Fisheries, tourism, and marine protected areas: Conflicting or synergistic interactions?

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Abstract

Most coastal degradation has been caused by anthropogenic actions, threatening the ecosystem services (ESs) humans depend on. Marine protected areas are a solution to protect ESs, such as fish stocks, although this could potentially lead to conflicts with fisheries and tourism. We investigated how fisheries and tourism in the SE Brazil interact with conservation, evaluating their potential for synergistic interactions. We sampled fish landings (n=823) in two villages and performed interviews with fishers and middlemen regarding fisheries and tourism, besides using secondary information regarding the MPA effectiveness. Fish production was high outside the MPA (9.25 t/day), and could be profitable, resulting in reduced fishing pressure, but a faulty market chain prevents this. Fishers involved with coastal tourism had better incomes than those who engaged in only fisheries. Tourism in permitted areas outside the MPA could benefit both fisheries and biodiversity conservation by reducing the time fishers allocate to fishing and by attracting visitors for wildlife viewing. Nonconflicting uses of ESs can be achieved by assuring that the local poor population benefits from more than one ES in a sustainable way, but that requires alternatives such as adding value to ESs and paying for environmental services.

Keywords: Marine protected areas, Small-scale fisheries, Resource use, Tourism, Paraty

1. Introduction

1.1. Ecosystem services in tropical developing countries

Since the rise of awareness about habitat loss and species extinction, a great deal of scientific effort has focused on maintaining the remaining biodiversity. For researchers, it was important to assure that nature would follow, as much as possible, its natural course (Mitra, 1982; Tallis et al., 2008). While this approach has led to important conservation initiatives, such as the designation of species conservation targets or the establishment of protected areas, it overlooked the dependency humans have on ecosystems and the help people can provide for conservation (Sheil and Lawrence, 2004).

Ecosystems provide people with direct and indirect goods and services, such as crop pollination, water and air filtering and purification, waste treatment, fish, game, and many others. Life, as we know it, would not be possible without these services (Costanza et al., 1997).

Humans, in fact, depend on several kinds of ecosystem services (ESs). Although there are multiple definitions for ESs, most of them agree to some degree that these services represent functions, products, or processes provided by nature that humans use for their well-being (Fisher et al., 2009). The renewed interest in researching and developing the appropriate use of these services resulted in the publication of the millennium ecosystem assessment (MEA, 2005). Since then, multiple studies have tried to better identify, contextualize, quantify, value (Brenner et al., 2010), and assess changes in ESs (Brenner et al., 2010; Fisher et al., 2009).

The rural poor usually have a stronger and more direct dependency on nature and their ESs, especially those related to food security (Daw et al., 2011; Fisher et al., 2014). However, by no means does such intense dependency, by rich or poor, imply the appropriate use of these services. In fact, conflicting, intense, and misguided use threatens the maintenance of such goods and services; the MEA pointed out that 15 of the 24 services investigated were in decline with likely negative consequences for human welfare (MEA, 2005).

Most of the poor around the world live in areas of high biodiversity and threatened ecosystems, so-called hotspots (Fisher and Christopher, 2007), which are mostly in the tropics or in the...
subtropics. This suggests that ESs in hotspots are mainly used directly in the form of timber, coal, game, fish, and food extraction in general. This type of use, if carried out intensively, could threaten not only the replenishment rate of such products, but also other services provided by the ecosystem, such as carbon sequestration and water purification, among others (Barbier et al., 2010). Hence, the dependence of some poor tropical countries on direct-use ESs could represent a trade-off for the maintenance of other services and of the biodiversity (Tallis et al., 2008). Finding alternatives to solve these conflicts without impairing the livelihoods of the poor is an important goal to pursue.

The ecosystem-based management (EBM) approach could be one of the first steps to maintain ESs and decrease conflicts over their multiple uses, in case overexploitation is identified. EBM implies integrated management that encompasses the whole ecosystem, including humans, in such a way that the ESs are provided in a healthy and resilient way (McLeod et al., 2009). This approach promotes the long-term maintenance of ESs rather than the typical maximization of goals (Rosenberg and McLeod, 2005), implying that at least initially people have to reduce their resource exploitation rate or even stop exploiting some direct ecosystem services until they recover. However, only slowing down exploitation may not be an alternative for people who face resource shortages (Scherl, 2004), a situation that sometimes requires compensatory mechanisms. One such mechanism that has been widely proposed is the use of payment for environmental services (PES) (Begossi et al., 2011), where the ones in charge of maintaining the maintenance of these services are paid by people (or the overall society) who benefit from these services (Engel et al., 2008). Other alternatives include adding value to the market chain (Hallwass et al., 2014) or diversifying the economy with activities such as community-based tourism (Okazaki, 2008), which can be highly prized in places with tropical beaches, reefs, and forests.

