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ISO 14001: Towards international quality environmental management standards for marine protected areas

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ABSTRACT

This paper addresses the current lack of internationally recognized standards for quality management practices in Marine Protected Areas (MPAs). The application of the ISO 14001 standard for environmental management systems to MPAs can provide a flexible and adaptive management system that can be integrated with existing MPA management practices as a standardized quality management process designed for the continuous improvement of MPA management. The paper provides a framework for applying ISO 14001 to MPAs and discusses the results of a practical case study in northern Chile wherein ISO 14001 was used as a benchmark for evaluating and improving the proposed management plan for a Chilean marine reserve.

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1. Introduction

The world's oceans are facing ever increasing human pressures resulting in the declining health of most marine ecosystems [1–4]. In part, it is suggested that these trends can be slowed if not reversed with increased conservation of the marine environment through the development of Marine Protected Areas (MPAs) [2,4–6]. The recognition that MPAs are a key component to the recovery and sustainability and of marine ecosystems combined with increasing public pressure to preserve the marine environment has motivated many nations around the world to slowly increase the number of MPAs [7–10]. While progress is being made toward a global system of MPAs, in many regions a significant number of MPAs exist as 'paper parks' and lack adequate management [8,11]. However, without adopting some essential quality management practices required to produce and demonstrate effective environmental management, the widespread development of MPAs will not meet the intended purposes of resorting and sustaining marine habitats and biodiversity.

To address this problem a number of guidelines and best practices have been prescribed by academics, NGO's, and individual governments for the planning, development, management and evaluation of MPAs [12–16]. In addition to these guidelines there

are numerous goals and strategies for the management of MPAs. For example, some MPAs are designed as marine reserves solely to protect some commercially important species and to manage these reserves through a species-based focus with the ultimate goal of enhancing fish stocks [17,18]. Other MPAs are developed and managed through an ecosystem-based approach to preserve important habitats and ecosystems, while integrating other human uses such as tourism, recreation, shipping, and fisheries [19,20]. Mechanisms such as co-management, community-based management, traditional management, or combinations thereof are also employed to plan and administer MPAs through collaborations and/or empowerment of local stakeholders [21–24]. Each of these management tools can have varying levels of effectiveness for protection, enforcement, monitoring and evaluation of MPAs [21,23]. However, while every MPA is slightly different in its surroundings, there is no one management system for MPAs that is currently recognized as an international standard. While it is important to have a suite of tools available for MPA management there should be some essential, internationally recognized and standardized quality management processes integrated into the management of all MPAs. This will help ensure that there is a system for continuously and systematically improving MPA management and the overall protection of the marine environment.

This paper attempts to address the current lack of internationally recognized standards for quality management practices for MPAs. It is proposed that because the International Organization for Standardization (ISO) is a global leader in both quality (ISO 9000) and environmental (ISO 14000) management standards, the application of the ISO 14001 standard for environmental

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management systems to MPAs can provide a flexible and adaptive management system which can be integrated with existing practices as a standardized quality management process designed for the continuous improvement of MPA management. To build a case for ISO 14001 to be used as a global standard for MPA management, the following examines the adoption of ISO as a global standard, the international collaborative effort that was undertaken to develop the ISO 14001 standard, and its wide range of applications; including an in-depth examination of the standard's application to terrestrial protected areas management. Subsequently, a theoretical framework is provided for applying ISO 14001 to MPA management by comparing it to and integrating it with existing MPA management guidelines. Finally, the results of a practical case study are presented wherein ISO 14001 was used as a benchmark for evaluating and improving the proposed management plan for a newly created Chilean marine reserve.

2. Why ISO 14001?

2.1. The global adoption of ISO standards

A non-governmental organization based in Switzerland, ISO is arguably the most representative and influential standard-setting organization in the world [25] and is considered the leading developer of international product and process standards [26]. Composed of a federation of the national standards bodies from 157 countries, ISO's global network identifies what international standards business, government, and society require and develops them through a transparent process of extensive discussion, negotiation and international consensus [26,27]. To date, ISO has developed over 16,000 product and process standards [26] and has published nearly 85% of all international standards [25]. Of the most widely known and popular standards, the ISO 9000 series has become the international reference for quality management requirements in business, while ISO 14000 and its family of standards provide guidance for environmental management systems [27].

2.2. Global collaboration and consensus-based standard

Like all ISO standards, the ISO 14000 family of environmental management standards have been developed based on discussions and consensus from the broadest possible base of stakeholder groups and are highly respected and accepted by both the public and private sectors around the world [26]. In fact, this particular suite of standards were developed by a technical committee (TC 207) which consisted of 52 participating member countries, 17 observer countries, a number of internal and external liaison organizations, and more than 100 environmental experts [28].

Within the ISO 14000 series of environmental management standards, "ISO 14001: Environmental Management Systems – Specifications and Guidance for Use" [29], is the main specifications document that outlines the standard requirements for the development of an environmental management system (EMS). An EMS is a documented process for a continual cycle of planning, implementing, reviewing and improving the procedures and actions that an organization undertakes to meet its environmental goals and objectives [28]. Built around a simple "Plan-Do-Check-Act" management cycle, an ISO 14001 EMS is designed to lead to the continual improvement of the environmental management and performance of any organization.

2.3. Flexibility and adaptability

The flexibility of ISO 14001 allows an organization to determine its own boundaries, goals and objectives for its EMS. This flexibility

has allowed it to be applied to organizations of all types and sizes giving it a worldwide reputation as "generic management system". No matter the scope or activity of an organization, its product or service, whether it is a private business enterprise, a non-governmental organization, or a public administration, if an organization wants to establish a quality environmental management system, then using the ISO system has a number of essential features for which this standard can provide the requirements [26].

When it was first released in 1996, the ISO 14001 EMS standard was primarily applied to the business operations of larger enterprises such as industry and manufacturers that produce goods for commercial markets. Such organizations can have significant impacts on the environment from the emissions, effluents, and waste generated from their production processes. Many of the aspects of these businesses' operations are often governed by various legislation and regulations. Thus, the underlying purpose and one of the main reasons for adopting an environmental management system was to prevent or minimize pollution and reduce the risk of violating environmental obligations [30]. However, additional benefits have been realized by these larger manufactures who have become ISO 14001 certified including continually improving environmental performance, demonstrating to shareholders and the public their commitment to environmental protection, enhancing product quality, cutting costs and saving money by conserving energy and reducing waste, and increasing market share [30,31].

