The Inherent Complexity of Collaboration:

Fishers' Perceptions of the Implementation of Community-Based No-Take Zones In the Sian Ka'an Biosphere Reserve, Yucatan Peninsula, Mexico

by

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ABSTRACT

The Sian Ka'an Biosphere Reserve (SKBR) is one of the sites in Quintana Roo where small, science-based NGOs have begun to negotiate and collaboratively design a network of no-take zones (NTZs) with three fishing cooperatives in response to the decline of fisheries in the Mexican Caribbean and of the health of the Mesoamerican Reef. This study analyzes fishers' perceptions on NTZs and the process of joint design, and compares results between cooperatives. A policy dialogue framework is used to identify challenges and facilitating factors in NTZ implementation and to provide insights on how the process can be improved. The study also analyzes nuances on the inherent complexity of collaboration in community-based marine conservation efforts.

Results show that fishers are aware, understanding and endorsing of the beneficial effects of NTZs in protecting spawning and species and improving fishing catch. The participatory process led by the NGOs included fishers in the design of NTZs and provided them with the final decision on which areas to implement. This level of involvement increased their sense of ownership and willingness to enforce these areas. Consistent with similar studies, fishers' perceptions of NTZs largely reflect their interests and concerns: they are motivated to endorse NTZs in as much as they provide additional benefits and do not conflict with their main fishing activity. Differences in attitude and endorsement of NTZs between cooperatives point to the importance of understanding the fishers' incentives to collaborate and the small-group dynamics that shape the participatory process. Fishers' main concern is that *others* will benefit from *their* sacrifice. This concern is embedded in a complex political context, the regulatory difficulties of enforcing fishing regulations and in underlying societal power dynamics, which increase the fishers' fear that they will not be guaranteed equitable access to NTZ benefits. Fishers' perceptions highlight the inherent challenges that small, science-based NGOs experience in advancing conservation strategies in a complex socio-economic and regulatory context, as well as the increased need for community-based management to transcend merely enhancing people's understanding of conservation measures and invest in sustainable and trustful working relationships.

ACKNOWLEDGEMENTS

"Nature is prodigious, but man has to mature to understand that."

The wise words of a fisher during an interview remind me of the nature of my journey. Life takes us, beyond our comprehension and beyond our control. I find myself constantly driven to understand our complex relationship with the Earth that sustains us. My inherited, profound connection to Latin America envelops this impetus in silent reflections of socio-economic inequality. People, nature, well-being: balance. This thesis is but a product, a vestige of a *process* of understanding, sharing, of transcending barriers of communication and misperceptions, of consciousness and action. And for this and the inexpressible, I have so much gratitude and so many to thank.

To my parents, for always allowing me to be; protected, supported and loved.

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"…and so we rest in the truth that what is most important is not how much of ourselves we leave with others, but how much we enable others to be themselves." –M.W.

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1. INTRODUCTION

No-take zones (NTZs) – also commonly known as marine reserves – are increasingly being implemented around the world to protect marine resources and fisheries. In contrast to Marine Protected Areas (MPAs), where some fishing activities are frequently permitted, NTZs are areas that are temporarily or permanently closed to any form of extractive activity. There is increasing evidence that marine protected areas have beneficial effects on marine resources and fisheries when they are associated with NTZs, artificial reefs and other fishing regulations (Roberts et al., 2001; Ward et al., 2003; Boudoresque et al., 2005). Until 2006, however, it was estimated that there were at least 4,500 MPAs in the world, covering 0.6% of the oceans; however, only 0.01% of these are strictly managed as permanent NTZs (PISCO, 2007). Research has shown that NTZs are beneficial for fisheries as a result of improved spawning success of protected population, increase of biomass and species abundance and export of biomass towards adjacent zones, referred to as the spillover effect (Allison et al., 1998; McClanahan & Mangi, 2000; Gell & Roberts, 2003; Russ et al., 2004).

However, in contrast to empirical research assessing the effectiveness of NTZs in protecting specific marine areas, there is a lack of data regarding fishers' perceptions of the value and performance of MPAs and NTZs (Pita et al., 2011). Fishers' perceptions can serve as an indicator of the social acceptance of NTZs, which is fundamental in the monitoring, enforcement and evaluation of these management strategies (Leleu et al., 2012). Although NTZ design, implementation and effectiveness has been found to vary largely according to social and ecological context (Pomeroy, 2007), there are some common trends on fishers' attitudes and perceptions that have important implications for management. Common trends identified by a literature overview on this topic (Pita et al., 2011) include the following:

- Fishers' attitudes towards implementation of marine protected areas largely reflected personal interests and concerns: *indicating a need to address these factors in the design and implementation of NTZs;*
- Fishers who benefitted the most by marine protected areas were those least affected by them and, as a result, also the ones who tended to be more supporting and accepting of these conservation measures: *indicating the importance of analyzing the impact of NTZ implementation on fishers' livelihoods;*
- Resistance to NTZ implementation was higher than it was to less restrictive measures, which researchers suggested was expected since the fishing industry is already highly regulated and the benefits of NTZs are still not sufficiently documented (Helvey 2004): *indicating the importance of evaluating NTZ implementation in relation to existing or alternative measures;*
- Not in all cases fishers' perceptions about the conservation benefits of NTZs coincided with biological findings: *indicating the need for establishing effective communication between fishers and scientists to adjust expectations and jointly evaluate outcomes;*
- Fishers perceived that their participation in the NTZ decision-making process was either lacking or insufficient: *indicating the urgency of increasing fisher involvement in the decision-making process to improve local ownership of this conservation strategy and ensure compliance and enforcement*.

Benefits of engaging fishers in co-management of NTZs are documented in additional studies. Comparing the perceptions of Chilean fishers from different fishing syndicates involved in the co-management of NTZs, Gelcich et al. (2008) noticed a significant positive relationship between the

amount of time spent in the co-management of marine protected areas and environmental stewardship. Working in Mediterranean fisheries, Guidetti & Claudet (2010) suggested that adaptive co-management between fishers, scientists, and managers can effectively achieve conservation and fishery management objectives. In California´s central coast, a network of NTZs is being established by considering the interests and concerns not only of fishers, but also of scuba divers, scientists, conservationists and managers, with results suggesting that a stakeholder-driven process can effectively strike a balance between conservation and socio-economic objectives (Klein et al., 2008).

Ideally, NTZs should be designed to facilitate long-term monitoring, compliance, and enforcement; achieved through high community involvement and participation in the decision-making process, supportive institutions and legislation, sustainable finances, and equitable sharing of the economic benefits (PISCO, 2007). Meeting these objectives is likely to require the involvement of a diversity of participants, with different interests, perspectives, resources and limitations. In this sense, on-the ground collaborative approaches to natural resource management are emerging as innovative styles of environmental problem solving (Wondolleck & Yaffee, 2000). These processes are engaging government agencies, non-governmental organizations, communities, researchers and private groups in a creative policy dialogue towards consensus and shared ownership over and responsibility for natural resources.

An initiative to establish network of NTZs along the coast of the state of Quintana Roo, in the Yucatan Peninsula, Mexico has been proposed by small, science-based Mexican NGOs in response to declining fisheries in the Mexican Caribbean (Aguilar-Perera, 2006; Sosa-Cordero & Ramirez-Gonzalez, 2011) and increasing ecosystem degradation along the Mesoamerican Reef (Healthy Reefs Initiative, 2010). There is also remaining uncertainty surrounding the impacts of local fishing practices on complex meta-populations, such as the Caribbean lobster (Lozano-Alvarez et al., 1993, Sosa-Cordero, 2011). Mexican legislation recognizes a NTZ – also termed *fishing refuge* – as an instrument to conserve fisheries and protect marine ecosystems in federal waters (LGPAS, 2007). In this sense, the NTZ initiative in Quintana Roo has been envisioned as a multi-stakeholder process to protect marine resources and coastal livelihoods in the region. However, lack of legislative clarity and institutional constraints make NTZ enforcement challenging for authorities (CEMDA & COBI, 2010) and imposition of NTZs are likely to result in resistance and lack of compliance from local communities (Suman et al., 1999).

The Sian Ka'an Biosphere Reserve (SKBR) is one of the three areas in Quintana Roo where NGOs have begun designing and implementing NTZs with the participation of the fishing communities. In this study, the NTZ process in Sian Ka'an has been selected as a case to analyze the challenges and facilitating factors in the collaborative efforts led by non-governmental actors. The effectiveness of this strategy in generating benefits for the environment and society will largely depend on the participation of the fishing communities in the process of designing and implementing no-take zones. This participation is critical, not only because the fishing communities will have to initially reduce their fishing areas and yields, but also because they will ultimately be in charge of the implementation, enforcement, evaluation and improvement of this strategy. By focusing on understanding fishers' perceptions of NTZs in the SKBR, one of the objectives of this study is to identify challenges and facilitating factors of the process and provide insights on how it can be improved towards compliance and effective monitoring, enforcement and joint evaluation. Another objective of this study, through understanding the broader collaborative, multi-stakeholder process in which this strategy is embedded, is to derive insights and key lessons about the inherent complexity of collaboration in NTZ implementation.

2. RESEARCH OBJECTIVES

Despite current management efforts, marine biodiversity and commercial fisheries in the Mexican Caribbean have declined. Addressing marine resource depletion of this area is also critical in light of the health of the Mesoamerican Reef. Inside the Sian Ka'an Biosphere Reserve (SKBR) in the state of Quintana Roo, the federal regulations that establish this region as a natural protected area and the artisanal fishing practices are insufficient to ensure biodiversity conservation and the vitality of fisheries. Accordingly, a network of no-take zones was proposed by local NGOs in collaboration with the fishing communities as a complementary strategy to current management. In this context, the main objectives of this study are to:

1. Document the process that has led to the negotiation and design of NTZs in the Sian Ka'an Biosphere Reserve and, in so doing, understand the multi-stakeholder context in which this initiative is embedded;
2. Understand and analyze fishers' perceptions within the three fishing communities in the SKBR as indicators of the social acceptance of this conservation measure, since they are uniquely positioned to advance the implementation, enforcement and evaluation of this conservation strategy;
3. Use a policy dialogue framework (Ehrmann, 1997) to analyze the fishers' perceptions in the broader collaborative context through which community-based NTZs are being negotiated with the fishing communities, to identify the challenges and facilitating factors in NTZ implementation and discuss how the process can be improved and applied to other fishing communities;
4. Use this case to derive insights about the inherent complexity of collaboration in community-based marine conservation efforts, which may be applicable to similar contexts in Mexico and in other places in the world.

3. METHODOLOGY

The following section explains the qualitative methodology used to accomplish the objectives of this study. It details the background research developed to document the NTZ process and understand the multi-stakeholder stage in which it is embedded; the interview methodology developed to analyze the fishers' perspectives on the NTZ strategy; data analysis process and the policy dialogue framework used to evaluate the results.

Background Research: documenting the NTZ process & understanding the multi-stakeholder context

Background research, semi-structured interviews and participatory observation were used to document the NTZ process, understand the multi-stakeholder context and assess the fishers' perceptions of the NTZ initiative within each of their fishing concessions. Prior to visiting the fishing communities, available documents related to the NTZ initiative in Sian Ka'an and Quintana Roo were reviewed (Morales, 1995; Sosa et al., 2002; Franquesa-Rinos y Loreto-Viruel, 2006; Franquesa-Rinos, 2008; COBI et al., 2007, 2010a, 2010b; ASK & COBI, 2010; Gonzalez Franco de la Peza, 2011). Additionally, informational interviews were conducted with 13 key external stakeholders, to document the process that has led to implementation of NTZs within the SKBR and to understand the higher-level context in which this strategy is embedded. These actors included the Director and the Project Managers of the leading NGOs behind this strategy (Comunidad y Biodiversidad and Amigos de Sian Ka'an); the Director and Deputy Director of the SKBR under the National Commission for Natural Protected Areas (CONANP); the Delegate for the National Commission for Aquaculture & Fishing (CONAPESCA) for the state of Quintana Roo; the Director for the local Regional Center for Fishing Investigation (CRIP); fisheries experts from The School of the South Frontier (ECOSUR) and the Technological Institute of Chetumal (ITECHE) who have done extensive research on the artisanal fisheries in Quintana Roo; the UNDP representative who works in the Yucatan Peninsula through the Community-Management of Protection Areas for Conservation (COMPACT) Project; and a philanthropist that is actively involved in the NTZ process and has land and tourism assets within the Holy Spirit Bay. Through the interviews these actors communicated their stance on the NTZ initiative and commented on advancements and challenges of conservation and sustainable development practices in the area of study. All of these interviews were conducted face-to-face and audio recorded with the interviewee's consent, with the exception of three that were done via telephone.

Also during this preparation phase, personal meetings were petitioned with the Presidents of the fishing cooperatives to present to them the research objectives of this study and ask their permission and support to visit their community and perform interviews with the fishers. All of the Presidents kindly accepted this petition and received a signed letter of confidentiality that outlined the objectives of the study, ensured the anonymity of all of the interviewees and guaranteed that all results would be shared with the fishing communities. During this meeting, the Presidents also presented their stance on the NTZ strategy and highlighted benefits and challenges of the initiative.

Semi-structured Interview: understanding the fishers' perceptions

After the background research, a semi-structured interview was designed to understand the fishers' perceptions on the NTZ strategy. The interview was designed with specific objectives and guiding questions (Table 1). Specifically, the interview sought to understand:

A. The fishers' perspectives of the overall NTZ strategy – its value, its limitations and its usefulness in addressing fisheries decline – by assessing their:
    1. Understanding of NTZs;
    2. Expectations of benefits;
    3. Perceived concerns;
    4. Perceived trends in lobster catch.

B. The fishers' perspectives on the specific NTZs that are being implemented within their fishing concessions and the process by which they were designed, by assessing their:
    1. Awareness and identification of the proposed NTZs within their fishing concession;
    2. Perceptions of the value of these areas;
    3. Perceptions of the cooperative's decision-making process;
    4. Views on who should be responsible for enforcement of these sites.

C. The fishers' perspectives on the collaborative and participatory process the NGOs have led, by assessing:
    1. If the fishers identify the people and organizations (external stakeholders) involved in the implementation of the NTZs;
    2. Perceptions of how trustworthy they perceive the external stakeholders to be;
    3. Perceptions of the NTZ information provided and on the overall collaborative process;
    4. Suggestions for improvement.

Although specific questions were developed to ensure measurement of key constructs, the interview was implemented under the interview guide approach, which is more structured than an informal conversational interview but allows for flexibility in its composition (Gall, Gall & Borg, 2003). The strength of this approach largely relies on the ability of the researcher to ensure that the same areas of information are collected with the opportunity to adapt the interview process in a way that ensures that each participant is giving the same information (Turner, 2010).

Table 1 : Semi-Structured Interview – Objectives & Questions

OBJECTIVE A. UNDERSTANDING OF NTZ OBJECTIVES, EXPECTATIONS OF BENEFITS AND CHALLENGES & PERCEIVED TRENDS IN LOBSTER CATCH
1. What do you understand is a no-take zone? 2. What benefits do you expect from implementing NTZ within the cooperative's fishing concession? 3. Do you expect there will be any challenges in the implementation of these zones? What are your main worries or concerns? 4. How has lobster catch or fishing production changed through the years?
OBJECTIVE B. AWARENESS OF THE PROPOSED NTZS WITHIN FISHERS' FISHING CONCESSION & THEIR PERSPECTIVES ON THE VALUE OF THESE AREAS, THE COOPERATIVE'S DECISION-MAKING PROCESS & ENFORCEMENT
1. Do you know which areas have or are being selected as NTZs? Could you show me on this map? 2. Why are the selected areas valuable as NTZs? 3. How were the NTZ selected and agreed upon within the cooperative? 4. Who do you think should be in charge of NTZ enforcement?
OBJECTIVE C. IDENTIFICATION OF EXTERNAL STAKEHOLDERS INVOLVED IN THE IMPLEMENTATION OF THE NTZS, PERCEPTIONS OF TRUSTWORTHINESS, THE PROCESS OF COLLABORATION & SUGGESTIONS FOR IMPROVEMENT
1. Do you know the people and the organizations that have come to talk and work with the cooperatives on the NTZ strategy? Can you name them? 2. Do you think these people & organizations are trustworthy and are looking out for the well-being of the fishers? 3. Did you participate in the meetings and talks where the NTZ objectives were presented and the zones were initially selected? What did you think of the information presented and the NTZ process of collaboration so far? 4. Do you have suggestions on how the NTZ process could be improved?

Field Research & Data Collection

Interviews were conducted (in Spanish) within the three fishing communities in Sian Ka'an between the 2nd and 26th of July 2011. A total of 89 fishers were interviewed during this time. This required 8 days in Maria Elena (Holy Spirit Bay), where the Cozumel fishers work and reside during the lobster season; 6 days in Punta Herrero (Holy Spirit Bay) with the Jose Maria Azcorra fishers; and 11 days in Punta Allen (Ascension Bay), where the Vigia Chico fishers reside. Because it was the beginning of the lobster season, most cooperative members were on-site. All of the members of the Cozumel and Azcorra Cooperatives could be easily approached since these remote settlements comprise only the fishers' houses along the beach-line and the only activity is the seasonal fishing. Of the total 29 fishers interviewed from the Cozumel cooperative, 25 were members and 4 were workers. In Punta Herrero, of the 23 fishers interviewed all were members except for 4 workers (3 of which were newly admitted members to be approved in the next Assembly) and 1 registered free fisher that is allowed by the cooperative to work in the concession (Table 2).

For the Vigia Chico Cooperative, a total of 37 of the total of 70 were interviewed. Punta Allen is a much larger settlement, with houses, restaurants, tourism facilities and roads, where the fishers are not as easily identifiable. Fishers were initially approached at the dock where lobster was unloaded. This allowed me to present myself and the study objectives and request interviews. Fishers were interviewed at a time and a location of their preference, and a snowball sampling methodology was used to identify additional fishers and their locations within the community (Morgan, 2012).

Table 2: Number of Fishers Interviewed per Fishing Cooperative

COOPERATIVE	SETTLEMENT	LOCATION IN SKBR	TOTAL # OF MEMBERS	# OF FISHERS INTERVIEWED
Cozumel	Maria Elena	Holy Spirit Bay (Northern part)	27	25 member & 4 workers = 29 total
Jose Maria Azcorra	Punta Herrero	Holy Spirit Bay (Southern part)	18	18 members , 4 workers & 1 free fisher = 23 total
Vigía Chico	Javier Rojo Gómez (Punta Allen)	Ascension Bay	70	37 members total

Most interviews lasted between 30 and 40 minutes. Interviews with influential fishers, usually leaders within the cooperative, lasted at least 60 minutes. During the first five interviews permission to audio record the interviews was requested. Although the fishers agreed, it was quickly evident that this made them uncomfortable, so the methods were adjusted to create a more trustful environment. The interviews were subsequently not recorded, and elaborate written notes were taken and later transcribed on-site, so the fishers could be consulted once again if there were doubts or inconsistencies in transcription.

A participatory observation approach (Chambers 1994; Campbell, 2001) was also used throughout the interview period. Participatory observation was necessary to establish a sense of trust and appreciation of the fishers' perspectives, which are vital in the creation of buy-in and a sense of ownership towards NTZ implementation and enforcement, and increase reliability of their answers and fluidity of conversation.

As part of participatory observation approach, I joined frequently in the lobster fishing activities in all three communities, which usually took up the entire morning. I would ask permission to accompany a fishing team (usually comprising two or three fishers) on their work day, assuring them that I was there to learn and part-take in their activities and not to disturb. Every morning I would accompany a different team, in an attempt to establish rapport with as many of the community members as possible. Interviews were conducted in the afternoons when the fishers were resting so as to not interrupt their work. Early on in the process they perceived my interest and taught me how to fish lobster and allowed me to contribute to harvesting. I also ate most of my meals with the fishers, who were very generous in this respect, and again tried to rotate between fishing groups both to establish a sense of trust but also of neutrality and respect for all the members.

It was also of critical importance to personally present myself to the women in the communities, particularly since most of the interviews were conducted in the fishers' houses, in deference to their

home and their hospitality. I participated in the process of lobster unloading, quality enforcement and shipping out of the settlements. I also participated in meetings where a CONANP representative come to present advancements on the lionfish project in Maria Elena and when a UNDP representative and a group of women in Vigia Chico gathered to continue their process of establishing a women's tourism cooperative. Finally I was invited to social activities, such as to watch local soccer matches. All of these activities helped in establishing a safe, trustful and productive interview environment, as was acknowledged by the fishers themselves, a lot of whom commented that these circumstances enabled them to better express their perspectives of the NTZ initiative during the interviews.

Data Analysis of Fishers' Responses

After on-site transcription of each interview, I translated the content of the data into English. Responses were then inserted into an Excel matrix (rows were comprised by each fisher and columns by each interview question). NVivo9 Software for qualitative data analysis was used to categorize the fishers' responses in the following manner:

1. The Excel matrix was imported into NVivo9;
2. Categorical nodes were assigned to each of the 89 fisher rows to include the following criteria: cooperative, age, years fishing and working status (leader, member or worker);
3. Categories were created by the researcher to capture the major themes that surfaced from the fishers' responses;
4. These categories were inserted in NVivo9 and responses per interview question were manually coded within categories; the program registered the frequency of responses that fell per category;
5. Recorded frequencies were graphed and analyzed by interview question;
6. Responses to each interview question were first analyzed for all cooperatives combined and then analyzed per cooperative to identify differences amongst them.

Analyzing the NTZ strategy using a policy dialogue framework

Data from the background research and the interviews with the fishers from the three communities in Sian Ka'an was analyzed by using a *policy dialogue framework* (Ehrmann, 1997). This framework was chosen because it offers a simple descriptive model designed to assist those parties in the collaborative problem solving process in dialogues that involve the convening of people representing diverse interests, that are affected by a common issue and that seek an outcome to which all participants can agree (Ehrmann, 1997).

The framework consists of three main dimensions: 1) negotiation process, 2) group dynamics and 3) political context. It also includes two underlying processes: power and data, information and communication (Figure 1). These dimensions may serve as powerful explanatory tools of a policy dialogue process, in order to ensure that it is appropriately designed and to identify avenues for viable implementation of the outcomes of the process (Ehrmann, 1997). Fishers' perceptions on community based NTZs in the SKBR are analyzed using this model in order to identify challenges and facilitating factors of the process and discuss how it can be improved.

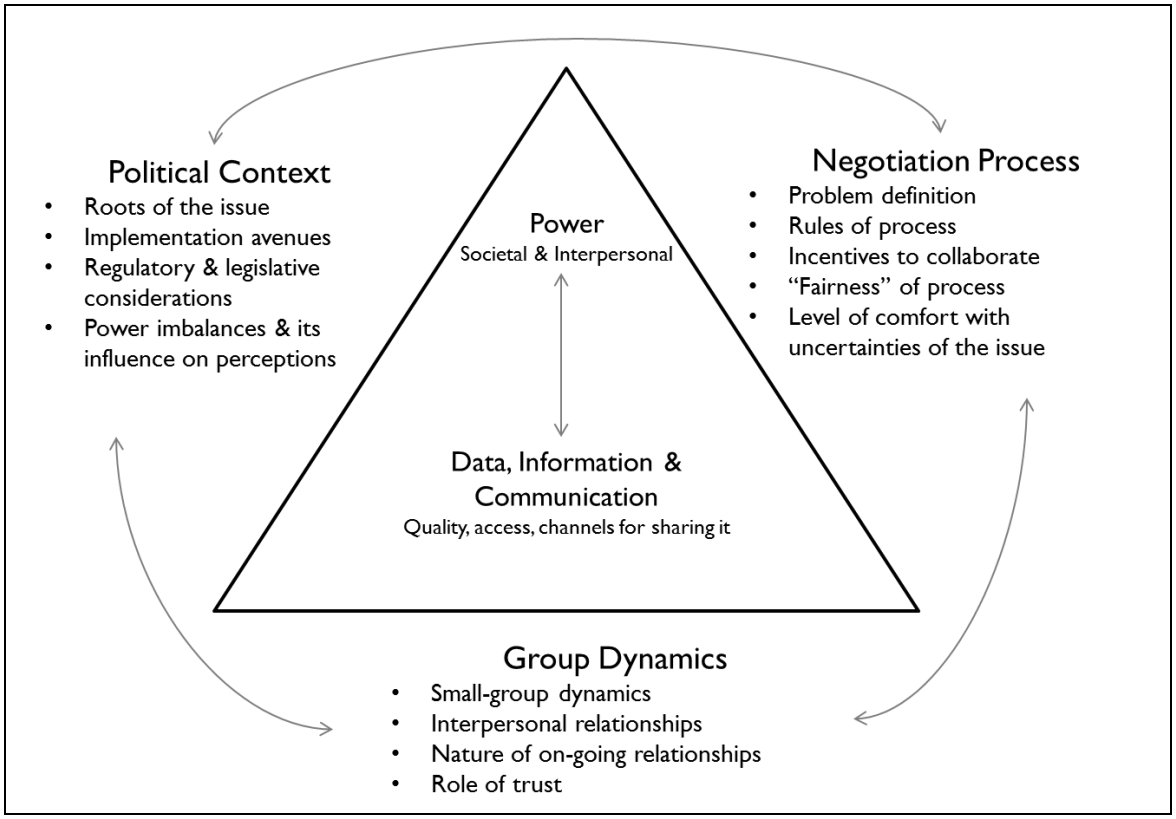


Figure 1: Policy Dialogue Model *(adapted from Ehrmann, 1997)*

4. CONTEXT

Fishing Communities in the Sian Ka'an Biosphere Reserve

The Sian Ka'an Biosphere Reserve (SKBR) is located in the State of Quintana Roo, in Mexico's Yucatan Peninsula (Figure 2). It was officially declared a Federal National Protected Area in 1986, and a year later a World Heritage Site by UNESCO. Around 97% of the reserve is federal property and 3% is owned by private owners or local communities (Bezaury-Creel, 1996).

