ONE KNOWLEDGE, TWO CONDUITS: THE SOCIAL, DEMOGRAPHIC, AND TOXICOLOGICAL FACTORS THAT GOVERN SERI ETHNOMEDICINE.

by

NEMER EDUARDO NARCHI NARCHI

(Under the direction of Brent Berlin)

ABSTRACT

Ethnomedicinal research has historically focusses on botanical products, ignoring, by and at large, the records on animal-based medicine. Whenever non-botanical -e.g. animal-based- remedies appear on indigenous pharmacopoeias, these are taken with little interest and are explained as de facto - i.e. “They occur because they occur-” This lack of interest impedes ethnobiologists to develop further investigations or theoretical afterthoughts that would enable to articulate ethnomedicinal systems as holistic ecological adaptations.

Among non-botanical medicines, those from marine origins hardly receive any mention. This dissertation describes how do botanical and marine medicines relate within an ethnomedicinal knowledge system.

In this research, I focussed on Seri ethnomedicine. The Seri are an indigenous group of hunter-gatherers located in the mainland portion of the Central Gulf Region in Sonora, Mexico. Seri posses a pragmatic ethnomedicinal system which provides a rich case for this examination as there is little room for cultural features to restrict the flow of ethnomedicinal knowledge between informants.

During a one year long survey in a Seri village, I used participant observation, focus-group interviews, and an ethnomedicinal knowledge test to interview 67 Seri informants. By presenting the individuals with an ethnomedicinal knowledge test, I evaluated each informant's proficiency in ethnomedicinal knowledge and gathered information on the organoleptic strategies used in the selection of medicinal organisms. I then determined the toxicological profiles of marine and terrestrial medicines.

Seri marine and terrestrial medicines are part of one single pharmacopoeia. The organisms are selected under the same criteria; toxicity. Organisms with higher toxicity profiles are used against more ailments. Flavor plays an important role in detecting toxicity. Organisms with bitter or acrid flavors are characteristically associated with high toxicity.

Seri ethnomedicinal knowledge transmission is conditioned to gender roles. Fathers teach about marine medicine while mothers teach about botanical medicine. Women know more about botanical medicine than men. However, 18% of marine medicine has a gynecological application, and women know at least as much marine medicine as men.

By comparing the selection criteria of marine versus terrestrial medicine an important generalization can be formulated; the brain senses medicines in bitterness.

INDEX WORDS: Seri, Comcáac, ethnomedicine, ethnobiology, marine medicine, cultural transmission, ethnography of hunter-gatherers, Sonora, Mexico

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DEDICATION

Al mia patrino, mia plej bona majstro

Al mia filino, mia pli irreverente lernanto

Al mia edzino, mia plej bona amikino

Al mia mentoro, por admirinda kariero

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INTRODUCTION

Zootherapeutics, defined here as animal-based medicines used in local pharmacopoeias, have customarily been ignored in ethnobiological studies. To the best of my knowledge, whenever zootherapeutics appear in the literature, they are presented in such a way that their mentioning is doomed to be just part of a checklist, an anecdotical situation, or a recipe.

Among zootherapeutics, those from marine origin hardly receive any mention in the scientific literature. However, marine-based zootherapy has continuously been practiced by humans for at least 5000 years (Halstead 1992)

While meager, the existing research on marine zootherapeutics has drawn special attention in utilitarian factors such as the identification of species, the recording of their use (Costa-Neto, 2005), and assessment of their pharmacological potential (e.g., Narchi, 2003; Fernández-Apango, et al., 2002). These literatures expose little effort towards theoretical speculation on the cognitive aspects involved in the selection of a given organism for medicinal purposes. Even more, there is no effort to rationalize the similarities and differences between animal and plant medicines in cognitive and cultural terms.

In such a light, research on the selection strategies of marine zootherapeuticals can be considered anything from bold to naive. The small amount of bibliography, the scarcity of sources, and the lack of readers currently interested present themselves as unsurmountable obstacles. However, the critical state of world fisheries, the neoliberal debates on sea tenure, the overall health of the ocean ecosystems of the world, and the social consequences that each of these situations carries, makes it an obligation to fill the theoretical vacuum around the selection of marine zootherapeutics.

Scope of this dissertation and fieldwork

In order to study how human societies integrate a complete pharmacopoeia, this dissertation focuses on Seri ethnomedicinal knowledge. The Seri are an indigenous group traditionally of hunter-gatherers and fishers located in the Central Region of the Sea of Cortez. Currently they inhabit two villages; El Desemboque in the municipality of Pitic, Sonora and Punta Chueca, in the municipality of Hermosillo, Sonora. Their current subsistence strategy is a consequence of market integration to which they offer a mixture of commercial fisheries, sports-hunting, ecotourism, and wonderful handcrafts.

Seri are well known for having an extensive and comprehensive botanical pharmacopoeia that is supplemented with medicines derived from minerals, and marine organisms (Felger and Moser 1974; 1985). In the last decade there has been a growing interest in reexamining the importance and abundance of marine organisms in Seri ethnomedicine. The lists of marine organisms used as medicine by the Seri has grown from seven to some twenty five different organsms (Narchi 2002; Narchi 2003).

Seri use of medicines is individual and personal. It is pragmatic as it is detached from spiritual practices and has no explicit explanation on the mechanisms and/ or doctrines explaining the efficiency of the remedies, which are used "**because they work**" (Felger and Moser 1974: 415).

In this dissertation, I try to elucidate the similarities and differences on the way Seri people use remedies derived from marine and terrestrial resources. I pay special attention to how these medicines behave toxicologically and draw trends between the toxicological profiles and the organoleptic characteristics of these elements. I also analyze the informants' proficiency in ethnomedicinal knowledge and relate this proficiency to factors previously identified as contributing to the variation on ethnomedicinal knowledge, such as age, gender, wealth, monthly income, years of formal schooling, identity of the person who taught this knowledge.

I draw special attention to explain the human-ocean relationship in a historical perspective. In such a light, I make a thorough description of the area of study, at a large scale. Such a description is important to pinpoint that the marine environment has to be seen as a whole. Specially in reference to the study of medicines and metabolites.

The nature and flow of metabolites in the ocean is far more dynamic than the terrestrial parallels as the microscopic communities are responsible of the variations in distribution of specific chemicals dissolved in sea water (Sverdrup *et al.* 1942) and the distribution of certain biotoxins overarches through entire trophic pyramids (Halstead 1965).

The dissertation fieldwork was mainly carried out in the community of Desemboque with sporadic and brief visits to Punta Chueca. I lived in the community of Desemboque from August 2008 to June 2009. I carried out a meeting at the elementary school in Desemboque to inform my research plans and objectives to the Seri, identify the first batch of participants, and obtain prior inform consent from these participants. Initial free-listing exercises were carried out exclusively in Desemboque in August and September 2008. From mid September 2008 to February 2009, I collected the specimens, with the permission of the Comisariado Ejidal, the Elders' Council, the Seri

Governor, SEMARNAT, and SAGARPA. Once the specimens were collected, I gathered data through knowledge tests and participant observation. Given the diverse nature of the collected organisms, which are a mixture of plants, algae, and marine invertebrates, the mounted specimens are scattered through various institutions, collections and herbaria (See Chapter 4).

The research was approved by the University of Georgia Human Subjects Institutional Review Board on February 12, 2008, project number 2008-10528-0. Names of the informants have been changed for privacy concerns.

Language and orthography

Being an isolated language, **cmique iitom** ‘Seri language’ is hard to learn...fortunately for me, most of the Seri are bilingual and speak excellent Spanish. However, in a quest for more reliable data, I pushed myself to acquire a basal working level in **cmiique iitom**. At least, a basic (and for the most part, unarticulated) vocabulary comprehending flavors, colors, numbers, illness, plant and animal names.

Comcáac have been beneficiaries of the American tourists ever since Kino bay opened its yacht club. Added to this, and fostered by NGO's ideas of sustainable ecotourism, every **Cmiique** is eager to learn English. Therefore, I exchanged English lessons for **cmiique iitom** an hour daily for 6 months, starting at 7 pm.

Added to this, I had two local assistants that helped me translate whenever possible.

One of them, <u>Caldito</u>, helped me to learn the language in informal settings. Whenever controversy arose or my pronunciation failed (miserably, most of the times) I helped myself with the Seri-Spanish-English dictionary compiled by Marlett and Moser. Added to this, my field season coincided with that of Carolyn O’Meara, a graduate student in linguistics at the University of Buffalo, who has a remarkable fluency and knowledge of Seri language. She helped me to accelerate the process of understanding **cmiique iitom** structure exponentially. In March 2009, both my wife and daughter joined me in the field. They had only sporadically heard **cmiique iitom** before, when I practiced my lessons during a short Christmas break in Mexico City. Ever since they came to Seriland, I was able to interpret simple conversations from **cmiique iitom** to Spanish for them. The phrase **ipnail caziim** 'nice skirt' became a weekly conversation opener, if, and only if, my wife had washed her blue hippie-type long skirt which **Comcáac cmajiic** 'Seri women' really loved.

My interactions with primary informants were entirely conducted in Spanish at first, then they were started evolving into an 'ask in Spanish, receive answer in **Cmique iitom** fashion. I did fairly well, up to the point of conducting my last structured interviews entirely in **cmiique iitom**, not without repetitious laughter and correcting of my pronunciation, and, sometimes, my manners.

Throughout the manuscript, **cmiique iitom** words are in bold. These are followed by their literal and gloss translations italicized and inside quotations. Spanish terms and phrases are underlined, scientific names are italicized, and Seri archaic terms are presented in bold, preceded by the symbol †. For **cmiique iitom** words I am using the Moser & Marlett Seri Dictionary (2005). When there is a different term found in the literature, the author is acknowledged. All or almost all the verbs mentioned are given in their subject nominalized form, exactly like they appear in the dictionary.

Seri alphabet is composed of 22 letters **a, c cö, e, f, h, i, j, jö, l, m, n, o, p, qu, r, s, t, x, xö, and z**.   In spite of some linguistic variation within the community, all members use the distinctive phonemes represented by these 22 letters (Moser and Marlett 2005:825). For a more detailed description of Seri phonetics see Moser and Moser (1965) .

The following explanation is taken from Moser and Marlett (2005: 825-827 *translation mine*):

Vowels:

a and **i** are pronounced exactly as in Spanish.

e and **o** sounds differ from Spanish.

For **e** the mouth has to be more opened than the Spanish e. The sound that has to be generated lies somewhere in between that of e [ɛ] as in English pet and the a [æ] as in English cat.

o Sometimes will be pronounces as in Spanish u but it is only a phonetical variant of **o**.

Long vowels **aa**, **ee**, **ii**, **oo** follow the same rules. These are only present in accentuated vowels.

Consonants

Cmiique iitom consonants are: **c**, **cö**, **f**, **h**, **j**, **jö**, **l**, **m**, **n**, **p**, **qu**, **r**, **s**, **t**, **x**, **xö**. Consonants that differ in pronunciation from Spanish are listed:

cö [k^w]. When preceding a pause or the consonants **s**, **t**, **j**, **x**, and **z** it is pronounced as a c followed by a light puff.

h [ʔ] Strong pause, it is pronounced by interrupting the voice.

jö [x^w] A little gust emitted while shaping the mouth similarly to the way in which o is pronounced in Spanish

l [ɬ] One of the most characteristic -and difficult- **cmiique iitom** phonemes. l is in no way similar to Spanish l. Resembles a slight puff emitted while trying to pronounce English c and l at the same time.

m Generally pronounced as one would pronounce m in spanish. however, when it follows a non-accentuated vowel preceding **c**, **qu**, **j**, or **x**, it sounds like n. When m follows **c** or **cö**, it is pronounced like a nasalized u.

x [χ] Pronounced like a Spanish j with a guttural remark shaking uvula.

xö [χʷ] Pronounced like Seri **x** followed by a puff. When preceding a vowel other than **o**, there is a slight anticipation that sounds like a very brief **o** before the consonant.

z [ʃ] Pronounced essentially as the sh in <u>sh</u>ow or su<u>sh</u>i.7

On the structure of this dissertation

Chapter 1 provides an overview on the human use of marine medicinal resources focusing in physiological, archaeological, and historical findings. A chronological description on human-ocean relationship serves as a prologue towards critiquing the meager number of scientific observations on marine-based ethnomedicines regardless of a millenarian human-ocean interaction. It concludes by providing a recollection of the occurrence of marine organisms in various pharmacopoeias from antiquity to present day. Chapter 2 looks at the environmental characteristics of the Sea of Cortez, and the history of human occupation of the area from prehistory to present day Seri settlements. By providing a thorough environmental and historical context, chapter 2 builds the foundations to understand how has this mega-diverse area shaped Seri ethnobiological knowledge. Chapter 3 gives an ethnographic description of the Seri. This includes their political organization, subsistence and economy, ethnobiological knowledge, health and ethnomedicinal system, as well as the changes that have occurred in these aspects.

Chapter 4 reports a quantitative study comparing Seri marine and terrestrial ethnomedicinal knowledge, measuring their ability to recognize, name, and describe the correct use of randomly selected organisms from both environments. The study, also describes a basal toxicological profile for a number of organisms and sorts the relationship of these profiles with the informants' individual knowledge scores. I draw inferences based on these tests to understand if there is a perceptual, toxicological, cultural, or socio demographic split that defines which Seri have access to these ethnomedicines.

Chapter 5 concludes summarizing and remarking on the inferred differences between marine and terrestrial medicine and the overlooked importance that the study of zootherapeutics has upon expanding ethnobiological theory.

CHAPTER 1: MARINE MEDICINES

The Pleistocene-Holocene transition: Humans become fishers.

It is an established dogma that fishing is a modern human behavior (McBrearty and Stringer 2007), developed during the Pleistocene-Holocene transition some 12,000 y.a (Clark 1948; McGoodwin 1990; Lubell, Jackes et al. 1994; Sandweiss 2008; Erlandson, Rick et al. 2009).

There is a number of reasons to think humans never fished or consumed any other marine resource at regular intervals before. Firstly, few coastal sites predate the late upper Paleolithic in the Old World. Those that predate the upper Paleolithic show scanty evidence of use of coastal resources or less use of those resources than upper Paleolithic or later times at the same locations (Singer and Wymer 1982; Yesner 1987).

In the Americas, there is no hard evidence for a commitment to maritime livelihoods that postdates the mid-Holocene (Yesner 1983; Yesner 1987). Secondly, the pleistocene megafauna associated with archaeological sites has lead researchers to think of Early humans as big game hunter-gatherers (Braniff 2001). The sharp rise in temperature, the migration of ocean currents, and the local shifts in precipitation, seasonality, coastline and vegetation that came with these changes from 12000 to 8000 y.a. are thought to have had an impact on the megafauna, directly affecting the ability of hunter-gatherers to procure food and survive (Straus 1996). Thirdly, a set of marine transgression-regression oscillations during the last interglacial period, some 115000 y.a., resulted in a mean sea level at least 15 meters higher than the present sea level (McBrearty and Stringer 2007).

These conditions lasted until the early Holocene (Erlandson and Moss 1996) and may have wiped out the archaeological repositories evidence to prove otherwise.

In spite of these arguments, there is some evidence suggesting that Neanderthals cooked shellfish in caves in Italy as early as 110,000 years ago (Stiner 1994). Moreover, novel and sound evidence from Pinnacle Point South Africa, offers a new glimpse into early human adoption of coastal behaviors (Bar-Matthews, Marean et al. 2010).

Marean's (2007), findings at Pinnacle Point show a large scale exploitation of shellfish beds by humans as long as 165,000 ago.

By evoking these findings it is not implied that a marine diet has shaped human cognition and given us tool use, language, and a bigger brain, as has been discussed elsewhere (Hardy 1960; Morgan 1982; Verhaegen 1985; Verhaegen and Puech 2000). After all, neither the fossil record (Langdon 1997) nor the patterns of synthesis and buffer of fatty acids in breastfeeding infants (Langdon 2007) support such views.

What is proposed is that humans have lived early on in a world of dynamic and drastic climate change. It is also worth of noticing that the human species has lived at least two interglacial stages. On the onset of each interglacial period, the species had to adapt to severe food scarcity and in the process, became coastal, not once, but twice. Addicott (1966) proved that molluscan species during the Pleistocene were equally susceptible to migrate due to phytoplanktonic biomass increases than to temperature changes. Addicott's findings suggest that ocean species, at least readily available mollusks, are less affected by large gradient climate change variations such as that at the end of the Dryas.

If the assumption is correct that there was more food in the sea at the beginning of each interglacial, as compared to the terrestrial resources, it suggests that at these times, sea food became advantageous because it was available year round, including the late winter and early spring, which are usually marked by scarcity of terrestrial flora (Yesner 1987). Optimal foraging theory suggests that at different times in human history, the availability of resources is almost as important as the resources nutritional quality (Yesner 1987).

Archaeological and ethnographic data show that population densities are higher on coastal regions (Yesner 1987). In addition, once a hunter-gatherer group starts exploiting shellfish, the population density increases while mobility decreases (Marean 2008). Thus, the exploitation of marine resources for human consumption may not be responsible for our big brain sizes, but it is, almost without doubt, the single most important event in the history of our species, as it became both the reason for rejecting and accepting agriculture, becoming sedentary, growing in numbers and increasing our socio-political complexity (Marean ; Yesner 1983; Yesner 1987; Marean 2008).

This dissertation has little to do with reconstruction Pleistocene scenarios for human development. However, its content is strongly linked with one of our most ancient behaviors, the exploitation of coastal resources. Keeping our coastal origins in mind seems to be of fundamental importance for the development of an understanding and appreciation of future discoveries in coastal archaeology.

A critique on the scientific neglect of marine ethnomedical history!

It is challenging to discuss an event that never happened. Marine ethnomedicine has just recently attracted the attention of academia. Colloquially speaking, coastal researchers came late to the party[i]. Not because they wanted to, but because of the history of ethnobiology as a discipline. To argue for the later, I will use this section to discuss the evolution of the discipline. I claim that the particular paths chosen by mainstream researchers in ethnobiology obscured the vast knowledge horizon offered by the ocean.

Most of the first accounts by naturalists on the plant knowledge of native people were produced in order to fulfill imperialistic and colonial motives (Alcorn 1995; Davis 1995). One of the best examples is the *Libellus medicinalibum indorum herbi*s, a document also known as the De La Cruz-Badiano Codex. The codex was elaborated by Xochimilca Indian Martín de la Cruz and translated by Juan Badiano under the order of Franciscan monks who were commissioned by Francisco de Mendoza, son of the Viceroy of the New Spain, to produce a document that could show King Carlos V the great natural wealth of his newest domain (Huerta 1997).

During the late XIX century, [proto] ethnobiology pursued purely economic (Berlin 1992) and utilitarian goals (Hunn 2007). In 1896, Harshberger suggested several other directions for ethnobiology to follow; i.e. 1) discern the cultural position of tribes who use plants, 2) reconstruct the past distribution of plant species, 3) analyze ancient trade routs based on the former points, and 4) explore industrial exploitation of these resources.

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[i] Llegaron tarde a la fiesta, a pretty popular phrase in Spanish.

About the same time, a sparse interest on ethnozoology started to grow among academics and naturalists. Castetter (1944) mentions the independent apparitions of ethnozoological topics in a considerable amount of reports; i.e. Allen (1876), Birket-Smith (1928), Hornaday (1889), Merrian (1905, 1926). Rasmussen, et al. (1925), and Steensby (1917). The increasing interest for ethnozoological inquiry at the time was also noted by Levi-Strauss (1962) on “La pensée sauvage,” in which studies in reptile lore (Speck 1923), and a handful of ethnozoological based remedies form Siberia (Zelenine, 1952) are mentioned. Ethnozoology became a formal term when Henderson and Harrington (1914) published their “Ethnozoology of the Tewa Indians”.

The discipline of ethnozoology remained dormant for a long time. The preference for ethnobotany was so strong that by 1960 it had become obvious that there was a much larger number of ethnobiological studies commissioned in comparison with ethnozoological ones (Sturtevant 1964).

The overwhelming difference in the number of published manuscripts continues to increase to the present day (Table x). Assuming that the double count of manuscripts remains constant for all the keywords, the ratio corresponding to the number of publications in ethnozoology to those in ethnobotany ranges from 1:6 to 1:15.

Table 1 Number of ethnobiological records by keyword in 3 different databases.

Field of inquiry by keyword	Number of Targets in Google Scholar	Number of Targets in Web of Knowledge	Number of Targets in GIL@UGA
Ethnobotany	28,500	2364	304
Ethnozoology	1910	99	50
Ethno-enthomology	17	0	0
Ethno-herpetology	931	1	0
Ethno-ichthyology	767	1	0
Ethno-malacology	15	1	0
Ethno-ornithology	95	5	0
Ethnoentomology	306	17	4
Ethnoherpetology	42	7	0
Ethnoichthyology	217	8	0
Ethnomalacology	15	0	0
Ethnoornithology	128	1	0
Ethnophycology	0	0	0
Fish lore	174	4	0
Insect lore	97	0	1
Marine mammal lore	1	0	0
Reptile lore	26	0	0
Shell lore	5	0	0
Snake lore	143	9	0
Ethnozoological records including the word lore, discarding ethnozoology	2979	54	5
Total ethnozoological records	4889	153	55

There are several factors that have influenced the preference for ethnobotanical research. By elaborating on these factors, I hope that it will become clear to the reader that the 'success' of ethnobotany over ethnozoology is not antagonistic or competitive in nature. It is a casual driven process in which initial conditions stochastically drove the discipline into a path that has favored research on plants over zoological research. Once these conditions were inertial, the trend continued, kept by a positive feedback loop.

Taxonomic resolution and the differences in sorting taxa

"There is a tendency among young and upwardly mobile ecologists to view museums and herbaria as 'dusty' old-fashioned places with old people working on them (Guerra García, Espinosa et al. 2008). In less harsh terms and in a broad generalization (*sensu* Godfray 2002), contemporary ecologists, conservationists, and biologists see taxonomy as an obstacle for their final goal - to analyze and discuss community-level phenomena. These views have resulted in little new hirings of taxonomists either in museums or other sorts of research institutions (Guerra García, Espinosa et al. 2008). Without the collaboration of taxonomists, biological science professionals wrongfully assume that plants have all descended from a common ancestor in relatively recent times (Vergara-Silva 2003). This assumption has lead to categorize plants as "less complex" and thus, easier to classify by single individuals. Even though there are specialized taxonomists for each botanical taxon, modern plant taxonomists most regularly specialize in classifying plants from specific ecosystems instead of classifying specific plant divisions (Berle per. comm. 2010). On the other hand, the nature of zoological taxonomy and the abundance of different clades have decomposed the discipline of zoology into various subfields; e.g. mammalogy, herpetology, ornithology, and entomology, which require each an expert taxonomy specialist (Berlin, per. comm. 2005). Therefore, ethnobotanical collections can be determined by a couple of taxonomist, while ethnozoological collections have to be sent to various specialists, usually working in different places, in order for the collections to be determined. The enterprise of ethnozoological research demands a greater multidisciplinary effort while consuming more time and resources, a deterrent to consider in the "publish or perish" environment.

The comparative nature of anthropological methods + the cross-cultural comparison tradition.

Before the 1950s, anthropological research was, for the most part, a mere collection of descriptions (Stepp 2005) which singled out societies from an isolationist perspective, without making any effort to either understand the ways in which these societies saw the world or articulating how these societies fitted within the world. During the 1950s anthropology sophisticated itself as a means to develop theories able to explain cultural processes, such as cultural change, and social structure (Wallace 1962). One of the emergent approaches was ethnoscience. This new approach aimed at studying cultural-ecological relations by means of incorporating new anthropological methods (Castetter 1944) to answer the newly emerged anthropological questions (Zent 2000) regarding the rise and evolution of cultural processes. To test the hypothesis on the cultural-ecological adaptiveness of human societies, there was a need to compare across cultures (Mace, Pagel et al. 1994). "Anthropologists working in an ethnoscientific framework began looking at domains of cross-cultural importance, most notably kinship, through a nexus of ethnographic, psychological, and linguistic frameworks" (Stepp 2005 :213). Suddenly, the search for other domains of cross-cultural significance led ethnographers to expand the comparable units to those found in the plant, animal, ecological, and geographical realms, just to name a few (Kottak 1999).

So important was the need for comparing the results of these new ethnographies, that researchers lead by George Murdock, undertook the colossal endeavor of constructing the Human Relation Area Files (Atran 2005), a collection of over 1000 codified ethnographies aimed at a cross-cultural comparison of ethnic groups (Tobin 1990; Mace, Pagel et al. 1994). Within the particular field of ethnobotany, and in the zeitgeist of cross-cultural comparison, it is important to underline the pioneer work of Harald Conklin (1954), who managed to demonstrate that Hanunóo ethnobotany was a complete and self- explanatory system for plants (Berlin 1992), a demonstration that shattered the long prevailing notion of a less sophisticated nonwestern mentality (Zent 2000). Conklin's (ibid.) work became such a landmark, that it was immediately considered a seminal reference and a research model to follow. In Mexico, two decades later, Berlin and collaborators (Berlin, Breedlove et al. 1973) found marked similarities to Conklin's findings regarding Tzeltal ethnobiology, a finding that allowed them to postulate universal principles for classification, still in force at present, in which the principles have expanded to a myriad of non biological folk taxonomies (Witkowski and Brown 1978; O'Meara and Bohnemeyer 2008).

These two works, Conklin (1954) and Berlin et al. (1973), became landmarks in ethnobiology at a time when cross-cultural comparison was considered fundamental, thereby eclipsing the potential rise of ethnozoology.

The development of ethnobiology and ethnoichthyology

Towards the end of the 1960s, Morrill (1967), using those propositions of ethonscience, produced a seminal work on the ethnoichthyology of the Cha-cha. This research described in acute detail the local perceptions on taxonomy, ecology, behavior and toxicity of fish as perceived by those people from French origin inhabiting the U.S. Virgin Islands (ibid.). Meanwhile, ethnobiologists were more interested in a new disciplinary trend: to use ethnobiological data to elucidate the cognitive, linguistic, and perceptual principles of folk taxonomies (Zent 2000; Hunn 2007). Most of the discussion in folk taxonomies was driven by examples taken from the botanical realm. Efforts to include any zoological data (e.g. Anderson 1967; Gal 1973; Hage and Miller 1976; Hunn 1977; Brown 1979) have also been used in the discussing folk categories. Parallel to the discussion of folk taxonomies, there was a need to answer why people named biological units. The question, raised by Levi-Strauss (1962), in response to the functionalist approach advanced by Malinowski (1974), advocated for a pre-existence of intellectual needs to name things before discovering what these can be used for. Ethnobiology kept evolving during the 1980s into a more practical and applied discipline, aimed at understanding how knowledge shapes behavior (Zent 2000). During the last 20 years, ethnobiology has become a political arena with a marked division between those who try to incorporate local knowledge into sustainable models and global economies, and those that argue against the commodification and misappropriation of local knowledge (Hunn 2007).

As a discipline, and from its early beginnings, ethnobiology has been remarkably successful in raising emancipatory ideas around peripheral societies and their knowledge. At the same time, it has been quite effective in provoking a continuous discussion on the universality of its principles, as well as on its intellectual/utilitarian character. The evolution of the discipline of ethnobiology has brought into existence a great diversity of interesting topics, useful for advancing theory (Gragson and Blount 1999), improving resource management (King and Faasili 1999), and modeling identity, agency and power of local communities (Hill 2000). Paradoxically, this success produces a tradeoff in which the bodies of knowledge regarding trends and 'topics *in vogue'* benefit and grow, while tangent topics remain peripheral.

A trend that reaches ethnopharmacology**.**

As Galton's problem points out (see Naroll 1973; Ross and Homer 1976; Mace, Pagel et al. 1994), cultures do not exist in social vacuums. Neighboring cultures have always exchanged, consciously or not, material and intellectual goods, including information about natural remedies. Moreover, people have, for centuries, been interested in observing, preparing and prescribing indigenous remedies (Heinrich, Edwards et al. 2009). Therefore, we can say that ethnopharmacology has existed for a long time. Having acknowledged the former, the points discussed in this section will refer to ‘formal’ ethnopharmacology. Ethnopharmacology is formally understood as “the interdisciplinary scientific exploration of biologically active agents traditionally employed or observed by man [sic]” (Bruhn and Holmstedt 1982 [Holmstedt and Bruhn 1983 :252]). The definition is so ample as to encompass bioactive agents from any natural source; e.g. plant, animal, bacterial. However, the authors diminish the importance of animal derived medicines and throughout their seminal article, advocate for the importance of phytochemical studies;

“Ethnopharmacologic research is based on botany, pharmacology and chemistry, but other disciplines have made vital contributions. “ (Holmstedt and Bruhn 1983 :252)

“It is essential, however, that anthropologists interested in ethnopharmacology seek contact and collaboration with experts in botany, chemistry and pharmacology.“ (Holmstedt and Bruhn 1983 :252)

After 30 years of ‘formal’ ethnopharmacological research, the discipline has finally considered the importance of an ethnopharmacological research that is comprehensive for all taxa;

“Ethnopharmacological data usually pertain to biological organisms and derived products, predominantly from flowering plants, but also to a lesser extent gymnosperms, ferns, mosses, algae, lichens, fungi, and also some animals and marine organisms.” (Heinrich, Edwards et al. 2009 :13)

Nonetheless, several reviews have pointed out that ethnopharmacological research still privileges Euro-American ideologies while brushing aside all the rest (Etkin and Elisabetsky 2005; Heinrich, Edwards et al. 2009). The former shows the need for for anthropologically oriented ethnopharmacology (Heinrich, Kufer et al. 2006).

The disdain of other sciences**.**

Marine natural product chemistry (AKA marine pharmacology), a fairly new specialization tracing its beginnings only to the late 1960s, focuses exclusively on discovering marine metabolites that could be directly used or serve as leads for biotechnological and pharmacological development (Ruggieri 1976; Haefner 2003; Proksch, Edrada-Ebel et al. 2003; David and Brian 2004). At the same moment that marine natural product chemistry was developing, anthropologists started getting more interested in cognitive and linguistic questions on folk taxonomies, rather than dealing with economic studies of folk biology. Anthropologists, consciously distanced themselves from those types of research that produced results which resembled more a “treat of botany with notes on ethnology” (Conklin 1954 :10).

The contraction on the amount of economic studies on how humans use biotic resources left other disciplines without any reference on the existence of marine folk medicine. To paraphrase the prominent chemist John Faulkner:

> **“Natural products from plants are often the cheapest and most effective drugs available, particularly in the Third World, and they come to us as a legacy of folk medicine based on herbal remedies.**
> **Unfortunately, we have no such legacy for the marine environment.”** (1992 :30)

The claim that the oceans have no marine ethnomedical history has pervaded the chemists’ conceptions under the assumption that “ **due to technical barriers there has been a lack of extensive marine folk medicine in the western**

world.” (Jimeno, Faircloth et al. 2004 :16). Therefore, **“until the development of scuba, it was impossible to explore undersea world, and even the intertidal zone was largely ignored because it was a dangerous environment.”** (Faulkner 1992 : 30)

The claims listed above result in a fallacy, as these are constructed over two unsupported premises; a) The marine world is too harsh for humans to explore without advanced XX century technology, and b) “The ocean lacks a marine ethnomedical history” (Carté 1996 :271).

Throughout the following paragraphs, I will discuss these claims, with special attention to the putative ‘danger’ of the sea, especially the intertidal zone. Secondly, I will give some historical examples of the amazing depths that humans can attain by breath-diving. Lastly, I will draw from historical and contemporary accounts that provide enough evidence to argue for a long-held existence of marine ethnomedical history.

Human ability to explore the ocean**.**

The study of written records makes it possible to assert that humans built boats and sailed on oceanic voyages as early as 3,000 BC in the Mesopotamia (McGrail 2003). These records, complemented with iconographic evidence suggest that humans have been sailing around the Mediterranean at least since the Early Bronze Age c. 3800 BC (Da Silva 2007). Theoretically, humans were capable of sailing on seafaring vessels long before the Bronze Age (McGrail 2003). The voyages would have been possible with such simple technologies as hide boats and complex log rafts, as well as adventuring themselves in oceanic voyages by means of using simple logboats. The oldest direct evidence of aquatic transportation known comes from the logboat found at Pesse, in the Netherlands (Rogers 2009). These kinds of boats, a hollow dug out log with no adjacent structures (Miyashita 2006) is believed to have been used c. 8000 BC. Logboat use was restricted to inland navigation because of the limits in their waterline beam, which in turns was constrained by the relatively small diameter of European trees (McGrail 2004). No prehistoric findings capable of providing material evidence of the existence of seafaring technology has yet been discovered (McGrail 2004). The marine environment is harsh for organic materials, such as those allegedly used in the construction of Pleistocene vessels, to be preserved (Thomas 2006). Wood, reed, and vegetable fibers such as sisal rope and hemp will be decomposed by benthic organisms such as shipworms (*Limnoria*), soft rot, tunneling bacteria and eroding bacteria, which can decompose an entire ship as quickly as 3 years (Brown, Bump et al. 2007).

However, indirect evidence of human seafaring abilities have been at hand two decades before archaeologists first postulated that human-ocean relationships were a recent phenomenon. During the late 1970s (Jones 1968) archaeologists were able to determine radiocarbon dates for prehistoric human settlements in Australia. A mind-numbing date of 18,000 -26,000 years before present (Jones 1979) proved seafaring to be a human ability much older than previously considered (Erlandson 2001). Even if the low sea levels of the late Pleistocene are considered and regardless of the route of colonization, the trip required several separate sea crossings, including voyages that distanced at least 80-100 km (Clark 1991; Irwin 1994; Bednarik 1999; Bailey 2004). It is not clear if these prehistoric Sandokans drifted away (Thiel 1987) or navigated with clear maritime ideas, knowledge, and objectives (Anderson, Chappell et al. 2006). The important fact is that, no matter how, they did it.

Curiously, these mariners arrived to the Australian coast long before previously recognized. Today we know that Australia was colonized by anatomically modern humans between 40,000-60,000 years ago (Roberts, Jones et al. 1990; Bednarik 2003).

Surprisingly, anatomically modern humans are not the first hominids with a love for "sailing fast and living slow". Tool evidence on the early occupation of the Flores Island suggests that *Homo erectus* reached Indonesia 800,000 years ago (Sondaar, Van den Bergh et al. 1994). This evidence was later corroborated by independent zircon-fission track dating (Morwood M.J. 1998). In order for *H. erectus* to colonize Flores, the species required a seafaring capability, since the access to eastern Indonesia required sailing over 600 miles of sea (McGrail 2003) that included deep-water crossings at least 20-30 km long (O'Sullivan, Morwood et al. 2001). One can easily suppose that members of the species can be capable of swimming from island to island. In fact, many land-based mammals, especially elephants frequently do so (Johnson 1980). However, there is a good amount of evidence to support the claim that, at that time, no earthbound species was capable of crossing by its own means the most famous biogeographic barrier in the world; the Wallacean line (Bednarik 2001). During the late XIX Century, Arthur Russell Wallace (1890) noted the abrupt discontinuity of species distribution between the Asian Islands of Sunda and the Australian Islands of Sahul. Wallace's observations, as well as a sound fossil records, suggest that Indonesia, Kalimanta, Bali, Java, and Borneo (Sunda) were connected to Asia during the times when the sea level was 150 m below present level, while the island to the East, starting with Lombok, remained separated from the mainland (Johnson 1980).

Human ability to explore the oceans without boats

A number of assumptions allow to illustrate that coastal life and utilization of marine resources is not dependent of the ability to navigate, or construct boats. Firstly, lets assume that *H. erectus* was not able to develop seafaring capabilities. Let us then assume that *H. sapiens* started navigating in more recent dates, lets suppose, that the Bronze Age saw the dawn of aquatic navigation.

All said, and acknowledging that we were hypothetically left without aquatic transport, 'anatomically modern' humans were, and still are, able to dive. In fact, when humans dive, their physiological response is qualitatively similar - despite being quantitatively not as pronounced - as the response observed in other diving mammals (Gooden 1994). The diving response is a cardiac, vascular, and respiratory mechanism triggered by breath-hold diving and understood as a physiological strategy for conserving oxygen during submersion (For a detailed description of the response, see Gooden 1994).

The human records for apnea diving are 171 m for depth (Fig. 1) and 8:58 minutes for time (Clauss-Martin, Ehrmann et al. 2005), an almost unattainable mark for the average human. However, thanks to the diving response, untrained humans in good physical condition can theoretically go underwater between 40 and 65 m just by means of breath-hold diving (Craig 1968).

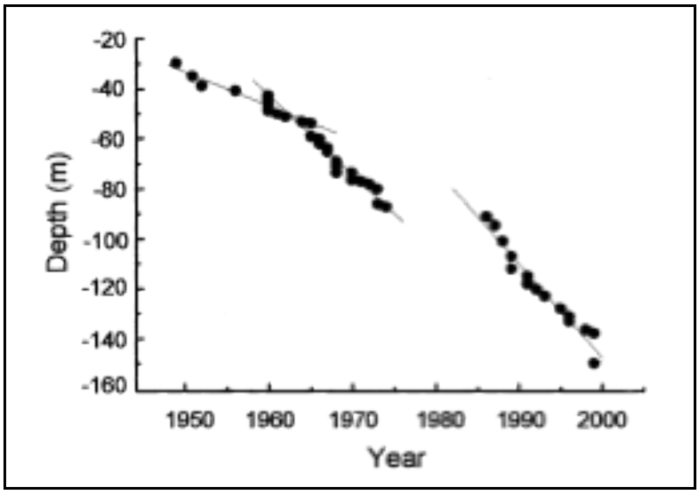

Fig. 1 Evolution of depth record in breath- hold diving. (Source: Ferretti 2001 :255)

There is a long history of human use of breath-hold diving, as a technology for extractive and belligerent purposes. Breath-hold diving has been practiced in Greece, Persia, India, Korea, and Japan for at least 2000 years (Ferretti 2001). According to Edmonds, Lowry and Pennefather (1975) the historical records of breath-hold diving go as far back as 4500 BC, when the Greeks used diving as a means to supply their communities with shells, food, and pearls. Around 1,194 BC, breath-hold divers sabotaged ships during the Trojan wars (Edmonds, Lowry et al. 1975; Acott 1999; Pelizzari and Tovaglieri 2006). Near 460 BC, Herodotus was mocked by Aristotle for documenting the immersions of *Scyllis,* a Phoenician sailor that could easily dive at depths of 60 m (Davis 1934). In 332, during the siege of Tyre, Alexander the Great commanded a squadron of his soldiers on an underwater demolition mission, in which they used a diving bell called *Colimphax* (Bachrach 1988).

More recently, and more related to the "western world", the recovery of £ 200,000 in sterling silver from a Spanish galleon sunk in the Caribbean, is credited to sir William Phipps, who allegedly, made the salvage entirely by breath-hold diving for the treasure back in 1680 (Kindwall 1990). Commercial diving was revolutionized on the year of 1873, when Augustus Siege invented the diving dress/diving helmet, a device that pumped air to the divers at a steady pace (Edmonds, Lowry et al. 1975).

Despite the invention and revolution of the diving dress, and later, the self-contained underwater breathing apparatus (S.C.U.B.A), some fishermen still practice breath-hold diving as a ludic activity, some others as a commercial enterprise.

In 1913 a Greek fisherman was able to recover an anchor grounded at 70 m deep after 3 consecutive dives and helped by a 15 kg ballast (Ferretti 2001).

Park et al. (1990) estimate that 20 years ago, there was a total of 20,000 active pearl collectors using breath-hold diving techniques along Japanese and Korean coasts.

In Panama, Kuna breath-hold dive for lobster. They regularly do not surpass 20 m in depth during their diving expeditions. In spite of these relatively short immersions, the lobster fishery yield under the breath-hold diving technique reach 67 kg lobster / Km^2, quite remarkable, considering that fisheries that use lobster traps and SCUBA diving techniques such as those on Brazil and Los Roques, Venezuela attain yields of 108.3 and 63.7 kg lobster / Km^2 respectively (Castillo and Lessios 2001).

Octopus fisheries on south Chile produce a yield of over 200 tons a year by solely relying on breath-hold diving operations (Rocha and Vega 2003).

Conch (*Strombus gigas*) and lobster (*Panulirus argus)* the two most important fisheries for the Turks and Caicos Islands (Medley and Ninnes 1999) represent 95% of the entire fisheries production for the area (Béné and Tewfik 2001). These resources, one of the mayor exports for Turks and Caicos are usually captured at depths of less than 10m and no more than 20m by means of breath-hold diving (Medley and Ninnes 1999).

There is a myriad of examples around the world that should be included to illustrate this discussion. However, and for the purpose of illustrating how easily it is to extract marine organisms from their environment, we will now assume a human population where no one is able to dive or even swim.

Tides, tidepools, and intertidal zones.

Tides can be understood as the increase in the level of a water mass due to the gravitational attraction of astral bodies (Denny 2007). Even though tides occur throughout the entire ocean - and are also perceivable in other big water masses such as the Great Lakes-, the place where the tidal increase is more obvious, is the shoreline (Fig. 2). In the open ocean, tidal range is, on average 0.5-1m, while along the coast it customarily falls in the range of 1.5 - 2 m, and a dramatic 5-6 m in narrow bays and interior seas (Kowalik 2004).

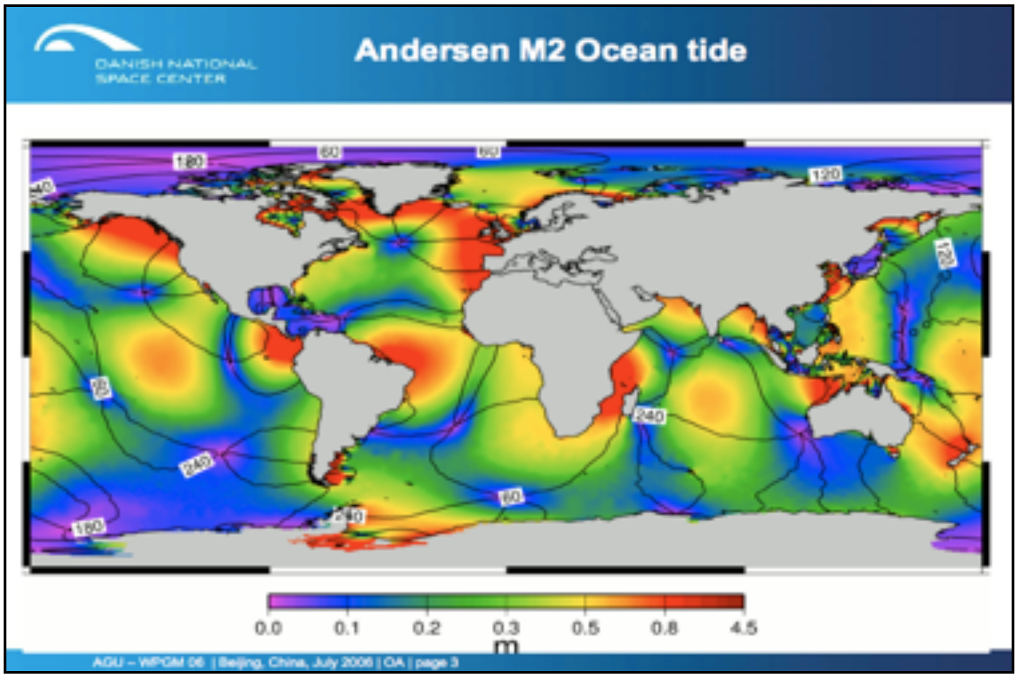

Figure 2. Andersen Ocean Tide M2 Model. The model shows the tidal amplitude of the principal semidiurnal lunar constituent (Hicks 2006). Tidal amplitude can be understood as the result of half the difference between the highest and the lowest tides for a given zone. (Source: Andersen, Egbert et al. 2006)

It is curious to see that when the tides go out, most of the marine organisms remain. These intertidal organisms are capable of enduring several hours of exposition to aerial conditions in which heat and air threat them with desiccation (for a detailed explanation see Hand and Menze 2007). These organisms cope with these temporal waterless situation either by activating biochemical and biophysical responses or by taking refuge in tidepools formed by the interaction of the last high-tide and the sediments on the intertidal zone. Tidepools can be as insignificant as small puddles or as big as small lakes (Fig. 3).

Figure 3. Tidepool exposed at low tide. Haxöl Iihom (Desemboque de los Seris), Sonora, 2009.

The amount of land that can be uncovered when the tide backs off will vary in relationship to the morphological features of the coast and the beach slope. The tidal uncover terrain can go from nearly imperceptible to uncovering hundreds of meters of water, specially in places where the gentle slope of the shoreline combines with high tidal excursion (Figure 4).

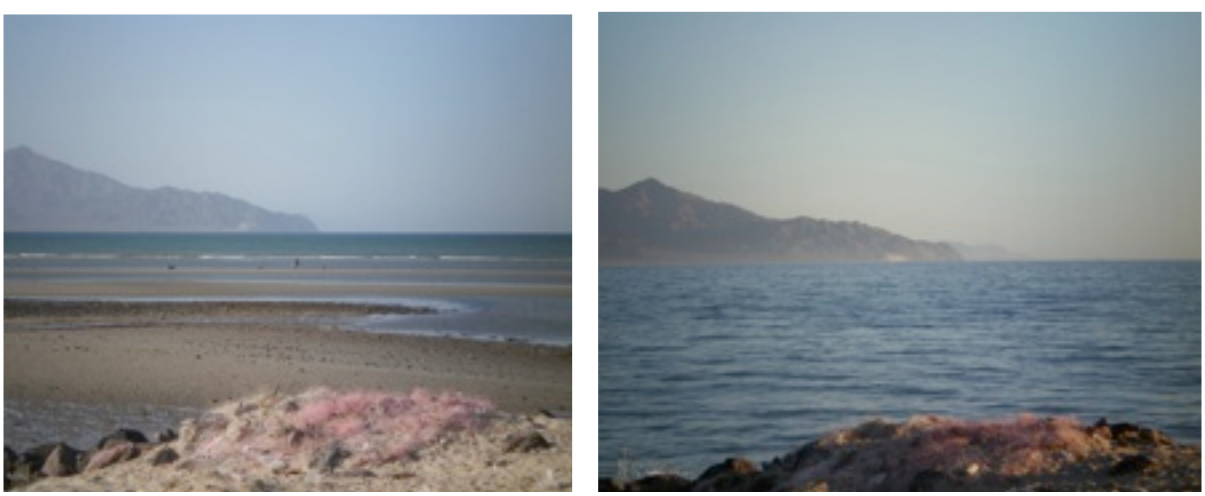

Figure 4. Exposition of a big intertidal zone during an extreme spring tide. Haxöl Iihom (Desemboque de los Seris), Sonora, 2009.

When water retreats, and in spite of the environment; mudflats, estuaries, rocky, or sedimentary shores, a whole universe of creatures is left within reach (Fig. 5). In fact, macro-invertebrate biomass on temperate rocky shores attains magnitudes 10-100 times higher than any other benthic marine environment (Ricciardi and Bourget 1999). Among these species, the globally preferred invertebrate group are mytilid mussels (Sink and Harris 2007), which includes the European blue mussel (*Mytilus edulis)*, the Mediterranean mussel (*Mythilus galloprovincialis)*, the Thailand green mussel (*Perna viridis)*, and the New Zealand green mussel (*Perna canaliculus)* (idem.), plus a huge variety of other edible invertebrates such as clams (*Crassostrea, Pteria,* and *Ostrea* species), octopi (*Octopus, sp.*), abalone (*Haliotis sp.*), snails and conchs (*Concholepas)*, sea cucumbers (*Holothurids*), sea urchins (*Echinoids*), and limpets (*Siphonaria*) just to name a few. If food is medicine and medicine is food (Etkin and Ross 1982), the intertidal zone is among the best convenience stores there are.

Figure 5. Extreme spring tide retreating as far back as 400 m. The pictures show how attractive these areas are for human, canine, and avian opportunists. ***Haxöl líhom****, (Desemboque, Sonora) 2009.*

Having access to the intertidal zone is not a synonym with extracting the organisms easily. Anderson (1981) has calculated the amount of time that it would have taken for the inhabitants of a 37 Km² coastline in New Zealand to collect the entire marine crops of the intertidal zone around 1800 CE. Such an area would have been entirely collected in around 2000 man-days if the area is collected during the 2 hour period of daylight low tide. Therefore, a single human can collect the whole population of a 27 m² area in an hour, or 54 m² on a tidal lowering period. This is enough to collect 240,000 limpets (*Cellana sp.*), 81,000 dark top snail (*Melagraphia aethiops*), 33,000 turban snails (*Lunella smaragua)* and 21,000 Pauas (*Haliotis iris*).

Empirical data on octopi collection by the Seri show that once the octopus is spotted, the collector can extract it as fast as in 1:30 minutes. A naive anthropologist, sensing clam with his feet, can extract about a dozen in 5 minutes.

A brief history of human use of marine medicines

It is now clear that humans enjoy relatively easy access to marine resources. With this in mind, I will illustrate on the geo-cultural extension the first written records on the use of marine medicines.

The first record of aquatic medicine is nearly 5000 years old. The tax records generated in China in the year 2953 BC, during the rule of emperor Fu Hsi, are proof that the empire was already levying fish derived medicine then (Halstead 1992). *Circa* 400 BC Hippocrates had already noticed the antibiotic effects of certain sponges, which he recommended to the Greek military to dress soldier wounds with (Riddle 1987). A real advancement in electricity and neurological treatment came around 41 AD with the observations of Scribonius Largus, personal doctor of Emperor Claudius, who recommended the discharges of electric fish (*Torpedo nobiliana*) to cure migraines and headaches (Kuhfeld 1995).

Dioscorides was among a great number of Greco-Roman physicians that described marine medicine in his *Materia Medica*, written around 65 AD he noted the beneficial effects of brown algae on erysipelas inflammation (Khalilieh and Boulos 2006). Some years later, Galen also described medicinal uses of algae, noting that the mucilage surrounding the thallus had remarkable properties to dress wounds (2006). Pliny “the elder” also plunged into marine medicine in 77 AD when he suggested stingray spines to alleviate toothache through the pages of his renowned “Natural history” (Secundus 1603).

The Greco-Roman medicine was later on adopted and studied by Arab scholars since the early Muslim period circa 600 AD. Before exploring the greco-arab medicine in more detail, it is necessary to mention the contribution of Chinese scholars to the understanding of marine medicine during antiquity. Two salient books on the topic are *Shen Nung Pen Ts’ao Ching (*神農本草經)*,* or The Divien Farmer’s Materia Medica *circa* 200 AD, and the *Chinese Materia Medica of Fish Drugs* belonging to the Tang Dynasty *circa* 618 AD (Halstead, 1992).

Lev (2003) offers a comprehensive listing of animal and animal-derived medicines for the region of Levant expanding from 600 AD into 1700 AD (Israel, parts of present-day Syria, Lebanon and Jordan) in which he includes mollusks (generic shells, pearls, talia, cuttlefish, and tritons) fish and corals. There is no question that the Islamic Classical Period was full of passionate scholars responsible for safeguarding the early Greek and late Roman science, prohibited by the Catholic church. Among these, Bakr Muhammad ibn Zakariyaa al-Razi (865-925 CE), and al-Muzaffar al-Rasuli used seaweed therapeutically (Khalilieh and Boulos 2006), of all these Abu Ali al-Husayn, Dawud ibn Umar al-Antaki ibn Ali ibn Sina, better known as Avicenna (980-1037 CE), stands out as an authoritative figure in Mediterranean medicine for centuries (Khalilieh and Boulos 2006). In his seminal book al-Qanun fi al-tibb -Canon of Medicine- he mentions 23 different marine resources used as medicine (Farooqui and Ahmad 1994). The list expands to include algae, mollusks (*Cypraea moneta, Sepia officinalis, Ostrea edulis, Pinctada, sp., Clanculus depictus, Strombus,* *sp. Aplysia sp.*), crustaceans (*Cancer marina, Crangon vulgaris*) sponges (*Spongia officinalis, Lapis spongia*), echinoderms (*Echinus marinus)*, fish (*Acipenser huso, Pterois russelli, Anguilla sp*), reptiles (*Chelonia mydas, Crocodilus palustris*) and mammals *(Physeter macrocephalus, Monodon monoceros*). Last, the Pen Tsao Kang Mu (本草纲目) written around 1590 AD holds several seaweed based remedies (Chapman 1952).

1)Contemporary research on marine ethnomedicine.

Most of the ethnographic research published so far omits the mentioning of marine-based medicine in detail. A brief search through the Human Relation Area Files revealed a scarce number of mentions for any type of aquatic-based remedy (N=25) compiled throughout 22 ethnographies (Fig. 6)

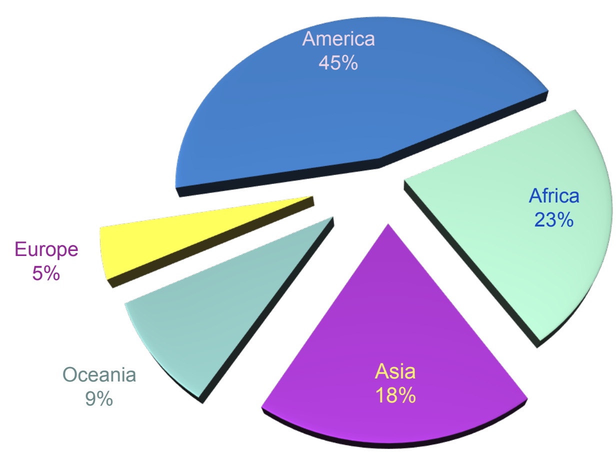

Figure 6. Number of entries in HRAF mentioning any use for marine-based medicine. N=22

Overall, the mentions of marine-based medicine on HRAF (i.e. Rattray 1929; Evans-Pritchard 1937; Tschopik 1946; McKim 1947; De Smidt 1948; Itkonen 1948; La Barre and Mason 1948; Barrett 1952; Glacken 1953; Sturtevant 1954; Speck 1955;

Sturtevant 1967; Mahony 1970; De Laguna 1972; Islam 1974; Simon 1975; Berglund 1976; Gould-Martin 1976; Attagara 1984; Linnekin 1985; Achebe 1986; Foster 1986) are more anecdotical than in-depth reflections, conveying less interest to marine-based medicines as a central topic, and just considering them as "ethnographic gifts" e.g.