Since its development the application of ISO 14001 has expanded and has been used in a variety of contexts including large service sector organizations such as hotel chains and banks [32,33]. Even small and medium sized enterprises are realizing the benefits of implementing an EMS by reducing waste and saving energy [34]. Natural resource sectors such as forestry, mining, agriculture, and aquaculture have also begun to adopt the ISO 14001 EMS standard as a means of achieving more sustainable resource management. With mounting public scrutiny and consumer demand for more sustainably managed and harvested natural resources, an ISO 14001 EMS provides natural resource organizations with the tools for clearly demonstrating and communicating to stakeholders and the public their commitment to environmental stewardship and sustainable resource management.

For example, the forestry industry has readily adopted the standard because of its international reputation for quality environmental management. Moreover, forest certification under ISO 14001 can act as a legitimizing tool for demonstrating good environmental practices, a commitment to environmental protection, and to gain international credibility among retailers, consumers, and other public stakeholders [35]. In fact, communication of information to prove to the public and stakeholders that forests are being managed acceptably has been shown to be one of the main drivers for ISO 14001 forest certification [35].

Like forestry, aquaculture and fisheries can also be environmentally destructive and often contentious activities. Growing consumer demand for environmentally responsible fisheries products has been pushing these industries toward international certification standards for sustainably reared and harvested seafood [36–38]. Due to the generic nature of ISO 14001, it has been advocated as an effective means of managing a wide range of maritime activities, including aquaculture, fisheries management and the management of marine ecosystems [37,39]. Applying the standard to the management of such marine activities can help to avoid conflicts and achieve better stakeholder relationships [37,39].

The aquaculture industry has embraced EMSs and ISO 14001 certification as a powerful tool for producers wishing to enhance their environmental performance and demonstrate sound environmental management, while ensuring food safety and quality

[36,37]. ISO 14001 EMSs have assisted in lowering the potential for environmental impacts in aquaculture operations while improving stakeholder communication, and ensuring compliance with the complex, and rapidly evolving legislation and regulations of the industry [37].

The core principles of ISO 14001 may also have potential for use in fisheries management and for addressing the protection of marine species [39]. Commercial fisheries have already begun to adopt standards for certifying the sustainable management of a fishery. For example, the Marine Stewardship Council (MSC) is attempting to improve the sustainability of fisheries through the development of eco-labelling standards [40]. Like ISO 14001, the MSC Principles and Criteria are established standards that describe a well-managed and sustainable fishery. Through independent third-party certifiers a fishery is assessed against the MSC Standard and, if certification is achieved, products from the fishery are eligible to use the MSC logo which demonstrates to consumers that the seafood they are buying comes from a sustainably managed fishery [38–40].

2.4. Applications in protected areas

Clearly ISO 14001 has the flexibility and adaptability to be used as a quality environmental management standard in a wide variety of organizations (both large and small) and is applicable to a number of sectors including industrial manufacturing, the service industry, and natural resource management. Combined with its highly regarded international reputation, it makes for an ideal system for any organization seeking to demonstrate their commitment to effective environmental management. But how has this standard been applied to the management of parks and protected areas?

Interestingly, ISO 14001 EMSs have been implemented in National Parks and protected areas in both North America and Europe. For example, in North America the two government agencies responsible for the management of national parks in Canada and the United States, Parks Canada and the National Parks Service (NPS) have implemented EMSs that adhere to the ISO 14001 specifications. Parks Canada has developed a national environmental policy and “National Environmental Management System Framework” based on ISO 14001 [41]. This environmental management framework document describes the structure and components of Parks Canada’s EMS, its policy, targets for all aspects of the Agency’s operations, roles and responsibilities, and the structure for the review and update of the framework. Similarly, the NPS directive 13A: Environmental Management Systems outlines the principles and policies for developing and implementing a Service-wide EMS approach. The NPS’s EMS was to guide their environmental decision-making and actions to help ensure compliance with regulatory requirements and to demonstrate their commitment to pollution prevention, waste reduction, sustainable planning, environmentally preferable purchasing, and the incorporation of environmental best management practices [42]. In addition to a headquarters and regional EMSs, each National Park, or grouping of parks under the same Superintendent, was required to develop and maintain an EMS that was consistent with the directive as well as with the Service-wide and regional priorities [42].

Unfortunately, both Parks Canada’s and the NPS’s EMSs do not focus on managing all the activities that go on within their national parks, but instead the scope has been limited to reducing the environmental impact of their own assets and operations. Both these organizations’ EMSs are the result of broader government policies geared toward ‘greening government’ with the focus being on managing the environmental impacts from the operation of government infrastructure and facilities. In examining the

environmental aspects addressed by these organizations’ EMSs it is clear that none of them deal with any other activities that occur within national parks such as tourism, resource extraction, scientific research and biodiversity protection.

While both Parks Canada and the NPS use other management tools such as ecosystem-based management (EBM) to ensure the social, cultural, ecological, and economic sustainability of their National Parks, it could be argued that by only applying an EMS to such a narrow scope, an opportunity has been missed to achieve a more holistic form of quality environmental management in National Parks across North America. However, because ISO 14001 simply provides a standardized framework for a quality EMS and does not prescribe which environmental aspects to manage under an organization’s EMS, it is up to each organization to define the scope of its EMS as narrow or broad as it deems necessary [28,43]. Provided that the organization’s EMS meets the specifications outlined in ISO 14001 it would be in compliance with the standard. The voluntary nature of ISO 14001 could be seen as one of the biggest limitations of ISO 14001 implementation in protected areas.

North America is not the only place where ISO 14001 EMSs are being applied to the management of protected areas. Recognizing that the simple application of ISO 14001 to the parks’ administration is not an effective use of the standard, a number of European National Parks have implemented and even certified EMSs that go far beyond those being applied in North America. For example, in 1999 the Italian National Agency for New Technology, Energy, and Environment (ENEA) began the “Quality Parks” pilot project which applied ISO 14001 to the management of two moderately size and well-established protected areas [44]. Using a more holistic, ecosystemic-approach, the EMSs implemented in this project were designed to address all the direct and indirect aspects (both natural and artificial) of a full range of activities within and surrounding the protected area [45]. Furthermore, the ENEA project also focused strongly on the involvement of stakeholders, with whom the environmental policy and the environmental management program were collaboratively developed [44,46,47].

In addition to developing a site-specific EMS for each park, the ENEA, in collaboration with the Italian national certification and standards bodies, representatives of the protected areas, accredited certifying bodies, consulting companies, and companies operating in the protected areas, developed general organizational principles to provide guidelines on how ISO 14001 is to be interpreted when it is applied to a protected area [46]. The guide “Applying the UNI EN ISO 14001 Standard to Protected Area” provided the general elements for applying the standard to protected natural areas for any park wishing to develop its own Environmental Management System [44].

