Determining the Feasibility of Establishing New Multiple-Use Marine Protected Areas in Chile

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Abstract This paper evaluates the feasibility of establishing a multiple-use marine protected area. The methodology was applied to evaluate three proposed sites in Chile with diverse conservation needs, social stress and poverty levels, and different economic activities (small-scale fishing, heavy industry, and mining activities). We use two broad categories for the evaluation: socio-economic and political–institutional. The methodology uses a combination of secondary data with personal interviews, workshops, and focus groups with stakeholders (e.g., fishermen, unions, politicians, social organizations) from different political, social, and economic backgrounds to characterize current and potential natural and social resources and to evaluate in an ordinal scale the feasibility of establishing the protected area. The methodology allows us to correctly identify the challenges faced in each site and can be used to develop appropriate strategies for balancing economic, social, and environmental objectives. This methodology can be replicated to evaluate the feasibility of other marine or terrestrial protected areas.

Keywords Protected Coastal Marine Areas · Feasibility · Sustainable development · Governance

INTRODUCTION

We propose and apply a methodology to evaluate the feasibility of establishing a sustainable multiple-use marine protected area (MU-MPA) in three sites in Chile, considering economic, social, political, and institutional factors.

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Worldwide interest in the establishment of MPA was expressed in two international conferences: the Special Symposium on Marine Parks (11th Pacific Science Congress, September, Tokyo, Japan, 1966) and the First International Conference on Parks and Marine Protected Areas (Tokyo, Japan, 1975) (Castilla 1986). In response, the annual rate of MPA growth is near 5 % at the global level, indicating the relevance of this mechanism in the conservation of biodiversity and marine resources (Pauly et al. 2002; Sale et al. 2005; Stefansson and Rosenberg 2005). In recent years, several countries have evaluated the costs and benefits of establishing a MPA (McCrea-Strub et al. 2011) and have introduced diverse mechanisms to assure their endurance and sustainability. In Latin America, there are at least 21 countries that have established marine reserves (MR) including the Dutch Antilles, Bahamas, Barbados, Belize, Brazil, Chile, Colombia, and Cuba (PISCO 2007).

In Chile, the national government can legally protect marine natural resources by declaring them a nature sanctuary, wetlands, marine park, or marine reserve (MR), and most recently a MU-MPA (LGPA, General Law of Fisheries and Aquiculture). Each legal status has different implications in terms of the property rights and economic activity limitations. For example, in a MR, the extraction of any resource for commercial purposes is completely forbidden, although small amounts can be extracted for research objectives resulting in a high monitoring and enforcement costs.

In contrast, the Chilean MU-MPA seeks to establish a governance structure that allows sustainable economic activities provided they are compatible with marine resource conservation. Additionally, since the MU-MPA integrates terrestrial and marines zones, considering them a single ecosystem (GEF-UNDP 2005), the creation and

management of a MU-MPA involves coordination between several public institutions (e.g., Ministries of Economy, Defense, and the Environment). They also specifically involve active participation of diverse private associations, including those that have social, economic, conservation, and/or research relevance in the area. The MU-MPA can be considered an important advance in integrated coastal management due to the integration of human development and conservation goals (Moreno-Bonilla et al. 2009), and ideally it should promote conservation, local development, and governability. As can be seen, the MU-MPA governance approach not only contrasts with top-down decision-making but also with market solutions based on formal neoclassical models.

Between 2003 and 2005, under the framework of the National Strategy for Biodiversity, the Chilean Environmental Protection Agency (CONAMA 2005) with the support of the Marine Global Environment Facility (GEF) identified three MU-MPAs based on their biological representativeness at global, regional, and local levels as well as a demonstrated interest of local political authorities and stakeholders in the area.¹ In 2009, the government began to consider the establishment of MU-MPA in three additional sites in Chile. The three areas selected are: Hualpén Peninsula (Site 1) located in southern Chile, Mejillones Peninsula (Site 2) located in northern Chile, and Punta Patache (Site 3) located in northern Chile (Fig. 1).

This process is not unique, like Chile other countries are also exploring similar mechanisms to promote sustainable use of marine resources. Therefore, field-tested methodologies that provide greater understanding of the complex processes involved in the public–private management and conservation of marine resources is required to select sites and develop strategies prior to MPA establishment. This paper fills this gap using co-management governance model that is characterized by consensual regulation based in user participation in decision-making (Ostrom 1990) and the recognition that sustainable solutions need to be socially constructed due to the increasing questioning of top-down natural resource management.

