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Marine Conservation in the Azores: Evaluating Marine Protected Area Development in a Remote Island Context

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In the Archipelago of the Azores, over 110,000 km^2 of marine areas presently benefit from some form of protection, including a suite of coastal habitats, offshore areas, seamounts, hydrothermal vents, and large parcels of mid-ocean ridge. These areas are integrated in the recently established network of marine protected areas (MPAs), which stands as the cornerstone of Azorean marine conservation policies. This article describes and analyses the process of MPA establishment in the Azores and the current network of protected areas. Three phases of MPA development are identified, progressing from individual MPA establishment with little scientific support in the 1980s, the increasing scope of scientific research during the 1990s under European Union initiatives and the gradual implementation of an MPA network in the 2000s. Expert critical evaluation of the contemporary situation demonstrates that this network must be integrated within a wider regional marine management strategy, with MPA success being contingent upon the implementation of management plans, appropriate enforcement and monitoring, and bridging gaps in scientific knowledge.

Keywords: marine protected area establishment, island settings, networks of marine protected areas, marine policy development, marine spatial planning

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INTRODUCTION

Marine protected areas (MPAs) have been established worldwide in an effort to halt marine ecosystem degradation. Initial steps for the establishment of MPA were mainly initiated in the 1980s, with a few pioneer nations such as Australia, the USA and the islands of the Azores in Portugal. The 1980s were a time of increasing environmental concern and awareness about marine ecosystems and the severe threats they were facing, coupled with widespread belief that traditional fisheries management methods allowed the overexploitation and collapse of several fish stock (Kenchington and Agardy, 1990; Guenette et al., 1998). Around the world, many coastal nations slowly developed their own efforts to establish MPAs (Tisdell and Broadus, 1989; Jones, 2001), which were typically small individual MPAs designated with little supporting scientific advice, as the rationale behind MPA establishment was yet to be properly tested (Roberts and Polunin, 1993).

The increasing number of designated MPAs, however, came to provide a wider variety of suitable study sites to test the efficacy of MPAs in achieving ecological goals (Ballantine, 1991). Moreover,

with politicians and decision-makers demanding hard evidence to support MPA establishment, and more funding allocated for applied conservation research, MPA science received a significant boost in the 1990s (Lubchenco et al., 2003). As MPA science developed, so did the concept of using networks of MPAs to match criteria of representativeness and connectivity (Halpern and Warner, 2003). In the 2000s, upscaling into comprehensive, representative and effectively managed networks of MPAs became the plan of action recommended by the scientific community (Laffoley, 2008) and agreed by coastal nations around the world under international instruments such as the World Summit on Sustainable Development (UN, 2002), the Convention on Biological Diversity (CBD, 2006, 2010) and IUCN's World Parks Congress (IUCN, 2003).

To date, the large volume of MPA research has improved our understanding of different factors that influence MPA design, establishment and management; yet it has also revealed serious shortfalls that undermine the action of current MPAs worldwide as effective marine conservation tools. While MPAs have been described as "simple yet elegant solutions to managing complex (…) fisheries" (Anonymous, 2006), most studies reveal that their establishment and management are anything but simple, and often result in failure to achieve the goals of either biodiversity conservation or fisheries management (Edgar, 2011; Mora and Sale, 2011). Besides the underlying complexity of marine ecosystems, MPAs entail intricate socio-economic and socio-political dimensions that affect governance, public support and compliance with regulations, undermining the proper implementation of these tools. Understanding the interplay between these dimensions and how they affect MPA establishment under different settings is key to ensure future MPA success.

There is widespread recognition of the need to assist the design and implementation of MPAs in island states through improving legal, institutional and political frameworks, data availability and decision-making capacity within organizations (Fanning et al., 2009). The urgency of these actions is grounded in the high significance of marine ecosystem services in supporting island states' economic and cultural wellbeing (Niesten et al., 2012). However, progress in implementing networked MPAs has been slow in island states and most literature focuses on single MPA "success stories" (Weeks et al., 2009), rather than tracing the phases of MPA network development and thereby identifying the drivers of policy-making. Through undertaking such a task in a case study—the Azorean Archipelago—it is hoped that the specific needs and problems faced by island states tasked with the creation of MPA networks can be identified.

In the Azorean archipelago, the most isolated group of islands in the North Atlantic, the current MPA network covers 110,000 km^2 of coastal habitats, offshore seamounts, hydrothermal vents and mid ocean ridges, both within and beyond its extensive Exclusive Economic Zone (EEZ; **Figure 1**). This article traces the establishment of Azorean MPAs, taking into account the socio-economic and socio-political context, particularly in terms of marine resource use, conservation research, and administrative backdrop. The latter is particularly complex because the archipelago is an autonomous region of Portugal, which imposes shared sovereignty and is itself a member of the European Union

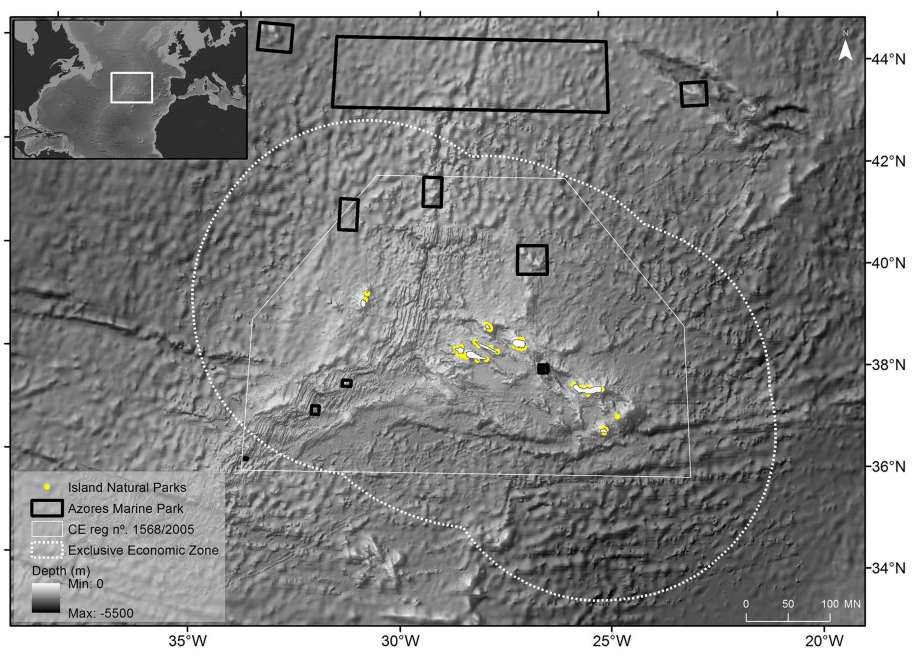

FIGURE 1 | The Archipelago of the Azores, located in the mid-North Atlantic, including the distribution of bathymetries and the current marine protected areas included in the Island Natural Parks and the Azorean Marine Park. The map also shows the limits of the Azorean Exclusive Economic Zone (EEZ) and the no-trawl area imposed by EU regulations (CE reg. 1568/2005). *Graphics: R. Medeiros ©ImagDOP.*

(EU). Consequently, the Regional Government is empowered to make decisions and produce environmental legislation, but these must be aligned with national, European and international policies and agreements.

