Sustainability Science
https://doi.org/10.1007/s11625-025-01770-z

ORIGINAL ARTICLE

Operationalizing enabling conditions: a social-ecological perspective on marine conservation success

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Received: 30 April 2025 / Accepted: 2 November 2025

Abstract

Area-based conservation is a popular strategy to address biodiversity decline. However, despite the identification of enabling conditions, many initiatives still fail at delivering positive outcomes for nature and people. This study examines how enabling conditions are operationalized and their influence on conservation effectiveness using social-ecological approaches. Guided by the central question of whether the way enabling conditions are put into practice affects conservation outcomes, the study pursues three objectives: (1) to document the processes through which enabling conditions are operationalized, (2) to distinguish the different forms of operationalization, and (3) to assess how these processes influence conservation outcomes, in order to extract lessons that may serve as best practices for future initiatives. By comparing the establishment of two coral reef conservation initiatives in the same region, we identified diverse ways in which enabling conditions are put into practice, providing examples for conservation practitioners. Discourse analysis of stakeholders' perception highlighted that enabling conditions being in place alone does not guarantee success. Instead, the way they are implemented—through specific action-situations, their interactions, and the stakeholders involved—plays a crucial role in delivering conservation outcomes. Operationalization can have both direct and indirect effects, influencing outcomes at one stage of establishment or at later stages. Sequencing and timing also emerged as critical factors affecting perceptions of benefits, compliance with regulations, and the sustainability of conservation measures. These findings offer practical guidance for decision-makers and managers by illustrating how enabling conditions can be operationalized to support more effective and context-sensitive conservation efforts.

Keywords Community-based management · Coral reefs · French polynesia · Marine protected area · Area-based conservation · Other effective conservation measure

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Published online: 23 December 2025

Introduction

The protection of 30% of marine ecosystems by 2030 has been set as a global conservation target under the Convention on Biological Diversity to secure benefits for nature and people (Arneth et al. 2023; Gurney et al. 2023). Area-based conservation measures, such as marine protected areas (MPAs), are central to this goal, offering the potential to conserve biodiversity while maintaining social interactions with marine ecosystems through regulatory frameworks and active management. Despite the expansion of protected and conserved areas, which cover 8.2% of the ocean, only a fraction of these areas are effectively managed or aligned with conservation objectives (Pike et al. 2024). This discrepancy highlights the need to look beyond the implementation of conserved and protected areas and examine the conditions that influence their effectiveness.

The heterogeneity in the objectives, contexts, governance and management of area-based conservation can lead to a wide range of outcomes, which can complexify pathways towards success (Arneth et al. 2023; Pellerin et al. 2025). However, this also offers the opportunity to learn from contrasting experiences (Pendleton et al. 2017). An effective way to recognize this heterogeneity and help address those challenges can be to develop guidance documents such as a code of conduct to ensure that marine conservation processes support ecological effectiveness while also being fair, just, and accountable (Bennett et al. 2017). In this line, the MPA Guide (Grorud-Colvert et al. 2021; Oregon State University 2023) was developed to provide a science-based, policy-relevant framework for understanding, evaluating, and planning MPAs. However, while enabling conditions provide a foundation for effective conservation, their impact on outcomes can depend on how they are operationalized. For instance, the MPA Guide defines "public participation with contextual and procedural fairness" as an enabling condition, but its operationalization can range from consultation to co-decision-making, influencing the legitimacy and acceptance of conservation measures (Reed et al. 2018). Differences in how enabling conditions are put into practice may significantly shape conservation outcomes, underscoring the need for a detailed analysis of the sequences of actions and interactions that operationalize them.

To understand variations in the establishment and effectiveness of conservation measures, it becomes necessary to use a holistic approach that tackles interactions between factors and outcomes within a specific social-ecological system (Zavaleta Cheek et al. 2023; Leenhardt et al. 2015). Traditional approaches have often evaluated an enabling condition or an outcome in isolation (Dubois et al. 2019), rather than considering them all as interdependent elements of a same dynamic system (Kimmich and Tomas 2019; Zuercher et al. 2022). A more integrated perspective is needed to capture the complexity of the intertwined influences between the various sets of enabling conditions and outcomes. This shift requires methodological approaches capable of mapping complex sets of interactions and understanding the feedback mechanisms between social and ecological components (Kimmich et al. 2023; Loiseau et al. 2021).

Here, we investigate how the operationalization of enabling conditions shapes the outcomes of area-based conservation. Our central research question guiding the analysis is whether the way in which enabling conditions are implemented influences conservation outcomes. We hypothesize that not only enabling conditions being in place, but also the ways in which they are put into practice, significantly affect conservation effectiveness. With our study, we therefore pursue three objectives: (1) to document the processes through which enabling conditions are operationalized, (2) to distinguish the different forms of operationalization, and (3) to assess how these processes influence conservation outcomes, in order to extract lessons that may serve as best practices for future initiatives. To achieve these aims, we compare two coral reef conservation areas in French Polynesia, analyzing how enabling conditions are operationalized through actions and how these processes have shaped their current conservation outcomes. Our study is anchored in social-ecological systems research, adopting an approach that goes beyond identifying enabling conditions to explore how they are put into practice. For this purpose, we employ the Social-Ecological Action-Situation (SE-AS) framework (Schlüter et al. 2019), which provides a means to capture the processes through which actors and ecological elements interact across levels, from individual actions to emergent system properties. Based on stakeholder discourses, we examine the clusters of actions that give operational meaning to enabling conditions and evaluate their influence on conservation effectiveness as reported by managers. Through this approach, we test the proposed hypothesis while providing practical insights for policymakers and practitioners seeking to strengthen area-based conservation initiatives.

Methods

1/Case studies

In French Polynesia, coral reef conservation is crucial for the well-being of local communities (Wencélius et al. 2022). To reduce impacts from local activities (e.g., tourism, coastal development, fishing) on coral reefs and address global changes like declining fish stocks and coral bleaching, the French Polynesian government and local communities have

implemented management strategies prioritizing marine conservation. This study examines two contrasting conservation initiatives: the community-led rāhui of Teahupo'o in Tahiti and the marine spatial management plan (PGEM) in Mo'orea[1] (Supp. Mat. 1). Selecting these two cases from the same Windward Society archipelago, located just ~ 50 km apart, helps minimize variability in contextual factors such as governance structures and cultural values.

Teahupo'o community, part of Taiarapu-West municipality in southwest Tahiti, is a rural district of 8,471 people (ISPF 2022) relying on surf tourism, agriculture, and fishing (Bambridge et al. 2020). It's located on the western side and southern coastline of the island and encompasses the southern part of an area called Fenua'Aihere (meaning "uncultivated land"). In response to declining fish stocks and conflict with external fishers, the community established a rāhui in 2014, inspired by pre-contact Polynesian governance systems. This hybrid governance regime integrates customary and contemporary legal frameworks, prohibiting all activities within a 767.5-hectare protected area and co-managed by the DIREN (the environmental agency of French Polynesia) and local communities (Fabre et al. 2021).

Mo'orea island, 20 km west of Tahiti, has a rapidly growing population of 18,332 people (ISPF 2022), in which tourism, agriculture, and fishing are key economic activities (Leenhardt et al. 2016). In 2004, the local government implemented the PGEM, covering the whole lagoon (49 sq. km), to protect ecosystems and control the economic growth. The PGEM is constituted of a network of eight conservation zones with specific activity restrictions and is managed by a steering committee of local stakeholders and several French Polynesian agencies (fishing, maritime, environment, and urbanism) (Wencélius et al. 2022). We chose to analyze the establishment of the PGEM as a whole rather than each individual MPA, since all MPAs were created through the same process. As the primary objective of the PGEM was biodiversity conservation, with marine spatial planning serving only as the instrument to achieve this goal, we studied the PGEM as an area-based conservation initiative.

2/Combining two social-ecological approaches

The MPA Guide (Grorud-Colvert et al. 2021) was developed from extensive best practices to strengthen the effectiveness of existing and future MPAs in achieving conservation goals. It synthesizes scientific knowledge on enabling conditions, which are key ecological and social factors such as cross-jurisdictional collaboration, stakeholder participation, resilience-based design, and ongoing monitoring that shape conservation outcomes. The Guide also defines four sequential stages of establishment, namely Proposed (or Committed), Designated, Implemented, and Actively Managed, and links these stages to enabling conditions. While some enabling conditions are critical to the success of conservation initiatives, not all conditions are required at each stage. The MPA Guide specifies twelve overarching enabling conditions that are important across all stages of establishment, together with additional conditions that become particularly relevant for advancing from one stage to the next (Fig. 1). We adopted this framework and extended its application to our case studies, which are not formally designated as MPAs but nevertheless align with the IUCN definition of "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (IUCN and WCPA 2018).

MPAs are expected to achieve both ecological and social outcomes, which are closely intertwined; ecological outcomes can influence social ones and vice versa (Ban et al. 2025; Bennett et al. 2014). This interdependence explains why many enabling conditions relate to governance and management, as social outcomes are often directly linked to these processes. While the MPA Guide is consistent with this literature, it primarily emphasizes ecological outcomes. The MPA Guide defines conservation outcomes as the benefits for species, habitats, and human communities that an MPA is expected to deliver under certain conditions, assuming that key enabling conditions are in place. In line with our objective to examine all enabling conditions and their influence on conservation outcomes, we extended the scope of outcomes to include both ecological and social dimensions rather than relying solely on the MPA Guide for this category. For this purpose, we adopted the list proposed by Reimer et al. (2021), which identifies 17 ecological and social outcomes relevant to all area-based management tools and by definition includes all area-based conservation measures (Fig. 2).