In this study we aimed to investigate potential synergistic or antagonistic interactions between direct-use (fish), indirect-use (tourism) ESs and marine conservation. For that purpose, we drew on a case study from the Brazilian coast. We also investigated how synergistic or antagonistic interactions among distinct services are influenced by management decisions regarding conservation and by the distinct use made by poor people of these ESs.

1.2. A case study of Brazil’s Green Coast: Tourism, fisheries, and biodiversity conservation

The state of Rio de Janeiro is part of Brazil’s so-called Green Coast (Costa Verde). Specifically, the area encompassed by Ilha Grande Bay (mainly the municipalities of Paraty and Angra dos Reis) (Fig. 1) has great tourism potential, given its multitude of islands and islets and the lush Atlantic Forest with its multiple rivers flowing into the calm and relatively clear waters of the ocean (Wunder, 2003). For the same reasons, the area is important for biodiversity conservation (with multiple parks protecting large areas) and for fisheries, both subsistence and commercial (Begossi et al., 2010; Lopes et al., 2013a, 2013b).

Although there are no clear conflicts between tourism and fisheries in the Green Coast region, the different segments of the fishery industry have undergone conflicts over fishing spots for decades. In some nearby areas, small-scale fishers have disputed space with shrimp trawlers, while in others commercial fishers have violated minimum distances from the coast, invading spots traditionally used by small-scale fishers from various islands and villages (Begossi, 1995). Some of these conflicts have recently gotten the attention of the government through the Ministry of Fisheries and Aquaculture, which has been helping fishers to establish fishery agreements in which boundaries, allowable equipment, and other rules can be decided in a participatory way as long as fishers respect federal laws (Begossi et al., 2011). However, such an agreement would have limited effectiveness because a local no-take marine protected area (MPA) (Tamoios Ecological Station) forbids fishing around 29 islands in the region, thus reducing the area traditionally used by small-scale fishers. At the same time, the MPA also limits tourism since diving and anchoring are not allowed around these 29 islands or in their 1 km buffer zones.

Even though it was established in 1990, this MPA did not give rise to conflicts until 2006, when the restrictions started being enforced (Lopes et al., 2013a). To decrease conflicts, the MPA managers proposed a commitment term that grants permission for small-scale fishers to fish around some of the now protected islands, based on individual agreements between fishers and the managers of the MPA (Trimble et al., 2014). One of the proposals is the deployment of anchoring buoys that may be used by any boat in case of bad weather as long as they inform the MPA office by phone or radio about their anchorage. These adjustments are provisional and still under discussion, but if done in a participatory way they could, for example, lead to changing the status of the MPA (or parts of it) from a no-take to an extractive reserve.

Agreements of this type have the potential to reduce the main conflicts over the anchoring limitations and the prohibition of fishing close to fishers' homes. Fishers that take part in the agreement are also expected to watch over the area, which could increase enforcement and compliance in a more legitimate way, decreasing the alleged antagonism of the police toward the fishers. If the users of the bay can reach a no-conflict situation, benefits are expected for fisheries and possibly even for biodiversity conservation through increased compliance on the part of the fishers (Karper and Lopes, 2014).

Despite its huge potential, the development of tourism has not been taken into consideration by the managers of the MPA. Undeterred by the prohibitions, professional companies in the bay have been conducting tours whether a particular island is protected or not. These trips usually take tourists on day trips to islands and coastal beaches. Dive companies also take tourists to specific diving spots, some of which overlap with fishing grounds. Tourist operators are ill prepared to explain the biodiversity of the coastal and terrestrial ecosystems, and they usually do not mention the nearby MPA in their trips even though an effective MPA would be expected to increase the abundance of fish in its surroundings, making diving sites more attractive.