The SKBR has an area of 528,000 hectares, of which around 150,000 are marine. The area's complex hydrological system and rich biodiversity includes wetlands, perennial, semi-decidisous and mangrove forests, as well as at least 800 plant and 2,100 animal species (CONANP). It has a discontinuous coral reef system, part of the Mesoamerican Reef, and two bays: Ascencion Bay and Holy Spirit Bay (Figure 3).

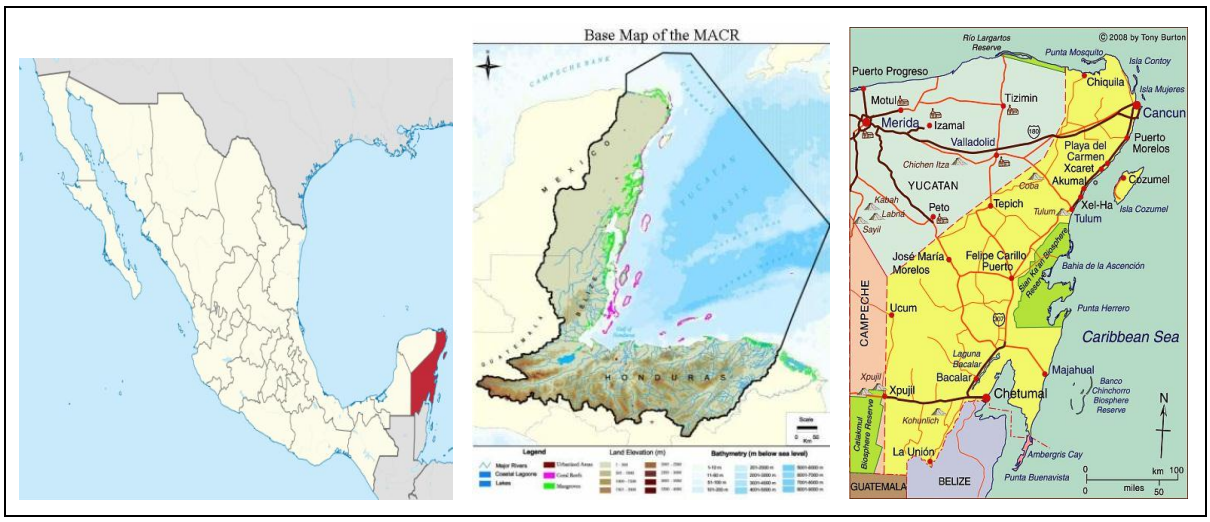


Figure 2: LEFT- Location of the state of Quintana Roo (red) within Mexico; CENTER- Range of the Mesoamerican Reef System; RIGHT- Location of the Sian Ka'an Biosphere Reserve (green area next to the coastline) within the state of Quintana Roo

Fishing practices

The main human settlements are the fishing communities located on Sian Ka'an's coasts. These communities established themselves in the area in the 1970s, before it was decreed as a federal reserve, and they played a key role in developing the fishing industry in the state of Quintana Roo (Sosa-Cordero, 2011). Fishing of the spiny lobster (*Panulirus argus*) represents their most important economic activity (CONANP). The lobster fishing season lasts for eight months, from July 15th to March 15th, and the minimum allowable size of capture is 13.5 centimeters. During the four month closed season fishers are known also to catch shark species, conk and fish, mainly mojarra (*Guerress spp*) and snapper (*Lutjanus spp*)(CONANP).

In protection of the marine resources that sustain their economies, the fishing communities in the SKBR have developed local management strategies that reinforce the federal management regime. These fishing communities employ low-impact, artisanal practices to catch lobster. They are known for their use of lobster shelters, the famous *casitas Cubanas* or *sombras* (Briones-Fourzán & Lozano-Alvarez, 2001). These artificial habitats are placed on the flat sea-floor within the bay to attract

lobster, improve their habitat and increase local lobster availability (National Research Council, 1988). These structures used to be made with chit palm, but the establishment of the reserve in the 1980s prohibited the harvesting of this palm, causing fishers to transition into the current cement structures. Fishing equipment usually consists of a small butterfly net or a *jamo*, a kind of lazo that fishers artfully position around the lobster's torax before sweeping it off the ocean floor. Harvesting lobster usually requires a team of two fishers: one to lift the shelter, the other to sweep the lobster with the net or lazo. These techniques allow fishers to catch lobster live, and check and realease females with eggs and lobster under the mininmum allowable catch size. All fishers skin-dive and SCUBA equipment is not allowed in either Ascension or Holy Spirit Bay. Some cooperatives have also banned the use of fishing nets or traps over their areas.

Moreover, cooperatives divide their fishing consession into *lobster fields* for each cooperative member (in Spanish, *campos* langosteros); in so doing, they assign fishing rights over sections of their concession. Fishers are only allowed to catch lobster within their designated areas. It allows for effective internal enforcement, since any fisher caught inside another's field is strictly sanctioned with the loss of its equipment and ultimately with exclusion from the cooperative. This scheme of limited entry reduces fishing pressure over each area. The Cozumel and Vigia Chico Cooperatives (described below) received in 2006 the Equator Price in recognition of their sustainable management of the spiny lobster in the SKBR (Equator Initiative, 2006).

Description of the fishing communities

No-take zones are being negotiated with three out of the five[1] of these fishing cooperatives in Sian Ka'an: the Vigia Chico, Cozumel and Jose Maria Azcorra Cooperatives. The cooperatives are structured so that each has a Directive Committee composed of a President, Secretary, Treasurer and Chief of Enforcement. The number of members and motorboats are limited according to the statutes of each cooperative. Each motorboat is usually comprised by a team of two or three fishers: the head/s of the motorboat that is/are cooperative member/s and a worker is sometimes hired to help out with the lobster harvesting.

The Cooperative Society of Fishing Production Vigia Chico has 70 cooperative members who are settled in Javier Rojo Gómez (also commonly known as Punta Allen) and operate in Ascension Bay (Figure 3). Most of the fishers in this cooperative both live in Punta Allen with their families and belong to one of the four tourism cooperatives, which means that during the closed lobster season they can work in the fly-fish and tourism industry. This cooperative frequently receives local and international researchers and students interested in their fishing practices.

[1] The other two cooperatives are SCPP Tulum and SCPP Tampalam. Tulum is based outside of the reserve, but its fishing activities extend to the SKBR up to Bocapaila, on the northern limit of Vigia Chico's concession. Tampalam operates south of Azcorra´s concession (Figure 3).

Figure 3: Range of the Sian Ka'an Biosphere Reserve (red polygon)
From top to bottom the fishing settlements (dark circles highlighted in yellow) starting with Punta Allen in Ascension Bay and then Maria Elena and Punta Herrero in Holy Spirit Bay; the last settlement being that of the Tampalam Cooperative with whom NTZs are not being negotiated.

The Cozumel Cooperative has 54 members, but only 27 are settled in Maria Elena and operate in Sian Ka'an, in the northern part of the Holy Spirit Bay (the rest work in Cozumel Island). The Jose Maria Azcorra Cooperative has 18 members settled in Punta Herrero. The Cozumel and Jose Maria Azcorra cooperatives are located in the Holy Spirit Bay, in the more remote settlements of Maria Elena and Punta Herrero respectively (Figure 3). Most fishers from these cooperatives reside in these settlements for the duration of the lobster season. During the closed season they go back to their homes in the Cozumel Island and in Chetumal, respectively, where their families live. In comparison to Vigia Chico, Cozumel and Azcorra fishers largely depend economically on lobster fishing. There are neither tourism cooperatives nor a tourism industry in their bay area.

Implementation of No-Take Zones in the SKBR

Implementation of NTZs in the Sian Ka'an Biosphere Reserve (SKBR) was first attempted in the 1990s by Amigos de Sian Ka'an (Friends of Sian Ka'an, ASK), a small Mexican NGO founded to promote conservation strategies in the SKBR and its surrounding region. As part of their *Cuadernos de Sian Ka'an*, a series of informative manuals, ASK published in 1995 a manual on zones for fishing reproduction where they proposed implementation of NTZs to address the effects of fishing pressure in the state of Quintana Roo (Morales, 1995). Although he NTZ initiative did not gain momentum, it was presented to the government, the academic sector and fishers, and set an important precedent in the process that led up to the present NTZ strategy. Between the late 1990s and 2008, NGOs, experts from academia and fishing communities collaborated in complementary research in support of NTZs. One of the main collaborative projects of this kind within the Sian Ka'an Biosphere Reserve was on the identification and in-situ verification of snapper and grouper spawning aggregations (Sosa et al., 2002; Franquesa-Rinos y Loreto-Viruel, 2006; Franquesa-Rinos, 2008).

In 2007 Comunidad & Biodiversidad (Community & Biodiversity, COBI), a small Mexican non-profit with experience in NTZ implementation in Baja California, reintroduced the idea of implementing NTZs in the region. Financed by the Mesoamerican Reef Fund and in collaboration with Mexico's National Commission for Natural Protected Areas (CONANP) and the National Fishing Institute (INAPESCA), COBI held a workshop in Quintana Roo on *The Use of Community-Based Marine Reserves for Fisheries Management*, to promote NTZs[2] along the coasts of the four countries that share the reef system (COBI et al., 2007). The workshop resulted in wide attendance of key stakeholders. Participants included: The Regional Federation for Cooperative Societies in the Fishing Industry of the State of Quintana Roo; the National Commission for Natural Protected Areas (CONANP) representing the Puerto Morelos National Park and the Sian Ka'an Biosphere Reserve; The National Fishing Institute (INAPESCA); the Ministry of Agriculture, Livestock, Rural Development and Fisheries and Food represented by its state delegate (SAGARPA); Amigos de Sian Ka'an (ASK), The Nature Conservancy (TNC), the UNDP Project on Community Management of Protection Areas for Conservation (UNDP-COMPACT); Colectividad Razonatura NGO; the Technological Institute of Chetumal (ITECHE) and the Toledo Institute for Development and Environment in Belize (TIDE).

According to COBI's workshop report:

> The reaction of the fishers and experts to the possibility of establishing a network of marine reserves in the communities along the coast of the Mexican Caribbean was very enthusiastic and positive. The communities have previous experience on conservation issues as a result of living in natural protected areas, and the idea of closing zones to fishing activities does not necessarily imply loss of fishing sites. The novelty is that these areas could be designed and established with the participation of both fishers and experts […] (COBI et al., 2007) *[Personal translation].*

In this vein, participants in the workshop agreed on the need to work on a more positive and integral conceptualization of a no-fishing zone as opposed to merely an area of restricted access. Through this workshop, COBI created the opportunity to catalyze collaboration between different

[2] It is important to note that the term *refugios pesqueros* or fish refuges is the one that is being mainly used in the region by experts, government officials, NGO representatives and fishers, instead of no-take zone, in an attempt to avoid the association of this conservation strategy solely with the limitation of fishing practices. However, to avoid translation inadequacies, this study will use the term no-take zones as its equivalent.

actors and sectors towards the implementation of community-based NTZs as a strategy for marine conservation and protection of coastal livelihoods. The result of this first multi-stakeholder meeting was the agreement that a NTZ strategy could:

1. Provide alternative benefits and economic opportunities for fishing communities;
2. Involve a wider range of actors in conservation efforts;
3. Integrate NTZs in the revision of the Natural Protected Area Management Plans;
4. Design site-specific proposals for places like Sian Ka'an, where there are already significant conservation measures (COBI et al., 2007).

In this sense, the NTZ strategy was framed not just a community-based project but as a scalable conservation strategy based on a multi-stakeholder collaborative policy dialogue, largely dependent on the will of the fishers to implement, monitor and enforce these areas within their concessions. During this workshop, the Cozumel and Jose Maria Azcorra Cooperatives also expressed interest in extending spawning aggregation research to the Holy Spirit Bay, which had previously been largely limited within Sian Ka'an to Ascension Bay, with the Vigia Chico Cooperative. This led to the implementation in 2008 of the project on the *Protection of Fish Spawning Aggregations in Sian Ka'an*, financed by the Global Environmental Facility's (GEF) Small Grants Program, in collaboration with COBI, ASK, the United Nations Development Program (UNDP) and the three fishing communities. Through this initiative, the same NGOs and researchers that are currently part of the NTZ initiative established working relationships and rapport with the fishing communities in Sian Ka'an.

The spawning aggregations project concluded in 2010. Its results included the verification of eight spawning aggregation sites in the SKBR in depths where free-diving – and thus fishing by artisanal practices – is difficult, but where fish stocks still showed signs of over-fishing (ASK &COBI, 2010). The participants of this project concluded that the design and implementation of a network of no-take zones in collaboration with fishing communities would be a viable way of protecting commercial and non-commercial marine species in the Sian Ka'an Biosphere Reserve and along the coast of Quintana Roo.

In view of these conclusions, COBI and ASK started negotiating and designing no-take zones with fishing communities in three reserves along the coast of Quintana Roo: Puerto Morelos, Sian Ka'an and Banco Chinchorro. Parallel to working with the fishing communities, these NGOs continued to formalize an alliance of interested and relevant actors to create an effective network of NTZs along the coast of Quintana Roo. This multi-stakeholder initiative was named the Kanan Kay Alliance for a Network of NTZs in Quintana Roo (SAGARPA, 2012). Its first working meeting was on September 2010, and it has been working since to establish specific goals and strategies to:

1. Design and implement NTZs with fishing communities;
2. Address the legal and institutional frameworks that serve as avenues of NTZ implementation;
3. Create local capacities for NTZ monitoring, enforcement and evaluation;
4. Ensure the financial viability of the strategy;
5. Communicate results with involved and interested parties (González Franco de la Peza, 2011).

This initiative now has around 33 parties from the public, private and non-governmental sectors, as well as representation of the fishing cooperatives of the state and the objective of protecting 20% of

the state's coastline by 2015 through NTZ implementation and strengthening the legal and institutional avenues for its effective enforcement (SAGARPA, 2012). Aligning the interests and leveraging the capacities and resources of these diverse actors towards effective and viable NTZ implementation is inherently challenging. Each participant has its own set of priorities, perspectives, strengths and limitations that create an inherently complex reality, some of which are described below.

Differences in priorities

In leading the negotiation process on the implementation of community-based NTZ in Quintana Roo, small NGOs such as COBI and ASK face a specific set of challenges. In the NGOs' perspectives, NTZs are both an urgent response to declining fisheries and coral reef degradation in the region and a versatile conservation strategy that can provide both species and habitat protection as well as improve fisheries (Bourillon). Some fisheries experts, who have long worked in the region and with the fishing communities, agree with the urgency and potential of this measure in protecting marine resources and coastal livelihoods (Sosa-Cordero).[3]

Involved authorities, however, have differing perceptions of the urgency of this measure. The fishing authority, the National Aquaculture and Fishing Commission (CONAPESCA) considers NTZ implementation as an opportunity to deal with some pressing challenges surrounding fisheries in Quintana Roo. Illegal fishing, declining fisheries, resource degradation, the expansion of the tourism industry and enforcement inefficiencies are all factors that play in fisheries management and that add complexity to NTZ implementation. As Quintana Roo's Delegate for CONAPESCA comments, "Mexico is still has a lot to do when it comes to fisheries management, let alone NTZ implementation as a conservation and fishing regulation strategy, but this initiative is providing an important opportunity to address challenges in this sector" (Cardenas).

The reserve authority, the National Commission for Natural Protected Areas (CONANP) is supportive of the NTZ strategy and the increased collaboration with the fishers that the NGOs are leading (SAGARPA, 2012). However, some CONANP representatives perceive that NTZs are to a certain extent a redundant measure. The SKBR is a terrestrial and a marine protected area, which already has *nucleus zones* or no-fishing zones which restrict fishing activities (CONANP). Moreover, CONANP's efforts in Sian Ka'an are focused on other type of collaborative management activities with the fishers, which include eradication of the invasive lionfish, the implementation of mariculture technologies, the expansion of the non-extractive fly-fishing industry and further regulation of the use of nets and traps in the Holy Spirit Bay (Ortiz-Moreno). The Director of the SKBR commented, "NTZ implementation is to a certain extent a *luxury*, not a measure of urgency, since there are standing measures that protect the area and low-impact fishing strategies already practiced by the fishers" (Ursua).

Differences in approach & dealing with uncertainty

Participants also face the challenge of dealing with differences in approach and uncertainty. The bottom-up approach that the NGOs are encouraging is based on the importance of the fishers' involvement in the design and effective implementation of NTZs. However, by allowing the fishers to choose the sites, the NGOs compromise to a certain extent the ecological viability of each NTZ.

[3] Sosa, Eloy. Researcher, expert on artisanal fisheries in Quintana Roo. Interview. June 16, 2011. El Colegio de la Frontera Sur, Chetumal, Quintana Roo, Mexico. Castro Perez, Jose Manuel. Researcher, expert fisheries in Quintana Roo. Interview. June 16, 2011. Technological Institute of Chetumal. Chetumal, Quintana Roo, Mexico.

NGOs are not imposing their scientific knowledge, so to speak, in the design of NTZs in areas where they would be most ecologically effective. Instead, they are encouraging a dialogue with the fishers and ownership and commitment amongst them over these sites, so they can be effectively monitored, enforced and evaluated in joint collaboration. As a COBI representative explains: "If 80% of the designed NTZs are not ecologically viable sites, we will know by the end of the first year and we will be able to jointly explore that with the fishers […] right now it is about building trust and a common language with the fishing communities" (Bourillon). Researchers that have worked with the fishing communities value the NGOs' approach because they themselves have experienced the value of engaging with the fishers (Sosa-Cordero & Castro-Perez).

The resource-intensive task of allowing the fishers to choose sites that do not conflict with lobster fishing, their main economic activity, is complicated further by a lack of scientific information and uncertainties regarding the ecological value of each site. Fisheries experts and authorities would like NTZs to overlap with spawning aggregation sites and coral reef areas and there are high expectations with regards to NTZ results. However, there is also recognition that a lot of the information that is needed to decide which areas would be most valuable as NTZs is not yet available and will be generated by this initiative. Effective and joint monitoring of NTZs could snowball the viability and acceptance of this strategy and provide important scientific information on the value of these areas (Moure).

Limited resources & regulatory challenges

In addition to the resources they are investing in establishing working relationships with the fishing communities, on a higher scale, the NGOs that are leading this strategy have positioned themselves in a sort of facilitator role. The creation of the Kanan Kay Alliance provides the NTZ initiative with political impetus, financial viability and the opportunity to embed this conservation strategy in an institutional and regulatory framework. This bold regional scale initiative also stresses the NGOs' capacities. They have to be working both in the field with the fishers and also as conveners and facilitators of a wider, multi-stakeholder policy dialogue.

Moreover, the Kanan Kay Alliance is in itself an experiment of collaboratively pooling together resources and addressing critical regulatory challenges in the state. The Alliance received official support from the Governor of Quintana Roo and the Secretary of Agriculture, Livestock, Rural Development and Fisheries and Food (SAGARPA) on February 2012, an event which provided the NTZ strategy substantial political momentum (SAGARPA, 2012). Support from federal and state fishing authorities will be vital in addressing the regulatory inconsistencies that make fisheries enforcement difficult in the state of Quintana Roo (Cajiao, 2010). Effective communication and collaboration between all parties will also be critical in integrating community-based NTZs in the traditional institutional structures, towards effective implementation, credibility and sustainability of this conservation strategy.

NTZ negotiation & design process with the SKBR fishing communities

In 2010, COBI and ASK formally began working with the Vigia Chico, Cozumel and Jose Maria Azcorra Cooperatives to design and negotiate no-take zones within their fishing concessions. The objective of this new initiative was to involve the three fishing communities in the design, implementation and monitoring of these zones, so as to develop a sense of local ownership and increase the likelihood of success of this conservation strategy and to replicate the participatory process in other critical sites along the coast of Quintana Roo (COBI et al., 2010a). As Luis Bourillon, Director of

COBI's Mesoamerican Reef Program explains, "there are high stakes in the implementation of a community-based network of no-take zones; this is not a pilot program in a single area but a regional initiative, and it all depends on the will of the fishers."

Between August 10th and 13th 2010, the NGOs led a first series of workshops on the *Use of Community-Owned Marine Refuges for Fishing Recovery and Marine Conservation*. These workshops were done in the fishers' settlements, one for each community, and all the cooperative members and workers were encouraged to attend. Through these interactions, COBI and ASK sought to create a common language of understanding between fishers and scientists and to inform the fishers of the value and functioning of no-take zones using specific examples from Mexico and other parts of the world (COBI et al., 2010b). The process enabled by these workshops between NGOs and fishers included the following activities:

1. Through a visual presentation which included a booklet with printed power point slides for each fisher and a video that was projected, fishers were explained the value of NTZ implementation. A NTZ was described as:

   > a marine reserve, a no-fishing zone, a completely protected marine zone, the nucleus zone of a natural protected area, a sanctuary, a protection zone, a zone of fish reproduction, zones for protection, zones where fishing is forbidden (COBI, et al., 2010b) *[Personal translation].*

2. The information provided significantly stressed the environmental benefits of NTZ implementation, by explaining the effects of NTZ on species reproduction and ecosystem recovery through specific examples (abalone in California, queen conch in the Caribbean, grey snapper in the Gulf of Mexico, algae in New Zealand, amongst others). The economic objectives of NTZs were addressed to a lesser extent by explaining the spill-over effects of NTZ in surrounding areas. The possibility of using the NTZ as "natural aquariums" that tourists could visit for leisure and education was also addressed (COBI, et al., 2010b).

3. These workshops were not only informational in nature, but provided a space for fishers and NGOs to jointly design and select NTZs within their fishing concessions. In order to do this, fishers and NGO representatives were first split into several groups. Each group discussed where potential NTZs could be established and drew them on a sketched map. All the groups then reconvened to compare the maps, discuss why NTZs had been selected and identified NTZ overlaps in each map.

4. The results of this first workshop series with each community were: the establishment of rapport and a working relationship with the fishing communities; the design of potential NTZs within the Cozumel and Azcorra fishing concessions; and the agreement that fishers from these cooperatives would discuss and decide amongst them the NTZs that they wanted to implement and would follow-up on their decision with the NGOs. Potential NTZS were not designed with Vigia Chico fishers because of the low attendance rate.

A second series of workshops was held between November 8th and the 10th the same year, to follow-up on the NTZ selection process with Cozumel and Azcorra fishers and to do preliminary GPS mapping of zones that had been internally approved. In the case of the Vigia Chico Cooperative, the goal of this second workshop was to ensure wider attendance of fishers, re-introduce the initiative and stimulate the selection process.

This second workshop series resulted in the following:

1. With the Azcorra fishers, NGOs were able to do GPS mapping of the three potential NTZs within their concession.
2. By the time NGOs had returned for the second collaborative workshop, the Cozumel fishers had not had an opportunity to discuss and agree on NTZs amongst cooperative members. As a result, the NGOs agreed to return at the beginning of 2011 to continue with the GPS mapping should the cooperative select NTZs.
3. NGOs managed a higher attendance of Vigia Chico fishers in this second workshop. NGO representatives reiterated the information provided in the first workshops and discussed the possibility of NTZ implementation with the fishers who participated in the session. Fishers and NGOs also discussed the possibility of establishing an NTZ within the bay area and of talking with cooperative members that had lobster fields over the reef, to negotiate with them the donation of the section of their field over the reef as a NTZ (COBI et al., 2010).

NTZ process with each fishing community by the time research was conducted

The process of negotiating and jointly designing NTZs with these three fishing communities continued during the first months of 2011 through conversations with the cooperative leaders and additional visits. The following section lays out where each fishing community was in the NTZ negotiation, design and implementation process at the time field research of the present study was conducted (June-August 2011).

Cozumel Cooperative (Holy Spirit Bay)

The Cozumel Cooperative had internally selected and agreed on 11 NTZs within their fishing concession and where ready for the NGOs to conduct GPS mapping so that the areas could be officially closed to fishing. Ten of these NTZs, although small, where spread along the reef (Figure 4) and were considered by COBI as "areas of great potential, presenting coral formations that are well developed, in growth and recovery, ideal for monitoring and evaluation of the no-take zones" (Guzman, 2011) *[Translation mine].* An additional NTZ was designed over a mangrove forest site known as Punta Niluc (Guzman, 2011). The cooperative had also created a NTZ Commission, formed by leaders and some of the members that were most resistant to the NTZ strategy, to collaborate with the NGO representatives in the siting of the areas. This mechanism was created as a result of the cooperative's consensus building process and in the negotiations with the NGOs.

