Mapping recreational ecosystem services from stakeholders' perspective in the Azores

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Abstract

Mapping and Assessment of Ecosystems and their Services (MAES) in Europe's Outermost Regions (ORs) and Overseas Countries and Territories (OCTs) is still underdeveloped compared to the European mainland. Most of those territories are small islands for which Marine and Coastal Ecosystems (MCE) constitute a significant resource and provide important provisioning, regulating and cultural Ecosystem Services (ES). Understanding the cultural dimension of ecosystems and considering the cultural benefits and values associated with them, demands methodological plurality, flexibility and creativity. This study focused on two activities related to recreational ES (recreational fishing and recreational SCUBA diving) that are particularly relevant to São Miguel Island (Archipelago of the Azores, Portugal). Stakeholders were interviewed using SeaSketch, a participatory mapping tool in which they indicated where they conduct recreational fishing and scuba diving, the relative value of those areas, in terms of preference over other areas and their willingness to relinquish them for the purpose of conservation. Responses were aggregated and represented in maps showing key areas for the provision of recreational ES around São Miguel. This approach can be used in the Azorean Maritime Spatial Planning (MSP) process and other on-going conservation initiatives, to better understand the trade-offs between relevant socio-economic activities and to support negotiations between the government and groups of stakeholders.

Keywords

MAES, social valuation, recreational activities, participatory mapping

Introduction

The concept of Ecosystem Services (ES) and its related terminology has become a powerful tool to understand the complex relationships between nature and humans (Millenium Ecosystem Assessment 2005). It is present in high level policy and management documents, such as the Aichi targets of the Convention on Biological Diversity and, at a regional scale, the EU Biodiversity Strategy to 2020, which foresees, in Action 5, that all member states shall "*map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020*" (European Commission 2011, p.12).

While various EU member states have already provided comprehensive ecosystem assessments, these efforts are focused on the European mainland (Drakou et al. 2018, Jax et al. 2018). On the contrary, Europe's Outermost Regions (ORs) and Overseas Countries and Territories (OCTs) seem to be overlooked in Mapping and Assessment of Ecosystems and their Services (MAES) (Sieber et al. 2018). Most ORs and OCTs are small islands or archipelagos with unique challenges and vulnerabilities in terms of sustainable development (Balzan et al. 2018). Naturally, Marine and Coastal Ecosystems (MCE) constitute a significant resource for these territories and deliver important provisioning, regulating and cultural ES to island communities (Balzan et al. 2018). Despite their relevance, marine and coastal ES in Europe's ORs and OCTs remain under-researched (Maes et al. 2020).

Understanding the cultural dimension of ecosystems and considering the cultural benefits and values associated with them is a distinguishing feature of ES-based approaches to environmental planning and management (Fish et al. 2016). The various conceptual frameworks and classifications that followed the Millenium Ecosystem Assessment (2005) include a category of cultural ES, which are also acknowledged in ES typologies specific for MCE (Beaumont et al. 2007, Liquete et al. 2013). Nevertheless, the information about cultural services derived from MCE and the importance that people assign to them is still limited compared to other ES categories (Garcia-Rodrigues et al. 2017).

The research targeted at marine and coastal cultural ES has traditionally focused on the economic valuation of nature-based recreation, tourism and landscape or seascape scenic beauty (Enriquez-Acevedo et al. 2018, Robles-Zavala and Chang-Reynoso 2018, Garcia-Rodrigues et al. 2017, Torres et al. 2017, Castaño-Isaza et al. 2015, Czajkowski et al. 2015 , Zhang et al. 2015, Pascoe et al. 2014), while non-monetary approaches are less developed. The most extended techniques to estimate the value of recreational ES,

derived from MCE, take a monetary approach, drawing inferences from observed types of behaviour (Czajkowski et al. 2015, Zhang et al. 2015, Pascoe et al. 2014) or making contingent behaviour questions (Enriquez-Acevedo et al. 2018, Robles-Zavala and Chang-Reynoso 2018, Torres et al. 2017, Castaño-Isaza et al. 2015). In that regard, the framework proposed by Fish et al. (2016) offers an alternative to monetary approaches and provides a structure to value cultural ES from a social perspective, since it investigates the relationship between environmental spaces (e.g. localities, seascapes) and cultural practices. Applying that framework, the direct-use value of cultural ES, such as recreation, can be related to an environmental space where recreational practices (e.g. wildlife watching, sailing, fishing) take place. Therefore, it allows us to map values associated with cultural ES, something particularly relevant when it comes to MCE.

Although mapping methodologies are rapidly advancing, Marine and Coastal Ecosystem Services (MCES) mapping is still limited when compared to terrestrial and inland water ecosystems (Burkhard and Maes 2017). In the case of cultural ES, one of the challenges associated with mapping exercises is the difficulty to link human experiences to a specific habitat (Burkhard and Maes 2017). Participatory mapping, or Participatory GIS (PGIS), can help to move forward in that regard, since it offers a means of collecting social values in a spatially explicit manner and facilitates integration with existing biophysical data layers within GIS-based decision support systems (Strickland-Munro et al. 2016). Typical participatory mapping studies, or map-based interviews, ask respondents to locate - and sometimes rank - values, ES and/or management preferences, by placing markers on to an online or hard copy map of a given area (Strickland-Munro et al. 2016). This approach presumes that “hotspots” or concentrations of values will emerge, helping to identify areas of high value (Brown et al. 2016). Research by van Riper et al. (2012), Strickland-Munro et al. (2016), Blake et al. (2017), Kobryn et al. (2018) provide examples of the use of participatory mapping to represent social values associated with cultural ES in MCE. Spatial data, collected using participatory mapping methods, when combined with ecological data, can be used to identify priority management areas, to evaluate whether mapped values are consistent with planning proposals and to provide evidence of conflicts between specific stakeholders' groups (Brown et al. 2016). In addition, the mapping exercise itself contributes to raise awareness and promotes stakeholders’ engagement.