2. Data collection

Over a four-year period (2010–2013), we recorded data on fish, fisheries, the fish market chain, general livelihood aspects, and tourism in Paraty Bay, a smaller bay in the larger Ilha Grande Bay (Begossi et al., 2012; Lopes et al., 2013a, 2013b). Most of our sampling effort was concentrated in two villages, Trindade and Praia Grande. The latter also included a nearby island community, Araújo, since Praia Grande serves as its main port, but its data were treated together with Praia Grande. The villages of Trindade and Praia Grande differ regarding their potential for fisheries and tourism. Trindade became famous in the 1960s, and since then has been recognized mostly for its alternative development with pristine ocean beaches, waterfalls, natural pools, and forest trails. Praia Grande is a more central beach, secluded by islands, closer to Paraty, and more subjected to traditional development and tourism. The fact that Trindade faces the open water whereas Praia Grande is on a bay surrounded by islands affects the type of fishing practiced in these villages as well (Begossi et al., 2012; Lopes et al., 2013b).
In both places, we sampled fish landings (n = 273 in Trindade; n = 400 in Praia Grande) in 2010 and 2011 during three to four days in each for 23 and 24 months, respectively, and performed interviews with fishers regarding tourism in 2013. For the fish landings, we approached fishers upon their arrival and interviewed them about their fishing spot and the duration of their fishing and then identified and weighed the catch. For the tourism approach, we gathered data on activities fishers perform that are directly or indirectly related to tourism (e.g., being captain of a day-trip boat or owning a small grocery store that specifically caters to tourists). Most of these activities were related to having rental houses, camping sites, restaurants, and bars; renting fishing boats or boats to take people to other beaches and islands; and/or working as boat captains for tourists. Twenty-seven fishers took part in these tourism interviews in Trindade, and 24 in Praia Grande, representing 45% and 30% of the estimated number of fishers in each village, respectively (Begossi et al., 2010).

For the market chain study, we visited four fish markets (one in Praia Grande and three in downtown Paraty), once in the summer and once in the winter during 2011 and 2013, to collect information on fish price (final price to the consumer of what was being sold), the origin of the fish, and its freshness. The chosen fish markets were the most representative ones in terms of volume of fish commercialized. The one in Praia Grande concentrates the sales from Araújo, Praia Grande itself and some nearby villages, and the ones in Paraty get fish from all villages in the town.

3. Results and discussion

3.1. Fish and tourism as services that maintain livelihoods

In Trindade and Praia Grande, most fishers benefit simultaneously from both of the two main types of ESs provided: fish stocks and tourism (Trindade = 81.5% of 27; Praia Grande = 75% of 24). According to the values provided by the fishers, both fisheries and tourism produce a higher average income in Trindade than in Praia Grande (Table 1).

Considering the values provided by the fishers, the two villages differed regarding the income fishers make from tourism, fisheries, and both activities together (F = 4.80; p = 0.031; df = 1): Trindade showed higher incomes from tourism (Fig. 2). For the two villages, the average income per activity was also different (F = 11.76; p = 0.0001; df = 2); income from fisheries was lower than that generated by tourism (Tukey a posteriori: p = 0.0001). There was no correlation between village and type of income (Fig. 2).

By extrapolating the values provided by the interviewed fishers on their sources of income to the remaining non-interviewed fishers (maintaining the percentage of participation in one or both activities), we estimated how much fisheries alone could be generating in both villages: Trindade, with a total of 60 fishers, and Praia Grande, with a total of 80 fishers. Due to the differences in number of fishers, Praia Grande would be generating a higher
general income both from fisheries and tourism, when the latter is also practiced by fishers (Table 1). This estimate does not take into account those people dedicated to tourism only.

