THESIS

RESPONSIBLE FISHING: STAKEHOLDER PERCEPTIONS PERTAINING TO FISHERIES IN LA ENCRUCIJADA BIOSPHERE RESERVE, CHIAPAS, MEXICO

Submitted by

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Abstract

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Fisheries throughout the world are increasingly exploited and in many cases, over-exploited. This situation is problematic not only for the natural resources, but for the communities that depend on them for their livelihoods. The increased pressure on fisheries creates stress on natural systems, individuals, and communities. These effects can be seen in Mexico, where artisanal fisheries are abundant. In the La Encrucijada Biosphere Reserve, in southwestern Mexico, fishing remains one of the main sources of income generation. Since the creation of La Encrucijada Biosphere Reserve in 1999, there have been a number of management changes that have affected the natural environment and the communities who rely on it.

Although management practices that are shared between several stakeholder groups, including fishers, practitioners, and researchers have made strides in advancing conservation and improving livelihoods, conflicts over management decisions exist. The implementation of aspects of The Responsible Fishing program of The Food and Agriculture Organization (FAO) in fisheries in the area is one point of potential contention. The notion of responsible fishing has gained popularity internationally as a fisheries management tool, although studies pertaining to perceptions of stakeholders are sparse in the literature.

This synergistic study is comprised of three objectives: Communication and agreement with Responsible Fishing program, perceptions of fishers and non-fishing stakeholders in regards to the reserve, and identification of perceived issues among

stakeholder groups. The data were collected during one month spent in six communities conducting interviews, attending workshops, and meeting with agency personnel. The results illustrate the current situation surrounding communication and perceived issues in both written and graphical representations.

The hope is that with the results of this study, resource managers and other stakeholders involved in the reserve will utilize the information to continue on a path that is collaborative, focused, and useful going forward.

Keywords: *fisheries, artisanal, conflict, perceptions, La Encrucijdada, Biosphere reserve, Chiapas, Mexico*

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Press Release

Graduate Students Conduct Analysis of Fishing Cooperatives in a Mexican Biosphere Reserve

Fort Collins, Colorado, United States – March 9, 2012 – Colorado State University graduate students Peter Mach and Scott Jones recently completed a study addressing boards of directors' and non-fishing stakeholders' responses and perceptions of The Food and Agriculture Organization (FAO) Responsible Fishing program in six cooperatives in La Encrucijada Biosphere Reserve in Chiapas, Mexico. The study was conducted in partnership with ECOSUR, a research institution in Chiapas, Mexico, and included participants from local NGOs, government agency personnel, and other academic institutions.

Although fishers have been living and working in this area for many decades, the observed effects from over-fishing have been documented. The FAO has begun to implement aspects of the Responsible Fishing program. During this project's development, CONANP expressed a concern that while managerial actions and policies are evolving to incorporate aspects of the FAO Responsible Fishing Code of Conduct (COC), it is unclear what the local fishing communities' perceptions are and whether or not they agree with the direction FAO is taking. Despite this, perceptions of the program were largely unknown amongst those involved.

This synergistic study includes perceptions of environmental and social aspects of Responsible Fishing, as well as potentially conflicting issues and areas of concern. The project produced a series of diagrams and a report addressing three objectives: Communication and agreement with Responsible Fishing program, perceptions of fishers and non-fishing stakeholders in regards to the reserve, and identification of perceived issues among stakeholder groups. The data were collected during one month spent in six communities conducting interviews, attending workshops, and meeting with agency personnel. The results illustrate the current situation surrounding communication and perceived issues in both written and graphical representations.

The study enabled managers and other stakeholders to better understand issues and potential areas of conflict of the six fishing cooperatives within the biosphere reserve. The study acknowledges that the issues described operate at different scales, from local to international. Each group of stakeholders has varying experiences with the issues, and also unique opportunities to address them.

La Encrucijada Biosphere Reserve is one of the most diverse areas in the world, yet also

vulnerable to the increasing anthropogenic pressures it faces. Through this study, the students hope that a more nuanced, collaborative approach to management within the reserve will yield a higher quality of life for those that make their livelihood in the area and also conserve this natural area.

Responsible Fishing: Stakeholder Perceptions Pertaining to Fisheries in La Encrucijada a Biosphere Reserve, Chiapas, Mexico

Introduction

Global and Mexico Fisheries Context

Historically, humans have taken advantage of the ecosystem services provided by coasts, and have made these the most favored locations to live permanently or for leisure, recreational activities, or tourism (Martínez, 2007). Additionally, coastal areas have for thousands of years been gathering places and hosts to bustling ports of trade. Given the amount and degree of human traffic taking place in these areas due to their relatively high accessibility rates and amount of services offered, the biodiversity that thrives in these regions has been impacted.

Throughout the world, fish supplies 1.5 billion people with nearly 20 percent of their average per-capita intake of animal protein, and three billion people with at least 15 percent of protein (Food and Agriculture Organization of the United Nations., 2011). In fact, in 2008, the per-capita supply of fish as human food reached an all-time high, which highlights the function of the importance of the sector providing artensenal fishers with livelihoods, as well as food for billions of consumers. As of 2008, the FAO has stated that of the fisheries they are currently monitoring that slightly more than half (53%) are estimated to be fully exploited, and thus are close to their maximum sustainable productions, with no room for expansion. Many of the remaining fisheries are overexploited (28%), depleted, or recovering from depletion (Food and Agriculture Organization of the United Nations., 2011)

In Mexico, similar trends can be observed. As one of the top twenty leading fish producers in the world, Mexico produces more than 1.3 million metric tons of fish per year. As such, it is officially characterized as a fish exporter. Despite being largely an exporter of fish and fisheries products, it is mainly dominated by artisanal fisheries (not commercial fleets). In fact, in 1998, 97% of the fishing vessels were artisanal boats, (Hernandez, 2003). Although fishing accounts for a large population's livelihood, constant budget cuts to subsidies programs limited government agencies from keeping fishing records and landing statistics. The general lack of collaboration between government agencies and university research has prevented resource managers from attaining a full understanding of the state of many of the fisheries in Mexico. As such, there is a need for more information regarding all aspects of fisheries in Mexico, particularly artensenal fleets.

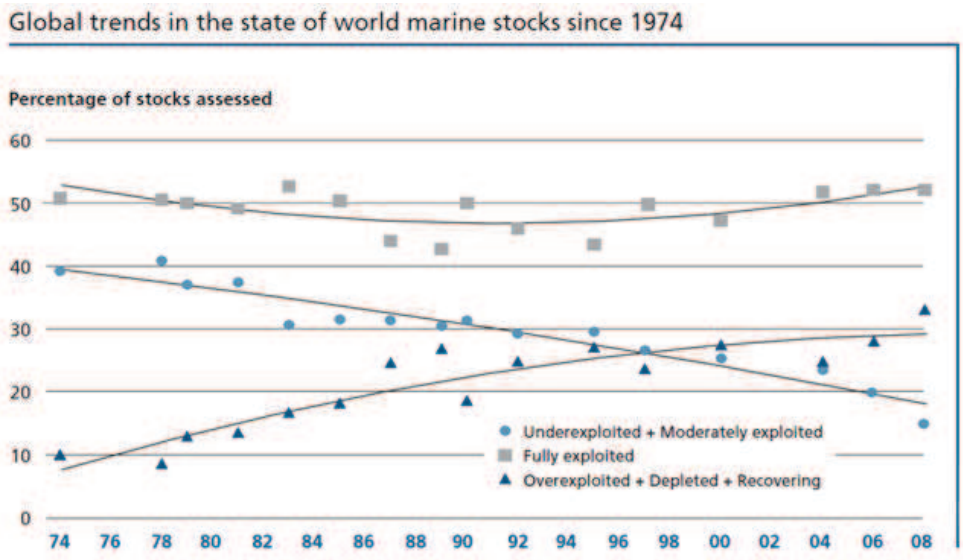


Figure 1: Tendencies and global fish stocks from 1974-2008 (FAO, 2010)

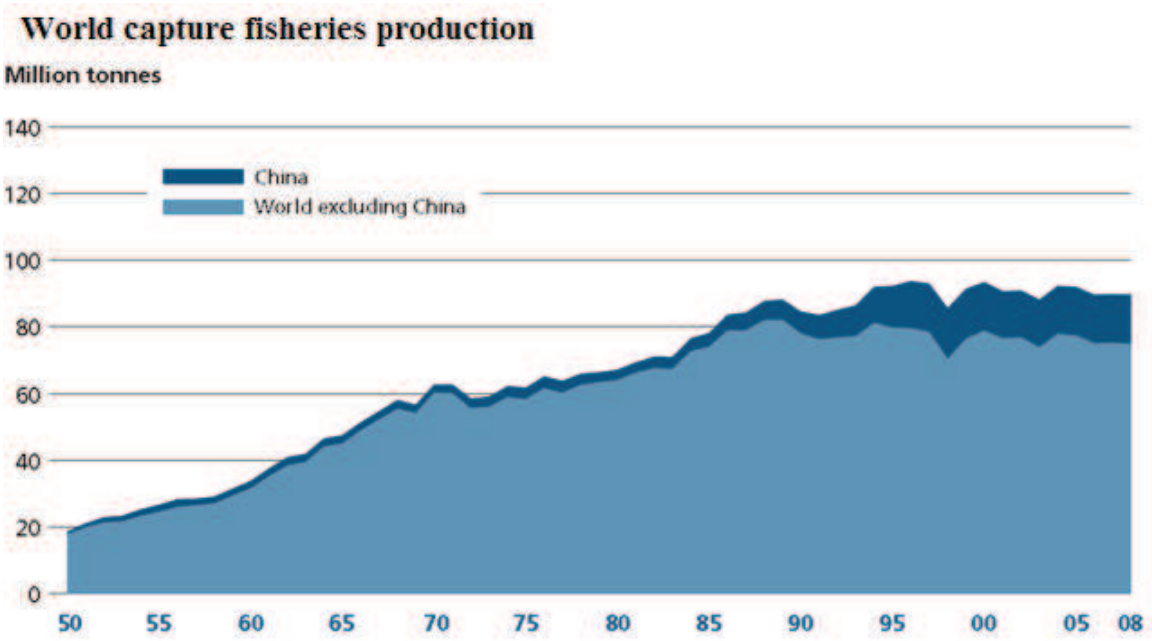


Figure 2: Global fisheries production in tonnage from 1950-2008 (FAO, 2010)

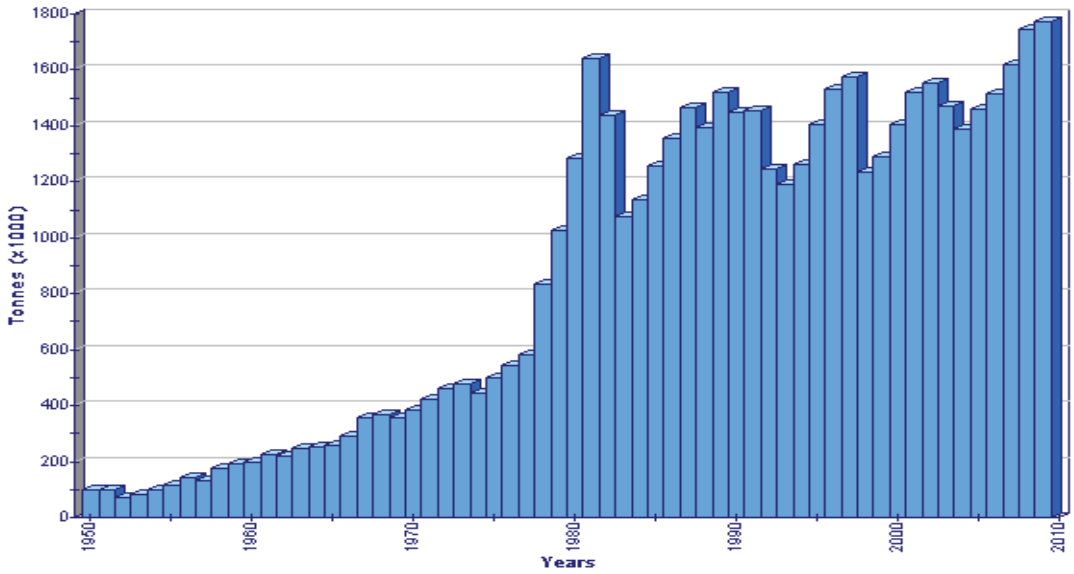


Figure 3: Mexico fishery production from 1950-2009 (FAO, 2004-2012)

1,773,643 tons of fishery production in Mexico in 2009

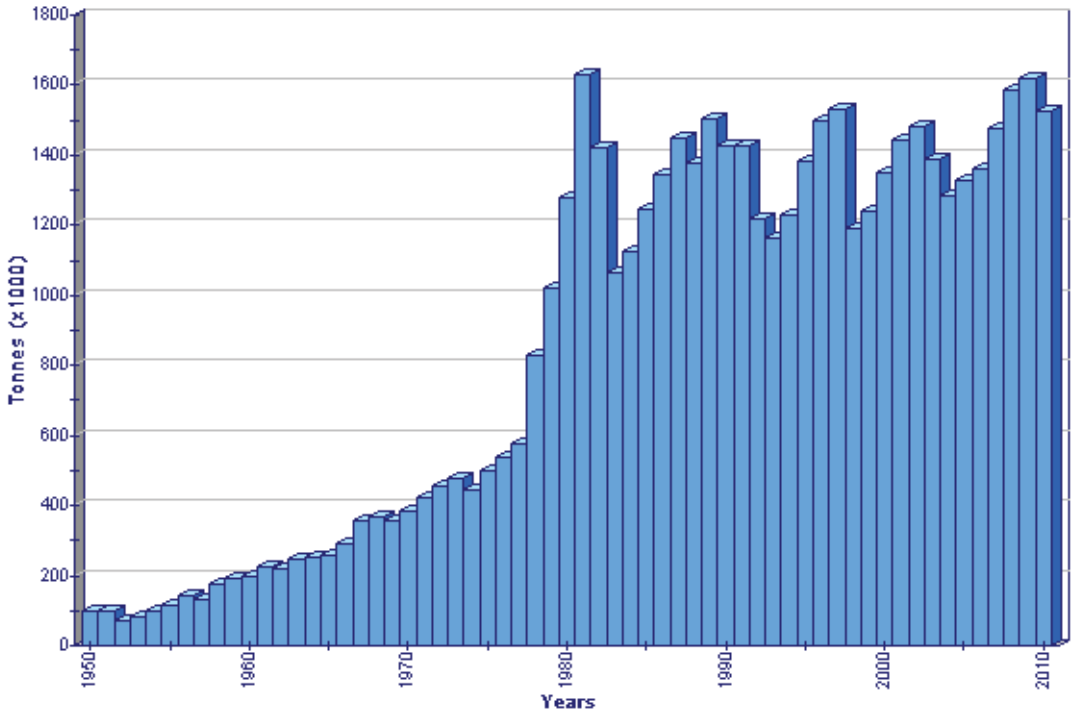


Figure 4: Tonnage of Mexico fish capture from 1950-2010 (FAO, 2004-2012)

1,525,665 tons of fishery capture in 2010 (Mexico)

Need For Study

La Encrucijada Biosphere Reserve (REBIEN), like many resource management institutions in the world, has the task to conserve marine resources within the boundaries of the reserve. In addition to the natural resource management, the National Commission of Protected Natural Areas (referred to by its Spanish acronym, CONANP), along with other stakeholders are charged with managing the economic resources utilized populations living in the reserve, namely fishers. The reserve is also valued as one of the most biodiverse areas in the world, a scientific laboratory, a growing tourist destination,

and its educational value. The conservation and management of the reserve must be accomplished within the restraints of the organization, which inherently carry limitations.

In an effort to reduce conflict amongst the stakeholder groups involved in the adaptation of \aspects of the Food and Agriculture Organization of the United Nations (FAO)'s Responsible Fishing program, and to improve the collaborative management strategy, more information is needed about and from fishers. To that end, this study aims to elicit information about communication, knowledge, and acceptability of existing and possible management strategies from six fishing cooperatives in the reserve. Lastly, information was gathered about levels of satisfaction of management practices, communication, fisheries involvement, future concerns, and general demographics of participants. The researchers address the following objectives in this study:

Objective 1: Communication and agreement regarding Responsible Fishing program:

During the project's development, CONANP expressed a concern; that while managerial actions and policies are evolving to incorporate aspects of the FAO Responsible Fishing Code of Conduct (COC), it is unclear what the local fishing communities' perceptions are and whether or not they agree with the direction FAO is taking. It is these communities who are ultimately impacted from changes in the reserve. This investigates the levels of acceptability towards issues surrounding the COC.

Objective 2: Perceptions of Fishers and Non-fishing Stakeholders in regards to La Encrucijada Biosphere Reserve:

After looking at how fishing and non-fishing stakeholders viewed the Responsible Fishing program, the scope of the study was extended to address general perceptions and

understanding of La Encrucijada Biosphere Reserve. Questions in research interviews asked both fishers and stakeholders open-ended questions about the reserve and problems associated with it. Three topics were explored within this objective: ecological perceptions, management and regulation within the reserve, and communication between stakeholder groups. The Potential for Conflict Index (PCI_2) model was utilized to determine within these topic areas where conflict may arise both among and between stakeholder groups. The PCI_2 model is used here to identify the levels of consensus among stakeholders' normative beliefs concerning certain management actions (Vaske, Beaman, Barreto, & Shelby, 2010).

Objective 3: Identification of Perceived Problems among Stakeholder Groups:

Often resource managers and users face a number of issues within a natural area. Many of these issues are not addressed in management actions because the matters are never overtly addressed, or in some cases not addressed at all. In order to identify the perceived problems within the reserve, interviewees were asked to list, in their opinion, the most significant problems in the reserve, and then describe what is driving these problems. These problems and their causes were then entered into a double-entry matrix to identify what is driving them and what additional problems they are perpetuating.

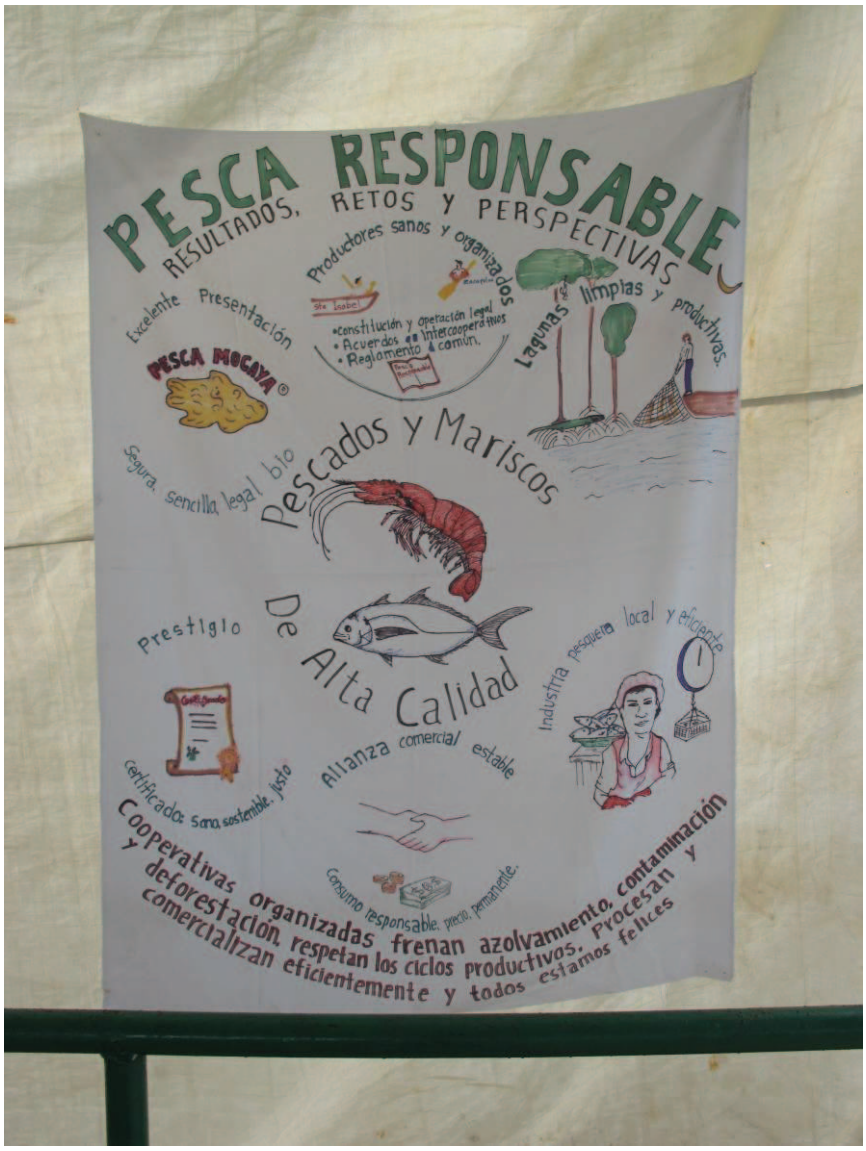


Figure 5: Workshop poster depicting aspects of the Responsible Fishing program

Mexico Context

Producing nearly 1.3 million metric tons of fish per year, Mexico is among the top 20 leading fish producers in the world. It is a country characterized as a fish exporter due to the positive balance of trade for fishery products. To illustrate this, in 1999, the balance was $520 million dollars (Hernandez, 2003). Given the large production numbers, many of the fisheries in Mexico are completely exploited, over-exploited, or

depleted. During the 1980s, many artisanal fisheries increased the number and proportion of landings of catch due to the limited governmental control that was in place. During this time, two models were in place: the cooperative system and private investment in commercial fisheries. Under these models, fishers were classified into cooperatives and industrial fishers. Cooperatives are administered in a union-like structure, where fishers organize together to garner governmental subsidies and protect monetary and labor rights. Usually the fishers in cooperatives own their own gear and boats, and have a low income that is variable throughout the year. In 1998, 97% of the fishing vessels in the country were artisanal boats, with 3% being industrial vessels (Hernandez, 2003). The prevalence of artisan fisheries remains high in Mexico today.

During the period between 1994 and 1999, several institutional changes took place on behalf of the federal government, due to signs of inefficiency observed by government and academic analyses. Previous budget cuts to subsidies programs limited government agencies from keeping fishing records and landing statistics (Hernandez, 2003). During this period, there was also a general lack of collaboration between government agencies and university research. The status of many fisheries was unknown because of hundreds of poor or non indexed records, and the government agency tasked with fisheries science had not addressed most artisanal fisheries, despite Mexican fisheries being overwhelming artisanal in nature. Fishery policy changed in the late 1990s, with the first element being scientific-based policy making. Along with this came the training of scientists in stock assessment. There was also a movement to try to stop or reduce fishing in areas where over-exploitation was detected. Lastly, there was evidence of active participation with non-fishing stakeholders, such as fisher organizations, state

governments, and local educational institutions. In fact, the Mexico Environmental and Natural Resource Secretariat (SEMARNAT), created a directory of local scientists at universities, which was organized by region to aid in giving a regional expertise when environmental issues arose (Hernandez, 2003).

Despite these changes, Hernandez and Kempton (2003) contend that these policy changes did not reduce over-exploitation, did not increase participation by fishers, and did not change land manager behavior (three goals of the intended policy changes). The researchers suggest that this was due to, "lack of laws that supported enforceability of those changes, fishers' short-term goals, inadequate scientific resources to address many artisanal fisheries, lack of local government participation in management, refusal by government scientists to share detailed data, and lack of appropriation of the fishers to the new elements."

Hernandez and Kempton suggest that there are needed remedies for future policies. One key piece, they suggest, is the sharing of more data by the government and the hiring of appropriate scientific consultants. This provides education to fishers, allowing fishers to be more empowered and act more responsibly to new regulations. Lastly, the authors postulate that the changes made to the fisheries' agency structure in 2000 terminated initiatives of the prior administration, and created an agency that is more like the one that existed in the 1980s – the one that initially was the root of the over-exploitation issues. In general, the lack of evaluation of previous policies is a waste of resources, and fosters a situation that does not address the long-term problems of fisheries (Hernandez, 2003).

In La Encrucijada Biosphere Reserve, in the coastal plains of Chiapas, fishing remains one of the main sources of income for the local population. The fishing is largely subsistence-based, with production for families and for domestic markets; however fishers are increasingly expanding the commercial opportunities for their products. Subsistence fishing uses simple methods and relatively inexpensive gear, and is often coupled with activities such as timber harvesting, ranching, and other agriculture (Inda-Diaz, Rodiles-Hernández, Naranjo, & Mendoza-Carranza, 2009). Recently, fishing has both increased and expanded in rural and suburban areas, and has largely replaced what were considered more traditional means of income (FAO, 2005).

Although subsistence fishing exists in all communities that are near bodies of water in southern Mexico, there is very little research done regarding them due to the inherent difficulty in studying them. Collaborative research is also scarce. Collaborative research projects that pair fishers, agency personnel, practitioners, and researchers with the intent of gaining a greater understanding of the fisheries is relevant to natural resource managers (Inda-Diaz, Rodiles-Hernández, Naranjo, & Mendoza-Carranza, 2009). This type of collaboration provides managers with a more nuanced look into the biological, social, and economic factors that make up a given region.

Environmental and Historical Description of La Encrucijada Biosphere Reserve

Environmental Description. The Pacific coast of Chiapas, Mexico's southernmost state, is comprised of an extensive coastline of roughly 270 km. It has 227.799 km² of exclusive economic zone, 11.734 km² of continental shelf and 30.6865 ha of estuaries and coastal lagoons. Three major estuarine-lagoon systems are present along

the coast: Mar Muerto-La Joya-Buenavista, Carretas-Pereyra and Chantuto-Panzacola. The latter two are recognized for their large and complex forest ranges and extensive mangrove swamps and combined make up the La Encrucijada Biosphere Reserve, one of the richest wetlands in the region in terms of both diversity and productivity (INE, 1999). The reserve is a coastal ecosystem of mangrove estuaries, semi-deciduous tropical forest, and seasonally flooded coastal forest located along the Pacific Coastal Plain in the southwestern portion of the state of Chiapas (INE, 1999). The reserve is geographically located between 14°43' and 15°40' north latitude and 92°26' and 93°20' west longitude (INE, 1999).

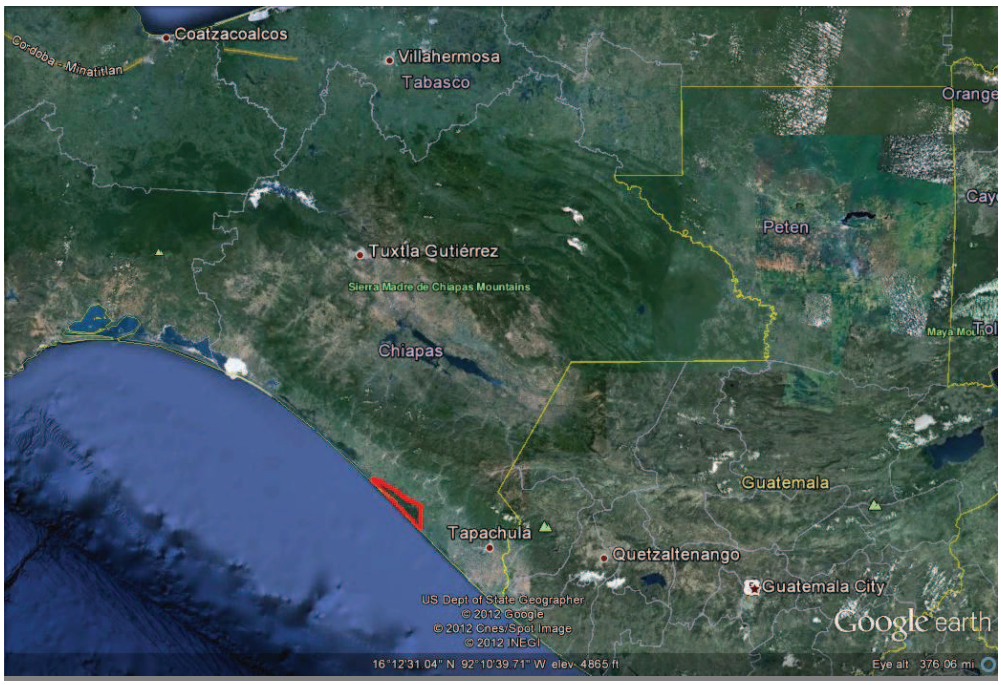


Figure 6: Location of the La Encrucijada Biosphere Reserve shown (in red) in a map of Southern Mexico and Guatemala (Adapted from: Google Inc. (2011). Google Earth (Version 6.1.0.5001) [Software].)