The engagement of stakeholders is crucial for effective Marine Spatial Planning (MSP) (Pomeroy and Douvere 2008), particularly when it concerns Marine Protected Areas (MPAs) (Charles and Wilson 2008). The benefits attributed to their involvement in MPAs' planning and management include an increased level of understanding, local support and legitimacy, leading to a higher level of compliance with the rules (Strickland-Munro et al. 2016). Conversely, inadequate consideration of social data (such as values, attitudes, preferences and opinions of the people who influence or can be influenced by planning and management strategies) may exacerbate conflict over MPAs, jeopardising their long-term success (Strickland-Munro et al. 2016). In a wider context, the importance of stakeholders’ involvement in ES assessment is emphasised in international initiatives, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and EU MAES. Such involvement promotes the policy uptake of the ES concept

and the adoption and implementation of the mapping and assessment results (Dick et al. 2018, Drakou et al. 2018).

Considering the importance of stakeholders' involvement in MAES and the importance of understanding the cultural dimension of marine ecosystems beyond economic approaches, we propose a novel and cost-effective approach, taking the Azores Archipelago as a case study. Compared to other ORs and OCTs, the region is a frontrunner in MAES implementation (Sieber et al. 2018), but with very few examples in the marine environment, despite its vast maritime territory (DGRM 2018). Additionally, the region is developing a MSP process (Ordenamento do Espaço Marítimo dos Açores) (OEMA) and an initiative to expand the MPA network, declaring 15% of the EEZ (Exclusive Economic Zone) as new MPAs (BlueAzores). Given the small extent of the current MPA network, which covers less than 5% of the EEZ (azores.gov.pt), there is a need for spatial information that, if collected taking an ES approach, is expected to contribute to better understand the socio-ecological relationships in the area, facilitating the on-going projects related to ocean management (Drakou et al. 2018, Börger et al. 2014, Liquete et al. 2013, Beaumont et al. 2007).

Amongst the various recreational maritime activities present in the Azores Archipelago (e.g. sailing, fishing, whale watching, diving), recreational fishing and recreational SCUBA diving, were identified as relevant in socio-economic terms and suitable to exemplify the applicability of MAES-related approaches in the regional context. Recreational fishing is seen as a tradition that has evolved from subsistence coastal fishing into a leisure activity highly appreciated by locals (Diogo and Pereira 2013), while recreational SCUBA diving is a popular activity amongst tourists. Despite their recreational nature, these activities use the resources in a different way (extractive versus non-extractive) and they are expected to be affected by the expansion of the MPA network, particularly recreational fishing, since the current number and extent of no-take zones is minimal (azores.gov.pt). In addition, the activities are expected to overlap with each other, due to the bathymetric characteristics of the Archipelago (Pinho and Menezes 2009) and with MPAs, generating potential conflicts.

This study presents a participatory mapping methodology that allows us to collect and represent stakeholders' values and attitudes towards the maritime space that they use in the Azores Archipelago. Specifically, it shows the most valuable areas for the provision of recreational ES from the perspective of two groups of stakeholders, namely recreational fishers and SCUBA divers, analyses the spatial interactions between those areas and MPAs and discusses how that information can serve to provide information for on-going projects related to ocean management in the region.

Methodology

Study area

The Azores Archipelago is an Autonomous Region of Portugal located in the North Atlantic Ocean, circa 1.450 km from the Portuguese mainland (Fig. 1). It consists of nine islands of

recent volcanic origin, which spread over more than 600 km in northwest-southeast direction, entailing more than 950,000 km^2 of Exclusive Economic Zone (EEZ) (DGRM 2018). The islands are characterized by a lack of or narrow coastal platforms and pronounced slopes where rocky substrates predominate (Pinho and Menezes 2009). The areas shallower than 1000 m are very limited, representing around 3% of the total EEZ and are discontinuously distributed along the Archipelago, between islands and seamounts (Pinho and Menezes 2009).

The approach developed in this work was applied to São Miguel Island, which is the largest of the Archipelago with about 745 km^2 of land surface and 230 km of coastline. It is also the most populous and visited island (SREA), where Ponta Delgada, the administrative capital of the Autonomous Region is located. There are six coastal MPAs (Fig. 1), of which five belong to the Island Natural Park (INP) of São Miguel and one is the Archaeological Underwater Park Dori. The MPAs under the figure of the INP of São Miguel are classified as IUCN category VI, with one of them (5. Calura - Ilhéu de Vila Franca) also having a zone classified as IUCN category IV (6. Ilhéu de Vila Franca).

The number of licences for recreational fishing in the Archipelago is around 4,400, of which 830 were issued in São Miguel: 22 for touristic fishing, 237 for leisure and sport fishing and 571 for spearfishing (Regional Directorate for Fisheries, unpublished data for the year 2018). The number of licences for recreational SCUBA diving in the Archipelago, in 2019, were 51 operators with 91 vessels, of which 14 operators with 19 vessels were based in São Miguel (Azores Government 2020).

Data collection

The data collection was accomplished through map-based interviews conducted individually and face-to-face using SeaSketch, a web-based tool that has been used around the world for collaborative MSP (SeaSketch). The tool can be adjusted depending on the purpose of each planning initiative. For this study, a new project was created, customised and adapted to the case.

