Received: 20 November 2023 | Revised: 13 May 2024 | Accepted: 1 July 2024

DOI: 10.1111/csp2.13196

CONTRIBUTED PAPER

Conservation Science and Practice
A journal of the Society for Conservation Biology
Open Access

WILEY

Establishing a Marine Protected Area network using a Marine Spatial Planning approach: A reflection on practical challenges and opportunities for social–ecological integration

Ana Nuno[1,2] | **Luísa Madruga**[3,4] | **Andy Cameron**[3] | **Frédéric Airaud**[5] | **Claricela Andrade**[4] | **Lodney Nazaré**[6] | **Albertino Santos**[7] | **Manuel Graça**[4] | **Márcio Guedes**[6] | **Nina da Rocha**[3,4] | **Patricia Puig**[3,4,8] | **Katy Walker**[3] | **Kieran Murray**[3] | **Sérgio Rosendo**[1,3] | **Berry Mulligan**[3]

[1]Interdisciplinary Centre of Social Sciences (CICS.NOVA), School of Social Sciences and Humanities (NOVA FCSH), NOVA University Lisbon, Lisbon, Portugal

[2]Centre for Ecology and Conservation, Faculty of Environment, Science and Economy, University of Exeter, Penryn, UK

[3]Fauna & Flora, The David Attenborough Building, Cambridge, UK

[4]Fundação Príncipe, Santo António, Sao Tome and Principe

[5]Independent Consultant

[6]Oikos – Cooperação e Desenvolvimento, Descida da Gracilda 88, Água Grande, Sao Tome and Principe

[7]ONG MARAPA, Largo Bom Despacho, São Tomé, Sao Tome and Principe

[8]Oceanogami OÜ, Blue Economy Consultancy, Tallinn, Estonia

Correspondence
Ana Nuno, Interdisciplinary Centre of Social Sciences (CICS.NOVA), School of Social Sciences and Humanities (NOVA FCSH), NOVA University Lisbon, Avenida de Berna, 26-C, 1069-061 Lisboa, Portugal.
Email: ananuno@fcsh.unl.pt; amnuno@gmail.com

Funding information
H2020 Marie Skłodowska-Curie Actions, SocioEcoFrontiers, Grant/Award Number: 843865; FCT - Foundation for Science and Technology (Portugal), Grant/Award Number: UIDB/04647/2020; Darwin Initiative Project, Grant/Award Number: 23-012; Blue Action Fund; Arcadia

Abstract

Integrative social–ecological approaches are crucial for addressing sustainability challenges in coastal and marine systems. Among these, Marine Spatial Planning (MSP) emerges as a pivotal approach for integrated management. Often, the establishment of Marine Protected Areas (MPAs) and the application of MSP occur in parallel. Given the potential synergies, there is a need to better understand and address barriers to the adoption of MSP approaches for integrative conservation mechanisms. Using São Tomé and Príncipe as a case study, we illustrate how MSP was employed as an operational framework for establishing an MPA network. Drawing on the experiences of people directly involved in this co-design process, we reflect on the main challenges and opportunities in achieving social–ecological integration, and highlight recommendations for conservation practitioners and planners. Applying MSP was perceived to contribute substantially to multiple project goals, with some (e.g., incorporating perspectives and needs of vulnerable groups) more challenging to achieve. While MSP enhanced conceptual, disciplinary,

methodological and functional integration, practical challenges in implementation hindered the extent to which each of these was achieved. Given international commitments to Blue Growth, high fisheries dependence and current patterns of change, developing effective integrative MSP approaches is essential for social–ecological resilience.

KEYWORDS

coastal communities, co-design, Gulf of Guinea, marine planning, MPA network, small island developing states, small-scale fisheries, stakeholder engagement, sustainable development goals, systematic conservation planning

1 | INTRODUCTION

International commitments often acknowledge that integrative social–ecological approaches are crucial to addressing sustainability challenges in coastal and marine systems (Reyers & Selig, 2020). Yet, while social–ecological interactions are increasingly being recognized, the implementation of integrative approaches in research and policy has lagged behind (Reid et al., 2017). For example, robust progress toward sustainable development goal (SDG) 14 (Life Below Water) requires considering human impacts on marine resources, as well as socio-economic and cultural dependence on them (Nash et al., 2020). However, the interdependencies between biodiversity, ecosystem services and sustainable development are generally omitted from SDG assessments (Reyers & Selig, 2020).

Social–ecological systems (SES) research points to different ways in which social–ecological integration can occur—conceptual (i.e., considering both social and ecological system components and their interactions), disciplinary (i.e., incorporating approaches from multiple disciplines), methodological (i.e., incorporating multiple frameworks, tools and/or theories and using both qualitative and quantitative methods) and functional (i.e., bridging science with policy or practice through the integration of different stakeholders and researchers in the research process and the merging of conceptual with problem-solving approaches to identify actionable recommendations) (Guerrero et al., 2018). Functional integration remains a particularly challenging but crucial dimension (Jarvis et al., 2020). To be effective, this dimension of social–ecological integration requires fostering collaboration among researchers from different disciplines but also between practitioners, policy-makers, and stakeholders (Bennett, Roth, et al., 2017)—thus making it particularly attuned to sustainability.

Although the potential of mainstreamed and integrated SES approaches is often not fully realized, several approaches have been proposed to achieve management that better integrates the social and ecological dimensions of resource systems (Binder et al., 2013; Guerrero et al., 2018), including Marine Spatial Planning (MSP). With increasing demands on marine resources and space, overlapping practices often cause conflicts among resource users (Arkema et al., 2015). MSP has emerged as a tool to help identify core use zones, assess trade-offs, stimulate discussion among stakeholders and ultimately improve decision-making (Douvere, 2008). By helping to plan activities while safeguarding marine environments and human needs, MSP aims to address potential conflicts and reconcile economic, social and ecological objectives (Arkema et al., 2015; Douvere, 2008). MSP is increasingly being applied globally; more than 300 MSP initiatives were identified in 102 countries or territories (IOC-UNESCO, 2022). While MSP can be used as an integrative social–ecological approach, the extent to which it acts as a tool for meaningful cross-sectoral discussions and supports effective integration of multiple and potentially conflicting interests (i.e., supporting functional integration) remains promising yet often uncertain (Smythe & McCann, 2019). For example, concerns have been raised about how it struggles to manage power imbalances and often prioritizes certain types of objectives and/or knowledge (Jentoft, 2017; Reimer, Devillers, Trouillet, et al., 2023).

Although marine conservation is generally one of the interests that should be included in MSP exercises, the design and designation of Marine Protected Areas (MPAs) and MSP are often parallel processes, with relatively little integration (Trouillet & Jay, 2021). Establishing MPAs through systematic planning is a strong spatial mechanism for protection (Álvarez-Romero et al., 2018), corresponding to the area-based rationale of MSP. Although the distinction between MSP and systematic conservation planning (SCP) for multi-zone MPAs is sometimes blurred (Guyot-Téphany et al., 2024; Trouillet, 2020), we consider that in an MSP exercise, MPAs would sit alongside spatial allocations for economic uses, such as shipping, fishing and energy supply,

integrating MPA planning into broader ocean zoning efforts (Agardy et al., 2011; Vaughan & Agardy, 2020). Given the potential synergies between these processes, their limited integration represents a missed opportunity. They could be more closely linked temporally (e.g., MSP improving the status of pre-existing MPAs) or spatially (e.g., MSP facilitating the creation of multiple-use MPAs; Trouillet & Jay, 2021). This may be particularly relevant when designing MPA networks, which rely on multiple decisions (e.g., size and distance) that affect how key goals are achieved (Metcalfe et al., 2015). There is therefore a need to share critical lessons on opportunities and challenges if we are to mainstream MSP as an integrative approach within conservation. This will require assessing and addressing barriers to its uptake among practitioners and planners (Frazão Santos et al., 2021; Zuercher et al., 2022).

Island nations—especially Small Island Developing States (SIDS)—are highly dependent on biodiversity for their socioeconomic wellbeing (Mouillot et al., 2020), are severely affected by biodiversity loss (Brooks et al., 2002) and face unique sets of conservation challenges (Burt et al., 2023), requiring integrative social–ecological approaches to robustly address conservation challenges. Using work in São Tomé and Príncipe (STP) (a small archipelago in the Gulf of Guinea) as a case study illustrating major sustainability challenges (e.g., marine biodiversity conservation, small-scale fisheries management, gender equality and poverty alleviation), we describe how an MSP approach was recently used to support the co-design and proposal of the country's first MPAs. After providing contextual information about the study system, we bring together insights from a wide range of co-authors directly involved (e.g., program and project managers, community liaison officers, spatial technical specialists and technical assistants), to report on this process and related stakeholder consultations. Finally, we reflect on the main opportunities and challenges, particularly in achieving social–ecological integration for more robust decisions, and highlight lessons for and from conservation practitioners and planners. Despite multiple implementation challenges, our findings highlight how MSP can be applied to integrate social and conservation objectives in relatively data-poor contexts, while promoting stakeholder engagement.

