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A systematic quantitative review of coastal and marine cultural ecosystem services: Current status and future research

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ABSTRACT

Cultural ecosystem services (CES) are the non-material benefits obtained from ecosystems that contribute to human well-being. They are often under-represented in ecosystem services assessments due to difficulties identifying and valuing intangible attributes. This risks a lack of understanding and consideration of CES by decision-makers. A systematic review was done on coastal and marine CES to identify: geographic distribution of research; effective methods for assessing CES; specific habitats/ecosystems that supply CES; subcategories most frequently addressed; and knowledge gaps. Results revealed limited information exists about coastal and marine CES. There is a disparity in the global distribution of studies with little knowledge about CES in developing countries, as well as a disparity within developed countries; with most research undertaken in Europe and North America. There is a dearth of information on CES derived from specific coastal and marine habitats/ecosystems, reflecting a poor understanding of socio-ecological relationships and the different values people assign to these areas. There is a need to develop indicators with the capacity to measure and track changes in CES over time. Participatory approaches using qualitative methods were most effective in identifying CES; however, these lacked a deliberative element that would provide a comprehensive assessment of shared values in public areas. Overall, publications typically theorised about the usefulness of data on CES to inform and support decision makers, and more research is required on how qualitative data on CES can be represented for practical use by coastal and marine resource managers, and the value of these in the real world.

1. Introduction

Anthropogenic activities affect natural ecosystems worldwide and are key drivers of environmental change. Therefore, natural resource management is a socio-ecological system consisting of the interaction and interconnection of four systems: the natural environment, economic, political, and social systems that are interrelated and interdependent, and best understood as relationships between natural resources, its users, and governance systems [34,40]. Natural ecosystems provide goods and services and receive inputs from the economic, political, and social systems [40]. While natural ecosystems provide readily quantifiable economic benefits, they also provide non-material and large unquantifiable benefits to human well-being through experiences and interactions with nature and natural settings that positively affect human physical, mental, and emotional well-being [38,48,57,84]. However, our mainstream model for development (i.e. the Washington Consensus), world economy, dependence on fossil fuels, and consumerism is destroying natural ecosystems on which humans depend [19,56,82]. The non-material benefits are being degraded and/or lost, and in the past two decades humans have changed ecosystems more rapidly and extensively than in any other time period of history [19,54,56].

Following the Millennium Ecosystem Assessment (MEA) in 2005, the ecosystem services approach to natural resource management is now a tool for sustainable development. Ecosystem services are broadly divided into four categories: provisioning (products obtained from ecosystems), regulating (benefits obtained from the regulation of ecosystem processes), supporting (necessary for production of all other ecosystem services), and cultural services (non-material benefits) [54]. Provisioning and regulating ecosystem services are important for human well-being, particularly meeting basic needs, and are easily quantifiable, assessed, and monitored. In contrast, there is limited information and recognition about the benefits cultural ecosystem services

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(CES) contribute to human well-being, particularly in decision making processes [35], because the intangible and subjective nature of CES makes it challenging to assign economic values [17]. Consequently, CES are routinely omitted from ecosystem services assessments or, if included, it is usually in a limited capacity focusing mainly on more easily quantified elements such as recreation and aesthetics [35].

Cultural ecosystem services (CES) are formally defined by the MEA as "…the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences…" and "…that are tightly bound to human values" ([53, pp. 58–59]). They provide intangible physical, emotional, and mental benefits to human well-being, and are valued by a diversity of people and cultures in a variety of ways [34,52]. In developed countries, CES are highly valued by societies for their therapeutic and recreational benefits [67]. In contrast, societies in developing countries value CES more for their cultural identity and survival [54]. Cultural ecosystem services are often under-represented in ecosystem services research and assessments due to difficulties identifying intangible and subjective attributes, and valuing these in monetary terms [16]. Most of what is known about CES is on terrestrial ecosystems, and little is known about coastal and marine ecosystem services [45,47,75].