The interviews were divided into two parts intended to collect complementary information. The first part of the interviews focused on stakeholders' values, asking where they practise their recreational fishing and SCUBA diving activities and how they value those places. For this, respondents were asked to draw polygons to show the areas used for fishing and diving and to assign a relative value to the locations by distributing 100 points between them. In the exercise, there were no restrictions on the number of polygons or the points assigned to each one, as long as the total was 100. Basemaps such as "*Imagery with labels*" and "*Oceans*" (available in SeaSketch) were used to facilitate navigating the map and identifying places. Three additional data layers were included in the project from the SIGMAR map server (SIGMAR): coastal bathymetry, reference distances from the coast and areas of current or potential constraint for the activities (designated MPAs, ports and bathing areas). The latter was used after the interview to answer questions raised by respondents, but it was not shown before or during the participatory mapping exercise.

The second part of the interviews focused on stakeholders' attitudes, asking if they would be willing to relinquish (stop using) any of the previously indicated areas to be protected and the reasons for their answer. The way in which the second question was formulated is inspired by the willingness-to-pay method (Enriquez-Acevedo et al. 2018, Robles-Zavala and Chang-Reynoso 2018), without the monetary component. In this case, the value that ES have for people is not deduced from how much they would be willing to pay to ensure their provision, but from what they would be willing to do (i.e. "relinquish" or "not relinquish"). This provides a non-monetary indication of the spatial conservation measures that people would be willing to adopt.

Participants were contacted through social networks (e.g. Facebook, Twitter) and email. The weeks prior to the interviews, in spring 2019, various associations, clubs and companies related to the activities were contacted. After the first interviews, a snowball sampling method was followed (Johnson 2014), reaching 35 participants (17 recreational fishers and 18 recreational SCUBA divers). The data registered in SeaSketch regarding number and characteristics of participants, number and area of polygons and reasons to relinquish them or not, are provided in Suppl. material 1.

A shortcoming of survey-based methods is the risk of under-representing some groups, which can only be overcome by over-surveying. Given the impossibility of over-surveying and the the lack of references from previous studies, the sample size was considered sufficient when the likelihood of acquiring new information was small, achieving saturation (Mason 2010).

Data processing and analysis

Survey responses were registered in SeaSketch and exported as comma separated values (CSV) and shapefiles (SHP) files to be summarised and represented using QGIS software (QGIS). From 35 interviews registered in the platform, two were not included in the results. The first corresponds to a shore angler, which is a group of recreational fishers that was ultimately not included in the study. The second corresponds to a diver who showed lack of experience and knowledge in the study area during the interview.

Information on number of polygons, area and degree of overlap between activities was extracted from the CSV and SHP files. The maps of relative value were produced summarising the responses according to the number of overlapping polygons and their values, following the workflow illustrated in Fig. 2. The SHP documents exported from SeaSketch were joined to a rectangular grid of 0.0025 degrees (equivalent to cell of 8 ha; 0.08 km^2), counting the cumulative score of each cell. Cell values were re-adjusted in relation to the one(s) with the highest cumulative score, which was assigned to 100. In that way, all the cells have values up to 100, allowing the use of the same colour scale in the maps of relative value and making comparisons easier. The areas that the respondents would be willing to relinquish were identified directly from the SHP documents exported from SeaSketch.

Results

With a close number of respondents in each group (16 fishers and 17 divers), recreational fishers drew fewer, but larger polygons than recreational SCUBA divers. Recreational fishers sketched 59 polygons that cover an area of 5476 km^2 when aggregated, while recreational SCUBA divers sketched 88 polygons that cover an area of 771 km^2 when aggregated. The answers overlap in 256 km^2, which equates to 5% of the area sketched by fishers and 33% of the area sketched by divers.

Each recreational fisher contributed on average with 3.7 polygons. The mean area of the polygons sketched by fishers is 127 km^2. From the 16 participants in this group, nine were boat fishers and seven spear fishers. Both sub-groups contributed with a similar number of polygons, but different in size and distribution. The polygons sketched by boat fishers extend over 5.304 km^2 and are distributed both inshore (close to the coast) and offshore, while the polygons sketched by spear fishers extend over 256 km^2 and are close to the coast. Besides these differences, both sub-groups of fishers attributed higher values to areas close to the coast, in the south and west parts of the Island. The most valuable spot for fishers is found to the west of Ponta Delgada (Fig. 3).

Each recreational SCUBA diver contributed on average with 5.2 polygons of 13 km^2. The polygons sketched by this group are concentrated in the coastal area, except for Formigas Islets, which is a seamount with small islets emerging and shallow reefs (< 50 m), located 40 NM SE of São Miguel and 20 NM NE of Santa Maria Island. The most valuable spots for divers are distributed along the south coast, standing out the coastal area of Caloura, to the east of Ponta Delgada and Dori, which is a wreck located about 1.5 NM from the entrance of Ponta Delgada's harbour (Fig. 3).

Merging all the answers (Fig. 3), the participants showed a preference for the south coast of the Island, where the overlap between polygons and, therefore, activities is particularly intense. Analysing the answers of both groups of stakeholders together, the best ranked spot is in the coastal area to the west of Ponta Delgada, followed by the area of Caloura.

The distribution of mapped values (Fig. 3 shows that three MPAs are highly valuable for the participants: Ponta da Ferraria – Ponta da Bretanha, in the west, especially important for recreational fishers; Dori for recreational SCUBA divers; and Caloura - Ilhéu de Vila Franca for both groups. Overall, the responses show that the activities overlap with all MPAs with two exceptions: the MPA on the east coast (Costa Este), where no polygon was drawn and Dori, where there are only polygons corresponding to divers.