"Some Hawaiians like the taste of all that *limu.* It's medicine, good for you. They take it for medicine."

(Linnekin 1985: 160)

"Several times the visiting nurse found a pregnant woman anemic and recommended that she pick up some medicine; sometimes she recommended fish liver oil for the children."

(Gould-Martin 1976 :188)

"Ingredients in the rain-making medicine are to a large extent material from the Indian ocean. *Ukhuningomile,* sea-weed, fetched from the rocks in the ocean form an essential part of the medicine and without it the medicine is of no avail. Equally important is *ikwindi,* mussel shell-fish, and *isikhukhukhu* sea-urchin, without which the medicine is not efficient. Other useful ingredients are pieces of vegetation cast up by the waves on the shore which have been picked up before they have dried. Two informants said that bone or fat from a whale, *umkhomo,* is an essential, making it as important an ingredient as sea-weed or any other produce of the sea. "This animal is very big. When the sky sees the fat of this animal it will say, 'Surely the drought must be very great when even this animal is dead.' For if a whale dies and its body is found on the shore, then it is known that there will be a very great drought." The male medicines also contain very well ground black pebbles picked up along the sea-shore, while the female medicine contains the fine produce of white stones found on the shore."

(Berglund 1976 :56)

"The fish Anotche was selling he had mixed with medicine so that the heart of any one who ate them would become like that of a woman."

(Rattray 1929)

Currently, there is an actively growing number of scientific studies on the medicinal use of marine medicinals. Most of these manuscripts remain unnoticed as their volume is not as considerable as those in other areas of ethnobiology. Added to the former, being an informal subfield of the discipline, most of the papers represent basic research, performed solely by intellectual curiosity and not as a research priority.

Table 2 offers a synthesis of contemporary research on marine-based ethnomedicine. The table reflects the taxonomic diversity of the organisms, the wide range of uses, the geographical dissemination of the research, and the lack of data for Europe, Asia, and most of the southern Pacific.

Table 2. Marine-based ethnomedicine in contemporary scientific literature.

Common name / Scientific name	**Use**	**Ethnic group/ Georeference**	**Reported by:**
Various snails & conchs	Diverse medicinal purposes	Sonora, México	Drake, 1953
Shark	Nutritional disorders	Maya/ Yucatan, Mexico	Borhegyi, 1986
Limu make o hana *Palythoa toxica*	Smear spear points to make them fatal	Hana / Hawaii	Moore & Sheuer, 1971
Sea turtle *Chelonia mydas*	Motion sickness / increase fertility	Comcaac/ Sonora, Mexico	Felger & Moser, 1974
Sea star *Luidia phragma*	Post-partum hemorrhage	Comcaac/ Sonora, Mexico	Felger & Moser, 1974
Sea star *Phataria unifascialis*	Antiinflammatory	Comcaac/ Sonora, Mexico	Felger & Moser, 1974
Octopi *Octopus sp.*	To run faster	Comcaac/ Sonora, Mexico	Felger & Moser, 1974
Mejillón *Modiolus capax*	Healing of the umbilical cord	Comcaac/ Sonora, Mexico	Felger & Moser, 1974
Fireworm *Eurithoë complanata*	Cut down menstrual flux	Comcaac/ Sonora, Mexico	Felger & Moser, 1974
Manatee *Trinchatus manatus*	Antihaemorrhagic	Venezuela	Pompa, 1983
Sea sponge	Mumps, rheumatism, goiter	Venezuela	Pompa, 1983

Common name / Scientific name	Use	Ethnic group/ Georeference	Reported by:
Sea urchin	Antiepileptic, cardiotonic	Venezuela	Pompa, 1983
Makuri-nori *Digenea simplex*	Anthelminthic	Kempo medicine/ Japan	Der Marderosian & Liberti, 1988
Catfish *Airus sp.* *Bagre sp.* *Siadichtyes sp.*	Scar treatment	Mestizo fishers/ Baja California Sur, Mexico	Encarnación & Contreras, 1992
Sea star *Astropectens armatus*	Antihaemorrhagic, antiabortive	Mestizo fishers/ Baja California Sur, Mexico	Encarnación & Contreras, 1992
Yellowtail *Seriola dorsalis*	Headache	Mestizo fishers/ Baja California Sur, Mexico	Encarnación & Contreras, 1992
Dogfish *Carcharinas sp.*	Bronchitis, asthma	Mestizo fishers/ Baja California Sur, Mexico	Encarnación & Contreras, 1992
Green sea turtle *Chelonia mydas*	Cough	Mestizo fishers/ Baja California Sur, Mexico	Encarnación & Contreras, 1992
Ray *Dasyatis brevias* *Dasyatis longus* *Urolophus halleri*	Analgesic	Mestizo fishers/ Baja California Sur, Mexico	Encarnación & Contreras, 1992
Sea urchin *Echinometra vanbrunti*	Scar treatment, antiabortive, antihaemorrhagic	Mestizo fishers/ Baja California Sur, Mexico	Encarnación & Contreras, 1992
Coral *Lophogorgia sp.*	Antiabortive	Mestizo fishers/ Baja California Sur, Mexico	Encarnación & Contreras, 1992
Pearl oyster *Pteria sterna*	Scar treatment	Mestizo fishers/ Baja California Sur, Mexico	Encarnación & Contreras, 1992

Common name / Scientific name	Use	Ethnic group/ Georeference	Reported by:
Black coral *Antipathes galapaensis*	Heart murmur	Mestizo fishers/ Baja California Sur, Mexico	Encarnación & Contreras, 1992
Hawksbill sea turtle *Eretmochelis imbricata*	Headache	Mestizo fishers/ Baja California Sur, Mexico	Encarnación & Contreras, 1992
Red mangrove *Rhizophora mangle*	Vitiligo, oral aphthas, venereal diseases, cramps,	Mestizo fishers/ Baja California Sur, Mexico	Encarnación & Contreras, 1992
Ray *Urolophus halleri*	Cancer	Mexico City	Fernández-Apango et al., 2002
Ochre sea star *Pisaster ochraceous*	Cancer	Mexico City	Fernández-Apango et al., 2002
Seahorse *Hippochampus sp*.	Cancer	Mexico City	Fernández-Apango et al., 2002
Manatee Trinchatus manatus	Bone ache	Saõ Felix, Bahia, Brazil	Andrade & Costa-Neto 2005
Mantis shrimp *Claridopsis dubia*	Asthma	Feira de Santana, Bahia, Brazil	Costa-Neto, 1999
Checkered puffer fish *Sphoeroides testudineus*	Rheumatism	Feira de Santana, Bahia, Brazil	Costa-Neto, 1999
Reidi seahorse *Hippocampus reidi*	Asthma	Feira de Santana, Bahia, Brazil	Costa-Neto, 1999
Sea star *Echinaster brasiliensis*	Asthma	Feira de Santana, Bahia, Brazil	Costa-Neto, 1999
Common glassworth *Salicornia europea*	Antidepression, diuretic	The Netherlands	Price, 2007

Common name / Scientific name	Use	Ethnic group/ Georeference	Reported by:
Sea star *Echinaster brasiliensis*	Asthma	Recife, Pernambuco, Brazil	Silva, Alves, & de Almeida, 2004
Sea urchin *Echinometra lucunter*	Asthma	Recife, Pernambuco, Brazil	Silva, Alves, & de Almeida, 2004
Spinny puffer fish *Diodon Hystrix*	Rheumatism	Recife, Pernambuco, Brazil	Silva, Alves, & de Almeida, 2004
Seahorse *Hippocampus sp.*	Asthma	Recife, Pernambuco, Brazil	Silva, Alves, & de Almeida, 2004
Dogfish Carcharinas sp.	Diverse pains	Recife, Pernambuco, Brazil	Silva, Alves, & de Almeida, 2004
Crocodile	Osteoporosis	Recife, Pernambuco, Brazil	Silva, Alves, & de Almeida, 2004
Sea turtle Chelonia mydas	Rheumatism, arthritis	Recife, Pernambuco, Brazil	Silva, Alves, & de Almeida, 2004
Whale	Rheumatism, arthritis, neuro-vascular disseases	Recife, Pernambuco, Brazil	Silva, Alves, & de Almeida, 2004
Enenue *Halophila hawaiiana*	Tuberculosis,	Hawaii	Napoleon, 2004
Huluhulu waena *Lyngbya majuscula*	Stomach, women's ailments	Hawaii	Napoleon, 2004
Ka'ole *Symploca hydnoides*	Arthritis	Hawaii	Napoleon, 2004
Kala *Sargassum echinocarpum, S. polyphyllum, S. obtusifolium*	Cancer, leprosy, tuberculosos	Hawaii	Napoleon, 2004

Common name / Scientific name	Use	Ethnic group/ Georeference	Reported by:
Kapiki *Polydactylus sexfilis*	Varicose veins	Hawaii	Napoleon, 2004
Ko'ele *Ahnfeltia concinna*	Arthritis	Hawaii	Napoleon, 2004
Kupipi *Cladophora laetevirens*	Unspecified	Hawaii	Napoleon, 2004
'aipi *Padina sanctae-crucis*	Drool, Diarrhea, Incontinence	Hawaii	Napoleon, 2004
ape pa'akai Codium arabicum	Dislocation, muscle spam	Hawaii	Napoleon, 2004
ihi kai *Cladophora vagabunda*	Unspecified	Hawaii	Napoleon, 2004
ihi 'ula kai *Halimeda discoidea*	Heart problems, asthma, convulsions	Hawaii	Napoleon, 2004
'ina *Halymenia* sp	Stomach, runny nose, runny eyes, flat voice	Hawaii	Napoleon, 2004
'upena ku'u *Microdictyon setchellianum*	Muscle spasm, muscle strain, artery, varicose veins, gout, rheumatism	Hawaii	Napoleon, 2004
Mahu *Colpomenia sinuosa*	Sores	Hawaii	Napoleon, 2004
Palaha *Ulva reticulata*	Diabetes, leprosy	Hawaii	Napoleon, 2004
Palaha kai *Ulva expansa, U. fasciata*	Unspecified	Hawaii	Napoleon, 2004
Wawae'iole *Codium reediae*	Dislocation, muscle spam	Hawaii	Napoleon, 2004

Common name / Scientific name	**Use**	**Ethnic group/ Georeference**	**Reported by:**
Wawae'iole makali'i *Codium edule*	Dislocation, muscle spam	Hawaii	Napoleon, 2004
Giant African threadfins *Polydactylus quadrifilis*	Enhance sperm capacity	Yorúba / Ogun, Nigeria	Sowunmi, 2007
Lesser African threadfins *Galeoides decadactylus*	Worm expeller for women	Yorúba / Ogun, Nigeria	Sowunmi, 2007
Royal threadfins *Pentanemus quinquarius*	Worm expeller for women	Yorúba / Ogun, Nigeria	Sowunmi, 2007
Alexandria pompano *Alectis alexandrinus*	Induce spiritual foresight	Yorúba / Ogun, Nigeria	Sowunmi, 2007
African pompano *Alectis ciliaris*	Induce spiritual foresight	Yorúba / Ogun, Nigeria	Sowunmi, 2007
African spadefish *Chaetodipterus goreensis*	Induce spiritual foresight	Yorúba / Ogun, Nigeria	Sowunmi, 2007
West African spadefish *Chaetodipterus lippei*	Induce spiritual foresight	Yorúba / Ogun, Nigeria	Sowunmi, 2007
Trunkfish *Gymnarchus niloticus*	Facilitate partum	Yorúba / Ogun, Nigeria	Sowunmi, 2007
Daisy stingray *Dasuatis margarita*	Severe fungal skin infections	Yorúba / Ogun, Nigeria	Sowunmi, 2007
Brown ray *Raja miraletus*	Severe fungal skin infections	Yorúba / Ogun, Nigeria	Sowunmi, 2007

The role of the local scientist.

During the year of 2007 I was walking down the streets of La Paz, Bolivia, as part of a crew of anthropology students waiting for some others to arrive and go down to the Bolivian Amazon to learn field methods in anthropology. Walking on Cerro Cumbre, where the famous *mercado de las brujas* -the witches' market- lays, I saw something that called for my curiosity (Fig. 7).

Figure 7. First plane: sea stars of undeterminable species sold at mercado de las brujas as a cure for heart disease (La Paz, Bolivia, 2007).

La Paz, being the highest administrative capital of the world is settled at some 12,000 feet above the sea level. As if the former was not strange enough, the country lost its coastal territories to Chile back in 1879. These facts pushed me to ask myself several questions, most of them unanswered yet. Why are sea stars being sold for medicinal purposes at a city of such an altitude? How old is this practice? Why has no one documented this? Why were my findings not as amazing in the eyes of my

companions? In fact, the sea stars passed unnoticed in front of most of these anthropologists who were more curious about handmade figurines and lama mummies. Years before seeing these ‘high-altitude sea stars’ being sold at bulk in La Paz, I participated in a research project studying marine-based organisms sold in popular markets around Mexico City (Fernández-Apango, Narchi et al. 2002), also a high-altitude (7200 ft.) landlocked location. ¿Would I have been as indifferent to the apparition of these organisms If I had not taken part in that previous research? ¿Was that previous experience what made me aware of such a bizarre encounter?
This last question seems of great importance, as I think that I would not have payed attention to the sea stars if I had not been aware that throughout the world, and not only near coastal communities, there is an active use of marine-based medicines, most of which can be classified as ethnomedicines.

After experiencing the former, I realized that it is not only Anthropology that has historically stretched **“the premises, logic and semantic categories of Euro-[American] experience to fit non-Western culture”** (Keesing and Keesing 1971 : 369-370). As Table 1 shows, ethnobiology, being an epistemological derivate of anthropology, has followed the same path, and both ethnobiology and ethnomedicine have been trapped inside the European tradition that medicines had, by any means, to be derived from plants. Davis (1995 :41-43) makes an excellent description of how plants became virtually the sole source for medicines in Europe since Dioscorides, throughout the Middle Ages and the Renaissance, all the way to the XX Century.

Table 2 reveals that most of the research on marine-based ethnomedicine has been carried out either by people immersed in their own society or researchers that have spent a considerable amount of years in their field sites. The logic behind my claim can be attached to that experience of myself recognizing and getting excited about sea stars in the Bolivian altiplano. If researchers are not trained or have had first hand experience with non-obvious aspects of culture, it is very likely that they miss perceiving an entire category of local knowledge such as marine-based medicine. Kim has previously pointed this out more eloquently (1990:197) “**Fieldwork in ones own society has the advantage of familiarity with it and to arrive at abstraction from the native’s point of view”**

I intend, through this research, to help the discipline of ethnobiology to stretch its premises, logics, and semantics into the realms of a longtime ignored coastal ethnobiology.

Chapter summary and conclusions

Humans have exploited the marine environment since the early dawn of the species. Despite the physiological, archaeological, and historical evidence of a long held human-ocean interaction there is few ethnobiological research exploring this relationship. There is an observational and thus, theoretical gap particular to the empirical use of marine ethnomedicines. Human use of marine ethnomedicines, has been treated as a mere curiosity and not explored in depth, regardless of the historical evidence of its widespread existence. The poor development of a serious study of marine ethnomedicine is consequence of the theoretical trends in ethnobiology, the taxonomic challenges posed by the diversity of marine organisms, and the poor involvement of local scientists in a global ethnobiological research.

CHAPTER 2: ECOLOGICAL AND HISTORICAL CONTEXT

Presently, the Seri territory roughly represents eleven percent of the continental coast of the Sea of Cortez. To restrict the description of the research area to this little portion of the Sea of Cortez without referring to the entire history of formation of the region would be unfair to the reader in many ways. Worse, it would be incomplete.

The genesis and conformation of the Sea of Cortez is a key element in understanding the configuration of local weather and regional climate and the abundance and diversity of its natural resources and habitats. Therefore, recognizing and understanding the environmental settings and ecotonal transitions observed throughout the coasts of this wonderful sea is fundamental to comprehend the origin and development of the different cultures and livelihoods that, for the most part, are still represented within the ethnic groups presently settled there.

The Sea of Cortez

The Sea of Cortez is unique in many regards, from its geographic location and conformation, to the impressive set of different ecosystems found within it. Consequently, there is no unique way to designate the different regions of the Sea of Cortez. There are different criteria used in published research to cluster characteristics into few regions (e.g. Allen 1937) or consider so many components as essential that divisions end up being almost as colorful as baroque mosaics (e.g. Santamaría Del Angel, Alvarez Borrego and Müller Karger 1994). Thus, to describe the Sea of Cortez biologically, oceanographically, meteorologically, geologically, and anthropologically, by means of using a common zonation system, is virtually impossible. Therefore, as I describe each of these aspects, I will do so in accordance to already established conventions for each of the subjects. The description will always take into account the general geography of the Sea of Cortez.

Geological Evolution of the Sea of Cortez

The Sea of Cortez is an interior basin of tectonic origin measuring 1130 km long and up to 209 km wide, presenting a maximum depth of around 3000 m (Lluch Cota, et al. 2007). Magnetic data analysis shows that the Sea of Cortez is a product of ocean floor spreading (Larson, Menard and Smith 1968). Therefore being formed as the result of the displacement of an extensional inter-plate boundary between the oceanic crust and the continental complex of Mexico within the last million years (Karig and Jensky 1972).

The geological events that shaped and have ever since modified the Sea of Cortez started between 130-90 Ma, during the Cretaceous (Ledesma Vázquez and Carreño 2010). The Farallon plate on the Eastern Pacific started its subduction into the North American western margin (Alles 2007). The plate had been carried northeasterly by a highly active production rift, the East Pacific Rise. In the meantime, the great Pacific plate was slowly being carried towards the Northwest by action of the East Pacific Rise. The East Pacific Rise, in turn, began “following Farallon plate towards the East (Ledesma-Vázquez and Carreño 2010).

The plate subduction process created a mountain range in Northwest Mexico. Much of what now is a weathered range can be found as the rocky foundation of the Baja California Peninsula. Known as the peninsular batholith (Fig. 8), the range extends from southern California into the twenty-eight parallel (Ledesma Vázquez and Carreño 2010).

Figure 8. Emerged boulders from batholithic origin. Parque Nacional Constitución de 1857, Baja California. Photo: Nemer E. Narchi, 1998.

Geochemical and magnetic analysis on the batholith reveal that, back in the Cretaceous, Southern California and the Baja Peninsula were located 330-400 km south of their actual position, with the tip of the peninsula all the way down to Bahia Banderas, Jalisco, Mexico (Ledesma Vázquez and Carreño 2010).

During the Oligocene ~30 Ma., the Farallon plate had almost finished drifting under the North America plate, creating a direct intersection between the Eastern Pacific Rise and the continental coast of northwestern Mexico. In the meantime, and while the spread zone shrunk, a thin and narrow layer of the earth's crust drifted towards the West, adding itself to the Pacific plate. The final steps, followed by the subduction process, created a volcanic arc throughout the coast during the middle Miocene 24-11 Ma (Figure 9). The arc is parallel to the modern gulf's axes (Ledesma Vázquez and Carreño 2010).

Throughout the late Miocene, the subduction created by the rifting taking place along the North America plate created a depression parallel to the Mexican coastline (Fig. 9).

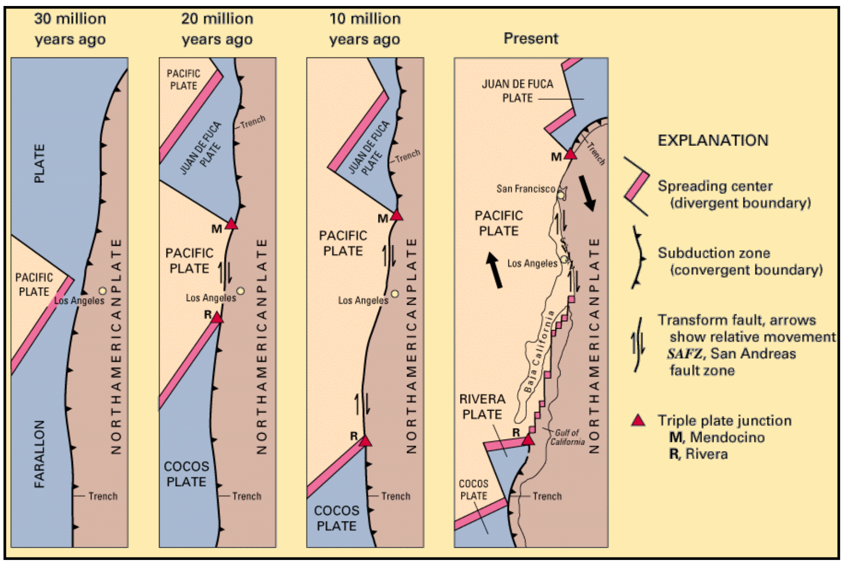

Figure 9. Evolution of the encounter between the Pacific and North American Plate. The shrinkage and subduction of the Farallon plate, is responsible for opening the Sea of Cortez. (Source: Kious, Tilling, and Russell 1996).

Between 9-6.3 Ma. this trough was somehow flooded with seawater, creating the so-called Proto-Gulf (Karig and Jensky 1972). Around 5.6 Ma. the Baja California rifting aided by the San Andrea's fault system started opening the Gulf's mouth (Karig and Jensky 1972).

Since the Miocene, numerous Islands have detached both from the peninsular and continental sides of the Sea of Cortez (Carreño and Helenes 2002). A few of the Islands -Coronado, San Luis, and Tortuga Islands- have a recent volcanic origin (Batiza

1978). The Sea of Cortez, as we know it, has remained relatively unchanged for the last ~4 My (Larson, Menard and Smith 1968).

Oceanographic characteristics

Bathymetry

The maximum depth of the basin varies along the longest (North/South) axis of the Sea of Cortez. The northernmost third has mean depths of 200 m. The middle third is characterized by the presence of an archipelago constituted by sills, channels, basins, and two notably large Islands: Angel de la Guarda and Tiburon. The southernmost third presents a dramatic increase in depth, averaging 3000 m (Lluch Cota, et al. 2007).

Oceanographic regions and their features

There are 6 different waters that constitute the Sea of Cortez. All of them have diverse origins. (Table 3).

Table 3. Sea waters found along the Sea of Cortez (Modified from Alvarez Borrego 2010)

Name	**Salinity range**	**Temperature range**
Gulf of California Water (GCW)	> 35 ‰	12 °C
California Current Water (CCW)	≤ 34.5 ‰	12 - 18 °C
Equatorial Surface Water (ESW)	> 35 ‰	> 18 °C
Subtropical Subsurface Water (SSW)	34.5 -.5 ‰	9-18 °C
Pacific Intermediate Water (PIW)	34.5 - 34.6 ‰	4-9 °C
Pacific Bottom Water (PBW)	>34.5 ‰	< 4 °C

PIW and PBW are present only south of Angel de la Guarda and Tiburon Islands. Beneath a surface water mixture of ESW, CCW, and GCW, there is a clear layering of SSW, PIW, and PBW, in that order (Álvarez Borrego 2010).

The water circulation is seasonal and strongly dominated by wind (Badan Dangon, et al. 1991; Beier 1997) and air- air sea heat exchange (Castro 2001; Marinone and Lavín 2003). Nonetheless, the influence of the Pacific Ocean is present yearlong at the gulf's mouth (Calvert 1966; Castro, Lavín and Ripa 1994; Ripa 1997).

Overall, inside the Sea of Cortez, evaporation exceeds freshwater input. Therefore, the Sea of Cortez is considered an evaporation basin. As such, it is capable of generating its own water mass. GCW is either ESW or SSW that has been transformed by evaporation (Roden and Groves 1959).

ESW exhibits a clear seasonal behavior, penetrating up to the Guaymas Basin during the summer, but being found only near the Sea of Cortez' entrance during the winter, except in El Niño years. Given its oligotrophic and warm characteristics, an ENSO-like effect is created that notably diminishes phytoplankton concentrations in a seasonal pulse (Álvarez Borrego 2010).

The tides are produced in cooscillation with the adjacent region of the Pacific Ocean. However, given the geographic configuration of the Sea of Cortez, the tidal wave travels progressively towards the north. That is, low tide at one end occurs almost at the same time that high tide is occurring at the other end. The time discrepancies for low and high water between the Colorado River Delta and the Gulf entrance are 5.5 hours for high tide and 6 hours for low tide (Álvarez Borrego 2010).

To characterize the Sea of Cortez in an oceanographically coherent way, the basin has to be understood as a composite of four major oceanographic areas (Maluf 1983).

1. The Colorado River Delta. The area is encompassed by Puerto Peñasco, Sonora, San Felipe, Baja California, and the Delta itself. The mean depth averages less than 200 m (Lluch Cota, et al. 2007), even though some authors consider it to be around 30 m (Álvarez Borrego 2010). This depth is a direct result of the gentle slopes and thick sediments, which cause high nearshore turbidity (Maluf 1983). The enclosed deltaic characteristics of the area give it particular properties such as "nearshore turbidity, temperature extremes, high evaporation, low precipitation, high salinities, large tidal amplitudes, strong rotatory tidal currents and small waves" (Maluf 1983: 42). These enclosed deltaic characteristics also influence it towards being the one area with greatest seasonal hydrographic changes (Álvarez Borrego 2010), such as those derived from the fluctuations in thermohaline and current properties. These conditions are better represented by the occurrence of large scale seasonally reversing gyres (Lluch Cota, et al. 2007). Given the intense evaporation driven by the intense summer heat, water temperatures and salinity increase, creating superficial thermohaline currents that move counterclockwise. These conditions will reverse during winter, giving clockwise movement to superficial currents (Maluf 1983) -see Lavín, et al. 1997; Palacios Hernández, et al. 2002 for a thorough description on the gires' behavior. The Colorado River Delta region is considered a warm temperate environment during the winter, displaying water

temperatures that range from 8 to 12 °C. In the summer, the region is considered tropical, given the fact that near-shore temperatures can surpass 30 °C (Lluch Cota, et al. 2007). “Tides occurring in this area are amongst the largest in the world” (Maluf 1983 :36), averaging more than 7 m in range throughout the northernmost region (Álvarez Borrego 2010).

2. The Midriff Island region is characterized by a very particular topographic configuration. This configuration, when combined with the geographic location of this marine ‘cul-de-sac’ creates unique oceanographic conditions (Maluf 1983). The presence of several large Islands modifies the tidal flows, restricting the exchange between the shallow North and the deeper South (Paden, Winant and Abbott 1993). The spring tides that occur inside this region have influence to depths of 300-500 m (Alvarez Borrego and Lara-Lara 1991), creating a pool of cold water rich in nutrients that is later transported toward the surface (Badan Dangon, Koblinsky and Baumgartner 1985). This vigorous stirring of water creates a condition that has been described as constant upwelling (Álvarez Borrego 2010), which leads to a relatively high primary production, as data on semiannual concentration of chlorophyll *a* shows (Kahru, et al. 2004). This peak in primary production supports a considerable number of sea birds and marine mammals year round (Álvarez Borrego 2010).

3. The Central Portion, starting below the Midriff Islands all the way to Topolobampo and La Paz, is considered a transition zone in which the enclosed basin conditions start resembling much more those of the Eastern Tropical Pacific

(Maluf 1983), specially concerning the thermohaline structure, which is sparingly the same despite some modifications in the surface masses due to excessive evaporation (Álvarez Borrego 2010). This portion is characterized by hipoxic and nearly anoxic environments at relatively shallow waters -less than 100 m (Hendrickx 2001), which register minima values for not only oxygen, but for salinity and pH, while presenting a maxima in phosphate concentration at depths between 500-1100 m (Álvarez Borrego 2010). In comparison with the northern parts of the Gulf, these properties vary monotonically with depth (Maluf 1983; Álvarez Borrego 2010). The undetectability of oxygen at this latitude and mentioned depth plays an important role in the ecology and geology of the Gulf, given its marked influence on the distribution of both pelagic and benthic organisms and modifying severely the sedimentation patterns (Álvarez Borrego 2010).

4. It was customary to consider the southern portion as the area stretches geographically from below Topolobampo and La Paz to the mouth of the Sea of Cortez (see: International Hydrographic Bureau 1953; Maluf 1983). However, this area has been extended according to the range of its oceanographic influence (SEMARNAT 2004). The heat exchange between the Sea of Cortez and the Pacific Ocean exports a current of less warmer surface waters that exercise influence all the way to the coasts of Nayarit (Álvarez Borrego 2010). It can be said without hesitation that the area behaves much more like an oceanic region; the basins are much deeper (3600 m), tidal amplitudes are smaller, salinities are lower, and the influence of Pacific storms is much higher (Maluf 1983).

Climate

The Sea of Cortez is not only an enclosed basin in terms of its oceanography, it is also enclosed topographically, as it is surrounded by mountainous chains on both the peninsular and the continental flanks. In Baja California, the height of these mountains oscillates between 1 and 3 km, while the Sierra Madre Oriental, on the continental flank exceeds 1500 m. These boundaries moderate the effect of the Pacific Ocean and it is only the air flow below 800 m that can be channeled along the gulf, which receives direct oceanic influence only from its mouth (Álvarez Borrego 2010). Therefore, the Sea of Cortez is a semi-enclosed basin in a meteorological as well as in an oceanic sense (Badan Dangon, et al. 1991). The climate resembles more that of the continent that surrounds the Sea of Cortez, resulting in large annual and diurnal temperature fluctuations (Badan Dangon, et al. 1991) with occurrence of freezing temperatures in winter, and means above 30 °C during the hottest summer season, normally occurring from July to August (Hastings and Humphrey 1969).

The northern half of the Sea of Cortez is dry and desert-like and presents an annual precipitation of 100 mm, normally registered during the winter. In comparison, the southeastern portion receives up to 1000 mm a year, mostly from June to October (Hastings and Humphrey 1969). The former can be translated in 60 rainy days for Los Cabos per year, in comparison to 5 rainy days per year at the MidriffIslands region (Álvarez Borrego 2010).

Overall, the climate is typically divided into two seasons: a mid-latitude winter and a subtropical summer (Mosino Aleman and Garcia 1974).

Fertilization mechanisms

There is not much nutrient input from rivers into the Sea of Cortez (Alvarez-Borrego 1983; Alvarez-Borrego and Lara-Lara 1991; Álvarez Borrego 2010). On the one hand, the Baja California shoreline is mostly rocky, and lacks drainage from rivers due to its predominant sub-desert climate conditions (Lluch-Cota, et al. 2007). On the other hand, the regular input from the Colorado River ceased in 1963 due to the construction of more than 20 dams along the Colorado River basin (Alvarez-Borrego and Lara-Lara 1991; Álvarez-Borrego 2010). This dam system has reduced the outflow of the Colorado River from 4 million acre-feet (Thompson 1965) to virtually nothing (Galindo Bect, et al. 2000).

In spite of the lack of riverine contribution, the Sea of Cortez is heavily influenced by three other fertilization mechanisms (Fig. 10); wind induce upwelling, tidal mixing, and water exchange between the Gulf and the Pacific (Alvarez-Borrego 1983; Álvarez Borrego 2010).

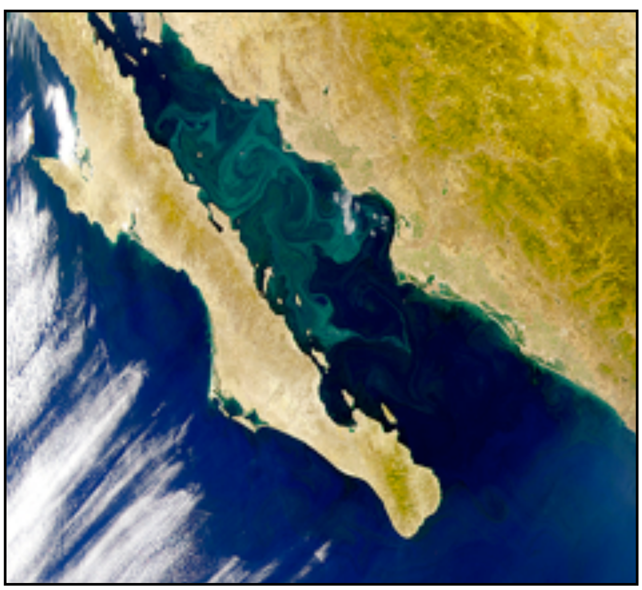

Figure 10. Sediment transportation in the Sea of Cortez. Upwelling, wind, and water exchange are responsible for fertilizing the entire ecosystem. Courtesy of NASA Visible Earth Catalog http://visibleearth.nasa.gov/.

Upwelling

Surface nutrient concentrations in upwelling areas of the Sea of Cortez are among the highest in any of the world's oceans (Álvarez Borrego, et al. 1978). Upwelling areas in the Sea of Cortez occurs from December to May off the mainland of the Eastern coast with northwesterly wind influence. Off the Baja coast it manifests itself throughout the summer with southwesterly wind influence (Álvarez-Borrego 2010).

Eastern coast upwelling is strong and severely affects phytoplankton communities (Fig. 11). The Baja California water column is strongly stratified, making it difficult for upwelling to affect planktonic communities on the western coast (Álvarez-Borrego 2010).

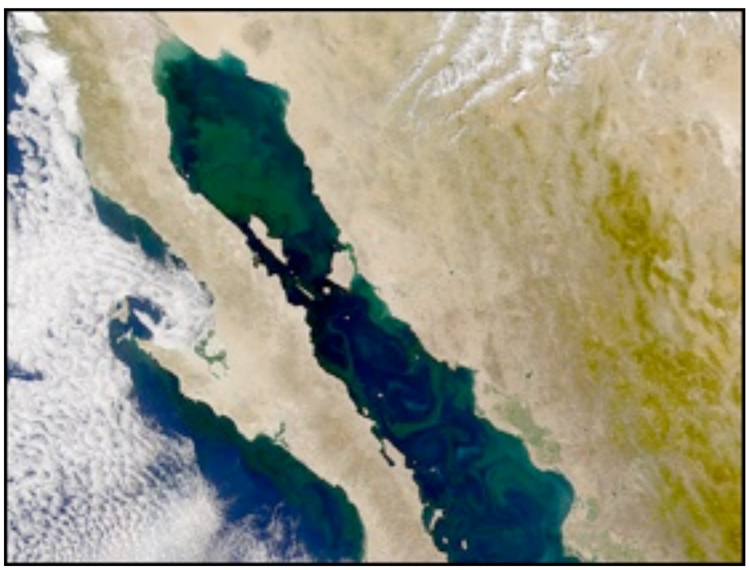

Figure 11. Algal blooms in the Sea of Cortez, notice the marked concentration of plankton patches on the eastern side of the basin. Courtesy of the SeaWiFS Project, NASA/Goddard Space Flight Center, and GeoEye.

Tides and tidal mixing

The tides within the Sea of Cortez are inextricably tied to the Pacific and are produced in co-oscillation with it, depending more on the variations of sea level at the entrance of the gulf than to gravitational attraction, which is responsible only for 5 percent of the total tidal rise (Filloux 1973). Most of the gravitational attraction is not considered when calculating tidal energy dissipation as it seems to be absorbed by the coastline (Álvarez-Borrego 1983; 2010). The behavior of tides regarding amplitude and speed changes as the tides travel north and there is also a striking difference in the behavior of semidiurnal and diurnal tides (Álvarez-Borrego 1983). The semidiurnal tide enters the Sea of Cortez with an amplitude of 30 cm (for the principal lunar component M_2), decreasing in amplitude and speed to one third of its initial value near the middle of the gulf. as it keeps traveling north it accelerates again, increasing also in amplitude to nearly five times its original amplitude (Álvarez-Borrego 1983). In contrast, the amplitude of the diurnal tide increases slowly and linearly to almost twice its amplitude as it reaches the Colorado River delta (Filloux 1973; Álvarez-Borrego 1983).

Water exchange

It has previously been discussed that the Sea of Cortez exports excess heat and salt to the adjacent Pacific in the form of hot surface water. Marinone and collaborators (2003) conclude that this water export takes place between 50 and 250 m. In order for this water to go out, cooler deeper water comes in at depths of 200 to 600 m. The deeper inorganic nutrient rich waters coming into the Sea of Cortez have a tremendous ecological implication as they replenish the gulf with components that are essential to primary productivity (Alvarez-Borrego and Lara-Lara 1991; Álvarez-Borrego 2010).

The macrofauna of the Sea of Cortez

The multiplicity of life forms occurring inside the Sea of Cortez makes it a remarkable biodiversity hotspot in terms of all taxa, either terrestrial or marine. Within the marine environment, high biodiversity indices have been mentioned for every habitual macro-category of creatures; i.e. plankton (Allen 1937; Cupp and Allen 1938; Brinton, Fleminger and Siegel-Causey 1986), nekton (Findley, et al. 1996; Thomson, Findley and Kerstitch 2000; Brusca, et al. 2005), benthos (Brusca 1980; Kerstitch 1989; Teske, et al. 2002) and ornithos (Velarde and Anderson 1994).

This section focuses exclusively on describing the characteristics of the marine macro-fauna of the Sea of Cortez. It is not inside the scope of this report to describe the entire biota -terrestrial plus marine- of such a notably diverse area. I will refer specifically to the marine macro-fauna because previous studies (Felger and Moser 1974; 1985; Narchi, et al. 2002; Narchi 2003) and the present research suggest that this category represents the backbone of Seri marine medicine (Figure 12).

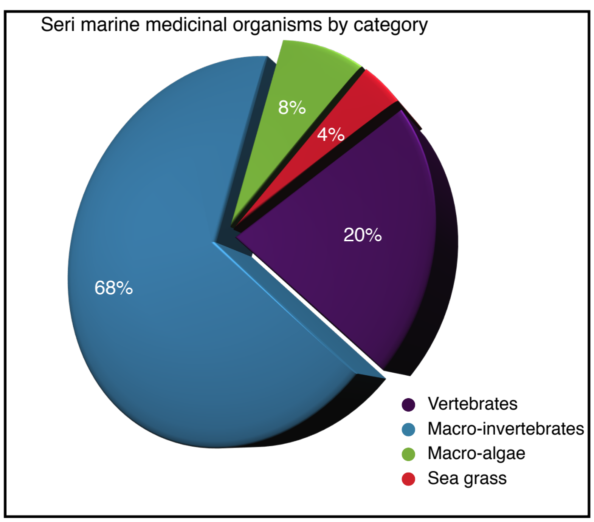

Figure 12. Categorical distribution of marine organisms used in Seri medicine (Modified from Narchi, 2003).

Taxonomic constitution of the macro-fauna of the Sea of Cortez

The total number of described macro-faunal species for the Sea of Cortez adds up to 5,969 species (Brusca, et al. 2005). These estimates, excluding copepods and ostracods (Lluch Cota, et al. 2007), account for 4,854 species of invertebrates and 1,115 species of vertebrates (Brusca, et al. 2005). The most representative group of invertebrates are mollusks (2,195 species), which account for 45 percent of the known invertebrate species, arthropods (1,051 species) 21.6 percent, polichaeta (717 species) 14.8 percent, cnidaria (253 species) 5.2 percent, and echinoderms (262) species 5.4 percent (Lluch Cota, et al. 2007). Some invertebrate groups are poorly represented either because of their limited occurrence in marine ecosystems worldwide or due to the lack of recognition in studies of this geographic area.

Abbott and collaborators (1968) have classified the Pacific of North America according to 5 molluskan provinces: Boreal, Arctic, Oregonian, Californian and Panamanian. Two of these provinces merge and interact within the Sea of Cortez, one other province, the West Indian, also exists inside the Sea of Cortez and is a result of fauna that migrated from the Caribbean by a now extinct pre-Pliocene water connection between the Atlantic and the Pacific. The majority of the Sea of Cortez' sponges and hydroids are Caribbean in origin.

The Panamanian province ranges from the Sea of Cortez to the Equator and 2,400 of the inhabiting species resemble those of the Central Pacific. The Californian province ranges from British Columbia to Point Conception in Central California. Some of the Californian species are isolated in the uppermost region of the Sea of Cortez (Abbott, Zim and Sandström 1968).

The second largest group are fish (911) species, of which 821 are bony fish (*Teleostei*), 87 are cartilaginous fish (*Chondrichthyes*), and 3 species represent the hagfish (*Hyperotreti*) (Findley, et al. 1996).

Birds are represented by 10 orders and number 181 species (Velarde and Anderson 1994). Enriquez et al. (2005) estimate the total number of birds as 530 without distinguishing marine form terrestrial. Marine mammals number 36 species (83 per cent of the world's marine mammal species), of which 23 are Odontoceti, eight are Mysticeti (61per cent of the existing species), four pinnipeds, and one bat (Lluch Cota, et al. 2007; Urbán 2010).

Lastly, the Sea of Cortez is home to 7 reptiles. Among these are 5 sea turtles, which account for 71 percent of the extant species (Seminoff 2010), one serpent and one crocodile (Brusca, et al. 2005).

The southern part of the Sea of Cortez offers a higher degree of diversity, hosting 69 percent of the species, while the central and the MidriffIsland regions host 67 and 47 percent, respectively (Brusca, et al. 2005).

This biodiversity combined with the high productivity taking part inside this dynamic environment, yields, in terms of fisheries production, some 500 x 10^3 tons of seafood a year (Enríquez Andrade, et al. 2005).

Endemism

The number of endemic non-planktonic macro-invertebrates is 766 species (15.8 percent of the total number of species), the vast majority being mollusks, which include 460 species, arthropods 118 species and polychaete 79 species (Lluch Cota, et al.

2007). In terms of fish, there are at least 77 endemic species (Enríquez Andrade, et al. 2005).

Habitats

Three factors influence the distribution of intertidal invertebrates (Hedgpeth 1969; Morris, Abbott and Haderlie 1980).

1. Wave shock
2. Bottom type
3. Tidal exposure

Brusca and collaborators (Brusca, et al. 2005) claim that benthic species diversity is high on reefs, stable shores and intertidal/shallow bottoms of softer sedimentary rock, while being low on beaches composed of smooth hard rocks like granite and basalt, and on unstable beaches of sand and cobble, being the latter the ones which probably harbor less diversity. Steinbeck and Ricketts (1941), consider rocky shores to be the most productive in terms of invertebrate species because of the available niches. These observations coincide with Brusca's (1980) observations that areas with more variant substrate types will host a greater number of species than the homogenous ones. Finally, estuaries, lagoons and mangrove forest areas are highly diverse and important, as they provide nursery and forage for a large array of macrofaunal organisms (Findley 1976; Brusca, et al. 2005).

The large seasonal fluctuation of some 20º C in water temperatures is entirely responsible for seasonal changes in invertebrate and algal populations all over the Sea of Cortez, with the exception of the Midriff Island region (Brusca 1980), where tidal mixing maintains constant conditions of cold temperatures (Badan Dangon, Koblinsky and Baumgartner 1985). Therefore, Seriland offers relatively the same intertidal resources year round.

Terrestrial plants

Annual rainfall classification of Mexico results in 3 major zones (see Sanders 1921: 213), which comprise many interior varieties due to different permutations of rain-bearing, windshield, and altitude (Sanders 1921): a) Humid, rainy for more than six months of the year and more than 50 inches of rain per year as average; b) semiarid, receives less than 50 inches of rain but more than 20 inches of rain per year and the rainy and dry seasons are of same length; c) arid, governed by drought during the greater part of the year, averaging less than 20 inches of rain per year.

Climatic conditions are not bounded by geo-political borders. Therefore, the climatic regions of Mexico sometimes extend across the former. Such is the case for the North American Desert. Shreve and Wiggins (1964) describe the North American Desert as an immense arid region that extends continuously through western North America from the Snake River Valley, in Washington, southward and eastward to the Mexican State of Puebla. Rainfall patterns vary not only with latitude along this 192,000 sq. km. region, but also with longitude (Shreve and Wiggins 1964). Eastern and western sections are separated by highlands and given that rain bearing winds come from the East, the eastern part of each division is rainier than its western counterpart (Sanders 1921). Largely influenced by these rainfall patterns, the region is divided into four major areas with respect to the character of its vegetation (Shreve 1926; 1934; 1951; Shreve and Wiggins 1964). Following geographic, meteorological, and biological criteria, these regions include the Chihuahuan Desert, the Great Basin Desert, the Mojave Desert, and the Sonoran Desert (Shreve and Wiggins 1964). I have previously discussed that the Seri people have always lived within the range of the Sonoran Desert region regardless of the side of the Sea of Cortez they were on (Bowen 1976; Bowen 1983; Felger and Moser 1985; Sheridan 1996a; Sheridan 1999; Canchola and Banister 2000; Nabhan 2003; Rentería-Valencia 2007). Throughout this section I will limit my description to describing the plant regimes inside the Greater Comcáac Territory as defined by Nabhan (2003).

The Sea of Cortez belongs is entirely surrounded by the arid region proposed by Sanders (1921). However, the mountainous ranges longitudinally dissecting the Baja California Peninsula, combined with the temperate influence of the northwestern Pacific coast, make most of the Baja Californian flora a completely different ensemble of vegetational regions (Shreve 1926), except for the narrow coastal plain going from the Colorado River Delta all the way into Bahia de los Ángeles (Figure 14).

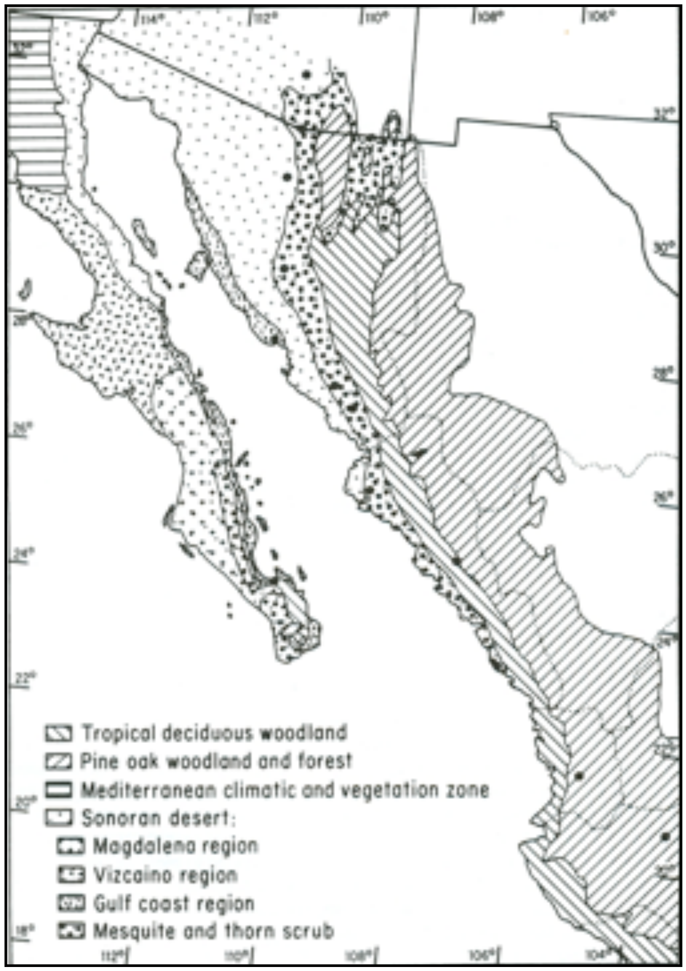

Figure 14. Distribution of the major vegetation types around the arid northwestern regions of Mexico. The Sonoran Desert is located around the head of the gulf and throughout much of Sonora. Source: Cody, et al. 2002: 70. Reproduced with permission from Oxford University Press.

The Sonoran desert region, which hosts the total Seri territory, surrounds the upper two-thirds of the Sea of Cortez (Shreve 1951). Among the four regions that comprise the North American desert, the Sonoran desert has the highest number and variety of life forms and diversity of plant communities (Shreve 1951).

This region is of special ecological and phytogeographic interest because of the clearly marked transition from desert to subtropical thorn forest (Sanders 1921). The desert conditions extend from eastern Washington southwards through the mouth of the

Colorado River all the way to the latitude 28º N where these conditions are rapidly ameliorated by a heavier and more evenly distributed rainfall that transforms the desert landscape into an arid type thorn forest (Shreve 1934) and almost immediately after latitude 28º 30’ -the southernmost part of the Greater Comcaac Territory- the thorny forest starts transforming into tropical deciduous woodland (Cody, et al. 2002).

As a result of the 193,128 square km through which the area extends (Shreve 1951), the description is confined just to the general features of the plant covering. The Sonoran Desert area undergoes a dramatic transformation in vegetational areas in terms of the short distance in which these progressions take place. Starting at latitude 34º and extending south to 30º the high dominance of xeromorphic vegetation progresses into an emergence of less xeric species all the way to the point at which they dominate (Shreve 1934).

Arizona Upland

The Arizona Upland comprises the northeastern part of the Sonoran Desert and marks the limit of the vegetation of the Sonoran Desert (Shreve 1951). This region is almost tangential and out of the periphery of the Greater Comcáac Territory. *Larrea* is an important plant in nearly all settings and has a great number of associates (Shreve 1926). Other characteristic species are *Prosopis juliflora, Olneya tesota, and Fouquieria splendens.* The most conspicuous cacti are *Carnegiea gigantea, Ferocactus Wislizenii,* and 15 species of *cylindropuntia and platyopuntia* (Shreve 1951).

Lower Colorado Valley

The region adjacent to the lower course of the Colorado River has the thinnest plant covering to be found in North America (Fig. 15). The former is a result of the less than 125 mm of rainfall that the region receives per year (Shreve 1934). This region presents the simplest vegetational composition of the entire Sonoran Desert (Shreve 1951). Species from the genus *Larrea, Franseria* and *Dumosa*, clustered in groups of 2, sometimes 3 species form the entire vegetation (Shreve 1934). Other perennials such as *Opuntia ramosisima, Encelia frutesens,* and *Atriplex barclaya*, among other perennials, can be found on plains which rarely exceed a total floristic arrange of 16 species (Shreve 1951). Logically, when small streams cross the plains, there is an increase in the number of plants per unit of area, the number of species present increases as well (Shreve 1934). Along the streams, pediments and bajadas it is possible to find small trees, most notably *Olneya tesota, Prosopis juliflora, Cercidium floridum,* and *C. microphillum* (Shreve 1951).

Figure 15. Lower Colorado Valley vegetation west of Reserva de la Biósfera El Pinacate. The vegetational conditions extend from the lower drainages of the Colorado and Gila Rivers, and the Salton Basin into the eastern coast of Baja California as far as Bahía de los Ángeles, and all of Sonora lying below 400 m. in elevation as far south as the valley of the Río Magdalena (Shreve 1951:49). Photo: Arlí De Luca, 2009.

Plains of Sonora

In the region between the Magdalena/Concepcion and Sonora Rivers, the vegetation remains very open but increases slightly in average height and number of abundant species (Shreve 1934). The rainfall amounts substantially more that the pluvial contributions in the Lower Colorado Valley ranging from 250 to 375 mm. Therefore, there is a considerable number of characteristic species that first appear in this area (Fig. 16), i.e *Opuntia thurberi,*and *Jatropha cinerea* (Shreve 1951)*. Larrea* starts to be less common and *Encelia* becomes the most ubiquitous and the general landscape is determined by the constant presence of *Olneya tesota, Prosopis juliflora, and Cercidium floridum* (Shreve 1934).

Figure 16. Opuntia forest in the Plains of Sonora. Carnegiea and Olneya can be seen in the distance. Photo: Arli De Luca, 2009.

Foothills of Sonora

Another tangential zone to the Greater Comcáac Territory includes the easternmost subdivision of the Sonora Desert, which extends from Arizpe, on the Sonora River, to a region some 80 km south of the Río Yaqui (Shreve 1951). With the except for a higher frequency of succulents, the lower altitudes of the area present little change in vegetational physiognomy and composition, keeping all of the moderately xeric characteristics present in the Plains of Sonora. The Plants are notably scattered and still of xeromorphic character (Shreve 1934). However, the higher altitudes near the center of the area register up to 500 mm of rainfall each year, marking the area as the least desert-like part of the region (Shreve 1951). Small trees are abundant in heights much taller (4-5m) than the ones found in the northernmost areas, and many of these are found nowhere else in the Sonoran Desert (Shreve 1951; Shreve and Wiggins 1964). The dominance of *Larrea* throughout the entire Sonoran Desert decays and it becomes a plant of minor importance that appears only in alluvial flats near the coast (Shreve 1934). Shreve (1934) recorded its last occurrence 8 km east of Empalme.

Central Gulf Coast

The vegetation around the two sides of the Gulf's head is not maintained in the central part of the Sea of Cortez. In Baja California, the Central Gulf Coast vegetational area extends discontinuously in the form of patches from Island Ángel de la Guarda (latitude 29° 35') to San José del Cabo (latitude 23° 03') through a narrow coastal strip (Shreve 1926). In Sonora, the area embraces all the central coast and starts being noticeable after Puerto Lobos (latitude 30° 17') near the mouth of the Río Magdalena extending southwards nearly to the mouth of the Río Yaqui (Shreve 1951; Shreve and Wiggins 1964). This area is characterized by low and uncertain rainfall patterns, high summer temperatures, except for those regions with immediate shoreline and onshore winds (Shreve 1951). Abundant plants of the Central Gulf coast area are sarcocaulescent and exaggerated in trunk diameter, including the following, which are culturally salient for the Seri people: (Felger and Moser 1974; 1985) *Bursera microphylla*, *B. hindsiana, Olneya tesota, and Prosopis juliflora* (Shreve 1951), several characteristic and culturally important cacti including *Pachycereus pringlei, Opuntia bigelovii, O. cholla, O. ramosissima, O. tesajo, and O. Clavellina* (Shreve 1951). Other important plants that were seen in abundance during the fieldwork for the present study were *Acacia, Cercidium, Fouquieria, Ambrosia,* and *Lippia* (Figure 17). This last group of plants does not extend to the southern end of Sinaloa (Shreve 1934). The Central Gulf Coast conditions start to ameliorate at about latitude 20° 30', where the area bears dense thickets of vegetation with trees, shrubs, herbaceous perennials, cacti, and vines, which combine in the form of communities, something that is not observed further north (Shreve 1934).

Figure 17. Central Gulf Coast vegetation. Easily noticeable are Fouqueria splendens, Larrea divaricata, Carnegiea gigantea, and Prosopis glandulosa. Photo: Nemer E. Narchi, 2009.