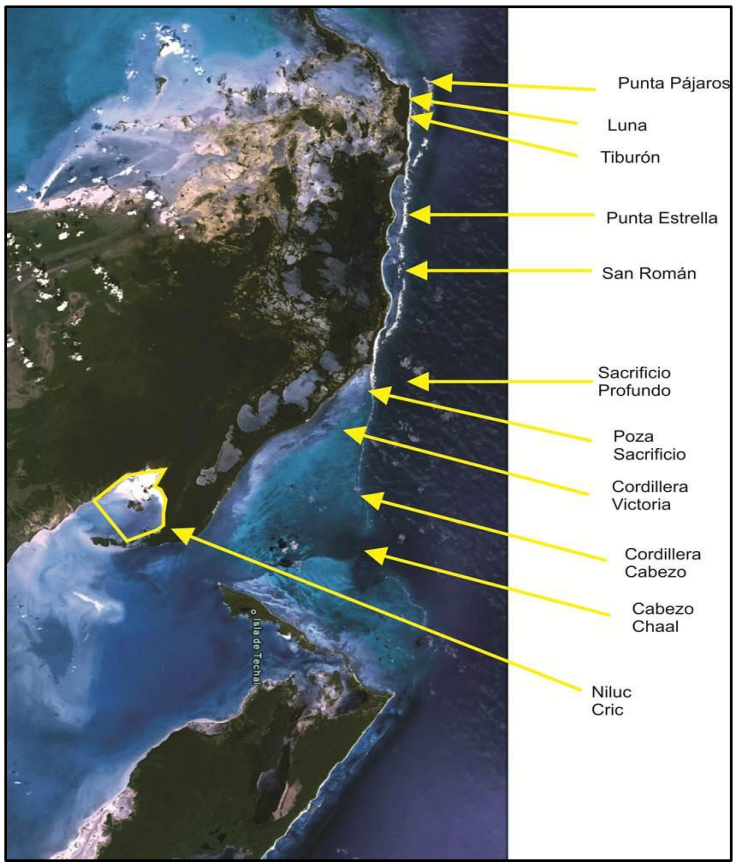


Figure 4: Selected NTZs in the Cozumel Cooperative Fishing Concession in the Holy Spirit Bay by July 2011
Yellow arrows point to selected NTZs by the Cozumel Cooperative members. NTZs along the reef are smaller and only the Niluc polygon is visible in this image. Map produced by Comunidad y Biodiversidad A.C., Quintana Roo, Mexico. August 2011.

Jose Maria Azcorra Cooperative (Holy Spirit Bay)

The Jose Maria Azcorra Cooperative had designed one NTZ in the central part of their corresponding area within the Holy Spirit Bay (Figure 5). The bay area NTZ consisted of muddy bottom and sea grass, which fishers rarely use for harvesting purposes (Guzman, 2011). Another NTZ was designed in the Canche Balam lagoon, largely consisting of mangrove forest (Guzman, 2011). Additional to these sites, NGOs were in the process of negotiating implementation of NTZs in the areas known as El Faro (the lighthouse) and/or a zone north of Chal Island, to protect reef systems within the Azcorra concession (Figure 5).

Figure 5: Selected NTZs in the Azcorra Cooperative Fishing Concession in the Holy Spirit Bay by July 2011
Yellow areas show selected NTZs by the Jose Maria Azcorra Cooperative members. Map produced by Comunidad y Biodiversidad A.C., Quintana Roo, Mexico. August 2011.

Vigia Chico Cooperative (Ascension Bay)

Consensus on which NTZs to implement had not been reached by Vigia Chico fishers. Because of the larger cooperative's size (in comparison to Cozumel and Azcorra) and the difficulty of presenting the initiative to all the cooperative members, the NGOs had to individually approach cooperative members who had lobster fields along the reef to explore the possibility of them donating these sections as NTZs. NGOs identified at least nine reef zones within lobster fields and approached owners to discuss this possibility (Figure 6). By the time this research was conducted, NGOs reported that at least five field owners were willing to donate their areas and the rest where required further negotiations. Additionally, the central bay area was proposed by some fishers as a possible NTZ to be negotiated amongst all the cooperative members (Guzman, 2011).

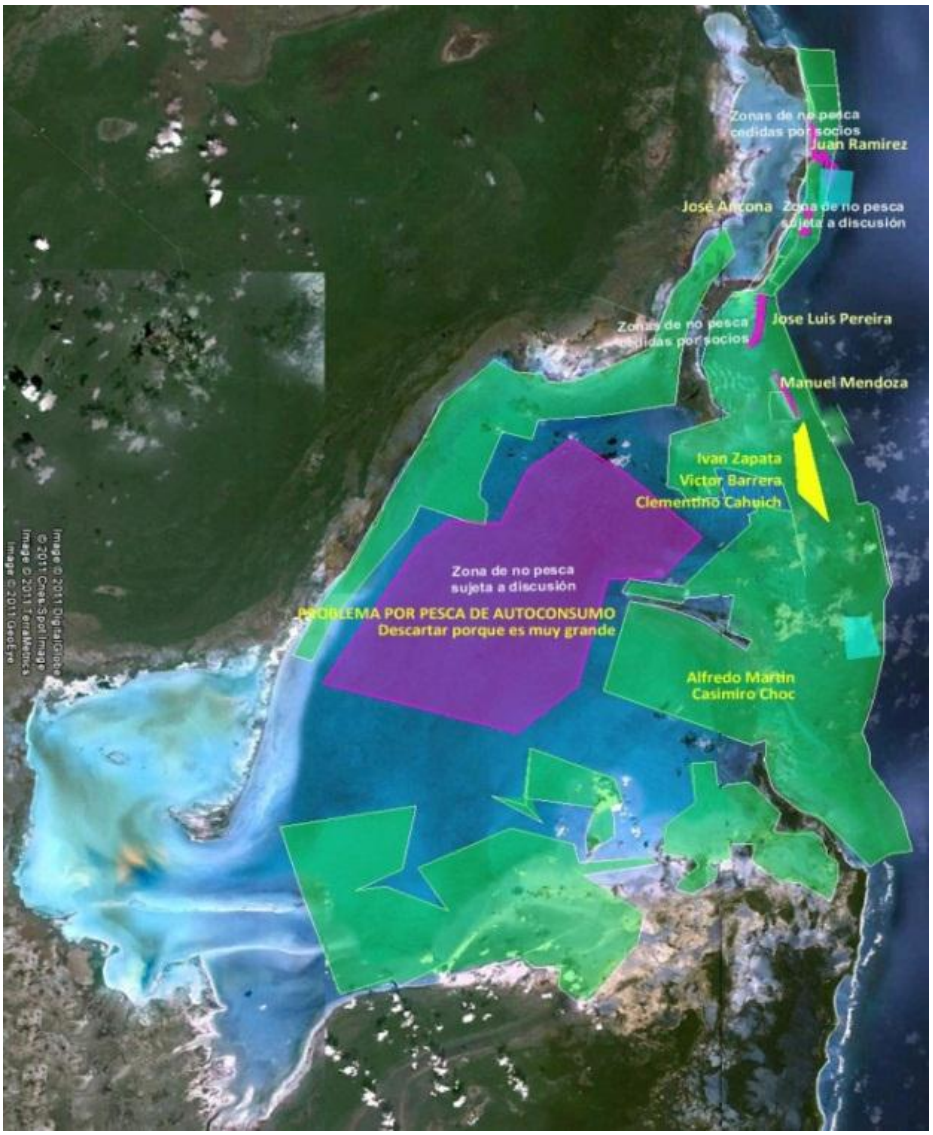


Figure 6: Selected NTZs in the Vigia Chico Cooperative Fishing Concession in Ascension Bay by July 2011
The bay area and negotiated NTZs with individual lobster field holders are marked in purple, alongside owner names. Potential NTZs pending individual negotiation are marked in yellow. Green areas show lobster fields. Map produced by Comunidad y Biodiversidad A.C., Quintana Roo, Mexico. August 2011.

5. RESULTS

The following section comprises a detailed explanation of fishers' responses to each interview question. The categories created to capture responses are explained in detail in each section by providing several examples of fishers' comments. Frequencies and percentages of responses are first analyzed by combining responses of fishers from all of the three cooperatives combined, and then main differences amongst cooperatives are assessed.

A. FISHERS' UNDERSTANDING OF NTZ OBJECTIVES AND EXPECTATIONS OF BENEFITS & CHALLENGES

The following questions were formulated to capture the fishers' level of awareness and understanding of NTZ objectives and benefits (Table 1: Objective A). This section addressed the following questions: Are most of the fishers aware of this initiative? Is their understanding compatible with the information that the NGOs provided to them through the workshops? What benefits do they perceive and which ones are most important to them? What attitudes do they express as they offer their perceptions?

Also, this section addresses the fishers' perceived concerns. According to them, what are the major challenges in NTZ implementation within their concession? What are their worries and concerns? Do they perceive decreasing trends in lobster that may require additional conservation or fishing regulation measures? Addressing these concerns will be critical in continuing collaboration with the fishing communities as the NTZ strategy progresses and in ensuring the effective implementation of NTZs through joint-collaboration.

A.1. Awareness of the NTZ Strategy & Understanding of its Objectives

Responses to the question *what do you understand is a no-take zone?* (Table 1: Objective A1) revealed a high level of awareness of the strategy and understanding of NTZ objectives among fishers from the three communities. Fishers demonstrated a high level of awareness of the NTZ strategy. Of the 89 fishers interviewed, only one fisher was not informed, which corresponds to a 99% level of awareness (Figure 7). The uninformed fisher was from Vigia Chico,[4] where COBI had the greatest difficulty ensuring attendance to the workshop. Responses to this initial question suggest that, by the time this research was conducted, awareness of the NTZ strategy had significantly permeated the communities.

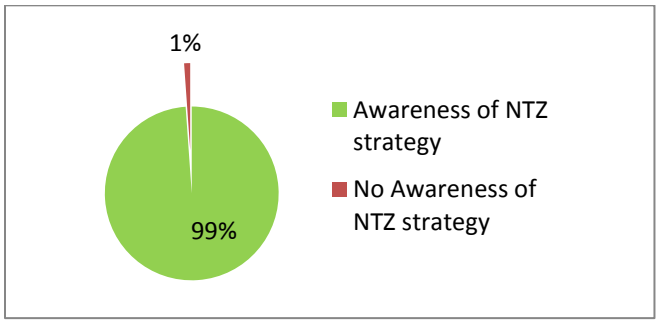


Figure 7: Awareness of NTZ Strategy by Total of Fishers Interviewed (n_T =89)

[4] The NTZ strategy was explained to him during the interview in order to record his responses for some of the other interview questions.

Three major categories are apparent in the responses of the 88 fishers who demonstrated awareness of the NTZ strategy. Fishers revealed their understanding of what an NTZ is by addressing its objectives to (Figure 8):

1) Regulate fishing by excluding it from a specific area;

2) Protect spawning and species;

3) Improve economic opportunities by increasing catch the tourism potential.

2% of fishers mentioned all three objectives, 31% mentioned two and 67% mentioned a single objective. Reference to these three categories suggests that fishers' understanding of NTZ objectives are compatible with the content presented to them during the workshops. The information provided by the NGOs focused on explaining the way that NTZs reduce fishing pressure to promote species reproduction and protection, and addressed the economic benefits to a lesser extent (see page 17 for more on the information provided during the workshops). Reference to these NTZ objectives suggests consistency between workshop content and fishers' understanding.

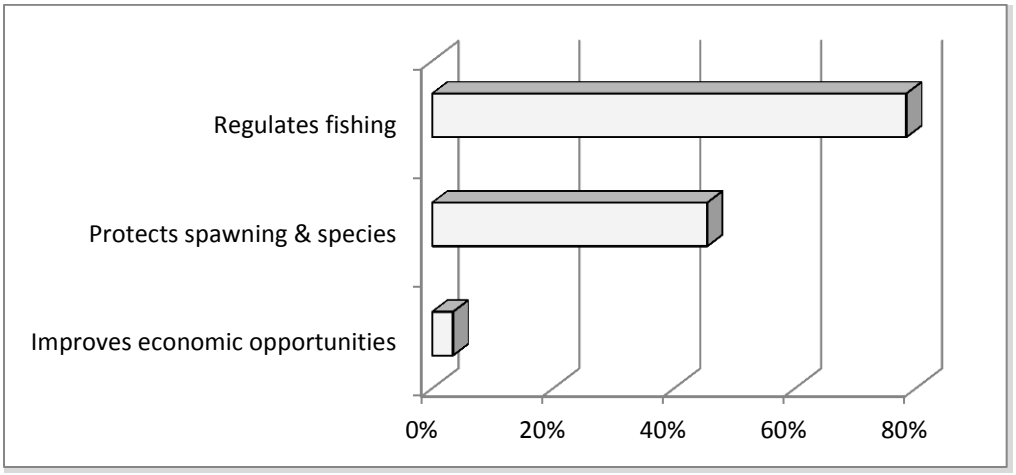


Figure 8: References to NTZ Objectives by Fishers Aware of the NTZ Strategy
(n_T=88; some fishers referenced more than one objective. For the three fishers who did not provide a response it was not because they were unaware of the strategy; the interview proceeded in a way that a specific definition of an NTZ was not provided)

Objective 1: Regulates Fishing

Of the 88 fishers aware of the NTZ strategy, 69 (78%, Figure 8) referred to the regulatory features of NTZs. Fishers described them as *"zones where no fishing is allowed," "restricted areas"* or *"zones that cannot be touched."* Some fishers relate to the concept of a NTZ because, having lived in the Sian Ka´an Biosphere Reserve prior to its establishment, they have already been exposed to conservation regulations. In this sense, fishers also describe the regulation objectives of an NTZ by defining it as *"a reserve within a reserve"* and *"a nucleus zone."* This new conservation measure was also often associated with the *veda* or the closed season, as one of the most stringent forms of fishing regulation.

Objective 2: Protects spawning & species

40 fishers (45%) explained their understanding by referencing the conservation and species reproduction objectives of NTZs. They define an NTZ as *"a reproductive zone," "a spawning site," "a*

zone to protect species" or *"a site where fish and other species cannot be disturbed."* When speaking of these aspects, fishers also associate the success of species reproduction with their *casitas cubanas*, since they already benefit from aggregation and reproduction of lobster within these artificial refuges during the four-month fishery closure. A fisher explains *"we see it with the lobster shelters and the closed season, how the species recovers."*

Objective 3: Improves Economic Opportunities

Finally, 3 fishers (3%) made reference to expected increases in catch and fishing production from the spill-over effects of NTZs, as well as to the associated tourism potential that could result from allowing reef systems to recover. Although only 3% of the interviewees immediately referenced these economic objectives, fishers addressed these aspects in greater depth through subsequent inquiries on perceived benefits and challenges.

Differences in perceived NTZ objectives among Fishing Cooperatives

In analyzing the data by fishing cooperative, it is observed that fishers in all three cooperatives stressed the regulatory and conservation objectives of NTZs. A high proportion of fishers (86%) of the Cozumel and Vigia Chico cooperatives expressed their understanding of NTZs as a measure to regulate fishing activities (Table 3) while about half of the fishers within the Azcorra cooperative referred to this objective.

Table 3: Understanding of NTZ Objectives-Percentages & Frequency of Responses per Cooperative
(Total n_T=88; some fishers referenced more than one objective)

NTZ Objectives	Cozumel (HSB)	Azcorra (HSB)	Vigia Chico (AB)
Number respondents	**29**	**23**	**36**
1) Regulates fishing	86% (25)	57% (13)	86% (31)
2) Protects spawning & species	41% (12)	74% (17)	31% (11)
3) Improves economic opportunities	10% (3)	0% (0)	0% (0)
4) No response	3% (1)	9% (2)	0% (0)

Results also begin to demonstrate the economic interests and motivations that are of importance to the Cozumel Cooperative, which are different to those in the other two cooperatives. It is interesting to note that two of the three fishers that mentioned the improvement of economic opportunities are leaders in Cozumel, and thus are well informed of the NTZ process. The third fisher works for one of these leaders and, although interviewed separately, voiced the same perspective as his superior.

This cooperative also had the highest percentage of fishers who explained NTZs by referring to more than one objective. The proportion of fishers that explained the NTZ concept by referring to more than one objective in this cooperative was of 38%. A slightly lower proportion of 30% of the fishers in Azcorra referred to more than one objective and only 16% of those in Vigia Chico. This may suggest a more detailed understanding amongst the fishers of the Holy Spirit Bay than those in Ascension Bay, where the NGOs had greater success in ensuring attendance to the NTZ workshops.

A. 2. Expectations of Benefits

Responses to the question *"what benefits do you expect from implementing NTZs within your cooperative's fishing concession?"* (Table 1: Objective A2) revealed 7 key motivations in the endorsement of the NTZ strategy amongst cooperatives. Fishers perceived NTZs to (Figure 9):

1) Protect spawning & species;

2) Increase their fishing catch;

3) Increase the tourism potential and access to financial resources;

4) Represent no cost or have no negative impact on their lobster catch;

5) Protect lobsters fields and reef by excluding outsiders;

6) Provide inter-generational benefits;

7) Provide recognition to the cooperative for their commitment to sustainable practices.

3% of fishers expected no benefit or were unable to identify any benefits. Analysis of responses also provided insight into the timeframe when benefits were expected and other attitudes towards the NTZ strategy, which are analyzed in subsequent sections. Beyond providing a definition of an NTZ, this question allowed the fishers to further express their perceptions and attitudes on the value of this conservation strategy.

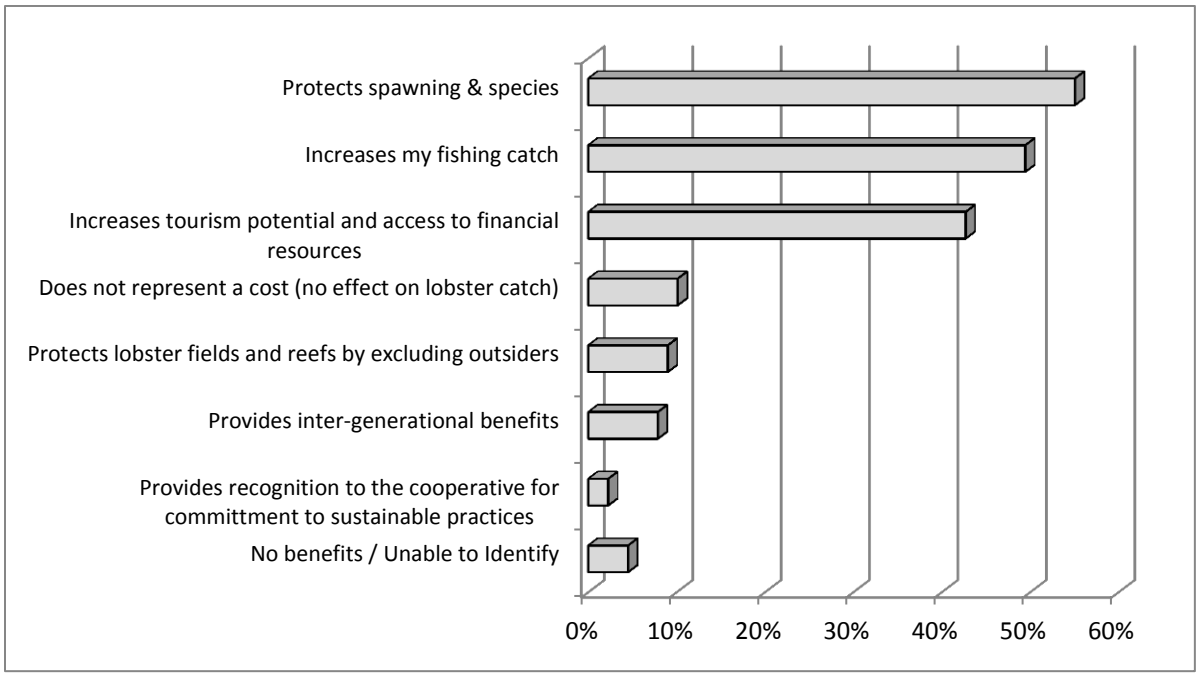


Figure 9: Expected Benefits from NTZ Implementation by Fishers of the Three Cooperatives Combined *(n_T=89; some fishers provided more than one response)*

Benefit 1: Protects spawning & species

In all three cooperatives, fishers made reference to the benefits of protecting habitats to increase reproduction success. A total of 49 fishers from 89 (55%, Figure 9) in all three cooperatives reemphasized how an NTZ is *"like a farm that allows species to grow and reproduce"* and *"protects species that are running out."*

Benefit 2: Increases lobster catch

In reference to additional benefits, responses revealed that fishers from all three cooperatives expected increases in their lobster catch. A total of 44 fishers (49%) in all three cooperatives spoke to this benefit in responses such as *"lobster migration from the NTZ will mean increases in our catch," "we will reap the benefits of reproduction in our catch"* and *"we should see the changes in our annual fishing records."* These responses speak of the some of the fishers' key motivations in endorsing NTZ implementation.

Benefit 3: Increases tourism potential & grants access to financial resources

The prospect of increasing low-impact tourism and of accessing additional financial resources was mentioned by 38 fishers (43%). These fishers proposed that the financial resources resulting from the activity in the project could be invested in the community (for lobster shelters, houses and part-time enforcement jobs). Fishers also remarked on the *type* of tourism they would like to see. At least 10 of the 38 fishers that made references (26%) to tourism, explained they would like to see *"low-impact tourism that could be developed with valuable resources from the NTZ initiative"* or *"ecotourism, which is what most convinced us [to support the NTZ strategy*]." Through these responses fishers expressed a preference for a sustainable tourism alternative that can help to diversify income and reduce dependence on fishing.

Benefit 4: Does not represent a cost (no effect on lobster catch)

Support for NTZs from 9 fishers (10%) was not motivated by a perceived benefit but rather because the zones are not overriding their lobster fields. When asked what benefits they expect, some fishers responded *"It is fine, because it does not limit me"* or *"I am unsure about how the zones will improve my catch but it* does not affect my lobster and fish catch." Some fishers thus endorse this conservation strategy because it has no effect over their main fishing activity, which is a unique aspect of this NTZ implementation strategy amongst fishing communities in the Sian Ka'an Biosphere Reserve.

Benefit 5: Protects lobster & reef by excluding outsiders

A total of 8 fishers (9%), mentioned the benefits of excluding outsiders from their lobster fields over the reef. The fishers were all from Vigia Chico (Table 4). In this cooperative during closed season and up to a month prior to the beginning of lobster season all fishers are allowed to catch fish over the reef irrespective of the ownership of the lobster field concessions. During the rest of the year there is a stringent compliance system, whereby a member can be expelled from the cooperative if caught fishing in another's lobster field. The open fish season seems to cause discontent amongst fishers with lobster fields over the reef; they would rather not deal with this situation and see NTZ implementation as a way to regulate this activity. Fishers commented on this regard, *"This would keep others away from my field, it is a great idea"* and *"Now no one will be able to enter the reef zones like before […this] would further benefit, provide more control."* Additionally, the benefit of regulation is mentioned not only to address this internal situation, but also as a means to keep

illegal fishers and the marines (who are unfortunately not trained to respect the fishing practices of the zones and are rotated frequently to other parts of the country) out of their fishing zone: *"NTZs would avoid people getting into the reef and also exclude the Marines."*

Benefit 6:Inter-generational benefits

Although only referred to by 7 fishers (8%), mostly Cozumel fishers (Table 4) references were made of intergenerational benefits from the NTZ strategy. Fishers provided responses such as: *"it will benefit the future generations," "the younger ones can have a 'savings account'"* and *"our children and tourists can see and enjoy before it all goes extinct."*

Benefit 7: Recognition to the cooperative

Only 2 fishers (2%) mentioned the benefit of additional recognition to the cooperatives for their commitment to sustainable fishing strategies. However, these fishers are leaders from the Azcorra and Cozumel cooperatives who provided this information in light of the expiration of their fishing concessions in 2015. In this sense, both cooperatives seek to ascertain their sustainable practices so that their concessions are renewed by the fisheries authorities.

Benefit 8: No benefit / Unable to identify benefits

Only 3 fishers (3%) from the Vigia Chico and Cozumel Cooperatives did not anticipate any benefits from NTZ implementation and rather voiced their concerns and lack of support for NTZ implementation (see section on challenges and concerns). An additional fisher from Cozumel was unable to identify any benefits.

Differences in Expectations of Benefits among Fishing Cooperatives

Analyzing the responses by fishing cooperative, it is observed that all reiterate the conservation benefits of NTZs. Over half of the fishers in every cooperative referenced these environmental benefits (Table 4). However, the frequencies by which other benefits are stressed suggest differences in priorities and motivations between cooperatives.

Table 4: Figure 10: Expected Benefits-Percentages & Frequency of Responses per Fishing Cooperative
(Total n_T=89; some fishers referenced more than one objective.)

NTZ Benefits Number of Respondents	Cozumel (HSB) 29	Azcorra (HSB) 23	Vigia Chico (AB) 37
1) Protects spawning & species	69% (20)	43% (10)	51% (19)
2) Increases my fishing catch	52% (15)	65% (15)	38% (14)
3) Increases tourism potential and access to financial resources	76% (22)	30% (7)	24% (9)
4) Does not represent a cost (no effect on lobster catch)	17% (5)	4% (1)	8% (3)
5) Protects lobster fields and reefs by excluding outsiders	0% (0)	0% (0)	22% (8)
6) Provides inter-generational benefits	17% (5)	4% (1)	3% (1)
7) Provides recognition to the cooperative for commitment to sustainable practices	3% (1)	4% (1)	0% (0)
8) No benefits / Unable to identify	3% (1)	0% (0)	5% (2)

Expectations that characterize the Holy Spirit Bay Cooperatives

A higher proportion of fishers from Cozumel than from Azcorra and Vigia Chico expressed expectations of benefits from protection of spawning, increases of tourism and access to financial resources, and intergenerational benefits, while perceiving no impact on economic activities. Results show that tourism and access to additional financial resources was a particularly relevant motivation for the Cozumel fishers. They explained that tourism as a result of NTZ implementation *"can reduce our dependence on fishing"* and *"diversify our income,"* particularly since *"there are financial resources in the project that would benefit the community."* The presence of fly-fish business near the Cozumel fishers' settlement largely drives the focus on the tourism potential for this cooperative. Moreover, and as analyzed in a later section, some fishers linked the tourism potential to the value of the proposed NTZs, since 10 out of the 11 zones selected by the time this research was conducted were reef zones of high tourism potential.

