

PERCEPTIONS OF FISHERIES MANAGEMENT, GILL NET USE AND INCOME  
DIVERSIFICATION AMONG SMALL-SCALE FISHERS IN BELIZE

by

Juliana Mayhew

Dr. Xavier Basurto, Adviser

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## EXECUTIVE SUMMARY

Belize is often recognized for its extensive efforts to conserve natural resources. In addition to placing approximately a third of its land area under protection and establishing a system of marine protected areas (MPAs), the country has been the beneficiary of significant conservation support from numerous national and international conservation NGOs. Despite these efforts, a decline in reef health and simultaneous concern regarding the overexploitation of fisheries has motivated fisheries management efforts to reduce fishing pressure on reefs. Aside from shifting to a Managed Access management system and efforts to expand no-take areas within MPAs, resource managers are interested in decreasing the use of environmentally destructive gear, such as gill nets, and diversifying the incomes of small-scale fishers.

Because of these efforts, it is important to understand small-scale fishers' perceptions of the state of the fisheries and management system, gill net use and income diversification. To help address this, I conducted a pilot survey with small-scale fishers in Belize in June and July of 2015. This report provides an overview of the survey results, potential implications of the findings, and things to consider for future studies and management decisions.

The first section of this report provides an overview of Belize. This section includes background information on geography, demographics and the economy as well as conservation policies, fisheries and fisheries management.

The second section of this report provides a brief overview of the five study sites where surveys were conducted for this pilot project. It also describes the methods used to collect data and the limitations of the study.

The third section includes the results of this study. Results are organized and presented in two categories: (1) descriptive statistics; and, (2) qualitative results and discussion. This section highlights the main findings and explores how this study relates to existing research and theory.

Ultimately, this study found that there is widespread concern among fishers regarding illegal fishing activity, especially by foreigners, at night and during closed seasons. There were also

many requests for increased stakeholder engagement and participation in decision-making at the community level. The survey data showed varying support for restrictions or bans on gill net use in Belize, with most of the interest in a ban coming from one community. There was widespread interest in income diversification among small-scale fishers, especially in opportunities related to marine tourism, aquaculture, mariculture and seaweed farming. In addition, a lack of trust between fishers and resource managers may be undermining management and conservation efforts.

In Belize, the foundation for improved relationships and co-management arrangements between fishers and institutions responsible for resource management already exists in the way of legislative support, appeals for participatory processes from the local level, a positive view of fishers' associations and their benefits, interest in diversifying incomes, and the involvement of conservation NGOs willing to work alongside fishers to sustainably manage resources. While protected areas are a key component to managing marine resources in Belize, increasing community involvement in decision-making processes and addressing issues of distrust between fishers and managers may strengthen long-term resource management efforts.

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## Introduction

With a rapidly growing world population and subsequent dependence on fisheries, sustainable fisheries management is becoming increasingly important. A reported global capture fishery production of 93.8 million tonnes in 1996 was the highest ever recorded, followed closely by 93.7 million tonnes in 2011 (“The State of World Fisheries and Aquaculture” 2014, 9). Belize, the least populated and one of the smallest countries in Central America, has historically faced less pressure on its natural resources than neighboring, more heavily populated countries such as Guatemala and Honduras (“Belize National Biodiversity Strategy” 1998, v). It has also received international recognition for its forward-thinking conservation initiatives, including placing a third of its land area under protection and establishing over a dozen marine protected areas (MPAs) (Meerman and Wilson 2005b, 18). Belize has also entered into several co-management arrangements that grant authority to enforce fishing regulations to NGOs in designated MPAs (Dahlgren 2014, 15). The country has benefited immensely from the economic, ecological, and cultural value of its marine resources and their ecosystem services, which include the largest barrier reef in the northern hemisphere, several offshore atolls, hundreds of cayes, as well as mangrove forests, coastal lagoons and estuaries (“Belize Barrier Reef Reserve System,” n.d.).

The Mesoamerican Barrier Reef, the second longest barrier reef in the world, runs from the southern Yucatan in Mexico to southern Belize, providing employment in the fishing and tourism industries to more than a million people in coastal cities (“Global Environment Facility” 2001). Between 2,500-3,000 fishers in Belize depend directly on small-scale fisheries for their livelihoods (Clarke, Canto, and Rosado 2013, 40) and the fishing industry is one of the largest contributors to the country’s GDP (“SIB Annual Report 2015” 2015, 15). A national and international push for conservation, over-exploited fisheries, declining reef health and increasing value of ecotourism has led to a shift in marine resource management over the past few decades. For example, in addition to the creation of MPAs, fisheries management is moving away from its traditional government licensing system, with little to no reporting on catch and landings, to a Managed Access program using Territorial Use Rights (TURFs) for areas within the MPAs.

According to a 2014 report commissioned by the Wildlife Conservation Society, Belize is currently in the process of expanding its national network of no-take zones from approximately 3% to 10% of its marine territory. The expansion of conservation efforts should be met with an immediate effort to understand socioeconomic aspects of these changes and their impacts on

coastal communities. In addition, gill nets are becoming increasingly contentious in Belize due to the gear's negative environmental impact and the country's emphasis on sustainable fishing practices. Resource managers would therefore benefit from an increased understanding of the cultural and economic importance of Belize's gill net fishery.

In an attempt to address some of these knowledge gaps, I conducted a pilot survey among small-scale fishers from five communities in Belize in June and July 2015 to understand perceptions about the fisheries and management system, gill net use, and income diversification. This study helps inform fisheries management by highlighting the voices of small-scale fishers with valuable local knowledge and a vested interest in the future of the resources they depend on.

## Overview of Belize:

### Background and Context

#### Geography and demographics:

Belize is located on the east coast of Central America with Mexico as its neighbor to the north and Guatemala to the west and south. It is the smallest country in Central America, with an approximate area of 8,867 square miles and estimated population of 370,300 as of September 2015 ("Statistical Institute of Belize," n.d.). The country is divided into six districts with more than 240 villages, including Corozal, Orange Walk, Belize, Cayo, Stann Creek and Toledo ("Belize National Biodiversity Strategy" 1998, v). Belize is also home to many ethnicities despite its small size, including Mestizo (48.7 percent), Creole (24.9 percent), Maya (10.6 percent), and Garinagu (6.1 percent), Mennonite (3.6 percent), East Indian (3.0 percent), Chinese (0.7 percent), and others (2.4 percent), including an increasing number of expatriates ("About Belize" 2016).

#### Economy:

According to the Statistical Institute of Belize, fishing is one of the country's most valuable primary industries, second only to agriculture and forestry, with both contributing an estimated BZE 128.9 million and BZE 249.4 million to the GDP in 2014, respectively ("SIB Annual Report 2015" 2015, 15). The major domestic exports in 2014 were: marine products (16 million pounds/BZE \$113.3 million); sugar (105.4 thousand long ton/BZE \$110.2 million); crude petroleum (24.7 million gallons/BZE \$102.3 million); bananas (225.1 million tonnes/BZE \$100.4 million); and, orange concentrate (3.9 million gallons/BZE \$82.6 million) ("SIB Annual

Report 2015” 2015, 18). According to the Belize Tourism Board, tourism contributes between 18 to 25 percent of the total GDP and accounts for approximately 28 percent of employment as of 2012 (“Tourism Statistics” 2013).

The poverty rate in Belize increased from 33 percent in 1995 to 41.3 percent in 2009 (UNDP 2010, 16) and a UN report indicates the average number of “working poor” increased from 34,739 in 1995 to 69,468 in 2007 (UNDP 2010, 36).

#### Marine resources:

The Mesoamerican Barrier Reef, stretching nearly 700 miles, is the second largest barrier reef system in the world and the source of great economic, ecological, and cultural importance to Belize (“Belize National Biodiversity Strategy” 1998, 3). Belize is also home to three of the only four offshore atolls in the western hemisphere and has more than 450 cayes totaling approximately 690 square km (266 square miles) (“About Belize” 2016). A study on the value of ecosystem services in Belize found that coral reefs and mangroves contribute USD 14-16 million annually to fisheries, USD 150-196 million to tourism, and contributed USD 231-347 million in terms of damage avoided by ecosystem services such as shoreline protection (Dahlgren 2014, 57). Unfortunately, the future health of these resources is uncertain. A recent study of the Mesoamerican Reef found that only 5 percent of reefs within Belize waters were in good condition and 73 percent were in poor to critical condition (Kramer et al. 2015).

#### Conservation Policies

As described by Dahlgren and Tewfik (2014), “in the wider Caribbean region, Belize has been a leader in the implementation of MPAs” (p. 264). Nearly one third of Belize’s land area is under protection and a series of MPAs have been established (Meerman and Wilson 2005b) since conservation became a priority for the country in the 1980’s. In January 2006, Belize established the National Protected Areas Policy and System Plan (NPAPSP) guided by the following statement:

“The Government of Belize shall promote the sustainable use of Belize’s protected areas by educating and encouraging resource users and the general public to properly conserve the biological diversity contained in these areas in order to maintain and enhance the quality of life for all. This shall be achieved by facilitating the participation of local communities and other stakeholders in decision-making and the equitable distribution of

benefits derived from them, through adequate institutional and human capacity building and collaborative research and development” (Meerman and Wilson 2005a, 5).

An internationally recognized conservation achievement was the naming of the Belize Barrier Reef Reserve System (BBRRS), which incorporates seven MPAs and encompasses 12 percent of the entire reef complex, to the list of UNESCO World Heritage Sites in 1996 (“Belize Barrier Reef Reserve System,” n.d.). In December 2010, Belize also banned the use of trawlers in its waters (*The San Pedro Sun* 2013) and a current objective to expand the designated “no-take” areas within MPAs from 3 percent to 10 percent of Belize’s territorial sea is underway (Dahlgren 2014, 80).

Belize MPAs fall under various categories and managing agencies and include different zones for multiple uses (Table 1). As described in a 2014 report:

“MPAs in Belize may be designated as Marine Reserves under the responsibility of the Fisheries Department, or National Parks, Sanctuaries, or Monuments under the responsibility of the Forest Department. In addition, there are Marine and Forest Reserves under the authority of both the Fisheries and Forest Departments. Within each of these areas, various uses are restricted, often within zones allowing different types of use. Zones may vary from one MPA to the next but typically include General Use Zones, limited-use zones (e.g. Conservation Zones) and no-take zones (e.g., some Conservation Zones and Preservation Zones)” (Dahlgren 2014, 14).

