San Pedro Fishery, Belize

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1 Part I: System Structure - Collective action

San Pedro is an island village in the northern part of Belize with approximately 1,200 residents in 1979. Located off the coast in a strategic place on the Ambergris Cay , it is close to the best local fishing areas and has an easy access to nearby commercial markets, such as Belize city, Corozal, and Chetumal. The community has largely relied on the use of natural resources to generate income and these activities have hardly produced a significant surplus of resources to generate investment in the long term. San Pedro was a strikingly poor community around the 1940's and beyond.

The fishing cooperative, Caribena Cooperative Limited was San Pedros official fishing organization. It was officially created in 1963 after the introduction of several cooperatives created in the area to strengthened the productive activities of fishermen in the region. It started activities with 50 members and it was the organization in charge of handling capture, processing and sale of the village produce primary resources. Specifically, the key common pool natural infrastructure relevant to the commons dilemma and making up the villages primary resource is spiny lobster, conch, scale fish, and shrimp. The institutional boundary is natural and artificial including coastline and open expanses of water, as well as customs, and traditional usage. The original case this fishery was studied from February 1977 to August 1979.

This case study is part of the original Common-Pool Resource (CPR) database. A summary of the original CPR coding conducted in the 1980s by Edella Schlager and Shui Yan Tang at Indiana University may be found here.

1.1 The Commons Dilemma

The center of the discussion in the first line and paragraph is the over appropriation problem and the under provision of public infrastructure, mainly, the soft infrastructure. San Pedranos have been affected by the depletion of a considerable number of resources, such as chicle (milky latex to produce chewing gum), turtles, rosette spoonbills, conch, etc. This case study focuses on the catch of the spiny lobster, an open access resource in the sea for which, there will be a potential problem of over exploitation. Very important to mention is the increasing problem of by product fish catch from this activity which, resulted in immense quantities of unplanned catch which, had to go in the market as compulsory sale due to its perish-ability at very low prices.

The potential under provision of private infrastructure was solved through the mechanism of the fishing cooperative which, pooled the village fishermans capital and collateral to purchase the equipment necessary to catch and process the fish. The potential for the under provision of public infrastructure was largely mitigated by the systems endogenous stability, which did not rely heavily on hard public infrastructure. There was a potential exogenous problem like price controls that, made the cooperative sold at a loss on the domestic market in addition to export rights, and tariffs. This market environment characterizes for imperfect competition and rent seeking from buyers of a perishable product at the upper stage of the chain that conditioned the fishermen to receive low prices for their fishing products. These risks were apparently overcome at the moment through the action of the cooperative, and further, for quotas, political lobbying and activism.

Through cultural sanctions, the mechanism of the cooperative profit sharing, and the consequences of age and wealth (older fishermen could no longer dive for fish, inhibiting them from long-distance fishing, younger fishermen could not afford seines and traps which could allow them to successfully fish locally), traditional fishing grounds were maintained and respected. There were no formal monitors to ensure compliance with fishing grounds, poaching, size limits, or off season fishing (though this was theoretically enforced by the national government) besides informally through the other co-op members and community, but it was the case that these rules were rarely broken. Export quotas were not observed as ever broken, though the mechanism of monitoring and enforcement was not documented.

1.2 Biophysical Context (IAD)

San Pedro is located at the relative middle of Ambergris Cay (a remnant of an old barrier reef made primarily from coral limestone), surrounded by warm water on three sides (to the north is a small passage between land), and coastal mangrove and coconut fields. The local oceanic geography consists of shallow shelves, coral reefs, lagoons and islands atolls.

The island is periodically subjected to damages from severe hurricanes, though the village itself usually responds well. The village was only severely damaged by hurricane one time in the 1940s.

Natural infrastructure (NI)
The natural infrastructure important to the village fishing system is entirely public and consists of diverse oceanic geography that provides a productive environment for many different aquatic species. Specifically, the coral reef and rocky atolls that provide habitats for mature lobster and conch, as well as, sea grass beds in lagoons that provide habitat for young lobster. Also, there is an abundance of local log wood which, has allowed for the non-market dependent production of fishing equipment, especially six-foot Cayucos (small dugout canoes) that were used as fishing vessels and wet boats to carry caught fish.