The reserve covers a total area of 144,868 ha which has 36,216 ha broken down into two core areas (La Encrucijada and Palmarcito) and the remaining 108,651 ha create the buffer zone (Diario Oficial de la Federación, 5 de junio de 1995). The reserve includes the municipalities of Pijijiapan, Mapastepec, Acapetahua, Huixtla, Villa Comaltitlán, and Mazatán and is shared between two economic areas: the Soconusco Coast and the Isthmus. The northern boundary of the reserve is the Pijijiapan Chocohuital community; the southern boundary is at Mazatán and is formed by the community San Simon Bar (INE, 1999).

The soils of the coastal zone are usually dark brown, but can occasionally be black, and have a tendency to be medium and fine texture or thick but are very rarely deep in depth. The soils making up the mangrove are usually clay and/or muddy-peat which form sandy clay deposits with fine-grained and irregular stratification. Fossilized mollusks and abundant organic material at different stages of decomposition can sometimes be found in some islets and outcrops (INE, 1999). In general, the soils located in the reserve are the product of the constant up river erosion and deposition. According to the FAO-UNESCO (1988) classification system, the followed soils are presently listed in the reserve: Cambisol, Regosol, Solonchak, Gleysol, Feozemand Fluvisol.

The reserve is located within the 23rd hydrological region of Mexico, which is highly influenced by climatic variation throughout the year with transport volume in some rivers within the system almost drying completely during the dry season. The hydrography of the reserve is made up of 17 watersheds which include: Huixtla, Cintalapa, Vado Ancho, Comaltitlán, Coapa, Urbina, Pijijiapan, Margaritas, Novillero, San Nicolas, Coates and Sesecapa Cacaluta, among others, as well as a various number of

secondary and tertiary streams that provide fresh water to the different lakes present in the reserve (INE, 1999). According to the CNA (1997), all but three watersheds (Pijijiapan, Vado Ancho and Coates) have a Water Quality Index (WQI) of acceptable. The three others are listed has having a higher level of contamination with the WQI listed between 50-70 with the main source of contamination attributed mostly to agrochemicals from above river agricultural practices and to a lesser extent from organic waste from surrounding cities (INE, 1999). Both the biotic and physical heterogeneity of the region responds to changes in water salinity, varying between 10 to 25 ppm (Ocampo, M. and A. Flores, 1995), which creates a hydrological environment suitable for the development of typical estuarine organisms (Contreras, et al., 1997).

The regional climate is warm and humid, with a high abundance of rain during the summer months. Since precipitation responds to geographic location, rainfall is higher inland near the mountains, with lower amounts on the coast. The rainy season begins in May and runs through November with occasional drought appearing from July to August. The remaining months are dry with occasional rains in February and March. The minimum annual precipitation is 1,300 mm and the maximum is 3,000 mm with a distribution of 100 to 200 rainy days a year. The average annual temperature is 28 °C, being constant throughout the year and is generally greater than 22 °C (García, 1973). Inhabitants of the region recognize two seasons which are winter (rainy season) and summer (dry season) (INE, 1999).

Vegetation types present in the reserve include: Zapotonal mangrove, Popal, Tulare, evergreen and deciduous forest, floating and underwater vegetation, coastal dunes and palms (INE, 1999). A preliminary study which took an inventory of the flora within

the reserve found 329 species belonging to 86 families. Among the most abundant species are the red mangrove (*Rhizophora mangle*), white mangrove (*Laguncularia racemosa*), button mangrove (*Conocarpus erectus*) and black mangrove (*Avicennia germinans*) (INE, 1999). Known as having the only Zapotonal forest in Mesoamerica, the area unites a unique corridor that connects the northern part of the continent with the central and southern portions, creating an ecosystem that supports a high level of biodiversity (INE, 1999). The reserve is home to 73 species of mammals, 294 species of birds 94 of which are migratory, and 45 species of reptiles. Included in this list of species is the state's only endemic bird, the giant wren (*Camphylorhynchus chiapensis*) as well as a number of other charismatic and threatened species such as the jaguar (*Panthera onca*), the spider monkey *(Ateles geoffroy)*, the anteater *(Tamandua mexicana)*, the camine (*Crocodylus aacutus*) which only exists in Mexico in this ecosystem, and the boa *(Boa constrictor),* as well as providing important wintering habitat for the 94 migratory birds (INE, 1999). A vast number of invertebrates also exist in the reserve, some of which are of high economic importance and several in danger of extinction, such as a number of bivalves (*Anadara sp.*). Among the crustaceans in the region include: the white shrimp (*Penaeus vannamei*), blue shrimp (*Penaeus stylirostris*), and to a lesser extent brown shrimp (*Penaeus californiensis*) and crystal shrimp (Penaeus brevirostris). Also included are a number of crab and crayfish species, all of which are the basis of a large portion of the fishing economy of the region. This mangrove ecosystem is also an important habitat and breeding ground for a number of fish species, as one study conducted in the Chantuto-Panzacola system of the reserve identified 31 species, 25 genera and 19 families of fish (Diaz-Ruiz et. al, 2004). Of these fish, some of the more economically

important species for the fishing industry include: Flathead mullet (*Mugil cephalus*), White mullet (*Mugil curema*), Yellowfin snook (*Centropomus robalito*), Blackfin snook (*Centropomus medius*), Black snook (*Centropomus nigrescens*), White snook (*Centropomus viridis*), Yellowfin snapper (*Lutjanus argentiventris*), Black gerreidae (*Amphilophus macracanthus*), Colorado snapper (*Lutjanus colorado*), Queen corvina (*Cynoscion albus*), and Goliath grouper (*Epinephelus itajara*). In addition to the high economic importance these fish bring to local communities, the reserve is also responsible for a number of important environmental services for the state of Chiapas, as these mangroves help retain soil nutrients, prevent flooding, and trap various types of pollutants that reach down river. These pollutants mainly consist of organic waste from municipals, industrial waste, agricultural waste and chemicals used for agricultural activities (Toledo, 1988).

Historical Description. In 1972, the Chiapas government designated an area of 2,500 ha of La Encrucijada as a reserve for mangrove and *Pachira aquatica* vegetation. Management programs have been implemented since 1991 and include operational programs, surveillance, monitoring and strategic planning. In 1995, the area was later recognized as a federally protected area. The site is now also inscribed in The Convention on Wetlands of International Importance "Ramsar Convention" list and is therefore recognized at the international level. The La Encrucijada area supported a relatively small population until the construction of a railroad in the 1900's and the Pan-American highway in the 1950's, which fragmented the watershed and promoted migration to the area. Currently an estimated population of 26,992 people live in 64 towns within La Encrucijada (INE, 1999). Population growth resulting from the railroad was not limited to

just this area, as growth also occurred in the upper regions of the Sierra Madre watershed which has created a number of issues in the downstream La Encrucijada Biosphere Reserve. Problems regarding overexploitation have also arisen due to a growing population in the Chantuto-Panzacola system as more fishers now depend on fish stocks to support their livelihoods.

Management. During the Eighteenth Regular Meeting of the Central American Commission on Environment and Development (CCAD) in 1995, a commitment was made to focus on conserving the Mesoamerican Biological Corridor to which La Encrucijada is a vital part. La Encrucijada is one of the priority 36 protected natural areas listed under the new system of care and administration of the National Institute of Ecology (INE), which means a significant amount of resources is provided by the federal government for its management (INE, 1999). The Institute of Natural History (IHN), which is an agency of the state government level, also assists in aspects of management and has a small annual budget for their operations (INE, 1999). Additionally, the municipalities located within the reserve are expected to manage, regulate, and conserve their own natural resources. Recently, the importance and necessity of sustainable natural resource use by the municipalities has been recognized changing the direction of IHN and particularly that of the reserve that now are encouraging the direct involvement of the municipal stakeholders in the management of their own resources. Lastly, an agreement exists between INE and IHN for joint management of the reserve. This partnership is framed within the National Planning and National Development Plan of 1995-2000 which establishes the guidelines by which two institutions will assist in operations. An Advisory Council has been created to help facilitate in the integrated management plan

comprised of representatives from the social sector, academia, municipal government, state government, federal government, and non-governmental organizations (INE, 1999).

Environmental, social, and political issues in La Encrucijada Biosphere Reserve

Environmental Issues. Currently three major economic activities exist within the reserve, which are ranching, farming, and fishing (INE, 1999). In order to create productive pasture lands, native vegetation has been cleared and the land sown with feed for livestock. The major limiting factors to available land for ranching in the reserve are: the salinity of the land, (which is high near wetlands and mangrove forests) and agricultural land that is already being farmed. Similar to ranching, farming practices have converted native forests or cleared native vegetation in order to create arid lands. Limiting factors for this economic activity are similar to ranching, with mangroves preventing the expansion of farming in many areas. Areas that tend to be too salty to convert to agriculturally productive land are often felled and the wood sold as building materials, primarily for house construction). Local populations also use wood from the red and white mangrove trees as a fuel source, mainly for cooking, and as a building material for houses or for poles that are used to construct shrimp pens used for aquaculture. Wildlife trade for food, ornamental fauna, and the pet trade have also had an economic impact in the region. Alligators, boa, white tailed deer, and certain bird species are commonly hunted, which has lead to a decrease in their populations and driven some into threatened or endangered status. Sea turtle eggs are often collected as a food source, which has threatened their populations as well. The most commonly hunted species are the green iguana (Iguana iguana rhinolopha) and red-cheeked mud turtle (Kinosternon cruentatum scorpiodes), which are highly sought after as ingredients to make traditional

food dishes (INE, 1999). Many parrot species in the reserve are often targeted for the pet trade or for ornamental purposes. The fishing industry is restricted almost exclusively to the capture and marketing of wild shrimp and fish species.

The 17 watersheds located throughout the reserve provide important features to the ecosystem, such as sediment and nutrient transport, which are vital to the reserve's health. Historical use and recent changes in management have led to decreases in biodiversity and loss of plant coverage, soil degradation, deterioration of water quality, and shifting of local and regional microclimates. According to data presented by the IHN, the channelization, rectification, and dredging on these rivers through the Coastal Water Plan conducted by the CNA, have caused some of the most profound damages to the reserve (IHN, 1994). These actions have caused an increase in the transport of sediment resulting in a loss of soil in the upper parts of the watersheds and an increase in sedimentation in the lower reaches of the watersheds. A study conducted in the reserve pertaining to sediment loads, found that while measurements of sediment in 2003 where similar to those in 1997, the grain size of sediment has been steadily increasing, which has led to the need for dredging parts of the mangrove since 2001 (Benítez et. al, 2006). These actions have also changed the natural flow patterns of these watersheds, which have led to irregular flow patterns that have also added negative stress to the systems. As previously mentioned, water quality has also been on the decline. An increase in agricultural practices in the upper parts of the watershed combined with the faster flowing water due to channelization of the rivers, has led to more agricultural wastes entering into the lower watersheds. During 1994-1995, one study found higher levels of

chemicals, primarily insecticides, in the Chantuto-Panzacola system than have traditionally been observed (Rueda and Botello, 1997).

Socioeconomic: Fishing. Through both extensive literature research and fieldwork between the reserve staff and academia, SEMARNAT has identified problems that they feel stand out as hurdles for the fishing industry in La Encrucijada. The following problems are presented in INE's management plan of the reserve (INE, 1999):

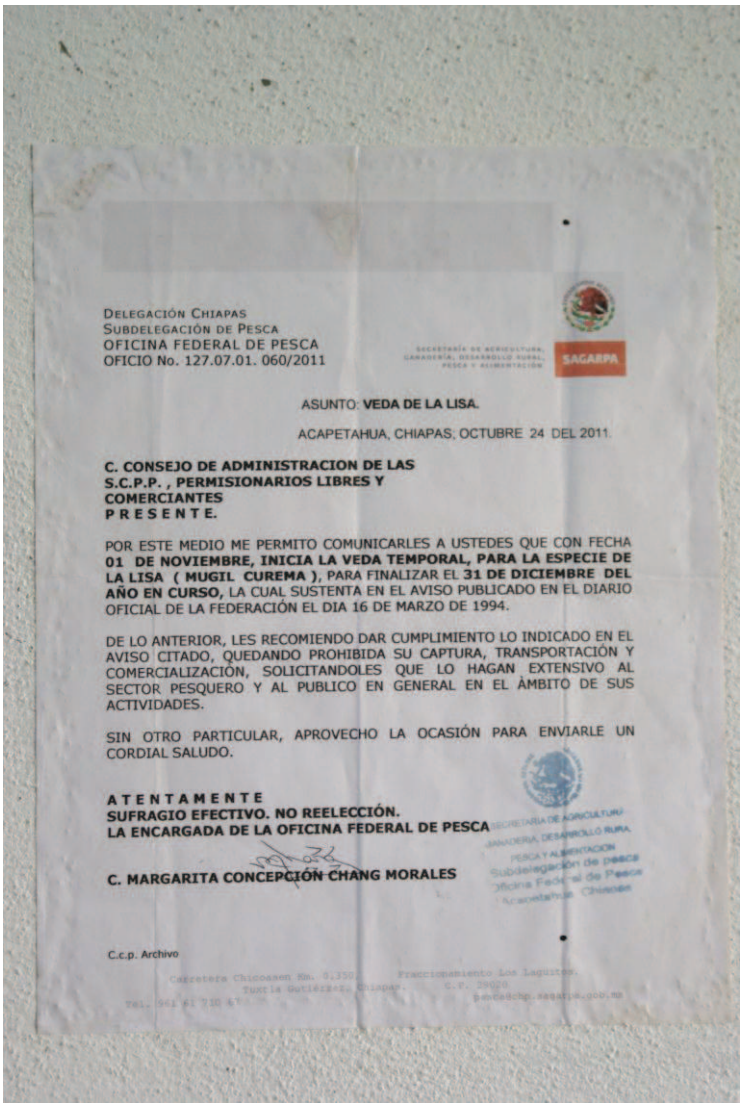
Fishing Operations

- The fishing operations have focused most of their efforts on a single product (shrimp) and to a lesser extent a few varieties of fin fish such as the Flathead mullet.
- Fishing techniques have not changed, with the exception of the outboard motor, as fisherman still use traditional styles which are high in bycatch.
- Exploitation and sale of shrimp in post larvae stage.
- Inadequate infrastructure for storage, distribution, and marketing of fisheries products.
- Middlemen exist in the market, taking large cuts of profits from the fishers.

Figure 7: Multiple species catch; product of stake netting

Education

- Lack of extensive research on the population dynamics of key species in the reserve, as well as commercially fished species.
- Lack of developmental programs and training for fishers.
- Lack of knowledge pertaining to the regulations of various activities (i.e. fishing, harvesting lumber, etc.) within the reserve.



DELEGACIÓN CHIAPAS
SUBDELEGACIÓN DE PESCA
OFICINA FEDERAL DE PESCA
OFICIO No. 127.07.01. 060/2011

SAGARPA

ASUNTO: **VEDA DE LA LISA.**

ACAPETAHUA, CHIAPAS; OCTUBRE 24 DEL 2011.

C. CONSEJO DE ADMINISTRACION DE LAS S.C.P.P. , PERMISIONARIOS LIBRES Y COMERCIANTES
P R E S E N T E.

POR ESTE MEDIO ME PERMITO COMUNICARLES A USTEDES QUE CON FECHA **01 DE NOVIEMBRE, INICIA LA VEDA TEMPORAL, PARA LA ESPECIE DE LA LISA (MUGIL CUREMA)**, PARA FINALIZAR EL **31 DE DICIEMBRE DEL AÑO EN CURSO,** LA CUAL SUSTENTA EN EL AVISO PUBLICADO EN EL DIARIO OFICIAL DE LA FEDERACIÓN EL DIA 16 DE MARZO DE 1994.

DE LO ANTERIOR, LES RECOMIENDO DAR CUMPLIMIENTO LO INDICADO EN EL AVISO CITADO, QUEDANDO PROHIBIDA SU CAPTURA, TRANSPORTACIÓN Y COMERCIALIZACIÓN, SOLICITANDOLES QUE LO HAGAN EXTENSIVO AL SECTOR PESQUERO Y AL PUBLICO EN GENERAL EN EL ÀMBITO DE SUS ACTIVIDADES.

SIN OTRO PARTICULAR, APROVECHO LA OCASIÓN PARA ENVIARLE UN CORDIAL SALUDO.

A T E N T A M E N T E
SUFRAGIO EFECTIVO. NO REELECCIÓN.
LA ENCARGADA DE LA OFICINA FEDERAL DE PESCA

C. MARGARITA CONCEPCIÓN CHANG MORALES

C.c.p. Archivo

Figure 8: Posting of catch limitations of Flathead mullet from Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA)

Policy and Management

- Mortifications and channelization of rivers entering into the reserve in accordance with works of the Coastal Chiapas Water Plan, conducted by CNA, have increased sedimentation and agrochemicals entering the fishing grounds, directly affecting fish stocks.

- High rate of habitat destruction resulting from unplanned activities such as dredging on the estuaries, drainage of wetlands, modification of rivers, alterations of natural hydrological patterns and diversion of water for irrigation. These processes have also increased eutrophication of coastal lagoons in the reserve.
- Conversion of mangroves and estuaries for agricultural purposes.
- Poor management and division among the administrations of the fishing cooperatives and La Federacion to which they belong.
- Very few fishing techniques are prohibited and fishers have few alternative fishing techniques to choose from.
- Inadequate regulations regarding use of certain areas during designated times of the fishing season.
- Fishing regulations during breeding seasons of species are scarce.
- No control over sustainable fishing efforts between members of the cooperative and fishers who are not part of the cooperatives.
- Pollution from agricultural and livestock practices from upland areas.

Sociological

- High population growth rate within fishing communities leading to overexploitation of resources.

Policy. The municipalities found within the reserve fall under Article 115 of the National Constitution which guarantees the existence of free and sovereign municipalities (INE, 1999). The highest authority in each municipality is the mayoral position that is

responsible for administration, municipal management and operational coordination with *ejidos* (communal land owners). Rural judges present in the municipalities act as representatives of the communities in assembly, and are responsible for authoritative matters of the municipality. Fishing cooperatives in the reserve have an elected president and a board of directors usually consisting of three other members of the cooperative. A number of laws and regulations are imposed upon the fishing communities living and operating within the reserve. The following is a list of the aforementioned laws/regulations: The Federal Fisheries Act, the General Law of Ecological Equilibrium and Environmental Protection, Forest Law, National Water Law, Federal Law of the Sea, Law on Hunting, and the National Assets Law (INE, 1999). Community members are becoming interested in addressing issues that affect their municipalities and are often eager to help create resolutions to these problems. In recent years, an increase in community participation in political and administrative matters has been observed.

History of Cooperatives in La Encrucijada. Within the boundaries of the reserve, 31 communities are economically dependent on the reserve for its resources. Within the past 20 years, 14 fishing cooperatives have been established by the communities to help with exploitation of aquatic species, although several are defunct or have been consolidated. Pijijiapan is the municipality with the most cooperatives with a listed total of eight; Acapetahua is listed as having five fishing cooperatives, and Mapastepec has three. An increase in cooperatives activity has been observed in Villa Comaltitlán, with newly formed cooperative societies that focus on aquaculture mainly in the form of shrimp farming, similar to projects in the other municipalities (INE, 1999).

Cooperative fishing in the Chantuto-Panzacola lagoon system began in 1941 with the founding of the fishing cooperative in the La Palma community. Subsequently, in 1942, 1977 and 1993, cooperatives were founded in the communities of Los Cerritos, Barra Zacapulco, and Unión Sta. Isabel, respectively (see Figure 9). Today, through fishing titles a total of 589 fishers operate within these cooperatives (Rodríguez-Perafán, Rodiles-Hernández & J. Nahed-Toral 2011). Four additional cooperatives have also been active within the reserve: El Castaño with 26 members and established in 1982, Barreta de Pajon with 175 members est. 1979, Seccion Prod Rio Arriba with 62 est. 1999, and La Chiapaneca with 60 members est. 1995.

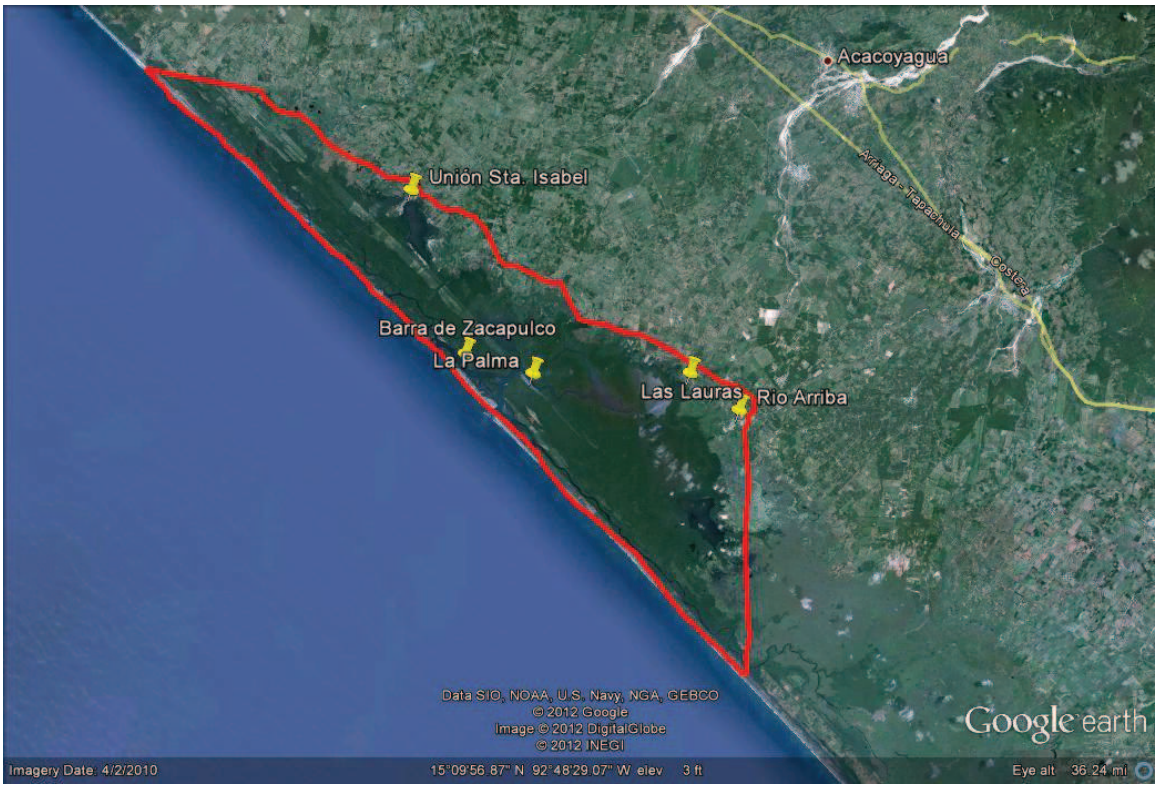


Figure 9: Map Showing Geographic Context of Study Area (La Encrucijada board shown in red and communities shown as yellow pins). (Adapted form: Google Inc. (2011). Google Earth (Version 6.1.0.5001) [Software].)

Figure 10: Fishing community of Unión Sta. Isabel

Figure 11: Fishing community of Barra de Zacapulco

Figure 13: Fishing community of La Palma

Figure 12: Fishing community of Los Cerritos

Fishing Structure

Role of cooperatives and issues they face today. Fishing cooperatives were established with the intent to help benefit the fishing communities economically by streamlining sales and opening new markets in which to sell products. Additionally, they were created to help protect fishing products and have the ability to create regulations that must be followed by anyone fishing within the cooperatives' waters. It is not a requirement to join these cooperatives in order to utilize their fishing grounds, but all fishers must abide by the regulations set by the cooperative within their geographic limits. For example, if a cooperative disallows fishing on Sundays within their waters, then even those outside of the cooperative are prohibited from fishing in their waters on Sunday. In order to enforce these regulations, the cooperatives themselves must police their own waters to catch infractions. Cooperatives are governed by an elected board of directors, and open meetings are held throughout the year to establish rules and management strategies within each cooperative. Fishers sell their products to the cooperative, which in turn sell the products to middlemen. By government law, only a certain number of legally registered fishers are allowed to be members of each cooperative.

Fishing gear. The fishing gear utilized by fishers varies depending and targeted species. A study conducted by Morales (2007) identified ten types of fishing gear commonly used in the reserve. That said, the most commonly used fishing gear include: cast net, gill or trammel net, stake net, and handline (see Figures 14–18). The following are the types of fishing gear utilized in the reserve:

Nets:

- Cast Net (Atarraya) - A circular net with small weights distributed around its edges. This net is used by one person who casts or throws the net by hand from either a fishing vessel or from the ground in such a manner that it spreads out on the water and sinks.

Figure 14: Fisherman cast netting

Figure 15: Fisherman retrieving cast net

- Gillnet or Trammel Net (Transmallo) – Net commonly used to catch fish and crustaceans which are made of a nylon thread base. The top portion of the net has a small buoy and the bottom portion has lead weights which proportionally balance the net, allowing it to retain a uniformed shape while in the water.
- Stake Net (Copo) - Consists of a mesh network with a mesh size of 2.5 cm and is tapered on each side of the widest part of the network. The mesh netting is attached to wooden stakes that are then embedded into the estuaries' substrate. The stake net is usually taken about three kilometers from the shore and placed against the tide to take advantage of the natural fluctuations in the estuary. Its main purpose is for capturing shrimp but its use often results in high levels as it is a non-selective type of fishing gear.

Figure 16: Semi-permanently placed stake netting

Figure 17: Sorting stake netting catch

Fishing Lines:

- Handline (Anzuelo) – Gear includes a nylon fishing line with an attached hook (which within the reserve usually range from size 4-10 cm) and are often weighted. The fishing line is wound around a wooden board and is cast and pulled in by hand.

Figure 18: Fishers utilizing handlines

- Trolling (Curricán) – Artificial lures are attached to fishing lines and secured to either rods of other lines under the boat. These lines and lures are then drug, usually around 50m, behind the boat at a moderate speed.
- Mota – Rudimentary style fishing gear which consists of two hooks that are tied to a nylon thread which is wound around a piece of wood similar to the handline. A weight which has a feather attached to it is threaded though the nylon and used for bait.
- Longline (Cimbra) - Very long fishing line (≈ 250 m) in which different sized hooks are tied to the line at different points to fish at different levels in the water column. This gear is rarely used in the inland waters of the mangrove ecosystem, but is sometimes utilized in the open ocean near the river mouths.

Spears:

- Pole Spear (Fisga) - Consists of a thin steel pole, a spear tip, and a rubber loop which acts as a sling to project the spear underwater.
- Spear Gun (Pistola de acero con arpón) – The basic components of a spear gun are: A spear, a stock/barrel, and a handle/grip containing a trigger mechanism which when pressed or pulled causes the spear to be fired.
- Trident (Trinche) – The trident consists of a piece of wood (approximately 2m long) which on one end three iron tips are attached. These tips are usually barbed tines which help trap the speared fish.

Other stakeholders currently involved in the reserve

A number of academic institutions, state and federal level governmental agencies, and non-governmental organizations are actively engaged in issues surrounding the management of the reserve and the livelihoods of those living within it. The following is a list of stakeholders who are active in the reserve; while this list is by no means a complete list of all stakeholders working in the reserve since this study was based on the livelihoods of fishers, only those stakeholders who specifically pertain to the fishing industry have been listed below:

Academic:

El Colegio de la Frontera Sur (ECOSUR), Universidad Autónoma de Chiapas (UNACH), Universidad Nacional Autónoma de México (UNAM): Academic institutions that are currently or have in the past been engaged in research pertaining to the livelihoods of peoples living within the reserve and/or the natural environment and ecosystems of the reserve.

Colorado State University (CSU): University in the United States which currently has master's students engaged in research focusing on livelihoods of fishers.