2 | STUDY AREA

The Democratic Republic of São Tomé and Príncipe (STP) consist of two small oceanic islands, located ~220 km off the coast of Central Africa. The archipelago is extremely biodiverse and lies within one of the 18 richest centers of marine endemism (Roberts et al., 2002). STP has about 220,000 inhabitants and is the second smallest economy in Africa. It has an agrarian-based economy heavily dependent on subsistence farming and fishing, with two-thirds of the population living in poverty and nearly half (47%) in extreme poverty (INE, 2020). The fisheries sector is highly gendered (women generally process, distribute and sell fish) and provides livelihood opportunities in a country where women's integration into economic sectors remains a major challenge for gender equality (INPPEEG, 2017). In recent decades, the number of artisanal fishers has increased considerably (Maia et al., 2018; Zacarias et al., 2022). STP has no national industrial fishing vessels, and international fleets are only allowed to operate ≥12 nautical miles from the coast.

São Tomé has no formal protection of marine areas. Príncipe was recognized as a UNESCO Biosphere Reserve in 2012, covering the Tinhosas, all other islets and 576 km^2 of surrounding waters, but there is no associated marine management. Since 2016, there has been a noticeable investment in coastal and marine conservation in STP, with a focus on sustainable fisheries through engagement with fishing communities. See Appendix S1 for additional information about the study area.

3 | OVERVIEW OF PROCESS

A project to establish a network of MPAs in STP was launched in late 2018. The project, ongoing at the time of writing, is being implemented by a consortium of international and national conservation and development non-governmental organizations (NGOs), in close collaboration with government agencies and fishing communities. To support the design and designation of a network of MPAs, the project aims to establish a system of participatory fisheries management and marine conservation, prioritizing community engagement in MPA design.

Due to the national scale of the project, the identification of potential MPAs needed to consider trade-offs with other economic uses, such as shipping and fishing, and potential decisions about the spatial allocation of different marine uses. This required going beyond what is generally within the scope of SCP, although distinctions between SCP and MSP can become tenuous when both aim to identify integrated spatial priorities for multiple sectors (Holness et al., 2022; Trouillet & Jay, 2021). This provided an excellent opportunity to contribute to the design of a network of MPAs using MSP as an operational framework, given the potential conflicts between different sectors (e.g., marine conservation, artisanal fisheries and tourism) and the need to make robust and

FIGURE 1 A step-by-step approach to Marine Spatial Planning (MSP) (specific Steps 1–10 identified by Ehler & Douvere, 2009), emphasizing stakeholder engagement throughout and the cyclical process (e.g., adapting marine spatial plans might require re-organizing the process through planning, drafting and approving revised plans).

participatory decisions on where future MPAs could be located. We acknowledge that MSP is inherently a government responsibility (Ehler & Douvere, 2009) but the process reported here can be seen as a predecessor to potential future government-led efforts.

Following a step-by-step approach recommended by UNESCO's Intergovernmental Oceanographic Commission (Ehler & Douvere, 2009), we link project activities to the MSP framework (Figure 1). While there is no single way to implement MSP and it should explicitly allow for the expression and comparison of different visions of the maritime space (Trouillet, 2020), this specific approach was adopted for providing practical guidance on tasks to be carried out by the project team (but see also Reimer, Devillers, Zuercher, et al. (2023) for guidance to support the implementation of best practices on the ground). Main actions implemented in the project for Steps 1–7 are described below, including some critical reflections, with key actions starting in 2016 (Figure 2). Steps 8–10 will take place once the spatial management plan is approved.

3.1 | Step 1: Identifying need and establishing authority and Step 2: Obtaining financial support

Before the project, limited efforts had been made to identify MPAs in the country (MEDSEA, 2016) and the lack of MPAs was identified as a constraint to marine conservation and sustainable resource use (e.g., within the National Biodiversity Strategy Action Plan 2015–2020). In 2017, two main marine conservation and sustainable fisheries projects were being implemented—one in São Tomé, another in Príncipe. While not focused on MPAs, their focus on participatory marine management was recognized as an opportunity to contribute toward MPA establishment. Given the geographical context and inter-island links (e.g., fishers migrating from São Tomé to Príncipe due to declining catches), focus was placed on improving management at the national level. Building on these efforts, funding was secured in 2018 for a project to establish MPAs. Software-assisted MSP using Marxan-with-Zones (a free and open-source software that supports spatial planning for multiple-use zones; https://marxansolutions.org) was identified during project design as the approach to be used for MPA identification.

Sound policy and institutional frameworks are critical to the success of MSP initiatives but there were clear limitations that could hinder project goals. This required additional efforts by the team (e.g., through advocacy). For example, at project inception and preliminary stages, the National Fisheries Law no. 09/2001 and its associated Regulation no. 28/2012 were in force, which did not consider MPAs. A more recent Fisheries Law (no. 09/2022) has now been approved (Decree-law no. 22/XI/5ª/2021), recognizing MPAs as a mechanism for fisheries management. In addition, the national legal framework for

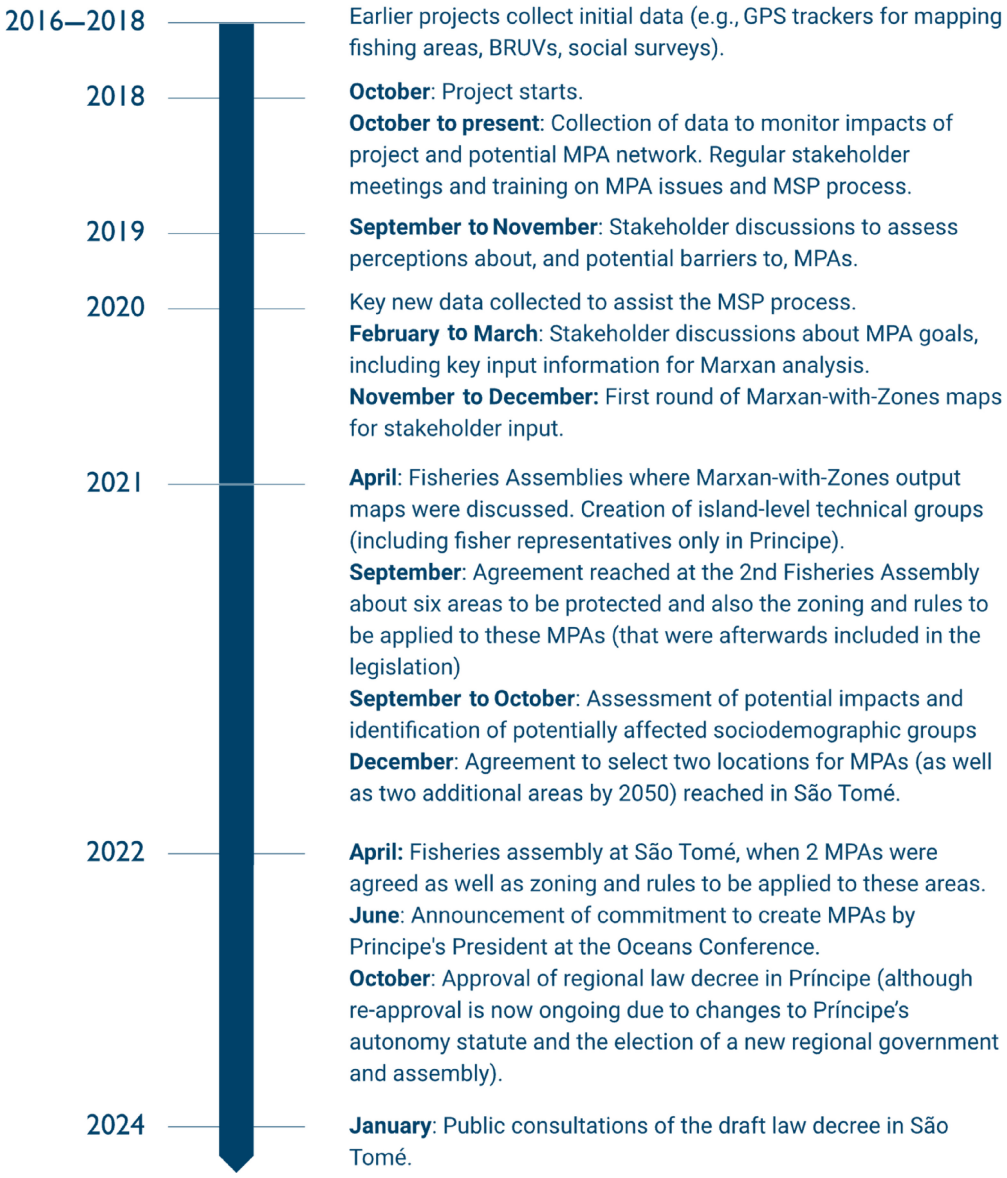

FIGURE 2 Key project actions related to applying a Marine Spatial Planning (MSP) approach for establishing Marine Protected Areas (MPAs) in São Tomé and Príncipe (STP).

spatial planning considers coastal zone management instruments and the need for a national government-led document focused on marine planning has been identified (Ministry of Planning, Finances and Blue Economy, 2022); however, this has not yet materialized, with government commitments to lead a nationwide MSP process currently on hold.

