**Exploring Marine Protected Areas: A baseline governance assessment of the Sian Ka'an Biosphere Reserve.**

by

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# Introduction

There is ever growing concern about the ability of our global society to be sustained by the planet's finite resources. As populations increase, demands on the natural environment and the effects of anthropogenic activities intensify. Our oceans and aquatic environments provide food, income and other resources for billions of people across the globe. Unfortunately marine and coastal ecosystems are in global decline, severely impacted by a variety of natural and human disturbances (IUCN 2008). Overfishing, land-based pollutants, excessive nutrient loads, habitat degradation and the increasing effects of climate change are all contributing to the collapse of our marine environment (Wilkinson 2004; Hughes et al. 2005). Learning to manage and conserve these complex ecosystems so that they can be sustained is a topic of debate among a variety of actors. A popular tool for conserving marine habitats that has been adopted internationally is the use of Marine Protected Areas (MPAs). MPAs are seen as effective, spatial approaches to protecting marine habitats (IUCN 2008). However, MPAs are often declared and then improperly governed; this may mislead and misrepresent indications of their effectiveness in conserving marine environments (Mora et al 2006).

Marine Protected Areas exist in a myriad of forms with diverse definitions and objectives, ranging from small, community managed reserves upwards to national or trans-boundary multi-million hectare areas (IUCN 2008). MPAs offer a wide spectrum of protection, the level of which is directly tied to the park's objectives. Full protection often encompasses no-take and no-entry areas, where human interaction and resource extraction (particularly fishing) is strictly limited or prohibited, while limited-take reserves often include the sustainable management of resource extraction and human interactions through tourism and community management (IUCN 2008). There are a variety of other terms associated with marine protected areas, including marine reserves, fishery reserves, no-take areas/zones, sanctuaries, parks, wilderness areas, etc., (Lutchman 2005; Marine Protected Areas Center 2008). The definition of these terms varies widely depending on local, national and international contexts (Agardy & Staub 2006), and can correlate to different levels of protection. For the purpose of this report, marine protected areas/reserves refer to "clearly defined coastal, tidal or sub-tidal spaces that are recognized, dedicated and managed through legal or other effective means for the long-term conservation of nature, with associated ecosystem, services and cultural values" (IUCN 2008).

Due to the diverse nature of the environments MPAs aim to protect and their varied management schemes, it can be difficult to determine and develop methods for assessing the success of a reserve in meeting its objectives. The purpose of this case study is to create a baseline governance assessment of the Sian Ka'an Biosphere Reserve (SKBR) in Quintana Roo, Mexico. This analysis will begin to determine how well the reserve is meeting its conservation objectives from a governance perspective. The focus will be placed on the five variables of governance outlined by Jones et al. (2011) in the Marine Protected Areas Governance framework (MPAG). These five variables include legal, economic, knowledge (role of science), interpretative, and participation incentives. Specifically, this study aims to answer the following research questions:

1. **How well is the Sian Ka'an Biosphere Reserve meeting its conservation objectives from a governance perspective?**
2. **What incentives are in place and how are they being used?**
3. **What challenges or gaps exist? How can these areas be improved?**

Upon completion of this study, it is hoped that identification of problem areas and the recommendations provided can be used to improve the overall governance of the reserve and its effectiveness in meeting its conservation mandate. This study is significant in a variety of ways, particularly in that there are no publically available, comprehensive assessments of the governance incentives or management involved in the SKBR. This governance analysis is also significant as it:

a) offers the opportunity to provide many of the organizations working within the reserve with an informal analysis from an outsider's perspective
b) holds the potential to identify problem areas and provide suggestions or recommendations
c) begins to bridge a gap in the public knowledge of the reserve, and
d) provides the potential to explore how the MPAG framework can be used as a successful tool for actors involved in MPAs to assess the success of their management.

## Limitations and Delimitations

There are several circumstances that limit this study, including access to information, the scope of an undergraduate thesis, timelines and the co-operation of those involved with the Sian Ka'an Biosphere Reserve. Language barriers also pose a potential barrier, as some information may only be available in Spanish. The majority of case studies or assessments completed on marine protected areas include biophysical, socioeconomic and governance indicators in their analysis. Due to the time constraints and scope of the project, only one of these areas could be properly investigated. Given the poor access to biophysical data and the expertise of my supervisor, Dr. Elizabeth De Santo, directed the project to focus on a governance analysis. It is important to note that this analysis is subjective to the knowledge base and expertise of the researcher. Therefore it is important to have the assessment reviewed by other environmental governance experts.

## Definition of Terms

**Actors**: persons from society, non-governmental organizations, user groups, regulatory agencies, corporate interests, etc. who interact with one another in a governance process (Jones et al. 2011)

***Campos*:** individually 'owned' marine plots; individual fishers have ownership over the *casitas* employed within these plots, which are loaned to fishing cooperatives by the government, giving them fishing rights within the area (Carr, D. 2007; Ley-Cooper, K. 2011)

***Casitas*:** artificial habitats installed on the seafloor to provide refuge to lobsters; these were traditionally made of chit palm but are now created from concrete blocks (Mazzotti et al. 2005)

**Decentralization:** "the transfer of power from the central government to lower-level governments" semi-independent government organizations, private sector or NGOs (Jones et al. 2011)

**Effectiveness:** the degree to which the ecological management objectives of a MPA are being fulfilled, with a particular focus on biodiversity and sustainable resource use (Jones et al. 2011)

***Ejidos*:** terrestrial version of *campos, ejidos* are communally owned parcels of land; community members are given a specific parcel to farm (Mazzotti et al. 2005)

**Governance:** the involvement of a wide range or institutions and actors in the production of policy outcomes, which involves coordination through networks and partnerships or guiding human behavior through combinations of people, state and market incentives in order to achieve strategic objectives (Jones et al. 2011)

**Incentive:** an articular institution that is instrumentally designed to encourage actors to choose to behave in a manner that provides for certain strategic policy outcomes, particularly biodiversity and conservation objectives, to be fulfilled (Jones et al. 2011)

**Institution**: "a broad term that covers a range or agreements, interactions, etc., which remain relatively stable over a certain period of time. These include:

- mutually agreed modes of cooperative behavior [norms];
- interactions through markets: local to distant;
- government policies and programs; and
- legal instruments and related obligations." (Jones et al. 2011)

**Protected Area**: a clearly defined geographic space, recognized, dedicated and managed through legal or other effective means to "achieve long-term conservation of nature with associated ecosystem, services and cultural values" (IUCN 2008)

**UNESCO World Heritage Site**: a designated site with outstanding universal value (cultural, environmental, historical, etc.) to humanity, and as such has been inscribed on the World Heritage List to enable the protection of the area for future generations to experience (**UNESCO 2013**)

**Abbreviations:**

| | |
|---|---|
| **ASK** | Amigos de Sian Ka'an |
| **CBD** | Convention on Biological Diversity |
| **CESiaK** | Centro Ecologico Sian Ka'an |
| **CIQRO** | Centro de Investigaciones de Quintana Roo |
| **COBI** | Comunidad y Biodiversidad Asociancion Civil |
| **CONANP** | Comision Nacional de Areas Naturales Protegidas |
| **GIS** | Global Information System |
| **GDP** | Gross Domestic Product |
| **IUCN** | International Union for the Conservation of Nature |
| **MAB** | Man and Biosphere Program (UNESCO) |
| **MPA** | Marine Protected Area (also refers to marine reserves) |
| **MPAG** | Marine Protected Area Governance |
| **NGO** | Non-governmental Organization |
| **SKBR** | Sian Ka'an Biosphere Reserve |
| **UNEP** | United Nations Environment Programme |
| **UNESCO** | United Nations Educational, Scientific and Cultural Organization |

# Methods

## Desktop Analysis

An in-depth desktop analysis was conducted on peer-reviewed articles and grey literature surrounding marine governance, conservation in Mexico, UNESCO World Heritage sites and on the Sian Ka'an Biosphere Reserve. This information was largely found online through various databases, media and communication outlets, and in published (print and online) literature. Keywords used to search for literature included: MPA governance, Sian Ka'an Biosphere Reserve, MPA management, Punta Allen, Amigos de Sian Ka'an, effectiveness and economic activity, among others. The literature was extensively reviewed; crosscutting themes were identified within all the articles, information on the reserve's management or activities occurring within the SKBR's borders, or to identify potentially transferable lessons. Information surrounding the SKBR, stakeholder groups, and incentives were highlighted and pulled from a variety of documents. These were then used to build informative tables for each of the five governance incentive categories (see Table 1). Connections between stakeholder groups and the flow of information between them were also identified through this document analysis.

## Informal Informative Surveys & Personal Communications

An informal, informative survey was drafted to help supplement the data gathered through the desktop analysis. The surveys were distributed to eight NGOs involved in SKBR, and were aimed at collecting objective information on ongoing activities within the reserve. There were four responses from the various NGOs; three of these responses were used in the analysis. This information will be presented in an anonymous way to avoid any conflicts. A copy of the survey can be found in Appendix A.

## Analysis Framework

A governance analysis framework was used to synthesize the data collected through the desktop analysis and personal communications. This framework was modified from the pre-existing Marine Protected Area Governance framework (Jones et al. 2011) and was adapted to appropriately fit the scope of the project.

The MPAG framework created by Jones et al. (2011) used a case study research approach to determine if MPAs were effective in achieving conservation objectives and to identify how marine governance could be improved (Jones et al. 2011). The framework was built to access the actual effectiveness of the governance approach (or approaches) used by an MPA through observation of actual occurrences of incentive use and governance, rather than theoretical or ideological ideals (Jones et al. 2011). The technical MPAG report produced 20 MPA case studies and identified 5 broad forms or 'frameworks' of governance. The MPAG framework focused on 'deconstructing' the complexities of MPA governance by using incentives from five categories: economic, legal, role of knowledge, participative, and interpretative incentives. These categories have been defined in **Table 1.**

**Table 1** Governance incentives as described by the MPAG Framework (Jones et al. 2011).

| Incentive Category | Description |
|---|---|
| Legal | These incentives involve the establishment and enforcement of relevant regulations, legislation, laws, etc. to promote compliance with decisions and thereby the achievement of MPA obligations |
| Economic | "The use of economic and property rights approaches to help promote the fulfillment of MPA objectives". |
| Participative | Incentives that provide the opportunity for MPA users, local communities and other interest groups to participate in and influence MPA decision making, that may potentially affect them in order to promote their ownership of the MPA and thereby their potential to cooperate in the implementation of decisions. |
| Knowledge | Incentives that respect and promote the use of knowledge (local, traditional, expert an scientific) to better inform MPA decisions. |
| Interpretative | Incentives that promote the awareness of the conservation features of the MPA, the related objectives for conserving them, the policies for achieving said objectives, and the support for related measures. |

Overall, there were 40 incentives outlined by Jones et al. (2011), a full list of which can be found in the MPAG Technical Report.
For the case studies, researchers were asked to identify the following information from/about their MPA:

- Context,
- MPA objectives,
- Drivers/conflicts,
- The governance framework/approach,
- Effectiveness,
- Incentives and
- Key issues.

For the purpose of this project, the context, objectives, and governance framework/approach will be outlined within the literature review, while the incentives, their effectiveness, drivers/conflicts and key issues will be detailed in the results and discussion sections. Recommendations will also be made within the discussion section, in hopes of improving the effectiveness of the governance approach within the SKBR.

## Effectiveness Ranking

To aid in the organization and display of information, each incentive was given an effectiveness ranking score of 1 – 5 (Table 2), based on its implementation, effectiveness and overall contribution to the SKBR's ability to meet its conservation objectives. The overall effectiveness of the reserve was based on low-moderate-high levels of successful incentive use. The effectiveness measure assigned to each incentive was assigned based on the literature reviewed and personal communications with the NGOs working within the SKBR.

**Table 2.** Effectiveness ranking definitions for incentives used within the SKBR.

| Effectiveness Ranking | Description |
|---|---|
| **1** | No incentives are used to mitigate issues or to enhance governance effectiveness |
| **2** | Some incentives are used, with limited effectiveness |
| **3** | Some incentives are used, with mixed effectiveness |
| **4** | Multiple incentives in use, the majority of which are fairly effective |
| **5** | Multiple incentives in use, with high effectiveness |

# Literature Review

## Marine Protected Areas

Marine and coastal ecosystems are in decline worldwide; overfishing, physical and chemical pollution, habitat degradation and the increasing effects of climate change all contribute towards the collapse of global marine ecosystem (Wilkinson 2004; Hughes et al. 2005). Marine protected areas (MPAs) are effective spatial approaches to marine conservation (IUCN 2008). They offer one of the more tangible approaches to ecosystem-based management, managing fisheries and promoting conservation (Bohnsack 1998; Murray et al. 1999, Pinnegar et al. 2000; Carr 2000). MPAs help maintain ecosystem health and productivity, which has the beneficial effect of safeguarding socioeconomic developments; they may even alleviate some of the fundamental problems with conventional management practices that focus on single species recovery (Carr 2000; IUCN 2008).