Some protected areas benefit from co-management agreements between the Belize Fisheries Department and various NGOs (Clarke, Canto, and Rosado 2013, 56). According to the Coastal Zone Management Authority and Institute, the arrangement is beneficial because NGOs have the ability to: “conduct hands-on management of protected areas, ensuring the sustainability of these areas that are of environmental, social, economic, and cultural importance to all Belizeans” and “tap into resource pools not accessible by the government agencies (Clarke, Canto, and Rosado 2013, 56).

Additional national policies for the protection of marine resources include: the Fisheries Act of 1948 (revised 1983), permitting multiple-use zoning to manage extractive use, no take areas,

and preservations; the Environmental Protection Act (1992) developed to ensure development initiatives within Belize are planned for minimum environmental impact; the Forest and Mangrove Regulations, protecting mangroves via restrictions on alteration and clearance; the Wildlife Protection Act, providing protection for marine species and regulations for hunting and commercial extraction; and the Protected Areas Conservation Trust (PACT) which taxes a conservation fee on non-residents when they leave the country and directs that money back into conservation efforts (Walker 2010, 13).

Table 1. Marine protected areas of Belize (Dahlgren 2014)

Protected Area Name	Management/ Co-management Authority	IUCN Category	Marine area (Km <sup>2</sup> )	No-take area (Km <sup>2</sup> )
Bacalar Chico National Park and Marine Reserve	Fisheries Dept.	IV	52.8	9.2
Blue Hole Natural Monument	Forest Dept. / BAS	III	4.1	4.1
Caye Caulker Marine Reserve	Fisheries Dept. / FAMRACC	VI	38.9	14
Caye Glory Spawning Aggregation	Fisheries Dept.	IV	5.5	5.5
Corozal Bay	Forest Dept.	IV	703.7	0
Gladden Spit & Silk Cayes Marine Reserve	Fisheries Department/SEA	IV	110.4	1.5
Glovers Reef Marine Reserve	Fisheries Department	IV	350.7	73.4
Half Moon Caye Natural Monument	Forest Dept./BAS	II	39.2	39.2
Hol Chan Marine Reserve	Fisheries Dept.	II	54.4	4.2
Laughing Bird Caye National Park	Forest Department	II	41	41
Nicholas Caye Spawning Aggregation	Fisheries Dept.	IV	6.7	6.7
Northern Glover's Spawning Aggregation	Fisheries Dept.	IV	6.2	6.2
Port Honduras Marine Reserve	Fisheries Dept./TIDE	IV	395	13.2
Rise and Fall Bank Spawning Aggregation	Fisheries Dept.	IV	17.2	17.2
Rocky Point Spawning Aggregation	Fisheries Dept.	IV	5.7	5.7
Sandbore Spawning Aggregation	Fisheries Dept.	IV	4.5	4.5
Sapodilla Cayes Marine Reserve	Fisheries Dept./SEA	IV	156.2	4.9
Seal Caye Spawning Aggregation	Fisheries Dept.	IV	6.5	6.5
South Pt. Lighthouse Spawning Aggregation	Fisheries Dept.	IV	5.3	5.3
South Water Caye Marine Reserve	Fisheries Dept.	IV	476.7	89.9
Swallow Caye Wildlife Sanctuary	Forest Dept./FOSC	IV	33.5	36.3
Tumefte Atoll	Fisheries Dept.	IV	1176.2	152.15
<b>Totals</b>			<b>3690.4</b>	<b>540.7</b>

## Belize Fisheries and Aquaculture

### Capture Fisheries

In 2010, the overall value of the reef and mangroves in Belize was estimated to be between US \$395 million and \$559 million a year with fisheries having an estimated direct contribution of \$14 million to \$16 million per year (Walker 2010, 20–21). More than 40 percent of the Belizean population lives and works in the coastal zone (Clarke, Canto, and Rosado 2013, 5) and approximately 2,500-3,000 registered fishers in Belize depend on extractive marine resources for

their livelihoods at the subsistence and commercial levels (Clarke, Canto, and Rosado 2013, 40). In 2011, the Belize Capture Fisheries Unit reported that spiny lobster exports generated \$13,325,300 in revenue, queen conch generated \$7,986,550, and fin fish generated \$265,878, totaling over 1,327,700 pounds of product worth \$21,577,729 (Clarke, Canto, and Rosado 2013, 40). According to recent quantitative data on fish populations, a major decline in populations of larger, commercially important reef fish (Walker 2010, 9) combined with an increasing number of fishers threatens the resource with overexploitation (Castañeda et al. 2011, 280).

### Aquaculture

Aquaculture operations in Belize for Pacific white shrimp (*Litopenaeus vanammei*), grey tilapia (*Oreochromis niloticus*), and cobia (*Rachycentron canadum*) have had mixed success due to fluctuating markets, disease, and hurricane damage. In 2010, farmed fish and shrimp exports from Belize generated \$1.3 million and \$38.4 million, respectively (Clarke, Canto, and Rosado 2013, 41). The damages caused by Hurricane Richard in 2010 caused a drastic decline in fish farming operations causing producers to scale back to small tilapia farms and cobia hatcheries near Dangriga (Clarke, Canto, and Rosado 2013, 41). As of 2013, Belizeans had begun experimenting with Florida pompano (*Trachinotus carolinus*) hatcheries, seaweed farming (*Euchuma isoforme* and *Gracelaria* spp.), and red drum (*Sciaenops ocellatus*), with additional interest in sea cucumber, snook, oyster and octopus (Clarke, Canto, and Rosado 2013, 41).

### Fisheries Management: Shifting to Managed Access

Belize has historically operated under an open access fishing licensing system with the government acting “as trustee for the public by managing fisheries in the interest of protecting the rights for future generations”(Castañeda et al. 2011, 279–80). The Belize Fisheries Department reported more than a 20 percent increase in the number of fishermen in Belize for 2000 to 2010 (Castañeda et al. 2011, 280), a trend that could be problematic under a management system that does not restrict the number of fishers or the amount of fish each individual is allowed to extract (“Managed Access: Moving Towards Collaborative Fisheries Sustainability in Belize” 2015, 2).

Challenges of fisheries management in Belize include: licensing issues (i.e. fishing licenses in the hands of “illegitimate” fishers and non-Belizeans); illegal, unreported, and unregulated (IUU) fishing; poaching by Guatemalan and Honduran fishers; pressure from international fleets,

and; an increase in Belizeans moving to the coast in search of economic opportunities (Castañeda et al. 2011, 280).

As described by Castañeda et al. (2011), “fisheries resources in Belize are increasingly faced with the predicament of too many people chasing too few fish” (p 280). To address this, the Belize Fisheries Department, Toledo Institute for Development and Environment (TIDE), Wildlife Conservation Society (WCS), and the Environmental Defense Fund (EDF) implemented a “Managed Access” pilot project in Glover’s Reef Marine Reserve and the Port Honduras Marine Reserve in 2011 to assess the feasibility of a rights-based fisheries management approach in Belize (Castañeda et al. 2011, 280). Under this system, fishers apply for a license to access the General Use Zones in marine reserves through their community’s Managed Access Committee (MAC) which then makes recommendations to the Fisheries Department. MACs are comprised of “select candidates considered to be central figures in the community and able to represent [fishers’] interests” and “provide community leadership, scrutinize license applications, verify transparency in the license granting process, inform their community of program updates, assist in improving data reporting, support the Catch Shares Task Force and advise on reserve management” (“Managed Access: Moving Towards Collaborative Fisheries Sustainability in Belize” 2015, 4). Upon receiving recommendations from MACs, the Fisheries Department either approves or denies the requests for licenses, ultimately controlling the number of legal fishers at each site. Additional conditions of the Managed Access program include required catch data reporting via log books by fishers and random audits at the discretion of managers (“Managed Access: Moving Towards Collaborative Fisheries Sustainability in Belize” 2015, 4).

The Managed Access approach aims to incorporate territorial use rights for fisheries (TURFs), enhanced data collection and enforcement, catch limits for commercially valuable species, and an improved licensing system (Castañeda et al. 2011, 280). The Food and Agriculture Organization (FAO) of the United Nations defines TURFs as “community held rights of use (or tenure) and exclusion over the fishery resources within a specific area and for a period of time” and may include “certain responsibilities for maintenance and proper management of the resource base, as well as restrictions on the exercise of the rights of use and exclusion” (Panayotou 1982).

The Managed Access approach “is designed to empower fishers by... ensuring greater participation in the decision-making process... [and] improving the benefits to be derived from the fish stocks themselves in terms of increased fish landings, larger size classes, and increased prices

and revenues”(Castañeda et al. 2011, 280). However, the adoption of a rights-based system is problematic for several reasons. For example, the Managed Access program only issues licenses to “traditional fishermen” (“Managed Access: Moving Towards Collaborative Fisheries Sustainability in Belize” 2015, 5) without a clear definition of what it means to be a “traditional” fisher. Applicants are also required to provide a utility bill as proof of residency in order to be issued a fishing license. This measure not only restricts Belizeans without electricity (“Managed Access: Moving Towards Collaborative Fisheries Sustainability in Belize” 2015, 5) but illegitimate fishers from Guatemala and Honduras can obtain a Belize fishing license by paying a Belizean for a utility bill and claiming residency. Additionally, one of the purposes of Managed Access is to limit the number of fishers in marine reserves; therefore, fishers would only be able to pass their Managed Access rights down to one child for the system to remain effective, a condition many Belizeans find problematic (“Managed Access: Moving Towards Collaborative Fisheries Sustainability in Belize” 2015, 5). Other concerns have developed over the amount of effort required to report catch data, varied terminology for marine species, and the ability of managers to actually enforce marine reserve regulations fairly and effectively (“Managed Access: Moving Towards Collaborative Fisheries Sustainability in Belize” 2015, 5).

According to Castañeda et al. (2011), Managed Access encourages capacity building for community fishers associations and strengthens licensing protocols through the creation of MACs, an upgraded licensing database that incorporates more “checks and balances” and information on all fishing vessels, and licenses printed on tamper proof PVC material (p 281).

## Study Sites

In this pilot study, Surveys were conducted in five fishing communities in Belize: Dangriga; Hopkins; Riversdale; Placencia; and Independence and Mango Creek. All five communities are located in the Stann Creek District on the coast and were chosen per request of the Fisheries Department due to their involvement in the fishing industry and geographic location perpendicular to the South Water Caye Marine Reserve (Figure 1).



**Figure 1.** Map of Belize and the five communities in the study.

**Dangriga Town**

Dangriga, often called “the culture capital of Belize” is the capital of the Stann Creek district and located on the central coast of Belize (“Stann Creek” 2015). It is the second largest town in this study, with a population estimated to be 10,108 (Statistical Institute of Belize, n.d.) and approximately 73-149 fishers. The majority of residents are Garinagu, an ethnicity born as a result of the intermarrying of West Africans and Carib Indians in the 17th and 18th Centuries (“The Garifuna” 2016); however, it is also home to many Creole and Mestizo people. Though once a vibrant hub for both Belizeans and visitors, I was informed by several residents that unemployment, increasing crime, and marginalization of the Garinagu people have started to wear away at its reputation. With the exception of a fishing lodge, water transportation to the cayes and atolls, and annual cultural celebrations that attract travelers, tourism within the town is minimal.