We argue that Azorean MPAs have gone through three distinct phases which roughly coincide with the development of MPAs worldwide: the early establishment of isolated MPA with little scientific support, an intermediate phase dominated by international (EU) initiatives that promoted scientific research and conservation policies, and finally an integrative approach to conservation that led to the establishment of a regional MPA network. Tracing back the history of MPA establishment in the Azores allowed us to undertake a comprehensive critical analysis that reflects how the strengths and weaknesses of the current MPA network have arisen and how external factors that affect this MPA network have developed. This critical analysis reveals that this MPA network is of key importance to the Azores, as it provides several opportunities to enhance marine conservation, reduce user conflicts, and promote sustainable development and research. Yet, it also shows that to achieve conservation goals, this network must be effectively implemented and integrated into a wider marine management strategy for the region. From the analysis, we make recommendations regarding future directions for Azorean MPAs, and draw conclusions about the significance of the lessons learned for the science and policy of marine reserves globally.

METHODS

Review of Azorean MPA Establishment

We conducted an extensive literature review to trace the development of MPAs in the Azores and the context in which this occurred. This encompassed legislation at the European, national and regional levels, government reports and gray literature along with scientific publications. Eleven key government officers and 10 researchers who have been mostly involved in MPA establishment in the Azores assisted in the identification of relevant information sources. To illustrate the overall trend in the production of scientific knowledge to support marine conservation, we conducted a simple bibliometric analysis in which every article listed on the Web of Knowledge that included the words "marine" and "Azores" as topics was examined. Of the initial 437 articles returned by the Web of Knowledge on a search conducted on September 24 2015, we identified 256 articles that focused on the Azorean marine environment.

Critical Evaluation of the Current Azorean MPA Network

Two strategic tools commonly used in business studies were used to critically evaluate the current Azorean MPA network. A SWOT (strengths, weaknesses, opportunities, threats) analysis was used to link internal and external factors that influence the MPA network, enabling the identification of strategic options and considerations for its successful implementation. It included an internal analysis, which identified characteristics of the MPA network that work particularly well (strengths) and specific features that compromise its goals (weaknesses), and an external analysis highlighting external factors that positively (opportunities) or negatively (threats) affect the MPA network. SWOT analysis is limited as a stand-alone tool because it may ignore important external factors, especially in broader contexts (Henry, 2008). Therefore, we combined it with a PESTLE analysis, which facilitated the wider scan of real and potential factors inherent to the overall context surrounding the MPA network. PESTLE identified the external factors included in the SWOT, using the prompts: Political-administrative, Economic, Social, Technology-research, Legal and Environmental. Both analyses were conducted over two consecutive focus groups composed of four experts in Azorean marine conservation research, which took place in October and November of 2012. All factors from both analyses were discussed between the experts until consensus was reached and consubstantiated by current available research.

AZOREAN MPAs

The 1980s – First Azorean MPAs

The Azores were a poor and isolated region when they were granted autonomy in 1976. To overcome this, socio-economic development was promoted and communications improved through both aerial and maritime transport linkages. Exploitation of marine resources was encouraged through financial incentives designed to increase the number of larger and better equipped fishing boats. New markets developed, fish value increased and extractive activities such as fishing and harvesting evolved from subsistence activities to business operations. Throughout the 1980s, catches significantly increased, new species and fishing grounds were exploited and the fishing season was extended (Gordon et al., 2003). Marine extractive activities were regulated to promote the rational management of stocks and the effective control of fishing activities, and several exploited species were provided with legal protection, which either banned their capture or set minimum size limits. Nevertheless, drastic declines of limpet populations in the late 1980s were early signs of overexploitation (Santos et al., 1990).

Environmental protection services were underdeveloped, understaffed and limited to a small office within the regional administration. Nevertheless, during the 1980s eight MPAs were established under the 1976 Portuguese national legal framework that defined different types of protected areas. The first one included a small coastal no-take MPA (0.01 km^2) that would correspond to the International Union for Conservation of Nature (IUCN) category I, and it was the only Azorean MPA for which a specific management plan was developed. The remaining MPAs were designated marine reserves (IUCN category VI), as they imposed certain limitations to specific activities to promote the sustainable use of marine resources. These MPAs consisted of one relatively large offshore reef (ca. 378 km^2), and six small coastal sites ranging in size from 0.05 to 4.5 km^2 (**Table 1**).

These early MPAs were mostly "paper parks," reflecting (a) limited data availability relating to the marine environment; (b) absence of an overall plan for MPA implementation; (c) emphasis

TABLE 1 | Marine protected areas (MPAs) established in the Archipelago of the Azores between 1980 and 2015, both within and beyond the Exclusive Economic Zone (EEZ), and including those MPAs legally established and driven by the Regional Government, included in NATURA 2000, and recognized by the OSPAR Commission and UNESCO.

Marine Protected Areas (MPAs) in the Azores		Period		
		1980–1989	1990–1999	2000–2015
Total number of designations		8	24	79
Total protected area (km^2)	Inside EEZ	384.08	435.59	11,175.04
	Outside EEZ	–	–	100,206.54
REGIONAL GOVERNMENT MPAs				
Total number	Inside EEZ	8	8	40
	Outside EEZ	–	–	4
Total protected area (km^2)	Inside EEZ	384.08	384.08	11,175.04
	Outside EEZ	–	–	100,206.54
Minimum MPA area (km^2)	Inside EEZ	0.05	0.05	0.10
	Outside EEZ	–	–	22.15
Maximum MPA area (km^2)	Inside EEZ	377.14	377.14	4013.00
	Outside EEZ	–	–	93,568.00
NATURA 2000				
Total number		–	16	18
Total protected area (km^2)		–	87.59	372.72
Minimum MPA area (km^2)		–	0.50	0.50
Maximum MPA area (km^2)		–	35.94	190.23
OSPAR NETWORK OF MPAs				
Total number	Inside EEZ	–	–	7
	Outside EEZ	–	–	4
Total protected area (km^2)	Inside EEZ	–	–	5674.15
	Outside EEZ	–	–	100,206.54
Minimum MPA area (km^2)	Inside EEZ	–	–	95.00
	Outside EEZ	–	–	22.15
Maximum MPA area (km^2)	Inside EEZ	–	–	4012.53
	Outside EEZ	–	–	93,568.00
UNESCO BIOSPHERE RESERVE				
Total number		–	–	3
Total protected area (km^2)		–	–	750.13
Minimum MPA area (km^2)		–	–	55.10
Maximum MPA area (km^2)		–	–	445.03

on top-down implementation and absence of community participation; (d) lack of management plans for individual MPAs; and (e) scarcity of resources allocated for enforcement (Martins and Santos, 1988; Santos et al., 1995b). To overcome these shortcomings, Martins and Santos (1988) pointed out the need to reform the regional environmental strategy and legal framework, and suggested the creation of a regional organization that could be responsible for MPA management and the articulation with other regional, national and European conservation institutions.

The scarcity of scientific data reflects the fact that most fieldwork was conducted by institutions based outside of the Azores and occurred only occasionally (Santos et al., 1995a). Nevertheless, some fieldwork conducted at this time was instrumental in recommending MPA establishment in the Azores (Saldanha, 1988). The founding of the University of the Azores in 1976 promoted the deployment of permanent researchers in the Archipelago, enhancing the region's capacity for scientific research (Santos et al., 1995b). Furthermore, following Portugal's accession to the EU in 1986, European funds became available for the development of a regional environmental strategy, including the necessary baseline research. The first EU-funded conservation project in the Azores—project BIOTOPES—identified and characterized 55 sites of community interest that were later used to establish protected areas (Vasconcelos and Gomes, 1988). **Table 2** summarizes the main marine conservation research projects carried out in the Azores.