To get a more accurate estimate of revenue coming from fish as an ecosystem service, we considered all the species present in the fish landings to which we had the corresponding value from the fish markets (Fig. 3). For Trindade, this represented 21 out of 63 species, corresponding to 60% of their catch, and those species yielded the village R$571,640.20 over the sampling period, or an average of R$209.40/fish landing and R$853.19/day (average). For comparison with the values provided by the fishers themselves, we calculated the monthly revenue, supposing that there is an average of 26 fishing days a month (excluding Sundays). In Praia Grande, 20 out of 41 species, corresponding to 84.5% of their catch, yielded the fishers R$142,621.20, or an average of R$356.55/fish landing and R$2852.43/day (average of 8 landings/day) (Table 1). These values differ significantly from what we estimated based on fishers’ information in Trindade but are relatively close for Praia Grande. Part of these differences in price between the two villages is due to the fact that many of the species caught in Trindade did not have their price registered in the main fish markets in Paraty, and we could only price 59% of their catch. This suggests that Trindade’s fish is either not sold in Paraty or meets the local consumption needs. The latter could imply the sale of the fish in the village itself or a strong contribution of the catch (up to 41%) to guarantee food security since the fish would be used to feed the local people. These figures, however, should be considered with caution, as they represent potential income generation rather than actual payments because the prices collected in the markets are the prices paid by consumers to the middlemen. Middlemen were usually reticent to reveal what they were paying the fishers.

### 3.2. Fish and its exploitation as an undervalued service

The fish provided by the two villages studied enter the local market chain together with catches by fishers from other Paraty villages (at least 11, plus different neighborhoods in town) (Begossi et al., 2010). Apart from what is directly consumed by the fishers and their families and sold in their own neighborhoods, most of the fish goes to multiple fish markets. Some villages have specific buyers, while others sell their product to multiple middlemen, based on previous ties, debts, arrangements, and prices. However, although the villages do provide a lot of fish (average monthly amount in the four fish markets: 2213 kg), part of the fish sold in the markets (41.57%) comes from a state distribution center (CEASA) (average monthly amount coming from CEASA = 1575 kg), based in the city of Rio de Janeiro (226 km from Paraty). Fish coming from CEASA have no discriminated origin by the time they reach Paraty, but some of them are certainly from Paraty itself. This incongruence happens because fish that come from the villages are originally offered in the Paraty market. After a couple of days, if not sold, they are frozen and sent to CEASA, together with any surplus of fresh fish, with the middlemen making some profit in relation to the first ex-vessel price. Days later, if the villages do not provide enough fish or the types of fish required by the market, the same middlemen can go back to CEASA and buy frozen fish (more expensive now) to be sold again in Paraty (at an even higher price) (Fig. 4).

The lack of planning and integration among fishers, middlemen, fishers’ associations, and governmental agencies results in economic losses for everybody, affecting mostly the fisher and the final consumer, who are the main links in the chain. Such a faulty market chain probably keeps middlemen from paying fishers better prices since the middlemen will incur in additional costs later to transport fish back and forth between Paraty and Rio de Janeiro. These fish costs did not consider external factors such as the environmental costs of transporting fish in refrigerated trucks and the risk of food poisoning due to spoiled fish.

Fixing a faulty market chain like the one observed in Paraty Bay and hence increasing the value provided by the fisheries service would require adjustments to the consumers’ demands, especially larger consumers, such as restaurants and hotels. For example, the species sold in the fish market did not represent the species being caught in the fishing villages (Spearman correlation kg; r = 0.015, n = 35, p = 0.05). Based on information provided by the fishmongers, larger consumers have a high preference for specific species, such as grouper, snook, king mackerel, red snapper, and even some imported farmed fish, such as salmon from Chile, although the poorer local population prefers the cheaper mullets and sharks. Therefore, consumers do not seem to be aware of an eventual seasonality in fish production or of the consequences of demanding some species year-round or demanding them at all. The latter is the case with the farmed Chilean salmon, which could establish naturalized populations, prey upon native fishes, transfer diseases to native fauna (Sepúlvera et al., 2013) and threaten pristine ecosystems due to the need for more farms (Niklitschek et al., 2013). Such demands put pressure on the fishing of specific species (e.g., the endangered dusky grouper Epinephelus marginatus, the near-threatened black grouper Mycteroperca bonaci, or the vulnerable red snapper Lutjanus analis; IUCN Red List) or favor unsustainable fish farming practices (Cabello, 2006). Also, if the number of links in such a market chain were reduced, fishers could get paid better for the same workload, bringing them closer to the pathway out of poverty through the use of an ecosystem service (Pinho et al., 2014).