Regarding participants' attitudes towards conservation, 91% of them would be willing to stop using valuable areas for their activity if it were to protect them, without major differences between groups. In 33 participants, only two (two fishers and one diver) would not renounce any of the areas previously sketched and identified as relevant for them. Both recreational fishers and divers would be willing to relinquish about 50% of the areas

indicated. The areas that more people would be willing to stop using largely coincide with the most valuable for them (Fig. 4).

The reason that most fishers would relinquish valued areas to create marine reserves (where fishing and other activities would be prohibited), was because they had noticed fewer fish in these areas. Presumably, marine reserves would restore fish populations. The reasons to not relinquish areas included the belief that the activity has no impact (in the case of spearfishing) and the belief that marine reserves do little to protect highly mobile and migratory species (targeted big game). When the participants answered why, they had the opportunity to add comments about their decision and several of them mentioned that recreational fishing is already regulated and sustainable. It was also pointed out the need for more control over commercial fishing and illegal fishing, as well as the need for effective surveillance. In other cases, the response was affirmative, but conditioned, explaining that they would be willing to relinquish fishing areas if it were for everyone (referring commercial fishing and/or all the activities taking place in there), if it were temporary, if there were proper enforcement or if there were a scientific reason to do so.

Amongst recreational SCUBA divers, one of the most cited reasons why they would be willing to stop using one or more areas to create marine reserves, was to protect areas where uncommon species can be observed and areas of fish hatching and/or nursery. As in the group of recreational fishers, the possibility to restore a perceived decline in fish populations was also mentioned as a reason. Their unwillingness to renounce areas was due to the perception that they are already heavily impacted and there is more value in visiting than in closing them.

Discussion

As in previous research that used participatory mapping techniques to represent social values associated with cultural ES in Marine and Coastal Ecosystems (MCE) (van Riper et al. 2012, Strickland-Munro et al. 2016, Blake et al. 2017, Kobryn et al. 2018), the results of this study confirmed that people attach different values to different places emerging the expected “hotspots” or areas of high value (Brown et al. 2016).

The answers of recreational fishers presented more variability in terms of area and distribution than those of recreational SCUBA divers. That variability can be attributed to the different gears or techniques used within the modality of boat fishing. If the answers of boat fishing and spearfishing are considered separately, it turns out that boat fishing presents the higher variability, followed by SCUBA diving and spearfishing. Thus, having more participants in the sub-group of boat fishers would be advantageous to better understand how they use and value the space. Conversely, the number of respondents in the case of divers was satisfactory since it achieved saturation (Mason 2010).

The overall distribution of activities is similar to that described for comparable island territories, such as Tenerife (Canary Islands), where recreational fishing occurs along the coast, being especially important close to coastal settlements and recreational SCUBA

diving occurs in a limited number of coastal places (Riera et al. 2016). In the case of São Miguel, the areas used by divers are much more restricted than those used by fishers, but recreational boat fishing does not only occur along the coast. The distribution of recreational boat fishing in São Miguel mainly occurs close to the Island, with a clear trend towards the south of the Island extending to offshore fishing grounds. This result also contrasts with the distribution of recreational boat fishing in Pico and Faial (central group of Azores Islands), where recreational boat fishing happens mainly around the Islands with no activity taking place at offshore fishing grounds (Diogo and Pereira 2013).

The preference for the south coast of the Island applies to both activities and it can be attributed to the presence of facilities (e.g. ports) and other factors, such as bathymetric characteristics, seafloor morphology, coastal accessibility and/or sea conditions. Consequently, the most valued spots or the key areas for the provision of recreational ES are in the south coast of São Miguel. Besides the factors that could explain the overall distribution of activities already mentioned, the reasons behind the attribution of more or less points to the different areas becoming more complex due to the recreational nature of the activities. The participants were not asked to explain why the areas had more or less value, but some of them provided comments. For recreational boat fishers, for example, aesthetic reasons, such as having a nice view of the coast, were amongst the most mentioned when scoring areas in the west part of the Island. This reinforces the idea that cultural ES are especially challenging compared to other categories of ES due to the physical and cognitive interactions between humans and nature that are in place (Fish et al. 2016, Garcia-Rodrigues et al. 2017).

Notably, the most valuable spots for divers are two MPAs (Calura – Ilhéu de Vila Franca and Dori) where fishing is restricted or not allowed. Those MPAs are areas with high natural and archaeological interest and Dori is very close to Ponta Delgada, making it easily accessible. In addition to these aspects that make them attractive for recreational SCUBA divers, having less pressure from extractive activities could also be related to the high value attributed to them. As a non-extractive activity, recreational SCUBA diving is very common in MPAs, particularly in tropical and subtropical areas (Sala et al. 2013, Hammerton 2017). In the Caribbean and Pacific coast of Central America, 50% of recreational dives take place within MPAs, indicating the interest of divers to frequent areas with more abundant marine life, particularly fish (Sala et al. 2013). On the contrary, recreational fishing in MPAs is more disputed (EAA 2017).

In the case of São Miguel, the results show that five out of six extant coastal MPAs have certain value for recreational users. Amongst them, the MPA Caloura - Ilhéu de Vila Franca is a highly valued area in general and particularly for divers. The complexity of spatial and managerial relationships in that MPA make it the place where conflicts are most likely to arise (see Fig. 1). However, it is also an area that many of the participants would be willing to stop using, which reinforces the usefulness of the methodology applied in this study to highlight both conflicts and convergences between stakeholder groups.