3.2 | Step 3: Organizing the process through pre-planning

The team of NGO staff and consultants implementing MSP-related tasks includes conservation program and project managers to coordinate efforts and guide implementation, community liaison officers to lead community engagement, a Geographic Information Systems (GIS) technical specialist to provide expert spatial input, among others (all included as co-authors of this publication). However, the project was designed to be implemented in close collaboration with government agencies and fishing communities, as well as private sector representatives and other environmental NGOs.

The overall stated goal of the project, defined by the project team at an early stage and guiding the MSP process, is "Marine biodiversity, sustainability of fisheries and the livelihoods of marine resource-dependent households in STP are conserved and secured." Although later expanded to include the entire island of São Tomé, the initial focus was on coastal waters <12 nautical miles from shore around the entire island of Príncipe and the surrounding district of Caué in southern São Tomé. This reflects the areas of previous projects, which focused on waters important for small-scale fisheries.

As a first step in the pre-planning process, stakeholder discussions were held to assess potential barriers to MPA creation (November 2019) and discuss potential MPA goals (February–March 2020). During these discussions, improved fish abundance, enhanced fisheries management and increased income from fishing and tourism were identified as the main expectations from MPAs. Several potential priority species (e.g., demersal fish of commercial interest and sea turtles) and habitats (e.g., mangroves and rocky habitats) were also listed. Finally, we identified disagreements over MPA locations (e.g., some mentioned that MPAs should be established in areas with low fishing pressure, while others argued that "it makes no sense to establish MPAs where there are no longer many fish"), highlighting the need for robust and transparent consideration of trade-offs to avoid exacerbating conflicts.

Specific objectives/targets were then defined by the project team, based on broader scientific advice and policy objectives. A compromise between safeguarding 30% of each conservation target while maintaining at least 80% of current small-scale fishing activity (based on areas weighted by fishing effort) and 80% of non-extractive recreational activity (based on area of known dive sites) was deemed to be an adequate starting approach based on the feedback on MPA goals, national priorities and international practices. The team also defined specific indicators, such as observations of locally commercially important and threatened species, catch per unit effort by fishers and household income. Although quantitative targets were only set by the project team, this was a pragmatic decision taken to move the technical process forward in a context of limited capacity and project delays/travel restrictions due to the COVID-19 pandemic. In addition, we also note that other marine activities (e.g., transportation, gas/oil extraction) were not included as objectives in the project's MSP process for two reasons: firstly, the lack of data for offshore benthos or adequate proxies (and the time/cost implications of filling this data gap); and second, the offshore and coastal activities were not considered to overlap significantly. A broader MSP process beyond the establishment of MPAs in inshore areas would require the inclusion of these marine uses; this decision ultimately limited the scope of the MSP exercise and made it more similar to SCP.

3.3 | Step 4: Organizing stakeholder participation

By bringing together key partners from the environmental and development sectors and expanding previous efforts on both islands, the project builds upon detailed knowledge of, and close relationships to, a wide network of stakeholders. As part of project design, a stakeholder analysis was carried out including the identification of stakeholders in marine resource use and management, analysis of their interests and potential influence on MPA establishment. While recognizing the diversity of stakeholder interests and groups, the project has focused most engagement efforts on governmental institutions, fishers and fish traders. This recognizes the primary role of these stakeholders in both influencing and being affected by decisions. Representatives from local communities or governmental institutions have thus been present in the consultation events and other project meetings. Information has also been collected from other stakeholders (e.g., tourism) and these sectors have been involved in consultations or kept informed.

Explicit efforts have been made to ensure that the concerns and priorities of marginalized and vulnerable groups are considered. In some fishing communities in São Tomé and more broadly in Príncipe, spear fishers are excluded from events and associations organized by fishers. In light of this, some discussions were held separately with spearfishers or women to ensure that they could express their concerns and priorities (women representatives were also explicitly asked to be present at certain group events). As the project progressed, the number of communities involved in consultations has also increased considerably and the role of stakeholders outside the project team has become more prominent (e.g., technical groups formed for MPA decision-making). This also meant that specific MPA outcomes were more out of control of the project team, resulting in trade-offs in terms of meeting project teams and/or funders' expectations.

3.4 | Step 5: Defining and analyzing existing conditions

Research on coastal and marine environments in the country is still relatively scarce and mostly dedicated to ichthyofauna (de Lima et al., 2022). From an early project stage, available datasets were compiled and main knowledge gaps identified, focusing on: conservation features (habitats and species); spatial information on relevant human activities; and oceanographic and other physical environmental features. When key data were not available within the project team or collaborators, new data were collected to assist the MSP process (e.g., participatory mapping of fishing grounds). After assessing which datasets could be used (e.g., based on their geographical scale), key maps used for MSP included: benthic habitats; distribution of key commercial fish species interpolated from Baited Remote

Underwater Video Systems (BRUVS); distribution of sea turtle nesting beaches (with weighting by species counts); fishing grounds and effort (based on small-scale fishing vessel tracking, fish catch data and participatory mapping); and locations of main recreational dive sites. When compiled and consolidated, some datasets were not comparable (particularly as the previous projects did not have the same objectives) and had to be excluded (e.g., cetacean sightings and seabird foraging areas modeled). Differences in geographical context (e.g., Príncipe is much smaller than São Tomé) also meant that some data could be relatively easily collected in one of the islands but not in the other.

After compiling and summarizing key information, stakeholder meetings were held in February–March 2020 to present the information to be used in the spatial analysis. These presentations aimed to clarify the information being considered in the process (i.e., highlighting the evidence-based approach). They also aimed to demonstrate how a robust consideration of all this information and potential trade-offs would benefit from software-assistance (i.e., highlighting decisions would be supported by spatial software tools, which would generate alternative options for discussion among key stakeholders).

Importantly, there was a shared understanding that artisanal fisheries in STP are threatened by the progressive degradation of marine ecosystems and that the resulting decline in fish catches has a significant impact on local livelihoods. For example, 67% of fishers and fish traders in Príncipe reported a decline in total fish catch over the last 10 years (Nuno et al., 2021). Mapping of fishing grounds and effort also highlighted the dependence of fishers on areas of high conservation value.

3.5 | Step 6: Defining and analyzing future conditions

Stakeholder decisions (particularly by government and fishing communities) were now required on whether the establishment of MPAs was going ahead and if so, where MPAs would be located and how different activities would be allocated across the seascape. To promote stakeholder discussions about potential MPA locations and associated trade-offs, a first round of maps based on pre-defined objectives (see Step 3) was produced using Marxan-with-Zones. For each "zone" (protected/highly restricted, restricted use or unrestricted/open use), information on (1) how much and what type of features (e.g., habitat, fishing grounds) should be included, and (2) the cost of implementing the zone (i.e., the impact on current levels of fishing that would result from its exclusion under a "no-take" management measure) was used to produce multiple options for MPA locations. Fishing grounds and effort were used as primary cost layers. These maps were discussed at stakeholder meetings on both islands in November–December 2020; stakeholders were shown a Marxan output map (Appendix S2) for their specific island and feedback on potential locations, concerns and suggestions was recorded.

After revising the Marxan analysis using stakeholder input (e.g., constraining options so that urban areas could not be selected), a second round of maps was discussed on both islands in April 2021. At the 1st General Sustainable Fisheries Co-management Assembly meeting of Príncipe Island (hereafter all similar events are referred to as "Fisheries Assembly"), representatives from 15 fishing communities identified 12 potential sites for MPAs around the island. A similar event was held in São Tomé, where representatives from 22 fishing communities listed potential sites for MPAs around the island. In São Tomé, it was decided to hold more detailed discussions about the location of MPAs in each community and with other stakeholders.

