biosecurity threat	Waage et al. (2005a)
Elsewhere	Non-Indigenous	Quantitative	Bio-economic model	Cultural	Biosecurity	The value of excluding a biosecurity threat	Waage et al. (2005b)
Elsewhere	Indigenous	Quantitative	Choice experiment	Provisioning	Water	Water quality	Bell, Yap, & Cudby (2009)
Elsewhere	Indigenous	Quantitative	Choice experiment, The Maori Cultural Identity scale (MCI)	Provisioning / R & M	Water; Biodiversity	Water quality and clarity; Healthy vegetation	Andersen, Kerr, & Lambert (2012)
Elsewhere	Indigenous	Quantitative	Contingent behaviour	Cultural	Rock art	Values associated with aboriginal rock paintings	Boxall et al. (2002)
Elsewhere	Indigenous	Quantitative	Contingent Valuation	Provisioning	Water	Waterways	Awatere (2005)
Elsewhere	Indigenous	Quantitative	Contingent Valuation	Cultural	Indigenous knowledge	Māori knowledge	Awatere (2008)
Elsewhere	Indigenous	Quantitative		Cultural / Provisioning	Cultural identity; water	Tribal and cultural Identity; Fresh water	Tipa & Tierney (2003)
Elsewhere	Indigenous	Qualitative		Cultural	Cultural knowledge	Cultural heritage and knowledge	Best (1973)
Elsewhere	Indigenous	Qualitative		Cultural	Cultural knowledge	Cultural heritage and knowledge	Blong (1982)
Elsewhere	Indigenous	Qualitative		Cultural	Ecological knowledge	Maintaining Maori knowledge	Forster (2003)
Elsewhere	Indigenous	Qualitative		Cultural / Provisioning / R & M / Health	Cultural knowledge	Cultural heritage and knowledge	Harmsworth & Warmenhoven (2002)

Australian or Elsewhere	Indigenous or Non-Indigenous	Qualitative or Quantitative	Valuation Method	Type of benefit	Details of benefit considered	Example	Source
Elsewhere	Indigenous	Qualitative		Cultural / Provisioning / R & M / Health	Cultural knowledge; Health; Protecting and enhancing species; fishing and hunting	Cultural heritage and knowledge; Improved diet / Health benefits	Harmsworth et al. (2002)
Elsewhere	Indigenous	Qualitative		Provisioning	Fishing		Hicks et al. (2013)
Elsewhere	Indigenous	Qualitative		Cultural / Provisioning	Tourism/Commercial	Benefits from sport fishing and cultural tourism	Hinch (1995)
Elsewhere	Indigenous	Qualitative		Cultural	Cultural knowledge	Cultural heritage and knowledge	King & Goff (2006)
Elsewhere	Indigenous	Qualitative		Cultural	Cultural knowledge	Cultural heritage and knowledge	King & Skipper (2006)
Elsewhere	Indigenous	Qualitative		Cultural	Ecological knowledge	Traditional ecological knowledge	Mauro & Hardison (2000)
Elsewhere	Indigenous	Qualitative		Cultural / Provisioning	Ecological knowledge; Water	Maintaining traditional ecological knowledge; Water quantity and quality	Steenstra (2009)
Elsewhere	Indigenous	Qualitative		Cultural / Provisioning	Cultural knowledge; Indigenous Heritage; Harvest for Arts and Crafts; Health; Dugong and Turtle	Cultural heritage and knowledge	Vansina (1985)
Elsewhere	Indigenous	Quantitative	Random Utility	Cultural	Protecting sacred areas and rock art	Aboriginal rock paintings	Boxall, Englin, & Adamowicz (2003)
Elsewhere	Indigenous	Quantitative	Replacement cost/value	Provisioning	Terrestrial hunting	Hunting	Haener et al. (2001)
Elsewhere	Non-Indigenous	Quantitative	Estimates	Provisioning	Plants for medicine	Native medicinal plants	Cadena-González, Sørensen, & Theilade (2013)