Vizcaino and Magdalena regions

The Vizcaino and Magdalena regions are unique areas within the Sonoran Desert vegetational classification. Both regions are found along the Pacific coast of Baja California, the latter lying entirely on the Pacific drainage (Shreve 1951). It is very likely that the Seri people never inhabited these regions (Felger and Moser 1974; Bowen 1976; Felger and Moser 1985; Sheridan 1999; Canchola and Banister 2000; Nabhan 2003). I acknowledge the overall importance of these areas for the Sonoran desert eco- and bio-diversity. Nonetheless, their discussion is not pertinent to the present manuscript.

Vegetational patterns of the Midriff Islands

The physical environment of the MidriffIslands does not differ drastically from nearby mainland and peninsular localities, particularly because the climate is essentially the same (Cody, et al. 2002). However, there is a slight difference with respect to temperature maxima and minima, which comes as a direct result from the Islands' small sizes and low elevation, which combine with the buffering effect of surrounding winds (Cody, et al. 2002).

The vegetational patterns follow those of the Central Gulf Coast with the exception that vegetation type transitions occur quicker along altitudinal variations (Fig. 18).

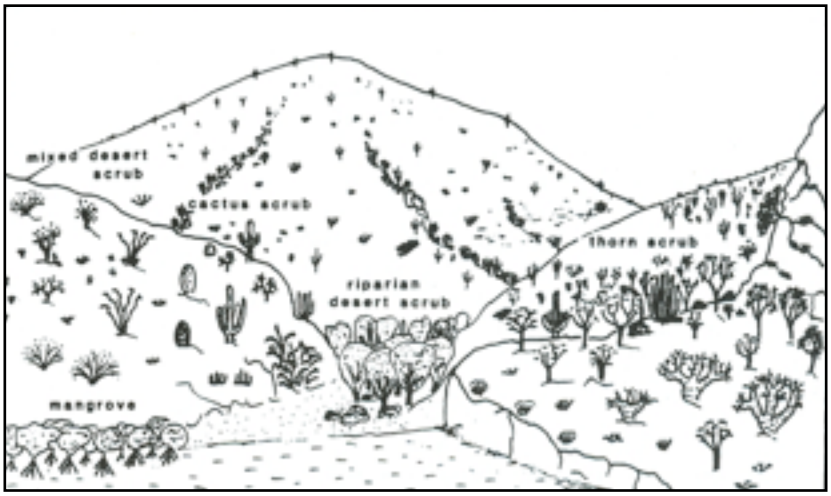

Figure 18. Representation of vegetational transition on a moderated size gulf Island. Source: Cody, et al. 2002:71. Reproduced with permission from Oxford University Press.

The main differences in plant community compositions derive from the Islands' geological origin. Tiburon, San Esteban and San Pedro Martir have clearly derived from Sonora. This is particularly evident for Tiburon, which is separated from the coast by a mile-wide, shallow channel. Among the 298 plant species found on Tiburon, 75 do not occur in any other Island, and another 9 are found only on San Esteban (Cody, et al. 2002). San Esteban hosts 123 plant species of which 3 are exclusively there, and another 8 can also be found on Tiburon and Ángel de la Guarda (Cody, et al. 2002).

Estuarine and wetland vegetation

The surface area of the Sea of Cortez extends through 26,589,400 ha (Wilkinson, et al. 2009). This enormous area harbors some 300 estuaries and other wetlands (Anonymous 2006). Among these wetlands, 43 major estuaries and marshes are found within the range of the Greater Comcáac Territory, latitude 28° N - 32° N (Glenn, et al. 2006). Nine of these are located within the boundaries of the Ejido Desemboque and Anexo Punta Chueca (Figure 19), deriving a substantial amount of income for Seri and non-Seri fishers alike (Basurto 2002). The utility that the Seri derive from these wetlands is not limited to fisheries yields, as they have historically extracted a vast number of biotic resources which are used as firewood, housing materials, tool material, food and medicine (Felger and Moser 1973; Felger and Moser 1974; Felger, Moser and Moser 1980; Felger and Moser 1985). Glenn et al. (2006) have registered the vegetation of intertidal, supra-littoral and non-tidal wetlands in the northern half of the Sea of Cortez, with which they have documented the existence of 20 plant species for intertidal marshes, 18 for supra-littoral marshes, and 16 for non-tidal marshes.

*Figure 19. Supra-littoral section of **Zaaj Cheel** (Estero el Sargento, Sonora). Easily perceivable is **Spitj** (Atriplex barclayana).*

Sonora hosts 92 percent (203,000 ha) of the total 221,000 ha of wetlands found throughout the northern half of the Sea of Cortez (Glenn, et al. 2006). 74,539 of these hectares are comprised of mangrove estuaries. Sadly, close to 97 percent of the shrimp aquaculture farms are located inside the Sea of Cortez, and 95 percent of the mangrove marshes within this region have been developed for aquaculture purposes (Meling López, Estrada Durán and Cruz-Varela 2004). However the relatively low anthropogenic impact and good health of the 9 estuaries found in the Seri territory, which can be measured by the productivity along **Xepe Coosot** -Infiernillo channel- (Basurto 2002), have made it possible for the Seri to keep using these areas as sources of raw material for various purposes (Felger, Moser and Moser 1980; Felger and Moser 1985; Basurto 2002; Basurto 2006).

Dune vegetation

Johnson (1977; 1982) estimates that the number of plant species found on the dunes along the 1400 km of the eastern coast of the Sea of Cortez ranges between 83 and 120. The spatial distribution of the species along the dune system follows an inland successional pattern (Fig. 20). Twenty-nine species on the foredunes are restricted to this habitat, whereas fifty-four back-dune species keep appearing in inland habitat (Johnson 1982).

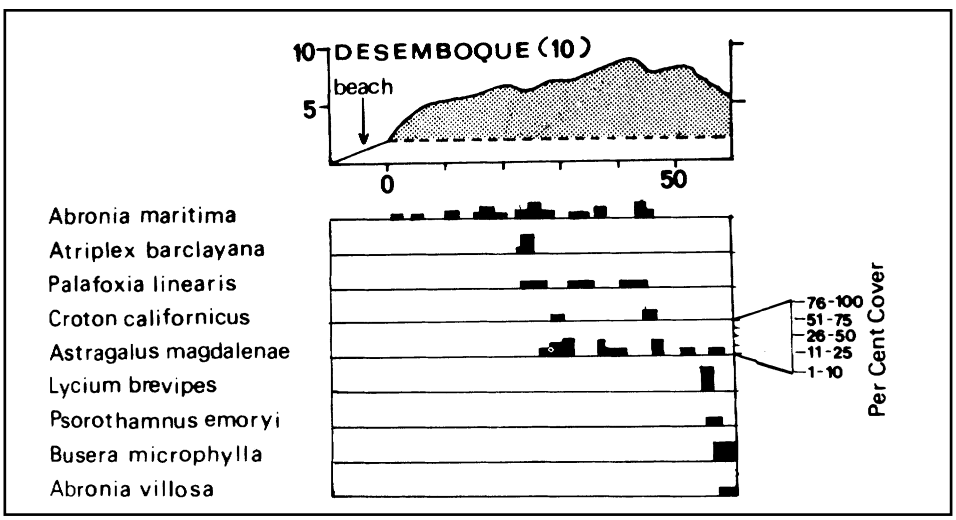

*Figure 20. Vegetational composition of a hypothetical sand dune inside **Haxöl Iihom** Gl. Desemboque de los Seris, Sonora. Source: Johnson 1982: 323. Reproduced with permission from John Wiley & Sons Ltd.*

Present day territory

Present day Seriland is located on the central portion of the Sea of Cortez (Fig. 21), an area considered to be the southernmost limit to the zoogeographical area known as the Northern Gulf of California (Walker 1960).

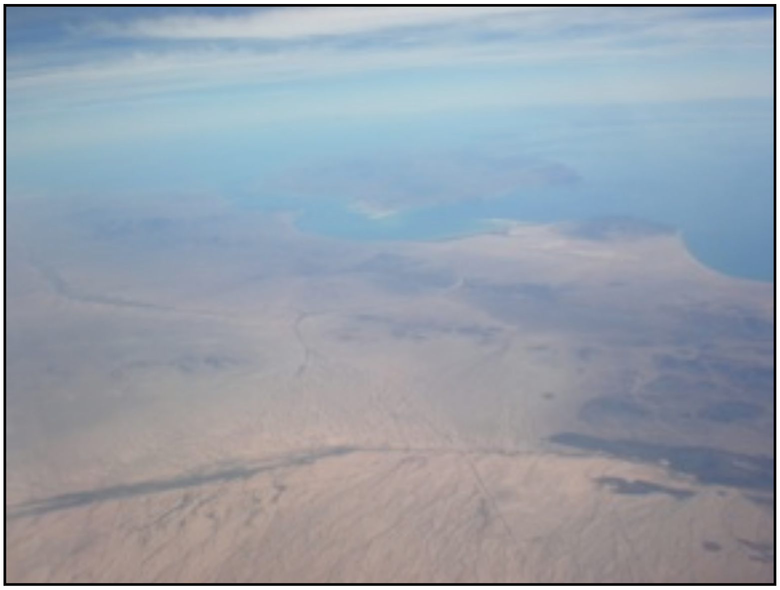

Figure 21. Aerial view of present day Seriland. Easily perceivable are Bahía Sargento, Punta Tepopa, Infiernillo Canal and Island Tiburon. Photo: Nemer E. Narchi, 2009.

The territory can be divided into two major zones: a) Infiernillo Canal, a 279 km^2 water strip in between Tiburon Island and mainland Sonora, characterized by shallow waters with average depths of 5.5 meters. The zone is governed by estuarine characteristics that enhance productivity and is geologically heterogeneous, featuring mangrove, sandy, muddy, rocky reef, and pebble areas –offering a vast variety of substrates for different organisms to inhabit (Torre Cosío, et al. 2002). These habitats are constantly fertilized by the action of two different water masses that meet in the middle of the Canal (Merifield, Marzolf and Lamar 1970). Estero Tastiota, Laguna de la

Cruz, Estero Santa Rosa and Estero Sargento are Seriland's mangrove areas (Fig. 22), with as much as 95 per cent of their total extension still intact (Meling, *per. comm.*).

*Figure 22. Mangrove areas of the exposed beaches at **Zaaj Cheel***

b) Tiburon Island has predominant oceanic characteristics (Torre Cosío, 2002). Depths go from 100 to 200 meters (Maluf 1983). The zone around Tiburon Island lacks estuaries, presents few sandy beaches, and is governed by a mix of rocky habitats (Torre Cosío 2002).

The terrestrial environment

Present day Seriland is located in the central coastal portion of the state of Sonora, between 26° 18' and 32° 29' N and 108° 25' to 115° 03' W. There are two main Seri villages: Punta Chueca, which is located in the municipality of Hermosillo and

Desemboque, which is located in the municipality of Pitiquito. The area is characterized by a dry, rocky soil near the mountains and sandy in the valleys (Scheffler 1987). The annual pattern of temperature is high for the summer and below freezing nights-to-dawn during the winter. Highest daytime temperatures occur in summer and are usually below 40° C. In winter the predominant influence of northwesterly winds lowers the daily temperature to an average of 10° C (Hastings and Humphrey, 1969).

The flora is a mixture of the typical Sonoran Plains type and a predominant Central Coast flora. Felger and Moser (1985) classified the dominant biotic communities in the area as marine vegetation (sea grass plains and algal communities), coastal scrub (mangrove and halophytic plain) desert scrub (coastal scrub, cactus, mesquite, riparian vegetation) and thorny shrubs (acacia).

Despite being surrounded by mountainous ranges and several smaller masses of volcanic origin (Bowen 1983), the Central Coast has no streams with perennial surface flow. The main drainages; Rio Sonora, Rio San Ignacio, and Rio Bacoachi, as most of the other drainages in the zone, carry surface water only rarely (Bowen 1976). Rio Bacoachi has no terminus to the sea and ends at Playa San Bartolo, (seasonal pond) behind the Sierra Seri and outside of present day Seriland. The former makes water a strategic resource in an area where temporary playas (dry lakebeds) and tinajas (pools) hold less than 1,000 liters each and there are only 5 permanent springs between Kino Bay and Puerto Libertad (Sheridan 1999).

Early human occupation of the Sea of Cortez

To talk about the archaeology of the area is to search for undeserved trouble. First, the area expanding through the Mexican Northwest and the American Southwest is divided by an international border. The border is much more than the geopolitical limits between two nations, it also embeds different politics and policies on science (Villalobos-Acosta 2007), which represent two different ways of understanding, funding, administering, prioritizing, divulging and appreciating research. For instance, American archaeologists were already trying to describe the area as early as 1913 (Gumerman and Gell-Mann 1994). In contrast, the first two Sonoran-based anthropologists were appointed by the Mexican government in 1973. The number of appointees was finally raised to four in 2003 (Villalobos-Acosta 2007).

On the one hand, it has been argued (see Ortega-León 2007) that as a direct result of the meager amount of research on the Mexican side, the American archaeological exploration of the Mexican Northwest has been transformed into a type of intellectual colonialism that tries to appropriate the Mexican Northwest to blur its singular characteristics by dissolving it into the American Southwest cultural area model (Braniff 2001a). On the other hand, the governmental, totalitarian, and ideological character of Mexican archaeology makes it almost impossible to find funding for projects outside the central Mexico areas (Gorenstein and Foster 2000). In Mexico, federal funding agencies will favor the funding of monumental archaeological sites that will potentially attract international tourists and international monies (Warman, et al. 1970). Fostering Mesoamerican monumental archaeology reiterates the official post-revolutionary discourse of a bronze race that will emerge in a juxtaposition of modernity and a glorious pre-Columbian past (Bonfil Batalla 1989; Paz 1989; Braniff 2001a) despite the fact of losing the opportunity to know the knowledge of Northwestern Mexico (Gorenstein and Foster 2000). Therefore, few places in Mexico have received so little analysis concerning their archaeology as has the Mexican Northwest (Braniff 2001a).

The conceptual frameworks that have -even simultaneously- been proposed for explaining the cultural area, are tainted with this Mexican versus American archaeological tradition, and it becomes evident that the interpretative models are relational, historically bounded and personal in nature (Villalobos-Acosta 2007). The cultural area frameworks are not objective tools, but socio-historical and cultural artifacts. León Portilla (1972) has pointed out that the region will hardly be defined as a cultural area as it is attached to a multicultural reality, in which cultural features are defined according to three different mindsets: Mexican, American, and Indigenous.

Despite the continuous feedback that these mindsets receive from each other, the conceptualization of the archaeological findings will always be driven by a cultural preconception of the facts.

It has been discussed elsewhere (Villalpando 1997; Villalobos-Acosta 2007) that these preconceptions have given place to two approximations to understanding the area; a) “isolationist” and b) “imperialist.”

The former implies little interaction among pre-Hispanic groups and sets focus on detailed description of the particularities of socioeconomic systems, means of production, and technologies, without including these in larger interaction spheres outside of the region. There is an assumption that there was never a direct Mesoamerican socio-political influence in the area, despite recognizing the northward dispersal of cultivars and ceramics. The latter draws upon world system theory (Wallerstein 1974) to describe the area as a peripheral region of Mesoamerica. Mesoamerica had a direct effect on the socio-political realm of the area by means of expanding its influence via the *Pochteca* traders.

The conceptual struggle between the American Southwest and the Mexican Northwest is evident not only in the form of discursive frameworks and conceptual artifacts, the pervasiveness of these ways of thinking can easily be seen in libraries around the world. For instance, the example of The University of Georgia Main library, where one finds the Seri in shelf FL1401, then one is forced to travel eight corridors to find Seri immediate neighbors the Tohono O'odham in shelf E99.

Besides the plurality of cultural interpretations and conceptual frameworks converging in these borderlands, there is much controversy in whether the region can be seen as a cultural area given its geophysical characteristics. The area extends over 3 major climatic and topographic zones, encompassing a considerable number of different cultures, regional systems, and behavioral and evolutionary patterns (Gumerman and Gell-Mann 1994) that present no uniform nor contemporary progressions (Gumerman 1994).

Material exchange and political organization, social hierarchy, degrees of social integration, and external influences will be hard to see in a glimpse unless using multiple scales of analysis (Gumerman 1994; Villalpando 1997) that permit the understanding of the interaction between intersociety and local systems.

Therefore, I am abandoning the theoretical framework of an ever debatable Mexican Northwest-American Southwest cultural area, and I will limit myself to describe the early human occupation of the Greater Comcáac Territory and the present day Seriland.

There is a consensual agreement that humans have inhabited the land surrounding the Sea of Cortez for at least 13,000 years (Braniff 2001a; Bahre and Bourillón 2002; Bowen 2005; Carpenter-Slavens 2009; Sánchez Miranda, Gaines and Holliday 2009). However, there is some evidence suggesting an earlier occupation of the area occurring around 20,000 y.a. (Hayden 1967; 1976). The lithic materials found by Hayden, named Malpaís Altithermal stage, are characterized by the occurrence of maceration and scraping artifacts manufactured by direct percussion over basaltic material. The constant findings on this horizon are shell knives, scrapers and gouges and the lack of evidence of projectile point manufacture (Hayden 1976). Evidence for a pre-projectile point stage can also be found in archaeological sites in Nevada, Texas, California, and central Baja California, as illustrated by Krieger (1962).

A peripheral but dramatic example is that of the archaeology of Pendejo Cave in New Mexico. The radiocarbon dates go as far back as 55,000 years B.P. (Chrisman, et al. 1996). However, the validity of this data is shaken by a controversy around the stratigraphic integrity of the cave sediments (Shaffer and Baker 1997).

More conservative estimates suppose that humans have inhabited the land surrounding the Sea of Cortez for at least 13,000 years (Braniff 2001a; Bahre and Bourillón 2002; Bowen 2005; Carpenter-Slavens 2009; Sánchez-Miranda, Gaines and Holliday 2009).

Nonetheless, the scenario for a pre-projectile stage is highly probable, especially when considering the plausibility of low population densities for human populations and therefore the existence of few archaeological sites which are hard to intercept. Hayden's findings still have to be more widely accepted within academia.

The human populations that are recognized as first occupying the area around the Sea of Cortez, usually referred to as Paleoindians, were inhabiting the area during the very last phases of the late Pleistocene and early Holocene 12,000-10,900 y.a (Cordell 2001a). During this period, these human populations were subjected to an interglacial transition, characterized by an increase in temperature. These groups, most likely hunter-gatherers, experienced a relatively sudden increase in global temperature and more arid environments (Villalpando 2001b). These climatic changes brought pleistocene megafauna to extinction and forced humans into a totally new economy, especially in the most northwestern part of the eastern coast of the Sea of Cortez, where the lack of abundance of large prey pushed them into hunting smaller game such as bighorn sheep (*Ovis canadensis*), mule deer (*Odocoileus hemionus*), pronghorn *(Antilocapra americana)*, jackrabbits (*Lepus californicus)*, rabbits (*Sylvilagus audubonnii)*, lizards and small rodents (Cordell 2001a). Villalpando (2000) notes that as early as in the onset of the Holocene, the overarching geophysical-ecological zones shaped two broad cultural systems that she distinguishes simply as Lowlands and Uplands. She emphasizes that hunting was predominant of the Uplands while the Lowlands were more dependent on gathering (Villalpando 2001a). The lowlanders were not only dependent on wild edible plants, which add up to 95 species strictly used for food and 106 as food-medicines, but had a strong reliance in marine resources as well, as is evident in dune and estuarine deposits where it is common to find remains of mollusks, crustaceans, sea turtles and fish in the form of human refuse (Villalpando 2001b).

Earlier in this manuscript, I discussed that the state of archaeological research in Mexico is in an initial descriptive state. Add the former to the fact that local systems collapsed quite frequently, bringing common decreases in complexity and customary abandonment of sites (Gumerman 1994), plus a very dynamic inter-regional economic exchange (Villalpando 1997) and you get an essence of Mexican northwestern-American southwestern archaeology, a large number of locally defined sites and a considerable diversity of archaeological cultures scattered all over the territory with huge overlap in space and time in some places and total absence in other places.

A general descriptive chronology for the region starts *ca.* 13000-10900 ya. and develops virtually *ad continuum* until today.

The Paleoindian diet during the last moments of the glacial Pleistocene was based on megafaunal game; bisons, mammoths, tapirs, bears, and some smaller animals such as musk rats and hares (Cordell 2001a). These dietary trends changed as the climate became warmer, by the time that the Pleistocene-Holocene transition was taking place, virtually all the macrofauna in the area was already extinct. There is a human adaptational timespan that is not clear throughout the archaeological record. However, we know that 7500 ya. humans were completely used to the aftermath of the altithermal, and were now hunting smaller species and collecting a significant amount of wild edibles (Cordell 2001b). These conditions, known as the Archaic, lasted 4000 years for northwestern Mexico, and were comparable to the European Mesolithic. Villalpando

(2001b) makes emphasis on the blurry archaeologically evident transition from the Paleoindian to the Archaic.

Villalpando notices that the sole difference between archaeological remains from both periods is the sudden disappearance of the grooved Clovis points and a sudden inclusion of milling artifacts -i.e. manos and metates), which make it clear that there was a new need for collecting wild edible plants. The Archaic culminates with the adoption of agriculture during the Agricultural period in around 3500 ya. (Carpenter-Slavens 2009). The Agricultural period ended *ca.* 500 CE with the apparition of pottery (Cordell 2001b) and absolute sedentism (Wills 1988). The region suffered a considerable dynamism after sedentary societies started to coexist in the same area. Cultures merged and dissolved, while settlements were created and abandoned on a frequent basis. Despite all this dynamism, there is no doubt that one of the most remarkable changes for the region was European contact. The first European to explore the region was Francisco Vázquez de Coronado in 1540-1542 CE (Braniff 2001b). Overall, the contact process was slower than the one taking place in central Mexico. Enduring for some 300 years, the conquest of the province of Nueva Galicia, as the northern part of the Americas was called, provided an extensive and detailed corpus of ethnohistoric narratives (Gutiérrez 2001).

Even if the process was slower, it was as intense. The indigenous groups of the region proved to be difficult to conquer (Behar 1987). Mastering the bow and arrow, surviving on wild edibles and knowing the location of water sources in such a dry place, helped the “Chichimecas” to develop a guerrilla-type resistance never before met by the Spaniards (Powell 1944a).

The Spaniard solution was simple, a war without quarrels, in which they emancipated a vast number of their indigenous slaves from central Mexico to permit their inclusion in the Royal Armed Forces, as soldiers, a policy that lasted for 50 years, and ended in 1585 CE (Powell 1944b). Later on, the diplomatic relations became less hostile, when a mestizo named Miguel Caldera imposed another type of pacification policy in which the Spanish crown offered gifts and persuasive favors to the indigenous war-chiefs. To add to their diplomatic enterprise, Spain intensified their missionary efforts, transplanted agriculturist natives to the frontier and provided native and foreign settlers with habitual provisions free of charge(Braniff 2001c). Despite all the efforts and resources invested over the course of 300 years, the Spanish Crown saw one of the most costly outposts that existed in the northern campaign. It can be said quite literally that some of the indigenous groups were never pacified. After Mexico gained its independence from Spain in 1821, there were several attempts to assimilate the northern indigenous groups into the broader Mexican culture, several groups, such as the Seri, would refuse to become sedentary and adopt agriculture or work for the ranchers as cowboys (Rentería-Valencia 2007). The rebellion against being assimilated resulted in armed conflict, against the government and local ranchers as well (Fontana and Fontana 2000).

A short introduction to Seriland

There is a peculiar fascination, almost irresistible, almost canonical, for researchers working with the Seri people, to refer to the geographic area of their studies as 'Seriland'. Coined spontaneously by W.J. McGee and his collaborators (1896:94) while in the field, the term has become more than just a catchy word for early explorers to play with. The term Seriland suits perfectly the needs of those whose intentions are to pinpoint such an eccentric geo-cultural area.

Further, the term Seriland encompasses a universe in which people that once were semi-nomadic (Kroeber 1931; Moser 1963) are now considered to be sedentary (Basurto 2006), despite being unceasingly moving between their two main settlements (Burckhalter 2000) and along seasonal fishing grounds (Rentería-Valencia 2007). In spite of being surrounded by Uto-Aztecan languages such as Yaqui (Gatschet 1900), Seriland inhabitants speak a language that is a linguistic isolate (Marlett 2007); **cmiique iitom** *Lit.*, 'what a Seri person speaks with'. *Cmiique iitom* is "the sole surviving member of its immediate linguistic family" (Marlett 2000: 612; -see also: Voegelin and Voegelin 1966; Moser and Marlett 2005; Marlett 2007). The Seri's Uto-Aztecan neighbors mastered agriculture long ago, but Seriland remains a place with no agriculture (Bowen 1983).

Seriland was home to 6 bands of Seri people that were later reduced to a single group, now known as the present day Seri people (Moser 1963). Seriland was home to 6 bands of people speaking a language that was divided into at least three different mutually intelligible dialects (Moser 1963). Some of the descendants of people from these bands or groups of people have survived up to this day, and some others have disappeared without a trace or even a plausible explanation for their disappearance or perhaps have assimilated as members of one of the other groups (Bowen 2000).

Throughout the ages, the Seri range land has expanded (Sheridan 2001; Nabhan 2003) and collapsed (Bowen 1983) several times. However “nobody knows how long *Comcáac* have been on Island Tiburon and the Sonoran coast other than the fact that they were there at the time of first European contact” (Bowen per. comm.). A single radiocarbon essay ‘A-1634’, indicates that the *Comcáac* have been in the region since A.D. 65 ± 130 (Bowen 2007).

The present day Seri territory lies within prehistoric Seriland, within a region usually referred to as the Central Gulf Coast (Bowen 1976), which starts north of Guaymas, and ends just north of Desemboque, it also includes the Tiburon and San Esteban Islands (Fig 23).

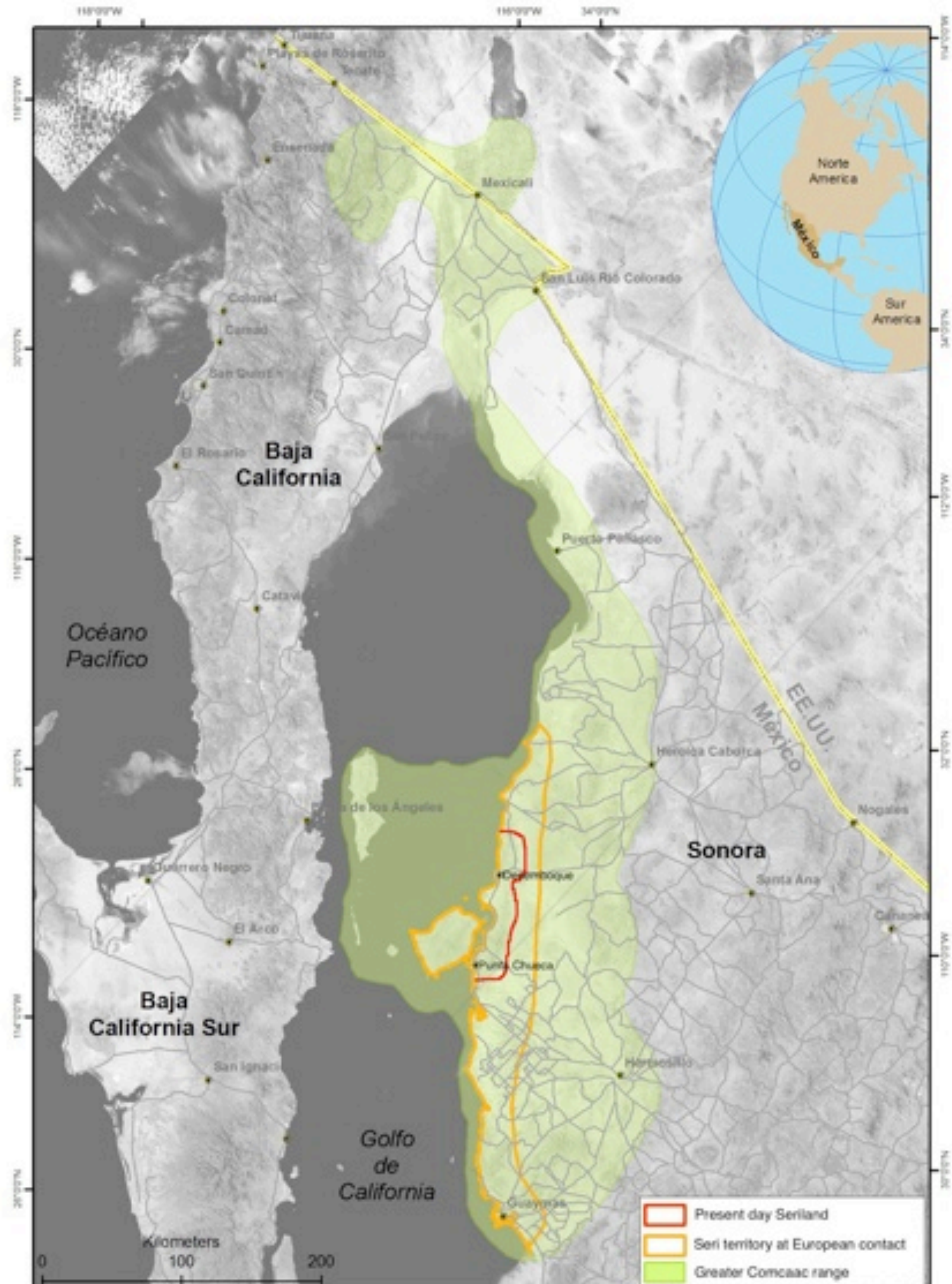

Figure 23. Seriland. Courtesy: Geovanni Cordero-Herrera.

Despite being a place inhabited by hunter-gatherers (Bourillón 2002), Seriland is not the “marginal” landscape in which hunter-gatherers are commonly found (Nicholas 1998), but one of the richest environments with respect to the abundance and diversity of its natural resources (McGee 1898; Torre Cosío 2002; Rentería-Valencia 2007). When Thomas Bowen stated that: “the geographic extent of this culture, its temporal position, and its cultural affinities have never been determined” (1976:9), he made the remark from an archaeological standpoint. Yet, the quote remains valid not only for Seri prehistory but for most of Seriland history as well.

Seriland prehistory

When European explorers arrived to the Central Coast of the Sea of Cortez they encountered Seri people living there (Di_Peso, Matson and Gilg 1965; Felger and Moser 1985; Villalpando 2001b). The former gives unquestionable evidence that the Seri have occupied the Central Coast of the Sea of Cortez for at least 400 years. However, it is nearly impossible to definitively determine the Seri occupation of the Central Coast before European contact. Besides the already discussed state of northwestern Mexican archaeology, there is the aridity of the Seriland that has forever affected the degree of human occupation of the area ever since the first humans occupied the Americas (Bowen 1976), which translates into low population densities and thus, less chances of intercepting archaeological sites. In addition, the prehistorical reconstruction of Seriland has been built mostly upon spotty non-ceramic surface reconnaissance and artifact collection (Bowen 1976; Bowen 1983). So meager is the information that the geographic extent, the temporal position, and the cultural affinities have never been determined, nor has it been established whether all remains belong to the same culture (Bowen 1976).

Seri prehistorical occupation of the coast has been determined by comparing surface deposits with remains of recently abandoned Seri camps (Bowen 1983). Considering these, Seri occupation of the Sonoran Coast and Tiburon Island is marked by the apparition of Seri eggshell pottery, formally known as Tiburon Plain pottery. Central Coast archaeological culture has become a synonym with eggshell pottery. The real problem remains to determine the age of eggshell pottery. Doctor Thomas Bowen has constantly made emphasis on the problematic nature of this situation.

> **"... all indicates that Seri have occupied the central coast since the beginning of ceramic times, which *a single radiocarbon assay* places no later than A.D. 220±130."**
> (Bowen 1983:232; emphasis mine).

The full panorama of the troublesome and murky situation on Seri dating starts with sample A-1634. The sample, A-1634, a piece of eelgrass stem, which came out of a multiple burial found along the mainland shore of **Xepe Coosot** Lit. 'narrow sea' Gl. 'Infiernillo Channel', where it was associated with Tiburon Plain Pottery (Felger and Moser 1985). According to Dr. Bowen (2009), there are four major problems with dating items of Seri material culture and remains, all of which derive from sample A-1634; 1) Single radiocarbon dates are unreliable and meaningless, 2) one has to be deeply skeptical of early Seri pottery dates, as it would be the earliest pottery in the entire Southwest, 3) when Felger and Moser present the datings for A-1634, the age they reported was for uncalibrated radiocarbon years, not calendar years. Finally and concurring with Felger and Moser (1985:378), 4) the date is not corrected for marine reservoir effects, which implies that it could be mistaken for hundreds of years (Bowen 2009, per. comm.).

So it seems that determining early Seri occupation dates is a complete disaster. This situation applies not only to Seri but to all of the Northwestern coastal populations due to the marine reservoir effects and the differences in carbon accumulation between the Pacific Ocean and the Sea of Cortez (Molto, Stewart and Reimer 1997). To be conservative, I will ignore the one proposed by Long (1977 [in Bowen 2007]) of 1940±130 radiocarbon years (Felger and Moser 1985:378), equivalent to a calibrated date close to 65±130 CE and assume that the Seri have been in the Central Coast for at least a thousand years, following Haynes, Damon and Grey's (1966) youngest sample dating of a human bone from Tiburon Island, estimated in 1100±300 radiocarbon years, which is approximately 850 CE.

The date has not been chosen arbitrarily. Bowen, based on typological continuity and distributional data, suggests that there is continuity between eggshell pottery and historical Seri pottery, concluding that the Seri have been the sole holder of pottery technology in the area (Bowen 1976). The typological continuity and the eggshell's similarity with Lower Colorado *tizon café and bayo* pottery suggests that the pottery was introduced into the area *circa* 700-800 CE (Villalpando 2001b), as can be verified by the archaeological sites at Tiburon Island, which is the location of the largest stratified archaeological sites on the central coast (Bowen 1976).

The scarcity of vestigial culture has led researchers into exploring other fields such as oral tradition, ethnohistory and colonial records (Villalpando and Banister 2000).

Thanks to this trans-disciplinary leap, it can be inferred that the Seri came to Sonora from Baja California.

Ever since Kroeber's observations (1915), there has been speculation around the existence of a Seri-Cochimí linguistic connection (e.g. Crawford 1976; Marlett 2007), which would link the Seri to the central portion of the Baja California Peninsula. Kroeber's conjectures became stronger after visiting Seriland and noting that Tiburon, San Lorenzo and San Esteban Islands could have been used as insular ladders to cross the Midriff Island region in reef balsas without much hassle and in a series of connected short-distanced trips between these Islands (Kroeber 1931).

Kroeber was right, Seri had the technological capability and seafaring dexterity to cross the Sea of Cortez using the Midriff Islands as connecting stations, as they did during the Spanish colonial period when they crossed over several times in order to raid the Baja California missions (Sheridan 1996a; Sheridan 1999). Seri oral tradition also points in the direction of Kroeber's notions (Griffen 1959; Moser 1963; Felger and Moser 1985).

The Seri distinguish between two types of mythological giants: the **hant ihiyáxi ctam** lit. 'land its-edge man'***,*** **hant ihiyáxi cmaam** lit. 'land its-edge woman' (Griffen 1959) *Gl.* 'Men and women who live on the outer edge of the world' (gloss mine)***.*** These people of enormous stature were believed to live in Baja California. They are commonly named **hant ihiyáxi comcáac** lit. 'land its-edge people' *Gl.* 'Those who live on the outer edge of the world' (gloss mine). However, Griffen's (1959) recording of the **hant ihiyáxi ctam** legend says that these giants found two Seri and rubbed the top of their feet with whale's brain (speculatively raw spermaceti or sperm oil from a sperm whale) and after that they grew immediately to **hant ihiyáxi ctam** size. These two giant Seri went back to their village in Sonora and regained their families. It can be inferred that these are the **hant ihiyáxi comcáac** and it is precisely their Seri origin (**Comcáac**) which distinguishes them from the **ziix coosyat**.

Ziix coosyat *lit.* 'thing that sings' *Sin.* **xiica coosyatoj**; **ziXósiat** (Griffen 1959) lived in San Esteban Island and supposedly extinguished themselves by ***quiimot*** (Griffen 1959) *Gl. '*gambling' (Moser and Marlett 2005). Some others, according to Seri oral tradition, perished in a great flood or metamorphosed into rocks, plants and animals when the world changed (Felger and Moser 1985). These beings have pervaded Seri oral tradition for a long time, as was attested by Father Adamo Gilg's letters to the Father Rector of the College of the Society of Jesus in 1692 (Di_Peso, Matson and Gilg 1965). Sheridan (1996a) argues that the Seri do not consider themselves as descending from these giants.

Felger and Moser (1985) note that the surviving **xiica coosyatoj** intermarried with the Seri, implying that Seri were already there at least when the **xiica coosyatoj** started to vanish. However, two ethnographic gifts I received from different Seri in Desemboque may point in a different direction. The first one of these exchanges occurred one afternoon while going to buy flour <u>tortillas</u> in the company of Manuel Monroy. As is usual in Seriland life, Manuel grabbed a rock to be used as an anti-dog land-to-land projectile that he carried throughout the duration of our <u>tortilla</u> saga. On our way back, having avoided all canine hostilities, he dropped the rock and rubbed his hand on his pants to get rid of the dirt. In the meantime he said: '<u>justo</u> <u>como</u> **Hant**

Hasóoma.' -just as **Hant Hasóoma*.*** The character is a mythological being credited with having created the first Seri (Moser and Marlett 2005).

According to my friend and primary collaborator Manuel, **Hant Hasóoma** rubbed the dirt out of his hands, and from that kneaded dirt, the first Seri were born. Based on Manuel's story, one can infer that **Hant Hasóoma** had a considerable size.

Nonetheless, he is described as "short, fat, and dirty, and wore a breechcloth and a hat with exceptionally wide brim" (Felger and Moser 1985:102) in other accounts. My second ethnographic gift is a most fortunate one. I was about halfway through my fieldwork season when news spread around Desemboque that Nando Torres found a giant's burial. In order to appease the giant's soul, a seven day celebration had to be carried out. After the celebration ended, personnel from Instituto Nacional de Antropología e Historia -National Institute for the Study of Anthropology and History- came to pick up the giant, analyze the remains, and give them back to the community.

To my surprise, the giant was somewhat average in size. Five feet eight inches, perhaps six inches at most. I went to Nando and asked why was this character considered to be a giant. He said: *"*Eduardo, gigante no es solo de altura, es de poder. Estos ancestros eran sabios y trajeron mucho conocimiento*..."* -Eduardo, giant does not only refer to size, but also power. These ancestors were wise and they brought a lot of knowledge...

The Seri associate these giants with "obsolete" Seri culture. They consider many technologies: eggshell pottery, gyratory crushers, disk beads, nose ornaments and lip plugs to be a **ziix coosyat** invention and most of them are considered to have been used exclusively by the giants. It is widely known (McGee 1898; Kroeber 1931; Di_Peso and Matson 1965; Bowen 1976) that both prehistorical and historical Seri made such artifacts and used nose and lip ornaments (Felger and Moser 1985). Furthermore, words used in archaic Seri language are also considered to be **ziix coosyat iitom** lit. ‘what a thing that sings speakers with’ (gloss mine) (Moser 1963; Bowen 1976; Felger and Moser 1985; Sheridan 1996a; Bowen 2000).

On the one hand, it is claimed that the Seri do not consider themselves to be related to the **ziix coosyat** in any way (Felger and Moser 1985; Sheridan 1996a; Bowen 2000). On the other hand, crediting the **xiica coosyatoj** with the creation of Seri artifacts, may be a way of referring to the Seri past (Bowen 2000). **Xiica coosyatoj** are tied to the San Esteban Seri in many ways: their “backwards” or “primitive” way of being, their desire to participate in **quiimot** even if it meant risking their own lives, their dialectical resemblance, etc. Bowen (2000) concludes that the San Esteban Seri may have retained their archaic dialect [and probably behaviors], a common characteristic for the most isolated communities within a group. This isolation and its consequences probably persuaded the other bands to reconsider the conceptual and chronological features of the San Esteban Seri, removing them over the boundaries of the recent past and turning their features into a myth that took the form of **ziix coosyat.** One thing is sure, there is enough material and historical evidence to claim that the Seri descend from **xiica coosyatoj**, who according to Seri oral tradition belonged both to the MidriffIslands and Baja California.

However, the different versions of the Seri creation myth invite us to reconsider if **Hant Hasóoma** and other deities responsible for forming Seri culture; e.g. **Hant Caai** lit. ‘he who made the land”, **Cmaacoj Cmasol** lit. ‘Old-man yellow’, **Hant Iiha Quimx** lit.‘he who tells what is on the land' **Sin. antia?k̃ wakómax** (Griffen 1959) were giants that survived the flood [and then created the world], as Manuel and Nando claim, or they simply were something else. The truth is that the etic understanding of both **ziix coosyat** and **hant ihiyáxi ctam** end up being lumped together into the term "giant", which further obscures inquiry given the existing information. I cannot help but to mention that back in the late 1930s, the Coolidges conducted ethnographic observations inside Seriland. These people gathered a vast amount of Seri oral histories and were compelled to reconstruct Seri origins from these. Knowing that **Cmaacoj Cmasol** was a large blond-haired seafarer, they decided that Seri ancestry had to be Viking without any reasonable doubt (Coolidge and Coolidge 1939). Without question, this was an extreme abuse of the etic perspective.

The dark-skinned Gachanías

Seri oral history can recall transnavigation of the Sea of Cortez taking place in the nineteenth century. Two of these voyages occurred around 1870. Allegedly, a prior voyage involving a group of San Esteban Seris in eight large <u>balsas</u> sailed to Baja California and never returned (Bowen 1976).

I was able to witness the preparations for one of these transpeninsular voyages during my stay in **Haxöl Iihom** 'Desemboque' during the years of 2008 through 2009.

The eleven hour voyage took place on a 15 feet fiberglass <u>panga</u> equipped with a 250 hp outboard motor that would travel some 260 kilometers from **Haxöl Iihom** to its final destination, San Felipe, Baja California. The trip was motivated by the lack of good luck with fish on the eastern side of the Sea of Cortez. Fishers had been waiting for fishing conditions to improve for some 6 weeks when the crew's captain finally decided to take the risk of such a risky enterprise. The crew stayed on the western coast for almost a month before coming back.

It is very likely that this type of voyage occurred more frequently than recorded. Until 1976, at least, Seris talked about the existence of a "group of dark-skinned people living on the peninsula at Mulegé who are called *Gachanías*" (Bowen 1976:96). In personal communication Edward Moser commented to Thomas Bowen that around 1940 some of these Gachanías arrived at Bahía Kino, moving later on to **Haxöl Iihom**, where they lived and stayed with the Seri. Both groups addressed each other by the term pariente. Seri conceptualize these people as the descendants of the San Esteban Seri and consider them to be the best turtle fishers on the Baja Peninsula (Bowen 1976).

There are no credible reports of surviving groups from the central and southern peninsula, plus, northern Yuman groups don't seem to have maintained any kind of turtle hunting adaptations into the twentieth century (Wilken per. comm.). Moser's account may suggest that this is a mainland group that migrated into Baja California and became established as turtle hunters.

The Colonial Period and the missions

During the sixteenth century, Alvar Nuñez Cabeza de Vaca roamed from Florida to Mexico City through the Americas and down the Pacific Coast in an epic voyage that took him eight years (Reséndez 2007). Cabeza de Vaca and his wandering companions had produced the most imaginative stories involving wealthy and opulent places referred to as the Seven Cities of Cíbola. Motivated by Cabeza de Vaca's Viceroy, Antonio de Mendoza sent a small expedition lead by Fray Marcos de Niza to the Northwest in search of the Seven Cities of Cíbola in 1539 (Bowen 2000). The sixteenth century marked Spain's first formal attempts to expand the colonial frontier further north of Sinaloa. Trying to protect from Antonio de Mendoza those lands that he considered in legitimate right to explore and conquer, Hernán Cortez dispatched Captain Francisco de Ullóa in a marine expedition to the Northwest in search of the Seven Cities of Cíbola.

The expedition was considered a failure by Cortez himself. Ulloa managed to explore the entire length of the Sea of Cortez, but he was not able to find the wealth that Cabeza de Vaca had described (Bowen 2000). Ullóa became the first European to see the heart of Seriland: San Esteban and Tiburon Islands. However, Ullóa encountered no inhabitants in the Islands, nor did he in Guaymas, all the way north into the Colorado River. All of Ullóa's journal entries as well as those from his pilot Francisco de Preciado indicate encountering abandoned camps (Felger and Moser 1985; Bowen 2000).

At the final stretch of his trip, Cabeza de Vaca heard word of Indians that lived in the coast, had no maize, and ate fish and processed flour from plants that were extracted from the sea [both fish and plants] with the aid of reed balsas. The description fits perfectly into the behavior and economy of the Seri. Cabeza de Vaca never experienced a direct encounter with the Indians described to him, nor was a name ever registered for this group (Felger and Moser 1985; Bowen 2000). It is somehow possible, yet inconclusive that Marcos de Niza may have met the Seri during his 1539 expedition (Bowen, per. comm.) Three quarters of a century had to pass before the Seri and the Spaniards encountered each other. In 1615 a pearl expedition organized by Tomás de

Cardona, directed by his Nephew, Nicolás de Cardona, and commanded by Juan de Iturbide, was beached on Tiburon Island where he found naked Indian fishermen, their women wearing buckskin aprons and glass beads on their throats and ears. Iturbide sailed to Patos Island and after three days in the company of six soldiers, used one of the boats to beach on the mainland (Bowen 2000). Posterior pearl expeditions organized by Nicolás de Cardona and lead by Francisco de Ortega took him to the Seri. On his last expedition in 1636 he reached the MidriffIslands to find fifty Indians without weapons coming to the beach throwing dirt into the earth as a sign of peace on San Sebastian Island [presumably Tiburon] (Bowen 2000).

There is no clear logic behind the origin of the word Seri. Nonetheless, there is little controversy in crediting Andrés Pérez de Ribas' account "Triunfos de nuestra fe" published in 1645 with being the first existing record of a Seri name variant (Di_Peso and Matson 1965; Bowen 1976; Sheridan 1979; Bowen 1983; Felger and Moser 1985; Sheridan 1996a; Sheridan 1999; Bowen 2000). It is very likely that Pérez de Ribas never visited the Seri, yet his account of the *Heris* is quite descriptive. Pérez de Ribas pictured the Seri as excessively wild people, without houses or villas, who customarily drank water from small ponds and puddles and embraced hunting and fishing as a livelihood. The account also mentions that the Seri held economic relations with their neighbors by offering hides and salt in exchange for maize (Felger and Moser 1985).

As early as 1631, the first colonial settlements started to appear near Seriland. Pedro de Perea, commander of the Presidio de Sinaloa was committed to the goal of developing mining and ranching in the Sonora and San Miguel valleys, for which he brought colonists and soldiers (Radding 1997).

The differences in livelihood between the native inhabitants of Central Mexico and their northern counterparts forced the Spaniards to implement new institutions and strategies to submit the territories of the Western Chichimeca. Military occupation was still an important piece of the stratagem. However, the most important part of the strategy was to control the eternal exoduses of semi-nomadic people, upon which no systematic collection of tribute could otherwise be imposed. To achieve these means, the mission system resurged as a way to erase the natives' recalls of earlier sLavíng expeditions, impose a new political order, and force the still untaxable native population to become sedentary. The plan required an agrarian economic base in order to both attract new colonists and to convert the natives into productive economic units (Radding 1997), all in the name of evangelization.

When ranchers started encroaching on Seriland, Seri began to kill cattle (Sheridan 1996b). The practice of petty rustling [a normal form of livelihood under the eyes of those that had always been hunters] along with the prejudices that the Chichimeca legends created in the Spaniards' minds, plus the radical differences in social organization, religious beliefs and means of sustenance between the two cultures, set an extremely violent and antagonistic template for the Spanish-Seri relationships to carry-on for nearly 150 years. A similar mode of engaging with the Seri would later be emulated by ranchers and governments of the post-independent and post-revolutionary Mexico.

In 1662 the rustling practices had unprecedented repercussions as hundreds of Seri were killed near Ures (Felger and Moser 1985) during a punitive expedition launched after some Seris raided mission Pimas (Bowen 2000). These sorts of conflicts were caused firstly because these cultures were simply unintelligible to one another and secondly because the Pearl hunters had done little for the establishment of towns and missions and consequently, for the pacification of the Sonoran gentiles. It was now time to use the carrot instead of the stick. In 1679 Father Juan Fernández established the Jesuit mission of Nuestra Señora del Pópulo in the lower Río San Miguel Valley (Felger and Moser 1985). The mission may have attracted just a handful of Seris, whose numbers fluctuated accordingly to the seasons and from year to year as Seris were deeply engrained with their usual livelihoods and left to "gather pitahaya fruit, hunt for sea turtles in the eelgrass meadows of the Canal del Infiernillo or even rustle Spanish horses and cattle" (Sheridan 1999:13). Besides the frequent "check-outs" of the Mission Seri, Nuestra Señora del Pópulo had to deal with European imports such as the 1683 pestilence, an event that nearly ended the life of this particular Mission (Di_Peso and Matson 1965; Felger and Moser 1985; Sheridan 1999).

On May 1685, driven away from a Baja California where the expedition had been beaten by scurvy, scarce rain, and famine, Father Eusebio Kino, Captain Blas de Guzmán, and their crew got acquainted with the Seri after reaching Sonora by sea in order to replenish the resources back at the colony. Guzmán and his soldiers camped at the southern tip of Tiburon Island in a place they named Playa de Balsas for reasons that seem obvious. The expedition was stranded at Kino Bay for some 45 days. Having encountered Seri camps on these shores, Kino devoted himself to establishing rapport with the Seri, who apparently liked Kino so much that they urged him to stay for a longer time, an offer that he would refuse (Bowen 2000).

Kino's refusal was not definitive. After the expedition arrived in Acapulco, Kino marched to Mexico City and requested that the Society of Jesus assign two missionaries to Northern Sonora. On his request he also asked for an official income in perpetuity for a permanent missionary who would stay specifically with the Seri. On March 11, 1688 Gilg arrived in Pópulo, reported to his superior Eusebio Kino, and took up the task of reactivating the Mission, which had been administered by Juan Fernández from its foundation in 1679 until 1683, when pestilence forced Fernández to leave the post, after which he was later reassigned (Di Peso and Matson 1965).

Since the very beginning Gilg felt that the Seri were antagonized with the livelihood that mission systems offered. He also sensed that the Seri were personally unreceptive to him (Di_Peso and Matson 1965).Perhaps it was this social breach that convinced him to write "not only the earliest ethnographic study of the Seri, but one of the best" (Di_Peso and Matson 1965:39). Adamo Gilg was a natural ethnographer and a dedicated linguist. The later was noted by Eusebio Kino when he witnessed Gilg preaching his dedication services for the missions of Remedios and Cocospera in the Pima language. Gilg's acute observations of the Seri were written in the form of a letter to the Reverend Father Rector of the college of the Society of Jesus in Brunn, dated February 1692.

In his writings, Gilg treats the Seri as people, and notices several of their cultural institutions and mechanisms, such as kinship terms, diet, language, customs and material culture. Pérez de Ribas had previously described subtle differences between the Seris that inhabited the coast in comparison with those established on the mainland. Gilg went beyond those observations and noticed the existence of several different Seri bands, whose habits he described separately. He was also able to describe one of the most common aspects shared by marginal hunter-gatherers, namely, “storing nothing, but eating as much as they could hold when nature provided” (Di Peso and Matson 1965:36).

In the meantime, the Seri kept resisting conversion and kept fleeing out of Pópulo and back to the coast and going in an out of the missionary life depending on the availability of native food resources and new species to hunt. Cattle increasingly became a natural food supply for roaming Seris (Bowen 2000).

For the first but not the last time in 300 years, the eternal trigger of Seri-outsider conflict was rustling. The first full scale military expedition to Seriland took place in January 1699 and was carried out by Lieutenant Ensign Juan Bautista de Escalante under the order of General Domingo Jironza Petris de Cruzat and by petition of Father Melchor Bartíromo, resident in Tuape, Sonora. The company, composed of Escalante, 12 soldiers and 100 Indian auxiliaries, recruited Father Gilg and gave chase to the Seri toward the coast, to find that the Seri had already escaped to Tiburon Island (Bowen 2000). Gilg abandoned the chase on February 7, 1699, after which he joined Kino for a trek to the Colorado, traveled to Baja California in 1706 and finally returned to Pópulo where he stayed until his death around 1714 (Di_Peso and Matson 1965).

On March 4, 1699, after returning empty-handed, Escalante marched again toward the gulf, determined to force the Seri to surrender. Escalante’s plan was to convince the rebel Seri to accept mission life after being relocated to the Río San Miguel Valley. On March 9, while waiting for his pacification emissaries, his expedition was attacked on a hit-and-run ambush. Other Seri groups were less determined and four days later some 40 Seri reached Escalante’s camp to accept his offerings. On

March 17, Escalante's troops combed the coast to gather all of the scattered Seri. Eight days later, he returned to the missions with 115 Seris (Bowen 2000).

Escalante was not ready to conclude his punitive expedition. On March 26, in the middle of events that remain unclear, Escalante headed towards Tiburon where his company killed nine Seri and took some prisoners, handing these over to Gilg at Pópulo (Bowen 2000).

A new attempt to evangelize the Seri would start in 1709 on rather serendipitous conditions. Juan María Salvatierra was chosen by Eusebio Kino to Christianize Baja California through a series of missions that would receive supply through a maritime route connecting them with the missions and presidios of Sonora and Sinaloa. On August of 1709, the vessel San Javier left Loreto, Baja California on a supply run to the Yaqui mission. In order to buy the supplies, the San Javier carried 3000 scudi. The vessel was caught up in a storm that took it to Seriland, stranding it on a shoal some 64 km north of Guaymas. The survivors buried the money and managed to get to the Yaqui villages in a canoe. A pearling vessel was dispatched in order to inform Salvatierra of the happening. Salvatierra took personal care of the boat's salvage. When he arrived to the Sonoran coast he discovered a starving reparation crew that had been dispatched earlier. Added to this, what was left of the San Javier had been dismantled and ransacked by the Seri, who were intrigued and fascinated with nails. The two months that were spent repairing the original damage and the ransack, were used by Salvatierra to build rapport with the Seri, from which he earned their friendship and trust, bringing enemy fractions together, and baptizing many. It is said that Seri asked Salvatierra to send a missionary to them. Given the limited funding that the Jesuits were experiencing, Salvatierra decided to use Baja California as a base from which to launch the Seri conversion (Bowen 2000).

