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Artisanal shark fishing in the Louisiade Archipelago, Papua New Guinea: Socio-economic characteristics and management options

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ABSTRACT

Small-scale shark fisheries in Papua New Guinea have developed rapidly and are largely unmanaged. While shark species are vulnerable to overexploitation, local fishers who depend on shark fin for income also have limited alternative income options. This implies a difficult trade-off for policy makers between conservation and community welfare. A case study of shark fishing activities in the Louisiade Archipelago of the Milne Bay Province, a major small-scale shark fin producing region, is presented to inform such trade-offs. The region has experienced a significant reduction in available income opportunities due to the recent closure of the local sea cucumber fishery in 2009. While it had been widely assumed that shark fin production and income was likely to have escalated in the region to replace lost sea cucumber income, our model of small-scale shark fin production shows that quarterly dried fin production was in fact, on average, 68 kg higher while the sea cucumber fishery operated (holding all else constant). Furthermore, annual shark fin income is estimated to have fallen by 75% following the sea cucumber fishery closure. Falling prices and a decline in market access resulting from the closure of the sea cucumber fishery appear to be the major drivers of the fall in shark fin production. These factors have been accentuated by the geographical isolation of Louisiade communities, high fuel costs and the low economic returns associated with the sale of shark fin (relative to sea cucumber). The influence of market access on shark fin production is also reflected in the modelled increase in shark fin production (119 kg per quarter on average) that occurred with the introduction of a transport boat in the region. Market access is likely to further improve, particularly if the sea cucumber fishery is reopened and/or shark fin prices increase. Therefore, low-cost, community-based management of shark resources based on the allocation of allowable shark catches to ward communities is recommended. Such an approach takes advantage of the communal characteristics of the local island communities as well as the fishery data collection and monitoring mechanisms that are already being used by the local government.

1. Introduction

Shark species are characterised by slow growth rates and low productivity and, as a result, are highly susceptible to overfishing (Hoenig and Gruber, 1990; Stevens et al., 2000; Walker, 1998). They also play a vital role as apex predators in the functioning of marine ecosystems (Ferretti et al., 2010). Despite this, the harvesting of shark resources internationally has been, in general, poorly managed and global shark catches have escalated dramatically (Clarke et al., 2013; Eriksson and Clarke, 2015; Lack and Sant, 2011) and international shark populations have declined as a result (Cortés, 2002). Also, as teleost target species have become less accessible, due to overfishing or catch restrictions, the fishing pressure on sharks has increased (Clarke et al., 2006; Lack and Sant, 2009).

These trends have been driven by the high prices paid for various shark products on Asian markets and in particular shark fin. Escalating prices have been caused by rising incomes and demand in China where the fin ceratotrichia (the elongated collagen fibres of the fin) are used to make shark fin soup, which is considered a prestigious dish in Chinese culture (Cheung and Chang, 2011;

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Fabinyi, 2012; Vannuccini, 1999). High shark fin prices have also led to the practice of "*shark finning*" whereby the fins of the animal are removed and the remainder of the animal is discarded (sometimes alive) given the low market value and low palatability of shark meat relative to other fishery products (Clarke et al., 2006).

International efforts to manage shark fisheries have improved more recently (Fischer et al., 2012). For example, a number of developed countries have adopted National Plans of Action (NPOAs) and have introduced new shark management measures (Fischer et al., 2012). A number of shark species are also now subject to trade restrictions under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Clarke et al., 2013; Dulvy et al., 2008) and more are likely to be listed. However, in developing countries efforts to better manage shark catches have generally not kept pace with these changes (Fischer et al., 2012). Limited government resources, substantial fishing territories, low political-will and the low value of shark relative to other fisheries are all explanatory factors. Papua New Guinea (PNG) provides an interesting example of a shark harvesting country that has such characteristics. Although FAO statistics suggest that PNG's shark harvests are low by international standards, exploration of official data indicate harvests are likely to be heavily underestimated (Vieira and Yaman, 2015). Although it is difficult to accurately quantify the changes in shark landings nationally, it is generally accepted that shark fishing activities in the country have dramatically escalated over the last two to three decades (Vieira and Yaman, 2015; Teh et al., 2014).

Shark fishing in PNG can be categorised into activities that occur in the large-scale sector, which includes a managed shark longline fishery as well as other managed large-scale fisheries where shark is taken as bycatch (Kumoru, 2003; Opu, 2007), and activities that occur in the small-scale sector. Small-scale activities include artisanal, localised fishing activities that use small vessels and relatively less developed technology and fishing gear. While information and management on shark fishing in the large scale-sector is relatively well established (Kumoru, 2003), PNG's small-scale shark fisheries are largely unmanaged and not well understood.