Since this pilot project was initiated, Parco Nazionale del Circeo, Parco Fluviale del Po, as well as other Italian parks have become certified under ISO 14001. Certification was sought as it was seen as a “seal of environmental quality”, which demonstrates to the public and other stakeholders a commitment to a high standard of environmental management [44]. In addition to safeguarding natural resources and enhancing their quality, one of the main benefits achieved from implementing an EMS was improved relations with local institutions and firms [44]. Due to the awareness and participation of local stakeholders in the development of the EMS there were fewer problems of land management, less conflict among interested parties, and greater efficiency of services and actions aimed at integrating the profitability of human actions with the conservation of natural resources [46]. Furthermore, it was found that those municipalities and companies that participated and adopted the EMS developed by the park gained advantages in terms of organization and competitiveness [44].

3. ISO 14001 and MPA management

The application of ISO 14001 as a quality environmental management tool in protected areas is quickly becoming more commonplace, however, up to now this international standard has been primarily applied to terrestrial parks. Thus, there is currently a unique opportunity to expand the application of the ISO 14001 EMS model to MPAs. Similar to the management of terrestrial protected areas there are no internationally recognized standards for environmental management in MPAs, but only guidelines and best practices [12,14,16]. Furthermore, there is no auditing and certification mechanism for publicly demonstrating the management effectiveness of an MPA. Therefore, using the lessons learned from ISO 14001 implementation in terrestrial protected areas and applying them to MPAs could help to achieve both continual improvement in the environmental management of MPAs and to provide an internationally recognized, standardized, and certifiable management system for MPAs. However, in doing so, the guidelines and best practices that have been painstakingly developed by experts in the field of MPA management cannot be ignored. Fortunately, much of the existing MPA management guidance materials already contain many of the key elements defined in ISO 14001 (Table 1). This should allow for an easy integration of ISO 14001 EMSs to MPAs.

3.1. Framework for MPA management using ISO 14001 specifications

The following is an overview of the main clauses and sub-clauses of the ISO 14001 EMS specifications (numbered accordingly) and an attempt to provide a framework for adapting the standard for the development of an effective management system for MPAs. This is done by drawing on the experience of applying ISO 14001 in European terrestrial parks as well as by making reference to the existing doctrine for MPA management and planning.

4.1. General requirements

In establishing an EMS following clause 4 of the ISO 14001 standard, an organization should begin by clearly defining the scope of the EMS which may vary depending on an organization's environmental policy, the nature of its activities, and the conditions which it operates [29]. As an organization may have multiple operating units it can opt to treat each as a separate organization or to have an organization-wide EMS [29]. In the context of MPA management, the MPA itself should be considered as the organization, which provides products (fisheries resources) and services (e.g., protection of habitat, a number of ecosystem services, recreation, tourism) and has a number of 'operating units' (e.g., flora, fauna, fishers, tourists, the local community, tourist operators, divers, managers, scientists) which have various activities that occur in and around the MPA. In defining the scope of the MPAs EMS it is important to decide how broad or narrow of a range of activities the EMS will manage. The pilot research by ENEA recommended that by applying ISO 14001 only to a narrow range of activities (e.g., operation of park facilities) the most significant activities occurring within the park may not be addressed [44,46]. Therefore, the scope of EMSs implemented in MPAs should strive for an ecosystemic-approach, designed to address all the direct and indirect aspects (economic, ecological, human, and operational) of a full range of activities both within and surrounding the MPA [47,48]. Finally, in keeping with existing guidelines for MPA planning, the scope should also consider the legislative basis and authority for the EMS, the boundaries of the MPA and the area that will fall under the EMS as well as a description of the resources and activities that will be managed by the EMS [12,16].

4.2. Environmental policy

One of the first steps of the MPA management planning process is to clearly establish the broad goals and objectives of the MPA [12,49] and having them endorsed by the site manager or person(s) ultimately responsible for meeting these objectives [16]. Similarly, an ISO 14001 EMS requires that an organization develops an environmental policy which outlines "the overall intentions and direction of an organization related to its environmental performance as formally expressed by top management" [29]. The policy must also be "relevant to the nature, scale, and environmental impacts of the organization's activities, products, and services" [29].

In the context of an MPA, the development of the environmental policy should take into account the specific legislation, regulations, and implementing decrees of the MPA, its purpose for being created, and the scope of the activities managed by the EMS [47]. It should be adapted to consider the needs and operations of the managing agency (or agencies) and ideally be developed in collaboration with local stakeholders [47]. To be in conformance with the ISO 14001 standard, the policy statement must also include commitments to prevention of pollution (may include both physical and biological pollution), to ensure compliance with applicable legislation (includes compliance by both MPA users and managers), and to continual improvement of the MPAs environment and its management. It must be endorsed by top management, documented, made operational, kept active, and communicated to the public [29]. The support and commitment by top-management is of utmost importance and serves at the basis for developing and improving the EMS [43]. The makeup of 'top management' may differ depending on the organizational and legal structure of each MPA. Some MPAs may consider the head of the government body that designated the reserve (e.g., Minister of Fisheries), the site manager, or a community leader as top management. Regardless, 'top management' should have the ability and authority to ensure that the environmental policy is implemented throughout the MPA.

4.3. Planning

4.3.1. Environmental aspects

The ISO 14001 standard requires that "an organization establishes and maintains procedures to identify the significant environmental aspects of its activities, products, or services that it can control and over which it can be expected to have an influence" [29]. For organizations without an EMS it is recommended that an organization review its operations and identify all those activities, products or services that have an impact (positive or negative) on the environment [28].

From the perspective of MPA management, ISO 14001's definition of 'environment' can be applied very broadly to include all the surroundings in which the MPA operates, which can include air, water, land, natural resources, flora, fauna, in addition to human factors (operational, social, political, cultural and economic activities), and their inter-relations. Furthermore, the "environmental aspects" of an MPA may include the ecological, economic, operational, and human components as well as the management issues and major threats to conservation of the MPA. ENEA [45,47] suggests that the environmental aspect identification stage be a very far-reaching, ecosystemic-approach and carried out on a larger scale for the lands within the confines of the protected area and on a smaller scale for the surrounding area that has potential impact on the MPA.