Increases in fishing catch was also one of the most frequently referred to benefits by fishers of this cooperative. 15 out of 20 fishers (52%) commented on *"the production increases from the spill-over effects of NTZs."* This cooperative also had the highest percentages of fishers that did not expect the NTZ strategy to affect them economically and who cited intergenerational benefits. An even higher percentage of Azcorra fishers also expressed their expectation of increases in catch. Followed by this benefit was their interest in increasing the tourism potential and access to financial resources, also as a form of diversifying their income.

Expectations that characterize the Ascension Bay Cooperative

The benefits of increased catch were also of main relevancy for Vigia Chico fishers. Moreover, a quarter of fishers considered tourism to be a benefit of NTZ implementation even if the industry is already developed within their bay. They commented *"this is good for tourism if the reef is given" and "we already are experiencing how much people enjoy seeing the reef in good state."* This suggests that Vigia Chico fishers see the value of increased conservation even if they already have a vibrant tourism industry (fly-fishing and tours).

A. 3. Time Expected for NTZ Results: Cozumel & Azcorra Cooperatives

Fishers from the Cozumel and Azcorra cooperatives also talked about their perception on the time it would take before they started getting the benefits from NTZs. These cooperatives were further along in the NTZ process as some zones had been collaboratively designed, approved and were about to be implemented.

A total of 35 fishers from these two cooperatives provided their time expectations. 76% fishers from Cozumel and 57% from Azcorra provided a response (Figure 11). Four categories of responses show that fishers expect to see results in:

1) In less than 1 year;

2) Between 2-3 years;

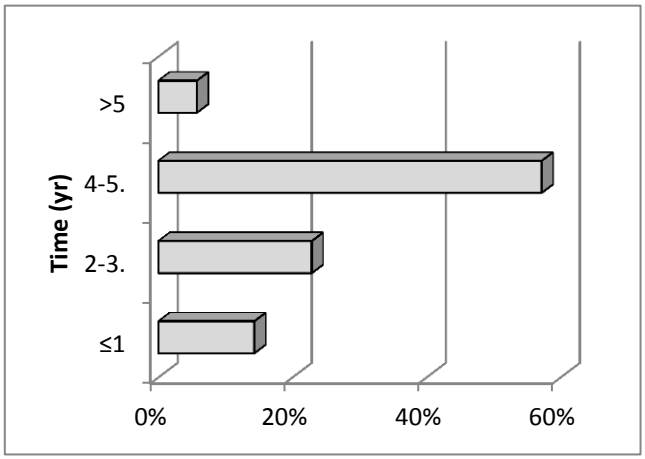
3) Between 4-5 years;

4) In more than 5 years.

Among the 23% of the fishers (Figure 11) that expected benefits in a shorter time frame considered that it would take between 2-3 years for results to start being evident *"if hurricanes don´t hit"* and

"for us to gain assurance that this really works." Of the 14% of the fishers that expected changes in a much shorter time frame, less than a year, remarked that *"it should be 6-8 months to start seeing a change, and a year from now to start seeing results"* and *"less than a year, because we are only fishing for 4 months."*

Among the 57% of the fishers that expected to see benefits in 4-5 years after implementation, most were from Cozumel. Many of the fishers that expected results within this time frame explained that they had this expectation because *"that is what the biologists explained"* and *"it makes sense because of the reproductive cycle of the lobster,"* and another fisher added *"but a more detailed explanation is needed."* The most cautious 6% of the fishers offered a longer time frame and commented *"we will see results between 5-10 years, like in Baja California where this has already been done."* In general, fishers from Azcorra have expectations that benefits will occur faster than fishers from Cozumel.



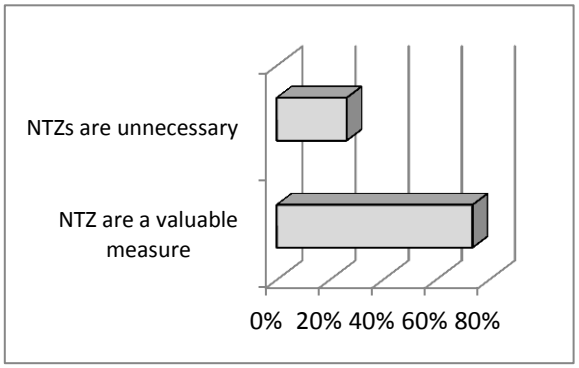
PERCENTAGES & FREQUENCIES PER COOPERATIVE

Time Expectations (yrs.)	Cozumel (HSB)	Azcorra (HSB)
Number of respondents	22	13
≤1	9% (2)	23% (3)
2-3.	18% (4)	31% (4)
4-5.	68% (15)	38% (5)
>5	5% (1)	8% (1)

Figure 11: Fishers' Time Expectations for NTZ Results-Total Percentages & by Cooperative
(n_T=35. LEFT- time expectations both cooperatives combined. RIGHT-percentages and frequencies per cooperative.)

A. 4. Attitude towards NTZ Implementation

Analysis of the fishers' responses on NTZ benefits revealed differences in attitudes between cooperatives towards the NTZ strategy. A total of 38 fishers offered value judgments in their references to NTZ benefits. Of the total of fishers, 74% of fishers perceived that NTZ implementation was a valuable measure (Figure 12). However, 26% of fishers, all from Vigia Chico, perceived that NTZs were unnecessary.



PERCENTAGES & FREQUENCIES PER COOPERATIVE

Attitude towards NTZs	Cozumel (HSB)	Azcorra (HSB)	Vigia Chico (AB)
NTZs are unnecessary	0% (0)	0% (0)	44% (10)
NTZs are a valuable measure	100% (10)	100% (5)	56% (13)

Figure 12: Attitude towards NTZs: LEFT-Percentages for Total of Fishers. RIGHT- Percentages & Frequencies per Cooperative.
(n_T=38; Cozumel n_C = 10; Azcorra n_A = 5; Vigia Chico = 23)

The Azcorra and Cozumel fishers all showed positive attitude in recognizing the importance of this conservation strategy for their cooperative and expressed their support by commenting that NTZs are *"good for conservation"* and *"something we hadn't thought of before which will help."* One of the leaders in Cozumel pointed out that *"the ecosystem is weak, not infinite and must be conserved […] this will allow the resources, habitat and ecosystem to grow."* Moreover, an Azcorra fisher expresses a sense of ownership over the benefits of this strategy by saying, *"this is for us; the zone will saturate and species will migrate so we can catch them."*

On the other hand, attitudes amongst Vigia Chico fishers varied. 13 fishers (56%) also showed a positive attitude towards NTZ implementation, in particular those that recognized the value of past conservation initiatives (i.e. *"everything that has been done here has granted benefits, first we see it as something bad and then it yields results."*) A positive attitude was also expressed by those that are being asked or are willing to donate the reef sections of their lobster fields. However, the remaining 44% of Vigia Chico fishers did not express an endorsing attitude towards NTZ implementation within their fishing concession, even if they recognized conservation benefits. Five of these fishers did not think NTZs are necessary for their cooperative, but could be beneficial for other communities and places that, according to them, are not as sustainable. In this sense a fisher commented, *"This is only good for the Bay of the Holy Spirit, where they have to do more conservation."* Other remarks supporting that NTZs should be implemented *"only for those places where they over-exploit, like Tulum and Punta Herrero; not here, because we are already conscientious."*

Additionally, Vigia Chico fishers made reference to the specific areas which are being proposed as NTZs in order to justify their perspective that the NTZs might not bring additional benefits. Five fishers pointed out that the proposed NTZ in the central bay area (Figure 11) could be beneficial *"if there was a study that proved the bay's value as a spawning site, but there is no information"* and *"if there is something to protect, then the reasons and the benefits need to be shown so that they*

[referring to external actors] can protect it." They also explained that this area is barely fished by them and is in fact considered a *"natural refuge that we already protect."* One fisher further commented that an NTZ *"does help, but we already treat the bay area as a reproductive zone."* Only two of the fishers that expressed an endorsing attitude suggested that *"declaring it a formal NTZ would imply more benefits and more control"* and that *"stricter reserves would allow for better reproduction of species and benefit us all."*

A. 5. Perceived Challenges & Concerns

To the questions *"Do you expect there will be any challenges in the implementation of NTZ? What are your main concerns?"* (Table 1: Objective A3) a total of 86 fishers provided responses. During the interview, fishers reacted to the concept of *challenges*, and many of them quickly responded *"no difficulties at all"*. However, they were more willing to express their concerns. Responses on concerns fell into 8 categories (Figure 13). Fishers were concerned that:

1) Others might reap the benefits;

2) NTZs were an unnecessary measure and a precedent for even more fishing restrictions;

3) There could be an economic impact to individuals;

4) NGOs and authorities were not fully committed to the strategy;

5) There was too much uncertainty of the impacts of the lionfish on NTZ effectiveness;

6) Hurricanes and extreme weather events would threaten the NTZs and leave the fishers without emergency zones to fish;

7) The quality of selected NTZs is low and positive results would be unlikely;

8) There was still resistance within the cooperative to accept the NTZ strategy.

10% of fishers specified that they had no concerns. In all three cooperatives fishers are mainly worried about enforcement of NTZs and role of third parties. Also a high proportion of the Vigia Chico fishers reiterated the perception that this measure was unnecessary and redundant of sustainable practices already in place. Other concerns pointed to additional factors that may influence the effectiveness of the NTZ implementation process.

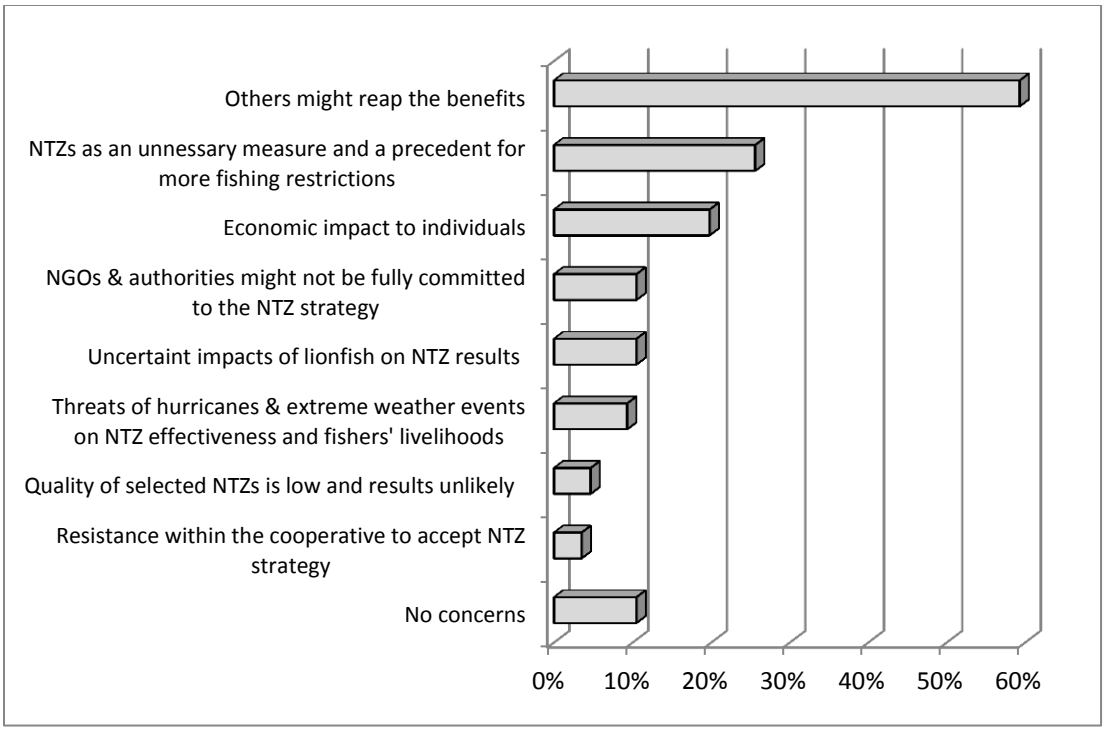


Figure 13: Fishers' Concerns Regarding NTZ Implementation
(n_T=86; some fishers provided more than one response)

Perceived concerns 1: Others will reap the benefits

51 out of 86 fishers (59%, see Figure 13) were concerned that they would not be the direct beneficiaries of the NTZs results, but that others would reap the benefits. Fishers were particularly worried about poachers in the area. To illustrate this concern, a fisher questioned, *"What if others take what we take care of?"* while another commented on the poachers that *"come with their motorboats to exploit what we are conserving."*

Tied to this concern is the challenge of enforcement. Fishers commented, *"Success depends on a lot of enforcement," "It [the NTZ] needs to be very carefully enforced, illegal fishers come at night when nobody is watching," "This will work if and only if it is respected, because others can come, dive and see what we protect"* and *"This needs more law, poachers are a big problem."*

Fishers also expressed the need for further internal regulations and sanctions to ensure collaboration of all of the cooperatives' members and workers, as well as the urgency to establish the legal basis of NTZs so that, as one of the leaders of the Cozumel cooperative expressed, *"changes in the authorities don't affect the progress we commit to."*

Poachers, however, were not the only third party that the fishers are concerned about. The Cozumel and Azcorra fishers were also concerned that parties with more financial resources could take advantage of the long-term tourism potential. On this regard, fishers responded: "*What if someone steals our tourism?" "It is not fair that that we protect areas so that the tourism entrepreneurs can use them for tourism"* and *"This needs to be fair, someone can take advantage of the situation […] those that already have a tourism industry."* These concerns need to be addressed in a collaborative environment with relevant stakeholders, to increase the sense of security and ownership amongst fishers, as well as to avoid conflicts along the process.

Perceived concerns 2: NTZs as an unnecessary measure & precedent for more fishing restrictions

22 fishers (26%) were concerned that the implementation of NTZs is both an unnecessary measure and a precedent for more fishing restrictions. Fishers voiced this worry with statements such as, *"We don't want to give too many sites […] giving up would set a precedent for more prohibitions down the road," "They can't close everything, we already respect and care," "We are already within a reserve"* and *"What if they want more? […] we are already conscientious."* This is particularly an issue for the Vigia Chico fishers (see below for main differences between fishing cooperatives).

Perceived concerns 3: Economic impact on individuals

17 of 86 fishers (20%) did feel that their lobster and fish catch was going to be limited by the conservation strategy. The reasons for this concern, however, differed amongst fishing cooperative (see section on main differences between fishing cooperatives).

Perceived concerns 4: NGOs & authorities are not fully committed to the NTZ strategy and asking for too many zones

9 fishers (10%) express their concern that the promoters of the NTZ strategy and relevant authorities may not be fully committed to the NTZ initiative. In reference to these external actors, the fishers commented, *"there is no consistency to their work," "they don´t share the results of their projects"* and *"they are forcing us to give zones, but it is our area, we know where to [best] put a no-take zone."* In specific reference to authorities, fishers commented that sometimes *"authorities say they are going to do something and then they don´t"* and *"there needs to be more involvement of the authorities, CONAPESCA for example."* It is important to note that most fishers did not express a negative attitude or a sense of distrust towards the promoters of the NTZ and the authorities. They simply expressed a limit to the number of zones they can establish as NTZs without detriment to their livelihoods, and they seem to be asking for more collaboration and involvement among parties. In fact, only one fisher from Vigia Chico expressed a distrustful attitude towards the external stakeholders while explaining his concerns.

Perceived concerns 5: Uncertainty of impacts of the lionfish on NTZ effectiveness

9 out of 86 fishers (10%) were concerned that the presence of the invasive lionfish, which has been an issue of increasing alarm in the region, would reduce NTZ effectiveness. Fishers commented on how *"lionfish will reproduce in the zones if we don´t deal with them"* and a leader from Azcorra questioned, *"What if by establishing these no fishing zones we give the lionfish a banquet and then it gets even more out of control?"*

Perceived concerns 6: Threats of hurricanes & extreme weather events on NTZ effectiveness & fishers´ livelihoods

In a region that is expected to get hit by hurricanes every 4-5 years (CONANP), 8 fishers (10%) were also concerned that the benefits of NTZs would be diminished by the impact of extreme weather events. *"They [the NGOs] have to consider the effects of hurricanes; there are still no studies on their impact despite their gravity,"* a fisher commented. In reference to these areas fishers also explained, *"We don´t want to give too many sites because we fish there when the winds get harsh"* and *"We fear that if these zones are implemented, we can never go in, and if production and weather change we might have to; right now the bay and the reef are our 'zones of rescue' when weather is bad, like with hurricane Dean."*

Perceived concerns 7: Quality of selected NTZs is low & positive results are unlikely

Four fishers (5%) were concerned that some proposed NTZs (specifically in the central bays) are areas that will probably not yield effective results. This concern only surfaced for Azcorra and Vigia Chico fishers. An influential fisher commented, *"It is not going to be what they expect […] The bay is especially turbid, how are we going to measure and conserve in those conditions?"* Another remarked, *"The sites are not good, there is not a lot of fish and it doesn´t stay there."* This is a perspective that is reinforced as the fishers are asked about the selected zones. Although only a few fishers expressed their concern on this issue, this perspective is important in balancing expectations of the results of NTZs amongst the communities and of NGOs jointly monitoring and analyzing results.

Perceived concerns 8: Resistance within the cooperative to accept the NTZ strategy

Three Vigia Chico fishers (5%) were concerned about the internal resistance or reluctance of some of the fishers within their cooperative to accept the NTZ strategy. Despite the sustainable practices that this cooperative is renowned for, these fishers insist that *"more conscience is still needed"* and *"first some feel affected [by additional conservation measures] but then they see the benefit of it."*

No expected difficulties or concerns

Nine out of the 86 fishers (10%) did not expect any difficulties and had any concerns. Fishers explained that this was because *"we have selected the zones," "it benefits us all"* and *"for the moment nothing, we will benefit from this".* In this sense, fishers did not express concerns because they felt ownership over the decision-making process or knew themselves direct beneficiaries of the results.

Differences in Perceived Concerns among Fishing Cooperatives

All cooperatives are highly concerned about the possibility of third parties, poachers and tourism entrepreneurs, reaping the benefits (Table 5). This interesting because tourism in Cozumel is perceived as a strong benefit and motivation but there is also the concern that they may not be fully involved in the process or that others may take advantage of this. It will be important to address this concern in a collaborative manner so that the fishers are well informed of the role and the interests of all the external stakeholders in the process.

The frequencies by which other concerns are stressed suggest differences among cooperatives that should be addressed in the process to ensure effective NTZ implementation and enforcement.

Table 5: Concerns-Percentages & Frequency of Responses per Cooperative
(Total n_T=86; some fishers provided more than one response)

Concerns	Cozumel (HSB)	Azcorra (HSB)	Vigia Chico (AB)
Numbers of respondents	**29**	**23**	**34**
1) Others may reap the benefits	82% (24)	61% (14)	38% (13)
2) NTZs as an unnecessary measure and a precedent for more fishing restrictions	14% (4)	4% (1)	50% (17)
3) Economic impact to individuals	10% (3)	39% (9)	12% (5)
4) NGOs & authorities may not be fully committed to the NTZ initiative	10% (3)	13% (3)	9% (3)
5) Uncertain impacts of lionfish on NTZ results	3% (1)	26% (6)	5% (2)
6) Threats of hurricanes & extreme weather events on NTZ effectiveness and fishers' livelihoods	10% (3)	13% (3)	5% (2)
6) Quality of selected NTZs is low and results unlikely	0% (0)	9% (2)	6% (2)
7) Resistance within the cooperative to accept the NTZ strategy	0% (0)	0% (0)	9% (3)
8) No concerns	7% (2)	13% (3)	12% (4)

Holy Spirit Bay: Additional concerns on economic impact and the uncertain impacts of lionfish & extreme weather events on NTZ effectiveness

Nearly half of all Azcorra fishers were also concerned about the economic impacts of NTZ implementation. Fishers explained: *"Our zone is too small, the NTZs will limit our fishing activities"* and *"our zone is small, we can´t give a lot [NTZs], we don´t over exploit." "We can't give it all,"* explained another fisher, *"we have a concession to uphold, the government can see we are not fishing and take away the permit."* This perspective on the size of their zones limited the number and type of NTZs proposed and agreed to by the cooperative. In comparison, only 10% Cozumel fishers are concerned about the economic impacts of NTZs. These fishers are mostly those who still catch fish, unlike others who only focus on lobsters fishing. They similarly express that with NTZs *"we will not be able to work and fish as before"* or *"it does limit catch."* This establishes a limit as to how far negotiations of additional NTZs can go with the Azcorra cooperative. They will have to be convinced by NTZ results in order for future negotiations or adjustment of NTZs to occur.

Moreover, Azcorra fishers were the most concerned of the effects of the lionfish and extreme weather events. 39% of the fishers in this cooperative mentioned these concerns, in comparison to the 14% and 12% from Cozumel and Vigia Chico respectively. This may likely be due to the difficulty that they have had in recent efforts to eradicate the lionfish. While the Cozumel fishers commented that they have seen a decline of lionfish in their area, Azcorra fishers still were concerned with the high numbers of this invasive species in their reef areas.

Ascension Bay: NTZs as an unnecessary measure & economic impacts

Half of the Vigia Chico fishers felt that this conservation strategy was redundant with existing sustainable practices. Reiterating their stance that this strategy was unnecessary for their cooperative, Vigia Chico fishers provided responses such as: *"This implies more restrictions, we are men of the sea! The bay is already a nucleus zone, what is the point of decreeing it as a no-take zone?", "We are not exploiting, this would only mean additional restrictions"* and *"We already take care of things here, we don't need a project for that."* Results suggest that more regulation, for Vigia Chico fishers is too much regulation, as already revealed by their responses to previous questions.

As for NTZ impacts on the fishers' economies, in the Vigia Chico Cooperative 12% of respondents identified this concern. The only fisher that still catches fish for commercial purposes expressed that *"It does affect me, so I decided not to give my field over the reef. We have to eat and reach the cooperative minimum [required by the fishing concession]"*. The rest of the Vigia Chico fishers who commented on this regard felt that this fellow fisher that still catches fish *"would be harmed by limiting entry to the bay and the reef"* and expressed reluctance to be limited by NTZs for subsistence fishing. Fishers further commented, *"It affects me, it is like a fence of control and it would be like stealing in my own house"* and *"it´s fine, as long as they don´t limit use of the reef which we use for off-season fishing. "*

A. 6. Perceived Trends in Lobster Catch

69 fishers responded to the question *"How has catch or fishing production changed through the years?"* (Table 1: Objective A4). This was asked to assess if fishers perceived a decrease in their fishing industry that could be addressed through additional measures such as NTZs. A total of 69 fishers responded that over the years catch had either:

1) Decreased;

2) Fluctuated by seasons;

3) Improved or remained stable.

Results show that the proportion of the fishers who perceived that catch has decreased did not vary by fishing cooperative. Moreover, fishers identified that the main factors that negatively impacted their catch were hurricanes and fishing pressure.

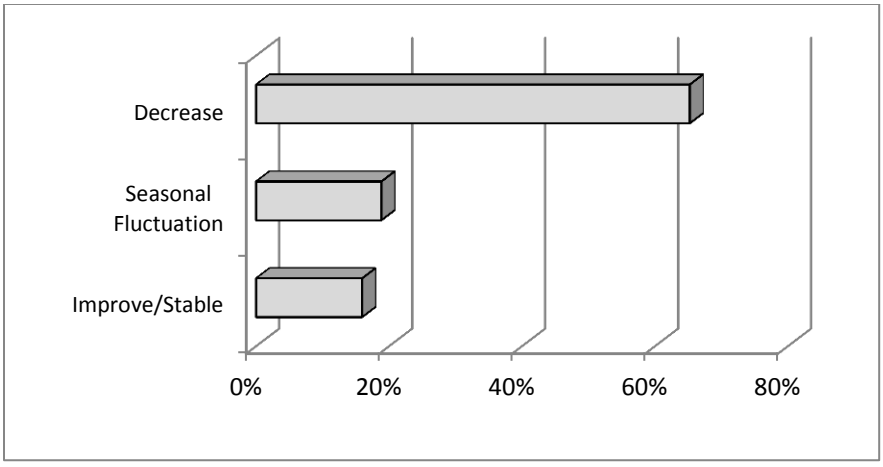


Figure 14: Perceptions of Changes in Catch from Total of Fishers *(n_T=69)*

Perceived decrease in catch

45 of the 69 fishers (65%, Figure 14)) who responded to this question perceived that catch or fishing production had decreased. *"Before there was more production"* fishers commented, along with, *"we have adopted practices and are not taking illegal species out like 4 years ago; there is more fish now but it is still decreasing"* and *"it has decreased a lot, we used to fill the boat with lobster and now we can only do that at the beginning of the season."*

Some of the fishers that perceived catch to have decreased also mentioned that changes in their fishing practices and regulations had helped but were insufficient to stabilize or increase production. Moreover, four of the fishers that had this perception insisted that additional measures were necessary to deal with a decreasing catch. A fisher detailed: "*We used to exploit everything, and it has gone down drastically, about a 50% decrease and there is less and less. It's already exploited, there is need to do more, because hurricanes affect us and there is no going around that, so we have to deal with our impact"* and others insisted, *"although changes in fishing methods have helped, it fluctuates with season, we do need more ideas", "we need to have new means of living."*

Perceived seasonal fluctuation

13 fishers (19%) perceived that catch fluctuated or varied by season. Fishers explained that *"it varies by season, last one was better"* and *"it fluctuates from season to season, it is more or less balanced."*

Perceived improvement or stability

The remaining 11 fishers (16%) perceived that catch was either stable or had improved. *"We take care of it so it hasn't decreased"* a fisher commented. The fishers that perceived that catch had increased or remained stable attributed it to their sustainable practices: *"we have changed our practices for eight years now," "we used to fish lobster even in closed season, now it is respected […] we have improved in these 6-7 years"* and *"catch has improved due to our sustainable practices and our efforts."*

Explanations of impacts on catch amongst those that perceived decreases in lobster trends

When asked *"why do you think lobster catch has decreased?"* 48 fishers either did not know why or identified one of the three following factors:

1) Hurricanes & extreme weather events;

2) Fishing pressure;

3) The invasive lionfish and its damaging effects on the ecosystem.