Hard human-made infrastructure:
The hard human made infrastructure required by the San Pedro fishermen varies depending on the species of interest. Long haul fishing to the islands past the reef require the largest investment, 18-30 boats with 1 or 2 outboard motors with 10-60 horsepower. Each boat requires one six-foot cayuco for each member of the crew, usually 5-6, commonly stored on

the deck, plus extra barrels of gasoline, propane for cooking on the small stove, ice to preserve the fish (usually 1,500 Lbs.), a battery powered radio for storm warnings, a compass, a provision of food for each member of the crew, consisting mostly of staples like rice beans and butter, and fishing equipment for each member of the crew consisting of a mask, fins, and a hook stick.

Local fishing is done either from the beach or a vessel, usually a Belizean sailing smack (a local style of small boat that includes a wet well to keep live fish, often modified with a sail or motor), a small skip, or a cayuco, either with hook and line or by diving with a mask, fins, and a hook stick, or by using seines (though this was becoming less common), or with lobster boxes either on the beach or lobster traps along the shallow shelf to the south and east of the island (often times booby trapped with protruding nails to prevent poaching), or finally with either wire or rock heart weirs (heart shaped arrangements in shallow water that have a narrow opening that fish swim into but cannot swim out of).

All fishing that uses boats also requires maintenance, including grease, oil, paint, sealant, line, and tools to clean the bottoms and sides of the boats, as well equipment to dry dock the boat (usually twice a year for cleaning).

1.3 Attributes of the Community (IAD)

1.3.1 Social Infrastructure

Caribena Cooperative Limited, the San Pedro fishing co-op has its own internally elected governing body (executive board) consisting of members of the co-op who served 1 or 2 year terms making authoritative decisions for the organization. The organization also relied on staff: a co-op manger (appointed by the board to handle day-to-day management), a cashier for the co-op supply store, a fuel attendant, a secretary, several laborers to process fish, and a generator and freezer plant engineer and assistant engineer.

In 1963, the co-op consisted of 50 resource users (fishermen) and by the mid 1970s was caped at 200 members. A high level of trust existed among community members at the beginning and end of the study period.

Trust and cooperation is required on long distance fishing trips where captains of boats often delegate responsibilities and consult the crew with decision making. Captains are usually boat owners which makes breaking into the long distance fishing industry difficult, keeping the industry relatively homogeneous. Conversely, captains are kept reasonable and efficient by having to compete for crew with other boat captains who may be more lenient or more productive.

1.3.2 Human Infrastructure

Human infrastructure in San Pedro at the time of the study consisted mostly of villagers who had only primary formal education. However, human capital in San Pedros fishing

system was high in the form of fishing knowledge and skill. Boat captains could navigate to all local and long distance fishing grounds without map or compass, divers would regularly spend 10 hours swimming per day, were able to peer through 30 of water to find lobster, and frequently dove to depths of 30 feet. Fishermen who use seines needed the knowledge to tie and knit the seines together as well as how and where to place them. Those who use lobster traps must learn how to build the traps and where to place them, as well as remember where they left them using memorized visual triangulation; San Pedro fishermen did not use ties or buoys to mark their traps in order to thwart poaching. There was a scarce level of human infrastructure in the co-op, which can be identified as one of their weaknesses, specially referred to as lack of educational attainment, poverty.

1.4 Rules in Use (IAD)

Position Rules: There are several positions in the San Pedro fishing system: there are co- op members and non members which are clearly defined and exclusive, and there are executive members and regular members. Of regular members there are boat owning long distance fishermen, boat owning local fishermen, non-boat owning long distance fishing crew, and non boat owning local fishermen. There were approximately twenty four boat owning long distance fishermen during the study and they can be separated into those who fish lobster, conch and scale fish, and two fishermen who fish for shrimp with shrimp crawlers. There are three to five long distance non-boat owning crew for every long distance boat (72-120). While approximately 20 fishermen use lobster traps, and 2-6 use seines or weirs.