This lack of knowledge about marine and coastal CES is critical given that approximately 40% of the world's population lives within 100 km of the coast, and 71% of coastal populations live within 50 km of estuaries [55,69]. Coastal population densities are about three times that of inland areas [55] and are expected to increase rapidly in coming years in line with coastward migration and economic growth in these areas [36,51,65]. Increased population densities, together with increased industrial development, shipping, extractive industries, aquaculture, waste disposal, and recreational demands, exerts pressure on coastal and marine habitats and ecosystems [29,39,55,69,76]. Anthropogenic activities are degrading and destroying coastal and marine habitats and ecosystem services vital to human well-being [4,83]. Globally, an estimated 20% of coral reefs, 29% of seagrasses, 35% of mangrove forests, 50% of natural coastal wetlands, and 85% of natural oyster habitat have been destroyed [7,21,55,69,73,78,80]. There is a move towards sustainable management of coastal systems based on an integrated ecosystem services approach, centred on the concept the environment is a socio-ecological system, to help address previous damage and avoid continued degradation [24,33,55,70]. However, trade-offs among the different ecosystem services requires management decisions among competing options to be informed by the multiple values society places on ecosystem services [11,24].

Policy development that includes CES contributions will help provide a balance between economic and non-monetary values of ecosystem services in decision-making processes, and help facilitate sustainable development and resource management that includes more than environmental and monetary values alone [16]. Over-exploitation of coastal resources and industrial development in coastal areas results in the degradation or loss of valuable habitat and numerous ecosystem services, including CES [5,7,20,55,66,81]. For instance, the health of the iconic Australian Great Barrier Reef Marine Park (GBRMP) and World Heritage Area is declining due to rapid and increasing coastal urban development and port expansions to accommodate the exportation of mineral resources [32,76]. This has been attributed in part to lack of independent and transparent decision making [23] that does not consider the full extent of social impacts. An example is the controversial port expansion of Gladstone Harbour, located adjacent to the GBRMP. The port has recently undergone extensive development and expansion, including dredging activities, to facilitate economic growth through coal and liquefied natural gas exportation. Community concerns (especially local users) regarding negative impacts on visual amenity, recreational and commercial fishing sites, mangroves and seagrass, iconic wildlife, Aboriginal cultural activities, as well as human health and well-being were largely ignored in the EIA [20,28,30]. This lack of consideration of CES has resulted in their degradation through damage to the natural attributes of Gladstone Harbour that are highly valued by local users, including: loss of natural beauty; death of wildlife such as turtles, dolphins and dugongs; significant negative impacts on recreational and commercial fisheries through the death and disease of fish; and the loss of seagrass [14,18,20]. There are continued community concerns about the environmental degradation and changes in water quality caused by the industrial activities and development of the port [20]. Hence, knowledge about the total value of ecosystem services, both monetary and non-monetary values, is needed to recognise the intangible benefits CES contribute to human physical and mental well-being.

The aim of this review was to determine the current state of knowledge about coastal and marine CES focusing on the geographic distribution of research undertaken, effective methods appropriate for assessing CES attributes, specific habitats/ecosystems that supply CES in coastal and marine areas, and CES subcategories. This review will provide a synthesis of this knowledge, and identify knowledge gaps that need to be the focus of research to assist management of coastal and marine systems.

2. Methods

A systematic quantitative review was used to determine the extent of coastal and marine CES peer reviewed literature. A literature search of article titles, abstracts and keywords in Science Direct and Scopus databases used search terms listed in Table 1. Terms other than CES were used in this search to capture studies addressing other types of non-material social values derived from coastal and marine ecosystems, but which did not specifically use the term CES. The search was restricted to peer-reviewed journal publications and did not include grey literature, but was not limited to literature published during a fixed period, country, or specific journal. The search of literature published up to December 2014 returned 281 potentially relevant peer-reviewed journal publications that were screened by reading the abstracts to eliminate: duplicates; publications that did not deal with coastal and marine ecosystems; publications solely based on monetary

Table 1
Search terms used in the literature search of the Science Direct and Scopus databases.

Terms used in literature search
• "coastal and marine ecosystems" AND "cultural ecosystem service*"
• "coastal and marine ecosystems" AND "intangible values"
• "coastal and marine ecosystems" AND "non-economic values"
• "coastal and marine ecosystems" AND "non-monetary values"
• "coastal and marine ecosystems" AND "immaterial values"
• "coastal and marine ecosystems" AND "non-material values"
• "coastal and marine ecosystems" AND "social values"
• "coastal and marine ecosystems" AND "cultural values"
• "coastal and marine" AND "cultural ecosystem service*"
• "coastal and marine" AND "intangible values"
• "coastal and marine" AND "non-economic values"
• "coastal and marine" AND "non-monetary values"
• "coastal and marine" AND "immaterial values"
• "coastal and marine" AND "non-material values"
• "coastal and marine" AND "social values"
• "coastal and marine" AND "cultural values"