Nonprofit:

Centro de Agroecología San Francisco de Asís A. C. (CASFA): Interested in poverty alleviation issues and hunger issues. Efforts mainly focus on implementing sustainable agricultural practices in communities especially in cocoa and coffee production. While most work in the past has focused on land based food supplies they have recently begun working with fisheries to create more sustainable fishing practices.

RARE Conservation: NGO that is actively conducting workshops within some of the fishing communities focusing on improving sustainable activities and roles of women within these communities.

Acción Cultural Madre Tierra (A.C.): Focused on strengthening sustainability through responsible fishing in the lagoon systems of Chantuto Pensacola and St. Nicholas of La Encrucijada, and Mapastepec Acapetahua municipality, Chiapas. Their two year grant allowed them to hold workshops within the reserve to help educate and spread the word of the Responsible Fishing program.

Figure 19: Responsible Fishing workshop in the community of Las Lauras

Public:

Reserva de la Biosfera La Encrucijada (LA REBIEN): This organization is in charge of the protected area.

The United States Agency for International Development (*USAID):* This organization has been financing the workshops for FAO's Responsible Fishing program in the area over the last two years.

Federación Regional de Sociedades Cooperativas Pesqueras de la Industria Pesquera del Estado de Chiapas (La Federación): This organization works with regional fisheries and has knowledge about how the Responsible Fishing program has been promoted

Comisión Nacional de Áreas Naturales Protegidas (CONANP): Administers the management and protection of Mexico's Natural Areas which includes the reserve. They are concerned with conservation in a sustainable development context.

La Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA): A unit of the federal government, whose objectives are to foster policies to help produce and better utilize the comparative advantages of Mexico's agricultural sector, integrate the activities of the rural environment productive chains from the rest of the economy, and encourage collaboration of producer organizations with programs and projects among themselves.

Comisión Nacional de Acuacultura y Pesca (CONAPESCA): Large governmental agency concerned with fishing policy and programs like FAO's Responsible Fishing program.

Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA): Involved in reducing risks of pesticides and other agro-chemicals.

Food and Agriculture Organization's Responsible Fishing Program:

History. Fisheries and the fishing sector have been rapidly developing to meet the international demand for fish and fishery products that has led to the push for larger fishing fleets and modernized factories. Studies are beginning to show clear signs of overexploitation of certain fish stocks, modifications of ecosystems, significant economic losses in certain fisheries, and international conflicts on management and fish trade (FAO: Rome, 1999). It has become clear that many fishery resources cannot be sustained at the current level of exploitation.

The FAO's Responsible Fishing program has been in development over the last two decades. To combat the potential collapse of many fish stocks and fisheries around the globe, the Nineteenth Session of the FAO Committee on Fisheries (COFI), held in March 1991, recommended that new approaches to fisheries management that embraced conservation and environmental, as well as social and economic, considerations were urgently needed (FAO: Rome, 1999). FAO was tasked with the development of the concept of responsible fisheries and asked to create a COC which could be used as a guideline for its application within fisheries. Additionally, the International Conference on Responsible Fishing held in Cancun, Mexico in 1992 further requested FAO to prepare an international COC to address these concerns. This led to the development of the Declaration of Cancun and in June 1992 this Declaration was an important contributor to the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil particularly its Agenda 21 (FAO, 1995). Another request to develop a COC was recommended at The FAO Technical Consultation on High Seas Fishing, held in September 1992 (FAO: Rome, 1999). The One Hundred and

Second Session of the FAO Council, held in November 1992, discussed the general direction and problems the COC should focus on, and decided that the COC should mainly address high seas issues. They recommended that proposals for the COC be presented to the 1993 session of the Committee on Fisheries (FAO: Rome, 1999).

The COC was formulated to conform with the relevant rules of international law, especially with respect to the United Nations Convention on the Law of the Sea, 1982, and the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of December 10, 1982, Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, 1995. (FAO: Rome, 1999).

A proposal for the COC was reviewed in March of 1993 at the Twentieth Session of COFI. Framework and content of the proposal were evaluated. The Session advocated for a time frame in which further elaboration of the COC could take place. Further review of the COC took place at the Twenty-eighth Session of the Conference in Resolution 4/95 and resulted in the full adoption of the Code of Conduct for Responsible Fisheries on 31 October 1995 (FAO, 1995).

Aspects of Responsible Fishing Code of Conduct. FAO's COC for Responsible Fishing is totally voluntary, however, as mentioned above; certain parts of it are based on relevant rules of international law. The COC provides principles and standards applicable to the conservation, management and development of all fisheries and also attempts to increase the data of fisheries by creating monitoring programs for the capture, processing and trade of fish and fishery products, fishing operations, aquaculture, fisheries research and integration of fisheries into coastal area management. The COC recognizes the

nutritional, economic, social, environmental and cultural importance of fisheries and attempts to address the interests of all stakeholders tied to the fishery sector.

The COC consists of 12 articles: Article 1; Nature and Scope of the Code, Article 2; Objectives of the Code, Article 3; Relationship with other International Instruments, Article 4; Implementation, Monitoring and Updating, Article 5; Special Requirements of Developing Countries, Article 6; General Principles, Article 7; Fisheries Management, Article 8; Fishing Operations, Article 9; Aquaculture Development, Article 10; Integration of Fisheries into Coastal Area Management, Article 11; Post-harvest Practices and Trade, and Article 12; Fisheries Research (FAO, 1995).

A full explanation of each article can be read in the *FAO Code of Conduct for Responsible Fisheries* (FAO, 1995) located online at:

ftp://ftp.fao.org/docrep/fao/005/v9878e/v9878e00.pdf

States and all others involved in fishery operations are encouraged by La Federacion to conform to FAO's COC of Responsible Fishing. CONANP believes that a form of responsible fishing could be implemented into the fishing communities that exist in the reserve in hopes that it will help limit overexploitation and mitigate future challenges that may arise from upriver activities. CONANP is currently in the beginning stages of implementing aspects of responsible fishing in the communities.

FAO's Responsible Fishing program in Mexico. Mexico's fisheries management system is constantly undergoing change as is the case with most of its sectors. New governmental administrations take office at the federal level every six years and they have the ability to change or adapt Sectoral Plans as seen fit. General objectives and emphasis of plans usually change as new plans are put forward. For example, during

the late eighties a focus was placed on increasing fish catches as the National Fisheries Development Plan 1988-1994 set as an objective to reach the "Maximum Sustainable Yield" of fisheries (FAO, 2003). In the mid nineties, a change of emphasis began to take shape mainly due to Mexico's support for FAO's Responsible Fishing COC, which was actively promoted at the 1994 Conference in Cancun. The new Fisheries Plan stated sustainability as a goal and the Precautionary Principle as a guideline (FAO, 2003) and has led to Mexico being one of 14 nations to accept the Compliance Agreement of the Responsible Fishing COC (Doulman, 2000). The four objectives found in Mexico's current Sectoral Plan for fisheries includes: exploit fisheries resources in a sustainable way; increase economic and social profitability of fisheries and aquaculture; increase legality of certainty fishing and aquaculture activities; promote and support programs for fishing and aquaculture activities (FAO, 2003). All of these are promoted under the Responsible Fishing COC.

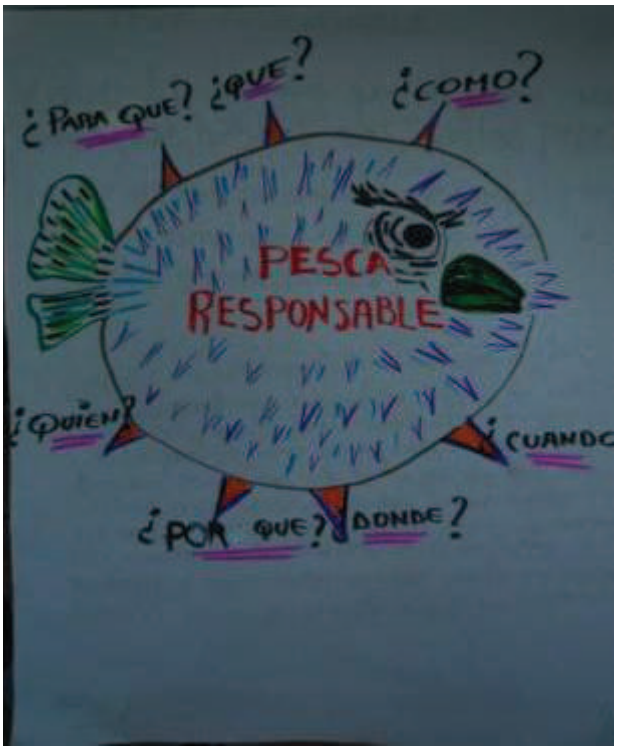


Figure 20: Introductory flipchart page at a Responsible Fishing workshop

A current example of how FAO's Responsible Fishing COC is being implemented in a Mexican fishery can be observed in the Red Grouper fishery in the Yucatan, Mexico, the largest producer of red grouper in the world (Heemstra and Randall, 1993). This fishery is the most important fishery of the Yucatan, contributing 70% of the national production of this species (OECD, 2000). Catches from the fishery were around 8,000 metric tons in the last 4 years, worth 10 million USD per year (SEMARNAT, 1999). This fishery alone generates 6,196 direct jobs and around 2,000 secondary jobs (OECD, 2000). Studies within the fishery all point to fish stocks of the Red Grouper being over-exploited leading managers and fishers to take direct action to make exploitation reasonable and help the stock recover to sustainable levels (OECD,

2000). Under these circumstances, the Mexican government is trying to set agreements that would comply within the COC for Responsible Fishing and would address all stakeholders in the fishery. The agreement includes setting a minimum size limit, setting a total allowable quota for boats or fishers, and closing the fishery in some areas and during certain times when there is aggregation for reproduction (OECD, 2000). Although the basis of these regulations is to help restore the Red Grouper stock in the Yucatan, undoubtedly setting quotas will hurt the economic production of fishers. The Mexican government is trying to address the livelihoods of these fishers by creating a Social Plan in line with the COC to help mitigate the negative economic backlash of these regulations on the Yucatan people.

Methodology

Description of Semi-structured Survey Instruments

Demographics of sampling population. The vast majority of fishers in the study area are male, and those surveyed are representative of this demographic. All board members of the cooperatives were male, and ranged in age from 35 to 70 years old. At least two board members from each community were interviewed, and several more when others were available. All interviewees had lived in their respective communities for greater than 10 years, with 60% never finishing grade school, 25% completing primary education, and 15% completing secondary education. Family sizes ranged from one to nine members living in one household. For 85% of the sampling population, fishing was their primary occupation, while the remaining 15% were primarily farmers.

It is important to note that one female fisher, who was not on the board of directors, was identified and interviewed with the same survey with the sole purpose of gaining a female perspective of the issues being explored. Her interview was not grouped with the other 20 interviews for analysis because she was not a board of director and therefore did not fit the targeted sampling demographic.

Non-fishing Stakeholders. In this investigation, non-fishing stakeholders were considered to be any of the aforementioned groups or groups actively engaged in the management and dealings of the reserve, including but not limited to practioners, researchers, members of NGOs, and state and federal government agency personnel. The survey guide used for non-fishing stakeholders was translated from English to Spanish, and trial runs of the survey were given to native Spanish speaking colleagues who provided grammatical and language corrections which were then applied to the survey. A list of NGOs, state and federal level governmental groups, and academic institutions who are involved in the reserve in some capacity were identified through research and conversations with a variety of stakeholders engaged in issues surrounding the reserve. Within these groups, individuals that had an intimate knowledge of the ecosystem or the fishing industry within the reserve were identified and sent an email with the non-fishing stakeholder survey (See Appendix B page 125 for English or Appendix C page 138 for Spanish). Email was chosen as the means for response collections due to the short time frame allowed for the study and because many of the organizations identified were located far from the study site.

Surveys were emailed in October 2011 and a follow up email was sent in November 2011. A total of 35 individuals from non-fishing stakeholder groups were

identified and sent emails. Eight responses were received (response rate = 23%), representing non-fishing stakeholders of the government (n = 3), NGO's (n = 2), and academic institutions (n = 3). This relatively low response rate can be attributed at least partially to the fact that eight responded that they had only worked briefly in the reserve and did not feel that they had a deep enough knowledge to complete the survey.

Derivation of Survey Questions. The survey instrument (see Appendix C for English version and Appendix B for Spanish version) was derived from prior research, observations in the area prior to the research, and from similar studies, primarily those done in the Philippines (Allegretti, Vaske & Cottrell, 2012) and Galapagos Islands, Ecuador (Finchum, 2002). The survey instrument addressed biological, economic, and social factors that impact the reserve and the livelihoods of those living in the region. Many of the questions addressed aspects of the FAO Responsible Fishing program. Survey questions included fisher evaluations of fishing policies and scenarios adopted by the fishing cooperatives. Many of these policies included fish gear regulation, fishing restrictions, and other aspects of the COC. Lastly, communication issues within the cooperatives and management organizations were addressed in the questionnaire.

Information arising from the semi-structured nature of the face-to-face interviews with the fishers was transcribed and entered into a Microsoft Word document where it was coded and analyzed for trends.

Figure 21: In-field semi-structured interview

Fishers. Surveys containing questions pertaining to the aforementioned objectives were administered to fishers through face-to-face interviews by the researchers, conducted from October to November 2011. On several occasions, the researchers were accompanied by a PhD candidate at ECOSUR, Carlos Perafan, due to his rapport with many of the communities. The total sample was 21 fishers, with representatives from each of the six communities that make up the fishing communities in the reserve. A final trial run for the fisher survey guide was given to Carlos Perafan. Suggestions of appropriate word usage to better suit fishers' everyday vernacular were suggested by him and the survey guide was altered to incorporate these changes.

On-site surveys were administered to fishers through face-to-face interviews between October to November 2011 (response rate = 100%). Face-to-face interviews were used with the fishers for two reasons; the first being the high illiteracy rate in Chiapas, 24% among those 25 years or older compared to the national Mexican average of 9.5% (INEGI, 2010), so interviews were conducted in person to help guide participants through questions in case of illiteracy. Secondly, face-to-face surveys allow the opportunity for interviewers to ask for clarification, to ask follow-up or "branched" questions, and to observe and make note of surroundings (Duke, 2011 pg. 408). This essentially turned the guided survey into a semi-structured survey which allowed for a deeper into the fishers' knowledge. Additionally, application of this technique tends to produce high response rates (Duke, 2011 pg. 408). These open-ended responses were recorded in a journal and later coded and transcribed.

The survey guide was broken down into five sections: 1) respondents' evaluations of communication and education of COC, 2) policies and management within the reserve, 3) communication between managerial groups, fishing cooperatives, and fishers themselves, 4) past and present ecological perceptions of the reserve, and 5) basic background information of the participants.

Cooperatives targeted for this study consisted of a board of directors containing four elected individuals from the community, one of which was the acting president. In each of the cooperatives sampled, all four individuals of each cooperative's board of directors were targeted for interviews. In some cases (i.e. Rio Arriba and Barra de Zacapulco) all four of each cooperative's directors were unable to be located or interviewed. To supplement these interviews, additional fishers who were actively

engaged in the Responsible Fishing program were identified in the towns of Los Cerritos and La Palma, the oldest and largest fishing cooperatives in the reserve, and interviewed. The total sample size was 21, representing the fishing cooperatives of Los Cerritos (n = 7), Rio Arriba (n = 2), La Palma (n = 5), Barra de Zacapulco (n = 3), and Unión Sta. Isabel (n = 4).

Variables Description. Stakeholders (fishers and non-fishing stakeholders) served as the independent variable. Dependent variables included; a) communication of Responsible Fishing, b) management of the reserve, c) communication between managerial groups, d) regulations, e) perceptions of past and current state of La Encrucijada ecosystem. Other dependent variables included perceived problems and their causes within the reserve which were analyzed using a methodology from Nahed & Tirado (2000) and (Nahed et al., 2008).

Description of Potential Conflict Index

The Potential for Conflict Index (PCI_2) was created to help facilitate understanding and applicability human dimensions findings relating to managerial concerns (Vaske et al., 2010). The PCI_2 model was used to quantify the degree of consensus (or lack thereof) between non-fishing stakeholder groups and the fishers themselves in regards to communication issues, education, management of the reserve, and perceptions of the current state of the ecosystem. The goal is to show where consensus or disagreement exists among stakeholder groups and highlight where conflict might arise from these disagreements. The PCI_2 scale ranges from 0 to 1, with a value of 1 representing a scenario with little to no consensus among stakeholder groups, which creates a scenario with a high potential for conflict and occurs when responses are

equally divided between the two extreme values on a response scale. A PCI_2 value of 0 signifies total consensus and a scenario with no potential for conflict (Vaske et al., 2010).

Results from this model are displayed as bubble graphs. The size of the bubble shows the extent of potential conflict; a small bubble represents little potential for conflict while a larger bubble reflects high potential for conflict. The center of the bubble represents the mean rating as plotted on the y–axis.

Analysis Strategy of PCI_2. One-way Analysis of Variance (ANOVA) was used to compare the mean normative evaluations between responses of fishers and non-fishing stakeholders. The PCI_2 was used to compare the amount of consensus for perceptions of communication, management, and the environmental state within the reserve. Statistical differences between the observed PCI_2 values were calculated using the software available from: *http://welcome.warnercnr.colostate.edu/~jerryv*. Using the Excel PCI_2 add-in, the simulation was set with the following inputs: a Bipolar with Neutral Value scale type and the scale width set at -2 to 2, with -2 in disagreement with question being addressed, 2 being in agreement and a value 0 being neutral. To include the neutral values in the simulation, the distance function was set at D2. The power function of the model was left at the default setting of 1 and the number of simulated replications was set at 400 (default value). The PCI_2, mean, and standard deviation were all computed using the Excel add-in.

When PCI_2 was approximately normally distributed, the standard deviations calculated using simulations were used to test differences between actual PCI_2 values using the following formula:

d = ABS (PCIa - PCIb) / √ (PCIaSD)2 + (PCIbSD)2 where d is considered to be N(0,1)

where:

The √ is the radical symbol for the square root of the sum of the squares

ABS = Absolute value

PCIa = Observed PCI_2 for the 1st sample or group

PCIb = Observed PCI_2 for a 2nd sample or group

PCIaSD = Std. Dev. of simulated PCI_2 distribution for 1st sample or group

PCIbSD = Std. Dev. of the simulated PCI_2 distribution for 2nd sample or group

If $d > 1.96$, difference is statistically significant at $p < .05$

Bonferroni's Correction. In order to lower the chances of receiving a Type I error when comparing PCI2 values, a Bonferroni correction was run to adjust (lower) the alpha value (α) to account for the number of comparisons being performed. This correction lowers the p value from 0.05 to 0.0001282 which increases d > 3.6623 to show significance. Although using a Bonferroni correction can help decrease the chances of a Type I error occurring, it is commonly criticized that using this correction could increase the chances for a Type II error Nakagawa (2004) & Perneger (1998). While much contention surrounds the implementation of a Bonferroni correction, its implementation was still used in order to prevent making a Type I error.

Excel model was used to calculate these values which can be found at: http://warnercnr.colostate.edu/~jerryv/PCI2/comparing_pci2_values.htm

These d values were utilized to highlight potential conflict that may arise between stakeholder groups.

Cross-impact Analysis Methodology

To create an analysis for the interdependence and ranking of the perceived problems of both fishers and non-fishing stakeholders within the reserve, a cross-impact analysis methodology from Nahed & Tirado (2000 and Nahed et al. (2008), was utilized. Within both surveys, participants were asked to identify, based on experiences, issues they considered most important, prevalent or pressing within the reserve. Once a problem and/or issue was identified, participants were asked to elaborate further and define in detail the cause or driving forces behind this problem taking into account the interactions between the causality of problems.

Using this methodology, it is possible to compile a list of priority problems and from this create a double entry matrix, which shows the interdependence between problems and the influence of each based on a weighting scheme. To develop the double entry matrix of influence, both the motility and dependence of listed problems were considered. Motility is the sum of interactions (where at least one participant identified a problem that affects another problem) and is displayed in rows within the matrix and indicated how many times each variable impacts others. The dependence is the sum of interactions and is listed within the columns in the matrix and indicates the number of times in which each variable is influenced by the other, i.e. the number of times each variable depends on others (Nahed & Tirado, 2000). With the information gathered from the double entry matrix, a chart can be produced which shows the interdependence of the priority problems hierarchically based on values and dependence to other listed problems. The chart is broken into four separate cluster areas which are known as variable zones. The four variable zones are as follows:

Power Variables Zone: Includes the variables that have the highest motor and lowest dependency.

Conflict (Link) Variables Zone: Variables with high motility and high dependency. These variables are highly vulnerable and have influence over others, and are, likewise, influenced by them, for that reason they are in conflict and are important because any change in this area will have effects on output and on themselves.

Autonomous problem variables area: So named because the problems in this area have no measurable effect on the other and are not influenced by others, for that reason have little mobility and little dependence.

Zone Out/Output Variables: In this area are all variables that are the product of the above, this area is characterized by low motility and high dependency.

To define the boundary between the four areas of the motility and dependency graph formula was applied: m = 100 / n, where n is the number of variables or conditions (Nahed & Tirado, 2000). A double entry matrix and chart were created for both fishers' and non-fishing stakeholders' responses and these charts were compared.

Results

General Background Information of Participants

Board of Directors. A total of 20 directors of the five different cooperatives existing with the reserve were interviewed to gain a fisher's perspective. All directors were male and had lived within the reserve for more than ten years. The mean age of the directors was 50.45 years with the youngest director interviewed being 35 years old and

the oldest 70 years old. Fifteen percent (15%) of the directors are secondary school graduates, 25% are primary school graduates, and 65% did not finish primary school.

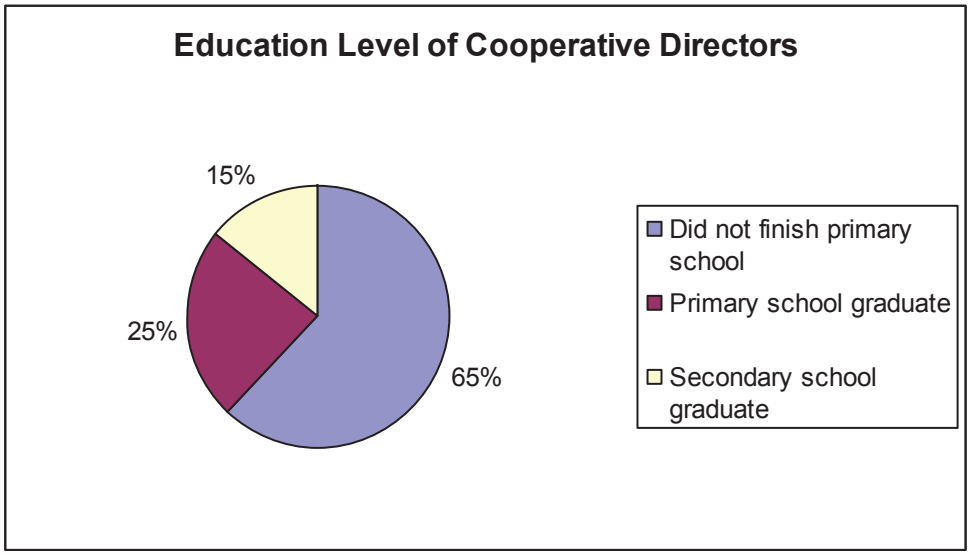


Figure 22: Education level of board of directors

The average number of people living in the directors' homes was 4.4 with the largest group being 9 people and the lowest being 2. Eighty-five percent of the directors identified their sole occupation as fishing, the other 15%, who had another occupation, listed agriculture as their other occupation. Two directors listed a third occupation as an additional source of income, one as an electrician and the other a tourist guide.

Non-fishing Stakeholders. Eight non-fishing stakeholders were identified and interviewed for this investigation. Seven (87.5%) of the non-fishing stakeholders interviewed were males and one (12.5%) was female. Three interviewees (37.5%) were from governmental organizations, three (37.5%) were from academic and research institutions, and two (25%) were from non-governmental organizations. Participants of the non-fishing stakeholder group were asked to list current projects in which they are invloved in. These include:

- Income support programs for agricultural equipment and components as well as the moderninzation of fishing practices and infrastructure.
- Aquacultural programs
- Aquatic species monitoring
- Artisanal fishing programs
- Mangrove ecosystem research
- Programs looking into the development of the Responsible Fishing program in the area.
- Family and livelihood programs focusing on creating sustainable jobs in the region.
- A program which supports productive reconversion-silvopastoral management

Figure 23: Abandoned fish processing infrastructure

Cooperative Information. One hundred percent (100%) of directors said that members of their community fish within their cooperatives' boundaries. They did

mention that many of the cooperatives have agreements with each other allowing certain parts of cooperatives' waters to be shared. For example, the Cerritos cooperative has an agreement with La Palma in which they can both use certain parts of each others' fishing grounds. La Palma also has an agreement with Barra Zacapulco to share parts of their waters.

The directors were asked to list the most common types of fishing gear utilized by fishers in their cooperative. Thirty-four (34) answers were given, all of which fell within three types of fishing gear: cast net, trammel net, and handline. Cast net was mentioned the most at 20 times (58%), handline was the second most commonly listed gear type at 8 (24%), and trammel net was mentioned 6 times (18%).

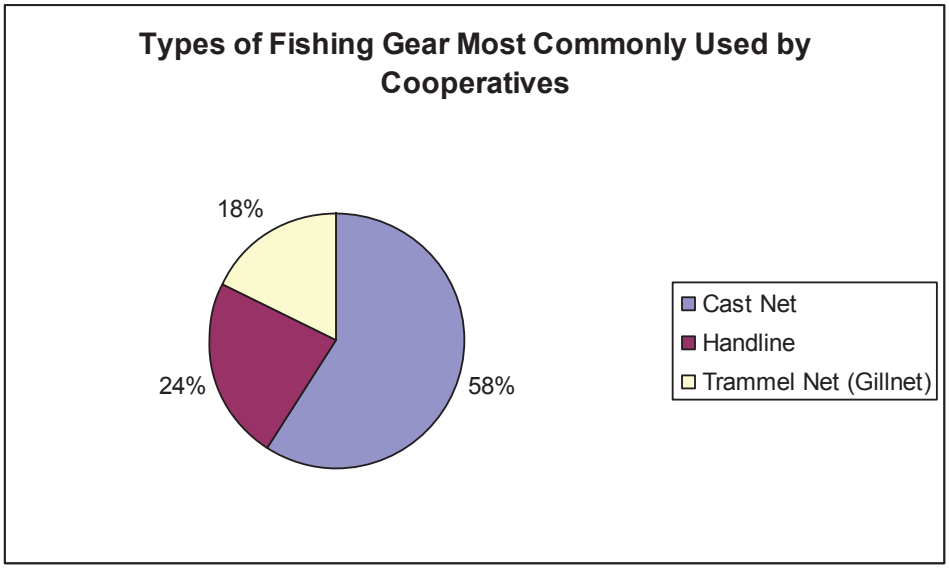


Figure 24: Graphical representation of commonly used fishing gear

The average length of time spent fishing per day was 5 hours- 30%, 4 hours- 25%, 6 hours- 25%, 3 hours- 10%, 8 hours- 5%, and 5% said it was dependent on ocean tides. The responses focusing on the dependence on ocean tides came from a cooperative that

was located very close to one of the river deltas in the reserve whose waters are very dependant on the daily ocean tides.