The 1990s – EU-Driven Initiatives

The 1990s were a period of rapid socioeconomic development due to capital transfers, subsidies and tax exemptions aimed at developing the EU's ultra-peripheral regions. Commercial fisheries in particular experienced a phase of full exploitation as a result of fisheries enhancement policies developed in the previous decade, along with improvements in fisheries knowledge, technology and market conditions. The number of fisheries regulations increased and the EU's Common Fisheries Policy was put into practice. Due to the collapse of Azorean limpet populations in the 1980s (Santos et al., 1990), the Fisheries Department established limpet reserves for every island in 1993. Nevertheless, a combination of poor enforcement and high commercial pressure brought this resource close to commercial extinction (Santos et al., 2010). Tourism was another economic activity that significantly increased during this decade as specific economic policies targeted this sector (De Menezes et al., 2008). The first marine tourism operators were established early in the decade, specializing in whale-watching, scuba-diving and big-game fishing.

Several advances in marine conservation took place in the 1990s. Firstly, its political relevance increased with the creation of a regional government department dedicated to environmental issues. Secondly, based on national laws, a regional legal framework for protected areas was defined in 1993, which promoted the establishment of a regional network of protected areas and defined regional administrative procedures, management entities, and a new classification system. The pivotal move was the implementation of EU environmental policies, particularly the NATURA 2000 network of protected areas. This was a major impetus for the systematic and integrated approach to environmental conservation and led to the preliminary designation of 23 Sites of Community Importance in 1998, 16 of which included or consisted of marine areas totalling around 90 km^2 (**Table 1**). However, NATURA 2000 was a long, bureaucratic and demanding process, so final designations and specific regulations would only be produced in the following decade.

As the ocean became a central theme in the Portuguese public arena in the 1990's, decision makers recognized its key role for future socio-economic development and implemented important marine-related governmental policies and programs,

TABLE 2 | Scientific projects carried out in the Archipelago of the Azores that focused on marine conservation and provided relevant outputs for the establishment of marine protected areas in the region, including their main funding sources and institutions involved.

Date	Project	Funding institutions	Research institutions	Main objectives and outputs for marine conservation in the azores
1986–1987	Biotopes	EU	GovAzores; Parks and Reserves National Services	Identification of 55 biotopes as Sites of Community Interest
1995–1998	Seabird Conservation *"Conservation of marine birds and their habitats in the Azores"*	EU RGAzores	UAc; GovAzores; RSPB, University of Glasgow	Seabird conservation actions (public outreach; data collection; standardization of monitoring methodology)
1996–1998	TURISUB "*Studies for the development of underwater tourism of the Azores"*	RGAzores	UAc/IMAR	Data collection
1996–1999	CLIPE "*Climatic effects on the ecology of littoral fishes*"	EU GovPortugal	UAc/IMAR	Data collection, standardization of coastal fish monitoring methodology
1998–2003	MARE *"Integrated management of coastal and marine zones in the Azores"*	EU RGAzores	UAc/IMAR RGAzores	Management plans for NATURA 2000 areas; public outreach; data collection; socioeconomic studies
1999–2002	Bird Atlas *"New Atlas of Birds Nesting in Portugal"*	EU	SPEA; RGAzores	Data collection; revision of regional network of SPAs
1999–2003	MAROV *"Coastal marine habitats, thematic mapping of the seabed using GIS, AUV and ASV"*	GovPortugal	UAc/IMAR, Instituto Superior Técnico	Acoustic and visual mapping of marine habitats and biodiversity, including within SCIs
2001–2004	MAREFISH *"Marine Protected Areas of the Azores: Effects on Fish Communities"*	EU GovPortugal	UAc/IMAR	Evaluation of MPAs benefits on fish communities; data collection on fish dispersal and MPA connectivity
2002–2005	CETAMARH "*Ecology and population structure of bottlenose dolphins and sperm whales in the Azores"*	EU GovPortugal	UAc/IMAR	Collection of baseline data to adapt the Azorean Marine Park management model to cetacean conservation
2002–2005	OASIS *"Oceanic Seamounts: an Integrated Study"*	EU	UAc; IMAR, (+8 international partners)	Site-specific management plan for Sedlo seamount
2003–2006	OGAMP *"Planning and Management of Marine protected Areas"*	EU RGAzores	UAc/IMAR; RGAzores	Integrated management plans for NATURA 2000 areas; public outreach; data collection; socioeconomic studies
2004–2006	PARQMAR *"Characterization, planning and management of marine protected areas in Macaronesia"*	EU	UAc	Management plan proposal for NATURA 2000 areas; data collection; socioeconomic studies; public outreach
2004–2008	MARMAC and MARMAC II *"Knowledge, promotion and valorization for a sustainable use of MPAs"*	EU	UAc/IMAR; Nauticorvo; RGAzores	Environmental education and awareness campaigns; preparation of educational tools; baseline data collection
2004–2008	MARINE IBAs *"Important Areas for the Seabirds in Portugal"*	EU ICNB	SPEA; UAc/IMAR; Birdlife International	Identification of 11 Azorean marine IBAs; data collection
2005–2008	EMPAFISH *"Marine Protected Areas as tools for fisheries management and conservation"*	EU	UAc (+13 international partners)	Integrating Azorean case-studies in European MPA research
2009-	CONDOR *"Observatory for Long-Term Study and Monitoring of Azorean Seamount Ecosystems"*	EEA	UAc; IPIMAR; Institute of Marine Research (Norway)	MPA establishment with stakeholder participation; data collection to improve management of seamounts; public outreach
2007-	CORALFISH *"Assessment of the interaction between corals, fish and fisheries, in order to develop monitoring and predictive modeling tools for ecosystem based management in the deep waters of Europe and beyond"*	EU	IMAR (+16 international partners)	Data collection to improve management of deep-sea habitats
2007-	MADE *"Mitigating Adverse Ecological Impacts of Open Ocean Fisheries"*	EU	UAc/IMAR (+12 international partners)	Data collection to propose measures to mitigate adverse impacts of open ocean fisheries
2009-	CORVO and VILA FRANCA *"Sanctuary Islands for Seabirds"*	EU RGAzores	SPEA; RSPB; Corvo Municipal Council	Recovery of seabird habitats; public outreach
2009-	DEEPFUN *"Biodiversity and functioning of the deep-sea hydrothermal field Menez Gwen–a contribution to management policies"*	EU GovPortugal	UAc/IMAR; RGAzores; University of the Algarve; EMEPC	Data collection to improve management of hydrothermal vent fields

EMEPC, Task Group for the Extension of the Portuguese Platform; EU, European Union; GovPortugal, Government of Portugal; IMAR, Institute of Marine Research; RGAzores, Regional Government of the Azores; RSPB, Royal Society for the Protection of Birds; SPEA, Portuguese Society for the Study of Birds; UAc, University of the Azores.

many of which contributed to a substantial investment in marine sciences using both national and EU funding sources (Costa and Gonçalves, 2010). As a result, the number of scientific projects gathering baseline information for MPA establishment in the Azores significantly increased from the mid-1990s onwards (**Table 2**). Most projects received funding from EU programs and were led by the University of the Azores, usually in close collaboration with the Regional Government. They set monitoring methodologies, initiated regional-scale awareness campaigns, and included the first consistent efforts to involve local communities in marine conservation through information outreach, education and stakeholder engagement.