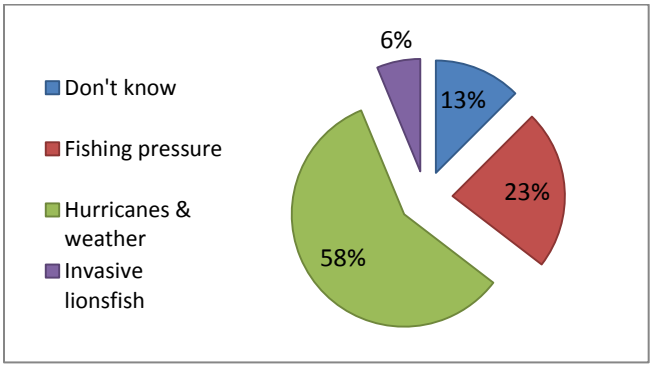


Figure 15: Explanations for Decreased Lobster Catch (n_R=48)

Explanation 1: Hurricanes & extreme weather events

48 answers were provided by the total of fishers that responded to this question to explain the detrimental effects on fishing production, and 58% referred to the impacts of hurricanes and weather (Figure 15). Fishers commented, *"Our worst enemies have been hurricanes Gilbert and Dean"* and *"We take care of it, but it´s the bad weather that affects us."*

Explanation 2: Fishing & exploitation

11 of the explanations provided (23%) referenced past and present fishing practices that still pressure the resources. Fishers commented: *"It is the exploitation that was done before that has impacted […] it won´t recover," "a lot of fellow fishers still don´t respect", "before we were not as many and there was more lobster, now there are more of us and more poachers and there is not enough for everyone"* or simply *"we are the cause of the decrease."*

Explanation 3: Lionfish

3 fishers (6%), one from each cooperative, mentioned that the lionfish had *"been affecting catch considerably"* and *"hitting us badly last year."* Conscience of the impacts of this invasive species is probable to be a growing concern of these fishers, especially as authorities and NGOs seek to mitigate the lionfish and control its impact.

Do not know the causes

Interestingly, some fishers expressed their uncertainty to the causes of changes in catch. A fisher commented, *"Catch has diminished but I don´t know if because of hurricanes or fishing pressure […] before Gilbert we broke a record of productions, then it affected us for 6 years and now there is less and it takes more effort to catch."* Another stated that catch *"has gone down substantially, but we don´t know why because there hasn´t been a hurricane recently."*

Differences among Fishing Cooperatives

There seem to be no major differences in perceptions of trends in catch per fishing cooperative. Between 62-65% of fishers in each cooperative who responded to the question perceive that catch has decreased (Figure 16). The highest percentage of this perspective is Vigia Chico. This may suggest that, despite the fact that members of this cooperative are very defensive and proud of their sustainable practices, there is still awareness of declining productivity.

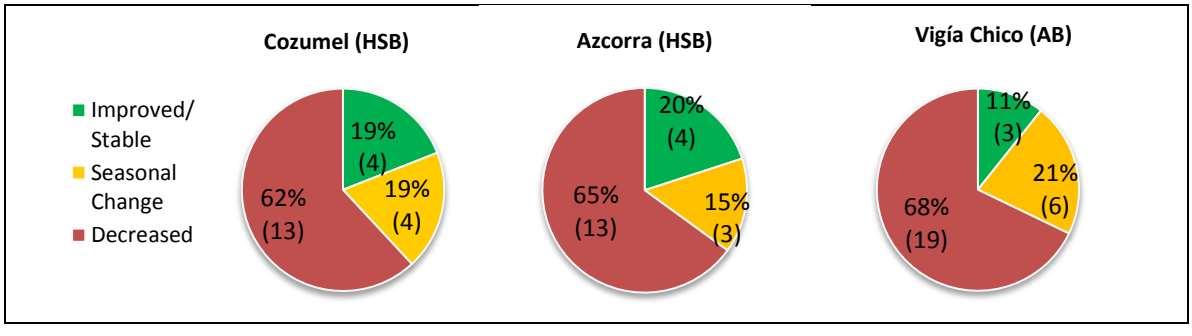


Figure 16: Perceived Changes in Catch-Percentages per Fishing Cooperative-Percentages & Frequencies
(Total n_T=89; Cozumel n_C = 21; Azcorra n_A = 20; Vigia Chico n_{VC} = 28)

In terms of factors that affected catch, a similar percentage of fishers in each cooperative identified hurricanes & extreme weather events as the main cause. Also, out of the 11 fishers that explained that decreases in catch were largely due to past and present fishing pressure and over-exploitation, 7 of them were Cozumel fishers (Table 6). This may suggest a higher sense of concern for their practices in comparison to the other two cooperatives, which could have influence the cooperative's receptivity to the NTZ strategy.

Table 6: Explanations for Decreased Lobster Catch by Cooperative *(n_T=48)*

	Cozumel (HSB)	**Azcorra (HSB)**	**Vigia Chico (AB)**
Number of Respondents	16	11	21
Don't know	0 (0)	0 (0)	29% (6)
Fishing pressure	44% (7)	27% (3)	5% (1)
Hurricanes & weather	50% (8)	64% (7)	62% (13)
Lionfish impacts	6% (1)	9% (1)	5% (1)

B. Awareness of the proposed NTZs & perspectives of the value of these areas & of the internal decision-making process

Questions in this section move away the more general perspective measured in the previous section, into the fishers' ability to identify proposed NTZs within their concessions, how valuable they think these sites will be as NTZs, if they have felt part of the cooperative's decision-making process to establish these zones and who they think should be in charge of enforcing them (Table 1: Objective B). In assessing the fishers' perspectives on these issues there is an attempt to understand each cooperative's level of involvement and sense of ownership over the NTZ strategy. What percentage of the cooperative is able to identify the NTZs that they will be involved in implementing, monitoring and enforcing? Why have they chosen these areas? Is it because they are ecologically valuable and viable as NTZs? Or is it because giving these areas does not threaten their fishing activities and as a result they are easy to agree upon? Do they feel they have been part of a process to establish NTZs that will require their help to be enforced? What aspects within each cooperative's internal decision-making processes have facilitated or challenged NTZ selection? Who do they perceive should be responsible for enforcement of these areas and why?

B. 1. Identification of Selected NTZs

As mentioned previously, by the time this research was conducted, each cooperative had selected a different number of NTZs in their concessions, with different ecological characteristics. The Cozumel cooperative had agreed to implement ten small reef NTZs and one over the Niluc mangrove forest (Figure 4). Azcorra had agreed to establish a NTZ on a section of the internal bay area, another encompassing the Canche Balam lagoon and NGOs were in the process of negotiating a reef zone along the southern coast of the reserve, near the lighthouse (Figure 5). Finally, in Vigia Chico no zones had been formally selected, but a NTZ within the bay area was being negotiated, as well as small zones along the reef within individually owned lobster fields (Figure 6).

To the questions *"Do you know which areas have or are being selected as NTZs in your concession area? Can you identify them in this map?"* (Table 1: Objective B1) all 89 fishers responded and pointed to areas. Fishers properly identified:

1) All proposed areas;

2) Most proposed areas;

3) None.

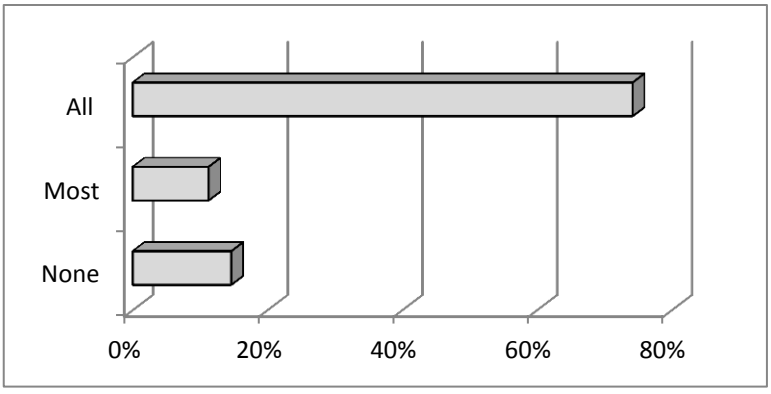


Figure 17: Identification of Selected NTZs by Total of Fishers *(n_T=89)*

The 74% of fishers that were able to identify all NTZs within their concession could name and point to the zones in the map provided (Figure 17). All Vigia Chico fishers fell under this category since there is only one NTZ that is being negotiated amongst all of them (the rest are being asked as individual donations).

Ten fishers (11%) were able to identify most of the NTZs. For Azcorra, fishers in this category identified only 1 of 2 selected NTZs. For Cozumel, fishers in this category either did not mention the NTZ over the Niluc mangrove forest or were not able to name or show on the map all 11 selected NTZs. It is important to note that the Cozumel Cooperative had selected 11 NTZs by the time research was conducted, in comparison to the 2 in Azcorra and only 1 in Vigia Chico (excluding independent donations from over the reef). They were also waiting for the zones to be mapped with specific GPS coordinates and signaled with buoys so as to gain a better sense of their location. This likely explains the reason why this cooperative showed the lowest percentage of fishers who could identify all of the zones.

13 fishers (15%) were not able to identify and point to the proposed or selected NTZs within their concessions. However, this includes 2 fishers from Cozumel who were nevertheless highly informed of the process. When analyzed by cooperative, awareness of selected NTZs is uniformly high (Figure 18).

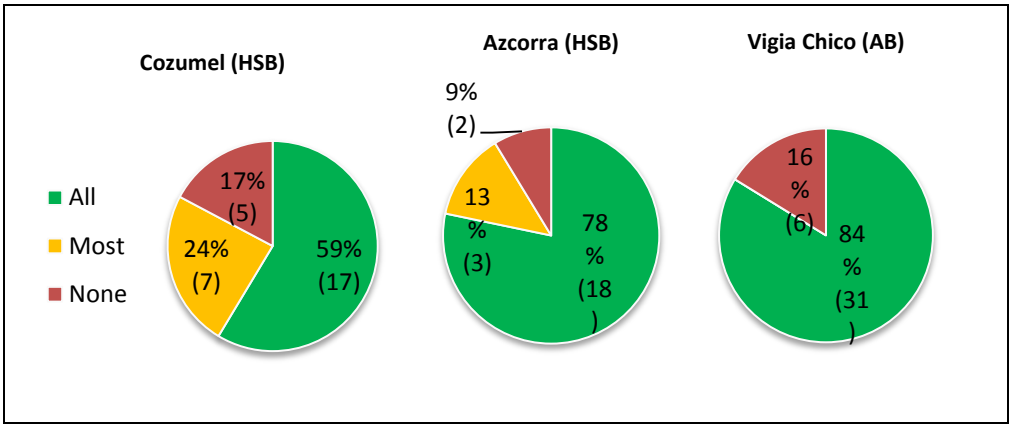


Figure 18: Identification of Selected NTZs per Fishing Cooperative
(Total n_T=89; Cozumel n_C = 29; Azcorra n_A = 23; Vigia Chico n_{VC} = 37)

B. 2. Perceived Value of Proposed or Selected NTZs

A total of 75 fishers responded to the question, "*Why are the selected areas valuable as NTZs?"* (Table 1: Objective B2). This question was asked to get a sense of whether the fishers highly valued the selected NTZs, a factor that could influence their sense of ownership and incentive to enforce these areas. Responses to this question are significant in the context of each cooperative.

Cozumel: high ecological value & low economic impact

25 of the 29 Cozumel fishers interviewed responded to this question. 23 fishers (92%) considered that the areas established as NTZs within their concessions were of high ecological value. Fishers commented, *"it is logical to give these reef areas, they are reproduction sites for species," "we all thought about what was most effective for lobster and fish reproduction," "these areas are full of marine life," "these areas are close to the spawning sites of snapper and full of caves"* and *"if we don't give places that are worth protecting, establishing NTZs is useless."* Additional to the ecological

value of these sites, some fishers were looking forward to having well protected areas for tourism. *"The reef sites are good for low-impact tourism"* a fisher commented, while another added, *"We will be able to take tourists there in the future to look at all the marine life."*

Specific to the mangrove forest area, Niluc, a few fishers explained that this area was easy to give up as a NTZ because *"nobody fishes there"* and *"Niluc has caves, can be good for fly-fishing later on and does not compromise our lobster fishing activities."*

10 fishers (40%) also commented on how these areas were selected because they did not override the lobster fields. They commented: *"These areas don't override our lobster fishing," "they are 'neutral' sites because they don't affect anyone's lobster fields*." Only 2 fishers (8%) considered that the reef NTZs did affect fish catch for the cooperative members that still depended on this economic activity. However, there is an overriding perspective within this cooperative that the selected areas are of high ecological value and will be productive as NTZs.

Azcorra: low economic impact & lack of alternatives

17 of the 18 Azcorra fishers provided an answer to the question on the value of their NTZs. 12 fishers (71%) responded that they had selected the area within the central bay because it was the only area that did not override their lobster fishing activities. They commented: *"We agreed on the bay area because we don't fish there," "the bay area doesn't affect our work,"* and *"it was easy to agree to give that area because we don't use it and we have nothing else to give."* Azcorra fishers perceived that their concession is small and that too many NTZs would significantly limit their livelihood activities.

Interestingly, there was disagreement as to how much the bay area was ecologically valuable and viable as a NTZ. 9 fishers (53%) insisted that although the area was turbid, *"it is spawning zone for lobster," "according to the elders that is where the lobster reproduces"* and *"it is good for larva development."* Yet, at least 5 other fishers (29%) commented on how *"there isn't much life there, maybe things can grow with artificial reefs but can never see because it is turbid"* and *"the bay area won't work because there are no fish."*

On the other hand, 7 fishers (41%) perceived that the ecologically valuable area was the other NTZ, the Canche Balam lagoon and mangrove area. *"Canche is a spawning zone for a lot of species", "Canche has snapper, other fish, lobster and it is a great spawning site"* and *"The Canche lagoon is very good ecologically, in comparison to the bay area which is uncertain that it will yield results."*

In comparison to the Cozumel fishers, Azcorra fishers did not consider that these areas would be useful for tourism. A fisher explained on this regard: *"For tourism we would take them to the reef areas, but we can't give these as NTZs, we don't have that much to give."* The main criterion for this cooperative, in comparison to Cozumel where ecological viability is priced, are the low-conflict, low economic impact aspects.

Vigia Chico: divergent views over the viability of the bay & high ecological value of the reef

33 of the 37 fishers from Vigia Chico responded to this question. 11 of them (33%) perceived that there was no value in establishing an NTZ within the bay area, since they already avoided fishing there. *"The bay is turbid in the center and nobody uses it, but it is not the best way to start the NTZ project," "nobody uses the bay, so what is the point of establishing it as a NTZ?"* and *"nobody fishes there so why make it official?"* The sense of redundancy with existing practices is again emphasized by these Vigia Chico fishers.

In contrast, 11 other fishers (33%) did consider setting an NTZ within the bay area as valuable. Similar to the perspective taken by most Azcorra fishers, some of them commented: *"The bay is a natural spawning site and it doesn´t affect us to give it," "the bay has caves and sponges, it is a spawning zone although a little turbid,"* and *"it doesn´t harm our fishing activities for consumption, we can give fish somewhere else."*

12 fishers (36%) considered that establishing NTZs along the reef would be of high ecological value. Fishers commented, "*There is more value in protecting the reef," "the reef is worth protecting because that is where the lobster spawns"* and *"there are a lot of fish and the reef should be conserved."* Only 2 fishers (6%) expressed doubt as to establishing reef areas as NTZs. One commented: *"It is a matter of talking with the individual owners, but it seems like agreeing to that would be difficult."* The other was one of the members with fields over the reef that was willing to donate but was unsure that establishing it as a NTZ would make a difference. *"The coral there is dead,"* he said, *"I don´t think it will get better but we will see."*

Finally, 5 fishers (15%) agree that a NTZ over the bay area does not affect the cooperative's members, but express uncertainty as to whether that is enough reason to establish it. *"It is true that the placing a NTZ* over the bay area doesn´t affect us because nobody works there anymore, but we don´t know for sure if it benefits us." These fishers suggested that selecting low-conflict areas is not enough justification to implement NTZs, particularly since they are still doubtful of the potential benefits.

B. 3. Cooperatives' Process of Selection and Agreement over NTZs

In order to assess the degree to which fishers felt part of the NTZ decision-making process, they were asked *"How were the NTZs selected and agreed upon within the cooperative?"* (Table 1: Objective B3) 77 fishers responded to the question. Analyzing the responses it is possible to group them into 3 categories. Fishers perceived that:

1) The process of selecting the zones was inclusive;

2) Leaders decided on behalf of the cooperative;

3) There is no consensus on which areas to select and how to decide.

Results indicate a clear distinction between the Cozumel and Azcorra fishers, most of whom perceived the cooperatives' decision-making process as inclusive, and the Vigia Chico fishers who revealed a lack of consensus on this matter.

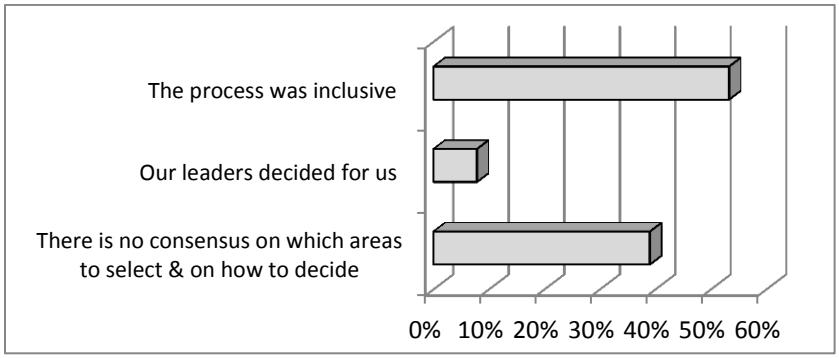


Figure 19: Fishers' Perception on the Cooperatives' Decision-Making Process *(n_T=77)*

Perception of selection process 1: The process was inclusive

41 of 79 fishers (53%, Figure 19) commented that the cooperative's internal decision-making process was inclusive and promoted consensus amongst the members in the selection and approval of the NTZs. Over 90% of fishers from Cozumel and Azcorra respectively had this perception (Figure 20). Fishers explained how *"everyone participated and gave their point of view," "the President calls monthly working meetings for all the members, guides us, and we approved the NTZs in the Assembly," "we all voted to decide"* and *"we all agreed […] we designed the zones in the meeting with the biologists and then we decided amongst the cooperative."* A fisher adds: *"I think they are good zones because we chose them, we decided amongst all of us, not only the directives,"* suggesting the importance of the inclusiveness of the process.

Cozumel fishers were particularly detailed about the process: the way that the leaders called for meetings, how everyone participated and even how those that were not convinced of the initiative were invited to form part of the Commission that would directly work with the NGO representatives. *"There is a group in charge"* commented the fishers and a leader added how they *"created the Commission with the most unconvinced members of the cooperative to reach consensus; we like 100% agreement here."*

Only 4 fishers of these 41 (10%) raised concern over a lack of consensus over some NTZs. All of these fishers were from Azcorra and still had some reservations about pending discussion over the possibility of adding another NTZ over the reef. Fishers commented, *"we still haven´t agreed over all of the sites […] having a zone over the reef is difficult, especially at the Faro, it is in the reach of illegal fishers," "the NGOs wanted the reef but we have not agreed as a cooperative, it is conflicting"* and *"some people want things to stay the same and it is hard to give the reef¸ some perceive that it would affect us too much."*

Perception of selection process 2: Leaders have decided for us

6 fishers (8%) expressed that their leaders, the Presidents and Directives of the cooperative, had decided on the NTZ strategy and zones selected. Fishers commented: *"The President did [decide]," "the directives are the ones that know"* and *"this is mostly being managed by the directives right now."* It is important to note that there are attitudinal differences between fishers of different cooperatives on this regard. The Cozumel and Azcorra fishers spoke approvingly of how their leaders have managed the situation. However, the Vigia Chico fishers that hold this perspective are not so approving. They commented, *"only the directives are working with the reserve authorities"* and *"our leaders say we will decide in the Assembly […] but they won't fool us, this is not congruent and they are not going to change our ways; it would be fine if everyone agrees, but it is redundant, the Bay is already a natural refuge and we already conserve."*

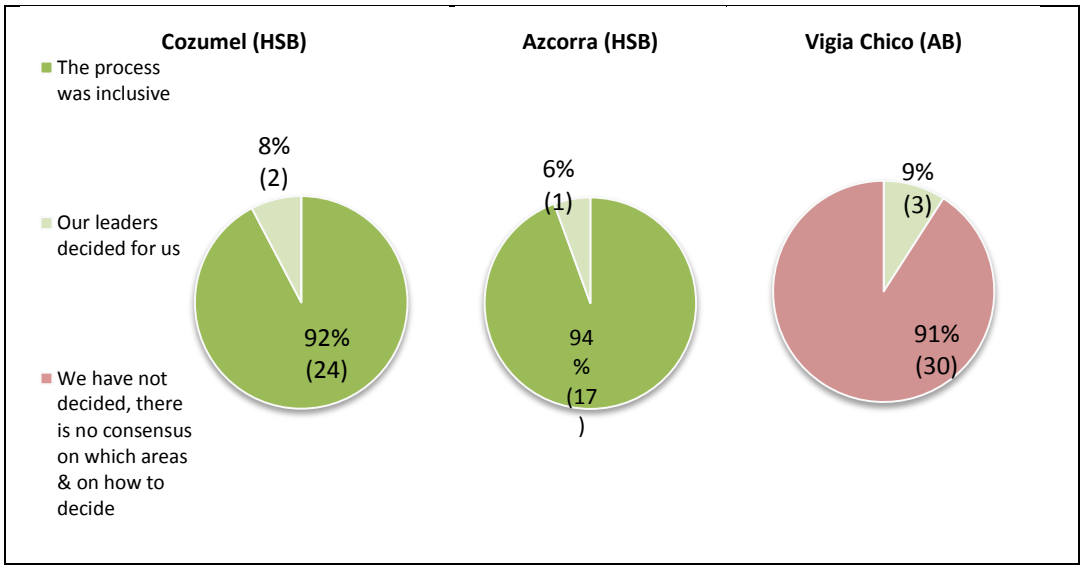


Figure 20: Perception of each cooperative's selection process of NTZs-Percentages & Frequencies
(Total n_T=79; Cozumel n_C = 26; Azcorra n_A = 18; Vigia Chico n_{VC} = 33)

Perception of selection process 3: There is no consensus on which areas to select & how to decide

30 fishers (31%), all from Vigia Chico (Figure 20), commented on the lack of agreement within the cooperative. These fishers mentioned that the selection of NTZs over the reef was the contentious issue. Some fishers were in opposition to the reef being considered and commented: *"We don´t agree with them [the external actors] wanting the reef, it is over our lobster fields"* and *"our lobster field would be divided in three parts if we agreed to this and it is not true that the majority is cooperating; it hasn´t been discussed amongst all of us."* Others are more available to the idea but still recognize it as a source of internal disagreement: *"the reef would be a big success if we all donated our parts, but there will be conflict"* and *"There seem to be differing perceptions, some members only have zones over the reef so it is going to be a conflict to donate it."* A member with fields over the reef commented on the implications of making an individual decision: *"It is going to be a fight to get the reef […] my part is up to me to decide, unless others feel motivated to oppose this as a group."*

There is also disagreement as how the NTZs should be selected, especially over the reef zones. *"Reef donations should be decided by everyone, even if it is an individual donation because we all use it for fish during the closed season,"* a fisher commented. Another fisher offered additional insight into some aspects of the internal decision-making process: *"Some members are more disposed; others don't want to give up anything […] I think everyone should cooperate and this whole process should be done according to our internal rules, because the final decision is ours."* Yet another fisher provided insight into some elements of fear and distrust implied in donating reef sections: *"I dare to support this; we barely fish anymore and not giving the reef is just resistance […] but people are not completely convinced about the initiative, so the idea of fear begins to take over."*

Of these 30 fishers, 16 expressed that individual donations should simply be decided upon by the owners of the lobster fields over the reef. In a more detached manner than the fellow fishers who expressed dissent, these fishers simply considered that *"reef zones should be the result of individual donations"* and *"there shouldn't be resistance from the cooperative as a whole because it is an individual donation and there is no pressure to do it."*

B.4. Enforcement

48 fishers responded to the question *"Who do you think should be in charge of NTZ enforcement?"* (Table 1: Objective B4). Fishers' responses fell into four categories and evidenced divided perspectives on this issue. The four perspectives indicated that enforcement should be:

1) Mainly a responsibility of the fishers;

2) A balanced collaboration between fishers and external actors;

3) Mainly a responsibility of the external actors;

4) Only a responsibility by external actors, mainly the authority of the reserve.

Results show divided perspectives across this spectrum of options, with some fishers preferring responsibility over enforcement and almost an equal percentage preferring external actors to be in charge of it.

