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Neglected ecosystem services: Highlighting the socio-cultural perception of mangroves in decision-making processes

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ABSTRACT

Despite the increasing recognition of the need to conserve mangroves, degradation has continued during the last two decades due to ineffective and non-inclusive decision-making processes exclusively based on economic factors. The purpose of the present study is to give tools to mangrove conservation management and policy, exploring the sociocultural valuation of the ecosystem services of mangroves through a case study in northeastern Brazil, an area highly impacted by shrimp aquaculture. We used a mix of methods to complement ecosystem services identified in the academic literature with those perceived as such by local people. We analyzed these locally perceived mangrove services in relation to community livelihoods, and highlighted that local people identified four additional cultural services related to maintenance of Traditional Ecological Knowledge (TEK), creation and maintenance of social relationship, personal satisfaction and mental and physical relaxation. This demonstrates that local people have a symbolic relationship with the mangrove forest, which goes beyond the material approach normally used to evaluate ecosystem services. Such findings suggest that the socio-cultural dimension of mangrove services needs to be considered by policy-makers as an indispensable criterion for confronting the key challenges in coastal ecosystems conservation.

1. Introduction

Mangroves are rich, diverse and complex ecosystems formed at the interface between terrestrial, estuarine and marine systems in coastal zones present in the tropical and subtropical regions of 123 countries (Barbier et al., 1997; Spalding et al., 2010). These ecosystems provide at least US $1.6 billion each year in ecosystem services, supporting coastal livelihoods of communities with raw materials and food, coastal protection, soil erosion control, water purification, maintenance of fisheries, and carbon sequestration, as well as recreation, education and research (Constanza et al., 1997; Barbier et al., 2011). They also provide cultural ecosystem services that are "non-material benefits that people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences" (MEA, 2005a).

In spite of the cultural, ecological and economic importance of mangroves and legislation designed to protect these frontier ecosystems worldwide, mangroves are in serious decline. The mangrove ecosystems have been greatly reduced and fragmented over the last decades due to excessive exploitation and development (Giri et al., 2011). In the last twenty years, mangroves have suffered degradation and annual loss of between 0.16 and 0.39% due to rapid coastal development (Hamilton and Casey, 2016). Extensive loss has left degraded and highly fragmented mangroves in many parts of their global distribution (Giri et al., 2011; Hamilton and Casey, 2016) that may have limited potential to deliver services into the future (Barbier et al., 2011; Lee et al., 2014).

It has been estimated that 26% of mangrove forests worldwide have been degraded due to over-exploitation for fuel wood and

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timber production (Valiela et al., 2001). In addition 38% of degraded mangrove areas are estimated to have been transformed by industrial shrimp aquaculture (Ellison, 2008). The shrimp industry is one of the most important sources of mangrove degradation, producing a considerable reduction in the forested area (EJF, 2003; FAO, 2010). Brazil is one of the countries that has been severely affected by the shrimp aquaculture industry, which is the greatest threat to mangrove conservation in this area (Queiroz et al., 2013).

Human society has and will always be faced with the decision of how to manage ecosystems for sustainability. This is also true for the mangrove ecosystem that has often been converted to alternate use, based solely on economic consideration by policymakers (James et al., 2013). One main reason for mangrove deforestation is that wetlands throughout the world are still considered to have little or no value, or even sometimes to have a negative value (Mitsch and Gosselink, 1993). Probably the main problem in this sense is a lack of appreciation of the multiple ecological functions, products and services produced by these coastal wetlands (James et al., 2013). This has been a reason for their subsequent low priority level in decision-making processes resulting in the destruction or substantial modification of the ecosystem (Turner et al., 2000). Researchers who view mangrove management beyond the merely ecological or economic perspective have advocated the use of an ecosystem services framework that introduces the cultural perspective in order to achieve an integrated management of such coastal ecosystem services for human well-being (James et al., 2013; Thiagarajah et al., 2015; Hsieh et al., 2015).