Boundary Rules: Co-op members are determined by owning a share in the co-op and the sale of shares can be limited. Membership on the executive board of the co-op is controlled by an election process and limited to a 1 or 2 year term. One of the key aspects of boundaries is the physical aspect of the fishery which, limited the action of fishermen. This were not explicit rules established by technical mean such as GPS positioning, buoys, delimiters, but it was a blurry limit, respected by member and outside of the system fishermen.

Choice Rules: Members of the co-op must sell their fish to the co-op. No fishermen in Belize, weather co-op members or not, can export their fish independently (not through a cooperative) or catch lobster during the closed season from March 15 to July 15, with a tail size smaller than four ounces or 3.5, or soft-shelled and egg-bearing lobster. The law prohibits the use of diving tanks and spear guns, and prohibits fishing in Mexican waters. Very important to note that these rules were not probably part of the legal official system in the country or village but it was shared, respected and validated within the community by social sanctioning.

Aggregation Rules: Individual boat owning fishermen have unilateral control over where, when, what, and how they fish within the limits of the choice rules. Non-boat owning fishermen are dependent on boat owning fishermen and subject to their decisions. All co-op members vote for the co-op executive committee members, executive committee members exercise collective authority of matters of the organization and appoint a co-op manger that has day-to-day control over the co-op only under the direct supervision of the board.

Scope rules: Co-op members can affect co-op elections, non-members cannot. All Belizean citizens can affect the primary resource used by the fishing co-op, though normally only co-op members do. Co-op members are entailed to profits of the seasons catch proportional to the amount of fish they contributed plus dividends on their stake in the co-op.

Information Rules: Co-op members are provided written documentation of their catch for reimbursement each time they deposit it for processing. The co-op provides written documentation of pounds of fish caught and money earned to the national government for taxation and regulation.

Payoff Rules: All co-op members must pay an equal amount for their share of stock in their co-op, all members must allow a equal percentage of their gross profits be set aside to fund the operations of the co-op itself, all members are entitled to net profits of the seasons catch proportional to the amount of fish they contributed plus dividends on their stock.

1.5 Summary

Cooperative fishermen in the village of San Pedro organize themselves into a collective organization through soft human infrastructure via legal, political, economic, and cultural traditional structures which, allow them to regulate the sustainable appropriation and equitable allocation of their primary natural infrastructure and resource: lobster, conch, scale fish, and shrimp. They gain access to this resource through their location and biophysical context, which is near abundant and dynamic oceanic ecosystems and ports with access to global fish markets. They rely on hard private infrastructure in the from of fishing and fish processing equipment and hard public infrastructure in the form of ports to sell their fish and soft public infrastructure in the form of fishing regulations which protect and mange their primary resource.

2 Part II. Dynamic Analysis - Robustness

This update extrapolates from research on changes in the San Pedro fishing community off the eastern shore of Belize based on publications from 1987, 1997, 2003, 2004, 2008, and 2010. In-text parentheses indicate corresponding links in the system representation (Robustness diagram) on the SES library.

2.1 Update on the Commons Dilemma

The original case review suggested that the appropriation of the fishery resources in San Pedro Belize was successfully managed by the fishing cooperative and the institutional rules in use. Based on case updates in the following years this has held largely true. Though,

particularly in the 2004 and 2010 papers, it can be seen that yields did decline in the 2000s and monitoring enforcement was not as robust as originally suggested. Nonetheless, as of 2004 the fishery was still operational with strong internal management and the capacity to continue to adapt to biophysical and social changes. Specific changes that were or can be addressed include: making repairs after 3 hurricanes that struck the island between 1998 and 2004 (these were blamed as causing part of the decline in yields) as well as updating what are now believed to be incorrect / ineffective size limits and issuing and restricting fishing license to combat what has become a problem of too many new fishermen causing overfishing (currently no limit is set on the amount of lobster an individual fisherman can harvest, nor is there a limit upon the number of lobster that can be delivered in any one season), it is within the cooperatives power to make these changes. As of 2009-10 yields had begun to increase. The most recent case-specific information found indicates that as of 2014 Caribena Cooperative Limited had closed, though San Pedro fishermen still fished and sold their fish to the nearby Northern Fisherman cooperative, who now have an office in San Pedro.

2.2 Shocks, Capacities, Vulnerabilities

Based on the static analysis of the system it is vulnerable primarily to an over appropriation of the fisheries resources (spiny lobster, conch, scale fish, and shrimp), so far this is has been largely avoided, though recent stock studies and somewhat declining yields have demonstrated that without careful management the resource is still vulnerable to over exploitation and there may not be sufficient management in place currently to prevent this, though this is still unclear. The system is also vulnerable to shocks on the resource user (Exogenous Drivers 8) from changes in the global prices of lobster. As well as shocks to the resource system and public infrastructure (Exogenous Drivers #7) from severe weather, including hurricanes.

Currently The Northern Fishermen Co-operative Society (NFCS) manages the hard public infrastructure, replacing Caribena Cooperative LLC. The cultural institutions that informally managed boundary and scope rules have remained consistent over time.

In order to develop capacity to vulnerabilities to the resource system (RU), the Belize Fisheries Department (BFD) established the Coastal Zone Management Unit (CZM Unit) in 1990. The CZM Unit was initially enacted to protect the Barrier Reef, however a multisectoral approach was later adopted by the CZM for the dual purposes of conservation and sustainable use of the Belize Barrier Reef Complex (Cho, 2005). This changed some specific scope rules for the fishermen of San Pedro, and forbid fishing in Marine Protected Areas (MPA) of the tropical seascape ecosystem. The Hol Chan Marine reserve was established in 1987 and the Caye Caulker Forest and Marine Reserve was established in 1998 (Cho, 2005) in the vicinity of San Pedro. Marine Protected Areas (MPAs) have become a widely used tool in managing coastal and marine resources in Belize; MPAs are just a portion of a more holistic process called Integrated Coastal Management (ICM).

The increase in wealth from fishing and decline in fishing yields compared to effort, coupled with an increasing demand for tourism on the Caye has slowly attracted people away from

fishing toward tourism.

One additional vulnerability was the lack of an institution to coordinate catch and sales at the beginning, in the form of soft infrastructure.Other aspects worth to be included are Exogenous drivers which are key components to understand robustness of the system. Also, there was not a clear set of characterization of rules within about sanctioning: probably, theft was tolerated even though they knew how it was generated. Also, the role of leadership is not included. This is a high value element of soft infrastructure available in the community. Other vulnerabilities: lack of response to international markets, lack of industrialization, lack of hard infrastructure, risk of stagnated prices of perishable goods, among others. It is also not clear who should be the provider of the public infrastructure at the local or national level.

2.3 Robustness Summary

The fishermen of San Pedro off the cost of Belize (RU) overcame exogenous shocks (shocks 8 and 7 to RS and PI) to their resource system (RS) and public infrastructure (PI) in the form of three hurricanes, Hurricane Mitch in 2000, Hurricane Keith in 2001, and Hurricane Iris in 2004. Most recently they overcame a shock to their public infrastructure provider (PIP) (shock 8 to PIP) with Caribena Cooperative LLC closing, being replaced by the Northern Fishermens Cooperative. They are still vulnerable to an over appropriation of their primary resource (spiny lobster, conch, scale fish and shrimp), though at this time, despite declining yields and imperfect monitoring, the system has not collapsed and provides sufficiently for the community. The increase in tourism on the island and move away from fishing toward tourism as a source of income for many residents if not full time then part time has increased the communitys robustness to changes in the fisheries resource. San Pedro fishery is an example of a struggling but a successful case study for institutional analysis which, require extensive collaborative work of the members in order to overcome market and public infrastructure challenges.

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