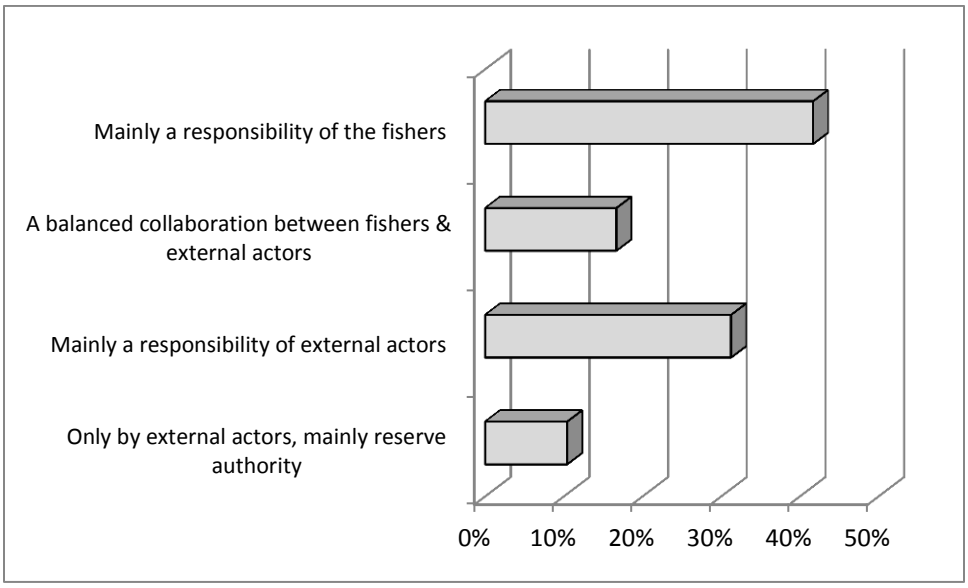


Figure 21: Fishers' Perception on Who Should be Responsible for NTZ Enforcement *(n_T=48)*

Response 1: Mainly a responsibility of the fishers

20 of 48 fishers (42%, Figure 21) responded that enforcement should mainly be their responsibility, with some support from involved NGOs and authorities. These fishers commented, *"We know where the sites are and can manage enforcement," "there are valuable financial resources in this and we will be very strict and expel those that do not respect the sites," "it should be done mainly by us because it benefits all of us"* and *"we are the ones that have main interest in this, it should start by us."* Their conviction on their enforcement capabilities, however, was paralleled with a need to receive support in effective enforcement. Fishers would add to their previous comments, *"With support from authority we need to get licensed to enforce"* and *"this should be done by us but the NTZs need to be declared formally and we need to receive capacity building and certification in order to enforce."*

Fishers also insisted that the authorities should collaborate to avoid corruption and address the threats of poaching. On this, fishers remarked: *"this is a highly important issue that is everyone´s responsibility […] the bay is easy to look over but authority must contribute to avoid internal*

corruption," "poachers are a problem near the reef areas" and *"the cooperative must take care of this with support from CONAPESCA because sometimes we deliver illegals but they are let go."*

Response 2: A balanced collaboration between fishers, NGOs and authorities

8 fishers (17%) responded that enforcement should be the results of a balanced collaboration between fishers and external actors. They remarked, *"this should be addressed by all parties, the cooperative, the biologists and the Sian Ka'an authorities," "we can look over the bay but the Sian Ka'an authorities must look over the other sites because of illegal fishing problems"* and *"enforcement needs to be stronger […] the Park Rangers don´t have time to continuously parole; the reserve, the cooperative directives and the fishers all need to help."*

Response 3: Mainly a responsibility of external actors, mainly authorities

15 fishers (31%) considered that it was mainly the responsibility of external actors to take care of enforcement, with some support of the fishers. The concern that poachers or fishers within the cooperative would take advantage of NTZ implementation is brought up again by the fishers that expressed this perception. They commented: *"It is better that external people enforce, because some [fishers in the cooperative] still do not follow the rules," "this cannot be done only by someone from here than can become friendly with the town; they gain confidence and start making exceptions," "this must be a collaboration between CONANP, CONAPESCA and then us, this might control the poachers"* and *"Sian Ka'an mainly should do it, with our support, because we have tried to help stop the poachers without success."* Other fishers insisted that they need additional support in order to effectively enforce: *"State and federal institutions should provide support for this; poaching is not an issue within the bay, but we need support for other areas"* and *"we need a lot more support, because the poachers and the Marines are not being controlled."*

Response 4: Should be done only by external actors, mainly the authority of the reserve

5 fishers (10%), all from Vigia Chico, perceived that enforcement should be done by external actors only. Some commented simply that *"the Park Ranger should do it because we are in a reserve"* and *"as far as I know this would be up to the reserve, which is what they said, that they would take care of things."* This suggests a lower sense of ownership and engagement in comparison to the other two cooperatives. The NTZ process is still not something they want to take care of on their own.

Differences in Perceptions of Enforcement Responsibility among Fishing Cooperatives

The most evident difference concerning enforcement responsibility among cooperatives is the fact that most fishers in the Cozumel and Azcorra cooperatives perceived that enforcement should either mainly be a responsibility of the fishers or a balanced collaboration with NGOs and authorities. 64% and 68% of Cozumel and Azcorra fishers respectively perceived that enforcement should be done mainly by them or as a balanced collaboration with external stakeholders (Figure 22). A higher willingness to enforce by the Cozumel and Azcorra fishers might be associated with their higher valuation of the NTZ strategy.

In comparison, Vigia Chico fishers, had mixed views on this regard and even perceive that the NTZ strategy is something that should be enforced only by the authorities, which is likely due to their geographic proximity to the reserve authority, as analyzed in the discussion. Fishers in this cooperative were willing to support enforcement but would prefer external actors to take the main responsibility. They have this perception because they are highly concerned about illegal fishers along the reef areas and the perception that internal enforcement would not be enough. Results

suggest that overall there is overriding willingness of the Cozumel and Azcorra fishers to support enforcement in collaboration with external stakeholders. This sense of ownership is likely to increase within the Vigia Chico fishers as the NGOs continue collaboration and discussion of the strategy amongst their cooperative members.

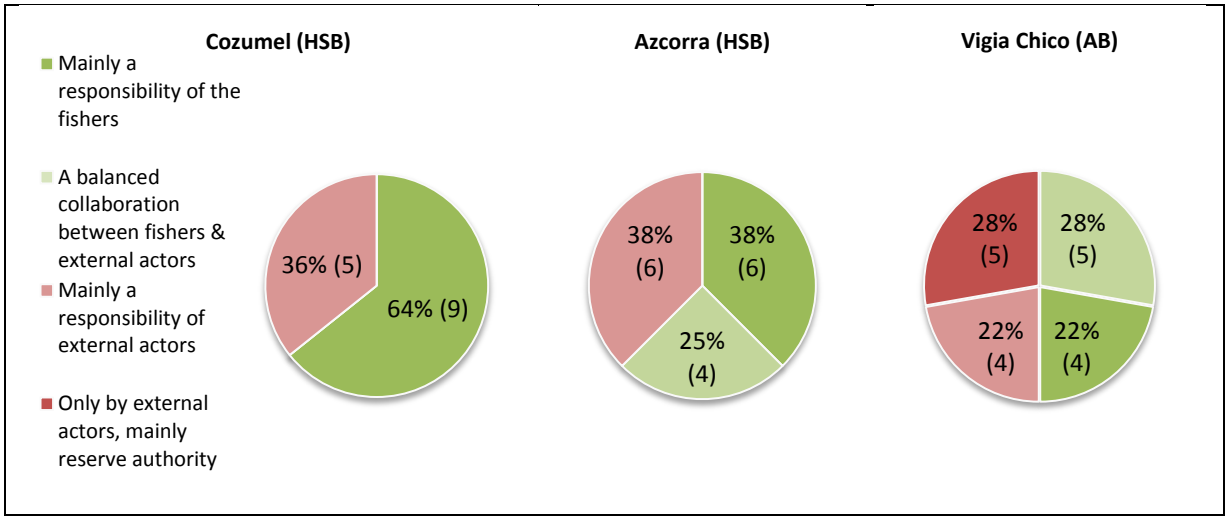


Figure 22: Perceptions of who should be responsible for enforcement by Fishing Cooperative
(Total n_T=48; Cozumel n_C = 14; Azcorra n_A = 16; Vigia Chico n_{VC} = 19)

C. Fishers' Identification of People and Organizations involved in the implementation of the NTZs, Perceptions of Trust & suggestions for improvement

This section was designed to assess the fishers' perception of the people and organizations (external stakeholders) involved in the implementation of NTZs and the process of collaboration (Table 1: Objective C). Do they recognize these people and what organizations they work for? Do fishers perceive them as trustworthy? Did fishers have an opportunity to participate in the NTZ workshops and how would they evaluate the information they received and the process that the NGOs have led?

Understanding the fishers' perceptions on these issues sheds light on the extent and effectiveness of collaboration between NGOs and fishers thus far, and the potential for further, trustful relationships between these parties in the advancement of the NTZ strategy. Finally, this section also discusses the fishers' suggestions for improvement.

C. 1. Identification of External Actors-People & Organizations Collaborating in the NTZ

87 fishers responded to the question *"Do you know the people and the organizations that have come to talk and work with you on the NTZ strategy?"* (Table 1: Objective C1). Results show that only 28% of these 87 fishers recognized the external actors who are working with them in the NTZ strategy (Figure 23). They were able to name the people by their names as well as their organizations. They identified the main NGOs, Community & Biodiversity (COBI) and Amigos de Sian Ka'an (ASK), the United Nations Development Program (UNDP), the tourism entrepreneurs and they understood that there is collaboration with the reserve authority (CONANP). The fishers spoke candidly and with respect about the people involved, which revealed a high level of interaction between representatives of these organizations and the fishers.

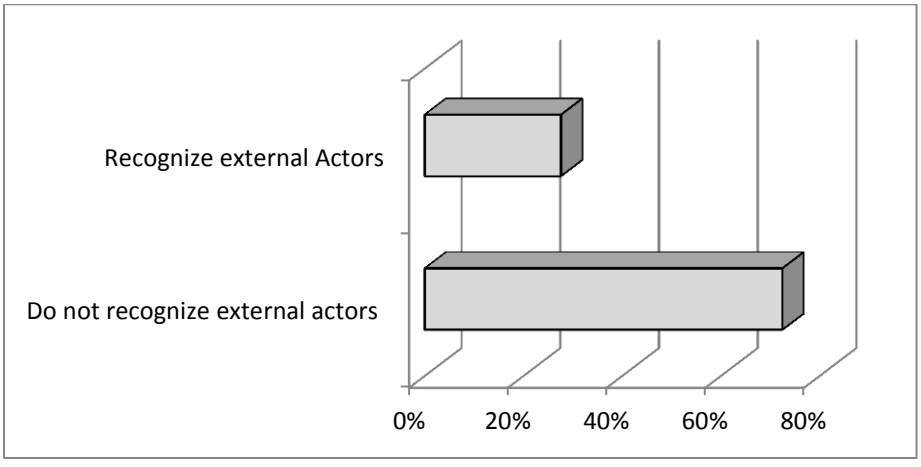


Figure 23: Identification of External Actors by Total of Fishers-Percentages *(n_T=87)*

The 72% of fishers that did not recognize actors working with them in the NTZ strategy responded in different ways (Figure 24):

1) Did not know them

2) Confused them with the reserve authority;

3) Referred only to their professional credentials;

4) Attributed their presence to the interests of the business entrepreneurs.

Almost half of the fishers did not know the external actors. Almost 30% confused them with the reserve authority and commented: *"they are people sent by the government"* and *"they are from the reserve authority."* 23% referred to their professional credentials by saying: *"they are biologists"* and *"specialists that come with their project."* Only 3% associated their presence to the interests of business entrepreneurs: *"they come with the tourism industry leader to push for more tourism"* and "*biologists and the entrepreneurs."*

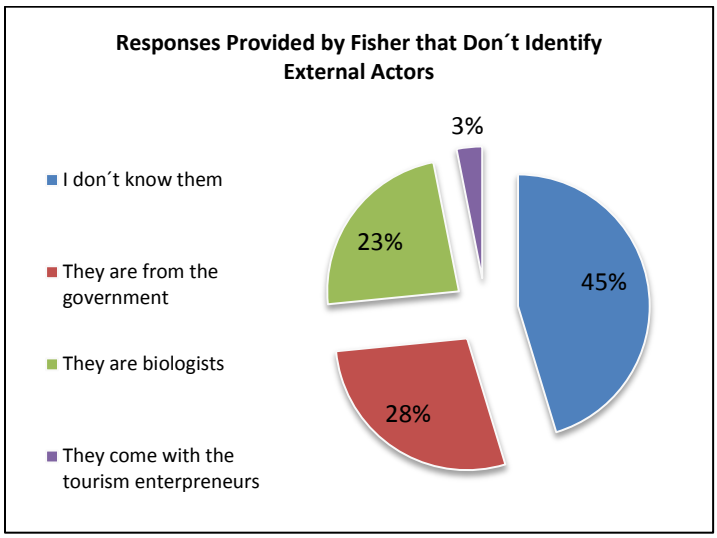


Figure 24: Responses Provided by Fishers that Do not Identify Actors-Percentages *($n_T = 63$)*

Differences in Identification of External Stakeholders among Fishing Cooperatives

Identification of External Actors

The Vigia Chico fishers seem to be the least familiar with the people and organizations that are promoting the NTZ strategy. 86% of respondents from this cooperative were not able to identify these external actors, in comparison to 66% in Cozumel and 61% in Azcorra (Figure 25). This is likely because the NGOs had less success in implementing the workshops with these fishers and because COBI had mostly worked in the Holy Spirit Bay in the spawning aggregations projects.

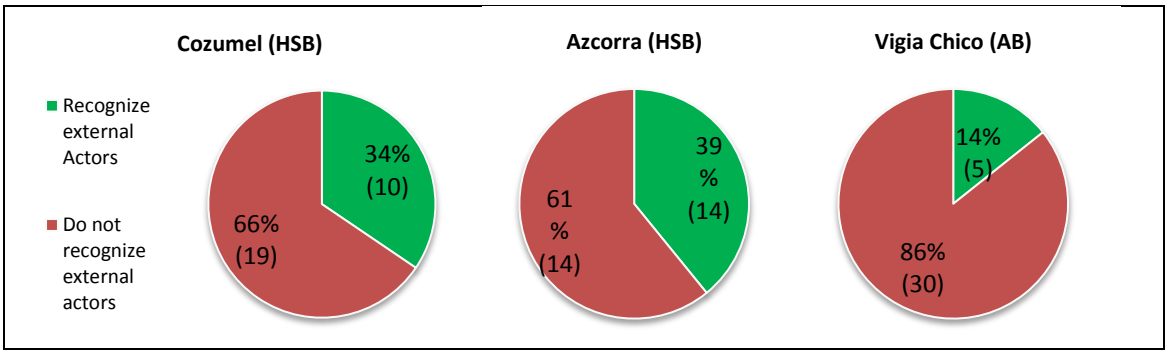


Figure 25: Identification of External Actors Promoting NTZ Strategy per Fishing Cooperative
(Total n_T=87; Cozumel n_C = 29; Azcorra n_A = 23; Vigia Chico n_{VC} = 35)

Explanations offered by fishers who did not recognize the external actors

Responses per cooperative about external actors show that 60% of Vigia Chico fishers did not know who the external actors were, in comparison to 21% and 43% in Cozumel and Azcorra respectively. In these latter two cooperatives fishers at least identified the profession of these actors or associated them with authorities.

Overall, the Cozumel cooperative is the one that mostly referred to the professional credentials of these actors (47%) and associated them least with the authorities (only 21% in Cozumel in comparison to the 36% and 30% in Azcorra and Vigia Chico respectively). Also, the Cozumel fishers are the only ones that make references to the entrepreneurs' role (Figure 26).

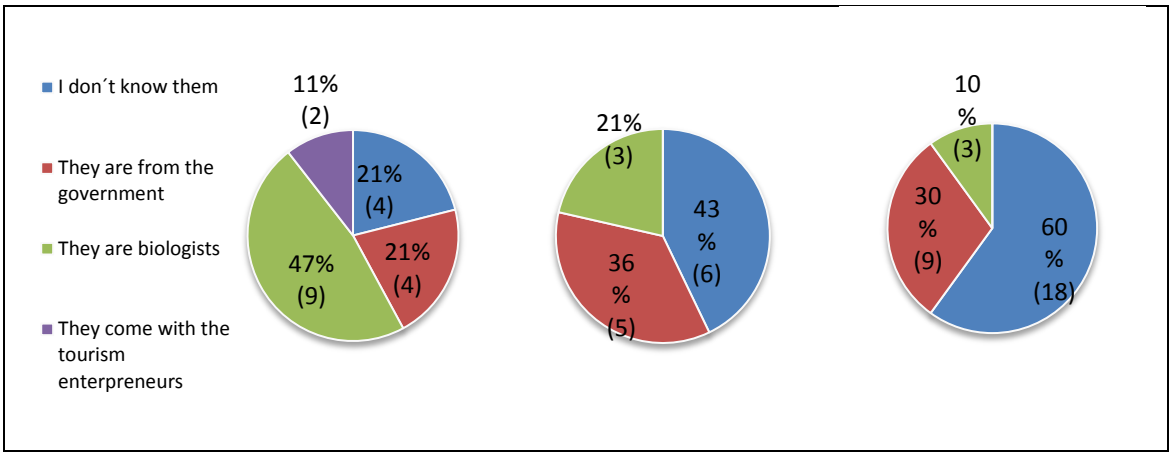


Figure 26: Responses Provided by Fishers per Cooperative that Do Not Identify Actors
(Total n_T=63; Cozumel n_C = 19; Azcorra n_A = 14; Vigia Chico n_{VC} = 30; % are of these totals.

C.2. Trustworthiness of External Actors

59 fishers responded to the question *"Do you think the people and the organizations proposing the NTZ strategy are trustworthy?"* (Table 1: Objective C2). Fishers´ responses fell into 3 categories. They perceived that:

1) They were trustworthy and had good intentions;
2) They may be trustworthy a but have yet to demonstrate it;
3) They were not trustworthy, there was not enough commitment and their motivations were beyond the fishers' well-being.

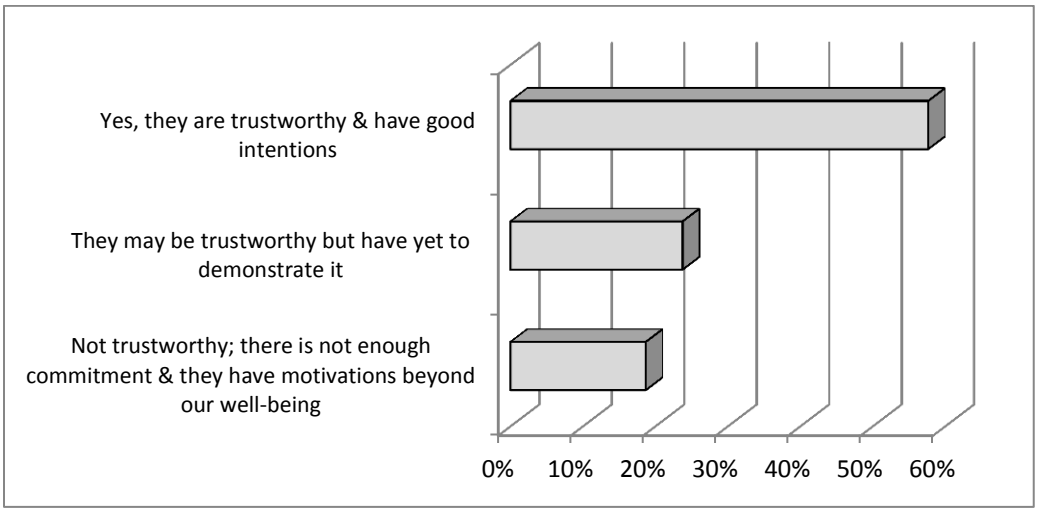


Figure 27: Fishers' Perception of External Actors- Are they trustworthy? *(n_T=59)*

Yes, they are trustworthy & have good intentions

Over half of the fishers (58%, Figure 27) who responded to this question perceived that the people and organizations that were promoting and implementing the NTZ strategy were trustworthy. Some fishers merely responded *"yes, they are trustworthy"* and "*yes, there is a lot of trust, they look out for our well-being,"* while others offered additional explanations to their perspective. Fishers made reference to their professional credentials and the value of their work: *"I respect them; they are biologists that know what they are doing, are dedicated to their conservation and are doing a good job at it"* and *"Yes, they seek to do good and they are very educated and prepared people; they showed proof of their work in other places."* Even 35% of the fishers who were unable to fully recognize the actors (see section on identification of external actors, page 49) commented: *"I don´t really know them, but they have good intentions"* and *"they are very respectful, with the ones [other fishers] that have worked with them there is more trust."*

They may be trustworthy but have yet to demonstrate it

About a quarter of the fishers (24%) suggested that trust is conditional on the results of the strategy, the commitment of the external actors and their own capacity to organize themselves. Some fishers commented on the commitment of these actors: *"Yes, they are trustworthy, but they need to me more serious about their work"* and "*There is trust if they do their work."* They also emphasize the conditionality of trust based on the results of the strategy: *"Yes, but there needs to be more studies"* and *"Once we talk further we can see; it depends on results."*

Other fishers expressed trust but rely more on their capacity to self-organize and decide for themselves for a sense of safety. Fishers commented: *"Yes, they are trustworthy, people we know, but it is because we organize ourselves to make sure this benefits us"* and *"Yes, they are trustworthy, but in a second meeting they are pushing too hard for the coral reef and that is too much […] we will be the ones to decide."*

Not trustworthy, there is not enough commitment & they have motivations beyond our well-being

The remaining 19% of fishers revealed a lack of trust towards the external actors. Fishers expressed: *"There is a lack of commitment, because they haven´t returned*" and *"They come and leave and I am unsure whether they really seek to benefit the communities."* Others commented on additional motivations: *"They are doing this only for tourism"* and *"First they gave fishers a bad feeling because they wanted the reef and the tourism entrepreneurs were mentioned as people who have a lot of resources, but it was not clear where they stood in all of this."* A fisher critical of the work of NGOs added *"they are selling this project to get money from the UN."* Interesting as well is a reaction towards foreigners: *"It is not all right that they come with Argentinians, they should be Mexican, it doesn´t make me feel like I trust them."* References to their level of commitment or their fear that more powerful parties may reap the benefits of NTZ implementation, may indicate that in addressing these concerns, trust will increase amongst the fishers.

Differences in Evaluation of External Actors among Fishing Cooperatives

Between 56-61% of fishers in each cooperative had the perception that external actors were trustworthy (Figure 28). Between 20-28% in all cooperatives believed that trust was conditional on commitment and results. Vigia Chico showed a slightly higher percentage of fishers that express a sense of distrust towards the external parties.

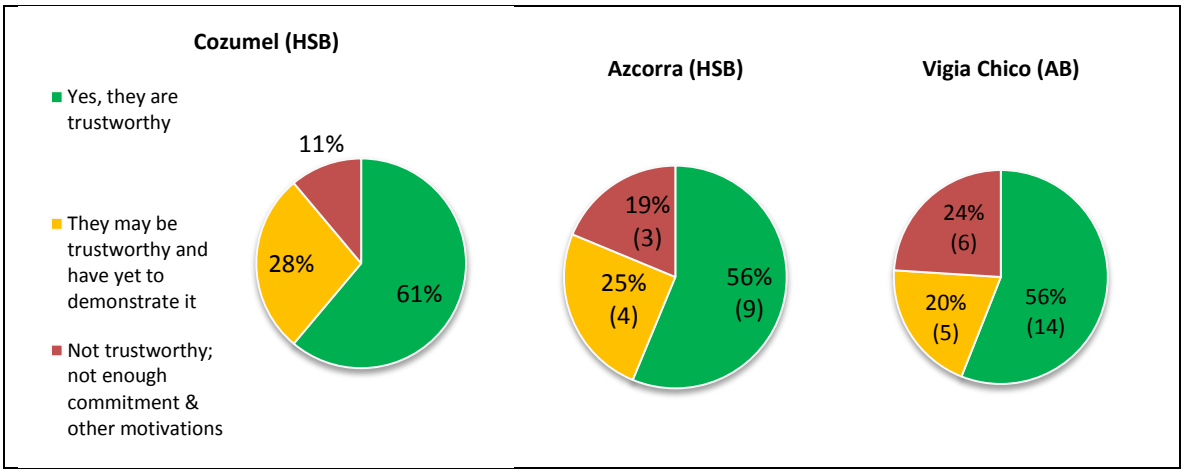
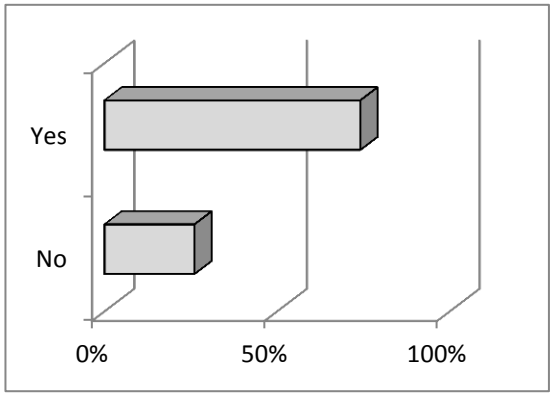


Figure 28: Trustworthiness of External Actors per Fishing Cooperative- Percentages & Frequencies
(Total n_T=59; Cozumel n_C = 18; Azcorra n_A = 16; Vigia Chico n_{VC} = 25)

C.3. Participation & Evaluation of the Process

77 fishers reported their participation or lack thereof to the workshops where the NTZ objectives were presented and the zones were initially designed. Of this total, 74% did participate and 26% did not (Figure 29). As expected, the highest percentage of respondents per cooperative who did not attend the workshops was in Vigia Chico.



