



Aligning public participation with local environmental knowledge in complex marine social-ecological systems



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ABSTRACT

The incorporation of local and traditional knowledges into environmental governance regimes is increasingly recognised as a critical component of effective and equitable conservation efforts. However, there remain significant barriers to integration of community-based knowledge within mainstream environmental governance. This paper explores community-based knowledge in the context of Environmental Impact Assessment (EIA), a widely-used governance tool designed to predict and manage the impacts of development. Drawing on a social survey and interviews, the paper documents local community knowledge of environmental changes associated with dredging and the construction of Liquefied Natural Gas (LNG) plants in a large industrial harbour located in the Great Barrier Reef World Heritage Area, and compares this knowledge with public consultation opportunities offered throughout the project lifecycle, including during assessment and after project approval. The findings highlight a misalignment between community knowledge of environmental change, which is acquired largely after impacts become apparent, and the public participation opportunities afforded through EIA, which generally occur before construction or dredging is undertaken.

1. Introduction

Local and traditional knowledges play an important role in the governance of complex ecosystems. Local communities are often custodians of experiential knowledge about species distributions and life histories (see [68,85]); ecosystem dynamics, trends and threats; local values and resource use patterns; and how the environment can be managed sustainably ([47]; Robertson and McGee; [55]). Such knowledge is learned by experience or transmitted through social and cultural practices, sometimes over many generations [37]. For example, studies have recorded fishers' understandings of the ecological role of coastal habitats including seagrasses and mangroves [30,43,96], and fish behaviour and distribution patterns [59,88]. Other research has highlighted the importance of traditional resource management practices (such as the establishment of taboo sites, or bans on fishing or collecting certain species) as examples of adaptive management critical to the successful protection of marine ecosystems [11,25,26].

The Great Barrier Reef, located off Australia's north-eastern coast, is an area of extraordinary biodiversity and ecological complexity, comprising intricate networks of interactions between the land-sea interface and the human communities that depend on coastal resources. In such complex social-ecological systems, local knowledge can inform innovative policy and management, and complement scientific information. Local knowledge and traditional practices can form the basis of self-managed resource systems, or in other cases can complement scientific understandings of marine ecosystems, 'filling in the gaps'

where information may be missing from the scientific record, and strengthening mainstream governance approaches [4,80,83]; Fabricius et al., 2006; [36,62,69,70]. Community input is also critical to defining policy problems, ensuring equitable decision making, legitimating governance initiatives, and granting industry a social license to operate [76][67,86,91]. As [82] point out, "even when the scientific characterization of risk is thorough...what is 'acceptable' depends on more than scientific criteria; acceptability depends on public perception."

Participatory approaches have become increasingly embedded in environmental policy and management over recent decades, reflecting the importance of harnessing local community knowledge and generating broad-based support for public decisions [78]. Scholars and practitioners have sought to integrate traditional and scientific knowledges (see [2,39,77]), to improve the adaptiveness and responsiveness of marine governance initiatives to community concerns [94], and to create spaces for collective discussion and decision making [15]. However, there remain institutional, political and cultural barriers to effective integration of customary and local knowledges within contemporary governance practices [24], and there are concerns that participatory approaches frequently fail to meet community expectations of transparency, efficacy and fairness [35,91].

Barriers to the integration of local and traditional knowledge into mainstream governance can include: the capacity of local communities to engage with decision making processes which require an investment of time and, often, substantial technical expertise; the inability of local knowledges to keep pace with change in social-ecological systems

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(Fabricius et al., 2006); government reluctance to relinquish decision making power or to substantially amend or abandon projects in response to community concerns [73]; the perceived risk of political deadlock over highly complex and contested environmental issues [73]; and a mainstream environmental governance culture that has historically privileged expert advice over other forms of knowledge. For example, [40] writes, “not only are experts socially situated between the [decision making] elites and public but their technical languages provide an intimidating barrier for lay citizens seeking to express their [views] in the language of everyday life.” Community opposition to science-based conservation measures can be seen as unnecessarily obstructive from scientific perspectives (see [93]). In addition, there is ongoing debate among scholars about how scientific knowledge can best be integrated with community perspectives to achieve sustainable outcomes for complex coastal systems [15]. A number of studies have found limitations to the comprehensiveness and generalisability of local knowledge [4,45]. For example, Tibby et al. [87] examined local knowledge of salinity changes in a coastal lake over multiple decades, finding that collective memories of the timing and quantum of environmental changes did not align with the scientific record. Fabricius et al. (2006) recognise the value of local knowledge to science assessments while also acknowledging its limitations. Other scholars have cautioned against evaluating traditional knowledges in a western scientific context, emphasising that local and traditional knowledges are complementary to, rather than substitutable for, scientific enquiry [56,60]; Bohensky and Maru, 2012.

