



## Marine resource management and fisheries governance in Belize exhibit a polycentric, decentralized, and nested institutional structure

Catherine Alves <sup>a,b,\*</sup>

<sup>a</sup> Environment, Ecology, and Energy Program, The University of North Carolina at Chapel Hill, Chapel Hill, NC, 27599, USA

<sup>b</sup> ECS Federal, Inc., Under Contract to the National Marine Fisheries Service, Northeast Fisheries Science Center, Social Science Branch, National Oceanic and Atmospheric Administration, 28 Tarzwell Drive, Narragansett, RI, 02882, USA

### ARTICLE INFO

**Keywords:**

Marine fisheries  
Governance  
Common pool resources  
Belize  
Institutions

### ABSTRACT

Overfishing is one of the most severe anthropogenic threats to the world's oceans, marked by widespread degradation of marine food webs and disruption of ecosystem functioning. Global fisheries can be categorized as common-pool resource (CPR) systems because restricting marine resource extraction is extremely challenging, and over-extraction contributes to an overall decline in availability to others. Because of these challenges, establishing effective institutions for the sustainable management of natural resource systems is essential. Community-based fisheries management offers a potential solution to overcome the challenges associated with fisheries as CPRs by including fishers in the management of their fisheries through collective action. The purpose of this study was to examine the institutional robustness (e.g. presence of nested and decentralized enterprises as indicators of resilience to shocks) of over 40 years of fisheries management in Belize. I used a mixed methods approach combining review of secondary literature, semi-structured interviews with key informants across the governmental, non-governmental, and fishers' sectors, and participant observation. The results of this study suggest that Belize has the institutions in place to overcome collective action problems and be a long-enduring CPR system. These conclusions have implications for the enforcement of Belize's new Fisheries Resource Bill (as of late 2019), and in other small-scale fisheries across the globe.

### 1. Introduction

Forests and global fisheries are often described as common pool resource (CPR) systems because excluding resource unit (e.g. trees, land, and fish) extraction is challenging, and the [over]consumption can contribute to the overall decline in resource availability to others (Olson 1965; Ostrom 1990, 2003; Ostrom 1990; Ostrom et al., 1999). Marine fish species are examples of common-pool resources because: 1) they are seemingly available for extraction (Anderson and Uchida 2014), 2) it is difficult to identify, track, and estimate their abundance (Levine and Richmond 2015), and 3) it is challenging to manage the access to the resource across large and sometimes international oceanic boundaries (Cudney-Bueno and Basurto 2009; Urquhart et al., 2014; Levine and Richmond 2015). Furthermore, the over-extraction of marine resources has implications for both environmental and livelihood outcomes. The overexploitation of marine systems and lack of effective management institutions manifests itself as overfishing, which leads to degradation of

food webs and disruption of overall ecosystem functioning (Jackson et al., 2001).

Because subsistence and commercial fishing provide nearly three billion people with fish protein annually (FAO 2014), it is essential to develop management approaches to restore fish populations and maintain food security. The majority of present-day fisheries management relies on local governance and stock assessments, which report catch per unit effort (CPUE) and estimate maximum sustainable yield (MSY) via population and ecosystem models (Costello et al., 2008; Valdés-Pizzini et al., 2012). To combat the threat of overfishing (Jackson et al., 2001), there has been increased interest in establishing multi-species fisheries, enforcing the use of a variety of gear strategies, setting catch limits (Valdés-Pizzini et al., 2012), restricting fishing in select areas (Gaines et al., 2010), and implementing adaptive management strategies (McDonald et al., 2017).

Fisheries management measures, including formal licensing procedures and Marine Protected Areas (MPAs), have been the primary

\* Current Address: ECS Federal, Inc., Under Contract to the National Marine Fisheries Service, Northeast Fisheries Science Center, Social Science Branch, National Oceanic and Atmospheric Administration, 28 Tarzwell Drive, Narragansett, RI, 02882, USA

E-mail address: [alves.catie@gmail.com](mailto:alves.catie@gmail.com).

management response to overfishing. MPAs function by restricting fishing access to select offshore locations with the intention of increasing fish abundances and diversity within those areas, with fish spilling over to adjacent non-protected areas (Gaines et al., 2010). MPAs then may be coupled with specific restrictions on fishing, e.g. catch share programs and special licenses, ideally leading to increased fish size and abundance to participating fishers (Costello et al., 2008). However, MPAs often fall short of achieving ecological and social benefits due to lack of specified policy and goals (e.g. “paper parks”), enforcement capacity, poaching, and limited spillover, as well as social conflict when fishers’ livelihoods are negatively affected by MPAs (Huntington et al., 2011; Gill et al., 2017; Bruno et al., 2019). Common challenges to effective MPA governance also include confused goals, increased conflict, and unrealistic aims to scale-up beyond institutional capacity (Christie and White 2007), which demonstrate a need for improved MPA management.

One promising way to overcome these issues with CPRs in fisheries is to include fishers in the management of their fisheries by leveraging social capital (Brondizio et al., 2009) and inspiring collective action among community members (Olson 1965; Ostrom 1990, 2003; Ostrom 1990; Ostrom et al., 1999). Social capital refers to the value of trust established by networks of individuals and institutions who share common interests (Brondizio et al., 2009). The organization of those institutions has the potential to inspire collective action from communities, where individuals self-organize into groups to perform actions that lead to group benefits that would not be available to a non-group member (Olson 1965; Ostrom 1990, 2003; Ostrom et al., 1999; Brondizio et al., 2009; Pinho et al., 2012; Uchida 2017). To encourage collective action among individuals in a community, a common objective and behavior towards resource utilization must be identified, but this is no easy feat (Brondizio et al., 2009; Ostrom et al., 2009; Pinho et al., 2012; Reddy et al., 2013). The success of such collective action depends on the networks of institutions involved, and the direction of motivation, which oftentimes begins on the local level and works up to the state- or country-wide level (Foley 2012; Catzim and Walker 2013; Barner 2015; Ayer et al., 2018).

Institutions for collective action in small-scale fisheries include fishing cooperatives and associations that advocate for fishers’ rights to management officials and that sometimes own shares of the total catch (Armitage et al. 2012, 2017; Basurto et al., 2013; Gelcich et al., 2013; Aceves-Bueno et al., 2017; Karr et al., 2017; Uchida 2017). Membership to fisher associations and cooperatives has the potential to increase economic opportunities to fishers by way of new market development, product differentiation, and direct sales to consumers (Uchida 2017). Such institutions provide a platform for fishers to become a part of community-based fisheries management (CBFM) by including them in the monitoring, enforcement, and overall decision-making processes involved in resource management in their communities (Wiber et al., 2004; Armitage et al., 2012; Pinho et al., 2012; Valdés-Pizzini et al., 2012; Islam and Yew 2013; Urquhart et al., 2014). Such participatory co-management may encourage environmental stewardship among fishers because they develop a sense of ownership of their fisheries, which provide additional incentives for sustainable fishing practices and continued collective action (Wiber et al., 2004; Cudney-Bueno and Basurto 2009). The overall polycentric governance structure of CBFM contributes to broad stakeholder involvement, increased policy freedom at local levels, improved spatial fits between knowledge and action, and ultimately better responses to complex changes facing fisheries in the future (Cvitanovic et al., 2018). These benefits can lead to long-term sustainability of conservation measures.

Scholars interested in CPR institutions have identified several design principles that enhance probability of success. For instance, Ostrom identified eight design principles of long-enduring CPR institutions that have been identified as potential means to solve collective action problems (Ostrom 1990). These principles can act as a means to empirically analyze the robustness of institutions in securing environmental and livelihood outcomes because they can be more directly

measured. The principles include: 1) clearly defined boundaries (such as a coastal region), 2) connection between local conditions and provisioning rules, 3) collective-choice arrangements, where the users participating in operational rules also have collective-choice rights, 4) monitoring of the resource system by the users, 5) graduated sanctions in place, 6) conflict-resolution mechanisms between all actors, 7) minimal recognition of rights to organize, where external government authorities do not challenge the rights of appropriators to make their own institutions, and 8) nested enterprises (Ostrom 1990). Such design principles can offer a method for determining the potential for the proper management of CPRs well into the future (Cinner et al., 2009; Levine and Richmond 2015).

The purpose of this study was to assess the robustness of institutions involved in fisheries management in Belize using Ostrom’s eight principles of long-enduring CPRs as a guide. I first identified the institutional roles and structure, then examined the impact of that institutional structure on the decision-making power and implementation of the Managed Access program (Fig. 1), and lastly determined that marine resource management in Belize exhibits Ostrom’s eight principles for long-enduring CPRs (Ostrom 1990). I define “institutional robustness” by the presence of nested and decentralized institutions, as they are more resilient to shocks (Ostrom et al., 2010), and can be identified through the lens of Ostrom’s design principles. I used a mixed methods approach that combined review of secondary data, semi-structured interviews with key informants, and participant observation. As of late 2019, a new Fisheries Resource Bill was approved by the government of Belize, introducing many institutional changes to fisheries management across the country. This provides an opportunity to review the history of fisheries management in Belize and look critically into the future. My results suggest that Belize has the institutions in place to be a long-enduring CPR system and overcome collective action problems (Ostrom 1990, 2003), leading to potential long-term sustainability goals being met.

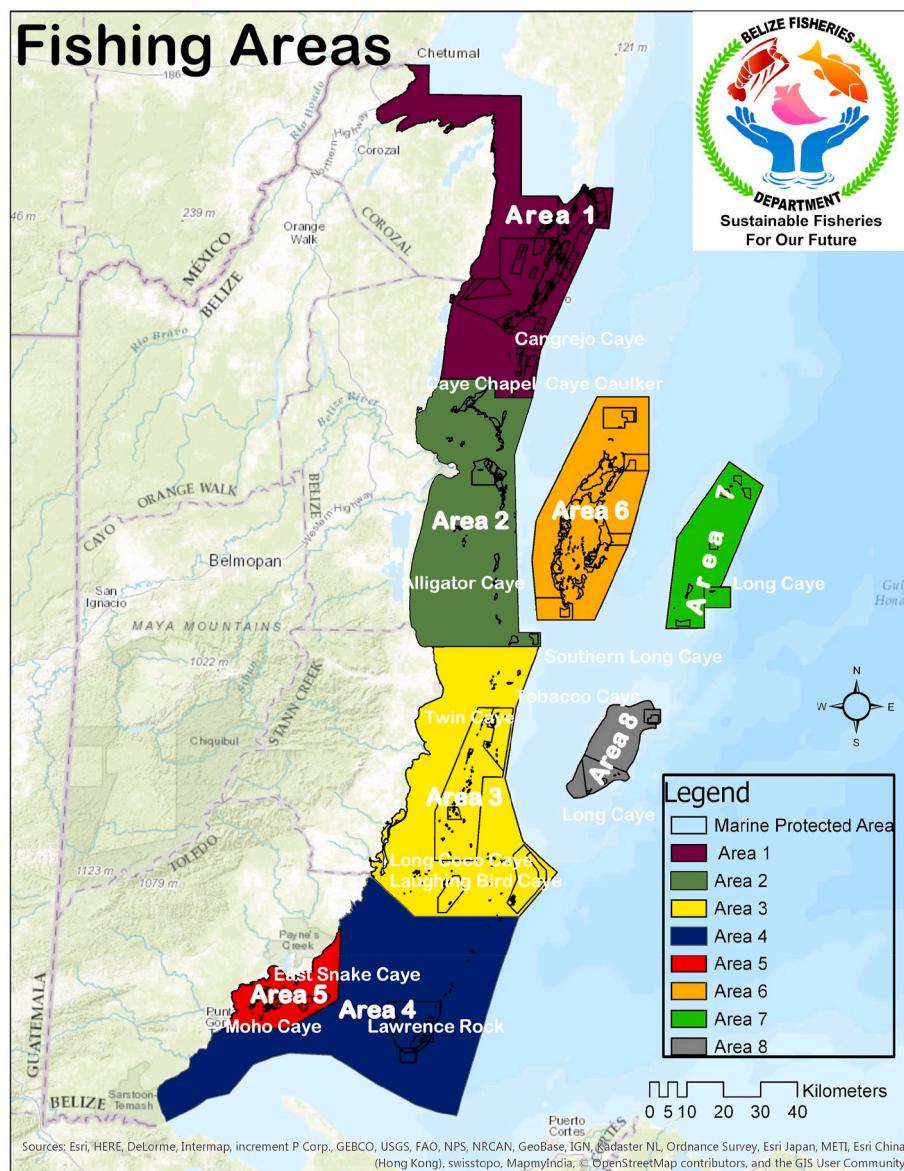
## 2. Case study context

### 2.1. Belize geography, ecology, and marine resource use

Belize is located in Central America. Natural resources are an important contributor to the national economy, including commercial fisheries, eco-tourism (marine and terrestrial), and logging (Karlsson and Bryceson 2016). Belize is home to the second longest barrier coral reef in the world – the Belize Barrier Reef (BBR). The Belize Barrier Reef is part of the larger Mesoamerican Barrier Reef System, which traces the coasts of Belize, Mexico, and Honduras. The reef system incorporates the diverse marine habitats of mangroves, seagrass beds, fringing and patch coral reefs, and several offshore atolls. Because of this rich biodiversity, ecotourism and fishing are two of the most prevalent livelihood strategies among Belizeans (Gopal et al., 2015). Lobster, conch, snapper, and grouper are the primary fishery target species across Belize, with upwards of 3000 licensed commercial fishermen per year (Huitric 2005; Catzim and Walker 2013). Since the 1980s, national yields for lobster and conch have been relatively stable while effort has increased (Huitric 2005).