On the other hand, turning fisheries into a more profitable service could be an incentive to fish more or to attract more people to fisheries, producing unintended consequences (Grafton...
et al., 2006). However, preliminary studies done on the north-eastern coast of Brazil suggest that small-scale fishers do not always tend to increase their workload even if there is a chance of higher yields. Instead, some of them prefer to work less and achieve what they consider to be enough for their maintenance, probably because fishing is a very exhausting and demanding physical activity (Lopes, pers. obs.). Nonetheless, fishers’ decision-making regarding how much effort to allocate to work could change with their increasing dependency on the external market, which requires more money to obtain resources that they were used to getting for cheaper prices or for free from nature (MacCord and Begossi, 2006). The attraction of new fishers could also be a problem, and specific studies of carrying capacity would be necessary to determine how much fish from the main target species can actually be removed from the bay. Based on that, license limits and quotas would have to be decided together with fishers in order to profit more from.

Fig. 3. The relationship between total catch per species in Trindade (A) and in Praia Grande (B) and the average prices paid by consumers at local markets in Paraty (Rio de Janeiro). Prices are shown in Real, the Brazilian currency (R$). The species of fish represented by popular names include: white and lebranche mullet (Mugil curema and M. curema); dolphin fish (Coryphaena hippurus); leatherjacket (Oligoplites silius and Oligoplites palometa); dog and red snapper (Lutjanus jucu, Lutjanus synagris); comb grouper (M. bonaci); dusky grouper (E. marginatus); blue runner (Caranx crysos and Caranx ruber); weakfish (Cynoscion leiarchus, Cynoscion jamaicensis, and Macrodon ancylodon); sand drum (Mugil cephalus); horse-eye jack (Caranx latus); bonnethead (Sphyrna tiburo); sea chub (Kyphosus sp.); bonnethead (Sphyrna tiburo); sea chub (Kyphosus sp.); king and serra mackerel (Scomberomorus cavala and S. brasiliensis); largehead hairtail (Trichiurus lepturus); round scad (Decapterus punctatus); Atlantic bigeye (Priacanthus arenatus); fat and common snook (Centropomus paraleus and Centropomus undecimalis), sharks (Carcharhinus spp.), sea bob shrimp (X. kroyeri), white shrimp (L. schmitti), squid (Loligo plei).

Fig. 4. Fisheries market chain in Paraty (Rio de Janeiro coast). Source represents the fishing villages, first market represents the fish markets in Paraty, and second market represents the state distribution center (CEASA).
this ES without increasing the pressure on it. The establishment of territorial rights could also be an initial solution to restrict the fishing efforts of local fishers and could counteract the entrance of new fishers in the bay if fishing became more profitable (Castilla et al., 2007; Gelcich et al., 2008; Lopes et al., 2011).

3.3. Fisheries and the MPA

The MPA currently in place consists solely of dispersed islands in a design that is highly criticized by some groups of fishers who claim that some of the islands were important fishing grounds before being protected. Although fishers usually do not dispute the need for an MPA, they say they would have chosen different islands or implemented different changes had they been consulted (Lopes et al., 2013b). It is important to establish whether the MPA, despite the conflicts it causes between fishers and managers, provides important ESs, such as biodiversity conservation or improvement of fisheries through spillover of fish and larvae dispersion to fished areas (Gell and Roberts, 2003).

While marine biodiversity has not been assessed in the MPA yet, its potential to benefit fisheries has partially been investigated. Two different studies evaluated the dusky grouper (E. marginatus) and showed that this important commercial fish is now showing some initial alarming signs, such as being fished mostly when immature and very small in size (Prioli et al., 2014; Silvano and Nora, 2014), but many fishers still believe it is one of the main types of fish they catch (Lopes et al., 2013b). One of the studies showed that the endangered dusky grouper has only one population encompassing the Paraty Bay and reaching at least 200 km to the north. This is a small but still viable (for recovery) genetic population (963 individuals) (Prioli et al., 2014). Since this is not a migratory species when adult, the MPA, if the restrictions were enforced, could support its local recovery and provide mature fish to nearby areas, as observed in the Mediterranean (Alono et al., 2011).