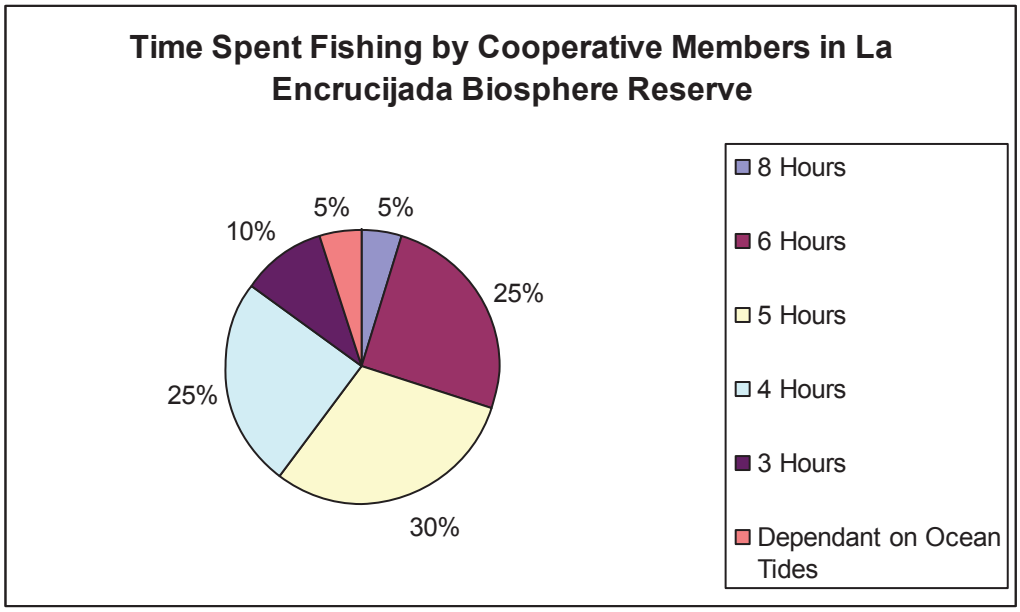


Figure 25: Graphical of average daily time spent fishing

Sixty-five (65%) of directors said fishers in the communities fish 6 days a week, 25% said 7 or every day, and 10% said 5 days a week.

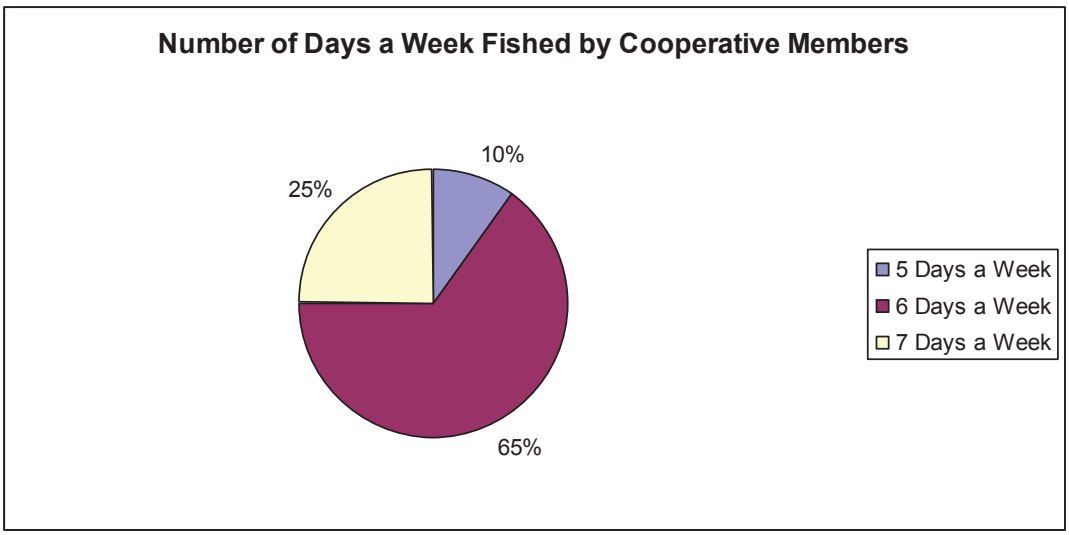


Figure 26: Graphical of average days spent fishing per week

Eight species were listed as the main species harvested by cooperatives. The most targeted species according to the directors are Snook (White and Black) (27%), followed by shrimp (White and Blue) (26%), Gerreidae (19%), Colorado snapper (17%), White mullet (8%), Crayfish (1%), Red Snapper (1%), and Armada (1%).

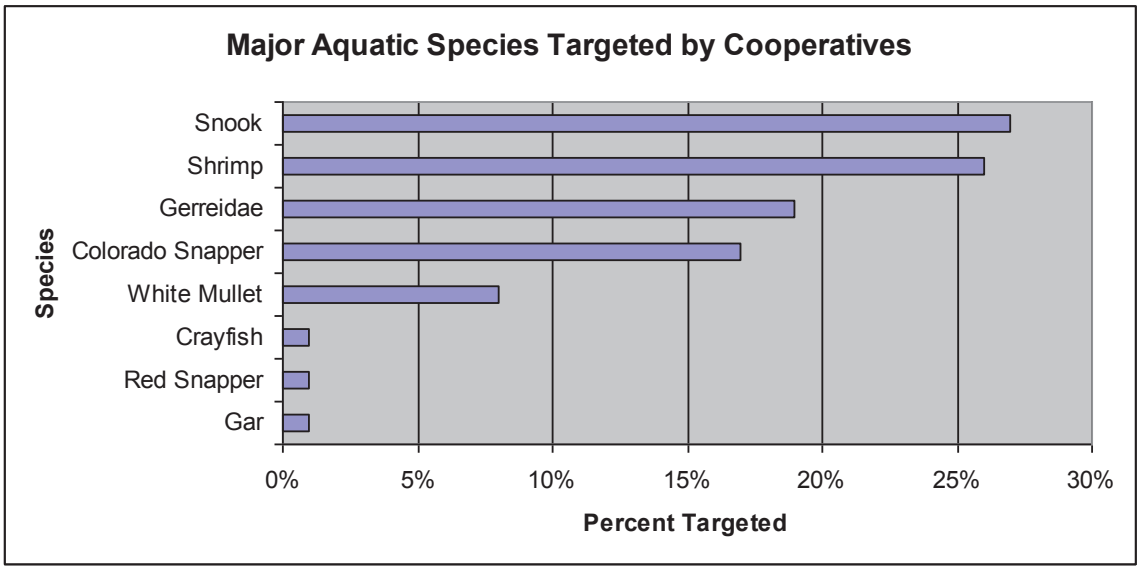


Figure 27: Graph of most highly targeted species amongst cooperatives

Environmental Perceptions. Both the cooperative directors and non-fishing stakeholders who participated in this study were asked to identify, using their knowledge or experiences, the state of important aquatic species populations over the past ten years. Participants were asked their level of agreement with Likert style questions, which were scored on a 1 to 5 level scale with the value of one representing total agreement and 5 being in total disagreement. The following table shows a comparison of both groups' responses to these questions:

In the last 10 years...	Rating Average For Board of Directors	Rating Average For Non-Fishing Stakeholders
The Flathead Mullet population has decreased	1.2	1.5
The White Mullet population has decreased	1.65	1.75
The Yellowfin Snook population has decreased	1.7	2
The Blackfin Snook population has decreased	1.7	2
The Black Snook population has decreased	1.75	2
The White Snook population has decreased	1.75	2.13
The Yellow Snapper population has decreased	1.55	2.13
The Colorado Snapper population has decreased	1.6	1.88
The White Shrimp population has decreased	1.3	1.63

Table 1: Board of Directors and Non-fishing stakeholder responses to changes in aquatic species populations in the last ten years

Both board of directors and stakeholders are in agreement that in the last ten years, all of the most economically important species for the fishery have experienced population decreases. Both groups had the highest average response ratings for Flathead mullet; 1.20 for fishers and 1.50 for non-fishing stakeholders, and white shrimp, 1.30 for fishers and 1.63 for non-fishing stakeholders, showing that all parties are in agreement that these populations have decreased significantly. During open-ended discussions about Flathead mullet populations, board of directors' comments included:

"There was a lot of Flathead mullet around an arms length and 2kg in the past but now they are all very small"

"We used to mainly target Flathead mullet but now we can't"

"Some species, mainly Flathead mullet, have been completely eliminated"

It would be important to note that while board of directors explained that all species they fish for have experienced a decrease in population size in the past ten years, only Flathead mullet appears to be almost eliminated from parts of the reserve. The directors also explained that shrimp populations have decreased dramatically in the last ten years. One director explained that, "In the past people could catch around 300 kg of shrimp in one night now they are lucky to get even 50 kg." The board of directors consistently listed both Snook species populations as experiencing the least amount of decrease in the past ten years. One commented, "Snook populations haven't decreased much; just the size of snook we catch has gotten smaller."

Communication and Importance of Responsible Fishing Program. One hundred percent (100%) of both board of directors and non-fishing stakeholders said that the Responsible Fishing program was beneficial for the reserve and for the livelihoods present within it. Both groups were asked to rate how well informed they are of its goals and the program in general. Questions were rated on a scale of 1 to 5, with 1 being very well informed and 5 being very poorly informed. Both groups felt that they were adequately informed on the topic with the average rating for cooperative directors being 2.00 and for non-fishing stakeholders 1.75.

How well informed are you of the Responsible Fishing program?	Rating Average
Board of Directors	2.00
Non-fishing Stakeholders	1.75

Table 2: Respondents level of knowledge to the Responsible Fishing program

The board of directors listed a number of places in which they learned about the program, most of which were through workshops presented in the reserve. Organizations

mentioned by the directors as having these workshops were CONANP, REBIEN, the NGO Madra Tierra, and CASFA. The other source listed was, 'other fishers,' or those who have attended workshops such as the presidents of the cooperatives. Most non-fishing stakeholders learned about the program through various organizations they are a part of. Many were on panels or forums which are involved in the planning processes within the reserve; others are part of the advisory task force of the Responsible Fishing program. Some said that they themsleves had learned about the program by attending workshops within the reserve and one claimed that they had learned about the program personally from fishers.

Figure 28: Presenting the findings of a brainstorm activity during a fishers' Responsible Fishing workshop

Fishing Policies. Both participatory boards of directors and non-fishing stakeholders were asked if they believed certain types of fishing gear should be regulated or prohibited within the reserve. Ninety-five percent of board of directors agreed that regulations should be put on certain types of gear. Trammel net was mentioned 14 times, cast net 8 times and stake net 7 times. In regards to trammel net and cast net regulations, the board of directors explained that they think the size of holes in each of these gear types should be regulated. Trammel net hole sizes of 1 cm, 1 ¾ cm, 2cm, 3cm, and 4 cm were all mentioned as needing regulation. One director mentioned that certain types of gear are already regulated by the cooperatives. This same director also mentioned that CONAPESCA has set regulations but they are not strict and often do not enforce them. Another explained that in their cooperative people cannot use trammel net with holes 2 cm or smaller and if the cooperatives catch people using these then they will seize the nets.

All of the non-fishing stakeholders agreed that regulations should be placed on certain types of fishing gear. Stake net was mentioned the most with four mentions; cast net and trammel net were both mentioned two times. Three of these participants mentioned that all types of gear should be regulated in some form or another.

When asked if parts of the fishing areas should be closed periodically by the cooperative for the recovery of fish stocks, 100% of participants said they were in favor of this. A follow up question was asked if future regulations should be based off of results of scientific research and/or monitoring projects and fisheries capture data. On a scale of 1 to 5 with 1 being in total agreement and 5 being in total disagreement and 3

neutral, both groups fell within the agreement range with an average response rating of 1.5 for fishers and 2.0 for non-fishing stakeholders.

Fishing bans and catch volumes should be based on results of scientific research and/or fisheries capture records.	Totally Agree	Agree	Neutral	Do Not Agree	Totally Disagree	Rating Average
Board of Directors	11	8	1	0	0	1.50
Non-fishing Stakeholders	3	4	0	0	1	2.00

Table 3: Agreement with fishery regulations being based off of scientific research

Current and future research and management. Non-fishing stakeholders were asked if they believed sufficient research existed within the fishery to establish management policies on such things as fishing gear, catch quotas and fishing seasons. All but one stakeholder (87%) said that there was not suffucient research currently in the fishery to set future managerial efforts. Those that did not think adequate research existed were asked to elaberate on what was missing. The following answers were given:

- Knowledge of the biological cycles of commercial fish is needed for the readjustment of closures and to create selective fishing areas.
- Long-term research projects focusing on the mangrove ecosystem.
- Training programs for fishers, to educate them on the biology of species, catch quotas, seasonal closures (which they actively participate in), in addition to programs to help police and watch over all of the reserve.
- Studies focusing on the social science aspects of fisheries management.
- A program in which local fishers are involved in developing the fishery, because they have knowledge about resources in the area. Involving them would also

indirectly help them by teaching them the importance and benefits of research and give them some short term benefits through wages.

- Educational programs to help fishers become aware that the fishery needs more sufficient data and that they may benefit from this information.

Lastly, non-fishing stakeholders were asked which policy or policies in their opinion are most detrimental to the reserve. The following are some of the answers mentioned:

- Frequent changes in the state and federal governments have resulted in a lack of development in this sector in terms of productive economic alternatives, land use planning and training of fishery organizations for the development of a responsible fishery.
- Hydraulic policies from CONAGUA which benefit agribusiness and economic development without considering the ecological impact on the lagoon system and the impact on artisanal fisheries.
- The lack of resources and production policies applied within the reserve as well as the lack of supervision, alternative work oppertunities and high levels of unemployment.
- Policies that have led to the rectrofication and channelization of rivers and deforestation of the upper basin.

Description and ranking of perceived problems from board of directors using cross-impact matrix analysis: A total of 40 problems were identified by the directors of the five cooperatives targeted for this study, which were grouped based on descriptive similarities causes. This allowed for the large number of identified problems to be

clustered into a smaller, more manageable synthetic list of 10 problems with their acknowledged causes: 1) inadequate management, 2) lack of communication with other stakeholders, 3) upper watershed issues, 4) insufficient markets, 5) unsustainable use of resources, 6) population and demographic change of fishing communities, 7) lack of education or knowledge, 8) inadequate policies or regulations, 9) water quality, and 10) loss of mangrove ecosystem.

1. Inadequate management:

This problem concerns the perceived lack of adequate managerial actions taking place within the reserve. The main causes are: i) management groups are underfunded and thus cannot staff sufficient workers to regulate the reserve, ii) groups only manage from a distance and rarely visit the reserve, iii) management groups are hard to get a hold of and do not answer their phones when needed, iv) lack of programs and/or policies do not exist that would allow for adequate management, and v) management does not give support to the local communities.

2. Lack of communication with other stakeholders:

This problem deals with the state of communication between the local fishing cooperatives and other stakeholders such as local government and management of the reserve, federal governmental groups, NGO's, research institutions, and other fishing groups. The main causes of this problem are: i) limited dissemination of knowledge from non-fishing stakeholder to the local fishing communities, ii) inadequate educational opportunities given to fishing communities, iii) communication between the reserve, communities, and cooperatives is not promoted, and iv) REBIEN does not work with cooperatives and active conversations are rare among the groups.

3. Upper watershed issues:

This issue deals with actions that take place in the upper regions of the watersheds (primarily in the coastal plains) whose waters end up in the reserve. Three major causes of this problem were identified and are: i) channelization, retrofication, and straightening of rivers, ii) deforestation of upper watershed primarily for agricultural purposes, and iii) an increase in industrial and agricultural operations in the upper reaches of the watershed. These actions were identified to be the cause of an increase of erosion in the upper portions which is increasing the amount of sediment reaching the reserve along with contaminants from agricultural practices.

4. Insufficient markets:

This issue references the fact that prices for fishery products is less than expected in relation to the costs of production and level of effort given to acquire these products. The causes of this problem according to the board of directors are: i) the infrastructure and transportation needed to sell products to larger markets further away do not exist so products can only be sold locally, ii) cooperatives are at the mercy of the authoritative groups in the reserve because they create and set the markets, and iii) price of gasoline is high because it must be shipped into the communities which makes the cost of production high creating low levels of revenue.

Figure 29: Abandoned infrastructure (fuel tank)

5. Unsustainable use of resources:

A major problem facing the reserve is the unsustainable use of its resources such as high levels of deforestation within the mangroves to create agricultural land or to obtain the wood for construction purposes and high levels of bycatch and capture of juvenile aquatic species (i.e. fish and shrimp). According to interviewees, the causes of the unsustainable use of resources are: i) harvest levels of fisheries' products are lower than in the past so people must collect smaller fish to supplement, ii) the population of communities are growing which causes more people to depend on local natural resources for their livelihoods, iii) demographics within communities are shifting creating more fishers through a large group of young fishers, iv) inadequate education exists in communities so many people are unaware that their actions are directly hurting the

reserve, v) high levels of poverty in the reserve causes people to depend on the land for survival such as using wood from the mangrove trees to build their homes.

6. Population and demographic change of fishing communities:

This perceived problem has to do with population increases that are occurring within the fishing communities and in the nearby towns along with a shifting in demographics. As the populations continue to grow the reserve must support a growing number of livelihoods as people utilize its waters to make a living. Also, communities are seeing a shift in the demographic age of its fishers as many young men are beginning to fish. These younger fishers are seen by the directors as practicing much less sustainable practices as they are more interested in making money than protecting the reserve for future use. The main causes of this growth and change are: i) social issues such as lack of education, ii) lack of social programs, and iii) regional poverty causing immigration into the reserve looking for work.

7. Lack of education or knowledge:

This problem deals with the idea that a void is present in local communities' educational levels and knowledge of how their actions are affecting their environments. The following were identified as causes for this problem: i) lack of policies for creating social programs addressing education, ii) low investment from management for educational programs, iii) population growth caused by immigration creating a situation where people are using the land with little connection to or knowledge of it.

8. Inadequate policies or regulations:

The board of directors identified a lack in reserve policies that help alleviate issues that are driving unsustainable practices. Board of directors also acknowledged that

a number of policies restrict and hamper their livelihoods. These include regulations against capturing or culling crocodile populations that endanger their communities and often take fish off their lines, communities are prohibited from growing some foreign plants in the reserve such as palm oil trees which could be used as a secondary income, and new regulations that make the process of creating a cooperative easier which is creating competition with preexisting cooperatives. Other policies were mentioned but it was felt that lack of enforcement make them essentially void in the reserve. The main causes explained by the directors were: i) a lack of communication between groups to identify what is needed and inhibiting, and ii) management doesn't enforce all policies in place.

9. Water quality:

This issue has to deal with the quality of water present within the reserve. Fishers identified that sediment, silt, and chemical contamination levels are higher than in the past along with the amount of trash, such as plastic bottles, reaching the estuaries of the reserve. It was identified that the causes of insufficient water quality levels are: i) above river activities such as channelization and straightening of the above rivers, ii) policies not in place to deal with trash in reserve, iii) increase in industrial and agricultural activities in the region, iv) population and demographic changes, and v) deforestation of mangroves in the estuary.

10. Loss of mangrove ecosystem:

This problem addresses the destruction of the mangrove ecosystem within the reserve which is a key part of the estuary ecosystem in the reserve. Some of the major drivers causing the loss of mangroves were identified as: i) increasing local populations

who are deforesting the mangroves to use the wood for housing, ii) lack of education to understand the problems with deforestation, iii) inadequate enforcement of polices by management, and iv) lack of further policies that would really help protect mangroves.

After the problems were clustered into the 10 identified groups, they were plugged into the double entry matrix to identify which variable zones they fell into by determining their motility and dependence in regards to other problems. The following is a list of where each of the 10 perceived problems landed:

Power Variables Zone: *1. Inadequate management, 2. Lack of communication with other stakeholders, 6. population and demographic change of fishing communities, 7. Lack of education or knowledge.*

Conflict (Link) Variables Zone: No perceived problems fit this category.

Autonomous problem Variables area: *3. Upper watershed issues, 8. Inadequate policies or regulations.*

Zone Out/Output Variables: *4. Insufficient markets, 5. Unsustainable use of resources, 9. Water quality, 10. Loss of mangrove ecosystem.*

Description and ranking of perceived problems from non-fishing stakeholders using cross-impact matrix analysis: A total of 17 problems were identified by the non-fishing stakeholders targeted for this study, which, like the perceived problems listed by the fishing cooperatives directors, were grouped based on descriptive similarities and the causes that create them. This allowed for the large number of identified problems to be clustered into a smaller more manageable synthetic list of 7 problems with their acknowledged causes: 1) loss of biodiversity 2) upper watershed issues 3) lack of research in the fisheries 4) lack of appropriate public policies 5) lack of

communication between fisheries, communities, government and academic institutions 6) low prices of fishery products and 7) rural poverty and established norms.

1. Loss of biodiversity:

A serious threat to the reserve is the loss of its biodiversity which plays a number of vital roles in the area such as providing ecosystem services and supporting the backbone of the economic sector of the natural resource dependent region. One of the major causes of this problem is the unsustainable use of resources by locals such as burning the mangroves, cutting the mangroves for construction supplies, and over extraction of aquatic resources. Over extraction was commented to be the cause of i) poor political policies in the area and ii) high rates of rural poverty. It was also mentioned that impacts (e.g., erosion) resulting from upper watershed management actions are playing a key role in the loss of biodiversity.

2. Upper watershed issues:

This issue deals with the channelization and straightening of the above reaches of the watershed in order to benefit the agricultural sector or prevent flooding. This has caused an increase in sediment and agrochemicals reaching the mangrove and is contributing to the loss of biodiversity in the area. The driver for this problem was identified as poor agricultural policies from CNA and SEMARNAT, which causes the modification of the hydrological systems in the upper basins of the watersheds leading into the reserve.

3. Lack of research in the fisheries:

This item addresses the lack of scientific knowledge present in the reserve due to insufficient or nonexistent monitoring programs. Because an extensive monitoring

program is lacking in the fisheries, it is unknown what fees should be placed on the fishing and resource extraction, the ecological state of target species, and when and where the fishery should be closed for rehabilitation. This is driving low market prices and is caused by i) lack of policies that would establish a quality monitoring program and ii) poor communication between stakeholder groups and the fishers as some of this knowledge is known but is rarely disseminated to the fishers themselves.

4. Lack of appropriate public policies:

The stakeholders acknowledged that the reserve is lacking policies that could help alleviate issues that are driving unsustainable practices and help reduce rural poverty in the region. The interviewees identified the cause of the lack of public policies to be: i) investment programs which are currently conducted in the area (agriculture, livestock and fisheries development) are conflicting and most of them cause a direct or indirect impact on the ecological health of the aquatic system and the conservation of fishery resources, ii) there are no consistent public policies between conservation and productivity (i.e. incentives to grow invasive plants for a secondary income) and resources allocated for conservation are limited, while growing exotic species are encouraged within the reserve by SAGARPA and other state governmental groups, iii) shifting and inconsistent taxes placed on those in the reserve, iv) lack of active participation and communication between all sectors with a stake in the reserve, and v) current policies have little focus on rural development in the reserve or on the development of more sustainable fishing practices and monitoring of the waters.

5. Lack of communication between fisheries, communities, government & academic institutions:

A lack of coordination and communication exists within the reserve between stakeholders groups present in the area. The major issues linked to the cause of this problem are: i) lack of public policies which drive communication between groups, ii) no consensus between stakeholder groups on what information should be disseminated within communities, so often no or contradicting information circulates, and iii) no focus on rural development to help promote education in the region.

6. Low prices of fishery products:

This problem covers the lack of markets in which fishery products are sold and the absence of marketing programs that value healthy and sustainable fishery production. The causes of these low prices were said to be: i) the prices placed on the product are too low and often times the middle men take a large cut of the profit, ii) cooperatives have low bargaining power with commercial intermediates so they are often at the mercy of them, iii) lack of public policies to open new markets in which to sell products, and iv) poor communication between all groups involved in the sale of fishery products.

7. Rural poverty and established norms:

This issue deals with the high rates of poverty present in the local communities both of those living inside the boundaries of the reserve and those municipalities directly bordering the reserve. It also covers the established norms that are in place among communities which tend to be unsustainable. The main causes of these problems are: i) absences of appropriate public policies focusing on rural development and poverty alleviation, ii) poor educational programs prevent the spread of knowledge concerning sustainable practices, iii) upper watershed activities which are harming biodiversity in the region, and iv) low market prices for fishery products.

Similar to the methodology used for the perceived board of directors' problems, the problems were clustered into seven identified groups, they were then plugged into the double entry matrix to identify which variable zones they fell into by determining their motility and dependence in regards to other problems. The following is a list of where each of the seven perceived problems landed:

> Power Variables Zone: *4. Lack of appropriate public policies, 5. Lack of communication between fisheries, communities, government & academic institutions*
>
> Conflict (Link) Variables Zone: *7. Rural poverty and established norms*
>
> Autonomous problem Variables area: *2. Upper watershed issues, 3. Lack of research in the fisheries*
>
> Zone Out/Output Variables: *1. Loss of biodiversity, 6. Low prices of fishery products*

Potential for Conflict Index (PCI_2)

The Potential for Conflict Index (PCI_2) was applied to investigate consensus levels for issues surrounding 1) environmental perceptions, 2) the importance of the Responsible Fishing program, 3) communication of the Responsible Fishing program, 4) management in the reserve, 4) management between stakeholder groups, and 5) communication between stakeholder groups. The questionnaires given to non-fishing stakeholders (n = 8) and board of directors (n = 20) suggest that within these five categories, there are several issues that are more prone to generate conflict. Inversely, the results identify a number of issues where both of the two groups exhibit a high degree of acceptability. Evaluations were measured on a response scale of 2 to -2, with 2 as Strongly agree, 1 as agree, 0 as no opinion, -1 as disagree, and -2 as strongly disagree.

The board of directors' evaluations of environmental perceptions are highlighted by the study's first research question investigating their opinions on environmental scenarios. In general, board of directors mean evaluation scores ($M \geq 1.05$) indicated consensus that environmental factors have degraded in the last 10 years. The exception to this being that the directors believe the cooperatives are continuing to capture the same species presently as they were in the past ($M \geq -.45$). This question also received a high PCI_2 value (.93) showing that among themselves the directors are unsure if the type of fish being caught has actually changed creating a situation for high risk of conflict among the board of directors. Other questions which also received high PCI_2 values among board of directors in this category where mangrove cover has been reduced (.51) and water clarity has decreased (.61). Similarly, non-fishing stakeholders indicated general consensus among questions regarding the degradation of environmental conditions ($M \geq 1.0$). That said the non-fishing stakeholders were generally of the opinion that fishers were capturing the same species ($M \geq .875$). The non-fishing stakeholders had a small PCI_2 value for this question (.27) showing a relative consensus among this group that the fish being caught has changed. The non-fishing stakeholder group also had a 0 PCI_2 value (0.0) for the question *water clarity has been reduced* which indicates that total agreement to this statement. By using $d = ABS(PCI_a - PCI_b) / \sqrt{(PCI_{aSD})^2 + (PCI_{bSD})^2}$ where d is considered to be N(0,1) it is possible to compare PCI_2 values to identify if conflict could arise between the two stakeholder groups. A higher d value indicates a greater potential for conflict between the two groups. With the Bonferroni correction applied, d values must be greater than 3.66 in order to be deemed significant. It is clear that potential for the highest conflict between the board of directors and non-fishing

stakeholders revolve around the issues of: water clarity decreasing (d = 3.79) and the change in the type of fish being caught (d = 3.61) although the second value falls just short of being statistically significant. As stated above, the Bonferroni correction could increase the chances for a Type II error (Perneger, 1998) it could be hypothesized that a one of this error could be occurring with this comparision.

The study's second set of research questions addressed issues about the importance of the Responsible Fishing program. In general, there was a large degree of agreement, both among the board of directors (M = 1.6) and non-fishing stakeholders (M = 1.3). The only chance for conflict regarding this subject is concerning whether the Responsible Fishing program should promote protection of living aquatic resources and their environments and coastal areas; there is a slight possible chance of conflict among non-fishing stakeholders (PCI_2 = .297). In comparing the two stakeholder groups, there are no issues in this category that possess the chance for conflict that are statistically significant (all values $d \leq 1.38$).