### 2.2. Evolving coastal zone management in Belize

Belize has a rich history of relying on natural resources (e.g. forest and marine products) for economic, political, and social benefit (Karlsson and Bryceson 2016), stemming from the colonial occupation of the British until Belize independence in 1973 (Wainwright 2009). Over the last 40+ years, tremendous changes in coastal zone management and fisheries policies have occurred in Belize (Fig. 2). Throughout this timeline, non-governmental organizations (NGOs) were formed, which are now some of the key stakeholders and regional co-managers of the marine reserves. The first marine reserve, Hol Chan Marine Reserve



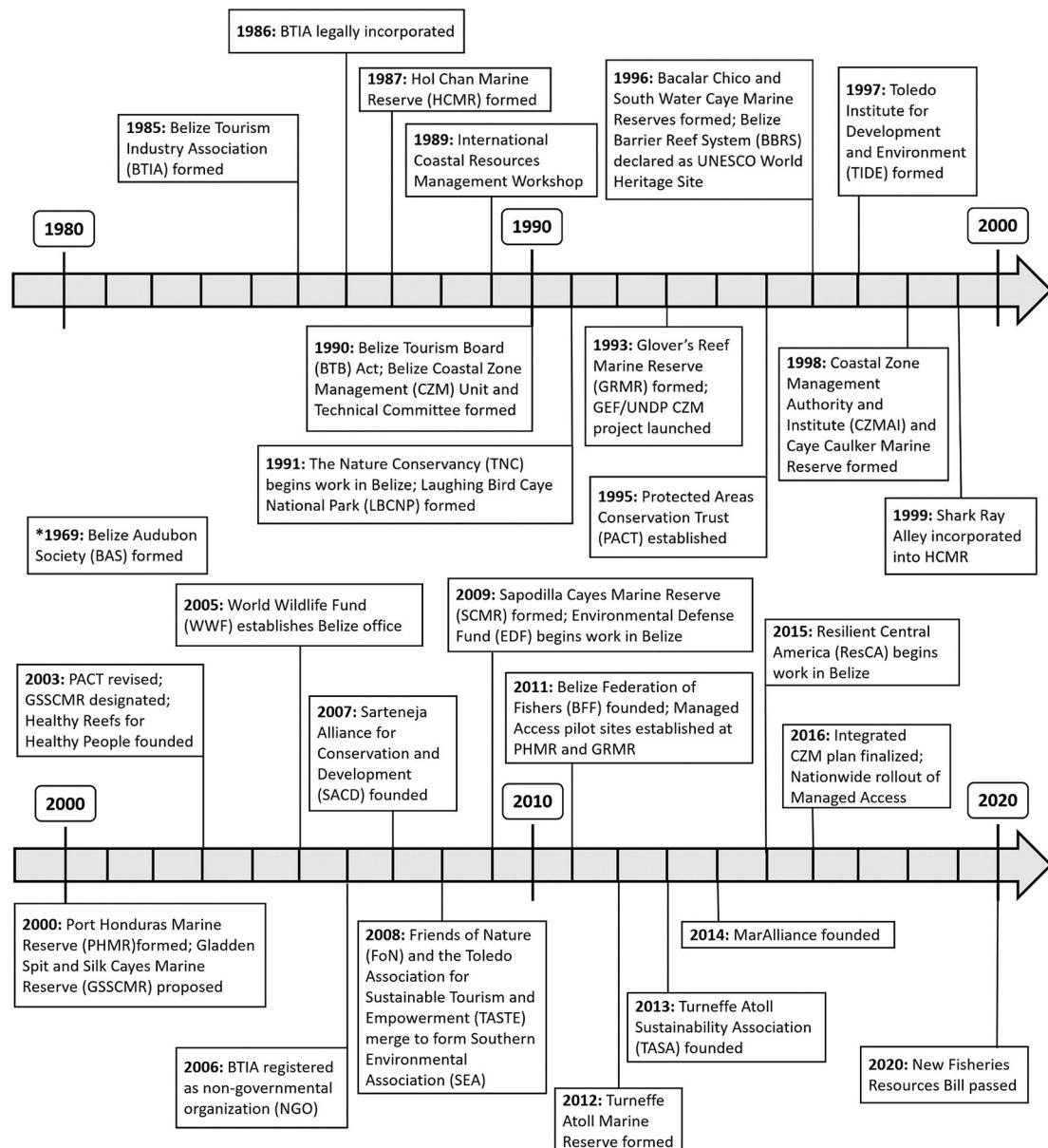
**Fig. 1.** Managed Access fishing areas in Belize. The polygons represent MPAs. The two pilot sites established in 2011 were: Area 5 (in red), the Port Honduras Marine Reserve (PHMR), and Area 8 (in grey), the Grovers Reef Marine Reserve (GRMR). The remaining Areas were established in 2016. Map from the [Belize Fisheries Department 2019](#). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

(HCMR), was formed in 1987, which started a precedent for future marine protection. Shortly after, in 1989, the first International Coastal Resources Management Workshop was held. The focus of the workshop was how to sustainably manage the use and development of coastal ecosystems for the benefit of future generations, which then became the main priority of the Coastal Zone Management Authority and Institute (CZMAI), established in 1998. In 1996, seven protected areas within the BBR became designated as a part of a UNESCO World Heritage Site. In 1997, the Toledo Institute for Development and Environment (TIDE) was formed, pioneering the way for other community-based conservation organizations throughout Belize.

In 2000, the Port Honduras Marine Reserve (PHMR) and Gladden Spit and Silk Cayes Marine Reserve (GSSCMR) were developed. TIDE soon became a co-manager of PHMR with the Belize Fisheries Department. In the early 2000s, additional NGOs began to form throughout Belize, including Healthy Reefs for Healthy People in 2003, the Sarteneja Alliance for Conservation and Development (SACD) in 2007, and the Southern Environmental Association (SEA) formed in 2008 from the merging of Friends of Nature (FoN) and the Toledo Association for

Sustainable Tourism and Empowerment (TASTE). In 2011, a rights-based fishery known as Managed Access (MA) was piloted at the Port Honduras Marine Reserve (PHMR) and Glover's Reef Marine Reserve (GRMR) ([Foley 2012](#), [Belize Fisheries Department 2015, 2019](#)). This rights-based fishery granted commercial fishers rights to fish in select areas while requiring them to report their catch to management officials. Piloting MA was the first step toward eliminating the “race to fish” associated with Belize’s open access fishery regime. After reported decreases in illegal fishing and increased catch by fishers ([Catzim and Walker 2013](#)), the MA program was implemented nationwide in 2016, with seven additional sites added to Belize’s territorial waters ([Fig. 1](#), [Belize Fisheries Department 2015, 2019](#)). Belize currently contains a network of marine reserves with varying levels of access and extraction of marine resources. Within the marine reserves are General Use Zones (GUZ) where regulated extractive activities are allowed, Replenishment Zones (RZ), where non-extractive activities are permitted, and Preservation Zones (PRZ), which are open to research activities only ([Belize Fisheries Department 2015, 2019](#)).

Most of the marine reserves are co-managed by an NGO and/or the



**Fig. 2.** Timeline of significant milestones in coastal zone/fisheries management in Belize from 1980 to present. Source: key informant interviews and review of secondary literature.

Belize Fisheries Department. As of late 2019, a new Fisheries Resource Bill was approved by the Cabinet, after nearly 10 years of deliberation by the federal government, scientists, fishers, and NGO co-managers. The Fisheries Resource Bill builds on an indicator-based adaptive management framework for the lobster and conch fisheries of Belize, which was developed in 2017. Included in the bill is the establishment of a Fisheries Council, with representatives from diverse sectors, increased enforcement and monitoring guidelines, and ways to improve fisheries management for sustainability and economic development ([Belize Fisheries Department 2019](#)).

### 3. Materials and methods

To assess the robustness of institutions (e.g. presence of nested and decentralized institutions ([Ostrom et al., 2010](#)) involved in fisheries management in Belize, this study sought to answer the following research questions: 1) What are the institutions involved in fisheries management in Belize, what are their roles, and how are they

structured? 2) How does the structure of enforcement and monitoring of Belize's Managed Access program ([Fig. 1](#)) affect decision-making power and implementation of the program? 3) Does marine resource management in Belize exhibit Ostrom's eight design principles for long-enduring CPRs ([Ostrom 1990](#)) and what implications does that have for the sustainability of the Managed Access program?

This study used a mixed methods approach that combined reviewing secondary data, semi-structured interviews with key informants and participant observation ([Bernard 1998](#)). The review of secondary data was ongoing throughout the process of this study, and included published and unpublished governmental and non-governmental reports, academic publications (thorough literature searches), and online resources. Semi-structured interviews with key informants and participant observation occurred in June and September 2017, and from April–June 2019.

Key informants included individuals in leadership positions and natural resource managers in the governmental ( $n = 8$ ) and non-governmental sectors ( $n = 26$ ) within Belize. Key informants were also

fishers ( $n = 23$ ), some of whom were leaders in their communities (e.g. served on committees, fisher associations), while others were vocal about voicing their opinions about several fisheries-related topics. Key informants were selected using snowball sampling (Bernard 1998) and by ensuring at least one member of each NGO, and at least one person from the Belize Fisheries Department, was interviewed. This process also involved extensive trust-building between myself and all stakeholder groups, particularly when it came to recruiting key informants to be interviewed. Many of my correspondences were facilitated through introductions made by trusted community members, therefore vetting me in the process. Participant observation included: attendance at fisher forums, meetings, and presentations by natural resource managers, and various formal and informal gatherings within the communities. Such community gatherings included the fish and produce markets and the Chocolate Festival in Punta Gorda, the Mango Festival in Hopkins, the Lobster Festival in Placencia, and the fish market in Dangriga. During participant observation and attendance at community gatherings, I followed Bernard (1998)'s guidelines for qualitative data collection and note taking. All respondents remained anonymous throughout this process.

#### 4. Results

##### 4.1. The identity, roles, and structure of institutions involved in fisheries management in Belize

Here, I describe the complex institutional structure of fisheries management to be polycentric and decentralized, due to the existence of many centers of decision-making formally independent of one another (Ostrom et al. 1961, 2010). The institutional structure is also nested because of governance activities organized within multiple layers (Ostrom et al., 2010). The government, tourism sector, NGOs, and fishers sectors represent the type of institutions involved in the fisheries decision-making process (Fig. 3). The key informant interviews and participant observations revealed that for many sectors, including the governmental and fishers' sector, institutions are nested within each other, providing for enhanced information transfer, collaboration, and decision-making power. In the NGO, tourism, and fishers sector, many institutions are also decentralized, representing the local community and protected area at regional and national levels.

###### 4.1.1. Government sector

The first institutional sector involved in fisheries management in Belize represents the federal government. Because coastal resource management in Belize involves the extraction of natural resources, use of Belize's territorial waters, and the trade and exporting of marine products, many governmental institutions are involved. The participant observation, key informant interviews and review of secondary literature revealed six ministries in the governmental sector, within which the

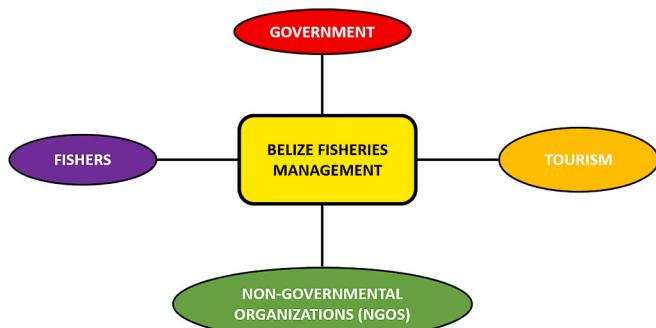
different governing institutions reside (Fig. 4). These nested institutions (McCabe and Feiock, 2005; Ostrom et al., 2010) set rules for domestic and international trade, economic development, natural resource management, national security and enforcement of governmental policies.

Within the Ministry of Economic Development, Petroleum, Investment, Trade and Commerce is the Belize Trade and Investment Development Service (BELTRAIDE, [Government of Belize 2019](#)). BELTRAIDE promotes and enables socio-economic development. The Belize Port Authority and Belize Customs and Excise are two institutions within the Ministry of Transport and National Emergency Management. The Belize Port Authority is led by the Ports Commissioner (a.k.a. Harbour Master) and is responsible for regulating and developing Belize's ports, harbors and shipping as well as ensuring the safety of all vessels navigating within Belize's territorial waters ([Belize Port Authority 2019](#)). Belize Customs and Excise develops and implements policies to ensure increased safety/security and develop the effective platforms for effective trade and revenue collection ([Belize Customs and Excise, 2018](#)). International trade policies are developed by the Belize Customs and Excise, which are essential to the export of lobster and conch as the primary marine products exported from Belize ([Belize Customs and Excise, 2018](#)).

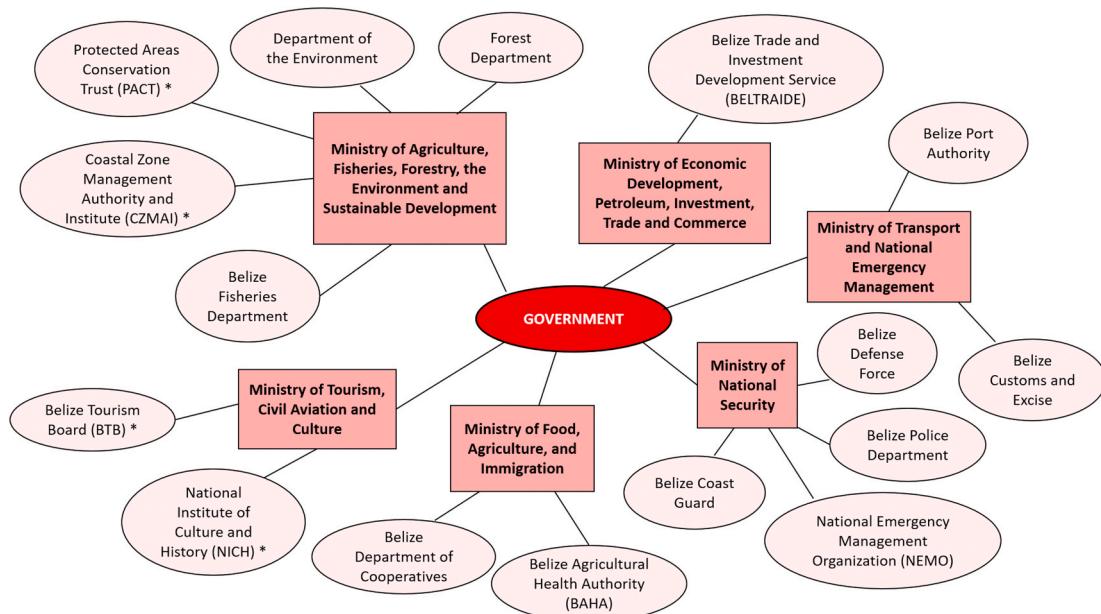
The Belize Tourism Board (BTB), and the National Institute of Culture and History (NICH) are within the Ministry of Tourism, Civil Aviation, and Culture ([Ministry of Tourism and Civil Aviation 2019](#)). The BTB is a partner between the government and the private (tourism) sector in Belize, working closely with four tourism stakeholder groups (hotels, tour operators, tour guides, and the cruise industry ([Belize Tourism Board 2020](#)). The role of BTB in natural resource management will be explained in the subsequent section. NICH is a statutory body that preserves and shares Belize's historic and ethnic roots ([National Institute of Culture and History 2020](#)).

The Belize Coast Guard ([Belize Ministry of National Security 2016a](#)), Belize Police Department ([Devex 2020](#)), Belize Defence Force ([Belize Defence Force 2020](#)) and National Emergency Management Organization (NEMO, [National Emergency Management Organization 2020](#)) are housed within the Ministry of National Security ([Belize Ministry of National Security, 2016b](#)) as entities all responsible for ensuring the safety and security of those in Belize. The Belize Coast Guard and Belize Defence Force are part of the professional military with soldiers trained in ensuring the safety and security of those in Belize. The Belize Coast Guard enforces maritime laws and protects Belize's territorial waters ([Belize Ministry of National Security 2016a](#)), while the Belize Defence Force is more focused on the defense of Belize and supporting the Civil Authorities in maintaining order in Belize ([Belize Defence Force 2020](#)). The Belize Police Department works on more local levels to preserve law and order across the country, with three police for every 1000 inhabitants ([Devex 2020](#)). NEMO is responsible for providing citizens with information regarding emergency preparedness, storm tracking, and natural disasters ([National Emergency Management Organization 2020](#)).

The Belize Agricultural Health Authority ([BAHA, Belize Agricultural Health Authority 2020](#)) and the Belize Department of Cooperatives ([Ministry of Food, Agriculture, and Immigration 2017b](#)) is housed within the Ministry of Food, Agriculture, and Immigration ([Ministry of Food, Agriculture, and Immigration 2017b](#)). The BAHA oversees animal health, plant health, quarantine and food safety services that prioritize the health and wellness of those it serves while strengthening national food security and facilitating trade/commerce. BAHA is directly involved in the production, management, and trade of the marine products (e.g., lobster, conch, finfish) that are sold domestically and internationally ([Belize Agricultural Health Authority, 2020](#)). The Department of Cooperatives provides regulatory services for entrepreneurial development programs related to the cooperative sector in Belize. The fisheries cooperatives (explained below) are regulated by this department ([Ministry of Food, Agriculture, and Immigration 2017b](#)).



**Fig. 3.** Visual depiction of the different sectors involved in fisheries management in Belize. Sources: key informant interviews, participant observations and review of secondary data.

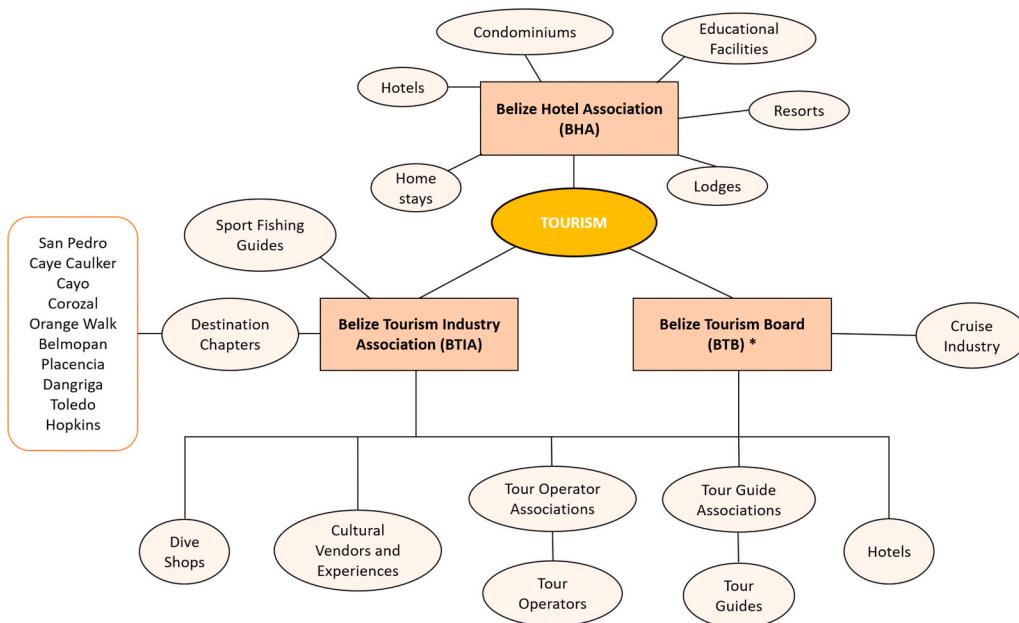


**Fig. 4.** Visual depiction of the governmental agencies involved in fisheries management in Belize. Each governmental organization is nested within a Ministry. The Belize Tourism Board (BTB) is also represented in the tourism sector. Asterisk indicates statutory body. Sources: key informant interviews, participant observations and review of secondary data.

The Forest Department ([The Forest Department 2019](#)), Department of the Environment ([The Department of the Environment, 2020](#)), Fisheries Department ([The Belize Fisheries Department, 2013](#)), Protected Areas Conservation Trust ([PACT, Protected Areas Conservation Trust 2019](#)) and Coastal Zone Management Authority and Institute ([CZMAI, Coastal Zone Management Authority 2019](#)) are all housed within the Ministry of Agriculture, Fisheries, Forestry, the Environment, and Sustainable Development ([Government of Belize 2020](#)). The Forest Department enforces the policies and regulations for the sustainable management of Belize's forested ecosystems ([The Forest Department 2019](#)). The Department of the Environment focuses on establishing, recommending and enforcing policies that improve environmental

quality, limit pollution, and promote public engagement ([The Department of the Environment, 2020](#)).

The Fisheries Department is responsible for the development and enforcement of management policies surrounding aquatic and fisheries resources, with a focus on sustainability for present and future generations. They are the primary government agency involved in fisheries management policies across Belize, working closely with the tourism and NGO sectors ([The Belize Fisheries Department, 2013](#)). PACT is a national conservation trust which manages Belize's National Protected Areas System (NPAS) through strategic partnerships and investment opportunities ([Protected Areas Conservation Trust 2019](#)). CZMAI is a statutory body within the government responsible for the development



**Fig. 5.** Visual depiction of the tourism institutions involved in fisheries in Belize. Asterisk indicates statutory body in the government sector. Sources: key informant interviews, participant observations and review of secondary data.

and implementation of coastal zone management (CZM) strategies in Belize ([Coastal Zone Management Authority and Institute 2019](#)).

#### 4.1.2. Tourism sector

The key informant interviews, participant observation and review of secondary data revealed three main tourism sector institutions involved in fisheries management in Belize: The Belize Tourism Board (BTB, [Belize Tourism Board 2020](#)), the Belize Tourism Industry Association (BTIA, [Belize Tourism Industry Association 2020](#)) and the Belize Hotel Association (BHA, [Belize Hotel Association 2020](#), Fig. 5). The tourism sector is included in this paper for a variety of reasons: A) fishers sell their catch to restaurants, resorts and hotels, B) many fishers are also tour guides (they even take tourists out to go recreational fishing, thereby relying on “healthy” marine ecosystems for guests), and C) they are a big economic and decision-making stakeholder in determining, expanding, and enforcing marine protected areas.

Both the BTB and BTIA act as connections between the private and public sectors of the tourism industry. As previously stated, the BTB is a statutory body within the Ministry of Tourism (government sector) that acts as a strategic partner between the government and the private tourism sector. It develops, markets and implements tourism programs to fulfill the emerging needs of local and international tourism markets. The organizational structure of BTB includes branches such as Marketing and Industry Relations, Destination Planning and Cruise, Information Technology, and Finance ([Belize Tourism Board 2020](#)). The BTIA is an umbrella organization for the tourism industry's private sector because it has representation on almost every government, legislative, advisory and consultative committee. BTIA is governed by a president and board of directors while the management of everyday operations is led by an executive director and secretariat ([Belize Tourism Industry Association 2020](#)).

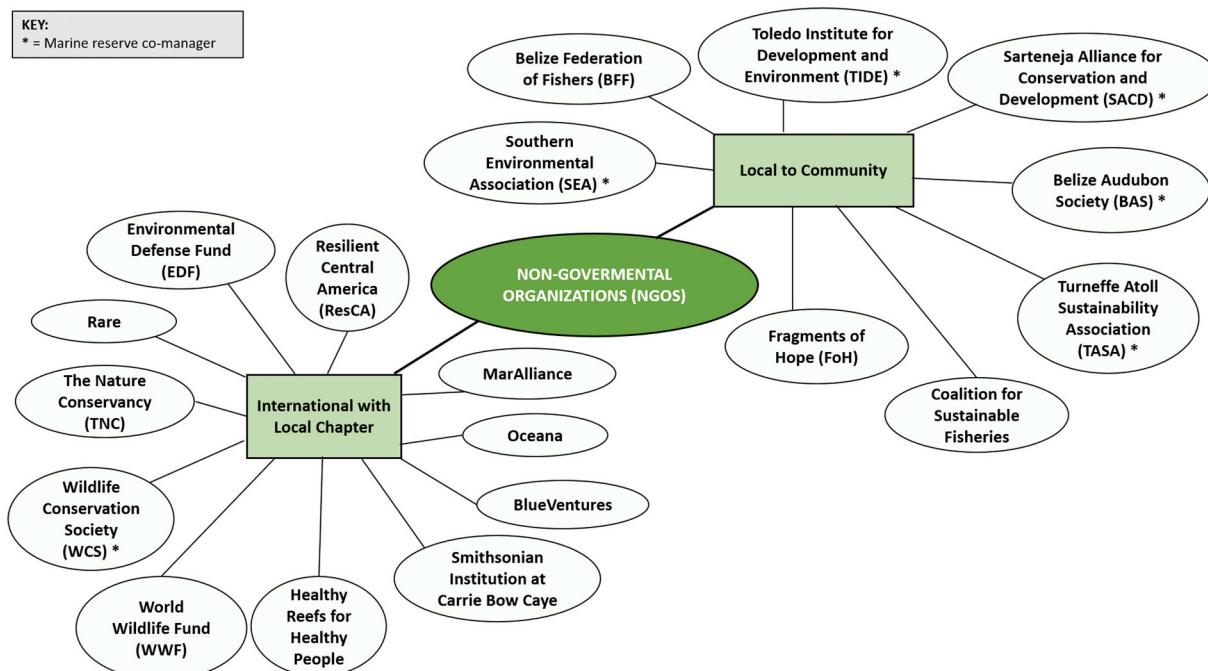
Both the BTB and BTIA represent dive shops, cultural vendors and experiences, tour operator associations, tour operators, tour guide associations, tour guides, and hotels. All tour guides and tour operators do not have to be members of their respective associations, but they need to be registered with the BTB. The cruise industry is only represented by

the BTB while sports fishing guides are only represented by the BTIA. The BTIA also has local chapters based on the destination, including (but not limited to) those in San Pedro, Caye Caulker, Cayo, and Corozol ([Belize Tourism Industry Association 2020b](#)). Lastly, the BHA is a non-profit, NGO and Belize's oldest private sector tourism organization. It supports the sustainable growth of member hotels and the tourism industry in Belize via marketing initiatives, inter-and intra-sector partnerships and training services. Its membership includes educational facilities, resorts, lodges, condominiums, homestays and hotels ([Belize Hotel Association 2020](#)).

#### 4.1.3. Environmental non-governmental organization (NGO) sector

The NGOs included in this paper focus on the environment and sustainability, and are not exhaustive of all NGOs in Belize. However, since the early 1990s, local and international NGOs have been working in Belize to promote the environmental conservation and sustainability of natural resources (Figs. 1 and 6). Some NGOs are also co-managers of marine reserves with the Belize Fisheries Department. For the purpose of this paper, I divided the NGOs into those that are international with a local Belize chapter, and those that are local to a community or region within Belize. Making that distinction is important when considering the institutional stability, resources, and governance potential of all of these NGOs. Through many semi-structured interviews with key informants, participant observation and detailed review of secondary data, I describe the NGOs involved in coastal resource management and conservation in Belize (Fig. 6).

Many of the NGOs local to a community focus on particular regions, marine reserves or a combination of the two. Many combine research, environmental monitoring, enforcement of fisheries policies, environmental outreach, and community development. The NGOs are led by a suite of full-time staff members, and overseen by boards of directors, which consist of community members, and representatives from the tourism and fisher sectors. The Southern Environmental Association (SEA) is based in Placencia, Belize, and is a co-manager of the Gladden Spit and Silk Cayes Marine Reserve (GSSCMR) and Laughing Bird National Park (LBNP, [Yello Belize 2020](#)). The Belize Federation of Fishers



**Fig. 6.** Visual depiction of the environmental non-governmental organizations (NGOs) involved in fisheries management in Belize. About half of them are local to a community in Belize, while the other half are international organizations with local chapters. Asterisk indicates an organization is a co-manager of a marine reserve (with the Belize Fisheries Department). Sources: key informant interviews, participant observations and review of secondary data.

(BFF) is an umbrella organization that represents many individual fishers and fisher associations, but not all of them. Membership to BFF is voluntary. The BFF is led by an executive managing committee of 16 community representatives, many of whom are in leadership positions in their communities and fisher associations. The BFF was registered as a fisher community-focused conservation organization for commercial fishers in 2011, and incorporated in 2013 ([BFFishers 2015](#)). The Toledo Institute for Development and Environment (TIDE) is based in Punta Gorda, Belize, and works primarily in the Maya Mountain Marine Corridor of southern Belize. TIDE co-manages the Port Honduras Marine Reserve (PHMR) with the Fisheries Department, co-manages Payne's Creek National Park, and manages TIDE Private Protected Lands ([TIDE 2020](#)).

The Sarteneja Alliance for Conservation and Development (SACD) is based in Sarteneja, Belize, and serves the stakeholder communities of the Corozal Bay Wildlife Sanctuary (CWBS, [SACD Belize 2020](#)). The Belize Audubon Society (BAS) is another NGO co-manager of Lighthouse Reef Atoll, where the Belize Blue Hole and Half Moon Caye are located. BAS is headquartered in Belize City and is the oldest environmental NGO in Belize, having been founded in 1969 ([Belize Audubon Society, 2015](#)). The Turneffe Atoll Sustainability Association (TASA) is also located in Belize City, and it co-manages the Turneffe Atoll Marine Reserve (TAMR, [Turneffe Atoll Marine Reserve 2020](#)). The Coalition for Sustainable Fisheries was formed in 2018 primarily to advocate for a gillnet ban throughout Belize and consists of conservation organizations, tourism operators, and sports and commercial fisherfolk ([The Coalition for Sustainable Fisheries, 2020](#)). Fragments of Hope (FoH) is another NGO local to Belize, which focuses on coral restoration projects and sustainable management of coastal habitats ([Fragments of Hope, Belize Ltd. 2015](#)).

On the other hand, international environmental NGOs with chapters in Belize focus on a variety of environmental issues, both marine and terrestrial, and their international status enables them to leverage broader resources. Many of these international organizations combine science-based conservation work with stakeholder engagement and community development. They often collaborate with many of the Belizean-based NGOs, fisher communities and government agencies to meet common conservation goals. One such environmental NGO is Healthy Reefs for Healthy People, with projects across the entire Mesoamerican Barrier Reef System (MBRS), in Mexico, Belize, Guatemala and Honduras ([Healthy Reefs 2020](#)). Healthy Reefs collaborates with NGOs and government agencies to co-produce annual ecological monitoring "Report Cards" on the status of the MBRS. MarAlliance is another international NGO, based in Sarteneja, Belize, which focuses on improving the conservation of threatened marine species and their habitats, most notably sharks and rays. They have other projects across the MBRS as well as in Cabo Verde and Micronesia ([MarAlliance 2020](#)). Oceana is another international NGO with projects in Belize. Oceana was established in 1999 in the United States as an ocean advocacy group dedicated to protecting and restoring the world's oceans. Their work in Belize includes the passing of legislation banning offshore oil drilling, decreasing ocean plastic pollution and most recently, petitioning for the elimination of gill net use by fishers ([Oceana 2020](#)). Blue Ventures also works Belize on grassroots marine conservation initiatives ([Blue Ventures Conservation, 2020](#)).

Headquartered on Carrie Bow Caye is a Smithsonian Institution Field Station for their Caribbean Coral Reef Ecosystems (CCRE) Program. The Carrie Bow Field Station includes a scientific laboratory, housing for visiting scholars, SCUBA facilities, and other resources for long-term monitoring of the Belize Barrier Reef System. The World-Wide Fund (WWF, formerly World Wildlife Fund) is another international organization that has been working in Central America since 1987. They were instrumental in the establishment of Belize's first MPA, the Hol Chan Marine Reserve. Since then, they have been involved in developing a season for spiny lobster, developing the Turneffe Atoll as an MPA and in the completion of Belize's National Integrated Coastal Zone

Management Plan ([World Wide Fund for Nature 2020](#)). The Wildlife Conservation Society (WCS) has also been working in Belize for several decades, with projects including improved enforcement of fishing regulations, education and outreach programs, and spawning aggregations research. WCS is also the only international organization that serves as a co-manager of the Glover's Reef Marine Reserve (GRMR) with the Belize Fisheries Department ([Wildlife Conservation Society, 2020](#)).

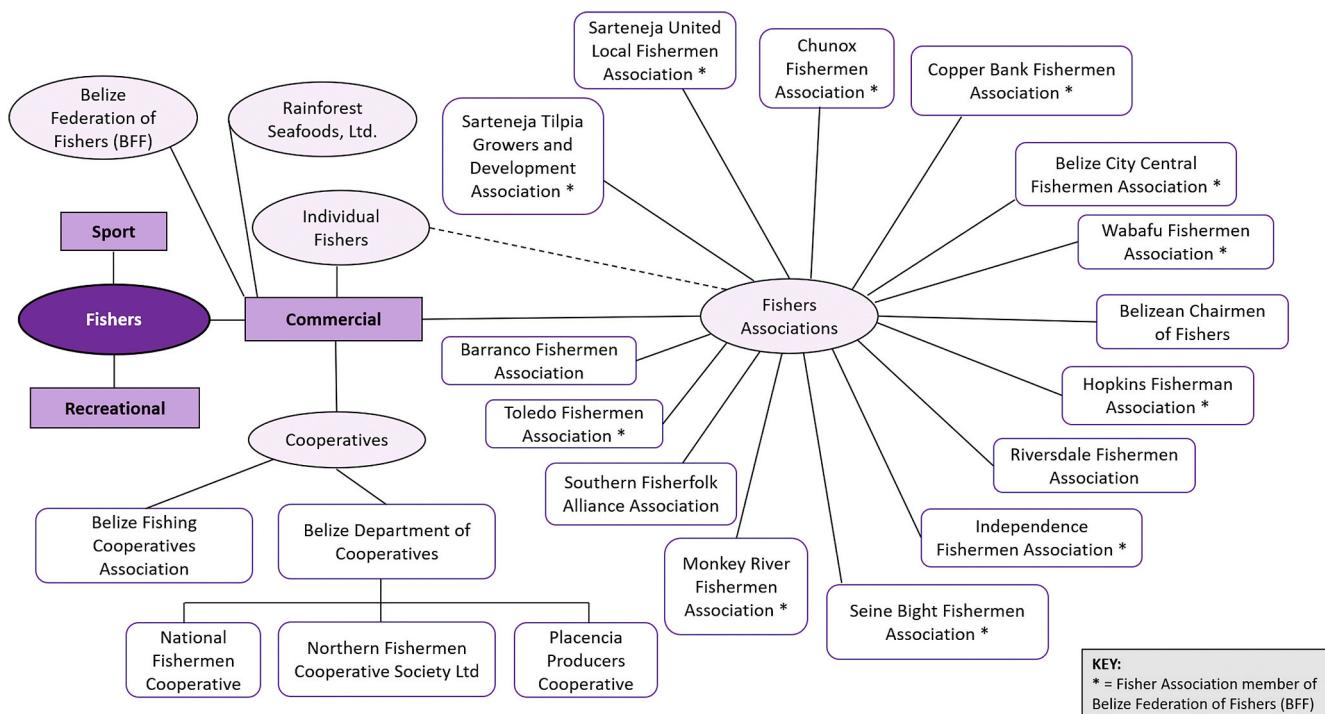
The Nature Conservancy (TNC) has been working in Belize since 1991, on projects ranging from seaweed aquaculture to seafood traceability in cooperatives ([The Nature Conservancy 2020](#)). They are working closely with Resilient Central America (ResCA) to improve seafood traceability at the National Fishermen Cooperative in Belize City ([The Nature Conservancy 2019, 2020](#)). The Environmental Defense Fund (EDF), and Rare collaborated with the government, NGOs, and fisher communities to transition fisheries management from an open-access regime to the rights-based/TURF program Managed Access from 2009 to 2017. They have also been integral in the development of the new Fisheries Resource Bill of 2020 ([Environmental Defense Fund, 2020; Rare 2020](#)).

#### 4.1.4. Fishers sector

From key informant interviews and participant observation, I divided the fishers sector into three broad categories with unique license requirements: sport, recreational, and commercial ([Fig. 7](#)). Sport fishers are required to have a specific license to participate in catch-and-release of these species: tarpon, permit, bonefish, and snook. Recreational fishers do not need licenses. As of July 2016, all commercial fishers are required to obtain a Managed Access license, which grants them rights to fish in 1–2 of the areas outlined in [Fig. 1](#) ([Belize Fisheries Department 2015, 2019](#)). All fishers are required to abide by the coastal zone management rules and follow guidelines for marine reserves (i.e. they are not allowed to extract marine products where it is prohibited). All three of these groups of fishers can economically benefit from their fishing activities, because commercial fishers sell their marine product to formal and informal markets within Belize, and the sport and recreational fishers often rely on income related to the tourism sector (source: key informant interviews and participant observation).

Commercial fishers include individual fishers, fishers' associations (of which many are a part), Rainforest Seafoods, Ltd., cooperatives, and the Belize Federation of Fishers (BFF). The Belize Federation of Fishers was previously described. Many fishers are members of – and therefore sell their product to – one or all of the following fishing cooperatives: National Fisherman Cooperative (in Belize City), the Northern Fishermen Cooperative (in Independence/Mango Creek and Belize City), and the Placencia Producers Cooperative. These three cooperatives fall under the governing body, the Belize Department of Cooperatives. National and Northern Fishermen Cooperatives purchase only lobster and conch, primarily for export, while Placencia Producers Cooperative purchases lobster, conch and finfish. For fishers to be members of these cooperatives, they must pay an annual membership fee. Fishers benefit from cooperative membership by not only getting competitive prices for marine products, but also opportunities for small grants, raffles, and professional development. Fishers can also choose to sell lobster and conch to Rainforest Seafoods, which has collection facilities in Mango Creek/Independence and Dangriga, Belize, and exports the product internationally ([Rainforest Seafoods, 2020](#)).

Providing the most direct opportunities= for fishers is participation in a fisher association. Most of the fishers' associations across Belize represent the commercial fishers of individual coastal fishing communities at regional and national scales. A complete list of the fishers associations can be found in [Fig. 7](#). Several communities have representation by multiple fisher associations. For instance, fishers engaged in aquaculture activities in Sarteneja can be represented by the Sarteneja Tilapia Growers and Development Association, and if they are also commercial fishers, be represented by the Sarteneja United Local Fishermen Association. Similarly, Dangriga has two fishers'



**Fig. 7.** Visual depiction of the fishers' organizations in fisheries management in Belize. Note this figure primarily focuses on the commercial fishing sector. Asterisk indicates Fisher Associations as members of the Belize Federation of Fishers (BFF). Sources: key informant interviews, participant observations and review of secondary data.

associations: the Wabafu Fisherman Association (“Wabafu” is a Garifuna word meaning “people power”) and the Belizian Chairmen of Fishers. In the Toledo District, and around Punta Gorda Town, fishers are represented by the Toledo Fishermen Association, and the Southern Fisherfolk Alliance Association. To be a functioning fisher association, there needs to be regular fee-paying membership, annual meetings, and meetings throughout the year. Executive meetings must also be held where records of the meetings are maintained and shared with the membership (source: key informant interviews).

Individual fishers may be members of one fisher association, 1–2 cooperatives, and the BFF (by way of their fisher association), any combination, or not represented by any of these organizations. Membership to a fisher association and/or cooperative is voluntary, and not all individual fishers are members/represented by any fisher-oriented organization. This provides a challenge when considering the equitable representation of fisher's needs at local, regional, and national scales (i.e. some voices and viewpoints will be excluded due to this structure).

#### 4.1.5. Summary

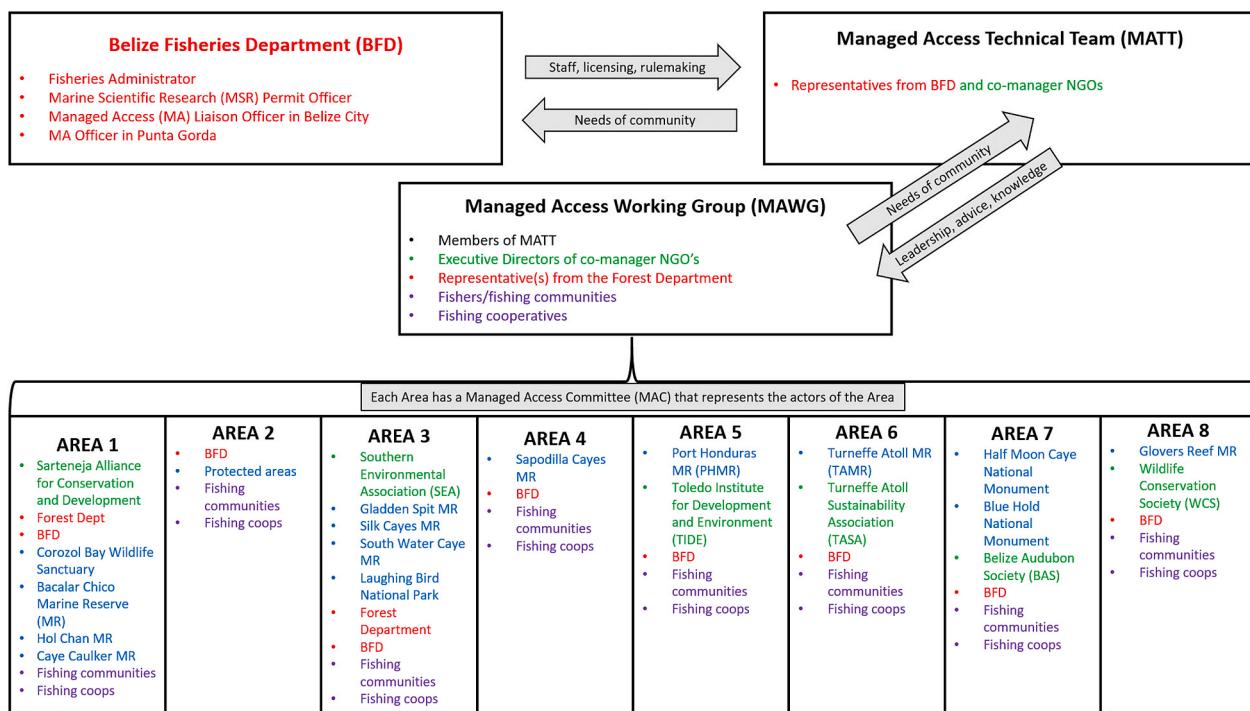
Overall, the governmental, tourism, NGO, and fishers sectors involved in fisheries management in Belize demonstrate highly polycentric, nested, and decentralized institutions. In total, there are 16 governmental institutions housed within six ministries all involved in the rulemaking, enforcement, and oversight of different aspects of fisheries management in Belize. The tourism sector is represented by three primary institutions, but they represent the breadth of actors involved in tourism at local and national scales. The NGO sector is vast, with international ( $n = 11$ ) and local ( $n = 8$ ) agencies invested in environmental and fisheries sustainability in Belize. Because many of the NGOs are involved in their local communities, and because decision-making and implementation of policies occurs at the local level, independent of one another, a decentralized structure is represented by these entities. Lastly, the fishers sector represents a complex arrangement of cooperatives, fisher associations, and individual interest groups, which

demonstrates the varying degrees of self-organization and collective action potential of the actors here.

#### 4.2. The enforcement and monitoring of Belize's Managed Access program is decentralized

From 2017-present, I conducted 57 key informant interviews to describe and understand the institutional framework for the enforcement and monitoring of the Managed Access program (Fig. 8). In Fig. 8, the Belize Fisheries Department (BFD) is depicted as the highest governing body because the BFD sets the rules and regulations for the licensing process, logbook reporting, and enforcement of MA (Belize Fisheries Department 2015, 2019). The individuals representing the BFD in this depiction include the Fisheries Administrator, who oversees the entire BFD. Working closely with her are the Marine Scientific Research (MSR) Permit Officer, and the Managed Access Liaison Officers in Belize City and Punta Gorda. The decision-making and implementation of fisheries management in Belize (Fig. 8) is decentralized (Ostrom 1990, 2010; Dietz 2003; Bardhan 2005; Chuenpagdee and Jentoft 2018) because the Belize Fisheries Department, a centralized governing body, has the final decision-making power, but the implementation of those decisions are done at the local, community-level, where each MA area is represented by its own committee. These MA committees consist of representatives from many of the sectors described in section 4.1. The basis for the MA program was to pair marine reserves with the territorial user rights for fishing (TURF) areas, so each of the eight MA areas has a marine reserve paired with it. As such, each area is [co-]managed by a government and/or NGO agency (Belize Fisheries Department 2015, 2019).

Because MA implementation was driven by a partnership between the Environmental Defense Fund (EDF) and the Belize Government, there are representatives from EDF and BFD on the Managed Access Technical Team (MATT). From 2014 to 2017 the MATT was an extension of the BFD and was responsible for implementing MA on a national level. Members of the MATT provided leadership, advice, and



**Fig. 8.** Depiction of the institutions (and individuals) involved in the co-management of the Managed Access program in Belize. Red indicates the governmental sector. Blue represents marine reserves and/or protected areas. Green represents the NGO sector. Purple represents the fishers' sector. Arrows indicate the roles and information transfer between the levels. Sources: key informant interviews, participant observations and review of secondary data. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

knowledge to those on the Managed Access Working Group (MAWG). The MAWG consists of the members of the MATT, but also the leadership (e.g., Executive Directors) of the co-manager NGOs, representatives from the Forest Department, individuals from the fisher communities, and academic partners. The role of the MAWG was to develop, implement, and oversee Managed Access (Belize Fisheries Department 2019). From 2013–15, the MAWG and BFD underwent an extensive consultation process with key stakeholders of the fishing industry to develop the framework and plan for MA implementation nationwide. The MAWG provides a link between each MA area and the BFD by providing information transfer, and resources for enforcement, licensing and logbook reporting (source: key informant interviews). The governance of each of the eight MA areas (excluding Area 9: deep water) involves diverse stakeholder groups (Fig. 8). The primary management institution for each MA area is the MA Committees, which consist of elected persons from the fishing communities, and representatives from the BFD and co-managers. The purpose of the MA Committees is to provide community leadership, scrutinize license applications, improve transparency in the license granting process, inform their communities about program updates, and assist with improved data collection and reporting (Foley 2012, Belize Fisheries Department, 2015, 2019).

Area 1 is co-managed by the Sarteneja Alliance for Conservation and Development (SACD), the Forest Department, and the BFD. SACD collaborates with the Forest Department to manage the Corozal Bay Wildlife Sanctuary. Area 1 encompasses these three marine reserves, which are all managed by the BFD: Bacalar Chico, Hol Chan and Caye Caulker. The fisher communities who mostly use Area 1 are Sarteneja, Chunox, Copper Bank, Caye Caulker, and San Pedro. Area 2 is managed by the BFD and is the only MA area that does not consist of a marine reserve. The fishing communities who mostly use Area 2 are the same as Area 1, but may also include Belize City. Area 3 is co-managed by the Southern Environmental Association (SEA), the Forest Department and the BFD. SEA manages the Gladden Spit and Silk Cayes Marine Reserve and works with the Forest Department to manage the Laughing Bird

Caye National Park. BFD manages South Water Caye, and the parts of Area 3 that are not managed by SEA or the Forest Department. The fishers that mostly use Area 3 come from these communities: Dangriga, Hopkins, Riversdale, Seine Bight, Independence, Placencia, and Monkey River.

Area 4 includes the Sapodilla Cayes Marine Reserve, which is managed by the BFD. The fisher communities that mostly use Area 4 are from Monkey River, Punta Negra, Punta Gorda, and Barranco. Area 5 is the entirety of the Port Honduras Marine Reserve (PHMR), which is managed by the Toledo Institute for Development and Environment (TIDE). TIDE works closely with the BFD to issue licenses to fishers and to improve enforcement of the area. There are general use areas of the marine reserve where fishing is allowed, but also conservation and replenishment zones, where fishing is restricted. The fishing communities who mostly use Area 5 are Monkey River, Punta Negra, Punta Gorda and Barranco. Like Area 5, Area 6 is also a marine reserve. Area 6 is the Turneffe Atoll Marine Reserve (TAMR), which is co-managed by the Turneffe Atoll Sustainability Association (TASA). The fishing communities who mostly use Area 6 are Belize City, Chunox, Caye Caulker, San Pedro.

Area 7 comprises the Lighthouse Reef Atoll, which is home to the Half Moon Caye and Blue Hole National Monuments. These sites are co-managed by the Belize Audubon Society (BASO) and the BFD. The fishers who mostly use Area 7 are from these communities: Belize City, Chunox, Caye Caulker, San Pedro, Copper Bank and Sarteneja. Area 8 is the Glover's Reef Marine Reserve (GRMR), which is co-managed by the Wildlife Conservation Society (WCS). The fisher communities who mostly use Area 8 are from Dangriga, Riversdale, Hopkins, Seine Bight, Placencia, and Independence. Area 9 is the only area that does not have a formal Managed Access Committee, and is where all fishers are allowed to fish. Area 9 is mostly deep slope fishing, which is very gear-and resource-intensive, so not many fishers go there. It is, however, being explored as a new fishery option (Belize Fisheries Department 2019).

In summary, the enforcement and monitoring of the Managed Access program in Belize is highly decentralized (Ostrom 1990; Dietz 2003; Bardhan 2005; Chuenpagdee and Jentoft 2018). This structure has implications for how decisions are made and implemented from the national levels down to the individual fisher communities. The presence of fishers, NGO leaders, and governmental representatives on each MA committee provides for improved information transfer and implementation between the local and national levels. Furthermore, having each MA area overseen by a committee enables for more equitable representation of the users of each area.

#### 4.3. Ostrom's eight design principles for long-enduring common-pool resource systems applied to Belize's Managed Access program

The results in this section suggest that fisheries management in Belize exhibits all eight of Ostrom's design principles for long-enduring CPRs (Ostrom 1990, Table 1), but some are more established than others. This leads to an imbalance of governing power and areas of improvement for the program in the long run. For instance, the MA fishing areas within Belize's exclusive economic zone (EEZ) represent the clearly defined boundaries of the resource system (Foley 2012, Fujita et al., 2017, Belize Fisheries Department, 2015, 2019), for which the provisioning rules of the actors apply. MA committees not only connect the local conditions to provisioning rules but they also give collective-choice arrangements to the fishers because they are platforms for fishers to represent the interests of their communities to natural resource managers (Belize Fisheries Department 2015, 2019 and key informant interviews). The local community-based NGOs as co-managers of marine reserves provide further connection between the local context and provisioning rule development at the national level (Belize Fisheries Department 2015, 2019 and key informant interviews). The NGOs, in collaboration with the BFD, do the majority of the monitoring and enforcement of the resource system, which takes the responsibility of monitoring away from the users (the fishers). However, fishers are quite aware of transboundary and non-licensed users in their area, leading to a potential increase in fisher-led monitoring efforts in the future. Many fishers expressed interest to me in learning more from co-managers about what they can do to help with the enforcement efforts (sources: key informant interviews and participant observation).

If users are found breaking the provisioning rules, then there are graduated sanctions in place. Currently, the BFD observes a three-strike rule; first a verbal warning, second a written warning, and third is arrest (Catzim and Walker 2013, Belize Fisheries Department, 2015; 2019, key informant interviews). However, the new Fisheries Resource Bill is much stricter and involves a multi-step process for citing infractions, providing evidence, charging, and then serving time in jail (Belize Fisheries Department 2019, key informant interviews). If a fisher receives an infraction, the MA committee may decide to deny them their commercial license in the following year (Belize Fisheries Department 2015, 2019, key informant interviews). This is a particularly important part of the devolution of power from the national to local level, where representative fishers from the fishing communities are involved in the vetting and licensing process each year. It also offers room for continued input and empowerment of fishers and their communities during the implementation of the Fisheries Resource Bill.

To resolve any conflicts that arise between resource user groups, certain mechanisms are in place, including fisher forums and outreach to fishers by co-managers. A majority of the conflicts that arise between users involves competing for access to fishing grounds, disagreements between fishers and managers, and conflicts between Belizean and transboundary fishers. Especially in southern Belize, non-licensed, non-Belizean fishers are accessing fisheries resources often at night, which causes great conflict among fishers who abide by the management rules (source: semi-structured interviews). Through my participant observation at several fisher forums, mechanisms to solve conflicts occur at least once a year between all marine stakeholders of the eight MA areas, and

**Table 1**

Ostrom's design principles for long-enduring CPRs applied to Belize's marine resource governance context.

Design Principle	Belize Context	Source(s)
1 Clearly defined boundaries	Belize's exclusive economic zone (EEZ) and the eight distinct MA areas where commercial fishers are granted access and ownership rights.	Foley (2012), Fujita et al., (2017), Belize Fisheries Department (2015), (2019)
2 Connection between local conditions and provisioning rules	The existence of MA committees, where fishers can serve and represent the interests of their communities. Local, community-based NGOs are co-managers of marine reserves. Fishers organizations and BFF represent the interests of fishers on local and national scales.	Belize Fisheries Department (2015), (2019), key informant interviews
3 Collective-choice arrangements	Fishers serving on MA committees can provide input about who gets MA license in subsequent years. Fishers were consulted during the development of MA and rewriting of the Fisheries Resource Bill. However, BFD has final say about how the resource units get accessed and used.	Belize Fisheries Department (2015), (2019), key informant interviews
4 Monitoring of resource system by users	The majority of the monitoring and enforcement are done by Fisheries Officers at BFD and NGOs. But, fishers are pretty aware of transboundary fishers and notice a non-licensed user in their area. This creates a potential for fishers to increase monitoring of areas in future.	Belize Fisheries Department (2015), (2019), participant observation
5 Graduated sanctions	Currently, there is a 3-strike rule by BFD (first is a verbal warning, second is a written warning, and third is an arrest). However, the Fisheries Resource Bill is much stricter (e.g., infractions, evidence, being charged, possible jail time, etc.). If a fisher has an infraction, they may not be able to get commercial license next year (as decided by MA committee).	Belize Fisheries Department (2015), (2019), key informant interviews
6 Conflict-resolution mechanisms	Fisher forums, which occur at least once a year between all marine stakeholders of each MA area, offer a place for information sharing between co-managers and fishers. However, from my participant observation, not all fishers attend, only a few vocal fishers voice concerns, sometimes fishers don't have enough time to speak, and they don't like seeing data visualizations.	Belize Fisheries Department (2015), (2019), participant observation

(continued on next page)

**Table 1 (continued)**

Design Principle	Belize Context	Source(s)
7 Minimal recognition of rights to organize	The Government recognizes active fishers' organizations, BFF and cooperatives and does not challenge the rights of the users to make their own institutions.	<a href="#">Belize Fisheries Department (2015, 2019)</a> , participant observation, key informant interviews
8 Nested enterprises	<a href="#">Fig. 8</a> depicts highly nested enterprises involved in governing the MA program. Fishers from local communities are often represented by fishers' associations, which advocate for them at regional and national levels. NGOs are local to villages and regions, but often serve on national committees. Included in the 2019 Fisheries Resource Bill is the development of a Fisheries Council, which will be an advisory body consisting of individuals representing the governmental, tourism, fisheries and NGO sectors, as well as someone with expertise in fisheries science and the Fisheries Administrator.	<a href="#">Belize Fisheries Department (2015, 2019)</a> , participant observation, key informant interviews

offer a place of information-sharing. However, not all fishers are in attendance, very few have the opportunity to speak, the few who do are occasionally cut short, and they do not prefer to be shown graphs of data from the co-managers. In Belize, there is minimal recognition of rights to organize as the government recognizes and does not challenge the rights of the users to self-organize by way of active fishers' organizations, the BFF, and cooperatives ([Belize Fisheries Department 2019](#), key informant interviews, participant observation).

The final design principle for long-enduring CPRs that Belize fisheries management exhibits is nested enterprises ([Ostrom 1990, Table 1](#)). Excellent examples of nested institutions can be found in [Figs. 4 and 8](#), where [Fig. 4](#) depicts each governmental agency nested within a Ministry, and [Fig. 8](#) demonstrates that the governance of each MA area is nested within the Managed Access Working Group, the Managed Access Technical Team, and all overseen by the Belize Fisheries Department. Furthermore, in the near future, a Fisheries Council will be formed, consisting of representatives from the government, tourism, fisheries and NGO sectors, an expert in fisheries science, and the Fisheries Administrator. These entities will be nested under the umbrella of the Fisheries Council, which will be an established advisory body to make recommendations to the Minister of Agriculture, Fisheries, Forestry, the Environment and Sustainable Development ([Belize Fisheries Department 2019](#)).

In summary, fisheries management in Belize demonstrates all eight components of a long-enduring CPR system, as defined by [Ostrom \(1990\)](#), suggesting the actors have the potential to overcome collective action problems in the long run. There are (1) clearly defined boundaries of the resource system, (2) a connection between local conditions and provisioning rules, (3) collective-choice arrangements by the fishers on MA committees, (4) monitoring of the resource system by the users, (5) graduated sanctions in place for rule infractions, (6) conflict-resolution mechanisms, (7) minimal recognition of rights to organize by the government, and (8) nested enterprises ([Ostrom 1990, Table 1](#)). While the nationwide MA program in Belize is less than a decade-old in action, the presence of all eight CPR design principles suggests it can be a

sustainable program well into the future.

## 5. Discussion

### 5.1. Belize's fisheries management policies demonstrate institutional robustness

Through extensive review of primary and secondary literature, semi-structured interviews with key informants, and participant observation, this study examines the institutional robustness of Belize's fisheries management strategies. Applying Ostrom's design principles for long-enduring CPRs to the context in Belize provides a method of comparison among other common-pool resource systems. The results of this study indicate that fisheries institutions are robust and resilient to future shocks due to their polycentric, decentralized, and nested governance structure ([Chuenpagdee and Jentoft 2018](#)). For example, fisheries management in Belize demonstrates polycentric governance because the governmental, NGO, tourism, fishers, and academic sectors each represent the many centers of decision-making that often function independently of one another ([Ostrom et al., 1961; Ostrom 2010](#)). In the case of Belize, these various sectors each play an important role in the monitoring, decision-making, enforcement and provisioning rules in the common pool resource system ([Ostrom 2010](#)). Polycentric fisheries governance has been found to overcome several limitations found in other systems because it promotes broad levels of stakeholder engagement, increases policy freedom at local levels and ensures governance responses are implemented at appropriate scales ([Cvitanovic et al., 2018](#)).

However, the institutions involved in fisheries management in Belize also function in a decentralized way because the decision-making power is distributed to those at the local community level ([Ostrom 1990, Dietz et al., 2003; Bardhan 2005](#)). For example, TIDE co-manages the Port Honduras Marine Reserve in southern Belize by working closely with fishers from several communities (Punta Gorda, Punta Negra, Monkey River, and Barranco). As an institution, TIDE builds trust with the fishers while also communicating their needs to the Belize Fisheries Department. Decentralization has been found to be a very effective tool in effective governance of natural resources because it takes the strain off of centralized forms of governance while granting the decision-making power to the users of the system ([Ostrom 1990; Dietz et al., 2003; Bardhan 2005; Wright et al., 2016](#)).

Further contributing to institutional robustness is the nested nature of several key institutions involved in fisheries management in Belize ([McCabe and Feiock 2005; Ostrom, 2010](#)). Like previously described, each government agency is nested within a Ministry, which oversees multiple agencies with similar objectives and provides for linkages between such agencies. The fishers' sector is another nested enterprise, where individual fishers can be represented by fishers associations local to their community, and then several fishers associations are a part of the Belize Federation of Fishers (BFF), which represents fishers at the national level. This nesting can lead to improved stability in the face of global change and ongoing stresses ([Chuenpagdee and Jentoft 2018](#)). Therefore, if polycentric, decentralized and nested governance structure exists in fisheries management institutions, as it does in Belize, then we may expect institutional robustness and resilience to shocks in the future ([Chuenpagdee and Jentoft 2018](#)).

### 5.2. Belize has the potential to be a long-enduring common pool resource system

This study demonstrates that Belize contains the necessary institutions in place to become a long-enduring CPR system and potentially overcome obstacles to collective action. While fisheries management policies in Belize represent all eight of Ostrom's design principles for long-enduring CPRs ([Ostrom 1990](#)), these three components could be improved upon to achieve further institutional stability:

the monitoring of the resource system by the users, conflict-resolution mechanisms, and minimal recognition of rights to organize. More time and resources are likely needed to fully implement these components of community-based management in Belize.

For example, in a comparison of Hawaii's community-based subsistence fisheries area legislation to that of American Samoa, the program in American Samoa comprised more of the design principles, primarily due to the successful implementation of its program (Levine and Richmond 2015). The Hawaii program has the potential to consist of the common-pool resource design principles, but only if effective institutions are in place (Levine and Richmond 2015). My study demonstrates that Belize has a variety of institutions and a diverse governance structure to ensure the design principles endure in the long-term. In two additional co-managed fisheries, one in Kenya and one in Madagascar, Cinner et al. (2009) found their systems to also be lacking several design principles to overcome CPR problems. Monitoring of resources and surveillance were two of the missing components of these co-management regimes, while clearly defined geographic boundaries, collective choice arrangements, graduated sanctions and nested enterprises were partially implemented (Cinner et al., 2009). Like in Belize, monitoring and surveillance were two components in Kenya and Madagascar co-managed fisheries needing improvement, demonstrating the challenge of encouraging users to become more involved in the monitoring and surveillance of the resource system. This study provides a jumping-off point for future analysis of fisheries institutions in Belize and a basis of comparison for other common-pool resource systems globally.

### 5.3. Fisher associations are mechanisms for collective action

The fishers' associations in Belize and other small-scale fisheries contexts are platforms for fishers to engage in collective action. They are self-organizing, where several motivated individuals recognize a need for increased representation at the local, community-level (Ostrom 2003). Because Belize has a wide range of fishers' associations, ranging geographically across the country, the likelihood of fisher representation at local levels is much higher than if there were very few associations (Partelow et al., 2020). However, not all commercial fishers are members of fisher associations, leading to discrepancies in equity, inclusivity, and representation across geographic scales. Therefore, some voices are lost while others are amplified. The inequitable representation of fishers by fisher associations can also lead to corruption (Hanich and Tsamenyi 2009; Cross 2016; Nunan et al., 2018) and biases in the decision-making processes (Semitiel-García and Noguera-Méndez 2019).

The self-organization of resource users into associations has the potential for individuals to build social capital and facilitate cross-level governance (Brondizio et al., 2009). Fisher associations can provide a platform for individual fishers to build trust within their communities and advocate for themselves at the national level, particularly with the NGO and governmental sectors. Fisher associations and cooperatives offer benefits to members that otherwise would not be available to non-group members (Uchida 2017). In a freshwater fishery in the Amazon, fishers identified a need for regulating their fisheries when the state failed to provide them with effective institutions to do so. Over time, this decentralized, community-based management led to protection of freshwater fish populations and stabilized livelihoods (Pinho et al., 2012). Similarly, in the Scotia-Fundy region of coastal Canada, fishers became more involved in the management and monitoring of marine resources by participating in fisher's association (Wiber et al., 2004).

Furthermore, inland fishers in Bangladesh who participated in a community-based fisheries management (CBFM) regime had greater access to fisheries resources and improved livelihoods compared to non-CBFM participating fishers (Islam and Yew 2013), demonstrating the livelihood benefits of participatory fisheries management. In small-scale

fisheries contexts where fisher associations are lacking, but that have horizontal and vertical linkages held by community-based organizations, as was the case in Jamaican marine reserves, collective action may not be sustained well into the future (Alexander et al., 2015). Belize's Managed Access program offers a potential solution to collective action problems because of the rights-based nature of the program, which gives access and governance rights to the users of the system (Viana et al., 2018; Barner et al., 2015; Catzim and Walker 2013).

### 5.4. Complexity in information transfer and collaboration between institutions

However promising Ostrom's CPR design principles are in Belize, there is incredible complexity in information transfer and collaboration between institutions, which has implications on management, economy, environment, and institutional stability. Often, different sectors work together and act as nested enterprises (McCabe and Feock, 2005; Ostrom, 2010). One example of that is the Nature Conservancy working closely with ResCa (both NGOs) to improve the seafood market traceability of the fishers who sell their product at the National Fishermen Cooperative. They are maximizing on the economic incentive of fishers to accurately report their catch. Through this, they are making up for shortcomings in the logbook reporting process by the Belize Fisheries Department. This is an example of smaller scale institutions (the NGOs and cooperatives) filling the gaps that exist in the government's capacity to accurately conduct stock assessments. It is therefore imperative for policymakers to receive accurate numbers of catch per unit effort by fishers so they may set feasible and data-driven catch limits (Schiermeir 2002; Reddy et al., 2013; Carruthers et al., 2014).

The membership of the Belize Federation of Fishers (BFF) is another example of complex institutional cross-over and information transfer. Those who serve on the leadership board of BFF are also in positions of power in the fisher associations and serve on the MA committees. They are therefore in charge of deciding who gets commercial licenses for their areas and are involved in advocating for their communities on a national level. By nature of this design, there is exclusion from the benefits of BFF organization. Fishers who are not members of fisher associations and fisher associations not members of BFF are excluded from the advocacy benefits provided by BFF. Furthermore, there are certain costs and benefits to having the same individuals serving on BFF for multiple years. Having the same individuals involved provides the benefits of improved information transfer, maintained trust, and not many changes in the structure, e.g., shocks (Wiber et al., 2004; Foley 2012; Wade et al., 2019). On the other hand, having the same individuals in these positions excludes others from the chance of being involved, therefore leading to uneven representation, exclusion, and missing voices (Bodwitch 2017). It could also increase the likelihood of corruption and biases in decision-making, as the same individuals making the decisions could be advancing their own agenda(s) rather than advancing the needs of the collective "group" they represent (Hanich and Tsamenyi 2009; Cross 2016; Nunan et al., 2018, Semitiel-García and Noguera-Méndez, 2019).

There is also a connection between fishers, the tourism industry, and the government, because many fishers, particularly those in southern Belize, are also tour guides. By becoming tour guides, fishers become stewards of their local environment, sharing their knowledge of the marine system with others (Bennett et al., 2018). However, such opportunities are highly location-specific and not available for all commercial fishers across Belize. This discrepancy leads to conflict among fishers in the same or neighboring communities (sources: key informant interviews, participant observation). Furthermore, to work as tour guides, fishers must attend training sessions and receive their license from the Belize Tourism Board (BTB) and the Belize Tourism Industry Association (BTIA). The license and training are also pretty costly, and require annual fees to be renewed. These policies demonstrate the integration between the governmental, tourism and fisheries sectors, but

also that becoming a fisher-tour guide has its own slew of complexities in policies and agency.

## 6. Conclusion

This case study demonstrates that over 40 years, Belize has developed polycentric, decentralized and nested institutions to sustainably manage its fisheries and coastal resources. This variety in governance structure can potentially lead to Belize overcoming the collective action problems associated with its fisheries being a common pool resource system (Olson 1965; Ostrom 1990, 2003; Ostrom et al., 1999; Levine and Richmond 2015). The partnerships across scale between local NGOs, fishers' associations, and the federal government are examples of cross-scale linkages that contribute to overall institutional stability, robustness, and improved information transfer across scale (Cudney-Bueno and Basurto 2009; Chuenpagdee and Jentoft 2018). All actors of this resource system are encouraged to engage in collective action to reach shared sustainability goals (Urquhart et al., 2014; Valdés-Pizzini et al., 2012).

An additional challenge to sustainable fisheries management in Belize is implementing the new Fisheries Resource Bill amid the ongoing COVID-19 pandemic. The pandemic led to small-scale coastal fisheries adapting to the market disruptions, increased health risk of fishers, processors, and communities, and exacerbated vulnerabilities to other stressors (Bennett et al., 2020). Because fisheries management in Belize is already institutionally robust, I am confident resource users and managers are continuing to collaborate to meet shared sustainability and livelihood outcomes. However, projecting into the future, the successful implementation of the Fisheries Resource Bill will require long-term buy-in by the fisherfolk and improved inclusion of them in the management processes. I suggest that the new bill should be implemented by maximizing the existing institutional structure, drawing upon the strengths of the local NGOs, enhanced participation by the fishers, and in valuing interagency partnerships. The Fisheries Council will ensure that a variety of voices across institutional and geographic scales will be heard during the adaptive management process (Belize Fisheries Department 2019). While Belize is not unique in its evolving natural resource management policies, it can become a global leader in sustainable fisheries.

## Funding sources

This work was supported through financial funding provided by the National Science Foundation Graduate Research Fellowship (# DGE-1650116), the Women Divers Hall of Fame, the National Geographic Society, the Rufford Foundation, and the Carolina Center for Public Service and Institute for the Study of the Americas at the University of North Carolina at Chapel Hill. This work was approved by the UNC Institutional Review Board (# 18-0413).

## Declaration of competing interest

The author declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgements

I am thankful for the many individuals who assisted with understanding the complexity of fisheries management in Belize, who made this work possible, and whose expertise I synthesize here. I acknowledge that the fieldwork component of this project was done on the ancestral land of the Mayan people. I thank the Belize Fisheries Department (BFD) and Institute for Social and Cultural Research (ISCR) at National Institute of Culture and History (NICH) for their support and for providing research permits (# 000032-19 and ISCR/H/2/81). I am grateful for the

guidance from those at Toledo Institute for Development and Environment (TIDE), the Turneffe Atoll Sustainability Association (TASA), the Environmental Defense Fund (EDF), the Southern Environmental Association (SEA), the Wildlife Conservation Society (WCS), the Caye Caulker Marine Reserve, The Nature Conservancy (TNC), MarAlliance, and the Environmental Research Institute at the University of Belize. Special thanks to the many individual fishers and those at the following Fishers Associations who spent time discussing their experiences with me: Wabafu Fishers Association, Belizean Chairmen of Fishers, Seine Bight Fisher Association, Monkey River Fishermen Association, Barranco Fisher Association, Southern Fisherfolk Alliance Association, Hopkins Fisherman Association, the Placencia Producers Cooperative, and Rainforest Seafoods. I am particularly thankful to R. Kramer, E. Havice, C. Mahung and D. Garcia, and to two anonymous reviewers, whose thoughtful feedback greatly improved the quality of this manuscript.

## References

- Ministry of Food, Agriculture, and Immigration, 2017a. Cooperative department. <http://www.agriculture.gov.bz/cooperative/>. Accessed 30 March 2020.
- Aceves-Bueno, E., Cornejo-Donoso, J., Miller, S.J., Gaines, S.D., 2017. Are territorial use rights in fisheries (TURFs) sufficiently large? *Mar. Pol.* 78, 189–195.
- Alexander, S.M., Armitage, D., Charles, A., 2015. Social networks and transitions to co-management in Jamaican marine reserves and small-scale fisheries. *Global Environ. Change* 35, 213–225.
- Anderson, C.M., Uchida, H., 2014. An experimental examination of fisheries with concurrent common pool and individual quota management. *Econ. Inq.* 52, 900–913.
- Armitage, D., De Loë, R., Plummer, R., 2012. Environmental governance and its implications for conservation practice. *Conserv. Lett.* 5, 245–255.
- Armitage, D., Charles, A., Berkes, F., 2017. Governing the Coastal Commons: Communities, Resilience and Transformation. Routledge, New York, NY.
- Belize Audubon Society, 2015. Belize Audubon society. <http://www.belizeaudubon.org/membership.html>. Accessed 30 March 2020.
- Ayer, A., Fulton, S., Caamal-Madrigal, J.A., Espinosa-Tenorio, A., 2018. Halfway to sustainability: management lessons from community-based, marine no-take zones in the Mexican Caribbean. *Mar. Pol.* 93, 22–30.
- Bardhan, 2005. Political Economy and Credible Commitment: a Review.
- Barner, A.K., et al., 2015. Solutions for recovering and sustaining the bounty of the ocean: combining fishery reforms, rights-based fisheries management, and marine reserves. *Oceanography* 28, 252–263.
- Basurto, X., Gelcich, S., Ostrom, E., 2013. The social-ecological system framework as a knowledge classificatory system for benthic small-scale fisheries. *Global Environ. Change* 23, 1366–1380.
- Belize Ministry of National Security, 2016a. Belize coast guard. <https://bcg.gov.bz/>. Accessed 30 March 2020.
- SACD Belize, 2020. Sarteneja alliance for conservation and development. <http://www.sacdbelize.org/>. Accessed 30 March 2020.
- Yello Belize, 2020. Welcome to SEA Belize. <http://www.seabelize.org/>. Accessed 30 March 2020.
- Belize Agricultural Health Authority, 2020. Baha. <http://baha.org.bz/>. Accessed 30 March 2020.
- Belize Defence Force, 2020. Welcome to the Belize defence Force official website. <http://www.bdf.mil.bz/>. Accessed 30 March 2020.
- Belize Fisheries Department, 2015. Managed Access Framework. Government of Belize.
- Belize Fisheries Department, 2019. Fisheries Resource Bill. Government of Belize.
- Belize Hotel Association, 2020. The Belize hotel association (BAHA). <https://www.belizehotels.org/>. Accessed 30 March 2020.
- Belize Ministry of National Security, 2016b. Ministry of national security. <https://mns.gov.bz/>. Accessed 30 March 2020.
- Belize Port Authority, 2019. The Belize Port Authority (BPA) continues to meet its mandate by regulating and implementing new ways to better serve the maritime interest. <https://www.portauthority.bz/>. Accessed 30 March 2020.
- Belize Tourism Board, 2020. Belize Tourism Board (BTB): a progressive institution fostering responsible development of the Tourism Industry. <https://www.belizetourismboard.org/>. Accessed 30 March 2020.
- Bennett, N.J., Whitty, T.S., Finkbeiner, E., Pittman, J., Bassett, H., Gelcich, S., Allison, E. H., 2018. Environmental stewardship: a conceptual review and analytical framework. *Environ. Manag.* 61, 597–614.
- Bennett, N.J., Finkbeiner, E.M., Ban, N.C., Belhabib, D., Jupiter, S.D., Kittinger, J.N., Manjubhai, S., Scholtens, J., Gill, D., Christie, P., 2020. The COVID-19 pandemic, small-scale fisheries and coastal fishing communities. *Coast. Manag.* 48 (4), 336–347.
- Bernard, H.R., 1998. Research Methods in Cultural Anthropology. Sage Publications, London, UK.
- BFFishers, 2015. Belize federation of Fishers. <http://bfffishers.com/>. Accessed 30 March 2020.
- Bodwitch, H., 2017. Challenges for New Zealand's individual transferable quota system: processor consolidation, Fisher exclusion, & Māori quota rights. *Mar. Pol.* 80, 88–95.

