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An ecosystems perspective for food security in the Caribbean: Seagrass meadows in the Turks and Caicos Islands

Susan Baker [a,b,*], Jessica Paddock [b], Alastair M. Smith [c], Richard K.F. Unsworth [d], Leanne C. Cullen-Unsworth [b], Heidi Hertler [e]

[a] Cardiff School of Social Sciences, Cardiff University, Glamorgan Building, King Edward VII Avenue, CF10 3WA Wales, United Kingdom
[b] Sustainable Places Research Institute, Cardiff University, Wales, United Kingdom
[c] Cardiff School of Planning and Geography, Cardiff University, Wales, United Kingdom
[d] Biosciences, Swansea University, Wales, United Kingdom
[e] The SFS Center for Marine Resource Studies, Turks and Caicos Islands, United Kingdom

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ABSTRACT

Drawing attention to interactions between processes affecting biodiversity loss in marine environments and effects on food security, we draw on research in the Turks and Caicos Islands (TCI), a UK Overseas Territory in the Caribbean. Seagrass meadows provide ecosystem supporting services critical for human wellbeing. They are declining globally due to coastal development, poor land management, and destructive fishing practices. These systems are linked to traditional ways of life with multiple intangible values representing an important cultural resource for coastal communities. Using the lens of food security, we undertake interdisciplinary social–ecological research, to better understand the governance of ecosystem services and the food system in TCI. Research draws on mixed qualitative methods and data gathered via SeagrassWatch, fish surveys and meta-analysis of fish assemblages, revealing anthropogenic stressors exposing TCI to economic and environmental shocks characteristic of small island Caribbean states. We find growing concern regarding the islands' high dependence on food imports, coupled with declining availability of local fish and seafood across socio-economic groups. Weak governance structures put TCI's marine resources under increasing threat, with consequences for food security. We argue for the application of the precautionary principle, suggesting conservation actions through societal participation and stakeholder engagement.

1. Introduction

The Millennium Ecosystem Assessment (MEA) recognises the ecosystem services provided by seagrass beds, namely provisioning services, such as food; regulating services, such as atmospheric and climate regulation, waste processing, flood and storm protection, and erosion control; and cultural services (Orth et al., 2006; SEQ Ecosystem Services Project, 2014). The MEA also recognises food provisioning in the form of fisheries catch as one of the most important services derived from seagrasses (UNEP, 2006). Research in East Africa also confirms a diversity of seagrass related social–ecological links important for the welfare of the local population (de la Torre-Castro and Ronnback, 2004). Seagrass meadows provided fishing grounds for finfish and invertebrates, whilst creating substrate for seaweed cultivation and sites for bait collection. Studies from Indonesia report similar findings (Unsworth et al., 2010). In addition, measures of the economic value of seagrasses place them as one of the world's most financially valuable natural systems (Costanza et al., 1997; Barbier et al., 2011). This value is currently growing given greater understanding of their role in carbon sequestration (Fourqurean et al., 2012), that is, as a regulating service.

Despite such importance, seagrass meadows are being lost at rates possibly equal to or faster than coral reefs and rainforests (Waycott et al., 2009). The location of seagrasses in sheltered waters places them in conflict with human users of the coastal environment, as development and poor land management act as stressors on these ecosystems (Orth et al., 2006), with consequences for human wellbeing (Cullen-Unsworth et al., 2013). Seagrass beds have suffered major losses in the Mediterranean, Florida, and Australia and degradation is expected to accelerate, especially in the Caribbean (UNEP, 2006). Greater understanding of the social, economic and ecological circumstances that lead to such declines are required in order to facilitate effective conservation management, especially given that marine conservation policies often fail to appreciate the

* Corresponding author.
E-mail address: Bakerscm@cardiff.ac.uk (S. Baker).

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role of these habitats in supporting fisheries production (Unsworth and Cullen, 2010).

Effective conservation requires understanding not just the type of stressors currently acting but their historic origins. Past choices, for example about economic development priorities, may create path dependencies that make it difficult to address the cause of environmental deterioration in the contemporary period. Understanding how local people use seagrass resources is needed because communities can act as both a source of environmental degradation and as local environmental champions. In addition, conservation plans have to be followed by implementation efforts. This requires a system of public administration that has the capacity to engage in effective implementation. Devising conservation plans in abstraction from understanding what the administrative system is capable of supporting will lead at best to cynicism, at worst defeatism, about undertaking conversation efforts.