To complement our approach, we applied the social-ecological action-situation framework (Schlüter et al. 2019), which examines the dynamic interactions between human and ecological systems. This framework was developed to analyze and explain the emergence of social-ecological phenomena, such as the success of ecosystem restoration efforts or fisheries collapses and can be applied to conservation measures (Schlüter et al. 2019). It is particularly valuable for identifying key system elements that drive emergent outcomes. Within this framework, the social-ecological system is depicted by a configuration of interactions between social and/or ecological Action-Situation (Schlüter et al. 2019). An action-situation refers to the space where human actors

[1] Authors acknowledge the existence of competing transcription systems of reo tahiti or reo ma'ohi (e.g. Fare Vanaa on the one hand [Mo'orea] and the Rapoto transcription system [Moorea])

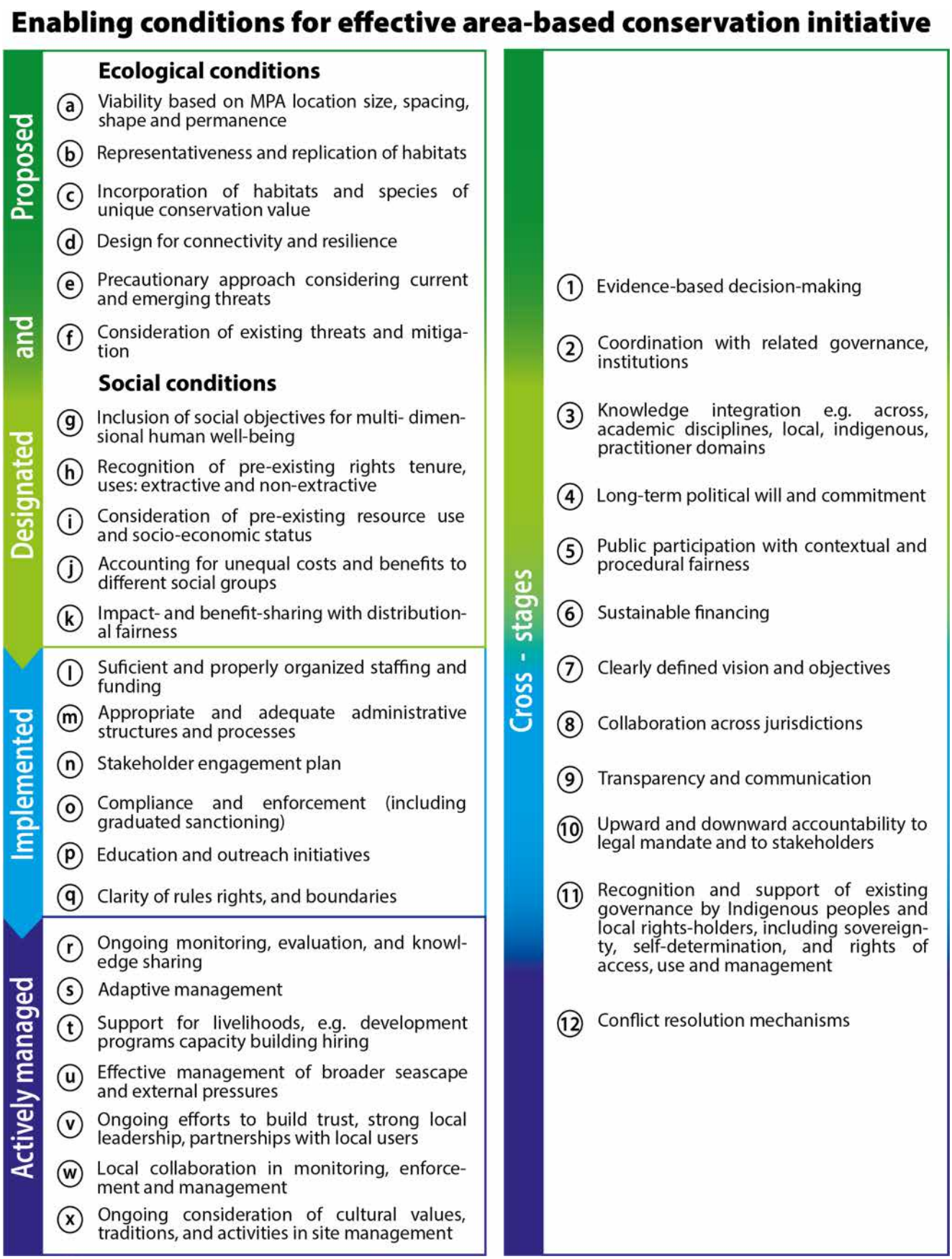

Enabling conditions for effective area-based conservation initiative
Proposed and Designated
Ecological conditions
a Viability based on MPA location size, spacing, shape and permanence
b Representativeness and replication of habitats
c Incorporation of habitats and species of unique conservation value
d Design for connectivity and resilience
e Precautionary approach considering current and emerging threats
f Consideration of existing threats and mitigation
Social conditions
g Inclusion of social objectives for multi- dimensional human well-being
h Recognition of pre-existing rights tenure, uses: extractive and non-extractive
i Consideration of pre-existing resource use and socio-economic status
j Accounting for unequal costs and benefits to different social groups
k Impact- and benefit-sharing with distributional fairness
Implemented
l Suficient and properly organized staffing and funding
m Appropriate and adequate administrative structures and processes
n Stakeholder engagement plan
o Compliance and enforcement (including graduated sanctioning)
p Education and outreach initiatives
q Clarity of rules rights, and boundaries
Actively managed
r Ongoing monitoring, evaluation, and knowledge sharing
s Adaptive management
t Support for livelihoods, e.g. development programs capacity building hiring
u Effective management of broader seascape and external pressures
v Ongoing efforts to build trust, strong local leadership, partnerships with local users
w Local collaboration in monitoring, enforcement and management
x Ongoing consideration of cultural values, traditions, and activities in site management
Cross - stages
1 Evidence-based decision-making
2 Coordination with related governance, institutions
3 Knowledge integration e.g. across, academic disciplines, local, indigenous, practitioner domains
4 Long-term political will and commitment
5 Public participation with contextual and procedural fairness
6 Sustainable financing
7 Clearly defined vision and objectives
8 Collaboration across jurisdictions
9 Transparency and communication
10 Upward and downward accountability to legal mandate and to stakeholders
11 Recognition and support of existing governance by Indigenous peoples and local rights-holders, including sovereignty, self-determination, and rights of access, use and management
12 Conflict resolution mechanisms

Fig. 1 Enabling conditions considered in this study, with social and ecological dimensions specified where relevant. This figure is adapted from the MPA Guide (Grorud-Colvert et al. 2021) and further details can be found in the MPA Guide User Manual (Oregon State University 2023). Enabling conditions 1–12 are cross-stages and enabling conditions a-x are stage-specific

and/or ecological elements interact, generating effects (e.g., rules, changes in fish abundance, ecological database) that influence other action-situations (adapted from Ostrom 2005). This framework enables a multi-level analysis, linking action-situations to broader social-ecological system and the emergent phenomena they produce. Additionally, it facilitates cross-case comparisons, aligning with our study's objective of assessing how enabling conditions are operationalized.

By combining these approaches, our analysis focused on the macro-level dynamics of how action-situations interact and shape both enabling conditions and social–ecological outcomes. This allowed us, first, to document the processes through which enabling conditions are operationalized, understood here as clusters of stakeholder actions and their interactions that activate enabling conditions (Fig. 3). Second, the comparison between the two case studies highlighted the different forms of operationalization. Finally, we identified the direct and indirect influences of these interactions on social and ecological outcomes, as reflected in stakeholder perspectives and existing studies.

3/Data collection and social-ecological mapping process

We were able to document the social-ecological configurations of action-situations for both case studies and to analytically represent them as a network of action-situation interactions through a two-pronged methodology. First, we conducted a literature review of empirical papers, grey literature reports, and policy documents dealing with both case studies by searching through academic databases, organizational and governmental websites, as well as documents provided by local stakeholders and organizations active in the sites. Documents were retained if they contained information on ecological, social, or governance dimensions of the case studies. We were able to characterize both enabling conditions being in place and how they are operationalized, from a total of 20 documents. Second, we conducted semi-structured interviews with stakeholders ($N = 84$) seeking to represent their diversity with a representative sample of staffers from French Polynesian agencies, local government and civil society representatives (details provided in Supp. Mat. 1). Relevant stakeholders were identified by local managers, by authors of this paper (with extensive field experience of both sites), as well as snow-ball sampling. During a three-month field campaign in 2023, we conducted these interviews with the prior-informed consent of all participants. Researchers who have conducted social-science fieldwork have complied to French Polynesian regulations regarding research involving Human Subjects as well as CRIOBE's Code of Ethics and CNRS' guidelines for complying to European Union regulations concerning the handling and storage of Personal Information (RGPD). The guiding questions was inspired by the ones formulated by Schlüter et al. (2019). We conducted the interview following the chronology of stages of establishment and for each stage, we asked questions about action-situation, interactions, enabling conditions and outcomes. (Supp. Mat. 1). Personal data were anonymized during interview transcription.

We first defined the timelines of the stages of establishment for each case study (Grorud-Colvert et al. 2021). Stage 1 (Proposed/Committed) corresponds to the initial intent to create a conservation area. Stage 2 (Designated) involves the formal definition of rules, the legal framework, and site boundaries. For Stage 3 (Implemented), we focused exclusively on the influence of these rules, without considering management actions. Stage 4 (Actively Managed) represents the point at which management actions are fully established. In both case studies, the timelines show that reaching the stage of actively managed conservation areas required approximately ten years (Supp. Mat. 1).

We used qualitative content analysis to categorize and then identify each part of document or transcript interview. We categorized bits of texts according to (i) the stage of establishment they matched and (ii) the type of element of our framework they described (action-situation, interactions, stakeholders, enabling conditions or outcomes) and identified them using ID code. (Supp. Mat. 1). The classification and naming of each action-situation was established through the use of - while not limited to - existing categories identified in other social-ecological case studies (definitions in Supp. Mat. 1). The list of enabling conditions was fixed but they were examined independently of the stages recommended in the MPA Guide (Fig. 1). The list of outcomes was identified by Reimer et al. 2021 (Fig. 2). To ensure consistency in the categorizing process, the text was analyzed several times before fixing the final category. The absence of certain enabling conditions mentioned in the MPA Guide, or of certain types of outcomes, does not imply that these were entirely lacking in the case studies, but rather that their being in place could not be demonstrated based on the evidence available in the literature and interviews we analyzed. Because our aim in this study was to examine the role of enabling conditions, our analysis focused exclusively on conditions and outcomes for which evidence was available, without distinguishing between cases of confirmed absence