Australian	Non-Indigenous	Quantitative	Choice experiment	R & M	Biodiversity	Healthy vegetation	Kragt et al. (2007)
Australian	Non-Indigenous	Quantitative	Choice experiment	R & M	Wetland	Wetland quality	Morrison, Bennett, & Blamey (1998)
Australian	Non-Indigenous	Quantitative	Choice experiment	Provisioning	Water	Water quality	Robinson, Clouston, & Suh (2002)

Australian or Elsewhere	Indigenous or Non-Indigenous	Qualitative or Quantitative	Valuation Method	Type of benefit	Details of benefit considered	Example	Source
Australian	Non-Indigenous	Quantitative	Choice experiment	R & M	Biodiversity	Healthy vegetation	Rolfe & Bennett (2003)
Australian	Non-Indigenous	Quantitative	Choice experiment, Benefit transfer	R & M	Wetland	Wetland quality	Morrison et al. (2002)
Australian	Non-Indigenous	Quantitative	Hedonic Pricing	Cultural	Aesthetics	Environmental amenities	Tapswan et al. (2012)
Australian	Non-Indigenous	Quantitative	Life Satisfaction	Provisioning	Amenities	Scenic amenity	Ambrey & Fleming (2011)
Australian	Indigenous	Qualitative		E & E / Cultural / Provisioning / R & M	Food/Employment/ Culture/Art/Protection	Benefits from control feral animals – e.g. reduced damage to bush tucker and bush medicine; less damage to waterways, cultural heritage sites, other animals and crafts; Opportunities to learn about country while controlling, so increased social capital and connection to country	Koichi et al. (2012)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Food/Ecological knowledge/Ceremonies	Dugong and marine turtles	Nietschmann (1984)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Food/Ecological knowledge/Ceremonies	Dugong and marine turtles	NLC (2004)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Hunting and gathering	Hunting and gathering, ceremonies, leadership	Altman (1987)
Australian	Indigenous	Qualitative		E & E / Cultural / Provisioning / R & M	Food/Employment/ Education/Ecological knowledge/Commercial	Increases in Employment and Income, fire monitoring and management, marine debris control, commercial utilisation of wildlife, access to country; knowledge transfer and sharing, improved school attendance, pathways to skills development, literacy and numeracy acquisition and employment on country	Altman & Fogarty (2010)

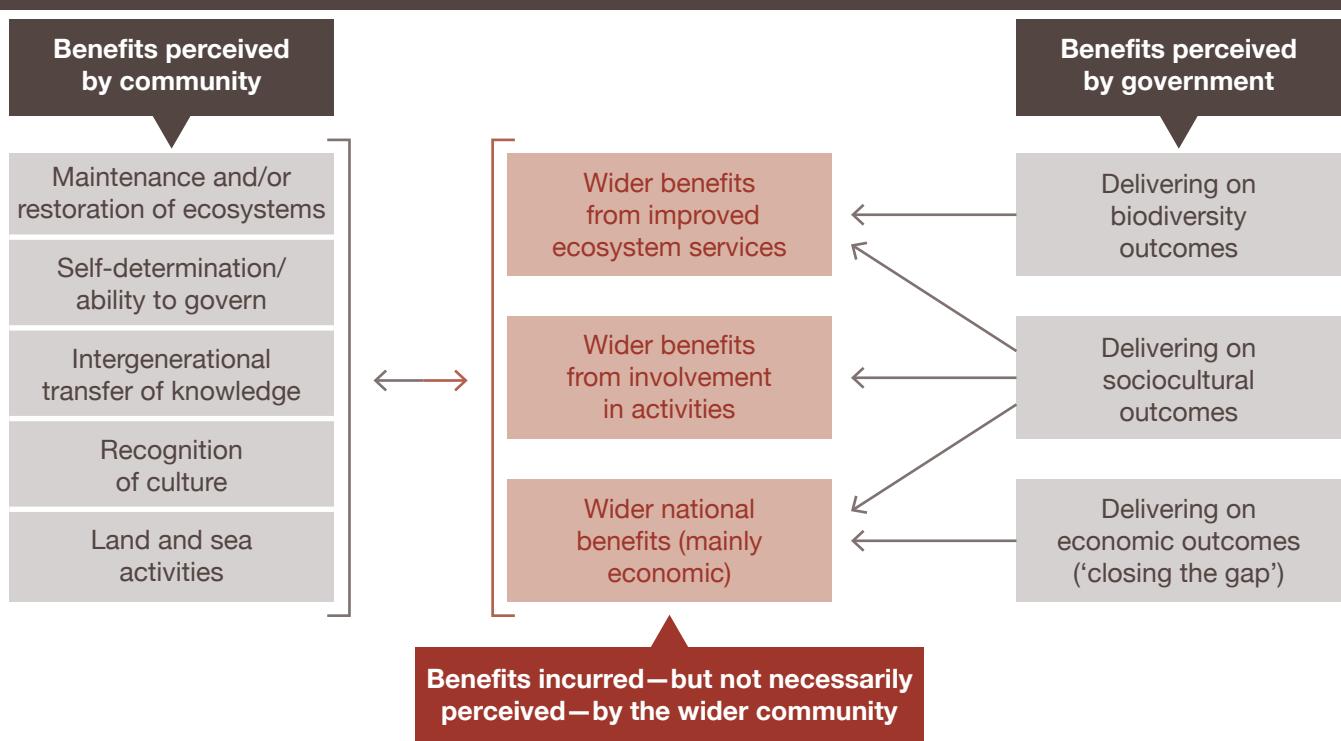
Australian or Elsewhere	Indigenous or Non-Indigenous	Qualitative or Quantitative	Valuation Method	Type of benefit	Details of benefit considered	Example	Source
Australian	Indigenous	Qualitative		Cultural / Provisioning / R & M	Food/Ecological knowledge/Commercial	Transfer knowledge of hunting, harvesting of wildlife and native plants, commercial harvest of native plants and animals	Altman & Whitehead (2003)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Food/Ecological knowledge/Ceremonies relating to Dugong and Turtle	Dugong and marine turtles	Barber (2005)
Australian	Indigenous	Qualitative		Provisioning	Dugong and turtle	Importance of dugong and marine turtles as food	Berson (2004)
Australian	Indigenous	Qualitative		Provisioning	Dugong and turtle	Importance of dugong and marine turtles as food	Bradley (1997)
Australian	Indigenous	Qualitative		Provisioning	Plants for medicine	Native medicinal plants	Brown (1992)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Food/Ecological knowledge/Ceremonies	Dugong and marine turtles	Chase (1980)
Australian	Indigenous	Qualitative		Cultural	Arts and Crafts		Davies et al. (2008)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Food/Ecological knowledge/Ceremonies	Dugong and marine turtles	Evans (1998)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Fishing/Ceremonies	Fishing, special ceremonial events such as weddings and funerals	Farrier & Adams (2011)
Australian	Indigenous	Qualitative		E & E / Cultural / Provisioning / R & M	Employment/Culture/ Education and training/Biodiversity/TK	Employment/Culture/Education and training/Biodiversity/TK	Fogarty et al. (2012)
Australian	Indigenous	Qualitative		Cultural	Arts and Crafts		Garnett & Sithole (2007)
Australian	Indigenous	Qualitative		Cultural / Provisioning / R & M	Healthy landscape, Healthy people, Biodiversity	Healthy landscape, Healthy people, Biodiversity/carbon abatement and invasive species	Garnett et al. (2009)
Australian	Indigenous	Qualitative		E & E / Cultural / Provisioning / R & M	Employment/Culture/ Education and training/Biodiversity/TK	Employment/Culture/Education and training/Biodiversity/TK/Cultural ecotourism	Hunt (2010)
Australian	Indigenous	Qualitative		Cultural	Cultural heritage	Aboriginal cultural heritage	Janke (1998)

Australian or Elsewhere	Indigenous or Non-Indigenous	Qualitative or Quantitative	Valuation Method	Type of benefit	Details of benefit considered	Example	Source
Australian	Indigenous	Qualitative		Provisioning	Dugong and turtle	Importance of dugong and marine turtles as food	Kennett, Munungurritj & Yunupingu (1998)
Australian	Indigenous	Qualitative		Provisioning	Dugong and turtle	Importance of dugong and marine turtles as food	Marsh, Gardner & Heinsohn (1981)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Food/Ecological knowledge/Ceremonies	Dugong and marine turtles	Memmott & Channels (2004)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Food/Ecological knowledge/Ceremonies	Dugong and marine turtles	Memmott & Trigger (1998)
Australian	Indigenous	Qualitative		Cultural	Arts and Crafts	Art and craft production	Morphy (1998)
Australian	Indigenous	Qualitative		Provisioning	Dugong and turtle	Importance of dugong and marine turtles as food	Morris & Lapwood (2002)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Food/Ecological knowledge/Ceremonies	Dugong and marine turtles	Nursey-Bray (2006)
Australian	Indigenous	Qualitative		Provisioning	Health	Improved diet/Health benefits	O'dea (1984)
Australian	Indigenous	Qualitative		E & E / Cultural / Provisioning	Employment/Education/C ommercial	Benefits from sport fishing and safari hunting	Palmer (2002)
Australian	Indigenous	Qualitative		Provisioning	Bush food	Bush food from water holes availability	Rae et al. (1982)
Australian	Indigenous	Qualitative		R & M	Feral animals		Robinson, Smyth, & Whitehead (2005)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Food/Ecological knowledge/Ceremonies; Dugong and Turtle	Importance of dugong and marine turtles as food	Rouja (1998)