PERCENTAGES & FREQUENCY OF RESPONSES PER COOPERATIVE

Participation	Cozumel (HSB)	Azcorra (HSB)	Vigia Chico (AB)
Number of Respondents	25	19	33
Yes	84% (21)	95% (18)	55% (18)
No	16% (4)	5% (1)	45% (15)

Figure 29: LEFT-Participation to the NTZ Workshops, all cooperatives combined *(n_T=77).* **RIGHT- Results per cooperative**

The 57 fishers that did participate proceeded to respond to the question *"What did you think of the information presented and the NTZ process so far?"* (Table 1: Objective C3). Fishers' responses fell into five categories, the first two encompassing positive comments about the process; the last three were critical comments (Figure 30):

1) Collaboration has been good; the external parties have worked with us and allowed us to make the final decisions on which zones to choose;
2) Information was clearly presented and the examples of results in other places were useful and convincing;
3) We still need more information and clarity about the project and areas selected as NTZs;
4) External parties need to show more commitment; they need to come back more often and work more with us;
5) They are forcing us to give too much; this project is affecting us negatively.

Results show that most fishers (61%) provided positive comments. Fishers were especially emphatic of the quality and clarity of the information provided during the workshops (Figures 30), while the most recurrent critical perception was that external parties need to show more commitment and work within the fishing communities more often to effectively advance the NTZ strategy.

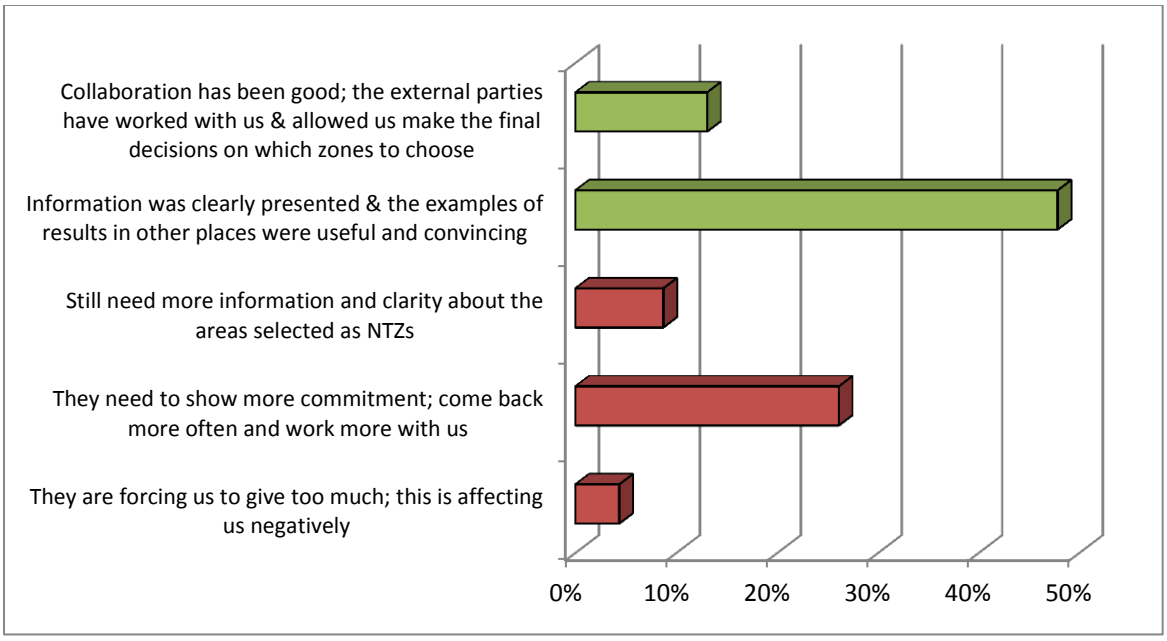


Figure 30: Perceptions of the NTZ Workshops & the Overall Process-Positive perceptions in green, Critical perceptions in red *(n=57; some fishers offered more than one response)*

Perception of process 1: Collaboration has been good; the external parties have worked with us & allowed us make the final decisions on which zones to choose

13% of fishers from all cooperatives perceived that collaboration with the external parties that are leading the NTZ strategy had been good (Figure 30). Fishers commented, *"This has been a good collaboration," "we need to continue the relationship with them [the NGOs]"* and *"the information is not the most important thing, it is consensus between all of us [fishers and NGOs] that is what matters."*

Moreover, fishers perceived that it was particularly valuable that the NGOs had allowed them to decide for themselves the areas to be delimited as NTZs: *"They [the external parties] said the NTZs were not obligatory or permanent until we decide," "they haven´t forced us," "they have helped use select the zones so that we can discuss it amongst us"* and *"they come, they sit down and we decide together."*

Perception of process 2: Information was clearly presented & the examples of results in other places were useful and convincing

The highest percentage of fishers responding to this question (48%) commented that the information provided during the NTZ workshops was clear and useful. Fishers commented how *"the video they showed us where we saw other fishers talk about the effects of the NTZs on their catch helped a lot," "they explained clearly and it was easy to understand the NTZ benefits, which convinced the fishers," "the visual explanations were very productive, we understood how the zones would work and benefit us," "they explained how long it would take for us to see benefits," "the information was very good, we understood how this project was convenient for everyone,"* and "*they explained well and with a good attitude, and that is why we all agreed."*

Fishers also expressed the value of seeing evidence of NTZ results in other places; it provided credibility to the NTZ strategy. Some fishers commented: *"We saw how they have done well in other*

places," "they presented proof of how this was working in other places," and *"it was good information and it was valuable to see that have done it in several places."*

Perception of process 3: We still need more information and clarity about the project and areas selected as NTZs

In contrast to the previous category, 9% of fishers felt like they had not completely understood the information provided and that more clarity about the project and areas selected as NTZs would be important. Fishers explained: *"We got it, I think […] There are the biologists issues and they use big words that sometimes we don´t understand," "I feel more or less informed"* and *"Information was more or less useful; it would be good to know about the areas that are going to NTZs because there is still uncertainty."*

Perception of process 4: External actors need to show more commitment; they need to come back more often and work more with us

Fishers were most critical about the external actors' level of commitment. 26% of fishers explained that it was taking the external actors too long to come back and move along the NTZ implementation process and considered that they needed to spend more time in the field, with the fishers. Fishers commented: *"they come and then they don´t come back […] we should have marked the NTZs by now," "they have to show more interest, because they don´t come back," "they need to spend more time here to get to know us," "we need more detailed information, but they take a long time to come back."* Fishers are probably not fully aware of the limitations that the NGOs themselves experience. They have limited staff, time and resources and are working at different sites and projects along the coast of Quintana Roo. These limitations need to be communicated so that fishing communities also understand the context in which the NGOs operate. Understanding of these aspects could increase trust and ownership of NTZs amongst fishers.

Perception of Process 5: They are forcing us to give too much; this project is affecting us negatively

4% of fishers commented that the NTZ process was affecting them negatively. This was a perception only to be found in the Azcorra and Vigia Chico Cooperatives, where fishers commented: *"They [the NGOs] are imposing, we already have a closed season and take care of things"* and *"instead of helping they are affecting us."*

Differences in Perception of the NTZ Process among Fishing Cooperatives

The Cozumel and Azcorra fishers, whose participation was highest in comparison with Vigia Chico fishers, equally emphasized their positive perceptions on the information provided and the collaboration with the NGOs (Figure 31). Cozumel fishers keenly mentioned that one of the results of this collaboration had been the creation of a Commission between fishers and NGO representatives to lead the NTZ implementation process. *"We formed a Commission to delimit areas and make sure we have 100% consensus within the cooperative"* a fisher explained. Moreover, fishers in this cooperative expressed only one category of critical perceptions; they insisted that external parties needed to come back more often and hurry up on the NTZ implementation process. *"NTZs should have been implemented by now,"* fishers commented, and *"the lobster season began, we should be protecting these areas as we speak."* In this sense, fishers express a sense of urgency and necessity for support in advancing the NTZ strategy, which overall demonstrates a high level of appreciation and desire for this conservation strategy.

The resistance that has been traced by previous questions on fishers' concerns and their perception of the trustworthiness of external actors reappears in this section to suggest the need for additional information, clarity and participation of NGOs and other external actors amongst the Azcorra and Vigia Chico fishers. Azcorra fishers stress the need for these parties to return and work with them more often. The motivation behind this concern is exemplified by a fisher who comments, *"They should remember we are here and alive […] sometimes these organizations only focus on Vigia Chico or they come here once and then time flies and they don´t come back."*

Vigia Chico fishers are likewise concerned that external parties have not been continuously present to explain the NTZ strategy, but a few of them recognize the factors that have impeded this. A fisher explained: *"We haven´t sat down with time to discuss the NTZ strategy with the NGOs because this has to be done during an Assembly, and nowadays fishers don´t participate as much."* Another commented: *"I can see that they [the NGOs] come with the best of intentions and are looking to collaborate and help us fishers […] but fishers show up to the Assemblies only if they are interested in what we are going to talk about, and most are not."*

Perception of Process	Cozumel (HSB)	Azcorra (HSB)	Vigia Chico (AB)
Number of Respondents	25	19	33
They are forcing us to give too much; this is affecting us negatively	0% (0)	5% (1)	6% (2)
They need to show more commitment; come back more often and work more with us	28% (7)	32% (6)	15% (5)
Still need more information and clarity about the areas selected as NTZs	0% (0)	16% (3)	9% (3)
Information was clearly provided & examples of results in other places was useful and convincing	60% (15)	63% (12)	18% (6)
Collaboration has been good; they have worked with us & allowed us to decide	20% (5)	16% (3)	3% (1)

Figure 31: Perception of the NTZ Workshops & Overall Process per Fishing Cooperative
(Total n_T=69; Cozumel n_C = 25; Azcorra n_A = 19; Vigia Chico n_{VC} = 33)

C. 4. Fishers' Suggestions to Improve the Process of NTZ Implementation

At the end of the interview, each fisher was asked if they had suggestions for how the NTZ process could be improved (Table 1: Objective C4). 55 fishers responded with suggestions, most of which fell equally across the following broad categories:

1) To improve the NTZ strategy within the fishing communities: focus on enforcement, implementation of artificial reefs in the bay areas and consideration of additional incentives & fishing regulations;
2) For the NGOs and authorities: increased communication;
3) For other fishing communities that may be involved as the NTZ strategy scales: encouragement to endorse this project and appreciate its benefits.

1. Suggestions for improving the NTZ strategy within the fishing communities

Enforcement through temporal contracts

Fishers emphasized the importance of enforcing selected NTZs. Fishers commented: *"there needs to be good enforcement, because that is the only way this is going to benefit us."* Fishers called for increased involvement of authorities so that they could be supported in the process and stricter patrolling of these areas: *"They should be careful and patrol and protect day and night."* Vigia Chico fishers offered suggestions on how the reef NTZs should be enforced. They proposed temporal contracts for fishers to enforce NTZs over the reef areas. *"Enforcement should be done through temporal contracts that pay fishers for enforcement to ensure commitment and effectiveness."*

Invite illegal fishers into the process

Concerned with the possibility of illegal fishers reaping the benefits of NTZ implementation, some fishers proposed inviting them into conversations about the value of NTZs. Fishers suggest that *"The promoters of this strategy should involve and convince poachers about the value of the NTZ"* and *"Invite illegal fishers into the process and tell them about the zones, see how they respond".*

Artificial reefs in the bay areas to improve habitat conditions for reproduction of species

Azcorra fishers, concerned about the ecological viability of the NTZ within the bay area, suggested adding artificial reefs to improve the habitat for species. Fishers commented: *"We could improve habitat conditions within the bay by putting in artificial reefs."* This suggestion was individually reiterated by a number of other fishers, and a leader confirmed that they were analyzing the possibility of investing in this option, parallel to supporting the NTZ strategy.

Tie collaboration to additional incentives & focus on other fishing regulations

Several Vigia Chico fishers recognized their cooperatives' resistance to the NTZ strategy and suggested focusing on non-NTZ alternatives. Some fishers commented that they needed to see additional benefits connected to the NTZ strategy, particularly since they saw no added value in regulating areas that they already protected: "*Fishers need to be motivated through other means […]"* In fact, fishers suggested that perhaps external stakeholders should focus first on other fishing regulations rather than on the NTZ strategy. They commented on the need to adjust the fishing season given the weather changes that they were experiencing: *"Rains are coming in sooner than expected now, and that drives the lobster out of the bay before the beginning of the season. Maybe we can adjust the season to these changes and make it shorter: six months for fishing and six months for the fly-fishing business"* and *"maybe we can mix the seasons, close from September to November*

when the rains are hitting the worst and then reopen." Through these comments, Vigia Chico expressed their preference for improving other fishing regulations as opposed to the NTZ.

2. Suggestions for the NGOs and authorities

Increased communication & involvement of NGOs and authorities

Fishers responded to this question with suggestions on how to improve the process by expressing the need for additional communication and involvement of the NGOs and authorities. Fishers insisted that they needed to be informed and involved in the process more thoroughly. Fishers suggested: *"there needs to be more energy in this project, not just talking, if not we will lose interest. We particularly need more communication between us and them, so that all fishers see this positively"* and *"there should be more consistency, more frequent communication and field visits so that we can collaborate effectively."*

Other fishers stressed the importance of communicating results before making additional decisions. *"Maybe we should try it out with one NTZ and see the results so that we are all convinced"* and *"They [the external parties] need to communicate more; the spawning project we worked on together ended and they kept all the information, we want to know how things ended."* In their perspective, this would render credibility to the project and added endorsement from the fishers.

Fishers from Vigia Chico who made suggestions along the lines of increased communication insisted that sharing scientific information was critical in advancing the study. *"We need to see a study that proves that there is something to take care within the bay so that everyone respects the zone; otherwise it is redundant and limiting"*, *"The people of the project need to show us the benefits and the results with studies and a lot of communication"* and *"There needs to be more communications of results and elders should be consulted because they are the ones that have been here the most and know about the changes."*

Also, fishers suggested that increased commitment and involvement of the external stakeholders would improve the NTZ process. They commented: *"They need to visit us more; they come and don't return […] Fishers do understand, but they lose interest if they take time to come back,"* "*time is flying, they need to come back more often"* and *"They need to stay longer and get to know us."*

Finally, some fishers acknowledged how positive the process of collaboration has been, and suggested always to leave the last decision to the fishers. *"If the final decision is the fishers' to make, they will accept the NTZs."* Fishers suggested that investing in communication and field visits, and making sure they had access to NTZ results would enrich collaboration and potentially improve the NTZ strategy within the communities.

Two fishers added that it would be wise to modulate the NTZ strategy according to each cooperative. One commented, *"Every cooperative has its own realities and questions, and this process should address them to ensure collaboration."* Finally, an encouraging fisher added that the NGOs promoting this project should, *"have patience, because there are a lot of fishers who are resisting, but this is something that must be pushed on for the benefit of all of us."*

3. Suggestions for other fishing communities that may be involved as the NTZ strategy scales

Endorse NTZ implementation

Fishers from the Cozumel and Azcorra cooperatives also offered suggestions to other fishing communities where the NTZ strategy could be implemented in the future. Their comments are

particularly encouraging and they insisted that other fishers should endorse this conservation measure. Fishers said, *"I would recommend that fishers in other communities say yes to this project, we have been convinced by the benefits," "this is good for their economies, they should accept this," "other fishing communities should really take advantage of this, it is a great benefit," "fishers in other places should not oppose, they should accept, choose good sites and respect them, this is a long-term benefit"* and *"fishers have to collaborate, seek agreements and avoid conflict, this is for our future."* These encouraging comments and suggestions are consistent with Azcorra's and Cozumel's acceptance of the NTZ strategy within their concession, as well as with their disposition to negotiate with the NGOs.

In line with these comments, some fishers were eager to start seeing results and travel to other communities to share their results. "*We are looking forward to sharing experiences with other places down the road, so that fishers know that there are results and that they just have to be patient"* and *"other communities can come here and see if the zones yield good results, this is for our future."*

6. DISCUSSION

Discussion of the results is divided in four parts. Section A discusses the methodology of this study. Section B discusses fishers' perceptions of NTZ implementation in the Sian Ka'an Biosphere Reserve and highlights findings consistent with other research. Section C takes analyzes these perspective by taking into account the broader multi-stakeholder and collaborative process in which the NTZ strategy is embedded and, through a policy dialogue framework, discusses how the process can be improved in the Sian Ka'an Biosphere Reserve and applied to other fishing communities as the initiative scales. Section D addresses some of the nuances of collaborative marine resource management and NTZ implementation.

A. ON THE METHODOLOGY OF THIS STUDY

The qualitative methods used in this study were effective in ensuring a large sample, high interview rate and in-depth responses that allowed for detailed exploration of the fishers' perceptions. The interview guide approach (Gall, Gall & Borg, 2003) was useful in ensuring that fishers provided the same information without the need of a structured and invasive question-answer format. The participatory observation approach was also successful in building rapport within the communities and establishing a sense of trust so that the fishers could reliably convey their perceptions, interests and concerns. Participatory approaches have been effectively used in the same region to establish rapport with rural communities and bridge data gaps in natural resource management (Arce-Ibarra & Charles, 2008). The discomfort caused by the presence of the tape recorder was substituted by detailed on-site transcription, so that the fishers could be consulted to clarify doubts or inconsistencies. All of the interviews, transcriptions, translations and response categorization were done by the researcher, which allowed for consistency in interview application and data analysis, although potential researcher bias could have been reduced by cross-checking response categorization. This case is not meant to fully illustrate the complex reality of fishing communities in the Sian Ka'an Biosphere Reserve, or be representative of other fishing communities or natural protected areas in Mexico.

The qualitative methods that have been prioritized by this study have been determined useful in understanding people's perceptions and experiences of well-being in other research, although these methods require time, energy, sensitivity and caution in establishing an ethical relationship between researcher and participant (Camfield et al., 2009). The semi-structured interview methodology has been effectively used in similar research (Pita et al., 2011). Additional to open-ended questions, similar studies on fishers' perceptions have used Likert-scale and multiple-choice surveys, ranking and rating approaches and statistical analysis to complement qualitative data analysis (Pita et al, 2011). One of the most commonly cited limitations of these survey methods are informant accuracy (Freeman et al., 1987; Presser and Traugott, 1992) which can be compensated for by observation and cross-validation (Arce-Ibarra & Charles, 2008). A Likert-scale survey was originally developed as part of this study as a cross-validation source of information, but the fishers had difficulty providing answers through the five-point scale – they preferred to provide more qualitative information – so the survey tool was abandoned early in the process to emphasize the value of their perceptions. Additional surveying methods and observations for cross-validation could have been applied through further visits to the communities. Another limitation of this study is that it relies solely on the fishers' perceptions, and does not correlate them with actual fish catch data, as done by similar studies (Leleu, 2012).

B. ANALYSIS OF FISHERS' PERCEPTIONS

High Awareness & Understanding of NTZ Objectives

Results showed that by the time research was conducted awareness of the NTZ strategy had significantly permeated the fishing communities of the Sian Ka'an Biosphere Reserve as an issue of importance. Fishers' understanding of the NTZ objectives to regulate fishing and protect spawning and species was high and consistent with the information provided to them through the NTZ workshops. The effectiveness of these on-site workshops to communicate the objectives of the NTZ strategy and promote participation of the communities is stressed by the fishers themselves. A majority of them perceived that the information and examples provided allowed them to clearly understand the benefits of NTZ implementation. The accessibility and sharing of information plays a key role in creating common understanding and establishing working relationships between fishers and NGOs towards improved collaboration and enforcement of NTZs.

Perception of a common problem between fishers & NGOs leverages collaboration

Fishers take pride in their work, in the practices they have adopted to sustain the fishery and in their ability to collaborate with external stakeholders (NGOs, authorities, researchers and private actors). Consistently across cooperatives, over 60% of fishers perceived a declining trend in lobster catch. NGOs and fishers share the perception of declining fisheries which may leverage the willingness to jointly explore the viability of NTZ implementation to address this problem.

Expected NTZ benefits increase perceived value of the NTZ Strategy

Fishers' perceptions of expected benefits revealed that the fishing communities care about the sustainability of the marine ecosystem: its health, viability for species reproduction and protection, as well as its existence for future generations. The fact that the NTZ strategy is currently not limiting these fishers' main economic activity – lobster fishing – motivates them to endorse it and focus on understanding and experiencing the added benefits.

Almost half of the fishers interviewed expressed their expectation of increases in lobster catch. Amongst Cozumel and Azcorra fishers a majority expected NTZ results in a timeframe of 4-5 years, which is again consistent with the information provided to them during the workshops. Fishers also expected to be benefitted by increases in the tourism potential and access to financial resources. This is particularly relevant for Cozumel fishers, who are willing to establish NTZs over reef areas and value the broader collaborative context of the NTZ initiative as a venue for developing their tourism industry. Amongst Vigia Chico fishers who have lobster parcels over the reef, the implementation of NTZs provides the added benefit of excluding others by prohibiting any extractive activities and thus showed an endorsing attitude towards the NTZ strategy. These expected benefits reveal key motivating factors in the acceptance of the NTZ strategy. Finally, Cozumel and Azcorra leaders are encouraged to support NTZs in their concessions if it means that they will be further recognized for their sustainable practices. These results are consistent with the research that suggests that fishers' perceptions of NTZ implementation largely reflect their interests and concerns (Pita et al., 2011).

However, results also showed differences in attitude towards the endorsement of the NTZs between fishers in the Holy Spirit (Cozumel and Azcorra) and Ascension Bays (Vigia Chico). In light of the varied benefits that they perceived, all of the Cozumel and Azcorra fishers who expressed an attitude towards NTZ implementation perceived this strategy to be a valuable measure. On the other hand, the 26% of fishers who expressed that NTZs were an unnecessary measure were from Vigia Chico. They were not opposed, in concept, to the NTZ strategy, but these fishers widely felt

that this strategy was unnecessary because its benefits pre-exist as a result of their careful fishing practices. Moreover, fishers in this cooperative insisted on additional studies and information to justify NTZ implementation within their bay area. In as much as they recognize the need to address the fact that fisheries are declining, they have other fishing regulations and measures in mind, such as the adjustment and reduction of their lobster fishing season since they can focus on the fly-fishing business as an income alternative. NTZ implementation for Vigia Chico is not the preferred alternative to dealing with fisheries decline; it is perceived to provide limited added value and increased restrictions. These results are consistent with the common trends identified in Pita et al. (2011) on fishers' preferences for less restrictive regulations, particularly in light of remaining uncertainties surrounding NTZ results (Helvey, 2004).

Fishers are concerned that others will reap the benefits of their sacrificed, that enforcement will be difficult and that lionfish and hurricanes can impact NTZ effectiveness and call for added involvement of NGOs and authorities

Fishers' greatest expressed concern was that *others*, illegal fishers and third parties with tourism interests, would reap the benefits of their sacrifice. Over half of the fishers were concerned about this issue and stressed the importance of effective NTZ enforcement. This concern points to an important distinction between fishers' ownership over NTZs – to ensure compliance and participation in monitoring and enforcement – and their ownership over the results and benefits. Addressing this concern and tracking fishers' perception of equitable sharing of NTZ results is critical in long-term compliance and enforcement of NTZs (PISCO, 2007).

Throughout the interview process fishers also expressed their concern about the level of involvement and commitment of the NGOs and on the interests of some of the other stakeholders, such as private actors and tourism entrepreneurs, which were still unclear to them. Avoiding misperceptions and shattering stereotypes requires that time and effort be devoted to engaging participants and fostering a shared understanding (Wondolleck & Yaffee, 2000). When asked to provide suggestions, fishers insisted on added involvement and participation of NGOs, authorities and private actors with the fishing communities so that through increased dialogue and collaboration the interests and concerns of each stakeholder could be better understood. It is important to respond to this concern in order to increase the fishers' sense of ownership over the NTZs towards enforcement and results, their sense of security as direct beneficiaries of a measure that limits their fishing activities, as well as to avoid conflict within the process.

Fishers were also concerned about the economic impact associated with NTZ implementation. Even if their lobster fishing is not being constrained, 20% of them still express that their fish catch will be limited and perceive the establishment of NTZs as an important extractive restriction over their fishing concessions. This is particularly the case with the Azcorra fishers, some of whom perceive that their fishing area is small so there is a limit to the amount of NTZs they can establish. Understanding these limitations and continuing constructive dialogue will be important in identifying the most ecologically viable NTZs with the least impact on fishers (Klein et al., 2008).

Finally, fishers were concerned that the invasive lionfish and the threat of hurricanes can have a significant effect on NTZ results. The fishers' and NGOs' ability to deal with this uncertainties and incorporate them into NTZ monitoring and enforcement will prove pivotal in the long-term value of this conservation measure.

High identification of selected NTZs & differences in perceived value of each site

Consistently across cooperatives, about 80% of the fishers identified the location of NTZs that had been selected within their fishing concessions. This again suggests a high level of awareness of the NTZ strategy amongst cooperatives. There are significant differences, however, in the type of zones that each cooperative designed and on their perceptions of the value of each site as a NTZ.

Cozumel fishers associate NTZ benefits with the value of the zones they have designed, since they are mostly coral reef areas in good condition and mangrove forest heavy in marine life. Azcorra fishers have a similar perception of the ecological viability and reproductive capacity of the Canche Balam lagoon, one of the two sites they have selected.