This paper adopts an interdisciplinary approach to address this range of ecological, socio-economic and administrative issues. The lens of food security is used to examine threats to seagrass in the Turks and Caicos Islands (TCI) and how these can be addressed. Our interpretation of 'food security' draws on the United Nations Food and Agricultural Organisation (FAO) understanding that 'Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life' (FAO, 2013). To meet the demands of such a definition, we must look to the systems of employment, procurement and distribution that impact upon the potential to access and afford a healthy diet (Lang and Barling, 2012). Furthermore, the concept also takes account of quality of life and the cultural appropriateness of the foods consumed. The lens of food security thus provides a way to explore the role of seagrass in providing supporting services that help deliver a local food source that is central to a culturally valued way of life for inhabitants of the TCI.

To clarify the links between seagrass, fisheries and food security, the historical interaction between the marine, coastal and terrestrial environment in providing sustenance for the growing human population across the TCI archipelago is first discussed. This focus on the socio-genesis (Harvey and Pilgrim, 2011) of threats to seagrass health particular to this region and is used to explore how interactions between different people at different times and places produce particular problems that, in turn, present specific conservation challenges. Data pertaining to rapid economic development in TCI, as well as qualitative in-depth interviews are used to explore the cultural and material importance of fisheries to the economy and local diet, before attention is paid to stressors that may come to undermine the security of this food source in the near future. The paper then explores the policy significance of findings, identifying conservation strategies to deal more effectively with the relationships between ecosystem services and the food system.

2. Methods

Our study utilises ecological and fisheries data collection as a basis for informing social research analysis. Primary research data was gathered using mixed qualitative research methods during three field trips in 2012–13. This includes 40 interviews with key informants, across all relevant government departments and public offices. Interviews with high ranking public officials were combined with interviews of Heads of governmental departments, local government officials and field officers. Actors from governmental agencies, such as the tourism board, economic development agencies and the Fisheries Advisory Council, were interviewed; as were individuals from key third sector organisations, including the Red Cross and the Reef Fund; the fisheries community (fishing, processing and selling) and food producers; business interest associations, such as the Chamber of Commerce, and private businesses associated with marine activities, such as dive operators and the cruise centre; and local environmental consultants and activists. Interviewees were identified using a snowball sampling method and selected on the basis of comprehensiveness, likely knowledge and accessibility (see Appendix A). We also undertook a four week period of participant observation with local community groups, including the Red Cross and church groups. Furthermore, two workshops involving administrative officials and stakeholder groups were held on main islands. These targeted DEMA Conservation and Scientific Officers, The National Trust as well as Government Departments, including District Commissioners, independent environmental research consultants and local dive operators. Following a training session on the importance of seagrasses for the marine environment, participants were taught seagrass identification, and were introduced to the SeagrassWatch Protocol, which they were supported and encouraged to implement in the course of their in-water activities. Participants were invited on the basis that they were considered well placed to recognise threats to seagrasses and to identify pathways for the promotion of conservation efforts on the ground and over the long term. These challenges and opportunities were explored in break-out group discussions on both Providenciales and South Caicos. Secondary data sources, including grey and policy literature, were employed and included TCI government economic, spatial development and marine conservation plans, and legal documents. Policy documents and official statements from the UK government were also analysed. Ecological data was collected between June and July 2013. Fifteen nearshore shallow water (<2 m) sites across TCI (see Fig. 1) were assessed for their seagrass status using the SeagrassWatch protocol (McKenzie et al., 2000). This examined seagrass percentage cover and key indicators of ecological health (e.g. macro-algae, epiphyte cover). These sites were chosen as representative of meadows throughout TCI, as they contained reef and lagoon meadows. At eight of the sites fish surveys were also conducted to determine the presence of species utilising seagrass. These sites were located around South Caicos and were selected for their accessibility. Surveys used a beach seine net ($2\text{ m} \times 15\text{ m}$), fyke nets (5 m) and Underwater Visual Census along 50 m transects (Edgar et al., 2004; Nagelkerken et al., 2000). Fish surveys were only conducted at the seagrass sites in South Caicos (Lagoon and Reef meadows). The use of multiple methods that incorporated diel sampling enabled a thorough estimate of the fish species present. As all sites in the TCI could not be sampled for their fish assemblages, an additional meta-analysis (Using the Web of Science) was conducted of all fish species utilising seagrass meadows in the Caribbean and Gulf of Mexico. This includes local research papers (Claydon and Kroetz, 2008). Monthly fisheries landing data from the main TCI fin-fish landing (South Caicos) was recorded throughout 2013 by the School for Field Studies as part of their long-term monitoring programme. Data from 2013 was amalgamated and the most abundant species (in terms of weight and absolute numbers) were determined. These abundant species were then examined relative to our seagrass species list to determine habitat support for the fin-fish fisheries.

3. An ecosystems perspective for food security

3.1. Part 1: socio-economic profile of TCI

TCI lie at the south-eastern extremity of the Bahamas Archipelago. They were first re-inhabited by Bermudan 'salt rakers' around 1668, following the decimation of the previous