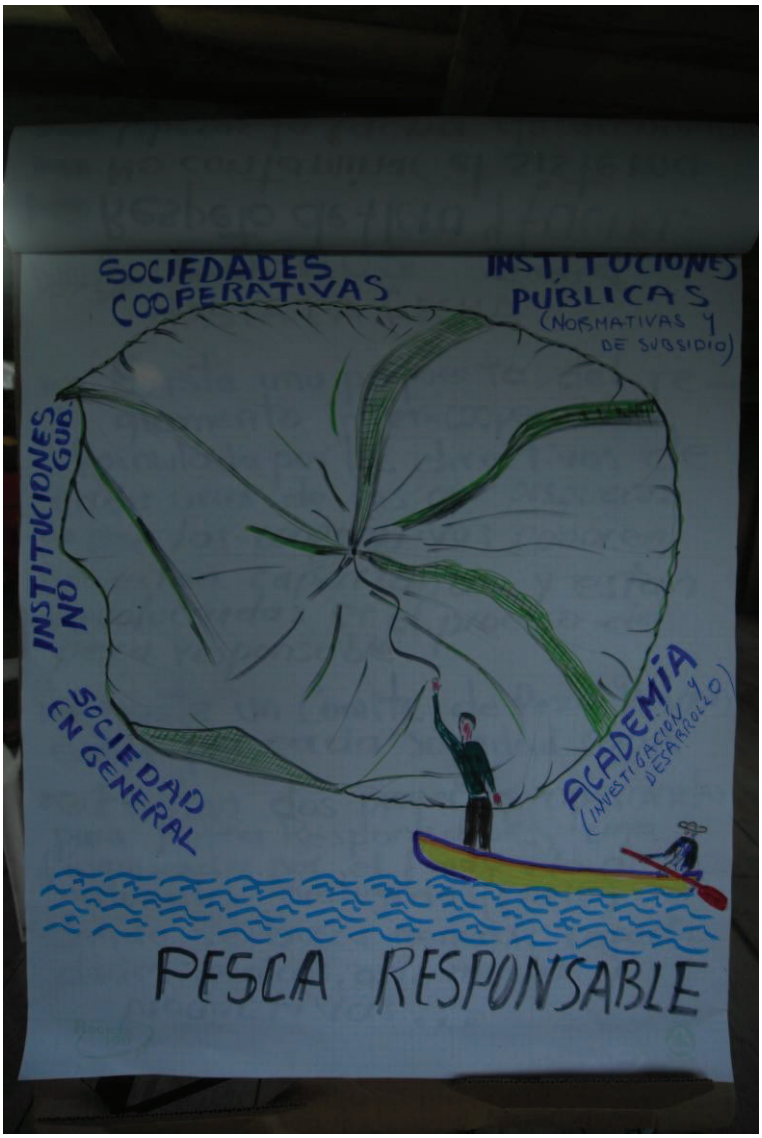


Figure 30: Graphical representation of stakeholders in Responsible Fishing

The third set of research questions focused on the communication of the Responsible Fishing program. Although the board of directors indicated they were generally informed ($M = 1$), non-fishing stakeholders only felt slightly more informed ($M = 1.25$). Both groups had small PCI_2 value for this question, board of directors (.35), non-fishing stakeholders (.28), which assumes a slight chance for conflict exists among each

group. The potential for conflict between the two groups is assumed to be fairly low (d = .27).

The questions surrounding the management of the reserve yielded the following results: there was an overall lack of satisfaction with *how the reserve is being managed* among the board of directors (M = -.05), where as non-fishing stakeholders had a more neutral position (M = 0). The board of directors received a high PCI_2 value (.83) with this question while non-fishing stakeholders had a much lower PCI_2 value (.438). Board of directors generally expressed that they were not informed in regards to the purpose (M = -.05) (PCI_2 = .83) and regulations (M = -.65) (PCI_2 = .70) of the reserve, where non-fishing stakeholders felt informed (M = 1.25 and 1.25) (PCI_2 = 0 and 0). The d values for being informed about the purpose of the reserve (d = 11.79), and being informed about the regulations of the reserve (d = 4.76) were significant showing a high potential for conflict between these groups in regards to the purpose and regulations of the reserve.

The set of research questions regarding management between stakeholder groups indicates that there is agreement that *local government and/or cooperatives should plan management within the reserve*, though more agreement exists amongst the board of directors (M = 1.5) than non-fishing stakeholders (M = .5). Both groups agree that it's the fault of communication between stakeholder groups and the cooperatives in regards to management, board of directors (M = .85) and non-fishing stakeholders (M = 1), although the board of directors showed a higher potential for conflict to arise among themselves with this question (PCI_2 = .59) while non-fishing stakeholders showed a much lower chance of conflict among themselves (PCI_2 = .24). Perhaps the most interesting statistic reveals that the board of directors believe (M = .05) that *managerial groups should*

considers opinions of fishers when they make decisions about management, whereas non-fishing stakeholders do not (M = -.625). The board of directors had a high potential for conflict with this question (PCI_2 = .77) showing a lot of confusion amongst themselves in terms of where they fit into the scheme of management. Non-fishing stakeholders were found to have a slight chance of conflict (PCI_2 = .17) representing that they are in consensus with the idea of including the opinions of fishers while making decisions on management. The PCI_2 difference test reflected municipality differences in the amount of consensus for managerial groups considering opinions of fishers when they make decisions about management as being a high potential for conflict (d = 3.69).

The final set of research questions that utilized the Potential for Conflict Index was aimed at communication between stakeholder groups. Although very few 'excellent' ratings were given between both board of directors and non-fishing stakeholders, both groups gave fishers, cooperatives, and CONANP 'good' ratings ($M \geq .875$ for both groups). PROFEPA and SEPESCA both received 'poor' ratings from board of directors ($M \leq$ -.3) and non-fishing stakeholders ($M \leq$ -.375). CONAPESCA received slightly favorable ratings from board of directors (M = .25), and slightly poor ratings from non-fishing stakeholders (M = -.25). La Federacion de Pesca had inverse results, receiving favorable results from non-fishing stakeholders (M = .125), and slightly poor overall remarks from board of directors (M = -.55). Although there are chances for conflict between all stakeholders with regard to communication (all positive values), the difference is not statistically significant at $p < .05$. A full list of mean values and PCI_2 values can be observed in Appendix A on page 112.

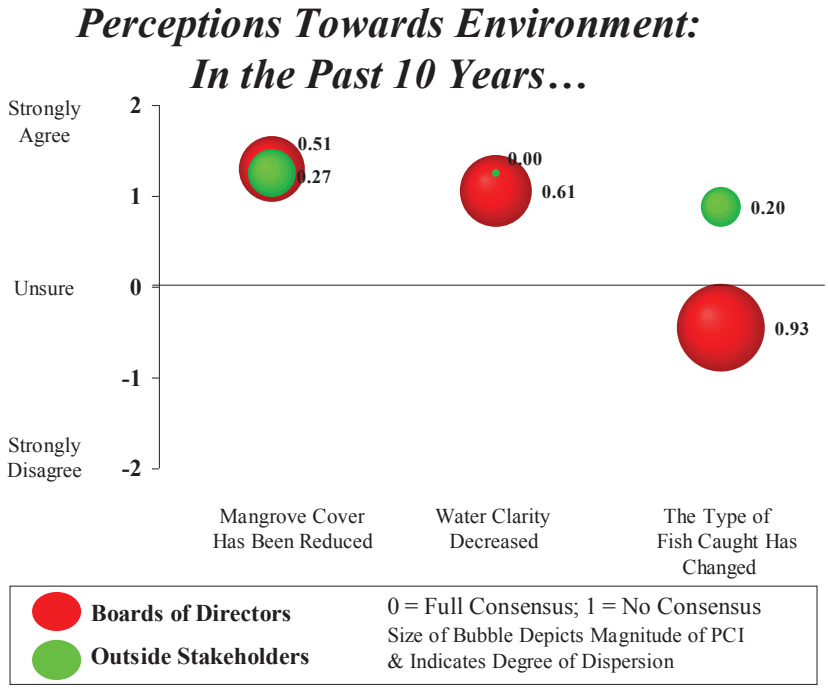


Figure 31: Stakeholders perceptions of changes in the environment over the past ten years with in the reserve

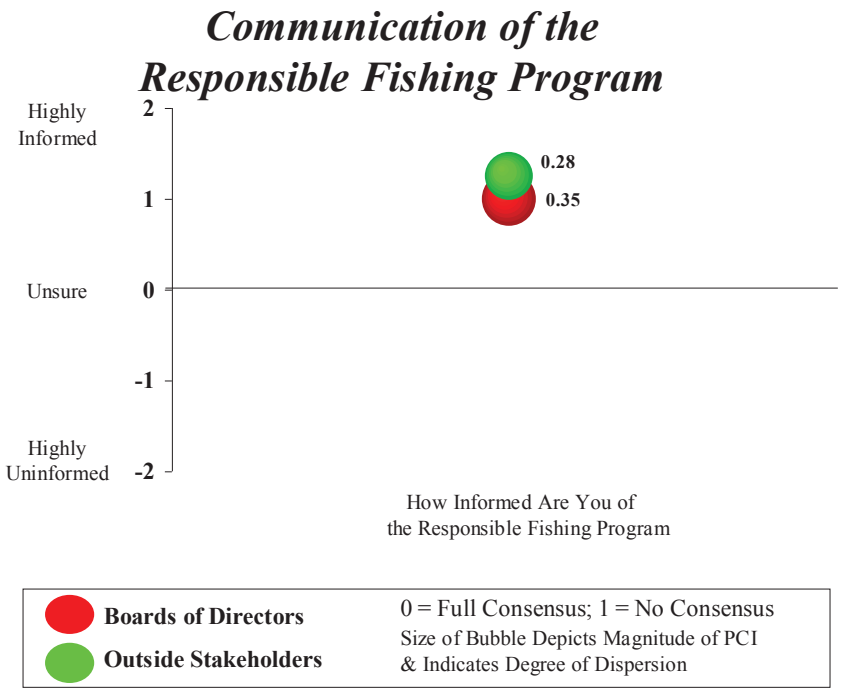


Figure 32: Stakeholders level of knowledge towards the Responsible Fishing program

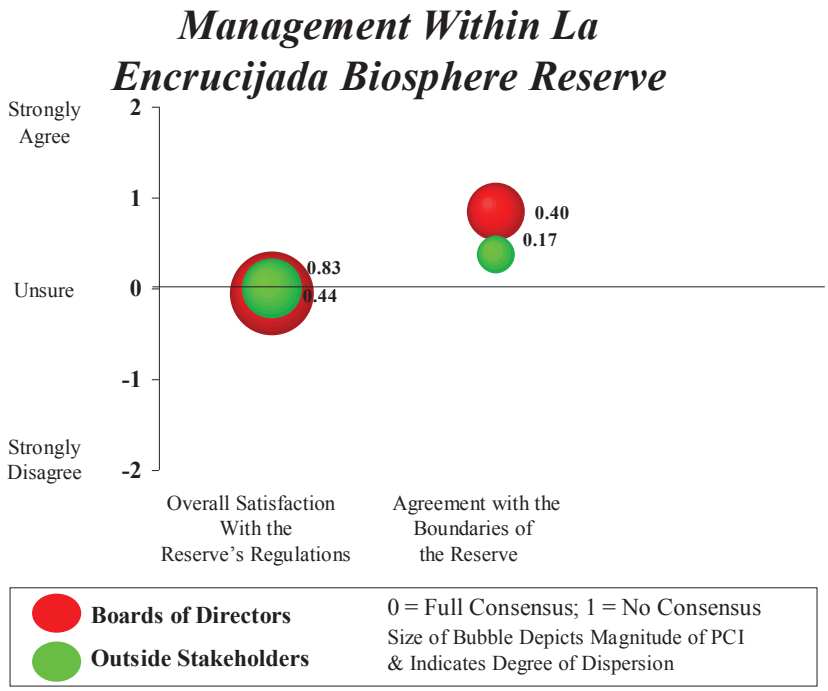


Figure 33: Stakeholders agreement towards management and regulations within the reserve

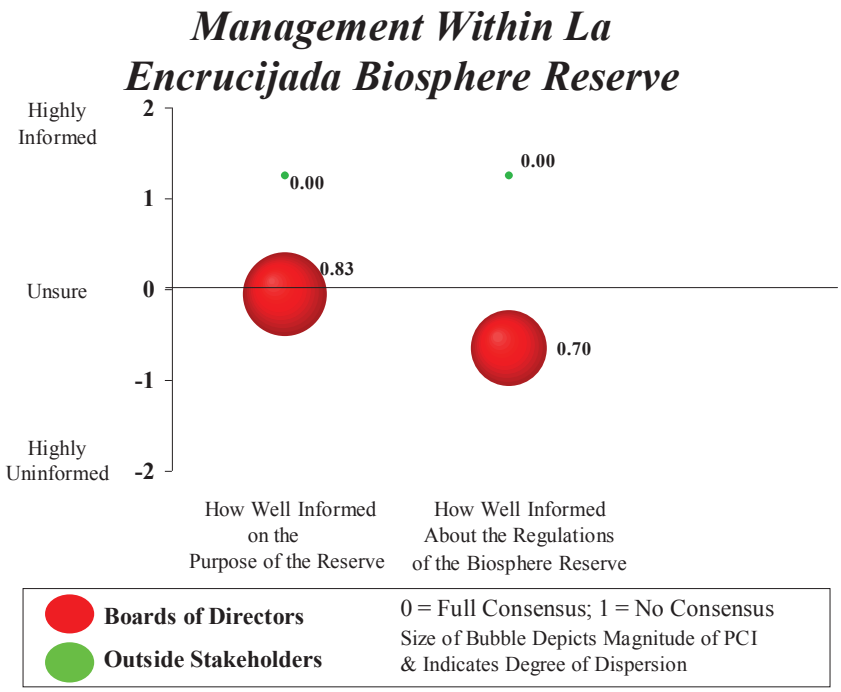


Figure 34: Stakeholders level of knowledge towards the reserves purpose and regulations

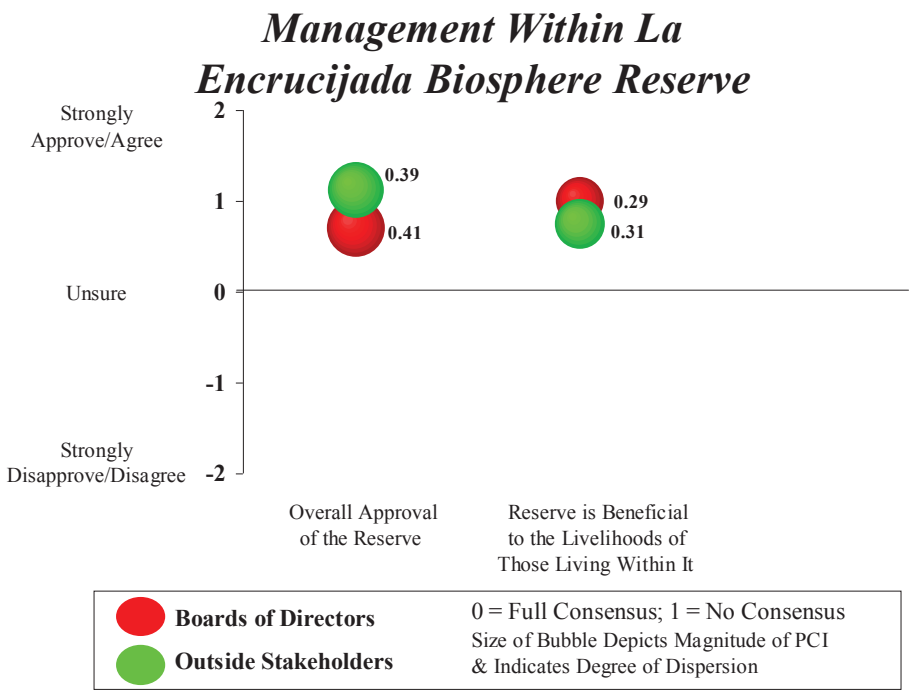


Figure 35: Stakeholders approval of the reserve and its benefits towards livelihoods

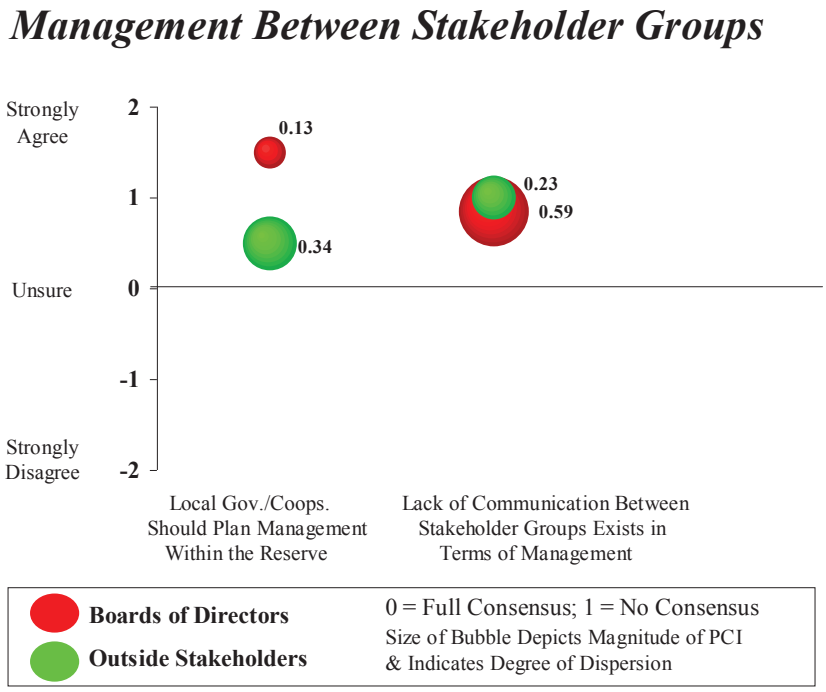


Figure 36: Stakeholder perceptions towards management of the reserve

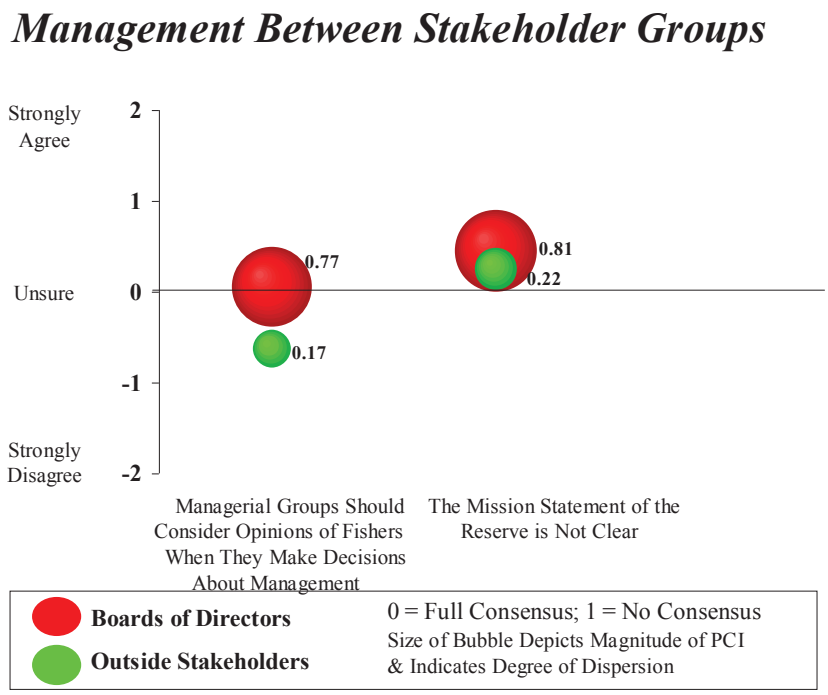


Figure 37: Stakeholders perceptions towards management of the reserve

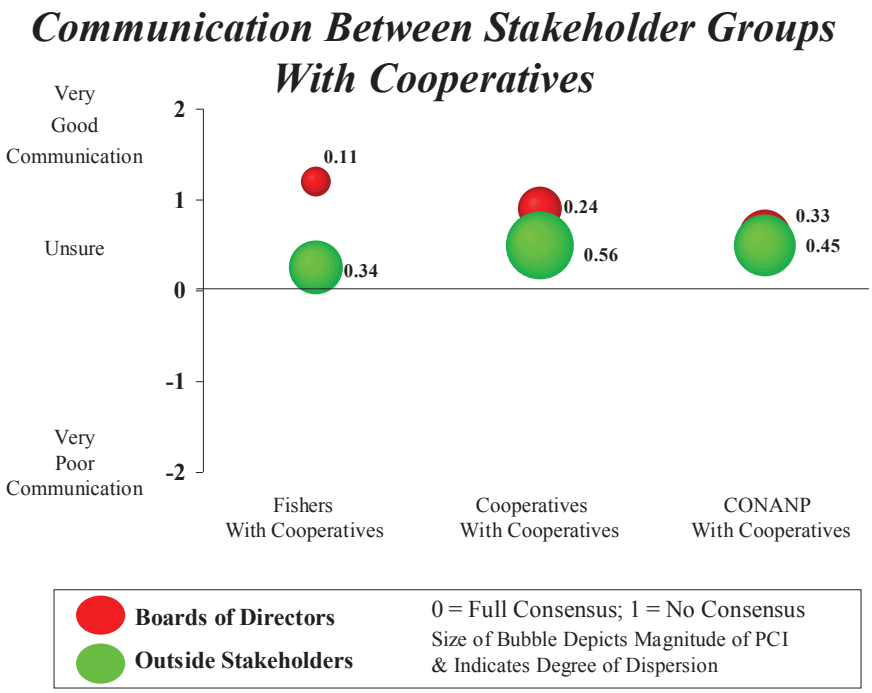


Figure 38: Stakeholder Perceptions towards communication between non-fishing stakeholder and cooperatives

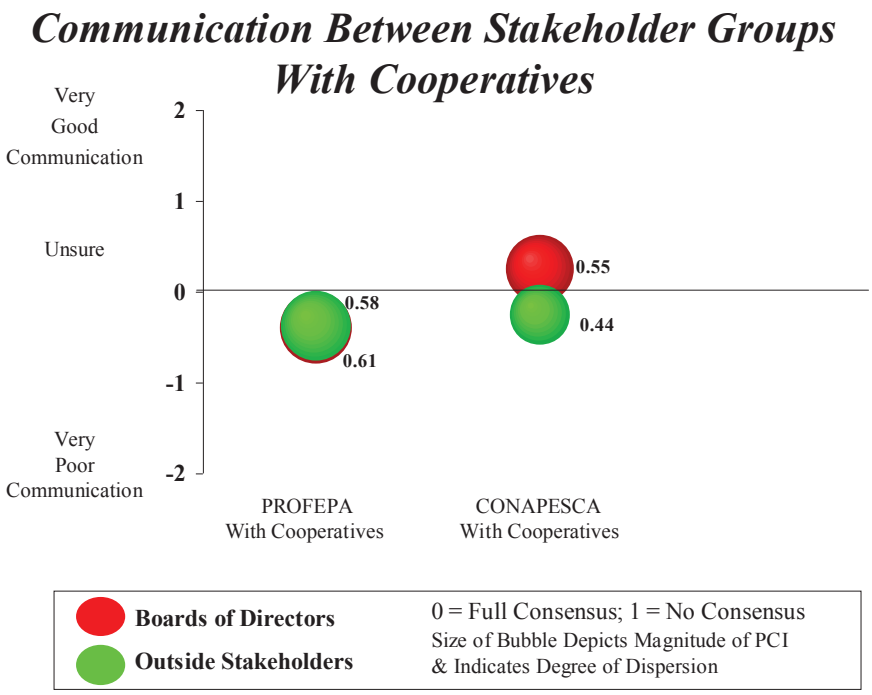


Figure 39: Stakeholder Perceptions towards communication between non-fishing stakeholder and cooperatives

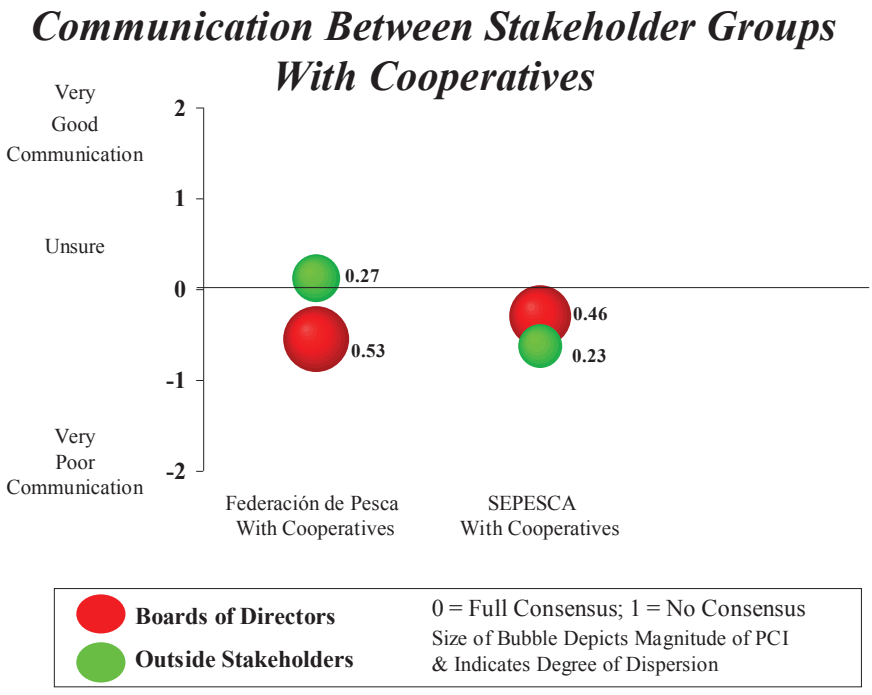


Figure 40: Stakeholder Perceptions towards communication between non-fishing stakeholder and cooperatives

Discussion

Objective 1: Communication and agreement with Responsible Fishing program

During the development of this project, CONANP expressed a concern that while managerial actions and policies are evolving to incorporate aspects of the FAO's Responsible Fishing COC it is unclear what the local fishing communities' perceptions are and whether or not they agree with the direction management is taking with regard to the Responsible Fishing program. It is these communities who would ultimately be impacted by changes in the reserve. We were asked to design a project that would address these concerns. We developed a series of questions that would explore the perceived benefits of the program, aspects of the COC which communities feel are important to the reserve, and how well informed they are of the program. These questions were asked of the fishing cooperative board of directors as well as non-fishing stakeholder groups who will be involved with the program. Results were looked at for agreement or conflict within groups, board of directors or non-fishing stakeholders, and between the two groups. When both groups were asked if they believe implementing the COC for Responsible Fishing into La Encrucijada would be beneficial to the reserve and their livelihoods, 100% of participants (n = 28) said that it was beneficial indicating that no real doubt exists within or between both groups about how this program will help sustain the reserves ecosystems and benefit livelihoods.

When reviewing the PCI_2 values concerning agreement with the objectives of the COC and how important they are to the reserve, it is apparent that both groups believe all

of the objectives listed in the COC are important to the reserve and should be focused on as all mean values ($M \geq 1.3$) showed agreement with each object. All but one of the questions had PCI_2 values of 0 for both groups meaning that there is not only a very slight if any potential for conflict among the groups themselves but also that both groups share the same ideals and objectives giving it an unlikely chance for conflict to arise when these groups collaborate on these objectives. One of the objectives, *promote protection of living aquatic resources and their environments and coastal areas,* received a small PCI_2 value ($PCI_2 = .30$) within the non-fishing stakeholder group. While a slight PCI_2 value does exist, its low score indicates only a small potential for conflict with this objective among non-fishing stakeholder groups. This PCI_2 value from the non-fishing stakeholder groups may indicate that some of them believe that social programs and education are more important to the COC than promoting the protection of living aquatic resources and emphasis should be put on other objectives. The low PCI_2 scores by board of directors on all objectives indicate that the board members in the cooperatives agree and think that the COC is beneficial to them and the reserve and that they also believe that all objectives of the COC are important and should be focused on.

Lastly both groups were asked to rate their *level of education and how well informed they are about the COC in general*. This question was asked to identify if 1) both groups felt that they had an adequate knowledge of the program, and 2) how they are hearing about the program to identify if it is coming from a single source or from multiple sources. Both groups were felt that they were well informed of the program, board of directors $M = 1$ and non-fishing stakeholder $M = 1.25$ with a value of 2 indicating very well informed and -2 very much uninformed. The PCI_2 values of both

groups regarding this question were low, PCI_2 board of directors = .35 and PCI_2 non-fishing stakeholder = .281, showing that among each group there is only a slight potential for conflict. As $d = .27$ it shows that when comparing these two PCI_2 values no conflict is potentially present between the two groups. The consensus among and between both groups is that they are well informed regarding the program.