After identifying all of the relevant environmental aspects of the MPA the significance of the environmental impact of each aspect should be evaluated. The ISO 14001 definition of 'environmental

Table 1

Similarities between of the “Content of a MPA Management Plan” and “Model Outline for MPA Site Management Plan” included in the IUCN MPA guidance material developed by Kelleher [12] and Salm et al. [16], respectively, with the main clauses and sub-clauses (in *italics*) of ISO 14001

ISO 14001 vs. guidelines for marine protected areas	
4.1 General	
	<ul style="list-style-type: none"> • Define the purpose and scope of the plan and explains the legislative basis and authority for plan development. • Definition of the area: a formal statement on the boundaries of the planned MPA. Geographic description of its setting and accessibility. • Description of the resources of the area. • Description of uses of the area (includes social and economic analyses of use).
4.2 Environmental policy	
	<ul style="list-style-type: none"> • Statement of the goal and objectives for management of the MPA as a whole.
4.3 Planning	
4.3.1 Environmental aspects:	
	<ul style="list-style-type: none"> • Description of management issues. • Evaluation of the principal threats to the conservation, management and maintenance of the area. • Analysis of constraints and opportunities for activities possible within the area.
4.3.2 Legal and other requirements	
	<ul style="list-style-type: none"> • Description of the existing legal and management framework, such as coastal fisheries, marine transportation and other relevant legal controls on present use of the area. • Description of traditional ownership or rights to the use of marine resources should be. • Statement of policies, plans, actions, inter-agency agreements and responsibilities.
4.3.3 Objectives, targets, and programmes	
	<ul style="list-style-type: none"> • Development of goals and objectives. • Management tactics.
4.4 Implementation and operation:	
	<ul style="list-style-type: none"> • An assessment of the financial, human and physical resources required to establish and manage the MPA including:
4.4.2 Training and awareness	
	<ul style="list-style-type: none"> - staffing - equipment and facilities - training - budget
4.4.3 Communication	
	<ul style="list-style-type: none"> - interpretation and education
4.4.6 Operational control	
	<ul style="list-style-type: none"> - surveillance - enforcement
4.4.7 Emergency preparedness and response	
	<ul style="list-style-type: none"> - contingency/emergency planning
4.5 Checking and corrective action	
4.5.1 Monitoring and measurement	
	<ul style="list-style-type: none"> - monitoring and research - restoration
4.6 Management review	
	<ul style="list-style-type: none"> - evaluation and review of effectiveness

impact’ can be applied to MPAs as any change to the environment (as defined above), whether adverse or beneficial, wholly or partially resulting from activities within or outside the MPA. When possible, it is helpful to quantitatively evaluate the significance of the identified impacts through a ranking matrix exercise to assist in planning and prioritizing which activities to manage. ISO recommends using a ranking matrix to quantify the scale, severity, duration of the impact and the probability of occurrence of the impact [28]. However, for MPAs the legal requirements, cost and difficulty of managing, the urgency for management, the effect of management on other activities in the MPA, the concerns of

interested parties, and the effects of management on public image may be the most critical considerations to use in quantifying significance.

All information gathered during environmental aspect identification and evaluation phase should be documented and kept in a single database. The information stored in it should be referenced temporally and spatially, where appropriate, according to standard documentation procedures established beforehand [45]. Such a database should be used in conjunction with a Geographic Information System (GIS) and to prepare standardized forms to aid in future data collection. The GIS should be designed as a support

tool for the application of the EMS that can be used by the park organization to monitor ongoing improvement in the MPAs environmental performance [45].

4.3.2. Legal and other requirements

ISO 14001 requires that in the planning stage an organization establishes a procedure to identify, or catalog, any legal or other requirements that are applicable to its activities, products, and services [43]. Kelleher [12] and Salm et al. [16] also recommend describing the existing legal and management framework, such as coastal fisheries legislation, marine transportation regulations and other relevant legal controls on present use of the area. A full regulatory evaluation should also include an evaluation of applicable international conventions, national, regional, and municipal legislation, policies, licenses, and permits that may apply to the management of the MPA.

4.3.3. Objectives, targets and programme(s)

The ISO 14001 standards require that “documented environmental objectives and targets shall be established and maintained” [29]. When establishing or reviewing the objectives and targets one must consider legal requirements and usually the highest ranked or most significant activities and their environmental impacts as well as financial, technological and social restraints [28]. The objectives must be specific and the targets measurable. They should also be consistent with the environmental policy, including the commitment to the prevention of pollution [29].

Following the development of the objectives and targets for the management of the activities that occur within the MPA, managers would then begin to establish individual programs or action plans to achieve those targets. ISO 14001 requires that these programs include designation of responsibility for achieving the objectives and targets as well as the means and time-frame by which they are to be achieved [29]. Finally, each objective, target, and action plan should be linked to specific management indicators to facilitate the future monitoring and evaluation of those targets [14].

4.4. Implementation and operation

4.4.1. Resources, roles, responsibilities, and authority

Upon the development of the MPA management plan, with targets, objectives and associated action plans it is now time for the implementation and operation of the EMS. A key component and requirement of ISO 14001 EMS implementation is the definition, documentation and communication of the management structure, roles, responsibilities and authority of those involved in managing the MPA and the goals, objectives, and targets of its EMS. Once again this is a basic element included in most MPA management guidance materials, wherein it is recommended that the tasks for management officers, rangers, boatmen, scientists, etc., must be specified in the MPA management plan [12,16,49].

Top management must identify and provide the resources essential to the implementation and control of the EMS [28]. Resources may include human resources, specialized skills, technology and financial resources. It is also helpful if there is a senior manager who will be responsible for ensuring that the EMS is implemented and for reporting on the performance of the EMS (in terms of meeting objectives and targets) for review and as a basis for continual improvement of the EMS and ultimately the MPA's environment [28].

4.4.2. Competence, training, and awareness

Competence and training needs should be identified for staff operating in the MPA [12,16,49] and aspects involving education and awareness should be applied both to the protected areas internal organization and to outside parties operating in the area

[47]. Each person of the MPA management team and potential MPA users should be aware of the environmental policy, the significant environmental impacts, their roles and responsibilities in achieving the policy, the objectives and targets for the MPA, as well as the potential consequences of not following specified operating procedures. This requirement of ISO 14001 standard represents another excellent opportunity to engage communities and other stakeholders in MPA management. In doing so, ENEA [47] has recommended that a standard internal operating procedure for public education is developed, to include (1) a designated programmer, training topics, results evaluation, etc.; and (2) a programme of public-awareness and informational events regarding the various environmental aspects to be conveyed to all those who make use of the area and whose activities have a potential impact on vulnerable natural resources.