September 1725 witnessed the first organized retaliation movement from the Seri. During the Jesuit mission period, the Seri expanded their range and widened their ecological niches, thanks to their hunter-gatherer mindset and mobility. Their adaptive radiation toward new ecological niches included the several times mentioned rustling. While rustling had produced some altercations and disputes, including Escalante's campaign to **Tahéjöc**, no altercation had previously resulted in an "eye for an eye" situation until the La Huerta affair.

La Huerta Affair

Early during September 1725 Salvador de la Huerta and Gerónimo Lorea, two ranchers of the now significant settlement of Opodepe, were joined by seventeen neighbors and Indian allies in order to trace and hunt down a group of Seris that had stolen some of their cattle and horses. At Chupisonora, the crew met with the Seri band, resulting in three dead Seris and the recovery of the stolen animals. Two weeks later, while Salvador de la Huerta was hosting a night party at his house in Opodepe, fifty Seris surrounded his house. Arrows started to fly through the windows and soon the roof was set on fire. All those who tried to escape met with the impossibilities of fleeing while facing either an arrow or a shot or being clubbed to death. Twenty-one people lost their life during the incident, regardless of their gender or age (Sheridan 1999).

After taking testimony of witnesses and neighbors, Sonora's alcalde mayor Manuel Álvarez de la Bandera dispatched Captain Cristóbal de León in the company of ten soldiers to apprehend the offenders.

On October 16, Captain León returned, reporting his battle with less than ten Seri men after which he captured one man, one woman, and seven children. These were interrogated back in Opodepe by Álvarez de la Bandera. Two days later, Álvarez de la Bandera interrogated other two Seri prisoners who declared that the La Huerta assailants were to be found at the ranchería of Ambrosio. Álvarez de la Bandera immediately sent for his Pima auxiliaries from the Pimería Alta, but he was almost immediately persuaded by the missionaries to delay the campaign for more than a month until the end of the Pimería wheat crop season. In the meantime, Captain León maintained the primal punitive expedition, engaging in battle every now and then. On November 13, his squad killed nine Seri men, and took twenty-four women and children as prisoners near Bacoachi. The next day, near the water hole of Tenuaje, they killed four more Seri men and captured nine women and children. That same night, having lost track of their position, they were attacked by a large group of Seris who wounded six and killed one of the Spaniard Soldiers. On November 19, the inhabitants of Valle de Opodepe had presented a petition to execute the Seri prisoners. Álvarez de la Bandera refused to follow the execution demands arguing that such an act would augment the blood debt amongst the antagonizing factions (Sheridan 1999).

Small groups of Seris such as the one lead by Nicolás, approached the Sonoran government in search of a truce. Álvarez de la Bandera insisted before them that truce could not be reached before they agreed to turn in the La Huerta raid leaders and the remaining Seris accepted to live in the missions. Sixty men and more than a hundred women and children went to live in Pitic. However, the Seri leaders Ambrosio and Nicolás scarcely turned in three La Huerta assailants. There is no clear conclusion to the La Huerta affair. Different historians propose or argue against punitive campaigns against the perpetrators. However, it is almost certain that almost all the Seris directly involved in the attack were never punished (Sheridan 1999).

Pearls, wars, Jesuits and greed

Ever since Cabeza de Vaca's imaginative tales, the quest for Sonora had been guided by greed and the pursuit of wealth. Two hundred years after hearing the stories of the Seven Cities of Cíbola, the Spaniard wealth hallucination was finally turning into tangible booty. In the late 1720s, the pearl fishermen had discovered the wealthy pearl beds of **Tahéjöc**, near **Zaaj Cheel**. In near no time, the Seri started harrying this flourishing industry (Sheridan 1979). In 1723, the Marqués de Casafuerte appointed Manuel Bernal de Huidrobo as the Captain of the presidio of Sinaloa and the first governor of the Sinaloa-Sonora province, titles that made him the most powerful royal official in all of northwestern Spain. The Marqués also licensed permission for Huidrobo to construct a boat and look for pearls. It was the binomial between power and interest for pearls that allowed Huidrobo to assemble a large scale military campaign against the Seri. He requested 200 Upper Pima from Father Agustín de Campos, rector of the Pimería Alta missions. Campos suspected that Huidrobo was more interested in personal benefits than in pacifying and evangelizing Seri souls. Therefore, Father de Campos refused the governor's request (Sheridan 1979; Sheridan 1999).

On July 27 de Campos was urged by his superior, Father Marcos Somoza, to comply with the governor's request. De Campos overtly responded that a) it was unfair to enroll the Pima while asking them to provide for their own food, and b) Huidrobo was more interested in gaining 1,000 slaves for the pearl industry than gaining 1,000 more soldiers to fight against the Seri (Sheridan 1999).

Huidrobo marched to the coast. He set up camp seven miles north of Kino Bay. From his position he dispatched messengers to persuade the Seris to surrender and move into the San Miguel mission. At first the Seris refused. A few days later, seeing the imminence of the attack, two groups accepted and marched with Huibrobo. At the very moment these Seris were deposited at Pópulo, they fled to Tiburon once again.
When these Seris returned to Tiburon, they held continuous small scale attacks toward the pearl fishermen in a gesture of vengeance (Sheridan 1979).

Meanwhile, Somoza had forged an alliance with Huidrobo. In 1735, the former asked de Campos to formally apologize to the governor. De Campos responded with a letter so bold that he was ordered to retire from San Ignacio after forty-two years of holding his post. When a group of ecclesiastical authorities arrived to remove de Campos, an armed band of Pimas gathered in San Ignacio to defend him. De Campos fled to Imuris, taking refuge with the Pima in the mountains. It seemed that a Pima revolt was going to be led by a Jesuit missionary, until Juan Bautista de Anza persuaded de Campo to go back. De Campos died on his way to the Jesuit college in Chihuahua 1736 (Sheridan 1999).

As early as 1734, after receiving the title of governor, Huidrobo had the intention of disempowering the mission system. Among many of his recommendations, Huidrobo proposed that it should be the Indians who should elect missionary officers. Jesuits saw this as a direct attack to the autonomy of the mission system (Sheridan 1999). Moreover, the conflict between Huidrobo and the religious authorities stopped any chance of articulating a coherent strategy for the pacification and reduction of the Seri (Sheridan 1979).

The overall political situation was complicated even more in 1740. An alliance of a Yaqui and Mayo majority complemented with some Seris and a number of Lower Pimas rose up in arms looting ranches and mining settlements. The revolt had to be controlled by new and most drastic measures, as the Spaniards feared a generalized insurgency in the form of a northwestern Indian alliance. The revolt was followed by the establishment of presidios at Buenavista and Pitic. The latter, it was argued, would enable the military to suppress future Yaqui uprisings while extending control over Guaymas at the south, while providing the Spaniards with a position of strategic importance to rapidly dispatch troops to the northern part of Seriland (Sheridan 1979).

The early XVIII century saw the dawn of the Enlightenment in Europe. The new humanistic ideology was playing an important perspective in the monarchical establishments of most of Europe. As a strategy to cope with the zeitgeist of the era, the Spaniard House of Borbon dictated a series of economic, administrative and political ameliorations known as the Borbonic Reforms, intended to reduce the power of local elites, reduce bureaucracy, and gain more tributary contributions. To set up the reforms, the Spanish monarch sent several reformers. Among these, José Rafael Rodríguez Gallardo was appointed as juez pesquisidor y visitador general de Sonora y Sinaloa (Sheridan 1979).

Rodríguez Gallardo was convinced that the political and economic changes he was commissioned to bring about could not be achieved until the Indians had been pacified (Sheridan 1999). One of the first actions under his administration, on March 1749 was to transfer the presidio from Pitic to San Miguel de Horcasitas. The development of this new presidio started encroaching on the San Miguel missions. The first altercation came when settlers started to seize Seri land. Soon, soldiers were forcing the mission Seris to grow their crops and look after their stock. Father Tomás Miranda warned about consequences that the mistreatment of the poorly fed and overworked Seris would bring to the mission. The mission rebelled against the new situation and so Gallardo decided to round up the leaders and place them in chains (Sheridan 1996a). As was now customary for the Seri, they abandoned the mission and once again, began to inflict devastation on central Sonora (Sheridan 1996a). Gentile -non-mission- Seris were also inflicting damage upon the new settlers: killing cattle and stealing horses under the leadership of a Seri named Manuel. After persecution, Manuel sent two of his nephews to plan his terms of surrender. Rodríguez Gallardo disarmed and incarcerated Manuel's messengers, a gesture that convinced Manuel to perpetrate an attack on a ranch of Chupi, Sonora, in which eleven Spaniards were killed. A rival war chief named Canito offered to track and surrender Manuel. Rodíguez Gallardo repaid Canito's intentions by arresting him and his followers and they were sent to the Sinaloa presidio and were subsequently deported to central New Spain (Sheridan 1979).

On May 28, 1749 the Seris attacked Nacameri, killing three Spaniards. The attack resulted in the eventual abandonment of the settlement. A bigger offensive was launched on September 18 over Real de Minas del Aguaje, a mining hamlet south of Hermosillo. The Seris killed forty-three people, burned houses, and raided the church. The raiders were pursued by soldiers, one of which was killed during the chase. The raiders managed to escape with a decent booty of mules and supplies (Sheridan 1979). In an effort to stop the hostilities, the viceroy of New Spain issued a general pardon to the Seris and subsequently eighty families went back to the missions (Sheridan 1996a). This sort of persuasion was seen as useless by Sonoran authorities.

In June 1749, Rodríguez Gallardo convoked a war council aimed at formulating a plan to finally remove the Seri from Tiburon. The plan, aimed at killing the rebellion leaders and deporting the rest of the Seri to the Caribbean. On June 23, 1749 General Diego Ortíz de Parrilla assumed the governorship of Sinaloa-Sonora, he would be bestowed with carrying Gallardo's plan to eradicate the Seri. The plan was supported by seven Jesuit missionaries (Sheridan 1979; Sheridan 1996a). By 1750, the attempts to reduce the Seri into a mission life were seen as a failure by the Jesuits themselves. By accepting this failure, consummated champions of Seri rights such as Father Miranda and Father Provincial Andrés Xavier García were ready to support a military expedition into Tiburon (Sheridan 1999).

The spring of 1750 saw the activation of Ortíz Parrilla's first part of the anti-Seri plan. Ortíz Parrilla convinced Pablo, the Seri governor of Pópulo to draw as many Seri as he could into the San Miguel River settlements. When Pablo's followers were finally settled, the Spaniards arrested all of the Seri they could find near Pópulo. The fate of the male prisoners is unknown; the women were deported to Guatemala. Once again, those who escaped joined their kin in the dessert (Sheridan 1979).

At that moment, with the Seri disbanded, deported, and eradicated, the plan to invade Tiburon was now feasible. The campaign started by transporting 121 men in seven large boats to Bahía Kino. At the same time, the governor dispatched three vanguard detachments to the coast, covering the territory to the northeast of Bahía Kino, the mouth of the Sonora River and the Bacoachi Mountains, respectively. Northeast of Bahía Kino, the vanguard constructed a defensive post at Carrizal, to which the entire expedition marched on September 10, 1750 (Sheridan 1979).

From Carrizal, forty-eight soldiers and 100 Pima auxiliaries were sent to Tiburon under the command of Captain Tomás Beldarrain in a recognition mission aimed at locating water and pasturage. As soon as Beldarrain set foot on the Island he sent a crew commanded by Pablo to contact the rebel Seris. The Seri war chief, Sing-the-Arrow-that-Kills[ii], told Pablo that the Seri were happy at Tiburon and meant the Spaniards no harm. However, the Seri were ready to respond to any attack. He gave Pablo a cross and an arrow, symbolizing Seri readiness for peace and war. On September 18, Ortíz Parilla marched to Tiburon with 520 of his soldiers. The first thing that the expedition learned was that the aguajes were poisoned and that the only sign Beldarrain left behind were two decomposing horses (Sheridan 1979).

After two decades of guerrilla warfare, deception and retaliation, the invasion of Tiburon, proclaimed as very successful by Ortíz Parrilla, costing 12,000 pesos, enlisted some 700 men among soldiers, militia, and Indian auxiliaries, to kill thirteen men and detain twenty-eight people. Once more, those who escaped broke up into small groups.

[ii] The cmique iitom name for chief Sing-the-arrow- that-kills derives from a Jesuit's (Pimentel) diary. No original record of the name in cmique iitom has been found according to my understanding. Seri informants have pointed me in the direction of **Haxáaza quiho** to be the correct name for Sing-the-arrow-that-kills

Tired of offering allegiance to the intransigent Spaniards, these small groups, based in Cerro Prieto, would keep besieging the northwest as the only strategy they could afford in order to resist genocide (Sheridan 1979; Sheridan 1996a; Sheridan 1999).

Since 1692, the Apache started to be driven away from the Great Plains by the Comanches (Sheridan 1999). "**Lured by the visible spoils of a relative opulent Spanish culture**" (Arbelaez 1991:325) the Apache kept all the Mexican Northwest on a permanent state of siege. Spaniard settlers never behaved as passive victims. With or without Spain's military, Spaniard settlers frequently banded together to plunder, stocking provisions and a handful of slaves to sell (Salmón 1988). Despite having had historical differences, native ethnic groups of the Mexican Northwest did the same. Therefore, it has to be acknowledged that most revolts involve not only Seri, or Pima, but a diverse mosaic of Apache, Yaqui, Mayo, Upper and Lower Pima, Papago, and Seri warriors (Sheridan 1996a).

During the year of 1751, the Upper Pima rose in revolt. The reasons for the upheaval were simple simple: the Upper Pima wanted to be the absolute masters of the products they were producing themselves. They wanted to be able to take as much as they wanted without being accused of thievery (Arbelaez 1991). If there was still any hope for the mission system, the frequent raids inflicted by the diverse native groups during the 1750s and 1760s, either separate or in alliance, helped exhibit the inefficiency of missionization (Sheridan 1979). The expulsion of the Jesuits in 1767 consummated the end of the Missions program (Felger and Moser 1985).

The constant revolts and the raiding guerrilla were not the only problems of the most chaotic decades for Colonial Sonora. In an effort to control this hectic zone from the British who had just ceased to seize the Havana years earlier, Spain decided to inspect all the northern presidios. After the revision, the government of Sonora realized that it had enough soldiers to invade Cerro Prieto, the most obvious bastion for Seri and Pima rebels (Rentería-Valencia 2007).

In October 1769, Colonel Domingo Elizondo "**launched the largest single military operation in the history of Colonial Sonora**" (Sheridan 1999:235). With more than 1,100 troops and an investment of 450,000 pesos that came from the pockets of merchants and the revenues from the sale of tobacco (Sheridan 1999), Elizondo established a naval base at Guaymas and his quartering at Pitic, from which he invaded canyons and forests of Cerro Prieto. The European-style warfare in which victory in a single battle was sought proved unsuccessful. After his fourth attempt using this sort of strategy, Elizondo decided to break his forces into little squadrons that would fight a guerrilla-style war without other strategy that killing every time any group of natives Elizondo's troops encountered (Sheridan 1996a).

So effective was Elizondo's new strategy that the anonymous author of "Relación de la expedición de las Provincias de sinaloa, Ostimuri y Sonora en el Reino de Nueva Españas" estimated the decrease in rebel families from 600 among Upper Pima and Seri, to a combined low of 181 (Sheridan 1999). Those who were still resisting in alliance broke their loyalty after long exposure to the rigors of war. Seri and Pima leaders deflected and joined the settlements now under Franciscan control (Sheridan 1999; Rentería-Valencia 2007).

In the year of 1770, near Pitic, modern day Hermosillo, the government of Sonora founded Villa de Seris, in which they gave arable land to a few hundred Seris.

The project was seen as an immense expenditure, but it was cheaper than garrisoning an army much needed elsewhere in New Spain (Sheridan 1999). The Seri remained at peace until 1773 when the Seri living at the recently erected Carrizal mission, lead by **Ixquisis,** killed the clerics and abandoned the mission (Bowen 1983).

The attacks escalated in intensity by 1780, Seris had raided Guaymas and attacked the mission of Santa Magdalena. In the spring of 1781, thirty Seris deserted Pitic. The village of Pitic was desolated by a measles epidemic soon after that, the epidemic spread to the Seri bands known as Tiburones and Tepocas. Combined with new military campaigns, the early 1780s saw temporary calm. One night on March 19, 1783, all of the Seris living at Pitic abandoned the settlement (Sheridan 1999).

From 1798 to 1803, Seris had refined their hit and run techniques and would not seek refuge inside Tiburon. Their switch in strategy consisted in escaping through the Sea of Cortez, using the Islands as a ladder, as they had used them to arrive in Sonora for the first time. The refinement of Seri strategies now allowed them to raid missions and settlements on both sides of the border as they did with the Santa Gertrúdis Cochimí mission (Sheridan 1999).

At this point in history, the Guaymas and Upanguaymas Seri groups had disappeared (Bowen 1983), Salineros were now referred to as Seris, while Tiburones and Tepocas still conserved their denomination (Sheridan 1996a; Sheridan 1999). Bowen (1983) speculates that Tiburones may have taken in many Salinero and Tepoca refugees.

It is interesting to think of these Seri in terms of the band system proposed by Moser (1963). The Seris had been fleeing and dispersing in rather serendipitous groups that were shaped more by opportunity and luck than by band/clan affiliation. This succession of events allows us to question the validity of the band system. If we assume it is valid, we must at least keep in mind that it may not be as old as the Seri themselves or as rigid as it appears to be described. Elizondo's guerrilla persecuted every Indian encamped, regardless of their ethnicity. The strategy resulted in stronger resistance than before. Strategic alliances had previously been equally common and ephemeral among the different Sonoran groups. However, none of the previous strategies had reached such a large scale as the conformation of the <u>Cimarrones</u> tribe, a coalition of Tiburones, Tepocas, Pimas from Caborca, Tubutama and Oquitos, a few Lower Pima, and Apache representatives (McGee 1898; Velasco 1975).

From the Mexican independence to the present day

The early part of the 1800s saw a weakening in governmental authority. By mid-September 1810 Mexico's war for independence had started, consuming Spain's economic and military resources for 11 years and providing Mexico, in the aftermath, with a weak, centralized, and unexperienced independent government.

In the year of 1824 Sargent R.W. Hardy was sent by the General Pearl and Coral Fishery Association of London to circumnavigate and map the interiors of Tiburon in search of pearls and gold. Hardy also got acquainted with the Seri who he describes as 3,000-4,000 people organized in several animal-named clans (Mcgee 1898).

With the lack of authority in the Northwest regions of the newly independent Mexico, Seri, Yaqui and Apache plundered and desolated ranches and settlements throughout the Northwest again from 1825 to 1832 (Felger and Moser 1985; Bowen

2000). These raids were followed by a failed expedition to Tiburon in 1842 under command of Captain Victor Araiza, and a later, more ambitious extermination campaign was launched by Sonora's governor General Francisco Ponce de Leon in 1844. That same year, a couple of local entrepreneur brothers, Pascual and Ignacio Encinas, established a new ranch between Hermosillo and Bahía Kino. In this ranch, Rancho San Francisco de Costa Rica, the Encinas brothers tried to coexist peacefully with the Seris by attempting to employ them as ranch-hands (Sheridan 1999; Bowen 2000). As this and other ranches expanded toward Seri territory, rustling intensified once again (Fontana and Fontana 2000).

One of the most famous raids, so full of romanticism that it became part of Francisco Rojas' famous novel "Lola Casanova," later represented in a film by Matilde Landeta. The story goes as follows: Coyote Iguana, also known as Jesús Ávila (Bowen 2000), an influential Seri leader because of his assurance and prowess as raider hunter and **Cocsar** *gl. 'non-Indian Mexican'*, led a raid against a caravan traveling from Hermosillo to Guaymas on February, 23, 1850 (Sheridan 1996a; Sheridan 1999; Bowen 2000; Irwin 2007). Some authors date the event as far back as a decade later. Bowen (1983), previously dated the event as occurring on 1854, Ives (1962) situates it somewhere between 1828 and 1861. Traveling with the caravan there was a most beautiful lady by the name of Maria Dolores (Lola) Casanova, whose beauty entrapped Coyote Iguana. She persuaded him not to kill her and instead to kidnap her and make her his wife, and as such, she would bare at least one child: Victor Ávila. Lola was taken to Tiburon, where she lived many years (Sheridan 1996a; Sheridan 1999). The story has many endings, different sources claim that she either ran away from Tiburon, was rescued by a punitive expedition, refused to return to Tiburon, died in a tribal feud, was murdered before the expedition came to her rescue, or died of old age still a putative Seri (Irwin 2007).

While William Neil Smith personally communicated to Ives (1962) that no Seri claimed descent from Coyote Iguana, Bowen (2000) points out that many Seri trace their descent to Coyote Iguana through Victor Ávila. In my field experience 30per cent of the people who consider themselves descendants of the Tiburones would claim direct kin ties to Coyote Iguana. Curiously, Coyote Iguana is considered to be a Pima who was raised as a Seri after being captured in his youth (Ives 1962). One of my Seri collaborators said he was Tohono O'odham. Regardless of which version is true, the recomposition of Seri identity becomes a recurrent theme all the time.

One real aspect of the legend is that it launched two different military expeditions toward Tiburon. Immediately after the caravan attack, a small expedition was launched from Guaymas. This expedition returned empty-handed, but gave an excuse to the Sonoran government to launch a much more ambitious attack. On March 12, 1850, under the command of Colonel Cayetano Navarro, more than 100 men and two vessels initiated another expedition. Finally on March 28, 1850, Navarro sailed to Tiburon and after some 20 days of combat returned to the mainland, reporting 12 Seris killed and 32 prisoners taken. However, he offered no details on the Mexican captives he was sent to liberate. On the particular case of Lola Casanova, he reported that the Seris had murdered her after learning of Navarro's expedition (Bowen 2000).

By 1855 and in spite of the efforts to influence the Seri, Pascual Encinas decided that it was impossible to alter the Seri's ways. Encinas armed all his cowboys and started one of the darkest periods in Seri history: the Encinas war. Encinas' cowboys hunted down and killed Seri wherever they were found. The Seri responded in kind, starting a decade long cycle of mutual killing (Bowen 2000).

The Encinas War killed more than half of the remaining Seri. The second half of the XIX century was surely a devastating period for the Seri culture, which was appropriately described by McGee:

> **"The Seri suffered a succession of external shocks more serious in their internal effects than any of those of the three centuries preceding; indeed it is just to say that during this half century the Seri range was curtailed, the Seri customs were modified, and the Seri population was diminished more effectively than during the preceding sesquicentury of fairly definite records. The chief factor of this transformation was an intrepid pioneer, who pushed actual settlement toward the Seri frontier more vigorously than any predecessor -Señor Pascual Encinas, a son of Sonora."**
> (McGee 1898:109)

The aftermath of the Encinas War brought occasional killings on both sides well into the 1920s (Bowen 1983). A parenthesis has to be drawn to say that the Seri-Encinas relationship was far more complex than total hatred, as it constantly oscillated from friendship to warfare, both before and after the ten year long war (Ryerson 2005). In spite of a brutal decade of guerrilla warfare, Bowen (2000) notes that the period between 1880 and 1900 should be considered the darkest for Seri history. First, there was an unwritten policy promoted by official circles that offered a reward of MEX $3 for every male Seri head. Second, in 1880 there was yet another revolt; Sonora's government launched a new retaliation campaign in which they managed to capture more than 150 Seris, who were placed at Villa de Seris under a new regime holding much similitude to the reservation system. The Sonoran government appointed a Seri governor to serve as a liaison as well as to maintain order among the prisoners. In trying to implement the carrot-and-stick policy, the Seri were provided with more than sufficient food allowances. Nonetheless, Seris would argue that more than once they were victims of intentional poisoning of the food they were given. One night, as had become characteristic of Seri culture throughout the colonial invasion, they rose up in revolt, nearly killing the Seri governor, afterwards they fled to the coast (Bowen 2000).

The last military action of the XIX century started with an insignificant skirmish in June 1890. As many other skirmishes related to the Seri, it ended in a full scale expedition toward Tiburon. This time, the excursion to Tiburon caused a Seri revolt on the mainland, which the Sonoran government could not settle for half a year. Towards the end of 1890, the Seris, numbering 192, were distributed among ranches to serve as wage laborers (Bowen 2000). A drawing by Roberto Thompson, one of the few Mexicans who liked the Seri at that time, dated 1895, shows how Seris were not being hired as wage laborers but sold as slaves (Ryerson 2005:129). Contemporary Seri culture connects this incident to the vanishing of the San Esteban Seris, by thinking that these people died at Villa de Seris after the initial roundup and killing (Bowen 2000).

The late XIX century was marked by increasing rumors of a Seri treasure, perhaps being formed by the accumulation of the many bounties captured during the much feared Seri raids (Bowen 2000). In my experience and up to this day, some Seris will approach visitors that have stayed for too long, to ask in harsh ways if these visitors are after the Seri gold. During the year of 1894 two of four gold prospectors visited Seriland and got murdered under unclear circumstances (Bowen 1983, 2000). Perhaps these murders were part of a plan to launch a military campaign that could help the prospectors in simplifying the task of eradicating the Seri without investing a single penny out of their pocket as Lt. Colonel Luís Lopez would suggest in his report (Bowen 2000).

As more prospectors started to see the economic benefits that could be derived out of Tiburon, diverse groups of Americans proposed to launch a private expedition to settle Seri matters. In September 1902 an expedition lead by “Arizona Charlie” Meadows landed on Tiburon. More concerned with evaluating the Island’s wealth than punishing the Seri, the incident registered no hostilities (Bowen 2000).

A little bit earlier, W.J. McGee became one of the first ethnographers to approach the Seri during two field trips conducted in 1894 and 1895, respectively (Mcgee 1896; 1898; Fontana and Fontana 2000). During his first expedition, he interviewed Seri along the coast, usingRancho Costa Rica as his field base. For the second expedition, he conducted a trip to Tiburon, stayed eight days on the Island in miserable conditions and fear, and saw no Seris while on the Island (Mcgee 1898). However, and in spite of being criticized early on by posterior ethnographers (see Kroeber 1931:18-28), his work is testimony of the first Seri ethnography and is very rich in the documentation of Seri archaeology (Bowen 2000; Fontana and Fontana 2000).

The last official campaign against the Seri at Tiburon took place during late 1904. Bowen (2000) notes that the problems may have started on the coastal ranch of La Máquina where a Mexican rancher known as Curved Back (Herrera-Marcos 1988 in Moser 1988) caught a Yaqui worker butchering one of his cows. The rancher killed the Yaqui worker. Some Yaquis near Guaymas got acquainted with the fact and killed the rancher in revenge. These Yaquis, that had been forming alliances with the Seri, at least as early as 1830s during the conformation of the Indios Cimarrones confederation, sought refuge in Tiburon from where they started a series of raids (Bowen 2000). One of my informants, a Yaqui living at **Haxöl Iihom**, who in turn is married to a Seri woman, told me that the band was referred to as La banda de sombrero negro after its leader, a Yaqui who always used a black hat. As it had become customary, the Sonoran government launched a military campaign toward Tiburon under the command of the Governor of Sonora, Rafael Izábal, himself. Izábal arrived on Tiburon on Debember 24, 1904, having 42 Tohono O'odham, 40 cowboys and 160 soldiers under his command.

After seven days of combat, eleven dead Seris and several women and children captured, Seris were forced to kill the Yaqui fugitives (Rentería-Valencia 2007).
To the Seri, the conflict started in a radically different way, as the attack to coastal camps and the invasion of Tiburon came without any justification. Prisoner women and children were murdered and innocent Yaqui families fled from the mainland in fear of retaliation (Herrera-Marcos 1988 in Moser 1988; Moser 1988; Bowen 2000).

From 1904 until 1920 most of the Seris were living permanently on Tiburon Island (Bowen 1983). This panorama changed as Sonoran towns and cities became more numerous and populated. In this spirit and in order to provide for the increasing demand for fish, Bahía Kino was used as a fishing port during the 1920s. During this period, some Seri began engaging in small-scale commercial fishing (Felger and Moser 1985). In the year of 1926, given the U.S. prohibition of alcohol, an American, Yates Holmes, established the Kino Bay Sportsmen's Club, with aims of developing recreational activities such as fishing, hunting, and exploring. The aforementioned would take place while members would enjoy alcoholic libations. These tipsy sportsmen and their families were remarkably generous with the Seri, in terms of providing them with clothes, food, and money. These non-hostile encounters started to reconcile the Seri way of life with the rest of the world (Felger and Moser 1985; Rentería-Valencia 2007). At about the same time, the government of Sonora appointed Roberto Thompson Encinas as a liaison with the Seri. Thompson Encinas, the nephew of Pascual Encinas, grew up in Rancho Costa Rica, where he developed a closer relationship with the Seri than that held by most of the other Mexicans (Kroeber 1931).

By 1910 there was an increase in demand of totoaba (*Totoaba macdonaldi*) emerging from the Chinese community of San Francisco, California (Bahre, Bourillon and Torre 2000). Totoaba, a fish endemic to the Sea of Cortez, had a particularly similar gas bladder to a fish used in China as the main ingredient of <u>sopa</u> <u>de</u> <u>buche</u> 'gas bladder soup'; a characteristic that made the market overtly interested in intensifying the totoaba fishery by the late 1920s (Cisneros Mata, Montemayor Lopez and Roman Rodríguez 1995). In 1930, Seri fishermen already settled in Bahía Kino started to get involved in the totoaba fishery. As a result of centuries of eradication campaigns that had left less than 200 Seris alive, and a later non-hostile involvement with the American sportsmen and commercial fishing, the Seris started to modify their seasonal patterns of subsistence migration (Bahre, Bourillon and Torre 2000).

In 1935, the Mexican federal government, under Lazaro Cardenas who ruled one of the most leftist episodes in the history of Mexico, fostered the constitution of isolated fishers into fishing cooperatives (Rentería-Valencia 2007). By 1937, Leví Rodríguez and his brother Arturo, owners of L.H. Rodríguez Seafoods, Inc. based in Tucson, Arizona, started buying from the Seri not only totoaba, but also shark liver, as the demand for vitamin A and shark liver oil was growing because of WWII (Bahre, Bourillon and Torre

2000). The opportunities offered by an expanding market, on the one hand, and the chance to build a fishing cooperative, on the other hand, encouraged Jesús Solórzano, a man from Colima, to organize the first fishing cooperative in Bahía Kino: Sociedad Cooperativa de Pescadores de la Tribu Seri, S.C.L. in 1938. By 1939 the composition of the cooperative's membership changed into a ratio of eight Mexicans per one Seri. At that moment, the exposition to exogenous culture was becoming detrimental to the Seri, as they were faced with drugs and alcohol, which proved pervasive throughout the population (Rentería-Valencia 2007).

The mixture of alcohol and tensions between the Seri and non-Seri fishermen convinced Solórzano to move the cooperative almost 100 kilometers north to Bahía Kino (Rentería Valencia 2001). Solorzano established a little grocery store in order to provide for the Seri, he also established a ban on drugs and alcohol. Solórzano invested part of his earnings in the new community. He built an office for the cooperative in which he assembled a considerably large storage fridge. He also brought attention from the government in order to build an elementary school, which he partially funded. However, internal tensions collapsed the cooperative in 1948 and Solórzano left for good (Rentería-Valencia 2007).

Having a majority of the Seris settled at **Haxöl Iihom** allowed an ever increasing number of anthropologists, missionaries, linguists, and health service providers to have contact with the Seris (Bowen 1983). These settlements brought new institutions into Seriland. By 1951 a pair of missionaries, Mary Beck and Ed Moser, working for the Wycliffe Bible Translators/Summer Institute of Linguistics, whose goal was to translate the bible into the Seri language, were quickly accepted by the Seri and established permanent residence at **Haxöl Iihom** (Bowen 1983; Rentería-Valencia 2007).

A year after the arrival of the Mosers, the American Friends Service Committee, another religious association, reestablished the schooling system by constructing a second school, in a privileged position in the middle of town (Bowen 1983). Yet a third missionary association, now of Mexican extraction, was better accepted among the Seri.

In 1953 the Iglesia apostólica de la Fe en Cristo Jesus, was established in **Haxöl Iihom.** Some time after the conversion of the first Seris into the apostolic faith, the social dynamics changed so much as to result in the coining of a new term for the emerging social category. Evangelized Seri became known as **ziix coostim** *Lit.* 'thing that sings' (mine) *gl.* 'evangelical parishioner'. During the 1950s, one-third of the Seris residing in **Haxöl Iihom** dissented from the prohibition of alcohol and long-held ritual practices by traveling 63 kilometers south of **Haxöl Iihom** to establish permanent settlement in **Socáaix,** to continue living their own life style (Rentería-Valencia 2007).

As the inhabitants of Seriland opened up to their surrounding neighbors and economies, Instituto Nacional Indigenista, guided by the ideas of Manuel Gamio (1916), considered Seri openness to be a good opportunity to promote its política indigenista: an effort to acculturate indigenous communities as a means to shape a mestizo post-revolutionary Mexican nation. A number of people from different disciplines were deployed to Seriland to evaluate their health and infrastructural needs, as well as their degree of integration into the Mexican society (see: Monzón 1953; Marroquin 1957):

"The Seri truly form part of our Western society, in so far as they catch fish, with fishhooks and motorboats, to sell in the markets of Hermosillo, Nogales, and Tucson, and they obtain payment in national species and coin." (Monzón 1953:90 Translation: George Bedell).

In 1958, Instituto Nacional Indigenista also revived the fishing cooperative (Bowen 1983) to ensure complete integration of the inhabitants of Seriland into the market system and Mexican society.

The cooperative proved to be successful to some extent, but according to one informant, not successful for all. There was conflict on how the profits were being administered and not all the Seri held partnership in the cooperative. Additionally, there was an incremental decrease in turtle hunting and fisheries in general (Felger and Moser 1985). One strategy in which women were providing an income was with the production and selling of the now world famous Seri handcrafts, which were sold mostly to Americans visiting Bahía Kino and **Haxöl Iihom**. Men that could not provide enough income from the fisheries started producing the wonderful Seri ironwood figures.

Ironwood (*Olneya tesota*) carving is considered to be neither traditional nor introduced, but the product of Seri traditional stone sculpting techniques and industrial tools (Felger and Moser 1985). Several versions exist regarding the origin of Seri ironwood carving. For some, and in contradiction to the views expressed by Becky Moser (1985), ironwood carving was introduced by the Instituto Nacional Indigenista, in the views of making handicrafts a major source of income for indigenous communities all over Mexico. Nabhan (2003) offers three versions. The first one, supported by Felger and Moser's (1985) explanations, points out that the first ironwood carving, in the form of an amorphous paperweight, was given by José Astorga to Alexander "Ike" Russell as a gift. The second one is attributed to the intervention of an American seasonal visitor, Mrs. Derwin, who asked the Seri to make some carvings. The third version is (see Sheridan 1996a), by far, the one I like the most:

"José Astorga had a vision -one gained through celestial travel with extraterrestrial beings- that by initiating a new income-generating activity based on ironwood forms the Comcáac would be able to survive in the modern world" (Nabhan 2003:148).

Intrigued by its glamour, I attempted to revise this version. Yetman's (1988) account acknowledges that José Astorga, in the fashion of a Seri **ziix haaco cama** *lit.* 'thing that has power', *gl.* 'shaman', deprived himself of sleep and food for several days, until a spirit manifested itself to José and commanded him to start an ironwood industry in order to save the Seri.

José passed away some time ago, but his daughters, MLA and AA, have a different version of the fact. José was hunting for a deer deep in the mountains. While tracking the game, he suddenly tripped over and his rifle discharged. The shot wounded José's abdomen. José tried to return to his house, but was weakened with each step, until he was so weak that he prepared himself for the worst. He lay down near the roots of a cholla (*Opuntia sp.*) and when he was about to lose consciousness, the roots of the cholla swallowed him and transported him directly to an extraterrestrial spaceship. The aliens immediately took care of his injuries. After he had healed, one of his rescuers ordered him to start producing ironwood moons and spoons, which would be sold to Americans to save the Seri.

One day, Ana Burgos, Jose's granddaughter visited my camp in order to see if I was interested in buying some ironwood carvings. Among the four or five figurines she offered me there was one particularly conspicuous. This figurine had no resemblance to any desert animal or plant (Fig. 24). When I asked what the figure represented, Ana told me it was el viajante, the being that had taught José how to make the ironwood carvings.

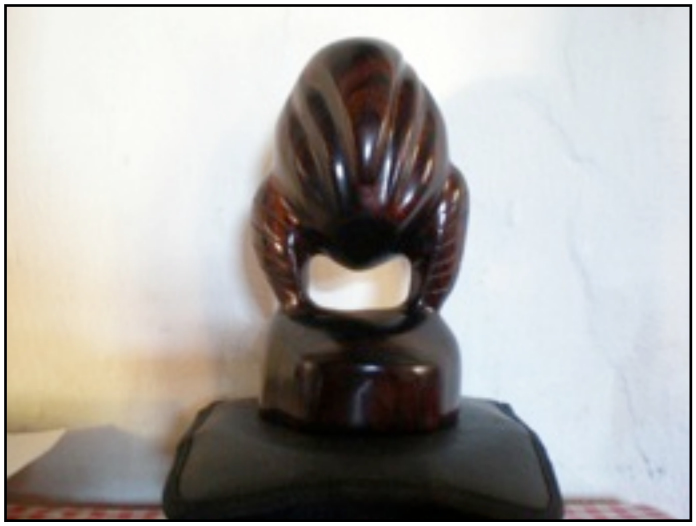

Figure 24. El viajante as represented by Ana Burgos.

Regardless of what the true version is, ironwood carving, an important source of income, was integrated into Seri economy between 1961 and 1962 (Bowen 1983; Felger and Moser 1985; Yetman 1988; Sheridan 1996a; Nabhan 2003).

In the year of 1963, without the knowledge of the Seri, the Federal Government declared **Tahéjöc** to be a natural reserve and wildlife refuge (DOF 1963). The decree was followed by a resolution recognizing the conformation of the remaining regions of Seriland, including **Tahéjöc** into the Ejido el Desemboque y su anexo Punta Chueca and crediting the Seri with the property of this ejido (DOF 1970).

A later decree, published in 1975, proclaimed **Xepe Coosot** and the waters adjacent to **Tahéjöc** to be fishing zones that were to be exclusively exploited by the Seri (DOF 1975). The decree brought up a series of claims from the non-Seri fishers already working within the surroundings of Seriland (Rentería-Valencia 2007). The conflict between Seri and non-Seri fishers keeps reemerging from time to time. Nonetheless, the decree helped to maintain the Seriland waters in near pristine condition up until recent times (Basurto, Bourillon and Torre 2000).

As part of the populist agenda under the Echeverría administration and with the intentions of forcing the Seri into absolute sedentism, somewhere in the 1970s the Seri were provided with modern cement houses built by the Mexican federal government (Felger and Moser 1985). As with other projects within indigenous communities[iii],the Seri housing project took no consideration of Seri requirements or environmental constrictions, and, as such, built houses with tin roofing, which are anything but suitable for a desert environment. The Seri used these houses as warehouses or storage sheds for a long time, until each could individually afford new roofing.

Around the same time, the US and Mexican governments were in search of a joint strategy to save bighorn sheep (*Ovis canadensis*) from extinction. Twenty of these animals were placed on **Tahéjöc** as part of a pilot program on bighorn repopulation. **Tahéjöc**, being an Island, was not part of the original habitat of the bighorn sheep.

Nevertheless, the Island shares similar vegetation and orography to that of its continental surroundings, but without the natural occurrence of predators. These characteristics make **Tahéjöc** an optimal place for reestablishing the bighorn sheep population.

In 1996 the project expanded into one of sustainable exploitation of bighorn sheep as hunting prizes. After establishing the guidelines for administering the project,

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[iii] e.g. A 15 thousand liter water tower built in San Andrés Coahamiata that was inaugurated by Echeverria himself. The reservoir had to be filled with water buckets and lots of man power. Otherwise, there would be no water flowing from the faucet when news reporters photographed the pompous event. Evidently, no one planned for the water tower to have a pump. In fact, San Andres had no electricity at the time (Gutierrez 2006).

two hunting permits were auctioned in the American state of Nevada. The total price for both permits was a surprising amount of US$ 395,000. Being the sole proprietors of the Island, the Seri received the amount in full. Since then, four permits are auctioned off each year, averaging a price of US$ 100,000 each. These amounts are almost paid in full to the Seri authorities; the remaining part is used to foster the project (Huerta-Martínez 2009). There is heavy internal controversy around the monies and administration of the project, a great number of informants manifested their concerns to me in informal settings.

The interference of non-Seri fishers in Seri waters, added to the plans of sustainable hunting programs not only to exploit bighorn sheep but also mule deer (*Odocoileus hemionus*) and the constant encounters with timber looters led to the formation of the Seri traditional guard by the mid-1980s. The guard has the duty to protect Seriland from potential reavers (Rentería-Valencia 2007). As with any other nonofficial paramilitary forces, the state and federal governments oppose the existence of the traditional guard despite the fact that these institutions provide no active surveillance to the ejido's surroundings.

Seri are famous around Sonora for possessing <u>carros chocolates</u>, irregular or blatantly illegal cars used, for the most part, to drive around Seriland. One of my friends jokes about the Oregon license plate on his car saying that it is a <u>placa Seri</u>. Unlike their looting ancestors, contemporary Seri do not roam around stealing horses or cars, for the matter. Most of these <u>carros chocolates</u> are sold to the Seri, inside Seriland, by federal and state police agents. If these agents catch someone with one of these cars outside of Seriland, the Seri suspect is taken into custody and, to everyone's surprise, the car is sold to another Seri, probably from the other village. In the end, these types of transactions have eroded internal relationships, since an eternal discussion over the legitimate proprietor of the car takes place with relative frequency among the Seris.

During the 1990s, and perhaps because of to the relative simplicity of associating the placa Seri to other felonies, the right-wing population of Sonora has linked the Seri with drug trafficking operations. While for a little fraction of the population this may be true, the great majority is overly concerned with the fact that participation in drug trafficking activity has contributed to problems of methamphetamine addiction among a growing fraction of the Seri youth (Rentería-Valencia 2007).

In spite of the marvelously planned urbanization of Seriland during the Echeverria administration, **Socáaix** started to receive tap water in 2004 and **Haxöl Iihom** joined the electric grid in 2001.

Presently, the Seri are faced with yet another facet of national change that could easily have cultural repercussions. First, during the Salinas administration article 27 of the Mexican constitution changed. In an effort to privatize the lands, ejidos were transformed from communal unsellable land, into private plots that could easily detach from the ejido as the ejidatarios saw fit. Second, the Fox administration assembled an ambitious tourism-focused megaproject. The project, known as the “Escalera Nautica”, planned by the federal government in coordination with the Mexican Bureau of Tourism, involves 4 states, and at least 20 new nautical ports –with a total of 24- located in dozens of cities and communities along the Sea of Cortez. It is estimated to be capable of hosting 520,500 boats by the year 2014 (FONATUR 2001). Because of the magnitude and impact of the project, it has been heavily criticized in regards to the dangers it poses to endemic species (WCMC 1992), water availability (CNA 2004), water quality (Páez Osuna, et al. 2002), and overall ecological conditions (Álvarez Castañeda and Ortega Rubio 2003). The project may bring much boat traffic and pollution to the Seri exclusive fishery zone. Moreover, with the aid of the modifications to article 27, it can persuade, either by gentile or hostile means, the disintegration of Seriland, in order to favor the construction of large-scale touristic sites, as has been done along the Mayan Riviera. Third, under Seri law, a Mexican can share the benefits of the exclusive fishing zone as long as he is married to a Seri wife (Rentería-Valencia 2007). This has persuaded a considerable amount of poor fishers and outlaws to marry Seri wives and take residence inside Seriland. These people, as is logical, bring with them a different set of values and cultural behaviors, but most importantly, some foster the existence of illegal activities within the community. Fourth, the Sea of Cortez has become an important hotspot in terms of both touristic development and conservation. As early as 1990, diverse conservation organizations managed to keep a considerable area of the Sea of Cortez free of fishers, regardless of whether these were industrial fleets or small-scale boats. With ten marine and thirteen terrestrial protected areas covering 9 million hectares, there has been a considerable repercussion for the poorest fishing communities along the Sea of Cortez (Carvajal, Robles and Ezcurra 2010).

Presently, to mitigate the social impacts, there is an ongoing attempt to synthesize tourism and conservation into an ecotourism project. The ongoing efforts to transform fishers into eco-guides have been followed by federal laws and regional programs that actively support the disappearance of fisher societies along both coasts of the Sea of Cortez (Valdéz Gardea 2008). As wonderful as it may seem, it is unlikely that rustic ecotourism projects will be able to compete with megaprojects. Even if small scale rustic ecotourism projects could compete with the luxurious all-inclusive resort complexes, it is very naive to think that there will be enough touristic demand to feed everyone involved. Sadly, as Victoria Chenaut denounced thirty years ago, fisheries policy is planned above a desk somewhere in Mexico City by someone that has never talked to a fisher or visited the fishing areas (1985).

Chapter summary and conclusions

The Sea of Cortez has a unique conformation given by its bathymetry, the desert-like irradiation that it receives on the North, the reigning continental climate, and the water dynamics caused by its arc island. All of these factors combine into a synergistic oceanography that makes it a highly productive, overtly dynamic waterbody. The latitudinal changes in climate and sedimentation patterns help in conforming a unique set of incredibly biodiverse habitats that include mangrove forests and coral reefs, plus a myriad of intertidal environments. The terrestrial surroundings are equally biodiverse as the Sonoran Desert is conformed by five different vegetational types which have been supporting human inhabitants over some ten thousand years.

The Seri have lived in the area for some 2000 years. Throughout this time-length, the Seri range has expanded and contracted several times. The most drastic changes recorded for Seri range and livelihood came with European contact. Encroachment, the Spaniard need for chap agricultural labor and the inception of new resources in the form of cattle set the initial conditions for a belligerent condition that overarched for three centuries. This guerrilla-like relationship decimated the numbers of the Seri and thus, altering their diversity, and collapsing the various Serian groups into one single society.

Bellicosity against the Seri continued after Mexico became and independent nation. The last part of the XIX century saw one of the most violent periods against the Seri. During the 1920s, diminished in numbers and confined to a smaller territory, The Seri started to integrate into the regional economy by joining the fishing industry, selling handcrafts to American tourists, and begging.

Today, the Seri have undergone deep cultural transformations by becoming sedentary, adopting commercial fishings as their most important source of income, accepting the evangelical faith, and joining consumerism and market integration. Along with these transformations, their dependence on the local biota for surviving has also been transformed from a semi-nomadic hunting-gathering mode of subsistence to that of a sedentary way of life in which resource extraction is destined to external markets in exchange for money and goods.

CHAPTER 3: ETHNOGRAPHIC CONTEXT

Sociopolitical organization

Clans, families, bands, and ihízitam

There are little means by which the state of Seri sociopolitical organization before European contact can be inferred. After the establishment of the European vanguard settlements it took some 70 years or so (Sheridan 1999) for the explorers to notice that the Seri lived in politically independent units occupying separate territories (Bowen 1983).

The existence and location of the Serian speaking groups is still highly contested because of historical, ecological, and archaeological discrepancies. First, the territorial scattering of different groups of people was sometimes enough for Spaniards to recognize separate nations. Slight differences in culture and dialect were also to blame for the artificial split of the Seri (Bowen 1983). In spite of the inconsistencies in identification, three groups -Tepocas, Salineros, and Guaymas- had been reliably identified by the Spaniards throughout all colonial period (Spicer 1962).

The first written mention of the Seris was made by Father Andrés Pérez de Ribas around 1617 and published in 1645. His account is not limited to mentioning the *Heris* (-Seris, but also the *Yaiamas* -Guaymas- indians, who inhabited the southernmost part of the Seri territory and were related to Lower Pima neighbors (Sheridan 1999).

By the end of the seventeenth century, it was not only the three above mentioned groups that were distinguished, but also the Seris de la isla or Tiburones who occupied

Tiburon Island. These distinctions persisted until the guerrilla warfare against the Seri decimated their numbers and obliged the different groups to band together .

Year	Author	Seri population
1780	Velasco[1]	3,000
1824	Troncoso[1]	1,000
1826	Retio[1*]	1,000-1,500
1826	Hardy[1]	3,000-4,000
1841	de Mofras[1]	550
1844	?[1]	500
1846	Velasco[1]	500-600
1855	Encinas[1]	250-300
1865	Encinas[1]	250-350
1894	Mashém[1]	250-350
1930	Thomson[2]	175
1930	Kroeber (1931)	≈ 200
1953	Monzón (1953)	218
1955	Marroquín (1957)	115
1959	Griffen (1959)	242
1960	Ascher (1962)	200
1985	Felger & Moser (1985)	500
1983	Bowen (1983)	475
1996	Sheridan (1996)	≥ 500
2000	CDI[3] (2002)	458 Total, 425 in Sonora
2001	Rentería-Valencia (2001)	≈ 900
2007	Lewis (2009)	800

[1] in McGee 1898 [2] In Kroeber 1931 [3] Comisión Nacional Para el Desarrollo de los Pueblos Indígenas de México [*] Tiburon only.

Table 4. Seri population since European contact.

As a result, some distinctions among the Seri groups were blurred (Table 4) and their range highly reduced (Bahre 1967; Sheridan 1999).

In this context, there was little or no new documentation on Seri sociopolitical organization until W. J. McGee visited the Seriland in two different seasons during the years of 1894-1895 (Fontana and Fontana 2000).

McGee (1898) describes the remaining Seri as loosely organized in maternal groups which he considers to be clans, making special emphasis in that the clan organization was stronger before the tribe suffered near-annihilation. McGee even names the major clans; the pelican, "**the chief tribal tutelary" and the turtle "a minor tutelary**" (1898 :11) and acknowledges the existence of a third clan, that of the rattlesnake.

McGee identifies a lack of formal leadership among the Seri by describing the total organization as "**variable as that of practically autonomous herds of cattle ranging the Sonora plain adjacent to Seriland**" (Mcgee 1898 :275). However, he later establishes the existence of a chief that will carry either a symbolic weapon, a counterfeit cartridge or an imitation machete that will distinguish him as the leader. The chief can also be distinguished by usually wearing a *white man's hat* or random garments that replace the deer or lion masks of early days.

McGees failed to recognize that the chief status was something recent in Seri history. In his atemporal treatment of Seri culture he misses the opportunity to see that formal chiefdom is more of a western imposition despite the fact that he recognizes that the chief's "**most prized fetish is a written certificate of his chiefship from the Encinas family or the Governor of Sonora**" (Mcgee 1898 :277).

McGee concludes that the Seri clan dynasties rise, flourish and decline, not without mentioning that their social organization is female run, but not avuncular. He notes that women are invested with exceptional legislative and judicative powers. To this observations he adds a diachronic perspective by noticing the absence of elder males, an obvious consequence of the continuous warfare in which the Seri were immersed. Despite defining the social organization as run-by-females but not avuncular, he notes that clan-mothers are administratively subordinate to her brothers. He concludes by defining the social organization as an ephemeral clan-based adelphicracy. Kroeber (1931) made serious corrections and additions to McGee's work Foremost, Kroeber correctly identifies the Seri as a consolidated remnant of dialectically distinct groups who took stronghold inside Tiburon Island where over 200 individuals, despite adverse environmental conditions, succeeded in maintaining themselves and their blended reduced culture. Secondly, Kroeber stressed that the original tribes describe by his informants; (1) Seris, (2) Tiburones, (3) Tepocas, and (4) Tastioteños, were part of a mnemonic construct that covered only the last part of the period of Spanish contact, while underlining that it had no modern application as the fusion of mainlanders and islanders was evident, and included the descendants of all Seri tribes with the exception of Guaymas and Upanguaymas who had been aculturated in syncretism with Yaqui values in the lowermost Yaqui village of Belem.

Moreover, Kroeber considers the whole matter of maternal totemic clans to be a fantasy, stressing that McGee contentiously admitted his information to be slender and subject to misinterpretation. Kroeber also points out that by the late nineteen century the matriarchate was still seen as the standard most primitive form of social organization within the prevailing anthropological doctrine. In this regard, Kroeber speculates whether the belittled social organization he was witnessing among the Seri was lost due to shrinkage of numbers, amalgamation of bands, shifts of residence, and contraction of territory.

Until the 1920s Seri had little friendly contact with exception of the Yaqui, the Papago, and those people of Santa Rosalía with whom they intermingled and married, recognizing, besides the already described Seri groups, new classifications such as Tiburon-Half-Pápago which Monzón (1953) registered in spite of considering these of little significance.

For Monzón there is little sociopolitical organization outside of the Seri nuclear family, which serves as the basic and probably the only Seri institution, by being the central axis of production, cooperation, division of labor, education, diversion, and government. Closely related families, usually three or four, occupy contiguous homes and interact frequently, forming habitation clusters that resemble extended families in function.

Monzón also notes that the cohesion among the Seri depends on a generalized-exchange marriage system in which the provision of spouses is established by means of a complex kinship system that takes into account “sex, polarity, generation, relative age, affinity, and consanguinity” in order to deny or permit the possibility of marriage.

A lustrum after Monzón, Griffen (1959) will concur that there is no perceivable sociopolitical organization other than the family, which overlaps with matrilineal and patrilineal extensions. In 1963 Edward Moser publishes his famous but controversial “Seri Bands” paper in which he uses oral history to reconstruct the original Seri sociopolitical structure. Contrasting heavily with Monzón' s (1953)opinion on the unreality and lack of real significance of the categorization of Seri groups, Moser claims the Seri macro-society is conformed by six bands encompassing three dialectic groups. the origin of this bands, he claims, was largely linked to internal struggles. In turns, these bands were later crushed and reduced to a single group by external conflict at the time of European contact.

