

University of Wollongong

Research Online

Faculty of Law, Humanities and the Arts -
Papers (Archive)

Faculty of Arts, Social Sciences & Humanities

January 2019

Maximising community wellbeing: Assessing the threats to the benefits communities derive from the marine estate

Natalie Gollan

University of Technology Sydney

Michelle A. Voyer

University of Wollongong, mvoyer@uow.edu.au

Alan Jordan

New South Wales Department of Primary Industries

Kate Barclay

University of Technology Sydney

Follow this and additional works at: <https://ro.uow.edu.au/lhapapers>

Research Online is the open access institutional repository for the University of Wollongong. For further information contact the UOW Library: research-pubs@uow.edu.au

Maximising community wellbeing: Assessing the threats to the benefits communities derive from the marine estate

Abstract

The coastal and marine environment is often managed according to the principles of sustainable development, which include environmental, economic, and social dimensions. While each are equally important, social sustainability receives a lower priority in both policy and research. Methodologies for assessing social sustainability are less developed than for environmental and economic sustainability, and there is a lack of data on the social aspects of sustainable development (such as social equity), which constitutes a barrier to understanding social considerations and integrating them into natural resource management. This paper explores a threat and risk assessment to the marine estate in New South Wales, Australia, which identified and categorised both the benefits that communities gain from the marine estate and the threats to those benefits. A broad range of benefits were identified including participation (e.g., socialising and sense of community), enjoyment (e.g., enjoying the biodiversity and beauty), cultural heritage and use, intrinsic and bequest values, the viability of businesses, and direct economic values. Threats to community benefits were categorised as resource use conflict, environmental, governance, public safety, critical knowledge gaps and lack of access. An integrated threat and risk assessment approach found that the priority threats to community benefits were environmental threats (e.g., water pollution), critical knowledge gaps (e.g., inadequate social and economic information), governance (e.g., lack of compliance), resource-use conflict (e.g., anti-social behaviour), and lack of access (e.g., loss of fishing access). Threat and risk assessment is an evidence-based tool that is useful for marine planning because it provides a structured approach to incorporating multiple types of knowledge and enables limited resources to be targeted to the threats identified as being most important to address.

Publication Details

Gollan, N., Voyer, M., Jordan, A. & Barclay, K. (2019). Maximising community wellbeing: Assessing the threats to the benefits communities derive from the marine estate. *Ocean and Coastal Management*, 168 12-21.



Maximising community wellbeing: Assessing the threats to the benefits communities derive from the marine estate

Natalie Gollan^{a,b,*}, Michelle Voyer^c, Alan Jordan^a, Kate Barclay^b

^a New South Wales Department of Primary Industries (Fisheries), Port Stephens Fisheries Institute, Locked Bag 1 Nelson Bay NSW 2315, Australia

^b Faculty of Arts and Social Sciences, University of Technology, Sydney, PO Box 123, Broadway, NSW 2007, Australia

^c Australian National Centre for Ocean Resources and Security (ANCORS), University of Wollongong, Building 233, Innovation Campus, NSW 2522, Australia



ARTICLE INFO

Keywords:

Community wellbeing
Benefits
Marine estate
Sustainable development
Threats
Threat and risk assessment

ABSTRACT

The coastal and marine environment is often managed according to the principles of sustainable development, which include environmental, economic, and social dimensions. While each are equally important, social sustainability receives a lower priority in both policy and research. Methodologies for assessing social sustainability are less developed than for environmental and economic sustainability, and there is a lack of data on the social aspects of sustainable development (such as social equity), which constitutes a barrier to understanding social considerations and integrating them into natural resource management. This paper explores a threat and risk assessment to the marine estate in New South Wales, Australia, which identified and categorised both the benefits that communities gain from the marine estate and the threats to those benefits. A broad range of benefits were identified including participation (e.g., socialising and sense of community), enjoyment (e.g., enjoying the biodiversity and beauty), cultural heritage and use, intrinsic and bequest values, the viability of businesses, and direct economic values. Threats to community benefits were categorised as resource use conflict, environmental, governance, public safety, critical knowledge gaps and lack of access. An integrated threat and risk assessment approach found that the priority threats to community benefits were environmental threats (e.g., water pollution), critical knowledge gaps (e.g., inadequate social and economic information), governance (e.g., lack of compliance), resource-use conflict (e.g., anti-social behaviour), and lack of access (e.g., loss of fishing access). Threat and risk assessment is an evidence-based tool that is useful for marine planning because it provides a structured approach to incorporating multiple types of knowledge and enables limited resources to be targeted to the threats identified as being most important to address.

1. Introduction

Coastal and marine environments provide communities with a wide range of direct and indirect benefits, including sources of food, health benefits such as increasing physical activity, education, the continuation of Aboriginal cultural practices, and support for coastal businesses such as fishing and whale watching. These benefits contribute to the livelihoods and wellbeing of both coastal communities and the broader community, as well as the maintenance of organisations and associations within them, such as surf lifesaving groups (Agardy, 1997; Millennium Ecosystem Assessment, 2005; Sandifer et al., 2015; UNEP, 2010; Watson et al., 2014). However, since the 1970s rapid increases in coastal populations and activities such as tourism, fisheries, aquaculture, and urban development have resulted in significant impacts on coastal and marine environments in many countries, including

pollution, competition for use of resources, and habitat fragmentation and degradation (Halpern et al., 2008; Mace, 2014; Millennium Ecosystem Assessment, 2005; Shafer, 2015).

Planning frameworks that support sustainable development in coastal and marine environments have been around since the 1970s (Dovers et al., 1996; IUCN, 1980; Thacher and Meith, 1980). The sustainable development principles became embedded in international policy when the Brundtland Report, *Our Common Future* (WCED, 1987) was published and the 1992 Rio de Janeiro Earth Summit advanced the concept of sustainable development. There have been many interpretations and alternative definitions of sustainable development, although the most commonly quoted definition remains that from the Brundtland Report (WCED, 1987): ‘sustainable development that meets the needs of the present without compromising the ability of future generations to meet their own needs’.

* Corresponding author. New South Wales Department of Primary Industries (Fisheries), Port Stephens Fisheries Institute, Locked Bag 1 Nelson Bay NSW 2315, Australia.

E-mail address: natalie.gollan@dpi.nsw.gov.au (N. Gollan).

<https://doi.org/10.1016/j.ocecoaman.2018.10.020>

Received 11 July 2018; Received in revised form 19 October 2018; Accepted 22 October 2018

0964-5691/ Crown Copyright © 2018 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

While there is general agreement that the three dimensions of sustainable development (environmental, economic, and social) are equally important (Barclay, 2012; Elkington, 1999), it has proved difficult to apply all three in coastal natural resource management. Social sustainability often receives a lower priority in both policy development and research to fill knowledge gaps (Barclay, 2012; Boström, 2012; Dillard et al., 2008; Helne and Hirvilammi, 2015; Vallance et al., 2011). Yet, environmental policy that also considers issues relating to economic and social sustainability will increase the likelihood of greater social acceptance of management priorities and policies (Geller, 1995; Kaplan-Hallam and Bennett, 2017). Despite increasing community concerns related to threats impacting the coastal and marine environment (Garcia and Prouzet, 2009; McCauley et al., 2015), assessments and decision-making are generally missing the important social and economic benefits provided by the marine and coastal environment.

Developing integrated approaches for the management of the coastal and marine environment has encountered substantial obstacles. Appropriate methodologies for integrating environmental, economic, and social dimensions are limited (Boström, 2012; Gibson, 2006; Littig and Griesler, 2005) and institutional barriers have resulted in a tendency for research disciplines to work in isolation (Boström, 2012; Harding, 2006). Similar issues have been experienced within government, with responsibilities fragmented amongst government agencies, so there are often considerable co-ordination problems (Beeton et al., 2012; Duxbury and Dickinson, 2007). Attempts to conduct integrated management often suffer from a lack of social data to inform environmental decision-making (Barclay, 2012; Brooks et al., 2015).

