

## Traditional Knowledge in the History of Coastal Resource Management in Costa Maya

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### Abstract

Traditional knowledge is based on a daily social dimension. It involves the existence of social and intergenerational relations that are directly associated with the environment. In addition, we can only understand local lore by analyzing it through its historic aspect. Therefore, we must think knowledge as a space-time schema to observe it as a social process shared and transmitted. Hence, our purpose lies on exploring the concept of traditional knowledge in the management of coastal resources in one of the micro regions of the Mexican Caribbean. We analyze the life histories of women and men of three main communities of the area known as Costa Maya (Mexican Caribbean in Quintana Roo): Xcalak, Mahuahual and Punta Herrero. We should point out that this paper is founded on a larger research conducted in Quintana Roo, Mexico. Although natural resource management does not imply sustainable processes neither environmental low impact activities, we believe that through this anthropological approach a set of the possibilities of human-environment interaction may be enable.

**Keywords:** Copra production; Fishery; Social-environment interaction; Traditional knowledge; Life history

### Introduction

Traditional knowledge takes place in a daily social dimension. This knowledge implies the existence of daily exchanges and intergenerational relations that go unnoticed in the here and now. It is necessary to think about space-time schemes to prove its existence as a social process shared and transmitted. This means that the analysis of the "must do" in the rural Mexican coast should include both a social and space-time axes.

Our interest lies on exploring the so-called "traditional knowledge" in the management of coastal resources in one of the micro-regions of the Mexican Caribbean; also, we are eager to evaluate "knowledge" as a concept using the coastal population's perception and historical social formation process of these coastal communities. We should mention that this paper is based on a larger research project conducted in the Costa Maya (Mexican Caribbean in Quintana Roo) prepared through inter-academic and inter-institutional work in the South East of the country.

It is important to point out that the southern area of the Caribbean state was founded as a result of a social conflict. The history of societies in southern Quintana Roo was impacted by a particular social dynamic raised in the early years of the twentieth century. On this matter, by the end of the first half of the nineteenth century and the early years of the following, an indigenous social war known as Guerra de Castas (War of the Castes) created the formerly unexplored southeastern region now known as Yucatan.

As part of the military strategy, the government created the Federal Territory of Quintana Roo on November 24, 1902 with an area of 50,000 km<sup>2</sup> [1]. This strategy aimed at controlling weaponry traffic (provided by the English) on the southern border between Mexico and

Belize. Thus, the foundation of Payo Obispo (today known as Chetumal, the capital of Quintana Roo) was one of the first mestizo cities and its origin was not fortuitous. The creation of Quintana Roo and the settlement of the banks of the Hondo River guaranteed a surveillance point on the border.

The official end of Guerra de Castas, issued by the Mexican president Porfirio Diaz in 1904, delivered the concessions to exploit the timber and natural gum area in southern Mexico. It was a strategic endeavor to encourage the development of communities and the issuance of permits for extracting wood and natural gum [2]. The southern part of the state became alive in social terms, but the northern and central territories remained under rebel Mayan control.

As a result of the social conformation of the territory, a series of colonization policies emerged from the Mexican government. In his administration as the first governor of Quintana Roo, José Siroub (1925-1930) requested that the federal government implement settlement programs for workers of northern Mexico. The purpose of this strategy was to promote agricultural activity in the region. But it was not until the mid-twentieth century when directed colonization produced its best effects [3].

Land distribution for immigrants, during Lázaro Cárdenas presidency (1934-1940), was promoted in the state by the governor of Quintana Roo, Rafael Melgar (1935-1940). Basically, the first land allocations were made with forestry purposes. The first beneficiaries of these land-living portions were northern and southern immigrants already established in Quintana Roo. The most relevant population, in the case of the southern area, was located near the Hondo River [4]. The population on the coastal side of Quintana Roo (today known as Costa Maya) started flourishing after the direct colonization emerged in the south, although there were unrecognized population settlements in the area.

The presidential administration of Adolfo Lopez Mateos (1958-1964) brought forth a directed colonization policy that changed the landscape of Quintana Roo. This large-scale farmer migration impacted Quintana Roo and other states in southeastern Mexico. This colonization policy allowed the relocation of 50,000 farmers to Nuevos Centros de Poblacion (new population centers) throughout the state. So, Chetumal, and the towns of Bacalar, Alvaro Obregon and Allende received peasant families coming from the states of Morelos, Michoacan, Mexico [Federal District] and Durango [3].