Based on answers given when asked to explain where interviewees learned of/about the program revealed that they are learning of/about the program from a number of sources: some learned by working on committees with those who are involved in how to implement Responsible Fishing into the reserve, which was the case with many non-fishing stakeholder interviewees. Others listed that knowledge of the program was acquired by attending workshops that have been hosted by a number of different stakeholder groups. In fact, one director explained that in 2010 alone he attended six workshops on the subject showing that many opportunities are available to learn about the program in the cooperatives. It is also interesting that some of the directors and non-fishing stakeholders were educated on the program by fellow fishers. One interviewee stated: "I learned of the program from other fishers in the cooperative. The president of our cooperative attended a meeting on the program and informed us about it." This shows that not only are workshops and information sessions being presented in the reserve regarding the program but also fishers seem to be telling each other about the program and talking amongst themselves about it.

In conclusion, it appears that all groups are in favor of the Responsible Fishing program and feel all objects included by FAO in the COC are beneficial. Additionally, it appears that groups involved in educating participants of the Responsible Fishing

program are doing a good job as both groups feel they are well informed about the program in general and little potential conflict is present among and between each group. The directors are also getting many opportunities to learn about the program from various types of presentations and from a number of different organizations or groups. Many organizations are involved in implementing this program into the reserve and are taking time to introduce the fishers to the program and educate them about it. This study shows that not only are the cooperatives well informed of the Responsible Fishing program but they also see the value in its implementation.

Objective 2: Perceptions of board of directors and non-fishing stakeholders in regards to the La Encrucijada Biosphere Reserve:

In addition to looking at how the board of directors and non-fishing stakeholders viewed the Responsible Fishing program it was decided to extend the research topic to look at their perceptions and understanding of the reserve in general. Questions in the research interviews asked both the directors and non-fishing stakeholders open ended questions about the reserve and problems associated with it. It was broken down into three areas: Perceptions of the Environment, Management of the reserve and Communication between board of directors and non-fishing stakeholders.

Perceptions of Environment. Questions asked were grouped by interviewees' perceptions of the state of the reserve especially the mangroves, fish number size, and type, and overall conditions. There was no disagreement among the two groups regarding overall conditions of the reserve. Both groups agreed that the mangroves have reduced in area in the past ten years. However there was a relatively higher PCI_2 score of .51 within the fisher group indicating that there was some disagreement on this subject. This is also

true when conditions of water clarity were asked. Both groups fall within a mean score of agreement that water clarity has decreased however there was a potential chance for conflict, PCI_2 score of .61, among directors. Both of these could be due to the location of the communities as some were located inland and subject to more mangrove destruction from agriculture than those communities accessible only by boat. Location could also affect clarity as some communities are more prone to flooding. Additionally both groups agreed that the water temperature within the reserve has increased with no conflict within or between groups. They also agreed that the lagoons have become shallower, with mean scores of 1.9 for directors and 1.5 for non-fishing stakeholders.

Directors and non-fishing stakeholders also share a commonality in the belief that fish populations have gone down and that some of the cooperatives' most economically important fish species have decreased. Both groups agree that fish are decreasing in size however among board of directors there was a PCI_2 .39 indicating that some may not agree with that statement. During the monitoring visits it was observed that large fish were caught daily by some fishers so the perception may be that you can still catch large fish. A more accurate question to ask may have been *do you catch large fish as often as you used to ten years ago*. Where the board of directors and non-fishing stakeholders disagree is when they were asked if the type of fish being caught has changed. Directors had an *M* of -.45 which places them in disagreement with this question. One board member responded with, "No the type of fish we catch hasn't changed, just the size and the amount of them." Non-fishing stakeholders, with a mean score of .875, were found to believe that the type of fish the fishers are catching has changed. A PCI_2 score of .203 indicates that among them, stakeholders for the most part share this belief. However

fishers were not as homogeneous in their responses with a PCI_2 score of .93 indicating a high potential for disagreement with this statement among them creating a high potential for conflict. This could be explained by fishing location as some communities by location focus on certain types of species. For example one community may focus on shrimp while another focuses on fin fish. As discussed above many of the directors explained that from their experiences Flathead mullet were almost depleted from the reserve and those communities more reliant on Flathead mullet in the past, which many were, would be more in agreement with this statement. The large difference in PCI_2 scores between the two groups almost creates a statistically significant *d* value of 3.61, which hypothetically could be significant based off of Bonferroni corrections tendency to increase chances for a Type II error, indicating a possible area of potential conflict between the groups. It also could be indicative of a breakdown in communication and potential issues in management of the reserve if non-fishing stakeholders are looking to set catch limits on certain types of fish. If fishers are catching the same types of fish as they did in the past this may show that they are not fishing down the food web, which can be a sign of a collapsing fishery (Pauly et al., 1998), but instead fishing down the age structure of the fishery. While this assumption cannot be made with the data from this study, it could be an important area for future studies in evaluating the health of the reserve.

Management and Regulations. Board of directors and non-fishing stakeholders were more divided in their opinions concerning management, regulation and enforcement. They agreed 100%, both among and between groups, that fisheries should be closed during certain periods of the year to help restore fish populations. During one

site visit an area of the reserve was closed for fishing Flathead mullet and no negative comments or remarks by fishers were recorded. Both groups were also in agreement that the types of gear utilized for capture should be regulated. Ninety-five percent of board of directors agreed with this statement and 100% of stakeholders were in agreement. This would suggest that management should continue to look at the practice of both closing certain areas to increase fish populations and regulating types of gear used. However comments by the directors indicated that even though management and cooperatives agree in principle they do not always work together or enforce the same things which could be an area for potential conflict. For example cooperatives may have different rules regarding types of gear used than those set by CONAPESCA.

Non-fishing stakeholders and board of directors begin to disagree when management and enforcement are discussed as illustrated in the discussion above. When asked *should managerial groups consider opinions of fishers when making decisions about management*, non-fishing stakeholders disagreed with this statement, *M*= -.625 and showed a PCI_2 of .17, indicating a high consensus among the group's response with little potential for conflict among themselves. Directors however were neutral on the subject, *M* =.05, but had a high PCI_2 of .77 showing that there is confusion and a potential for conflict among them. This may be due to the fact that managerial actions in this area have traditionally been a top down approach and it may be that these fishers are unclear of their place or role with managing the reserve. While some may believe that their opinions need to be considered, others may think it is management's job and this creates the conflict. This question scored of *d* value of 3.69 indicating a significant potential for conflict between the two groups which could potentially cause problems as new

regulations are developed and enforced such as the Responsible Fishing program if fishers opinions are not considered. In the COC for Responsible Fishing under Article 7.22 (once again, a full description of the articles included in the COC can be found at: ftp://ftp.fao.org/docrep/fao/005/v9878e/v9878e00.pdf) lists that "the interests of fishers, including those engaged in subsistence, small scale and artisanal fisheries, are taken into account." To achieve this, further elaboration may be required to identify the regions' specific requirements and available options, including detailed mechanisms on co-management, taking into consideration local socio-economic and cultural aspects (FAO, 1995). A goal of the Responsible Fishing program is to include interests of fishing groups which could be through co-management actions so if groups are really serious about implementing aspects of FAO's Responsible Fishing program then interests and opinions of fishing groups needs to be considered. The fact that this project was developed to evaluate the opinion of fishers shows that CONANP is starting to consider the importance of fishers' opinions. Additionally, due to limited resources and manpower to manage the reserve it may become necessary for the cooperatives to take over this role. This may be difficult if their opinions are not included in the decision making.

There was also disagreement on how well informed groups were on existing regulations within the reserve. Non-fishing stakeholders all agreed that they were informed of regulations with an M=1.25 and PCI_2 of 0. In contrast directors did not feel they were informed of regulations M = -.65. However there was not true consensus among them with a PCI_2 of .695, indicating some felt informed while others did not. A potential for conflict could arise if management believes the regulations are clear but fishers do not. This is indicated by a d value of 4.76. These regulations are designed to be

followed by the fishers yet if fishers feel these regulations are unclear they will have difficulty adhering with them.

When asked about overall satisfaction with reserve regulations both groups had neutral responses. However the directors' PCI_2 of .828 and stakeholders of .438 shows some dissention within the individual groups. The most interesting aspect of this question is the responses of the directors. While they seem to agree that regulations for fishing and gear used within the reserve are necessary they had disagreement over regulations in other areas of the reserve. In particular they disagreed with regulations governing crocodiles and invasive plant populations within the reserve. Some did not understand the need to regulate hunting of crocodiles, cultivating invasive plants such as palm oil or the ability to use mangroves for wood. This could indicate a lack of education and a misunderstanding of the sustainability goals of the reserve and in general why it exists. Addressing these issues with the cooperatives could be a good way to facilitate a collaborative relationship between management and fishers.

Communication. Communication was addressed in two parts, communication about the reserve and secondly communication between stakeholder groups including cooperatives. Communication about the reserve was addressed by asking them to rate their approval of the reserve in general. Both groups approved of the reserve in general and both had similar PCI_2 values among their groups with a *d* value of .06 indicating a low potential for conflict in this area. Both groups also showed consensus in seeing the reserve as beneficial to their livelihoods with $M = 1$ and PCI_2 of .29 for directors and $M = .75$ and PCI_2 of .312 for non-fishing stakeholders. So even though directors may disagree

with some regulations within the reserve they continue to view it as a positive and important to their livelihoods.

One of the most significant potentials for conflict in this study came when the groups were asked how informed they were about the purpose of reserve itself. This question produced the highest *d* value in the study of 11.79. Non-fishing stakeholders had an *M* of 1.25 showing that they believe themselves to be well informed of the purpose of the reserve and scored PCI_2 of 0 indicating a potential for overall consensus on this issue. Board of directors however were neutral with a mean of -.05 but showed a high rate of discourse among themselves when responding to this question. Directors' responses indicated lots of confusion and misunderstanding surrounding the reserve. When one director was asked to explain the purpose of the reserve he stated: "The purpose is to protect the flora and fauna but in reality I do not know fully what its full purpose is." While the Non-fishing stakeholders who have helped form the reserve are clear about its purpose this knowledge appears to not have been transferred to the fishers in the various communities within the reserve. This is in sharp contrast to the results found concerning the Responsible Fishing program where fishers felt very knowledgeable about the program. It follows that misunderstanding and confusion about the purpose of the reserve could create problems for management. An illustration of this is the need to regulate the killing of crocodiles and cutting of mangroves to preserve the ecosystem of the reserve.

Objective 3: Identification of perceived problems among stakeholder groups:

Both the board of directors and the non-fishing stakeholders perceived a lack of communication between stakeholder groups as a power variable which is driving a

number of other issues in the reserve. This indicates that both groups believe communication among groups is not on point and there fore should be addressed in the future in order to help curb some of the problems it was perceived to be driving.

Where these two groups differ most drastically in the cross-impact analysis of perceived problems is with public polices. Non-fishing stakeholders perceived that a lack of appropriate public policies is present within the reserve and is one of the strongest power variables causing a multitude of problems. A few comments by the non-fishing stakeholders addressing this are as followed:

“Investment programs are conducted in the area but often have direct or indirect impacts on the ecological health of the aquatic system”.

“There are no public policies consistent between conservation and productivity in the fishery.”

Conversely, the board of directors placed a lack of public policies under the autonomous problem variables zone meaning they do not see a lack of public policies as a driver of problems or as being driven by others but instead as an entity on its own. In its place they perceived inadequate management as the strongest power variable driving other perceived problems within the reserve. Some comments by the board of directors when describing this inadequate management are:

“Managerial groups don’t manage us.”

“Organizations are not managing efficiently because they lack personnel.”

“Regulations are in place, but not always enforced.”

“Management is hard to reach and only manages from far away.”

It appears that the board of directors believes that public policies are in place within the reserve but is not causing the problems they face. It is the fact that these policies are not being managed effectively that is driving many other problems.

It is interesting to note that both groups placed above watershed issues under the autonomous problem variable zone meaning that they see this issues as an outside entity not driving or being driven by other problems in the reserve. This appears to be counter intuitive as these above watershed issues are influencing the increase in sediment and chemicals entering the reserve which can account for a decrease in mangrove cover and biodiversity, decrease in water quality, and could potentially be lowering productivity in the fishery. This may be explained by the fact that the questioned framed to these stakeholders was *what are the most important problems in the La Encrucijada Biosphere Reserve* and they may see these above watershed issues as outside the realm of the reserve. This could mean that the stakeholders feel at the mercy of this issue and that they can neither influence nor prevent it.

Researchers' observations

Over the last ten years there has been a growing concern amongst fishers the reserve regarding fisheries management. The FAO has identified trends in global landing statistics that reaffirm the questionable effectiveness felt locally of management and assessment of fisheries on a global scale. The projected increases of demand for fisheries products, future prices, and population increases all drive a need for improved management frameworks (Caddy, 1999).

A more nuanced view of local situations is needed, however, as well as knowledge of the axioms and assumptions that take place in management. Included in

this is the need for a paradigm shift that acknowledges natural resources, as well as socio-economic issues (Caddy, 1999). Particular management issues arise when biophysical marine systems and human communities that are dependent on fishing are stressed by global changes. These changes are not limited to demographic changes, but also environmental changes, health issues, or shifting societal values. Alcohol abuse, for example, is a factor in some communities. This plays into productivity, influence of the younger generation, and the social framework in general. Due to this dynamic interdependence, management needs to develop frameworks that maintain the capacities of both nature and the communities that live there, as social-ecological systems (Perry, Barange, & Ommer, 2010).

The living standards in the reserve are directly linked to the small-scale fishing practices. Connections to tradition, poor education levels, marginalization in the economy, and low incomes are characteristics of small-scale fishing communities (Jiménez-Badillo, 2007). Artisanal fishers require effective participatory associations to gain and build access to micro-enterprise finance, consolidate capacity-building, and the development of marketing outlets. (Jiménez-Badillo, 2007).

Cooperatives in the reserve have recently begun focused efforts to offset the impoverished conditions they face through alternative income generation, including ecotourism. The conflicts that have been created over access to common-pool resources that ultimately have attributed to decreases in fish stocks have spurred this. That said, even if ecotourism provides a significant new source of income through environmentally friendly, non-consumptive resource use, this may not be enough to keep fishers and community members from participating in destructive forms of consumptive resource use

(Young, 1999). But resource conflicts may not preclude efforts to promote conservation and livelihoods through ecotourism. There are a number of stakeholders that have been identified that are actively engaged in community-based conservation, yet the support of the government is needed. That said there are a number of issues that the board of directors have identified as being perceived to be out of their own control. Sedimentation issue is largely out of the hands of the downstream users of the waterways. Likewise, crocodile prevalence has come to the forefront in recent years as an issue in several of the communities. The policies regarding the culling of some crocodiles have been abolished, and the threat of what may be driving other grievances with management organizations.

Gender issues in the fishery were apparent to the researchers as outside observers. Although 100% of board members in every cooperative were male, gender issues were addressed, if only slightly. One director said, "We need to take gender into account and see what the thoughts are of all those in the communities because we view things from different perspectives." Parks in Peril, an organization that supports the reserve suggests that community approaches can often act against women's interests. On an international scale, women have a small political presence on community councils, due to public meetings being perceived as "male spaces". In PIP's work in La Encrucijada, a public meeting with PIP evaluators drew only the fishers. Women were working elsewhere. One woman suggested, "Many programs have no women. Many staff members do not talk with them. They are women." ("Working with Community-Based Conservation with a Gender Focus: A Guide," n.d.) The lack of female participation in the fisheries in La Encrucijada suggests the need for investigation into this issue.

The basis of co-management is the collaborative discussion of management between government, non-fishing stakeholders, boards of directors and fishers. (JiméNez-Badillo, 2007). There is an overall lack of female participation in the fishing process. Some intervention has been done by non-fishing stakeholders, but there is still a lack of participation and funding in these programs which would allow for a more holistic management approach.

During a workshop attended by the researchers on October 27, 2011, RARE Conservation discussed the Responsible Fishing program with fishers in Las Lauras. One of the main themes the fishers raised was the strength of the cooperative. In fact, many fishers proposed the unification of the six cooperatives, to help increase profits and cut costs. “The market is the biggest problem for us fishers, and the strength of the cooperative is key.” Market access, for example, remains elusive to the majority of the cooperatives. The primary inhibitors appear to being transport costs (mainly gasoline), and the strong presence of middlemen “coyotes”. There has been some intervention, yet the issues remain unsolved, and more importantly perhaps is the issue of how to make the fishery sustainable. The general lack of communication, it seems, is one of the main drivers to unsustainability in the area.

Figure 41: Photo depicting fishery product transport by middlemen

As prices of oil to continue to increase, many fishers are turning to more efficient four-stroke motors, but are eager to find a means to reduce costs further. To help illustrate the concepts further, the fisher were instructed to draw what the fisheries looked like ten years previously, what they look like now, and what they might look like in five years. Fishers described the rivers as being much deeper and narrower in the past, and clearer. About the future, one fisher stated, "The rivers will be like highways – the sedimentation from above will completely dry them out." Fishers expressed hope, however, through fishing restrictions, a better market, learning to process fish, and certification as a "sustainable fishery."

During the researcher's Observation of a fish warden meeting led by the La Palma cooperative on November 19, 2011, a ban on Sunday fishing was passed. This meeting and outcome was significant to the researchers in several ways, namely it demonstrated the benefits of education on several fronts. During the meeting several fishers were afforded the opportunity to visit a cooperative (primarily consisting of lobster fishers) in the neighboring state of Quintana Roo. "The sustainable fishing efforts there have advanced in the last few years, primarily in part to the efforts by youth" stated one fisher during the meeting. The future of the fisheries in the reserve is in jeopardy due to the fact that many of the younger generation are being driven to other sources of income generation. These younger fishers do not have a stake in the fishery and do not care if they overexploit it until they have enough money to leave. In fact, even amongst the older generation, much of the population has fled to the US to seek employment, only to return to Mexico after being captured by the INS. Others have tried to seek other forms of income generation through tourism, a group of cabanas as recently been built in the community of La Palma to attract tourists and a resort style structure has been build near Barra de Zacapulco, and through local arts and crafts cooperatives. As they talked about their experience there, one fisher said, "If we continue [fishing] like this, there will be no more fish. Responsible Fishing betters our lives and allows us to generate more income. We need to change the manner of fishing so we have fish tomorrow… we need to be conscious." As the discussion continued, one fisher proposed a closed-season on snook, say that if they did not impose a closed period, the populations would end up like the flathead mullet, which has been nearly eradicated in La Palma. After the presentation of

the speakers, the decision to ban fishing on Sundays was unanimously passed by the 87 fishers in attendance (of the total 126 registered fishers in La Palma).

Future Research and Limitations

Throughout the literature there is a general absence of research utilizing stakeholder perceptions in the management of artisanal fisheries, which depicts the need for future research in this area. Through this lack of knowledge about community dynamics, local governance, and socio-economic statuses, management decisions will fall short in achieving any lasting goals.

Future research can include the emerging norms and regulations that the Responsible Fishing program embodies. A continued look into the benefits of this program is needed, accompanied by the evidence of community support for such programs. Limitations of this study involve the need for a sample representing fishers, not just board members, in the La Encrucijada communities. Within this, there is large room for investigating the role of women in artisanal fisheries, as well as the impacts of policies on women and children.

Further studies could also include investigating factors, such as political will, institutional strength, and legitimacy of policies that influence public support, consensus and conflict about policy. Studies are also needed on the influence of sanctions and incentives for compliance and support for coastal management policies. These studies could enable local governments and managers to better understand fishers' livelihoods and perceptions, so that more effective policies can be put in place.

The use of the PCI_2 to influence local government decisions in coastal management should be further investigated. By graphically displaying the responses of

stakeholder groups, there is a barrier that is let down that allows for the participation of all stakeholders. Coastal resource management could be greatly improved by the inclusion of soci-economic research that is both qualitative and quantitative in nature.

Lastly, many researchers have visited the area, yet many of the same questions are potentially being repeated. This is due to the lack of participation by several stakeholders, including government management agencies. Overall, there seems to be an absence of the research results coming back to the cooperatives and a general lack of collaboration amongst stakeholders. As researchers administering this study, the authors intend to make sure the results of this study reach the fishers, managers, and all participants in the study.

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Appendix A

Question	Fisher PCI	Non-fishing PCI	Std. Dev. Of Fishers	Non-fishing Std. Dev.	Mean Fisher	Non-fishing Mean

Environmental Perceptions						
Mangrove tree cover has been Reduced	0.51	0.27	0.176	0.196	1.3	1.25
Water clarity has decreased	0.61	0	0.161	0	1.05	1.25
The lagoon has become shallower	0	0	0	0	1.9	1.5
Water temperature in the lagoon has increased	0	0	0	0	1.85	1.25
The rainy season has become more unpredictable	0.245	0	0.135	0	1.5	1
The size of fish caught has decreased	0.39	0	0.17	0	1.05	1
The amount of fish caught has changed	0	0	0	0	1.85	1.25
The type of fish being caught has changed	0.93	0.203	0.11	0.169	-0.45	0.875
Fishers currently spend more time fishing for the same amount of fish than they did in the past	0.14	0	0.125	0	1.8	1
Importance of Responsible Fishing Program						
Establish principles, in accordance with the relevant rules of international law, for responsible fishing and fisheries activities, taking into account all their relevant biological, technological, economic, social, environmental and commercial aspect	0	0	0	0	1.7	1.62
Establish principles and criteria for the elaboration and implementation of national policies for responsible conservation of fisheries resources and fisheries management and development	0	0	0	0	1.75	1.625
Serve as an instrument of reference to help States to establish or to improve the legal and institutional framework required for the exercise of responsible fisheries and in the formulation and implementation of appropriate measures	0	0	0	0	1.6	1.5
Facilitate cooperation between fishing cooperatives	0	0	0	0	1.8	1.75
Facilitate and promote technical, financial and other cooperation in conservation of fisheries resources and fisheries management and development	0	0	0	0	1.8	1.75
Promote the contribution of fisheries to food security and food quality, giving priority to the nutritional needs of local communities	0	0	0	0	1.65	1.75
Promote protection of living aquatic	0	0.297	0	0.216	1.8	1.3

resources and their environments and coastal areas						
Promote the trade of fish and fishery products in conformity with relevant international rules and avoid the use of measures that constitute hidden barriers to such trade	0	0	0	0	1.8	1.625
Promote research on fisheries as well as on associated ecosystems and relevant environmental factors	0	0	0	0	1.8	1.5
Provide standards of conduct for all persons involved in the fisheries sector	0	0	0	0	1.6	1.5
Communication of Responsible Fishing Program						
How informed are you of the Responsible Fishing program	0.35	0.281	0.147	0.213	1	1.25
Management in the Reserve						
Overall satisfaction with the biosphere reserve's regulations	0.828	0.438	0.084	0.146	-0.05	0
Agreement with the boundaries of the biosphere reserve	0.398	0.172	0.18	0.16	0.85	0.375
How well informed are you about the purpose of the biosphere reserve	0.825	0	0.07	0	-0.05	1.25
How well informed are you about the regulations of the biosphere reserve	0.695	0	0.146	0	-0.65	1.25
Approval of the biosphere reserve	0.41	0.391	0.155	0.281	0.7	1.125
How beneficial or harmful is the biosphere reserve to livelihoods of those living within it	0.29	0.312	0.163	0.224	1	0.75
Management Between Stakeholder Groups						
The local government and or cooperatives should plan management within the reserve	0.125	0.344	0.11	0.158	1.5	0.5
It's the fault of communication between stakeholder groups and the cooperatives in terms of management	0.593	0.2345	0.148	0.181	0.85	1
Managerial groups should considers opinions of fisherman when they make decisions about management	0.77	0.172	0.098	0.129	0.05	-0.625
When people violate rules and a fine is in place that should go towards the cooperatives	0	0	0	0	1.6	1.375
Fishers should only sell their products at the local level	0	0.297	0	0.22	-2	-0.625

The amount of fish captured has increased since the creation of the reserve	0	0	0	0	-1.8	-1
The mission statement and regulations of the reserve are not clear	0.807	0.219	0.134	0.126	0.45	0.25
Communication Between Groups						
Fishers	0.11	0.344	0.101	0.18	1.2	0.25
Cooperatives	0.24	0.562	0.139	0.234	0.9	0.5
CONANP	0.328	0.453	0.143	0.195	0.6	0.5
PROFEPA	0.608	0.578	0.082	0.194	-0.4	-0.375
CONAPESCA	0.55	0.438	0.122	0.223	0.25	-0.25
La Federación de Pesca	0.532	0.266	0.115	0.16	-0.55	0.125
SEPESCA	0.46	0.234	0.097	0.194	-0.3	-0.625

Table 4: PCI_2 values, standard deviation, and mean values of both stakeholder groups

Question	*d*
Environmental Perceptions	
Mangrove tree cover has been Reduced	0.91
Water clarity has decreased	3.79
The lagoon has become shallower	0
Water temperature in the lagoon has increased	0
The rainy season has become more unpredictable	1.81
The size of fish caught has decreased	2.29
The amount of fish caught has changed	0
The type of fish being caught has changed	3.61
Fishers currently spend more time fishing for the same amount of fish than they did in the past	1.12
Importance of Responsible Fishing Program	
Establish principles, in accordance with the relevant rules of international law, for responsible fishing and fisheries activities, taking into account all their relevant biological, technological, economic, social, environmental and commercial aspect	0
Establish principles and criteria for the elaboration and implementation of national policies for responsible conservation of fisheries resources and fisheries management and development	0
Serve as an instrument of reference to help States to establish or to improve the legal and institutional framework required for the exercise of responsible fisheries and in the formulation and implementation of appropriate measures	0
Facilitate cooperation between fishing cooperatives	0
Facilitate and promote technical, financial and other cooperation in conservation of fisheries resources and fisheries management and development	0
Promote the contribution of fisheries to food security and food quality, giving priority to the nutritional needs of local communities	0
Promote protection of living aquatic resources and their environments and coastal areas	1.38

Promote the trade of fish and fishery products in conformity with relevant international rules and avoid the use of measures that constitute hidden barriers to such trade	0
Promote research on fisheries as well as on associated ecosystems and relevant environmental factors	0
Provide standards of conduct for all persons involved in the fisheries sector	0
Communication of Responsible Fishing Program	
How informed are you of the Responsible Fishing program	0.27
Management in the Reserve	
Overall satisfaction with the biosphere reserve's regulations	2.32
Agreement with the boundaries of the biosphere reserve	0.94
How well informed are you about the purpose of the biosphere reserve	11.79
How well informed are you about the regulations of the biosphere reserve	4.76
Approval of the biosphere reserve	0.06
How beneficial or harmful is the biosphere reserve to livelihoods of those living within it	0.08
Management Between Stakeholder Groups	
The local government and or cooperatives should plan management within the reserve	1.14
It's the fault of communication between stakeholder groups and the cooperatives in terms of management	1.53
Managerial groups should considers opinions of fisherman when they make decisions about management	3.69
When people violate rules and a fine is in place that should go towards the cooperatives	0
Fishers should only sell their products at the local level	1.35
The amount of fish captured has increased since the creation of the reserve	0
The mission statement and regulations of the reserve are not clear	3.2
Communication Between Groups	
Fishers	1.13
Cooperatives	1.18
CONANP	0.52
PROFEPA	0.14
CONAPESCA	0.44
La Federación de Pesca	1.35
SEPESCA	1.04

Table 5: Comparison of PCI_2 values between interviewed stakeholders. Highlighted numbers signify statistically significant values * Includes Bonferroni correction value

$d = ABS(PCI_a - PCI_b) / \sqrt{(PCI_{aSD})^2 + (PCI_{bSD})^2}$ where d is considered to be N(0,1)
where:
The √ is the radical symbol for the square root of the sum of the squares
ABS = Absolute value
PCI_a = Observed PCI_2 for the 1st sample or group
PCI_b = Observed PCI_2 for a 2nd sample or group

PCI_{aSD} = Std. Dev. of simulated PCI_2 distribution for 1st sample or group
PCI_{bSD} = Std. Dev. of the simulated PCI_2 distribution for 2nd sample or group

Excel model was used to calculate these values which can be found at:
http://warnercnr.colostate.edu/~jerryv/PCI2/comparing_pci2_values.htm

If $d > 1.96$, difference is statistically significant at $p < .05$
* With Bonferroni correction p value decreases from 0.05 to 0.0001282 which increases d > 3.6623

Cross-impact Analysis:

Variable	1	2	3	4	5	6	7	8	9	10	Motility
1. Inadequate management		1	1	1	1	0	0	1	1	1	7
2. Lack of communication with other stakeholders	1		0	1	1	0	1	1	0	1	6
3. Upper watershed issues	0	0		0	0	0	0	0	1	1	2
4. Insufficent markets	0	0	0		0	0	0	0	0	0	0
5. Unsustainable use of resources	0	0	0	0		0	0	0	1	1	2
6. Population and demographic change of fishing communities	0	0	0	1	1		1	0	1	1	5
7. Lack of education or knowledge	0	1	1	0	1	0		0	1	0	4
8. Inadequate policies or regulations	1	0	0	1	0	0	0		1	0	3
9. Water quality	0	0	0	0	0	0	0	0		1	1
10. Loss of mangrove ecosystem	0	0	0	0	0	0	0	0	1		1
Dependance	2	2	2	4	4	0	2	2	7	6	31

Table 6: Double-entry matrix results of perceived problems in the La Encrucijada Biosphere Reserve for board of directors

Variable	No.	Motility	Motility %	Dependance	Dependance %
1. Inadequate management	1	7	22.5	2	6.4
2. Lack of communication with other stakeholders	2	6	19.3	2	6.4
3. Upper watershed issues	3	2	6.4	2	6.4
4. Insufficent markets	4	0	0	4	12.9

5. Unsustainable use of resources	5	2	6.4	4	12.9
6. Population and demographic change of fishing communities	6	5	16.1	0	0
7. Lack of education or knowledge	7	4	12.9	2	6.4
8. Inadequate policies or regulations	8	3	9.6	2	6.4
9. Water quality	9	1	3.2	7	22.5
10. Loss of mangrove ecosystem	10	1	3.2	6	19.3

Table 7: Motility and dependency percentages of perceived problems in the La Encrucijada Biosphere Reserve for board of directors

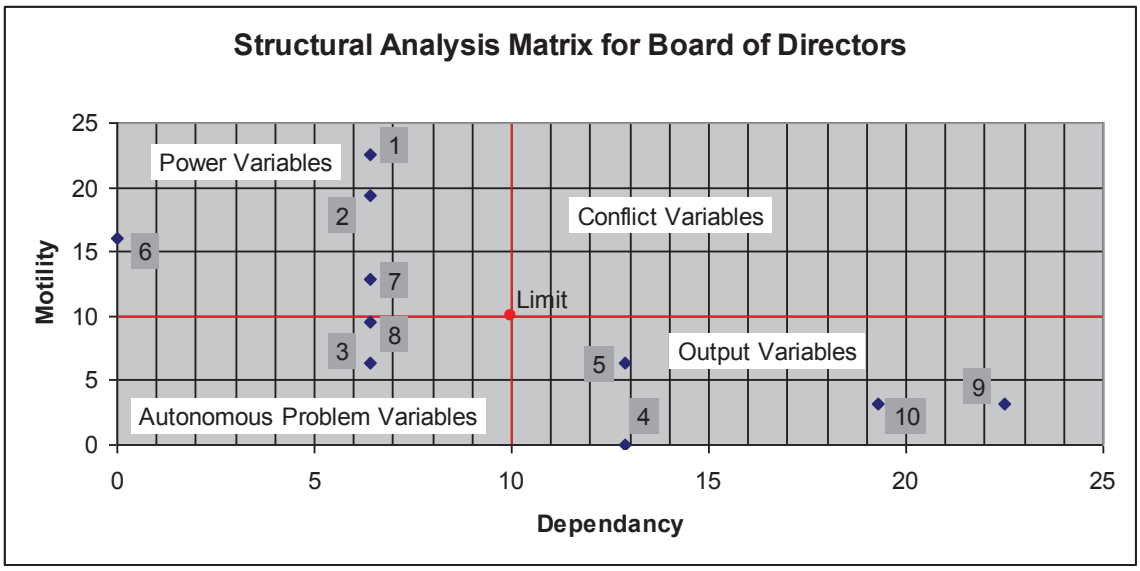

Figure 42: Structural analysis of board of directors' perceived problems

Non-fishing Stakeholders:

Variable	1	2	3	4	5	6	7	Motility
1. Loss of biodiversity		0	0	0	0	0	0	0
2. Upper watershed issues	1		0	0	0	0	1	2
3. Lack of research in the fisheries	0	0		1	0	1	0	2
4. Lack of appropriate public policies	1	1	1		1	1	1	6

5. Lack of communication between fisheries, communities, gov. & academic institutions	0	0	1	1		1	1	4
6. Low prices of fishery products	0	0	0	0	0		1	1
7. Rural poverty and established norms	1	0	0	0	1	1		3
Dependence	3	1	2	2	2	4	4	18

Table 8: Double-entry matrix results of perceived problems in the La Encrucijada Biosphere Reserve for non-fishing stakeholders

Variable	No.	Motility	Motility %	Dependance	Dependance %
1. Loss of biodiversity	1	0	0	3	16.6
2. Upper watershed issues	2	2	11.1	1	5.5
3. Lack of research in the fisheries	3	2	11.1	2	11.1
4. Lack of appropriate public policies	4	6	33.3	2	11.1
5. Lack of communication between fisheries, communities, gov. & academia institutions	5	4	22.2	2	11.1
6. Low prices of fishery products	6	1	5.5	4	22.2
7. Rural poverty and established norms	7	3	16.6	4	22.2

Table 9: Motility and dependency percentages of perceived problems in the La Encrucijada Biosphere Reserve for non-fishing stakeholders

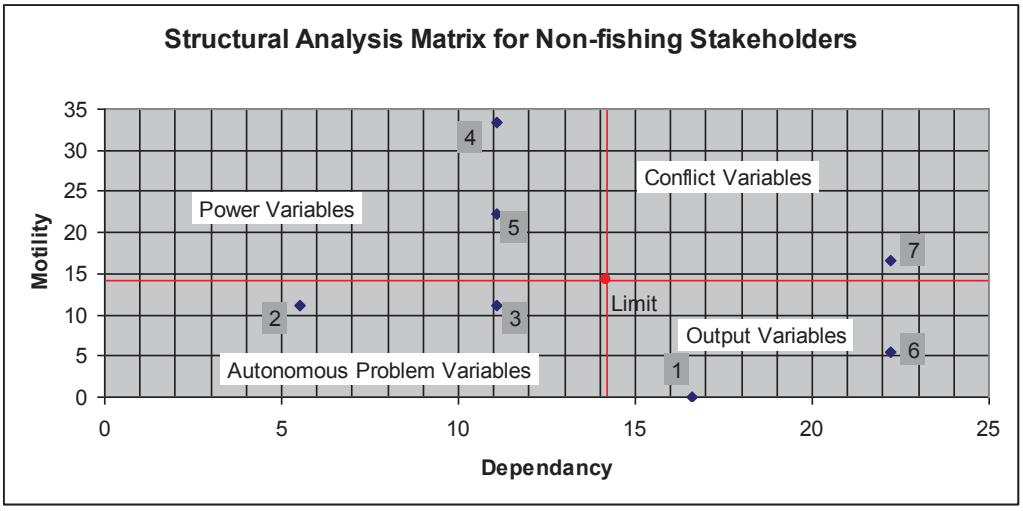

Figure 43: Structural analysis of non-fishing stakeholders' perceived problems

Appendix B: Survey Instuments (Spanish)

Survey Instrument for Board of Directors

El siguiente documento contiene una serie de preguntas sobre una variedad de temas acerca la pesca y la gestión dentro de la Reserva de la Biosfera La Encrucijada. Este estudio está siendo facilitad por El Colegio de la Frontera Sur (ECOSUR), una institución que tiene mucha experiencia en el manejo participativo de reservas de la biosfera. Este cuestionario le da la oportunidad de expresar sus opiniones acerca de la Reserva de la Biosfera La Encrucijada. Como parte de las estrategias de gestión están en constante cambio en el área, las prácticas se están iniciando orientado a la pesca responsable. Nuestra esperanza es que este enfoque participativo presente nuevas oportunidades que beneficien a todas las comunidades dentro de la reserva de la biosfera. La información recogida será presentada a todos los que participan como sugerencias que pueden ser incorporados como prácticas de gestión que pueden mejorar que tienen en sus preocupaciones y opiniones.

Agradecemos su participación en esta encuesta voluntaria.
Va a ser anónimo – su nombre y la cooperativa. Vamos a dar una copia de los resultados a uds.

Estamos interesados en lo que *usted* piensa. Por favor, complete la encuesta con sus propias opiniones. Si usted no tiene una opinión, sólo tiene que indicar "ninguna opinión". Sus respuestas serán confidenciales y su nombre no será recolectado.

Por favor, conteste todas las preguntas de la encuesta. Se tardara unos treinta minutos en completarla.

Gracias por su participación.

Sección 1 - Artes de Pesca y experiencias

1. a) ¿Generalmente, dónde pescan los miembros de la cooperativa?
   - ☐ ***dentro*** de las áreas concesionadas a la cooperativa ☐ ***fuera*** de las áreas concesionadas

   b) Si pescan fuera de estas áreas, ¿ dónde pescan?

_____

b) ¿Qué arte de pesca es el más utilizado en la comunidad?: _____
c) ¿En general, cuántas horas al día pescan los pescadores en la comunidad?: _____
d) ¿En general, cuántos días a la semana pescan los pescadores de la comunidad?: _____
e) Indique los tres principales productos (pescado, camarón, jaiba, chacalin) que los pescadores pescan en su comunidad:

i) _____ ii) _____ iii) _____

2. Evalúa que tan de acuerdo esta con estas declaraciones:

En los últimos 10 años, le parece que….	**Estoy muy de acuerdo**	**Estoy de Acuerdo**	**No tengo opinión**	**No estoy de acuerdo**	**No estoy muy de acuerdo**
a) Las zona de manglares se han reducido	1	2	3	4	5
b) En general, la claridad del agua ha disminuido	1	2	3	4	5
c) La lagunas son menos profundas	1	2	3	4	5
d) La temperatura del agua en las lagunas se ha incrementado	1	2	3	4	5
e) La temporada de lluvias se ha cambiado	1	2	3	4	5
f) En general, el tamaño de los peces capturados ha disminuido	1	2	3	4	5
g) La cantidad de pescado que captura ha disminuido	1	2	3	4	5
h) Las poblaciones de Lisa han disminuido	1	2	3	4	5
i) Las poblaciones de Liseta han disminuido	1	2	3	4	5
j) Las poblaciones de Juelita han disminuido	1	2	3	4	5
k) Las poblaciones de Wite han disminuido	1	2	3	4	5
l) Las poblaciones de Robalo romo han disminuido	1	2	3	4	5
m) Las poblaciones de Robalo hocicudo han disminuido	1	2	3	4	5
n) Las poblaciones de Miche han disminuido	1	2	3	4	5
o) Las poblaciones de Pargo Colorado han disminuido	1	2	3	4	5
p) Las poblaciones de camarón blanco han disminuido	1	2	3	4	5
q) El tipo de pescado que la cooperativa esta capturando ha cambiado	1	2	3	4	5
r) Hoy en día, los pescadores pasan más tiempo pescando por la misma cantidad de pescado que lo hacían en el pasado	1	2	3	4	5

Sección 2 - Pesca Responsable

Pesca Responsable intenta crear principios y normas internacionales de conducta para las prácticas responsables con la meta de conservar y gestionar el ecosistema. La Pesca Responsable reconoce el valor nutritivo, la importancia económica, social, ambiental y cultural de la pesca y los intereses de todos los interesados en la pesquería.

1. a) En general, ¿Qué tan informado está usted del programa de pesca responsable?

Muy informado	Informado	No tengo opinión	No estoy informado	Estoy muy mal informado
1	2	3	4	5

b) En caso afirmativo, ¿cómo ve el programa de Pesca Responsable en términos de cómo podría afectar a su economía familiar-personal?

□ Es beneficioso □ Es negativo □ No tengo ninguna opinión

c) En caso afirmativo, ¿Dónde eschuchó sobre el programa de Pesca Responsable?

_____

2. Las siguientes son declaraciones sobre el programa de pesca responsable. Esto evalúa su nivel de acuerdo con:

En general, ¿qué tan importante es para **usted que el Programa de Pesca Responsable aborde los siguientes temas:**	**Es muy importante**	**Es importante**	**No tengo opinión**	**No es Importante**	**No es muy importante**
a) Tomar en cuenta todos los aspectos biológicos, tecnológicos, económicos, sociales, ambientales y comerciales de la pesca	1	2	3	4	5
b) Establecer reglas para el manejo de la pesca responsable	1	2	3	4	5
c) Mejorar la legalidad de la pesca responsable	1	2	3	4	5
d) Facilitar la cooperación entre las cooperativas	1	2	3	4	5
e) Facilitar la cooperación entre los pescadores y las organizaciones de manejo (por ejemplo, CONANP y CONAPESCA)	1	2	3	4	5
f) Promover el acceso a comida de calidad para su familia	1	2	3	4	5
g) Proteger el medio ambiente	1	2	3	4	5
h) Promover el comercio de nuestros productos de la pesca y limitar los obstáculos al comercio	1	2	3	4	5
i) Promover la investigación en la pesquería	1	2	3	4	5
j) Proporcionar reglas de manejo para a la pesquería	1	2	3	4	5

Sección 3 - Comunicación y Educación de la Pesca Responsable

1. ¿Existen talleres, charlas, capacitaciones, o cursos que se enfocan en la pesca responsable?
____Si ____No
2. ¿Existen talleres o charlas que se enfocan en el propósito de mejorar el manejo de la pesca de su comunidad?
____Si ____No

3. ¿Ha asistido a reuniones en donde se ha tratado en el manejo de las areas de pesca de su comunidad?
____Si ____No

En *caso afirmativo*, por favor conteste las siguientes preguntas:

a) ¿Ha asistido a estas reuniones en los últimos 6 meses? Sí ____No _____

b) Por favor, indique la razón principal por la cual ud. Ha asistido a estas reuniones públicas

- □ Ellas proporcionan información sobre temas actuales de la comunidad
- □ Ellas me dan la oportunidad de colaborar con otras personas sobre este tema
- □ Me da la oportunidad de expresar mi opinión

- Me gusta aprender nuevas maneras de proteger el medio ambiente en el que vivo
- Otros razones_____

c) Si *no*, por favor revise las siguientes razones por las cuales no ha asistido a estas reuniones públicas:

- Tenía otras cosas que hacer No me escuchan en las reuniones
- Me siento sin educación en los temas Yo no sabía que había una reunión
- No tenía tiempo para asistir Otra razón_____

4. ¿Está de acuerdo con la mayoría de las prácticas de manejo de las áreas de pesca de su comunidad? __Si __No. Por favor, explique por qué:
_____

5. Por favor califique su satisfacción general con las regulaciones de la reserva de la biosfera: (ejemplo: la venta de huevos de tortugas)

Estoy muy satisfecho	Estoy satisfecho	No tengo opinión	No estoy satisfecho	No estoy muy satisfecho
1	2	3	4	5

Por favor, explique por qué se siente así:_____

Sección 4- Reserva de la Biosfera y CONAPESCA

1. ¿Está consciente de que su comunidad esta ubicada dentro de una reserva de la biosfera? ____Sí ____No

2. ¿En sus propias palabras, que representa la Reserva de La Biosfera La Encrucijada?
_____
_____

La Reserva la Biosfera abarca los municipios de Acapetahua y Mapastepec:

3. ¿Está de acuerdo con los límites de la reserva de la biosfera?

Lo aprueba firmemente	Lo aprueba	No Tengo Opinión	Lo desaprueba	Lo desaprueba Fuertemente
1	2	3	4	5

4. ¿En general, qué tan informado esta usted sobre el objetivo de la Reserva de la Biosfera?

Estoy muy Informado	Estoy informado	No Tengo Opinión	No estoy Informado	Estoy muy mal Informado
1	2	3	4	5

5. ¿Qué tan informado esta usted con respecto a las regulaciones de la Reserva de la Biosfera?

Estoy muy Informado	Estoy informado	No Tengo Opinión	No estoy Informado	Estoy muy mal Informado
1	2	3	4	5

La Reserva de la Biosfera fue declarado en .....(need to add date):

6. ¿Hasta qué punto esta usted de acuerdo con la declaración del manejo de la reserva de la biosfera?

Aprueba firmemente	Aprobar	No Tengo Opinión	Desaprobar	Desaprueban Fuertemente
1	2	3	4	5

7. Por favor indique en qué tanto beneficia o perjudica la reserva de biosfera:

Me beneficío mucho	Me beneficío	No Tengo Opinión	Me Perjudicia	Me perjudicia mucho
1	2	3	4	5

a) ¿Por qué cree esto?_____

8. ¿Conoce ud. Sobre la existencia de la CONAPESCA? ____Sí ____No

a) En caso afirmativo, ¿qué hacen?: _____

9. Ciertas artes de pesca deben ser reguladas por CONAPESCA? Sí ____No_____

a) En caso afirmativo, ¿cuales?: _____

10. Algunas áreas de pesca deben estar cerradas periódicamente por la cooperativa para la recuperación de los productos pesqueros: Sí ____No_____

11. Las vedas de pesca y los volúmenes de captura deben basarse en resultados de investigaciónes científicas o registros periódicos de captura pesquera.

□ Totalmente de acuerdo □ Acuerdo □ Neutral □ No estoy de acuerdo □ Totalmente en desacuerdo

Sección 5 – Comunicación y Manejo

1. Las siguientes son declaraciones sobre las iniciativas de manejo de la comunidad. Que tanto esta de acuerdo con estas declaraciones:

Está de acuerdo que….	**Muy de Acuerdo**	**De Acuerdo**	**No Tengo opinión**	**No estoy Acuerdo**	**No estoy muy De acuerdo**
a) Las cooperativas deben planificar el manejo de la pesca dentro de la reserva de la biosfera.	1	2	3	4	5
b) Hay una falta de comunicación entre La CONAPESCA y las cooperativas de pescadores en temas de manejo	1	2	3	4	5
c) La CONAPESCA considera nuestras opiniones cuando se toman decisiones sobre temas de manejo	1	2	3	4	5
d) Cuando las multas se aplican a violaciones a los acuerdos internos o entre cooperativas, una parte de ese dinero debe reinvertirse en las mismas cooperativas pesqueras.	1	2	3	4	5
e) Sólo debemos vender nuestro pescado y productos pesqueros a nivel local	1	2	3	4	5
f) La cantidad de pescado que captura ha aumentado desde la creación de la Reserva de la Biosfera.	1	2	3	4	5
g) No entiendo las reglas relacionados al manejo de la Reserva de la Biosfera.	1	2	3	4	5

2. ¿Cuáles son los problemas más importantes en La Reserva de la Biosfera La Encrucijada? Estos pueden ser tecnológicos, ecológicos, económicos, sociales, culturales o políticas institucionales. Por favor, indique

los problemas abajo y lo que usted cree que es la causa del problema. Por favor identifique un problema a la vez.
Problema:_____
_____
Causa:_____
_____

3. Algunas veces los problemas se deben a la falta de comunicación entre las diferentes organizaciones involucradas en el manejo de las pesquerías. Por favor, evalúe cómo cada uno de los siguientes grupos se comunican con la cooperativa:

Grupo	**Excelente Comunicación**	**Buen Comunicación**	**No Tengo Opinión**	**Mala Comunicación**	**Muy mala Comunicación**
a) Pescadores	1	2	3	4	5
b) Las Cooperativas de Pescadores	1	2	3	4	5
c) CONANP	1	2	3	4	5
d) PROFEPA	1	2	3	4	5
e) CONAPESCA	1	2	3	4	5
f) La Federación de Pesca	1	2	3	4	5
g) SEPESCA	1	2	3	4	5

Sección 6 – Información General

1. a) ¿Cuántos años hace que vive en esta comunidad?
____0-5 años ____5-10 años ____>10 años

b) ¿Cuál es su género? _____Masculino ____Femenino c) ¿Cuál es su edad? _____

2. a) ¿Cuánta educación formal ha terminado? *Marque una respuesta:*
□ No terminé la primaria □ Grado de primaria □ No terminé de secundaria
□ Grado de secundaria □ Un poco de universidad □ Me gradué de la universidad
□ Técnico / vocacional de la escuela
b) ¿Cuántos miembros de su familia están viviendo en su casa? _____

3. a) ¿Es la pesca su principal ocupación? ____Sí ____No
i) Si no, ¿qué otra ocupación(s) tiene(n)?
□ Agricultor □ Vendedor de pescado □ Jefe de la cooperativa
□ Trabajo en el gobierno local □ Transporte □ Otro

¡Gracias por su participación!

ECOSUR

Survey Instrumentfor Non-fishing Stakeholders

El siguiente documento contiene una serie de preguntas sobre una variedad de temas relacionados con la actividad pesqura y la gestión de la Reserva de la Biosfera La Encrucijada. Una de las estrategias de gestión que realiza la Reserva, está orientada a la pesca responsable. Este estudio está siendo facilitad por El Colegio de la Frontera Sur (ECOSUR), una institución que tiene mucha experiencia en el manejo participativo en reservas de la biosfera.. Nuestra esperanza es que este enfoque participativo presente nuevas oportunidades que beneficien a todas las comunidades dentro de la reserva de la biosfera. La información recogida será presentada a todos los participantes y las sugerencias y opiniones ayudarán a mejorar los procesos de gestión y colaboración que se están impulsando actualmente.

Agradecemos su participación en esta encuesta voluntaria.

Sus respuestas serán anónimas (razón por la cual no se incluye su nombre) . Al finalizar el trabajo se entregará una copia de los resultados a cada uno de los participantes.

Estamos interesados en lo que *usted* piensa. Por favor, complete la encuesta con sus propias opiniones. Si usted no tiene una opinión, sólo tiene que indicar "ninguna opinión".

Por favor, conteste todas las preguntas de la encuesta. Se tardará menosde treinta minutos en completarla.

!Gracias por su participación!.

Sección 1 – Información General

1. a) ¿Cuál es su género? ☐ Masculino ☐ Femenino
   b) ¿Cuál es el nombre de suorganización/ Empresa/Dependencia?:
   c) ¿Cuánto tiempo ha estado en esta organización?:
   d) ¿Cuál es su posición actual en esta organización?:
   e) ¿Cuánto tiempo ha ocupado este puesto?:
   f) ¿Cuál es la actividad o programa que desarrolla actualmenteen la zona de influencia de la Reserva de la Biosfera La Encrucijada?:
   g) ¿Está usted afiliado con otras organizaciones que trabajan en el área? ☐ Sí ☐ No
   i) En caso afirmativo, indique el nombre de ellas:

Sección 2- Reserva de la Biosfera La Encrucijada

1. En sus propias palabras, ¿cuál es el propósito de la Reserva?

2. ¿Está de acuerdo con los límites territoriales de la reserva de la biosfera?

Lo aprueba firmemente Approve	Lo aprueba	No Tengo Opinión	Lo desaprueba	Lo desaprueba Fuertemente Approve
☐	☐	☐	☐	☐

3. ¿En general, qué tan bien informado está sobre las actividades de la reserva?

Estoy muy Informado	Estoy informado	No Tengo Opinión	No estoy Informado Informed	Estoy muy mal Informado
☐	☐	☐	☐	☐

4. ¿Qué tan bien informado está sobre las regulaciones de la Reserva de la Biosfera?

Estoy muy Informado	Estoy informado	No Tengo Opinión	No estoy Informado Informed	Estoy muy mal Informado
☐	☐	☐	☐	☐

5. ¿Está de acuerdo con la existencia de esta reserva ?

Lo aprueba firmemente Approve	Lo aprueba	No Tengo Opinión	Lo desaprueba	Lo desaprueba Fuertemente Approve
☐	☐	☐	☐	☐

6. Por favor indique que tan benéfica o perjudicial ha sido la existencia de la reserva para el sustento de los pescadores.

Mucho beneficio	Poco beneficio	No Tengo Opinión	Poco Perjuicio	Mucho perjuicio
☐	☐	☐	☐	☐

a) ¿Indique algunas de las razones de su respuesta?

Sección 3 - Pesca Responsable

Pesca Responsable intenta crear principios y normas internacionales de conducta para las prácticas responsables con la meta de conservar y gestionar el ecosistema. La Pesca Responsable reconoce el valor nutritivo, la importancia económica, social, ambiental y cultural de la pesca y los intereses de todos los interesados en la pesquería.

1. a) En general, ¿usted está bien informado del programa de pesca responsable?

Estoy muy Informado	Estoy informado	No Tengo Opinión	No estoy Informado Informed	Estoy muy mal Informado
☐	☐	☐	☐	☐

b) En caso afirmativo, ¿ el programa de Pesca Responsable puede influir (de forma negativa o positiva) a los medios de subsistencia de los pescadores?

☐ Es benéfico ☐ Es negativo ☐ No tengo ninguna opinión

c) Si usted conoce el programa de pesca responsable que se impulsa dentro del área de la Reserva de la Biosfera, ¿cómo se enteró del programa?

2. ¿Cual es su nivel de participaciónen el programa de pesca responsable (asesor, observador, invitado, miembro del comité, directiva, etc)?

Las siguientes son declaraciones sobre el programa de pesca responsable. Esto evalúa su nivel de acuerdo con:

Está de acuerdo que el programa de Pesca Responsable va a….	**Muy de Acuerdo**	**De Acuerdo**	**No Tengo opinión**	**No estoy Acuerdo**	**Totalmente En Desacuerdo**
a) Establecer principios, de acuerdo con las normas pertinentes del derecho internacional, para la pesca y actividades pesqueras responsables tomando en cuenta todos los aspectos biológicos, tecnológicos, económicos, sociales, ambientales y comerciales	☐	☐	☐	☐	☐
b) Establecer principios y criterios para la elaboración y aplicación de políticas nacionales para la conservación y manejo sustentable de los recursos pesqueros	☐	☐	☐	☐	☐
c) Servir como un instrumento de referencia para ayudar a los organismos gubernamentales a establecer o mejorar el marco jurídico e institucional necesario para el ejercicio de la pesca responsable y en la formulación y aplicación de medidas adecuadas	☐	☐	☐	☐	☐
d) Facilitar la cooperación entre las cooperativas de pescadores	☐	☐	☐	☐	☐
e) Facilitar y promover la cooperación técnica, financiera para la conservación de los recursos y el	☐	☐	☐	☐	☐

ordenamiento pesquero

f) Promover la contribución de la pesca a la seguridad alimentaria y calidad de los alimentos, dando prioridad a las necesidades nutricionales de las comunidades locales	☐	☐	☐	☐	☐
g) Promover la protección de los recursos acuáticos y ecosistemas costeros	☐	☐	☐	☐	☐
h) Promover el comercio de pescado y productos pesqueros, de conformidad con las normas internacionales pertinentes y evitar el uso de medidas que constituyan obstáculos encubiertos a dicho comercio	☐	☐	☐	☐	☐
i) Promover la investigación pesquera, así como de los ecosistemas asociados y factores ambientales pertinentes	☐	☐	☐	☐	☐
j) Proporcionar normas de conducta para todas las personas involucradas en el sector pesquero	☐	☐	☐	☐	☐
k) Proporcionar orientaciones que puedan utilizarse en su caso, en la formulación y aplicación de los acuerdos internacionales y otros instrumentos jurídicos, tanto obligatorios como voluntarios	☐	☐	☐	☐	☐

Sección 4 – Comunicación y Educación de Pesca Responsable

1. ¿Existen talleres, charlas, capacitaciones, o cursos que se enfocan a la pesca responsable?
☐ Si ☐ No

2. ¿Existen programas educativos en La Encrucijada que se centran en el propósito de regular la pesca?
☐ Si ☐ No

3. . ¿Ha asistido a reuniones en donde se ha tratado en el manejo de las áreas de pesca en La Encrucijada?
☐Si ☐ No

En *caso afirmativo*, por favor conteste las siguientes preguntas:

a)¿Ha asistido a estas reuniones en los últimos 6 meses? ☐ Sí ☐ No

b) Por favor, indique la razón principal por la cual ustede ha asistido a estas reuniones públicas:

C) Si no, por favor indique por qué:

4. ¿Está de acuerdo con la dirección general de La Encrucijada? ☐ Si ☐ No
Por favor, explique por qué?