### Hopkins Village

Hopkins Village, just a short 20-mile drive south of Dangriga, is a much smaller Garifuna community with approximately 1,500 residents. According to the Belize Fisheries Department, the number of fishers in Hopkins is between 73 and 149. Traditionally a fishing village, Hopkins is now emerging as a tourist destination due to its rich culture and simultaneous access to South Water Caye Marine Reserve, the Mayflower Bocawina National Park, and the Cockscomb Basin Wildlife Sanctuary and Jaguar Preserve. Within the village, backpacker-tourism has become a mainstay, while upscale resorts and private homeowners continue to claim property north and south. There is also an increasing number of expatriates settling in, or just outside of, Hopkins village.

### Riversdale

Riversdale, the smallest of the five communities in the study, is located south of Hopkins at the North end of the Placencia Peninsula. Due to its small size, economic opportunities within the community are virtually nonexistent and most residents either fish or take a bus into a nearby town or village. The Belize Fisheries Department estimates the number of resident fishers living in Riversdale to be 11 to 29.

### Placencia Village

Placencia village is predominately a Creole community located at the end of a peninsula jutting between the Placencia lagoon to the west and Caribbean Sea to the east. The Peninsula is in an ideal location for an economy based on marine resources and Placencia has historically been a fishing village with the Fisheries Department estimating 73 to 149 resident fishers. However, a relatively recent and rapid influx of tourism has drastically altered the social, cultural, and economic landscape of the community. Placencia transitioned from a fishing village to the third most important tourist destination in Belize in less than a decade (Theriault 2007, 3), after a push at the national level to diversify income and increase foreign investment (Key 2002, 4). In recent years, the Placencia Fishing Cooperative has been in decline due to the overexploitation of fishing grounds, dependence on external markets, and the “lack of a diversified economy of goods produced alongside the governmental priority for tourism as a form of development” (Key 2002, 2). Many villagers saw the tourism industry as a more reliable and prosperous way to make a living due to the uncertain nature of fishing (Key 2002, 12) and as a result, many commercial fishers are

now guides, captains, dive masters, or businessmen, while women commonly work in shops, hotels and restaurants (Gray 2008, 69).

### Independence and Mango Creek

Independence and Mango Creek is located directly across the lagoon from Placencia, with many residents commuting back and forth via a ten-minute trip on the Hokey Pokey Water Taxi. The area has approximately 4,014 residents (Statistical Institute of Belize, n.d.) and an estimated 73-149 local fishers. Independence and Mango Creek fishers are also working to bolster the local fishers' association in the hopes of gaining more government recognition and support.

### Methods

Semi-structured interviews with both open and closed-ended questions were conducted in five communities from June 2015 to August 2015. Participants were all small-scale commercial fishers in Belize over the age of 18, enlisted via a combination of contacts provided by the Wildlife Conservation Society and Belize Fisheries Department, as well as snowball sampling and referrals once in the field. Surveys took place at docks, marinas, fish cleaning stations, private homes, fishers' association meetings, and markets, typically early in the morning or at the end of the day while they cleaned their catch. Due to varying levels of literacy among the fishers in each community, I used paper surveys to ask participants questions and record their responses. Individual survey time varied based on whether or not the participant was a net user (due to additional questions about gill net use) but typically lasted between 20 to 30 minutes. Surveys were stored and locked per approved IRB protocol.

Fishers from Dangriga and Hopkins were surveyed in June and fishers from Riversdale, Placencia, and Independence and Mango Creek were surveyed in July 2015. In addition, four fishers from Sarteneja were surveyed while their fishing boat was docked in Placencia. Sarteneja is one of the country's largest fishing communities and although respondents were not residents of the five communities in this study, their perceptions on fisheries issues are relevant to the study.

Due to the opening of the spiny lobster fishing season in June, fishers in Hopkins spent most of the month offshore on cayes and were generally inaccessible for surveys. In total, 60 surveys were obtained from Dangriga (n=17), Hopkins (n=5), Riversdale (n=6), Placencia (n=21), Independence and Mango Creek (n=7), and Sarteneja (n=4). Of the 60 survey participants, 11

identified themselves as gill net users.

## Limitations

There were many limitations to this pilot project, including: the absence of a focus group and pretest to assess the survey instrument; a non-random sampling method; the potential for biased responses due to the affiliation with the Belize Fisheries Department and Wildlife Conservation Society; pre-existing distrust for NGOs; difficulty getting in touch with key informants; a language barrier for Spanish speaking gill net users; difficulty locating fishers during the beginning of the lobster season; and, the limited time period (8 weeks) within which to conduct the surveys.

Due to time restrictions and the lack of office resources in remote communities I was unable to conduct a focus group in Belize City and pre-test the survey in each community before implementation. Errors in question wording and response categories affected the quality of data collected, to a certain degree, and pose a challenge for data analysis in some cases. As this was a pilot project, revisions and recommendations will be made for future survey instruments.

Also due to time and resource constraints, as well as the understanding that it was a pilot project, survey participants were not randomly selected and therefore not representative of the population. The combination of references from the Fisheries Department, subsequent snowball sampling, and intercept surveys in public spaces may have produced a bias sample of participants and results cannot be applied generally to the communities.

The affiliation with the Wildlife Conservation Society and Belize Fisheries Department may have introduced bias in the participants' answers due to their previous positive or negative personal experiences with the organizations and perceived intentions of the study. Several key informants were either unavailable or could not be reached all together, which increased the amount of time it took to establish connections within communities and locate fishers willing to participate in the survey.

In addition, gill nets have become a contentious issue in Belize, with some NGOs advocating further restrictions and a complete ban. This led to some respondents feeling uneasy about providing gill net information. In addition, some gill net users immigrated to Belize from neighboring Latin American countries and spoke primarily, or solely, Spanish and often kept to themselves. Because gill net users did not gather in public areas in some communities, such as the docks or fish cleaning stations, it was much more difficult to locate and interview them. The

opening of the lobster season posed a challenge because many fishers lived on the cayes for most of June and were therefore inaccessible for surveys. The 8-week data collection period, while still very useful for this pilot project, proved limiting due to the number of interviews feasible during that time, as well as all of the complications mentioned above.

## Results: Descriptive Statistics

### Demographics

All of the fishers surveyed were born in Belize, including: 17 from Dangriga; 5 from Hopkins; 6 from Riversdale; 21 from Placencia; 7 from Independence and Mango Creek; and 4 from Sarteneja. More than half of respondents were between the ages of 45 and 64 and 90 percent have been fishing for at least 10 years (Table 2, 3).

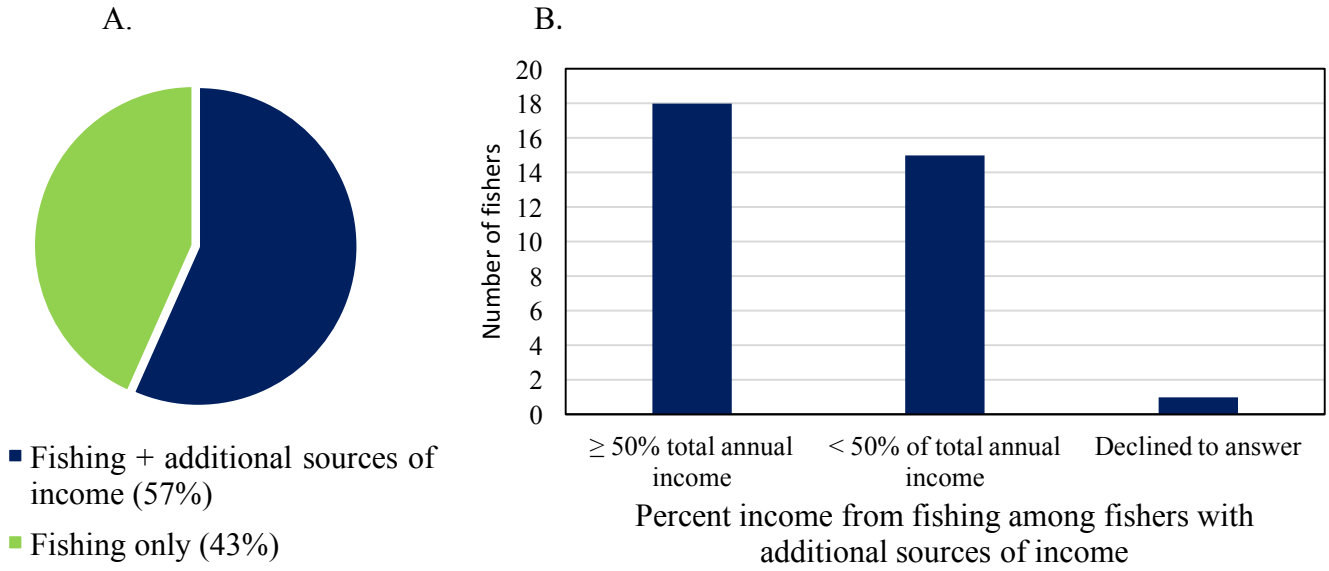
Table 2. Age of respondents (n=60)

Age	Number of Respondents
≤24	9
25-34	10
35-44	18
45-54	13
55-64	6
≥65	4

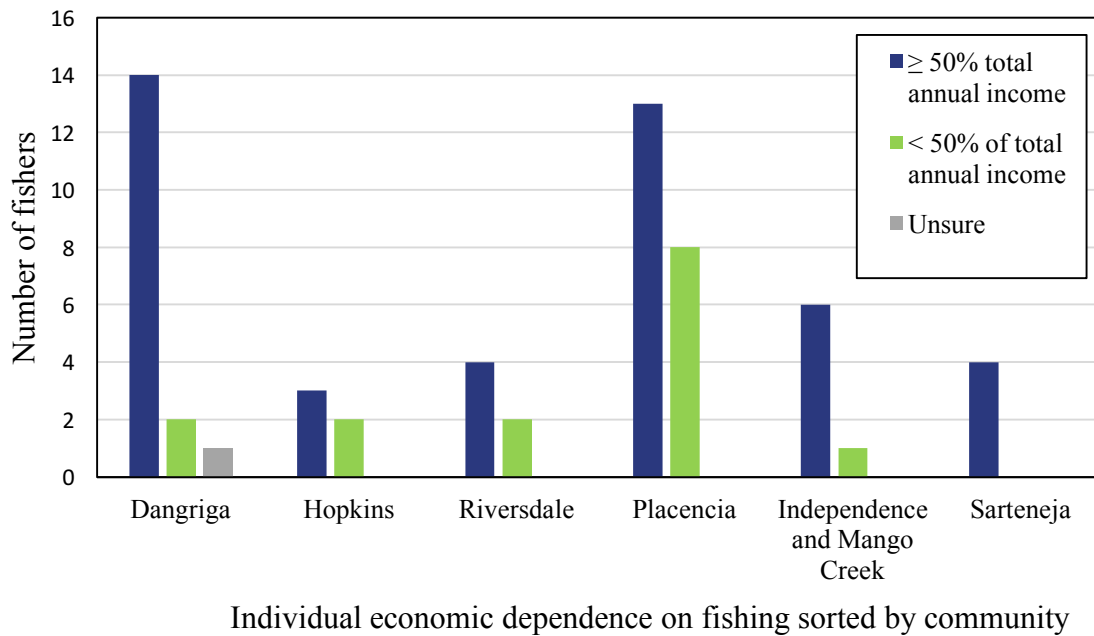
Table 3. Fishing experience of respondents

Years Fishing	Number of Respondents
Under 10	5
10-19	17
20-29	20
30-39	9
40-49	5
50+	3

Just under half of participants said fishing is their only source of income. However, among the 34 fishers with additional sources of income, 18 reported that at least half of their total annual income is from fishing (Figure 2). The distribution by community is provided in Figure 3.