At the end of the 1960's and in the early 1970's, another kind of colonization arose: spontaneous colonization. Even before land distribution occurred, smallholders came to the border but not at the same rate as directed colonization. However, when the new population centers were consolidating, a large wave of immigrants from Yucatan started to come towards different points of the region [5]. The small holders who arrived at this point founded their own settlements. Unlike directed colonization that promoted the arrival of peasant families to established camps, the Yucatecan concentration formed their own settlements and requested official recognition from the Secretaría de la Reforma Agraria (Secretary of the Agrarian Reform).

Broadly speaking, this was the historical and social context in southern Quintana Roo. Given this scenario, we will present two sections of this essay. The first one refers to the conceptual perspective of traditional knowledge. On this matter, we will discuss the work that other researchers have done on traditional resource management in similar contexts. The next section will present the results obtained in the Costa Maya through proprietary research. In general terms, the research consisted of personal interviews conducted in Spanish. On this regard, we should state that even though they are translated in English, we tried at all costs to preserve their meaning to reflect the true essence of the informants.

## Can Knowledge be Traditional? A Conceptual Approach

In many ways, the word knowledge is associated with wisdom. In etymological terms, knowledge (early 12th century: *cnowledge*; also see *nolej*) means "acknowledgment of a superior, honor, worship;" also denotes "capacity for knowing, understanding; familiarity; fact of knowing"; in these examples its use is found in the late 14th century. It is possible that by that time word usage started to imply "an organized body of facts or teachings"; also, "state of knowing; assure belief; that which is known; information, instruction; enlightenment, learning; practical skill." Now, [6] when did knowledge became, from being a practical concept, to a scientific state of knowing?

The difference between traditional knowledge and knowledge itself consist, specifically, in a semantic dimension. The latter implies a certain position of the subject before the object that is being observed (known). The former involves some sort of relation between the subject and those elements being apprehended. In other words, official knowledge results in acquisition and traditional knowledge implies appropriation and embracing. But the idea turns more complex if we position the concept in a specific scenario. For instance, when is applied empirically to a community where "local knowledge" refers to the range of skills that are rather acquired with every day practice and are also transmitted orally [7].

Traditional knowledge is defined as the set of know-how abilities about the natural and supernatural world, transmitted orally from generation to generation. For many of these societies, especially for

indigenous, there is an organic relation between natural and supernatural world onto social organization. Thus, for them, there is neither a dualistic classification nor a rigid division between 'natural' and 'social' but a continuum between both of them [8].

At some point, it is normal that traditional knowledge is considered an inferior set of abilities because of its lack of methodological procedures. Instead, these abilities depart from repetition and generational transmission. Nevertheless, traditional knowledge has a particular effect on the community where it is reproduced. Where knowledge is validated and shared with everyday practice there is a sense of community life integration. For this reason, it is fundamental to analyze it in its relation with the daily activities and with the belief system of the society who practice it [9]. Before such arguments on the concept, it is necessary to perform a brief state of the art base on the use of the word "knowledge" applied to the study of resource management in different social contexts.

In the artisanal fishery production in Chile, analyzed through an Anthropology of Territory approach, "the dimension of traditional knowledge and artisanal fishing corresponds to the socio-productive tasks related intimately with the ways of living and inhabiting at specific territories." On this regard, Gajardo and Ther [10] describe knowledge and artisanal fishery of two fishermen settlements located at the western board of Isla Grande de Chiloé, in Chile. Their analysis allows establishing a sort of proposal for wilderness preservation departing from their description of alternatives and possibilities that the fishermen observe before the imminent seafood resource crisis.

Sanchez [11] undertook a study within the Biosphere Reserve of the Monarch Butterfly in Mexico. He found that there are various indigenous communities that maintain specific relation with its natural environment. The author shows the results of a specific approach into the Mazahua community of Francisco Serrato in Michoacán, exploring mainly traditional relation established with the amphibians and reptiles in the locality.

Zamudio et al. [12] have found that the local community of Xhazil in Quintana Roo has developed traditional management and specialized knowledge of the local natural resources. The authors' findings consist on the analysis of the crocodile hunting and the current ecological knowledge of the local Mayans. The Maya lagarteros (crocodile hunters) know the seasonal migration, the inhabit rank, ecosystem and crocodile behavior. Traditional knowledge development of the Mayans points out the practical use of the local principles and the relationship between nature. This constitutes an example of adaptive management. Moreover, the authors demonstrate that local ecological knowledge it is one of the most essential elements for wild fauna management. We must indicate that this type of studies contributes to establish theoretical bases for natural resource management according to the social and natural environment.

Ruiz [13] recognizes the need to design and execute ethno-botanical studies where local knowledge helps to preserve diverse endemic flora. His research stands over three coffee-growing communities in Veracruz. The author enlisted an inventory of local wild and semi-cultivated flora to understand the complex forms of resource management. Furthermore, he estimated the communities' contribution to local livelihood systems and explored the knowledge and values that people in these localities built around them.

In the Norwest side of Puerto Rico et al. [14] studied the mental and cultural schema of thirteen fishermen in their daily activities. In their everyday tasks, the researchers ask them to sort fish and other sea

fauna according to their experience. In this classification the interviewed fisherman proved the existence of a relationship between the sea environment, the habitat and the mental schema used to categorize the fauna.

Garcia [15] described and interpreted tecno-productive knowledge of the Reina community, located in Consejo Popular Reina-Arango, in the southwest of Cienfuegos city, in Cuba. Garcia's study aimed to elaborate and inventory of traditional fishery knowledge in the locality throughout ethnographic method, participant-observation and deep interviewing. On the same topic, Calderon's research [16] was executed at the Hondo River area, at the political frontier between Mexico and Belize. The main objective was to compile traditional knowledge about white turtle. Calderon conducted informal interviews and observations in ten communities that manage the turtle.

Studies about traditional knowledge on wildlife are common. There are also specific investigations that aim to explore the lore over soil, water and climate. Our study does not focus on any specific local resource; quite the contrary, in order to recover traditional knowledge, we expect to identify all resources that the communities of Costa Maya have used in the past, including practices that encourage knowledge preservation in the present as well. It bears repeating that this document is based on a larger study. Therefore we will present a summary of the overall findings trying to be specific in some areas.

## History of Resource Management and Traditional Knowledge in Costa Maya

The area known as Costa Maya is newly established. The landscape, biodiversity and the coast site motivated the National Tourism Institution (known in Spanish as Fonatur) to create a sort sun and sand corridor with apparently low social and environment impact. This micro-region included the towns of Xcalak, Mahahual and Punta Herrero. These populations inhabiting the area have a particular history associated with migration, social adaptation and the knowledge apprehended and reproduced for over a century. Before sharing the results on the lore of the micro-region, it is important to explain some of the historical and social formation of these three communities.

### Xcalak

This locality was founded on May 19, 1900. At that time, the location was one of the largest ports in the Mexican Caribbean; it is currently the second community in importance on the south coast of the state [17]. Its history is divided into two periods: from its foundation in 1900 until 1955 (year in which the hurricane Janet struck the Yucatan Peninsula) and the second historic period is from 1955 to present days. During the first period Xcalak was a thriving village with wooden houses of Caribbean English style of two and three stories, with an estimated population of 1,800 people in 1950. In the census of 1910 it was considered an established town, along with Holbox, Cozumel and Isla Mujeres, located at the northern area. During that stage, there were 13 registered villages on the eastern coast of the Peninsula [18].

In the second period, after the hurricane struck, there remained only the memory of the wealthy years. Due to the magnitude of the cyclone, the town was in ruins with few survivors. After Janet, coconut palms and coprero (coconut cultivating men) ranches were abandoned. The few families lingered restored their life; then the place was repopulated with people coming from San Pedro and Sartenejas, Belize, Honduras and El Salvador. More recently, in the 1980s, Noh-

bec, in Quintana Roo, Veracruz and Tabasco, and in current years people from Spain and the United States inhabited Xcalak. With the falling price of copra (coconut kernel) and lobster (*panulirus argus*) market opening, the activity of the residents of Xcalak transformed. The new citizens found in fishing an option to meet their needs.

### Mahahual

Mahahual's community shares a similar history with Xcalak. The first coprero ranches were established in the early twentieth century. At the beginning of the century, in 1909, shortly after the creation of the Federal Territory of Quintana Roo, Valerio Rivero, resident of Xcalak, acquired land extension in a town today known as Mahahual. The property of mister Rivero was almost 81 squared acres dedicated exclusively to coconut plantation. Later in 1937, Valerio Rivero took for himself a fraction of Mahahual with an area of 22 squared acres and established a coprero ranch. When the hurricane of 1955 struck in Xcalak, a similar sequence of events occurred in Mahahual. The cyclone caused loss and destruction of the coconut plantation. As a consequence, Mahahual was abandoned and later, in 1981, the Mexican government repossessed the land extension given away before to don (mister) Rivero. Around the same time the fishing community of Xcalak requested the state government a small extension of land on which to build a fishing camp. From that moment, Mahahual began to be known as a fishermen community who currently live in this location [19].

### Punta Herrero

The community of Punta Herrero, which is within the limits of today's Sian Ka'an's Biosphere Reserve, share historical background with the colony of Javier Rojo Gomez, better known as Punta Allen. The history of Herrero's population began with the first coprero ranches settled on the north coast of the Reserve between 1930 and 1940 with the fishermen who arrived from Cozumel Island.

One of the important settlements was Vigia Chico Ranch. After the hurricanes Hilda and Janet in 1955, and because of the damages they suffered with the weather events, people from this ranch decided to move to Punta Allen (alongside Punta Herrero). The re-occupation of the site originated in 1950, when don Epitacio Hoil Beltran and his family arrived from Cozumel and decided to settle into Bahia del Espiritu Santo (Bay of the Holy Spirit). According to the informants in this research, the community is called Punta Herrero (Horseshoe Point) by its horseshoe shape that the place has, site which is where this community is located.

Due to the common historic events of these three communities, their population made use of practically the same resources to make a living in the coast. Moreover, the nearness of the localities allowed the population to interact constantly. This leads us to think of two possibilities. On the one hand, social interaction and knowledge transmission was a means to obtain a sort of traditional method to use coastal resources. On the other hand, social interpretation of this knowledge might result in a minor difference on the actual management process. Despite the similarities and differences between the communities about supply usage our interest is to provide the cultural elements in which traditional knowledge is displayed onto shared discourse. Hence, we will present the speeches that make vivid the lore of these three populations by summarizing people life histories.

In the costal surroundings, copra usually means two things. People refer to copra when they speak about dried kernel or flesh of the coconut. Likewise, when they refer to coconut related work, that is to say, planting, caring, harvesting and extracting coconut meat. At the flourishing point of Xcalak, Mahahual and Punta Herrero, this activity was the first actual work that this people had. Copra, as an economic activity, started in the beginning of the 1920s and gain importance in the 1930s. At these decades, the economy of the three localities was based on coconut work [20].

Copra production took place onto coprero ranches; and because the local economy was based on the extraction of coconut flesh, all human settlements dedicated their land to exploit this plant. In the first half of the twentieth century, the most relevant coprero ranches were Uvero, Rio Indio and Puerto Angel. There were also small ranches working on copra, but the entire kernel (including those of higher production) was taken to Xcalak to be sold and distributed to ships arriving from Belize, Yucatán and Veracruz.

Copra was considered a manly labor. However, due to the rise and the demand of this resource, all family members (as well as the smallholders) were obligated to work on coconut plantations. Women work was really important for the working families. Most of the time, they managed to do both jobs: house holding and kernel extraction. Doña (Misses) Emilia recalls: I used to live on a ranch after my mother died. Almost every day, we were taken on other ranches to work at coconut plantations, especially in Xcalak. Only my brothers and me because my dad had his own ranch to take care of... that's why he couldn't stay to work in Xcalak, he had to stay and work on his ranch nearby Rio Indio where we used to live. Then, we were dedicated to work copra, together by picking coconuts and copra making what did women do? Well, picking coconuts when breakfast was served; then, we used to gather coconuts and place them in one area.

Another copra worker, don Fotunato, also remembers that kernel extraction was an actual family labor: "My parents, my father and my mother, they had the pleasure of working copra: Yes, they were copreros. My mother, being a woman, used to pick up 5,000 coconuts and peel up to 3,000 in one day. She was an old shaped woman, working woman, and had to work to support us... we were a large family."