3.6 | Step 7: Preparing and approving the spatial management plan

The process to finalize agreement on MPA locations involved a further round of stakeholder engagement. In Príncipe, this was led by a technical group including representatives from 15 fishing communities, Regional Fisheries Department, Regional Environment Department, Port Authority, Biosphere Reserve and Regional Assembly. Based on their preliminary work, at the Fisheries Assembly held in Príncipe in September 2021, an agreement to establish a network of MPAs incorporating six areas around the island was reached (Figure 3). In São Tomé, the existing technical group does not include representatives from fishing communities due to requirements by the Fisheries Directorate. This group met in December 2021 and a potential agreement to select two locations for MPAs was reached, with two additional areas selected to be considered for protection in the future. These two proposed areas (Figure 3) were presented and discussed with all relevant stakeholders in a new round of consultations and agreed at the Fisheries Assembly that took place in April 2022. At this stage, stakeholder decisions on zoning and specific regulations were also made for both islands. Different areas within these MPAs were allocated varying degrees of protection: highly restricted (e.g., only fishing with one line and one hook from the shore is allowed) and sustainable use zones. In addition to fishing, restrictions also apply to

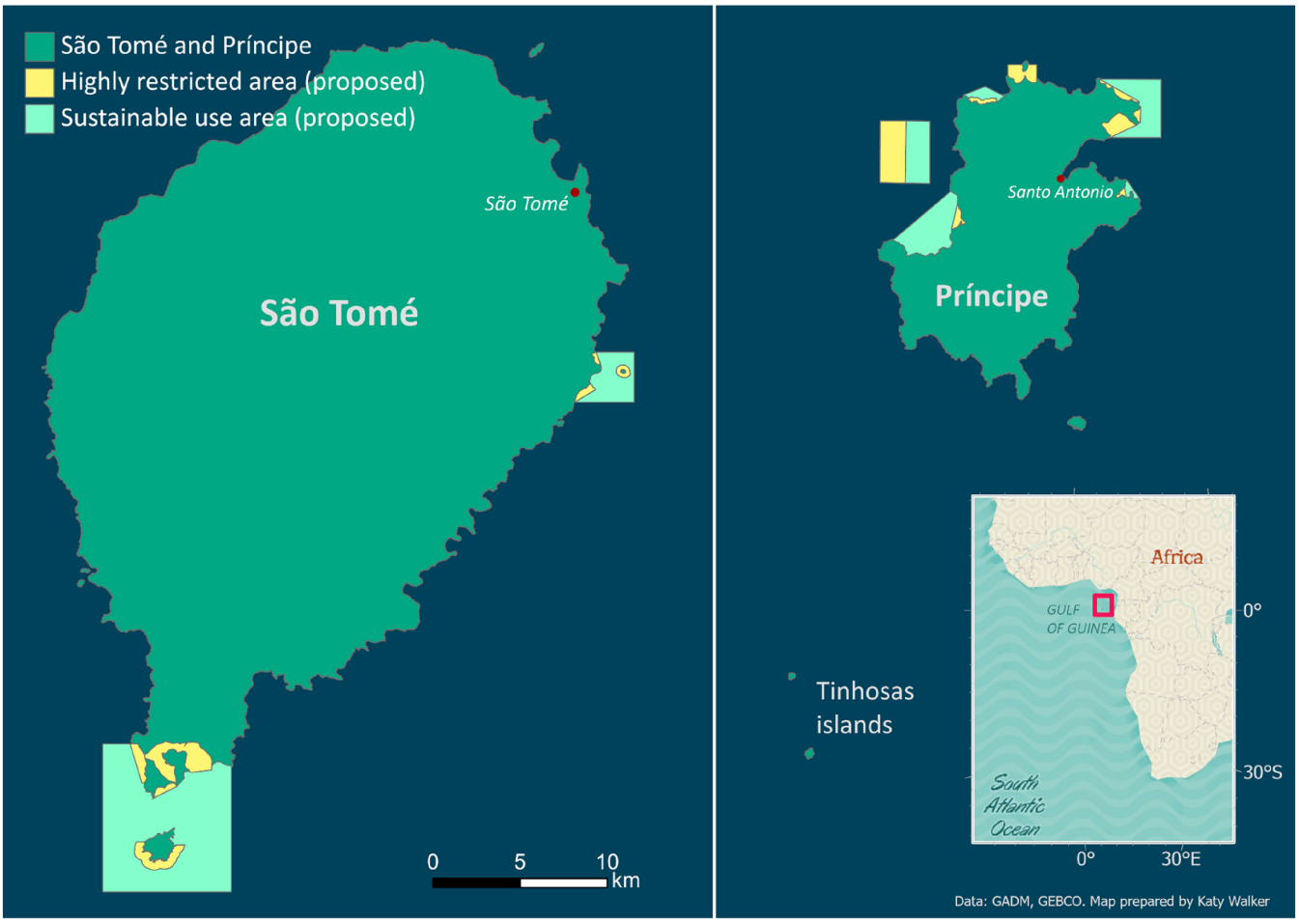

FIGURE 3 Broad location of eight proposed MPAs (two in São Tomé and six in Príncipe) agreed during the islands' respective stakeholder co-management Assemblies, with endorsements of Decree Laws from regional and national governments currently nearing completion.

tourism, aquaculture, new infrastructure, extractive activities, scientific research, dredging and dumping, and the hunting of seabirds and turtles.

The agreed network of MPAs covers 93 km^2 and represents a small subset of the initially recommended areas. Thus, while specific goals and targets were used as input for conducting Marxan analyses within an MSP approach, these will not be fully achieved. Nevertheless, in a context with no previous marine protection, this represents an important milestone in the history of marine conservation in STP. While the area contribution is small as a proportion of the total Exclusive Economic Zone (EEZ), the approach will establish a precedent for marine planning and protection - a first step toward meeting very ambitious policy commitments.

Once agreements about MPA locations, zoning and specific regulations were achieved, the project moved to the last planning phase. A Regional Legislative Decree establishing six MPAs in Príncipe was unanimously approved by the Regional Assembly on October14, 2022 (due to political issues related to the level of devolved responsibility granted to the Autonomous Region of Príncipe, re-approval is now ongoing). Public consultations of the draft Decree Law in São Tomé were held in January 2024 and sign-off is still pending. The national legislation mentions that an MPA management plan is required within 1 year of the approval of the legislation and should include socio-environmental monitoring and sustainable financing plans. The project team has also focused on disseminating information about MPAs, identifying and implementing mitigation measures, such as livelihood diversification through training, and contributing to the piloting of monitoring activities (including threat monitoring).

4 | A REFLECTION ON KEY OPPORTUNITIES AND CHALLENGES

Everyone in the project team consulted ($n = 14$) has recommended the application of MSP approaches to

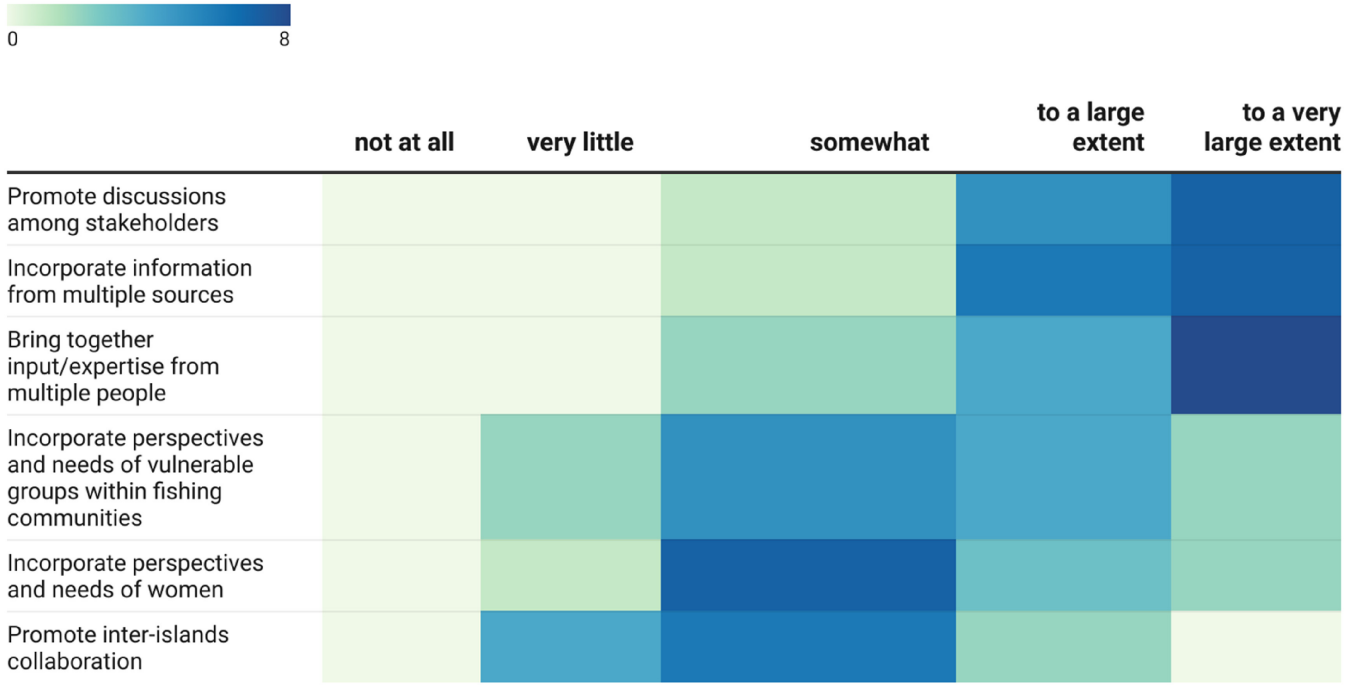

FIGURE 4 Perceived effectiveness of applying a Marine Spatial Planning approach for achieving potential social and ecological outcomes when establishing Marine Protected Areas (MPAs) in São Tomé and Príncipe (STP); only the three top and bottom outcomes are shown (see Appendix S5 for full list of outcomes). Each co-author was asked to score how much the project's MSP approach has contributed to achieving each outcome. All questions were answered using a Likert scale ranging from 1 (not at all) to 5 (to a very large extent). Colors represent frequency with which the opinion was expressed among the group of 14 co-authors (all except S. R. who was not involved in project implementation).

people planning to create, improve, or expand MPAs (interview guidelines developed and analyzed by the lead author available in Appendix S3). The main perceived benefits of applying this approach included: facilitating and informing decision-making ($n = 6$ project members); potentially more effective MPA implementation ($n = 6$); bringing people together for discussion ($n = 5$); bringing together different types of (social and environmental) information ($n = 5$); potentially better/more equitable social outcomes ($n = 5$; full list of perceived benefits available in Appendix S4).