The available information that does exist on small-scale shark fishing activities in PNG suggests that the Milne Bay Province, which is located off the south-eastern tip of the PNG mainland, has been a focal point for such fishing activity in PNG. Recent evidence (Foale, 2006; Sabetian and Foale, 2006; Kinch, 1999) and available data indicates increasing and potentially unsustainable levels of shark fishing activity in the region. These trends are concerning not only due to the important ecological role played by shark stocks but also the international significance of the Milne Bay Province region. Its waters form part of the Coral Triangle and include one of the most diverse assemblages of coral reef fishes in the Triangle (Allen et al., 2003).

While some government intervention would likely be required to prevent these trends continuing, such action is complicated by the socio-economic vulnerability of Milne Bay island communities. Isolation, low land availability and minimal infrastructure and services all contribute to a lack of food, employment and income opportunities in many areas (Kinch, 1999, 2001, 2007; Foale, 2006). More recently, natural disasters (including cyclones and drought) and rapid population growth has made local socio-economic circumstances even more difficult. For all these reasons as well as the close proximity of communities to the marine environment, socio-economic dependence on marine resources is typically significant.

The socio-economic situation of most island communities in the area is also likely to have deteriorated in recent years following the national closure of the sea cucumber fishery in 2009 (Pomat, 2012). This fishery provided large injections of cash into island communities via the processing of sea cucumber to produce and trade beche-de-mer[1] (Foale, 2006; Kinch, 2002, 2004; Kinch et al., 2008) so the socio-economic consequences of its closure were likely to be severe. Dependence on other sources of income including shark fin is likely to have increased as a result.

Given the high levels of shark fishing in the Milne Bay Province, the vulnerability of shark stocks to overfishing and the socio-economic circumstances of the Province's island communities, there is a need for better informed management of shark fishing in the region. The current study attempts to partly address this need by providing a socio-economic evaluation of shark fishing activities in the Louisiade Rural LLG of the Milne Bay Province based on data collected during a field survey conducted in 2014. Socio-economic information and data were collected including information on fishery characteristics, management arrangements, marine commodity prices and sales, livelihood characteristics and the views and attitudes of fishery stakeholders were collected. Data on marine product sales collected by the National Fishery Authority (NFA), the agency responsible for the management of PNG's fisheries were also analysed. Using this information, the drivers of shark fishing activity and the financial dependence on shark relative to other marine commodities is evaluated for the 2007 to 2014 period to assess the changing socio-economic role of shark fishing activities pre- and post-sea cucumber moratorium. The results and observations are drawn on to discuss and highlight potential fishery management approaches to improve the status of shark fisheries in the region.

The paper provides a snapshot of the recent socio-economic situation of a relatively under-researched region of Papua New Guinea. It is the first paper to explore the interactions and relationships between marine resource based livelihoods in the area and generates an unexpected result: rather than increasing to replace lost sea cucumber based income, shark fin production has in fact declined. This finding sheds light on the importance of market access in the region and how capricious it can be. Finally, the paper also makes novel suggestions for the management of shark resources in the region that take advantage of current management processes, governance frameworks and social characteristics in the region. These suggestions could also be applied to other key marine resources in the region, including sea cucumber.

2. Background

2.1. Physical and socio-economic characteristics

The province of Milne Bay is located on the southeastern tip of the PNG mainland (Fig. 1). It includes a small part of the PNG mainland where Alotau, the provincial capital is found. The province is divided into four districts and sixteen local level government areas (LLGs). Field research focused on the Louisiade Rural LLG which is one of four LLGs in the Samarai-Murua District. It comprises the western part of the Louisiade Archipelago which extends from the PNG mainland in an east-southeasterly direction. Major islands and island groups within the Louisiade Rural LLG include Misima Island (which includes the district capital of Bwagoia), the West Calvados Chain which includes Brooker Island (also known as Utian), Motorina and Bagaman Islands; the Deboyne Island group which includes Panaeati, Panapompom and Nivani Islands; Jomard Island and the Duchateau Island Group; and Kimuta. The Louisiade Rural LLG is divided into thirty two wards, twenty three of which

[1] As used here, the term '*sea cucumber*' refers to the harvested animal while '*beche-de-mer*' refers to the traded product that is produced from harvested sea cucumber.