The most commonly cited reason for participants willing to stop using an area for conservation was to restore what were perceived to be depleted fish populations.

Nonetheless, it seems that the selection of the areas to stop using was based on their value rather than on their degree of overexploitation, given the overlap between the most valuable areas and the areas they would relinquish. The fact that the two groups coincide in being willing to abandon some of the most valuable areas can also indicate that those areas are under more pressure and the stakeholders would be willing to renounce to them to support the recovery of fish stocks. In any case, it was demonstrated that, despite of the conflicts between the activities, both groups share conservation concerns, exemplifying how the integration of social-ecological systems approach with sectorial perspectives serves to establish a meaningful dialogue amongst stakeholders (Drakou et al. 2018).

The on-going projects related to ocean management in the Azores Islands could benefit from this approach as a means of spatial prioritisation. The social valuation of ocean areas enriches the information on the spatial distribution of relevant socio-economic activities, highlighting the relative importance of different areas for the stakeholders. In the case of São Miguel, the results indicate that, in order to minimise conflicts and ensure the supply of recreational ES, the focus of managers and policy-makers should be on the south and west coast of the Island. Considering the biophysical conditions (e.g. coastal morphology, bathymetry, wind patterns), the situation is likely to be similar in other islands of the Archipelago. In addition, the use of the coastal area is expected to be more intense with the expansion of current activities, such as tourism and with the emergence of new ones, such as aquaculture.

The information on stakeholders' values can also contribute to the development of alternative scenarios, highlighting the consequences of different management strategies for the groups that would be affected by them (Börger et al. 2014). In this case, knowing the relative value of the maritime space for recreational fishers and SCUBA divers allows us to estimate how the extension of the MPAs network would affect the activities (e.g. if the current MPAs in São Miguel were declared no-take zones, recreational fishers would have to stop using part of their most valuable spots). Regardless of the designation of new MPAs, turning the current ones into marine reserves (no-take zones) would imply losing some valuable spots for recreational fishers. Even though the answers to the second part of the interviews indicate that there would be a general willingness amongst recreational users to abandon recreative grounds for the purpose of conservation, the premise in the interviews was that any activity (except for monitoring or surveillance) would take place in those areas, which is unlikely to happen in reality. Thus, the information about willingness to stop using areas for the purpose of conservation should be seen as a basis for negotiations between groups of stakeholders, rather than as a direct way of collecting information to declare protected areas.

For a comprehensive MAES exercise, the approach presented in this study should be extended to all the islands of the Archipelago, to properly represent the value of the maritime space for recreational fishers and SCUBA divers in the Azores. Ideally, it should also include stakeholders from other relevant recreational activities, such as sailing or whale watching and the public in general, resulting in a complete social valuation of recreational ES provided by the Azorean sea. If it were meant to be replicated to other

activities and/or other territories, the specificities of each case-study should be considered by making the appropriate methodological adjustments.

Conclusions

The methodology presented here has proved to be a suitable approach to obtain spatial information on recreational activities in the study area. Due to their territorial and developmental specificities, the EU's ORs and OCTs require novel and cost-effective MAES-related approaches, such as the example provided by this work. This study highlights the relevance of participatory mapping tools to collect and represent non-monetary social values of ES and how such information contributes to a better understanding of the socio-ecological systems. Overcoming the methodological challenges associated with cultural ES valuation requires integration and adaptation of different methods on a case-by-case basis, depending on the information available, information needs, the ecosystems and their services. The proposed methodological approach works particularly well for recreational ES. As shown in this paper, people's preferences reflect the value of the space supplying recreational ES and, at least in part, the value of the ecosystems themselves. This information, combined with biophysical data, provides useful insight into the relative importance of different areas and a straightforward way to prioritise areas supplying the ES. If the social valuation of ES is done by activity or stakeholder groups, it reflects the relative importance of different areas for existing activities, improving our understanding of the relationships amongst activities and between them and the environment. In this regard, ES valuation is a key tool for understanding values and interests of stakeholders. This study suggests that ES valuation may also be useful in anticipating the consequences of management alternatives (e.g. extension of the MPA network) for different groups and, as such, help planners facilitate negotiations and meaningful dialogue amongst stakeholders.