There has been an increasing trend in the management of natural resources of using structured, risk-based frameworks to provide defensible evidence-based advice to managers (Boldt et al., 2014; Fletcher, 2005; Hobday et al., 2011). A risk-based approach provides transparency and rigour in the decision-making process and informs the development of priorities for management (Gibbs and Browman, 2015; Fletcher 2005, 2008, 2014; Hobday et al., 2011; Smith et al., 2007). The outputs of risk assessments can also be used to identify knowledge gaps, select indicators, refine conservation objectives, and develop monitoring strategies and programs. To date, the use of environmental risk assessment tools has concentrated mainly on the ecological risks associated with specific environmental threats (Malekmohammadi and Rahimi Blouchi, 2014; Williams et al., 2011). With an increasing number and level of threats, there is a need for the development of a methodology that can integrate social, including cultural and economic components into overall assessments of risk (e.g., Dale et al., 2013).

In 2013, the New South Wales (NSW) Government (Australia) implemented a new approach for managing the NSW coastal and marine environment, which they defined as the 'NSW marine estate'. The *Marine Estate Management Act 2014* replaced the *NSW Marine Parks Act 1997* with a vision to have a 'healthy coast and sea, managed for the greatest well-being of the community, now and into the future' (MEMA, 2013). The new legislation includes principles that require risk-based assessment and prioritisation, and clear assessment of the social, cultural (particularly Aboriginal), and economic benefits that are gained from the marine estate to maximise the wellbeing of current and future generations (Jordan et al., 2016; MEMA, 2015).

In response to this legislation and new approach to management of the marine estate, the NSW Government conducted a cross-departmental statewide threat and risk assessment. A methodology was developed for an integrated triple bottom line (i.e., social, economic, and environmental) risk assessment framework, drawing on a social wellbeing approach to understand key threats to community benefits. A risk assessment process was conducted for the entire NSW marine estate, which aimed to identify and prioritise threats and target management efforts to priority threats. The threat and risk assessment approach builds on similar approaches of qualitative risk assessment methodologies in fisheries and aquatic management (e.g. Fletcher, 2014;

Fletcher, 2005; Newman et al., 2018), but has a greater focus on social and economic threats and the impact these may have on community wellbeing. The list of threats and benefits communities derive from the marine estate are common to many regions and could be applicable to coastal assessment and planning at a range of scales.

A possible methodology which may be of value in this context is the social wellbeing approach. This approach has been used to measure people's wellbeing in the context of sustainability and provides a framework that integrates environmental, economic and social components of sustainability (Coulthard et al., 2011). There are three dimensions to a social wellbeing framework; material, relational and subjective. The material dimension reflects the physical or tangible aspects of wellbeing including the physical environment, food and shelter. The relational dimension reflects how people interact with others, and involves power, identity and connections between people. The subjective dimension reflects the feelings people have about their quality of life including their beliefs, cultural values and their perception of their life circumstances (Britton and Coulthard, 2013; Gough and McGregor, 2007; McGregor, 2007; McGregor et al., 2015b; White, 2009). A wellbeing framework is being used in the risk assessment as an approach for understanding threats to community benefits.

The prioritisation of threats to community benefits provides an effective means for stakeholders and communities to understand risk and the evidence supporting the attributed risk level and integrated perspective in decision-making. Given the complexity and scale of many coastal management decisions, and the limited resources available to manage all assets and stressors, it is essential to prioritise management initiatives explicitly. The threat and risk assessment presented here is a key component of the prioritisation of management actions in the Marine Estate Management Strategy, which is an overarching framework for the NSW Government in accordance with the objects of the *Marine Estate Management Act 2014* (MEMA, 2018).

This paper describes the use of qualitative risk assessment as a tool for integrating social, cultural, and economic considerations into coastal and marine decision-making, and focusses on a community-based approach to assessing risk. Through the examination of the NSW case study, this paper demonstrates how a threat and risk assessment approach addresses some of the obstacles in developing an integrated approach to the marine estate management by: assessing the threats to community benefits through the lens of social wellbeing; enabling transparent and accountable decision-making; and providing an integrated perspective on environmental policy and decision-making.

2. Materials and methods

2.1. Spatial extent

The NSW marine estate includes tidal rivers and estuaries, the shoreline, the submerged lands and the waters out to three nautical miles in NSW, including that of Lord Howe Island (MEMA, 2013). While this assessment included waters around all offshore islands in NSW (which are mostly 0.5–10 kms offshore), it excluded Lord Howe Island (which is located approximately 600 kms off the mainland coast) (see Fig. 1).









2.2. Identifying community benefits and threats

The NSW community includes 'those communities across the whole of NSW inland as well as coastal and local residential as well as visitors to coastal regions' (Brooks and Fairfull, 2017). A community survey of over 1700 participants was conducted across NSW to identify and categorise the social, cultural, and economic benefits of the NSW marine estate. The survey explored the values, benefits, threats, and attitudes concerning the NSW marine estate. A mixed method approach was applied that involved a series of one on one in-depth interviews (thirty-six interviews with a cross-section of key user groups in the marine



Fig. 1. NSW planning area for the statewide threat and risk assessment (Source: marine.nsw.gov.au).

Table 1
Classification of social, cultural, and economic benefits used in the threat and risk assessment (icons credit [flaticon.com](https://www.flaticon.com/)).

Social benefits	
	Participation - Safety, health, & wellbeing
	Participation - Socialising & sense of community
	Enjoyment - Enjoying the biodiversity & beauty of the marine estate
	Enjoyment - Consumptive use (extracting)
Cultural benefits	
	Cultural heritage & use
Economic benefits	
	Intrinsic & bequest values
	Viability of businesses
	Individual enjoyment value (consumer surplus)

estate including professional fishers, Aboriginal community representatives, conservation groups); regional focus groups discussions representative of the community (6 coastal, 1 central NSW); an online questionnaire involving a representative sample of NSW residents (1003); and an intercept survey (727) along a number of locations along the NSW marine estate. The screening criteria for the representative survey were a resident living in NSW; over the age of 18; and not working for marine estate management authority government agencies. In this survey, data was weighted based on gender, age and regional location to ensure representativeness and reliability in the analysis to ensure that full representation of NSW general population

was achieved (Sweeney Research, 2014). The survey results were used to develop the benefit categories, which were also guided by the social wellbeing framework, and informed the threats and associated stressors that impact on the benefits (Table 1).

The stressors that are driving the key threats are defined as a consequence of an activity (e.g. water pollution, overcrowding) that causes an effect on an environmental asset (e.g. clean waters) or social, cultural and economic benefit (BMT WBM, 2017). These stressors can be linked to a specific set of overarching drivers, which are generally consistent at a larger scale that assessed here, and have been defined across the marine estate of Australia's Great Barrier Reef as economic growth, population growth, technological development and societal attitudes (GBRMPA, 2014).

2.3. Assessing threats and risk to community benefits

A qualitative risk assessment framework was used to assess the risk of a threat to a community benefit from the marine estate in accordance with AS/NZS ISO 31000:2009 (BMT WBM, 2017). The framework was based on a risk-based approach to ecosystem based management (Fletcher, 2014). The threat and risk assessment included a social/cultural objective statement 'to provide for recreational, cultural, and social uses of the marine estate, and an economic objective statement 'to provide for economic values, uses and opportunities of the marine estate'. These provided specific risk objectives and were developed by Marine Estate Management Authority agency staff with guidance from the Marine Estate Expert Knowledge Panel, independent group that provide expert advice on aspects of marine estate science and management to the NSW Government.