This paper examines community participation and local knowledge in the context of Environmental Impact Assessment (EIA). First legislated by the United States National Environmental Policy Act 1969, EIA is a proactive governance tool designed to anticipate and manage the impacts of development at the project scale. Since its inception, EIA legislation has provided for some form of public engagement [74], although these opportunities vary across jurisdictions and projects. Recent scholarship has “demonstrated the importance of meaningful public participation both to ensure the integrity of the EIA process as well as to realize the potential for sustainable development” [97], while also recognising a democratic deficit associated with EIA [38]. In the United States, for example, legal action over EIA processes under the National Environment Protection Act 1969 (NEPA) has been ongoing issue since the inception of the Act more than 40 years ago (Baber and Bartlett, 2006).

This paper begins by exploring local community understandings of environmental change through a case study of Port Curtis, an industrial harbour located on the continental margin adjacent to the Great Barrier Reef, Australia. The recent expansion of heavy industry in the port and a major flooding event have been linked to short-term declines in water quality and health of the port environment and key species. The paper also critically assesses key barriers to public participation in EIA processes related to the recent expansion of heavy industry. In concluding, the paper discusses the benefits of aligning these processes with community knowledge and needs in the context of future coastal development and impact assessment practice.

2. Case study

2.1. Dredging and industrial development in Port Curtis, Australia

Water quality and ecological health in ports along the Australian coast is determined by the interaction of a range of natural and human processes, including agricultural runoff, industrial development, flooding and extreme weather events such as cyclones [49,81]; 2013; [66]. In recent years, the expansion of ports to accommodate heavy industry such as coal and gas processing and exports, has raised concerns about the impacts of such development on water quality, seagrass and coral ecosystems in the World Heritage-listed Great Barrier Reef, located off the coast of Queensland (see Fig. 1). In particular, dredging operations

in two of Australia's eastern ports, Port Curtis and Abbot Point, have attracted substantial public scrutiny for their potential to affect water quality through the mobilisation of sediments, metals and other contaminants [33]. This research focuses on Port Curtis, also known as Gladstone Harbour, a large multi-commodity port that underwent dredging and construction works between 2010 and 2016 to facilitate the export of Liquefied Natural Gas (LNG).

Port Curtis is an estuarine system comprising rivers, creeks, inlets, shoals, mud banks, channels and islands. The port experiences naturally high sediment loads [50,54]. It has historically supported large sub- and intertidal seagrass meadows dominated respectively by paddleweed (*Halophila ovalis*) and eelgrass (*Zostera muelleri* subsp. *Capricornii*; see [21,28]). These species are highly sensitive to changes in water quality, light availability and local sediment dynamics [1,19,23]. Seagrass cover in Port Curtis has declined substantially over the past decade [18] and reporting indicates that seagrass meadows in the port are in poor condition [27,44,49]. The port and surrounds are also known to support populations of dugong (*Dugong dugon*), green turtles (*Chelonia mydas*), flatback turtles (*Natator depressus*), Australian humpback dolphins (*Sousa sahulensis*) and the Australian snubfin dolphins (*Orcaella heinsohni*; see [20,84]).

Port Curtis is a major hub for the Australian coal, bauxite and gas industries, and undergoes periodic dredging to create and maintain shipping channels, swing basins and commodity export terminals. In addition to heavy industry, the port is used for recreational boating and fishing activities by residents from Gladstone, a small port city and industry service centre. The Traditional Owners of lands in the Gladstone Region are the Gurang, Gooreng Gooreng, Taribelang Bunda and Bailai peoples, sometimes collectively known as the Port Curtis Coral Coast peoples. Approximately 3.5% of the regional population identifies as Aboriginal or Torres Strait Islander [7].

Since 2010, three gas liquefaction plants (the Queensland Curtis LNG (QCLNG), Gladstone LNG (GLNG) and Australia Pacific LNG (APLNG) projects) have been constructed on Curtis Island (see Fig. 1). In association with these developments a dredging campaign, known as the Western Basin Dredging and Disposal Project (WBDDP), was conducted between 2010 and 2013. The WBDDP involved the removal and disposal of 22 million cubic metres of dredge spoil behind a bund wall in a land reclamation area within the port boundary [46,95]. In September 2011, dredge spoil was found to be leaking into Port Curtis through the bund wall, leading to localised increases in turbidity levels (Commonwealth of Australia, 2014). Remediation works on the bund wall were completed in August 2012 (Commonwealth of Australia, 2014).

Dredging and the inshore disposal of dredge spoil have been found to reduce water clarity in Port Curtis, with the extent and duration of dredging activities influencing the quantum and duration of impacts [65,75]. High turbidity levels were observed in Port Curtis in November 2010 and April–May 2011, and turbidity exceeded guideline limits at several monitoring sites in Port Curtis from 9 to 16 January 2012 [75]. Marine turtle strandings in the port have been linked to seagrass decline and dredging activities [16,42]. Commercial and recreational fishing in the port was impacted by the discovery of diseased and injured fish in 2011 [32].

2.2. Impact assessment of the Gladstone LNG projects and Western Basin Dredging and Disposal Project

In the Australian federal system, decision making authority is shared between a central government (the Australian Government), eight states and territories, and more than 500 regional and local government authorities. Primary responsibility for impact assessment rests with state governments. However, the Australian federal government holds a constitutional mandate to intervene when a development is determined to be a ‘controlled action’ that may impact on Matters of National Environmental Significance (MNES) under Part 2 of the

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