Another study done in islands inside and outside the MPA, assessed the local abundance of fish from the Serranidae family (groupers, E. marginatus, Mycteroperca acutirostris, and M. bonaci) and the Haemulidae family (grunts, Haemulon aurolinatum, and Haemulon steindachneri) (Lopes et al., 2013b; Silvano and Nora, 2014), which could indicate that fisheries impact reefs (Ferreira et al., 2004). As expected, Haemulidae fish were abundant because they are not a target of fishers (Silvano and Nora, 2014). Overall, the number of groupers differed depending on the protection status of the island and its location. Groupers were more abundant outside the MPA limits in the northern sector, where the conflicts with fishers are stronger, but were more common inside the MPA in its southern part (Lopes et al., 2013a).

Hence, while the overall potential of this MPA to provide biodiversity conservation is yet to be evaluated, its potential to support fisheries (specifically groupers) seems to depend more on the resolution of local conflicts and effective enforcement than on habitat variability (Silvano and Nora, 2014). Migratory fish species that are locally important, such as Scomberomorus brasiliensis (Serra Spanish mackerel) (Begossi et al., 2012), are less likely to benefit from the MPA protection, but other reef species or species that need calm shallow waters with access to mangroves (e.g., snook (Centropomus spp) and shrimp (Litopenaeus schmitt and Xiphopenaeus kroyeri)) could benefit greatly from the MPA, through the spillover effect (Bohnsack, 2011).

3.4. Sharing the benefits and fostering stewardship of ESs

There is no denying the need to protect ESs (Bradshaw et al., 2008), but controversies arise over how such protection ought to be done and how much of these services can be used. In some cases, the same service (e.g., game) can support different extraction levels depending on initial conditions (e.g., game population size) (Tallis et al., 2008). The conservationist approach regards biodiversity an important nature equilibrium asset, as the most important aspect worth protecting (Fisher and Christopher, 2007). Such an approach tends to disregard the extent to which this integral protection would affect the livelihood of the people who depend on biodiversity as a basis for food security, such as fishers.

Rural poor people who depend on resources are more vulnerable to environmental changes, and thus one could argue that protecting nature would benefit them the most (Fisher et al., 2014; Pinho et al., 2014). That is true as long as prudent ways are found to reconcile conservation and use because the poor are also socially vulnerable (Milder et al., 2010). Excluding them from one form of livelihood does not mean they will automatically find different and equivalent ways of making a living (Marshall and Marshall, 2007).

Hence, assessing social/livelihood vulnerability and the ESs people depend on should be a first step before establishing full protection no-take areas, such as the studied MPA on the Brazilian coast. In Paraty Bay, fish and tourism are services that people depend on and that could benefit from an MPA, depending on how parks are implemented. Fisheries, for example, could benefit from having a source of fish spilling over from protected areas as long as such areas are truly enforced and if they include actual fish spawning or shelter grounds (McClanahan and Mangi, 2000). Tourism, on the other hand, even if it is not allowed in certain parts of a park, could benefit from a pristine environment through a zoning system, as is done in the Great Coral Barrier (Australia) or in parts of the Brazilian Amazon (e.g.: Mamirauá) (Day, 2002; Gouvea, 2004). To enjoy these benefits of an MPA, tour operators need to learn how to capitalize on the occurrence of high biodiversity and sell this as “part of the package”.

Finally, in an area where poor people depend on ESs, in order to reconcile the benefits of an MPA with its disadvantages, fisheries and tourism must share the benefits. Livelihood vulnerability would only decrease through the use of extra ESs, meaning that tourism development, for example, has to involve the poor (Schevens, 1999). There are alternatives to that, such as community-based tourism, but participatory tourism seems to be more the exception than the rule among fishing villages undergoing transitions (Hoeffe, 2014). Also, decisions that will clearly affect fisheries, such as the closing of important fishing grounds, cannot be made without the participation, understanding, and acceptance of fishers (Lopes et al., 2013b). The profitable use of services cannot be used as a wedge to exclude the poor even further.

Therefore, rather than merely establishing protected areas, conservation now has to reach out to the rural poor, who are after all the ones occupying and using the areas that are important to preserve (Gurney et al., 2014). The inclusion of ES analyses and development may be a way out of the conservation dilemma. It is important to answer questions about what services are available, how they interact, whether this interaction is negative (and if so, could it be changed), and whether full protection is the only solution or if there could be a compromise between protection and use.