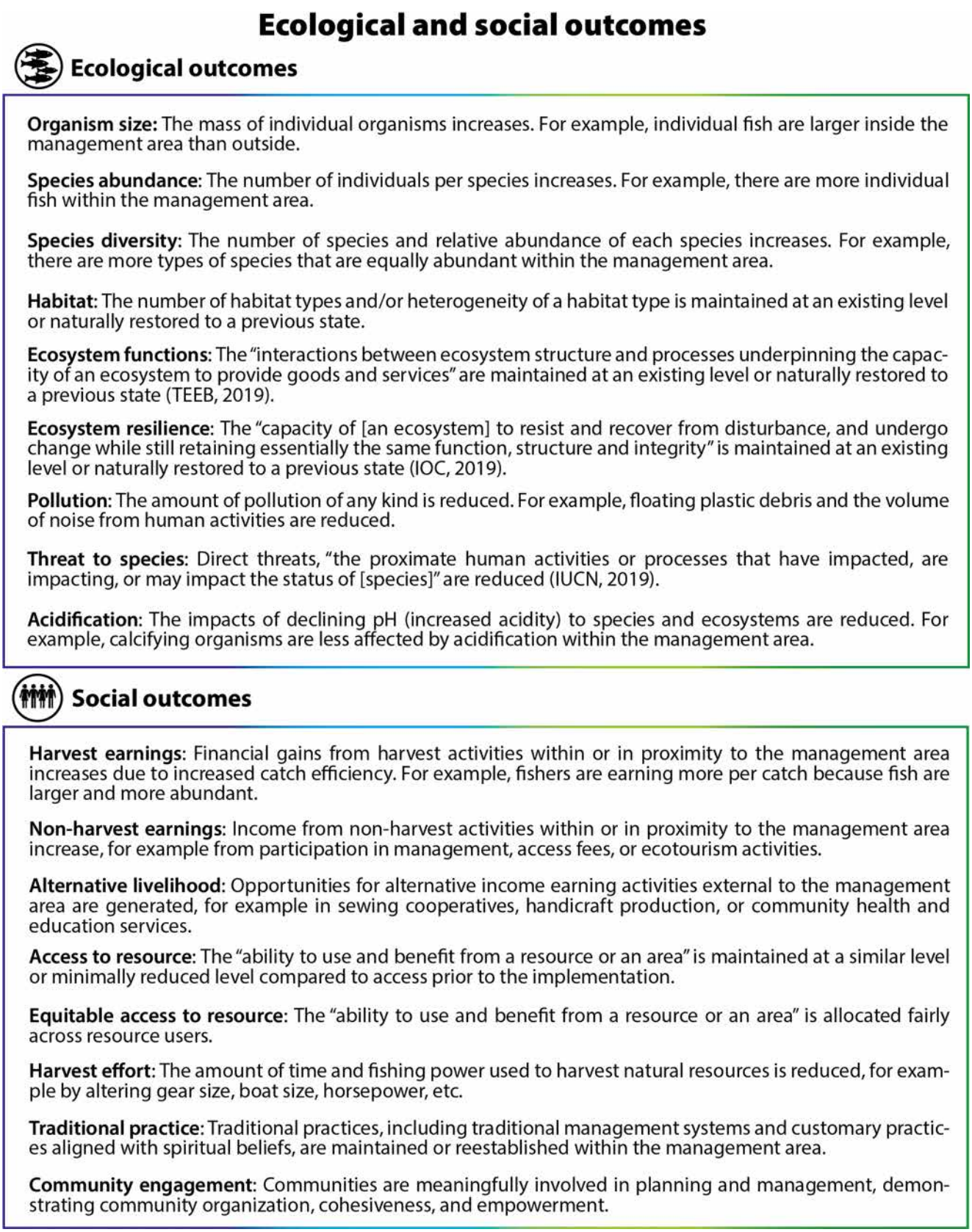


Fig. 2 Ecological and social outcomes considered in this study.(Modified from Reimer et al. 2021). References can be found in Reimer et al. 2021.

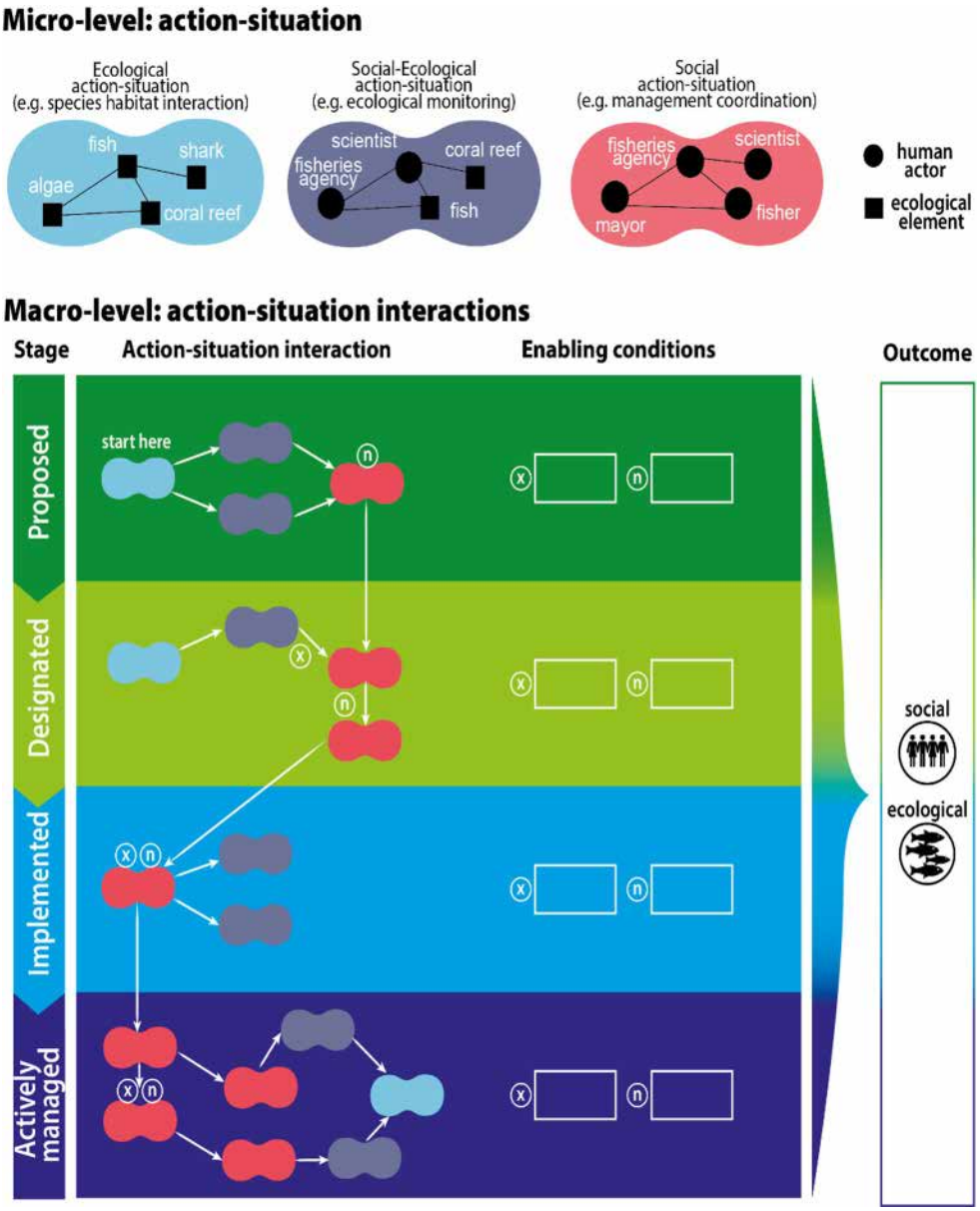


Fig. 3 Application of the Action-Situation Framework to map how enabling conditions emerge and interact across the stages of establishing an area-based conservation initiative. Action-situations are defined by the components they represent (human and/or ecological) and labeled accordingly. Interactions between them form a causal network showing how conditions influence social and ecological outcomes. Stages and enabling conditions follow the MPA Guide: stage-specific conditions are lettered; cross-stage conditions are numbered (see Fig. 1 for details and list of corresponding enabling conditions)

and cases where no evidence of being in place was found. The evaluation of the normative quality of outcomes (positive, negative or neutral) was not based on our own assessments but on those made explicit by interviewees or by authors of the references examined in the literature review. Furthermore, preliminary results regarding outcomes were presented to the management committees of each site in report meetings, which served to validate the interpretation of ecological and social outcomes that are presented in the study.

To map the social-ecological system for each stage and case, we linked interactions, stakeholders and enabling conditions to a specific action-situation, using ID. Then, we represented action-situation as a node, interactions as links between action-situations, and stakeholders or ecological elements as components of an action-situation (Fig. 3). The enabling conditions and outcomes were integrated as emerging components of the social-ecological configurations and assigned to a stage based on the available evidence of their timing. We then reduced the size of the social-ecological system, both to ensure a better understanding of the emergence of enabling conditions and to ensure consistency across the case studies, further enhancing the readability and comparability of the findings. For example, in Mo'orea, we initially provided a detailed description of the conflicts arising between users during the designated stage. The first draft categorized each type of conflict as an action-situation (e.g., conflicts over resources, traditional policies, safety, and space). However, these conflicts influenced in the same way the deliberating actions-situation. Therefore,

we decided to consolidate these details into a single representation of opposition. The final configurations for the two case studies can be seen in the supplement material 2.

Specifically, in mapping the social-ecological system of the PGEM of Mo'orea, we focused on conservation measures, while recognizing that other measures adopted might be embedded within a broader marine spatial planning framework. Since our analysis centered on area-based conservation, measures such as tourism regulations, navigation rules, or speed limits were not examined in detail, but were taken into account when they influenced conservation outcomes.

Results

In each case study, the enabling conditions were analytically depicted as emerging from a cluster of action-situation's interactions representing the operationalization process. This enabled mapping operationalization processes across the four stages of establishing the conservation areas.

Process of operationalization of each enabling condition

Holistically, the establishment of Teahupo'o rāhui's operationalized 13 enabling conditions, while the PGEM establishment operationalizes 15, corresponding to 39% and 42%, respectively, of all enabling conditions recommended by the MPA guide (Figs. 4 and 5). Below we detailed the operationalization of each enabling condition for both sites.

Teahupo'o's rāhui

The enabling conditions of "inclusion of social objectives for multi-dimensional human well-being" and "evidence-based decision-making" were met during the proposal stage. Indeed, the proposal for area-based conservation in Teahupo'o emerged in response to concerns over declining fish stocks and conflicts between local and external fishers regarding fishing rights in the lagoon adjacent to the Teahupo'o community (Fabre et al. 2021; interview with hotel/pension representative). These issues underscored the need to protect the area from external fishing pressures while ensuring resource conservation.

The enabling condition of "coordination with related governance, institutions" was integrated across three stages: proposal, designation, and active management. This condition has been achieved mainly through a collaboration between local stakeholders and French Polynesian governmental agencies responsible for environmental and fisheries management. During the proposal stage, this collaboration initiated a diagnostic process to explore legal avenues for establishing a protected area (interview with engineering company and fishing agency representatives; Direction de l'environnement 2009a, b). This diagnostic, which concluded in the designation stage, also involved external stakeholders such as scientists, who then contributed to the collaborative effort (Fabre et al. 2021, 2022; Bambridge 2020).

Fig. 4 Action-situation mapping of enabling condition emergence across four stages of conservation establishment for the Teahupo'o rāhui (dotted arrows/circles). The process begins with the species-habitat action-situation and traces only those interactions directly contributing to enabling conditions (detailed relationships in Supp. Mat. 2). Stages and enabling conditions follow the MPA Guide: stage-specific conditions are lettered; cross-stage conditions are numbered (see Fig. 1 for details and list of corresponding enabling conditions)

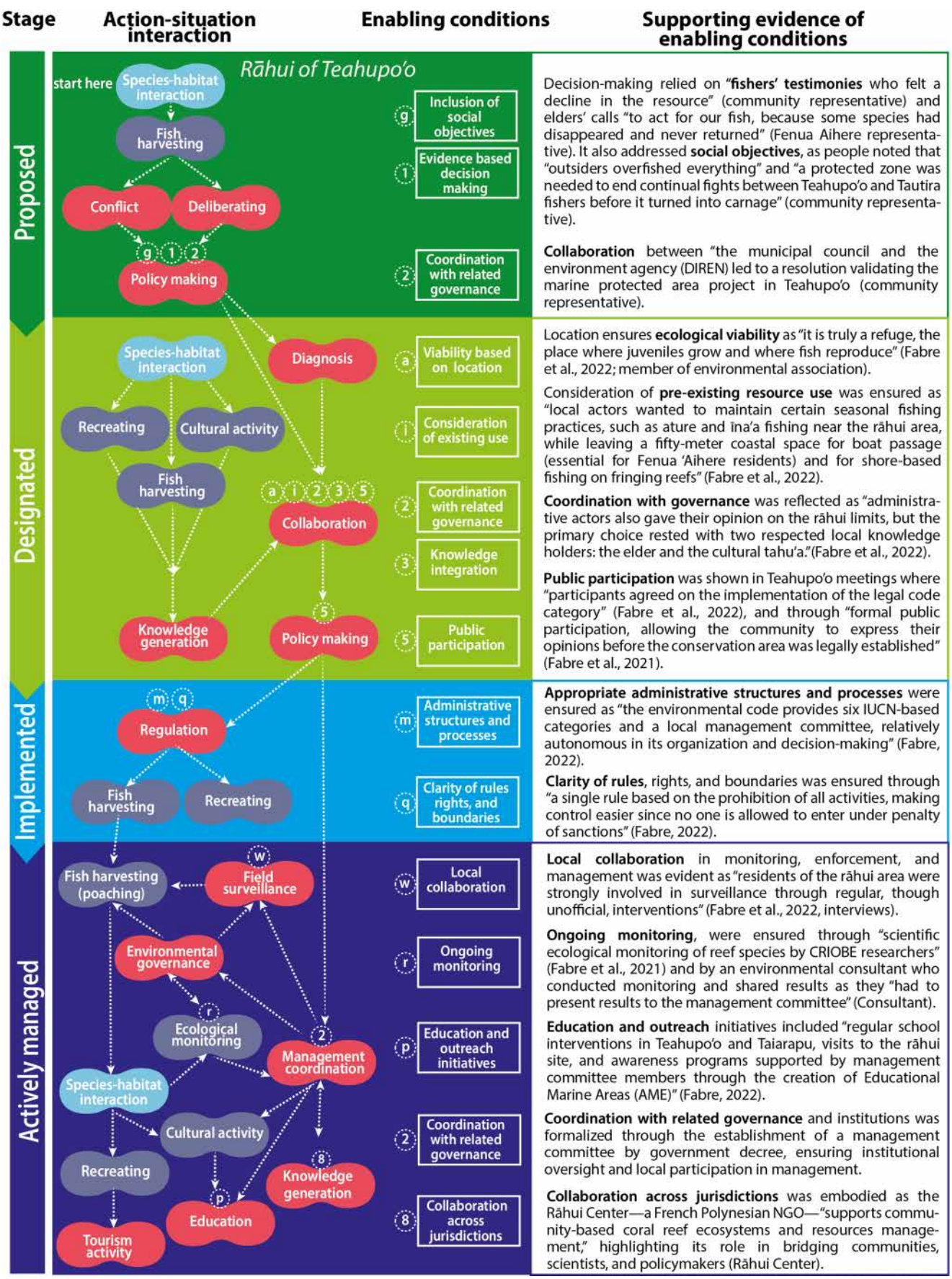
The enabling conditions of "consideration of pre-existing resource use and socio-economic status", "knowledge integration e.g. across academic disciplines, local, indigenous, practitioner domains", and "viability based on MPA location, size, spacing, shape and permanence" were addressed during the area's designation stage. Indeed, the decision to establish a rāhui was based on cultural knowledge from fishers and input from recreational stakeholders as well as on an assessment of existing practices and potential new spatial uses conducted by the urbanism agency. This was made possible through a scientific study that explored plurality of knowledge and local representations (interview with Hotel/pension, Engineering company and scientists representatives).

The enabling condition of "public participation with contextual and procedural fairness" was ensured during the designation stage through a decision-making process that allowed the community to express their opinions on the final version of the conservation area before its legal establishment (Fabre et al. 2021).

The enabling condition of "clarity of rules, rights, and boundaries" was implemented through the establishment of a single regulation prohibiting all activities, including passage through the area, thereby simplifying enforcement (Fabre et al. 2021; ARRETE no. 864 CM du 6 juin 2014).

The enabling condition of "appropriate and adequate administrative structures and processes" was ensured by choosing a legal framework based on French environmental code legislation. This framework permits the establishment of various level of environmental protection and the creation of management committees as required by local stakeholders (Fabre et al. 2021; ARRETE n° 864 CM du 6 juin 2014).

The enabling conditions of "ongoing monitoring, evaluation and knowledge sharing", and "education and outreach initiatives" were carried out through actions coordinated by the management committee such as the creation of posters available for schools and interventions in elementary classes


Stage
Action-situation interaction
Enabling conditions
Supporting evidence of enabling conditions
Proposed
Designated
Implemented
Actively managed
Rāhui of Teahupo'o
start here
Species-habitat interaction
Fish harvesting
Conflict
Deliberating
Policy making
Inclusion of social objectives
Evidence based decision making
Coordination with related governance
Decision-making relied on "fishers' testimonies who felt a decline in the resource" (community representative) and elders' calls "to act for our fish, because some species had disappeared and never returned" (Fenua Aihere representative). It also addressed social objectives, as people noted that "outsiders overfished everything" and "a protected zone was needed to end continual fights between Teahupo'o and Tautira fishers before it turned into carnage" (community representative).
Collaboration between "the municipal council and the environment agency (DIREN) led to a resolution validating the marine protected area project in Teahupo'o (community representative).
Species-habitat interaction
Diagnosis
Recreating
Cultural activity
Fish harvesting
Collaboration
Knowledge generation
Policy making
Viability based on location
Consideration of existing use
Coordination with related governance
Knowledge integration
Public participation
Location ensures ecological viability as "it is truly a refuge, the place where juveniles grow and where fish reproduce" (Fabre et al., 2022; member of environmental association).
Consideration of pre-existing resource use was ensured as "local actors wanted to maintain certain seasonal fishing practices, such as ature and īna'a fishing near the rāhui area, while leaving a fifty-meter coastal space for boat passage (essential for Fenua 'Aihere residents) and for shore-based fishing on fringing reefs" (Fabre et al., 2022).
Coordination with governance was reflected as "administrative actors also gave their opinion on the rāhui limits, but the primary choice rested with two respected local knowledge holders: the elder and the cultural tahu'a." (Fabre et al., 2022).
Public participation was shown in Teahupo'o meetings where "participants agreed on the implementation of the legal code category" (Fabre et al., 2022), and through "formal public participation, allowing the community to express their opinions before the conservation area was legally established" (Fabre et al., 2021).
Regulation
Fish harvesting
Recreating
Administrative structures and processes
Clarity of rules rights, and boundaries
Appropriate administrative structures and processes were ensured as "the environmental code provides six IUCN-based categories and a local management committee, relatively autonomous in its organization and decision-making" (Fabre, 2022).
Clarity of rules, rights, and boundaries was ensured through "a single rule based on the prohibition of all activities, making control easier since no one is allowed to enter under penalty of sanctions" (Fabre, 2022).
Fish harvesting (poaching)
Field surveillance
Environmental governance
Ecological monitoring
Management coordination
Species-habitat interaction
Cultural activity
Recreating
Knowledge generation
Education
Tourism activity
Local collaboration
Ongoing monitoring
Education and outreach initiatives
Coordination with related governance
Collaboration across jurisdictions
Local collaboration in monitoring, enforcement, and management was evident as "residents of the rāhui area were strongly involved in surveillance through regular, though unofficial, interventions" (Fabre et al., 2022, interviews).
Ongoing monitoring, were ensured through "scientific ecological monitoring of reef species by CRIOBE researchers" (Fabre et al., 2021) and by an environmental consultant who conducted monitoring and shared results as they "had to present results to the management committee" (Consultant).
Education and outreach initiatives included "regular school interventions in Teahupo'o and Taiarapu, visits to the rāhui site, and awareness programs supported by management committee members through the creation of Educational Marine Areas (AME)" (Fabre, 2022).
Coordination with related governance and institutions was formalized through the establishment of a management committee by government decree, ensuring institutional oversight and local participation in management.
Collaboration across jurisdictions was embodied as the Rāhui Center—a French Polynesian NGO—"supports community-based coral reef ecosystems and resources management," highlighting its role in bridging communities, scientists, and policymakers (Rāhui Center).

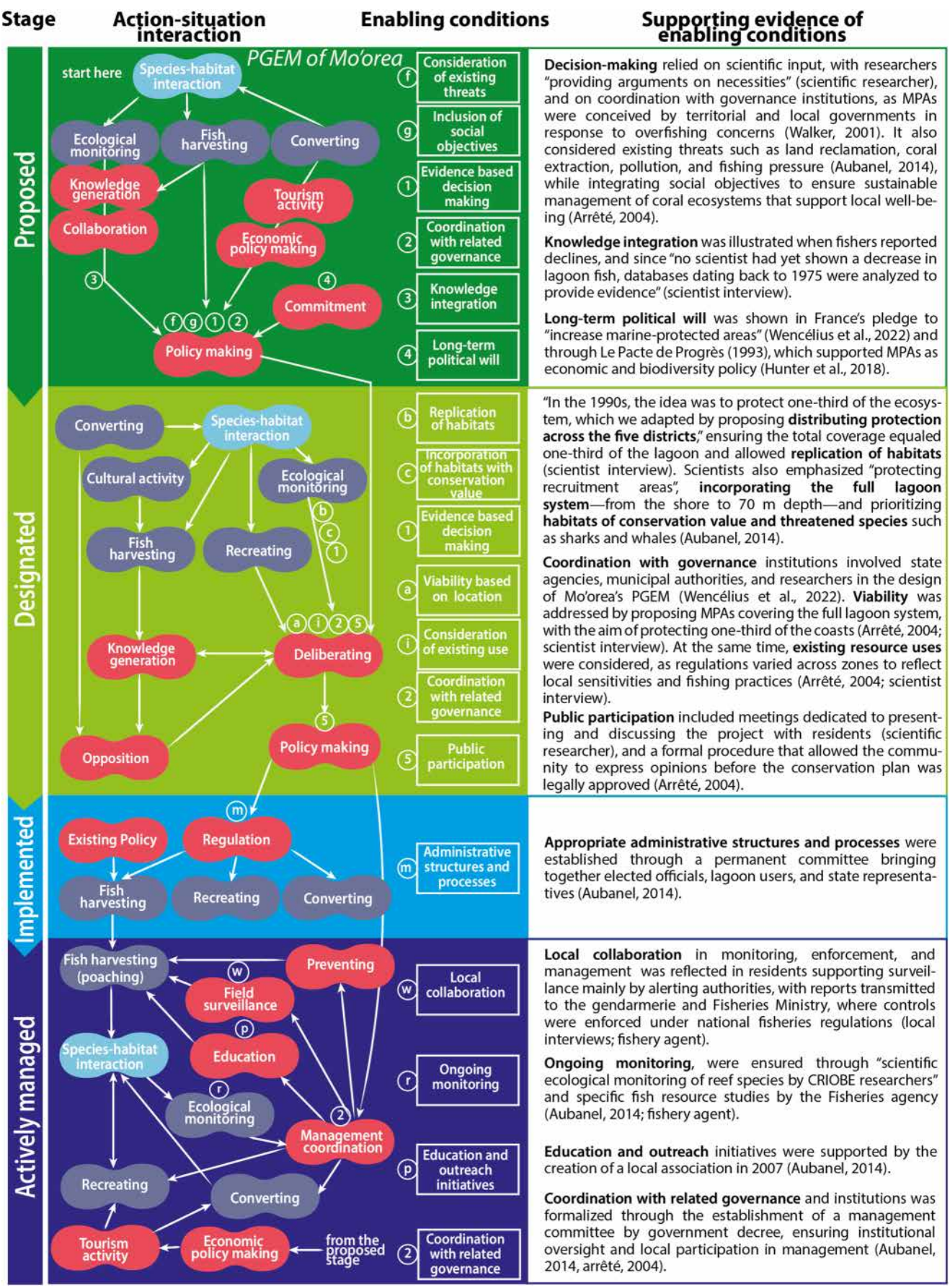

Stage
Action-situation interaction
Enabling conditions
Supporting evidence of enabling conditions
Proposed
PGEM of Mo'orea
start here
Species-habitat interaction
Ecological monitoring
Fish harvesting
Converting
Knowledge generation
Tourism activity
Collaboration
Economic policy making
Commitment
Policy making
Consideration of existing threats
Inclusion of social objectives
Evidence based decision making
Coordination with related governance
Knowledge integration
Long-term political will
Decision-making relied on scientific input, with researchers "providing arguments on necessities" (scientific researcher), and on coordination with governance institutions, as MPAs were conceived by territorial and local governments in response to overfishing concerns (Walker, 2001). It also considered existing threats such as land reclamation, coral extraction, pollution, and fishing pressure (Aubanel, 2014), while integrating social objectives to ensure sustainable management of coral ecosystems that support local well-being (Arrêté, 2004).
Knowledge integration was illustrated when fishers reported declines, and since "no scientist had yet shown a decrease in lagoon fish, databases dating back to 1975 were analyzed to provide evidence" (scientist interview).
Long-term political will was shown in France's pledge to "increase marine-protected areas" (Wencélius et al., 2022) and through Le Pacte de Progrès (1993), which supported MPAs as economic and biodiversity policy (Hunter et al., 2018).
Designated
Converting
Species-habitat interaction
Cultural activity
Ecological monitoring
Fish harvesting
Recreating
Knowledge generation
Deliberating
Opposition
Policy making
Replication of habitats
Incorporation of habitats with conservation value
Evidence based decision making
Viability based on location
Consideration of existing use
Coordination with related governance
Public participation
"In the 1990s, the idea was to protect one-third of the ecosystem, which we adapted by proposing distributing protection across the five districts," ensuring the total coverage equaled one-third of the lagoon and allowed replication of habitats (scientist interview). Scientists also emphasized "protecting recruitment areas", incorporating the full lagoon system—from the shore to 70 m depth—and prioritizing habitats of conservation value and threatened species such as sharks and whales (Aubanel, 2014).
Coordination with governance institutions involved state agencies, municipal authorities, and researchers in the design of Mo'orea's PGEM (Wencélius et al., 2022). Viability was addressed by proposing MPAs covering the full lagoon system, with the aim of protecting one-third of the coasts (Arrêté, 2004; scientist interview). At the same time, existing resource uses were considered, as regulations varied across zones to reflect local sensitivities and fishing practices (Arrêté, 2004; scientist interview).
Public participation included meetings dedicated to presenting and discussing the project with residents (scientific researcher), and a formal procedure that allowed the community to express opinions before the conservation plan was legally approved (Arrêté, 2004).
Implemented
Existing Policy
Regulation
Fish harvesting
Recreating
Converting
Administrative structures and processes
Appropriate administrative structures and processes were established through a permanent committee bringing together elected officials, lagoon users, and state representatives (Aubanel, 2014).
Actively managed
Fish harvesting (poaching)
Preventing
Field surveillance
Species-habitat interaction
Education
Ecological monitoring
Management coordination
Recreating
Converting
Tourism activity
Economic policy making
from the proposed stage
Local collaboration
Ongoing monitoring
Education and outreach initiatives
Coordination with related governance
Local collaboration in monitoring, enforcement, and management was reflected in residents supporting surveillance mainly by alerting authorities, with reports transmitted to the gendarmerie and Fisheries Ministry, where controls were enforced under national fisheries regulations (local interviews; fishery agent).
Ongoing monitoring, were ensured through "scientific ecological monitoring of reef species by CRIOBE researchers" and specific fish resource studies by the Fisheries agency (Aubanel, 2014; fishery agent).
Education and outreach initiatives were supported by the creation of a local association in 2007 (Aubanel, 2014).
Coordination with related governance and institutions was formalized through the establishment of a management committee by government decree, ensuring institutional oversight and local participation in management (Aubanel, 2014, arrêté, 2004).

Fig. 5 Action-situation mapping of enabling condition emergence across four stages of conservation establishment for the PGEM of Mo'orea (solid arrows/circles). The process begins with the species-habitat action-situation and traces only those interactions directly contributing to enabling conditions (detailed relationships in Supp. Mat. 2). Stages and enabling conditions follow the MPA Guide: stage-specific conditions are lettered; cross-stage conditions are numbered (see Fig. 1 for details and list of corresponding enabling conditions)

to explain the role of the rāhui, the implementation of a volunteer monitoring schedule and the designation of a contact person to report any non-compliance behavior (interview with local government and associations representatives).

The enabling condition of "local collaboration in monitoring, enforcement, and management" was facilitated by delegating outreach, education initiatives, and field surveillance responsibilities to two local associations (interview with local government and associations representatives).

The enabling condition of "collaboration across jurisdictions" was carried out through committee members who shared experiences in establishing a rāhui. They visited schools and other local towns to discuss their conservation projects and help in similar initiatives (interview with cultural representative).

Mo'orea's PGEM

The enabling condition of "evidence-based decision-making" was implemented during both the proposal and designation stages. At the proposal stage, concerns raised by scientists and the French Polynesian Urbanism agency regarding the sustainable use of lagoon resources and environment preservation led to discussions on area-based conservation (Loma et al. 2008; interview with marine biologists, scientific representatives). This scientific input played a crucial role in shaping the proposal of the managing plan. During the designated stage, scientists provided data on fish recruitment processes and habitat connectivity. This information directly informed the decision-making and supported the justification for conservation measures (interview with scientific representatives).

As with Teahupo'o's rāhui, the enabling condition of "coordination with related governance, institutions" was implemented in the establishment of Mo'orea's PGEM across three stages: proposal, designation, and active management. During the proposal stage, French Polynesian agencies and other stakeholders were involved separately (Walker 2001), while during the designation stage they were consulted conjointly through a deliberation process (ARRETE n° 410 CM du 21 octobre 2004; Aubanel et al. 2013). During the active management stage, coordination continued through the management committee, working alongside fishery services under French Polynesian jurisdiction and the Gendarmery (military police) under French jurisdiction to ensure the compliance with rules (interview with local and French Polynesian government representatives).

The enabling conditions of "consideration of existing threats and mitigation", "long-term political will and commitment", and "inclusion of social objectives for multi-dimensional human well-being" were put into action through multiple stakeholders. First, concerns raised by fishers about resource depletion served as a catalyst for area-based conservation efforts, highlighting the urgent need for protection (Hunter et al. 2018; Loma et al. 2008; Walker and Robinson 2009; interview with marine biologist, scientific representative). Second, international conservation strategies promoted the establishment of marine protected areas, reinforcing local initiatives with broader global support (Wencélius et al. 2022; Walker 2001; Aubanel et al. 2013). Finally, further institutional backing was possible because conservation was seen as a means to enhance tourism and generate revenue for French Polynesia and therefore was aligned with political objectives (Walker and Robinson 2009; Walker 2001; Aubanel et al. 2013; Wencélius et al. 2022; Hunter et al. 2018; ARRETE n° 167 PR du 20 mai 1996).

The enabling condition of "knowledge integration e.g. across academic disciplines, local, indigenous, practitioner domains" was reflected in the incorporation of fishers observations of declining fish stocks alongside scientific understanding of coral reef ecosystem dynamics. This combined knowledge, supported by the French Polynesia Urbanism agency, enabled pressure on the government to establish a conservation area (interview with marine biologist, scientific representative).

The enabling conditions of "representativeness and replication of habitats", "evidence-based decision-making", and "incorporation of habitats and species with conservation value" were operationalized through a deliberative process led by the Local Commission for Maritime Space (CLEM). This process involved all lagoon stakeholders, including scientists, cultural representatives, hotel owners, lagoon activity providers, fishers, and the general public. Scientists contributed ecological data on fish recruitment and habitat connectivity to inform the decision-making (Aubanel et al. 2013; ARRETE n° 410 CM du 21 octobre 2004; interview with scientific representatives).

The enabling conditions of "viability based on MPA location, size, spacing, shape and permanence" and " consideration of pre-existing resource us and socio-economic status " were considered in the deliberation process, ensuring that input from all stakeholders and all districts was included to promote equitable distribution of benefits from conservation areas (ARRETE n° 410 CM du 21 octobre 2004; Aubanel et al. 2013).

As with the rāhui, the enabling condition of "public participation with contextual and procedural fairness" was ensured during the designation stage through a decision-making process that allowed the community to provide feedback on the final version of the PGEM before its legal establishment (ARRETE n° 410 CM du 21 octobre 2004).

The enabling condition of "appropriate and adequate administrative structures and processes" was ensured by selecting a framework that enabled the establishment of a management committee composed of lagoon users and government representatives (Aubanel et al. 2013).

The enabling conditions of "ongoing monitoring, evaluation and knowledge sharing", and "education and outreach initiatives" were operationalized through management actions, including education, outreach, field surveillance, regulatory enforcement, and ecological monitoring, all coordinated by the steering committee.

The enabling condition of "local collaboration in monitoring, enforcement, and management" was operationalized by delegating education and field surveillance responsibilities to local stakeholders (interview with local government representatives).

Differences and commonalities in the operationalization of enabling conditions

When comparing the two case studies, 11 shared enabling conditions can be identified (Fig. 6). We also compared the overall process of establishing area-based conservation by examining the action-situation and the interactions between them. The two sites share 16 similar action-situations (Fig. 6), but the interactions among action-situation diverge largely (Supp. Mat. 2). Considering both the type of action-situation (detailed in Supp. Mat. 2) and the type of relations affecting each action-situation, only one interaction was similar across the two sites—policy-making legally establishing conservation area and influencing management coordination during the final stage (Fig. 6), —though in the case of Mo'orea it also continue to lead to opposition of the fishers (detailed in Supp. Mat. 2). More importantly this interaction is the only one that supported the same number and type of enabling conditions across both sites (e.g. "public participation"). This indicates that there is a large variation in how operationalization is carried out, and that one enabling condition can be implemented in multiple ways.

Overall, the two case studies follow a similar pattern in establishing area-based conservation: a sequence of action-situations leading to same enabling conditions (Fig. 6). This pattern begins with the government's decision to approach conservation through "coordination with

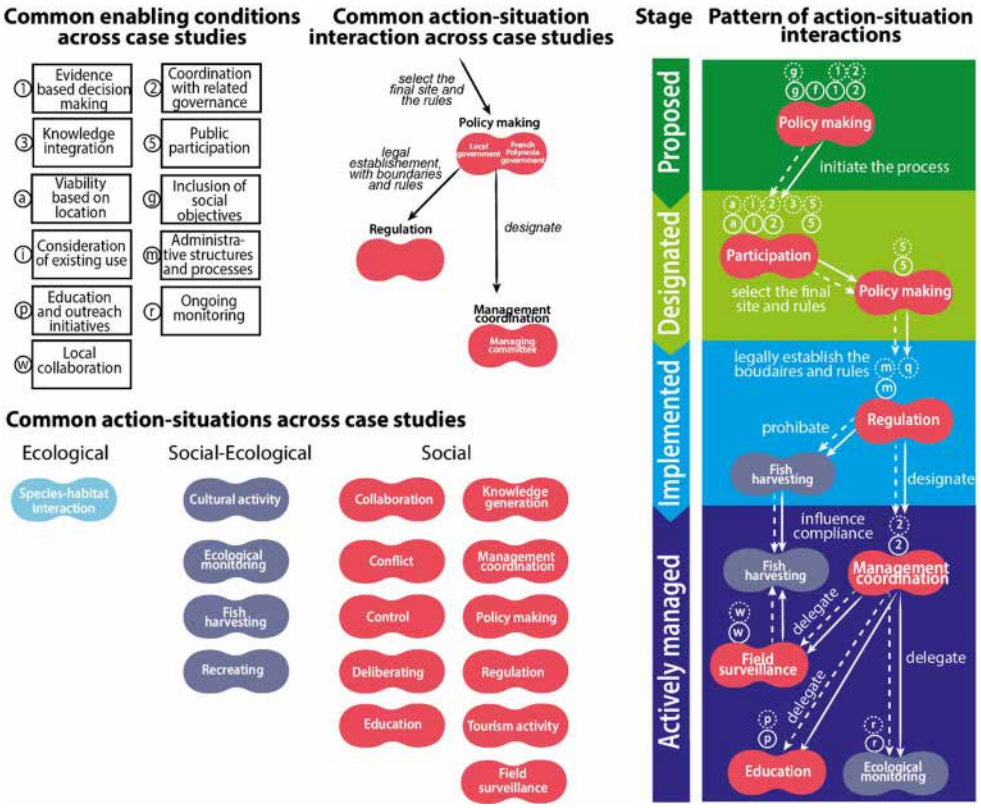


Fig. 6 Commonalities in the operationalization of enabling conditions across the case studies: the rāhui of Teahupo'o' (dotted arrows/circles) and the PGEM of Mo'orea (solid arrows/circles). Stages and enabling conditions follow the MPA Guide: stage-specific conditions are lettered; cross-stage conditions are numbered (see Fig. 1 for details and list of corresponding enabling conditions)

related governance", "evidence-based decision-making" and "inclusion of social objectives" at the propositional stage. These enabling conditions shape the policy-making process, which determines the type of stakeholder participation engaged for designating the areas and rules (e.g., deliberation or collaboration). This participatory process is driven by four enabling conditions such as "viability based on location" and "coordination with related governance". These factors influence the final conservation policy, which is implemented ultimately through formal public participation, and which influenced the type of management coordination for the conserved and protected areas. The pathway culminates in three key action-situations: education, field surveillance, and ecological monitoring.

Influences of operationalization on social and ecological outcomes

We compared the two case studies to identify specific elements such as the types of actions, the forms of interaction, and the enabling conditions that are crucial for achieving positive outcomes. Some social outcomes emerged during the establishment of area-based conservation and continued to evolve, while ecological outcomes generally required more time and became significant only at later stages.

In our case studies, two outcomes appeared in the early stages and developed progressively: the maintenance of traditional practices and the active involvement of community members. The nature of participatory action and the integration of knowledge played key roles in shaping the maintenance of traditional practices (Fig. 7, upper panel). In both sites, clusters of action-situations began with the influence of coral reef habitats on fisheries and related activities, which in turn generated diverse forms of knowledge. Differences emerged in how participatory actions were implemented, particularly in the timing, level, and nature of stakeholder involvement and interaction. We classified these differences according to typologies of participation, defined by the degree to which stakeholders are engaged, following Reed et al. (2018) and, where deliberation refers to processes in which stakeholders are consulted but decision-making authority is retained by others, reflecting a top down process, and collaboration refers to processes in which diverse sources of knowledge are integrated into decision-making, reflecting a bottom up process. At Teahupo'o, diverse knowledge sources were integrated to inform collaborative decisions during the designated stage, culminating in the establishment of a cultural practice of resource management known as the rāhui. At Mo'orea, collaboration arose earlier in the process and led to the adoption of a management practice that differed from traditional approaches, guiding deliberations and rule-making during the designated stage. As the process continued, these outcomes in Mo'orea evolved during the implemented stage toward the continuation of traditional fishing activities themselves, with methods such as the capture of juvenile goatfish (*Mulloidichthys flavolineatus* and *Mulloidichthys vanicolensis*) using small beach seines operated by one or two fishers still being practiced (Fabre and Bambridge 2017). Whereas at Teahupo'o, teaching local children about the Polynesian cultural heritage and history through presentations and sharing experiences among local communities helped disseminate the rāhui conservation initiative as a traditional management practice during the actively managed stage.

The active involvement of community members evolved in both cases from high participation to more neutral participation (Fig. 7, lower panel). At Teahupo'o, strong involvement resulted from collaboration and the integration of knowledge among different members and activities during the designated stage, but it decreased during the managed stage because environmental policy kept the legal authority for regulation at the institutional level, limiting the role of local participation in field surveillance. At Mo'orea, involvement was shaped by the activation of opposition groups who contested the government's chosen framework for lagoon management. Although participation was initially high, it decreased during the managed stage, leading to limited engagement in compliance despite continued involvement in field surveillance.

Outcomes at the implementation stage reflected the policy choices made during the designation stage. In Teahupo'o, the establishment of a rāhui that restricted access to all users provided directedly the creation of clear and equitable rules as a positive outcome, yet it reduced harvesting revenues for fishers who depended on this fishing ground (Fig. 8, upper panel). In contrast, in Mo'orea, under the PGEM, different strategies were applied to manage each activity, with restrictions placed on fisheries and regulations introduced for tourism. This approach created the perception among fishers that access to resources was unequal, fostering resentment toward the rules as flawed and unjust.

Ecological outcomes only emerge after the establishment of area-based conservation measures and are undirectedly influenced by the operationalization of enabling conditions (Fig. 8, lower panel). In the case of the Teahupo'o rāhui, management actions have contributed to enhancing ecosystem functions, reducing threats to species, and improving habitat quality and species diversity (Fabre et al. 2021; interview with various local stakeholder representatives). However, there is no conclusive evidence of increases in organism size or species abundance (interview with engineering company and environmental state agency representatives). For the PGEM of Mo'orea, management efforts have focused on maintaining ecosystem functionality by

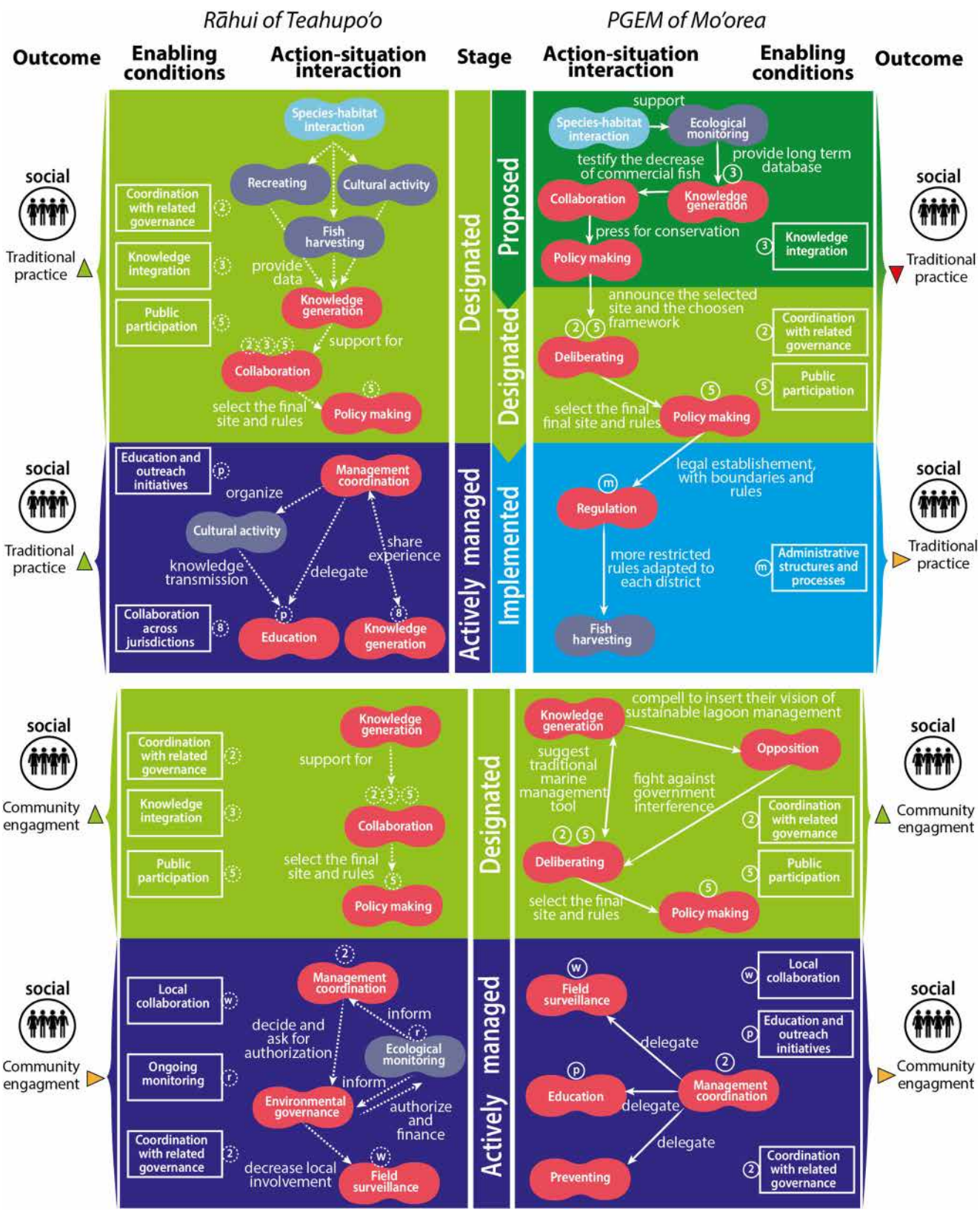


Fig. 7 Comparison of action-situation interactions and the emergence of enabling conditions leading to outcomes that evolve during the establishment stages of the rāhui of Teahupo'o and the PGEM of Mo'orea. Stages and enabling conditions follow the MPA Guide: stage-specific conditions are lettered; cross-stage conditions are numbered (see Fig. 1 for details and list of corresponding enabling conditions). Outcomes are indicated as green (positive), orange (neutral), or red (negative) triangles (see Fig. 2 for definition and Supp. Mat. 1 for proof of evidence)

ensuring the provision of goods and services and preventing habitat degradation. Yet, no significant changes have been observed in organism size, species abundance and diversity, or threats to turtles and whales (Moritz 2021; Caritg et al. 2022; Thiault et al. 2019).

Finally, the social outcome of decrease in harvest effort is also closely linked to compliance with conservation rules. In Teahupo'o, harvest effort is perceived as decreasing, although some poaching persists. In Mo'orea, limited surveillance and reports of continued night-time poaching do not appear to reduce harvest effort (Thiault et al. 2019).

Although the processes leading to ecological outcomes are complex in both cases, three main differences help explain the contrasting results. First, the timing of knowledge integration played a critical role. In Mo'orea, the adoption of a framework perceived as a form of Western management generated opposition, which persisted over time and reduced compliance with rules, thereby limiting ecological outcomes. In contrast, in Teahupo'o, the establishment of the rāhui was culturally embedded, fostering respect for rules and supporting compliance. Second, the clarity of rules influenced effectiveness. The implementation of a single, clearly defined rule facilitated compliance in Teahupo'o, whereas in Mo'orea, multiple overlapping rules and areas of application created confusion, making compliance more difficult. Finally, the use of educational initiatives and communication strategies shaped compliance differently. In Mo'orea, awareness-raising activities and preventive actions helped explain new regulations and encouraged adherence, while in Teahupo'o such efforts were less systematically applied. The first two main differences also explained the contrasting social outcomes: the timing of knowledge integration (influencing the maintenance of traditional practice outcome) and the choice of a single rule (influencing both the equitable access to resources and the harvest earning). While social outcomes can often be adjusted and improved over time, ecological outcomes are more dependent on the continuity and coherence of the entire implementation process, making them less reversible once compromised.

Discussion

Our analysis shows that enabling conditions alone are insufficient to explain conservation success, as their influence depends on how they are operationalized through specific actions, their sequencing, and the interactions among stakeholders. The comparison of two coral reef initiatives illustrates that enabling conditions can be introduced in different ways at different stages of establishment, generating both direct and indirect effects on perceptions of benefits, compliance with regulations, and the sustainability of conservation measures. The descriptive results provide policymakers and managers with new insights into how enabling conditions can be implemented at each stage, either individually or in combination, and the different possibilities this creates for planning or later on adaptive actions. Our comparative approach also produces a general framework for establishing area-based conservation, which can be adapted to the needs of specific contexts. Our findings further demonstrate that enabling conditions and their modes of operationalization are interconnected and together shape conservation outcomes. This emphasizes the importance of considering the sequencing and timing of actions when aiming to strengthen conservation effectiveness. Overall, the analysis provides lessons that can guide practitioners and policymakers in improving management, while also helping to anticipate challenges, resolve conflicts, and plan future stages more effectively.

A significant limitation in our case study is the absence of comprehensive social and ecological outcome assessments, which hinders a complete understanding of the overall effectiveness of the area-based conservation initiatives. This issue has been recognized in the literature, where the lack of social outcome assessments is a well-documented challenge (Reimer et al. 2021). To address this limitation, we conducted interviews to fill in the missing information and validated these insights during report meetings with management committees. Since stakeholder perceptions are pivotal to understanding the acceptance of and compliance with area-based conservation measures, we documented how stakeholders themselves frame conservation outcomes, whether positive, negative, or neutral. Despite our efforts to document the nature and quality of outcomes from the point of view of stakeholders, we were unable to collect information on all of the expected social and ecological outcomes. This gap may reflect a lack of importance regarding these specific outcomes, though it does not necessarily indicate that these outcomes were not delivered. Furthermore, our study explored enabling conditions being in place through discourse analysis. Consequently, our findings should be understood as a qualitative representation of the establishment of protected and conserved areas, grounded in stakeholder perceptions. Future research could complement this approach by employing quantitative analyzes, such as scoring enabling conditions (Zuercher et al. 2022). Finally, the reliance on only two case studies constrains the broader applicability of our findings. While selecting cases from the same region helped minimize governance differences, variations in size and establishment timing may have influenced outcomes. Future research could expand the comparisons, develop a broader database of best practices, and identify

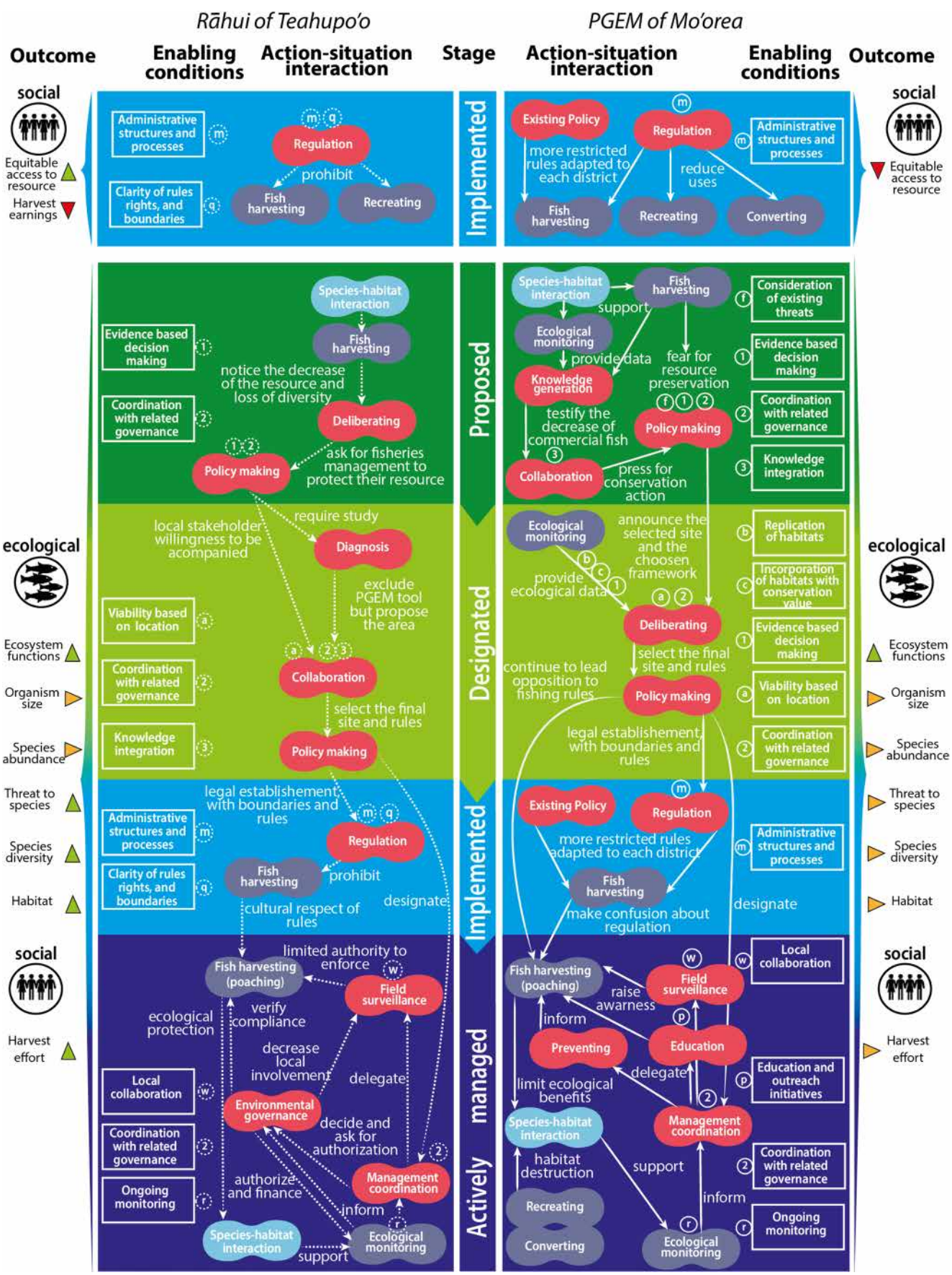

Rāhui of Teahupo'o
PGEM of Mo'orea
Outcome
Enabling conditions
Action-situation interaction
Stage
Action-situation interaction
Enabling conditions
Outcome
social
Equitable access to resource
Harvest earnings
Administrative structures and processes
Clarity of rules rights, and boundaries
Regulation
prohibit
Fish harvesting
Recreating
Implemented
Existing Policy
Regulation
more restricted rules adapted to each district
reduce uses
Fish harvesting
Recreating
Converting
Administrative structures and processes
social
Equitable access to resource
Species-habitat interaction
Fish harvesting
Evidence based decision making
notice the decrease of the resource and loss of diversity
Coordination with related governance
Deliberating
Policy making
ask for fisheries management to protect their resource
Proposed
Species-habitat interaction
Fish harvesting
support
Ecological monitoring
provide data
fear for resource preservation
Knowledge generation
testify the decrease of commercial fish
Policy making
Collaboration
press for conservation action
Consideration of existing threats
Evidence based decision making
Coordination with related governance
Knowledge integration
ecological
Ecosystem functions
Organism size
Species abundance
Threat to species
Species diversity
Habitat
require study
local stakeholder willingness to be acompanied
Diagnosis
exclude PGEM tool but propose the area
Viability based on location
Coordination with related governance
Collaboration
select the final site and rules
Knowledge integration
Policy making
Designated
Ecological monitoring
announce the selected site and the choosen framework
provide ecological data
Deliberating
select the final site and rules
continue to lead opposition to fishing rules
Policy making
legal establishement, with boundaries and rules
Replication of habitats
Incorporation of habitats with conservation value
Evidence based decision making
Viability based on location
Coordination with related governance
ecological
Ecosystem functions
Organism size
Species abundance
Threat to species
Species diversity
Habitat
legal establishement, with boundaries and rules
Administrative structures and processes
Regulation
Clarity of rules rights, and boundaries
Fish harvesting
prohibit
designate
cultural respect of rules
Implemented
Existing Policy
Regulation
more restricted rules adapted to each district
Fish harvesting
make confusion about regulation
designate
Administrative structures and processes
social
Harvest effort
limited authority to enforce
Fish harvesting (poaching)
Field surveillance
ecological protection
verify compliance
decrease local involvement
delegate
Local collaboration
Environmental governance
decide and ask for authorization
Coordination with related governance
Management coordination
Ongoing monitoring
authorize and finance
inform
Species-habitat interaction
Ecological monitoring
support
Actively managed
Fish harvesting (poaching)
Field surveillance
raise awarness
inform
Preventing
Education
delegate
limit ecological benefits
Species-habitat interaction
habitat destruction
Management coordination
support
Recreating
Converting
Ecological monitoring
inform
Local collaboration
Education and outreach initiatives
Coordination with related governance
Ongoing monitoring
social
Harvest effort

Fig. 8 Comparison of action–situation interactions and the emergence of enabling conditions leading to outcomes during the implementation stage (upper panel) and during the actively managed stage (lower panel) for the rāhui of Teahupo'o' and PGEM of Mo'orea. Stages and enabling conditions follow the MPA Guide: stage-specific conditions are lettered; cross-stage conditions are numbered (see Fig. 1 for details and list of corresponding enabling conditions). Outcomes are indicated as green (positive), orange (neutral), or red (negative) triangles (see Fig. 2 for definition and Supp. Mat. 1 for proof of evidence)

common patterns linking actions, stakeholders, and governance levels.

Both enabling conditions being in place and how they are operationalized determine the course of social-ecological outcomes. Comparing the two study cases, we found only two examples where either enabling conditions being in place or their operationalization alone had a direct impact on conservation outcomes: the enabling condition "clarity of rules" and the way the enabling condition "education" was operationalized. In most other cases, it was difficult to distinguish whether the observed influence was primarily due to enabling conditions being in place or their operationalization, as these two factors are closely intertwined. This finding underscores the importance of considering both the enabling conditions themselves and the ways in which they are operationalized in practice. In this line, our analysis uncovered diverse approaches to operationalizing the same enabling condition, providing potential models for policymakers and future conservation managers. For instance, in one case, local knowledge was incorporated through scientific research that mapped the spectrum of social-environmental values, while in another, it was embedded by separately addressing the concerns of distinct stakeholder groups. Our findings further emphasize that the way an enabling condition is operationalized can shape social-ecological outcomes, either directly within the same stage of establishment or indirectly in subsequent stages.

Several factors can influence the effectiveness of how enabling conditions are operationalized providing useful insights to guide the establishment of area-based conservation. The use of the action-situation framework helps highlight the different dimensions in which operationalization can shape conservation outcomes: At the level of the action-situation itself, through the timing of operationalization and via the overall sequence of enabling condition implementation.

Our results show that the way the action-situation was put into practice influenced the outcomes. In one case, education efforts focused on teaching rules, while in the other, they centered on explaining the cultural value of the conservation area. This suggests that similar actions can serve different purposes, a distinction that could be further explored to optimize management strategies and improve their efficiency. This is particularly relevant given that conservation practitioners often face human resource constraints, particularly for compliance efforts. Using this perspective can help reveal potential synergies between different management actions and improve the allocation of resources (Bergseth and Day 2023).

While the MPA Guide suggests specific stages for some enabling conditions, others are recommended for continuous consideration throughout the conservation establishment process. Our findings indicate that for some enabling conditions, the stage at which they are operationalized may be more critical than others and should be prioritized accordingly. For example, in Teahupo'o, the integration of knowledge through collaborative actions during the designation stage contributed to building trust and equity in conservation planning. In contrast, in Mo'orea, although knowledge integration had occurred in a previous stage, its absence during the designation stage was negatively perceived by stakeholders, leading to a sense of injustice. Acknowledging diverse environmental values and knowledge systems is especially critical during the designation stage, as prioritizing some values over others at this point can limit the diversity of perspectives included in conservation planning (Raymond et al. 2022; Bennett et al. 2021). This aligns with research emphasizing that engaging stakeholders in knowledge exchange during the designation phase contributes to achieving conservation goals while maintaining equity and justice (Raymond et al. 2022; Bennett 2022; Ban et al. 2019).

For more than two decades, conservation scholars have recommended combining top-down decision-making processes with bottom-up community-led initiatives to establish area-based conservation measures (Kelleher 1999). Both of our case studies illustrate how these approaches can reinforce each other, demonstrating how their synergy drives change (Orach and Schlüter 2021; Patterson et al. 2017; Herrfahrdt-Pahle et al. 2020). This is particularly clear in Teahupo'o where bottom-up and top-down approaches facilitated collaborative solutions to identify frameworks and rules with the local community through diagnosis and scientific investigation. In Mo'orea, although bottom-up efforts initially influenced the conservation proposal, locals perceived the final implementation as a top-down process. This feeling stemmed from the fact that policymakers had selected the framework for conservation measures before consulting stakeholders. Conversely, in Teahupo'o, the top-down process only was perceived later during the managed stage when agency-led actions were viewed as overriding local efforts. The stakeholder's perceptions on the decision-making process warrant attention, as they can fuel opposition, limit adherence to regulations, and ultimately undermine the effectiveness of conservation initiatives (Sena-Vittini et al. 2023).

Further exploring the overall establishment process by mapping the social- ecological network of action-situations can help understand how latent conflicts emerge, how stakeholders frame their root causes and the solutions they sought to implement to solve them. Although the primary objective of these areas is conservation, their main role is to regulate uses that diverse stakeholders (such as fishers, tourists, divers, etc.) make of the lagoon environments and resources as well as to better manage the interactions among users who are key agents of change (Jentoft et al. 2007). Establishing an area-based conservation measure redistributes environmental resources among stakeholders, which can lead to competition for access to resources, inequalities in access to resources, or exclusions, often resulting in significant conflicts (Cánovas-Molina and García-Frapolli 2020). Indeed, area-based conservation measures are known to generate or exacerbate conflicts among stakeholders during the planning process (Ban et al. 2019). Addressing these conflicts is crucial at this stage, as they can escalate and either reveal or intensify underlying issues that may become difficult to resolve after their establishment (Ban et al. 2017; Reed et al. 2018). In the case of Mo'orea, existing conflict between hotel keepers on one hand, and fishers and environmental associations on the other, fighting over access to the lagoon have become more pronounced and drive the opposition against the establishment of the protected and conserved area. This opposition led to well-coordinated community engagement efforts, including protests and direct appeals to government authorities, which ultimately led to a revision of the PGEM framework, designed between 2015 and 2021 and implemented in 2021 and incorporates the now-formalized issues (Wencélius et al. 2022). In this context, conflict acted as a driver for governance adaptation, pushing authorities to reconsider and adjust conservation measures in response to stakeholder concerns (Hunter et al. 2018). Research on marine protected areas supports this perspective, showing that, when managed effectively, conflicts can serve as catalysts for innovation, leading to more tailored and effective conservation strategies (Cadoret and Beuret 2022; Cánovas-Molina and García-Frapolli 2020).

Conclusion

The effectiveness of area-based conservation initiatives cannot be fully explained simply by enabling conditions being in place. Instead, the ways these conditions are operationalized play a crucial role in shaping conservation outcomes. A comparison of two coral reef conservation initiatives revealed different approaches to implementing enabling conditions, offering insights that may be valuable for conservation practitioners and policymakers.

Findings suggest that operationalization can influence conservation effectiveness both directly, within a given stage of establishment, and indirectly, by shaping future processes and stakeholder relationships. However, when operationalization did not align with stakeholder expectations or failed to address emerging conflicts, it appeared to contribute to opposition and governance challenges. These findings offer practical insights into how conservation efforts can be optimized to align both with ecological objectives and local stakeholder needs. Additionally, the use of combined approaches, such as the Action-Situation Framework and the MPA Guide, provides new avenues for policymakers and managers to analyze how enabling conditions are put into practice. Finally, social-ecological mapping emerges as a valuable tool for revealing barriers, such as conflicts, and for understanding how past misperceptions continue to shape present-day outcomes.

In line with the growing integration of social-ecological approaches in conservation, this study sheds light on pathways of action that influence conservation outcomes. The implications extend beyond area-based conservation, offering insights for broader spatial management strategies, such as marine spatial planning. Mapping social-ecological interactions across all establishment stages—not just during management—can deepen our understanding of why conservation outcomes unfold as they do. Future research should further explore the sequencing and interplay of enabling conditions to refine recommendations, ensuring that they support the development of adaptive governance structures and decision-making processes.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11625-025-01770-z.

Acknowledgements This work is an output of the SYNERGY project funded by LabEx CORAIL. JC received financial support from Fondation de France (MultiNet), biodiversa+ (MOVE) and the European Commission (GES4Seas and MarHab). This work is a contribution to the BRIDGES program funded by France 2030.

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