The 2000s – Toward an Integrated Approach to Marine Conservation

Throughout this decade, social and economic indicators greatly improved and marine-related activities became more relevant to the regional economy. Azorean fisheries showed increasing catches and profits in the early 2000s (Pham et al., 2013) as a result of higher fishing effort and the expansion of fishing grounds. Despite earlier warnings that some fish stocks were depleted or entering overexploitation (Santos, 1999), the Regional Government implemented a program of incentives in the mid 2000's to renew the commercial fleet, which served to increase fishing effort as vessels were able to operate for longer periods and travel greater distances. By the end of the decade, important demersal fish species were considered to be approaching a critical level of exploitation. Recreational fishing developed to the point of exerting considerable pressure on marine resources (Pham et al., 2013), as the number of recreational boats increased almost fourfold during this decade (www.estatistica.azores.gov.pt). As for tourism, the incentives and policies previously adopted resulted in the industry's rapid growth. With greater number of tourists, the number of licensed marine tourism operators increased and diversified into activities like boat tours and rentals, fishing, scuba-diving, shark-diving and whale-watching (Ressurreição and Giacomello, 2013).

The strong investment in marine science initiated in the previous decade resulted in the proliferation of marine conservation research projects during the 2000s (**Table 2**). This trend is also illustrated by the significant increase in the number of peer-reviewed scientific articles published yearly on the Azorean marine environment as of 2000 (**Figure 2**). The EU remained the leading funding source for marine conservation research projects (**Table 2**). Likewise, the University of the Azores, in association with the Institute of Marine Research ("Instituto do Mar"–IMAR), remained the leading research institution, participating in 75% of projects, while the participation of environmental NGOs and international partnerships increased. The main outputs of these research projects were baseline data and recommendations that were used for establishing the boundaries and regulations of current Azorean MPAs. The increasing desire to promote public support for MPAs is reflected in the inclusion of public outreach and stakeholder participation activities in most projects' goals. In addition, several projects incorporated the monitoring of MPAs that had been initiated in the 1990s, filling the gap of a long-term monitoring plan in the region.

International Conservation Tools

In the latter half of the 2000s, the Regional Government worked toward including international programs and specific agreements in its environmental conservation strategy. Between 2007 and 2009, UNESCO approved the applications submitted by the Regional Government to the Man and Biosphere Program, recognizing the islands of Corvo, Flores and Graciosa and their surrounding marine environment as Biosphere Reserves (**Table 1**). As the Regional Government would assure enforcement, these different zones were defined so that they matched official plans for marine conservation in those islands.

In a joint effort between the Regional Government, the University of the Azores and, and at a later stage, the Task Group for the Extension of the Portuguese Continental Shelf, several applications were submitted to the OSPAR Commission. Between 2006 and 2011, OSPAR included 11 Azorean MPAs in its network of MPAs (**Table 1**): seven within national waters and four outside national jurisdiction but within the limits of the areas proposed for legal continental shelf extension that Portugal submitted to the United Nations Commission on the Limits of the Continental Shelf. Eight of these OSPAR MPAs incorporated the protection of the seafloor and sub-seafloor for two coastal areas, three seamounts and two hydrothermal vent fields within the EEZ, and for an additional hydrothermal vent field located outside the EEZ. The latter, named "Rainbow" was the first national MPA to have been proposed under the high seas and accepted by OSPAR. This made Portugal, and particularly the Azores, a pioneer in the protection of marine biodiversity at an international level (Ribeiro, 2010) and a progressive player that helped to progress the ground-breaking OSPAR high seas MPAs process. These eight MPAs encompassed a set of priority habitats like sponge aggregations, hydrothermal vent fields, deep-sea coral gardens and reefs, and species like the long lived and late maturing orange roughy, reflecting the growing importance and knowledge of deep-sea ecosystems. During the 2010 OSPAR ministerial meeting in Bergen (OSPAR, 2010), OSPAR adopted measures to establish and manage the high seas superjacent to the seabed of three areas (Altair, Antialtair, and the Mid-Atlantic Ridge North of the Azores) as OSPAR MPA. This complemented the measures for management of these MPAs reported by Portugal to the OSPAR Commission as components of the OSPAR network of MPAs, which were integrated into the Azores Marine Park. The collaboration between OSPAR and Portuguese entities toward the development of common management strategies for these three MPAs located outside the Azorean EEZ was also a ground-breaking step for the establishment of OSPAR's Network of High Seas MPAs (O'Leary et al., 2012) and was welcomed as significant progress at the inter-ministerial OSPAR meeting in Bergen.

EU initiatives

Following the development of a legal Sectorial Plan, based on studies undertaken by the University of the Azores and