Moser converges with Monzón in that a strong link with the Papago and the Yaqui once existed, at least in some bands, and these groups intermarried frequently, but they separated after misunderstandings led to violent fights.

Moser's six bands differ amongst themselves in degree of social intercourse, number of subdivisions, territory, and even technology (Table 5). Felger and Moser (1985) will later point out that these bands also differed in foraging habitat and, in turn, in dietary preferences.

There are strong criticisms towards Moser's (1963) band divisions starting with his observations that bands are subdivided into patrilineal exogamous groups not much different from McGee's (1896; 1898) clans in terms of rigidity of the membership[iv]. The criticisms are based on demographic and ecological assumptions. Historic estimates pertaining to XVIII and XIX presented earlier in Table 4 suggest that more than six bands must have existed (Sheridan 1979). The former coincides, as pointed out by Bahre (1980), with Carl Sauer's (1935) revision of colonial material that estimated the existence of 5000 Seri, some 830 per band, a figure somewhat high for the average of hunter-gatherer groups (Binford, et al. 1966), but not uncommon (Kosse 1990;

[iv] Edward Moser had much more ethnohistorical information on the Seri Band than that published in 1963. The information may tackle some of the criticisms once it is published (Moser-Marlett, per. comm.)

Hamilton, et al. 2007) for hunter-gatherer societies. Such a large population, would face serious challenges in gathering enough resources to sustain themselves.

Table 5. Seri bands, their territorial distribution and dietary preferences

Band[1]	**Territory**[1]	**Dietary preferences**[2]
Xica hai ic coii	Puerto Lobos to Cabo Tepopa with sparse campsides as far north as the mouth of the Colorado River Delta.	Relied heavily on terrestrial food sources such as wooly plantain, goosefoot, columnar cacti, and edible chollas. An informant told me of sporadic inclusion of sea life in their diet.
Tahejöc	Northern and eastern coasts of Tiburón Island	Mixed and varied between terrestrial; mule deer, desert tortoise, all edible chollas, mesquite, ironwood, agave, mangrove. and sea life; eelegrass, sea turtle, mullet, crabs, oysters, and clams.
Heno comcaac	Central Tiburón Island	Little dependence on sea life. relied heavily on wild lepary, sahuaro, senita choyas,
Xnaa motat	Vicinity of Estero El Sargento	Eelgrass, agave, saiya, cliff fig, pajocsim
Xica Hast ano coii	San Esteban Island	The island's biogeographic characteristics made them fully dependent on sea life; sea lions, sea birds, fish, sea turtles, chuckwallas.

The criticisms are framed under the premise that Seri bands were scattered on a small territory which included Tiburon and San Esteban Islands and extended through coastal Sonora from the vicinity of Guaymas towards the North somewhere near Puerto Lobos (Moser 1963). In such a small territory, the existence of bands with firm patrilineal descent and rigid control over the resources of a specific area would have severely limited the access to resources (Sheridan 1982), specially permanent potable water (Bahre 1980) and even though the food sources are varied and relatively abundant, as well as diverse in origin, as the Seri exploited both the desert and the sea, these resources were highly seasonal, even the marine resources (Sheridan 1982).

At any rate, the number of bands, the existence of patrilineal descent and patrilocality could not be proven by Moser (1963). In addition, if one takes into account the environmental conditions on scarcity of permanent water sources and extreme seasonality of food sources, it would make more sense to see the Seri sociopolitical organization as bilateral and flexible (Bahre 1967; 1980; Sheridan 1982) since the exchange of material resources in times of extreme scarcity is a vital cohesive force for any human group (Hamilton, et al. 2007).

Another important strategy humans use for survival in xeric environments is the adoption of a mobile and flexible way of life, which, given the almost complete similarity in environment was a conventional norm for the Cochimí in Baja California (Aschmann 1959). Even when relying in a cross-cultural comparison (see Sheridan 1982) there is insufficient data to reconstruct either the socio-political organization or the habitation patterns.

For a long time Seri habitation patterns were described as patrilineal and territorial (Griffen 1959; Moser 1963; Felger and Moser 1985). While Bahre (1967; 1980) and Sheridan (1982) has articulated against these notions by means of ecological, demographic, and cross-cultural arguments, this past notions have sound manifest in contemporary literature.

One particularly important paper to comment on is Renteria-Valencia's (2001). I make special emphasis on it because it is the most recent paper on the Seri published by Comisión Nacional para el Desarrollo de los Pueblos Indígenas, the Mexican Federal Bureau for Indigenous Affairs. As such, this taxpayer funded paper symbolizes a national statement around the Seri.

Rentería-Valencia uses Elman Service's (1962) political classification to center his discussion. He argues that the Seri social organization fails to adhere to Service's model of social organization under the argument that the bands do not observe patrilocality. Instead, they behave in a bilateral and flexible way. Rentería-Valencia's interpretation is shallow and incomplete at best.

First of all, Rentería-Valencia was using Service's classical reference, he fails to realize that for Service, cases such as the historic Seri conform a composite band; "a product of near-destruction of aboriginal bands after contact with civilization and is a merging of previously unrelated people" (Service 1962:108). It seems that Rentería-Valencia conformed to the current state of the Seri society without observing the historical context.

Anyhow, we have known for quite a time that Service's classifications, even with all the neatness of their formulations are not ecologically sound as they leave little flexibility to the behavior of hunter-gatherer groups during seasonal variations of food or under the long term effect of variance in sex ratios (Lee and Devore 1966).

Going back to the Seri Bands and despite all criticism, Moser brought attention upon an interesting Seri concept of socio-political organization; the **Ihíizitim** *Lit. 'homeland Gl. homeland of the ancestor*.'

The **ihíizitim** can be understood as a group of people of common kin that resides and dominates each subdivision of the Seri bands. The **ihíizitim** is exogamous, cohesive and independent of the rest of the bands (Moser 1963). Yet, this data converges in the existence of at least three related groups of families with strong economic and emotional attachment to certain parts of the Seri territory (Sheridan 1996b). Each **ihíizitim** is characterized by a descriptive name taken from a geographic feature (Nabhan 2003). The name of each refers only to the geomorphological feature and may not be used to refer to a campsite and regardless of where the group is camping, each **ihíizitim** has at least one waterhole in a location remote from encampment. Moser (1963) registered twenty-five **ihíizitim** found among Bands I, III, and VI. Curiously, each **Ihíizitim** is represented in the name of the oldest male dog associated to one's extended family group (Nabhan 2003).

The data on the existence of the **ihíizitim** is fascinating but extremely fragmentary data on the existence of the **ihíizitim** (Sheridan 1982). In such a light, it has been proposed that the **Ihíizitim** was once real and active, but no longer is it the case (Bowen 1983). Yet, in a mapping exercise conducted by Hine and Hill (2000), where twenty-four Seris were requested to draw their land, each individual depicted an area of land within the historic range of the Seri and nineteen of the twenty-four informants drew an area in which they held no residence at the time of the interview.

Among these informants, eighteen mapped the area in which they were born. Hine and Hills' findings suggest the persistence of an individual identity strongly associated with a well defined geographical area, inviting us to reconsider the current state of validity on the notions of **ihíizitim.**

Even if the **ihíizitim** is still in use today, the notion would have to confront the same ecological limitations that Sheridan (1982), Bahre (1980), and others have stressed overt the Seri band system. Clearly, each **Ihíizitim** would require enough land and resources to suffice the needs of their membership. Calculations from the neighboring Cochimí in Baja California suggest that a figure of 0.97 people per square kilometer would be nearly optimal to sustain a Hunting-gathering population in a xeric environment(Aschmann 1959). Obviously, the current Seri range and even the extended historic Seri range proposed by Sheridan (1999) would have a population many times higher than 0.97 people per square kilometer. Nonetheless, a greater Seri territory has previously been suggested to extend from the vicinity of Guaymas to the Colorado River Delta (Moser 1963; Felger and Moser 1985). It has also been suggested that the greater Seri territory may cover the eastern coast of Baja California as well (Nabhan 2003). In my own experience, Some of the elder seri can still recall a time when they lived near the Colorado River Delta. Whether these were seasonal camps or semi-permanent encampments, I cannot know. Besides, with such a mobile group, this distinction would make little difference in establishing the northern limits of a total Seri range. In my own estimation, presented as a map in Figure 23, the area of the total Seri range, discounting the inter island spaces solely occupied by water, and assuming a maximum population of 5000 people, would hold 0.29 inhabitants per square kilometer.

One has to be cautious with this figure since there are enough food resources, but little information has been gathered on my part to discuss the availability of water year round. This fault comes with the difficulty to know the location of the common batholithic granite tinajas in an area that up until today remains relatively unpopulated and poorly charted. However, a unilateral and flexible social organization would still represent an optimal strategy for dealing with those seasons of extreme climatic events.

War chiefs, matrons, comisarios, governors, and elders.

It has already been discussed that there is little political organization outside of the Seri nuclear family (Mcgee 1898; Monzón 1953; Griffen 1959; Sheridan 1982; Bowen 1983; Sheridan 1996b; Bowen 2000). While Kroeber (1931) discards the existence of matrilineal clans and others question the validity of the Seri bands in a long-durée perspective (Bahre 1967; Sheridan 1982), it makes sense to consider the Seri political association as flexible as their habitation organization. Thus, in times of near extermination, as in McGee's visit, which occurred immediately after the Encinas war, when the male population declined dramatically, it would not be so adventurous to think that women took the lead, a mere speculation, but an informed one.

What we do know is the Seri appointed war-chiefs in the midst of conflict (Sheridan 1979), some of which are as legendary as **Haxáaza quiho** or as contemporary as Sombrero negro. It is also clear that the Spaniard regime had to devise a system of communicating with its Seri subjects in some way. In order to do this, they appointed Seri chiefs in every mission, and gave special emphasis in the importance of that one occupying office in Villa de Seris (Sheridan 1999; Bowen 2000).The system of appointing loyal Seris as chiefs was later adopted by the Encinas family even before the Encinas war, as McGee has already pointed out (1898), and long time before Roberto Thompson-Encinas was officially named officer for Seri affairs early in the XX century. As officer for Seri affairs, Thompson-Encinas became officially entitled by the state of Sonora to name the Seri Governors at will (Coolidge and Coolidge 1939; Moser 1988; Ryerson 2005). This action consummates the creation of a new political figure in Seri culture; the governor.

A new addition of offices to the Seri political arena came in 1970 automatically after the President of México Luís Echeverría-Álvarez promulged a decree which consolidated EL Desemboque and Punta Chueca as an ejido (DOF 1970) -a legal entity that gives communal land tenure to Mexican-born peasants. The ejido is conformed by three offices; 1) Asamblea general, 2) Consejo de vigilancia, and 3) Comisario ejidal. Among these three offices, I have noticed that when there is no assembly, the power rests on the Comisario ejidal the one legally embedded to represent the ejido and is responsible for implementing acts adopted by the Asamblea general. However, his customary faculties go beyond the implementation of agreements and has a saying in any internal quarrel, dispute, fight, or simpler issue needing a judge or jury.

A third and relatively new authority is the elders council. According to some Seri this has existed forever, which would coincide with McGee's (1898) narration on determining the chiefship when two clans meet. The chiefship is determined by a) the seniority of clans in regards to tribal mythology, b) the prowess of respective clan leaders, and c) the numerical strength of respective clans. There are two councils of elders, each rules its own village and teach traditional tales and dances at the Escuela Tradicional Comcáac. The council of elders advises in cultural matters, but according to the late council chief of Desemboque, they take the ultimate decision regarding the future of the entire Seri nation.

In individual interviews with each of the officers, the Comisario ejidal admitted to deal only with matters pertaining to the ejido and the interests of its members. As stated above, the chief of the council of elders claims to have power over the decisions exerting an effect on the well-being of the entire community. The Seri governor, which surprisingly was a position taken simultaneously by two antagonizing parties at the time of my stay, also claims to have the last word pertaining the well-being of the Seri nation.

To add to my amazement, the only legal figure who could speak on behalf of the Seri according to Mexican law is the ejido, represented by all three of the offices. However, it is the Seri governor who takes part in meetings and assemblies with the official government of the state of Sonora. This figure is also the one that represents the Seri when confronted with federal instances such as SEMARNAT -Mexican Bureau for the Environment and Natural Resources-, and CDI -Mexican Bureau for Indian Affairs. I had the opportunity to see all these authorities interact during the fieldwork stay I realized as a part of my PhD research.

On a given day, some of the men in **Haxöl Iihom** were carrying the sound system regularly used in church services into an open area which, for the day, functioned as an esplanade. It was early and the tone of angry arguments could already be heard. As most of the ranches and ejidos in the dry desert of Sonora, Desemboque gets most of its income from outsiders willing to spend their time hunting. Seasonal hunting bans are well observed by the ejido. normally, these bans coincide with the early fishing season, when there is little catch because schools of fish are just coming in, despite the fishing effort. As a result, it is one of the times throughout the year in which income becomes very scarce. I will not reveal the exact dates because it will be evident what type of game I am referring to, endangering the people in the community.

Given the former scenario, someone inside the community and despite the ban, decided to take an outsider in a hunting trip. After they got their prize they came into one of the road locks set up by the Seri guard to deter furtive hunters and timber looters. Being a seasonal ban, the traditional guards stopped both the hunter and his Seri guide and asked for a considerable bail to let the hunter go. So it happened. However, several different issues arose from this circumstances; a) The Consejo de vigilancia claimed that the traditional guard, particularly the people directly involved in the road lock, never transferred the bail monies to the ejido, b) a faction of the inhabitants of Desemboque wanted the hunter to go to jail, other said that the bail was enough, and finally, c) if the hunter went to jail, the hunting guide would face the federal authorities as his accomplice, a matter that some others in the community opposed to.

The communal assembly gathered, at first very orderly around an improvised podium. The podium had four chairs, three of which were reserved for those involve directly; the Comisario ejidal, the guard, and the hunting guide. A fourth chair was destined to one of the most educated Seri in **Haxöl Iihom**, a man also recognized as an authority since he holds a diploma in indigenous law and rights and usually serves as a leading member of Seri retinues before local and federal authorities alike. This time he was acting like the facilitator for the meeting. At first, the muster was conducted in an extremely ordered fashion. Each of the parts presented their version of the events.

At a given time, the orderly manners broke away and two clear factions formed. One of these factions wanted the immediate arrest of the hunting guide while claiming that the guard should keep the bail for himself and for those present that day on the road lock. The second faction claimed forgiveness for the guide and the need for the bail to go to the ejido's treasury.

Most of the attendants started to yell to the antagonizing part. After a while, the crowd physically separated into two factions. Soon after the split, rocks flew from one side to the other along with high-volumed dialogue. I remained a distant observer and given that most of the passionate dialogue was being spoken in **cmiique iitom** I could just understand random words instead of the complete dialogue. Nonetheless, the context was visually clear. The factions that assembled responded to kin grouping. Even though the majority of the Seri hold some kind of familiar relationship, even if it is distant, it was obvious to me that those supporting the guard were all closely related, as it was also evident that those supporting the hunting guide belonged to the same family cluster.

The situation got its conclusion the next day, after the two antagonizing sides pursued a negotiation and brought the resolution to the ejido authorities.

In my own opinion, the formal authorities within the Seri society are of greater relevance when negotiating with foreign authorities. Inside the Seri community, the rules are constantly negotiated by communal decision. These communal decisions are reached not by individuals, but by kin groups, which are the real political actors despite individual agency. Years have gone by over the everlasting discussion of a lack of political organization in the Seri community other than the nuclear family. In the end, and in spite of ecological and demographic critiques, I think that there is a great validity in the notion of **ihíizitim** and there is also a lot of sense in reevaluating McGee's (1898) observations with some twist. It is not the chiefship but political power that is determined by seniority of the clans, prowess of their leaders, and numerical strength inside the Seri society.

Subsistence and economy

Seri formally integrated into the Mexican market in the late 1920s thanks to the effervescence of the very activity they are naturally good at; fishing (Bahre, Bourillon and Torre 2000; Basurto, Bourillon and Torre 2000). The Seri attribute this integration to the fact that their Governor, Chico Romero, signed a peace treaty some years earlier. What can be proven is that in addition to the the sudden success of totoaba and shark fisheries, the Seri had some other material incentives to leave guerrilla warfare behind and start a new relationship with the surrounding neighbors. The alcoholic prohibition in the United States brought many tourists to the beaches of Sonora. On each recurrent trip those tourists brought clothing, food and other items to the Seri, some of which started camping in the outskirts of Bahia Kino to receive gifts more often (Rentería-Valencia 2001; Rentería-Valencia 2009), and to choose these gifts before their relatives in **Haxöl Iihom**, and later **Socáaix** could see them first.

However, it should be noted that the Seri participated in the Mexican market economy before 1930, as several families travel each year from Tiburon Island into the mainland to work for several months as ranchers and domestic assistants and also to trade pearls, baskets and deer, coyote, and pelican hives in Hermosillo (Griffen 1959). Not surprisingly, the Seri were already integrated into a regional market economy before the time of European contact.

Pérez de Ribas (1985) manifested in his 1645 manuscript, Triunfos de nuestra santa fe entre gentes las más bárbaras y fiera del Nuevo orbe, that these wild people without houses or towns who lived on hunting and drank water from puddles, waited for the maize harvesting season to go to their agricultural neighbors to exchange deer hive and salt for vegetables.

It is in the 1930s, however, that the Seri started to change from a poor autochthon material culture to one of imported goods. Seri clay ceramic technology began to decline with the introduction of cooking and eating materials such as pots, pans, dishes, knives and forks (Bowen and Moser 1968). These introduced technologies were bought from fish merchants and itinerant traders (Griffen 1959). The itinerant trader tradition has prevailed until today (Fig. 25)

*Figure 25. Itinerant trader in **Haxöl Iihom**. Photo: Arlí De Luca, 2009.*

In an otherwise ignorant and misinformed paper Davis and Dawson are correct to point out that "**the present life of the Seri is but an echo of its past**" (1945:193). However, the argument has to be understood in a shallow manner, as the same claim can be used when confronting any other society.

As early as the 1950s it was already perceivable that the Seri ways were drastically changing. Fire was never again made in a traditional way, instead, every Seri preferred matches and lighters, abandoned the bow and arrow for the rifle and ket bone awls and needles as their only original tool (Griffen 1959), and thanks to the sporadic traders, the fishing industry and the American tourists all together, they had a relatively stable food supply and less need to keep roaming through the desert in search for seasonal fruits became more sedentary.

Sedentary and market integrated. The Seri are far away from being affluent in monetary terms. However, my own observations over a period of seven months suggest that 73 percent of all the economic transaction held with outside traders who come to **Haxöl Iihom** to sell fruit, vegetables, kitchen, and beauty supplies, are done with money. Every time that I coincided with the Seri at the village's local food stores, usually run by Seri, I noticed, in lax methodical and quite sporadic observations made the village's food markets every transaction was made with money.

Seri get a hold on cash in several ways. Years after their incursions into Hermosillo to sell hives, fostered by an increase in tourism towards the coast (Spicer 1962), Seri artwork became a considerable industry (Rentería-Valencia 2001). Women manufactured necklaces of sea shells, bone, and seeds (Felger and Moser 1985) as well as rudimentary clay crafts and basketry (Ryerson 1976) to sell it to the tourists.

Then, in 1961 Alexander Russell Jr, a frequent visitor to the Seri, bought what is allegedly the first piece of carved ironwood ever sold as art; a shapeless paperweight (Nabhan 2003). Seri ironwood art is fascinating, just fascinating. (Fig. 26). These figurines are so carefully planned by the artists who use the gains and shades of the wood that they turn into very plastic and subtle abstraction of nature (Nabhan 2003). In spite of the apparent simplicity, they are so fluid, their silhouettes so smooth, that they seem to be filled with real movement. Brent Berlin (*per. comm.*) and Bernice Johnston (1968) have agreed that there is a remarkable resemblance in detail, simplicity, and honesty between the Seri ironwood art and the First Nations soapstone art. They are, indeed, almost identical.

Figure 26. Ironwood turtle made by Armando Torres circa 2008. Courtesy of Alicia Narchi, 2010.

Basketry is one traditional industry that perfectly adapted to the market intrusion. Originally made for utilitarian purposes, Seri baskets, made with limberbrush (*Jatropa cuneata)* started to be sold or used for bartering with outsiders somewhere in the nineteenth century (Felger and Moser 1985). In the 1930s Seri basketry had an automatic boom with the entrance of tourists to the Seri range At the same time, their domestic use started to decay and by the 1960s they were exclusively made for sale (Idem1985). As the demand increased, so did the size of the artistic baskets (Figure 27).

The **haat hanóohcö caacoj** *'Lit. limberbrush deep-concave-thing large'* is a basket of tremendous size and extreme beauty, as it is fully adorned with classic Seri basketry patterns, but they extend to tremendous heights for a basket. These pieces of art are manufactured over a period of 1 to 3 years and are sold for amounts of money that could easily buy a car.

Figure 27. ***Haat hanóohcö caacoj*** *months away from being finished by Lourdes Hoffer. Photo: Arli De Luca, March 2009.*

There is strong confusion in the literature (Nabhan 2009; Rentería-Valencia 2009) between this type of basket and another giant basket; the **saptim** *'No analyzable translation'*. This second type of large basket was made long before present on Tiburon

Island and probably was meant to serve it's makers own use which had some sort of supernatural importance, even though the role is not really clear(Felger and Moser 1985). Nonetheless, this confusion has justifiable origins, as the **haat hanóohcö caacoj** has also been embedded with supernatural powers, specifically the **haat hanóohcö caacoj** have a soul that is awakened when they have been finished. This soul has to be appeased with a celebration in their honor (Burckhalter 2000; Rentería-Valencia 2001).

The last of the major economic modifications that Seri have adopted is fishing. While it is true that the Seri have always fished for subsistence and sporadic trade (Bowen 1976; Felger, Moser and Moser 1980; Felger and Moser 1985; Perez De Ribas and Cabeza De Vaca 1985; Basurto, Bourillon and Torre 2000; Bowen 2005) it is only within the past century that they have turned this activity in their most significant source of income, either by hiring themselves with Mexican and German fishers (Bahre, Bourillon and Torre 2000) or by running their own fisheries (Bowen 1983; Sheridan 1996b; Basurto 2002).

A local fish buyer Maximino, better known as "El Chimi" explained to me that the best fishery int terms of income is that of **caasquim** *'Gl. flounder' (Paralichtys aestuarius)* which lasts from January to May*. T*he second best fishery is that of prime fish or <u>primera</u> as is known in Spanish. The season of prime fish is quite short, lasting only three months, with luck, from May to July. The prime fish fishery includes several species, being the most conspicuous: 1) **caanj** *'Gl. Gulf grouper' (Mycteroperca jordani),* 2) **zixcám coospoj** '*Lit. spotted fish' 'Gl. spotted cabrilla (Epinephelus analogus),* 3) **tatcö** *'Gl. leopard grouper' (Mycteroperca rosacea),* and 4) **zixcám cheel** *'Lit. red fish' 'Gl. Pacific red snapper' (Lutjanus peru).*

An equally important fishery is that of callo de hacha, actually composed of two species **seeten** *'Gl. sea pen shell'* (*Pinna rugosa*) and **seeten cmaam** *'Lit. female* ***seeten****'* *'Gl. kidney pen shell'* (*Atrina tuberculosa*). The fishery started in 1973 by non-Seri entrepreneurs. It became a major source of income for the seri after five years. To illustrate the magnitude of this fishery it is worth to mention that a single buyer was getting between 400-600 kilograms of pen shell a day (Basurto 2002). From 1980 to 1984, the parastatal company PROPEMEX -Productos Pesqueros Mexicanos- entered the Seriland with the goal of exploiting sea pen shell fisheries. The company employed Seri and non-Seri alike. Non-Seri fishermen felt attracted to the Seri females. The Seri response was to ostracize extra-ethnic marriages. However, some couples went along, bringing strong intensity to this type of social change inside the community.

PROPEMEX became bankrupt and contracted. When the company retired, it had an outstanding debt with its employees, so the directors decided to leave the company's fishing equipment including, fiberglass boats and air compressors, to the Seri, who undertook the commercial callo fisheries on their own this time (Basurto 2006).
Seri expanded their sessile and semi-sessile fisheries to include not only the sea pen shell fishery, but also **iimox** *'Gl. spiny rock scallop'* (*Spondylus calcifer)* and **xnoocat** *'Gl. murex snail'* (*Hexaples sp.)* fisheries (Basurto and Ostrom 2009). All of these fisheries are carried out in an area in which the Seri have been granted exclusive fishing rights by presidential decree (DOF 1975).

Despite the legitimacy of the property rights given to the Seri, they do not have a cost-effective way to control access to the immense terrain they posses. Given the existence of these and other 36 marine species of commercial value in the area

(Bourillón 2002), plus a lack of effective control over the territory, external fishers have recurrently contested the validity of the exclusive fishery zone as there are many areas within this zone that are virtually never exploited by the Seri (Basurto and Ostrom 2009). This situation has forced the Seri into designing communally accepted rules and norms to access, operate, and govern their exclusive fishing zone (Idem).

Because of the exclusive fishing zones, the Seri way of life, and the low level of infrastructure that the Seriland remains in relatively pristine conditions. However, the territory, the Seri sovereignty over their natural resources and thus, the livelihoods of its inhabitants remain constantly threatened by external pressures and intrusions, that range from fishing territory disputes (Aguilar 1998; Basurto, Bourillon and Torre 2000; Basurto and Ostrom 2009), and aquaculture-related pollution (Páez-Osuna, Guerrero-Galván and Ruiz-Fernández 1998; F. Páez-Osuna, et al. 2002; Páez-Osuna, et al. 2003) to the encroachment of touristic developments of unfathomable proportions (WCMC 1992; Fonatur 2001; Álvarez Castañeda, et al. 2006). Being in the middle of island, marine, and terrestrial ecotones and habitats, more than a dozen NGOs, both national and international have been working actively with the Seri to preserve nature, organize their governance instruments, and raise the standards of living in a sustainable framework. The phenomenon that results in a really significant change in terms of relationship between the Seri and the exterior is the generation of indigenous environmental organizations planned, instrumented, and administered by the Seri.

Organizations such as Comcáac Native Aquaculture, The Comcáac Environmental Monitoring Team, **Xepe Cooil**, and Grupo Tortuguero Comcáac, formed by the seri youth have challenged the traditional tendencies of the Seri to wall themselves off (Roig Franzia 2007) and are renegotiating the ways in which the Seri deal with exogenous forces and interests.

The intensification of market integration and the acculturation processes that have been occurring on the Seriland since the 1950s, have lead to changes in economic structure (O'Meara and Narchi 2010), abandonment of traditional staple foods (Felger and Moser 1973; Felger, Moser and Moser 1980; Burckhalter 2000), transforming marriage patterns (Basurto 2006) and an increasing rate of cardiovascular, mental and degenerative illnesses (Villela and Palinkas 2000). However, in spite of how profound the impact of all of these acculturation processes is, many traditional practices and sporadic hunting-gathering were remarkably evident in 1983 (Felger and Moser 1985).

In addition, the practical knowledge on ethnoecology (Nabhan 2000; Torre Cosío 2002; Nabhan 2003; Nabhan 2009; Morales-Vera 2010), ethnomedicine (Narchi, et al. 2002; Smith-Monti 2002; Narchi 2003), and ethnogeography (O'Meara and Bohnemeyer 2008) has been preserved, in one way or the other, all the way through the XXI century.

Seri ecological knowledge

Among all the remarkable aspects of Seri culture and Seri history, there is without question, one that is outstanding; their vast and diverse ecological knowledge. Felger and Moser (1985) noted that regardless of the region each of the bands occupied, each group of people is acquainted with names for 350-400 plants and at least half as many animals. Regarding animals, these authors correctly pointed out that the Seri know at least 125 names. I am confident they calculated this number based on Becky Moser's vast experience, and not a question on the figures offered earlier by Malkin (1962). Malkin's study (idem), a genuine attempt to relate Seri environmental knowledge to the general economy of the tribe, noted that the extensive and deep Seri ecological knowledge was inevitably a product of biocultural processes in an environment so harsh that it forced its human inhabitants [and some non-human mammals too] to hunt and gather both in land and the sea. The findings mention the names of 21 mammalian species, twenty eight avian species, 42 ichthyological species, 37 molluscan species, 9 crustaceans, and a miscellaneous category including polychaetes, echinoderms, coelenterates, and sponges. Malkin was able to learn that the knowledge of these species is not limited to naming. Instead, he noticed, appreciated, and recorded the insightful Seri notions of habits, reproductive behavior, migration, predation, distribution, and ecology. All of these descriptions are precise and full of details except for the ecological descriptions for jellyfishes and sand dollars.

Malkin concludes that the Seri knowledge of animals is slanted as some groups are better known than others. The reason, he claims is because Seri knowledge is related to the adults interests which are leaned towards the economically important species.

If Malkin would only knew that his observations were shallow in this regard. Currently, we know that Seri do not only known the organism, but have intentionally manipulated plants and animals to various degrees. Nabhan (2003) argues that at least 20 plants are manipulated and propagated intentionally and more surprisingly, that the several different species of **heepzoj** '*Gl. spiny-tailed iguana*' (*Ctenosaura spp.*) have been intentionally scattered by the Seri through the Midriff Islands to secure food in times of famine. After the artificial scattering, these spiny-tailed iguanas speciated on their own.

As dramatic as this may seem, there is enough molecular evidence to prove that the Seri version on the origin of island spiny-tailed iguanas is accurate (Davy, et al. 2010).

Moreover; what would Malkin say if he was able to scrutinize the list of mollusk names collected by Cathy Moser-Marlett (per. comm.) which limited to mollusks and mollusks alone gathers some 250 different names for over 150 mollusk?

What if Malkin became familiar with the work of Torre (2002), and that of Torre and Findley (2010), that contain in their pages a hundred ichthyological ethnospecies comprehensive of fourteen Chondrichthyes and eighty-six Osteichthyes or the work of Morales-Vera (2006) in which he offers a list of one hundred and forty-five ethnoornithological species? Seri ecological knowledge is enormous, just enormous.

Utilitarian (Randall 1976; Hunn 1982; Randall and Hunn 1984; Ellen 2005) and cognitive (Berlin, Breedlove and Raven 1966; Raven, Berlin and Breedlove 1971; Boster 1985; 1986; Boster and Johnson 1989; Boster 2005) treatments on folk species and form of subsistence (Brown, et al. 1985) are strongly tied to the modification and manipulation of plants and animals by the process of domestication. Considering the relationship between the structure of taxonomies and subsistence patterns, Brent Berlin (1992) has described the Serian taxonomical system as anomalous given that in spite of their non-agricultural form of living, their classification system closely conforms to that of horticultural groups in diverse parts of the world. The proportion of monotypic to politypic folk genera among the Seri: 80:20, opens up the possibility to think of the Seri as devolved agriculturalists, whose system of classification lost the subgeneric taxa, reflecting lesser and lesser direct contact with the living world.

Berlin's contribution is interesting, especially when it throws light into the possibility of devolution within knowledge, but something important is missing. I will not anticipate my discussions entirely, but his analysis falls short of treating the Seri as the Seri and builds upon a generalized hunter-gatherer ontology of subsistence without considering the recent origins of these people that grew out of a conglomerate of different bands and even allied with some other ethnic groups from time to time, all of this in a dually rich [terrestrial-marine] biodiversity hotspot.

Along with the taxonomic classification, the economic use that Seri give to natural resources has always mesmerized visitors and scholars alike. In the texts of Lieutenant R.W.H. Hardy (1829) one can find the most wonderful narration on the allegedly Seri way to poison arrow tips:

> **"They kill a cow and take from it its liver. They then collect a number of rattlesnakes, scorpions, centipedes, and tarantulas, which they confine in a hole with the liver. The next process is to beat them with sticks in order to enrage then, and being that infuriated, they fasten their fangs and exhaust their venom upon each other and upon the liver. When the whole mass is in a high state of corruption, the old women take the arrows and pass their points through it. They are then allowed to dry in the shade, and it is said that a wound inflicted by them will prove fatal. Others again say that the poison is obtained from the juice of <u>yerba de la flécha</u> (arrow wort)"** (Hardy 1829:298-299)

Regardless of Hardy's admirable imagination, the second type of Seri, the real ones, I may argue, used to prepare their arrow tips with **hehe coáanj** *'Lit. poisonous plant,' 'Gl. Mexican jumping bean' (Sebastiania bilocularis).* Nonetheless, Hardy writes in a period defined by Ryerson (2005) as the "Stone Age Cannibals" literary period (Fig. 28), which extended for over fifty years and was characterized by absurd commentaries on their primitive and savage ways of being (see: Thompson 1931; Hyatt 1936; Davis and Dawson 1945; Forbes 1957).

Beads Tame Last Cannibal Tribe

Women Force Men to Trade for Trinkets and Seri Killing Lust Dies Out

By ROBERTO THOMPSON

Figure 28. First page of article “Beads tame last cannibal tribe” (Thompson 1931). Reproduced with permission from Bonnier Corporation.

Leaving poison and cannibal stories aside, Seri use of plant food involves some 89 plants that can be found in a gradient that goes from completely terrestrial to overtly marine, with some coastal shrubs and halophytes in between (Felger and Moser 1985). Seri use of plants is not limited to dietary necessities. In a culture so meager of archaeological data, it is safe to infer that most of the material culture comes from organic sources. So it is the case for the Seri who used, and for the most part still use marine and terrestrial plants for creating: a) weapons (Mcgee 1898), b) tools (Nabhan

2003), c) adhesives (Ascher 1962), d) tanning materials (Sheldon 1979), e) pigments (Xavier 1946), f) personal, ritual, and commercial adornment (Johnston 1968; Ryerson 1976; Espinoza-Reyna 1987; Yetman 2000), g) musical instruments (Bowen and Moser 1970; Yurchenco 2002), h) recreation supplies (Moser 1963), i) storage items (Smith 1959; Bowen 1973; Macfarlan and Henrickson 2009), j) shelter (Hinton 1955; Eckhart 1960), k) fuel (Suzán, Patten and Nabhan 1997), and l) medicines (Felger and Moser 1974; 1985; Smith-Monti 2002).

Seri health

The first reports on Seri health date back to the mid-1950s. Marroquin (1957:337) notes that "**in general, the Seris have a healthy appearance**." However, he mentions the occurrence of gastrointestinal diseases as a frequent health disorder. Marroquin's observations match those of Felger and Moser (Felger and Moser 1974; 1985) who note that native remedies were most commonly used against diarrhea and dysentery as well as against headache, which women experienced near parturition. Taking into account not only the use of native remedies, but a pedestrian saliency index of care demands, Zolla *et al.* (1994) constructed a bigger list of health concerns for the Seri. These concerns still prioritize gastrointestinal diseases as a mayor concern, followed second by pregnancy and birth, and lastly among the most salient, respiratory diseases, and skin ailments. In addition, the same team found that there was a marked difference between the most recurring care demands and the most common causes of death, which hierarchically are reported as 1) high blood pressure, 2)tuberculosis, 3)diabetes,

4) kidney disease, 5) aging, 6) cancer, 7)gastrointestinal ailments, and 8)respiratory diseases.

In terms of care demands, Zolla's (1994) team observations concur with my own findings. On December 2008, I had the pleasant opportunity to talk to Dr Jesus Antonio Romero Rodríguez, resident medic in the health center at **Haxöl Iihom**. Over his two years of residence he has noticed that the care demands obey to seasonal patterns. Gastrointestinal diseases come with the months of heat and the appearance of respiratory diseases is governed by winter. Dr. Romero also mentioned that patients with chronic-degenerative ailments visited him the year round without any seasonality.

The sudden boom in chronic-degenerative diseases such as obesity, high blood pressure, and diabetes is not rare in a society with a transitional market integration. As early as the late 1950s, it was clear that urbanized desert-dwellers presented higher blood pressure levels because of dietary change (Padmavati and Gupta 1959; Truswell, et al. 1972; Sheridan 1996a), sedentism (Kaminer and Lutz 1960; Scotch 1960), and disruption of social networks (Henry, Meehan and Stephens 1967).

Seri healers and ethnomedicine

Seri ethnomedicine is strongly but not entirely based in botanicals. It includes algae (Felger and Moser 1985; Narchi 2003), minerals (Felger and Moser 1974), and terrestrial (Felger and Moser 1974; Morales-Vera 2006) and marine (Felger and Moser 1974; Narchi, et al. 2002) animals alike.

The administration of traditional medicine is highly pragmatic, lacking complex theories or explanations on how and why the medicines work. Therefore, the Seri ethnomedicinal system is one of the few medicinal systems in the Americas that has not been strongly influenced by the Arabic-Hippocratic-Galenic medicinal systems brought to the continent after European contact (Foster 1987; Foster 1994). That is, the Seri cannons of medicine are not guided by humoral theory (see Etkin and Ross 1982; Messer 1996) or, as I will discuss later on; a doctrine of signatures (see Dubick 1986; Leonti, Sticher and Heinrich 2002).

It has to be noted that the categories and conceptions on Seri ethnomedicine are very different from allopathic conceptions, as they strongly adhere to the concept of "food as medicine and medicine as food" (Etkin and Ross 1982; Etkin 1988).**Ziix iic cöihíipe,** the Seri word for medicine, literally means *'thing that is good',* and it can be applied to specific remedies well and long known to be medicines or to supplementary foods such as fish stock.

Moreover, the Seri ethnomedicinal system is individual and personal (Felger and Moser 1974) resulting in a high variation and overlap in usage (Felger and Moser 1985). There is little specialization in the human resources that administer Seri medicine. While proficiency is recognized among the Seri, all of the existing research on Seri ethnomedicine (Felger and Moser 1974; 1985; Zolla 1994; Smith-Monti 2002; Narchi and Navarijo 2005) recognizes that most of the knowledge is shared evenly among Seri elders. In the case of younger generations, market integration processes of acculturation such as replacement of ethnomedicine by commercial pharmaceuticals and the possibility to go to Hermosillo to get medical treatment are to be blamed for the loss of knowledge (Felger and Moser 1985). However, it should not be discarded that there exists the possibility of a secular trend (Godoy, Garcia and Jha 2006) that cannot be discovered because of the absence of a long term panel study on Seri ethnomedicine.

Zolla *et al.* (1994) argue for the existence of five different experts in terms of Seri health provision: a) e'éyakkishim kukájtim , b) e'éyatki koatikpan. c) shi'apjkaiti, d) kushá kunalsha, and e) haaco cama.

According to the authors, the first three terms correspond to healer or curandero, the fourth, kushá kunalsha is linked to midwives, finally, haaco cama is also related to healer/curandero. The lack of differentiation of the first three, presented with no explanation at all, suggests that there was no strong emphasis in presenting sound ethnographic data. Cathy and Steve Marlett (per. comm.) suggest that these names, if written in conventional Seri grammar should result in a) **hehe** 'Lit. plant' the rest undecipherable, b) **hehe iyat cöcaticpan** *'Lit. plant tip to-cut', 'Gl. the person who works with the tips of plants'*, c) **ziix hapsx caatim** *Lit. Thing that performs well-mannered', Gl. Medicine Doctor.'* I strongly suspect that these names are not conventional for Seri health professionals, as the only previous record of (b) was a nickname given to Richard Felger while he was on the Seriland collecting plants for his Seri pharmacopeia (Felger 2000). Thus, these are names used by the Seri in a descriptive way, and not as a cultural label.

Kushá kunalsha strongest possibility is **cola conáaij '***Lit.,* the one that grabs up' '*Gl. the one who receives the new- born baby*.' **Cola conáaij** is indeed a recognized cultural label.

There are few midwives alive today inside Seriland, not a single one of them practices the profession anymore. When I was visiting **Socáaix**, M.C.B., wife of P. “largo” told me:

> **“El partero tradicional quedó olvidada cuando los Seris conocieron al doctor. Ya después, las personas no quisieron las plantas ni los remedios, pero los viejos todavía tienen los secretos”.**
>
> **"The traditional midwife was relegated when the Seris met the doctor. Later, the people refused to use plants and remedies, but the elders still have secrets. "** (Translation mine)

A concept that is completely ill-represented in Zolla’s research is **ziix haaco cama** *‘Lit. thing that has power,’ ‘Gl. shaman.‘* In my personal opinion, this is one of the most significant topics in all the Seri culture because of its strong relationship with Seri cosmogony, and it is radically different from a healer, an herbalist, or a curandero.

Ziix haaco cama is an expert in supernatural technology, his/her (Griffen 1959) curative powers do not come from the administration of remedies, but from the manipulation of the supernatural realm (Felger and Moser 1974).

The **ziix haaco cama** healing powers involving the plants are limited to the use of the spiritual powers embedded in the plant’s soul itself (Felger and Moser 1974). The term **hehe** *‘Lit. plant’* is not only specific of the material aspects of plants, but also reflects the very life and spirit of a plant. A ziix haaco cama would cure a person by using his personal supernatural powers channeled through singing. She would also rely on invoking the **hehe** of powerful plants such as **xoop** *‘Gl. elephant tree’ (Bursera microphylla)*, or **xeescl** *‘Gl. desert lavender’ (Hyptis albida)* by holding a handful of branches on her hand or chewing some leafs while administering her curing powers (Felger and Moser 1985).

Ziix haaco cama also create figurines (Figure 29), carved out from the wood of **xopinl** *'Lit. elephant tree hand', 'Gl. red elephant tree' (Bursera hindsiana)* (Felger and Moser 1974). These figurines, **ziix icóocmolca** *'LIt. Thing that is put', 'Gl. fetish'* , also called santitos (Felger and Moser 1985).

Figure 29. Ziix icóocmolca made by Ana Burgos. Courtesy of Alicia Narchi, 2010

There are three types of ziix icóocmolca (Griffen 1959): a) for protection and welfare of the home, which are fairly large, almost one feet in length, b) For personal benefit, smaller and in the form of human beings, round, triangular, or square amulets, usually used around the neck, and c) healing **ziix icóocmolca**.

A **ziix haaco cama** would carve the santito herself. **"[S]he sang a song to the santos before [s]he began to carve. As [s]he sang [s]he spread his[/her] arms wide open, then cupped his [/her] hands as if gently massaging a grapefruit. Then**

[s]he spread them wide again and repeated a song "it was a song about the power of the santo. Its power extends out to all the world. The song asks the santo to bring good to all the people, to the whole round world"" (Yetman 2000:408).

After being crafted, the santitos were rented to the people by the **ziix haaco cama** (Griffen 1959; Felger and Moser 1985). In retribution, the people payed her back with food, material items, or most recently, money. In that regard, the **ziix haaco cama** represented the most important native institution outside of the family, as her influence extended over other persons and resources (Griffen 1959; O'Meara and Narchi 2010). However, that power was highly disseminated, in the late 1950s there was one **ziix haaco cama** for every 7.5 people (Griffen 1959).

To conquer the supernatural forces the pedestrian Seri could to become a **ziix haaco cama** either by acquiring power through a lifetime, as they acquire power naturally with age or undergoing a vision quest (Griffen 1959). The people that got power with age were not as prestigious as those who gave into the vision quest (idem). The vision quest usually lasts four days (Griffen 1959), in which the supernatural entrepreneur abstains from sexual intercourse, finds and secures a cave known to be used for vision quests, builds a small ramada with a framework of **jomjéeziz** *'Gl. ocotillo' (Foquieria splendens)* and covered with **xoop** and **xeescl** into which she places a number of santitos given to her by an expert **ziix haaco cama**. When the ramada is ready, she isolates herself inside, fasting for four days and drinking a minimum of water mixed with **xoop**. After the fourth day, the potential **ziix haaco cama** calls the santitos with an **hacáaij** *'Lit. what makes spin', 'Gl. bullroarer'*, enters the cave and lies down on

xoop, waiting for the <u>santitos</u> to come from the ramada. As the <u>santitos</u> arrive, the cave becomes a beautiful house. The aspirant learns by watching, as one <u>santito</u> cures the other another. They also teach her power songs.

According to one of my informants, one of these <u>santitos</u>, **Ziix Heecot Cmiique** *'Lit. Thing that is in the mountain', 'Gl. spirit of a vision cave'*, a little blond fellow, will open a luminous door inside the cave. Behind the door there is a collection of powers from which the aspirant chooses the one she has come to find. This informant told me that **Haxáaza quiho** was looking for useful power to use against alien invaders, he was given a song that would give aim to all of his arrows, and ever since he became known by that name. The same informant also mentions that one of his relatives chose the power to be a great slugger. Baseball is very popular among the middle-aged Seri and I am confident that supernatural powers will give an edge on anyone, not just Seri athletes.

While the ritual ascension of a **ziix haaco cama** is considered to be more prestigious, the passive passage to this stage is far more relevant for discussing Seri ethnomedicine. In dreams, the Seri and the supernatural beings can transgress the worlds that separate them. In liminality, these beings give even greater powers to those that have already become **ziix haaco cama** (Harrington, Barnett and Barnett 1988), while transforming neophyte aspirants into consummated medicine men and women as the introductory paragraph of this dissertation has already illustrated.

The individual and personal characteristics in the administration of Seri ethnomedicine allow these people, with or without slumber training, to continuously experiment or try different permutations on ingredients, administration, posology, and use against different ailments (Smith-Monti 2002).

The individual characteristic of Seri ethnomedicine may represent a challenge under the scope of traditional ethnomedicinal research on cultural consensus and informant agreement.However, this characteristic are a definite advantage in figuring out if marine and terrestrial Seri remedies belong to the same body of knowledge, which is the main objective of this dissertation.

Chapter summary and conclusions

The Seri have traditionally lived as a semi-nomadic group united by kinship links. Recently, the Seri have been forced to settle in sedentary populations. Sedentary settlement is a recent introduction, adopted nowadays by most of the population. Kinship relations in this population are very intricate and the kinship system is configured in a series

Throughout most of their history, the Seri have had little political organization outside of the family. Their customary political setup conforms to the ecological needs of desert-dwellers that need to travel and live in small groups. War chiefs were occasionally elected, but their time in office was ephemeral regardless of their success in battle. Ever since the first missions, Seri sociopolitical organization started to change because of the apparition of imposed figures such as the Seri Governor. Later on, new offices were added to the political organization with the organization of the Seri communities into an ejido and the creation of an elders' council. Nonetheless, the power structure is ill defined up to the present date and most of the political activity is carried out in communal discussions where highly defined kinship groups lobby for their own cause and against the others.

Seri economy even though highly integrated to the market, still depends on a hunting-gathering subsistence, as all of the fisheries production, the hunting monies, and the handcraft production depend on non-domesticated plants and animals. This particularity is highly responsible of keeping the Seri ecological knowledge alive and relatively well.

Seri ecological knowledge is vast and deep. The Seri lexicon for all live beings surpasses previous expectations by two orders of magnitude. The ecological knowledge is not limited to naming, but also to describe ecology, biology, and in the proper case, the ethology of the observed organisms.

Regarding health, Seri have historically been defined as relatively healthy and well built. The mayor sanitary problems of the ethnic group deal with gastrointestinal and respiratory diseases. Lately, chronic-degenerative diseases, such as obesity, coronary diseases, and diabetes have bloomed in the Seriland. Seri use all their ecological and medicinal knowledge in finding a cure for chronic-degenerative diseases of recent apparition.

There are few specialists within the traditional medicinal system of the Seri. The administration of Seri medicine is particular and individual, resulting in overlap of remedies and most important, in constant experimentation and innovation. The only real specialists are **Cola conáaij** or the midwife, and **ziix haaco cama** who is more related to spiritual support and supernatural technology than with the administration of any material remedy other than the **ziix icóocmolca** that are rented to her patient.

The rich environments that surround the Seriland and the human adaptations to the area's ecologies allow thorough use of natural resources via a hunting-gathering strategy. These livelihoods, and a strongly naturalistic belief system joined to the particularly interesting social organization of the Seri result in a rich and adaptive medicinal knowledge.

CHAPTER 4: ONE KNOWLEDGE, TWO CONDUITS: THE SOCIAL, DEMOGRAPHIC, AND TOXICOLOGICAL FACTORS THAT GOVERN SERI ETHNOMEDICINE.

The indispensable role that plants and animals have historically played in human healthcare systems has compelled scientists to study ethnobiological knowledge (Berlin 1992). Ethnobiological studies are of important intellectual transcendence as human use of biotic resources is not limited to obtaining food, garments, and tools (Schultes 1992), as they are extremely important in building theory on the fields of human health (Ireland, et al. 1988), biodiversity conservation (Rosa, et al. 2005), evolutionary medicine (Huffman and Seifus 1989), and finally, human cognition (Etkin 1988). Ethnobiological knowledge is also fundamental in understanding our trophic (Castetter 1935; Pieroni, et al. 2009), economic (Vestal and Schultes 1981 [1939]), habitational (Speck and Dexter 1952; Rijal 2008), religious (Reis and Hibbeld 2006), ornamental (Johnston 1968; Ryerson 1976), ludic (Ruan-Soto, et al. 2006), sexual (Andrade and Costa-Neto 2005), and medicinal (Schultes 1988; Cox and Balick 1994; Balick, et al. 1996; Berlin and Berlin 1996) biocultural relationships.

The written evidence for indigenous medicinal knowledge has existed for at least 5000 years (Jia, et al. 2004).

It is safe to assume that the existence of such a knowledge predates *Homo sapiens* itself, as there is enough evidence to appreciate that not only illiterate societies (e.g. Mafimisebi and Oguntade ; Tangjang, et al. ; Felger and Moser 1970; 1971; Felger and Moser 1974; Felger and Moser 1985; Larme 1998; Alves, et al. 2007; Martinez-Rodriguez 2009) but also non-human primates (Huffman and Seifus 1989; Rodríguez and Wranghan 1992; Ciddi and Kokate 1996; Raman and Kandula 2008)   medicate themselves. However, it is not clear if the latter can share this knowledge with others of their kind in a conscious manner (Huffman 2001; Morrogh-Bernard 2008).

The occurrence of indigenous medicinal knowledge has been documented in virtually all of the world (Bussmann, et al. ; Fontenot 1994; Ventocilla, et al. 1995; Leonti, et al. 2002; Pieroni, et al. 2004; Sezik, et al. 2004; Dafni 2006; Pordié 2008). Medicinal systems are a cultural universal (Kleinman 1981; Foster 1983; Pelto and Pelto 1997) despite a continuous discussion on valid ways to define this universality (Press 1980).

Early attempts to understand indigenous medicinal knowledge were limited to collecting pharmacopoeias, herbal recipes, or meager lists of plants with brief efficacies descriptions (Elvin-Lewis and Lewis 1995). These early attempts were full of preconception, as allopathic medics did not allow themselves to detach from their own cultural framework to appreciate what they were witnessing in the field. Thus, in most of the cases, their observations achieved little but mislabeling ethnomedicine as "**queer superstitions**" (Ackernecht 1971:7) or evaluating other medicinal systems as previous steps in the evolution of contemporary allopathic medicine (idem). In the 1920s W.H.R. Rivers revolutionized the ways in which we think on local medicinal knowledge by bringing ethnomedicine to life in terms of treating medical systems as social institutions. (Erickson 2008).

In laying down his agenda for the study of social institutions, Rivers (1924) defines three major approaches of inquiry; 1) the study of the historical and evolutive aspects of the institution, 2) a psychological approach that studies collective and individual states of mind, the sum of which result in the formation and development of the institution, and 3) a sociological method that inquires into the relations of ethnomedicine to other social processes, in order to determine the interactions between these two. It is Rivers' (1924) third approach that we will explore.

To the purpose of investigating ethnomedicine as a social institution, the Seri bring an excellent case of study. The Seri hold extensive knowledge of plants and animals living in their terrestrial (Felger and Moser 1970; 1971; Felger and Moser 1974; Felger and Lowe 1976; Felger and Moser 1985) and marine (Malkin 1962; Felger and Moser 1973; Felger, et al. 1980; Torre-Cosío 2002; Nabhan 2003; Morales-Vera 2010) environments. They have no active specialists in their medical system (Felger and Moser 1974). Only one of the two specialists known to have existed in the past dealt with the procurement of herbal and animal remedies (Zolla 1994). The second specialist worked with supernatural technologies but did not deal with the administration of mundane remedies (Felger and Moser 1985). Thus, the administration of Seri medicine is personal and individual (Felger and Moser 1974; 1985), potentially shaping an expert on each person within the culture . Lastly, Seri ethnomedicinal knowledge develops in two different realms, the marine and the terrestrial (Narchi 2010). This sole fact, may suggest the existence of more than one social process within the same medicinal system.

Objectives

The central aim of this study is to look into the dynamics of transmission of Seri ethnomedicinal knowledge and the influence of socio-demographic factors in this kind of knowledge. I specifically measure ethnomedicinal knowledge as recognition and naming ability and medicinal organism use among Seri adults. A central topic is to find how marine and terrestrial knowledges relate. I initially expected to find a natural division between these two types of knowledge, mainly because Seri division of labor is, as in many other cases, driven by gender. Division of labor translates into time allocation and time spent in a particular environment, surrounded of its specific resources.

Secondary objectives to this dissertation are elucidating the influence of age, income, line of ancestry, wealth, and years of schooling completed on ethnomedicinal knowledge proficiency. I expected age, income, wealth, and formal schooling to play a significant role in ethnomedicinal knowledge proficiency. I expected to find significant differences in ethnomedicinal proficiency levels based on line of ancestry, as the despite the recent criticisms to the validity of the Seri band categories.

Finally, I wanted to generate a comprehensive list of Seri marine ethnomedicinal organisms as I suspected that the low numbers of Seri marine therapeutics already reported reflect little on one of the most evident human capabilities; exploiting the environment.

The objectives were complemented by performing a general toxicity test using brine shrimp (*Artemia salina*). I intended to test if Trotter and Logan's (1986:95) hypothesis that **"remedies known pharmacologically to be effective would not enjoy greater group consensus regarding their use that would species which are inactive or ineffective,"** worked in the same way for both marine and terrestrial organisms.

Methods for data collection

Preliminary studies

I conducted previous research on the Seriland in the winter of 2000 to gather ethnopharmacological data and samples for my bachelors dissertation (see Narchi, et al. 2002; Narchi 2003).