4.4.3. Communication

One of the key aspects of sound environmental management is strong communications with employees, the public, and other interested stakeholders [43]. Communications and stakeholder involvement is also a common recommendation for MPA management planning [12,14,16]. The ENEA pilot project also stressed that communication is a fundamental aspect that determines the success of any initiative and the chance to achieve a real improvement in environmental quality [47]. Under ISO 14001 there is a requirement that procedures must be in place for maintaining internal communications, receiving, documenting, and responding to communications from external interested parties, and delivering external communications on the EMS's environmental aspects. In an MPA context, communications may be achieved through periodic newsletters and publications, annual reports, periodic presentations to community groups, and awareness training for staff and external operators. Community-based social marketing campaigns may also help to boost public-awareness and foster change toward more sustainable behaviours to achieve enhanced environmental conservation [50,51].

4.4.4. Documentation

A documented EMS manual should outline the core elements of an organization's EMS and provide direction to related documentation including process information, organizational charts, operating procedures, internal standards, and site emergency plans [29]. When organizing documentation, it is important to make a distinction between documents and records, with the former being any material that can be altered or adapted over time and the latter being permanent and unchangeable [52]. Documentation can be paper or electronic [43], however, in the context of protected areas management it is recommended that documentation be electronically stored in a single database which, ideally, can be used in conjunction with GIS [45].

4.4.5. Control of documents

In terms of document control, ISO requires that a system be in place to maintain and update all EMS documentation [29]. At a minimum, documents should be dated (with the dates of revision), clearly identified and organized, and reviewed and updated on a fixed schedule [43]. Such procedures will aid in ensuring that documents can be easily located, reviewed and kept up-to-date. Again, a well-organized database should assist with the control of documents. In protected areas it is recommended that the filing and management of documents are handled by the park's management organization [47].

4.4.6. Operational control

ISO 14001 requires that an organization shall identify those operations and activities that are associated with the identified

significant environmental impacts and develop operational controls to ensure that there are procedures in place for those activities that could lead to deviations from the environmental policy if those procedures were not followed [43]. Procedures should be simple to understand, communicated and distributed, provided through training and motivation to those responsible for carrying them out, and reviewed, kept current, and relevant to users [43].

In protected areas management, operational control involves both monitoring of environmental quality for the entire area, and monitoring of environmental services through performance indicators for the park's own management organization and for those organizations that operate within the protected area [47]. Furthermore, because the standard provides that the organization must establish and update procedures that identify the actions and requirements that suppliers and contractors must meet in order to work on behalf of the organization, ENEA recommends that all parties interacting with the protected area and who may be contributors (suppliers) of environmental quality develop their own EMS [47]. To this end, the park organization, in accordance with the representatives of the organizations present in the area, should work to establish operational instructions for certification for all parties wishing to participate in the park's management system [47].

4.4.7. Emergency preparedness and response

Another integral part of ISO 14001 EMS and MPA management planning is to establish and maintain procedures to identify potential accidents and emergency situations that may impact the environment or human health (e.g., hydrocarbon spills, chemical releases, natural disasters, etc.) [29]. There should also be a response plan (periodically tested and reviewed) for preventing and mitigating potential environmental impacts associated with such emergencies [28,29]. In MPAs roles and responsibilities must be established between the MPA management and the other parties (e.g., Coast Guard or Navy) in the area having specific responsibilities in the event of an emergency [47].

4.5. Checking and corrective action

4.5.1. Monitoring and measurement

ISO 14001 requires that an organization must establish and maintain documented procedures to monitor and measure the performance toward the organization's environmental objectives and targets [29]. In the case of MPA management this would mean having documented scientific procedures for qualitatively and quantitatively monitoring the various environmental indicators that are directly linked to the objectives and targets established. The guidance material "How is your MPA doing" provided by Pomeroy et al. [14] may be useful in providing such documented procedures to evaluate a wide range of management indicators.

4.5.2. Evaluation of compliance

ISO 14001 specifies that an organization establishes and maintains a documented procedure for periodically evaluating compliance with relevant environmental legislation and regulations [29]. Elements contained in such a procedure might include a list or matrix of applicable national laws and regulations, permits, and methods for evaluating compliance [43]. In MPAs there should be a mechanism for tracking the activities that have occurred within the MPA to determine if management and users are adhering to regulatory requirements. Furthermore, there should also be a procedure and roles and responsibilities in place for investigating noncompliance issues such as illegal fishing, poaching, or dumping inside the MPA. In the evaluation of compliance issues, MPA managers should work to develop mitigation measures or

preventative actions to reduce the risk of repeated regulatory breaches. For example, this might mean providing an awareness session with local fisherman or industry.

4.5.3. Nonconformity, corrective action and preventative action

Nonconformance refers to deviations in the EMS from the requirements of ISO 14001 and should not be confused with noncompliance with regulations [43]. ISO 14001 stipulates that a process must be in place to identify, investigate, and mitigate any EMS nonconformance [29]. Mitigation generally includes corrective and/or preventative action to ensure that the nonconformance will not occur again. Nonconformances may be identified through root causes analysis, checklists, or a gap analysis [43].

4.5.4. Control of records

Procedures for the identification, maintenance and disposition of environmental records must be developed under ISO 14001 specifications. Such records for a MPA may include training and awareness records (both internal staff and external public), monitoring results, any scientific publications, and the results of any audits and/or reviews. Records must be legible, traceable, retrievable, and maintained for a defined period of time [29]. Again, this would be best achieved through the use of an electronic database, with records designed to be integrated with a GIS tool that can be used by MPA management team to monitor ongoing improvement in its environmental performance [45].

4.5.5. Internal audit

An organization's EMS must be periodically audited or reviewed, in order to determine if the EMS meets ISO standards and has been properly implemented and maintained. The results of the internal audit should also provide information to top management for the continued improvement of the EMS. The audit program and procedures for MPAs should cover the activities to be considered in the audit, the frequency of the audit, the responsibilities associated with managing and conducting audits, auditor competence, how the audits will be conducted and the results communicated [43].

4.6. Management review

Under ISO 14001, an organization must review the results of the EMS audit and monitoring programs. In an MPA, management review would be performed by the MPA management organization and carried out by top management with the participation of the appropriate external stakeholder groups [47]. Such follow-up and review processes have also been noted as very critical to an effective MPA management plan [12,16,49]. This review, presented to top management, will also address the need for changes to policy, objectives, targets, and other elements of the EMS. The review should be documented in the form of a yearly EMS performance report which should be publicly available [43]. Finally, this process should feed back into the initial planning stage for the next period of EMS implementation with the overall result being a management approach in MPAs that achieve continual improvement.