**Figure 2.** **A)** Fishers’ individual dependence on fishing for income generation (n=60). **B)** The percent annual income derived from fishing among those with additional sources of income (n=34).



**Figure 3.** Percent annual income from fishing for each survey respondent, categorized by community.

## Fishing Gear and Target Species

The most common fishing gears used by survey participants were hand-lines, spears, and hook-sticks, followed by lobster traps, lobster sheds, fish traps, gill nets, and rod and reel. The three most targeted finfish by all gear types (excluding gill nets) were snapper, grouper, and barracuda, followed by jack, mackerel and shark (Table 4, Table 5).

Table 4. Most common fishing gear used

Fishing gear	Number of users
handline	48
sling/spear	45
hook-stick	40
lobster trap	15
lobster shed	14
fish trap	12
gill net	11
rod & reel	5

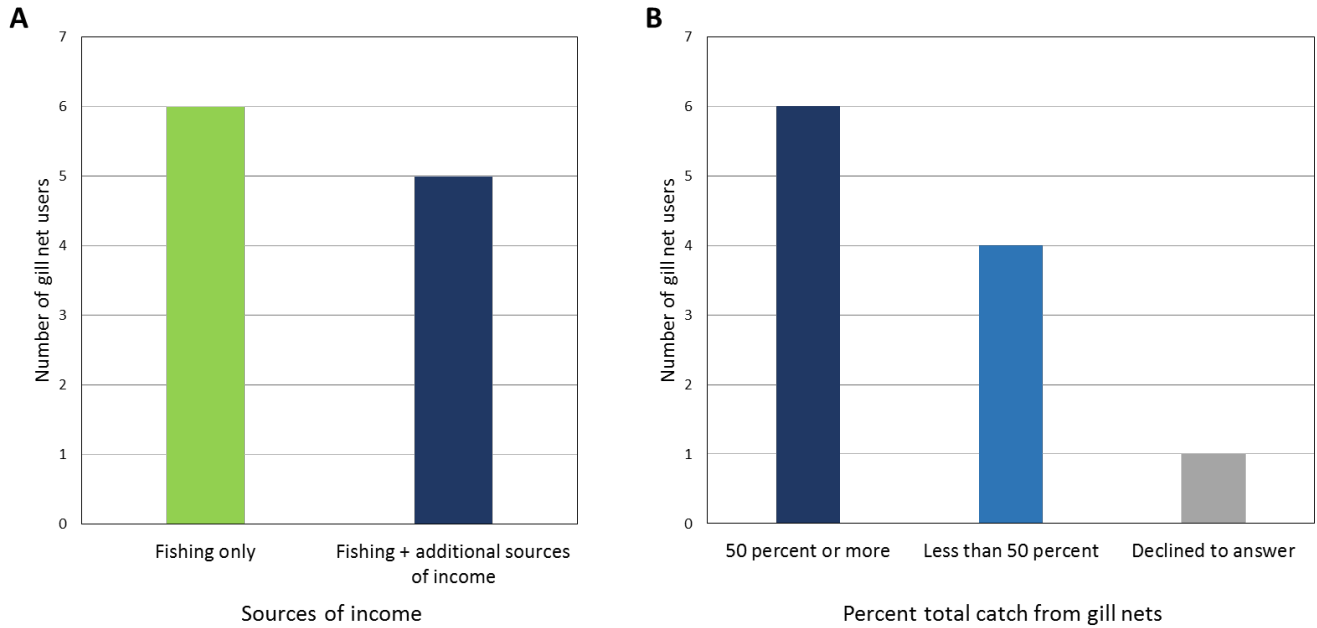
Table 5. Targeted finfish

Species targeted with all gear	Number of fishers
snapper	56
grouper	31
barracuda	22
other	13
jack	9
mackerel	8
shark	3

## Gill Net Use

A total of 11 gill net users were surveyed: 9 from Dangriga; 1 from Independence and Mango Creek; and, 1 from Hopkins. Just over half of the net users reported fishing as their only source of income, three of which stated gill nets provide more than half of their total annual catch. Among net users with additional sources of income, three reported that gill nets still provide over half of their total annual catch (Figure 4).

Respondents claimed to sell their gill net catches to local markets (n=5), other members of the community (n=3), and/or resorts (n=3). As for dependence on gill nets, more than half of gill net fishers interviewed said they use them 10 to 12 months out of the year, and the top three species targeted are snook, snapper and mackerel, followed by cobia, jack, shark and drum (Figure 10).



**Figure 4.** A) Dependence of fishing as sole source of income. B) The percent total annual catch produced by gill nets.

Table 6: Finfish most commonly targeted by gill nets

Species targeted with gill nets	Number of fishers
snook	7
snapper	7
mackerel	6
cobia	5
jack	3
shark	2
drum	1

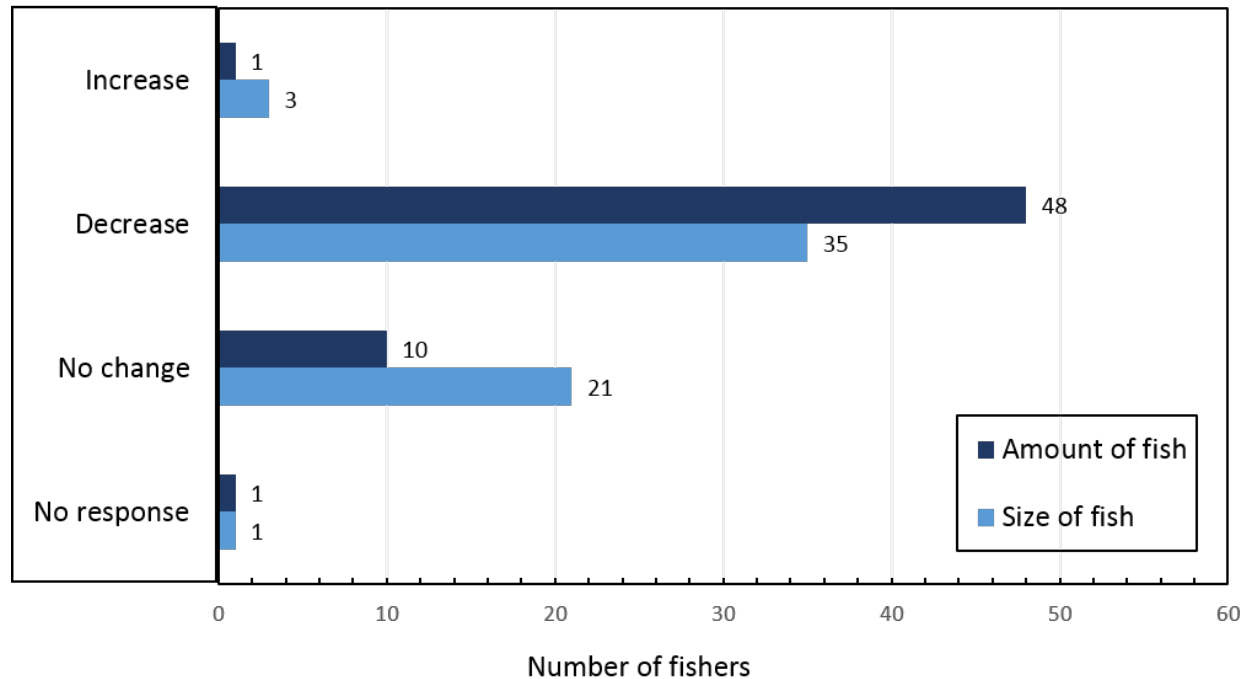
## Qualitative Results and Discussion

### Perception of Fisheries and Management

#### Changes in the fishery

More than half (59 percent) of fishers in this study reported a decrease in the size of fish they are catching and just over 80 percent reported a decrease in the amount of fish they are catching (Figure 5). These results are similar to those in a 2000 study conducted by the Toledo

Institute for Development and Environment (TIDE) and the Tri-national Alliance for the Conservation of the Gulf of Honduras, which found fishers in southern Belize broadly agreed that “fish have decreased in size and abundance” (Heyman and Graham 2000, 34).



**Figure 5.** The number of respondents that reported a change in the amount and size of fish in their catches since they first started fishing.

#### Perceptions of marine protected areas (MPAs)

As for perceived effects of MPAs, most fishers stated that the South Water Caye Marine Reserve (SWCMR) did not affect them at all (n=44). Among the minority affected, there were very divided opinions. Seven fishers felt the MPA increased their catch, eight felt it decreased their catch, and one was unsure of the impact the MPA had on his catch. One Placencia fisher articulated his perceived benefits the following way “[the] benefits [of the MPAs] right now are limited, but Managed Access will improve situations.”

