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Blue Growth and the relationship between ecosystem services and human activities: The Salento artisanal fisheries case study

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ABSTRACT

This paper proposes a tool for the management of marine and coastal areas based on the ecosystem service framework and the Bayesian network approach. The participative methodology used makes this tool very suitable for addressing issues related to community-led coastal development and Blue Growth. The Salento (Italy) artisanal fisheries case study is used to test the usefulness of our approach. Salento is characterized by declining fisheries and increasing tourism development. Cause–effect relationships between human activities and ecosystem services are modeled to show the differences in stakeholder behavior under different scenarios. Results indicate that increasing tourist flow and related infrastructure are not perceived as threats to the local ecosystem equilibrium, but the problem of water quality should be carefully considered to prevent future negative feedback. The model can be used as a methodological guide by local public authorities as well as economic and civil society groups. It may be particularly useful for the Fisheries Local Action Groups, which have been explicitly created to design and implement bottom-up strategies that fit their regions' needs to increase economic, social, and environmental welfare.

1. Introduction

Marine and coastal ecosystems support numerous economic activities. This is strongly related to the recently proposed concept of “Blue Growth,” which is defined by the European Union (Communication from the Commission 13.09.2012) as the maritime contribution to achieving the EU goal of sustainable growth. Seas and oceans are considered, in other words, as drivers for the economy. Blue Growth includes all the economic sectors related to seas and coastal areas including tourism, shipping, fishing, mining, and biotechnology, among others. All these sectors are valued, according to the EU approach, considering their contribution to gross value added (GVA) and employment. Emphasis is on the growth of all sectors as a whole, rather than on the maximization of only one sector's objectives. Furthermore, to achieve positive long-term results, economic activities and ecosystem potential must be in equilibrium.

According to the EU's definition and previous examples, not all Blue Growth activities (e.g., shipping and mining) are supported by ecosystems, but many others are, especially fisheries, aquaculture, tourism, and biotechnology. However, even if they are not directly supported by the ecosystem, all Blue Growth components may nonetheless affect the stock and quality of ecosystem resources. This, in the long run, can affect the activity of stakeholders that use these resources (e.g., fishers), causing changes in behavior and diversification of income-producing activities.

Under this context, the ecosystem service approach seems to be the most suitable way to show the connection between costal/maritime human activities and the environment, and consequently, it is an effective methodological framework to analyze Blue Growth.

This paper applies an analytical framework based on the ecosystem service literature (Boyd and Banzhaf, 2007; Fisher et al., 2008; Haines-Young and Potschin, 2009a; Potschin and Haines-Young, 2011; TEEB, 2010). The framework is first presented from a theoretical perspective and then adapted for a Bayesian network application. In the case of aquatic, marine, and coastal ecosystems, Bayesian networks have been used for several different objectives, such as predicting natural events (Johnson et al., 2010), assessing climate change adaptation (Richards et al., 2016), modeling species

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interactions (Stafford et al., 2016, 2015), evaluating fish population viability (Marcot et al., 2001), managing potential conflicts (Tiller et al., 2013), and supporting marine planning (Stelzenmüller et al., 2010).

Further, the Bayesian network was developed to create a qualitative model that could be used to simulate the main socio-ecological relationships of coastal and marine areas, and to show the likely changes under different scenarios. In particular, we want to focus on the environmental changes caused by human activities and the manner in which these environmental changes, in turn, affect the outcomes and behavior of other stakeholders.

We examine these relationships in Southeast Italy (Salento, Apulian peninsula), where artisanal fisheries and tourism are closely connected. However, while fisheries are currently declining due to the overexploitation of fish stocks, tourism is developing rapidly. Given the specific characteristics of this area, the study mainly focuses on the behavior of artisanal fishers and on the possibilities of economic diversification provided by the natural environment.

The model can be useful as a management tool, in order to understand the cause–effect relationships between economic activities and ecosystem services, and can be applied by both public authorities and local associations to manage bottom-up development initiatives. The participation of stakeholders, including managers of local institutions (public, economic, and civil society), was crucial for building the model, and this participative approach should be a further aid to increase the management capacities of the population.

2. Material and methods

2.1. Description of the study area

The Salento region (corresponding with the Province of Lecce) is located at the southeastern tip of the Apulian Peninsula (Fig. 1). It has approximately 807 000 inhabitants, of which 309 000 (38%) are located in coastal municipalities. Excluding the coastal municipality of Lecce (93 000 inhabitants), the remaining population lives in towns and villages with fewer than 30 000 inhabitants (ISTAT, 2013).