4. Case study: Islas Choros–Damas Marine Reserve

4.1. Background

The Islands Choros and Damas (29° 13' 29" S, 71° 31' 38" W) are located in northern Chile, ~5 km offshore from the small fishing community of Punta Choros (Fig. 1). The islands themselves provide habitat and breeding grounds to number of large amphibious marine fauna such as the common sea lion, *Otaria flavescens*, the sea otter, *Lontra felina*, the endemic Humboldt penguin,

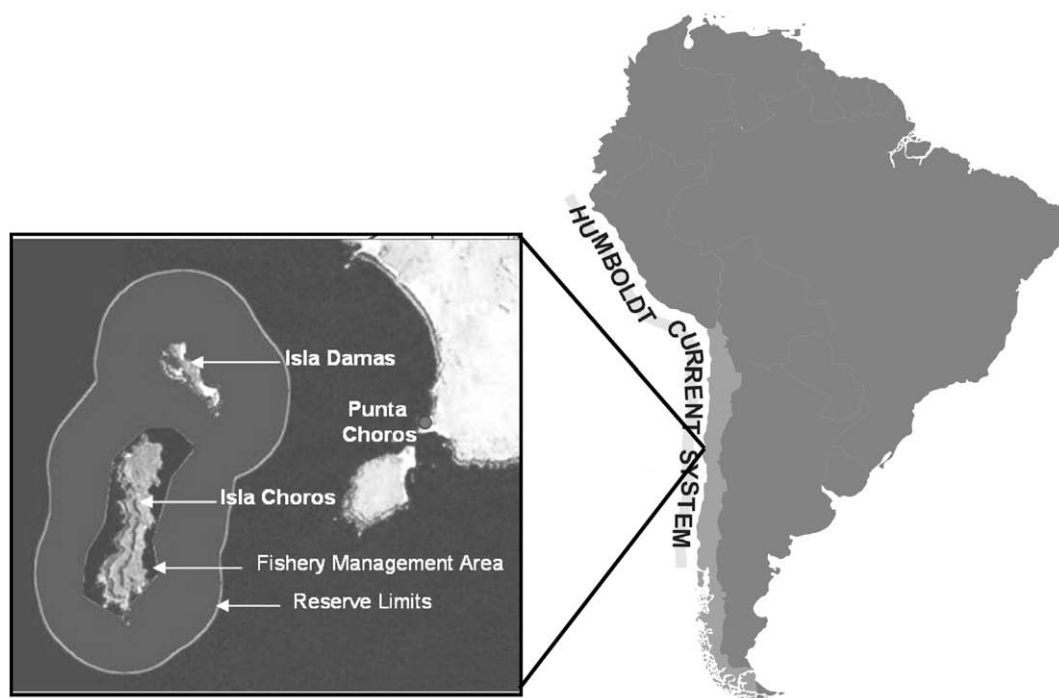


Fig. 1. Map of Chile and inset of Islas Choros–Damas Marine Reserve noting the reserve's limits and the fisheries management area.

Spheniscus humboldti as well as to an incredible diversity of marine avifauna including cormorants, diving petrels and seagulls [53]. Situated directly in the path of the highly productive waters of the Humboldt Current System, these dry and rocky islands are also surrounded by a rich diversity of subtidal marine communities with over 150 species from 14 different phyla [53,54].

Declines in the population of the Humboldt penguin due to over fishing of prey species, entanglement in fishing nets and commercial guano operations [54] prompted Chilean legislators bring the two islands plus a third island, Isla Chañaral, under protection as the Humboldt Penguin National Reserve. The protection of the islands has restricted access to Isla Choros (291.7 ha), while tourist activities such as day hiking and camping were permitted to continue on the smaller Island Damas (60.3 ha) [55]. In addition to these activities, a number of other activities such as SCUBA diving, whale watching, and artisanal fishing occur just offshore of both islands.

Due to overexploitation of a number of benthic invertebrates that are extracted from the waters surrounding the islands, which are amongst the most productive of the northern Chilean coast, the Economy Ministry, through the Sub-secretary of Fisheries (SUBPESCA), established the protection in the radius of one nautical mile from the coastline excluding the Isla Choros fisheries management area and declared the creation of the Islas Choros–Damas Marine Reserve in 2005 [53,56,57]. The main reason for protecting this area was to aid in the recovery of several vulnerable commercial benthic invertebrates (and their habitats) including the Chilean abalone, *Concholepas concholepas* (also known as Loco), keyhole limpets, *Fissurella* spp. and the red sea urchin, *Loxechinus albus* [54]. Moreover, protection was also sought to safeguard populations of the benthic community structuring kelps, *Lessonia trabeculata* and *Lessonia nigrescens* and to protect various emblematic and/or endangered species including the bottlenose dolphin *Tursiops truncatus*, sea otters, the Humboldt penguin and the Peruvian diving petrel *Pelecanoides garnotii*. All were threatened from negative interactions with human activities such as unregulated tourism, fishing and entanglement in fishing gear, poaching, and human disruption to the islands coasts [53,54].

Although the creation of the Islas Choros–Damas Marine Reserve was a positive step toward achieving Chile's National Biodiversity Strategy and the Chilean commitment to the United Nations Convention on Biological Diversity, there have been some social conflicts that have arisen as a result of the authoritative manner in which the Reserve had been designated and a general lack of communication between the Chilean National Fisheries Service (SERNAPESCA), and the local stakeholders [54]. In particular, several artisanal fishermen's unions in the area found that the creation of the marine reserve took them by surprise and that they were unaware of the criteria that supported the designation of the marine reserve [53]. While they tend to understand that the marine reserve is there for protection and/or conservation of marine resources, there is a general feeling that it may threaten their traditional fishing activities. This has sparked interest by some fishers into the possibility of practicing an effective co-administration of the reserve to ensure that they are informed of management decisions as well as empowered to be a part of that decision-making process [53]. Other members of the local community, above all the tourist sector, see the marine reserve as an opportunity to create new forms of employment, local development, and new identities related to ecotourism [53].

The administration of marine reserves in Chile falls under the jurisdiction of SERNAPESCA. Under Chilean national regulations SERNAPESCA and SUBPESCA are required to develop a general plan of administration for all of Chile's MPAs, which is to be executed by SERNAPESCA [53,58]. This general plan considers programs for the administration, research, management, extension, monitoring, surveillance and enforcement of Chile's MPAs [53,56]. Using this general framework, a specific plan for the administration of each MPA is to be developed. However, as the creation of MPAs in Chile is a relatively new phenomenon there was no precedence for the management of MPAs. Thus, to develop a plan for the administration of the Islas Choros–Damas Marine Reserve, SERNAPESCA and SUBPESCA sought out advice from within the country's academic community and from international partnerships. As a result an interdisciplinary team from the Centro de Estudios Avanzados en Zonas Aridas (CEAZA) and Universidad Católica del Norte (UCN), in

collaboration with marine management experts from the Port Cros National Park and the Mediterranean Marine Mammal Sanctuary (PELAGOS), France, were awarded a contract to develop a management plan for the newly designated marine reserve.