Those who thought the SWCMR decreased their catch most commonly claimed it was due to the loss of fishing grounds. For example, one fisher from Dangriga said:

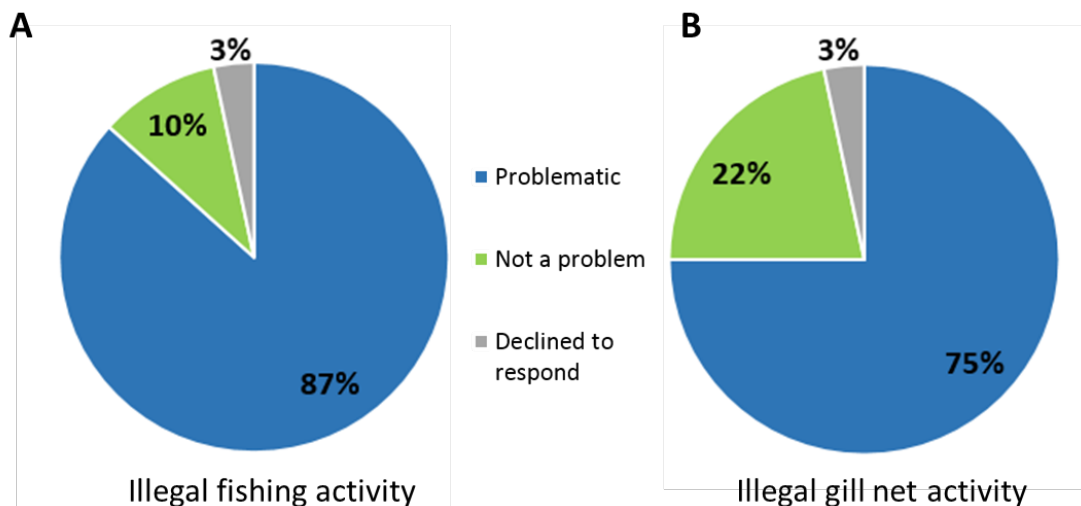
*“The South Water Marine Reserve has occupied all the rich fishing grounds, leaving us to struggle for a living in less productive grounds... the Fisheries Department is talking about more reserves and more managed access area which will limit our catch and production.”*

Among fishers who felt the marine reserve benefited them, several claimed it increased their catch due to the “spillover effect” of the no-take zones. A couple participants also mentioned that MPAs further incentivize fishers to work in the tourism industry. Examples of this include one fisher who said “reserves and preserves make it more beneficial to get involved in tourism – they phase out fishermen” (Dangriga fisher) and another claiming that despite the SWCMR decreasing his catch, it increased his income as a tour guide (Placencia fisher).

The above results echo a 2008 report titled *Vulnerability and Perceptions in the Coastal Communities of Belize*, which states “the perception of the fishermen [in Placencia] is that the protected areas are only for the benefit of the tourism industry... For this reason many of them consider that their condition of life... [has] been affected negatively” (Brune and Sanders 2008, 25). However, as mentioned by survey participants, MPAs also create employment opportunities in the tourism industry and increase catch due to the spill-over effect.

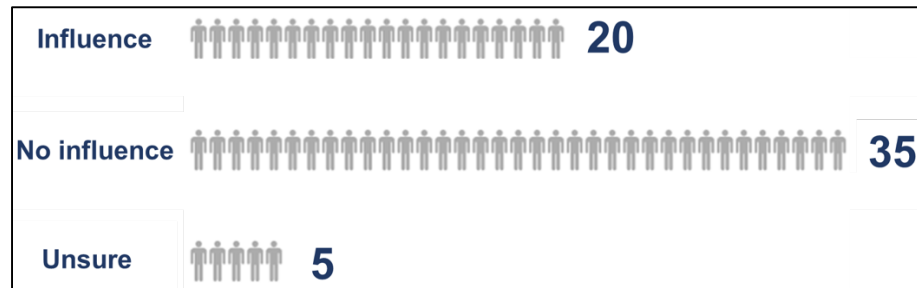
#### Perceptions of Management

Concern over the capacity for authorities to effectively monitor and enforce fishing grounds repeatedly surfaced during interviews with fishers in this study. For example, 87 percent (n=52) believe illegal fishing is a problem in their fishing areas (Figure 6).

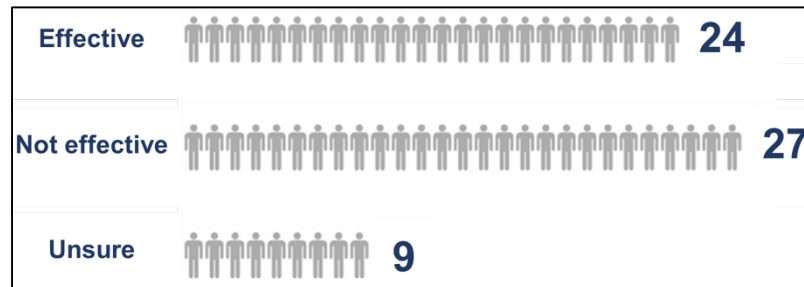


**Figure 6.** Percent of fishers that believe illegal fishing (A) and illegal gill net activity (B) are problematic in their fishing areas.

Approximately half of the survey respondents felt they had an influence on the fishing laws and regulations (Figure 7) and just over half perceived the existing regulations to be effective (Figure 8).



**Figure 7.** Perceived individual influence on the creation of fishing regulations.



**Figure 8.** Perception of the effectiveness of the existing fishing regulations.

In addition, 70 percent of fishers expressed concern over the absence of enforcement, especially during closed seasons and at night. To explain why they perceived the current regulations to be ineffective, several fishers lamented:

*“No, [they are not effective]. They could be if enforced on poachers and illegal fishing. The laws are enforced harder on local people than on foreigners. There is no patrolling during the closed seasons – only once the season is open. If they could keep people out until opening day, the local fishers wouldn’t be forced to start early. If [local] fishers wait until opening day [we] lose out because people have already taken most of the resource. A lot of Hondurans with Belize licenses take product back to Honduras.”* – Placencia fisher

*“Need more enforcement and protection from Guatemalan and Honduran fishers. We respect size limits but many Guatemalan and Honduran fishers take everything. The lobster population could be in big trouble in only ten years.”* – Riversdale fisher

*“Need more punishment for breaking laws, more patrols, and smarter patrols. The (Fisheries Department) [should] listen to the stories the fishers tell about the problems with illegal fishing. Officers say they ‘don’t have the time’, [but] they need to take initiative and take their jobs seriously.”* – Hopkins fisher

Another concern raised by survey respondents was the growing number of fishers in Belize waters, many of whom are non-Belizeans that have obtained a fishing license illegally and take products extracted from Belize waters back to other countries. Comments were focused on the ease within which one can obtain a fishing license in Belize and the lack of respect “outsiders” have for the resource:

*“[We] need a better system for handing out fishing licenses. Right now, people from other countries will pay for a utility bill from a Belizean and use it to get a license. [Officers] should focus on outsiders more than Belizeans.”* – Independence fisher

*“There are more fishers from other places in Belize who don’t respect the sea. They take undersize lobster, conch, and grazers (parrot and angel fish). They are going to degrade the fisheries. The Fisheries Department should require a course before giving permits, especially if they are coming from inland.”* – Placencia fisher

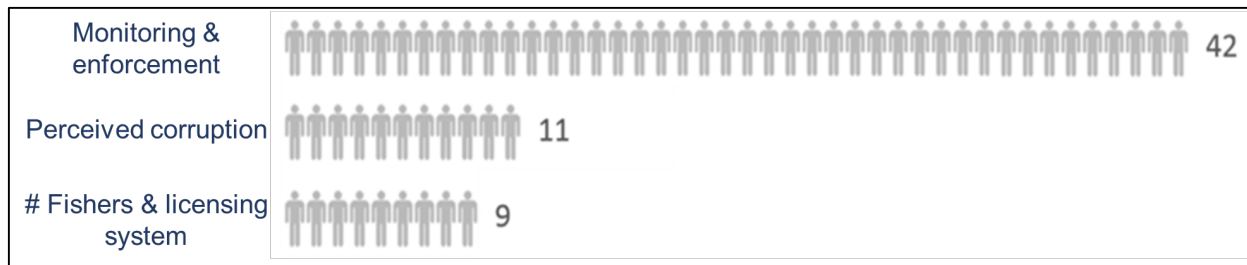
*“They need to stop giving licenses because there are too many fishers for the areas and now they are overfished.”* – Placencia fisher

Additional concerns over perceived “corruption” among officers and managers responsible for enforcing the regulations were voiced by 11 fishers. Combined with the lack of confidence in the regulations and enforcement capacity, these results indicate distrust between two principal stakeholders (Figure 9). In this study, respondents typically described corruption as the abuse of power, usually through accepting bribes or favoring certain individuals or groups of people. In their own words:

*“The people in charge of enforcing the regulations do not know what they are doing, there is a lack of knowledge and communication skills. Fisher folk keep ignorant of regulations on purpose – [we] need to exchange information. Officers bully fisher folk and take advantage of [their] power which creates problems. The current regulations are not enforced [and they] should increase punishment for illegal fishing – there is no incentive to respect laws”* – Hopkins fisher

*“The Fisheries officers hustle and benefit off the reserves instead of protecting them. They give special preference to certain people.”* – Dangriga fisher

*“There are a lot of corrupt fisheries officers. Officers take bribes in parks and have favorites... it all depends on money. There is not enough money and resources [to enforce] and the ones they have are not used effectively. Officers sell and trade gas.”* – Dangriga fisher



**Figure 9.** The most common management problems identified by fishers.

Many of the concerns of the fishers interviewed in this study were similar to those reported in the 2000 TIDE study, which stated “fishermen complain about the lack of involvement and participation in fisheries management and planning. They request better access to information”(Heyman and Graham 2000, 38). In response to this finding, the study included the following five recommendations:

1. Increase the flow of information to fishermen about marine biology, existing laws, and their rationale, such that fishermen will become more involved in developing and supporting new legislation.
2. Promote marine environmental education in and outside of schools, especially at the primary level.
3. Work with fishermen to develop sustainable economic alternatives that do not harm the environment and value added fisheries products.
4. Promote hand line fishing, which fishermen agree is the most sustainable gear to use in the region.
5. Promote co-management of marine reserves that involve fisheries authorities, NGOs and local fishermen. (Heyman and Graham 2000, 38–39)

Fisheries authorities have responded to this, in part, by shifting to a Managed Access system, but concerns remain regarding the ability of co-managers to enforce the regulations “when patrol staff are already struggling with limited resources to enforce existing laws” (“Managed Access: Moving Towards Collaborative Fisheries Sustainability in Belize” 2015, 5). The 2000 TIDE study claimed that fishers’ greatest concern was “the lack of enforcement of existing laws” (Heyman and Graham 2000, 35). Although considered a relatively progressive country regarding its conservation efforts and amount of protected areas, Gillet (2003) points out, “the existence of a legislative framework does not always reflect or guarantee a coordinated view of agencies

responsibilities and power, leading to jurisdictional and enforcement problems” (p. 144). If we look beyond national interagency coordination to the community level, only a third of the fishers surveyed in this study felt that they had an influence on the fishing laws and regulations. Nine fishers specified they only had influence through their fishing cooperatives or associations, which vary in strength among communities. Placencia and Hopkins had what appeared to be fairly organized and active fishers’ associations, while survey respondents from Dangriga, Riversdale, and Independence and Mango Creek expressed frustration with barriers they faced regarding their ability to organize and successfully represent themselves, including administrative obstacles and the lack of time and resources to tackle these challenges.