When considering expected social and ecological outcomes of applying MSP (see Appendix S5 for full list of outcomes considered), promoting discussion among stakeholders, bringing together input/expertise from multiple people, and incorporating information from multiple sources were perceived as outcomes that benefited most from the MSP approach applied (based on average scores of perceived effectiveness; Figure 4). However, this approach was not able to contribute equally to all outcomes; the least successful were: promoting inter-island collaboration, incorporating women's perspectives and needs, and incorporating the perspectives and needs of vulnerable groups within fishing communities. Our approach was intended to be inclusive by design and included dedicated meetings with specific groups using different engagement formats to promote their active participation when it was thought there was the risk of either exclusion or just presenteeism in other meeting formats. Nonetheless, even with specific approaches guided by funder policies and technical expertise within the project, the results reflect the challenge in ensuring active participation of all stakeholders and the enhanced attention this requires in MSP.

When assessing the overall main perceived challenges of applying an MSP approach, the following were mentioned: lack of (standardized) ecological and social data ($n = 7$ project members); lack of local capacity to apply MSP and related tools ($n = 5$); governance issues (particularly due to focus on two islands with different sociopolitical contexts; $n = 4$). Full list of perceived challenges available in Appendix S4.

When looking more closely at the challenges that may particularly affect conceptual, disciplinary, methodological and functional social–ecological integration, key issues were identified (Table 1). For example, an MSP approach would not be possible without considering the simultaneous interaction of social and ecological components (i.e., successfully promoting conceptual integration). However, the limited consideration of dynamic

TABLE 1 Key challenges to achieving conceptual, disciplinary, methodological and functional social–ecological integration (Guerrero et al., 2018) when applying a Marine Spatial Planning approach for establishing Marine Protected Areas (MPAs) in São Tomé and Príncipe (STP).

Types of social–ecological integration	Challenge for achieving social–ecological integration	Example of supporting quotes
Conceptual	Limited consideration of dynamic and/or alternative social and ecological conditions	• "*limited consideration of different magnitudes and directions of impacts (*e.g., *modeling different scenarios of resource use, biodiversity abundance and management options)*" [P14]
	Incorporation of specific social and/or ecological dimensions hindered by general lack of/limited data	• "*Lack of data to assess ecological connectivity*" [P11]
	Incorporation of specific social and/or ecological dimensions hindered by predetermined decisions on scale/geographical focus and associated data limitations	• "*Different priorities/desires of partners in terms of area of interest (...) meant prioritization of some datasets and exclusion of others*" [P11]
	Incorporation of specific social and/or ecological dimensions hindered by urgency of process and time that would be required to collect additional data	• "*The lack of data was not only a problem in itself, but also that the time and resources it would take to fill some of the gaps were not necessarily factored into the project timelines and plans*" [P10]
	Potentially limited and/or inaccurate understanding of social and/or ecological dimensions due to stakeholders' reluctance to share information	• "*Fishers were often reluctant to reveal to others (...) which fishing grounds they visited. As a result, they often withheld this information from our key informants during the fish landing surveys, or simply gave false information*" [P9]
Disciplinary	Generalized prioritization of and more familiarity with ecological data hinders use of, or collection of, information about social components	• "*Generalised prioritisation of and familiarity with ecological data within projects/partners, meaning there was less* [social data] *to draw on and expand on, or rapid gap filing was necessary*" [P11]
	Only occasional involvement of specific members from other fields/disciplines	• "*Ideally the interdisciplinary team should have included provision for direct technical support during all stakeholder sessions related to MSP outputs and negotiations*" [P10]
Methodological	Priority given to quantitative data/methods for inputting into decision-making tools	• "[It was challenging to] *convert quantitative and qualitative data into spatially explicit patterns of resource use for integration into a GIS*" [P11]
Functional	Data unavailability or relatively subjective decisions hinders incorporation of specific sectors	• "*(...) have not 'managed' to map the spatial distribution of the purse seine fishing effort; resulted in the absence of use of this fundamental information*" [P5]
	Difficulties promoting meaningful and active engagement across all stakeholder groups	• "*palaiês* [i.e., fish traders] *rarely spoke at the community consultations despite being present. When asked why, they would often respond that it was not their place to voice their opinions, since the fishers knew best*" [P9]
	Governance differences between areas and political tensions hindered standardization	• "*Different levels of government (national, regional) brought different levels of engagement on each island, requiring adapted approaches and adjusted expectations from partners*" [P1]
	Institutional limitations and legal complexity delayed or hindered ability to enhance links to policy	• "*Complexity of the existing legislation and policy framework (...) has taken time to unpick by legal experts and which still leaves unknown areas in the creation and approval of MPAs*" [P1]
	Institutional turnover hindered ability to enhance links to policy	• [what has affected project links to policy?] "*the elections and the changes of successive governments and staff of partner institutions to the project*" [P7]
	Need to achieve support for MPA scenarios alongside MSP process represents additional complexity	• "*Initial suspicion, misconceptions and lack of knowledge by most of relevant stakeholders about MPAs (*e.g., *fishers, government staff)*" [P13]

TABLE 1 (Continued)

Types of social–ecological integration	Challenge for achieving social–ecological integration	Example of supporting quotes
	Political instability hindered ability to enhance links to policy	• "*a change in governing political party after the 2022 elections and an attempted coup d'état in late 2022 caused delays in the final signoff*" [P12]
	Poor governance hindered ability to enhance links to policy	• [what has affected project links to policy?] "*little rigor in the management of fisheries resources*" [P8]
	Poor governance hindered stakeholder trust in the decision-making process	• "*lack of confidence in the authorities' maritime surveillance capabilities and in law enforcement*" [P13]
	Previous interactions affect neutrality of process	• "*some of the fishing communities in São Tomé had a conflicting relationship with one of the partner institutions*" [P14]
	Technical complexity of decision-making hindered meaningful and active engagement	• "*I got the feeling that people were not very familiar with reading maps and this was the main medium used to present our results*" [P9]
	Time requirements and consultation fatigue hindered stakeholder engagement	• "*Length of the process seemed to bother several stakeholders which wanted more action and less meetings*" [P9]
	Variable buy-in and/or local ownership among key stakeholder groups	• "*Among some fishers, there was difficulty supporting the project without monetary compensation*" [P4]

Note: Challenges were identified based on co-authors' responses to open-ended questions developed by lead author A. N. (interview guidelines available in Appendix S3). Different types of social–ecological integration are likely to be interrelated, and each challenge may fall under several types; only the main type is presented below. P1–14 indicates which project member/study participant provided a specific quote.

conditions and/or alternative scenarios, the selection of specific social and environmental components to be considered (e.g., due to data availability, predetermined decisions on scale and geographical focus, or the time required for additional data collection), and even the potentially limited and/or inaccurate understanding of social and/or ecological dimensions due to stakeholder reluctance to share information, were key challenges to a more robust and comprehensive representation and conceptualization of these components within a single approach. As noted by a team member, there was a "*need for speed in MPA design in a relatively data-poor context*." Overall, the availability of data, particularly for the social components, was seen as the main barrier to conceptual integration. This was influenced by the initiatives already in place (i.e., providing initial information/datasets) and the composition of the team implementing the MSP process (e.g., influencing which priority knowledge/data gaps were identified), both of which had a major impact on the extent to which conceptual integration was achieved.

A general prioritization of and greater familiarity with ecological data also emerged as a key challenge to achieving disciplinary integration, as acknowledged by one of the team members: "*Despite diversity, team mostly had natural sciences backgrounds and was conservation-driven (i.e., moderate levels of multidisciplinary)*." In addition, as mentioned by another team members, "*not all information was quantifiable, which limited the types and sources of evidence used in the Marxan analysis (or considered potentially useful for Marxan and then collected)*." This priority given to quantitative data/methods for input into decision support tools influenced the extent to which methodological integration was achieved.

The challenges listed are of course likely to reflect the specific project, social context, area of implementation and team composition; given the applied nature of the project and the practice-focused team, functional integration was unsurprisingly much more prominent in the team's reflections. Within functional integration, institutional limitations, legal complexity, political instability, poor governance and staff turnover were key barriers to enhancing project links to policy. In addition, links to practice through inclusive stakeholder engagement were affected by: data unavailability or relatively subjective decisions hindering inclusion of specific sectors ("*Conflicting opinions on who should be involved in decision making … e.g., Fisheries Directorate wishing to exclude fishers from decision making on São Tomé*"); difficulties in promoting meaningful and active engagement of different groups ("*Although the process was as inclusive as possible in terms of gender, palaiês* [i.e., fish traders] *rarely spoke at the community consultations despite being present*"); governance differences between areas and political

TABLE 2 Key recommendations for practitioners and planners considering the use of Marine Spatial Planning approaches in marine conservation. Recommendations are listed for each step of MSP (Ehler & Douvere, 2009), based on our team's experience in using this approach to establish marine protected areas (MPAs) in São Tomé and Príncipe (STP).

Step of marine spatial planning approach	Recommendations
Step 1. Identifying need and establishing authority and Step 2. Obtaining financial support	• "*It is important to work with key organisations working in the country that are recognised as key stakeholders, as they have a good understanding of needs and priorities, have strong networks on the ground and can lead the project locally*." • "*Consider a pre-MSP project or phase to comprehensively compile and review data and design a programme to develop appropriate datasets*." • "*Meaningful collaboration allows for co-design of designations, zoning and regulations that are more likely to be complied with. Consider early on if specific funders can accommodate this flexibility*." • "*Ensure that there is adequate financial support for human resources to manage, administer and deliver the complex process ahead. It's also invaluable to have flexible funding that can be adjusted to meet changing needs*."
Step 3. Organizing the process through pre-planning	• "*The challenges of working at larger scales and in different governance contexts should be recognised early on so that potential costs (including realistic timescales) and benefits can be properly considered*." • *Some datasets [...] are fundamental to reserve design in a Marxan analysis and careful consideration should be given at the project planning stage whether adequate datasets already exist, and where they do not ensure that there is time and budget built into the plans to fill those data gaps*. • "*Maintain consistent, open and flexible communication between all team members and partners working on a project*." • "*Understand that your intended approaches or outcomes/priorities may need to be adapted according to community priorities and government approaches*."
Step 4. Organizing stakeholder participation	• "*Assess stakeholder needs and expectations early on, and provide capacity for meaningful participation (stakeholders and team members)*." • "*Involve stakeholders in data collection (important for legitimacy and accountability)*—e.g., *fishers and fish traders in fish landing surveys*." • "*Consider hiring external facilitators (*i.e., *not from within partner organisations) to avoid concerns about potentially biased views on MSP*." • "*Ensure there's a suitable political engagement strategy to push this through, and be prepared to adjust to political changes along the way*." • "*People in key roles in certain institutions may leave/new people may be appointed, so stakeholder engagement is not static and support for the MSP process cannot be taken for granted*." • "*Recording stakeholder feedback is key to ensure transparency of the MSP process*."
Step 5. Defining and analyzing existing conditions	• "*Carefully assess social data available and ensure ecological data isn't unduly prioritised*." • "*When reviewing available data, look for spatial and temporal information that covers the majority of the marine management area. If this is not consistent across datasets, be clear about gaps in knowledge and consider illustrating where data are lacking for specific areas*." • "*When working in data and resource scarce locations, prioritize habitat maps which would be a pre-requisite for spatial analysis, including connectivity crucial to develop climate change resilient MPA networks*." • "*The result you get out is only as good as the data you put in. Carefully consider the reliability and spatial resolution of the data used and how this may influence the results obtained*." • "*Don't let the perfect be the enemy of the good when it comes to filling data gaps using conventional science—trust that consultation with resource users and local stakeholders will provide the expertise to enable robust design, combined with all available data sources*." • "*There will always be more and better data to collect (but time is limited, especially when engaging stakeholders who want to see things move forward). Be prepared to clearly communicate what information is being used, acknowledge potential limitations and explain the value of the evidence available despite uncertainties*."
Step 6. Defining and analyzing future conditions	• "*Take time to raise awareness and build trust and social capital as you move through the consultation process*"

TABLE 2 (Continued)

Step of marine spatial planning approach	Recommendations
	• "*It is important to clearly communicate the rationale for decisions, with the level of information provided adapted to stakeholder needs*." • "*Stakeholder negotiations* (e.g., *when discussing multiple alternative scenarios) benefit from a dedicated interdisciplinary team* (e.g., *social scientist to help design tools, GIS/data/Marxan person, community representative/liaison, sessions run by neutral facilitator, support staff to run breakout groups, note-takers, translators as needed)*." • "*The use of a decision support tool such as Marxan helps to surface available information and identify data gaps and limitations, but should not overshadow stakeholder consultation and local expertise*." • "*Insist on a paper trail of the technical approaches and data used in the MSP process, as technical support will change and expertise will move on, often taking with it important knowledge and institutional memory. This is also linked to building local capacity to take the MSP process forward from here* (e.g., *management, future extensions)*."
Step 7. Preparing and approving the spatial management plan	• "*Ensure focus is placed on simplicity and effectiveness*." • "*Draw on other examples of well-functioning management planning* (e.g., *integration of key monitoring and control priorities)*." • "*Ensure adequate human resources to work on project implementation and management, ideally those who can maintain institutional and project knowledge and build on prior learning and relationships in the local context*." • "*Develop a clear communication strategy, highlighting the benefits and the rationale behind key decisions*." • "*Ensure that there is a clear monitoring and evaluation framework in place to measure the impact and effectiveness of the plan*." • "*Address potential conflicts that may arise from plan implementation at an early stage and have conflict resolution mechanisms in place*." • "*Incorporate adaptive management principles so that the plan can be flexible in the face of new information or unforeseen challenges*."

Note: Different types of recommendations may fit under several MSP steps (e.g., stakeholder engagement contributes to all steps); only the main step is presented below, and more detail on the approaches used is provided in the relevant sections above.

tensions ("*the creation of the MPAs is always going to be a deeply political issue, exacerbated by the political climate and any existing tensions between the two islands*"); need to gain support for MPA scenarios alongside the MSP process ("*Marine protection not considered as a priority by many stakeholders, including some government entities*"); poor governance hampered stakeholder trust ("*generalised lack of trust from fishers in the government*"); previous interactions affected the neutrality of the process ("*perceived neutrality (or lack thereof) is particularly challenging given the small country size and the same people often being involved in multiple initiatives … and jumping among different organisations*"); technical complexity of decision-making ("[It was challenging to] *communicate the results to stakeholders in a simple way, given the complexity of the approach and analysis*"); time requirements and consultation fatigue ("*Length of the process seemed to bother several stakeholders which wanted more action and less meetings*"); and variable buy-in and/or local ownership ("*Some opposition to the project from key government officials led to some delays in the designation*").

Some recommendations for practitioners and planners considering the use of MSP approaches in conservation are also provided in Table 2, including considerations on how challenges related to functional integration could be addressed at different stages. These recommendations were identified by the project team on the basis of what worked well and what did not go as planned.

5 | DISCUSSION

Applying an MSP framework to an initiative supporting the establishment of a network of MPAs in STP was a useful, insightful and challenging process. To inform the design of the MPA network, consultation was informed by spatial planning software outputs incorporating best available knowledge and data on fisheries, ecological and social aspects. By involving all key local stakeholders, including fishers and fish traders, regional and national government, civil society organizations and the private

sector, MSP was used to bring together different ocean users and stakeholders to make informed decisions on the potential establishment of MPAs (e.g., location, zoning and regulations) while promoting low impact uses of marine resources. As people directly involved in the MSP process, with a broad view of the process as a whole or of specific components within it, we have sought in our reflections to be critical of ourselves and our approaches (although including the perspectives of other stakeholders would be useful for a more robust assessment of specific outcomes). Despite acknowledging the multiple social, political and technical challenges, a systematic marine conservation approach through MSP was essential to bring people and different types of social and ecological information together, to facilitate and inform decision-making, and to lay the foundations for effective MPA implementation and more equitable social outcomes.

Given the ongoing social changes in STP (Muñoz-Torrent et al., 2022) and the associated environmental impacts, effective spatial planning is needed to reduce social vulnerability and threats to the islands' unique biodiversity. We have described step-by-step how an MSP approach was used to support the co-design and proposal of the country's first MPAs. While the process is still ongoing, we provided insights into how MSP can be applied in a relatively data-poor context while promoting stakeholder engagement. This required learning and adaptation as it moved forward; trying to converge marine conservation efforts in two islands resulted in running two MSP initiatives in parallel due to differences in governance, data availability, geography and threats. The project subsequently became considerably more complex than initially expected; strategies for engagement and expectations about targets and goals had to be adapted based on regional specificities for facilitating sustainable solutions for each island. However, we caution that the challenges of working at broader scales and under different governance contexts should be recognized early on so that potential costs (including realistic timescales) and benefits can be adequately considered. We acknowledge the many implementation challenges and hope that the lessons learned from our experience of using MSP in a marine conservation project can provide guidance for others. By better understanding the realities of MSP, we will be able to more effectively address the barriers to its uptake among practitioners and planners (Flower et al., 2020; Zuercher et al., 2022).