Trying to build this dissertation on multi-cultural comparison, I traveled to San Mateo del Mar, Oaxaca to study the marine ethnomedicine of the Huave on the summer of 2006 thanks to a Melissa Hague Field Studies Award and a Tinker Graduate Field Research Summer Travel Awards. I later decided not to work with the Huave for reasons not pertinent for this document. Nonetheless, it was during this fieldwork that I pilot tested the surveys on ethnomedicinal knowledge with adults willing to participate. I asked two expert informants willing to cooperate to free-list marine medicinal remedies. The free-lists resulted in fifteen remedies of which fourteen were marine organisms. I used these fifteen organisms to test the clarity of the ethnomedicinal knowledge questionnaire that would later develop in the final version used for this dissertation. However, I had little visual stimuli at hand for two reasons: a) the immense amount of secrecy that the Huave, via the municipal government of San Mateo del Mar exercises over their resources, and b) the remote access to the fishing grounds. My visit coincided with the celebration of *Corpus Christi* which had the whole municipality busy with organizing the fiesta. I could not find a fisherman willing to take me to Laguna Superior, the closest to San Mateo del Mar, to gather the stimuli material. I finally got a grip on a dried specimen (Fig. 30) of porcupine fish (*Diodon holocanthus*) and a ray (*Raja ecuatorialis*).

Figure 30. Porcupine fish (Diodon holocanthus) used for adornment by the participants of the Corpus celebration in San Mateo del Mar, Oaxaca. The fish is also used by the Huave as medicine.

I was not prepared ho handle fish as stimuli material. First, my previous experience with the Seri had given me the idea that marine pharmacies are based on invertebrates. Second, while my training in zoology taught me that marine invertebrates can be preserved by drying them below a shade in the open air with a fair amount of success, the preservation of fish necessarily needs a formalin or formaldehyde liquid medium. In the light of these unexpected findings, I was in no position of getting formaldehyde near San Mateo. Third, even though ichthyological samples preserve well the specimen's size and shape, they loose color too quickly, adding difficulty to posterior identifications.

In 2007, I traveled to Bolivia through the National Science Foundation Summer Field School in Methods for Data Collection in Cultural Anthropology. During my summer in Bolivia I reviewed econometric analysis and given its relevance in discussing traditional ecological knowledge, I decided it was pertinent to include sociodemographic data as explanatory variables.

Lesson learned

Thanks to the experience in San Mateo del Mar, I was able to learn that there are no standard settings for marine ethnomedicine data collection. Making particular emphasis on the collection of specimens, the methods and procedures are far more diverse than those of terrestrial ethnobotany. Marine ethnomedicine requires one to foresee a broader logistic strategy for specimen collection. Lacking the visual stimuli while conducting secondary interviews would result in unsupported claims. Given the diversity of species of the marine environment, informants may be talking about to related, but taxonomically related, organisms. This would potentially resulting in an overlap and consequent encryption of a given number of organisms, and finally, a depiction of marine pharmacies as irrelevant given their small amount of marine organisms used.

Dissertation fieldwork

From August 2008 through June 2009, I began my doctoral dissertation fieldwork with the Seri in the community of **Haxöl Ilhom**. To adapt the Huave questionnaire, I resorted to the help of a **Cmiique iitom** interpreter. Together we re-formulated the questions, testing these until there was no ambiguity on the type of answer we wanted to obtain. I interviewed seven informants recognized as expert by other inhabitants of **Haxöl Iihom** seeking a list of the most common botanical and marine remedies. I gave each expert five minutes to name all the medicinal plants they could recall and five more minutes to list all the medicinal marine organisms they could recall. The total lists summed 50 terrestrial plants, 9 marine invertebrates, 7 marine algae, 4 halophytes, 2 fish, 1 marine reptile, and 1 seagrass.

Preparation of visual stimuli

With the help of three of the experts I collected all the marine organisms except fish, and for obvious legal reasons, the marine reptile, to be used as visual stimuli during the ethnomedicinal knowledge test. The terrestrial botanicals were collected by the experts, who frequently go on collection expeditions to restock the raw material with which they prepare different soaps and ointments that they both sell and allocate to their personal use. I was invited to witness their collections. The territory we had to travel to gather the complete collection amounts to some 80 square kilometers (Figure 31) with several changes in plant landscape coverage, altitude, substrate, and in the case of the beaches, tidal and wave exposition. I held three independent sessions with three of the seven informants. These three informants verified the cmiique iitom name of each organism and gave their opinion on the use and preparation.

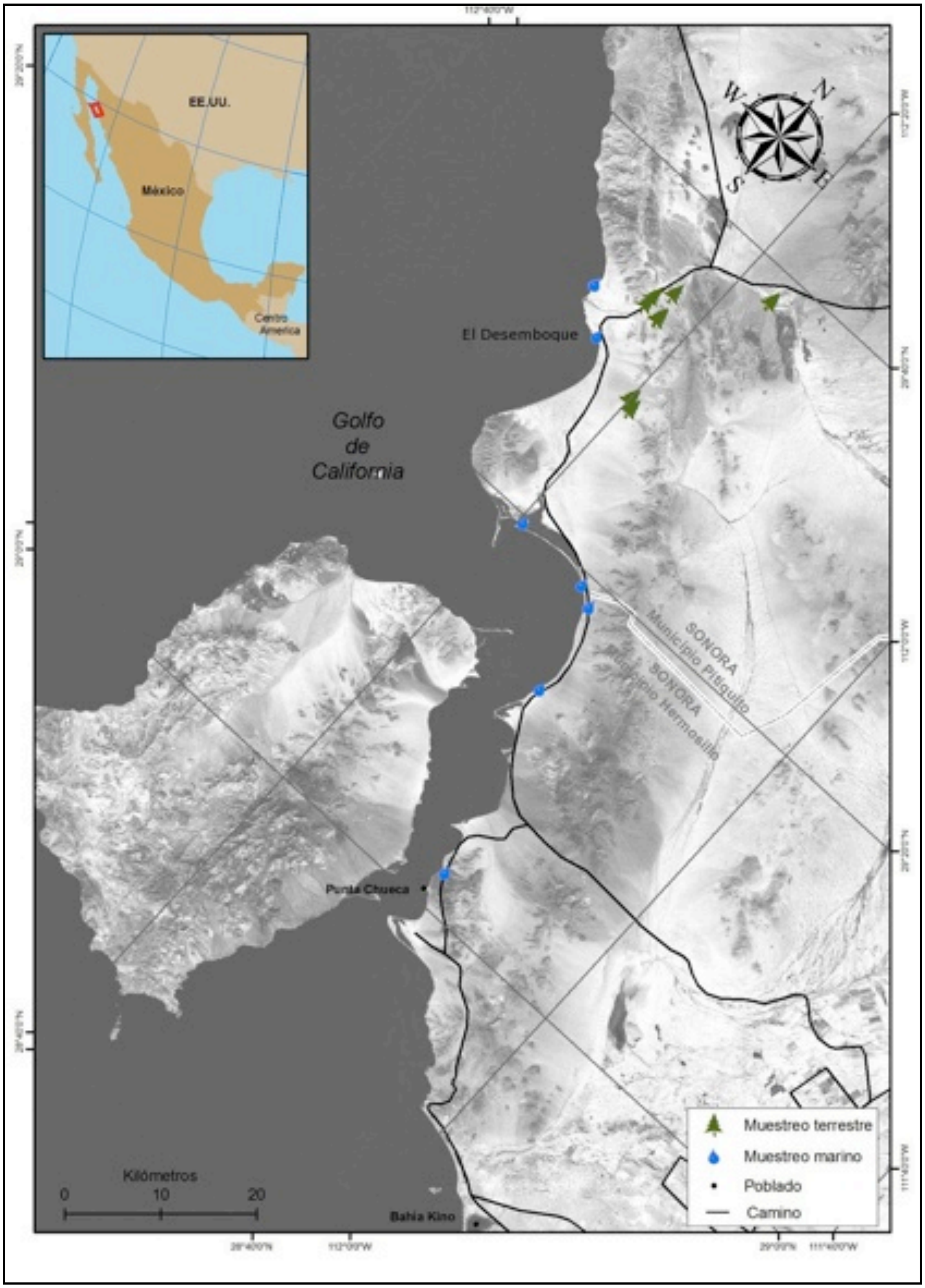

Figure 31. Map depicting the different geographic references for the places in which ethnomedicinal collections were made. The tree symbolizes terrestrial collections, the blue waypoints represent places in which marine and coastal organisms were collected. Courtesy: Geovanni Cordero-Herrera.

All of the specimens were preserved in the field (Figure 32). The botanical specimens, including halophytes were pressed and let to dry out with the aid of frequent wrap changes. There are few things as sweet as preserving botanicals in a xeric environment, as there is little risk of specimen destruction by fungi or molt. All of the terrestrial specimens collected were identified by Ing. José Jesus Sánchez Escalante director of the Herbario de la Universidad de Sonora (UNISON) hosted at the Departamento de Investigación Científica y Tecnológica de la Universidad de Sonora (DICTUS) in Hermosillo, Sonora. As part of the research agreement with the community, the specimens are currently deposited at Escuela Primaria Guadalupe Victoria, Clave 26DPB0048X to let young Seri familiarize with their traditional pharmacy in their school environment.

The marine animals were independently preserved inside glass jars containing an eight percent formalin solution with enough volume to cover each organism. The samples were identified by MS. Dora Ofelia Waumann Rojas at Laboratorio de Zoología de Invertebrados at Universidad Autónoma de Baja California (UABC) where they are currently deposited.

Marine algae were fixed for 24 hours in an eight percent formalin solution. After being fixed, they were pressed in the same way as terrestrial botanicals. All the phycological specimens and halophytes were identified in collaboration by Raúl Aguilar Rosas (Facultad de Ciencias Marinas, UABC) and Luis E. Aguilar Rosas (Instituto de Investigaciones Oceanológicas, Universidad Autónoma de Baja California) and deposited in Herbario CMMEX of the Facultad de Ciencias Marinas, UABC.

Succulents, particularly *cacti*, mangroves and *cheloniidae* were excluded from the collection given their protected status. Fish were excluded from the collection due to the logistic problems for collecting them and the disadvantages of their rapid color decay while in preservation.

Figure 32. The author pressing Maytenus phyllanthoides samples. Photo: Arli de Luca, 2008

I prepared the collected organisms to be used as visual stimuli in carrying out a knowledge test among 68 consenting adults, 18 years old and above; 55 from **Haxöl Iihom** and 13 residents of **Socáaix.** My intentions were to use village as an explanatory variable, as the social composition and degree of market integration are different. However, the number of informants for **Socáaix** was too small rendering an ill-correlated analysis when considering village as an explanatory variable.

To minimize the effect of natural overlap in use and preparation of medicinal organisms within Seri medicine (see Chapter 3), I structured questionnaire as open-ended interviews. This decision also gave me an opportunity to capture all the diversity embedded in the possible permutations in Seri medicinal knowledge.

The questionnaire contained three components; 1) theoretical ethnomedicinal knowledge, 2) practical ethnomedicinal knowledge, and 3) sociodemographic data. Both components were evaluated during the same interview and with the help of the visual stimuli. Theoretical questions are limited to examine a person's passive knowledge on a topic (e.g. What is X [v] good for?") Practical questions inquire about self-assessed skills in using the plant (e.g. "Have you personally prepared X for curing Y?"). Sociodemographic data questions create an identity profile for each informant based on age, gender, wealth, income, years of formal schooling. The complete set of questions is presented in APPENDIX I.

A **Seri** translator helped me to carry out the questionnaire. The former was decided for two reasons; 1) The need for a perfect understanding of the questions by our informants, and 2) even though I attained some level of proficiency in speaking **Cmiique iitom**, it was enough to cover the basics (e.g. "Is this a medicinal plant?", "How about this one?", "What is your family's lineage?"), when highly elaborated answers were obtained, I needed help in translating.

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[v] Where X is an interchangeable name for a given number of plants and Y is the name of a given ailment customarily associated with the knowledge of X.

Pilot testing of stimuli materials

The pertinence and increased benefits of using visual stimuli in ethnobiological interviews have been known for a long time (Boster and Johnson 1989). Even though, it is a logical assumption, researchers have conducted studies that prove that the presence of visual stimuli raises the quality, in level of detail, and the quantity, in amount of organisms, that an ethnobiological informant can provide (see Miranda, et al. 2007). The conundrum lays not in debating over the use of visual material, but on defining what is considered to be an optimal, or at least appropriate stimuli material. Optimally, one would undergo ethnobotanical trekking trips in the company of wise informants through a biologically rich, predator-free trail full of life and paradisiac landscapes. However, "**as those readers who have conducted ethnobiological fieldwork will readily acknowledge, the work would never get finished under such movie-set conditions**" (Berlin 1992:202). In addition, I could not imagine trying to persuade seventy informants to go snorkeling in a taxonomical mission. Therefore, one has two options; either use prepared specimens or use different informants who identify multiple plants in their natural state (Berlin 1992). I chose to use a combination of both. As I have already mentioned, different expert informants walked with me through the Seriland on several occasions in order for me to learn about their native medicinal resources (Fig. 33). They identified the plants, explained the mode of preparation and posology, and listed all the ailments that a given organism was used for.

Figure 33. The author in search for herbal medicine in the company of three Seri experts near ***Xana*** *(Campo el Almo, Ejido El Desemboque y su anexo Punta Chueca, Sonora). Photo: Arli De Luca, 2008.*

After learning from the experts, we prepared the voucher specimens for identification. There can be many arguments against dried specimens. On the one hand, the organisms distort and loose color (Berlin 1992), making it harder for the informant to asses their Classification. On the other hand, the informant is deprived of all the botanical and ecological information associated with the natural settings (Alexiades 1996). However, it has been suggested that there exists no literature comparing plant recognition accuracy based on either fresh or dried collections or photographs (Thomas, et al. 2007).

To avoid methodological inconsistencies and ensure the quality of my data, I pilot tested the questionnaire and the visual stimuli materials. I used the entire battery of organisms that had been collected and interviewed 5 adults. I asked the participants if they could recognize the organisms, name them in **cmiique iitom**, asses if these had a medicinal use, and if one could relate the medicinal use to a human body part or organ by noticing any resemblance in shape between the organ and the organism. I realized that some of the questions were not presented in a culturally meaningful way. Special problems came with questions around the doctrine of signatures. When I asked if the organism resembled a specific body part, no informant could relate the question to a sick organ. The informants took one or two minutes while carefully observing the stimuli material, then some started looking at their own body parts, specially hands and legs, and concluded with base on the obvious; "If I had to relate this sea star with something, it would surely be my fingers, the arms are as long and slender as my fingers, but there is really no resemblance." A second problem has to do with the way in which Seri naming system works. "Eduardo [my middle name, which I use by default in the field] you know nothing, you are dumb. **Haxz iztim** [*'Gl. fairy duster' (Callandria eriophylla)]* already has a name." Dumb in fact, as those little seedpods of the fairy duster hold a remarkable resemblance with a dog's hipbone. I abandoned the doctrine of signatures part of the experiment after innumerable and sequentially unsuccessful permutations on the questions relevant to the subject.

The identification of algae was also troublesome, specially among three sargassum species hard to tell apart by anyone, two of which had no reported medicinal use.

The questionnaire was ridiculously long, 4 hours per informant. At that rate and with the aim of interviewing at least 50 people, my grandson would had been typing my posthumous doctoral dissertation in 2063.

The final selection of the stimuli material arbitrarily cut the plant number to a third, I got rid of the troublesome sargassum species, and decided to use all of the marine organisms and halophytes. The sea turtle's place was taken by a sea turtle drawing found in the house that I was staying and which I assume was part of Dr. Gary Nabhan's experiments at some point.

The final stimuli portfolio was constituted by 5 algae, 4 halophytes, 9 marine invertebrates, a drawing of a sea turtle, and 13 terrestrial plants.

Ethnobotanical knowledge test

I present here the Seri plants and animals used for the ethnomedicinal knowledge test. The organisms are presented in **Cmiique iitom**, followed by the gloss translation in italic, and the scientific name in parenthesis. Each organism is hyperlinked to a picture of the actual collections. The organisms are presented in two broad groups that follow kingdom. First, organisms corresponding to kingdom *Plantae* are alphabetized by taxonomic family. Second, those under kingdoms *Animalia* and *Chromisa* are alphabetized by *Phyla.* The brief explanations *o*n the characteristics of the organisms are taken from Felger and Moser (1985) for *Plantae* and *Chromista* and those for *Animalia* are based on Kerstitch and Bertsch (2007). Other sources are highlighted throughout the text.

KINGDOM ANIMALIA

PHYLUM ANNELIDA

Class *POLYCHAETA*

AMPHINOMIDAE

Xepenozátx *'stingy bristle from the sea'* (*Eurithoë complanata* Palles)

A pink to pinkish-blue amphinomid averaging 100-150 mm in size. Possesses a pair of dorsal cirri per segment. The bushy spines on its sides produce painful burning stings. In combination with *Cenchrus palmeri* it is prepared in a tea in order to cease menstrual flow. **Xepenozátx** may be a generic name, in the taxonomic sense, as other stinging annelids like *Cloeia viridis* are also identified as **xepenozátx** (Narchi 2003)

PHYLUM CHORDATA

Class *REPTILIA*

ORDO TESTUDINES

CHELONIIDAE

Moosni (*Chelonia mydas* L.)

The largest of the hardshell turtles, *C. mydas* is characterized for having a comparatively small head. Adults grow to more than 3 feet and weight 300-350 pounds. The carapace is smooth with variation in color, possessing shades of black, gray, green, brown, or yellow. The plastron is yellowish-white (NOAA 2010). Sea turtles play an important cultural and ecological role in Seri life. This same importance is reflected on the number of medicinal uses for which it is used. Felger and Moser (1974) mention that the dried penis is cooked and made into a tea which is drunk to induce conception. The dried intestine is boiled into a small amount of water and the liquid is drunk to aid in cases of motion sickness. Kóoyam [**cooyam**] a young migratory black *C. mydas* with white chest (Moser and Marlett 2005), noted for its relatively large amount of fat was used to cure a "crazy" person. **Cooyam**'s fat was burned in a fire and the patient had to sit in the smoke. When people went crazy over their vision quests they could be cured by rubbing their head and face with the fat of **cooyam** (Felger and Moser 1974)**.** Narchi (2003) recoded that *C. mydas* was used as expectorant and as an aid against bronchitis. The hemipenis can be boiled in water, forming a slim layer of fat above the surface. The fat is then rubbed on a man's penis to either increase his sexual potency or enlarge his phallus. The majority of the expert informant interviewed for this dissertation agreed with the above mentioned uses, with the exception of the penis enlargement. One of the informants made special emphasis in saying that every single use attributed to *C. mydas* was an import from Mexican culture and disregarded the sexual uses of the hemipenis by classifying these as jokes.

PHYLUM ECHINODERMATA

Class *ASTEROIDEA*

HELIASTERIDAE

Pyooque (*Heliaster kubinjii* Xantus)

Numerous stout arms (20-25) rounded at the tips. The star grows from 63-200 mm. Juveniles may show a banded appearance. Ranges from the mid-intertidal zone to 120 ft. in depth. The name is generic, in the taxonomic sense for a variety of sea stars. Felger and Moser (1974; 1985) relate it to *Luidia phragma* and *Phataria unifascialis*.

Narchi (2003) relates it to *Echinaster tenispinula* and wrongfully to *Ophioderma panamense.* All of the species with exception of *O. panamense* are used to cease menstrual flow and post-partum hemorrhage. *P. unifascialis* is mixed with kidney fat and salt into a paste used to combat trauma-induced swelling.

Class *ECHINOIDEA*

ECHINOMETRIDAE

Xepenosiml '*Marine barrel cactus*' (*Echinometra vanbruti* Agassiz)

Dark purple spines and body. The spines are sturdy, attain medium length and are taper to a sharp point. The test diameter rarely surpasses 2.5 in. It would be very easy to mistake the specimen with *Strongylocentrotus purpuratus* if *E. vanbruti* did not have the characteristic asymmetrical growing pattern of the spines. The organism has previously been reported by Narchi et al. (2002) and Narchi (2003) as used in a decoction to wash the vagina in the presence of infection. *E. vanbruti* It is prepared into a rather smelly tea to treat various types of cancer. A similar species has been reported to be sold at popular markets in Mexico City for the same purpose (Fernández-Apango, et al. 2002). This is one of the organisms with highest Smith's saliency indexes on all Seri ethnomedicine.

Class *OPHIUROIDEA*

OPHIODERMATIDAE

Hanol cahít '*Arms are broken' (Ophiocoma aethiops* Lütken)

Arm side spines are stout and perpendicular to the arms axes. The disc is covered with fine granules and an apparent pouch between the arm insertions. Usually 3.5-19.5 in. in diameter. This brittle star is scorched and later macerated into a paste that is applied into swollen areas. Narchi's (2003) identification mistook this species for *Ophioderma panamense.*

GORGONOCEPHALIDAE

Hamt itóozj '*Earth-its guts'* (*Astrodictyum panamense* Verrill)

The color is yellowish with encircling brown bands on the arms. The bands form obvious ridges. The extended arms' length reaches over 1 foot. This species has never been reported to be included in Seri medicine before. **Hamt itóozj** usually refers to a plant; *Cuscuta corymbrosa,* which has no medicinal use among the Seri.

A. panamense was mentioned by 3 expert informants to cure vaginal cancer and cease menstrual flow when prepared in an infusion.

PHYLUM MOLLUSCA

Class *BIVALVIA*

MYTILIDAE

Satoj (*Modiolus capax* Conrad)

This mussel is armed with a thin shell which is covered with a heavy rich-brown periostracum bearing coarse hairs. Attains lengths to 6 in (UC Libraries 2010). The shell is ground, mixed with water and applied to the umbilicus of an infant to make it heal faster. Can be substituted by **Cotopis**.

Class *CEPHALOPODA*

Hapaj cosni (*Octopus sp.)*

Small octopi, not bigger than 1 in. long. It is highly probable that these organisms represent the offspring of various species that breed in the region and place their eggs inside tide pools. Felger and Moser (1973:430) mention that "**it was crushed and cooked with dock (*Rumex*) and the resulting tea is given to a person OR HORSE to make him run fast.**" Seri experts have told me that it can be eaten fresh without altering the desired effect. Some support the explanation that one will run faster, others say that the remedy will help the runner to build stamina for longer periods of time. Narchi (2003) speculates that the organism acts like an expectorant thanks to the presence of eledoisin, a drug that is very common in octopi and highly concentrated in younglings (Nakano 1964).

Class GASTEROPODA

JANIROIDEA

Cotopis ‘*fasten oneself by suction’* (*Turbo sp.*)

The shell color is variable, usually greenish-brown. The base diameter rarely exceeds 2-3 in. The shell is ground, mixed with water and applied to the umbilicus of an infant to make it heal faster.

KINGDOM CHROMISTA

PYLUM CHLOROPHYTA

Class *BRYOSIDOPHYCEAE*

CODIACEAE

Tacj oomas ‘*bottlenose dolphin's fishing line'* (*Codium simulans* Setchell and Gardner)

The frond reaches 15 cm high and 3-4 mm in diameter. The branching is dichotomous, with characteristic cylindrical shape, slightly flattened, forking, and cuneate below. There is no previous registry of medicinal use (Setchell and Gardner 1924). One expert informant pointed out its properties as an eyewash that can be simply be used by soaking it in seawater and squeezing it directly into the eyes.

PHYLUM HETEROKONTOPHYTA

Class *PHAEOPHYCEAE*

SARGASSACEAE

Xpanams caacöl *'Large seaweed'* (*Sargassum sinicola* Setchell and Gardner)

Smooth branches and branchlets. The leaves are linear and lanciolate with acute margins and serrate dentate midrib percurrent. Numerous vesicles born near the basal of pedicel supporting the receptacles with accuminate apices. Not spinose (Setchell and Gardner 1924). There is no previous report of this algae referring to medicinal use. One of the expert informants argues that the frond is boiled in freshwater, resulting in a tea that should be drunk to prevent epilepsy.

Class PHAEOPHYCEAE

SCYTOSIPHONACEAE

Xpeetc (*Colpomenia tuberculata* D.A. Saunders)

A sessile, hollow hemispherical olive-brown algae. Averages 5-10 cm in diameter. It has a deeply convoluted surface. Mature plants are fully covered with tubercules (Saunders 1898). No previous medicinal report has been found for the Seri. The algae, when washed ashore, holds seawater on its hollow center. The expert informants say that this water, when drunk, cures dehydration, headache, and light headedness.

PHYLUM RHODOPHYTA

Class *FLORIDEOPHYCEAE*

LOMENTARIACEAE

Xepe an impós *'Sea **impós**'* (*Gelidiopsis variabilis* (J. Agardh) Schmithz)

The thallus arises from stoloniferous bases, giving the impression of a mat-like growth. Subcylindrical to compressed subdichotomous branching with interwinding fronds of multi-axial construction. The fresh specimens cast ashore can provide with water. (Schmitz 1895). No previous ethnomedicinal record for the Seri is available. One expert informant mentioned that the water contained in this plant was used to wash the nose in the presence of sinusitis.

Class *FLORUDEOPHYCEAE*

KALLYMENIACEAE

Moosni ipnáail *'Sea turtle's skirt'* (*Kallymenia pertusa* Setchell and Gardner).

The fronds are tiny and flabby with indefinite form and size. Rose colored with numerous nearly circular and smooth perforations. It is commonly cast ashore. Seri informants assure that despite being so thin, a frond can be heated by placing it on top of a stone near a campfire. Once the frond is hot, it is used as a cataplasm in swollen areas of the body.

KINGDOM PLANTAE

AIZOACEAE

Spitj Caacöl '*Large* ***spitj***' (*Sesuvium sp.*)

A perennial succulent of narrow leaves and succulent stems as well. Spreads in the form of leafy mats through vast areas in estuaries and tidal flats. Commonly coexisting with *B. maritima*, *A. maritima*, *S. bigelovii,* and even *A. barclayana.* No previous record of medicinal use has been reported. One expert informant mentioned that Sesuvium is mixed with *Encelia farinosa*, and the resulting tea helps to accelerate parturition.

APOCYNACEAE

Tanóopa (*Vallesia glabra* Cav.)

Medium to large shrub with small shiny green leaves and translucent white fruits which are copiously produced up to several times a year. The leaves are toasted and macerated. The resulting powder is used to control the itch of a rash, measles or chickenpox.

ASTERACEAE

Caasol cacat '*Bitter* ***caasol***' (*Hymenoclea salsola* Torr. and A. Gray.)

Feathery shrub averaging 2 to 3 feet tall, found along arroyos, floodplains and drainages. Upright stem 5 cm in thickness with resinous-viscid herbage. Moderately soft and brittle wood. A tea made with the stem is used to heal swollen parts of the body and respiratory ailments. The tea can also be used as a topical solution against skin infections and as a wound cleanser. In recent years, a considerable number of women use *H. salsola* as raw material to create medicinal soaps.

BATACEAE

Pajóocsim '*Chew and spit'* (*Batis maritima* L.)

A perennial succulent that forms extensive colonies on tide flats, and mangrove estuaries. The roots were chewed as candy, allegedly it is very sweet. Some people would macerate the plant in water, as a drink sweetener. There is no previous record of medicinal use for this plant. Among the experts just one recognized it as medicinal, but refused to reveal what it was good for.

BURSERACEAE

Xoop (*Bursera microphylla* Gray)

Fat limbs and a short trunk. Semi-succulent, pithy and soft wood. The bark becomes papery in late spring. The high concentration of turpentines give its sap a highly aromatic characteristic. Flowering occurs various times around the year. Flowers turn into hard round yellowish fruits. The plant is a pharmacy by itself, having a myriad of uses. The leaves are mixed with those of *A. barclayana* to clean wounds. For headache, it is recommended to mix it with *Stegnosperma halimifolium* and water, and wash the head. The little yellow fruits are mixed with *Lippia palmeri* herbage and applied as a shampoo to get rid of lice. The inner bark is grounded and use to treat the wounds on the head of children. It is also used as a tea to treat gonorrhea. The sap may be used to cover recently acquired scars and prevent these from having a different coloration than the rest of the body. The sap is also used to treat head infections.

According to the expert informants it is also used as shampoo to fight baldness. *B. microphylla* has recently been introduced as a remedy against diabetes. Smith-Monti (2002) points out that it is not *B. microphylla*, but *B. laxiflora* the one used against diabetes. *B. microphylla* occupies an important place in Seri culture, being one of the few plants used to manipulate supernatural technology and according to the expert informants, the seeds are mixed with water, letting it settle for some time, after which the water is drank by a **ziix haaco cama** to catalyze supernatural vision quests.

Xopinl '*Xoop* *hands*' (*Bursera hindsiana* Benth..)

Thick with woody trunk, surrounded by a very smooth reddish-gray bark. Large, simple or trifoliate. *B. hindsiana* is used in mixture with *Hyptis emoryi* to prepare a tea against asthma. Three expert informants argued that it can also be used against less aggressive tussive ailments, including mild bronchitis, excessive coughing, and dyspnea.

CELASTRACEAE

Cos (*Maytenus phyllanthoides* Benth.)

A medium to large multi-stem shrub with evergreen succulent leaves. It appears to be a mangrove, reason for which its name in Spanish is mangle dulce. Small fleshy red fruit that ripens at the end of April. Tolerant of seawater inundations, the shrub attains its maximum development on saline wet soils. In the Seriland the species is very abundant in the dune coastline and the berm. The bark is used in tea for dysentery. A tea prepared with the leaves is used for a sore throat.

CHENOPODIACEAE

Hatajípol '*Black vulva*' (*Suaeda sp.)*

Usually *S. nigra* (Torr.) Greene. It is a culturally salient plant from which Seri extract a black dye commonly used in their basketry. It is a dense hemispherically-shaped perennial with succulent leaves and brittle stems. It is very common along the beaches and also manifests with frequency in lower slopes near the shore. A tea made from the roots is used against a cold.

Spitj (*Atriplex barclayana* (Benth.) Dietr.)

Semi herbaceous perennial salt brush. Yellowish-grey foliage with occasional drought tolerant characteristics. As the rest of the halophytes it thrives on saline soils. *A. barclayana* is used in a concoction in conjunction with *B. microphylla* against the painful sting of rays and skates.

EUPHORBIACEAE

Queejam iti hacniiix '*That that creates bundles out of its season*' (*Acalypha californica* Benth.)

A small drought-deciduous shrub with hairy and juicy toothed leaves. The flowers have long spikes with tiny red and pink bracts and a pistillate part at the base of the spike.

The plant is let in water to settle for a night. The water is then used to wash the head in presence of neuralgia.

FABACEAE

Hehe quinla '*Plant that makes sound*' (*Sennia covesii = Cassia covesii* Gray)

A pale perennial, regularly no more than 0.5 m tall. Characteristic yellow flower. When the pods dry, the seeds inside rattle even with slight wind, which relates to its **Cmiique iitom** name. A tea from this plant is used to whet the appetite. The same tea is used to clean the stomach and fight kidney pain. It is also used to induce labour. People with chickenpox would feel better after taking a bath with tea made from *S. covessi*. According to the expert informants it is also used to fight diarrhea and fever as well as diabetes.

MALPIGHIACEAE

Haxz oocmoj '*What the dog drops*' (*Calleum macropterum* D.C.)

Brushy perennial that can become a vine in the presence of abundant watering and denser vegetational surroundings. Adorned by bright yellow penta-petaled orchid-like flowers in spring and summer. The plant is brewed in a tea. The tea is used against common cold, diarrhea, and to help women regain their strength after partum. One of the expert informants argues that it also cleans the uterus after labour.

MARTYNIACEAE

Jcoa ctamöc ‘*Male **jcoa***’ (*Sphaeralcea ambigua var. ambigua* Gray).

Perennial with orange petals with scurfy foliage, sticky sap. This plant can easily be confused with *Hosfordia alata* (S. Wats.) and *Abutilon incanum* (Link), specially when collecting with ethnomedicinal purposes in the Seriland, as the three have not only the same appearance but also the same use. The inner bark and pulp are pounded and made into a tea to cure diarrhea and sore throat. The grounded bark is also used as an eyewash. The expert explanation is that the material is so slimy that it will take away any particles of sand or dust with the greatest of ease.

MENISPERMACEAE

Comíxaz (*Cocculus diversifolius* D.C.)

Slender perennial dependent on considerable moisture. Throughout the Seriland it has only been reported on Arroyo San Ignacio. There is no previous report on the medicinal use of the plant. One of the expert informants uses the plant to prepare an infusion in case someone has been stung by a scorpion or a wasp.

RHIZOPHORACEAE

Xnazolcam (*Rhizophora mangle* L.)

Predominant silt roots, shiny green semi-succulent leaves. Distinctive propagule that forms an embryo while still attached to the parent plant. The propagule, **mojépe pisj**, is linguistically distinctive in **Cmiique iitom**. It is also considered a different medicinal entity, differentiating its use from the rest of the plant and considered an excellent medicine for diarrhea. *R. mangle* is considered by the expert informants to cure a sore throat, disinfect skin injuries and deep wounds, and cure diabetes. Smith-Monti (2002) suggests a series of biochemical mechanisms by which it is very plausible that *R. mangle* may have a real impact as an anti-diabetic medicine.

VERBENACEAE

Xomcahíift (*Lippia palmeri* S.Wats.)

Thin brittle stems and small leaves with notably incised veins. Drought deciduous foliage is characteristic to appear after each soaking rain.A decoction to wash the head is applied in the presence of seasickness. In combination with B. hindsana it is used as a shampoo to fight head lice. The expert informants agree that it is good to cure respiratory diseases, from mild colds to phlegm congestion. Two of the informants say it is an excellent antidote against the stings and bites of poisonous animals and insects. One of these informants also argued that it is among the best remedies to clean the uterus after partum and it is also recommended as contraceptive. A tea prepared with the roots of *L. palmeri* is said to be very effective against gastrointestinal infections.

VISACEAE

Eaxt (*Phoradendron californica* Nutt.)

Characteristic leafless green stems with numerous small white or reddish translucent berries. A plant widely used to treat diarrhea, specially in children. One expert informant uses *P. californica* to prepare a tea to fight high-blood pressure.

ZYGOPHYTHACEAE

Haaxat (*Larrea divaricata* Cav.)

Characterized by a hard-wooden stem that rarely exceeds 5 cm in diameter. Some Seri affirm that little twigs can puncture and deflate off-road tires with the greatest of ease. Possesses bright yellow-petaled flowers. A gummy foliage develops in response to rainfall at any time of the tear. The foliage is resinous, the resin possesses a pungent odor that can be detected from afar. *L. divaricata* is prepared in a poultice to treat post-partum swellings and pain. For swelling and pain a little pit has to be dug and filled with coals, it is covered with *L. divaricata* and the affected part has to be in constant contact with the emerging smoke. The leaves are chewed in the raw for a sore throat. The roots are prepared in an infusion against dizziness. It is also made into an infusion to wash the area affected by a stingray or skate attack. A certain lac can be extracted by placing branches with high lac content next to the fire. As the lac melts down it has to fall into a container filled with water. This mixture is then drunk by females as a contraceptive measure. The expert informants claim that *L. divaricata* is one of the most powerful, and perhaps the most characteristic, of the Seri medicinal plants. It is used to treat wounds, smelly feet, skin infections, swelling, diarrhea, gastric parasites, colds, rheum, and in combination with *K. grayi*, it is used to help women who have difficulties conceiving.

Toxicity

Almost thirty years ago, Trotter and Logan (1986) suggested that intra and inter group similarities in the use of organisms would persist because particular remedies produce desirable and predictable reactions. These authors defined ethnomedicinal mechanisms in exclusive terms of bioactivity levels. While the approach may be incorrect as it discards a whole universe of emic explanations and mechanisms towards ethnomedicine, it opens up the possibility to test if the Seri select each of the two types of ethnomedicines on the same bases, namely their bioactive potential.

To test the bioactive behavior of the organisms, I adapted a brine shrimp *(Artemia salina*) lethal concentration assay to perform it in field conditions.

The extracts of each of the test organism was prepared by using previously dried specimens that I had collected with the aid of the native informants. I recorded the weight of each specimen and prepared a matrix solution with a $^{100\text{mg dry weight}}/_{1\text{ ml distilled water.}}$ A basal toxicity level was assumed to be standard for all the organisms supposing that the least amount of dry weight per milliliter of water would be more toxic. as a bioassay unit of response I chose brine shrimp nauplius because of their portability, easy storage, and readiness.

It has been suggested that the brine shrimp assay (BSA) is an excellent approach to discover antineoplastic, and antitumoral compounds (Meyer, et al. 1982). Nonetheless, BSA is too basic to fulfill such expectations and brine shrimp is biochemically too different to cancerous cells. BSA is a preliminary step in identifying potentially useful natural products (Sam 1993) and the only result it can suggest is that the tested extracts are capable of eliciting a pronounced effect against brine shrimp. Brine shrimp is set to hatch at room temperature for about 24 hours. once an approximate 75% of the population has hatched, the organisms are taken in one milliliter aliquots with the aid of a Pasteur pipet. The number of live organism per aliquot is calculated before putting the organisms in a container which will be used to run the assay. These containers are previously prepared with sequential dilutions of the matrix extracts. Each dilution is one order of magnitude smaller than the previous one (Fig 34).

Figure 34. Field bioassay versus A. salina. The color gradient for each extract denotes an increase in concentration. Courtesy: Thor Morales Vera, 2008.

The subsequent dilutions are prepared in triplicate. The BSA is run for 24 hours. Period after which, the number of dead and surviving nauplius are counted. There are several methods for calculating the lethal concentration for 50% of the population (LC_{50}). Given the field conditions and assuming the difficulties to attain normality in the data, I chose Reed-Muench's cumulative count (Meyer, et al. 1982) because of its flexibility while treating non-normal data.

The calculations of the LC_{50} were done via a matlab interface designed by myself. The cumulative counts are plotted against the logarithm of the toxicity.Wherever the counts of dead and survivors intersect, one obtains the LC_{50} by looking at the X coordinate value of the intersection (Figure 35).

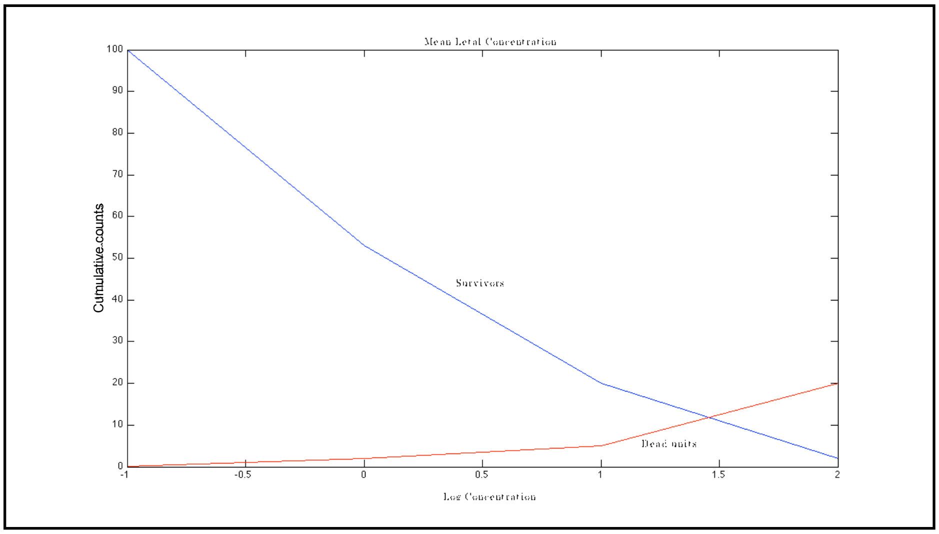

Figure 35 Determination of mean lethal concentration by the Reed-Muench method.

Consensus

I determined two types of consensus. The first one, cultural relevance was determined by obtaining Smith's saliency index of two free lists (APPENDIX 2) that were processed with ANTHROPAC (Borgatti 1996).

These free-lists were elicited with the questions:

a) ¿Zó ziix iic cöihiipe xepe com ano tiih ma ntaa? 'Can you name all the medicine from the sea that you know?'

b) ¿Mos hehe án com ano tiih ma ntaa? Gl. 'Can you name all the medicinal plants that you know?'

The second measurement captures the cultural consensus for the use, preparation, and taste of each remedy with the aid of CONSENSUS2 a Matlab routine of my authorship that calculates informant agreement by using Friedman's (1986) fidelity level;

$$\mathbf{Fl = {}^{I_p}/_{I_u}}$$

Where:

Fl = Fidelity level

I_p = Informants who suggested the use of an organism for specific purpose

I_u = total number of informants who mentioned the organism for any purpose

Each organism used as stimuli material provided two fidelity levels; 1) fidelity level of use, which captures the informant agreement regarding the number of uses of a specific ethnomedicine. 2) fidelity level of flavor, which captures the informant agreement ration on the taste of each ethnomedicine in an effort to link taste with toxicity.

Results

The first impression that the ethnomedicinal knowledge test results bring (Figure 36) seems to show no difference between marine and terrestrial ethnomedicinal knowledge. In most of the cases, the proficiency of each informant shows some degree of correspondence between what they know of marine medicine and what they know of terrestrial medicine. Whenever informants displayed a higher degree of knowledge in one of the two medicinal realms, they display some level of mastery in the other.

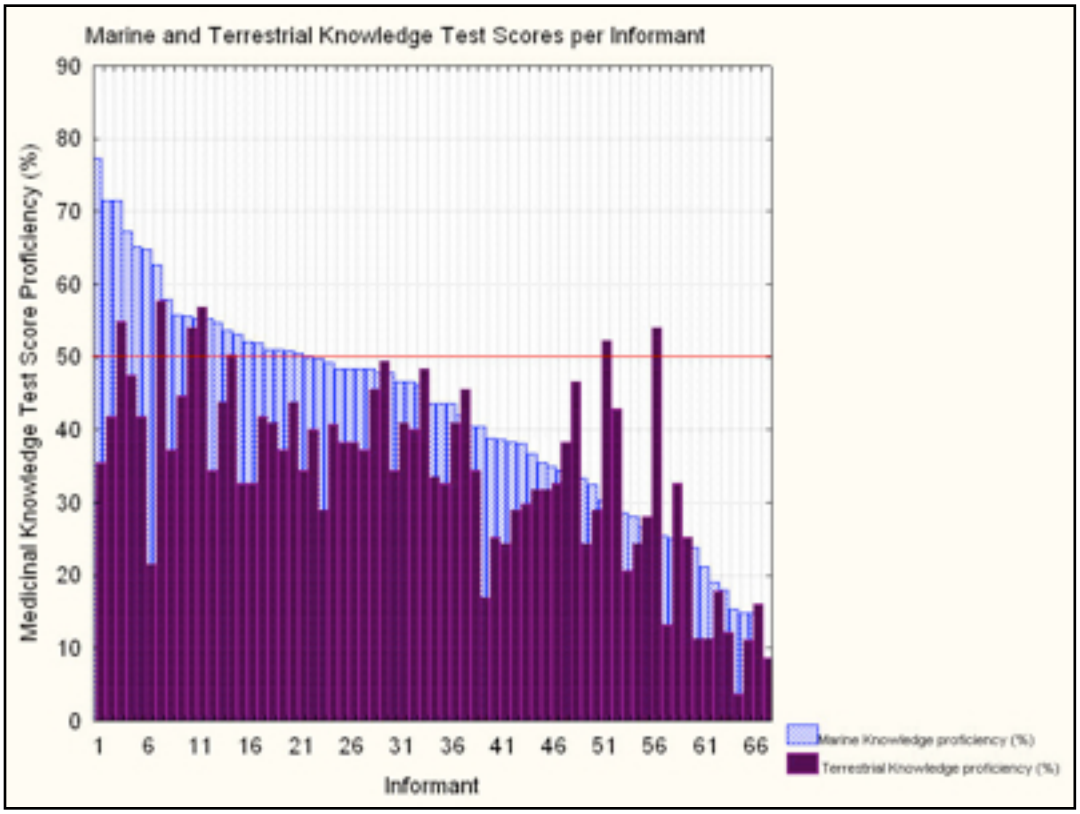

Figure 36. Marine and Terrestrial Knowledge Test Scores per Informant. Proficiency is expressed in function of achieved percentage by informant. The red line indicates a 50% level of proficiency.

The relationship between these two types of knowledge is not a perfect correlation. This becomes blatantly evident by observing that informants 1-2, 5-6, 11-13, 37, 48, 51-52, and 57 (18% of the sample population) show ethnomedicinal knowledge scores above fifty percent when tested on terrestrial knowledge but not when tested in marine knowledge. Conversely, informants 34 and 39 display a certain degree of proficiency in marine knowledge but their scores languish when faced with terrestrial plants.

Figure 37 illustrates the lack of direct correspondence between proficiencies. Not all informants displaying a relatively high proficiency in ethnomedicinal knowledge of terrestrial plants were as successful when faced with marine ethnomedicinal knowledge and vice-versa.

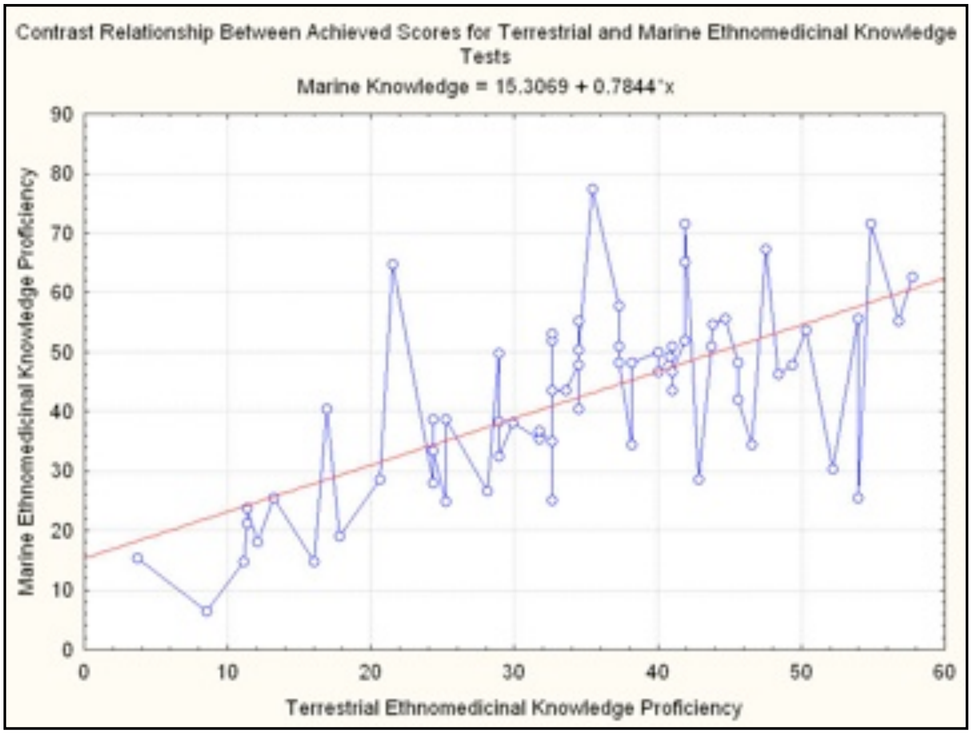

Figure 37. Contrast relationship between achieved scores for terrestrial and marine ethnomedicinal knowledge tests. Proficiency is expressed in function of achieved percentage by informant.

The aforementioned results suggest that the arbitrary categories in which I had divided Seri ethnomedicinal knowledge may be the result of natural grouping and these two different ways of procuring health care are transmitted by different social institutions and thus, are impacted differently by the same socio-demographic factors.

Age

Age has a mild overall effect for both types of knowledge (Fig. 38), capable of explaining 14% of the marine ethnomedicinal knowledge test scores (MEKT) and 16% of the terrestrial ethnomedicinal knowledge test scores (TEKT). The effect, although mild, possesses enough statistical significance (p = 0.001261 for MEKT and p = 0.000404 for TEKT) to claim that age plays an important role in acquiring Seri ethnomedicinal knowledge.

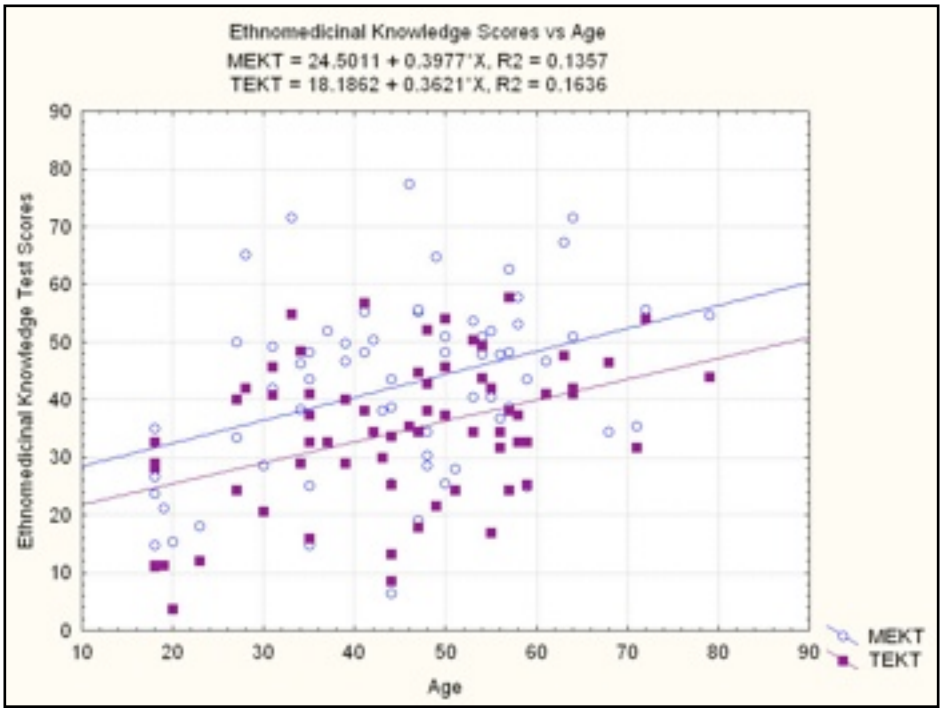

Figure 38. MEKT and TEKT as a function of Age. Proficiency is expressed in function of achieved percentage by informant.

Gender

Gender is the first variable that reflects a significant difference between these two types of knowledge as there is no significant difference between genders in MEKT (p = 0.102) but there is enough evidence to assume with statistical significance (p = 0.001986) that females have higher TEKT than males (Figure 39).

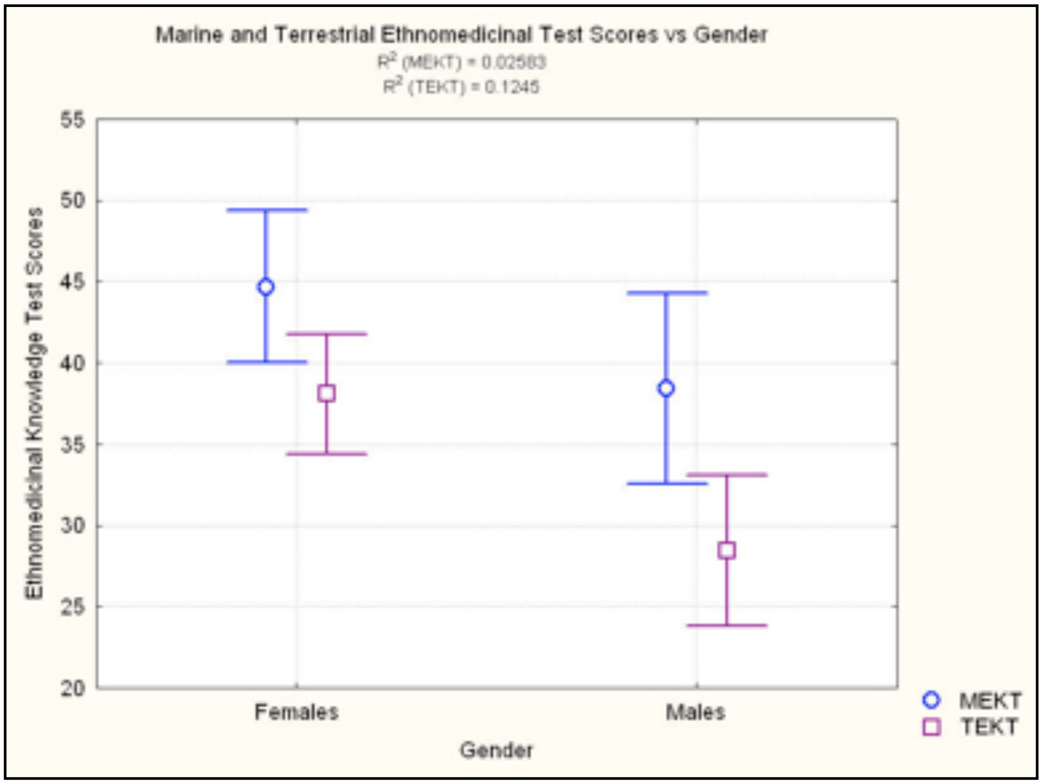

Figure 39. Whisker plot of mean value of MEKT and TEKT by gender. Mean values were determined by the least square method and were treated in function of achieved percentage by informant. The vertical bars, illustrating the confidence intervals, show no difference for MEKT in relationship to gender and statistically significant differences between genders for TEKT since the confidence intervals for the two categories of MEKT overlap in range, while those of TEKT remain distant.

Marital status

Marital status shows no difference (Fig. 40) regardless of the knowledge (p = 0.095 MEKT, p = 0.202 TEKT). I came across three types of informants; a) singles, b) married, and c) widows. Of these, the last showed tremendous variation. There were widows with considerably high knowledge test results and others with low proficiencies on the test. When widows were artificially removed from the sample, the results showed that married informants would obtain better results which were statistically significant for MEKT (p = 0.032) and statistically irrelevant for TEKT (p = 0.999). However, the contribution of marital status towards a the acquisition of marine ethnomedicinal knowledge was so insignificant ($R^2 = 0.05615$) that it can be discarded towards the overall effect.