In their promotion of ecosystem conservation, MPAs also help protect and maintain a full range of genetic variation, which is essential in securing viable populations of species. This genetic diversity is key in sustaining evolutionary processes and ensuring resilience in populations and ecosystems (Agardy and Staub 2006). Conservation objectives within MPAs often focus on species at risk of extinction, species that are endemic to an area, or species that hold important socioeconomic or cultural values (IUCN 2008). When a MPA is located and managed well, it holds the ability to conserve biological diversity and associated ecosystems (mangroves, lagoons, reefs, sea grass beds, etc.), protect critical spawning and nursery grounds, mitigate direct anthropogenic impacts and provide baseline sites for scientific research (IUCN 2008).

MPAs also act as focal points for education and the promotion of ecotourism and other nature-based recreation. Programs within MPAs often look to provide alternative sources of income for local communities and aim to share the costs and benefits of the reserve among a variety of stakeholder groups (IUCN 2008). The comparison of protected areas versus unprotected areas offers an ecosystem-wide understanding of anthropogenic impacts on coastal marine environments (Carr 2000). Small MPAs have shown to provide benefits to the environment, but large MPAs or networks of MPAs will be needed to help preserve marine biodiversity and maintain fisheries (Halpern 2003). MPA networks are collections of MPAs within a large geographic area that work together to meet objectives that may not be possible to accomplish in or by an individual MPAs

(IUCN 2008). For example, MPA networks may be able to protect critical habitat for cetaceans, which are highly mobile species (Bailey & Thompson 2009).

Marine environments include an incredible variety of ecosystems, ranging from deep-sea vents to shallow estuaries, coral reefs to temperate kelp forests and more. The management of MPAs varies just as widely as the environments they aim to protect. The objectives of a reserve define both the design of its physical borders and its management scheme (Carr 2000). The evaluation of an MPA is often also defined by its objectives. What are the objectives? Are these objectives being met? Exploring MPA management often reveals that there are cases of conflicting objectives (e.g. ecosystem or biodiversity conservation and fisheries enhancement or heavy promotion of tourism). Institutional and governance considerations have significant effects and influence on the design, implementation and success of MPAs and MPA networks (IUCN 2008).

## MPA Governance

Governance is the political dimension of human activities, acting to create a system of authority and accountability (IUCN 2008). Management is the process that leads to implementation within the institutional framework that governance creates (IUCN 2008). Well-designed and case/place-appropriate legislative and regulatory frameworks are fundamental to the creation of an effective MPA (IUCN 2008; Jones et al. 2011). Governance is a key component of sustainable ocean management, utilizing stakeholder collaboration to build resilient management systems (Jones et al. 2011); it emerges from the interaction of actors, including community, government, private and NGO stakeholder groups (IUCN 2008). The ability of a reserve to meet its objectives depends heavily on the ability of stakeholder groups to communicate effectively and work cohesively. Marine governance is built through laws, regulations, negotiations, incentives and other decision-making mechanisms (Lebel et al. 2006; Jones et al. 2011). The ability of institutions working within marine governance frameworks to be adaptive in a dynamic and fluctuating ecological setting is key to the success of conservation objectives (IUCN 2008).

MPAs are governed from a top-down, bottom-up, market-based or cooperative/collaborative approach, all of which involve a variety of actors. The four forms of management in MPAs include:

1) Government-based management (top-down approach),
2) Collaborative management (combined top-down and bottom-up approach),
3) Private management (market-based approach), and
4) Community-based management (bottom-up approach).

The top-down approach stems from centralized, government controlled management. The MPA is often designated under state or federal laws, regulations and other legal mechanisms that aim to protect biodiversity and natural resources from unsustainable use (Jones et al. 2011). On the other side, bottom-up approaches form when MPAs are largely governed by local stakeholder groups and decentralized decision-making processes (Jones et al. 2011). This approach focuses on the use of traditional knowledge

and cultural uses of natural resources that promote sustainable use and the conservation of biodiversity (Jones et al. 2011). Market-based or private approaches to MPA management focus on economic incentives and initiatives that support alternative livelihoods; this often involves property rights and the attachment of economic values on natural resources and biodiversity (Jones et al. 2011). The collaborative/cooperative approach to MPA governance combines top-down, bottom-up and market-based incentives. This approach looks to promote partnerships between local and government stakeholders while including economic incentives (Christie and White 2007; Jones et al. 2011).

## Conservation in Mexico

Federal conservation of natural areas in Mexico started over a century ago, when the first national parks were designated in the early 1900s. El Bosque Nacional Mineral del Chico was established in the state of Hildago while El Desierto de los Leones was designated in a forested area near Mexico City (García-Frapolli et al. 2009). Extensive protection and conservation of natural resources didn't become a priority for the Mexican federal government until 1934, when the Cárdenas administration came into power (García-Frapolli et al. 2009). Cárdenas saw the conservation of natural resources as a complimentary goal to development, which drove the implementation of 40 national parks in a six-year span (García-Frapolli et al. 2009). Since then, the Mexican federal government has protected nearly 10% of Mexico's territory (CONANP 2009 as cited by García-Frapolli et al. 2009). At the end of 2006, Mexico recognized the decrees of around 158 federally protected areas. Approximately 23% of these areas protect marine or coastal ecosystems (Rodríguez-Martínez 2008). There are 10 areas that represent the protection of coral reefs, seven of which have defined management plans (Rodríguez-Martínez 2008).

The majority of the protected areas in Mexico were designated under six different federal regimes (Gómez-Pompa and Kaus 1999). Despite the extensive official protection statues of natural areas, the majority of these parks were considered to be valid on paper only, otherwise known as 'paper parks' (Gómez-Pompa and Kaus 1999). Paper parks are areas that may hold official status, but lack proper enforcement, regulation and preservation; this is often attributed to the lack of resolve on part of governments and their inability to secure effective biodiversity conservation (Jentoft et al. 2007; Jameson et al. 2002). If all of the declared protected areas were recognized as more than paper parks, over 50% of the country's territory would be covered (Gómez-Pompa and Kaus 1999). In addition, only a small portion of the land protected by the Mexican government was federally owned; approximately 95% of the land in protected areas was privately owned or cooperatively managed though *ejidos* (García-Frapolli et al. 2009). Natural protected areas have since evolved to be more broadly seen as generators of regional development, thought of as opportunities to create alternative, sustainable economic activities (INE 2000 as cited by García-Frapolli et al. 2009).

Globally, there are approximately 564 UNESCO Biosphere Reserves of which 37 are located in Mexico (Brenner and Job 2011). 50% of protected areas in Mexico are managed as biosphere reserves, which cover an estimated 6.1% - 6.44% of Mexico's

terrestrial and marine territories (Brenner and Job 2011; Pino-Del-Carpio et al. 2011). The use of UNESCO's "Man and Biosphere" program (MAB) to develop and implement biosphere reserves was so extensively used that it was informally referred to as the "Mexican model" of biodiversity conservation (Pujada and Castillo 2007, as cited by García-Frapolli et al. 2009). UNESCO's MAB program focuses on zoning within the protected areas and promotes the participation of local communities in the decision-making process (Brenner and Job 2011). The zones used within a reserve consist of 'core', 'buffer' and 'development' areas. The MAB program also promotes the distribution and sharing of economic benefits with local communities (Brenner and Job 2011). The total investment of funds in protected areas in Mexico is difficult to quantify; however, it is estimated that on average, US $469,000 are used to finance each protected area (Bezaury-Creel 2005). Three quarters of these funds come from national sources, while the rest is sourced from foreign investments (Bezaury-Creel 2005). These foreign investments often come from large, well-funded NGOs like the World Wildlife Fund (WWF) and The Nature Conservancy (TNC).

## Governance of Natural Protected Areas & MPAs in Mexico

The current biodiversity conservation strategy for protected areas in Mexico was adopted in the 1990s when the institutions devoted to conservation policy design were created (García-Frapolli et al. 2009). The main instruments for conserving biodiversity are federal policy and legal frameworks (García-Frapolli et al. 2009). MPAs are considered to be natural protected areas in Mexico, and as a result, fall under the jurisdiction of current policy. Protected areas have historically been created and managed with a centralized rationale in Mexico, which has created considerable conflicts with local communities and other stakeholder groups. These conflicts arise between stakeholder groups internationally, and are primarily caused by the assumption that government institutions are monolithic entities at all levels (federal, state, municipal), with similar mandates and goals (Mathews 2005 as cited by García-Frapolli et al. 2009), and the exclusion of local perspectives in the processes of decision-making, implementation and enforcement (García-Frapolli et al. 2009). Government institutions that operate at a federal level are often considerably different from those that operate at state or regional level, even if they are from the same branch of government (Berkes 2004 as cited by García-Frapolli et al. 2009). Considerable separation occurs between the officials who design policies and regulations and those that implement and enforce them; this often causes difficulties in ensuring the effectiveness of legal frameworks (García-Frapolli et al. 2009). The most common difficulties that surround conservation in Mexico stem from:

1) Uncoordinated public policies,
2) Conflict between environmental authorities and local communities over the management of natural resources, and
3) The exclusion of local stakeholder perspectives, values and cultural beliefs surrounding conservation, policy development and implementation.

The National Institution of Ecology (INE) and the National Commission for Knowledge and Use of Biodiversity (CONABIO) were the federal government's first attempts to institutionalize the rational planning of public environmental management

(García-Frapolli et al. 2009). The objectives of these institutions were to generate and provide information to decision makers surrounding natural protected areas, resource use and the environment. These sectors gave rise to the Ministry of Environment and Natural Resources (SEMARNAT), which in turn created the National Commission of Natural Protected Areas (CONANP) in 2000. CONANP was an attempt by the federal government to decentralize the management of the environment. Federal and state level branches of CONANP operate across Mexico.

The majority of MPAs in Mexico are managed in part by CONANP, but there is no systematic approach to marine and coastal management or policy in Mexico (Bezaury-Creel 2005). Eight out of a total of nineteen cabinet functions at the federal level have direct involvement in coastal and marine management issues, while the remaining eleven have hold some form of indirect function (Bezaury-Creel 2005). SEMARNAT has jurisdiction over several areas, including forestry, wildlife, endangered species, water, pollution and the 20-meter Federal Maritime-Terrestrial zone. The Secretariat for Agriculture, Livestock, Fisheries and Nourishment (SAGARPA) has responsibility for fisheries management (notably stocks), while the Secretariat of Communications and Transportation (SCT) has control of ports and vessel navigation within Mexican waters. The Navy Secretariat's main responsibility is to aid in the assertion of Mexico's sovereign rights, which includes the control of maritime pollution, fishing restrictions and navigation corridors. The Secretariat of Tourism (SECTUR) is responsible for the promotion of tourism and for the regulation of tourism-related activities (Bezaury-Creel 2005).

The legislative framework that revolves around coastal and marine management in Mexico is composed largely of International Conventions and Agreements signed by the federal government, as well as by a framework of Mexican laws, regulations, decrees, secretarial agreements and official Mexican standards (Bezaury-Creel 2005). The Mexican government has signed and ratified all of the major international legal instruments relevant to costal and marine biodiversity (Bezaury-Creel 2005). The federal government has signed the UN's Convention on the Law of the Seas (UNCLOS), the Convention on Biological Diversity (CBD), the London Convention, the Convention on the International Trade of Endangered Species (CITES) and many others (Bezaury-Creel 2005). Overall, highly fragmented legal and political frameworks govern the management of MPAs and other natural protected areas in Mexico.