4.2. ISO 14001 MPA EMS gap analysis

Working with this interdisciplinary team, an opportunity was provided to examine ISO 14001's potential for strengthening MPA management by using the standard as a benchmark for evaluating the proposed management plan for the Islas Choros–Damas Marine Reserve. Typically, when implementing ISO 14001 in an organization it is recommended to carry out a gap analysis to determine the current state of the organization's management system and what is required to meet the ISO 14001 specifications [43,45]. Thus, an MPA EMS Gap Analysis Tool (Appendix A) was developed to assist in the evaluation of a MPAs management system in accordance with the ISO 14001:2004 EMS standard. This tool was created by combining materials provided by Cascio et al. [43] with concepts adapted and integrated from the Italian pilot application of EMSs in protected areas [45–47] and the Ecosystem-Based Management System conceived by Mendoza et al. [48]. After reviewing the available documentation and draft management plan for the marine reserve, this gap analysis tool was used as a simple checklist to evaluate the overall management system proposed for the Islas Choros–Damas Marine Reserve against each of the requirements found in the main clauses/sub-clauses of the ISO 14001 EMS specification standards. It is recommended that this tool be used by those with some prior knowledge and/or experience with the basic workings of the ISO 14001:1996 or ISO 14001:2004 specifications.

4.3. Gap analysis results

The gap analysis revealed that the proposed management plan for the Islas Choros–Damas Marine Reserve would not result in a management system that would meet all of the requirements described in the whole of clause 4 of ISO 14001. While the gap analysis did find that some components of an ISO 14001 EMS had been already incorporated into the draft management plan, many of these needed improvements in order fully meet the standard (Table 2). For example, the management plan included a very brief legal assessment, however, to fully conform to ISO 14001 a complete inventory of applicable legislation and other regulations should have been assembled and documented. Other areas where the management plan needed improvement included enhancing the definition of the roles, responsibility, and authority of the various management councils and reserve staff, developing an internal and external communications strategy to keep the reserve's management and external stakeholders engaged and informed of management activities, improving linkages between objectives and targets and the bio-physical, socioeconomic, and governance indicators adopted from Pomeroy et al. [14], and better defining operational controls and protocols for achieving, monitoring and measuring progress toward the reserve's goals and objectives.

The gap analysis also revealed that there were some critical EMS components that were completely missing from the draft plan. For example, the management plan lacked a well-defined environmental policy to guide the overall management for the marine reserve. There was also no evidence of a mechanism for maintaining and controlling documents and records. Another vital element that the gap analysis identified was that the management plan completely lacked an emergency preparedness and response plan for evaluating, responding and mitigating emergencies that may harm the environment or human health. Finally, there was no

Table 2

Gap analysis summary of ISO 14001 clauses and sub-clauses (in *italics*) where the current proposed management system for the Choros Islas Choros–Damas Marine Reserve meets, does not meet, or needs improvement to meet the ISO 14001 EMS standard

ISO 14001 specification clause/sub-clause	Status
4.1 General requirements	Needs improvement
4.2 Environmental policy	Not met
4.3 Planning	
4.3.1 <i>Environmental aspects</i>	Met
4.3.2 <i>Legal and other requirements</i>	Needs improvement
4.3.3 <i>Objectives, targets and programme(s)</i>	Needs improvement
4.4. Implementation and operation	
4.4.1 <i>Resources, roles, responsibilities and authority</i>	Needs improvement
4.4.2 <i>Competence, training and awareness</i>	Not met
4.4.3 <i>Communication</i>	Needs improvement
4.4.4 <i>Documentation</i>	Not met
4.4.5 <i>Control of documents</i>	Not met
4.4.6 <i>Operational control</i>	Needs improvement
4.4.7 <i>Emergency preparedness and response</i>	Not met
4.5 Checking and corrective action	
4.5.1 <i>Monitoring and measurement</i>	Needs improvement
4.5.2 <i>Evaluation of compliance</i>	Needs improvement
4.5.3 <i>Nonconformity corrective and preventative action</i>	Not met
4.5.4 <i>Control of records</i>	Not met
4.5.5 <i>Internal audit</i>	Not met
4.6 Management review	Not met

clear definition of how and when the management plan would be evaluated, reviewed, and updated.

After identifying the missing ISO 14001 EMS components, a series of recommendations were developed for each of the main clauses and/or sub-clauses of the standard (Appendix B). These recommendations were to guide the CEAZA/UCN team toward meeting the ISO 14001 requirements and to assist in strengthening the draft management plan prior to being finalized and put into operation. For example, the final management plan included a clarification of the roles and responsibilities of the management councils and reserve staff, and how the plan would be evaluated. Moreover, a complete inventory of applicable legislation and other regulations was defined as a priority for SERNAPESCA. As research from the ENEA pilot project demonstrated that a well-established organizational structure facilitates EMS implementation in protected areas [44], it was recommended that complete ISO 14001 conformance should not be an immediate goal for the Islas Choros–Damas Marine Reserve, but instead it should be something to work toward as the Reserve's management structure evolved over time.

Although the recommendations developed from the gap analysis should significantly improve the overall management system of the marine reserve and place it well on its way toward meeting the ISO 14001 standard, there were a number of barriers to ISO 14001 implementation that were also identified. For example, the cost of implementing and becoming ISO 14001 certified can be quite high. While the costs associated with registration depend on the size of an organization, Yiridoe et al. [31] reported that the internal costs associated with registration for a small organization (<100 employees) ranged from USD \$5000 to USD \$60,000 (average USD\$17,000). This is a considerable cost given that the estimated budget for the administration of the entire marine reserve was roughly USD \$160,000 per year.

Lack of commitment from top management was another potential barrier to ISO 14001 implementation in the marine reserve. Wilson [59] reports that any organization that attempts to implement an EMS without the full support of top management

will fail. Commitment and leadership from top management ensure that the appropriate resources (human and financial) are made available for the proper implementation of an EMS. At the time of the evaluation, it was unknown what level of support exists from the SERNAPESCA and the Chilean Government in terms of pursuing ISO 14001 in its own operations.