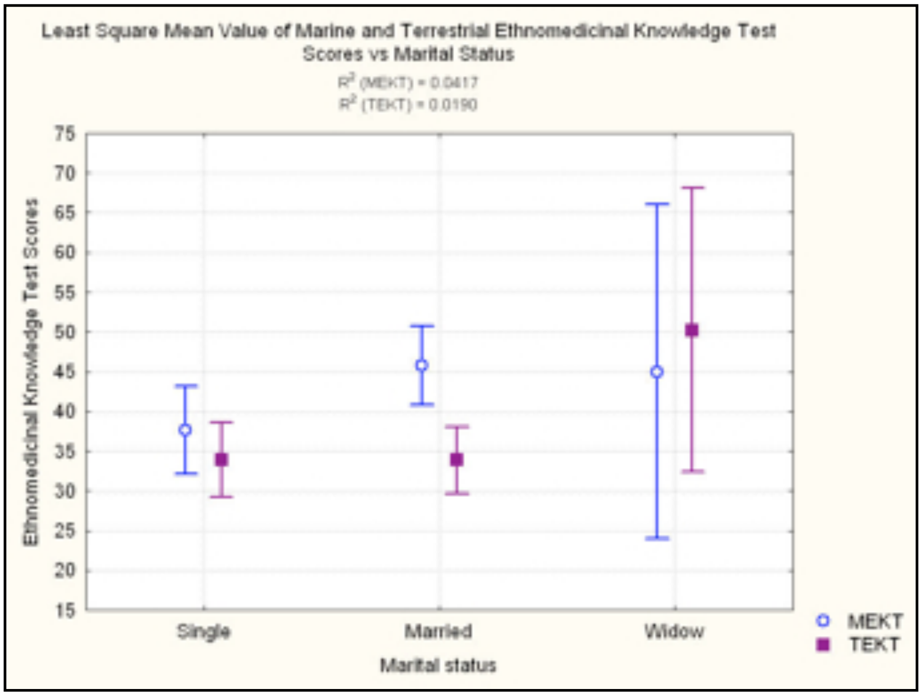

Figure 40. Whisker plot of mean value of MEKT and TEKT versus marital status. Mean values were determined by the least square method and were treated in function of achieved percentage by informant.

Literacy level

Years of formal schooling was used as a proxy for literacy level. This variable affects both knowledge test scores with relatively significant importance (Figure 41), explaining 11% of METK ($p = 0.0040$) and 23% of TEKT ($p = 0.00026$).

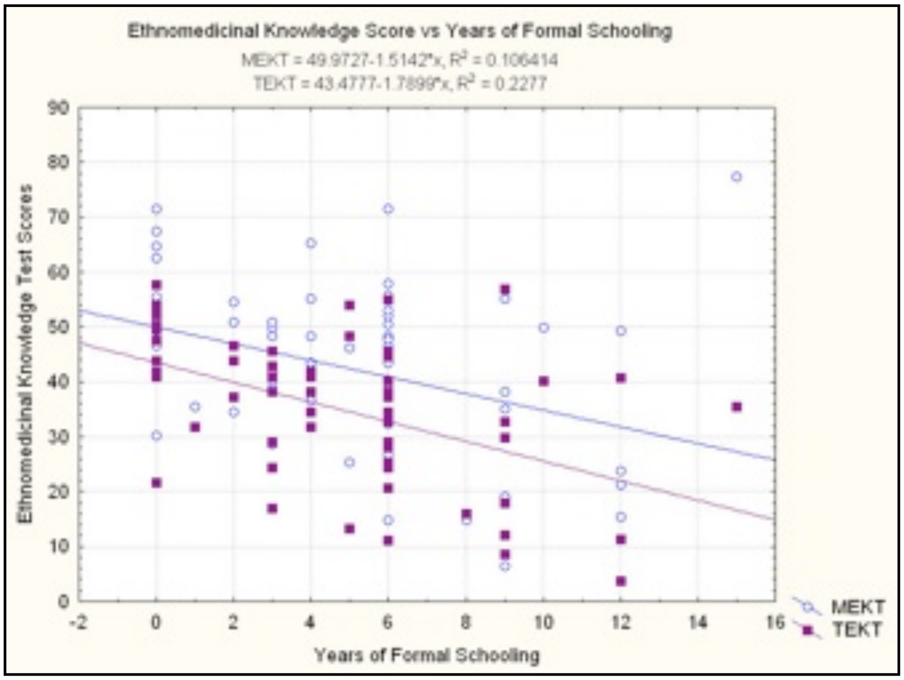

Figure 41. MEKT and TEKT versus years of formal schooling. Proficiency is expressed in function of achieved percentage by informant.

Adults per household

I found a wide range of adult inhabitants per household, with seven as the maximum. Regardless of the variation, the number of adults per household has no effect over either MEKT (p = 0.3758) or TEKT (p = 0.5893).

Infants per household

The number of infants per household has an overall negative effect in ethnomedicinal knowledge proficiency (Fig. 42). The effect is remarkably low (R^2 = 0.059), but statistically significant for METK (p = 0.0264). For TEKT, the tendency has no statistical significance (p = 0.134747).

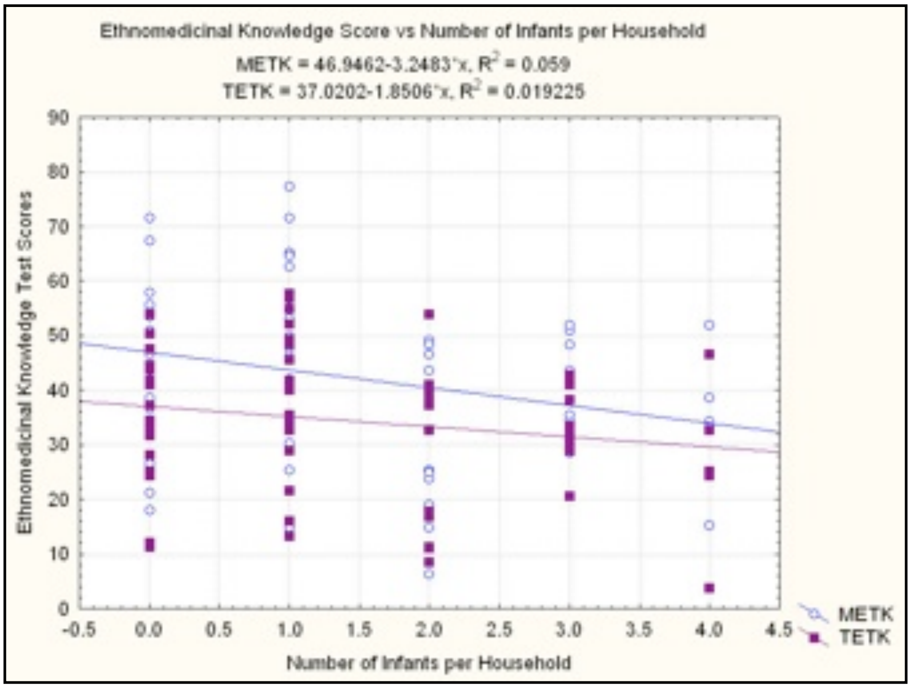

Figure 42. MEKT and TEKT versus number of infants per household. Proficiency is expressed in function of achieved percentage by informant.

Monthly income

Monthly income showed results that were not expected on my original design. The results have little significance for the overall model; MEKT ($R^2 = 0.0419$) and TEKT ($R^2 = 0.0846$). In addition, these results show no statistic significance; MEKT ($p = 0.7362$) and TEKT ($p = 0.4958$).

Wealth

Wealth was calculating by adding up all the assets that I supposed were important to the Seri. The measure is an addition of the value of the assets as the Seri would buy them in **Haxöl Iihom.** The assets are: 1) car or truck, b) a cel phone, 3) diving equipment, 4) fishing traps, 5) rifle, 6) fishing boat, 7) television, 8) satellite television service and equipment, 9) air conditioned unit, 9) out of board motor, and 10) governmental aid. In order to include wealth as an explanatory variable, I had to agree to the informants' petition of showing an index and not a real amount. The index goes from less wealthy (1) to more wealthy (3) and even though it is quasi-categorical in nature, the influence of wealth on MEKT was statistically significant ($p = 0.0311$). However, its explanatory power is limited as it is responsible for 7% of the effect for the score results (Fig. 43). In contrast, there is not enough statistical evidence to claim that wealth exerts any effect over TEKT ($p = 0.105$).

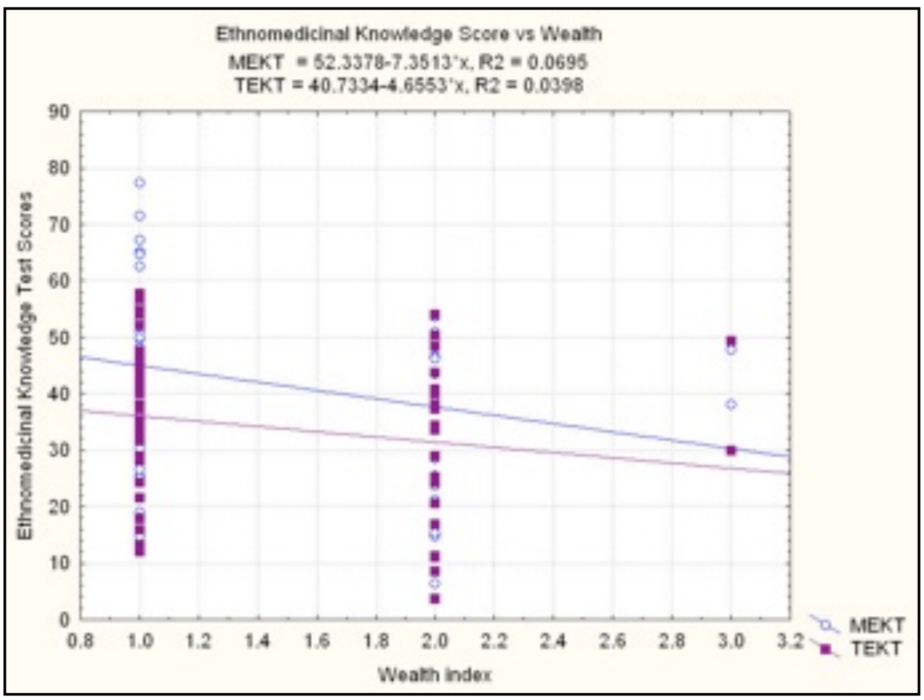

Figure 43. MEKT and TEKT versus wealth. Wealth is expressed as an index, proficiency is expressed in function of achieved percentage by informant.

Household

Sorting informants by household (Fig. 44) provided enough statistical evidence to claim that household exerts a statistically significant effect on METK ($R^2 = 0.0507$, $p = 0.031$). The effect was not statistically significant for TEKT ($R^2 = 0.037$, $p = 0.0645$).

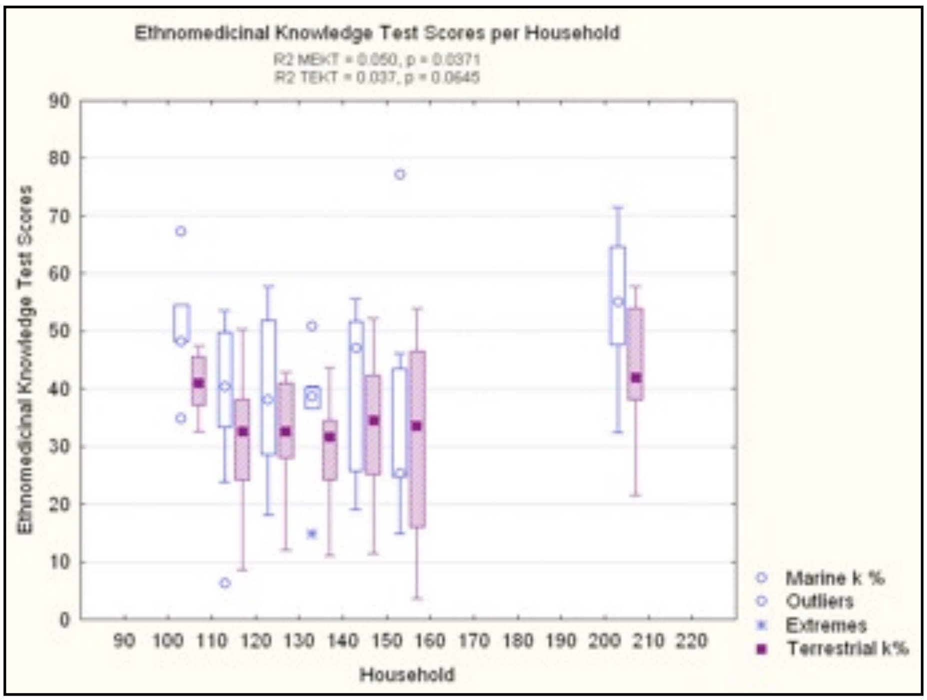

Figure 44. Ethnomedicinal Knowledge Test Scores by household. The whiskers represent the non-outlier range instead of a confidence interval. Households 109 and 209 posses statistically significant higher knowledge proficiency when compared to the rest. Proficiency is expressed in function of achieved percentage by informant.

Ancestry

The scarce number of Seri existing at the beginning of the XX century, the flexible nature of the marital rule, and the various ecological arguments against the plausible existence of the bands *(Bahre 1980; Sheridan 1982)* are powerful enough arguments not to consider this variable. However, given the persistent oral narratives around the authenticity of the band system *(Nabhan 2003)* and a perceived line of ancestry reported by my informants counteract these arguments.

Ancestry was determined arbitrarily, using the patrilineal line, as the total permutations between fathers' and mothers' line of descent would have resulted in an immense number of combinations that would obscure the correlation analysis.

I found five lines of Seri ancestry among the informants; 1) Xnaa motat, 2) Tahejöc, 3) Heno comcaac, 4) Xica hast ano coii, and 5) Xica xnai ic coi. The number of informants that identified their patrilineal descent with Seri bands accounts for 67% of the sample (N = 45). The remaining 33% identified their patrilineal decent outside of the Seri bands in three main groups; 1) Tohono O'odham, 2) Yoreme, and 3) Other. The later refers to Mexican ancestry. However, each of the 11 informants that identified themselves as Mexican, see the identity as not-genuine and relate their true ancestry to that of their grandfathers and great grandfathers in a conglomerate of Spaniard, French, Italian, and 'Gringo' identities.

When Seri and non-Seri lines of ancestry were contrasted there was no significant effect observed. Being a categorical variable, all the lines of ancestry were contrasted against 'Other.' MEKT = 0.6455, TEKT =0.4072. Comparing the Seri lines alone, the results were not altered, and remained non-significant; MEKT = 0.785, TEKT = 0.8628.

Teacher

The sample size made it hard to include this categorical variable in the analysis. I came across as many as six different enculturators. On the one hand (Fig. 45), the results for METK (R^2 = 0.038) are not statistically significant (p = 0.231).

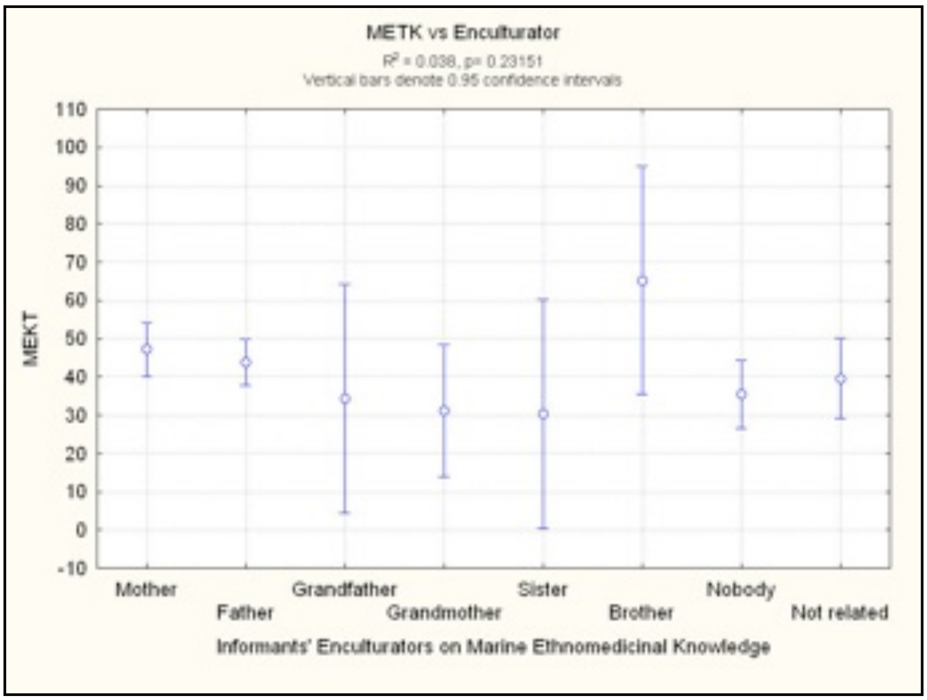

Figure 45. MEKT vs informants' enculturator.

On the other hand, there is enough evidence to suggest statistical significance (p = 0.0377) for TEKT (R^2 = 0.117662) when the enculturators are compared to 'nobody.' Enculturation by the mothers is most closely associated with a high TEKT (Fig. 46). However, TEKT looses statistical significance among the groups when the enculturator 'nobody' is removed from the analysis.

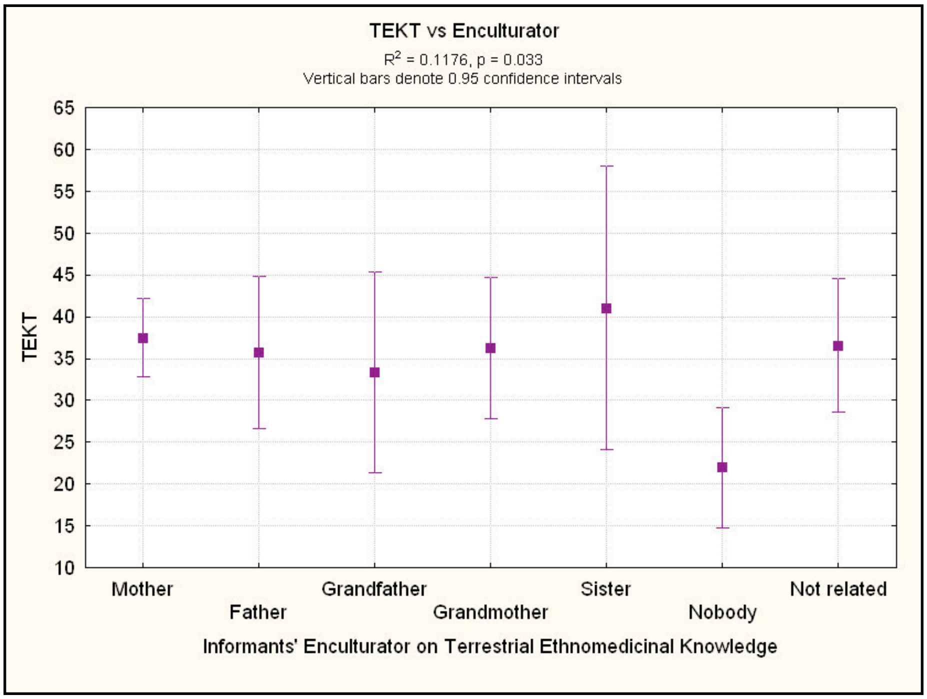

Figure 46. TEKT vs informants' enculturator.

Teacher and Ancestry

I modeled the relationship between enculturator and ancestry for each of the descent lines.

The model lacks strength because of the linearity existing between the number of informants and the number of enculturators; MEKT (R^2 = 0.6114, p = 0.0133), TEKT (R^2 = 0.8519, p = 0.000671). In spite of this statistical eventuality, the data suggests that suggests that knowledge acquisition is driven by gender. MEKT (Fig. 47) involves paternal enculturation father in seven of the eight reported lines of ancestry. In five of the eight cases, fathers plays a very significant role in terms of the proportion of informants they have enculturated in marine ethnomedicinal knowledge. TEKT (Fig. 48) is driven by maternal enculturation. Mothers are found in seven of the eight lines of ancestry, and play the primary role as enculturators in all of them.

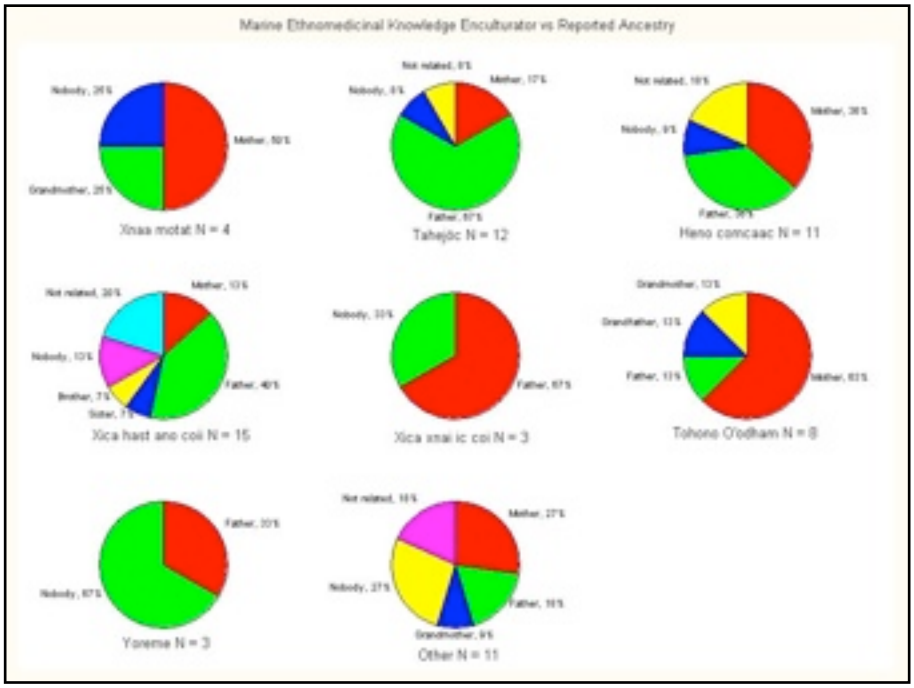

Figure 47. Categorized pie chart of informants' marine ethnomedicinal knowledge enculturator according to the reported line of ancestry.

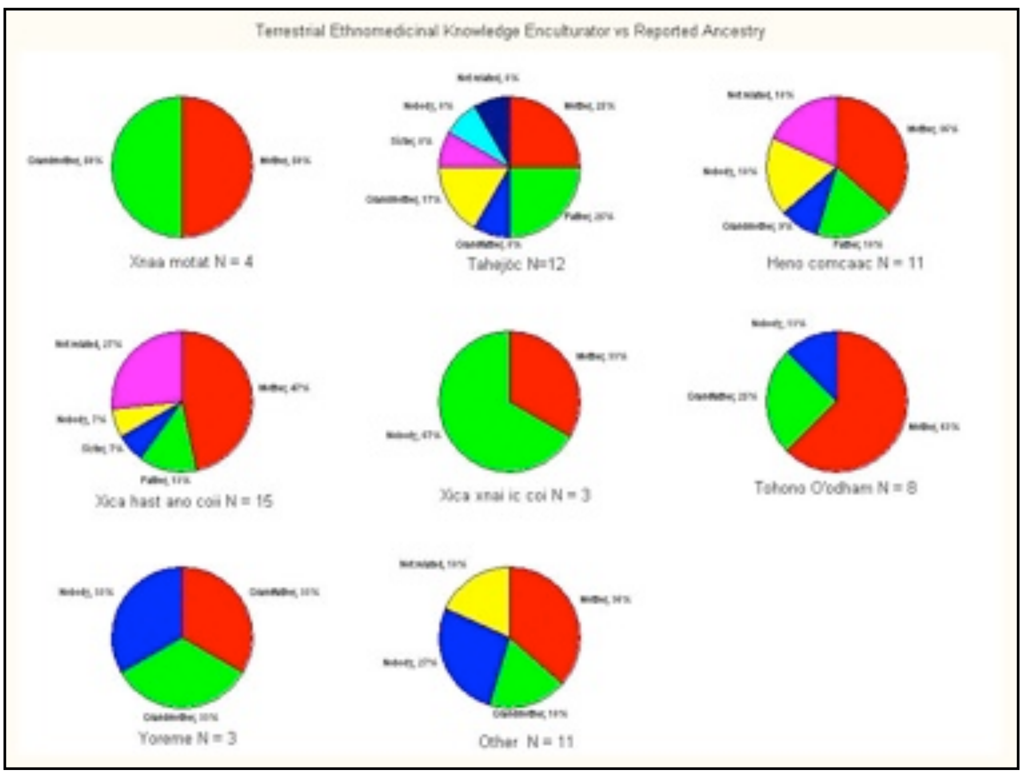

Figure 48. Categorized pie chart of informants' terrestrial ethnomedicinal knowledge enculturator according to the reported line of ancestry. A comparative animation of both figures can be found here.

The ethnomedicines, their uses, toxicity, and fidelity level.

Use

There is a considerable overlap in the types of uses that Seri give to terrestrial and marine ethnomedicines. The organisms collected as stimuli material have a 37% overlap in their uses (Fig. 49). A fraction of the uses for marine ethnomedicines (28%) serves as gender specific medicine. These medicines can only be used by females, as they serve to ‘clean the womb’, combat vaginal infections, or regulate the menstrual flow. I have used the term hysteramedicines to refer to female specific medicines. Terrestrial hysteramedicines represent only 10% of the uses. Terrestrial hysteramedicines overlap with their marine counterpart for ‘cleaning the womb,’ but it is only terrestrial plants that are used to accelerate parturition.

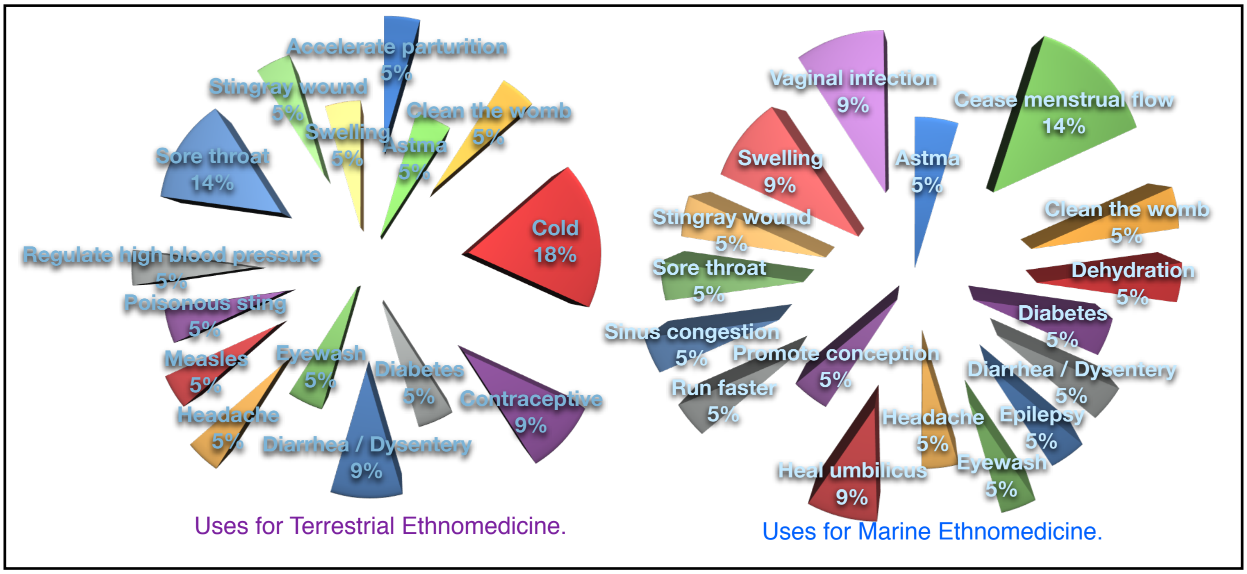

Figure 49. Proportion of uses for terrestrial and marine ethnomedicines used as visual stimuli.

Toxicity

Initially, all the organisms used as stimuli material were going to be screened for their toxicity. The assay had to be abandoned before the totality of the organisms was processed (Apendix N). I present data for the sixteen organisms that could be processed (9 marine and 7 terrestrial).

The number of uses of Seri ethnomedicine correlates with their toxicity, not mattering if these are sought from marine or terrestrial environments (Fig. 50). The incremental number of uses as a function of toxicity has a statistically significant correlation of 48% with marine ethnomedicines ($p = 0.0022$) and 59% with terrestrial ethnomedicines.

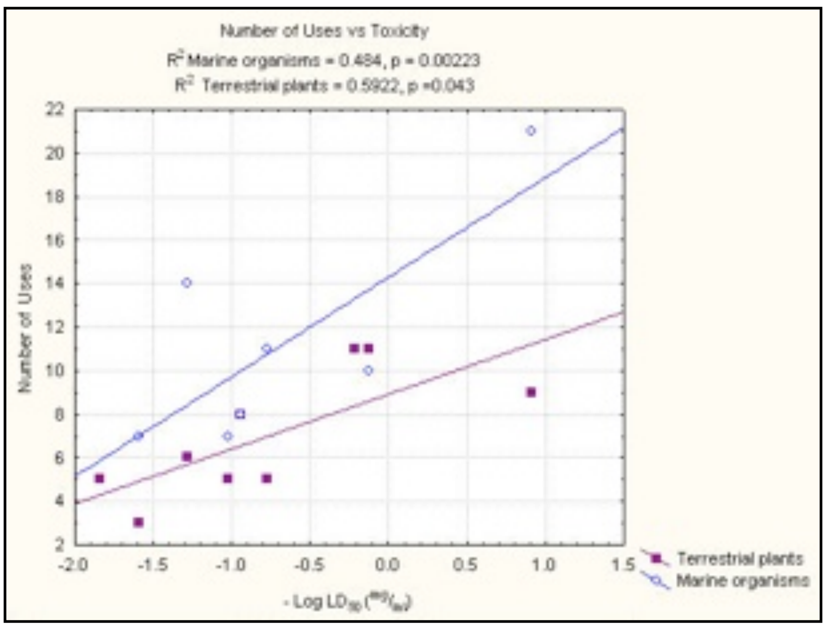

Figure 50. Linear relationship between numbers of use and toxicity. Toxicity is expressed as a function of its negative logarithm to add sense to the direction of the graph.

These results enable me to assume that at least the totality of the ethnomedicines submitted to the toxicological screening assay obey the same pattern - more uses = more toxicity. Thus, we can see Seri ethnomedicines obeying a toxicological pattern regardless of their source (Fig. 51).

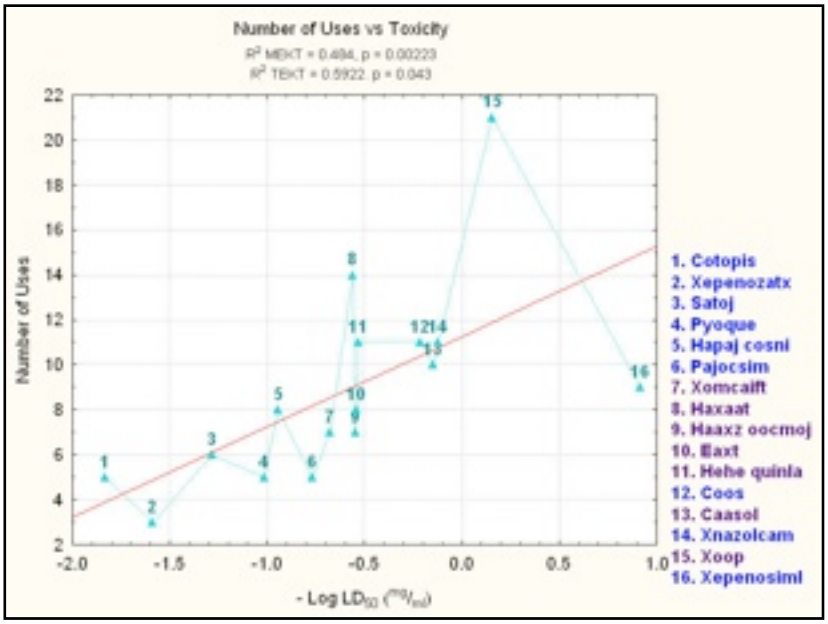

Figure 51. Seri marine and terrestrial ethnomedicines seen in a toxicological continuum that corresponds to the number of reported uses.

Saliency

Saliency has no correlation with toxicity either for marine ($p = 0.048$) or terrestrial ($p=0.321$)organisms. In relationship to number of uses, saliency bears no significant correlation either with marine ($p= 0.4233$) or terrestrial ($p=0.4233$) ethnomedicines.

Fidelity level of use

The fidelity level of use for those organisms screened for their toxicology render no statistically significant correlation ($p=0.5040$) when contrasted to their LC_{50}.

Fidelity level of flavor

Flavor and toxicity strongly correlate ($R^2 = 0.3160$, $p = 0.013$). There is enough evidence to suggest that informant consensus regarding flavor goes hand in hand with toxicity (Fig. 52).

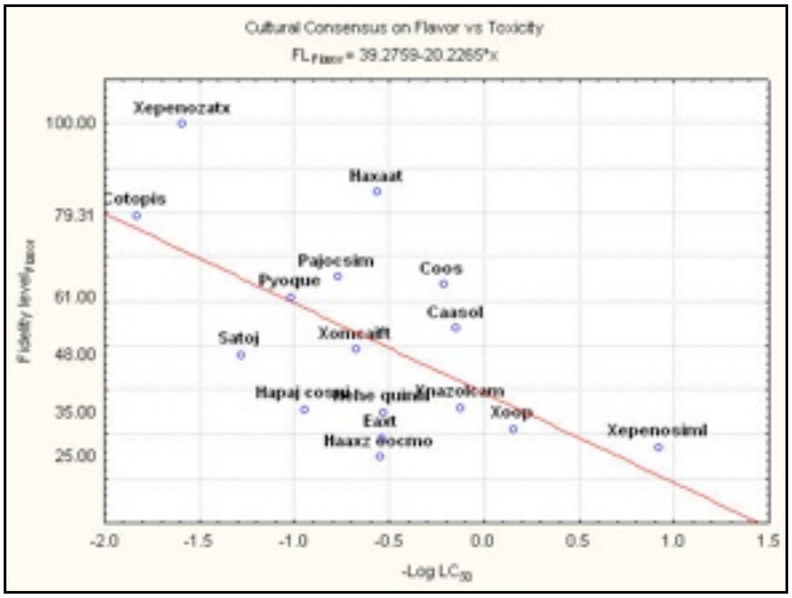

Figure 52. Fidelity level of flavor versus Toxicity. The figure shows that as consensus on the flavor of Seri ethnomedicine grows, so does toxicity.

Flavor and toxicity

The ANOVA results for contrasting flavor versus toxicity gave a statistically significant correlation (R2 = 0.4727, p = 0.037). Having encountered six different flavors, I submitted the data to a Fisher's LSD test to identify which flavors were different in terms of their toxicity (Table 6).

Table 6. Fisher's post-hoc Least Square Difference results for flavor when contrasted with toxicity.

	Flavor	Ccotp	Quiipe	Caax	Caacat	Coatjo	Not edible
1	Ccotp		0.015274	0.589731	0.282212	0.237628	0.019058
2	Quiipe	0.015274		0.010102	0.082789	0.501006	0.721410
3	Caax	0.589731	0.010102		0.143013	0.140795	0.012103
4	Caacat	0.282212	0.082789	0.143013		0.613796	0.081011
5	Coatjo	0.237628	0.501006	0.140795	0.613796		0.390970
6	Not edible	0.019058	0.721410	0.012103	0.081011	0.390970	

Given the small number of samples, it is evident that some but not all the perceived flavors differ. Nonetheless, the analysis is robust enough to evidence that the toxicity of ethnomedicines can be clustered in various groups when these ethnomedicines are grouped by their perceived flavor (Fig. 53).

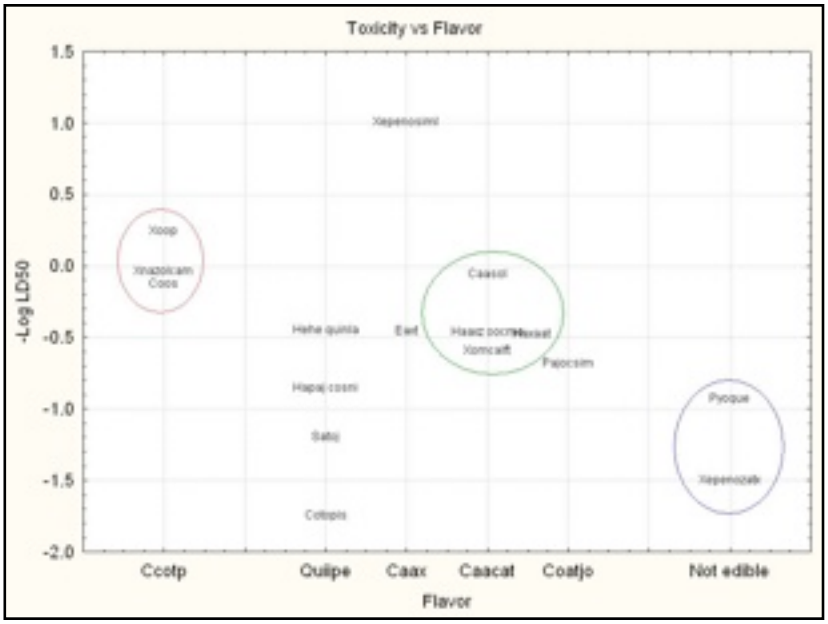

Figure 53. Clustering of ethnomedicines by contrasting their toxicity versus the perceived flavor.

Discussion

Seeing the world through a linear model.

There is no better criticism against the use of linear regressions than the article by Schreiber and Anderson *(1970)*: “Properties and Composition of Lunar Materials: Earth Analogies” in which the authors, aided by a linear regression model, prove that the moon is made out of cheese as previously supposed. The logic behind associating previously unrelated data in a regression analysis can be further illustrated by endless examples (Fig. 54). Thus, it is my best intention to let the reader know that linear models are probabilistic tools instead of deterministic statements. The universe is not linear. As a result, it will not behave in linear ways. However, subsets of the universe can be understood with much more ease if we simplify these subsets to search for the most obvious effects, which may very well manifest in linear fashions.

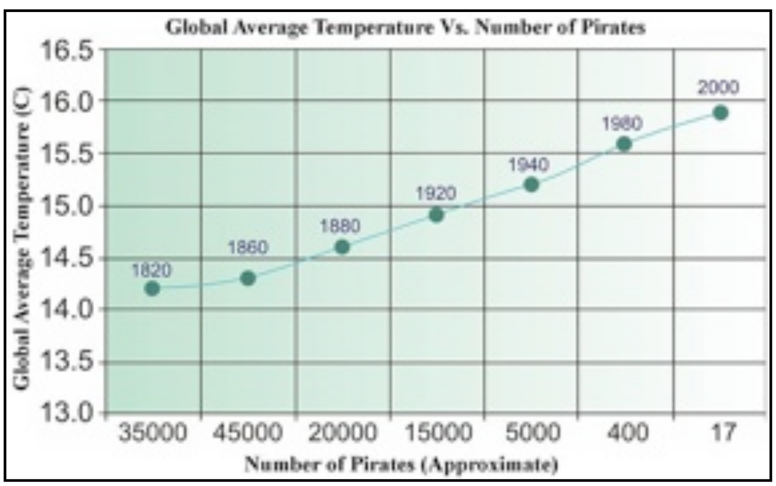

Figure 54. Global Average Temperature versus Number of Pirates. Courtesy: Mnation2 through Wikipedia under an Attribution-share alike creative commons license.

It should be taken into account that the interpretation of these models depends on drawing results not only from different variables and analysis but also from ethnographic data, field observations, and qualitative experiences.

Age

Seri ethnomedicine knowledge is highly correlated with age both for MEKT and TEKT. These observations are consistent with the historical development of events that lead the Seri to become sedentary (Felger and Moser 1985), embrace a market economy (Bahre 1967; Bahre, et al. 2000; Rentería-Valencia 2001; Rentería-Valencia 2009), and become less dependent on traditional resources (Felger and Moser 1974). Thus, people born before the acme of Seri economic integration around the mid-1950s, will show better proficiency when faced with their ethnomedicinal resources. The trend positive association of age and ethnomedicinal knowledge scores cannot discard the effect of a secular trend (Godoy, et al. 2006) by itself. However, Hills (2000) has proven that Seri mental maps tend to become smaller as time goes by. A notable symptom of the extinction of experience (Nabhan and St-Antoine 1993).

Gender

Gender is one of the most interesting variables, sensibly affecting TEKT but not MEKT. The results are related to Boster's (1986) observations on the difference in knowledge based on gender roles. Traditionally, Seri men are fishers and hunters and women are gatherers (Mcgee 1898; Malkin 1962; Bahre, et al. 2000; Basurto, et al. 2000; Torre and Findley 2010). Nonetheless, the labor divisions by gender are far from being rigid. I have personally witness the hunting skills of women when chasing rattlesnakes from which they make necklaces out of the vertebrae. Seri women are quite successful and very skilled at hunting, collecting sea pen shells, and processing fish and crustaceans for food.

Felger and Moser (1974; 1985) have stated that Seri medicine is personal and individual. While this may have been the case in the past, the Seri now rely heavily on the aid of medical doctors either in their own communities or traveling outside, to Puerto Libertad or Hermosillo. Presently, the people with most contact with ethnomedicines are women who prepare these as balms, creams, and soaps to sell outside of the Seriland. Women are also the major participants in picking up several fruits, wood, raw materials for their baskets. Furthermore, women take care of the children, therefore, they need to have the ethnomedicinal knowledge at hand. On the contrary, it is men who spend most of the day fishing. Some of their fishing expeditions require them to travel offshore and rely on whatever resources they can find on the midriff islands or the Baja California shore.

If it is men who have the marine expertise, why is there no significant difference in MEKT when we compare it by gender?

First, most of the marine organisms used in Seri ethnomedicine come from the intertidal zone. These organisms are accessible to anyone. During extreme low tide events it is common to see women (Fig. 55) going into the intertidal zone to collect shells that will later be used as necklace beads and clams for food.

Figure 55. Seri woman picking sea shells at low tide. ***Socaaix,*** *Sonora. Photo: Nemer E. Narchi 2000.*

Second, as has been shown in Figure 49, around 28% of Seri marine ethnomedicines are hysteramedicines. Women consume them, and it is very likely that women prepare them in all the cases.

Taking into account that the ethnomedicinal knowledge tests include but one andromedicine - sea turtle- which can also be used for medicinal purposes not related to any sex, sex-specific nature of hysteramedicines has an obvious effect in regards to the ethnomedicinal knowledge tests.

Marital status

Marital status has no effect over the ethnomedicinal knowledge test scores when widows are present in the sample. The fact that MEKT has a statistically significant relationship with marital status, and married people have better results than singles may be a reflection of the effect of hysteramedicines and learning from the female partner through direct observation or even by oral enculturation. After all, the exchange of personal experience is directly linked to the individual and sub-group range and accuracy in the knowledge of biotic resources (Ellen 1979).

Years of formal schooling

Market integration may be beneficial for traditional knowledge depending on how one defines and measures each of the variables that have been considered in a model. Nonetheless, market integration inevitably overlaps with acculturation (Godoy 2001). A very good measurement of acculturation is the level of literacy. Here it is expressed in its simplest proxy; years of formal schooling. The variable is interesting as school-based education can devaluate local environmental knowledge while it also subtracts opportunities for the school attendants to interact directly with the local environment and/or learn from their elders (Mcdade, et al. 2005).

In this case, more years of formal schooling have a deleterious effect on MEKT (11%) and TEKT (22%) alike. This variable shows colinearity with age and if ran together in the final model would cancel each other, affecting the test scores.

Number of infants per household

The number of infants per household has a negative effect over ethnomedicinal knowledge overall, being statistically significant for MEKT. Why this variable affects MEKT is not clear.

Wealth

Wealth affects MEKT but not TEKT. In my observations, I realized that wealthy Seri are those entrepreneurs who import food and other merchandises into Seriland. These people also control informal political power and have influence over communal decisions. In part, because of the large numbers of relatives that constitute such factions. Since wealthiest Seris are merchants, they have the constant opportunity to travel to nearby cities and towns. It is not infrequent that during these travels they visit the doctor or buy allopathic medicines. In this fashion, marine ethnomedicinal knowledge is displaced by alien knowledge and practices. TEKT is not affected by wealth. This observation can be explained in part because some of the plant-derived ethnomedicines generate wealth themselves, since these are sold outside of the Seriland in different forms. Moreover, plants can be transplanted and manipulated up to the point of being quasi-domestic (Nabhan 2003) and it is not uncommon to see little ethnobotanical plots or at least pots in front of Seri households (Fig. 56). Botanical ethnomedicine is far more accessible for any Seri than marine ethnomedicine.

Figure 56. Small plot in front of an informant's house. The plot contains medicinal, alimentary, and ornamental plants. The imagery allows to notice the strong bond between cultural identity and native flora. Photo: Nemer E. Narchi, 2008.

Furthermore, aided with this gardens and plots, the economic burden of using terrestrial ethnomedicine is relatively nothing. In such scenario, it is very convenient to use the ethnomedicines before deciding to venture into an allopathic treatment.

A male biass

The way in which I calculated the wealth index may have introduced a strong male bias since the majority of the assets taken into account, namely, the fishing and diving gear, rifle, boat, and car are customarily possessed by men. This are post-hoc observations and thus it is necessary to consider assets typically owned by females in future occasions.

Household

The household, the single most important unit in Seri social, political, and economic organizations (Monzón 1953; Griffen 1959). Therefore, it was expected that there was a great amount of variation between households. However, the only variations observed are those between the cluster of households 100s and 200s. The numbers represent the village. Households whose label starts with a hundred are those form **Haxöl Iihom** and households whose label starts with two hundred represent the village of **Socáaix.** In an unfortunate turn of events I was only able to interview 13 people from Socáaix, who were distributed in 7 households. The number is too small too infer any inter-village variation. In addition, the majority of the people I interviewed in **Socáaix** customarily deal with ethnomedicine in one form or another. It is very likely that the data reflects an upper level of proficiency for the village of **Socáaix** just because those who agreed to participate have a particular interest for their ethnomedicinal tradition.

Line of Ancestry

I was expecting to come across a great variance in the responses of the informants with base in their perceived line of ancestry. Informal conversations with Carolyn O'Meara and Cathy Moser-Marlett who are some of the researchers actively working with Seri culture, added to my own experience in the area had led me to think that the controversy around the validity and existence of the Seri bands (see Chapter 3) had never been discussed in terms of differences in ecological knowledge for each band. Surprisingly, there is no difference in knowledge scores either for the different Seri lines of ancestry or between the knowledge scores for each of these lines of ancestry and the knowledge scores of those who live inside Seriland but do not consider their paternal line of ancestry to be Seri, and in some cases, have no consanguineal connection with the Seri at all.

In such a light, one can align his opinion with that of Bahre (1980) and Sheridan (1982) and assume that the ecological constraints, specially the scarcity of water and some foods, are too harsh for the Seri to regulate the access to resources by means of instituting the band system.

One can also align with Moser (1963) and perhaps with Nabhan (2003) who has proposed one of the largest Seri ranges in all literature, the range starts at Guaymas, Sonora, and ends in Baja California, circumventing the Sea of Cortez. The range also penetrates into the mainland almost to Ures, Sonora.

Amongst all of these speculations, there is one thing that every researcher on Seri culture has for certain; the near extinction of the Seri around the mid 1950s (Figure 57).

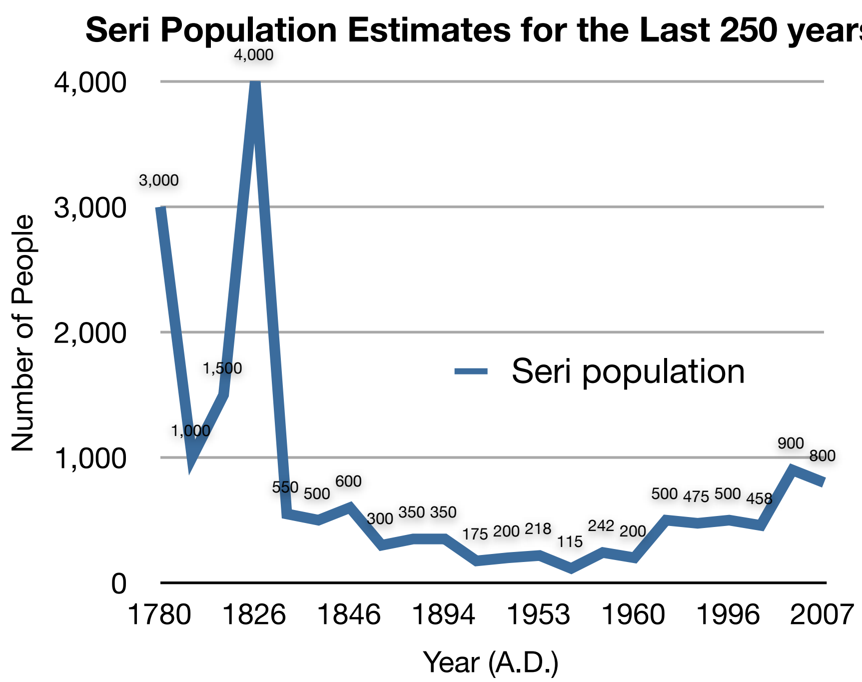

Figure 57. Fluctuation of the Seri population since the time of first contact with Europeans. Generated from Table X presented on Chapter 3.

The relatively recent collapse of the seri population may well explain the collapse of the Seri band system. This collapse can also explain why do knowledge tests scores between the perceived lines of ancestry are so similar.

In the 1930s the few Seris remaining started to settle, reducing their range and in consequence the diversity of the resources they could access. In an environment so rich and diverse, it is very likely that those groups that used to populate the most remote areas in relationship to the settlements in Bahía Kino, were not able to obtain all of their resources. The disjuncture between these people and their customary foods and medicines forced them to learn from those that were more familiar with the area, thereby homogenizing their ecological culture.

Before these events, the Seri had fought a long-lasting guerrilla war with Mexicans and Spaniards alike. As mentioned in Chapter 2, the Seri were not alone in this war, and kept a state of intermittent aggregation and alliance with surrounding

Tubutama, Oquitos, Lower Pimas, Yaquis, and Apaches alike. These alliances provided the different factions not only with a greater manpower to be used belligerent campaigns. It also provided a grater dispersal and sharing of ecological knowledge as these posses had to hide in several different environments of the Sonoran desert. The idea is not new, it has previously been recognized that the movements of people from place to place brings hybridize and transform cultures and knowledges (Clark and Murdoch 2002).

These notions of a hybrid culture have happened at least three times in Seri history. The first time, it happened in a passive and gradual manner, when the Seri traded hives and salt for edible botanicals with neighboring groups. The second time during the ephemeral alliances of the Indios cimarrones, with its acme in the adoption and enculturation of Coyote Iguana, the most famous of the Seris. At this time, after centuries of inter-ethnic war the bands were collapsing. Lastly, in recent times, in which the remaining Seri unified in a single group.

The processes of hybridization homogenized the pharmacopoeia of those groups that traded and had later roamed the desert together while forming alliances. The evidence of this homogenization can be seen in the large amount of species that these groups, share in the form or remedies with similar or exactly the same posologies (Zolla 1994; Moreno-Salazar, et al. 2008).

Margarita Artschwager-Kay (1977) has proposed that it is the Jesuits who created and disseminated an overarching herbal therapy throughout the Sonoran desert with the aid of a compilation of remedies edited in the *Florilegio Medicinal* 250 years ago. Her claim; that related and unrelated indians alike show a great degree of consensus on ailments, medicinal plant species, and modes of preparation thanks to Jesuit missionaries may be truth for those herbs imported from Europe. However, it cannot account for the fishermen of Baja California Sur (Encarnación and Contreras 1992) who fight the same ailments with marine remedies prepared under the same posology that was reported by Felger and Moser (1974) for the Seri. The latter tend to sail offshore to Baja California when the catch is not good on the Sonoran side of the Sea of Cortez. Furthermore, her account is not considering a historical perspective in the economic dynamics of these societies, which she treats as if living in a pre-Columbian social vacuum.

If imitation (Dawkins 1999) and socialization (Ellen 1979) are the ways in which we are enculturated in a particular language, religion, accent, scientific paradigm, and if the contact of different societies leads to hybridization of cultures, inter and intra-group similarities for the ethnomedicinal of the Sonoran desert societies can be explained in terms of exposition to knowledge. To do so, I have treated ethnomedicinal knowledge as an infection, based on the outbreak model proposed by Munz *et al.* (2009).

The assumptions of my modified model are:

3.There is only one way to get ethnomedicinal knowledge, to be exposed to it -to be enculturated on it.

4.There are three basic classes of individuals:

a) Susceptible to enculturation (S)

b) Enculturated (E)

c) Not enculturated (NE)

There is one liminal state in which susceptibles can become ‘infected’ (I) with ethnomedicinal knowledge.

5.Susceptibles can become enculturated by becoming in contact with ethnomedicinal knowledge. Susceptibles can become in contact with ethnomedicinal knowledge but never assimilate it.

6.Not enculturated are individuals who have not been in contact with ethnomedicinal knowledge because they rejected this knowledge willingly.

7. The recruitment of individuals for the population (or birthrate) remains constant.

The basic model can be understood with a flowchart (Fig. 58).

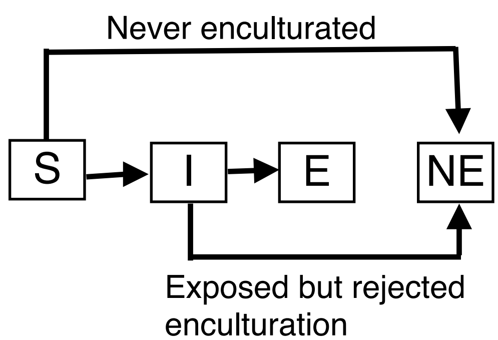

Figure 58. Basic enculturation model flowchart.

If we assume that Seri bands were real political entities at some point in history, the basic model for ethnomedicinal knowledge is capable of explaining why did do people with different reported line of ancestry present similar knowledge tests scores. When the bands collapsed, people merged into a single group and learned from each other.