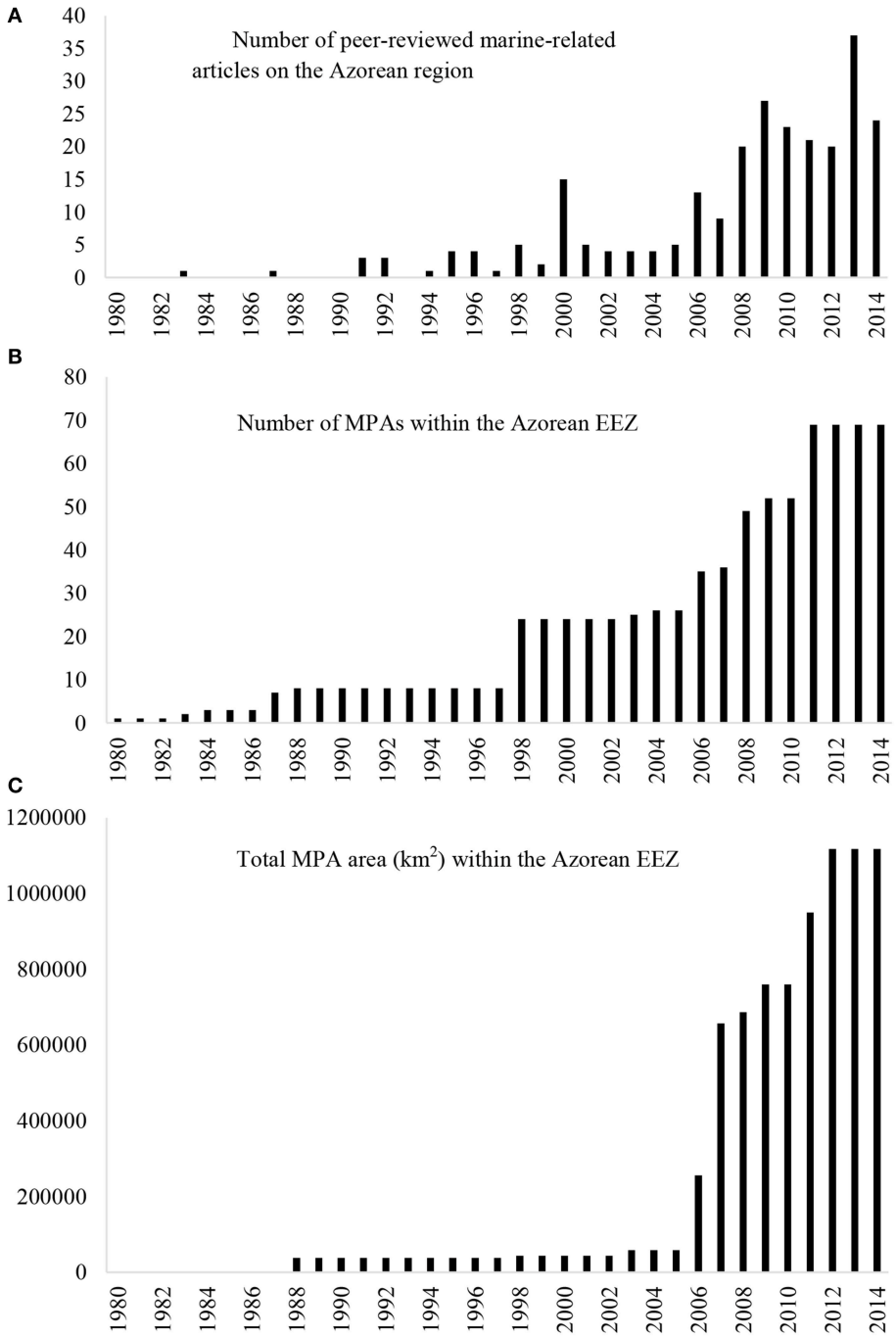

FIGURE 2 | Main marine conservation trends in the Archipelago of the Azores since 1980. (A) number of peer-reviewed scientific articles about the Azorean marine environment published each year; **(B)** total number of MPAs in force each year within the Azorean Exclusive Economic Zone (EEZ); **(C)** total MPA area (km^2) in force each year within the Azorean EEZ.

the Portuguese Society for Study of Birds, the NATURA 2000 protected areas were formally recognized and established by the Regional Government and the EU. In addition, two new Azorean MPAs consisting of hydrothermal vent fields were designated, increasing the number of NATURA 2000 MPAs to 18 (**Table 1**).

Regional Conservation Tools

Under the legal framework approved in 1993, the Regional Government embarked on the creation of a Regional Network of Protected Areas by reclassifying existing MPAs and establishing the first Regional Natural Park in Corvo Island, which included the island's entire marine surrounding. However, the 1993 legal

framework proved to be ill adapted to the Azorean administrative backdrop. There was no coherence nor territorial integration in the way that protected areas within this network were organized (Calado et al., 2009), and this was worsened with the introduction of a wider range of legal tools including NATURA 2000 and OSPAR MPAs. As each protected area was created and regulated by regional decree, it involved a tremendous legislative effort. Furthermore, the institutional organization was complex, as the attribution of responsibilities presented both gaps and overlaps (Calado et al., 2009) and did not include spatial management tools created outside the Environmental Department.

To overcome these difficulties, the legal framework was reviewed in 2007 to standardize the diversity of designations into IUCN categories and to establish a management model adapted to the Archipelago's geographic and administrative conditions. This new model integrated all existing protected areas, including the early 1980's MPAs, NATURA 2000 and OSPAR MPAs, and other spatial tools such as the limpet reserves and coastal zone management plans. It also integrated new protected areas that resulted from significant advances in scientific knowledge or were necessary to assure the ecological continuity of ecosystem services and functions (Calado et al., 2009), such as Important Areas for Birds identified by project MARINE IBAs (**Table 2**). This way, two pivotal tools for spatial management were established in the Azores between 2008 and 2011: (1) a network of nine Island Natural Parks, autonomous in management and including all terrestrial and coastal MPAs within territorial waters, and (2) the Azorean Marine Park, including all MPAs located outside the territorial sea. As a result of this reorganizing process, the total marine area under protection increased substantially because the new MPAs units were enlarged and their limits simplified into polygon shapes. In total, they include 44 MPAs covering more than 10 thousand km^2 (1.12%) of Azorean waters and over 100 thousand km^2 of the continental shelf outside the Azorean EEZ (**Table 1**), which constitutes a major increase in MPA number and total area comparing with the previous decades (**Figure 2**).

CRITICAL ANALYSIS OF AZOREAN MPAs

The recently established MPA network described in the previous section is now the cornerstone of Azorean marine conservation policies. In this section, we conduct a critical analysis of the current Azorean MPA network and identify factors that might influence its future success. The results of this analysis are summarized in **Table 3** and are discussed below.

Strengths and Weaknesses

The relatively healthy Azorean marine environment, geographically distant from significant pollution sources and with limited coastal construction, is a significant strength of Azorean MPAs. Another major asset is the completion of the legislative process that established the Azorean Network of Protected Areas, as a clear legislative framework defining conservation goals has been found to be an important governance attribute to MPA establishment (Osmond et al., 2010). Moreover, this process introduced several conservation measures for Azorean MPAs, like strict regulation of activities that disrupt the seafloor (mineral extraction and depositing, equipment installment), exclusion of certain fishing activities and establishment of governmental authority over specific economic and research activities. For small island contexts, the Azorean MPA establishment process is pioneering in achieving a representative coverage of a full range of ecosystems habitats and vulnerable marine environments whilst enabling the establishment of large offshore MPAs both within and beyond the Azorean EEZ (Glowka, 2003; Ribeiro, 2010; Ribeiro and Santos, 2010; O'Leary et al., 2012). It leveraged itself on the involvement of recognized international organizations and programs such as OSPAR, UNESCO, and NATURA 2000, providing international recognition for the region's conservation efforts. The involvement of the scientific community was a major strength because it resulted in a large volume of MPA research and baseline data, providing the basis for much of the design of the Azorean Marine Park and some other MPAs (Calado et al., 2011). Finally, the design of some MPAs included the views and interests of local stakeholders (Abecasis et al., 2013a), a feature that is widely advocated as essential for MPA success (Reed, 2008). Moreover, the legal requirement to develop Consulting Councils for each Island Natural Park is an important step toward stakeholder participation in MPA management.

As for weaknesses, MPAs comprise only 1.12% of Azorean waters, which is considerably lower than the minimum 10% coverage considered necessary to ensure marine conservation established in the Aichi Biodiversity Targets (CBD, 2010). Effective marine conservation is impaired by shortcomings in the design of coastal MPAs, as they lack the appropriate ecological criteria and forecast necessary to maximize spill-over, connectivity, and the potential net benefits of MPAs. Moreover, current no-take areas are unlikely to achieve significant conservation goals because they are small and limited in number. This situation is worsened by the absence of management plans and the allocation of limited resources for enforcement and long-term monitoring plans, which derive from limited funding for MPA implementation. Consequently, Azorean MPAs so far have had little influence on the previously exploited populations within their limits (Schmiing et al., 2014). Weaknesses also include social factors, as most of the MPAs established in the Azores over the past three decades included low levels of community involvement and insufficient provision of public information throughout the process (Calado et al., 2011). Moreover, the profusion of MPA designations that resulted from the different phases of MPA establishment described in Section Methods undermined the public understanding of MPAs (Abecasis et al., 2013a).

Opportunities and Threats

Political and Administrative Factors

Recent regional policies and legislation aim at reconciling economic and social development with marine environment conservation. This vision of sustainable development has been a basic principle not just for MPA establishment, but also for the regulation of different economic activities (e.g., aquaculture, mineral extraction, tourism, fisheries). At an international level,

TABLE 3 | Summary of the critical analysis of the current Azorean MPA network, including identified internal factors (strengths and weaknesses) and external factors (opportunities and threats provided by the different PESTLE factors: political and administrative, legal, economic, social, environmental, and technology and research).