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Conflicts of interest

References

- Azores Government (2020) Regional Directorate for Air and Maritime Transport. https://portal.azores.gov.pt/en/web/drt/atividade-mar%C3%ADtimo-tur%C3%ADstica
- Balzan M, Potschin-Young M, Haines-Young R (2018) Island ecosystem services: insights from a literature review on case-study island ecosystem services and future prospects. International Journal of Biodiversity Science, Ecosystem Services & Management 14 (1): 71-90. https://doi.org/10.1080/21513732.2018.1439103
- Beaumont NJ, Austen MC, Atkins JP, Burdon D, Degraer S, Dentinho TP, Derous S, Holm P, Horton T, van Ierland E, Marboe AH, Starkey DJ, Townsend M, Zarzycki T (2007) Identification, definition and quantification of goods and services provided by marine biodiversity: Implications for the ecosystem approach. Marine Pollution Bulletin 54 (3): 253-265. https://doi.org/10.1016/j.marpolbul.2006.12.003
- Blake D, Augé A, Sherren K (2017) Participatory mapping to elicit cultural coastal values for Marine Spatial Planning in a remote archipelago. Ocean & Coastal Management 148: 195-203. https://doi.org/10.1016/j.ocecoaman.2017.08.010
- Börger T, Beaumont N, Pendleton L, Boyle K, Cooper P, Fletcher S, Haab T, Hanemann M, Hooper T, Hussain SS, Portela R, Stithou M, Stockill J, Taylor T, Austen M (2014) Incorporating ecosystem services in marine planning: The role of valuation. Marine Policy 46: 161-170. https://doi.org/10.1016/j.marpol.2014.01.019
- Brown G, Strickland-Munro J, Kobryn H, Moore S (2016) Stakeholder analysis for marine conservation planning using public participation GIS. Applied Geography 67: 77-93. https://doi.org/10.1016/j.apgeog.2015.12.004
- Burkhard B, Maes J (2017) Mapping Ecosystem Services. Pensoft https://doi.org/10.3897/ab.e12837
- Castaño-Isaza J, Newball R, Roach B, Lau WY (2015) Valuing beaches to develop payment for ecosystem services schemes in Colombia's Seaflower marine protected area. Ecosystem Services 11: 22-31. https://doi.org/10.1016/j.ecoser.2014.10.003
- Charles A, Wilson L (2008) Human dimensions of Marine Protected Areas. ICES Journal of Marine Science 66 (1): 6-15. https://doi.org/10.1093/icesjms/fsn182
- Czajkowski M, Ahtiainen H, Artell J, Budziński W, Hasler B, Hasselström L, Meyerhoff J, Nõmmann T, Semeniene D, Söderqvist T, Tuhkanen H, Lankia T, Vanags A, Zandersen M, Żylicz T, Hanley N (2015) Valuing the commons: An international study on the recreational benefits of the Baltic Sea. Journal of Environmental Management 156: 209-217. https://doi.org/10.1016/j.jenvman.2015.03.038
- DGRM (2018) Directorate-General for Natural Resources, Safety and Maritime Services. Maritime Zones under Portuguese Sovereignty and / or Jurisdiction. https://www.dgrm.mm.gov.pt/en/web/guest/am-ec-zonas-maritimas-sob-jurisdicao-ou-soberania-nacional
- Dick J, Turkelboom F, Woods H, Iniesta-Arandia I, Primmer E, Saarela S, Bezák P, Mederly P, Leone M, Verheyden W, Kelemen E, Hauck J, Andrews C, Antunes P,

Aszalós R, Baró F, Barton D, Berry P, Bugter R, Carvalho L, Czúcz B, Dunford R, Garcia Blanco G, Geamănă N, Giucă R, Grizzetti B, Izakovičová Z, Kertész M, Kopperoinen L, Langemeyer J, Montenegro Lapola D, Liquete C, Luque S, Martínez Pastur G, Martin-Lopez B, Mukhopadhyay R, Niemela J, Odee D, Peri PL, Pinho P, Patrício-Roberto GB, Preda E, Priess J, Röckmann C, Santos R, Silaghi D, Smith R, Vădineanu A, van der Wal JT, Arany I, Badea O, Bela G, Boros E, Bucur M, Blumentrath S, Calvache M, Carmen E, Clemente P, Fernandes J, Ferraz D, Fongar C, García-Llorente M, Gómez-Baggethun E, Gundersen V, Haavardsholm O, Kalóczkai Á, Khalalwe T, Kiss G, Köhler B, Lazányi O, Lellei-Kovács E, Lichungu R, Lindhjem H, Magare C, Mustajoki J, Ndege C, Nowell M, Nuss Girona S, Ochieng J, Often A, Palomo I, Pataki G, Reinvang R, Rusch G, Saarikoski H, Smith A, Soy Massoni E, Stange E, Vågnes Traaholt N, Vári Á, Verweij P, Vikström S, Yli-Pelkonen V, Zulian G (2018) Stakeholders' perspectives on the operationalisation of the ecosystem service concept: Results from 27 case studies. Ecosystem Services 29: 552-565. https://doi.org/10.1016/j.ecoser.2017.09.015

- Diogo H, Pereira J (2013) Recreational boat fishing pressure on fish communities of the shelf and shelf break of Faial and Pico Islands (Azores Archipelago): implications for coastal resource management. Acta Ichthyologica Et Piscatoria 43 (4): 267-276. https://doi.org/10.3750/aip2013.43.4.02
- Drakou E, Kermagoret C, Liquete C, Ruiz-Frau A, Burkhard K, Lillebø A, van Oudenhoven AE, Ballé-Béganton J, Rodrigues JG, Nieminen E, Oinonen S, Ziemba A, Gissi E, Depellegrin D, Veidemane K, Ruskule A, Delangue J, Böhnke-Henrichs A, Boon A, Wenning R, Martino S, Hasler B, Termansen M, Rockel M, Hummel H, El Serafy G, Peev P (2018) Marine and coastal ecosystem services on the science–policy–practice nexus: challenges and opportunities from 11 European case studies. International Journal of Biodiversity Science, Ecosystem Services & Management 13 (3): 51-67. https://doi.org/10.1080/21513732.2017.1417330
- EAA (2017) European Anglers Alliance. Marine Protected Areas and recreational fisheries: Sustainable management and benefits. https://www.eaa-europe.org/european-parliament-forum/ep-recfishing-forum-2014-2019/09-october-2017-marine-protected-areas.html
- Enriquez-Acevedo T, Botero C, Cantero-Rodelo R, Pertuz A, Suarez A (2018) Willingness to pay for Beach Ecosystem Services: The case study of three Colombian beaches. Ocean & Coastal Management 161: 96-104. https://doi.org/10.1016/j.ocecoaman.2018.04.025
- European Commission (2011) Our life insurance, our natural capital: an EU biodiversity strategy to 2020. Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of Regions, Brussels, Belgium, 17 pp.
- Fish R, Church A, Winter M (2016) Conceptualising cultural ecosystem services: A novel framework for research and critical engagement. Ecosystem Services 21: 208-217. https://doi.org/10.1016/j.ecoser.2016.09.002
- Garcia-Rodrigues J, Conides A, Rivero Rodriguez S, Raicevich S, Pita P, Kleisner K, Pita C, Lopes P, Alonso Roldán V, Ramos S, Klaoudatos D, Outeiro L, Armstrong C, Teneva L, Stefanski S, Böhnke-Henrichs A, Kruse M, Lillebø A, Bennett E, Belgrano A, Murillas A, Sousa Pinto I, Burkhard B, Villasante S (2017) Marine and Coastal Cultural