This is not the case, however, with the bay area NTZs that are being proposed within the Azcorra and Vigia Chico cooperatives. These sites are mostly muddy sea-grass areas, and there is uncertainty about their value as reproductive sites. Some fishers insist lobster spawns in those areas, others express there is very little marine life and yet others simply express uncertainty regarding its ecological value. In selecting this zone, Azcorra fishers perceive, not ecological viability, but value in establishing this area as a NTZ because it does not affect any cooperative member – i.e. it is a low-conflict decision, decided on the basis of consensus –. Their expectation of results is low or uncertain and, unlike Cozumel fishers, they do not see it as a site with tourism potential. Vigia Chico fishers likewise expressed mixed views about the reproductive potential of their bay area, but generally agreed that there is no real value of establishing it as a NTZ because fishers already do not fish there. In this sense, decreeing this site as an NTZ is not likely to provide added benefits but merely added regulatory demands. Monitoring and comparing NTZ results between these ecologically different sites is important in continuing to collaboratively protect marine resources and fisheries. Moreover, ensuring that the fishers both receive and understand the NTZ results will avoid differences in perception between fishers and scientists and promote joint-evaluation and adaptive NTZ management.

Varied perceptions of the cooperative's NTZ selection process & enforcement responsibilities

Over 90% of the fishers in the Cozumel and Azcorra fishers perceived that the cooperative's decision-making process was inclusive and resulted in the selection of zones that all fishers agreed upon. Cozumel fishers were particularly detailed on the consensus-based process that was driven by their leaders to make sure that everyone was on board with the NTZ strategy. They also proposed a model for dealing with resistance within the cooperative, whereby fishers that were not convinced of the value of the strategy became part of a Commission that sited the NTZs in collaboration with NGO representatives. This cooperative's investment in consensus is a strong measure of ownership and perceived value of NTZs amongst all members, which is likely to result in high compliance and engagement of fishers in monitoring of the results. This result is reinforced by the fact that over 60% of fishers in the Cozumel and Azcorra cooperatives also expressed their willingness to be in charge of or jointly enforcing NTZs with the NGOs and authorities.

On the other hand, 90% of Vigia Chico fishers expressed that there was no consensus on how to decide and which zones to select, which further challenged their endorsement and sense of value over the NTZ initiative. Only 50% of fishers in this cooperative expressed a willingness to enforce the NTZs, the other half preferred that external actors and authorities be mainly responsible for this activity. These results are not surprising, given that Vigia Chico fishers saw less value in accepting NTZs than did their neighbors in the Holy Spirit Bay and thus had not invested in generating internal consensus. Moreover, there are geographical differences to consider in evaluating their willingness

to enforce NTZs. There is more immediate access to Ascension Bay than there is to the Holy Spirit Bay and, given their limitations and the geographical constraints, the reserve authority has had more presence in Ascension Bay. As a result, fishers' expectations of what the authority can and should do are different than those in the Holy Spirit Bay. As further analyzed in the next section, addressing the political context and regulatory constraints will be critical in viably implementing NTZs.

High participation in the NTZ workshops and positive perceptions of the process led by external stakeholders in the Holy Spirit Bay

Over 70% of fishers participated in the NTZ workshops. Nearly all of Cozumel and Azcorra fishers were able to participate. In contrast, Vigia Chico fishers, who live in a more dispersed settlement, have more cooperative members and a more complex organizational structure, had slightly over half participation.

Fishers were appreciative of the participatory process led by the NGOs, which included them in the design of the NTZs and left the final decision on which areas to select to the fishers. Over half of the fishers were particularly positive about the quality of information provided and the usefulness of the examples provided on NTZ implementation in other areas of Mexico and around the world, which allowed them to understand the benefits and value of this conservation measure. However, increasing fishers' understanding of conservation measures is only one factor of a more complex collaborative dynamic to ensure stewardship over the NTZs. In this sense, the most recurring critical comment about the NTZ negotiation process was, once again, on the level of commitment and involvement of the NGOs and authorities. The recurrence of this concern highlights the challenges of small NGOs in pursuing community-based, scalable, conservation strategies with limited human, informational and financial capital, as will be analyzed in the next section.

Positive perceptions of trust and respect of external stakeholders

Despite the fact that only 30% of the fishers fully recognized the people and organizations that are leading the NTZ process, almost 60% did perceive the external actors as trustworthy, which facilitates dialogue and collaboration. Fishers also expressed respect for the professional credentials of the external actors and the knowledge they brought into the communities. In this sense, the NGOs ability to access information empowers and renders them the necessary credibility to promote NTZs within the fishing communities. Moreover, these results suggest a positive start in the creation and sustaining of the working relationships that can ensure effective implementation and evaluation of NTZ results.

An additional 24% of fishers expressed that trust could increase as collaboration continued. In so doing, they highlighted the importance of on-going relationships in the advancement of the NTZ strategy. Interestingly, perceptions of trust were consistent across cooperatives, regardless of the fact that Cozumel and Azcorra had overridingly agreed on the implementation of NTZs and Vigia Chico had not, or that most fishers did not fully recognize the external actors. This reveals the complex nature of trust and its relationship with the establishment of working relationships, exploration of interests and the potential for consensus building (Wondolleck & Yaffee, 2000).

Fishers' suggestions

Fishers gave their perceptions on how to improve the NTZ strategy within the communities and directed additional suggestions to NGOs, authorities and other fishing communities in which this initiative might later be implemented.

On how to improve the NTZ strategy, fishers were particularly concerned about enforcement, which ties the community-based NTZ strategy with a larger and highly complex political and regulatory context. They proposed temporal contracts for fishers to enforce the sites a measure that is already being taken by the Kanan Kay Alliance, along a with capacity building strategy. Also, some fishers suggested inviting illegal fishers into the participatory process. They thought that by including them they could understand the benefits and contribute to the protection of the zones. Azcorra fishers, concerned with the ecological viability of the NTZ in their bay area, proposed investing in artificial coral to improve the habitat for species reproduction within this site.

Suggestions for NGOs and authorities reiterated the need for additional investment, communication and presence of these external actors in the communities. This again highlights an area of opportunity for additional trust and strengthening of working relationships. However, this also reveals the need for the NGOs to differentiate themselves from the authorities' agendas and activities and of communicating their limitations to the fishers so that they can adjust their expectations.

Fishers from the Cozumel and Azcorra cooperatives offered suggestions to other fishing communities where the NTZ strategy might also be implemented. They called on other fishers to also endorse this measure and select viable sites, stressing the long-term benefits of this conservation measure.

C. ANALYSIS OF RESULTS USING THE POLICY DIALOGUE FRAMEWORK

The following sections analyze the results of this study using the Policy Dialogue Framework (Ehrmann, 1997) to identify facilitating factors and challenges in the implementation of NTZs in the SKBR towards improving the process in the Sian Ka'an Biosphere Reserve and applying it to other fishing communities as the initiative scales.

C. 1. Negotiation & group dynamics: process, trust, incentives & organizational structures

Co-designing and implementing NTZs between fishers and NGOs is a negotiation. The NTZ process in Sian Ka'an has been the result of conversational interactions between participants with different interests and concerns, who are working collaboratively to address the issues of marine resource and fishery degradation along the coast of Quintana Roo. Reaching consensus on how to address these issues requires the careful consideration of participants' incentives, their level of comfort with the underlying uncertainties of complex environmental issues, their perceptions of whether the process is proceeding in a fair manner, as well as their perceptions of trust (Ehrmann, 1997). Moreover, patterns of communication and familiarity of stakeholders involved can play key roles in shaping small group dynamics and influence the wider decision-making process.

The analysis of fishers' perceptions on NTZs in the Sian Ka'an Biosphere Reserve has already discussed the effectiveness of the NTZ strategy to create awareness and understanding amongst fishers of the value of this conservation measure. NGOs and fishers share the perception of declining fisheries. A platform for interaction, dialogue and sharing of high quality information is being established by the NTZ strategy in Quintana Roo to address marine resource challenges. NGOs have managed to promote wide participation of all of the fishers of the Cozumel and Azcorra cooperatives. In turn, these fishers are appreciative of the fact that they are being directly involved in the decision-making process and their nascent perceptions of trust towards the NGO representatives are signs of an effective working relationship that can be strengthened by continued commitment, communication and presence.

However, differences in attitude and overall endorsement of the strategy between fishers in the Holy Spirit (Cozumel and Azcorra) and Ascension Bays (Vigia Chico) point to the importance of understanding the fishers' incentives to collaborate and of understanding small-group dynamics during the policy dialogue process. Even if fishers from all three cooperatives showed a high level of awareness and understanding, all of the Cozumel and Azcorra fishers who expressed an attitude towards NTZ implementation perceived this strategy to be a valuable measure. This was not the case with Vigia Chico fishers who widely felt that this strategy was unnecessary and, in general, provided no added value to the cooperative, which indicates the importance of an NTZ approach that considers the fishers' economic niches and main concerns (Gelcich, 2005).

Endorsement of the NTZ strategy amongst the Cozumel and Azcorra cooperatives was facilitated by a number of factors. First, the fact that the NTZ strategy is currently not limiting lobster fishing motivated them to endorse it and focus on understanding and experiencing the added benefits. Also, one of the leading NGOs (COBI) had established a working relationship with the fishers in the Holy Spirit Bay through the spawning aggregation projects that preceded the NTZ strategy. A previous opportunity to establish rapport, along with the fact that these two cooperatives have a fewer number of members and the logistic ability to easily summon them for workshops and meetings, helped in ensuring nearly global participation of fishers from these cooperatives at the NTZ workshops.

Moreover, fishers from these cooperatives had strong incentives and perceived long-term value in the NTZ strategy, which compelled them to display endorsing attitudes and call on fishers in other communities to likewise approve this conservation measure. In comparison to their Ascension Bay neighbors who have a developed tourism industry, fishers in the Holy Spirit Bay are still highly dependent on lobster fishing. Also, given the remoteness and difficulty of access to the fishing settlements in the Holy Spirit Bay, these cooperatives have historically received less attention from authorities and third actors. In this context, the NTZ strategy provides an opportunity for these cooperatives to strengthen their relationships with external actors, increase access to political and financial capital, invest in future tourism opportunities and gain recognition for their compromise to sustainable practices. These interests clearly define the negotiation dynamic between NGOs and these cooperatives, and point to the importance of the larger political context which influences the fishers' decision-making.

The level of endorsement of the NTZ strategy amongst Cozumel and Azcorra fishers was also facilitated by the commitment of its leaders and the group dynamics within the cooperatives. Cozumel and Azcorra leaders highly valued the NTZ strategy: they were looking forward to receiving recognition from authorities and researchers for their continued commitment to sustainable fishing practices, which in turn would increase their chances of renewing their fishing concessions in the future. As a result, Cozumel and Azcorra leaders invested considerable time and effort organizing their communities towards consensus on this issue.

The Cozumel Cooperative has proven particularly effective at creating consensus amongst its members and has effectively dealt with resistance through the creation of the NTZ Commission. In this context, the NGOs' participatory approach, in coordination with the cooperatives' own internal regulations and organizational dynamics, seem to be generating a high level of ownership and approval of the NTZ strategy amongst these communities. This result is not trivial, since a sense of group process and ownership over agreement is likely to influence the fishers' willingness to protect these areas. This dynamic begins to be perceived through the fishers' intent to collaboratively enforce NTZs towards joint-gains for the fishers and the environment.

On the other hand, Vigia Chico fishers displayed a different attitude towards NTZ implementation than that of their neighbors in the Holy Spirit Bay. With a higher economic status and a tourism industry already developed, they perceived no significant added value in the long-term economic benefits that largely drive Cozumel and Azcorra. They have also already received national and international renown for their sustainable fishing practices. Only the fishers that are being asked to make these donations – with the exception of a few who still depend on fish catch – show an endorsing attitude towards the NTZ strategy. They are motivated by the added benefit of increased protection of their lobster fields through the exclusion of others and the prohibition of any extractive activity over these areas. As a result, Vigia Chico fishers are not opposed in concept to the NTZ strategy, but widely feel that this strategy is unnecessary. Moreover, these fishers widely demand additional scientific basis for the implementation of NTZs within their fishing concession. Hence, NTZ implementation seems to provide limited added value and impose new restrictions on this fishing community, while increasing the costs of collaboration for NGOs who are being asked to provide additional information to prove the value of NTZ implementation within this area.

Additionally, their small-group and organizational dynamics are also different from those of the Holy Spirit Bay cooperatives. They have at least twice as many members as the other two cooperatives – most of whom are also part of a tourism cooperative within Punta Allen – and a more complex

internal group dynamic that makes it harder to inform cooperative members, generate consensus amongst them and engage them in the design and decision-making process.

In this context, leading NGOs may need to pursue additional interest and issue exploration with the Vigia Chico fishers to incentivize the implementation of NTZs within Ascension Bay. It may be necessary to first negotiate the implementation of NTZs over individual donations over the reef and use the results to further inform the fishers of the benefits of the strategy. One possible challenge, however, is the added enforcement difficulties of these zones: fishers might be motivated to donate zones over the reef but perhaps not be in charge of enforcing them since that could create conflict of interests with the rest of the cooperative's members.

The alternative of continuing negotiations with Vigia Chico fishers would be to focus NTZ implementation efforts with the fishing cooperatives that are more involved and committed, and expand as the results legitimize the validity of this conservation strategy, as the communities that experience the benefits become its ambassadors and as the strategy gains political momentum. Overall, however, results suggest important differences in how incentives, consensus building and small-group dynamics influence the vitality of the NTZ negotiation process. These factors should be considered and addressed in pursuing NTZ implementation with other communities along the coast of Quintana Roo.

C. 2. Data, information & communication: adjusting expectations & jointly-analyzing results

Beyond informing the fishing communities of the benefits of added conservation measures, critical in the effective implementation, enforcement and evaluation of the NTZ strategy is the understanding of and being responsive to the fishers' expectations.

Fishers' stated expectation of increases in lobster catch is particularly important in terms of evaluating the effects of NTZ implementation, as well as in increasing credibility of the strategy within fishing communities. Only monitoring biophysical indicators – species abundance, key species, ecosystem recovery, etc. – will not be sufficient to legitimize the benefits of NTZ in the medium and long term. The expectation that NTZs will be linked to direct economic gains requires that changes in catch be monitored and recorded in close collaboration between NGOs and fishers. Prioritization not only of biophysical indicators but also of socio-economic and governance indicators will be pivotal in measuring long-term NTZ effectiveness (Pomeroy, 2004).

Adjusting expected increases in catch to the specific ecological viability of each NTZ will also be of importance in communicating and understanding results, and in making sure that fishers' perceptions coincide with monitored outcomes (Pita et al., 2011). As already discussed, there are significant differences in the type of zones that each cooperative has selected and on their perceptions of the value of each site as a NTZ. The fact that each fishing community has selected different types of ecological sites will yield different results for each cooperative. Although only the Cozumel fishers relate their expectations of benefits to the ecological value of the zones they have chosen, constant communication of these observed differences is critical in adjusting expectations, reducing uncertainty and increasing credibility, understanding and knowledge of NTZ effects. Ensuring that this information is shared with and made accessible to the fishers is critical in adjusting fishers' common perception that they are excluded from the NTZ decision-making process (Pita et al., 2011). Authentic informational exchange and joint evaluation of NTZ results will

strengthen ownership over the NTZs and relationships with the external stakeholders and potentially incentivize them to establish added NTZs in the future.

Finally, the impact of hurricanes on fisheries looms large on the fishers' minds, as well as the new threats to their ecosystem, such as the invasive lionfish. Coordinating the NTZ strategy with recent efforts to control this invasive species is paramount in ensuring benefits for the environment and fisheries throughout the implementation of this conservation measure. In this sense, the joint generation, evaluation and interchange of data between fishers and NGOs will be vital in ensuring the credibility, effectiveness and value of the NTZ strategy. Fishers' perceptions of respect for the educational credentials of other participants uniquely positions NGOs and researchers to ensure that the NTZ strategy is defined by joint access, generation and evaluation of information. However, a formal mechanism of communication between the communities and the NGOs who are tracking NTZ results will be necessary to adapt NTZs, advance the strategy in other communities and to increase credibility, commitment and trust amongst participants.

C. 3. Political context: power imbalances & regulatory challenges

The NTZ strategy evolves in a political context in which other public and private entities make decisions that affect both the ecosystem and the fishers' activities, interests, concerns and their perceptions of external stakeholders. This reality "muddies the water" for the NGOs that are promoting the NTZ strategy, it introduces distrust and potentially conflicting decisions. Moreover, the political context includes societal power dynamics – where differences in socio-economic status, access to resources and information and legitimacy play a complex role in shaping negotiations – as well as the legislative and regulatory factors that can both challenge NTZ negotiation but also create a venue for viable implementation within institutional structures. In this sense, the negotiation of NTZs with the fishing communities cannot be understood in isolation of the political context in which it is embedded.

Addressing fishers' concerns: power imbalances & distrust

Fishers' greatest expressed concern is that *others* – poachers and third parties – will benefit from *their* sacrifice. This concern is embedded in the regulatory difficulties of enforcing fishing regulations in Mexico and in underlying societal power dynamics, which may increase the fishers' fear that they will not be guaranteed equitable access to NTZ benefits and discourage them from compliance and collaboration. In expressing their concern that others will benefit from NTZs, fishers call for added engagement of NGOs and authorities and many insisted that trust was conditional on continued commitment of the external stakeholders, as well as on reliable communication of results. These perceptions suggest that there is still work to be done in guaranteeing fishers their role in the NTZ process as stewards, beneficiaries and contributors.

In this context, the fishers are relying on the NGOs' continued commitment and interaction with the fishing communities. Fishers' expectations highlight the inherent challenges that small, science-based NGOs experience in advancing conservation strategies. The objective of advancing a network of NTZs along the coast of Quintana Roo and the rest of the Mesoamerican Reef is bold and admirable. Their informational strategy seems to be effective at communicating the value of this conservation measure to the fishing communities and their on-site approach is helpful in the establishment of working, trustful relationships with the fishers. The NTZ initiative in Quintana Roo is also gaining political momentum as the Kanan Kay Alliance coalesces and serves as a forum to combine and leverage the capacities of local and international NGOs, federal and state government agencies, fishing cooperatives (SAGARPA, 2012). However, as *managers* of the process and the faces

of the NTZ strategy within the fishing communities, these NGOs are burdened with the task of leveling the playing field by creating a process which effectively engages key participants in a manner that addresses power imbalances and political challenges.

In reality, there is only so much they can do with limited human, financial and resource capacities. It also seems likely that fishers are not fully aware of the limitations that the NGOs themselves experience. Hence, communicating these limitations to the fishers and being clear about their conditions will be central in creating a more collaborative environment, in reducing distrust and in strengthening mutually beneficial relationships.

Finally, the underlying power dynamics between authorities, private actors, NGOs and fishers inevitably influence perceptions of trust and the potential of relationships. Participants need to clearly communicate their interests, concerns, strengths and limitations, in order to avoid misperceptions and stereotypes from influencing the trust-building process and participatory efforts. This is particularly important given that results show that a significant percentage of fishers do not fully recognize the people and organizations that lead the NTZ strategy, and some of them confuse them with the reserve authority, which has its own working agenda with the fishers, its own position on the NTZ strategy and their own set of limitations. The need to clarify positions and agendas and compensate for power imbalances also applies to the fact that the private actors' intents are not entirely clear to the fishers, some of whom are wary about the influence of these financially powerful actors on the NTZ strategy. The ability of this multi-stakeholder process to effectively engage varied actors will be pivotal in empowering the fishing communities to implement and enforce NTZs within their fishing concessions.

Addressing regulatory challenges

Enforcement is particularly important in light of the concern that illegal fishers could take advantage of the fishers' commitment to NTZ implementation, and offers its own sets of political and regulatory opportunities and challenges. Given the institutional limitations and legal inconsistencies that still surround NTZ implementation (CEMDA & COBI, 2010), the NGOs limited staff and resource capacities and the cooperatives' own internal constraints, there is a strong need for joint enforcement of these valuable zones. Involved parties will have to address the following questions, amongst other:

1. How can fishers be supported by NGOs and authorities to deal with illegal fishers entering the zones?
2. Can fishers be accredited or receive training to deal with illegal fishers in the absence of authorities in a manner that is effective, safe, aligned with the mandates of authorities and that consistently reduces the incentives of poachers to enter the zones?
3. How will the fishers be compensated to perform enforcement duties? How will this be decided within the cooperatives and included in their internal regulations?
4. In line with some of the fishers' most forward-thinking suggestions, can illegal and unorganized fishers, whose livelihoods are also likely dependent on marine resources, be included in the policy dialogue towards effective enforcement of these areas?
5. How can this initiative embed itself in regulatory and institutional frameworks to gain credibility and momentum?

The Kanan Kay Alliance is beginning to address these questions and the challenges of enforcing NTZs along the coast of Quintana Roo (Bourillon). Although its effectiveness as a multi-stakeholder collaborative forum is a work in progress, its creation is testimony to the way that the NTZ initiative

has become an opportunity to coalesce energy and resources for improved enforcement of fishing regulations and marine conservation measures in Quintana Roo (SAGARPA, 2012). The complexity of this scenario is consistent with Ehrmann (1997) who explains that the permeability of the policy dialogue to political events can be both strength and weakness: an on-the ground initiative with a few communities in Quintana Roo has become a multi-scalar, multi-stakeholder policy dialogue. Participants of the NTZ strategy will have to strike a balance between its consolidation in a complex political context, its ability to embed itself in a formal policy implementation process and its effective management within the fishing communities.

D. NUANCES OF A COMPLEX REALITY: HOW COLLABORATION OCCURS MATTERS

This study provides baseline information of fishers' perceptions in the Sian Ka'an Biosphere Reserve, which should be continually measured as an indicator of the social acceptance of NTZs. Understanding these perceptions is critical in ensuring ownership over NTZs and their results, efficient monitoring and performance, as well as to enable communication towards adaptive management of marine protected areas. Results are consistent with some of the common trends identified by previous literature and summarized in Pita et al. (2011): Fishers' perceptions on marine protected areas reflect their interests and concerns and they are endorsing NTZs in as much as they do not largely affect their main economic activity (lobster fishing in this case), but some fishers still prefer less restrictive fishing regulations (Vigia Chico fishers are a good example) and they perceive that their involvement in the decision-making process could still be improved. Also consistent with previous findings (Pomeroy, 2007; Gelcich, 2005), differences between the fishers in the Holy Spirit and Ascension Bays suggest that the NTZ process needs to be modulated according to the interests, small group dynamics, economical niches and geographical differences of each community.

By analyzing the fishers' perceptions in a larger context, this study also reveals insights on the inherent complexity of collaborative approaches to marine resource management. A NTZ is an apparently simple concept, a well-defined measure to prohibit extractive activities over marine areas. Complexity unfolds in attempting to measure its biophysical effectiveness at protecting marine resources and in addressing the socio-economic and governance issues that surround it. This inherent complexity calls for an interdisciplinary approach to marine resource management. However, making collaboration work is not just about sharing information from different disciplines or different sources as it is sometimes described (Sievanen et al., 2011). People engage in problem solving with a range of expertise, experience, interests and perceptions and these differences can and should be addressed in a collaborative logic using guiding frameworks to tailor and adjust the process to a specific set of local circumstances. Determining *how* to integrate these differences to achieve benefits for people and for the environment is the essence of interdisciplinary work.

Fishing communities are not static entities that are solely sources and recipients of information and data. Fishers in this study expressed, not only a desire to be more engaged in decision-making, but also a sense of fatigue with the number of researchers that solicited information and studies that had required the fishers' participation but had failed to inform them of the outcomes. They recognized the importance of collaborating with authorities, researchers and non-governmental agencies, but also feel discouraged and disenfranchised with the ways in which some of these actors entered their communities, demanded their time and availability, the manner in which they asked for information without investing in a meaningful interaction and interchange of perspectives. Stark socio-economic disparities pose additional challenges to overcoming misperceptions, power dynamics, political and governance complexities and resource constraints.

Capitalizing on this complex reality towards socio-ecological well-being is inherently challenging and requires a different engagement with the fishing communities; one that is both respectful and culturally appropriate, that does not transcend ethical boundaries and that values the legitimate perspectives and contribution the fishers can provide. The objectives of this study were largely and reliably met as a result of the participatory methodology that was used and adjusted according to the fishers´ reality. Showing a sincere interest in the fishers' livelihoods, their key role in the implementation of conservation strategies and their perceptions of NTZs, participating in their communities and investing time in establishing a working relationship, made a difference. Fishers were surprised and grateful to observe interest beyond the research objectives; they were encouraging teachers in their fishing arts and generous hosts. They were thankful that the interview process was not structured and demanding, but rather inviting, with enough time for a sincere channeling and recording of their perspectives, and additional opportunities – in fishing boats, kitchens, meals and leisure activities – to provide more insights.

Emphasis on interaction with the communities is not in defense of the fishers and their perceptions – they too need to be more responsive to the limitations of other participants – but in favor of a sustainable collaborative process. *How* we, as fishers, researchers and managers, interact, communicate and leverage our capacities, *matters*, because "while enhancing people's understanding is important, collaboration ultimately takes the shape of interpersonal relationships" (Wondolleck & Yaffee, 2000). Building and sustaining these relationships requires time, commitment, mutual respect and authentic interest in fully understanding the perceptions of *the other*. In order to achieve this there is work to be done in envisioning the meaning of interdisciplinary work, which consists of different knowledge systems but also of jointly creating an effective *process*. These constraints can be overcome by advancing time and effort in understanding not only our interests but those of the other, by recognizing a shared problem and establishing shared objectives, by pooling resources, ideas – not only knowledge and expertise – in a committed and adaptable process, by ensuring equitable sharing of results. Investing in the quality of interactions with the fishing communities is a durable and effective way of advancing the adaptive capacity of these communities to deal with the ecological shifts which are affecting their livelihoods, creating political capital in advancing conservation measures and of bridging informational, resource and capacity gaps towards joint understanding and decision-making in the face of increasing ecological and governance challenges.

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