	Strengths	**Weaknesses**
	Healthy marine environment Legal basis for the Azorean Network of Protected Areas Azorean MPA establishment considered pioneer Representativeness Large offshore MPAs Involvement of international organizations and programs Involvement of scientific community Science-based process Incorporation of stakeholder's interests in MPA design in some cases Legal requirement for stakeholder consultation	Only 1.12% of EEZ is legally protected MPA design in most PNI is largely inadequate Small and very few no-take areas Current absence of management plans Low resources for enforcement and monitoring plans Weak community involvement and information Profusion of MPA designations
	Opportunities	**Threats**
Political and administrative	International political incentives for MPA establishment Regional policies follow vision of sustainability	Conflicting within different governmental sectors Inadequate governmental structure for marine issues Lack of political will
Legal	Current MPA legal framework Development of legislation on marine spatial planning	History of unregulated MPAs in the region Legal obstacles to cooperation between different agencies
Economic	Sustainable practices of Azorean commercial fisheries MPAs as fisheries management tools High potential to develop ecotourism in the region Promoting ecotourism activities and products Applying precautionary principle to economic activities Spatial mediation of conflicts between economic activities Introducing mitigating measures to economic activities	Over-exploitation by commercial fisheries Reducing available fishing grounds Increasing economic pressure to develop mineral extraction Sporadic impacts of shipping activities Potential threats from developing economic activities
Social	Maintaining recreational extractive activities at sustainable levels High public awareness about conservation issues Potential to increasing public awareness on marine conservation Mediating spatial conflicts between users and stakeholders Improving environmental standards and quality of life	Increasing pressure from extractive recreational activities Low levels of compliance
Environmental	Partial protection of migratory species Partial protection of seabirds Protection of Vulnerable Marine Ecosystems	Invasive species Migratory and highly mobile species Seabird species Vulnerable Marine Ecosystems
Technology and research	Independent research assists in MPA monitoring Research progress may improve MPA design VMS technology MPAs provide research opportunities	Knowledge gaps Reduced expression of social sciences Low levels of interdisciplinary research

approval of the Marine Strategy Framework Directive was a step toward the application of ecosystem-based management in EU waters (Markus et al., 2011), in which the establishment of an ecologically representative network of MPAs is instrumental. National commitments under the Biodiversity Convention and OSPAR also provide key political incentives for MPA establishment (Marinesque et al., 2012; O'Leary et al., 2012).

However, Azorean MPAs are also affected by political and administrative constraints. Governance is not just vertically fragmented (UE, national, regional, and local levels of government), but also horizontally fragmented, with different administrative departments providing competences and representing different interests in marine issues (e.g., Environment, Fisheries, Tourism, Science, and Technology). Conflicts often arise as different departments, pressured by different lobbying groups, have contradictory strategies and agendas. In particular, fisheries and environmental agencies are frequently in opposition. Furthermore, this government structure entails fragmented and overlapping jurisdictions. For instance, although several enforcement agencies operate in Azorean marine areas, as each agency has specific and different jurisdictions and inter-agency cooperation is low, the amount of resources required for enforcement is tremendous. This is a typical problem of overly-bureaucratic administrative systems (Rodríguez-Martínez, 2008; Gerhardinger et al., 2011) and a frequent excuse for sub-optimal MPA effectiveness. Finally, as

MPAs entail controversial measures there is little political will to implement them, a common threat to European MPAs (Fenberg et al., 2012) that results in limited funding and, consequently, the absence of management plans and insufficient resources.

Legal Factors

The initial legal framework for MPA establishment failed by protecting isolated natural values, without considering environmental conservation as a whole. The 1993 legal framework that replaced it introduced the concept of protected area network, yet it failed to consider the complexity and administrative constraints underlying multiple types of protected areas. The 2007 review of this legal framework improved the legal process and provided opportunities for MPA success. By integrating every spatial management tool into island units and a wider Marine Park, it defined a management model adapted to the region's geographic and administrative conditions. By standardizing the many designations developed under different legal contexts, it simplified MPA objectives and how they are perceived. Finally, by including international and EU-driven conservation into the regional legal system, it assured that they are perceived as legally binding regulations by the public (Calado et al., 2011).

Presently, the Regional Government is developing marine spatial management plans. These should strengthen the role of MPAs as effective conservation tools while addressing common MPA shortfalls and reducing the gap between MPAs and fisheries management (Agardy et al., 2011). On the negative side, the conservation impact of most Azorean MPAs was seriously undermined because legally required management plans were never developed. Consequently, many stakeholders perceived them as "paper parks" and doubted that they would be implemented (personal observation). In matters of enforcement, inter-agency cooperation is frequently limited by the legal assignment of specific jurisdiction to enforcement agencies.

Economic Factors

Commercial fishing, tourism and marine transports represent sectors of economic activity of significance with respect to marine conservation in the Azores. MPAs are compatible with the environmental practices of Azorean commercial fisheries. Of the regional commercial fishing fleet, 90% is comprised of the small-scale sector, which employs more people, achieves higher landed volume and value, is less fuel intensive than the large-scale sector and has greater capacity to adapt to the changing economic, ecological, and social circumstances that stem from establishing MPAs (Carvalho et al., 2011). Moreover, Azorean fisheries have received renowned ecological certifications for the use of non-destructive fishing techniques. These practices have led regional authorities to legally contest the 2003 EU's Decision of opening Azorean waters to EU fishing fleets on the basis that it would enable the entry of industrial fleets using destructive fishing practices not allowed in the region. Consequently, the EU banned deep-sea trawling and other netting gears in Azorean waters to assure the protection of vulnerable ecosystems (**Figure 1**; Morato et al., 2010). These environmental practices, however, have not prevented the high exploitation levels that now threaten the region's marine resources, including within MPAs. With appropriate planning, management and evaluation, MPAs have the potential to improve fisheries management (Agardy et al., 2011) and may help achieve the sustainability goals set for this economic activity, even though they are likely to affect fisheries by reducing available fishing grounds.

Tourism has developed to become the main tertiary activity in the Azores (Soukiazis and Proença, 2008). Its sustainable development is assured through regional policies and legislation that regulate and manage marine tourism activities, and promote environmental conservation and education. Brand-awareness campaigns promote the islands as premium nature destinations, in which marine activities are major attractions. The region's potential to develop eco-tourism is an opportunity for Azorean MPAs because it provides alternative and supplementary livelihoods to extractive activities (Pollnac et al., 2001; Peterson and Stead, 2011). MPAs can add value to eco-tourism activities; for example, the recognition of Azorean natural assets by UNESCO and OSPAR have reinforced the Archipelago's image in the international tourism market. In addition, MPAs benefit tourism by maintaining healthy marine environments (Hall, 2001), and managing and promoting nature-oriented activities and certified local produce.

Marine transports are key for the Azorean economy, which like other remote islands depends on them for most import and export activities (marine shipping) and for passenger traffic, (mainly inter-island). However, marine transports can result in sporadic incidents such as oil pollution, collisions with marine mammals, and in the Azores are believed to have introduced invasive species (Cardigos et al., 2006; Amat et al., 2008). Other key economic activities also pose actual or potential threats to the Azorean marine environment, although it is unquestionable that their development is essential for the regional economy. Mineral resource exploitation significantly impacts the seabed and associated ecosystems. In Azorean inshore waters, sand dredging has been conducted despite the region's limited resources and its impacts on coastal habitats. There is also increasing economic interest to exploit Azorean deep-sea minerals, an activity that threatens the ecosystems where they are found, including hydrothermal vents and seamounts (Van Dover, 2011; Santos et al., 2012; Collins et al., 2013). MPAs are opportunities to protect these vulnerable ecosystems and, together with recent regional legislation, have applied the precautionary principle to this developing economic activity (Davies et al., 2007). Activities such as aquaculture and renewable energy generation hold promise of economic growth for the Azores, but may also cause negative environmental impacts (Read and Fernandes, 2003; Grecian et al., 2010). For all economic activities, however, MPAs are tools for reducing spatial use conflicts and introducing mitigating measures.