As this survey did not explicitly ask about fishers’ cooperatives or associations, future studies should examine the perceived advantages and/or disadvantages of these organizations, as well as success, failures, and barriers to organizing. Strong fishers’ cooperatives or associations that can effectively advocate for their community’s needs is an important component to any co-management approach. As described by Pomeroy and Berkes (1997), “there is a hierarchy of co-management arrangements from those in which the fishers are merely consulted by the government before regulations are introduced, to those in which fishers design, implement and enforce laws and regulations with advice and assistance from the government” (R. S. Pomeroy and Berkes 1997, 466). The co-management agreements in Belize appear to resemble the former arrangement, with much of the emphasis on shared responsibilities between the Belize Fisheries Department and NGOs and relatively little on actually incorporating fishers in the decision-making process. Pomeroy and Berkes (2007) also argue that “co-management involves the recognition and legitimization of traditional or informal local-level management systems” and “a certain degree of community-based resource management is a central element of co-management” (R. S. Pomeroy and Berkes 1997, 467).

The results of this pilot survey suggest any efforts to incorporate fishers in management processes and decisions may have fallen short. The concept of community participation in Belize fisheries management is not new; however, management has historically been “top-down and not sufficiently participatory” and “while the concept of the participatory principle has been embraced by legislation, its practice lags far behind” (Gillet 2003, 144). Belize’s National Protected Areas Policy and Systems Plan (NPAPS), for example, incorporates socio-economic considerations in policy statements that should be applied to “decisions regarding the declaration, modification and

re-designation; administration and management; economic and ecological assessment and analysis, and monitoring and evaluation of marine and terrestrial protected areas in Belize” (Meerman and Wilson 2005b, 31). Among the considerations are the following:

(17) Participatory mechanisms which are vital to optimizing socio-economic benefits, such as collaborative management agreements and landscape-level management plans, shall be encouraged to maintain the cultural and ecological integrity of the protected areas.

(18) Equal opportunity for access to the benefits derived from protected areas shall be encouraged for all stakeholders, particularly local communities and indigenous peoples living near protected areas (Meerman and Wilson 2005b, 31).

Berkes (2008) also argues that “mere consultation or ad hoc public participation” is often not considered co-management because “most definitions of co-management require some institutionalized arrangement for intensive user participation in decision-making” (p. 1693).

Garnering community trust, support, and involvement would greatly benefit management efforts in Belize. As stated by Gillet (2003), “management concepts cannot be simply imposed upon those intended to benefit from it. A buy-in process has to be developed within which all stakeholders participate in developing, implementing, and monitoring the performance of policies” (p. 145). A 2016 study conducted in Providencia and Santa Catalina, Colombia found a close relationship between the amount of trust in local government and the level of acceptance or rejection of resource management programs by fishers (Matera 2016, 26). The report concluded that “trust in governance institutions, particularly at the local level, was the variable that most predicted whether or not fishermen would comply with marine conservation programs” (Matera 2016, 28). Increasing the no-take area from 3 percent to 10 percent of its territorial seas would likely have positive impacts on conservation if accompanied by widespread support and compliance; however, the lack of trust in authorities among fishers, whether due to perceived corruption or little faith in the capacity to enforce regulations, may undermine existing and future conservation initiatives, especially those involving MPAs.

One of the proposed benefits of the Managed Access system is that fishers will have more “ownership” over the resource. While some fishers expressed hope about the new approach to fisheries management in Belize, others were concerned about their access to rights and how these

rights would be transferred to family members. In addition, many fishers believed that changing the management approach won't improve the situation until authorities have the capacity to monitor and enforce fishing regulations. As this is already a pervasive problem throughout the country, great effort must be channeled into monitoring and enforcing Managed Access areas and permits if authorities want to gain and maintain support from fishers. As Foley (2012) suggested "considerable investment will be necessary to build enforcement capacity up to the required standard to effectively enforce Managed Access and maintain confidence in the program among legitimate Managed Access license holders" ("Managed Access: Moving Towards Collaborative Fisheries Sustainability in Belize" 2012, 5).

When asked what they thought the Belize Government could do to improve fisheries management, respondents stated a need for: more and "smarter" patrolling, especially at night and during closed seasons; harsher punishments for people who break the law; an enhanced licensing system; better training for new fishers and managers; reduction in "corruption" among officers; communication with Honduran and Guatemalan leaders to reduce illegal fishing; allowing local fishers to "self-police"; assistance to local fisher associations that are "struggling" to get started; a ban on gill nets; extending closed seasons for commercially important species, and; stakeholder engagement and involvement. One fisher expressed many of these sentiments in the following statement:

*"[The Fisheries Department] should reach out to fishers and stakeholders in the community who have a sustainable view on fishing – people raised to respect the resource – to figure out where the problems are and discuss how to fix it. Need more enforcement and patrolling where it is actually needed. They should stop taking bribes. Fishers [are also] coming from other places, desperate for a living to survive and they take everything. They are not taught to fish responsibly."* – Placencia fisher

Survey respondents also recognized a need for better relationships between both their communities and NGOs involved in marine resource management, enforcement and conservation. When asked what they thought NGOs could do to improve fisheries management efforts, survey respondents recommended the organizations: apply for grants to fund subsidies for more sustainable gear, offset gas prices, and bolster income diversification opportunities, such as seaweed farming, fish farming, and tourism; increase enforcement capacity by directing resources to enforcement efforts alongside the government; work as a type of "checks-and-balances" system by ensuring the government is doing its job; and, communicate with fishers to increase dialogue,

relay information from the government, and build a better relationship. Suggestions were also made regarding “mapping” local knowledge, holding meetings to exchange views and perspectives, reaching out to stakeholders in the community with a “sustainable view on fishing” to discuss the problems, recognizing the value of traditional ecological knowledge, and strengthening community organizations and fishers’ associations. Specific comments regarding NGO-community relations included:

*“[NGOs should] invest more time and resources to talk to the communities and fisher folk. We can map out the knowledge and info about illegal fishing and use this knowledge to inform and pressure the government”* – Hopkins fisher

*“A lot of NGOs do not respect fishermen, [but] traditional knowledge is greater – more important than just showing up and making rules”* – Placencia fisher

*“[NGOs should] help provide opportunities for alternative livelihoods and lower the desperation and take pressure off reefs.”* – Placencia fisher

Due to co-management agreements between the Belize Fisheries Department and several NGOs in the country, fishers typically regarded NGOs as enforcement agencies, often requesting they increase patrols and monitoring efforts. This was especially true for the Southern Environmental Association (SEA) located in Placencia. SEA works as an extension of the government to help patrol protected areas in southern Belize and was regarded by many of the fishers surveyed as the only agency with a meaningful presence in that part of the country.

When asked what they thought the community could do to improve management efforts, a third of all survey respondents claimed community members and fishers should report illegal activity when they see it. Several respondents also said community members should not buy products obtained illegally. Five respondents mentioned a need for more local autonomy to “self-police” and take action against illegal fishers, especially due to the relatively limited resources for patrolling. One informant spoke of specific instances where Belizean fishers could see Honduran fishers waiting for dark to enter fishing areas illegally:

*“[We need] community policing and should give local fishermen authority. [We] can see Honduran boats waiting for nightfall to come in and fish.”* – Placencia fisher

However, two survey respondents expressed unease about “snitching” when they know there will be no legal ramifications for the violators:

*“We don’t want to create enemies within the community. It would be better to give fishers more power because they would have the authority to enforce.”* – Placencia fisher

*“We can report but don’t. Sometimes it is our family and if we do, nothing is done anyway. The authorities [are] receiving bribes.”* – Dangriga fisher

### Perceptions of Gill Net Use in Belize

The eleven gill net users surveyed in this study were mostly from Dangriga with the exception of one from Independence and Mango Creek and one from Hopkins. While the sample is very small, it shows that opinions on gill net use varied most drastically between Placencia, whose participants seemed primarily concerned with conservation, and Dangriga, where much of the conversation was focused on livelihoods and survival. One Dangriga fisher stressed community dependence on gill net catches. Other Dangriga fishers emphasized that recent restrictions placed on net usage, such as the legal number and length, were already inhibiting their ability to make a living. In their words:

*“Sometimes the fishermen and the community depend on the products from gill nets when other methods are not productive.”* – Dangriga fisher

*“The nets are too short to make a living in open ocean. [We] are not allowed the amount of nets needed to make a living.”* – Independence gill net fisher

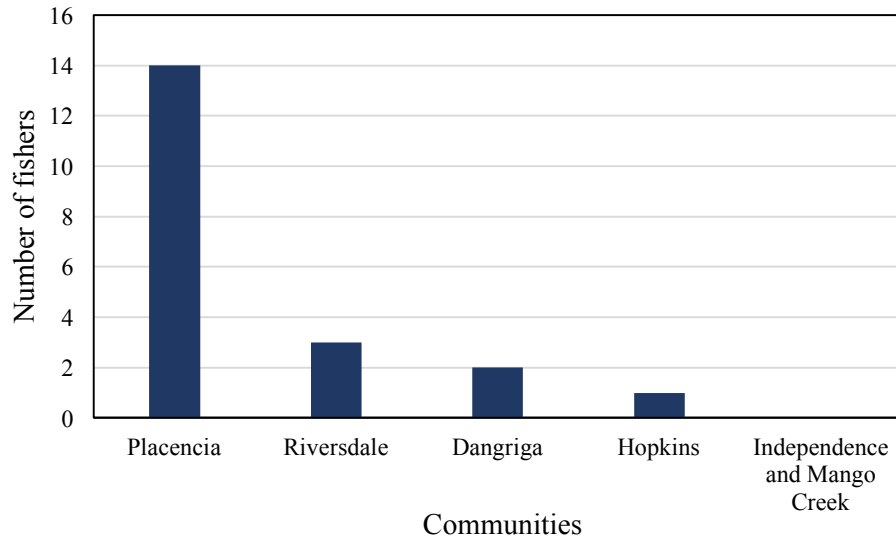
*“The number of fish has decreased and out of my three [nets], probably one net catches fish, and sometimes just 10 fish are caught [in total].”* – Dangriga gill net fisher

When asked about ways to improve gill net management, a third of survey respondents suggested a complete ban on gill net use, including 14 from Placencia, two from Dangriga, three from Riversdale, and one from Hopkins (Figure 10). Comments from those in favor of a ban included:

*“Gill nets? I think they should use those to make hammocks.”* – Placencia fisher

*“Ban completely from Dangriga south. Illegal setting [of nets] in estuaries and lagoons hurts valuable tourism fish.”* – Placencia fisher

*“Gill nets should be banned. Fishers should be taught not to use nets because they are destructive. [Gill nets] came from Guatemala. Younger fishers should be schooled on sustainable fishing practices. Traditional fishers respect size limits and seasons.”* – Placencia fisher



**Figure 10.** Number of fishers in support of a ban on gill nets from each community (n=20).

However, three of these respondents said they would only support a ban if net fishers were offered alternative sources of income and/or subsidies to change gear type:

*“They should find alternative methods of fishing and income and then they can ban nets, but not until the fishers are taken care of”* – Hopkins fisher

*“Need subsidies to help fishermen offset costs - only ban gill nets if they’ll help support fishermen.”* – Dangriga fisher

Fishers that did not advocate for a ban on nets suggested: better enforcement of the existing laws with a focus on illegal gill net fishers from Guatemala; an increase in net mesh size to reduce the amount of juvenile fish caught; outreach and educational programs and workshops for fishers focused on sustainable fishing practices; enhanced communication between fishers and authorities to exchange “views and perspectives”; and, the rotation of fisheries officers to avoid friendships forming between managers and fishers.