MPA design within an MSP framework generally involves the articulation of larger scale (MSP) and smaller scale (MPA) planning (Ehler & Douvere, 2009). Although the STP process was more limited in its geographical scope and range of stakeholders involved (e.g., SCP and MSP became increasingly tenuous in our case study as the participatory process gradually focused on areas very close to the coast where other economic uses were limited), using an MSP framework as guidance provided a logical sequence of steps toward the project's goals, while emphasizing stakeholder engagement throughout. A broader national MSP process, beyond the establishment of coastal MPAs, would involve a wider range of marine uses and stakeholders. For example, the government in STP has ambitions to develop a full spatial plan for its EEZ, which should incorporate both existing data and proposed MPA locations, but can also learn from the process applied to our smaller project focus area. An MSP framework is valuable regardless of the scale at which the planning process takes place (Lagabrielle et al., 2018) and this further highlights the potential of MSP as an operational framework to promote functional integration in the country, particularly if a future expanded MPA network includes offshore areas that are likely to have greater overlap with industrial marine resource use (e.g., fishing, oil and gas, shipping).

While MSP may be undertaken for a variety of reasons, including to support the identification of areas for conservation and associated zoning strategies, the strong link between MSP and MPAs is rarely explicitly recognized (Vaughan & Agardy, 2020). Strengthening these linkages could help address some of the shortcomings often affecting MPAs (e.g., poor planning and unintended consequences of MPA establishment due to limited consideration of potential displacement effects on fisheries; Agardy et al., 2011). For example, to inform the "cost" layer of the Marxan analysis and to identify potential access restrictions resulting from different MPA decisions, the collection of baseline fisheries and social data and subsequent socio-economic monitoring was essential for a more robust understanding of potential impacts. This also helped to identify potential mitigation measures (e.g., livelihood interventions) and it is likely that these acted as an incentive to engage in MPA design and MSP (e.g., due to perceived future benefits and thereby improving engagement and acceptance of project activities). The use of an MSP approach to inform management measures and to assess the potential impacts of new or strengthened restrictions thus contributed to increased transparency and robustness of decision-making, as well as to stakeholder buy-in. To facilitate the MSP process and the establishment of MPAs, similar initiatives in areas of high poverty and high reliance upon marine resources (e.g., small island developing states) should promote coordination between multiple types of interventions and that they are truly seen as making a significant contribution to local wellbeing. This is particularly important given that best practice requires conservation

interventions to be fair and responsible, promoting an equitable distribution of benefits and actions that are ecologically effective and socially acceptable (Bennett, Teh, et al., 2017). However, we also note that while the original MPA design aimed to protect 30% of each conservation target, the final design agreed after extensive consultation falls short of these ambitions.

Spatial management plans should be designed to integrate conservation into MSP as a way of supporting sustainable ocean use (Reimer, Devillers, Trouillet, et al., 2023). However, MSP often favors Blue Growth objectives over conservation, with important implications for which sectors are integrated and which sustainability challenges are addressed (Frazão Santos et al., 2014). In our case study, an MSP approach was likely more appropriate because the MPA co-design focused on a national network with objectives clearly linked to sustaining biodiversity and small-scale fisheries. When assessing whether an MSP approach could be useful for a particular conservation project, we suggest considering issues related to scale (e.g., larger individual MPAs or networks), the intended use of MPAs (e.g., as defined by IUCN category), the actors driving the process (e.g., funder and civil society driven vs. national government or multilateral agency), and timing. Although there has been less focus on MSP in small islands and developing nations, perhaps in part due to a lack of examples to follow (Flower et al., 2020), we emphasize MSP can be particularly useful when working on islands, given its focus on balancing context-specific social and environmental characteristics with sustainable development opportunities.

By incorporating social, economic and ecological considerations, a successful and evidence-based MSP process can result in the implementation of essential measures to achieve international conservation and SDGs (Ntona & Morgera, 2018), ultimately improving links between science, policy and practice. However, significant work is needed to achieve the promise and potential of integrated SES research and practice (Guerrero et al., 2018). This is critical if we are to solve complex real-world sustainability problems. Our case study illustrates how MSP can promote social–ecological integration, but resource and time constraints, combined with complexity on the ground, prevent MSP from achieving its full potential. Challenges faced were particularly related to data requirements, stakeholder engagement and cross-sectoral considerations, with the realities of MSP often contrasting with its conceptual ideals (Jones et al., 2016). Our reflections on enablers and barriers ultimately contribute to a realistic reflection on the implementation of MSP in conservation, and the challenges and opportunities it presents. Ultimately, this knowledge will provide critical insights into how to improve the robustness of management decisions, with implications for the social and ecological resilience of SES.

AUTHOR CONTRIBUTIONS

Ana Nuno, Sérgio Rosendo, and Berry Mulligan conceived the idea for the manuscript. Ana Nuno led the analysis of the data and the writing of the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

ACKNOWLEDGMENTS

The main conservation initiative described here was undertaken within the project "*Establishing a network of marine protected areas across São Tomé and Príncipe through a co-management approach*" and was funded by Blue Action Fund and Arcadia. This work was also made possible through the support of Rainforest Trust and Oceans 5, a sponsored project of Rockefeller Philanthropy Advisors. Preliminary work underpinning this initiative was funded by the Darwin Initiative—a UK government grant scheme (Project 23-012), European Union, through a support line for non-state actors, and Instituto Camões (Portugal). A.N. acknowledges the support of the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement SocioEcoFrontiers No. 843865. This work was also financed by national funds through FCT—Foundation for Science and Technology (Portugal), within the scope of the project "UIDB/04647/2020" of CICS.NOVA—Centro Interdisciplinar de Ciências Sociais da Universidade Nova de Lisboa.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this study as no new data were created in addition to what is published directly in the paper.

ORCID

Ana Nuno https://orcid.org/0000-0003-4680-2378

REFERENCES

Agardy, T., di Sciara, G. N., & Christie, P. (2011). Mind the gap: Addressing the shortcomings of marine protected areas through large scale marine spatial planning. *Marine Policy*, *35*, 226–232.

Álvarez-Romero, J. G., Mills, M., Adams, V. M., Gurney, G. G., Pressey, R. L., Weeks, R., Ban, N. C., Cheok, J., Davies, T. E., Day, J. C., Hamel, M. A., Leslie, H. M., Magris, R. A., & Storlie, C. J. (2018). Research advances and gaps in marine planning: Towards a global database in systematic conservation planning. *Biological Conservation*, *227*, 369–382.

Arkema, K. K., Verutes, G. M., Wood, S. A., Clarke-Samuels, C., Rosado, S., Canto, M., Rosenthal, A., Ruckelshaus, M., Guannel, G., Toft, J., Faries, J., Silver, J. M., Griffin, R., & Guerry, A. D. (2015). Embedding ecosystem services in coastal planning leads to better outcomes for people and nature. *Proceedings of the National Academy of Sciences*, *112*, 7390–7395.

Bennett, N. J., Roth, R., Klain, S. C., Chan, K. M. A., Clark, D. A., Cullman, G., Epstein, G., Nelson, M. P., Stedman, R., Teel, T. L., Thomas, R. E. W., Wyborn, C., Curran, D., Greenberg, A., Sandlos, J., & Veríssimo, D. (2017). Mainstreaming the social sciences in conservation. *Conservation Biology*, *31*, 56–66.

Bennett, N. J., Teh, L., Ota, Y., Christie, P., Ayers, A., Day, J. C., Franks, P., Gill, D., Gruby, R. L., Kittinger, J. N., Koehn, J. Z., Lewis, N., Parks, J., Vierros, M., Whitty, T. S., Wilhelm, A., Wright, K., Aburto, J. A., Finkbeiner, E. M., … Satterfield, T. (2017). An appeal for a code of conduct for marine conservation. *Marine Policy*, *81*, 411–418.

Binder, C. R., Hinkel, J., Bots, P. W. G., & Pahl-Wostl, C. (2013). Comparison of frameworks for analyzing social-ecological systems. *Ecology and Society*, *18*, art26.

Brooks, T. M., Mittermeier, R. A., Mittermeier, C. G., Da Fonseca, G. A. B., Rylands, A. B., Konstant, W. R., Flick, P., Pilgrim, J., Oldfield, S., Magin, G., & Hilton-Taylor, C. (2002). Habitat loss and extinction in the hotspots of biodiversity. *Conservation Biology*, *16*, 909–923.

Burt, A., Nuno, A., Turnbull, L., Fleischer-Dogley, F., & Bunbury, N. (2023). An international assessment of the barriers influencing the effectiveness of Island ecosystem management. *People and Nature*, *5*, 134–146.

de Lima, R. F., Deffontaines, J.-B., Madruga, L., Matilde, E., Nuno, A., & Vieira, S. (2022). Biodiversity conservation in the Gulf of Guinea Oceanic Islands: Recent progress, ongoing challenges, and future directions. In L. M. P. Ceríaco, R. F. de Lima, & M. B. R. C. Melo (Eds.), *Biodiversity of the Gulf of Guinea Oceanic Islands* (pp. 643–670). Springer International Publishing.

Douvere, F. (2008). The importance of marine spatial planning in advancing ecosystem-based sea use management. *Marine Policy*, *32*, 762–771.

Ehler, C., & Douvere, F. (2009). *Marine spatial planning: A step-by-step approach toward ecosystem-based management*. IOC Manual and Guides.