The relative risk of harm to community benefits was determined using a consequence-likelihood approach for a 20-year timeframe in the context of current management controls. The potential interactions between the identified threats and benefits were scored based on the potential consequence of a threat impacting a benefit, and the likelihood that the consequence could occur. The process of attributing risk is outlined in Fig. 2 and involved literature reviews, a community survey, stakeholder workshops, application of an interactive online tool, community engagement and expert-based technical teams.

The consequence of a threat impacting a benefit was scored on a five-point scale (Table 2) adapted from Fletcher (2014), from insignificant (no/barely discernible negative impacts on the social and economic benefits at a state-wide scale or minor impacts on a single region/sector/user group); minor (discernible and/or temporary negative impacts on the social and economic benefits enjoyed by the NSW community at a state-wide scale or moderate impacts on a single region/sector/user group); moderate (on-going negative impacts on the social and economic benefits enjoyed by the NSW community at a state-wide scale or major impacts on a single region/sector/user group); major (substantial measureable and ongoing negative impacts on the social and economic benefits by the NSW community at a state-wide scale or catastrophic impacts on a single region/sector/user group), to catastrophic (significant on-going and/or permanent negative impacts to the broader community or at a state-wide scale). The likelihood of a consequence occurring as the result of a threat was also scored on a five-point scale (Table 2), from rare (never reported, but still plausible within the timeframe < 5%); unlikely (uncommon, expected to occur here only in specific circumstances within the timeframe (5–30%); possible (some clear evidence exists to suggest this is possible in this situation within the timeframe (30–50%); likely (expected to occur in this situation within the timeframe (50–90%); to almost certain (a very large certainty that this will occur in this situation within the timeframe > 90%). The relative risk rating was determined by combining the consequence and likelihood ratings using the matrix in Table 2. Risk ratings were based on a four-point scale from minimal to high (Table 2).

A social wellbeing approach was used to select and gather evidence for the social, cultural, and economic benefits as the approach captures

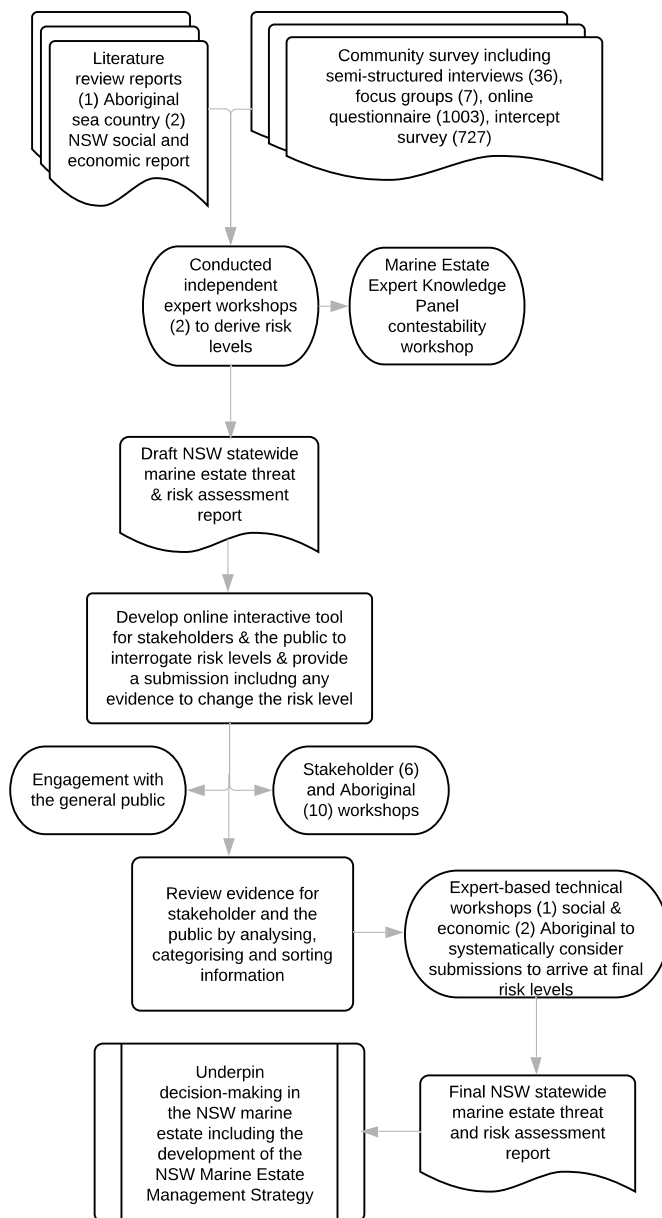


Fig. 2. Flow diagram of the threat and risk assessment process including streams of evidence.

not only objective information but also the impacts that are intangible (e.g., values, aspirations, and cultural traditions) and an analysis of relevant governance issues. This process included an evaluation of the

material (e.g., bio-physical environment), relational (e.g., relationships with family and friends, the community), and subjective (e.g., values, perceptions, beliefs) aspects of threats to benefits (McGregor et al., 2015a). The attribution of risk was then undertaken through the lens of community wellbeing where, for example, the threat of marine debris and littering on the wellbeing of communities was examined by considering how marine debris impacts on community values, enjoyment and recreation with family and friends as well as impacting on businesses operating in the marine estate.

Specific independently facilitated workshops were conducted involving independent social and economic experts with local knowledge and NSW government agency experts. Multiple lines of evidence were used to inform consequence and likelihood scoring, including literature reviews (Feary, 2015; Vanderkooi Consulting, 2015), government reports (MEMA, 2017), expert opinion, media reports, engagement reports (e.g. Origin Communications Australia, 2017) and surveys, including the marine estate community survey (Sweeney Research, 2014). Content analysis was performed to assign a preliminary risk ranking. Experts were then required to substantiate their expert opinions with reference to evidence at the independently facilitated expert workshops, and these risk attributions were later reviewed by the Marine Estate Expert Knowledge Panel to ensure consistency in the application of the risk analysis.

Public engagement was conducted following the completion of the draft threat and risk assessment. Evidence-based decision-making that is transparent is a key component of the threat and risk assessment and this was achieved by providing access to this evidence via an online tool (NSW Government, 2017). Additionally, six general stakeholder workshops and ten Aboriginal workshops were held throughout NSW coastal regions so the public could provide direct input on the draft assessment. Following this, three expert-based technical teams were formed (social/economic, cultural, and environmental) to analyse and review the evidence provided from public submissions and data collected from workshops. Content analysis was performed by systematically categorizing and classifying submissions by specific risk levels, and information about the risk levels and the latest opinions on these were gathered. Following content analysis by expert-based technical teams (consisting of marine estate management agency experts), workshops were held for social and economic (1) and Aboriginal culture (1) that were independently facilitated to assess whether changes in risk levels or supporting evidence was justified.

To provide an assessment of the uncertainty associated with risk attributions the level of confidence was defined as either inferred (very limited evidence e.g., only based on expert opinion), limited (limited evidence for the regions, but evidence for other areas outside of the State), or adequate (strong documented evidence in the NSW marine estate).

Prioritisation of risk was done by attributing a scoring system where a high risk scored 3 and moderate risk 2. The combined risk score for each row was calculated to prioritise threats to community benefits.

Table 2

Matrix used to determine risk levels in the NSW statewide social, cultural, and economic threat and risk assessment (Source MEMA, 2015).