Although a third of survey respondents were in support of a gill net ban in Belize, it is important to note that 14 of them were from Placencia. Placencia’s rapid transition from a fishing village to important tourist destination altered social and economic dimensions in a way that sets it apart from the other communities in this study. While the other communities are involved in tourism to some extent, including Hopkins, which is currently expanding its tourism industry, Placencia is one of the top tourist destinations in Belize and the local economy has been shaped accordingly. Of the 21 Placencia fishers surveyed in this study, 16 had additional sources of

income, including 13 employed in tourism. In Placencia, the most common jobs outside of fishing included construction, fishing guide, marine tour guide, boat captain, SCUBA instructor or Divemaster, and arts and crafts.

The Placencia's Producers Cooperative Society Limited was formed in 1962 to enable fishers to take some control over the management of their resource (Key 2002, 9). The cooperative had grown to over 100 members by the mid 1980's but has seen a decline in recent years due to the overexploitation of fishing grounds, dependence on external markets, and the "lack of a diversified economy of goods produced alongside the governmental priority for tourism as a form of development" (Key 2002, 2). As a result, many villagers saw the tourism industry as a more reliable and prosperous way to make a living due to the uncertain nature of fishing (Key 2002, 12) and many commercial fishers are now guides, captains, dive masters, or businessmen, while women commonly work in shops, hotels and restaurants (Gray 2008, 69).

The combination of a decline in fisheries and opportunities to diversify income through tourism and seaweed farming have likely influenced fishers' attitudes and priorities regarding the management of their coastal resources. Several Placencia fishers commented on the negative impact gill nets have on valuable "tourism" and game fish, while others said the establishment of MPAs benefited their work as marine guides. It is important to note that the fishers interviewed in Placencia spoke of strong historical and familial ties to fishing, often describing their fishing methods (mostly hand lines, spears and hook-sticks) as sustainable methods passed down from older generations – methods they emphasized were important to use out of respect for the sea and the future of the resource. Placencia fishers referred to themselves as "traditional" fishers and often suggested gill net users were not because the practice was introduced by Guatemalans.

## Future in Fishing and Income Diversification

### Future Outlook

Despite the perceived decrease in fish size and abundance, survey respondents were mostly optimistic about their future in the fishery. Nearly 70 percent believe they will be able to continue to make a living from fishing in the future and intend to pass the trade to other members of their family. Respondents who did not see a future in fishing claimed it was mostly due to the increasing number of fishers and limited fishing grounds, especially with the number of MPAs. For example, one fisher explained he did not believe he would be able to continue to make a living from fishing in the future because the fish are "getting scarce... there are more fishermen and the government

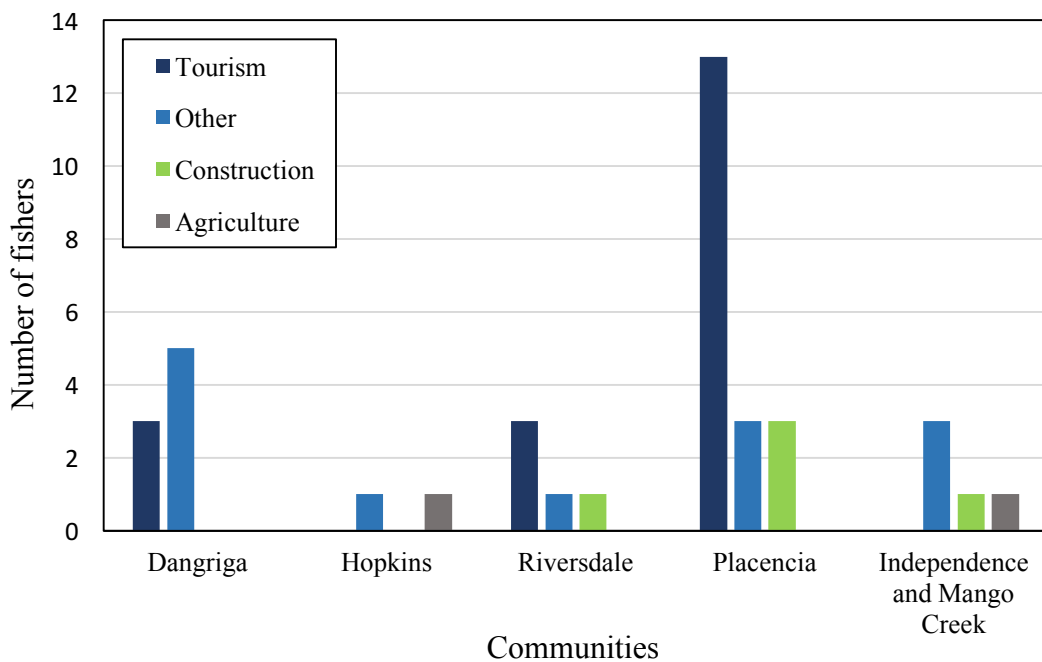
is creating more reserves” (Riversdale fisher). One survey respondent believed he had a future in fishing, but would not continue to make as much money from the trade, stating that there are “more fishermen because reserves force more people into the same fishing area and increase pressure, [so] increasing tourism is a good thing” (Placencia fisher).

When asked to explain why they would not pass the trade on to others, fishers expressed concern over the health of the fishery:

*“It’s better for them to have an education because I just don’t see a future in fishing.”*  
Independence fisher

*“It’s getting too hard to fish. When kids get older there won’t be enough fish to live off”* – Hopkins fisher

Out of the 60 fishers surveyed, 57 percent reported having additional sources of income, including a range of economic activities (Figure 11).



**Figure 11.** Occupations of the 57% of survey respondents that have additional sources of income. The “other” category includes water transportation, arts and crafts, seaweed farming, electrical wiring, marine biology research, NGOs, school teaching, personal business owner and security.

## Income Diversification

Strong familial, historical and cultural ties to fishing and the ocean were conveyed by survey respondents, a connection that requires serious consideration when assessing the feasibility of alternative livelihoods and reduction in fishing. For managers interested in reducing fishing pressure, it is encouraging that 78 percent of survey respondents are interested in diversifying their incomes; however, among the 57 percent of fishers who reported having additional sources of income, nearly 40 percent said they still depend on fishing for at least half of their annual income. Even in communities with a heavy tourism presence, such as Placencia where 16 of the 21 fishers surveyed had additional sources of income, 62 percent claimed fishing comprises at least half of their total annual income. Matera (2016) reported that in Providencia and Santa Catalina “even with a diversified livelihood, most of the fishermen’s nutritional and economic security was tied to the fisheries, making conservation programs of significant concern for local communities” (p. 27).

Perhaps unsurprisingly, fishers interested in diversifying their income showed the most interest in opportunities that would keep them working on the water, such as seaweed farming, tourism, aquaculture and other fisheries. Survey respondents expressed the importance of remaining on the water, whether fishing or doing something else, due to their cultural and historical ties to the ocean and fishing:

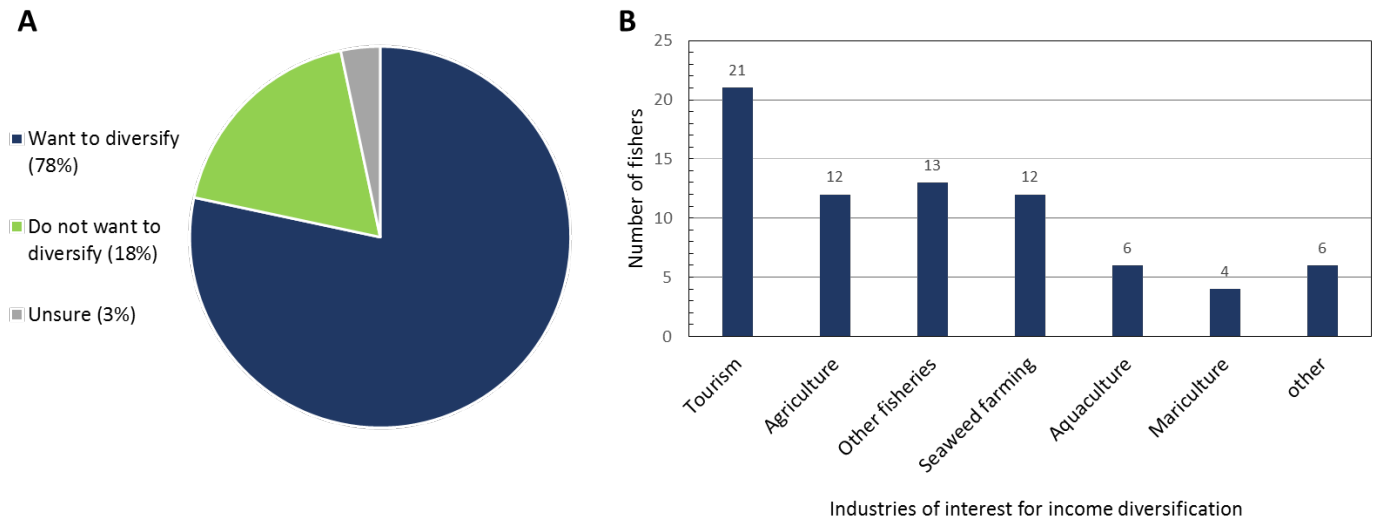
*“I grew up on the sea and have never done anything else. I like to work for myself, it doesn’t feel like work.”* – Independence fisher

*“I still want to remain in the water but doing something different.”* – Hopkins fisher

*“Fishing is all I know, it’s my history.”* – Dangriga fisher

*“Nothing could stop me from fishing for ever and ever.”* – Dangriga fisher

Among those who want to diversify their income, 45 percent are interested in the tourism industry, 26 percent are interested in agriculture, 6 percent are interested in other fisheries, and 53 percent are interested in other opportunities, including: seaweed farming; aquaculture or fish farming; carpentry and construction; raising pigs; and, working for the government or an NGO (Figure 12).