Fisheries and tourism are the most iconic activities of the coastal area. In the Apulia region as a whole, fisheries and aquaculture account for 0.4% of the total gross value added, while the share of restaurant and hotel services is about ten times larger. Tourist arrivals registered an 80% increase between 2002 and 2009, followed by a more moderate 7% increase between 2009 and 2013 (ISTAT, 2013).

There are approximately 428 vessels operating in the Salento area, of which 334 use passive gears and 94 use towed gears. Vessels smaller than 12 m using passive gear, which are usually classified as artisanal vessels, number 313, or 73% of the fleet. In addition to these, about 30 vessels are used for diving fisheries. There was an 11% drop in the number of artisanal vessels from 2004 to 2015 (Community Fishing Fleet Register, 2015).

Catch statistics for the Apulia Region as a whole show that in the last nine years (2004–2013), catches have decreased by 46% (by 56% for artisanal fisheries), revenue has decreased by 19% (by 46% for artisanal fisheries), and catches per vessel have decreased by 30% (by 51% for artisanal fisheries) (IREPA-NISEA, n.d.).

In the recent past, Salento's cooperatives of artisanal fishers have implemented voluntary management initiatives (such as rest periods) to decrease the impact on fish resources and have initiated testing activities to improve the selectivity of fishing gears. At present, all the cooperatives have together established a coordination body that will prepare a local management plan.

In the Salento area, we find two Fisheries Local Action Groups (FLAGs), which are institutional partnerships between fishery actors and other local public/private/environmental/NGO stakeholders. These FLAGs are promoted by the European Fisheries Fund to foster bottom-up coastal development projects (e.g., direct sale, pesca-tourism, and environmental protection). Salento is also characterized by the presence of a small Marine Protected Area[1] and several inland protected areas.

2.2. The ecosystem service framework

After the Millennium Ecosystem Assessment (Millenium Ecosystem Assessment, 2005), several ecosystem services frameworks have been developed (e.g., Tallis et al., 2008; Haines-Young and Potschin, 2009b; Wainger and Mazzotta, 2011; Salles, 2011; Plieninger et al., 2012). One of the most successful is probably the ecosystem service cascade first designed by Haines-Young and Potschin (Haines-Young and Potschin, 2009a; Haines-Young, 2011), which describes ecosystem services as nature's free gifts that linearly flow from biophysical structures and processes to human populations. Most of the latest cascade versions accept the idea that ecosystem services must be distinguished as either final or intermediate (Boyd and Banzhaf, 2007). Final ecosystem services are defined as the components of nature directly enjoyed, consumed, or used to yield human well-being. Intermediate services have been referred to under different terms, such as structures, processes, or functions (Haines-Young and Potschin, 2009a; Spangenberg et al., 2014), where structures (natural ecosystems) are generally seen as assets able to produce a flow of beneficial services over time (Barbier, 2007). Furthermore, it is also widely accepted that final ecosystem services are used to produce benefits (Boyd and Banzhaf, 2007; Fisher et al., 2008; Haines-Young and Potschin, 2009a; Potschin and Haines-Young, 2011; TEEB, 2010), and that such benefits are the result of some human intervention, such as investments of labor, time, resources, or money. In marine and coastal environments, these human interventions can be defined as Blue Growth activities. Finally, benefits are normally seen as physical outputs (goods or services) to which a monetary value can be attributed (Potschin and Haines-Young, 2011; TEEB, 2010). However, here an important difference between the Blue Growth approach and the ecosystem service approach does exist. In fact, in the EU Blue Growth approach, only market activities are valued (using GVA). On the contrary, in the ecosystem service approach, the Total Economic Value is normally considered, including the value of services provided by the environment that have not a market (e.g. bathing, recreational fishing, scuba diving, but also non-use values such as in the case of biodiversity conservation).

We propose a theoretical framework (Fig. 2) which combines the key steps of the classic ecosystem service cascade with a second cascade that includes the major drivers of change, degradation, or loss of marine and coastal ecosystems (UNEP, 2006). In the cascade, we employ the terms *intermediate services*, *final ecosystem services*, and *benefits*, which are the result of a human activity. The level of benefits supply, clearly depends on several entrepreneurial choices. Furthermore, the value of the benefits depends both on the level of supply and on the level of demand (linked to consumer preferences), where entrepreneurs (e.g., fishers) clearly try to maximize their utility (i.e., the net value of the benefit).

We follow UNEP (2006) for identifying the direct and indirect drivers of change of marine and coastal ecosystems. With indirect drivers, we mainly refer to large-scale (national/regional/global) sociopolitical, demographic, economic, scientific, and technological

[1] The Porto Cesareo MPA, with a sea surface area of 16.654 ha.