Background

In most cases, the site selection for a MU-MPA is determined by an identified need for conservation. However, there is growing recognition that the scientific understanding of the ecosystem or species to be protected is insufficient (Kelleher 1999; Salm et al. 2000) and that the sustainability also depends on economic, social, political,

and institutional factors. Therefore, a useful evaluation requires a multidisciplinary approach to consider the diverse aspects that should be weighted in the decision-making process. Further, several empirical evaluations of MPA feasibility found that the use of ecological, socio-economic, and political criteria resulted in better conservation strategies (Klein et al. 2008; Green et al. 2009; Ramírez et al. 2009).

The evaluation of MPA performance regarding optimal resource use has been gaining interest in the international literature (Pomeroy et al. 2005), although the evaluation of their economic and social feasibility when establishing a MPA is not as clear-cut. Additionally, given the fact that a perfect monitoring and control system for protecting natural resources is expensive and aligning interests of the stakeholders involved in the MPA is crucial for the success of these conservation initiatives, an inexpensive, effective methodology to select sites is required.

Economic and Social Feasibility

Vásquez et al. (2008) and Sierralta et al. (2011) showed that the implementation of a MPA in a location where there is no obvious sustainable economic development path will probably produce significant social costs. Further, these authors also found that total/partial restrictions on economic activities or historical rights that created elevated burdens for some stakeholders resulted in opposition to the proposed conservation goals.

Some MPAs had considered incorporating environmentally compatible economic activities in the area, but these new activities have negatively impacted conservation goals. A typical example of such activities is tourism, which has become the most important economic activity included after MPA implementation (Gaymer et al. 2007). But this activity may not be as environmentally neutral as assumed, for example, a World Resources Institute report (Burke and Maidens 2005) on the Marine Park *Bonaire* in the Dutch Antilles found that the coral reef has significantly decreased after 10 years in areas of high scuba diving activities, surpassing the ecosystem's load capacity after the threshold of 5000 dives.

Pomeroy et al. (2005) suggest several indicators to evaluate the feasibility of implementing a protected area. These indicators combine economic and social aspects, such as knowledge on human impacts, perceptions of seafood availability, perceptions about resource extraction and nonmarket values, style of life, family income distribution, occupational structure of the families, user knowledge of natural history, community access to scientific knowledge, number (or percentage) of people with leadership capacities, and cultural and historical values. In

¹ The three areas were Punta Morro-Río Copiapó, in Northern Chile (declared in December 2004), Lafken Mapu Lahual (August 2003) and Francisco Coloane (October 2005) in the southern Chile.

Fig. 1 Map of the three possible sites for MU-MPA establishment: Hualpén Peninsula (Site 1), Mejillones Peninsula (Site 2), and Punta Patache (Site 3). *Source* author elaboration

addition to the economic aspects, an evaluation of the social costs and benefits generated by area establishment also needs to be evaluated. For example, the establishment of a MU-MPA could help to reduce contamination and other pathogenic agents that negatively impact public health. Thus, a MU-MPA site can also be created to establish greater control over contaminating activities in protected areas; it could also be important for scientific investigation and environmental education.

A cost-benefit analysis considering all economic and social impacts of the proposed MU-MPA needs to evaluate the desirability from economic and conservation perspectives with a clear identification of winners and losers. In the case that losses are generated for stakeholders, then compensation should be considered, minimizing the social impacts of these measures.

Political and Institutional Feasibility

Biodiversity conservation can also be politically threatened when users or inhabitants perceive that limitations on resource extraction are unjust or are not effectively monitored, resulting in ineffective or conflictive environmental protection. Indeed, even when it is clear that the specific ecosystem or species is environmentally very important, the surrounding community may not value this environmental service. For example, in Sandy West End Bay, Honduras (Forest 1998) the non-governmental organization independently managed the MR, organizing beach cleaning, offering environmental education activities, and participating in the review process of coastal zoning permits. Fishing activities were especially controlled and penalized, while other activities such as dredging and construction

were neither controlled nor penalized. As a result, the local fishing community felt excluded from an area they traditionally used and actively opposed the MR. The ex-post conflict diagnostic identified a series of problems: poorly trained marine reserve staff, lack of coordination between the NGO, the local community and the marine reserve staff, a private sector uninterested in working with the community, and top-down decision-making.

In general, there are multiple actors that will be positively or negatively affected by MPA establishment and the potential conflicts and solutions are closely related to their perception of MU-MPA goals and functioning. Thus, it is important to analyze the compatibility between the objective of sustainable development of the MPA and actors' interests and agendas, especially those that can jeopardize sustainable resource use.

Still, even when there is an intention to involve the community and other stakeholders, most public actors interested in promoting environmental conservation face important challenges to define sustainable management rules based on the voluntary participation of multiple organizations, social groups, and individuals with different time constraints, needs, resources, and interests. Nevertheless, and despite these challenges, co-management governance structures have spontaneously emerged to sustainably manage commonly pooled resources (Ostrom 1990). A governance structure is essentially the "action arena" where exogenous variables such as rules, biophysical conditions and social contexts, and participants interact to produce outcomes (Ostrom 2005).

According to both policy and academic literature, the feasibility of any governance structure depends on its collaborative nature and shared understandings because the regulation structure (management model) is socially constructed, where interactions can be collaborative and/or conflictive due to competing objectives, diverse interests, and varying levels of trust between the different participants. In other words, so that all stakeholders come together and work collectively, they must perceive that sustainable resource use is beneficial. Consequently, during the negotiation of the management model, all stakeholders should understand the costs and benefits of both present and future actions. Ideally, there will be complementarity between each stakeholder's objective and the objective of the Area. However, even when actors have certain conflicting interests, they may form alliances when their previous collaborative relations were successful (Evans 1996).

Based on the analysis of successful cases of natural resource management, Ostrom (1990) concludes that sustainable governance structures are based in local knowledge as well as in traditional practices that informally structure relations between the participants. Furthermore, since the

social and environmental contexts are intricately related, both should be analyzed from users' perspectives prior to establishing new or additional rules on resource use. Even when we look for general institutional rules, governance solutions are context dependent (Ostrom 2005).

Additionally, when the co-management model involves both public organisms and private actors, clarity about roles, responsibilities, and financing is essential although agreement on an initial set of rules is rarely sufficient to assure its viability (Ostrom and Ahn 2003). Indeed, since conditions are dynamic, all actors should clearly understand and agree to the basic principles of area establishment. A consistent finding in the social science literature is that communication among participants greatly increases commitment to collective goals and affects the functioning of the relationships within those partnerships (Ostrom 1998). Further, since conflicts over rule interpretation and adjustments will surely occur, conflict resolution mechanisms should also exist. Finally, to assure viability of the governance structure, a minimal level of resources (time, money, and/or human resources) need to be available to mitigate costs for some stakeholders as well as to facilitate network formation.

Finally, MU-MPA establishment in Chile requires the creation of a public–private non-profit partnership, an inter-organizational network, which requires specific leadership skills due to the lack of formal authority and hierarchy. Indeed, leadership needs to assure that rules are respected and to establish/strengthen relations of trust and collaboration between the stakeholders, to lead as peer problem solver, to build broad-based involvement, and to sustain hope and participation (Chrislip and Larson 1994). A recognized leader who is respected by all the stakeholders will favor a sustainable model, while its absence will surely result in coordination problems and distrust.

MATERIALS AND METHODS

The methodology combines economic and social analysis with stakeholder analysis to determine the feasibility of a sustainable MU-MPA. Since several criteria depend on people's perception, we based our analysis on field work through interviews, focus groups, discussion, and presentation of the initiatives with stakeholders (see Electronic Supplementary Material for a list of stakeholders, guidelines for interviews to different types of actors). The economic analysis focuses on the feasibility of maintaining the current economic activities and the identification of new activities that are compatible with conservation objectives. This analysis also considered possible social benefits that could be generated with the establishment of the area. We analyzed whether MPA establishment would have negative

Fig. 2 Methodological steps. *Source* own elaboration

or positive economic impact on the community, based on the main resources that will be protected and the restrictions impose to the agents. Based on secondary information on current economic activities and the identified new possible activities in the government proposal for the new MU-MPA, we identified whether declaring the new protection status for the area would affect the current extractive activities, income generation and whether there is enough evidence that the new proposed economic activities will effectively contribute to MPA sustainability.

To evaluate political and institutional characteristics, we used stakeholder analysis to determine commitment, trust, shared goals, leadership, and financial support for the project as well as associated conflicts. Stakeholder analysis (SA) is a tool commonly used to identify possible conflicts and determine the feasibility of public projects and programs, especially in planning instruments, collaborative policy making, and strategic decision-making. Further, Grimbé and Wellard (1996) argue that SA is a powerful analytical tool with incredible potential for sustainable development natural resource management strategies, including when there are multiple uses or users of a resource, as in the case of MPAs. In the case of coastal land administration, SA has been used to understand the conflicts that emerged over competing resource use (Foell et al. 1999; Rockloff and Lockie 2004).

Even though SA establishes several assumptions based on a cost–benefit analysis and bounded rationality of the actors, the characterization of actors is complex and requires understanding of the context. First, each actor seeks to maximize his/her interests at minimal cost. Secondly, each actor uses an implicit or explicit framework to analyze the situation (i.e., define interests, determine costs, and benefits).

Additionally, each stakeholder is assumed to possess different capacities to influence public decisions based on their resources. Although there are diverse types of resources, typical organizational resources include legally recognized authority, economic resources, leadership, popular support, networks, and ability to form alliances. Implicit in SA is the assumption that the most powerful actors will achieve their objectives.

Figure 2 presents the steps to accomplish our objective. Based on the literature review, a series of rubrics were established to estimate the level (low, medium, and high) for each criterion (Table 1). The evaluation of “medium” in all the elements was defined as the minimum required for a sustainable governance structure. The evaluation of “low” is considered to be an important weakness that needs to be addressed prior to the establishment of a MPA. We then combined the individual evaluation of each criterion in an overall evaluation of the feasibility of developing a MU-MPA in each study area. For each area, critical points were identified and improvement strategies were proposed.

Additionally, the typical stakeholder analysis matrix was adapted to the context of MU-MPA, characterizing each actor according to type of actor (public, private for profit, private non-profit), resources (institutional authority, financial resources, social legitimacy), capacity to influence the final result (including veto capacity), capacity to lead or oppose change, immediate interests, long-term objectives, orienting logic, opinion of the protected marine area and its possible impact, and past and present conflicts with other stakeholders. The stakeholder matrix is completed based on the interview responses with respect to actors and the potential for conflict and/or collaboration. An example of this matrix is given in Table 2 below for one of the interviewed institutions.

RESULTS

Site Characterization

The site of Hualpén Peninsula (Site 1) is located in southern Chile near to the third largest city and industrial port of Concepción. At present, according to the Law of National Monuments, the Hualpén Peninsula is a natural sanctuary. In the adjacent woody coastal area, there are three small fishing villages, a beach, and a private park. Hualpén Peninsula is considered to be a biodiversity conservation object because it is the only conservation space in

Table 1 Rubric to evaluate feasibility

	Evaluation criteria	High feasibility	Medium feasibility (minimum conditions)	Low feasibility
Social and economic feasibility	Potential to develop economic activities	Sustainable economic activities that are compatible with the conservation goals are being implemented	Sustainable economic activities that are compatible with the conservation goals have been identified and can be easily implemented	Conservation goals require limitation on actual economic activities and alternative activities have not been identified
	Potential for scientific research and environmental education	Area establishment will open up new opportunities for scientific research or environmental education; there are actors interested in pursuing these activities	Area establishment will open up new opportunities for scientific research or environmental education, but there are not actors interested in pursuing these activities	The possibilities for scientific research and environmental education is limited
Political and institutional feasibility	Knowledge and understanding of the objectives and agreements achieved in establishment of the area	All the actors indicate the same objectives and agreements	The most important actors indicate the same objectives and agreements	There are distinct visions with respect to the objectives and agreements; lack of consensus
	Complementarity between stakeholder objectives and area objectives	The proposed model allows the majority of actors to achieve their goals	The proposed model allows several actors to achieve their goals	Several actors have goals that conflict with the model's or other actor's goals
	Commitments accepted by the actor in the management model	All the actors accept the roles and responsibilities present in the proposed model	Almost all the actors accept the roles and responsibilities present in the proposed model	Several key actors do not support the establishment of the MPA
	Perception of costs and benefits associated with the establishment of the MC area; identification of possible problems	Most of the actors express a clear and shared understanding of costs and benefits associated with the establishment of the area; shared understanding of possible problems	Although the majority of the actors present a general understanding the costs, benefits and problems involved, many cannot identify all the costs and benefits	The majority of the actors present a unrealistic vision of the problems that will be generated by the area; many beneficiaries do not perceive that they are beneficiaries
	Leadership	Clear leadership that motivates team work	Coordination between the different stakeholders but without clear leadership	Limited coordination and no clear leadership
	Rules and responsibilities	Management model is perceived as clearly defined and coherent with the objectives of the MPA and national jurisprudence	Management model is perceived as clearly defined and coherent with the objectives of MPA, but several points could produce conflicts with the national jurisprudence	Management Model is perceived as confusing and/or incoherent with the objectives of the MPA and/or national jurisprudence
	Financing	Clearly defined funding sources and supported by institutional commitment	Funding sources are identified but without institutional commitment	Funding sources have not been identified

Source own elaboration

the Biogeographic Mediterranean District (Camus 2001) and for the estuarine ecosystem formed by the Biobío River and coastal upwelling (EULA 2009).

Site 2 is the Mejillones Peninsula, is located in the Marine Humboldt Ecoregion, in northern Chile. Described by Sullivan-Sealey and Bustamante (1999), it is characterized by a uniform desert coast with limited rivers (poor runoff) and general lack of geographical features. Further, it is characterized by an oceanic regime of salty, cold water with local upwelling events. The conservation

objects include the reproduction zones of the green tortoise (*Chelonia mydas*), olive tortoise (*Lepidochelys olivacea*), and the habitat of the Humboldt Penguin (*Spheniscus humboldti*) and the animal species *Pyura praeputialis*. This site is not located near urban areas, although there is a fishing village nearby. It is also located near a legally recognized benthonic resource hatchery (Promar 2009a).

The third site (Punta Patache) contains a good part of the marine coastal biodiversity of Chile's Norte and like the

Table 2 Stakeholder matrix for National Fishing Service in Site 2 (Mejillones Peninsula)

Actor	National Fishing Service (SERNAPESCA)
Type of actor	Governmental
Resources, considering institutional authority, economic power, leadership, popular support, networks, etc.	Formal power: responsible for the implementing national fishing policy and monitoring and controlling fishing activity Indicates that they will not contribute financial resources Capacity to articulate private and public interests The relation with the local fishers is formal
Capacity to promote or oppose MPA establishment	Low capacity to promote or oppose Its principal role is to ensure the health quality of fished products for international markets, propose plans for recreational fishing, supervise marine parks and reserves and provide official fishing statistics. Responsible for monitoring and controlling managed areas in collaboration with the Port's Capitan
Capacity to lead MPA	Low capacity to lead MPA SERNAPESCA is responsible for monitoring and controlling managed areas and supervising marine parks and reserves. It does not have the responsibility to lead or implement any of these areas
Short-term interests	Conservation of marine resources in the area Establish new economic activities that are compatible with sustainable resource management Obtain additional resources to improve vigilance in the managed fishing areas
Long-term objectives	Obtain and assure the human and material resources required to effectively supervise and monitor MU-MPA
Orienting logic	Efficiently fulfill the national fishing policy
Perception of MU-MPA and its impact	Favorable. Favors adequate zoning and a sustainable resource management plan, which requires the participation of all stakeholders and recognition of their interests, especially artisanal fishers
Past and present conflicts with other actors	Certain overlapping of functions with the Navy The principal conflict is that they question the artisanal fishers who are reticent with respect to the area
Knowledge of MU-MPA	Clearly understands the administrative process involved in the MU-MPA, but is unclear with respect to the functions that correspond to the National Fishing Service
Complementarity	The principal motivation is to protect natural resources and encourage sustainable social-economic development by introducing new activities. The objectives are complementary with other public actors in the commission
Commitment	Protagonist of the commission Seeks to generate agreements between the stakeholders although expressed distrust in the fishers
Perception of costs and benefits	The benefits highlighted are protection of ecosystems and the sustainable use of natural resources. Clearly understands the financial resources needed for the area, and his principal concern is how to achieve efficient supervision
Leadership	Protagonist in the declaration of MU-MPA
Financing	His organization can only contribute economic resources for partial financing of the area
Other comments	Demonstrates distrust in the fishers and their capacity for sustainable resource management

Source own elaboration

Mejillones site is located in a Humboldt Marine Ecoregion. There are two conservation objects: (1) macro-algae forests “huirales” (*Macrocystis* spp.), due to their structural role in the ecosystem, and (2) the habitat of vulnerable migratory birds. There are no fishing villages or social organizations with presence in the proposed area (Promar 2009b), although there are important mining and energy activities located nearby.

Stakeholder Identification and Characterization

In each study area, we identified eight stakeholders: five public actors and three private actors. Four of the public actors represented government interests: two were from the

Ministry of Economy and are responsible for marine resources (SERNAPESCA² and SUBPESCA), one from the Ministry of Environment (MMA), and the regional government. The role of the representative from the Ministry of Mining (SERNAGEOMIN) and/or the private research center was principally technical although s/he could play a more political role. The three remaining actors represented private economic interests in the area: artisanal fishing, industry, and/or mining.

In each selected site, the regional MMA office had already established a MU-MPA Task Force with the majority of the stakeholders in order to socialize MU-MPA

² SERNAPESCA: National Marine Fisheries Service.

Table 3 Stakeholder matrix for the proposed sites in Chile

	National Fishing Service	Sub-secretary of fishing	Environmental Ministry	Regional Government	Ministry of Mining	Research Center	Artisanal Fishers	Firms
Leadership	High	Medium	High	Medium	Medium	High	High	High
Influence	Low		High	High	High	Medium	High	Low
Interest in Area	High	High	High	High	Low	High	Medium	Medium
Perception of impact	Favorable	Favorable	Favorable	Favorable	Favorable	Favorable	Distrust	Undefined
Conflict with other actors	Artisanal Fishers	No	Artisanal Fishers	Artisanal Fishers	No	No	Governmental actors, other Artisanal Fishers	Ministry of Environment
Knowledge of area	High	High	High	Medium	Medium	High	Medium	Low
Goals complementary with the area	High	High	High	Medium	Low	High	Medium	Medium
Commitment	High	High	High	Medium	Low	High	Medium	Low
Perception of costs-benefits	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Contribute financing	No	No	Yes	Yes	No	Yes	Yes	No

Source own elaboration

objectives and to collaboratively define a MPA management model. The task force meetings were considered the governance “action arena” where the stakeholders can negotiate their participation in the management model. The MMA considered the private actors to be potential administrators of each area.

Semi-structured interviews were held with the stakeholders participating in the MU-MPA Task Force. The majority of the stakeholders demonstrated in the interviews that they clearly understood the objectives of the MU-MPA as well as how their organization could contribute to MU-MPA management. Documents and official web pages of different public organizations were also analyzed to complement the interviews.

For each stakeholder interviewed, a stakeholder matrix was characterized based on official information on each organization and the interview responses. As an example, Table 2 presents the characterization of the National Fishing Service for Site 2.

Once all the stakeholders were characterized in a similar way, a comparative table was prepared for each site. Table 3 shows this analysis for each criterion in the stakeholder matrix. In general, all the stakeholders had a significant capacity to influence the results of the management model, and thus their participation and approval of the decisions is important. The actors with more influence did not exercise a leadership role, except for the representative from the Environmental Ministry.

Most of the actors perceived the area’s impact as favorable, except for the economic actors (fishers and

firms), who tended to emphasize the negative aspects. This response is common due to the restrictions on economic activity that will be generated by MU-MPA implementation. It could also be due to their limited knowledge about the purpose, functioning, costs and benefits of the MU-MPA. The commitment of the stakeholders and the identification of potential obstacles and problems were also evaluated as low.

Economic Costs and Benefits of Area Establishment

We identified the costs and benefits of area establishment on economic activities, considering their environmental impact, that is, whether this new protection status would reduce income availability or generate new flows of revenues associated to the already identified new activities implicit in the government’s proposal. The sources of information were previous studies and official documents. Most of the gathered information was merely descriptive, environmental impact studies of current economic activities on the marine resources were practically non-existent, which limited the precision of the assessment regarding the feasibility of MU-MPA establishment. Even more dramatic is the lack of any evidence of potential of the suggested new economic activities. This fact is yet another example in which selection and proposal of a MPA lacks the necessary information to determine the contribution and sustainability of the new economic activities.

In Site 1, the principal economic activities are artisanal fishing and gastronomic tourism. The proposed MU-MPA

will affect three artisanal fishing villages and close to 100 fishers and their families (SERNAPESCA 2006). The estimated average monthly income for fishers is US\$300 (EULA 2009). Unfortunately the government proposal did not identify whether or not extraction activities would be reduced in the area and did not specify the main environmental goals for MPA establishment. It is expected, however, that there will be extraction and access limitations, reducing fishing revenues. Similarly, even when stakeholders in the interviews suggested tourism activities (whale watching), no cost–benefit study has been performed. The only references found was an earlier study for a completely different Chilean area (Gaymer et al. 2007), which estimated the annual benefits of US\$ 260 000 for artisanal fishermen for the Chilean Marine Reserve of Choros-Damas. Nevertheless, we cannot assume that these revenues would be captured in this area due to different climatic conditions. Following the criteria in Table 1, we found that no current or future sustainable economic activity exists in the area. Thus for Site 1, we classified economic feasibility as “medium.”

In Site 2, the principal economic activities are artisanal fishing (pelagic fish) and aquiculture concessions (benthonic resources). The proposed MU-MPA will affect three artisanal fishing villages and 200 fishers and algae collectors (SERNAPESCA 2006). There was insufficient information available on the economic and social costs associated to the fishing limits that area establishment would produce. In this case the new proposed tourist activity was scuba diving. Once again, this suggestion lacks an objective demand or supply analysis. Due to the area’s geographical isolation and the lack of cost–benefit studies for the new economic activities, we also classified economic feasibility as “low.”

In contrast to Sites 1 and 2, the establishment of a Site 3 will not affect artisanal fishers. However, two important industries are located nearby and there are three mining concessions that are partially present in the proposed site. As in the other sites, biodiversity conservation could become an important tourist attraction, especially for the Humboldt penguins. However, Site 3 does not have access to potable water or electricity, and thus the implementation of tourist activities would be costly.

Area establishment would also require environmental control of nearby industrial activity, although the specific costs involved have not been calculated. In the interviews, the industrial companies expressed their interest to financially support the area as part of corporate social responsibility, but they do not currently participate in the MPA task force.

Site 3 presents contradictory results since these industries expressed a positive attitude toward MPA establishment but are at the same time the most significant

environmental threat to the area. A MU-MPA tries to combine economic activities and environmental protection, therefore, in principle, in this there is potential for both conservation and significant economic activity since there are empowered private actors interested in MPA establishment, contrasting with the conflicts with the artisanal fishers in Sites 1 and 2. Consequently, economic feasibility was estimated as “medium.”