**Figure 12. A)** The percentage of fishers that are interested in diversifying their income. **B)** Economic industries fishers are interested in.

A study by Smith et al. 2010 indicated that there are always short-term costs to fishers from creating no-take zones, and while long-term benefits to fishers can be achieved, “these benefits depend on the condition of the fishery and value of the no-take zone area to populations of target species” (Dahlgren 2014, 54). While well-planned no-take zones can have numerous ecological benefits, efforts to address short- and long-term effects of reduced fishing area and resources should be a priority among the Belize government and partner organizations. Matera (2016) argues:

“Understanding the complexity of social systems, then, allows resource managers to focus on the interaction of social, political, and environmental aspects, and the ways in which communities cope with change. In addition, managers gain the ability to support resource users that are faced with concerns such as overharvesting from local and regional fishing fleets, degrading ecosystems, and recent marine conservation programs by implementing management strategies that enhance their inherent resilience (e.g., create alternatives, increase efficiency, etc.) and take into account the need of communities to access marine resources” (p. 27).

For NGOs and government officials interested in lessening fishing pressure on reefs, seaweed farming may be a sustainable, viable option for several communities along the coast. The Placencia Fishing Cooperative began to farm seaweed (*Gracelaria* and *Euchuma* spp.) in an effort

to diversify their income, reduce fishing pressure on reefs, and establish an industry that may be an economically viable and environmentally sustainable option for future generations. Traditionally, fishers have harvested seaweed for supplemental income but in recent years the cooperative has “shifted its focus from catching fish to establishing sustainable seaweed farms” (Robinson 2015). Worldwide, approximately 25 million tonnes of seaweeds and other algae are used in fertilizers and soil conditioners, skin and spa treatments, cosmetic products, thickener used in the preparation of food, and animal and fish feed (“The State of World Fisheries and Aquaculture” 2014, 7). A recent FAO report found that the world production of farmed seaweeds has more than doubled since 2000 and further rapid development is expected (“The State of World Fisheries and Aquaculture” 2014, 25). While Belize is relatively new to this industry, there is real potential for seaweed farming to provide a sustainable alternative to fishing in coastal communities in Belize. Fishers from the Placencia Cooperative expressed concerned over the cost and feasibility of leasing the seafloor from the Belize Fisheries Department as well as the difficulties involved in obtaining grants from NGOs to fund seaweed-related initiatives. When asked what the government could do, one fisher replied it could “make it easier to access seeds and get seaweed farming started”.

In this study, of the 47 respondents interested in income diversification, approximately 45 percent were interested in the tourism industry. A 2011 tourism report projected an increase in Belize tourism expenditure from \$248 million in 2008 to \$1.2 billion a year by 2030 (Tourism and Leisure Consulting 2011, 6). Nature-based tourism has become a mainstay in Belize, simultaneously providing employment opportunities to local communities and generating local support for conservation (Lindberg et al. 1996). MPAs have also shown to be a more profitable use of the marine areas than extractive fisheries. For example, a 2007 comparison of fisheries revenue and reef-related tourism revenue within the Glover’s Reef Marine Reserve found that tourism contributed USD 2.7- 4.5 million more than fisheries (Cooper et al. 2008). While an increase in tourism would likely provide more economic opportunities for locals and decrease fishing pressure, it could also have direct negative impacts on the health of coastal resources via coastal development, wastewater management, and marine-related activities such as SCUBA diving and snorkeling.

## Conclusion

In situations where there are simply too few resources to effectively monitor such a large area, increased cooperation and involvement of fishers and communities at the local level may enhance conservation efforts and sustainable fisheries management, both within and outside of MPAs. As described by Pomeroy (1995), “the effective capacity of many fisheries agencies to regulate what goes on in widely scattered, often isolated fishing grounds, is distinctly limited. Under these conditions, the delegation of fisheries management and allocation of decisions to the local level may be more effective than the management efforts which distance, under-staffed and under-funded national government fisheries agencies can provide” (p. 144).

Belize benefits from its conservation-oriented legislation, large portion of terrestrial and marine area already under protection, and notable number of NGO partners providing supplemental resources in the form of scientific data, increased monitoring and enforcement capacity via co-management agreements, and funding sources unavailable to government agencies. Bolstering conservation efforts by focusing on building trust among communities, incorporating fishers into management process in meaningful ways, and directing resources towards opportunities to diversify incomes, such as seaweed farming, will likely be key to the future success of the country’s MPAs. Berkes (2008) argues that “justice, equity and empowerment are... relevant because the basic idea behind co-management is that people whose livelihoods are affected by management decisions should have a say in how those decisions are made” (p. 1692). Management efforts that neglect to address broader livelihood aspects affected by conservation efforts run the risk of fueling dis-trust of regulatory institutions (Matera 2016, 27), which will only setback conservation efforts in the long-run.

Appeals for increased community participation and involvement in fisheries management were common among fishers interviewed for this study. Future conservation initiatives, including those that focus on the gill net fishery, should first direct personnel and resources into off setting negative socioeconomic consequences of changes to the regulations. Overall, fishers are willing to adapt alongside changes in the resource, as indicated by the 78 percent of fishers interested in diversifying their incomes. In addition, increased support for fisher associations and cooperatives, including administrative assistance, may further conservation initiatives by providing a platform for fishers to exchange ideas and concerns with managers. Fishers in Placencia, a community with a particularly strong cooperative, benefited from relatively unified sentiments about gill nets, the

benefits of MPAs, and importance of conservation. As an organized group, they have initiated a community-based seaweed farming project and plan to expand the industry with government support.

The foundation for improved relationships and co-management arrangements between fishers and institutions responsible for resource management already exists in the way of legislative support, appeals for participatory processes from the local level, a positive view of fisher associations and their benefits, interest in diversifying incomes, and the involvement of conservation NGOs keen to work alongside of fishers to sustainably manage the resource. While MPAs are a key component to ensuring the future of fisheries, effective management simply may not be possible without robust community involvement and support (Matera 2016).

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## APPENDIX I

### Survey Duke University

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#### **Background and Demographic Questions:**

1. What is your age?
  
2. Were you born in Belize?  
 Yes                       No                       I prefer not to say
  
3. How many years have you lived in (name of community)?
  
4. How many years have you been fishing in Belize?
  - 4a. Months out of the year fished:
  
  - 4b. Types of fishing gears used:
  
5. Is fishing your only source of income?  
 Yes                       No                       I prefer not to say
  - 5a. If not, what else do you do to earn money?
  
6. Approximately how much of your annual income is from fishing?  
 <25%                       25%-50%                       ~50%  
 50%-75%                       >75%                       I don't know

#### **Socioeconomic, Environmental, and Regulatory Aspects:**

7. Since you started fishing, have you noticed a change in the size of fish caught?  
 Yes                       No                       I don't know

7a. If yes, has the size of individual fish increased or decreased?

8. Since you start fishing, have you noticed a change in the amount of fish caught?

Yes                       No                       I don't know

8a. If yes, are you catching more or less fish?

9. Do you think the South Water Caye Marine Reserve affects the amount of fish you catch?

Yes                       No                       I don't know

9a. If yes, do you think it increases or decreases the amount of fish you catch?

9b. Please explain:

10. Do you think you will be able to continue to make a living from fishing in the future?

Yes                       No                       I don't know

10a. Please explain:

11. Do you plan to pass this trade on to other members of your family?

Yes                       No                       I don't know

11a. If no, please explain why:

12. Do you feel that you have an input in fishing regulations and laws?

Yes                       No                       I don't know

13. Do you think that the fishing regulations and laws are effective?

Yes                       No                       I don't know

13a. Please explain:

14. In your opinion, what improvements could be made to current gill net regulations to make them more effective?

**Fishing Gear**

15. Do you use gill nets?

\_\_\_\_ Yes                      \_\_\_\_ No                      \_\_\_\_ I prefer not to say

15a. If yes, how many gill nets do you use?

15b. What are the size and lengths of your nets?

15c. Months per year:

15d. Approximately what portion of your total catch is caught using gill nets?

\_\_\_\_ <25%                      \_\_\_\_ 25%-50%                      \_\_\_\_ ~50%  
\_\_\_\_ 50%-75%                      \_\_\_\_ >75%                      \_\_\_\_ I don't know

15e. In terms of effort, how many other persons fish with gill nets with you?

16. What are the main species targeted with gill nets?

16a. Approximately how many pounds of each do you catch every year with gill nets?

16b. Do you sell your gill net catches?

\_\_\_\_ Yes                      \_\_\_\_ No                      \_\_\_\_ I prefer not to say

- 16c. If yes, where do you sell your catch?
- 16d. What is the average price per pound you sell each species for?
17. What other types of fishing gear do you use to catch fish?
- 17a. What species of fish do you target with each gear? (top 3 for each)
- 17b. Approximately how many pounds of each species (top 3) do you catch each year?
- 17c. What is the approximate price per pound for each species (top 3) you land?
- 17d. Does it take more effort to use these methods (than gill nets)?  
 Yes                       No                       I don't know
- 17e. Does it cost more money to use these methods (than gill nets)?  
 Yes                       No                       I don't know
18. Are gill nets usually placed in a line or spread out in various locations?
19. For approximately how many hours are the gill nets deployed each time?

20. When is the best time of the day or night to set gill nets?

21. When is the best time of year to set gill nets?

22. What species are most commonly caught as bycatch?

23. Is the bycatch usually alive?

Yes                       No                       I don't know

24. Do you think illegal gill netting is a problem where you fish?

Yes                       No                       I prefer not to say

25. Do you think illegal fishing activity is a problem where you fish?

Yes                       No                       I don't know

25a. If yes, what do you think your community could do to help this?

25b. What do you think the Belize government could do to help this?

25c. What do you think NGOs could do to help this?

26. Have the current gill net regulations had a positive or negative impact on your ability to provide for your family?

Positive       Negative       I don't know

26a. Please explain:

27. Would you be interested in diversifying your income?

Yes       No       I don't know

27a. If no, please explain:

27b. If yes, which of the following would you be interested in?

Other fisheries       Agriculture       Tourism

Other: