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Food, money and lobsters: Valuing ecosystem services to align environmental management with Sustainable Development Goals

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ABSTRACT

With over 1 billion people currently relying on the services provided by marine ecosystems – e.g. food, fibre and coastal protection – governments, scientists and international bodies are searching for innovative research to support decision-makers in achieving the Sustainable Development Goals (SDGs). Valuing past and present ecosystem services allows investigation into how different scenarios impact the SDGs, such as economic growth, sustainability, poverty and equity among stakeholders. This paper investigates the past and current value of the lobster fishery located in the Table Mountain National Park Marine Protected Area. It then uses InVEST to highlight future changes under different scenarios. While we found a significant decline in fishery value over the next ten years under all three scenarios, the exclusion of large-scale fisheries from the marine protected area seems to yield the most positive results in regard to South Africa's SDG commitments. This scenario has the potential to generate approximately 50% more revenue, while also producing the highest available protein to local communities, highest quantity of spawners and highest economic distribution to small-scale fisheries. It is clear through this research that valuing ecosystem services can enable a future of healthy economies, people and environments; the highly sought-after triple-bottom line.

1. Introduction

The ocean provides invaluable services including nutrition, regulation of our climate, protection to our coastlines and absorption of our pollution (Hoegh-Guldberg et al., 2015). The vastness of this blue economy once gave the impression of limitless services, but years of overexploitation and broad-scale pollution has come at the cost of habitat degradation and loss of ecosystem function (Arkema et al., 2015). This limits the ability of marine ecosystems to continue to provide these critical services for human survival (MEA, 2005; Rockstrom et al., 2009; UNEP, 2015; Arkema et al., 2015; Hoegh-Guldberg et al., 2015; de Groot et al., 2012). As the global human population grows to a predicted 9 billion by 2050, so does the pressure on oceans to provide vital ecosystem services such as food, climate regulation and storm protection (Godfrey et al., 2010; Maseyk et al., 2016). There are currently 1 billion people directly relying on nutrition derived from oceans (Hoegh-Guldberg et al., 2015; The World Bank, 2012). This number is predicted to steadily increase, particularly in developing countries such as the Republic of South Africa, where inequalities and food insecurity are more prevalent (Hoegh-Guldberg et al., 2015; The World Bank, 2012; Charles et al., 2010). Even though South Africa has seen economic and political advances in the post-Apartheid era, the country remains plagued with inequalities, a stagnant economy and elevated rates of poverty (Labadarios et al., 2011). Following the UN-backed Sustainable Development Goals (SDGs), South Africa has pledged to grow the economy, encourage environmental sustainability, eradicate poverty and reduce fisheries inequality by 2030 (FAO, 2014). In order to reach these SDGs, decision-makers require innovative research that highlights future changes impacting the success of these goals (Arkema et al., 2015; UN, 2016). With 3 billion people currently depending on marine ecosystem services for their livelihoods (Hoegh-Guldberg et al., 2015), the need for SDG-focused ocean research is urgent.

Valuing ecosystem services is one research approach to sustainable ocean management that has gained popularity in recent

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years (Costanza et al., 1997; Millennium Ecosystem Assessment, 2005; de Groot et al., 2012). Ecosystem services are defined as the benefits provided to humans from ecosystems (Costanza et al., 1997; Millennium Ecosystem Assessment, 2005). These services can be divided into four interlinking categories: provisioning, supporting, regulating and cultural services (Silvestri and Kershaw, 2010; Millenium Ecosystem Assessment, 2005). All life on this planet fundamentally depends on the flow of these services for survival, however humans are currently overusing the natural capital (i.e. the world's stock of natural materials or assets), resulting in a demand of more than 1.51 planets' worth of resources (Ewing et al., 2010; Costanza et al., 1997).

Valuing ecosystem services helps decision-makers incorporate environmental, social and economic concerns into policy and management (Daily et al., 2009). With approximately 2 billion people living in poverty, an economic strategy that disregards natural capital comes at the expense of the planet and, therefore, our own long-term future (Guerry et al., 2015). By integrating natural capital into economic valuations, decision-makers can use a common metric for both the tangible and intangible benefits resulting from different management scenarios. Some valuation techniques, such as the Integrated Valuation of Ecosystem Services and Trade-offs (InVEST) approach, allows users to model spatially explicit outcomes of future scenarios based on ecological production and anthropogenic pressures (Nelson et al., 2009; Arkema et al., 2015). By valuing the future services provided by nature, decision-makers are able to connect the direct benefits, synergies and trade-offs associated with different management decisions. These benefits, synergies and trade-offs may include changes in equality, poverty, environmental sustainability and economic growth. With these futures mapped out, decision-makers are able to make informed, robust decisions to ensure SDGs are met.