Social and Educational Activities Compatible with Conservation Goals

In Site 1, due to the large number of universities in the surrounding area, this site also has great (yet underdeveloped) potential for scientific research and environmental education. Additionally, there is a private Museum and Park that receives visitors year-round and one local university expressed its interest in developing research associated with fisheries resources. One study (CONAMA 2005) also indicates that Site 1 offers important archeological potential. Considering that area establishment could trigger use of this potential, we classified social availability as “medium.”

At the same time, preliminary information suggests that Site 2 offers a potential for educational purposes. There are reports of archeological remains in the area although no studies were found. Additionally, the nearby university presently develops research and community outreach activities related to the area’s biodiversity and there are environmental organizations and a nearby neighborhood council that have also developed similar outreach projects. Considering that area establishment will favor present-day activities as well as coordination with diverse public institutions, we classified social feasibility as “high.”

In Site 3, there is a research center interested in area establishment and there are also unconfirmed reports of archeological remains. Several academics from nearby universities have carried out research in the area, but there is no presently declared interest. There is also a vague plan to develop an environmental education program. Due to the absence of active organizations and the vague proposals, the social feasibility was estimated as “low.”

Compatibility of Stakeholder Interests and Agendas

We present a more detailed analysis for Site 2 as an example, and a brief description for the other two sites. In Site 2, although the Task Force includes both public and private actors, only the public actors regularly attended the meetings and have played the principal roles in the design of the MU-MPA management model. The most committed public actor is MMA (a characteristic of all the sites). The nearby local

government expressed interest in the area, but they legally cannot provide the needed resources. The other actors expressed ambivalence with respect to area establishment.

In this site, the MU-MPA has been included in the parallel coastal zoning process being led by the Regional Government and the Fishing Service of the Ministry of Economy (SERNAPESCA). Further, there is complementarity between the objectives of the public actors, who express optimism with respect to obtaining financing, although active coordination to achieve this goal is limited.

In contrast with the active participation of public stakeholders, private actors have played a limited role in public–private coordination. The fishing communities with presence in the area have not participated in the discussion, principally because they lack clear leadership and do not have sufficient preparation to understand the technical issues. As a result, they present a generalized opposition to area establishment, principally due to their distrust of government actors. The only private actor who regularly participates in the task force is a scientist from a nearby university, but he has not exercised a mediation role.

Despite the adequate levels of public coordination and medium level of social conflict, the public actors expressed distrust of private actors (fishers and mining interests) and weakly value their participation. Consequently, the political feasibility for Site 2 was evaluated as “low.”

Site 1 shares many similarities with Site 2. In this site, private stakeholders expressed little interest and weak commitment to the establishment of a MU-MPA. The principal conflict present in the action arena was the resistance of the artisanal fishers, who expressed a generalized distrust of government actors and competing artisanal fishermen. In short, although whale watching has a potential to become an important economic activity, the fishers do not believe that there will be sufficient support to convert to this new activity.

At the same time, there is good communication between the public stakeholders, and consequently a great potential for agreements and coordination between public actors, especially with respect to coastal zoning. But they also expressed their distrust of the artisanal fishermen, especially with respect to conservation goals. Thus, the potential benefits of public coordination are threatened by the distrust existing between public and private actors, principally due to unresolved conflicts over previously established marine reserves. This conflictive situation is even more complex due to the vulnerable economic and social situation of the artisanal fishing villages. Still, the local government has played an important role in conflict mediation between public and private actors, although they do not have the financial resources necessary to contribute to area management. Consequently, the political feasibility in Site 1 was evaluated as “low.”

Site 3 presents important differences with the other two sites. First, a potential conflict could develop because the MU-MPA is not included in the parallel zoning process. Second, mining companies and not artisanal fishers are the principal private actors involved, which results in an important financing potential but potential contamination sources. Consequently, the National Mining Services is a relevant public actor in this site due to its administration and regulation of mining concessions, constituting an important veto capacity. Principally because of the expressed private interest in area establishment, the political feasibility in Site 3 was evaluated as “medium.”

Leadership and Financial Support

In all the proposed sites, the MMA has played a leadership role in the Task Force, although they will not be responsible for managing the area and do not show any interest in doing so. No other actor has accepted the responsibility for area, although most of them declared support for area creation. Consequently, no area has proposed a socially accepted management model that can be evaluated.