The adequate use of ESs could also work as a value-adding mechanism. Services could be sold as commodities rather than being seen just as a niche market. Currently there are alternatives such as PES, which is already a way to benefit those who maintain these services. Although widely studied and with successful examples established for land services, PES schemes are still being developed for marine and freshwater environments (Hallwass et al., 2014). In the case of fisheries, PES has been established to compensate small-scale Brazilian fishers during seasonal fishing closures (Begossi et al., 2011). Such a PES system has been in place for decades, but it still needs adjustments. For example, fishers usually receive their compensatory...
salary months after the closed season has passed. Because they must make a living, many fishers go ahead and fish during the closed season despite the risk of being caught breaking the law (Kapner and Lopes, 2014).

However, in addition to PES, people could get paid more for the sustainable use of services since today the economic value of ESs is usually treated as an externality (Kabaya and Managi, 2012). Ecolabeling, an indirect type of payment scheme and a straightforward way to create a market for ecosystem services, could also take into account the correct use of a service, not just of a specific product. Ecolabeling falls within a broad market category called linked market. This name refers to the link between a social good (the ES) and a private good (the product being sold) (Ribau et al., 2010). In this scheme, people willingly pay more for a product when they trust the source and the way the product was produced, supporting the maintenance of the services in the region the product came from. The labels “organic” and the even stricter “biodynamic” are examples of ecolabeling applied to agriculture; the “Forest Stewardship Council” label is applied to forest products; and the Marine Stewardship Council is in charge of certifying fisheries.

Joining the benefits of consumptive uses (e.g., fisheries) to non-consumptive uses (e.g., ecotourism) of ESs may be a good alternative (and perhaps the only one) for meeting the opportunity costs of conservation (Rands et al., 2010). Rather than seeing people as unrestrained users of services at the expense of species, habitats, and ecosystems, marine conservation efforts, such as the establishment of MPAs, should involve people in assessing conservation together and finding ways either to use more services in a sustainable way or to add value to the service already being used.

4. Conclusions

Overall, in the studied region of Paraty Bay, the ESs of fisheries and tourism are not conflicting but are at odds with biodiversity conservation through the MPA. The formula for achieving sustainable and nonconflicting use of marine ESs is, at first glance, not that hard; it involves a mosaic of uses in a given area, allowing the recovery and maintenance of exploited resources. This mosaic of uses should be inclusive, which here specifically means including fishers in tourism activities. As a way to compensate for immediate losses due to extraction restrictions or fishing closures, additional measures such as PES, ecolabeling, and efficient market chains should be adopted.

However, in tropical developing countries, obstacles such as chronic corruption (Smith et al., 2003; Zanetell and Knuth, 2002), bureaucracy, and lack of social capital may impair the adequate maintenance of ESs (Tallis et al., 2008). Money allocated to PES might disappear en route or get entangled in the red tape of bureaucracy, as in the case of the fishers’ salary being delayed during the closed fishing period.

The lack of social capital results in most communities being unable to launch initiatives on their own. In Brazil, for example, it results in concrete consequences, such as the inability to write proposals that benefit fishing communities through the acquisition of fishing support equipment (e.g., ice factories and processing plants) that could add value to fishing products locally. Also, low literacy levels, along with poor organization, impair communication and the ability to understand problems and make connections. Higher levels of organization could probably empower fishers to work out a more beneficial value chain for themselves with value added to sustainably exploited products.

This is not to say that there is no way out for small fishing communities. In some cases, social capital has been built and fishers have managed to put sustainably exploited products into the market, getting paid extra value for maintaining biodiversity, sometimes with the support of nonprofit organizations and researchers, usually responding to crisis in the exploited resources (Castello et al., 2009; Castilla et al., 2007). Hence, although it is hard to imagine that tropical developing countries could devise large-scale programs to value marine ESs, societal initiatives could overcome problems regarding the maintenance of these services on a local or regional scale.

Role of the funding source

IDRC (Canada) and FAPESP (Brazil) supported this project, but played no role in the design, analysis, writing, and in the decision to submit this manuscript.

Acknowledgements

Special thanks to Vinicius Nora and Robson Posidônio for sampling the fish landings. Thanks to IDRC (Canada) and FAPESP (Brazil) for financial support to this project (grants nos. 104519-004 and 2009/11154-3, respectively), to CNPq for research scholarships and grants to R.A.M.S. and to A.B., to the FAPESP for research grant to R.A.M.S (2012/16722-2).

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