Institutional Analysis of Lobsterfishing in Caye Caulker, Belize

May 31, 2016

1 Part I: Static Analysis - Collective action

Caye Caulker is a small coral island located some 15 miles off the northeastern coast of Belize. The resource unit being appropriated is lobster. Boundaries are drawn based on natural barriers such as the barrier reef, that lies to the east of the Caribbean Sea.The set of individuals who have rights to withdraw from this resource were well-defined at the time of the study. When the case was documented, the appropriators were attempting to exercise de facto closed access to the lobster fishery.The resource appropriated from Caye Caulker is lobster.

This case was part of the original CPR database developed in the 1980s by Edella Schlager and Shui Yan Tang at Indiana University and can be found here.

1.1 The Commons Dilemma

- The potential appropriation problem was overcome. The availability of lobster is largely a product of the fecundity of the surrounding tropical seascape ecosystem. The effective management of the Caye Caulker lobster fishery stems from the fact that its sociocultural institutions, such as the Northern Fishermen Cooperative Society (NFCS), draw on the strengths of particular cultural features (individualism, independence, family organization and kinship, loyalty, and reciprocal exchange), which enable the effectively management of the lobster fishery. Since the inception of the NFCS in 1960, the shareholders have been economically successful. The institution has been able to effectively produce and market Caribbean Spiny Lobster for international trade. As of 1986, the NFCS has effectively mitigated the over-harvest of lobster surrounding Caye Caulker, thus, effectively managing the common-pool resource. However, with the success of the cooperative, increased production, and increased tourism, hidden fragilities are hypothesized to arise in the system.

- The potential under provision of public infrastructure was not overcome. Stealing from other fishermen's lobster traps is a most serious problem that keeps worsening every year, specially given the lack of monitoring and sanctioning mechanisms. Fishermen attempt to solve these conflicts by not sharing the location of their traps, their hauling schedules, or avoiding any strict schedules with respect to when they set and haul traps. Fishermen also refuse to reciprocate with known thieves and deny them norma courtesies. The NCFS also refuses to lend money to known thieves.

1.2 Biophysical Context (IAD)

- **Natural infrastructure:** Caye Caulker is a 4-mile long "caye" (a type of sandy island along a coral ridge) approximately 10 miles off the coast of Belize and 21 miles northeast of Belize City. Being a sandy island, Caye Caulker does not support agricultural production, which renders fishing a primary economic activity. The shallow reef complex provides suitable habitat for the Caribbean spiny lobster (*Panulirus argus*), a nocturnal species, where they hide during the day and come out of to feed at night. Fertilized lobster eggs develop while attached to the female for up to 4 weeks until they hatch and drift in the water column as larvae for 6-10 months during which they can become widely distributed before settling into the shore seafloor to become juveniles and subsequently adults. Lobster trapping territories are not officially mapped and there are no recorded boundaries, though this is fairly public knowledge given their relative location to physical features on the island?s shore. Calm and clear waters provide good visibility and facilitate trap hauling. Caye Caulker is sheltered from wave erosion and extreme weather events by the second largest barrier reef in the world, which stretches 190 miles along the coast. Severe storms from December through February ("northers") interrupt fishing activity and influence mass movements of lobster, though there is an increase in catch before the arrival of the storms. At the time of the study, the lobster abundance had been remained relatively stable.

- **Hard human-made infrastructure:** Lobster trapping is the most profitable and popular method of extracting lobster, and a fisherman needs a boat, a motor, traps (or diving gear in the case of diver fishermen), membership to the NFCS cooperative, and lobster territory in order to have good access to the resource, which are not all equally available to everyone. Traps are build out of trapezoid-shaped slatted wood crates (3 1/2 feet long x 1 1/2 feet high) with a hole shaped as a funnel so lobster can enter but not leave the trap. Traps are arranged in a given order in a zig-zag pattern no closer than 100 yards apart. Usually between 150 and 500 traps are set per fishermen who they know the exact location of each one. Traps are checked by sections ever 3-7 days and hauled usually by 1 to 3 partners. Lobster territories are more and more scarce and usually passed down generations through close relatives. As of 1995, half of the NCFS membership belonged to Caye Caulker fishermen.

1.3 Attributes of the Community (IAD)

- **Social Infrastructure** A 1980s census reported a population of 413 residents at Caye Caulker of Yucatecan Mestizo descent living in 100 houses in the island. The community has developed a kinship structure based on strong family ties. There are clear distinctions between islanders and non-islanders (Belizeans), mainly in terms of economic differences and status. However, no elite is created, and the community has a long history of ignoring power hierarchies outside the island's boundaries and guarding their local independence and political autonomy. Caye Caulker fishermen share ideals of individualism and independence exemplified by their having control of their own production and not necessarily having to work for others to make a living. They also portray strong family organization and loyalty as exemplified by the way in which territories, equipment, and knowledge are inherited from relative to relative.

- **Human Infrastructure** Fishermen control of their catch depends on knowledge of

the sea, of fishing, and on family support. As a whole, the culture exhibits the ideals of independence, individualism, honesty and hard work. Another cultural norm is that of non-interference and tolerance. A thief will be tolerated and individuals will respond with a change in behavior rather than confrontation. This is exhibited in a wide variety of social contexts.

1.4 Rules in Use (IAD)

Position Rules: 1) NCFS members, 2) NCFS managing committee (7 members), 3) Non-islanders.

Boundary Rules:

- Membership to the NCFS is preferentially given to islanders, and they must have access to a licensed boat.
- Lobster fishing territory acquisition primarily occurs through inheritance; other means are possible, but difficult.

Choice Rules:

- Fishermen must not fish between March and July, as it is punishable by fine.
- Older fishermen may leave their fishing territories to family members.

Aggregation Rules: The cooperative comprises of a Managing Committee of 7 members; four producing members are voted in each year, the three with the most votes stay in office for 2 years, the fourth, only 1 year. Producing members may be voted in multiple times.

Scope rules:

- Fishing for lobster is permissible from July 15th to March 15th.
- Undersized (pre-reproductive) lobsters (under 4 oz) cannot be sold to NFCS.

Information Rules:

- Territories and boundaries within the general vicinity of a fisherman are known, but not mapped.
- The NFCS provides an annual report to shareholders.
- Government officials provide information on the current state of the fishing industry.

Payoff Rules: Membership to the NFCS provides market and handling facilities, immediate cash payment, a rebate at the end of the season, credit for supplies during the year and loans to purchase harvest equipment, and better prices for lobster. The NCFS also provides financing for education to members with management aptitudes.

1.5 Summary

The social infrastructure, scope, and informal boundaries rules led to a situation of limited pressure on the resource, which has prevented the overexplotation of the resource. The Caye Caulker community exhibits a mentality of non-interference and tolerance, which has made monitoring of the resource difficult, but the NFCS only purchases lobster of legal size and has therefore reduced the incentive for fishermen to harvest pre-reproductive lobster. Lobster fishermen do not mark their traps in order to prevent excessive theft, which is common within and outside of the cooperative. Theft is tolerated within the community, but excessive levels will prompt action. The rules-in-use are formal within the NFCS and have collective-choice arrangements; the rules-in-use within the community are informal. The success of the lobster fishery can be owed to three major aspects: 1) Organized production dealing directly with buyers from international markets; 2) Strong sociocultural institutions and values of nuclear family ties, tolerance, individualism, and independence; 3) Flexibility by balancing lobster production with tourism.

2 Part II. Dynamic Analysis - Robustness

2.1 Update on the Commons Dilemma

The changes in the Caye Caulker lobster fishery have indicated that the institutional arrangement was vulnerable to exogenous shocks. These shocks have impacted the capacity of the NFCS and cultural norms ability to effectively prevent the overexploitation of the lobster resource. Over time, hidden fragilities become apparent by changing system conditions.

2.2 Shocks, Capacities, Vulnerabilities

...to and of the Resource (link 7 to R):
New international markets for lobster have increased demand for the resource, as a result, larger fishing operations and greater use of technology have increased resource extraction rates. Encroachment by commercial fishing fleets has been found in the waters surrounding Caye Caulker (Chapman, 2008), and reflects greater market demand. This increased fishing pressure for lobster has had a dramatic impact on the lobster population. Another impact on the resource is the harvest of pre-reproductive lobster. Traditionally, fishing families would consume these lobsters but the levels were less substantial. The advent and growth of tourism has created a market for these lobsters at local restaurants, which are illegally harvested and sold at the caye (King, 1997). On a national level, stock size, biomass, recruitment, and catch-per-unit-effort (CPUE) have decreased in the period of 1999-2009 (Belize Fisheries Department, 2010).

...to and of the Public Infrastructure (link 7 to PI):
The growing ecotourism industry throughout Belize has increased competition for the tropical seascape ecosystem and increased the intensity of the shocks to the public infrastructure, the tropical seascape ecosystem. Biophysically, coral dominated ecosystems thrive in marine areas with low levels of nutrients in the water and low turbidity. Any persistent disturbances that affect water quality will have an impact on the seascapes resilience.

There are a number of shocks ranging from persistent to impulse disturbances that impact the tropical ecosystem and its capacity to regenerate. Shocks include nutrient pollution, sedimentation, overfishing, and other regional threats (Cho, 2005). The tropical

seascape is well adapted to recovering from impulse disturbances, such as hurricanes, but do not deal well with persistent disturbances.

...to and of the Public Infrastructure Providers (link 8 to PIP):
The NFCS still manages the hard public infrastructure, but has diversified its efforts to incorporate products from other fisheries (King, 1997). The cultural institutions that informally managed boundary and scope rules have changed over time.

In order to develop capacity to vulnerabilities to the public infrastructure (PI), 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 multi-sectorial approach was later adopted by the CZM for the dual purposes of conservation and sustainable use of the Belize Barrier Reef Complex (Cho, 2005). 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 Caye Caulker. Marine Protected Areas (MPAs), which prohibit fishing and are just portion of a more holistic process called Integrated Coastal Management (ICM), have become a widely used tool in managing coastal and marine resources in Belize.

...to and of the Resource Users (link 8 to RU):
Over past decades, there has been a large increase in international demand for ecotourism. Since the original documentation of this case, tourism arrivals to Caye Caulker have increased substantially, and affected development of the island. Due to the economic success of the lobster fishery on Caye Caulker, fishermen were able to diversify their investments. The most common choices for investing capital were that of: 1) educational opportunities for kin, 2) diversification or expansion of fishing efforts, and 3) tourism development (King, 1997). Each of these investment avenues affects, either directly or indirectly, the interactions that resource users have with the resource (R) and the public infrastructure (PI).

For example, educational opportunities for young men led to their emigration from Caye Caulker and inadvertently changed the boundary rule relating to lobster territory acquisition through the commodification of lobster territories, thus providing access to outsiders who would have traditionally been denied access to the lobster fishery. Larger fishing operations and greater fishing pressure have been the result.

2.3 Robustness Summary

The system has been found to be vulnerable to international demand for ecotourism, tourism development, encroachment by commercial fishing vessels, increased international demand for lobster, and emigration of community members. As of the first documentation of this case, the NFCS reduced the incentive for catching pre-reproductive lobster. Traditionally, families would keep these for home consumption. The advent and growth of tourism industry provided another avenue for pre-reproductive lobster, namely, local restaurants. This portion of the catch is undocumented and will likely have a significant impact on the resource and lead to depletion (King, 1997). However, the institution did not exhibit design principles 4 and 5, which related to monitoring and graduated sanctions respectively. This institutional failure has led to the decline of the biomass, stock size, and recruitment of the Caribbean Spiny Lobster. Despite extensive capacity building of organizations, the institutions in place have led to a decline in stock size, biomass, and recruitment within the Belizean Lobster Fishery (Cho, 2005). As a result, recommendations have been made to increase the size of the minimum tail weight from 4 to 4.5 ounces (BFD, 2010).

3 Part III. Case Contributors

Michael Moreau, School of Sustainability, Arizona State University.
Cathy Rubinos, School of Sustainability, Arizona State University.
Maria del Mar Mancha Cisneros, School of Life Sciences, Arizona State University.