Flower, J., Ramdeen, R., Estep, A., Thomas, L. R., Francis, S., Goldberg, G., Johnson, A. E., McClintock, W., Mendes, S. R., Mengerink, K., O'Garro, M., Rogers, L., Zischka, U., & Lester, S. E. (2020). Marine spatial planning on the Caribbean Island of Montserrat: Lessons for data-limited small islands. *Conservation Science and Practice*, *2*, 158.

Frazão Santos, C., Agardy, T., Andrade, F., Crowder, L. B., Ehler, C. N., & Orbach, M. K. (2021). Major challenges in developing marine spatial planning. *Marine Policy*, *132*, 103248.

Frazão Santos, C., Domingos, T., Ferreira, M. A., Orbach, M., & Andrade, F. (2014). How sustainable is sustainable marine spatial planning? Part I—Linking the concepts. *Marine Policy*, *49*, 59–65.

Guerrero, A., Bennett, N., Wilson, K., Carter, N., Gill, D., Mills, M., Ives, C., Selinske, M., Larrosa, C., Bekessy, S., Januchowski-Hartley, F., Travers, H., Wyborn, C., & Nuno, A. (2018). Achieving the promise of integration in social-ecological research: A review and prospectus. *Ecology and Society*, *23*, 38.

Guyot-Téphany, J., Trouillet, B., Diederichsen, S., Juell-Skielse, E., Thomas, J.-B. E., McCann, J., Rebours, C., Scherer, M., Freeman, P., Gröndahl, F., Walsh, J. P., & Lukic, I. (2024). Two decades of research on ocean multi-use: Achievements, challenges and the need for transdisciplinarity. *npj Ocean Sustainability*, *3*, 8.

Holness, S. D., Harris, L. R., Chalmers, R., De Vos, D., Goodall, V., Truter, H., Oosthuizen, A., Bernard, A. T. F., Cowley, P. D., da Silva, C., Dicken, M., Edwards, L., Marchand, G., Martin, P., Murray, T. S., Parkinson, M. C., Pattrick, P., Pichegru, L., Pistorius, P., … Lombard, A. T. (2022). Using systematic conservation planning to align priority areas for biodiversity and nature-based activities in marine spatial planning: A real-world application in contested marine space. *Biological Conservation*, *271*, 109574.

INE. (2020). *Perfil da Pobreza Com Base no Inquérito de Orçamento Familiar de 2017*. Instituto Nacional de Estatística.

INPPEEG. (2017). *Profil de Genre en Agriculture et Developpement Rural*. INPPEEG.

IOC-UNESCO. (2022). *State of the ocean report, pilot edition*. IOC-UNESCO.

Jarvis, R. M., Borrelle, S. B., Forsdick, N. J., Pérez-Hämmerle, K. V., Dubois, N. S., Griffin, S. R., Recalde-Salas, A., Buschke, F., Rose, D. C., Archibald, C. L., Gallo, J. A., Mair, L., Kadykalo, A. N., Shanahan, D., & Prohaska, B. K. (2020). Navigating spaces between conservation research and practice: Are we making progress? *Ecological Solutions and Evidence*, *1*, e12028.

Jentoft, S. (2017). Small-scale fisheries within maritime spatial planning: Knowledge integration and power. *Journal of Environmental Policy and Planning*, *19*, 266–278.

Jones, P. J. S., Lieberknecht, L. M., & Qiu, W. (2016). Marine spatial planning in reality: Introduction to case studies and discussion of findings. *Marine Policy*, *71*, 256–264.

Lagabrielle, E., Lombard, A. T., Harris, J. M., & Livingstone, T. C. (2018). Multi-scale multi-level marine spatial planning: A novel methodological approach applied in South Africa. *PLoS One*, *13*, e0192582.

Maia, H. A., Morais, R. A., Siqueira, A. C., Hanazaki, N., Floeter, S. R., & Bender, M. G. (2018). Shifting baselines among traditional fishers in São Tomé and Príncipe islands, Gulf of Guinea. *Ocean and Coastal Management*, *154*, 133–142.

MEDSEA. (2016). *Relatórios Técnicos: «A MMA proposta na Ilha do Príncipe» e «A MMA proposta na Ilha de São Tomé»*. MEDSEA.

Metcalfe, K., Vaughan, G., Vaz, S., & Smith, R. J. (2015). Spatial, socio-economic, and ecological implications of incorporating minimum size constraints in marine protected area network design. *Conservation Biology*, *29*, 1615–1625.

Ministry of Planning, Finance and Blue Economy. (2022). Serviços de consultoria, Ref no 79/STP/COMP2/C/WACA/2022: Recrutement d'un cabinet international pour l'élaboration du plan spatial maritime.

Mouillot, D., Velez, L., Maire, E., Masson, A., Hicks, C. C., Moloney, J., & Troussellier, M. (2020). Global correlates of terrestrial and marine coverage by protected areas on islands. *Nature Communications*, *11*, 4438.

Muñoz-Torrent, X., da Trindade, N. T., & Mikulane, S. (2022). *Territory, economy, and demographic growth in São Tomé and Príncipe: Anthropogenic changes in environment*. Biodiversity of the Gulf of Guinea Oceanic Islands.

Nash, K. L., Blythe, J. L., Cvitanovic, C., Fulton, E. A., Halpern, B. S., Milner-Gulland, E. J., Addison, P. F. E., Pecl, G. T., Watson, R. A., & Blanchard, J. L. (2020). To achieve a sustainable blue future, progress assessments must include interdependencies between the sustainable development goals. *One Earth*, *2*, 161–173.

Ntona, M., & Morgera, E. (2018). Connecting SDG 14 with the other sustainable development goals through marine spatial planning. *Marine Policy*, *93*, 214–222.

Nuno, A., Matos, L., Metcalfe, K., Godley, B. J., & Broderick, A. C. (2021). Perceived influence over marine conservation: Determinants and implications of empowerment. *Conservation Letters*, *14*, e12790.

Reid, A. J., Brooks, J. L., Dolgova, L., Laurich, B., Sullivan, B. G., Szekeres, P., Wood, S. L. R., Bennett, J. R., & Cooke, S. J. (2017). Post-2015 sustainable development goals still neglecting their environmental roots in the Anthropocene. *Environmental Science & Policy*, *77*, 179–184.

Reimer, J. M., Devillers, R., Trouillet, B., Ban, N. C., Agardy, T., & Claudet, J. (2023). Conservation ready marine spatial planning. *Marine Policy*, *153*, 105655.

Reimer, J. M., Devillers, R., Zuercher, R., Groulx, P., Ban, N. C., & Claudet, J. (2023). The marine spatial planning index: A tool to guide and assess marine spatial planning. *npj Ocean Sustainability*, *2*, 15.

Reyers, B., & Selig, E. R. (2020). Global targets that reveal the social–ecological interdependencies of sustainable development. *Nature Ecology & Evolution*, *4*, 1011–1019.

Roberts, C. M., McClean, C. J., Veron, J. E. N., Hawkins, J. P., Allen, G. R., McAllister, D. E., Mittermeier, C. G., Schueler, F. W., Spalding, M., Wells, F., Vynne, C., & Werner, T. B. (2002). Marine biodiversity hotspots and conservation priorities for tropical reefs. *Science*, *295*, 1280–1284.

Smythe, T. C., & McCann, J. (2019). Achieving integration in marine governance through marine spatial planning: Findings from practice in the United States. *Ocean and Coastal Management*, *167*, 197–207.

Trouillet, B. (2020). Reinventing marine spatial planning: A critical review of initiatives worldwide. *Journal of Environmental Policy and Planning*, *22*, 441–459.

Trouillet, B., & Jay, S. (2021). The complex relationships between marine protected areas and marine spatial planning: Towards an analytical framework. *Marine Policy*, *127*, 104441.

Vaughan, D., & Agardy, T. (2020). Marine protected areas and marine spatial planning – Allocation of resource use and environmental protection. In J. Humphreys & R. W. E. Clark (Eds.), *Marine protected areas* (pp. 13–35). Elsevier.

Zacarias, W. B. M., Dai, X., Kindong, R., Sarr, O., & Moussa, A. H. (2022). Analysis of fishery resource management practices in São Tomé and Príncipe: Perception of the dynamics of catches from 1950–2020, recommendations and strategies for future research. *Sustainability*, *14*, 13367.

Zuercher, R., Motzer, N., Magris, R. A., & Flannery, W. (2022). Narrowing the gap between marine spatial planning aspirations and realities. *ICES Journal of Marine Science*, *79*, 600–608.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Nuno, A., Madruga, L., Cameron, A., Airaud, F., Andrade, C., Nazaré, L., Santos, A., Graça, M., Guedes, M., da Rocha, N., Puig, P., Walker, K., Murray, K., Rosendo, S., & Mulligan, B. (2024). Establishing a Marine Protected Area network using a Marine Spatial Planning approach: A reflection on practical challenges and opportunities for social–ecological integration. *Conservation Science and Practice*, *6*(10), e13196. https://doi.org/10.1111/csp2.13196