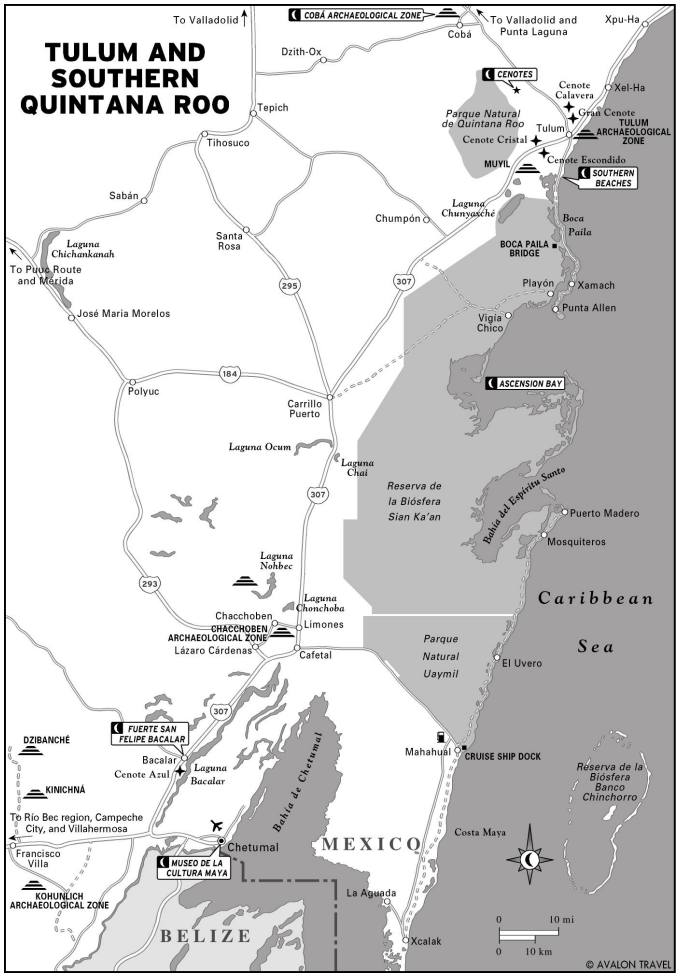


**Figure 1** Map of Southern Quintana Roo, outlining the Sian Ka'an Biosphere Reserve. Imaged sourced from: Moon Travel Guides, (2013). [http://www.moon.com/destinations/cancun-the-yucatan/cancun-cozumel-and-the-riviera-maya/tulum-and-southern-quintana-roo/sian-ka-biosphere-reserve]

# Sian Ka'an Biosphere Reserve (Objectives, Rationale, History, Description)

Located on the eastern side of the Yucatan Peninsula in the Mexican state of Quintana Roo (Figure 1), the Sian Ka'an Biosphere Reserve protects an extensive swath of marine, coastal and terrestrial environments (UNEP-WCMC 2011). Originally established in 1982 by the federal government, it was re-designated as a biosphere reserve in 1986 (UNEP-WCMC 2011). A year later, the SKBR was nominated and accepted as a World Heritage Site by UNESCO. It is listed as a UNESCO world heritage site under Natural Criteria vii and x (Appendix B). In 2002, the reserve was identified as a Wetland of International Importance under the Ramsar Convention and is considered a national park under the IUCN's Management Categories (Appendix C) (UNEP-WCMC 2011).

The reserve's boundaries encompass 408,00 ha of terrestrial habitats and over 120,000 ha of marine and coastal areas, totaling 528,148 ha. Since its designation in 1986, it has grown to include the Uaymil Flora and Fauna Protection area to the South, further encompassing approximately 89,118 ha of critical habitats (UNEP-WCMC 2011). As is traditional within biosphere reserves designed under the MAB program, the SKBR is composed of multiple zoned areas, including one core marine area and two core terrestrial zones (Figure 2)(UNEP-WCMC 2011). These core areas are often off limits to extractive activities, while the buffer zones only allow local communities to live within and use the reserve's natural resources (Mazzotti et al. 2005).

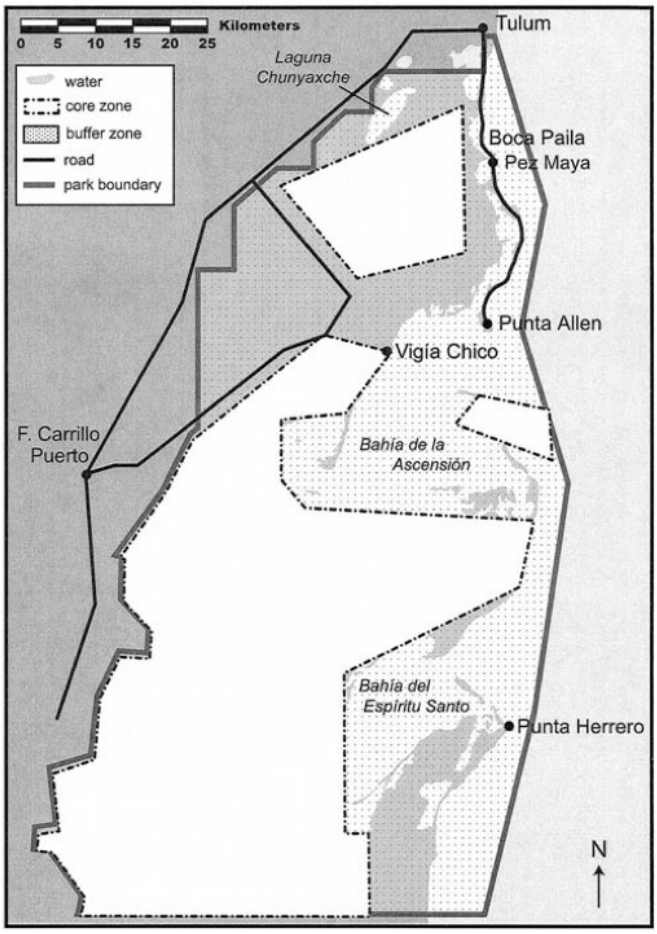


**Figure 2** Boundaries of the SKBR, including core and buffer zones. Image sourced from Mazzotti et al. (2005). The location of Punta Allen and Punta Herroro are also demarcated.

The Yucatan Peninsula is known worldwide for its unique hydrological and geological formations, which are characteristic of the karst landscape it encompasses (UNEP-WCMC 2011). The SKBR is situated on a partially submerged coastal plain formed of limestone; *cenotes* (sinkholes) are a common characteristic of the reserve (UNEP-WCMC 2011). This unique landscape causes the water table to lie no deeper than eight meters, thus ensuring that a fifth of the terrestrial marshes stay flooded during the peak of the dry season and during the wet season, increasing to nearly 70% during the wet season (UNEP-WCMC 2011). Salt, brackish and freshwater marshlands extend up to 40 km inland, particularly along the extensive shallow bays of Ascension and Espiritu Santo. In total, over 120 km of coastal habitats are protected by the reserve, including: sandy beaches, creeks, *cenote* outflows, mangrove stands, coastal dunes and sea grass beds (UNEP-WCMC 2011). The SKBR boundaries extend out into the ocean to a depth of about 50 m, including a 110 km stretch of the 1,200 km long Mesoamerican reef. This effectively covers 15,000 ha of the reef, which is the second largest barrier reef in the world, and acts as a buffer for the coastline during large climate events such as hurricanes and tropical storms (UNEP-WCMC 2011).

The climate within the SKBR is fairly consistent, with marked wet and dry seasons. The temperatures tend to stay between 20˚C and 35˚C, although they have been recorded to drop as low as 5˚C and rise to over 40˚C (UNEP-WCMC 2011). The area sees considerable rainfall each year, with an annual average of 1,300 mm. The majority of this rainfall occurs between May and October. During this timeframe, large climate events such as hurricanes and large tropical storms are known to occur; hurricanes in 1995 2005 2007 and 2011 caused considerable damage to the coral reef, coastal habitats and the forests further inland. They also did considerable damage to buildings and homes within the reserve. Increasing global temperatures and more frequent occurrences of strong storm events pose a considerable threat to the SKBR's ecosystems and human inhabitants.

Mexico is considered to be one of the most biologically rich countries in the world (Gómez-Pompa and Kaus 1999). The SKBR is home to an abundant diversity of flora and fauna, including many endangered and endemic species. The vegetation ranges from semi-evergreen forests to palm savannas, dunes, mangroves and both fresh and saltwater marshes. An estimated 14% of flora species within the reserve are considered to be endemic (Kramer and Kramer 2002; UNEP-WCMC 2011). The fauna found within the reserve is equally diverse; it is home to an incredible variety of vertebrate and invertebrate species. Around 339 species of birds have been sighted 219 of which have been known to breed within the reserve's boundaries (CONANP 2005 as cited by UNEP-WCMC 2011). Many of these species are water birds, which form the second largest population of wading or waterfowl in Mexico (Kramer and Kramer 2002). Over 100 species of mammals have been recorded within the reserve's boundaries. The reserve provides critical habitat for a variety of endangered species, including the Central American tapir (*Tapirus bairdii*), the black-handed spider monkey (*Ateles geoffroyi*), and the Yucatan howler monkey (*Aloutta pigra*) (UNEP-WCMC 2011). It is also home to one of the largest populations of large wildcats, including the jaguar (*Panthera onca*), puma (*puma concolor*) and ocelot (*leopardus pardalis*) (UNEP-WCMC 2011).

The reserve protects a large swath of marine and coastal habitats. Four species of marine turtle are known to live in the reserve; the vulnerable loggerhead turtle (*Caretta caretta*), endangered green turtle (*Chelonia mydas*) and the critically endangered hawksbill (*Eretmochelys imbricata*) and leatherback turtles (*Dermochelys coriacea*) nest on the white sandy beaches annually (UNEP-WCMC 2011). The extensive shallow bays and sea grass beds provide refuge for many juvenile shark species and the endangered manatee (*Trichechus manatus*). The coral reef contains around 63% of the species of coral found within the Caribbean (CONANP 2005), and over 400 species of benthic, pelagic and estuarine fish. The fragmentation and isolation caused by the cenotes has led to a high number of endemic species, some of which exist only within one or two of these sinkholes. The reef is also home to rare, endemic species, like the splendid toadfish (*Sanopus splendidus*). Over 100 species of mollusks have been recorded, while the reef supports 24 species of sponges, 171 species of algae and an extensive number of echinoderms (CONANP 2005).

The SKBR lies 50 km north of Chetumal and 130 km south of Cancun, with development, tourism and rising population encroaching from both directions (UNEP-

WCMC 2011). Unlike tenure in other reserves in Mexico, the federal government is the predominant landowner in the SKBR. In fact only 1% of the land within the reserve is privately owned (UNEP-WCMC 2011; other citation).

The reserve is home to several communities of largely indigenous peoples, especially within the villages of Punta Allen and Punta Herrero (UNESCO 2013; MRAG 2012;Walker et al. 2006). Both of these fishing villages were established and active prior to the designation of the reserve. Punta Allen was formed in 1968 when a group of 49 fishermen formed a lobster cooperative (Solares-Leal & Alvarez-Gil 2003). The population has since grown to encompass about 1000 people (Walker et al. 2006).

The SKBR has a rich cultural heritage, with evidence suggesting that the Mayans occupied the area as long as 2,300 years ago (UNEP-WCMC 2011). There are 23 known archeological sites located within the boundaries of the reserve, with several other significant sites located nearby. Most notably, the well preserved Mayan ruins of the Tulum National Park are located only 10 km north of the entrance to the SKBR.

Studies have revealed that the local peoples have traditionally used over 400 species of local flora and fauna for food, medicine, clothing and building materials (UNEP-WCMC 2011). The Caribbean spiny lobster (*Panulirus argus*) fishery is the main economic activity within the SKBR (Ley-Cooper at al. 2013), followed closely by an increasing tourism industry. The spiny lobster is the most valuable resource fished within the Mexican section of the Caribbean, however increased fishing pressure has reduced its abundance and catches have decreased as a result (Ehrhardt et al. 2010 as cited by Ley-Cooper at al. 2013).

Tourism within the reserve is primarily low-impact ecotourism, and includes bird watching, kayak and canoe tours, snorkeling and fly fishing (ASK 2013; CESiaK 2013). The local communities have a primary role in running the tours and several tourism cooperatives have been formed. The Centro de Ecológico de Sian Ka'an (CESiaK) is an ecotourism and education center that promotes sustainable activities and resource use in the area (UNEP-WCMC 2011; CESiaK 2013).

Amenities and hospitality facilities are limited within the reserve, as is visitor access. Only 15% of the reserve is open to tourists, which is in part the result of poor infrastructure. There are only five terrestrial entrances to the reserve, all of which are guarded. In addition, roads are often unpaved and in poor condition, further restricting movement within the reserve (UNEP-WCMC 2011). The proximity of nearby tourist hotspots such as Tulum and Cancun has had a trickle down effect on the SKBR and tourism continues to increase despite the somewhat unfavorable conditions. On average, the SKBR hosts 36,000 tourists annually.