Social Factors

The marine environment is deeply rooted in Azorean livelihoods and culture (Ressurreição et al., 2012c). Recent studies show that most Azorean people consider marine conservation a priority and are willing to pay to avoid loss of marine biodiversity (Ressurreição et al., 2011, 2012a), both essential

attitudes for MPA success. Conversely, MPAs may be used to increase environmental awareness regarding marine issues and sustainable development. They also provide opportunities to reduce conflicts between different users and stakeholders, improve environmental conditions and enhance quality of life in general. With improved coastal access and a growing number of private boats, recreational activities are widely popular, but the intensification of extractive activities like fishing, spear-fishing and harvesting threatens coastal marine resources (Diogo and Pereira, 2013a,b). While regional regulations like closures, minimum sizes and protected species have decreased their negative impacts, MPAs may facilitate maintenance of these activities at sustainable levels (McPhee et al., 2002). Unfortunately, compliance with regulations amongst Azorean recreational fishers is low, which is a threat to MPA success.

Environmental Factors

Invasive species represent a distinct threat to the isolated Azorean marine ecosystems. For example, in <10 years the invasive algae *Caulerpa webbiana* has caused major benthic landscape disruptions in coastal areas of Faial Island, some inside MPAs (Amat et al., 2008). Other environmental factors represent serious challenges for successful MPA design. Azorean MPAs cannot fully protect the populations of a large number of migratory cetaceans, sea turtles, seabirds, and fish species that visit the archipelago, many of which are considered threatened under the IUCN Red List, the Bern Convention and NATURA 2000 Annexes, because only part of their life cycle is spent within Azorean waters. Seabird conservation is rendered even more difficult as seabirds face a suite of threats to their nesting colonies on land, especially invasive predators and light-induced mortality (Fontaine et al., 2011). In addition, many commercial fish species exhibit high mobility within Azorean waters, which may limit the use of MPAs as fisheries management tools and require multispecies criteria when designing MPA networks (Afonso et al., 2009a,b). The region also includes "Vulnerable Marine Ecosystems" (VMEs) such as seamounts and deep-sea fields of hydrothermal vents, cold-water corals and deep-sea sponge aggregations. Easily damaged and slow to recover, these ecosystems are highly vulnerable to human impacts and represent a greater challenge to achieving the conservation goals set by MPAs (Davies et al., 2007; Morato et al., 2008a), as the timeline for anticipating a reserve effect is much longer than the socio-political complex may be willing to accept. Although challenging, Azorean MPAs represent opportunities to provide at least partial protection to these species and ecosystems.

Technology and Research

In spite of recent important findings, there is a worldwide critical need for research that bridges the knowledge gap on the functioning of marine communities and reserves (Sale et al., 2005). The Azores is no exception. Four reasons converge to explain this challenge. Firstly, the complexities of marine systems almost preclude us from drawing general conclusions about the benefits of MPAs and the best processes to achieve their goals. Secondly, even though fairly substantiated rules of thumb can be adopted when designing MPA networks, differences between local systems inevitably prompt the need for local baseline reference points and ecological indices. Thirdly, another common shortfall in the Azores is the limited reference to social sciences in MPA establishment. Lastly, there has been a prior absence of interdisciplinary research. The combination of these four factors results in the need to undertake interdisciplinary research that is locally driven and specifically oriented toward improving the performance of the Azorean MPA Network.

On the positive side, the last 25 years have seen much research progress that can directly or indirectly aid in designing and fine-tuning the Azorean MPA network. In the absence of specific long-term MPA monitoring programs, several independent fisheries research programs run by the University of the Azores have managed to collect important baseline data. Arguably, these have so far focused on coastal and seamount fish communities, which sustain local fisheries, and on a few protected species (e.g., seabirds) and VMEs (e.g., hydrothermal vents), lacking a full ecosystem assessment. Still, they should be able to provide the critical backbone to which effects of current and future protection can be compared. More recently, relevant research has been conducted on the identification of essential habitats and habitat use patterns (Menezes et al., 2006; Morato et al., 2008b; Amorim et al., 2009), predictive habitat modeling (Schmiing et al., 2013), connectivity and spill-over potential (Afonso et al., 2009a,b; Fontes et al., 2009), and trophic chain functioning (Morato et al., 2009; Martins et al., 2011; Colaço et al., 2013). In addition, considerable technological advances and synergies between academia and the technological sector have put the region at the forefront of some research areas, including animal tracking technologies (Olsen et al., 2009; Afonso et al., 2012), underwater robots, the maintenance of deep-water organisms under laboratory conditions and the application of Vessel Monitoring Systems to ecosystems research and management. The latter also constitutes an opportunity to greatly enhance enforcement, especially in the Azorean offshore MPAs. These and other areas of research should benefit from the solid and effective establishment of MPAs in the region, especially with regards to the ability to observe and study communities and systems in relatively undisturbed conditions (Morato et al., 2010).

FUTURE PROSPECTS

Marine conservation in the Azores has reached a critical point. The environmental sector is now well established in the regional administrative structure, and its political weight is expected to further increase with recent policies and agreements that push toward higher protection and ecosystem-based management. The region is equipped with a legal framework that establishes a comprehensive network of MPAs. This network is already bringing benefits to the region, such as added value to nature tourism products, application of the precautionary principle to certain VMEs and restrictions on harmful activities, in spite of still being at an implementation phase. It follows that it is essential to ensure an appropriate implementation of Azorean MPAs, overcoming the political, financial and administrative constraints previously described.

Given the history of unregulated Azorean MPAs, the development and implementation of management plans should become a priority for MPA implementation. To ensure that MPAs achieve both ecological and socio-economic objectives, MPA managers should develop these plans in partnership with scientific researchers, local stakeholders and communities, which in the Azores are known to have different views and expectations of MPAs as conservation and management tools (Ressurreição et al., 2012b; Abecasis et al., 2013a,b). This may promote the wider understanding and acceptance of MPA goals, outputs and shared responsibilities, reduce conflicts between users, and lead to higher levels of compliance with MPA regulations (Reed, 2008). MPA success has often been associated with co-management practices (Smith, 2012). In the Azores, this will largely depend on the Island Natural Parks Consulting Councils, which could become effective tools for stakeholder participation, thus increasing both accountability and compliance to regulations by assuring that MPA governance is based on shared visions and goals of what MPAs are for. Because these practices imply working with stakeholders and communities, it is important to convey simplified information about the MPA process and how to participate.

Effective MPA implementation will require funding so that sufficient resources are allocated for enforcement and long-term monitoring. Enforcement is essential to ensure that regulations are complied with and perceived as playing a role. Without it, a culture of disregard for the rules can become established and undermine future efforts if resource users become accustomed to breaking rules. This is of particular concern as local stakeholders in the Azorean island of Corvo already perceive MPAs as "paper parks" (Abecasis et al., 2013a). Promoting inter-agency cooperation may reduce enforcement costs and overcome legal and administrative constraints. In addition, stakeholder participation and co-management practices may increase compliance and further reduce enforcement costs, especially for coastal MPAs. For offshore MPAs, given the extent of the areas, the distance to the islands and the presence of a higher number of stakeholders, including foreign fleets, the use of remote sensing technologies such as Vessel Monitoring Systems is likely to increase enforcement capacity.