- Brondizio, E.S., Ostrom, E., Young, O.R., 2009. Connectivity and the governance of multilevel social-ecological systems: the role of social capital. *Annu. Rev. Environ. Resour.* 34, 253–278.
- Bruno, J.F., Côté, I.M., Toth, L.T., 2019. Climate change, coral loss, and the curious case of the parrotfish paradigm: why don't marine protected areas improve reef resilience? *Ann. Rev. Mar. Sci.* 11, 307–334.
- Carruthers, T.R., Punt, A.E., Walters, C.J., MacCall, A., McAllister, M.K., Dick, E.J., Cope, J., 2014. Evaluating methods for setting catch limits in data-limited fisheries. *Fish. Res.* 153, 48–68.
- Catzim, N., Walker, Z., 2013. Assessment of the effectiveness of managed access implementation in Glover's reef marine reserve and port Honduras marine reserve. In: Report: Toledo Institute for Development and Environment, Wildlife Conservation Society, Environmental Defense Fund, and the Fisheries Department.
- Christie, P., White, A.T., 2007. Best practices for improved governance of coral reef marine protected areas. *Coral Reefs* 26, 1047–1056.
- Chuenpagdee, R., Jentoft, S., 2018. Transforming the governance of small-scale fisheries. *Marit. Stud.* 17, 101–115.
- Cinner, J.E., Wamukota, A., Randriamahazo, H., Rabearisoa, A., 2009. Toward institutions for community-based management of inshore marine resources in the Western Indian Ocean. *Mar. Pol.* 33, 489–496.
- Coastal Zone Management Authority and Institute, 2019. CZMAI welcome. <https://www.coastalzonebelize.org/>. Accessed 30 March 2020.
- Wildlife Conservation Society, 2020. WCS Belize. <https://belize.wcs.org/>. Accessed 30 March 2020.
- Costello, C., Gaines, S., Lynham, J., 2008. Can catch shares prevent fisheries collapse? *Science* 321, 1678–1681.
- Cross, H., 2016. Displacement, disempowerment and corruption: challenges at the interface of fisheries, management and conservation in the Bijagós Archipelago, Guinea-Bissau. *Oryx* 50, 693–701.
- Cudney-Bueno, R., Basurto, X., 2009. Lack of cross-scale linkages reduces robustness of community-based fisheries management. *PloS One* 4 (7), e6253.
- Belize Customs and Excise, 2018. Belize Customs and Excise: Customs fostering sustainability for people, prosperity and the planet. <http://www.customs.gov.bz/index.html>. Accessed 30 March 2020.
- Cvitanovic, C., Hobday, A.J., McDonald, J., Van Putten, E.I., Nash, K.L., 2018. Governing fisheries through the critical decade: the role and utility of polycentric systems. *Rev. Fish Biol. Fish.* 28, 1–18.
- Devex, 2020. Belize police department. <https://www.devex.com/organizations/belize-police-department-137625>. Accessed 30 March 2020.
- Dietz, T., Ostrom, E., Stern, P.C., 2003. Struggle to govern the commons. *Science* 302, 1907–1912.
- Environmental Defense Fund, 2020. EDF. <https://www.edf.org/>. Accessed 30 March 2020.
- FAO (Food and Agriculture Organization of the United Nations), 2014. The State of World Fisheries and Aquaculture: Opportunities and Challenges. Food and Agricultural Organization of the United Nations, Rome, p. 243.
- Foley, J.R., 2012. Managed access: moving towards collaborative fisheries sustainability in Belize. In: Proceedings of the 12th International Coral Reef Symposium, Cairns, Australia, pp. 9–13.
- Fragments of Hope, Belize Ltd, 2015. Fragments of Hope. <http://fragmentsofhope.org/>. Accessed 30 March 2020.
- Fujita, R., Epstein, L., Battista, W., Karr, K., Higgins, P., Landman, J., Carcamo, R., 2017. Scaling territorial use rights in fisheries (TURFs) in Belize. *Bull. Mar. Sci.* 93, 137–153.
- Gaines, S.D., White, C., Carr, M.H., Palumbi, S.R., 2010. Designing marine reserve networks for both conservation and fisheries management. *Proc. Natl. Acad. Sci. U.S.A.* 107, 18286–18293.
- Gelcich, S., Guzman, R., Rodríguez-Sickert, C., Castilla, J.C., Cárdenas, J.C., 2013. Exploring external validity of common pool resource experiments: insights from artisan benthic fisheries in Chile. *Ecol. Soc.* 18 (3), 2.
- Gill, D.A., Mascia, M.B., Ahmadia, G.N., Glew, L., Lester, S.E., Barnes, M., Craigie, I., Darling, E.S., Free, C.M., Geldmann, J., Holst, S., Jensen, O.P., White, A.T., Basurto, X., Coad, L., Gates, R.D., Guannel, G., Mumby, P.J., Thomas, H., Whitmee, S., Woodley, S., Fox, H.E., 2017. Capacity shortfalls hinder the performance of marine protected areas globally. *Nature* 543, 665–669.
- Gopal, S., Kaufman, L., Pasquarella, V., Ribera, M., Holden, C., Shank, B., Joshua, P., 2015. Modeling coastal and marine environmental risks in Belize: the marine integrated decision analysis system (MIDAS). *Coast. Manag.* 43, 217–237.
- Government of Belize, 2019. The Belize trade and investment development service. <https://www.belizetradeinvest.org.bz/>. Accessed 30 March 2020.
- Government of Belize, 2020. The Ministry of agriculture, fisheries, Forestry, the environment, and sustainable development and immigration services and refugees. <https://www.belize.gov.bz/Ministry/Ministry%20of%20Agriculture,%20Fisheries,%20Forestry,%20the%20Environment%20and%20Sustainable%20Development%20and%20Immigration%20Services%20and%20Refugees>. Accessed 30 March 2020.
- Hanich, Q., Tsamenyi, M., 2009. Managing fisheries and corruption in the Pacific Islands region. *Mar. Pol.* 33, 386–392.
- Huitric, M., 2005. Lobster and conch fisheries of Belize: a history of sequential exploitation. *Ecol. Soc.* 10 (1), 21.
- Huntington, B.E., Karnauskas, M., Lirman, D., 2011. Corals fail to recover at a Caribbean marine reserve despite ten years of reserve designation. *Coral Reefs* 30, 1077–1085.
- Islam, G.M.N., Yew, T.S., 2013. Property rights and access: the case of community based fisheries management in Bangladesh. *J. Agric. Sci.* 5, 164–173.
- Jackson, J.B.C., Kirby, M.X., Berger, W.H., Bjorndal, K.A., Boomsma, L.W., Bourque, B.J., Bradbury, R.H., Cooke, R., Erlandson, J., Estes, J.A., Hughes, T.P., Kidwell, S., Lange, C.B., Lenihan, H.S., Pandolfi, M., Peterson, C.H., Steneck, R.S., Tegner, M.J., Warner, R.R., Pandolfi, J.M., 2001. Historical collapse overfishing of and the recent coastal ecosystems. *Science* 293, 629–638.
- Karlsson, M., Bryceson, I., 2016. Continuity and change: understanding livelihood shifts and adaptation in coastal Belize 1830–2012. *Local Environ.* 21, 137–156.
- Karr, K.A., Fujita, R., Carcamo, R., Epstein, L., Foley, J.R., Fraire-Cervantes, J.A., Gongora, M., Gonzalez-Cuellar, O.T., Granados-Dieseldorf, P., Guirjen, J., Weaver, A.H., Licón-González, H., Litsinger, E., Maaz, J., Mancao, R., Miller, V., Ortiz-Rodríguez, R., Plomozo-Lugo, T., Rodriguez-Harker, L.F., Rodríguez-Van Dyk, S., Stavrinakis, A., Villanueva-Aznar, C., Wade, B., Whittle, D., Kritzer, J.P., 2017. Integrating science-based co-management, partnerships, participatory processes and stewardship incentives to improve the performance of small-scale fisheries. *Front. Mar. Sci.* 4, 345.
- Levine, A., Richmond, L., 2015. Using common-pool resource design principles to assess the viability of community-based fisheries co-management systems in American Samoa and Hawai'i. *Mar. Pol.* 62, 9–17.
- Olson, 1965. Logic of Collective Action. Public Goods and the Theory of Groups. Harvard University Press, Cambridge, MA. Ch. 1 and 2.
- MarAlliance, 2020. MarAlliance. <https://maralliance.org/>. Accessed 30 March 2020.
- McCabe, B.C., Feiock, R.C., 2005. Nested levels of institutions: state rules and city property taxes. *Urban Aff. Rev.* 40, 634–654.
- McDonald, G., Harford, B., Arrivillaga, A., Babcock, E.A., Carcamo, R., Foley, J., Fujita, R., Gedamke, T., Gibson, J., Karr, K., Robinson, J., Wilson, Jono, 2017. An indicator-based adaptive management framework and its development for data-limited fisheries in Belize. *Mar. Pol.* 76, 28–37.
- Ministry of Food, Agriculture, and Immigration, 2017b. Ministry of food, agriculture, and immigration. <https://www.agriculture.gov.bz/>. Accessed 30 March 2020.
- Ministry of Tourism and Civil Aviation, 2019. Ministry of tourism and Civil aviation. <http://tourism.gov.bz/>. Accessed 30 March 2020.
- National Emergency Management Organization (NEMO), 2020. NEMO preserving life and property. <http://site.nemo.org.bz/>. Accessed 30 March 2020.
- National Institute of Culture and History (NICH), 2020. NICH Belize. <https://nichbelize.org/>. Accessed 30 March 2020.
- Nunan, F., Cepić, D., Yongo, E., Salehe, M., Mbilingi, B., Odongkara, K., Onyango, P., Mlahagwa, E., Owili, M., 2018. Compliance, corruption and co-management: how corruption fuels illegalities and undermines the legitimacy of fisheries co-management. *Int. J. Commons* 12, 58–79.
- Oceana, 2020. No gillnets now, No gillnets ever. [https://belize.oceana.org/?\\_ga=2.1.67811553.1555014417.1587568086-1964056180.1585255393](https://belize.oceana.org/?_ga=2.1.67811553.1555014417.1587568086-1964056180.1585255393). Accessed 30 March 2020.
- Ostrom, E., 1990. Governing the Commons: the Evolution of Institutions for Collective Action. Cambridge University Press, Cambridge, UK. Princeton, NJ: Princeton University Press.
- Ostrom, E., 2003. How types of goods and property rights jointly affect collective action. *J. Theor. Polit.* 15, 239–270.
- Ostrom, E., 2010. American economic association beyond markets and States: polycentric governance of complex economic systems beyond markets and States: polycentric governance of complex economic systems. *Am. Econ. Rev.* 100, 641–672.
- Ostrom, V., Tiebout, C.M., Warren, R., 1961. The organization of government in metropolitan Areas: a theoretical inquiry. *Am. Polit. Sci. Rev.* 55 (4), 831–842.
- Ostrom, E., Burger, J., Field, C.B., Norgaard, R.B., Policansky, D., 1999. Revisiting the commons: local lessons, global challenges. *Science* 284, 278–282.
- Ostrom, V., Tiebout, M., Warren, R., 2009. The organization of government in metropolitan Areas: a theoretical inquiry. *Am. Polit. Sci. Rev.* 55 (4), 831–842.
- Partelow, S., Seara, T., Pollnac, R.B., Ruiz, V., 2020. Job satisfaction in small-scale fisheries: comparing differences between Costa Rica, Puerto Rico and the Dominican Republic. *Mar. Pol.* 117, 103949.
- Pinho, P.F., Orlove, B., Lubell, M., 2012. Overcoming barriers to collective action in community-based fisheries management in the Amazon. *Hum. Organ.* 71, 99–109.
- Protected Areas Conservation Trust, 2019. PACT. <https://www.pactbelize.org/>. Accessed 30 March 2020.
- Rare, 2020. Rare voices. <https://rare.org/>. Accessed 30 March 2020.
- Reddy, S.M.W., Wentz, A., Aburto-Oropesa, O., Maxey, M., Nagavarapu, S., Leslie, H.M., 2013. Evidence of market-driven size-selective fishing and the mediating effects of biological and institutional factors. *Ecol. Appl.* 23, 726–741.
- Healthy Reefs, 2020. Healthy reefs for healthy people. <https://www.healthyreefs.org/cms/>. Accessed 30 March 2020.
- Schiermeir, Q., 2002. How many more fish in the sea? *Nature* 419.
- Rainforest Seafoods, 2020. Rainforest seafoods. <https://rainforestseafoods.com/>. Accessed 30 March 2020.
- Semitiel-García, M., Noguera-Méndez, P., 2019. Fishers' participation in small-scale fisheries. A structural analysis of the Cabo de Palos-Islas Hormigas MPA, Spain. *Mar. Pol.* 101, 257–267.
- The Belize Fisheries Department, 2013. Belize fisheries department. <http://fisheries.gov.bz/>. Accessed 30 March 2020.
- The Coalition for Sustainable Fisheries, 2020. The coalition for sustainable fisheries. <https://www.bangillnetsbelize.com/coalition-partners>. Accessed 30 March 2020.
- The Department of the Environment, 2020. Our natural environment is a priceless treasure. <http://doe.gov.bz/about/>. Accessed 30 March 2020.
- The Forest Department, 2019. The forest department Belize. <http://forest.gov.bz/>. Accessed 30 March 2020.
- The Nature Conservancy, 2019. Resilient Central America. <https://www.resilientcentralamerica.org/en/>. Accessed 30 March 2020.
- The Nature Conservancy, 2020. Latin America: Belize. <https://www.nature.org/en-us/about-us/where-we-work/latin-america/belize/>. Accessed 30 March 2020.
- TIDE, 2020. Toledo Institute for Development and Environment. <https://tidebelize.org/>. Accessed 30 March 2020.

- Belize Tourism Industry Association, 2020a. BTIA: Belize tourism industry association. <https://btia.org/aboutbtia/who-we-are/>. Accessed 30 March 2020.
- Belize Tourism Industry Association, 2020b. Destination chapters. <https://btia.org/aboutbtia/destination-chapters/>. Accessed 30 March 2020.
- Turneffe Atoll Marine Reserve, 2020. Belize's largest and most significant marine reserve. <http://www.turneffeatollmarinereserve.org/>. Accessed 30 March 2020.
- Uchida, H., 2017. TURFs, collective fishery management, and fishery cooperatives. *Bull. Mar. Sci.* 93 (1), 83–99.
- Urquhart, J., Acott, T.G., Symes, D., Zhao, M., 2014. Social Issues in Sustainable Fisheries Management, 9, Springer Science & Business Media, MARE Publication Series, Dordrecht, p. 353.
- Valdés-Pizzini, M., Garcíá-Quijano, C.G., Schärer-Umpierre, M.T., 2012. Connecting humans and ecosystems in tropical fisheries: social sciences and the ecosystem-based fisheries management in Puerto Rico and the Caribbean. *Caribb. Stud.* 40 (2), 95–128.
- Blue Ventures Conservation, 2020. Blue Ventures beyond conservation. <https://blueventures.org/>. Accessed 30 March 2020.
- Viana, D.F., Gelcich, S., Aceves-Bueno, E., Twohey, B., Gaines, S., 2018. Design trade-offs in rights-based management of small-scale fisheries. *Conserv. Biol.* 33 (2), 361–368.
- Wade, E., Spalding, A.K., Biedenweg, K., 2019. Integrating property rights into fisheries management: the case of Belize's journey to managed access. *Mar. Pol.* 108, 103631.
- Wainwright, J., 2009. The first duties of persons living in a civilized community': the Maya, the Church, and the colonial state in southern Belize. *J. Hist. Geogr.* 35, 428–450.
- Wiber, M., Berkes, F., Charles, A., Kearney, J., 2004. Participatory research supporting community-based fishery management. *Mar. Pol.* 28, 459–468.
- World Wide Fund for Nature, 2020. The WWF global organization. [https://www.wwfca.org/en/wwf\\_guatemala/history/](https://www.wwfca.org/en/wwf_guatemala/history/). Accessed 30 March 2020.
- Wright, G.D., Andersson, K.P., Gibson, C.C., Evans, T.P., 2016. Decentralization can help reduce deforestation when user groups engage with local government. *Proc. Natl. Acad. Sci. U.S.A.* 113, 14958–14963.