LIKELIHOOD	LEVEL OF RISK				
ALMOST CERTAIN	MINIMAL	LOW	MODERATE	HIGH	HIGH
LIKELY	MINIMAL	LOW	MODERATE	HIGH	HIGH
POSSIBLE	MINIMAL	MINIMAL	LOW	MODERATE	HIGH
UNLIKELY	MINIMAL	MINIMAL	MINIMAL	LOW	MODERATE
RARE	MINIMAL	MINIMAL	MINIMAL	MINIMAL	LOW
CONSEQUENCE LEVEL	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC








Threat	Stressor	Social benefits				Cultural benefits	Economic benefits		
									
Resource use conflict	Conflict over resource access & use	M	M	L	L	H	L	L	L
	Anti-social behavior & unsafe practices	M	M	M	L	H	M	M	M
	Overcrowding/congestion	M	M	L	L	M	M	Min	M
	Loss or decline of marine industries	M	L	Min	M	M	Min	M	Min
	Excessive or illegal extraction	L	L	Min	L	M	Min	M	L
Environmental	Septic runoff, point source pollution & sewage overflows	L	L	M	L	M	L	M	L
	Urban stormwater discharge	M	M	M	M	H	M	M	M
	Agricultural diffuse source runoff	M	M	M	M	H	M	M	M
	Litter, solid waste, marine debris & microplastics	M	M	M	M	H	M	M	M
	Wildlife disturbance	L	L	M	Min	H	L	Min	L
	Habitat disturbance	L	L	M	M	H	L	Min	L
	Reductions in abundances of species & trophic levels	L	L	M	H	H	M	M	L
	Pests/diseases	M	L	L	M	M	L	M	L
	Modified hydrology/hydraulics & flow regime	L	M	L	M	M	L	L	L
	Sediment contamination	M	M	M	M	H	M	M	M
	Climate change (20 years)	L	L	M	M	H	L	M	M
Governance of the marine estate	Inadequate, inefficient or over-regulation	M	L	M	M	H	Min	M	L
	Lack of or ineffective community engagement	L	L	L	L	H	Min	Min	Min
	Lack of community awareness of the marine estate	Min	Min	M	L	H	L	L	L
	Lack of compliance with regulations or lack of compliance effort	M	M	M	M	H	L	M	L
	Inadequate social and economic information	M	M	M	M	H	M	M	M
Public safety	Wildlife interactions	M	L	Min	Min	Min	L	L	L
	Seafood contamination	M	L	Min	M	H	L	M	Min
	Other water pollution/contamination	L	L	L	Min	H	L	L	L
Lack of access	Limited or lack of access infrastructure	M	M	M	M	M	Min	M	M
	Loss of public access	M	L	L	M	H	M	M	L

Fig. 3. Threats to social, cultural and economic benefits communities gain from the marine estate *Risk levels: High = **H**, Moderate = **M**, Low = **L**, Minimal = **Min** (icons credit flaticon.com).

3. Results

3.1. Community benefits and threats

The community survey identified eight benefits of the NSW marine estate, including social (4), cultural (1), and economic (3) benefits (Table 1). The social benefit includes participation and enjoyment that communities gain from the marine estate. These include activities such as diving, swimming, recreational boating and fishing which are important to physical and mental health of the community and can contribute to sense of belonging within the community. Cultural heritage and use benefit is reflected in tradition, cultural practices including Aboriginal cultural use. Economic benefits include intrinsic and bequest values, viability of businesses and direct (individual enjoyment) values.

The marine estate provides a livelihood for many businesses such as fishing, aquaculture and marine tourism.

The key threats (and associated stressors) impacting the community benefits include: resource use conflict (5), environmental (14), governance of the marine estate (4), public safety (3), critical knowledge gaps (1), and lack of access availability (2) (Fig. 3).

3.2. Assessing threats and risk to community benefits

The threats that result in the greatest risk (moderate/high risk; Fig. 4) to the social, cultural, and economic benefits communities derive from the marine estate were water pollution (from urban stormwater discharge; agricultural diffuse source run-off; litter, waste, debris, and micro-plastics), inadequate social and economic information, as

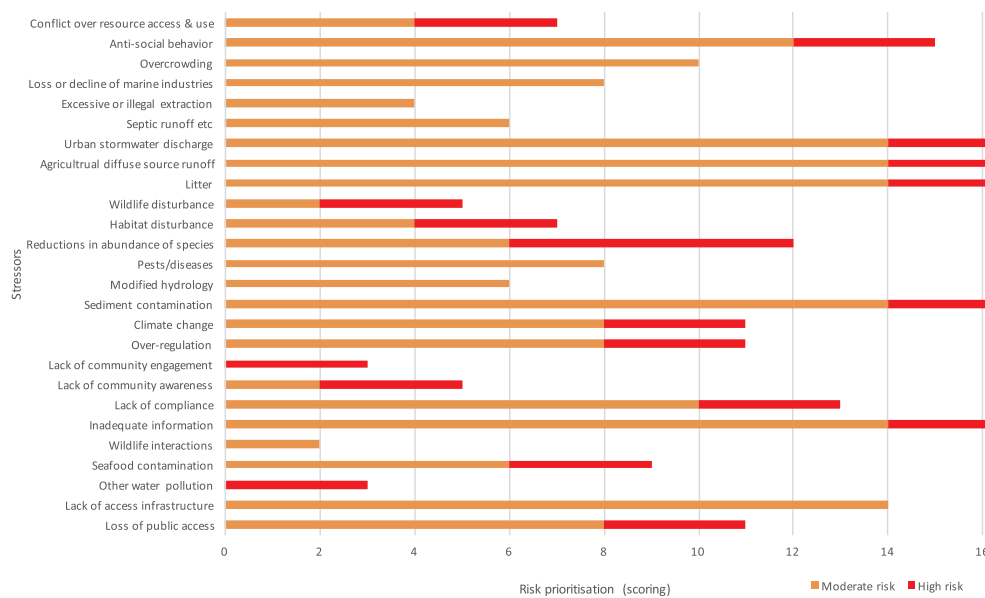


Fig. 4. Risk prioritisation of moderate and high threats to community benefits (social, cultural and economic).

well as sediment contamination at a regional scale. The relative importance of the stressors across community benefits helps to prioritise management efforts to reduce threats.

3.2.1. Threats to social benefits

3.2.1.1. Threats to participation. The threats posing the highest risk to participation benefits (including safety, health, and wellbeing and socialising and sense of community) include resource use conflict, lack of compliance with regulations, and lack of access to the marine estate (Fig. 3). The many competing uses of the marine estate can sometimes come into direct conflict with each other, for example kite surfing, the impact of wakeboarding boats in rivers, and tension between the local community and tourists. Wellbeing benefits associated with use of the coast can also be threatened by competing use of coastal land (e.g., foreshore development of the coastal zone).

The threat of climate change was determined to pose a high risk to the participation benefits some people and communities derive from the marine estate (Fig. 3). These risks incorporate impacts on safety, health, and wellbeing associated with loss of beach amenity through increased frequency of dangerous storm events. Inadequate governance of the marine estate, including lack of compliance with regulations (such as littering or breaking fishing regulations), can increase stress levels and reduce relaxation among marine estate users.

3.2.1.2. Threats to enjoyment. The enjoyment of biodiversity, beauty, and consumptive uses the community derives from the marine estate may be damaged by environmental threats, including wildlife and habitat disturbance, reductions in abundances of species, climate change, as well as rule breaking, and lack of access (Fig. 3).

The environmental threats disproportionately impact those who value direct interaction and enjoyment of biodiversity and wildlife, including snorkelers, divers, those involved in nature-based passive use, and fishers. The threat of inadequate governance, including lack of knowledge and awareness of the marine environment by other users, may detract from the full extent to which people can appreciate and enjoy the benefits the marine estate provides (Fig. 3).

3.2.2. Threats to cultural heritage and use

A consistently high risk (moderate to high risk) to cultural heritage and use was identified as part of the Aboriginal workshop across all threat categories (Fig. 3). Impacts in this category specifically relate to Aboriginal people, and to a historical and ongoing loss of access to the

coast associated with urbanisation, private development, and protected area closures. This loss may lead to damage to cultural sites or artefacts and limit access to food sources.

Stressors relating to lack of community engagement or participation in governance, lack of community awareness about the importance of the marine estate to Aboriginal people, and over-regulation were identified as high risks to Aboriginal culture and heritage (Fig. 3). Aboriginal people identified concerns that they have insufficient input into management and planning decisions, that the wider community has an inadequate understanding of Aboriginal worldviews of culture and nature, and that restrictions on harvesting seafood for social events impact their cultural practices in the marine estate.

3.2.3. Threats to economic benefits

3.2.3.1. Threats to intrinsic and bequest values. The impacts on the intrinsic and bequest values the community derive from the marine estate are driven by the environmental threat of reductions in abundance of species and trophic levels and loss of public access (Fig. 3). Declining fish abundance may have some impact on intrinsic values, with the Marine Estate Community Survey (Sweeney Research, 2014) identifying that people believe fish stocks have declined due to over-fishing, and that a high level of intrinsic value is placed on the diversity and abundance of marine life in the marine estate.

Loss of public access has the potential to impact intrinsic values, particularly given the strong belief in protecting public ownership of the coast. Further, a lack of knowledge about the nature and extent of intrinsic and bequest values was a moderate risk (Fig. 3) as a lack of knowledge means that these values are unable to be considered in decision-making.

3.2.3.2. Threats to viability of businesses. Most threats impacting on the economic benefit of viability of businesses resulted in moderate risk (Fig. 3). Water pollution can impact on businesses such as fishing, aquaculture, and tourism.

The threat of pests and diseases was also found to be a moderate risk to viability of businesses, including tourism operators, commercial fishers, and aquaculture producers. Outbreaks of pests and diseases have the potential to affect potential visitors at significant cost to the wider community. Anti-social behaviour may also have significant impacts on the viability of businesses and on employment situations where people are deterred from visiting the coast.

3.2.3.3. Threats to individual enjoyment values. Direct values (individual enjoyment) is an economic benefit that can be gained from activities such as swimming and whale watching in the marine estate. In particular, direct value is where the value of the benefit is larger than the cost of the activity to the user. It was found that water pollution can impact individuals using the marine estate for recreational purposes such as swimmers, surfers, and tourists, who may be deterred to visit the coast. Climate change is also likely to have significant impacts on enjoyment benefits some people and communities derive from the coast (Fig. 3). In particular, more extreme weather events, flooding, and impacts on marine habitats will negatively impact a range of user groups (tourists, residents, fishers, etc.).

4. Discussion

A threat and risk assessment framework was applied by exploring threats to community wellbeing in the NSW marine estate (Australia) in a novel way, that allowed an assessment of threats to environmental, social, cultural (particularly Aboriginal), and economic benefits that the NSW community derives from the marine estate. A social wellbeing approach was used to attribute risk by investigating threat to benefits through a community wellbeing lens rather than a single sector approach. This assessment supports an integrated approach to environmental policy and decision-making prioritisation, addressing the lack of attention that has hitherto been paid to social threats and the impact these threats may have on community wellbeing.

4.1. Providing an integrated perspective on environmental policy and decision-making

While the social dimension of sustainability has been largely ignored in the past, there is a growing number of published studies incorporating social sciences in the management of natural resources early in the decision-making process (e.g., Breslow et al., 2016; Gooch et al., 2017). The inclusion of threats to community benefits in a threat and risk assessment approach enables the social dimension to be considered alongside environmental dimension, and supports the idea that measurable threats, such as governance of the marine estate and resource use conflict, need to be considered early in coastal planning decisions.

Prior studies have noted the importance of incorporating multiple types of knowledge in environmental decision-making (Bennett, 2016; Failing et al., 2007; Raymond et al., 2010). For example, perceptions of 'water quality' play a significant role in the wellbeing of local communities in the Great Barrier Reef region, including that related to the 'beauty' of the beaches, as well as for fishing and swimming (Larson, 2009). Looking beyond environmental measures of water quality to its importance as a subjective element of community benefits may have the potential to generate more considerable support for conservation interventions from the community (Larson, 2009). The fact that water quality was identified as a priority threat in the NSW threat and risk assessment to social, cultural, and economic benefits confirms that this is a common issue. The threat and risk assessment identified that water quality was important to all coastal communities and Aboriginal people for swimming, surfing, culture, and viability of businesses and a priority threat to be addressed in the management of the NSW marine estate.

There is a clear recognition of the need to consider incorporating multiple types of knowledge, e.g., perceptions, values, expert judgement to provide a more complete picture that can inform and enable integrated perspective in environmental policy and decision-making (Bennett, 2016; Voyer et al., 2015). In this study, perceptions and values of the threats impacting on Aboriginal communities were explicitly incorporated in the threat and risk assessment. Aboriginal communities in NSW have had an association with the coast for tens of thousands of years, with the coast providing a central role in community wellbeing (Feary, 2015). Engagement with Aboriginal communities revealed that

cultural heritage, including tangible (historic objects, places, items, and sources of food) and intangible (traditions, practices, and spiritual values) benefits are at high risk due to a range of environmental and governance threats. These results are in line with those of previous studies that have highlighted the importance of understanding Aboriginal knowledge, value systems, and perceptions at the local scale for effective environmental decision-making (Biddle, 2014; Sangha et al., 2015).

4.2. Community wellbeing as an approach to assessing social aspects of sustainable development

The community wellbeing approach has previously been used to measure community wellbeing in the context of sustainability and provides a framework that integrates environmental, economic, and social dimensions of sustainability (Coulthard et al., 2011). The social wellbeing approach to environmental decision-making has demonstrated the importance of not just considering environmental sustainability in terms of conserving resources, but also including relationships between people and the natural environment (e.g. Adams et al., 2014; Britton and Coulthard, 2013; Larson, 2009; Narayan et al., 2000).

The wellbeing approach used in the NSW assessment guided the identification of community benefits, specifically the material dimension (including the viability of businesses), relational dimension (including socialising and sense of community), and subjective dimension (including intrinsic and bequest values). The threats from inadequate governance of the marine estate, including lack of user compliance with regulations or a lack of enforcement by agencies, was found as part of the threat and risk assessment process to be impacting on the wellbeing of coastal communities.

A lack of compliance with regulations to manage, protect and enhance fisheries or other forms of consumptive use (e.g., controls on visitor numbers/vessel anchoring or mooring areas) is likely to have ongoing impacts on the success of these management arrangements. This in turn impacts subjective benefits such as intrinsic and bequest values as well as material benefits such as business viability.

Poor compliance is a governance problem that can arise from a lack of resources, but in addition the perception of poor compliance by stakeholders and communities can affect community wellbeing. Research into recreational fisher attitudes indicated a high level of concern about illegal activity and enforcement levels, including a high degree of concern about equity and justice, such as 'other users' doing the wrong thing and getting away with it (McIlgorm et al., 2016; Voyer et al., 2015). Anger, resentment and frustration about illegal activity (actual or perceived) is likely to impact individual stress levels, and have moderate impacts on relaxation. Prior studies have noticed the importance of understanding community perceptions, with similar findings of perceived lack of compliance in particular fisheries and coastal development viewed as a major issue in the Mackay region (Great Barrier Reef) which negatively impacted local community wellbeing (Dutra et al., 2016).

The threat and risk assessment underpinned the Marine Estate Management Strategy 2018–2028 that identified actions to address moderate and high threats (MEMA, 2018), including the development of new technologies and education programs to support proactive compliance by users, as well as greater compliance co-ordination across multiple government agencies. It also identified social, economic and cultural aspects to be key components of a marine integrated monitoring program to evaluate and report on community perceptions. Viewing benefits from the marine estate through a wellbeing lens allows policy makers to take better account of what matters to stakeholders and communities (Marshall et al., 2017; McGregor et al., 2015b).

4.3. Enhancing transparency and accountability in decision-making

Improving effective engagement between communities and government resource managers is an essential element of social sustainability (Boström, 2012). Engagement should be participatory and accessible to all sectors of the community (Halpern et al., 2013). The community engagement component of the threat and risk assessment highlighted the importance of including benefits based on what people think is important, not just quantifiable (mostly economic) benefits. A focus on less tangible benefits such as intrinsic and bequest benefits can strengthen community support for conservation initiatives, as these benefits influence attitudes towards the environmental initiatives (Chaigneau and Brown, 2016).

Decision-making in natural resource management is complex, and there is an expectation that governments are accountable in their decision-making (Leith et al., 2014; Nursey-Bray et al., 2014; Oreskes, 2004). Transparency in the decision-making process for the NSW marine estate was increased by providing the scoring and results of the threat and risk assessment via an open access interactive online tool (NSW Government, 2017). This tool provided stakeholders and communities with extensive information on how the risk levels were attributed, highlighting the quantity of evidence and competing claims that decision-makers need to consider. The interactive online tool increased the legitimacy of the decision-making process, and clarified some of the complexity of the threat and risk assessment. This transparency of the science behind the decision-making is desirable for the social acceptability of policy, supporting scientific integrity and evidence-based policy (Carroll et al., 2017).

4.4. Limitations

The limitations of the threat and risk assessment include: limited information on aspects of social, cultural, and economic stressors and values; a lack of research on the cumulative impacts of social, cultural, and economic threats; and the large amount of data associated with determining consequence and likelihood resulting in difficulties for both management agencies and the public to understand and engage with. While qualitative risk ratings are not as reliable in some cases compared to quantitative risk assessment methods (Cox et al., 2005), the definition of risk objectives, a multi-step process to attribute risk, documentation of evidence to support decision on consequence and likelihood, and categorisation of uncertainty all aimed to minimise the known limitations of the qualitative approach. A more quantitative approach across a large range of identified threats to social, economic and cultural benefits would require an improved understanding of the correlations between these attributes requiring considerably more data and statistical approaches.

An improved focus on social, economic and cultural research knowledge gaps and management effectiveness evaluation will contribute to more quantitative approaches as it is recognised that priority lists from qualitative assessments do not always generate effective management decisions to reduce the risk (Cox, 2009). Implementation of a hierarchical risk assessment approach for ecosystem based management where a range of qualitative and quantitative tools and models are progressively applied will reduce the uncertainties in such assessments, but increase the time, complexity and costs (Dunstan et al., 2015).

As the Marine Estate Management Strategy has an identified focus on monitoring of the NSW marine estate addresses these limitations and knowledge gaps, this information can be fed into future iterations of threat and risk assessments. This will increase the accuracy of the assessment and allow managers to re-evaluate priorities.

5. Conclusions

This study identified and determined the relative risk of the threats

to social, cultural, and economic benefits the community derives from the marine estate. The findings of this study have a number of practical applications, including informing the prioritisation of management actions in the Marine Estate Management Strategy to reduce threats to community benefits (MEMA, 2018). The actions identified as being the most effective at addressing the moderate and high threats include addressing water quality issues; tackling lack of awareness through education and awareness programs; and collecting social research data through, for example, activity mapping, surveys and interviews (MEMA, 2018).

The threat and risk assessment provided an integrated approach that explicitly considers social sustainability in government decision-making. The threats to the benefits communities derive from the marine estate are common to many regions and could be applicable to other marine and coastal areas. Understanding the benefits communities gain from the marine estate and the perceived threats to community well-being leads to informed decision-making to protect the marine and coastal environment and enhance community benefits. This study highlights the potential benefits of going beyond a traditional sector-based approach to one that enhances broader community wellbeing.

Declarations of interest

None.

Acknowledgments

This work was undertaken and funded by the four member agencies of the NSW Marine Estate Management Authority: The NSW Department of Primary Industries; Office of Environment and Heritage; Transport for NSW, Australia; and Planning and Environment, Australia. The work has also benefited from the advice of the independent NSW Marine Estate Expert Knowledge Panel. Thanks also to Kate Thornborough for advice and assistance in the development of this paper.

References

- Adams, Vanessa M., Pressey, Robert L., Stoeckl, Natalie, 2014. Navigating trade-offs in land-use planning: integrating human well-being into objective setting. *Ecol. Soc.* 19 (4).
- Agardy, Tundi S., 1997. *Marine Protected Areas and Ocean Conservation*. Elsevier Science Publishing Co Inc, San Diego, United States.
- Barclay, Kate, 2012. The social in assessing for sustainability. *Fisheries in Australia. Cosmop. Civil Soc. Interdiscip. J.* 4 (3), 38–53.
- Beeton, R.J.S., D Buxton, C., Cutbush, G.C., Fairweather, P.G., Johnston, E.L., Ryan, R., 2012. Report of the Independent Scientific Audit of Marine Parks in New South Wales. NSW Department of Primary Industries and Office of Environment and Heritage, NSW, pp. 1–124.
- Bennett, Nathan James, 2016. Using perceptions as evidence to improve conservation and environmental management. *Conserv. Biol.* 30, 582–592. <https://doi.org/10.1111/cobi.12681>.
- Biddle, N., 2014. Measuring and analysing the wellbeing of Australia's indigenous population. *Soc. Indic. Res.* 116 (3), 713–729. <https://doi.org/10.1007/s11205-013-0317-8>.
- BMT WBM, 2017. *New South Wales Marine Estate Threat and Risk Assessment Report – Final Report*. for NSW Marine Estate Management Authority.
- Boldt, Jennifer L., Martone, Rebecca, Samhouri, Jameal, Perry, R. Ian, Itoh, Sachihiko, Chung, Ik Kyo, Takahashi, Motomitsu, Yoshie, Naoki, 2014. Developing ecosystem indicators for responses to multiple stressors. *Oceanography* 27 (4), 116–133.
- Boström, Magnus, 2012. A missing pillar? Challenges in theorizing and practicing social sustainability: introduction to the special issue. *Sustain. Sci. Pract. Pol.* 8 (1).
- Breslow, Jo, Sara, Sojka, Brit, Barnea, Raz, Basurto, Xavier, Carothers, Courtney, Charnley, Susan, Coulthard, Sarah, Dolšák, Nives, Donatuto, Jamie, García-Quijano, Carlos, 2016. Conceptualizing and operationalizing human wellbeing for ecosystem assessment and management. *Environ. Sci. Pol.*
- Britton, Easkey, Coulthard, Sarah, 2013. Assessing the social wellbeing of Northern Ireland's fishing society using a three-dimensional approach. *Mar. Pol.* 37 (0), 28–36. <https://doi.org/10.1016/j.marpol.2012.04.011>.
- Brooks, Kate, Fairfull, Sarah, 2017. Managing the NSW coastal zone: restructuring governance for inclusive development. *Ocean Coast Manag.* 150 (Suppl. C), 62–72.
- Brooks, Kate, Schirmer, Jacki, Pascoe, Sean, Triantafillos, Lianos, Jebreen, Eddie, Cannard, Toni, Cathy, M., Dichmont, 2015. Selecting and assessing social objectives for Australian fisheries management. *Mar. Pol.* 53 (0), 111–122. <https://doi.org/10.1016/j.marpol.2015.04.011>.

- 1016/j.marpol.2014.11.023.
- Carroll, Carlos, Hartl, Brett, Gretchen, T., Goldman, Daniel J. Rohlf, Adrian, Treves, Kerr, Jeremy T., Ritchie, Euan G., et al., 2017. Defending the scientific integrity of conservation-policy processes. *Conserv. Biol.* 31 (5), 967–975. <https://doi.org/10.1111/cobi.12958>.
- Chaigneau, Tomas, Brown, Katrina, 2016. Challenging the win-win discourse on conservation and development: analyzing support for marine protected areas. *Ecol. Soc.* 21 (1). <https://doi.org/10.5751/ES-08204-210136>.
- Vanderkooi Consulting, 2015. Social and Economic Background Information Report on the NSW Marine Estate. (Sydney).
- Coulthard, Sarah, Johnson, Derek, Allister McGregor, J., 2011. Poverty, sustainability and human wellbeing: a social wellbeing approach to the global fisheries crisis. *Global Environ. Change* 21 (2), 453–463. <https://doi.org/10.1016/j.gloenvcha.2011.01.003>.
- Cox, L.A., 2009. What's wrong with hazard-ranking systems? An Expository Note. *Risk Anal. Int. J.* 29 (7), 940–948.
- Cox, L.A., Babayev, D., Huber, W., 2005. Some limitations of qualitative risk rating systems. *Risk Anal.* 25 (3), 651–662.
- Dale, A., Vella, K., Pressey, R.L., Brodie, J., Yorkston, H., Potts, R., 2013. A method for risk analysis across governance systems: a Great Barrier Reef case study. *Environ. Res. Lett.* 8 (1). <https://doi.org/10.1088/1748-9326/8/1/015037>.
- Dillard, Jesse, Dujon, Veronica, King, Mary C., 2008. Understanding the Social Dimension of Sustainability. Routledge.
- Dovers, S.R., Norton, T.W., Handmer, J.W., 1996. Uncertainty, ecology, sustainability and policy. *Biodivers. Conserv.* 5 (10), 1143–1167. <https://doi.org/10.1007/bf00051569>.
- Dunstan, Piers, Dambacher, Jeff, Bax, Nic, Smith, Tony, Fulton, Beth, Paul, Hedge, Hobday, Alistair, Foster, Scott, 2015. A Hierarchical Risk Assessment Framework for Ecosystem Based Management. National Environmental Research Program.
- Dutra, Leo X.C., Dichmont, Catherine M., van Putten, Ingrid E., Olivier, Thébaud, Deng, Roy A., Pascual, Ricardo, Owens, Randall, et al., 2016. How important is the coast? A survey of coastal objectives in an Australian regional city. *Mar. Pol.* 71 (Suppl. C), 229–241. <https://doi.org/10.1016/j.marpol.2016.05.020>.
- Duxbury, Jane, Dickinson, Sarah, 2007. Principles for sustainable governance of the coastal zone: in the context of coastal disasters. *Ecol. Econ.* 63 (2–3), 319–330. <https://doi.org/10.1016/j.ecolecon.2007.01.016>.
- Elkington, John, 1999. Triple bottom line revolution: reporting for the third millennium. *Aust. CPA* 69 (11), 75–76.
- Failing, L., Gregory, R., Harstone, M., 2007. Integrating science and local knowledge in environmental risk management: a decision-focused approach. *Ecol. Econ.* 64 (1), 47–60. <https://doi.org/10.1016/j.ecolecon.2007.03.010>.
- Feary, S., 2015. Sea Countries of New South Wales: a benefits and threats analysis of Aboriginal people's connections with the marine estate. In: Final Report to the NSW Marine Estate Management Authority.
- Fletcher, Warrick Rick J., 2005. The application of qualitative risk assessment methodology to prioritize issues for fisheries management. *ICES J. Mar. Sci.* 62 (8), 1576–1587.
- Fletcher, W.J., 2008. Implementing an ecosystem approach to fisheries management: lessons learned from applying a practical EAFM framework in Australia and the Pacific. In: Bianchi, G., Skjoldal, H.R. (Eds.), *The Ecosystem Approach to Fisheries*. FAO-CABI, Rome, pp. 112–124.
- Fletcher, Warrick Rick J., 2014. Review and refinement of an existing qualitative risk assessment method for application within an ecosystem-based management framework. *ICES J. Mar. Sci.*
- Garcia, Serge M., Prouzet, Patrick, 2009. Towards the implementation of an integrated approach to fisheries resources management in Ifremer, France. *Aquat. Living Resour.* 22 (4), 381–394.
- Geller, E Scott, 1995. Actively caring for the environment: an integration of behaviorism and humanism. *Environ. Behav.* 27 (2), 184–195.
- Gibbs, Mark T., Browman, Howard I., 2015. Risk assessment and risk management: a primer for marine scientists. *ICES J. Mar. Sci.*
- Gibson, Robert B., 2006. Beyond the pillars: sustainability assessment as a framework for effective integration of social, economic and ecological considerations in significant decision-making. *J. Environ. Assess. Pol. Manag.* 8 (03), 259–280.
- Gooch, Margaret, Curnock, Mathew, Dale, Allan, Gibson, Josh, Hill, Rosemary, Marshall, Nadine, Molloy, Fergus, Vella, Karen, 2017. Assessment and promotion of the Great barrier reef's human dimensions through collaboration. *Coast. Manag.* 45 (6), 519–537. <https://doi.org/10.1080/08920753.2017.1373455>.
- Gough, Ian, McGregor, J Allister, 2007. Wellbeing in Developing Countries: from Theory to Research. Cambridge University Press.
- Great Barrier Reef Marine Park Authority, 2014. Great Barrier Reef Outlook Report 2014. GBRMPA, Townsville.
- Halpern, Benjamin S., Walbridge, Shaun, Selkoe, Kimberly A., Kappel, Carrie V., Micheli, Fiorenza, D'Agrosa, Caterina, Bruno, John F., Casey, Kenneth S., Ebert, Colin, Fox, Helen E., 2008. A global map of human impact on marine ecosystems. *Science* 319 (5865), 948–952.
- Halpern, B.S., Klein, C.J., Brown, C.J., Beger, M., Grantham, H.S., Mangubhai, S., Ruckelshaus, M., et al., 2013. Achieving the triple bottom line in the face of inherent trade-offs among social equity, economic return, and conservation. *Proc. Natl. Acad. Sci. U. S. A.* 110 (15), 6229–6234.
- Harding, R., 2006. Integrated Concepts in Water Recycling Ecologically sustainable development: origins, implementation and challenges. *Desalination* 187 (1), 229–239. <https://doi.org/10.1016/j.desal.2005.04.082>.
- Helne, T., Hirvilammi, T., 2015. Wellbeing and sustainability: a relational approach. *Sustain. Dev.* 23 (3), 167–175. <https://doi.org/10.1002/sd.1581>.
- Hobday, A.J., Smith, A.D.M., Stobutzki, I.C., Bulman, C., Daley, R., Dambacher, J.M., Deng, R.A., et al., 2011. Ecological risk assessment for the effects of fishing. *Fish. Res.* 108 (2–3), 372–384. <https://doi.org/10.1016/j.fishres.2011.01.013>.
- IUCN, 1980. *World Conservation Strategy: Living Resource Conservation for Sustainable Development*. IUCN, Gland, Switzerland.
- Jordan, Alan, Fairfull, Sarah, Creese, Bob, 2016. Managing threats to the marine estate in New South Wales (Australia) to maximise community wellbeing. *J. Coast Res.* 642–646. <https://doi.org/10.2112/si75-129.1>.
- Kaplan-Hallam, Maery, Bennett, Nathan J., 2017. Adaptive social impact management for conservation and environmental management. *Conserv. Biol.* 00 (0,1–11). <https://doi.org/10.1111/cobi.12985>. n/a-n/a.
- Larson, Silva, 2009. Communicating stakeholder priorities in the Great barrier Reef region. *Soc. Nat. Resour.* 22 (7), 650–664. <https://doi.org/10.1080/08941920801992102>.
- Leith, Peat, Kevin, O'Toole, Haward, Marcus, Coffey, Brian, Rees, Chris, Ogier, Emily, 2014. Analysis of operating environments: a diagnostic model for linking science, society and policy for sustainability. *Environ. Sci. Pol.* 39, 162–171. <http://doi.org/10.1016/j.envsci.2014.01.001>.
- Littig, Beate, Griesler, Erich, 2005. Social sustainability: a catchword between political pragmatism and social theory. *Int. J. Sustain. Dev.* 8 (1–2), 65–79.
- Mace, Georgina M., 2014. Whose conservation. *Science* 345 (6204), 1558–1560.
- Malekmohammadi, B., Rahimi Blouchi, L., 2014. Ecological risk assessment of wetland ecosystems using multi criteria decision making and geographic information system. *Ecol. Indic.* 41, 133–144. <https://doi.org/10.1016/j.ecolind.2014.01.038>.
- Marshall, Nadine, Adger, Neil, Attwood, Simon, Brown, Katrina, Crissman, Charles, Cvitanovic, Christopher, De Young, Cassandra, et al., 2017. Empirically derived guidance for social scientists to influence environmental policy. *PLoS One* 12 (3). <https://doi.org/10.1371/journal.pone.0171950>.
- McCauley, Douglas J., Pinsky, Malin L., Palumbi, Stephen R., Estes, James A., Joyce, Francis H., Warner, Robert R., 2015. Marine defaunation: animal loss in the global ocean. *Science* 347 (6219). <https://doi.org/10.1126/science.1255641>.
- McGregor, J Allister, 2007. Researching human wellbeing: from concepts to methodology. In: Gough, I., McGregor, J.A. (Eds.), *Wellbeing in Developing Countries: from Theory to Research*. Cambridge University Press, Cambridge.
- McGregor, Allister, Camfield, Laura, Coulthard, Sarah, 2015a. Competing interpretations: human wellbeing and the use of quantitative and qualitative methods. In: *Mixed Methods Research in Poverty and Vulnerability*. Springer, pp. 231–260.
- McGregor, Allister, Coulthard, Sarah, Camfield, Laura, 2015b. Measuring what Matters: the Role of Well-being Methods in Development Policy and Practice.
- McIlgorm, A., Voyer, M., Magee, C., J Pepperell, G., O'Toole, E., Li, O., 2016. Improving our understanding of the motivations and attitudes towards fisheries management of recreational Fishers in NSW. In: Report to the New South Wales Department of Primary Industry Recreational Fishing Trusts.
- MEMA, 2013. In: NSW Government (Ed.), *Managing the NSW Marine Estate: Purpose, Underpinning Principles and Priority Setting*.
- MEMA, 2015. In: NSW Government (Ed.), *Threat and Risk Assessment Framework for the NSW Marine Estate*.
- MEMA, 2017. In: NSW Marine Estate Management Authority (Ed.), *NSW Marine Estate Threat and Risk Assessment - Background Environmental Information*. NSW Marine Estate Management Authority.
- MEMA, 2018. In: NSW Government (Ed.), *NSW Marine Estate Management Strategy 2018–2028*.
- Millennium Ecosystem Assessment (MA), 2005. *Ecosystems and Human Well-being: Current State and Trends*. Island Press, Washington, D.C. USA.
- Narayan, D., Chambers, R., Kaul Shah, M., Petesch, P., 2000. *Voices of the Poor-Crying Out For Change*. University Press for the World Bank, New York: Oxford.
- Newman, Stephen J., Brown, Joshua I., Fairclough, David V., Wise, Brent S., Bellchambers, Lynda M., Molony, Brett W., Lenanton, Rodney C.J., et al., 2018. A risk assessment and prioritisation approach to the selection of indicator species for the assessment of multi-species, multi-gear, multi-sector fishery resources. *Mar. Pol.* 88, 11–22. <https://doi.org/10.1016/j.marpol.2017.10.028>.
- NSW Government, 2017. Threat and Risk Assessment Tool. <https://www.marine.nsw.gov.au/key-initiatives/threat-and-risk-assessment/threat-and-risk-assessment-tool>. Accessed date: 30 January 2018.
- Nurse-Bray, Melissa J., Vince, Joanna, Scott, Michael, Haward, Marcus, Kevin, O'Toole, Smith, Tim, Harvey, Nick, Clarke, Beverley, 2014. Science into policy? Discourse, coastal management and knowledge. *Environ. Sci. Pol.* 38, 107–119.
- Oreskes, Naomi, 2004. Science and public policy: what's proof got to do with it? *Environ. Sci. Pol.* 7 (5), 369–383. <https://doi.org/10.1016/j.envsci.2004.06.002>.
- Origin Communications Australia, 2017. *Aboriginal Engagement Report - Community and Stakeholder Workshops*.
- Raymond, Christopher M., Ioan Fazey, Mark S., Reed, Lindsay C., Stringer, Guy M., Robinson, Evelyn, Anna C., 2010. Integrating local and scientific knowledge for environmental management. *J. Environ. Manag.* 91 (8), 1766–1777. <https://doi.org/10.1016/j.jenvman.2010.03.023>.
- Sandifer, Paul A., Sutton-Grier, Ariana E., Ward, Bethney P., 2015. Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: opportunities to enhance health and biodiversity conservation. *Ecosyst. Serv.* 12 (0), 1–15. <https://doi.org/10.1016/j.ecoser.2014.12.007>.
- Sangha, Kamaljit K., Le Brocq, Andrew, Costanza, Robert, Cadet-James, Yvonne, 2015. Ecosystems and indigenous well-being: an integrated framework. *Global Ecol. Conserv.* 4, 197–206. <https://doi.org/10.1016/j.gecco.2015.06.008>.
- Shafer, Craig L., 2015. Cautionary thoughts on IUCN protected area management categories V–VI. *Global Ecol. Conserv.* 3, 331–348.
- Smith, A.D.M., Fulton, E.J., Hobday, A.J., Smith, D.C., Shoulder, P., 2007. Scientific tools to support the practical implementation of ecosystem-based fisheries management. *ICES J. Mar. Sci.* 64 (4), 633–639. <https://doi.org/10.1093/icesjms/fsm041>.

- Sweeney Research, 2014. Marine Estate Community Survey Final Report.
- Thacher, Peter S., Meith, Nikki, 1980. Approaches to regional marine problems: a progress report on UNEP's Regional Seas Program. *Ocean YB* 2, 153.
- UNEP, 2010. The Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets: Document UNEP/CBD/COP/DEC/X/2. Secretariat of the Convention on Biological Diversity, Nagoya, Japan.
- Vallance, Suzanne, Perkins, Harvey C., Dixon, Jennifer E., 2011. What is social sustainability? A clarification of concepts. *Geoforum* 42 (3), 342–348. <https://doi.org/10.1016/j.geoforum.2011.01.002>.
- Voyer, Michelle, Gollan, Natalie, Barclay, Kate, Gladstone, William, 2015. 'It's part of me'; understanding the values, images and principles of coastal users and their influence on the social acceptability of MPAs. *Mar. Pol.* 52 (0), 93–102. <https://doi.org/10.1016/j.marpol.2014.10.027>.
- Watson, James EM., Dudley, Nigel, Segan, Daniel B., Hockings, Marc, 2014. The performance and potential of protected areas. *Nature* 515 (7525), 67–73.
- WCED, 1987. Our Common Future. World Commission on Environment and Development. Oxford University Press, Oxford.
- White, S., 2009. Bringing Wellbeing into Development Practice. WeD Working Paper No 09/50. University of Bath, Bath.
- Williams, A., Dowdney, J., Smith, A.D.M., Hobday, A.J., Fuller, M., 2011. Evaluating impacts of fishing on benthic habitats: a risk assessment framework applied to Australian fisheries. *Fish. Res.* 112 (3), 154–167. <https://doi.org/10.1016/j.fishres.2011.01.028>.