Australian	Indigenous	Qualitative		Cultural / Provisioning / R & M	Culture/Plant and animal biosecurity/IK/Health/ Training	Culture/Plant and animal biosecurity/IK/Health/Training	Sithole et al. (2008)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Food/Research/Culture/ Art	Dugongs and marine turtles	Smyth (2006)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Food/Culture/Protection	Dugongs and marine turtles, fishing	Smyth & Monaghan (2004)
Australian	Indigenous	Qualitative		Provisioning	Dugong and turtle		Venn & Quiggin (2007)

Australian or Elsewhere	Indigenous or Non-Indigenous	Qualitative or Quantitative	Valuation Method	Type of benefit	Details of benefit considered	Example	Source
Australian	Indigenous	Qualitative		Cultural / Provisioning	Traditional hunting, commercial native plant and animal harvesting	Dugong and turtle, native plants	Wilson et al. (2010)
Australian	Indigenous	Qualitative		Provisioning / R & M	Biodiversity, emission control	Biodiversity protection, land cleaning control	Winer, Murphy, & Ludwick (2012)
Australian	Indigenous	Qualitative		Cultural / Provisioning	Tourism	Cultural and ecotourism	WWF (2014)
Australian	Indigenous	Qualitative		Cultural	Indigenous Heritage	Indigenous Heritage tourism	Zeppel (2000)
Australian	Indigenous	Quantitative	Change in income (reduction/increase)	Provisioning	Harvest for Arts and Crafts		Griffiths, Philips, & Godjuwa (2003)
Australian	Indigenous	Quantitative	Change in income (reduction/increase)	Provisioning	Dugong and turtle	Dugong and marine turtle harvest	Raven (1990)
Australian	Indigenous	Quantitative	SROI	E & E / Cultural / Provisioning	Education and training; Reduced welfare payments; pride & leadership; protecting sacred areas; healthy community; connection to country; happier place; employment and income; cultural knowledge; culturally appropriate regional employment; Reduced welfare payments	More highly skilled Indigenous people; Reduction in income support payments	SVA Consulting (2014)
Australian	Indigenous	Quantitative	Choice experiment	Cultural	Indigenous Heritage	Cultural heritage	Bennett (2000)
Australian	Indigenous	Quantitative	Choice experiment	Cultural	Indigenous Heritage	Aboriginal cultural heritage sites	Rolfe & Windle (2003)
Australian	Indigenous	Quantitative	Choice experiment	Cultural	Indigenous Heritage	The value of Aboriginal heritage sites	Windle & Rolfe (2003)
Australian	Indigenous	Quantitative	Other Quantitative (Input-Output)	E & E / Cultural / Provisioning / R & M	Employment/Culture/Art/ Education and training	Employment/Culture/Art/Education and training	The Allen Consulting Group (2011)

Australian or Elsewhere	Indigenous or Non-Indigenous	Qualitative or Quantitative	Valuation Method	Type of benefit	Details of benefit considered	Example	Source
Australian	Indigenous	Quantitative	Other Quantitative (Ranks, Costs, Harvest rate)	Cultural / Provisioning / R & M	Commercial native plant and animal harvesting	Commercial native plant and animal harvesting	Gorman et al. (2008)
Australian	Indigenous	Quantitative	Other Quantitative (Harvest rate, Harvesting trips, Availability of species)	Cultural / Provisioning / R & M	Aquatic ecosystems benefits	Benefits related to rivers, wetlands and other aquatic ecosystems	Jackson, Finn & Featherston (2012)