The SKBR has been subject to considerable research since the early 1980s, largely guided by the Centro de Investigaciones de Quintana Roo (CIQRO). Several privately funded NGOs provide considerable amounts of research, most notably the Amigos de Sian Ka'an (ASK). ASK is largely staffed by local individuals, and receives funding from

the WWF, The Nature Conservancy, the Gillette Foundation and other NGOs (UNEP-WCMC 2011; ASK 2013).

## Overview of Stakeholder Groups active within the Sian Ka'an Biosphere Reserve

The SKBR is one of the largest protected areas in Mexico (Walker et al. 2006). Its listing under UNESCO's World Heritage program and several other international designations, cultural history and size have all attributed to the number of stakeholder groups involved in the SKBR's governance**.** Local communities and cooperatives, international and regional non-governmental-organizations (NGOs), as well as multiple branches of the Mexican government are involved in varying capacities. For the purpose of this report, focus was placed on the local communities, cooperatives and a selected group of NGOs and government organizations. There are two communities that have existed within the reserve since its establishment, formed primarily of the fishermen and their families. These fishermen are part of three fishing cooperatives, outlined in Table 3.

**Table 3.** Summary of local stakeholder groups involved/active within the SKBR, including local communities, organizations and cooperatives.

| Group Title | Status | Involvement in the SKBR |
|---|---|---|
| Punta Allen | Local community (fishers, guides and families) | The community is largely composed of fishers and their families (~470 people), who live within the reserve near the north. |
| Punta Herrero | Local community (fishers and families, some guides) | Small community located within the SKBR, near the southern entrance, composed of fishermen and their families. |
| Community Tours Sian Ka'an (CTSK) | Tourism Cooperative | Composed of several local cooperatives formed by the local Mayan community. Operates ecotourism opportunities within the SKBR, as well as marketing local products and running programs with local peoples. |
| Visit Sian Ka'an (VST) | Tourism Company | Operates tours within the reserve, employing local guides when possible. Based in Punta Allen. |
| Sociedad Cooperativa Pescadores de Vigía Chico | Fishing Cooperative | One of the three cooperatives that fishes lobsters within the reserve; fishers often run fishing and snorkeling tours during the off season. Based out of Punta Allen (~80 members). |
| Sociedad Cooperativa Cozumel | Fishing Cooperative | One of the cooperatives fishing within the SKBR, (~30 members). |
| Sociedad Cooperativa Jose Maria Azcorra | Fishing Cooperative | One of the cooperatives fishing lobster within the SKBR. Based out of Punta Herrero (~20 members) |

Local, regional, national and international NGOs and social enterprise organizations have been involved in the SKBR through a variety of initiatives. Many of these NGOs have been connected to the reserve since its establishment. Many of them work with local communities and the government to ensure the conservation objectives of

the reserve are met. Table 4 outlines some of the major NGOs, their contribution to the reserve and the connections they host between other stakeholder groups.

**Table 4.** Overview of non-governmental organizations (NGOs) that are involved in the SKBR. This is not an exhaustive list of the NGOs involved in the reserve, highlighting instead the organizations with the most direct involvement or indirect involvement through funding and partnerships.

| Organization | Status/Description | Involvement in the SKBR | Stakeholder Connections |
|---|---|---|---|
| Amigos de Sian Ka'an (ASK) | NGO operating on a local & regional level | Began operations when the SKBR was first designated; runs education and training programs, engages in research and helps form public policy. Comprised of local, national and international members. | Local communities, local tourism and fishing cooperatives, COBI, WWF, TNC, the Gillette CO., CONANP, SEMARNAT, GVI, SKBR and more. |
| Centro Ecológico Sian Ka'an (CESiaK) | NGO working primarily in local area, but has extended workshops to greater Caribbean | Formed through collaboration between tourism coops; works to run an education and environment center that develops programs and trains guides. Comprised of local and international members. | Local communities, tourism cooperatives, SKBR |
| Comunidad Y Biodiversidad Asociacíon Civil (COBI) | NGO that works nationally, with programs in many MPAs | Works with fishing cooperatives to designate no take zones, identify spawning/aggregations of economically important fish, and work to train fishermen in research techniques. | Local community, local fishing cooperatives, ASK, SKBR, CONANP, SEMARNAT, CONAPESCA, INE, INAPESCA, RARE, WWF, IUCN, UNEP, and more. |
| World Wildlife Fund (WWF) | International NGO; funds projects on national, regional and local levels | Primarily involved in the SKBR through funding programs and research initiatives run by ASK. | COBI, ASK, TNC, CONANP, SEMARNAT, SKBR |
| The Nature Conservancy (TNC) | International NGO; funds projects on national, regional and local levels | Primarily involved through funding and partnering with WWF, ASK and local cooperatives/communities. | SKBR, ASK, WWF |
| Global Vision International (GVI) | Social Enterprise that runs conservation, research and education programs worldwide | Partnered with ASK; volunteers provide survey information on coral health and fish populations within the reserve. The staff and volunteers are also involved in English and environmental education within Punta Allen. A recent initiative has revolved around introducing recycling and waste diversion within Punta Allen. | ASK, Punta Allen |
| RARE Conservation | International NGO; funds, organizes and implements programs worldwide | Involved primarily through funding and tourism training programs for local communities within the reserve. | Partners with ASK, COBI, SKBR, CONANP, local cooperatives, and WWF, CTSK. |

The Mexican government has an extensive number of Commissions, Institutions and other bodies that are involved in the design, implementation and enforcement of factors that effect the SKBR's governance and management. Table 5 outlines some of the major government bodies responsible for legislation that affects the reserve; it is important to note that this is not a comprehensive list of the government bodies involved. Instead, it focuses on identifying some of the key players.

**Table 5.** Summary of key government stakeholder groups who have some form of jurisdiction over MPA management or activities that occur within the SKBR. Abbreviations of the institutions have been highlighted and will be used in the remainder of the text.

| Name | Status | Description |
|---|---|---|
| Commission on Natural Protected Areas Quintana Roo (**CONANP Q.R**.) | State | State office for CONANP, responsible for management of protected areas in the state of Quintana Roo. The management of SKBR is part of this office (MRAG 2012). |
| Department of Tourism (**SECTUR**) | Federal/State | Government body responsible for managing and developing tourism and related regulations; works at a federal and state level (SECTUR 2012). |
| Environmental Protection Attorney (**PROFEPA**) | Federal | Responsible for the legal enforcement of SEMARNAT's regulations; works at a state and federal level (PROFEPA 2013;MRAG 2012). |
| National Commission on Fisheries and Agriculture (**CONAPESCA**) | Federal/State | Participates in the regulation and enforcement of fisheries at a state and federal level; branch of government under SAGARPA (CONAPESCA 2012; MRAG 2012). |
| National Forestry Commission (**CONAFOR**) | Federal/State | Decentralized branch of government under SEMARNAT, responsible for management and enforcement surrounding Mexico's forests and forestry industry (CONAFOR 2012). |
| National Commission on Protected Areas (**CONANP**) | Federal/State | Decentralized branch of government under SEMARNAT; responsible for establishment, management and enforcement of MPAs and other protected areas (CONANP 2010). |
| National Commission on Research and the Use of Biodiversity (**CONABIO**) | Federal | Government body responsible for promoting, coordinating, supporting and carrying out research and activities related to biodiversity within Mexico; it is often used to bridge gaps between other government organizations such as SEMARNAT and SAGARPA (CONABIO 2013). |
| National Fund for Tourism Development (**FONATUR**) | Federal | Institution responsible for planning, promoting and developing tourism projects that will have a national impact; they promote investment and training within the tourism sector (SECTUR 2013). |
| National Institute of Ecology (**INE**) | Federal | Responsible for generating data and technical information on environmental issues to inform decision making by SEMARNAT (INE 2012). |
| National Institute of Fisheries (**INAPESCA**) | Federal/State | Responsible for fishery research and management recommendations; decentralized branch of government under SAGARPA that works at state and federal levels (INAPESCA 2010). |
| Secretariat of Agriculture and Fisheries (**SAGARPA**) | Federal | Federal branch of government in charge of fisheries and agriculture; the official mandate is to support development of agriculture, livestock and coastal areas (fish stocks, fishing regulation) (SAGARPA 2012). |
| Secretariat of the Environment and Natural Resources (**SEMARNAT**) | Federal | Federal branch of government with jurisdiction over wildlife, endangered species, water, pollution, etc. They are responsible for promoting restoration, conservation and sustainable development of natural resources (SEMARNAT 2012). |

## Management and Objectives of the Sian Ka'an Biosphere Reserve

Pomeroy et al. (2005) identify the SKBR as conventionally managed through a top-down governance approach. Similar to other federally designated protected areas, the SKBR is governed by CONANP, under SEMARNAT. The SKBR management team is composed of a director and 21 additional staff (UNEP-WCMC 2011). A management

plan specific to the reserve was originally created in 1993 and then updated in 1995 (UNEP-WCMC 2011). Within this document, ten primary, conservation objectives are listed (SEMARNAT, 1996):

1. To conserve the natural ecosystems of the central coastal region of Quintana Roo, as a representative sample of the Mesoamerican and Caribbean region of the Mexican Republic.
2. To preserve the genetic diversity of the area, particularly endemic species, species at risk of extinction and species with socioeconomic value.
3. To contribute to the maintenance of ecological and hydrological processes that ensures the productivity of fisheries, the conservation of soil and the regulation of climate impacts.
4. To protect and emphasize the aesthetic and cultural values of the area, including archaeological sites and areas of traditional resource use.
5. To offer options for sustainable development of tropical forests, flood zones and coastal areas by means of integral, multiple and sustained use of natural resources to local populations.
6. To provide training facilities for local people and to promote alternative sources of income for residents within SKBR programs.
7. To promote ecological, socioeconomic and resource management research.
8. To have areas that can serve as a reference, so assessments/evaluations of human changes to the ecosystems of Yucatan Peninsula can be made.
9. Provide regulated opportunities for tourism and nature-based recreation.
10. To promote and facilitate interpretation and environmental education, with emphasis on local and regional levels.

Funding for the SKBR comes from a variety of actors, including the federal government, local NGOs such as ASK, and international donors like the WWF, TNC, the Gillette Company, and the UN Fund. An estimated US $750,000 was granted towards the reserve, for the purpose of increased protection (UNEP-WCMC 2011). Other external organizations donate funds towards research projects and restorations programs (SEMARNAT 1995, as cited by UNEP-WCMC 2011).

The Sian Ka'an Biosphere Reserve has a management plan that is the result of a review completed in 1996. The purpose of this plan is to act as a tool for the integration, follow-up and evaluation of the protection and sustainable use of natural resource strategies. It is comprised of physical, sociocultural and natural resource characteristic descriptions and the major objectives of the reserve. It also outlines the SKBR's strategies for short term, medium term and long-term goals that revolve around the reserves objectives. The management plan is divided into five categories each containing sub-components with specified objectives and implementation strategies. It includes a section describing the basic legal framework and established regulations and zoning limits inside the reserve, but it is not considered a legal instrument or incentive, as it has not been officially published in the Official Diary of the Federation. When the management plan was originally created, the SKBR management team was not aware of the need for official publication and mandates, so it was simply published as a public

policy to help guide the reserve's management. Nevertheless, local resource users do recognize, respect and observe many of the regulations outlined within the management plan (Pomeroy et al. 2004).

## Incentive use within the Sian Ka'an Biosphere Reserve

The in-depth document analysis and personal communications with three of the NGOs working within the SKBR revealed that there are a variety of on going initiatives. The focus of the analysis was placed on identifying key incentives in the five categories outlined in the introduction: legal, economic, knowledge-based, participative and interpretative incentives. This section of the paper will overview and identify initiatives and incentives within each of the categories.

### Economic Incentives

Numerous incentives have been undertaken within the SKBR to promote sustainable economic development. Many of these initiatives have proven to be so successful that they are used as models for sustainable development in other regions of the Caribbean (CESiaK 2013). The majority of these incentives revolve around the economically important fisheries and tourism industries supported by the reserve's ecosystems (Mazzotti et all 2005; ASK 2013). The following table (Table 6) outlines the major incentives and examples of their implementation.