Ecosystem Services: knowledge gaps and research priorities. One Ecosystem 2 https://doi.org/10.3897/oneeco.2.e12290

- Hammerton Z (2017) Determining the variables that influence SCUBA diving impacts in eastern Australian marine parks. Ocean & Coastal Management 142: 209-217. https://doi.org/10.1016/j.ocecoaman.2017.03.030
- Jax K, Furman E, Saarikoski H, Barton D, Delbaere B, Dick J, Duke G, Görg C, Gómez-Baggethun E, Harrison P, Maes J, Pérez-Soba M, Saarela S, Turkelboom F, van Dijk J, Watt A (2018) Handling a messy world: Lessons learned when trying to make the ecosystem services concept operational. Ecosystem Services 29: 415-427. https://doi.org/10.1016/j.ecoser.2017.08.001
- Johnson T (2014) Snowball Sampling: Introduction. Wiley StatsRef: Statistics Reference Online https://doi.org/10.1002/9781118445112.stat05720
- Kobryn H, Brown G, Munro J, Moore S (2018) Cultural ecosystem values of the Kimberley coastline: An empirical analysis with implications for coastal and marine policy. Ocean & Coastal Management 162: 71-84. https://doi.org/10.1016/j.ocecoaman.2017.09.002
- Liquete C, Piroddi C, Drakou E, Gurney L, Katsanevakis S, Charef A, Egoh B (2013) Current Status and Future Prospects for the Assessment of Marine and Coastal Ecosystem Services: A Systematic Review. PLoS ONE 8 (7). https://doi.org/10.1371/journal.pone.0067737
- Maes J, Teller A, Erhard M, Condé S, Vallecillo S, Barredo J, Paracchini M, Abdul Malak D, Trombetti M, Vigiak O, Zulian G, Addamo A, Grizzetti B, Somma F, Hagyo A, Vogt P, Polce C, Jones A, Marin A, Ivits E, Mauri A, Rega C, Czúcz B, Ceccherini G, Pisoni E, Ceglar A, De Palma P, Cerrani I, Meroni M, Caudullo G, Lugato E, Vogt J, Spinoni J, Cammalleri C, Bastrup-Birk A, San Miguel J, San Román S, Kristensen P, Christiansen T, Zal N, de Roo A, Cardoso A, Pistocchi A, Del Barrio Alvarellos I, Tsiamis K, Gervasini E, Deriu I, La Notte A, Abad Viñas R, Vizzarri M, Camia A, Robert N, Kakoulaki G, Garcia Bendito E, Panagos P, Ballabio C, Scarpa S, Montanarella L, Orgiazzi A, Fernandez Ugalde O, Santos-Martín F (2020) Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment. Publications Office of the European Union, Ispra, 2020 [ISBN 978-92-76-17833-0]. https://doi.org/10.2760/757183
- Mason M (2010) Sample Size and Saturation in PhD Studies Using Qualitative Interviews. Forum Qualitative Sozialforschung / Forum: Qualitative Social Research https://doi.org/10.17169/fqs-11.3.1428
- Millenium Ecosystem Assessment (2005) Ecosystems and Human Well-being: Synthesis. Island Press [ISBN 1-56973-597-2]
- Pascoe S, Doshi A, Dell Q, Tonks M, Kenyon R (2014) Economic value of recreational fishing in Moreton Bay and the potential impact of the marine park rezoning. Tourism Management 41: 53-63. https://doi.org/10.1016/j.tourman.2013.08.015
- Pinho M, Menezes G (2009) Demersal fishery off the Azores. Boletim do Núcleo Cultural da Horta 18: 82-102. URL: www.nch.pt/biblioteca-virtual/bol-nch18/Boletim_2009-p85.pdf
- Pomeroy R, Douvere F (2008) The engagement of stakeholders in the marine spatial planning process. Marine Policy 32 (5): 816-822. https://doi.org/10.1016/j.marpol.2008.03.017