Finally, failure to achieve stakeholder buy-in and involve interested parties may be another significant barrier to ISO 14001 adoption. The ENEA [44,47] pilot project highlighted the importance of encouraging external stakeholders to adopt the same quality environmental management practices that are undertaken in Italian National Parks. When pursuing the development of an EMS, interested parties must be identified and their concerns for the overall environmental performance of the marine reserve need to be considered. A system should be developed to ensure the concerns of interested parties are heard and addressed. An EMS that is designed and implemented without the input of interested parties will lack transparency and credibility with the public [59]. Thus, stakeholder buy-in is critical to the success of EMS implementation in the marine reserve and could best be achieved through the proposed “consejo consultivo” (advisory council). Furthermore, it is important to communicate to stakeholders that the EMS is not only applied to the marine reserve’s management team, but to all of the reserve’s users and, as a result, everyone must be accountable for it. To achieve stakeholder buy-in the reserve’s management team needs to ensure that stakeholders share a common vision (i.e., adoption of the environmental policy), that they have the proper training and awareness of their obligations, and that there are rewards and incentives available for those who are on board with the EMS. A good example of such an initiative is the proposed use of annual signed agreements by fishermen and SCUBA diving operators, which signifies their commitment to adhering to the defined acceptable behaviours and best practices for these activities when carried out in the marine reserve [56]. Signing the agreement would give fishers and divers the right to conduct their operations within the waters of the reserve and allow them to use the logo and flag of Islas Choros–Damas Marine Reserve.

5. Conclusions

The results from the field study of the Islas Choros–Damas Marine Reserve highlight the potential for using ISO 14001 as the benchmark for MPA management. By using ISO 14001 to evaluate the marine reserve’s draft administrative plan, a number of missing management components were readily identified. In doing so, they can be prioritized such that some of these standard management practices can be integrated into the management plan before it was finalized, while others can be implemented as the marine reserve’s management matures over time. Integrating these standard environmental management practices into the management of the Islas Choros–Damas Marine Reserve should result in more than just a management plan, but instead, an entire quality management

system which can bring about continual improvement of the management of the marine reserve and ultimately preserve and/or enhance its environmental quality.

In general, adopting the ISO 14001 EMS standard for MPA management could help to codify the existing MPA management guidelines and best practices by providing the essential components required for quality environmental management. This paper has demonstrated that ISO 14001 can provide a standardized, certifiable, and internationally recognized management system that is extremely flexible and can be applied to a wide variety of contexts, including protected areas management. Furthermore, using ISO 14001 in protected areas management can enhance communications, raise awareness, and engage the public in the planning process for protected areas, thereby reducing confusion and potential conflicts [46].

The widespread use of ISO 14001 in MPA management could usher in a new internationally recognized standard for MPA management, which is auditable and certifiable. Adopting this ISO standard will provide a global benchmark for MPA management that can be utilized for identifying weaknesses in the management systems of MPAs around the world. Of course, the theoretical EMS framework proposed in this paper is by no means a ‘standard’, but an attempt to compare and integrate the existing doctrine on MPA management with the ISO 14001 standard. This should be considered as the first step in opening a dialogue for developing a new ISO standard specifically designed for the implementation of ISO 14001 in MPAs. As our case study revealed, implementing an ISO 14001 EMS requires, at a minimum, that a management and organizational structure be in place. It would be interesting to apply the EMS Gap Analysis to a well-established MPA to determine if it can be readily certified to the ISO 14001 standard.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.ocecoaman.2008.07.004](https://doi.org/10.1016/j.ocecoaman.2008.07.004).

Appendix B. Summary of recommendations from the MPA EMS gap analysis of the management plan for the Isla Choros–Damas Marine Reserve

Recommendations summary

4.1 General requirements:

- Once the marine reserve’s management and organizational structure is finalized and put in place, work toward implementing an EMS in accordance with ISO 14001.
- Ensure that the appropriate scope is defined for the marine reserve’s EMS.

Appendix B (continued)

Recommendations summary

4.2 Environmental policy:

- Develop an environmental policy which meets the requirements of ISO 14001.
- Ensure that the policy is developed with and communicated to external stakeholders.

4.3 Planning:

4.3.1 Environmental aspects:

- Create and document a process or protocol for determining the significance of the identified 'issues' of the marine reserve (ex. Ranking Matrix).
- Ensure documentation for the ATEN framework (or other framework) to determine the Reserve's 'issues' is available to marine reserve's administration.

4.3.2 Legal and other requirements

- Add legal expertise to the UCN/CEAZA team and develop an inventory of all applicable legislation as well as a documented procedure for conducting a full legislative review.

4.3.3 Objectives, targets and programme(s)

- Improve targets by making them more specific and quantitative that can be easily measured and evaluated against the selected management effectiveness indicators.
- Ensure the future development of objectives and targets are done in collaboration with local stakeholders.

4.4. Implementation and operation

4.4.1 Resources, roles, responsibilities and authority

- Define the councils' roles, responsibilities, and authorities more clearly.
- Draft a framework of understanding for cooperation and collaboration between the various government, academic, and public stakeholders.
- Communicate roles, responsibilities, and authorities to each of the respective administrative positions.

4.4.2 Competence, training and awareness

- Create a process to identify ongoing training needs for the marine reserve's management staff.

4.4.3 Communication

- Put in place procedures for maintaining internal communications, and receiving, documenting, and responding to communications from external interested parties.

4.4.4 Documentation

- Develop an ISO 14001 EMS manual which contains direction to EMS-related documentation.

4.4.5 Control of documents

- Develop an electronic database to manage the documents associated with the marine reserve.
- Develop procedure the procedure should ensure that documents are dated (with the dates of revision), clearly identified and organized, and reviewed and updated on a fixed schedule.

4.4.6 Operational control

- Develop of a full spectrum of procedures and controls to better define the means by which the objectives and targets are to be met.

4.4.7 Emergency preparedness and response

- Examine the risks of emergencies that may occur in or around the marine reserve.
- Develop emergency preparedness and response plan for the marine reserve.

(continued on next page)

Appendix B (continued)

Recommendations summary

4.5 Checking and corrective action

4.5.1 Monitoring and measurement

- Link indicators to specific 'operaciones' and the exact procedures/methodology as to how these indicators will be measured are not specified.

4.5.2 Evaluation of compliance

- Document procedures for recording and evaluating the number of regulatory infractions that are occurring within the marine reserve.

4.5.3 Nonconformity corrective and preventative action

- Adopt Gap Analysis Tool as one method for investigating the conformance with the ISO 14001 EMS.

4.5.4 Control of records

- Create an electronic database and associated GIS (with backup) for the deposition of the marine reserve's environmental records.

4.5.5 Internal audit

- Document a mechanism for auditing the marine reserve's entire management system to ensure that it is meeting both the environmental objectives as well as the requirements of the ISO 14001 standard.

4.6 Management review

- Clearly state how and how often the reserve's management system will be reviewed, revised, and updated.

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