At all sites, regional governments were open to provide financial support through the Regional Development Fund, although this funding is short-term and would require constant renewal. Additionally, the Ministry of the Environment, research centers, and artisanal fishers also indicated the possibility to provide resources through planning, research and vigilance, respectively. The remaining actors indicated they could not contribute resources. All three sites thus received the same evaluation of “medium” for institutional feasibility because four actors indicated low or medium complementarity with MU-MPA objectives yet only two confirmed financing.

Table 4 summarizes the results obtained for the three proposed sites. As can be seen, each site presented a distinct configuration even when they have certain characteristics in common. Considering the importance of all the criteria, an area should be considered to be feasible when all present a medium evaluation.

In the three proposed sites in Chile, Sites 1 and 3 were considered to present a medium level of global feasibility because they presented medium feasibility in three of the four criteria, which indicates that they need to address the weaknesses identified in order to favor a sustainable MU-MPA. Our analysis suggests that Site 3 has a greater opportunity to establish a sustainable MU-MPA, although it will generate less social benefits.

In contrast, Site 2 presented the only high level (environmental education and research) found in the study. At the same time, two criteria were evaluated as low feasibility (economic and political feasibility), presenting important weaknesses that need to be addressed.

Table 4 Economic, social, political, and institutional viability

	Site 1	Site 2	Site 3
Economic feasibility	Medium	Low	Medium
Feasibility for scientific research and environmental education	Medium	High	Low
Political feasibility: potential for collaboration between stakeholders	Low	Low	Medium
Institutional feasibility: potential for sustainable governance structure	Medium	Medium	Medium
Global feasibility	Medium	Low	Medium

Source own elaboration

The Ministry of Environment and other public actors demonstrated high levels of participation and interest in the establishment of MU-MPA, probably due to their favorable perception of its impact. A second strength observed in all sites is that all stakeholders understood the purpose and functioning of the proposed MPA, although the artisanal fishers did not have a clear understanding of the costs and benefits.

At the same time, the principal weakness was associated with the limited participation of private actors (artisanal fishers and private companies), who in general were skeptical that the area could produce favorable impacts. Due to the non-exclusive nature of commonly pooled resources, the tragedy of the commons is the most likely outcome if economic agents only assume the private costs and ignore the social costs of their actions (Gordon 1954; Hardin 1968). In order to avoid this tragedy, all economic agents with presence in the area need to accept the management rules as legitimate in order to avoid their over-exploitation (Feeny et al. 1990; Ostrom 1990). Considering that the artisanal fishers demonstrated in general high levels of distrust of public actors, this weakness must be effectively addressed to establish a sustainable MPA in Sites 1 and 2.

Despite the many similarities observed between the proposed sites, our general results reveal a certain degree of spatial variability in all the criteria used to characterize the feasibility of establishing a MU-MPA in each site, confirming the importance of the local context and the fact that there is no recipe on how to design a sustainable management model for environmental resources. The more favorable situation found in Sites 1 and 3 was associated to (1) the presence of economic agents whose objectives are compatible with the conservation objects and (2) the existence of legal instruments (zoning plans) that included the MPA. In conclusion, the greater degree of global feasibility found in Sites 1 and 3 indicates that these specific configurations are more favorable for the establishment of a sustainable MU-MPA and could imply a lower social cost in the short-term.

DISCUSSION

We identify several policy suggestions to increase the feasibility of each area and to assure the support from the government, the community, and the private sector. First, it is necessary to disseminate the importance of these natural areas to the community and the productive sectors through environmental education programs emphasizing the development of social responsibility of the State and the private sector. Second, the selection of new areas for protection should be accompanied by a set of technical reports about current and potential economic activities and its impact on the conservations goals. Third, those environmental goals should be defined more precisely in order to orientate the evaluation of different courses of action. So far, the declaration and selection of these three MPAs are too vague in terms of their environmental goals, reducing the effectiveness of the feasibility analysis.

More specifically, in Site 1, the government needs to incorporate the artisanal fishermen in the process of economic development in order to increase the feasibility of the creation of a MU-MPA in Hualpén. In the case of Site 2, it is necessary to implement strategies to approach the various coastal communities to resolve their conflict of interests, while in the case of Site 3, private companies should be incorporated in the task force since they have declared their interest to participate but have yet to be involved due to public sector distrust of their motives.

As can be seen, our results reflect the argument given by Vásquez et al. (2008) who argue that the actors associated with Chilean Marine Reserves do not have complete knowledge on the conservation mechanisms. Indeed, at times, the economic activities of stakeholders do not respect the conservation mechanisms and produce errors in the evaluation of property rights, benefits, and costs. Additionally, even when certain (industrial) fishers will accept conservation mechanisms that do not negatively impact their economic activity, smaller fishing communities tend to be reticent and distrusting as found by Bess and Rallapudi (2007) in Maōri fishing communities and the artisanal fishers in the present study.

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