6. Por favor califique su satisfacción general con las regulaciones de la reserva de la biosfera:

Estoy muy satisfecho Satisfied	Estoy satisfecho	No tengo opinión	No estoy satisfecho	No estoy muy satisfecho Dissatisfied
☐	☐	☐	☐	☐

a) Por favor, explique algunas de las razones de su respuesta anterior:

Sección 5 – Comunicación y Manejo

1. Las siguientes son declaraciones relacionadas con iniciativas de manejo en las comunidades. Que tanto está de acuerdo con estas declaraciones:

Está de acuerdo que….	Muy de Acuerdo	De Acuerdo	No Tengo opinión	No estoy Acuerdo	No estoy muy De acuerdo
a) El gobierno local debe planificar las regulaciones dentro de la reserva de la biosfera.	☐	☐	☐	☐	☐
b) Los pescadores y/o cooperativas deberían participar directamente en las gestiones de la reserva de biosfera	☐	☐	☐	☐	☐
c) Existe una falta de comunicación entre el gobierno local y las cooperativas de pescadores en relación con cuestiones de gestión de recursos y proyectos	☐	☐	☐	☐	☐
d) El gobierno local considera las opiniones de los pescadores cuando se toman decisiones de gestión.	☐	☐	☐	☐	☐
e) Las multas aplicadas a violaciones de pesca deben servir como un incentivo para que las cooperativas de pesca. Una parte de ese dinero se debe dar a las cooperativas para realizar actividades de vigilanciade pesca.	☐	☐	☐	☐	☐
f) Los pescadores sólo deben vender sus productos a nivel local	☐	☐	☐	☐	☐
g) Las poblaciones de peces se ha incrementado desde la aplicación de la reserva de la biosfera.	☐	☐	☐	☐	☐
h) La cantidad de pescado que se captura se ha incrementado desde la creación de la reserva de la biosfera	☐	☐	☐	☐	☐
i) Las políticas de gestión de la pesca en la reserva de la Encrucijada no están claras en la organización que represento	☐	☐	☐	☐	☐

2. ¿Cuáles son los tres problemas más importantes en La Reserva de la Biosfera La Encrucijada? (pueden ser tecnológicos, ecológicos, económicos, sociales, culturales o políticas institucionales, de comunicación, etc.). Por favor, indique los tres principales problemas y las causas que usted considera que los ocasionaron.

Problema:
Causa:
Problema:
Causa:
Problema:
Causa:

3. Algunas veces los problemas se deben a la falta de comunicación entre las diferentes organizaciones involucradas en el manejo de las pesquerías. Por favor, evalúe cómo cada uno de los siguientes grupos se comunican con su organización:

Grupo	**Excelente Comunicación**	**Buen Comunicación**	**No Tengo Opinión**	**Mala Comunicación**	**Muy mala Comunicación**
a) Pescadores	☐	☐	☐	☐	☐
b) Directiva de las Cooperativas de Pescadores	☐	☐	☐	☐	☐
c) CONANP	☐	☐	☐	☐	☐
d) PROFEPA	☐	☐	☐	☐	☐
e) CONAPESCA	☐	☐	☐	☐	☐
f) La Federación de Pesca	☐	☐	☐	☐	☐
g) SEPESCA	☐	☐	☐	☐	☐

Sección 6 – Percepciones del Medio Ambiente

1. Evalúa que tan de acuerdo está con estas declaraciones:

En los últimos 10 años, le parece que….	**Estoy muy de acuerdo**	**Estoy de Acuerdo**	**No tengo opinión**	**No estoy de acuerdo**	**No estoy muy de acuerdo**
a) Las zona de manglares se han reducido	☐	☐	☐	☐	☐
b) En general, la claridad del agua ha disminuido	☐	☐	☐	☐	☐
c) La lagunas son menos profundas	☐	☐	☐	☐	☐
d) La temperatura del agua en las lagunas se ha incrementado	☐	☐	☐	☐	☐
e) La temporada de lluvias ha cambiado	☐	☐	☐	☐	☐
f) En general, el tamaño de los peces capturados ha disminuido	☐	☐	☐	☐	☐
g) La cantidad de pescado que se captura ha disminuido	☐	☐	☐	☐	☐
h) Las poblaciones de Lisa han disminuido	☐	☐	☐	☐	☐
i) Las poblaciones de Liseta han disminuido	☐	☐	☐	☐	☐
j) Las poblaciones de Juela han disminuido	☐	☐	☐	☐	☐
k) Las poblaciones de Wite han disminuido	☐	☐	☐	☐	☐
l) Las poblaciones de Robalo romo han disminuido	☐	☐	☐	☐	☐
m) Las poblaciones de Robalo hocicudo han disminuido	☐	☐	☐	☐	☐
n) Las poblaciones de Miche han disminuido	☐	☐	☐	☐	☐
o) Las poblaciones de Pargo Colorado han disminuido	☐	☐	☐	☐	☐
p) Las poblaciones de camarón blanco han disminuido	☐	☐	☐	☐	☐
q) El tipo de pescado que la cooperativa esta capturando ha cambiado	☐	☐	☐	☐	☐

r) Hoy en día, los pescadores pasan más tiempo pescando por la misma cantidad de pescado que lo hacían en el pasado	☐	☐	☐	☐	☐

2. Ciertas artes de pesca deben ser reguladas por CONAPESCA? ☐ Sí ☐ No
   a) En caso afirmativo, ¿cuáles?:

3. Algunas áreas de pesca deben estar cerradas periódicamente por la cooperativa para la recuperación de los recursos pesqueros: ☐ Sí ☐ No

4. Las vedas de pesca y los volúmenes de captura deben basarse en resultados de investigaciones científicas o registros periódicos de captura pesquera.

Lo aprueba firmemente Approve	Lo aprueba	No Tengo Opinión	Lo desaprueba	Lo desaprueba Fuertemente Approve
☐	☐	☐	☐	☐

6. ¿Qué estudios o proyectos se están llevando a cabo por su organización en La Reserva de la Encrucijada?:

7. ¿Qué información / investigación hace falta en la zona para lograr una gestión exitosa?

8. En su opinión, existe suficiente información sobre la pesquería y captura de especies para establecer políticas de gestión, por ejemplo artes de pesca, cuotas de captura y l temporadas de pesca?
   ☐ Si ☐ No
   a) Si no es así, que considera que falta?

9. ¿Cuál ha sido la política más benéfica para la Reserva de la Biosfera y o el sistema lagunar?:

10. ¿Cuál ha sido la política más perjudicial para la Reserva de la Biosfera y o el sistema lagunar:

¡Gracias por su participación!

Appendix C: Survey Instruments (English)

Survey Instrument for Board of Directors

The following document contains a series of questions on a variety of topics about the fishery and management within the La Encrucijada Biosphere Reserve. This study is being conducted by El Colegio de la Frontera Sur (ECOSUR), an institution which has research experience and interest in participatory management within biosphere reserves. This questionnaire gives you the opportunity to express your views about La Encrucijada. Management strategies are constantly changing in the area, which recently include the implementation FAO's Responsible Fishing program. Our hope is that this participatory approach will create opportunities that will benefit all the communities within the reserve. The information collected from this study will be presented to all who participated as suggestions that may be incorporated in new management practices.

We appreciate your participation in this voluntary survey.
It will be anonymous - your name and the cooperative yo0u are affiliated with will not be recorded. Upon completion of the stufy, we are going to give your cooperative a copy of the results.

We are interested in what *you* think. Please fill out this survey with their own opinions. If you do not have an opinion, simply indicate "no opinion". Your answers will be confidential and once again your name will not collected.

Please answer all the questions in the survey. It will take about thirty minutes to complete.

Thank you for your participation

.

Section 1 – Fishing Techniques and Experiences

1. a) Generally, were do members of your cooperative fish?

□ ***Inside*** the boundary area of your cooperative □ ***Outside*** the boundary area of your cooperative

b) If members fish outside your cooperatives boundaries where do they fish?

_____

c) ¿What type of fishing gear is most used in your community?:_____

d) ¿Generally, how many hours do people in your community?: _____

e) ¿Generally, how many days a week do fishers fish in your community?: _____

f) Indicate the three principal products (fish, shrimp, crayfish, crab) fishers fish in your community:

ii) _____ ii) _____ iii) _____

2. Evaluate how much you agree with the following statements:

In the last 10 years, do you think...	Very Much Agree	Agree	No Opinion	Disagree	Very Much Disagree
a) The area of mangroves has reduced	1	2	3	4	5
b) In general, water clarity has decreased	1	2	3	4	5
c) The lagoon has become shallower	1	2	3	4	5
d) Water temperature in the lagoon has increased	1	2	3	4	5
e) The rainy season has become more unpredictable	1	2	3	4	5
f) The average size of fish caught has decreased	1	2	3	4	5
g) The amount of fish I catch has decreased	1	2	3	4	5
h) Flathead mullet populations have decreased	1	2	3	4	5
i) White mullet populations have decreased	1	2	3	4	5
j) Yellowfin snook populations have decreased	1	2	3	4	5
k) Blackfin snook populations have decreased	1	2	3	4	5
l) Black snook populations have decreased	1	2	3	4	5
m) White snook populations have decreased	1	2	3	4	5
n) Yellow snapper populations have decreased	1	2	3	4	5
o) Colorado snapper have decreased	1	2	3	4	5
p) White Shrimp populations have decreased	1	2	3	4	5
q) The type of fish the cooperative is catching has changed	1	2	3	4	5
r) Fishers currently spend more time fishing for the same amount of fish than they did in the past	1	2	3	4	5

Section 2 – Responsible Fishing

Responsible Fishing attempts to create principles and international standards of behavior for responsible practices trying to conserve and manage the ecosystem. It recognizes the nutritional, economic, social, environmental and cultural importance of fisheries and the interests of all those concerned with the fishery.

1. a) In general, how well informed are you of the Responsible Fishing program:

Extremely Informed	Informed	No Opinion	Not Informed	Extremely Uninformed
1	2	3	4	5

i) If yes, how do you view the program in terms of how it might affect your fishing livelihood?

□ Beneficial □ Negative □ No Opinion

ii) If yes, where did you hear about the Responsible Fishing program?

_____

2. The following are statements about the Responsible Fishing program. Rate your level of agreement:

In general, how important do you think it is that a Responsible Fishing Program addresses the following issues:	Very Important	Important	No opinion	Not Important	Not Important at all
a) Take into account all relevant biological, technological, economic, social, environmental and commercial aspects of the fishery	1	2	3	4	5
b) Establish policies for responsible fishing management	1	2	3	4	5
c) Improve the legality of responsible fishing	1	2	3	4	5
d) Facilitate cooperation between fishing cooperatives	1	2	3	4	5
e) Facilitate cooperation between fishers and managing organizations (e.g. CONANP, CONAPESCA, SAGARPA)	1	2	3	4	5
f) Promote the contribution of fisheries to food security and food quality	1	2	3	4	5
g) Protect the environment	1	2	3	4	5
h) Promote the trade of our fishery products and limit barriers to trade	1	2	3	4	5
i) Promote research in the fishery	1	2	3	4	5
j) Provide regulations for the fishery	1	2	3	4	5

Section 3 – Communication and Education of Responsible Fishing

1. Are there any educational programs that focus on responsible fishing? ____Yes ____No

2. Are there any educational programs that focus on the purpose of regulating your community's waters? ___Yes ____No

3. Have you attended any meetings focused on managing your community's waters? ____Yes ____No

If *yes*, please answer the following questions:

a) Have you attended these meetings in the past 6 months? ____Yes ____No

b) Please state the main reason for attending these public meetings:

- ☐ They provide information on current community issues
- ☐ They give me the chance to collaborate with others on this topic
- ☐ It gives me the opportunity to voice my opinion
- ☐ I like to learn about new ways to protect the environment I live in
- ☐ Other reasons_____

c) If *no*, please check the following reasons for not attending these public meetings:

- ☐ I had other things to do
- ☐ People do not listen to me at the meetings
- ☐ I feel uneducated on the issues
- ☐ I did not know there was a meeting
- ☐ I did not have the time to attend
- ☐ other_____

5. Do you agree with most management practices in your community? ___Yes ___No. Please explain why or why not:

_____

5. Please rate your overall satisfaction with the biosphere reserve's regulations:

Strongly Satisfied	Satisfied	No Opinion	Dissatisfied	Strongly Dissatisfied
1	2	3	4	5

a) Please explain why you feel this way: _____

1. Are you aware that your community exists within a biosphere reserve? ___ Yes ___ No

2. In your own words, what does the Reserva de La Biosphera La Encrucijada mean? _____
_____
_____

3. Do you agree with the boundaries of the biosphere reserve?

Strongly Approve	Approve	No Opinion	Disapprove	Strongly Disapprove
1	2	3	4	5

4. In general, how well informed are you about the purpose of the biosphere reserve?

Extremely Informed	Informed	No Opinion	Not Informed	Extremely Uninformed
1	2	3	4	5

5. How well informed are you about the regulations of the biosphere reserve?

Extremely Informed	Informed	No Opinion	Not Informed	Extremely Uninformed
1	2	3	4	5

6. To what extent do you approve of this biosphere reserve?

Strongly Approve	Approve	No Opinion	Disapprove	Strongly Approve
1	2	3	4	5

7. Please rate how beneficial or harmful the biosphere reserve is to your livelihood:

Very Beneficial	Beneficial	No Opinion	Harmful	Very Harmful
1	2	3	4	5

a) Why do you feel this way? _____

8. Are you aware of CONAPESCA? ____Yes ____No

a) If yes, then what do they do: _____

9. Should certain types of fishing techniques should be regulated by CONAPESCA: ____Yes ____No

a) If yes, then what types? _____

10. Should certain sections of the fishery be closed periodically by CONAPESCA for breeding purposes? ____Yes ____No

11. Fishing seasons and harvest levels should be based on scientific information about aquatic species:

□ Strongly Agree □ Agree □ Neutral □ Disagree □ Strongly Disagree

Section 5 – Communication and Management

1. The following are statements about the community's management initiatives. Rate your level of agreement with these statements:

Would you agree that….	Strongly agree	Agree	No opinion	Disagree	Strongly disagree
a) The local government must plan the regulations within the biosphere reserve.	1	2	3	4	5

b) Communication is lacking between the local government and fisher cooperatives on management issues.	1	2	3	4	5
c) CONAPESCA should consider fishers opinions when making management decisions.	1	2	3	4	5
d) If fines were implemented for fishing violations, a portion of that money should be given to the fishing cooperatives.	1	2	3	4	5
e) We should only sell our fish and fish products locally.	1	2	3	4	5
g) Fish stocks have increased since the implementation of the biosphere reserve.	1	2	3	4	5
g) I don't understand the rules and regulations pertaining to the management of this biosphere reserve.	1	2	3	4	5

2. What do you think are the most important problems in the La Reserva de la Biosfera La Encrucijada? These can be technological, ecological, economical, social, cultural, or institutional policies. Please indicate problems below and what you believe to be the cause of said problem. Do not group various problems into one problem.

Problem:_____
_____

Cause:_____
_____

3. Sometimes problems come from the lack of communication between the different organizations involved in the management of this fishery. Please evaluate how each one of the following groups of people has communicated with your cooperative:

Grupo	**Excelente Comunicación**	**Buen Comunicación**	**No Tengo Opinión**	**Mala Comunicación**	**Muy mala Comunicación**
a) Pescadores	1	2	3	4	5
b) Las Cooperativas de Pescadores	1	2	3	4	5
c) CONANP	1	2	3	4	5
d) PROFEPA	1	2	3	4	5
e) CONAPESCA	1	2	3	4	5
f) La Federación de Pesca	1	2	3	4	5
g) SEPESCA	1	2	3	4	5

Section 6 – Background Information

1. a) How many years have you been living in this community?

____0-5 yrs ____5-10yrs ____>10 yrs

b) What is your gender? _____Male ____Female c) What is your age? _____ Years old

2. a) How much formal education have you completed? *Check one response.*

□ Did not finish Elementary School □ Elementary School □ Some high school
□ High school degree □ Some college □ College degree
□ Technical / vocational school

b) How many family members are living in your household? _____

3. a) Is fishing your primary occupation (full time fisher)? ____Yes ____No

i) If no, what other occupation(s) do you have?

□ Farmer □ Fish seller □ Head of Cooperative
□ Community local government □ Transportation □ Other

Thank you for your participation

ECOSUR

Interview Guide for Non-fishing Stakeholders

The following are a series of questions on a variety of topics about fishing and management within the La Encrucijada Biosphere Reserve. This is study is being facilitated by El Colegio de la Frontera Sur (ECOSUR), an institution that places great emphasis on local participation in the management of biosphere reserves. This questionnaire gives you the opportunity to state your opinions about La Encrucijada Biosphere Reserve. As part of the ever-changing management strategies in the area, practices are being initiated geared toward responsible fishing. Our hope is that this participatory approach will present new opportunities that will benefit all the communities within the biosphere reserve. The information collected will be presented to all those involved as suggestions for ways management practices can be improved that take in your concerns and opinions.

While your participation in this survey is voluntary, we would appreciate your help. We are interested in what *you* believe. Please complete the survey with your own opinions. If you do not have one, simply indicate 'no opinion'. Your responses will be kept confidential and your names will not be collected.

Please answer all the questions in the survey. It takes about twenty minutes to complete.

Thank you for your participation.

Section 1- Background Information

1. a) What is your gender? ☐ Male ☐ Female
   b) ¿What organization, group, or unit do you represent?:
   c) How long have you been with this organization?:
   d) What is your current position in this organization?:
   e) How long have you held this position?:
   f) In what capacity are you involved in the fisheries within La Encrucijada Biosphere Reserve?:

g) Are you affiliated with any other organizations working in the area? ☐ Sí ☐ No
i) If yes, please indicate which:

Section 2- Biosphere Reserve and Responsible Fishing

2. In your own words, what does the Reserva de La Biosphera La Encrucijada mean?

2. Do you agree with the boundaries of the biosphere reserve?

Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

3. In general, how well informed are you about the purpose of the biosphere reserve??

Very Informed	Informed	No Opinion	Not Informed	Very Much Not Informed
☐	☐	☐	☐	☐

4. How well informed are you about the regulations of the biosphere reserve?

Very Informed	Informed	No Opinion	Not Informed	Very Much Not Informed
☐	☐	☐	☐	☐

5. Do you approve of this biosphere reserve existing?

Very Much Approve	Aprove	No Opinion	Do Not Approve	Very Much Do Not Approve
☐	☐	☐	☐	☐

6. Please rate how beneficial or harmful the biosphere reserve is to the fishers' livelihoods

Very Beneficial	Beneficial	No Opinion	Non Beneficial	Very Non Beneficial
☐	☐	☐	☐	☐

a) Why do you feel this way?

Section 3- Responsible Fishing

Responsible Fishing attempts to create principles and international standards of behavior for responsible practices trying to conserve and manage the ecosystem. It recognizes the nutritional, economic, social, environmental and cultural importance of fisheries and the interests of all those concerned with the fishery.

1. a) In general, how well informed are you of the Responsible Fishing program?

Very Much Informed	Informed	No Opinion	Not Informed	Very Much Not Informed
☐	☐	☐	☐	☐

b) If yes, how do you view the program in terms of how it might affect the fishers' livelihood

☐ Beneficial ☐ Negative ☐ No Opinion

c) If yes, how did you learn about the Responsible Fishing program?

2. In what capacity do you work with the Responsible Fishing program?

The following are statements about the Responsible Fishing program. Rate your level of agreement with these statements.

In general, how likely do you think the Responsible Fishing program will:	**Strongly agree**	**Agree**	**No opinion**	**Disagree**	**Strongly disagree**
a) Establish principles, in accordance with the relevant rules of international law, for responsible fishing and fisheries activities, taking into account all their relevant biological, technological, economic, social, environmental and commercial aspects	☐	☐	☐	☐	☐
b) Establish principles and criteria for the elaboration and implementation of national policies for responsible conservation of fisheries resources and fisheries management and development	☐	☐	☐	☐	☐
c) Serve as an instrument of reference to help States to establish or to improve the legal and institutional framework required for the exercise of responsible fisheries and in the formulation and implementation of appropriate measures	☐	☐	☐	☐	☐
d) Facilitate cooperation between fishing cooperatives	☐	☐	☐	☐	☐
e) Facilitate and promote technical, financial and other cooperation in conservation of fisheries resources and fisheries management and development	☐	☐	☐	☐	☐
f) Promote the contribution of fisheries to food security and food quality, giving priority to the nutritional needs of local communities	☐	☐	☐	☐	☐
g) Promote protection of living aquatic resources and their environments and coastal areas	☐	☐	☐	☐	☐
h) Promote the trade of fish and fishery products in conformity with relevant international rules and avoid the use of measures that constitute hidden barriers to such trade	☐	☐	☐	☐	☐
i) Promote research on fisheries as well as on associated ecosystems and relevant environmental factors	☐	☐	☐	☐	☐
j) Provide standards of conduct for all persons involved in the fisheries sector	☐	☐	☐	☐	☐
k) Provide guidance which may be used where appropriate in the formulation and implementation of international agreements and other legal instruments, both binding and voluntary	☐	☐	☐	☐	☐

Sección 4 – Comunicación y Educación de Pesca Responsable

1. Are there any educational programs in La Encrucijada that focus on responsible fishing?

☐ Si ☐ No

2. Are there any educational programs in La Encrucijada that focus on the purpose of regulating the fisheries?

☐ Si ☐ No

3. Have you attended any meetings focused on managing these fisheries?

☐Si ☐ No

If *yes*, please answer the following questions:

a) Have you attended these meetings in the past 6 months? ☐ Sí ☐ No

b) Please state your main reason for attending these public meetings?

C) If *no*, please state why:

5. ¿Está de acuerdo con la dirección general de La Encrucijada? ☐ Si ☐ No
Por favor, explique por qué?

5. Please rate your overall satisfaction with the biosphere reserve's regulations:

Very Satisfied	Satisfied	No Opinion	Dissatisfied	Very Dissatisfied
☐	☐	☐	☐	☐

a) Please explain why you feel this way:

Section 5- Communication and Management

1. The following are statements about management initiatives. Rate your level of agreement with these statements:

Would you agree that….	Strongly agree	Agree	No opinion	Disagree	Strongly disagree
a) The local government must plan the regulations within the biosphere reserve.	☐	☐	☐	☐	☐
b) Fisher or fisher cooperatives should manage the biosphere reserve	☐	☐	☐	☐	☐
c) Communication is lacking between the local government and fisher cooperatives regarding management issues	☐	☐	☐	☐	☐
d) The local government considers the opinions of fishers' when making management decisions.	☐	☐	☐	☐	☐
e) If fines were implemented for fishing violations, as an incentive for fishing cooperatives, a portion of that money should be given to fishing cooperatives operations.	☐	☐	☐	☐	☐
f) Fishers should only sell their products locally	☐	☐	☐	☐	☐
g) Fish stocks have increased since the implementation of the biosphere reserve.	☐	☐	☐	☐	☐
h) The amount of fish that is being caught has increased since the establishment of the biosphere reserve	☐	☐	☐	☐	☐
i) The management policies for fisheries in La Encrucijada are unclear in the organization that I represent	☐	☐	☐	☐	☐

2. What do you think are the most important problems in the La Reserva de la Biosfera La Encrucijada? These can be technological, ecological, economical, social, cultural, or institutional policies. Please indicate problems below and what you believe to be the cause of said problem. Do not group various problems into one problem.

Problem:
Cause:
Problem:
Cause:
Problem:
Cause:

3. Sometimes problems come from the lack of communication between the different organizations involved in fisheries management. Please evaluate how each one of the following groups of people have communicated with the organization you represent:

Group	Excellent Communication	Good Communication	No opinion	Poor Communication	Very Poor Communication
a) Pescadores	☐	☐	☐	☐	☐
b) Directiva de las Cooperativas de Pescadores	☐	☐	☐	☐	☐
c) CONANP	☐	☐	☐	☐	☐
d) PROFEPA	☐	☐	☐	☐	☐
e) CONAPESCA	☐	☐	☐	☐	☐
f) La Federación de Pesca	☐	☐	☐	☐	☐
g) SEPESCA	☐	☐	☐	☐	☐

Section 6- Environmental Perceptions

1. Rate your level of agreement with these statements:

In the last 10 years, would you agree that….	Strongly agree	Agree	No opinion	Disagree	Strongly disagree
a) The area of mangroves has reduced	☐	☐	☐	☐	☐
b) In general, water clarity has decreased	☐	☐	☐	☐	☐
c) The lagoon has become shallower	☐	☐	☐	☐	☐
d) Water temperature in the lagoon has increased	☐	☐	☐	☐	☐
e) The rainy season has become more unpredictable	☐	☐	☐	☐	☐
f) The average size of fish caught has decreased	☐	☐	☐	☐	☐
g) The amount of fish I catch has decreased	☐	☐	☐	☐	☐
h) Flathead mullet populations have decreased	☐	☐	☐	☐	☐
i) White mullet populations have decreased	☐	☐	☐	☐	☐
j) Yellowfin snook populations have decreased	☐	☐	☐	☐	☐
k) Blackfin snook populations have decreased	☐	☐	☐	☐	☐
l) Black snook populations have decreased	☐	☐	☐	☐	☐
m) White snook populations have decreased	☐	☐	☐	☐	☐
n) Yellow snapper populations have decreased	☐	☐	☐	☐	☐
o) Colorado snapper have decreased	☐	☐	☐	☐	☐
p) White Shrimp populations have decreased	☐	☐	☐	☐	☐
q) The type of fish the cooperative is catching has changed	☐	☐	☐	☐	☐

r) Fishers currently spend more time fishing for the same amount of fish than they did in the past ☐ ☐ ☐ ☐ ☐

2. Should certain types of fishing techniques be regulated by CONAPESCA? ☐ Sí ☐ No
a) If yes, than what types?:

3. Some fishing areas should be closed periodically by the cooperative for the recovery of fish stocks:
☐ Sí ☐ No

4. Fishing bans and catch volume limits should be based on results of scientific research or fishery capture records.

Very Much Agree	Agree	No Opinion	Disagree	Very Much Disagree
☐	☐	☐	☐	☐

6. What research/studies are currently being conducted by your organization in La Encrucijada?:

7. What information/research is lacking in La Encrucijada that needs to be collected for successful management?

9. In your opinion, has sufficient information been collected on the fishery and it's harvested species to set management policies e.g. caught quotas and fishing seasons?
☐ Si ☐ No
a) if no, what is lacking?

9. What single policy has been most beneficial to the Biosphere Reserve?:

10. What single policy has been most detrimental to the Biosphere Reserve?:

Thank you for your participation.

Acronyms

ANOVA	One-way Analysis of Variance
C	Celsius
CASFA	San Francisco de Asis Center of Agroecology
CCAD	Central American Commission on Environment and Development
Cm	Centimeter
CNA	Mexico National Water Commission
COC	Code of Conduct
COFI	FAO Committee on Fisheries
CONANP	National Commission of Protected Areas
CONAPESCA	National Commission of Aquaculture and Fishing
CONAGUA	National Water Commision
CSU	Colorado State University
ECOSUR	College of the Southern Border (Chiapas)
Est.	Established
FAO	Food and Agriculture Organization of the United Nations
Ha	Metric unit of area (10,000 square meters)
IHN	Institute of Natural History
INE	National Institute of Ecology
Km	Kilometers
La Federación	Regional Federation of Cooperative Fisheries of the State of Chiapas
M	Meter
Mm	Millimeter
NGO	Non-governmental Organization
PCI_2	Potential for Conflict Index model
PIP	Parks in Peril
Ppm	Parts per million
PROFEPA	Federal Attorney for Environmental Protection
RARE	Rare Animal Relief Effort

REBIEN	La Encrucijada Biosphere Reserve
SAGARPA	Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food
SEMARNAT	Environmental and Natural Resource Secretariat (Mexico)
SENASICA	National Health, Food Safety and Food Quality Service (Mexico)
UNACH	Autonomous University of Chiapas
UNAM	National Autonomous University of Mexico
UNCED	United Nations Conference on Environment and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
USD	United States dollar
WQI	Water Quality Index

Figure 44: Researchers traveling to study sites for interviews