**Table 6.** Brief summaries of the economic incentives ongoing within the SKBR. Each of the incentives has been given an 'effectiveness' ranking, following the system outlined in the methods (see Table 2).

| Incentive | Implementation | Effectiveness |
|---|---|---|
| **Promotion of sustainable resource extraction** | • Annual closed seasons on all economically important marine species, including the spiny lobster, exist within the reserve.<br>• Subsidies are only provided for sustainable practices within the reserve; they support enforcement, fuel purchases and repairs.<br>• Equipment restrictions within the reserve limit harvesting practices; these restrictions are specific to the SKBR. | **3** |
| **Promotion of sustainable products** | • Creation and use of 'Chakay' eco-label for local goods, including lobster, jams, baskets and weavings.<br>• Marine Stewardship Council (MSC) certification of the spiny lobster fishery. | **2.5** |
| **Promotion of alternative economic opportunities** | • Development of tourism cooperatives, which undergo training by local NGOs to increase sustainable, low impact economic opportunities. | **3** |
| **Assignment of property rights/ promotion of ownership to local stakeholders** | • Use of *ejidos* in outlying, forested areas of the reserve help promote sustainable use.<br>• Use of *casitas* by local fishermen within the *campos*. These artificial shelters are owned by individuals and self-regulated; fishing from someone else's *casita* is considered a major transgression worthy of expulsion from the cooperative. | **3.5** |
| **Existence of mechanisms to direct economic benefits to local communities** | • Tourism cooperatives were formed to ensure economic benefits from tours and other recreational activities within the reserve were funneled back into the local community; these cooperatives receive priority for permits and licenses if they have completed training programs with local NGOs. | **3** |
| **Funding for governance support and sustainable initiatives** | • Annual federal budget sets aside approximately 617 million pesos to manage MPAs.<br>• Considerable funding from NGOs such as WWF and TNC, and international donors such as the UN Fund and the Gillette Company. | **3** |

*Promotion of sustainable resource extraction.*

Within the Sian Ka'an reserve, spin fisheries, sport fishing and the annual lobster harvest provide fishermen and their families with secure incomes. The lobster catch from the SKBR and nearby Banco Chinchorro makes up over 50% of the total annual catch in Quintana Roo (Ley-Cooper 2011; Mazzotti et al 2005; Brenner and Job 2011). The total landings of spiny lobster have remained relatively stable over the past two decades, in large part due to the sustainable and self-regulated harvesting systems of the local fishing

cooperatives (Ley-Cooper et al. 2013). While the primary fishery within the reserve is lobster, fishermen do fish for snapper, grouper and other large pelagic fish during the closed lobster season (Solares-Leal & Alvarez-Gil 2003). Each of these economically important species has a regulated closed season to help manage the fish stocks. The lobster fishery is closed from March to July each year (Ley-Cooper 2011).

The equipment and methods used to harvest the lobsters from casitas are restricted, both by federal and self-imposed regulations enforced by the fishing cooperatives (Ley-Cooper at al. 2013). Small boats, GPS devices and hand nets or snares are used to harvest the lobster. SCUBA equipment and large fishing nets are banned within the reserve, as are lobster hooks. The fishermen rely on skin-diving to retrieve the lobsters from their *campos* (Ley-Cooper at al. 2013). The ban on SCUBA equipment was an internal decision made by the fishermen, as was the decision to forbid lobster traps, hookah-diving, lobster hooks and fishing within someone else's *casitas/campos* (Ley-Cooper at al. 2013). To promote the fishermen's continued use of sustainable harvesting practices, the government provides small subsidies that often go towards fuel, boat repairs and self-enforcement support (MRAG 2012). These subsidies are usually channeled through the cooperatives; the government works to avoid subsidizing unsustainable practices.

*Promotion of sustainable products.*

To promote the sustainably caught lobster, local government officials and NGOs worked to implement an eco label. "Chakay" was implemented as a management tool to encourage the continued use of sustainable fishing practices within the reserve, and promote locally sourced, sustainable products. The label also covers locally made jams, weavings and carvings (Ley-Cooper 2011; CESiaK 2013). This particular incentive is aimed at directing and strengthening sustainability policies and management arrangements to enforce good practices and increase the economic benefits to the local communities (Ley-Cooper 2011). The incentive is aimed at promoting sustainable 'eco-friendly' goods to the tourist industry. It also seeks to encourage the fishermen to continue collaboration with government stakeholders and local NGOs to sustainably extract resources (Ley-Cooper 2011). It is important to note that the fishing cooperatives within the SKBR have developed a well-established reputation for their harvesting techniques, sustainable management and self-regulation. The eco label itself was not responsible for establishing the sustainable management of the fisheries lobster by the fishing cooperatives, but has proven to be a useful economic incentive to continue building a resilient fishery.

The three main cooperatives operating with the SKBR (see Table 3), and several other fishing cooperatives operating inside Banco Chinchorro underwent an extensive fisheries review by MRAG Americas (2012), for the purpose of gaining a Marine Stewardship Council (MSC) certification. The assessment identified the lobster fishery

as well managed and sustainable and ultimately recommended that the cooperatives receive the certification. The assessment began in 2009 and finished at the end of 2012.

*Promotion of alternative economic opportunities.*

Middle-class to luxury tourism has become a significant source of income for local populations and has even begun to outpace the benefits achieved from traditional fishing and lobster harvesting (Solares-Leal & Alvarez-Gil 2003). This tourism is largely community-directed, with well-established tourism cooperatives managing the tourism activities within the reserve. These cooperatives have worked with local NGOs, particularly the Amigos de Sian Ka'an (ASK), to develop sustainable ecotourism as an alternative source of income or to supplement the income derived from the lobster harvest. Another NGO, CESiaK, was formed by the four main tourism cooperatives in the areas, and acts as a training and education center that promotes sustainable ecotourism (CESiaK 2013). Tourism provides alternative economic opportunities for the fishermen, as well as for the women in the community. Surveys, focus groups and informal observations conducted for a guidebook by Pomeroy et al. (2004) show that women within the community of Punta Allen have begun to bring in income on par with that of the fishermen through tourism, property ownership and the production of local, sustainable goods.

*Assignment of property rights and promotion of ownership to local stakeholders.*

Within the reserve, the fishery is based on a 'casita/campo' system, where large artificial shelters are installed on the seafloor. These shelters offer a refuge for a wide variety of lobsters form all stages of their life cycle (Ley-Cooper at al. 2013). An organizational scheme is used to manage the casitas within the reserve through the allotment of *campos,* or sections of seabed, to each fisherman within the active fishing cooperatives (Ley-Cooper at al. 2013). The fisherman does not own this parcel of the seabed, merely the casitas within it (Ley-Cooper at al. 2013). The semi-ownership of the *campos* system has promoted effective self-regulation and management for these fisheries (Ley-Cooper at al. 2013). Similarly, ejidos are used within the terrestrial portion of the reserve. These operate in a similar manner to the fishing *campos*, where families are given the right to farm on small tracts of land by the government (Mazzotti et al. 2005).

*Existence of mechanisms to direct economic benefits to local communities.*

The tourism cooperatives formed by local community members were established to consolidate tourism services within the reserve and to ensure that benefits from the tours stayed in the community. These cooperatives and their guides often receive priority for permits and licensing if they have completed training programs with local NGOs. Punta Allen, which is the larger of the two communities established within the reserve, lies within one of the buffer zones. This is significant, as the legislation controlling

development within the reserve, Ley General de Equilibrio Ecológico y Protección al Ambiente (LGEEPA, 1996 as cited by Solares-Leal & Alvarez-Gil 2003), decrees "productive activities within these areas will only be developed by local communities that were established at the moment of the issuing decree…" Under this decree the tourism activities that occur within the reserve must be developed and run by the local community, although there are several partnerships with external tourism organizations (Solares-Leal & Alvarez-Gil 2003). These partnerships often involve the tourism cooperatives paying a fee to tourism offices outside of the reserve that organize trips into the reserve for their guests. However, the majority of the funds earned from tourism go directly into the communities of the SKBR.

*Funding for governance support and sustainable initiatives.*

Local communities, NGOs, fishing cooperatives, tourism cooperatives and other grass roots organizations receive fairly significant funding to provide alternative lifestyles and to promote sustainable activities within the reserve. This funding comes from government sources (national and regional) as well as from national and international NGOs (Brenner and Job 2011), such as the WWF, the Nature Conservancy (TNC) and the UN Fund.

Finding exact sums of funding provided to the SKBR is difficult; there are only a few estimations made, and even then, they account primarily for the donations and funding made by NGOs and private companies. The federal government has set aside approximately 617 million pesos to manage their MPAs (Rodríguez-Martínez 2008). Some sources have identified that the SKBR receives preferential budgeting due to its World Heritage status (Brenner & Job 2011).

## Legal Incentives

There are four legal incentives in use within the SKBR. A description of these incentives and how they are implemented is outlined in Table 7.

**Table 7.** Summary of legal incentives in use within the SKBR. Each incentive has been designated an effectiveness ranking, following the ranking scheme outline din the methods (Table 2).

| Incentive | Implementation | Ranking |
|---|---|---|
| **Official legal obligations at the international, regional, national and local level** | • The Mexican federal government has signed every international agreement pertaining to MPAs, including: UNCLOS, CITES, and the CBD.<br>• The SKBR is a designated UNESCO World Heritage site and must abide by the obligations it incurs.<br>• The SKBR is designated as a Wetland of Importance under the Ramsar Convention.<br>• 8 of 19 federal cabinets have direct legal jurisdiction within the SKBR; the remainder have indirect jurisdictions. | **2** |
| **Regulations and restriction relating to conservation** | • Cooperative-enforced regulations exist, primarily focused on the harvesting methods used by fishermen.<br>• National and state level regulations restrict resource extraction, fishing catches, fishing seasons, harvesting techniques, etc.<br>• The Environmental Zoning Plan restricts building and development within the reserve, particularly along the coast. | **2** |
| **Legal system to address transgressions** | • State and federal judicial systems exist to prosecute illegal activities within the Reserve. | **1** |
| **Establishment of transparent management systems** | • Official management manual for the SKBR is available online (in Spanish). | **2** |

*Official legal obligations at the international, national, regional and local level.*

On an international level, the Mexican government has signed all of the major international agreements that surround conservation of biodiversity and marine environments. Many of these agreements were agreed to by the UN Parties, and include the United Nations Convention on the Law of the Sea (UNCLOS), Convention on Biodiversity (CBD) and the Convention on the International Trade in Endangered Species (CITES). The SKBR is also designated as a UNESCO World Heritage site and a Ramsar Wetland of Importance, meaning that the reserve's management must abide and operate under the obligations of these designations (UNEP-WCMC 2011).

There are both internal and external resource management schemes within the SKBR. These include internal regulations that are enforced by the fishing and tourism cooperatives, as well as federal and state regulations (Carr 2008). The spiny lobster fishery within the SKBR is co-managed by federal governmental institutions such as CONANP and CONAPESCA (Ley-Cooper at al. 2013). SEMARNAT imposes regulations on the use of resources, with mandates that there be no palm wood or chit

cutting, no large fishing or gill nets used within the reserve, and absolutely no sea turtle captures, etc. (Carr 2008). The management of fisheries has traditionally been run in a centralized fashion in Mexico, but the recent enactment of the law "Ley General de Pesca y Aguacultura Sustenables", which was put into force in 2007, aims to decentralize the regulation of fisheries and include state and municipal participation in the decision making process (MRAG 2012).

Protected areas like the Sian Ka'an Biosphere Reserve have their own regulations, many of which are derived from the Ecology Law. Most MPAs have regulations that specify fisheries catches, including limitations on bycatch (Bezaury-Creel 2005). This regulation states that bycatch cannot exceed the total allowable catch for the target species, but it is a poorly enforced and somewhat ineffective attempt at increasing the sustainability of fisheries within protected areas (Bezaury-Creel 2005).

*Regulations, restrictions and requirements relating to conservation.*

The SKBR is protected under Mexican federal law, but has regulations and restrictions decreed in a variety of documents at the national and state level. A large variety of actors are involved in the legal framework that surrounds the governance of the SKBR (see Figure 1 for a diagram of the main stakeholders). Government focus tends to be on fishing regulations and other resource use restrictions within the SKBR. The government partners with local cooperatives and NGOs to enforce, fund and foster sustainable practices within the reserve (Brenner and Job 2011). Federal and state fishing restrictions enforce fisheries closures, and to some extent, the forms of extractive activities that can occur within the reserve. The local fishing cooperatives have adopted these mandates and increased them voluntarily, and worked with local NGOs and the management team from the SKBR to adopt restrictions on SCUBA, lobster hook and net use in harvesting lobster. Failure to abide by these cooperative mandated regulations can result in suspension or expulsion from the cooperative (Solares-Leal & Alvarez-Gil 2003; Brenner & Job 2011; Ley-Cooper, K. 2011; MRAG 2012).