This approach defines cultural ecosystem services as the interactions between environmental spaces (i.e. physical settings such as coasts, woodlands, allotments) and the cultural or recreational practices that take place within them. This places cultural ecosystem services in a geographic or place-based context. In this framework, cultural benefits (in terms of experiences), identities and capabilities are seen to arise from the mutually reinforcing relationships between environmental spaces and cultural practices (Fish et al., 2016). Thus, most of these services operate outside the market system and are integrally linked to the way of life, traditions and other values of the communities (NRC, 2004). Even though the cultural dimensions of well-being are multi-faceted and complex (Russell et al., 2013), many studies highlight the importance of taking into account the cultural benefits of the environment to human well-being in environmental decision making (e.g. Satz et al., 2013; Fish and Church, 2014). In this sense, the concept of cultural ecosystem services offers one powerful way of conveying that natural systems underpin a range of life-enriching and life-affirming benefits to people (Fish and Church, 2014). This approach presents some of the most compelling reasons for ecosystem conservation; these benefits are considered a fundamental component of all current ecosystem services frameworks (Chan et al., 2011). Neglecting the cultural services that ecosystems provide excludes considerations that often matter to vulnerable and otherwise underrepresented communities (Satz et al., 2013). It is thus of fundamental importance to understand how people perceive the mangroves, this being an essential element in making such social-ecological systems sustainable in the long-term perspective (Kittinger et al., 2012; Gould et al., 2014).

Despite their importance, cultural ecosystem services remain poorly understood as they are commonly subjective and have multi-faceted and complex dimensions (Russell et al., 2013). Much of the coastal wetland valuation literature is focused on the economic value, the social and cultural values not being directly ascribable to the ecological or the economic domain (Chiesura and De Groot, 2003). The complexity of the perception of landscape and well-being by the community should be considered in the ecosystem services quantification, even if the (quantitative) tools used are new. A rigorous application of methods to quantify non-economic values of mangroves is still underdeveloped (James et al., 2013; Thiagarajah et al., 2015; Hsieh et al., 2015) and the decision-making process should not neglect the experience of the local population (Raheem et al., 2012).

In this sense, the concept of cultural ecosystem services offers a powerful way of conveying that natural systems underpin a range of life-enriching and benefits for people (Fish and Church, 2014). This approach presents some of the most compelling reasons for ecosystem conservation, being considered a fundamental component of all current ecosystem services frameworks (Chan et al., 2011). However, there is no doubt that this social value of coastal wetlands is seldom captured by policy and decision-making actors (Turner et al., 2000).

The purpose of the present study is to inform mangrove conservation policy by exploring the diversity of values of the ecosystem services provided by mangroves based on sociocultural perceptions. We present our analysis, from a community (bottom-up) perspective, through a case study in the Brazilian community of Cumbe, Ceará. Cumbe's traditional management of mangroves and the direct and extensive dependence of local livelihoods on these ecosystem services make this community an interesting and appropriate case study for the purposes of this research that can be adapted to other coastal communities around the world. To achieve this aim, we: 1) identify, characterize and value the ecosystem services of mangroves based on the existent literature and community perception, and 2) analyze how the ecosystem services of mangroves are embedded into community livelihoods. Our findings contribute to the understanding of mangrove sociocultural perception from an ecosystem service perspective and can provide management and policy tools for mangrove protection.

2. Methods

2.1. Study site description

The study was carried out at the Quilombola community of Cumbe (October to December 2011). Cumbe is located along the shores of the fluvio-marine system of the Jaguaribe River, in the Aracati municipality of the state of Ceará, Brazil (Fig. 1). The Jaguaribe River Basin is the largest in Ceará with an area of 72,645 km^2, occupying 50% of the territory. In the Jaguaribe Basin, 44.2% of the shrimp farms constructed in the Jaguaribe River, interfered directly with the mangrove ecosystem and 63.6% caused serious damage to the riparian forest (carnaubal palms), which is one of the most important ecosystems of NE Brazil primarily for the protection of areas of recharge (Queiroz et al., 2013).

This community has 621 inhabitants, whose livelihoods are directly dependent on mangroves. The main activities are fishing, gathering shellfish and collecting crabs in 'gamboas', these activities are carried out individually or in groups. Due to its geographical location, the community of Cumbe is furthest from the sea and therefore maintains a close relationship with the mangrove and the estuary.

In agreement with previous studies (Queiroz, 2007; Teixeira, 2008) the community of Cumbe has developed a traditional system of natural resources management through a relationship of respect, gratitude and complicity with nature. Cumbe maintains strong economic and symbolic ties with the land and the sea through continuous observation and accumulated knowledge of natural cycles based on fishing and other activities such as handcrafting.

The study followed the guidelines of the code of ethics of the International Society of Ethnobiology and the guidelines of the Ethical committees at both the *Universidade Federal do Ceará* and the *Universitat Auntónoma de Barcelona*.