The laborers were hired seasonally and worked on large coprero ranches, including Uvero (one of the largest and most important one) that belonged to the Coldwell family (a relevant last name in southern Quintana Roo). "The coprero performed a very heavy work that was not always recognized by the low prices that copra industry had." The coprero men and women were not always in one ranch; they worked across several ranches on the coast and stayed where they were paid better [21]. This means that entire families constantly change their residence.

Based on the information gathered in the interviews, copra activity was carried out throughout the year. There was a momentary ending point; a sort of pause of the activity. However, cropping started all over again giving monetary income to copreros all year long. Each month, boats were loaded with coconut kernel. Although there were timeouts from copra activity that lasted a few days, coprero men did not rest. Most of this time, they were hired to clean the farms and prepare them for next month harvest. Some workers took advantage of this time to do other activities like fishing, while waiting for the next harvest. It is noteworthy that fishing was practiced since copra period, but as subsistence activity.

As note before, the community of Punta Herrero also started as a coprero locality. The largest farms of this area were Sardinas, San Carlos, Pulché, Mosquitero, Maria Elena, La Victoria and Sacrificios. Regarding the organization and method of production, coprero activity in Punta Herrero ranches was similar than the one performed in Mahahual and Xcalak. Don Baltazar recalls about these ranches:

Around Punta Herrero was the ranch called Sardinas, but the closest one to this town was San Carlos. This had a smaller production. Next was Sardinas, Pulche and Mosquitero that are closest ranches onto the south of Punta Herrero. To the north side is La Victoria, Maria Elena and Sacrificios. Those were the farms that produced copra alongside of Punta Herrero. Beyond that side there is Mahahual, Uvero, Placer, but they are no longer in the area of Punta Herrero.

After the hurricane event many survivors, particularly those from Xcalak, migrated to other estates and countries, such as Campeche, Yucatan, Cozumel, Chetumal and Belize, abandoning Xcalak and nearby ranches for the purpose of looking for other ways of living. From that time life in the Mexican Caribbean coast changed. After many years of economic devoutness to copra production, villagers had to find alternative financial activities to survive. Between 1955 and 1958, in Xcalak a few survivors remained in the community. Then, people from San Pedro and Sarteneja, in Belize, joined the small population and opted for the exploitation of sea resources. A former resident of Xcalak, don Nemesio, evokes the following:

In 1955 the coconut plantations were vanished. We came back to Xcalak to see what was left from the hurricane, but we found nothing. At the age of 14 I moved back to Xcalak and I started working on fishery. I didn't work copra because I was a child at that time. With Janet, a lot of ranches were destroyed, many people died, many people migrated to faraway places, some emigrated to Yucatan, Cozumel, Belize, only a few people stayed to recover Xcalak.

Interviewees mentioned that after Hurricane Janet the entire coast population began to spend time fishing. By being geographically located nearby, in Mahahual and Xcalak fishing economy grew significantly. Mahahual was transformed from a whole coprero camp to a fishermen community. The same conversion happened in Punta Herrero. Seafood (squamous type) began with very humble techniques: harpoons, figas (three pointed harpoon) and nets. These fishery instruments were used by their predecessors and were roughly elaborated. The first year of fishing after the hurricane was for self-subsistence; soon fishery became a business. Belize and Chetumal were the leading markets of sea food from -no yet named- Costa Maya.

Shortcut traps (trampas de atajo) were the first gear (and technique, at the same time) they learned to elaborate. This fishing tool was adopted from Belizeans that visit Xcalak from time to time. Thus, this place was the first locality that made and used traps on the coast of Quintana Roo. At the beginning, these traps were placed along the coast by the fishermen of Xcalak; and then the knowledge spread all the way to Punta Herrero. Subsequently, the communities began to develop their own traps and were installed in strategic places. These traps were used only six months a year, specifically from June to December, time when natural migrations of many species occurred. With this utensil, they realized the amount of marine resources they could capture in half of the year. This activity brought them economic benefits. Among the most captured species with this gear, they mentioned: snappers (*Lutjanus sp.*), chacc chii (*Haemulon sp.*), white crappie (*Gerres cinereus*) bonefish (*Albula vulpes*) and mullet (*Mugil cephalus*), among others.

During the adaptation process to fishery, the interviewees mentioned that they had difficulties in this economic activity. For example, there was a transportation issue due to the lack of suitable roads. Their most reliable transportations were wooden canoes and small rowing boats. Most of the time, fishermen contracted ships with a built tank better known as vivero (nursery) so the fish may survive the seven-hour trip to Chetumal and sell their product fresh. It should be added that although the traps were used only for fish, different species of shellfish, including turtles, were captured; in these cases, the surplus were used for self-consumption.

In Punta Herrero, as well as in Mahahual, people who were living in nearby ranches began practicing fishing as a commercial activity. Both localities initiated as fishing camps. The fishermen worked alongside men from Punta Allen. However, for many years (just after Hurricane Janet) they did neither made nor used shortcut traps; instead, their fishing tools consisted in harpoons, fisgas and nets (similar to fishing utensils in Xcalak at first). Transportation and commercialization was made in the same manner as in Xcalak.

In the three communities hunting was also a subsistence activity. The difference from fishing is that they only hunted for self-consumption, not selling. They used to hunt white-tailed deer (*Odocoileus virginianus yucatanensis*), peccary (*Tayassu tajacu nelsoni*), Central American Agouti (*Dasyprocta punctata*), chachalaca (*Ortalis vetula*), pheasant (*Crax rubra*) brush turkey (*Meleagris ocellata*) and iguana (*stenosaura sp.*). Only a few species were hunted for a local market for their skin and meat: crocodile (*Crocodylus moreletii*), white turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*) and hawksbill turtle (*Eretmochelys imbricata*).

In the early 1960s, coprero ranches that resisted the Hurricane still continued into production: However, product level was no longer the same. Some of the people who worked on ranches that were located near the coves had the opportunity to watch turtles nest in the sand. The workers took advantage of their position to catch turtles. They called this activity virar-tortuga (turn-turtle) and it involved waiting for the turtle to climb onto the sand for nesting and just before the turtle finished laying her eggs, the animal was turned upside down and workers proceeded to kill her. The meat was for self-consumption, women cooked different dishes with it. After, the shell was sold to people who dedicated to craft making. The turtle species that were generally hunted were hawksbill and loggerhead.

Punta Herrero, alike in Xcalak and Mahahual, turtle hunting was practiced. In this case, white turtle was the most common species. These chelonians were caught with turtle nets. Their meat was very popular in the community, and was sold in Belize and Chetumal. This activity became important in Punta Herrero. Nonetheless, it ceased because (along with other turtle species) of the national law of wilderness preservation.

Between 1970 and 1980, the copra activity stopped completely. The ranches that had survived until this time, entirely collapsed when the coconut palm was affected by the disease called Lethal Yellowing (LY). LY is caused by a phytoplasma, an unculturable cell wallless bacterium [22]. The disease affected all coastal ranches that had survived along the decade. Although most interviewees assured that the appearance of this disease occurred in the 1970s, this infection expanded in the 1980s [23] ending all copra activity. In addition, the price of copra was already very low causing its abandonment in the three communities. In this period, people from Punta Herrero started to use other fishing methods such as boat hooking (bichero).

In 1986, Sian Ka'an's Biosphere Reserve was officially declared. This event represented a great change to the community of Punta Herrero, particularly in their regime of resource exploitation in the area protected. There were serious restrictions about the material which they used to make lobster traps; for example, they were forced to replace chit and taciste (local palm trees) with cahumitos [24], a lower quality plant. As additional data, in this period the use of shortcut traps gain strength by the extraction of important commercially species: mulatto snapper (*Mugil cephalus*) and bream (*Diplodus vulgaris*), for instance.

In 1988, hurricane Gilberto severely affected the southern coast of Quintana Roo. Thus, lobster production was entirely stopped. This event meant losses for fishery communities. Additionally, because of massive exploitation of natural resources, the communities began to realize the declining of natural ecosystems. Most of the population of the three localities began to take responsibility about it, so that in 1990 they requested to the Mexican government the sea snail law veto by first time.

Along the declaration of the Xcalak Reef as a Natural Protected Area, on November 27, 2000, tourism was a newly attractive activity. Actually, regarding Punta Herrero's history, tourism activity started in 1992 with the creation of the first Tourism Cooperative. In 2000, the community of Xcalak (as well as Mahahual) started ecotourism activities. Nowadays, they continue setting shortcut traps to capture fish in the months from June to December. Even though fishing production is not similar to the former decades, it stills the most important self-subsistence activities in these communities.

## Conclusion

When we talk about usage and management of natural resources we refer to people who have access to a certain type of resource; also, who and how they use it, and who and how it is administered. Therefore, the word is a synonym of handling and administration. In particular, the management of natural resources is related to their care, regulation and allocation or distribution. Natural resource management does not imply sustainable processes neither environmental low impact. As we presented, most of the traditional knowledge was not associated at any time with an ecological care ideology. Nonetheless, this anthropological approach gives us a glance of the possibilities of human-environment interaction.

We identified how communities have been linked to their surroundings and how they made use of coastal resources by using different harvesting techniques and their traditional knowledge. In all cases, development of production processes and economic activities derivative from these resources has been different. For instance, we should rephrase that copra increased because there was a demand for an extra regional market (soap and oils fabrication), while fishing grew initially as a local activity to satisfy family food needs. Later, when copra declined mostly due to the struck of Janet (along with the falling prices of coconut oil because of substitute products), fishing took place into local and regional markets. Essentially, fish production today has declined due to the general increase in demand for sea food, which has led to an over-exploitation schema. The development of turtle and crocodile hunting had a similar fate, but their markets lasted a shorter period. As a matter of fact, turtle and crocodile are considered today vulnerable species, which has categorized them into a protection category.

Harvesting techniques for copra were used in the three communities. Although the amount and condition of coconut kernel was established by the market needs, the operation and the tools for extraction were locally designed and/or adapted for Belizean technics. In the case of fishery, even though the species exploited had a particular distribution throughout the coast, the tools used for this activity depended on the natural resource. The equipment was determined by the knowledge population had about the behavior of the species and on its growing processes (period of abundance, distribution, climate, migrations, size, etc.). Unlike the case of copra, fishing utensils evolved and provided fishermen more efficiency. The arrival of fiberglass boats, outboard engines, network and lines of synthetic material, increased the catch volumes, which paradoxically later led to overexploitation of the marine resource.

The social relations that emerged since the foundation of the communities are relevant for this research. Social interaction allowed the apprehension of new techniques for handling coconut kernel, fishing and hunting in this side of the Caribbean coast. These relations permitted the people of three localities to share their knowledge and innovate in many cases. A clear example is the wide variety of fishing tools and methods developed. The knowledge and experience brought by people from different states and countries, in addition to the fusion of diverse cultures likewise Mayan and Caribbean, enabled local population to create various versions of instruments. Hence, the shortcut trap implied knowledge regarding fish reproduction cycle and local materials; information gathered and transmitted from generation to generation.

This analysis is consistent with the idea that different settlements in the coastal communities generated and accumulated knowledge from their experience of the environment, allowing them to distinguish different ecological components, behaviors and cycles. E.g., coprero ranches and fishing sites nearby functioned as eco-geographic units for resource exploitation. By having this kind of knowledge the communities took advantage of the production and the development of new strategies of natural resource management (considering time and space axes mentioned in the beginning). The knowledge of these units represents the first level of conceptual appropriation in the process of management of natural systems by human communities.

The point here is to understand how they acquired that knowledge, how they processed it and internalized it, so it allowed them to exploit resources depending on geographic availability (seasonal or permanent abundance), as well as the local demand and the national market. It has been mentioned that the acquisition of knowledge happened by oral tradition, experience and observation, as well as the relationship with foreign actors. Armitage [25] mentions that in fact the improvement of performances in managing natural resources depends on the participation of endogenous and exogenous variables. These variables always influence not only the actions of individuals managing resources, but also the determination of their collective actions in order to react to changing circumstances (economic and environmental) and improve learning and the capability for adaptation.

Another important issue is whether it is possible or not that some resources handled by the residents of Mahahual, Xcalak and Punta Herrero can again be managed in a sustainable manner, hereinafter. We should first identify how the current handling conditions are, and compare them with what they had years ago. In other words, is it possible to bring back traditional knowledge for sustainable resource management today? We should recognize that not all indigenous

practices are necessarily sustainable, especially in times of technological change and population growth. However, the collaboration of local people is necessary for the construction of more low impact every day subsistence activities [26].

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