State and federal governments published a document titled the Ecological Land Use Management Plan for the Sian Ka'an Biosphere Reserve Coast (POQROO) which originated from an effort on behalf of ASK. In addition, the EZP (Environmental Zoning Plan) makes it illegal to build any kind of development on 28% of the reserve's coast, and the remaining coast (approximately 102 km) is under regulation that restricts the ability of new buildings to be developed. Homes and other developments are not allowed to be built within 100m of the oceanfront, and any larger accommodations (lodges, villas, hotels) are limited to nine rooms (Mazzotti et al 2005).

*Effective legal system to address transgressions.*

State and federal judicial systems are used to prosecute individuals who are caught conducting illegal activities within the reserve. PROFEPA, the environmental attorney, is responsible for prosecuting transgressors, although they can only effectively penalize activities outlined as illegal within the Mexican "Diario Oficial de la Federación" (DOF) (Cudney Bueno et al. 2009). The DOF is the government's official publication of laws and regulations (DOF 2013). Each government body publishes a diary containing updated legislation (DOF 2013). The legal framework is highly fragmented due to overlapping policies and enforcement responsibilities among several

governmental institutions. Almost all of the federal agencies have some form of jurisdiction over some aspect of marine and costal environments in Mexico (Rodríguez-Martínez 2008).

*Establishment of transparent management systems.*

Many of the official, legal documents that outline legislation relating to activities within and the protection of the SKBR are available online in Spanish. Many of these documents are dated, while some are undergoing review. The Management Plan (MP) specifically designed for the SKBR is available online on CONANP's website (accessible from: http://www.conanp.gob.mx). All of these documents are only available in Spanish.

## Knowledge Incentives

Many of the NGOs involved with the SKBR are science based, with research and education as their main program objectives. The SKBR management team also promotes the use of knowledge incentives, which are outlined in Table 8.

**Table 8.** Brief summary of the knowledge incentives in place within the SKBR. Each incentive has been given an effectiveness ranking, following the ranking scheme outlined in Table 2.

| Incentive | Implementation | Ranking |
|---|---|---|
| **Promotion of respect between local and scientific stakeholders** | • Inclusive monitoring systems to study lifecycles of spiny lobster were instated within the SKBR, involving local fishermen, government and NGOs.<br>• Designation of no-take zones was implemented through collaboration with local fishermen, NGOs and scientific stakeholders.<br>• Critical spawning grounds were located and mapped through collaborative efforts between local fishermen and NGOs. | **3.5** |
| **Use of scientific research within MPA decision-making and evaluations** | • Fishing regulations can be altered through collaboration between scientific stakeholders and fishermen.<br>• Coral reef monitoring has been in place since 1992, largely promoted by NGOs. Data from this program is given to government stakeholders to inform decision-making.<br>• Terrestrial and marine monitoring programs exist for fish, coral, birds, reptiles and a variety of other species. Government actors and NGOs lead these initiatives. | **4** |

*Promotion of respect between local and scientific stakeholders.*

A multidisciplinary and inclusive effort to monitor and study spiny lobsters at all stages of life has been implemented and involves governments, NGOs and local fishermen (Ley-Cooper, K. 2011). This includes a mark and recapture system largely driven by members of the cooperatives.

Voluntary designation of no-take zones was done through collaboration between COBI, a science based NGO and the local fishing cooperatives, which helped identify critical habitats for economically important fish species. Research by Walker et al. (2006) identified a few key areas of reef that they encourage the fishermen to mark as no-take

zones, to promote biodiversity and recruitment. Critical spawning grounds for species like snapper and grouper were identified by fishermen and locations provided to a variety of science-base NGOs (Personal Communication, anonymous, November 2012).

*Use of scientific research within MPA decision-making and evaluations.*

Coral reef monitoring has been in place since 1992 and continues today, with the aid of the organization Global Vision International and ASK (Mazzotti et al 2005; Personal Communication, Lluvia Soto, February 2013). The information collected on the health of the reef (focusing on coral health and fish populations) is provided to CONANP to aid in their decision making process (Pers. Comm., Lluvia Soto, February 2013). The extent to which this information is used is not known. CONANP and ASK have initiated (collaboratively and individually) a variety of monitoring programs for species of economic importance, endangered species and for terrestrial and avian species (Mazzotti et al 2005). Regulations surrounding the fishing industry (both spin fishing and lobster harvesting) can be changed through collaboration between fishermen and scientific research (MRAG 2012).

Figure 3 identifies a variety of stakeholders who are involved in information exchange on the SKBR. Most notably, INAPESCA, CONANP, ASK, and the fishing cooperatives all record data, which are then passed on to authorities directly involved in the decision making process.

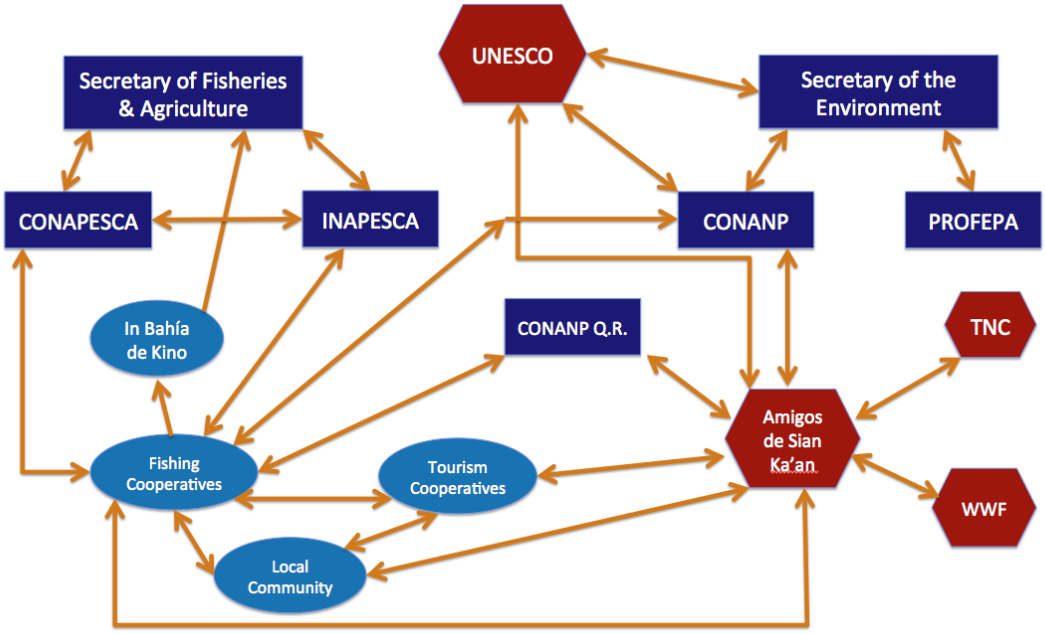


**Figure 3** Simplified flow of information within the management and overall governance among various stakeholders involved in the SKBR. Arrows indicate the direction of movement (to or/and from). Rectangular borders signify a government organization, circles represent local community groups and hexagons represent NGOs & ENGOs. Stakeholder groups shown in this diagram represent those with the greatest influence of role in the SKBR management, not necessarily every group involved in the management of the reserve.

## Participative Incentives

Participative incentives often involve government stakeholders initiating collaborative work between local communities and NGOs. There are a variety of participative incentives in place within the SKBR, outlined in Table 9.

**Table 9.** Brief summary of participative incentives in use within the SKBR. Each incentive has been given an effectiveness ranking, reflecting how well each incentive is being implemented. The ranking scheme is found in Table 2.

| Incentive | Implementation | Ranking |
|---|---|---|
| **Use of participative governance structures and processes** | • An advisory board was created to involve local and non-government actors in the decision-making process.<br>• Quarterly meetings through Consejo de Pesca workshops promote a strong relationship between fishing cooperatives and the federal government. | **2** |
| **Establishment of trust and/or collaboration between stakeholders** | • Interactions between the fishing cooperatives and the federal government are strong. The relationship between the cooperatives, local community and the SKBR is also healthy; these relationships were built through workshops, collaborative programs and other inclusive initiatives.<br>• The MesoAmerican Reef Tourism Initiative (MARTI) is a large, multi-stakeholder project in development.<br>• Kanan Kay Alliance (KKA) is a collaborative think tank that works to promote incentive use and effective management of marine ecosystems. | **4** |
| **Use of participative enforcement and delegation of responsibility to local stakeholders** | • Fishing within the SKBR is largely self-regulated through the fishing cooperatives and the *campos/casitas* system. | **3** |

*Use of participative governance structures and processes.*

An Advisory Board was created to ensure that all non-governmental actors had a participative role in crucial management issues and decision-making, including annual budget approval. While non-government groups may have a superficial say in the annual budget, they are not involved in the budget creation nor in the distribution of funds once the budget has been approved (Brenner and Job 2011). Communications between the fishing cooperative and the federal government are maintained by quarterly workshops through Consejo de Pesca (MRAG 2012). These workshops have gone towards ensuring a strong relationship between the fishers and the federal government.

A survey of 51 locals from Punta Allen showed that 60% of respondents felt the reserve consulted with them about management decisions and strategies, although 35% of respondents felt that the reserve's management failed to consult or simply informed them of decisions made by management (Pomeroy et al 2004). Many of these individuals (upwards of 55% of respondents) felt that they were slightly active to inactive regarding participation with the reserve's management and decision-making processes (Pomeroy et al 2004).

*Establishment of trust and/or relationships between stakeholders.*

ASK, one of the most active locally based NGOs, has been working with local communities and the government since the reserve was established. This has helped build trust with the local communities. Overall, there seems to be a good relationship between the local communities and several NGOs, as well as different levels of the government. The SKBR management team has worked with NGOs to implement education programs, training workshops and other participative measures to ensure that the people of the SKBR had an opportunity to develop alternative lifestyles, understand their environment, and learn about the benefits of MPAs (Solares-Leal & Alvarez-Gil 2003; Pomeroy et al. 2004)

Recently, two large collaborative initiatives have been launched: the MesoAmerican Reef Tourism Initiative (MARTI) and the Kanan Kay Alliance (KKA) (MARTI 2013; KKA 2013). MARTI involves government, private, NGO and local stakeholders in an collaborative effort to ensure the health of the Mesoamerican barrier reed and the benefits it creates are maintained for the future (MARTI 2013). The focus is on controlling and supporting sustainable tourism, and provides a platform for stakeholders to build relationships and work together for the benefit of the environment and community. While the focus of MARTI is broader than just the SKBR, many of the NGOs and cooperatives from the reserve are partners of the initiative.

The Kanan Kay Alliance is a science-based organization (self titled as a "think tank") that works to connect partners of the initiative with one another to share knowledge and skills, while promoting the importance of conserving the marine environment (KKA 2013). The focus is primarily on sustainable fisheries management, which they hope to achieve through six objectives (KKA 2013):

1) Design and implement fish refuges (no-take zones)
2) Build legal and institutional frameworks for the management of these refuges
3) Link economic and social development to fisheries
4) Guide and strengthen the ability of the Alliance to establish and maintain an effective network of people and fish refuges
5) Promote communication and awareness among stakeholders
6) Aid in financing the network and the Alliance's initiatives.

All three of the fishing cooperatives within the SKBR are partners with the initiative, as are MARTI, CONAPESCA, CONANP, COBI, ASK, the SKBR management team, and a variety of internationally based NGOs (KKA 2013). The Alliance's focus is on the region of Quintana Roo.

*Use of participative enforcement and delegation of responsibility to local stakeholders.*

The sense of ownership many of the fishers have over their *campos/casitas* has led to self-regulation and enforcement of fishing regulations (both federal and cooperative initiated). There are mechanisms in place to allow for anonymous communication between the fishers of the cooperatives and the government, so that illegal fishing within the cooperative's *campos* can be dealt with externally if need be (MRAG 2012).

## Interpretative Incentives

Interpretative incentives focus on promoting the benefits of conservation, MPAs and the policies in place to help meet the objectives of the reserve; they often foster environmental education and awareness of the benefits that the MPAs hold. Descriptions of the interpretative incentives in place within the SKBR are outlined in Table 10.