Australian	Indigenous	Quantitative	Other Quantitative (Resource & sales accounting)	Cultural / Provisioning	Arts and Crafts	Art and craft production	Koenig et al. (2011)
Australian	Indigenous	Quantitative	Other Quantitative (Store-turnover method- community-store food invoices)	Provisioning	Food	Intake of food and nutrients	Lee, O'Dea & Mathews (1994)
Australian	Indigenous	Quantitative	Psychological	Cultural	Reconciliation		Halloran (2007)
Australian	Indigenous	Quantitative	Replacement cost/value	Provisioning	Dugong and turtle	Value of annual catch	AFMA (2007)
Australian	Indigenous	Quantitative	Replacement cost/value	E & E / Cultural / Provisioning / R & M	Employment/Ecological knowledge/Biosecurity/ Debris removal etc.; Dugong and turtle	Dugong and marine turtles; Food	Buchanan et al. (2009)
Australian	Indigenous	Quantitative	Replacement cost/value	Provisioning	Aquatic species and site for Indigenous subsistence	Provisioning services generated by tropical rivers, that are benefit for food, fibre & medicine	Jackson, Finn & Scheepers (2014)
Australian	Indigenous	Quantitative	Replacement cost/value	Provisioning	Food	Bush tomatoes	Morse (2005)
Australian	Indigenous	Quantitative	Replacement cost/value	Provisioning	Aquatic resources	Value of aquatic resources	Scheepers & Jackson (2012)

Australian or Elsewhere	Indigenous or Non-Indigenous	Qualitative or Quantitative	Valuation Method	Type of benefit	Details of benefit considered	Example	Source
Australian	Indigenous	Quantitative	Replacement cost/value	Provisioning	Dugong and turtle	Value of annual catch	Skewes et al. (2004)
Australian	Indigenous	Quantitative & Qualitative	Change in income (reduction/increase)	E & E / Health / Provisioning	Education and training; Employment	Education and training - number of people who undertake education and training; Increase in employment	Department of Prime Minister & Cabinet (2014)
Australian	Indigenous	Quantitative & Qualitative	Change in income (reduction/increase)	Cultural / Provisioning	Food/Ecological knowledge/Ceremonies; Dugong and Turtle	Meat consumption estimates; Importance of dugong and marine turtles as food	Kwan (2002)
Australian	Indigenous	Quantitative & Qualitative	Estimates	Provisioning	Commercial harvest and trade in native plant products	Commercial harvest and trade in native plant products	Walsh & Douglas (2011)
Australian	Indigenous	Quantitative & Qualitative	Replacement cost/value; Return rates	Cultural / Provisioning	Dugong and turtle	Return rates of turtle hunting with other customary fishing; Importance of dugong and marine turtles as food	Blige Bird & Bird (1997)
Australian	Indigenous	Quantitative & Qualitative	Replacement cost/value	E & E / Cultural / Provisioning / R & M	Food/Employment/Biodiversity/Culture	Wild resources harvested (consumption), the use of wild resources as an input into something which is sold (e.g. a work of art), and employment resulting from connection with wild resources and the consequent increased income, any intangible benefits from employment such as self esteem	Gray, Altman & Halasz (2005)



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This project is supported through funding from the Australian Government's National Environmental Science Programme.