For the past 120,000 years, Cape Town's marine ecosystems have played an important, supportive role to human life (Branch, 2000). This culturally significant natural resource has allowed tribes and communities to flourish through fishing, trading and spiritual connections (Branch, 2000). Today, there are over 3.74 million people living along Cape Town's coastline, benefiting from the cultural, provisioning, regulating and supporting services the coastal zone provides (Department of Environmental Affairs and Tourism, 2005). Fisheries contribute an estimated $332.5 million (R2.4 billion) to South Africa's national economy, yet ironically, this industry threatens the very ecosystems that support it (South African Maritime Safety, 2015; Fisheries and Aquaculture Organization of the United Nations, 2008).

Here we develop a method for assessing future scenarios of environmental management change that improve coastal ecosystem services and thereby, support the success of the SDGs. We illustrate application of the method using a case study of South Africa's West Coast Rock Lobster fishery within the Table Mountain National Park (TMNP) Marine Protected Area. The aim of this research is to (i) determine how rapidly ecosystem service values can change under different environmental management scenarios and (ii) determine how ecosystem service valuations can be used to highlight social, environmental and economic changes that impact the success of the SDGs. To accomplish these aims, the paper first uses existing data to provide insight into the value of the fishery during the 1950s, when exploitation peaked (Johnston and Butterworth 2005). It will then capture the value of the fishery before the study area transitioned into a Marine Protected Area (i.e. pre-2004). The paper then analyses the current value of the West Coast Rock Lobster fishery, before finally providing an evaluation of three possible future scenarios with respect to economic value, distribution of value to all stakeholders, sustainability of the fishery and nutritional distribution. The past and current values are calculated using published and unpublished data, while the future scenarios are derived using the InVEST model. To our knowledge, this study is the first to analyse how the SDGs can be impacted based on historic, current and future values of an ecosystem service.

2. Methods

We calculated the retrospective and current value of the West Coast Rock Lobster fishery using published and unpublished data from various sources and combined the market worth of landed lobster from recreational fishers, small-scale fisheries (SSF), large-scale fisheries (LSF) and poachers. Then using the InVEST tool, we combined data to build scenarios that describe possible futures for the West Coast Rock Lobster fishery (see Table 1). The first scenario, entitled 'Business as Usual' (BAU), takes the current situation and most up-to-date data to model the future if harvest continues at the existing rate. The second scenario is entitled 'Redirect the Poachers' (RP), which attempts to model implementation of strict management, whereby poaching is minimised from the Marine Protected Area and other economic and nutritional sources are made available through government initiatives. The third scenario, entitled 'Large Scale Cutbacks' (LSC), excludes large-scale fisheries from harvesting West Coast Rock Lobster within the TMNP Marine Protected Area. These scenarios are not forecasts, absolute bounds or policy prescriptive.

Table 1
Overview of the future scenarios, timeframes, descriptions and justifications.

Scenario	Timeframe	Description	Justification
Business as Usual (BAU)	100 years	- Harvest continues at the existing 9% rate	The BAU scenario represents the baseline scenario if current policies continue into the future. This is similar to a 'do nothing' pathway
Redirect the Poachers (RP)	100 years	- Stricter law enforcement and MPA management, thus resulting in minimal poaching- Poachers are provided other economic and nutritional sources through government initiatives (fishing charters, ocean safaris, wildlife charters, seal snorkelling, boating expeditions, etc.) - Harvest percentages from small-scale, recreational and large-scale fisheries continue at the same rate	The RP scenario addresses the common issue of poaching within South Africa. More recently, studies have shown a dramatic increase of poaching within the TMNP Marine Protected Area (Brill and Raemaekers, 2013)
Large Scale Cutbacks (LSC)	100 years	- Excludes large-scale lobster fishing from within the MPA - Harvest rate of 2% from small-scale, poachers and recreational fisheries continue at the same rate - In some analyses, we explore the option of increasing to a 9% harvest rate	This pathway places greater emphasis on the socio-economic needs of the small-scale fisheries. More recently, small-scale fishing communities have begun to legally push for their constitutional right to restoring dignity and redress for past injustices (Constitution of South Africa, 1996)