**Table 10.** A brief summary of interpretative incentives used within the SKBR. Each incentive is given an effectiveness ranking, the scheme of which can be found in Table 2.

| Incentive | Implementation | Ranking |
|---|---|---|
| **Promotion of environmental education and awareness** | • Multiple NGOs work with the local communities to promote awareness of the environment through workshops and other events.<br>• The federal government provides limited funding to support education of conservation and the environment within local communities (within and near the SKBR).<br>• Online resources, often provided by NGOs (ASK, CESiaK, COBI, etc.), promote awareness of the reserve, environmental education and sustainable initiatives. | **4** |
| **Promotion of MPA benefits** | • The spiny lobster population is considered to be healthy, with fisheries catches remaining stable; lobster populations and catches have decreased remarkably elsewhere in the Caribbean.<br>• The use of no-take zones and their benefit to fisheries was promoted by COBI and ASK to encourage compliance.<br>• ASK and other NGOs have used the World Heritage designation to push conservation objectives and block potentially damaging projects. | **4** |

*Promotion of environmental education and awareness.*

The federal government provides a limited source of funding each year that goes towards promoting knowledge on conservation and the environment in the local communities and an around the SKBR (Pomeroy et al. 2004). Due to the limited funds, there is heavy reliance on NGOs like ASK to provide training and education programs, as these NGOs usually have access to financing schemes from international donors (Pomeroy et al. 2004). Training for ecotourism tour guides has been in place since 1999 and is offered to all those interested in using tourism within the reserve. Individuals within the local community who voluntarily undertake this course are given special accreditation towards developing their tourism activities (Pomeroy et al 2004). An example of such education programs comes in the form of the recycling and compost initiative promoted by GVI and ASK within Punta Allen (Pers. Comm., Lluvia Soto, February 2013). Many of these programs have promoted alternative incomes, sustainable practices and aided the local community in becoming further involved in the reserve's management (Pomeroy et al 2004).

ASK, COBI, CESiaK and joint efforts with the SKBR management has led to the installment of environmental education within schools in Punta Allen, as well as workshops for adults (Pomeroy et al. 2004; Walker et al. 2006; CESiaK 2013; ASK 2013; Pers.Comm., Lluvia Soto, February 2013).

The Sian Ka'an Biosphere Reserve has a management plan that is the result of a review completed in 1996. The purpose of this plan was to act as a tool for the integration,

follow-up and evaluation of the protection and sustainable use of natural resource strategies. It is comprised of physical, sociocultural and natural resource characteristics descriptions and the major objectives of the reserve. It also outlines the SKBR's strategies for short term, medium term and long-term goals that revolve around the reserves objectives. The management plan is divided into five categories each containing sub-components with specified objectives and implementation strategies. The plan includes a section describing the basic legal framework and established regulations and zoning limits inside the reserve, but it is not considered a legal instrument or incentive, as it has not been officially published in the Official Diary of the Federation. When the management plan was originally created, is was not aware of the need for official publication and mandates, and was simply published as a public policy to help guide the reserve's management. Local resource users do recognize, respect and observe many of the regulations outlined within the management plan (Pomeroy et al. 2004).

*Promotion of MPA benefits.*

Workshops with the fishers were used to outline the benefits associated with MPAs, particularly no-take zones (Pomeroy et al. 2004; Walker et al 2006; MRAG 2012). Many of the education programs provided by local NGOs have touched on the benefits of MPAs, and the importance of conserving the marine habitat.

# Discussion

There are a wide variety of governance incentives in place within the SKBR, and many of these incentives are effective in promoting the reserve's conservation objectives. However, there are several incentives that need to improve, most notably the legal incentives. Overall, the reserve shows moderate to high success in meeting its conservation objectives from a governance perspective. While some of the objectives are not met effectively by current incentive use, there seem to be several participative projects in the works meant to address these gaps, both within the SKBR and the wider Caribbean area.

One of the major indicators that the SKBR is having moderate to high success in meeting its objectives is seen through the health of the reef within the reserve. A study done by Walker et al.(2006) shows that the reef within the SKBR is in good health and is considerably more productive in comparison to reefs in the wider Caribbean region. The spiny lobster harvest has remained stable within the reserve, which is in stark contrast to the fisheries in other areas of the Caribbean, including other coastal zones of the Yucatan Peninsula (MRAG 2012; Ley-Cooper 2011). The success of the SKBR is largely attributed to the efforts of local communities and NGOs, particularly the fishing cooperatives of Punta Allen and Punta Herrero, ASK, CESiaK and COBI. This section will discuss the various incentives used within the SKBR, identify problem areas and provide recommendations for improving the reserve's governance (Table 11).

**Table 11.** Governance incentives that are in use/needed within the SKBR. A description of each incentives' implementation in the SKBR can be seen in Tables 6-10.

| Incentive Category | Incentives in use at the SKBR | Incentives needed to improve governance of the SKBR |
|---|---|---|
| **Economic** | • Promotion of sustainable resource extraction<br>• Promotion of sustainable products<br>• Promotion of alternative economic opportunities.<br>• Assignment or property rights/promotion of ownership to local stakeholders<br>• Existence of mechanisms to direct economic benefits to local communities<br>• Funding for governance support and sustainable initiatives | • Ensuring sufficient state funding is available to support governance |
| **Legal** | • Official legal obligations at the international, national, regional and local level<br>• Regulations and restrictions relating to conservation<br>• Legal systems to address transgressions<br>• Establishment of transparent management systems | • Clarity and consistency of legal objectives, zoning restrictions and the roles and responsibilities of different authorities and organizations<br>• An *effective* legal system for penalizing transgressors in a way that deters illegal activity |
| **Knowledge** | • Promotion of respect between local and scientific stakeholders<br>• Use of scientific research within MPA decision-making and evaluations | |
| **Participative** | • Use of participative governance structures and processes<br>• Establishment of trust between stakeholders<br>• Use of participative enforcement and delegation of responsibility to local stakeholders | |
| **Interpretative** | • Promotion of environmental education and awareness<br>• Promotion of MPA benefits | |

Common difficulties within Mexican national protected areas were identified earlier as being the lack of coordinated public policies, conflicts around natural resource regulation, and the inclusion of local perspectives in governance processes (García-Frapolli et al. 2009). For the SKBR, the lack of coordinated public policies seems to be the biggest problem. On the whole, the federal government of Mexico lacks a clear,

comprehensive legal framework that addresses coastal and marine environments and the activities that take place within these environments (Rodríguez-Martínez 2008). Instead, marine habitats are governed through zoning legislation, fisheries management and a variety of other disconnected pieces of legislation. Within the SKBR, this hinders legal incentives, such as enforcement and effective prosecution of transgressors.

Legislation is divided between five different legal frameworks, including the General Law for Ecological Equilibrium and Environmental Protection (LEEGPA), the General Wildlife Law, the Federal Fisheries Law, the General Sustainable Forestry Development Law, and the Official Mexican Standard (OMS) (Bezaury-Creel 2005). The OMS is responsible for listing endangered and threatened species of flora and fauna (Bezaury-Creel 2005), while LEEGPA governs the use of natural resources, which are in turn regulated by Fisheries Law.

Regulations revolving around ocean pollution are also dispersed among a variety of legal frameworks; in total, there are five frameworks that cover maritime pollution, including: the Federal Oceans Law, the Ecology Law, the National Waters Law, the General Health Law, and the Official Mexican Standards (Bezaury-Creel 2005). In addition to the disjointed legal regulation, environmental law enforcement is in its infancy in Mexico. PREOFEPA, a branch within the SEMARNAT, is responsible for prosecuting individuals who are caught acting illegally within the SKBR. However, PROFEPA will only prosecute offenders if they have broken a law that has been published in the federal government's *Diario Oficial de la Federación* (Cudney-Bueno et al. 2009). In addition, the offenders must be caught engaging in illegal activities by the Navy or members of CONANP. The lack of enforcement capability and capacity is a critically important issue that affects the SKBR and all other natural protected areas in Mexico. It is at the point where investors, developers and people using natural resources feel that it is "better to ask for forgiveness than for a permit" (Bezaury-Creel 2005).

For the most part, the legal incentives within the reserve received low effectiveness rankings (Table 7); however, there are a few legal incentives that are working well within the SKBR, particularly the Environmental Zoning Plan (EZP). This management plan regulates and restricts development of private and public lands within the reserve (Mazzotti et al 2005). As a result, the SKBR is the first Mexican biosphere reserve that has combined regulatory tools with innovative mechanisms (i.e. transfer of development rights and environmental easements) in order to achieve conservation objectives and control development in public and private sectors (Mazzotti et al 2005). The EZP was developed in large part by ASK and adopted by the government of Quintana Roo. It has become an important and effective legal incentive, and identifies how effective zoning of natural areas can benefit conservation. It has helped protect the delicate mangroves, dunes and beaches from the rapid development occurring to the north and south of the reserve.

The economic incentives within the SKBR seem to be the most numerous and are fairly effective. Many of these incentives received moderate to high effectiveness rankings (Table 6). The success of these incentives is largely driven by the activities undertaken by local communities, many of which would occur regardless of the economic incentives. The annual closure of fisheries works fairly well for the lobster fishery within the SKBR and it happens to coincide with the peak tourist season. This

allows fishermen to devote time to running fishing and snorkeling tours through one of the tourism cooperatives. The fishing cooperatives within the SKBR have gone above and beyond federal and state regulations on their fishery, implementing self-regulated restrictions. These efforts have been successful, although there is some indication that illegal catches of female lobsters bearing eggs does occur within the community (Solares-Leal & Alvarez-Gil 2003). For the most part, the fishermen ensure that illegal fishing does not occur within their *campos*. This effectively reduces illegal fishing within the two large, shallow bays of the reserve. However, it is considerably more difficult to enforce the fin fishery because the *campos* system is no longer in effect. The fin fisheries focus on catching large fish like grouper, snapper and tarpon. Fishers can fish outside of their own *campos*, and the self-regulation and enforcement that makes the lobster fishery so successful declines. Unless the Navy (who enforce the restrictions/regulations created by SAGARPA) is able to catch illegal fishing as it happens, it can be difficult to enforce these fisheries restrictions (Solares-Leal & Alvarez-Gil 2003).

The strength of the knowledge, interpretative and participative incentive used in the SKBR comes from their collaborative approach to a variety of issues (Table 8, 9 and 10). The sense of ownership and involvement that the local community has over the resources within the reserve has made initiatives like no-take zones and voluntarily adopted restrictions successful, highlighting the importance of community stakeholder engagement in MPAs. The success of the SKBR and the involvement of local stakeholders, particularly fishermen, has been well recognized not only by the government and NGOs, but by groups working outside of the reserve. CESiaK has been involved with the promotion of sustainable tourism and education programs in other regions of the Caribbean; COBI has enlisted the help of the fishers to help build trust in fishing communities in other regions of the country, and many of the fishing cooperative members have been included in trans-boundary workshops looking to improve the protection of the Mesoamerican Barrier reef.

While the Advisory board meetings are an opportunity for local people to be involved in this process, the government often receives little or no input or strong suggestions. The Advisory Board has not proven to be very effective due to internal fragmentation caused by animosity between groups and the self-interests of 'elite' individuals within communities. This has caused a break down of any productive discussion or attempts at placing pressure on CONANP or other government stakeholders (Brenner and Job 2011). There is potential for this distrust to be mitigated through workshops run by NGOs to encourage cooperation between communities within the Sian Ka'an. As NGOs, they could be quite persuasive in convincing all groups that working together to obtain government changes is in everyone's best interests. While the participation of local communities and public in the regulatory and policy processes can cause short-term slow-downs, it may produce more durable policy in the long term (Bezaury-Creel 2005).

The government has recognized that the effort of local and international NGOs and the work of local communities has had a significant effect on sustaining the SKBR. They have begun to partner with these organizations on a variety of local and regional

initiatives, most notably MARTI and Alianza Kanan Kay. There are strong interactions between the government at a state and federal level and the fishing cooperatives, as well as between the SKBR authorities and the cooperatives (MRAG 2012). The SKBR fisheries, particularly the lobster harvest, have been historically in good standing, with federally instituted regulations as well as local mandates such as restrictions on gear type used within the reserve (Ley-Cooper, K. 2011). The success has been largely attributed to the fishing cooperatives and their '*campos*'.

Results of a fairly extensive survey of fishermen within the cooperatives operating within the SKBR show that the fishermen are aware of and understand the benefits of no-take zones, and in many cases, endorse the protection of spawning aggregation locations and species to promote fish catches in the future (Laris 2012). It is believed that participatory efforts by local NGOs promoted the designation of no-take zones by the fishers, increasing the sense of ownership and willingness to enforce and comply with these restricted areas (Laris 2012).

The SKBR provides an example where the UNESCO World Heritage designation has proven to be beneficial for a variety of stakeholders, particularly in protecting the reserve's delicate ecosystems and being used to push for funding and better legislation. The reserve is given priority when it comes to allocation of funds by CONANP, due to its World Heritage and Ramsar designations (Brenner and Job 2011). On several occasions, the World Heritage status of the reserve has been used to push the conservation objectives and continue the mandates on which the reserve was established. ASK and other NGOs have often successfully used the designation to add strength to their causes, rebuff the push for greater tourism and development within the area and gain international leverage. In addition to being a UNESCO World heritage site, the SKBR is also a Wetland of Importance under the Ramsar convention. Both of these designations help the reserve receive funding, internationally and nationally.