Another key factor for MPA success is long-term monitoring, which improves MPA science and feeds back into the performance of MPAs. Monitoring is especially important because it allows managers to follow an adaptive management approach based on sound science, whereby the design, goals, measures and methods might change over time as new information is obtained and new challenges develop, in contrast to a one-off attempt to set MPA design and management (Ban et al., 2012). Azorean MPAs would benefit from adaptive management to improve the network design by integrating more technical knowledge. Directions for future MPA monitoring in the Azores could include continuing partnerships with regional research institutes, which have proved to be instrumental in the past, assuring funding for research directed at overcoming previously identified knowledge gaps and citizen science programs to involve the community and other stakeholders potentially increasing their buy-in of MPA management. In particular, it should include specific research on:

- The performance of the MPA network as a fisheries management tool, including models that predict benefits such as spill-over and larval export;
- Maximizing the extent of protection provided to migratory species, seabirds and VMEs—e.g., by applying knowledge of aggregation sites, migratory bottlenecks and essential habitat—while articulating MPAs with other management and conservation measures—e.g., fisheries regulations, international agreements and species-specific management plans;
- Identification of key areas for marine conservation that might become no-take areas;
- Socio-economic aspects of MPAs, such as understanding social impacts, changes in the social context, the environmental management process and institutional design principles;
- Mechanisms for engaging communities and stakeholders in marine conservation.

In order to reach the 10% conservation target (CBD, 2010), MPA coverage within the Azorean EEZ should be increased, provided that new designated areas contemplate socio-economic dimensions and aim at achieving a network effect by following ecological criteria such as ecologically and biologically significant areas, representativity, connectivity, replicated ecological features and adequate and viable sites (CBD, 2008). However, emphasis should be put into achieving effective implementation of the current MPA network. Otherwise, designating more MPAs will only be a means to achieve the region's international conservation commitments on paper. Moreover, while MPAs are an important tool for Azorean marine conservation, they are not the solution for all problems. Instead, they should be integrated into a regional marine management strategy, which in turn should present sustainability goals and follow an ecosystem-based approach.

THE AZORES AS A MODEL OF MARINE CONSERVATION FOR ISLAND STATES AND REGIONS

Despite the need to progress in terms of effective management and governance and upgrading into a coherent network of MPAs, the Azores did in fact pioneer the implementation of a set of marine conservation instruments that may be a particular inspiration to other remote islands states or regions. Silva and Pinho (2007) identified a large number of island states/regions with high or medium seamount densities where seamount fisheries are occurring. The understanding that seamount fishing resources are particularly vulnerable and that industrial fishing may exert irrecoverable impacts on those ecosystems (Morato et al., 2006) has led the Azores to influence a non-trawling policy implemented by the EU, to establish several seamount MPAs within its EEZ and to promote the establishment of high-seas MPAs protecting large seamount areas under international agreements.

Some islands states or regions also harbor sought-after massive polymetallic sulfides and cobalt crusts which could be exploited by future mineral extraction. The pioneering actions taken by the Azores to protect hydrothermal vents in deep-waters, potentially rich in these noble minerals, in a time of increasing interest in deep-sea mining, has resulted in the establishment of several untouchable sites. While we recognize that the Azores, as part of the EU, is bound by important governance and policy instruments, the fact is that some EU directives were applied to deep-water and offshore in the Azores before they were applied elsewhere in Europe. For example, seamounts were first protected under the Habitats Directive in the Azores (namely D. João de Castro, Formigas and Dollabarat). Also, in anticipation of the Natura 2000 revision to include habitats beyond 200 m deep, in 2005 the Azorean government proposed the inclusion of the deep-sea hydrothermal vents Lucky Strike and Menez Gwen in this network (Probert et al., 2007). The background instruments and initiatives implemented in the Azores may be of particular inspiration for recent efforts of implementation of a regulatory framework for deep-sea minerals exploration and exploitation in oceanic island states and regions across the oceans that are facing interest on their deep-sea resources (SCP, 2012).

LESSONS LEARNED

The review and analysis presented in this study show that the Azorean case represents a true and valuable contribution to the global conservation policy arena and, more specifically, to the governance, research and societal processes involved in marine spatial management. Indeed, the region arguably offers one of the oldest experiences of the MPA "modern era" in the world, having started in the 1980's when few countries were actively engaged in marine spatial management for conservation. The value of the Azores as a case study is even more important if we consider the specific case of small island states, which face specific challenges and have an umbilical dependence on marine resources (Teelucksingh et al., 2013).

The importance of adequate financing across the MPA process is one lesson from the Azores. General political support and engagement of the scientific community have been a characteristic of the Azorean case study across its three decades, ultimately enabling the region to engage in the MPA experience. Yet, the intensity of phases requiring more actions in the field, whether scientific (characterization, monitoring), management (planning, implementation) or outreach (public and stakeholder engagement), seem to have fallen short of matching that same commitment. Underfunding is the main cause of a gap that ultimately explains most of the weaknesses identified. Of particular concern is the dependence of longer actions (e.g., monitoring, implementation), typically at the 5-year or even decadal scale, on external funding sources (e.g., EU research projects and infrastructural measures) that are not coincidental with such a time frame. Most island cases will face similar challenges, as many represent small island developing states or smaller, underfunded states within the sovereignty of larger countries. A longer term commitment to adequate budgetary resources and the identification of appropriate funding mechanisms, including governmental and stakeholder contributions, are key in achieving a long term, sustainable process concomitant to the adaptable management perspective.

Another aspect of wide significance is the emerging risk that without enforcement, particularly from the outset, a culture of disregard for the rules can become established and then be difficult to reverse. This behavior undermines not only the objectives of the MPAs *per se*, but also the shared responsibility for any successful spatial management involving a variety of interests and stakeholders. Therefore, it is essential that MPAs are enforced as early after their development as possible to avoid adversarial scenarios. This need has been recognized and pointed out as a major concern by all stakeholders, in the Azores (Abecasis et al., 2013a) as well as other places studied (e.g., Österblom and Sumaila, 2011; Perez De Oliveira, 2013).

From the point of view of the MPA network definition, achieving representativeness is a major challenge in highly fragmented and diverse systems typified by islands states. In the Azores, reaching such a goal has arguably been the hardest caveat within a system that encompasses nine inhabited islands, a variety of habitats from coastal reefs to deep-water hydrothermal vents to dynamic multispecies pelagic hotspots, and different fisheries coexisting with other extractive and non-extractive activities. Yet, reaching current level of legal representativeness has been a very long process requiring multiple steps, sometimes even undoing what had been done (e.g., legislative actions). The adoption of a long term, transversal sectorial plan may allow these shortcomings to be avoided.

While the case of Azorean MPAs presents the characteristic marine conservation challenges of remote island regions, some of the lessons it provides can be loosely applied to marine conservation at large or even to the spatial management processes of terrestrial species and habitats in island settings. Common conservation challenges worldwide include developing a shared vision amongst multiple stakeholders and community groups, sourcing sufficient funding for conservation initiatives, ensuring adequate enforcement and achieving representativeness. It is therefore essential to learn from past experiences such as the Azorean case when dealing with conservation issues elsewhere.

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