- Riera R, Menci C, Sanabria-Fernndez JA, Becerro MA (2016) Do recreational activities affect coastal biodiversity? Estuarine, Coastal and Shelf Science 178: 129-136. https://doi.org/10.1016/j.ecss.2016.05.022
- Robles-Zavala E, Chang-Reynoso AG (2018) The recreational value of coral reefs in the Mexican Pacific. Ocean & Coastal Management 157: 1-8. https://doi.org/10.1016/j.ocecoaman.2018.02.010
- Sala E, Costello C, Dougherty D, Heal G, Kelleher K, Murray J, Rosenberg A, Sumaila R (2013) A General Business Model for Marine Reserves. Columbia University https://doi.org/10.7916/d8x92n95
- Sieber IM, Borges P, Burkhard B (2018) Hotspots of biodiversity and ecosystem services: the Outermost Regions and Overseas Countries and Territories of the European Union. One Ecosystem 3 https://doi.org/10.3897/oneeco.3.e24719
- Strickland-Munro J, Kobryn H, Brown G, Moore S (2016) Marine spatial planning for the future: Using Public Participation GIS (PPGIS) to inform the human dimension for large marine parks. Marine Policy 73: 15-26. https://doi.org/10.1016/j.marpol.2016.07.011
- Torres P, Bolhão N, Tristão da Cunha R, Vieira JAC, Rodrigues AdS (2017) Dead or alive: The growing importance of shark diving in the Mid-Atlantic region. Journal for Nature Conservation 36: 20-28. https://doi.org/10.1016/j.jnc.2017.01.005
- van Riper C, Kyle G, Sutton S, Barnes M, Sherrouse B (2012) Mapping outdoor recreationists' perceived social values for ecosystem services at Hinchinbrook Island National Park, Australia. Applied Geography 35: 164-173. https://doi.org/10.1016/j.apgeog.2012.06.008
- Zhang F, Wang XH, Nunes PL, Ma C (2015) The recreational value of gold coast beaches, Australia: An application of the travel cost method. Ecosystem Services 11: 106-114. https://doi.org/10.1016/j.ecoser.2014.09.001

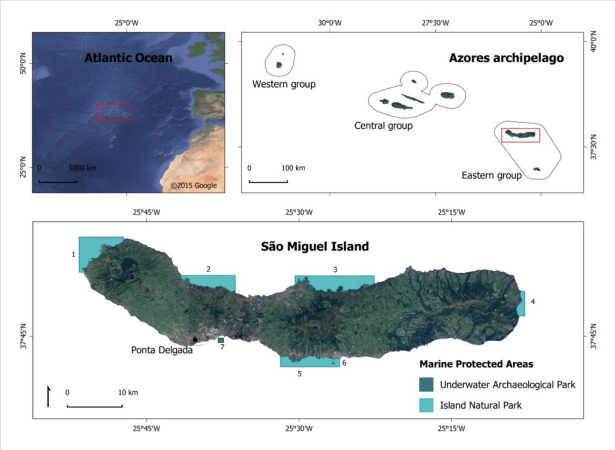

Figure 1.

Geographic location of São Miguel within the Azores Archipelago and the North Atlantic Ocean (top) and coastal MPAs (bottom): 1. Ponta da Ferraria - Ponta da Bretanha, IUCN cat. VI; 2. Porto das Capelas - Ponta da Bretanha, IUCN cat. VI; 3. Ponta do Cintrão - Ponta da Maia, IUCN cat. VI; 4. Costa Este, IUCN cat. VI; 5. Caloura - Ilhéu de Vila Franca, IUCN cat. VI; 6. Ilhéu de Vila Franca, IUCN cat. IV; 7. Dori. (Source: SIGMAR)

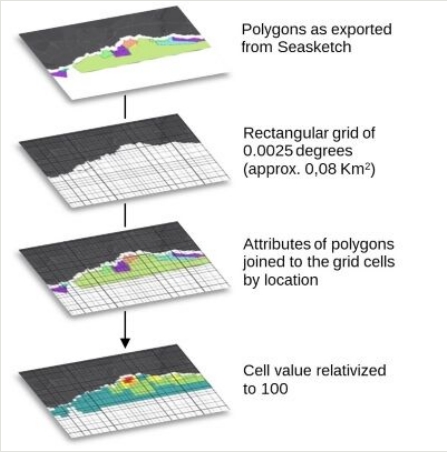

Figure 2.

Steps to convert the responses registered in SeaSketch in maps of relative value.

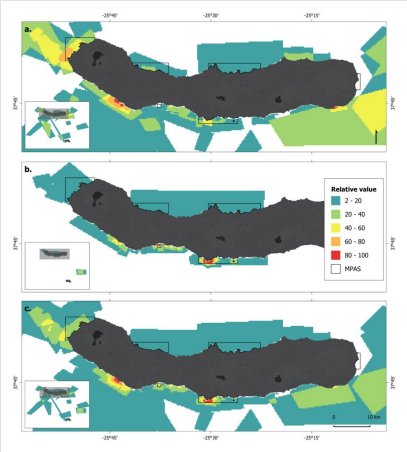

Figure 3.

Relative value of the maritime space around São Miguel Island, 2019: a. From recreational fishers' perspective; b. From recreational SCUBA divers' perspective; and c. Considering both groups together.

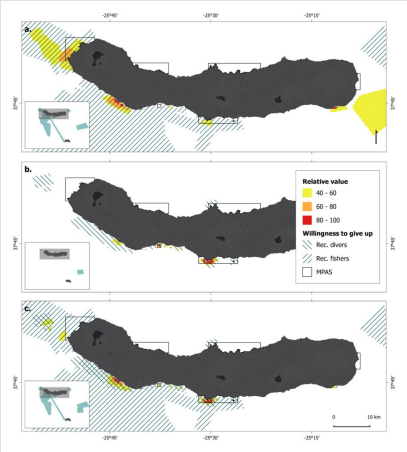

Figure 4.

Willingness to stop using valuable space for the purpose of conservation around São Miguel Island, 2019: a. From recreational fishers' perspective; b. From recreational SCUBA divers' perspective; and c. Crossing the answers of both groups.

Supplementary material

Suppl. material 1: Summary of data registered in SeaSketch

Authors: Cristina Seijo
Data type: Data collected through map-based interviews
Brief description: The file contains tables summarising the data collected through map-based interviews and registered in SeaSketch.
Download file (147.75 kb)