A study funded by the WWF and IUCN that used a survey, semi-structured interviews, focus groups and informal community observations provided information on the local stakeholder perception of threat to the ecosystem from anthropogenic sources. Members of the Punta Allen community identified that they felt impacts from tourism development would be the highest concern; many felt that increased tourism would displace the local community, damage delicate mangroves and beaches, and also increase boat traffic and subsequent oil spills and pollutants (Pomeroy et al. 2004). The people of Punta Allen identified increasing tourism as the largest threat not only to the environment, but to their livelihood; they fear being overtaken by large national and multinational organizations.

There are two experimental integrated coastal management projects, both of which include protected area component, that have been carried out through the development of partnerships established between academic institutions, local NGOs and coastal communities (Bezaury-Creel 2005). Most notably, the University of Rhode Island, through its Coastal Research Center, initiated a partnership with the Xcalak Community Committee, Amigos de Sian Ka'an and the University of Qinutana Roo (Bezaury-Creel 2005).

## What can we learn? Lessons from the SKBR.

There are a variety of lessons that one can take away from the SKBR. Many of these revolve around collaboration and trust between stakeholders, which helps incentives from all categories work effectively to meet conservation objectives.

*Successfully meeting conservation objectives through collaboration.*

The SKBR has demonstrated the importance of effective collaboration between stakeholders. The participatory and knowledge incentives have helped drive the success of economic and legal incentives within the SKBR. Educational and training efforts on the part of the SKBR management and NGOs like ASK and CESiaK have helped to develop a strong relationship between these stakeholders. The local community has recognized that many of these workshops have helped improve their understanding of their environment and the importance of its health, and in many instances it has provided them with opportunities to improve their livelihoods. This has fostered sustainable economic incentives, such as the voluntary designation of no-take-zones (Pomeroy et al. 2004; Walker et al. 2006). It has also helped boost compliance with regulations; the community may have more confidence in what restrictions and regulations are attempting to accomplish if they have a strong knowledge base and trust the stakeholders initiating the restrictions. Engaging local communities may also provide insight on sustainable resource use; in the case of the SKBR, lobster fisheries within the area have been managed in a historically sustainable manner. This has significantly contributed to the economic and environmental success of the fishery and its target species, which is in decline elsewhere within the Caribbean.

It is also important for authorities and different branches of the government, be they federal, state or municipal, to collaborate on the legal framework that encompasses MPAs. This may reduce conflicting objectives (particularly economic and conservation objectives) and create effective management schemes. For example, if SECTUR and SEMARNAT worked cohesively to protect critical habitats and promote sustainable tourism, damage to ecosystems might be mitigated and economic benefits may be established for the long term.

Collaboration can also help secure funding for sustainable initiatives and enforcement. International NGOs invest considerable amounts of time and funding into building integrated approaches to biodiversity management (Heyman and Stronza 2011). These programs often have mixed success, as insufficient local participation, both from a numbers and quality perspective, causes them to suffer (Heyman and Stronza 2011). If the local communities are active and engaged in the process, large funding bodies may be willing to allocate more funds over longer periods of time.

*Building trust between stakeholders to build resilient MPAs.*

Building trust between stakeholders is key to building a resilient MPA. This does not only refer to trust between local communities and cooperatives, NGOs and government stakeholders; it is important for the community to work together as a whole. Distrust between members of the community can lead to ineffective engagement with the government, an occurrence highlighted by the ineffective Advisory Board meetings

within the SKBR (Brenner & Job 2011). If it is understood that everyone within the community holds the same goal (namely of conserving the environment and protecting their livelihoods), people can work together to effectively engage in the participative incentives the government works to establish. This in turn may lead to effective legal incentives. And again, if the local community trusts that the authorities are not attempting to take away livelihoods, make a profit at the expense of the community, and that the MPA will produce benefits, they may be more willing to comply with restrictions. This trust will also help ensure the success of future incentives.

*Supporting community development through effective social mechanisms: the power of cooperatives.*

The SKBR has provided two strong examples of how social mechanisms like cooperatives can bolster community stakeholder engagement. The sustainable use of resources and the maintained health of the SKBR's marine ecosystems has been widely attributed to the success of the fishing and tourism cooperatives. These cooperatives have been able to build successful economic incentives, participate in workshops, public policy meetings, and act as a consolidated voice for the community. The local people who form these cooperatives are clearly invested in the health of their community and the environment they live in and rely on.

The fishing cooperatives are largely attributed with the success of their sustainable lobster fishery, demonstrating fairly successful self-regulation and enforcement. Tourism cooperatives and the NGO established as a result of their efforts, CESiaK, have become a model for environmental education and sustainable economic initiatives outside of the SKBR (CESiaK 2013). Ensuring local communities have the ability to form these kinds of organizations helps make them resilient.

*Keeping it local: ensuring economic benefits stay within local communities and that alternative opportunities reflect cultural heritage.*

Regulations that restrict resource use and habitation within an MPA to the communities established within an area prior to the designation of an MPA and those with cultural connections, may help mitigate environmental damage in a variety of ways. First, it could provide alternative incomes to local people, leading to a reduction in unsustainable or illegal harvesting of natural resources. Secondly, it could prevent large international organizations from capitalizing on a resource they have little to no personal investment in. These organizations may not comply with regulations or actively seek to produce sustainable and non-damaging efforts because they are not as heavily reliant on the natural ecosystem as local people.

**Research Limitations**

This governance assessment of the SKBR was fairly in-depth, but could have encompassed a greater breadth of incentives. Had the scope of the project been larger, and had there been a longer timeline, it would have been pertinent to conduct a wider variety of stakeholder investigations. Specifically, interviews and surveys of local government officials, cooperative members and the local community may have provided greater insight into the success and failure of the incentives used to aid in the governance of the SKBR. This additional information would have greatly aided in the effectiveness

ranking of the incentives, and helped identify problem areas that were over looked within the literature. These interviews may have also helped navigate some of the conflicting information that was available in the literature.

## Conclusion

Overall, the SKBR is doing a good job of meeting its conservation objectives from a governance perspective. It is suggested that a biophysical assessment of the SKBR's marine ecosystems, including the coral reefs, shallow lagoons, mangroves and coastal habitats, be undertaken. This will help provide a better idea of how healthy the reserve's ecosystems are, which, in turn, will provide a greater indication of the reserve's overall success. A socioeconomic analysis will also add greater breadth to the analysis.

It may also be possible to extend the governance assessment through on the ground research. Interviews, focus groups and surveys of a greater number of stakeholder groups may provide greater insight on the incentives in place within the SKBR and how successful these are, not only in meeting conservation objectives, but ensuring the reserve is resilient.

To further the assessment of the SKBR, it is critical that an analysis of biophysical indicators be reviewed; this will provide scientific evidence that the reserve is benefiting the conservation of the reef and other coastal habitats. If the assessment shows that there is a continued decline in overall ecosystem health, it may help identify further areas of improvement within the governance of the reserve.

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## Appendix A : Letter of Intent and Informal Survey

Dear [Organization],

My name is Robyn Pirie, and I am a fourth-year student at Dalhousie University in Halifax, Nova Scotia, Canada. I am completing my Bachelor of Science as a double major in the Environment, Sustainability and Society program and in Marine Biology. I am currently researching my honors thesis project, which focuses on a baseline governance assessment of the Sian Ka'an Biosphere Reserve. I am examining how well the Sian Ka'an reserve is meeting its conservation objectives from a governance perspective.

The purpose of this survey is to learn about how [Organization] engages with the Sian Ka'an reserve, from a governance perspective. Please note that I am not asking for your personal opinion, but for information from the perspective of your organization that will help me understand the governance framework of the reserve. My governance analysis is using data collected through extensive literature reviews and this survey. My approach is based on the Marine Protected Area Governance (MPAG) framework developed by my supervisor Dr. Elizabeth De Santo and her colleagues in partnership with the United Nations Environment Programme. For more information on the framework, please see: http://www.mpag.info.

Due to the time constraints of my degree (the project must be completed by the end of March 2013) I would be grateful if you could complete the survey and return it to me by 4 February 2013. If you cannot do so within this time frame, please let me know as soon as possible so I can make other arrangements. I am attaching a Microsoft Word version of the survey, please return it to me via email (to rb659841@dal.ca) and let me know if you have any problems with this format.

Thank you very much for your time and assistance. I look forward to hearing back from you. If you have any questions about my project, please do not hesitate to contact me.

Yours sincerely,

Robyn Pirie
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**Survey**

Please return this survey to Robyn Pirie via email: rb659841@dal.ca by **4 February 2013**. If you cannot complete and return it by that date, please let me know so I can make other arrangements.

Thank you for taking the time to complete this brief survey. As explained in my letter, I am conducting a governance analysis of the Sian Ka'an Biosphere reserve for my undergraduate Honours Thesis research. **The information you provide below should reflect the official position or perspective of your organization, not your personal opinion**, and by completing and returning the attached survey, you are agreeing that I may use any information provided in my analysis.

[Contact name],
[Organization]

| |
|---|
| 1. **Please describe your organization's involvement in the Sian Ka'an Biosphere Reserve** |
| 2. **To what extent are stakeholders engaged in decision-making in the reserve? Please specify if you are referring to the wider community, the fishing communities, or other relevant stakeholders.** |
| 3. **What kind of tourism operates within the park? Are funds from tourism directed towards management of the reserve? Are there other economic incentives from the reserve that I should be aware of?** |
| 4. **How is your organization involved in the decision-making processes of the reserve, if applicable?** |
| 5. **If your organization has access to the decision-making processes of the reserve, please comment on how scientific information is used in its management (and/or not – i.e. how is decision-making operating under scientific uncertainty?)** |

| |
|---|
| 6. **How does your organization engage with local communities (both within and surrounding the reserve), if applicable?** |
| 7. **If your organization is involved in the governance of the Sian Ka'an Biosphere Reserve, please comment on how the area is enforced.** |
| 8. **Please comment on any other issues related to governance that your organization feels is relevant or important concerning the management of the Sian Ka'an Biosphere Reserve.** |

# Appendix B: UNSECO World Heritage Designation Criteria

**Table 12**. Natural criteria for World Heritage Designation, as stated by UNESCO (2013). Relevant criteria to the SKBR has been highlighted in bold.

| Criteria | Description |
|---|---|
| v | "be an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change;" |
| **vi** | **"be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria)"** |
| vii | "contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;" |
| viii | "be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;" |
| ix | "be outstanding examples representing significant on- going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;" |
| **x** | **"contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of Outstanding Universal Value from the point of view of science or conservation."** |

## Appendix C: IUCN Management Criteria

**Table 13** IUCN Categorization of protected areas (Wells & Day 2004; IUCN 2008). The category relevant to the SKBR is highlighted.

| | Category | Main Objective or Purpose |
|---|---|---|
| IA | Strict Nature Reserve | Implemented to protect biodiversity and/or geological/geomorphological features. Strictly controlled and limited human visitation, use and impacts to ensure the preservation of conservation values. These protected areas serve as significant baseline reference areas for scientific research and monitoring. |
| IB | Wilderness Area | Slightly modified or large areas that retain their natural character and influence without permanent or significant human habitation. These areas are protected and managed to preserve their natural condition. |
| II | National Park | Large natural or near-natural areas set aside to protect large-scale ecological processes, complement species and ecosystem characteristics of the area. This is done to provide a foundation for environmentally and culturally appropriate/compatible spiritual, scientific, educational, recreational and visitor opportunities. |
| III | Natural Monument | Assigned to protect a specific natural monument of geomorphological (landform, seamounts, submarine caves, etc.) or natural (old growth forests, ancient plant growth, etc.) significance. Generally small in size, with high visitor values. |
| IV | Habitat/Species Management Area | Designated areas to protected specific species or habitats. Management reflects this priority, with regular and active interventions used to address the requirements of the species or to maintain the habitat. |
| V | Protected Landscape/Seascape | Designated in an area where extended interaction between people and nature has produced an area with distinctive ecological, biological, cultural and scenic characteristics and values. Safeguarding the integrity of this interaction is made the priority to protect and sustain the area and its associated conservation and cultural values. |
| VI | Managed Resource Protected Area | Significant areas in a natural condition where a proportion if under sustainable natural resource management. Exploitation is a main objective of the area. |