The model is also capable of contesting Berlin’s (1992) proposition that according to the polytypy ratio of folk genera the Seri are a devolved horticulturalist society. Berlin's position is based on the sound argument that the structure of the systems of ethnobotanical classification are a direct result of the degree of modification of plants and animals by the process of domestication. There is clear evidence that this, a 80:20 ratio of polytypy, is the case for a great number of societies in the world (Berlin 1972; 1973; 1976; Geoghegan 1976; Brown, et al. 1985).

What is not clear are the mechanisms that allowed the Seri to devolved into taxonomically proficient hunter-gatherers.

I argue that the different groups inhabited 4 different vegetation types of the Sonoran Desert at one point of history (see Chapter 2). These regions are characterized not by punctual distinctions, but by a gradient of vegetational change. This gradient is reflected in subtle varietal changes that correspond to latitude. In addition, the human groups more familiar with the midriff islands were in contact with plants that were strongly related to those of the mainland but had diverged slightly because of the founders' effect propelled by their geographic isolation. The different Serian groups contracted and expanded during the colonial era. On the one hand, these bands of renegades brought in new members from other vegetational regions. On the other hand, since these bands roamed in search for refuge, it is almost certain that some of the members were alien to the vegetation areas visited. Both situations confronted these people with enculturation (Fig. 59) and given the varietal gradient of plants, polytypy occurred.

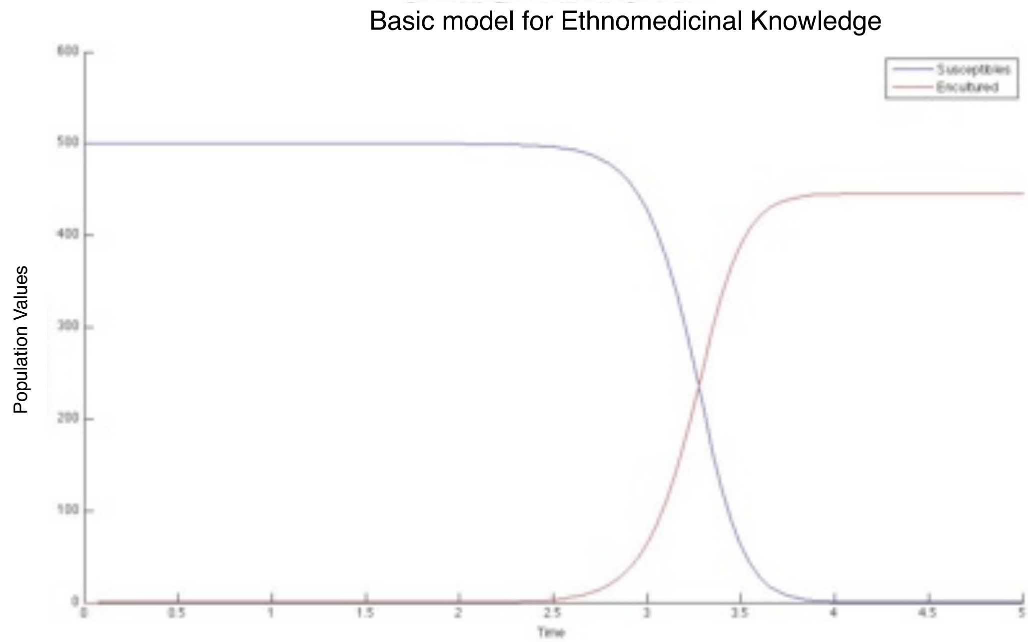

Figure 29. Basic model for ethnomedicinal knowledge propagation. The enculturated are quickly transformed and enculturated take over. Note that the propagation is rejected by some of the susceptibles, whose numbers never reach those of the original population. (modified from Munz et al. 2009).

When the Seri finally settled and formed one village, the different knowledge and experiences hybridized, forming their current ethnobiological system of use and classification. The ethnobiological system is constantly suffering modifications given the market integration processes that have been occurring since the early XX century. It is important to note that these modifications, as the preceding ones have homogenized the knowledge of the different lines of ancestry.

Seri monotypic to polytypic genera ratios are anomalous, not because of a devolution in their subsistence strategy, but by virtue of the collapse of the Seri bands and the rise of the contemporary ethnic group.

Teacher

Having a teacher is better for increasing ethnomedicinal knowledge than learning by oneself. These results show no difference between the proficiencies of the informants regardless of the teacher. These observations correspond to those of the homogenized knowledge between the lines of ancestry but are contradictory to a number of empirical findings (Cruz-Garcia 2006; Martinez-Rodriguez 2009) on horticultural and agricultural societies.

Teacher and Ancestry

When I tested the teacher versus ethnomedicinal knowledge test scores while controlling for ancestry interesting results were obtained.

In spite of no statistical significance, the contrast between Figures 18 and 19 evidences a marked difference in teacher ratios.

There are, without a doubt, many actors involved in enculturating others in Seri ethnomedicinal knowledge. These numbers may correspond to the various individual life histories of the informants. However, The constant pattern between MEKT and TEKT shows that the enculturation in Seri ethnomedicinal knowledge is gender specific. Mothers, usually performing tasks that are related to plants and plant gathering will enculturate on terrestrial plant medicine. Fathers, normally consumed fishers will enculturate their children in marine related issues.

This sole result may well explain why there are only 14 references to marine ethnomedicine inside the diverse and thick corpus of the Human Relation Area Files (see Chapter 1).

I do not have enough evidence to claim that there are two different formal institutions governing over the same knowledge. Clearly, ethnomedicinal knowledge is transmitted by two different channels.

Similar gender splits for knowledge has been observed in other coastal hunting-gathering groups such as the Inuit of Kangiqsualujjuaq who teach line-fishing matrilineally and knowledge about fishing with nets and spears through a patrilineal conduit (Heyes 2007).

Toxicity

For toxicity, both types of ethnomedicines behave in the same way. The greater the number of uses, the more toxicity they posses against *A. salina*. This suggests that Seri select marine and terrestrial organisms with a strategy based on toxicity. The most toxic organisms are then used to experiment on different ailments. Whenever there is a broad spectrum effect, the organism is considered to have more than one use, usually antibiotic. The relationship between toxicity and number of uses contradicts the observations of Berlin *(1999)* who found that the greater number of uses a plant has, the less active it is.

It is very likely that these variations have to do with the bioassay. First, it can be argued that the field method outputs a tendency, not a real LC_{50} measure. Nonetheless, whether tendency or real concentration, the regression should be sufficed with the data. Second, the *A. salina* bioassay has complicated biochemical routes and sometimes interesting LC_{50} levels are perceived at very small concentrations *(Trotter and Logan 1986)*. I could not achieve small concentrations with the field method given the logistic limitations. Third, and most important, there is a great biochemical difference between killing *A. salina* and inhibiting the growth of microbes. This can be seen in the work of Almeida-Alves *et al. (2000)* in which 42 Brazilian plants are contrasted against many organisms, including *A. salina*, gram positive, and gram negative microbes. The extracts of ten different plants exhibited some kind of effect on all the microbes but not against *A. salina* and thirty-four of the plants exhibited high bioactivity against at least one microbe, but not *A. salina*. Broad spectrum antibiotics will perform poorly against particular bacterial strains, but successfully against *A. salina*. In a parallel situation.penicillin, one of the most ‘miraculous’ of antibiotics, is not useful to treat gram-negative bacteria *(Plotkin 2000)*, and despite its more than fourteen uses *(Florey 1944; Putney 1944; Goldman and Guralnick 1948)*, would render negative results in strain specific bioassays.

Saliency and fidelity level of use

The lack of correspondence between both saliency and fidelity level of use when contrasted to toxicity is very noticeable as it defies the notions of cultural consensus and efficacy proposed by Trotter and Logan (1986). One would expect that the most efficacious plants were easily recognized by a culture as salient.

Felger and Moser (1974; 1985) draw attention on the excessive overlap and lack of consensus for most of Seri ethnomedicines. It is very likely that these overlaps plays some part in diluting saliency. A second factor that is, without a doubt, playing an important role in biasing the results is the sample size used on the toxicity test. With only sixteen organisms contrasted against a tenfold of answers resulting from the free-listing exercise, the linear model looses resolution.

Using data from Narchi's *(2003)* antibiotic tests of Seri marine ethnomedicine, and combining it with my saliency indexes, I can infer a relationship between consensus and bioactivity (Fig. 60) as the one described by Trotter and Logan *(1986)*. Nonetheless, the data is too meager to be conclusive.

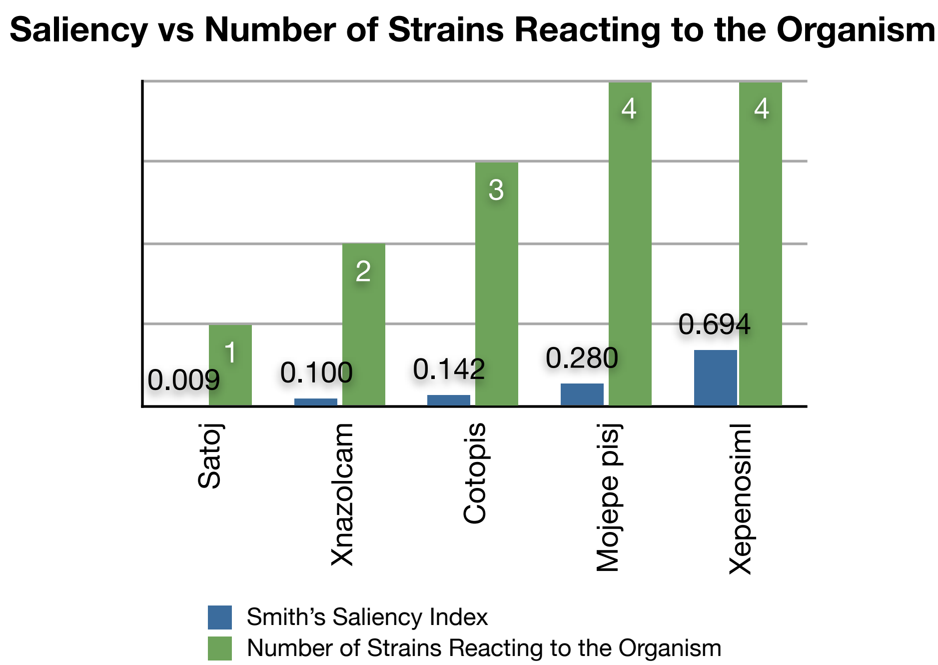

Figure 60. Seri marine medicine reacting to four bacterial strains (S. aureus, B. subtillis, E. coli, and P. vulgaris) in relationship to Smith's cultural saliency index.

Flavor and toxicity

For Levi-Strauss, the 'primitive' scientist comprehends nature by observing its obvious properties (Wiseman and Groves 2002). Flavor is no exception and that is why humans group tobacco and grilled stake in one sensible and intelligible group (Lévi-Strauss 2003 [1962]).

One of the most obvious organoleptic groups is that of ethnomedicines (Etkin 1988). Biologically active ethnomedicines are detected by the characteristic smell and taste of the compounds that give them their characteristic bioactivity (Johns 1999). The flavor most strongly associated with bioactive compounds is bitterness (Schultes 1979; Johns 1990; Elisabetsky 1991; Huffman 2001; Bennett 2007). The data shows that with the Seri there is no exception. The Seri conform to observations in other groups and the results are faced with the same problems. for instance, Etkin and Ross (1982) note that for the Hausa, there is a strong association of astringency, pungency, or bitterness with the efficacy of ethnomedicines. Seri have a category for acrid flavors; **ccotp** and a category for bitter flavors **caacat**. These categories are hard to distinguish. Figure 23 shows that the level of consensus in perceived flavor drops as bioactivity increases, except **xepenosiml** which is considered not edible despite being reported on several occasions as a Seri ethnomedicine. The organisms grouped under the categories of **ccotp** and **caacat** (Figure 53) are grouped in a tight bunch in terms of their toxicity, suggesting that it is indeed flavor which has created two intelligible groups of medicines regardless of their terrestrial or marine origin. Flavors the level of consensus of animals having these flavors (Figure 52). The organisms grouped under these two flavor categories are also related in terms of the amount of consensus on their perceived flavor. All of them, with the exception of **caasol** posses fidelity levels smaller or equal to fifty percent. The case of caasol is not a mystery, the binomial name of the plant; **caasol caacat**, may give a hint to the informants when the flavor of the plant comes into the conversation.

Chapter summary and conclusions

Ethnomedicines have allowed researchers to expand our scientific understanding of human health, biodiversity conservation, evolutionary medicine, human ecology, and cognition. However, insight towards these and other areas of knowledge related to ethnomedicines has inclined to the study of terrestrial botanicals. Whenever animals and animal by-products emerge in a medicinal system, it is seen as a mere curiosity, as an anomalous and isolated inclusion. These' anomalies' are attributed to the specific features of cultural systems and the important ideological role that a given animal species plays on the cosmogony of a given group.

I conducted this research to answer why is animal-based medicines seen as a sporadic occurrence within ethnomedicinal systems. In order to do so, I used an extreme case, that of marine-based medicine. It was my greatest expectation that the profound environmental differences between terrestrial botanicals and thalasso-fauna could provide with enough evidence to prove that all the elements within a pragmatic and non-spiritual ethnomedicinal system conform to the same principles. I measured organism naming ability and use knowledge among Seri adults from two villages. I hypothesized that there were significant institutional differences between the two types of ethnomedicine. I also looked at the toxicological and organoleptic properties by which these ethnomedicines are chosen.

I used 5 algae, 4 halophytes, 9 marine invertebrates, 1 marine reptile, and 13 terrestrial plants as visual stimuli to elicit organism name, use, flavor, and mode of preparation. In this exercise 72 informants participated and 67 were considered as a final sample.

The results show that marine and terrestrial ethnomedicines are affected differently by the sociodemographic profile of the study population. Age, and literacy level affect both MEKT and TEKT. Marital status, adults per household, monthly income, and reported line of ancestry, on the other hand, do not exert an effect on any of the two knowledge test scores. I speculate that the lack of effect of the reported line of ancestry has to do with the near extinction of the Serian groups and the subsequent hybridization of the surviving individuals into one single society.

Number of infants per household, household, and wealth have a significant effect on MEKT. The former has no clear explanation. The effect of households suggest a village effect but the data may be biassed due to the small amount of people interviewed in **Socáaix.** Nonetheless, it is almost a truism that different households will have stronger ties towards the ethnomedicine. The effect of wealth can only be understood in terms of the effect of gender. Gender exerts an effect over TEKT but not over MEKT. Women have higher plant knowledge scores. The difference has to do with the gender-driven division of labor in the Seri culture. The former explanations would contradict what happens with MEKT, as men are the fishers and seafarers. However, close to 28% of the marine ethnomedicines are used exclusively for women purposes.

Wealth obeys these gender-driven divisions as women can gather terrestrial medicine with more ease than marine, and this easiness may encourage them to try what they have in hand instead of investing in a trip to go to the doctor. Marine medicine, being less accessible, is seen as effort demanding, and people that can afford going to the doctor outside of the village may well prefer this investment.

The persons who teach ethnomedicine exert no effect in their pupils' MEKT or TEKT except when the informant has learned from nobody. However, the gender and relationship of the teacher is very important in arguing that marine ethnomedicinal knowledge is transmitted patrilineally and terrestrial ethnomedicinal knowledge is transmitted matrilineally.

In terms of toxicity, the marine and terrestrial organisms behave in similar ways. Those organisms with a great number of different ethnomedicinal uses are more toxic against *A. salina.* The toxicity has no relationship with saliency or level of consensus in use. However, there is a trend that may correlate saliency with efficacy against microbial strains. The organoleptic properties of the organisms have the same relationship with toxicity for marine and terrestrial ethnomedicines. Bitter ethnomedicines cluster together in tight groups when contrasted with their toxicity. Marine ethnomedicines conform to the same organoleptic and toxicological principles that govern botanical ethnomedicine. These findings suggest that humans seek animal-based and botanical ethnomedicines with aid of the same biological and cognitive mechanisms. These medicines are part of one mental category and it is social conduits and not the environment, what makes the split between marine and terrestrial knowledge.

CHAPTER 5: CONCLUSION

"I dreamed that Haxaat was behind Miguel's house. Haxaat was talking to me. Haxaat has no mouth, but I know it was talking as it was moving its branches and leaves. It told me that my ancestors used its fruits when they had to walk far away. They placed the fruit inside their mouths and kept chewing to produce water. That is why they never got tired nor thirsty. The plant also told me that my ancestors used its sap.
In this dream I see a very old man, he is sitting. He is haxaat. I saw a lot of people and I saw the weapons of the old man. This was my dream."

I.M. primary informant. **Haxöl lihom**, 2008 (Translation mine)

The Seri ethnomedicinal system can be divided into two different realms; 1) the ethereal or supernatural realm, in which Seri people learn how to use and manipulate the spiritual world. Inside this realm, just as IM's description of a dream illustrates, people are instructed in the ways to use medicinal plants and animals in a pragmatic way, and 2) the mundane or practical realm which is initially associated with the ethereal realm to seek knowledge and ask for the aid of supernatural beings. The ethereal-mundane bond is eroded after the knowledge has been sought and the former realm becomes totally pragmatic and dissociated from any active supernatural mechanisms.

Throughout this research I have focused on the second realm to elucidate the differences between Seri marine and terrestrial ethnomedicinal knowledge.

The mundane realm is 1)highly pragmatic in the sense that there is no other explanation on the efficacy of the remedies other than "because [] it [] works" (Felger and Moser 1974 :415), 2) relatively free of the Arabic-Hippocratic-Galenic influence brought to the continent after European contact (see Foster 1987; Foster 1994; Messer 1996) since the medical system is not bounded by the hot/cold illness dichotomy (Felger and Moser

1974; 1985), and 3) it does not depends on a figure of authority since the application of remedies is a personal and individual practice (Felger and Moser 1974; 1985).

The aforementioned characteristics make it an ideal ethnomedicinal system in which to study the differences between ethnobotany (Harshberger 1896) and zootherapy (Costa Neto 1999) given the fact that the variation in the individuals proficiency in ethnomedicinal knowledge tests is determined solely by their individual life stories and enculturation.

Findings

Specific findings of this research show that Seri mundane ethnomedicine is selected and sorted accordingly to the toxicity of the medicinal organisms. Marine and terrestrial organisms with higher toxic potentials against *Artemia salina* are used against a battery of ailments. In addition, marine organisms with high cultural saliency levels are capable of inhibiting a broad spectrum of microbes. Flavor plays an important role in detecting the most toxic organisms. Organisms with bitter, acrid, and tart flavors are characteristically associated with high toxicity levels against *A. salina.* These findings suggest that marine and terrestrial ethnomedicines are selected by using the same organoleptic and cognitive strategies.

Observing that the toxicological profiles of marine and terrestrial ethnomedicines behave in the same way one could anticipate that regardless of the environment from which the ethnomedicines are sought, they are part of an overarching medicinal system and therefore they should be associated in the same direction and with similar magnitudes with socio-demographic variables.

Literacy level shows a negative association with ethnomedicinal knowledge. The variable is closely liked with the degree of market integration an outside influence over the Seri settlements.

Age is directly associated with proficient ethnomedicinal knowledge. Older people acquired ethnomedicinal knowledge at a time of incipient market integration. Thus, they had to rely more on the natural resources of the Seriland. Nonetheless, the punctual data for age can be masking a gradual acquisition of knowledge. Longitudinal study is needed to distinguish between age effects and secular trends (Godoy, et al. 2006) in Seri ethnomedicinal knowledge acquisition.

Monthly income has no association with ethnomedicinal knowledge scores. These results may be due to the low variability of income within the sample. Marital status shows no association with ethnomedicinal knowledge test scores either. These findings take into account the presence of widows in the sample. When widows are excluded from the analysis, married people have significantly higher scores than single individuals, which might indicate that interacting with a partner adds a component to the process of ethnomedicinal knowledge acquisition. An alternative explanation is that people with higher scores are more likely to get married, but again longitudinal study would be required to distinguish these explanations.The effect is not observed in TEKT.

The reported line of ancestry has no association of ethnomedicinal knowledge. I had hypothesized that the the proficiency level in the ethnomedicinal tests would be associated with the lines of ancestry given that the different Seri bands would presumably occupy different ecological environments within the Seriland. These findings can be interpreted in the light of recent Seri history as the remaining Seri merged into a single society and their range became smaller. These aspects acted in synergy potentially extinguishing some Seri lines of ethnobiological knowledge and hybridizing the surviving.

The findings related to gender and ethnomedicinal knowledge test scores show an interesting relationship. Women had significantly higher ethnomedicinal knowledge scores than men when asked about terrestrial ethnomedicine. No significant difference was observed between genders when informants were asked about marine ethnomedicines. A first approach may suggest that gender division of labor influences the proficiency in terrestrial ethnomedicine but not in marine ethnomedicine. Further exploration of the findings suggests that as much as 28% of marine ethnomedicine is exclusively used to alleviate feminine conditions. I refer to this type of remedies as hysteramedicines.

The contrast between identity of the teacher and informants' ethnomedicinal knowledge bear no significant association. It is important to note that while informants get enculturated by various different teachers, mothers have a significant role in teaching terrestrial ethnomedicinal knowledge. An equally perceivable role is played by fathers in regards to marine ethnomedicinal knowledge.

It is common to think that Seri mundane ethnomedicinal knowledge can be split into two different pharmacopoeias based in the environmental origin of the organisms. In addition, the two categories react differently to socio-demographic factors, an element that could allow further support for this position.

While tempting, the division may be an arbitrary one imposed from our cultural notions, as remedies from the marine and terrestrial environments display the same behavior in terms of toxicity and Seri people have selected them by following precisely the same organoleptic cues. The Seri pharmacopoeia is unitary since the organisms are selected under a same toxicological and organoleptic strategy, and even though it is covert, there is a basal theory of what organisms would make good medicine. Furthermore, any other split -e.g. dicotyledonous vs monocotyledonous, infra-littoral vs supra-littoral, etc.. will show variations when contrasted against socio-demographic variables, simply because at least two different organisms [treatments] are subdued to the same statistical analysis.

The real separation in Seri mundane ethnomedicinal knowledge obeys a gender-driven division of labor. Traditional roles of men and women get them closer to one or the other environment and make them more familiar with one of the elements of a unified pharmacopoeia. The division is not as structured as to say that Seri ethnomedicinal knowledge is divided and administered by two institutions. Nonetheless, this division is evident enough to argue that there is one ethnomedicinal knowledge and two conduits of transmission.

Further directions

General aspects of non-plant medicine

The use of non-plant organisms in traditional pharmacopoeias has been left out of the mainstream ethnobiological research since the early beginnings of the discipline. Presently ethnobiologists concerned with the ethnomedicinal use of animals have found intellectual contentment in one-dimensional explanations such as Marques's (1994) universal zootherapeutical hypothesis - which states that all human cultures presenting a medical system will utilize animals as remedies. Rephrasing Marques; people use animals as medicines simply because they have an established medical system, as if animal use was given *de facto*. Ethnobiology at large, and particularly ethnomedicine, needs to tests if the selection of therapeutic non-plant organisms adhere to the strategies used in detecting plant-based ethnomedicines. The results will result in interesting conclusions regarding the universality of the selection strategies and the cognitive processes involved. These findings will contribute directly to ongoing discussions in human evolution and health. Moreover, there is also a need to explore if the gender-based generation of ethnomedicinal knowledge transmission conduits is widely disseminated and not particular to the Seri. Pursuing the latter will contribute not only to better realize how to identify and select informants but also to build complete pharmacopoeias inclusive of non-plant elements. Pharmacopoeias with a larger and more diverse sets of life kingdoms will describe more comprehensive mechanisms of human adaptation and manipulation of the environment.

Marine ethnomedicine

Specific to marine organisms it should be pointed out that the current state of fisheries and the overall health of the marine environment has called for new conservation schemes and mechanisms. These new conservation efforts fall short of fulfilling their goal because they are conceived to respond rapidly to a perceived state of emergency. As such their planning and implementation occurs *ipso facto* despite meager sociodemographic and biophysical information (Kelleher and Recchia 1998), limiting the definition of stakeholder to those economically active in the area (see

Cudney and Turk 1998; Fuentes and Vázquez 2003) or those empowered by concessions made by the state (see Walker, et al. 2007; Cinti, et al. 2010). Marginal but active actors are left out from the sample universe.

If marine ethnomedicines have not even been detected by scientists, how can the interests of their users be presented to the authorities concerned with planning and implementing the conservation strategies?

Furthermore, among these new conservation schemes, one of the most pervasive is the growing tendency to privatize natural resources to preserve them (Vogel 1994; Mcafee 1999; Büscher 2008).

The 'neoliberal' solution to environmental conservation has been conceived without noticing that there are a great number of marine elements in coastal ethnopharmacies (see Chapter 1). Thus, the privatization of marine areas will, as it does in terrestrial environments, restrict the access of coastal communities (FAO 2005), usually the economically marginal, to relatively inexpensive resources that have always been part of their health systems. As no-fishing zones and private ownership of marine areas continue to develop we will see the same distancing between dominant discourses of biodiversity conservation and the postures of social movements in much the same way as described by Escobar (1998). In the end, poor information equals poor policy (David and Brian 2004).

In the long-run marine ethnomedicines will also be affected by climate change. The most inflammatory of predictions; that the sea levels may rise several meters may not be as concerning as medium-term consequences of climate change. As ocean temperatures change, there will be a large scale redistribution of species, especially in the southward margins of semi-enclosed seas (Cheung, et al. 2010). Moreover, as the amount of CO_2 increases in the atmosphere, the rate of abundance (as dictated by Henry's law) in the oceans increases as well. The uptake of of CO_z by the oceans alters their pH through the formation of carbonic acid (Pauly 2009). The presence of an excess of carbonic acid affects the saturation state of calcium carbonate (Doney, et al. 2009), an essential chemical used by shellfish, echinoids, corals and phytoplankton to form their carbonate shell (Caldeira and Wickett 2003; Hoegh-Guldberg, et al. 2007). Redistribution of marine stocks and ocean acidification will affect the availability of the marine alimentary and medicinal resources known by coastal communities.

Seri ethnomedicine

In their remarkable ethnography on a Seri pharmacopoeia, Felger and Moser perceive that ethnomedicinal knowledge was eroded as early as 1974. Their statement comes from the observations that people stopped using local remedies and substituted these for allopathic medicine. Almost forty years after Felger and Moser's work, I was able to find remnants of Seri ethnomedicinal knowledge. Unfortunately, the data are not sufficient to run a comparative analysis on the prevalence of this knowledge. There is also a lack of data on the rate of use of each remedy. When people were asked: **¿In tactim?** 'have you used it? The response was usually yes. However, there is no corroboration to these affirmations. Thus, I cannot conclude whether the remaining knowledge is practical or theoretical and if these conditions change from organism to organism. What I can claim with absolute certainty is that Seri mundane ethnomedicinal knowledge is still transmitted to younger generations. In the case that the Seri wish to preserve their ethnomedicinal knowledge, it would be very useful to construct a model of cultural transmission that will enable them to incorporate a parallel scheme into their formal schooling system.

The socio-demographic variables presented here were not intended to describe a complete model, but to identify the differences and similarities between marine and terrestrial ethnomedicines. Therefore, these variables are not enough - and sometimes not appropriate- to construct a lineal model on Seri ethnomedicinal knowledge transmission.

A new battery of variables should be incorporated to further research in order to develop a suitable model of knowledge transmission. It is priority to measure the amount of time allocated to resource gathering and outdoor activities. It will also strengthen the linear model to illustrate its flow throughout the community by using genealogical trees.

As discussed in Chapter three, Seri culture has undergone a tremendous amount of change in the last two centuries. These changes reach a crescendo with the final settling of the remaining Seris in the village of **Haxöl Iihom** and the overt inclusion of the Seri in a regional and national economy. With these changes, Seri people have renegotiated how they relate to and depend of their environment.

In recent years, the changes in the ever-conflictive Mexican northwest have been more intense and dramatic. On the one hand, the Mexican northwest experiences a growing occurrence of para-economic forces consequential of proximity with the international border. Ortega-León (2007) describe the conditions as characterized by transhumance, clandestinity, and hermeticism. These characteristics provide a complete spectrum of illegal occupations that are further described by Ortega-Leon as a mythological bestiary of <u>cazadores,</u> <u>pollos,</u> <u>burros,</u> <u>pericos,</u> <u>gallos,</u> <u>and</u> <u>cuernos de chivo.</u> An easily noticeable influence of these factors and bestiaries is perceived inside the Seriland. It is present in the way people talk, in the communal fears, and in the occasions that the anthropologist is looking somewhere else.

On the other hand, the intervention of environmental conservation groups, federal institutions, and academic researchers have lead the Seri to renegotiate once again their relationship with the natural resources of the Seriland. Once seen under a mere extractive lens, these resources are now integrated into Seri economy under a different category of assets. Presently, the Seri are motivated, and most of the time compensated for preserving mangrove, cacti, sea turtles, and sea pen shell beds among others. These projects are diverse and planned by different organizations. Some aim at being sustainable, others have the intention to transform resources in no-touch assets.

Seri are surrounded by relatively pristine marine and terrestrial areas, in part because of the aforementioned conservation efforts. Young Seri professionals are starting to graduate from Mexican universities and institutes with great expectations to apply their knowledge to preserve the Seriland. However, these reductions in natural resource extraction and changing lifeways are likely to be a cause of increasing rates of degenerative illnesses. The no-extraction schemes also pose a risk towards the extinction of experience in regards to local ethnobiological knowledge.

Having to decide between these economic trade-offs betweens management strategies, the Seri sometimes find themselves in a position of internal conflict and struggle that inevitably leads to reinventing their identity and just as with the emergence of ironwood carving, their belief systems. I cannot help but to be a distant observer since the most basic principle that anthropologists should follow is to recognize any culture's right for self-determination and autonomy.

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APPENDIX I QUESTIONNAIRE

1. **¿Zó ziix iic cöihiipe xepe com ano tiih ma ntaa?** 'Can you name all the medicine from the sea that you know?'

2. **¿Mos hehe án com ano tiih ma ntaa?** 'Can you name all the medicinal plants that you know?'

3. ¿**Me zo hant cayaxi ya?** 'What is your age?'

4. ¿Me quihiimet ya? 'Are you married?'

5. ¿Me az iyat cöimjc ya? 'For how many years have you attended a school?'

6. ¿Iti mi ha az iyat coimjc ya? 'Did your parents attend school?'

7. ¿Zo cyaxi ya inyaaco cop ano toii? 'How many people live with you?'

8. ¿Xica quiistox queej zo cyaxi inyaaco cop ano toii? 'How many adults live with you?'

9. ¿Xica quisil quih zo cyaxi inyaaco cop ano toii? 'How many children live with you?'

10. ¿**Tom zo cyaxi ya ntizi iizax cop?** 'How much money do you earn each month?'

11. ¿**__________** Zo ntyaa? 'Do you have **________**?'

12. ¿Me quihehe quij tom oaactim pac me tafp oxtpactamax? 'Do you receive any governmental aid in the form of money?'

Ethnomedicinal knowledge

13. ¿Ziix cha zon ta? 'What is this?'

14.¿Zot pai? 'What is its name?'

APPENDIX I - Questionnaire (continued)

15. ¿Az ihasijim ya? 'What do you use it for?'

16. ¿Zo tah pacta? 'How do you prepare it?'

17. ¿In tactim? 'Have you used it?'

Organoleptic qualities

18. ¿In tactim? 'Have you tasted it?'

19. ¿Zo ihapi amuta? 'What is its flavor?'

20. ¿Xica tacöl zo miiha itmis? 'Does this organism resembles any part of the human body?'

Knowledge transmission

21. ¿Zo cmique haqyux ti me tamx hehe iyat ziix icöiihipe? 'Who taught you plant medicine?'

22. ¿Xepe com ziix ano quiih quih me tamx? 'Who taught you about marine knowledge?'

23. ¿Me az iyat cöcoop ya? 'What is your line of ancestry?'

APPENDIX II - SALIENCY

Marine saliency

Item	Frequency (%)	Average Rank	Salience
xepenosiml	79.2	1.40	0.694
mojepe pisj	47.2	3.16	0.280
hapaj cosni	39.6	2.76	0.245
xnazolcam	26.4	3.93	0.100
cotopis	22.6	2.33	0.142
pyoque	13.2	2.29	0.098
heeesam	9.4	3.20	0.060
hamt itoozj	7.5	1.50	0.062
eaz	7.5	3.00	0.044
tacj oomas	5.7	4.33	0.036
moosni ipnail	5.7	2.33	0.041
hatam	3.8	2.50	0.031
haxˆl	3.8	2.50	0.021
xepe ano zaah	3.8	3.50	0.018
zix coaafp	3.8	2.00	0.025
zixcam	3.8	3.00	0.024
moosni	3.8	5.50	0.014
xpezoj	3.8	6.00	0.014
satoj	1.9	6.00	0.009
spitj	1.9	3.00	0.006
seepol	1.9	2.00	0.015
pnacoj acaiz	1.9	8.00	0.004
zixcam canj	1.9	5.00	0.010
zamt	1.9	5.00	0.011

Item	Frequency (%)	Average Rank	Salience
zixcam coospoj	1.9	2.00	0.017
zixcam ihaxi iiziix	1.9	1.00	0.019
xepe yamaasij	1.9	2.00	0.014
xnois	1.9	8.00	0.002
xtiip	1.9	5.00	0.006
xpanams	1.9	2.00	0.014
xpetc	1.9	9.00	0.002
zixcoaafp	1.9	1.00	0.019
cataamax hapx	1.9	2.00	0.009
cataamax hampx	1.9	9.00	0.004
chig¸ili	1.9	2.00	0.014
coos	1.9	3.00	0.006
coosotoj	1.9	2.00	0.015
caanj	1.9	3.00	0.006
alga calcarea	1.9	2.00	0.017
canj ixaaj	1.9	5.00	0.008
can coospoj	1.9	2.00	0.013
canj	1.9	7.00	0.006
pnaacoj ixai	1.9	5.00	0.008
oxquiim	1.9	10.00	0.002
otacj	1.9	4.00	0.013
moosni ixaaj	1.9	7.00	0.003
pajocsim	1.9	7.00	0.006
pnaacoj	1.9	4.00	0.008
hacˆzj	1.9	1.00	0.019
hecoj	1.9	4.00	0.009
haxˆl ixaamataj	1.9	7.00	0.003
iyaaz	1.9	3.00	0.015

Item	Frequency (%)	Average Rank	Salience
iij	1.9	6.00	0.003
istalca	1.9	5.00	0.004

Plant saliency

Item	Frequency (%)	Average Rank	Salience
haaxat	66.7	3.67	0.499
xoop	50.8	5.13	0.313
xescl	42.9	5.07	0.284
xomcaift	39.7	6.24	0.218
xoop cacˆl	38.1	5.50	0.228
hehequinla	34.9	6.95	0.169
xtisil	25.4	5.56	0.169
xomete	22.2	5.79	0.128
sea	20.6	5.15	0.097
heepol	20.6	5.62	0.127
caasol	20.6	6.08	0.139
xcocoj	17.5	6.45	0.101
heejac	17.5	8.64	0.075
xaasj	15.9	6.30	0.088
cotj	15.9	4.50	0.114
xazacˆz	14.3	6.22	0.072
haas	14.3	5.56	0.074
satoml	12.7	7.38	0.059
haaca	12.7	11.25	0.031
cos	12.7	7.25	0.072

Item	Frequency (%)	Average Rank	Salience
xcoa	11.1	10.43	0.055
xomxeziz	11.1	11.43	0.025
tinl	9.5	6.33	0.054
xopinl	9.5	5.50	0.048
an icˆs	9.5	7.83	0.048
coozi	9.5	10.83	0.038
comihitin	9.5	8.00	0.055
pnaacol	7.9	13.60	0.014
hejac	7.9	13.00	0.024
xtinl	7.9	5.40	0.066
seepol	6.3	2.25	0.048
caoj	6.3	7.50	0.021
eaxt	6.3	5.25	0.047
hehe yapxˆt cmhaasol	6.3	6.25	0.022
totjoc	4.8	4.67	0.031
haxzoocmoj	4.8	4.00	0.031
aniux	4.8	8.00	0.011
spitj cooxp	4.8	6.67	0.032
mojepe siml	4.8	5.00	0.026
xnejam sictoj	4.8	10.33	0.013
spitj	3.2	12.50	0.016
tisil	3.2	5.50	0.019
hexac	3.2	12.00	0.013
coti	3.2	7.00	0.016

Item	Frequency (%)	Average Rank	Salience
cset	3.2	8.50	0.015
haat	3.2	4.50	0.015
ziij	3.2	9.00	0.022
comihitin yapxˆt	3.2	5.00	0.008
chicura	3.2	1.50	0.029
haxeat	3.2	3.00	0.021
hapsx iti icoocax	3.2	6.50	0.020
hataj iipol	3.2	18.50	0.007
mas	3.2	6.50	0.011
hant ipxz itija	3.2	3.50	0.026
opuntia	1.6	4.00	0.011
pnaˆl	1.6	3.00	0.014
sapatx	1.6	4.00	0.012
ool	1.6	15.00	0.007
yapxˆt	1.6	7.00	0.010
xnazolcam	1.6	1.00	0.016
ziix is ccapxl	1.6	4.00	0.008
siml	1.6	8.00	0.006
spitj cacˆl	1.6	21.00	0.005
xhaasjl	1.6	12.00	0.001
tanoopa	1.6	2.00	0.013
xaosj ipxasi	1.6	11.00	0.003
ziizahox	1.6	4.00	0.011
haas hahoj cacat	1.6	4.00	0.006

Item	Frequency (%)	Average Rank	Salience
haasizcinal	1.6	4.00	0.013
coteziix seq itiquij	1.6	1.00	0.016
coot	1.6	19.00	0.004
hant cocpeetij	1.6	15.00	0.007
hahjˆ hihaxat	1.6	7.00	0.010
hamisj	1.6	6.00	0.011
hahjoistj	1.6	13.00	0.003
hap iphapxeen	1.6	6.00	0.009
amisj	1.6	20.00	0.003
andipz jitija	1.6	14.00	0.007
ajopiyani	1.6	6.00	0.003
comaanal	1.6	3.00	0.012
cap yaail	1.6	18.00	0.001
anipz jiptija	1.6	2.00	0.014
caasol ziih ic coiipe	1.6	2.00	0.013
auj	1.6	10.00	0.002
nujcaazc	1.6	3.00	0.012
hhaasahcapjo	1.6	7.00	0.010
istalca	1.6	16.00	0.003
hepool	1.6	3.00	0.010
hehe yapxˆt	1.6	1.00	0.016
nim	1.6	2.00	0.014
izaahox quih aqueect	1.6	3.00	0.012

Item	Frequency (%)	Average Rank	Salience
monjeziz	1.6	6.00	0.005
mangle	1.6	5.00	0.005
hasahcapok	1.6	13.00	0.001
heecle	1.6	3.00	0.010
heecoj	1.6	6.00	0.005
hatajeen	1.6	10.00	0.006
hasahpoj	1.6	12.00	0.010
hehe cuanj	1.6	9.00	0.011
hehe cozlil	1.6	9.00	0.009
heel ixai	1.6	5.00	0.012
hehe con cooxp	1.6	28.00	0.002
hehe con cheel	1.6	29.00	0.001

APPENDIX III TOTAL NUMBER OF USES REPORTED FOR THE STIMULI MATERIALS

1. Healing injuries
2. Increase sexual potency
3. Epilation
4. Fights fatigue
5. Heals cancer
6. Heals venereal diseases
7. Heals diabetes
8. No use
9. I don’t know
10. Treats disenteria
11. Stops menstrual flow
12. Heals sprains
13. Alleviates rheuma
14. Heals swelling
15. Treats infections
16. Treats a sore throat
17. Contraceptive
18. Heals wounds caused by a stingray
19. Treats seasickness
20. Treats gastritis
21. Heals sores
22. Treats a cold
23. Treats coughs
24. Treats diarrhea
25. Makes one run faster
26. Sunblock
27. Used by **ziix haaco cama**
28. It is good / it is benign
29. Treats fever
30. Alleviates toothache
31. Eyewash
32. Baldness treatment
33. Alleviates anemia
34. Treats tuberculosis
35. Rash treatment
36. Poisonous
37. Good for the heart
38. Heals spider bites
39. Fights smelly feet
40. Shampoo
41. Treats kidney ailments
42. Treats pinta
43. Heals gumboils
44. Alleviates stomach ache.
45. Lowers cholesterol levels
46. Alleviates ear pains
47. Alleviates heat stoke
48. Heals burns

APPENDIX III (continued) - Total number of uses reported for the stimuli materials

49. Heals horses with heat exhaustion

50. Weight loss aid

51. Fights headache

52. Alleviates pain

53. Treats menstrual cramps

54. Taboo

55. Eliminates phlegms

56. Extends life

57. Lowers high blood pressure

58. Erases wart

59. Cures epilepsy

60. Kills lice

61. Alleviates constipation

62. Improves vision

63. Fortifying tonic to be used after partum

64. Helps deworm

65. Laxative

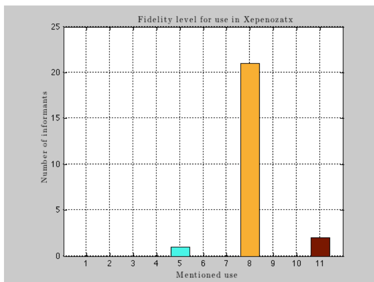
APPENDIX IV - TOTAL NUMBER OF REPORTED FLAVORS REPORTED FOR THE STIMULI MATERIALS

1. Bitter
2. Sweet
3. Sour
4. Acrid/Tart
5. Unripe
6. Like water
7. I don't know
8. Tasteless
9. Not edible
10. Good
11. Salty

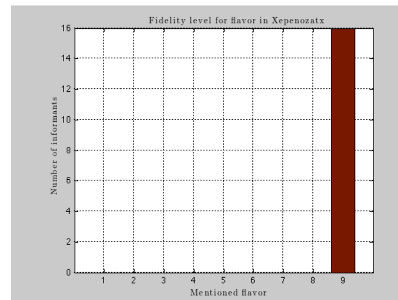
APPENDIX V FIDELITY LEVEL ANALYSIS RESULTS

Appendix 5 - Fidelity level analysis results

Xepenozatx[1]

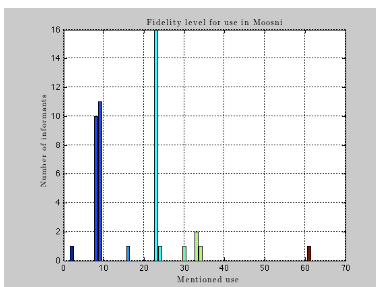


Fidelity level = 87.5

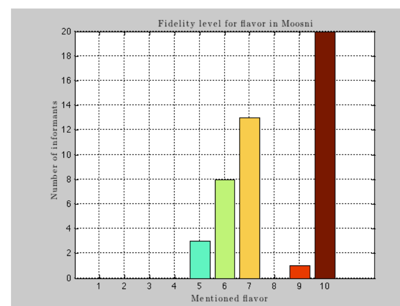


Fidelity level = 100

Moosni



Fidelity level = 35.55

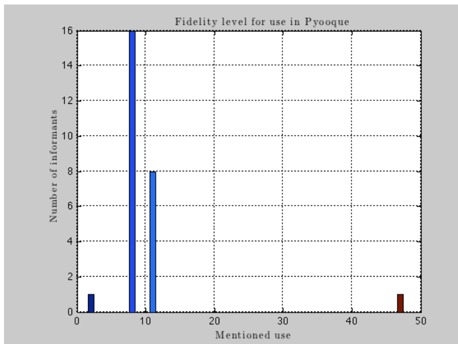


Fidelity level = 44.44

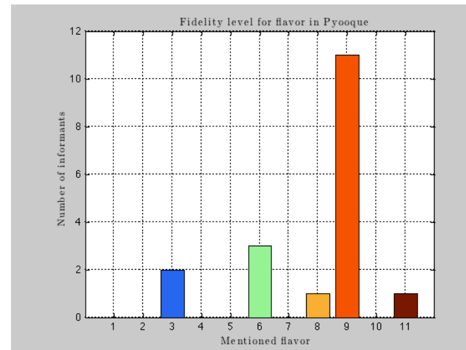
[1] To be interpreted with the use values from Appendix III and the flavor values of Appendix IV

Appendix 5 - Fidelity level analysis results

Pyoquee

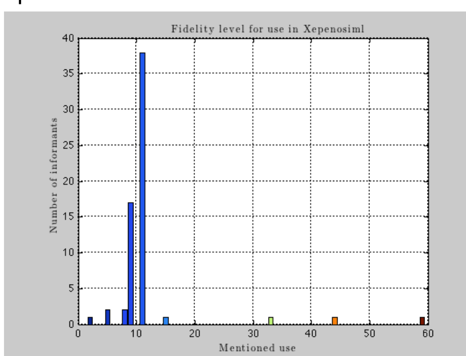


Fidelity level = 61.53

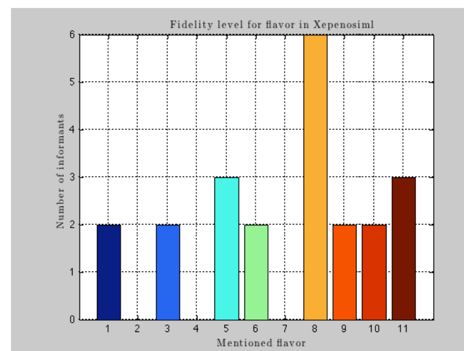


Fidelity level = 61.11

Xepenosiml



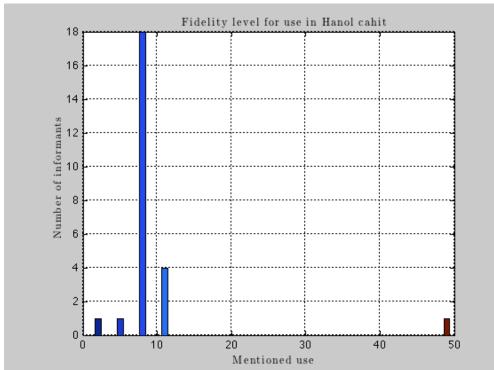
Fidelity level = 59.37



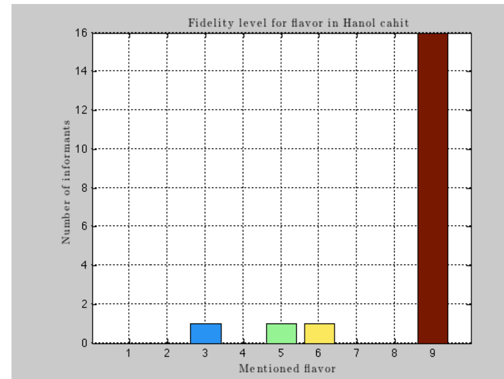
Fidelity level = 27.27

Appendix 5 - Fidelity level analysis results

Hanol cahít

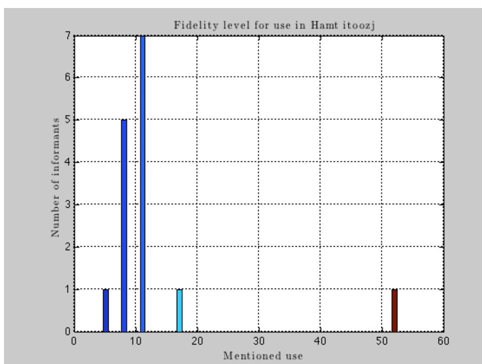


Fidelity level = 72

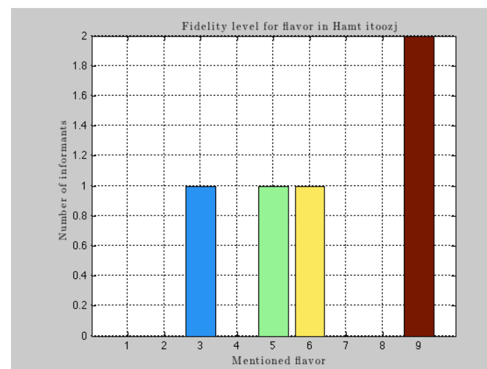


Fidelity level = 84.21

Hamt itooz



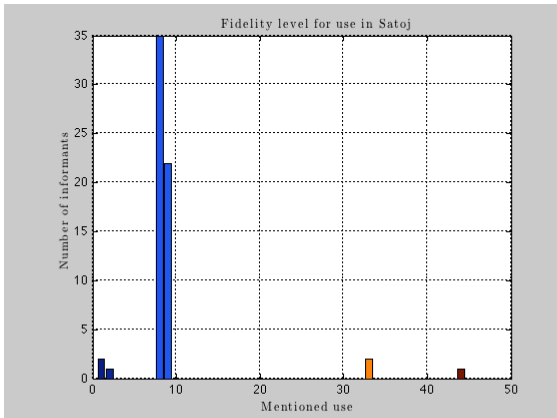
Fidelity level = 46.66



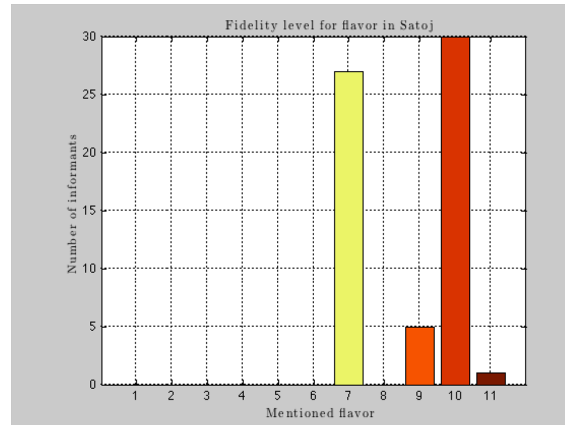
Fidelity level = 40

Appendix 5 - Fidelity level analysis results

Satoj

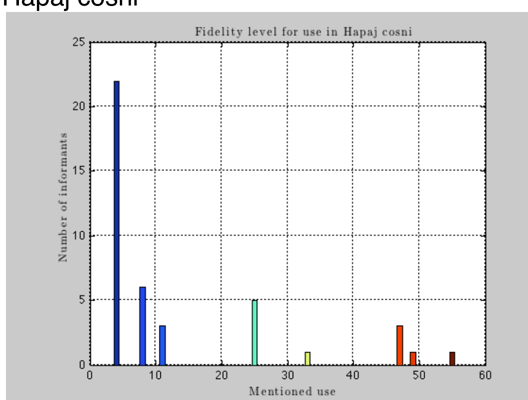


Fidelity level = 55.55

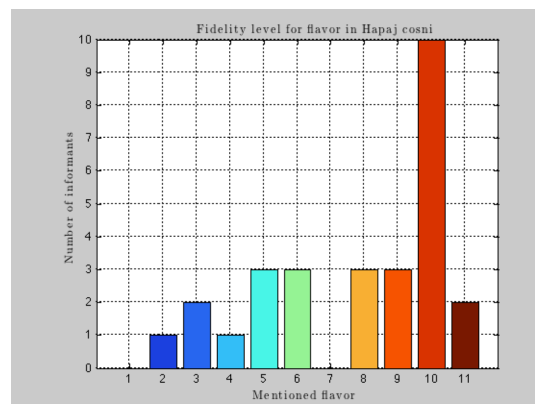


Fidelity level = 63

Hapaj cosni



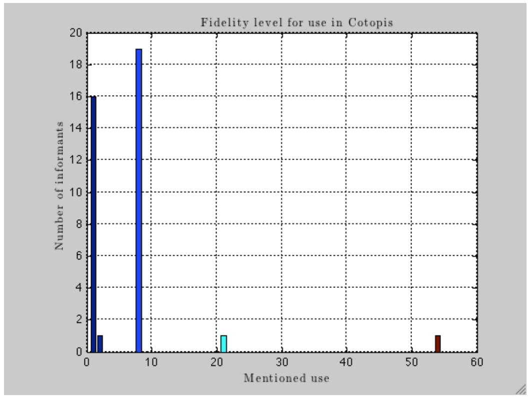
Fidelity level = 52.38



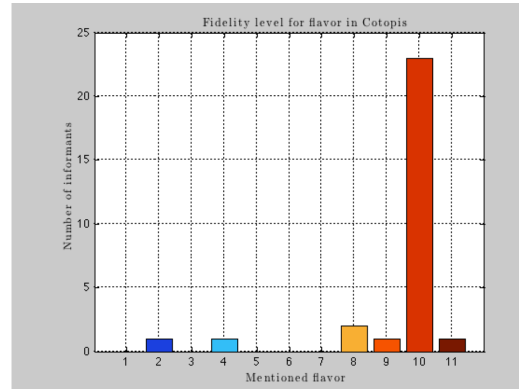
Fidelity level = 35.71

Appendix 5 - Fidelity level analysis results

Cotopsi

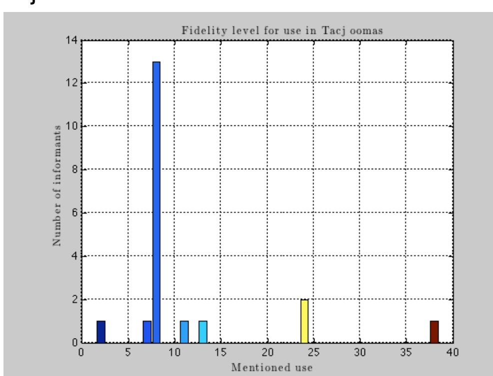


Fidelity level = 50

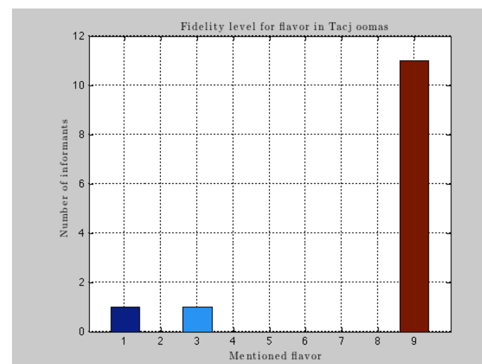


Fidelity level = 79.31

Tacj oomas



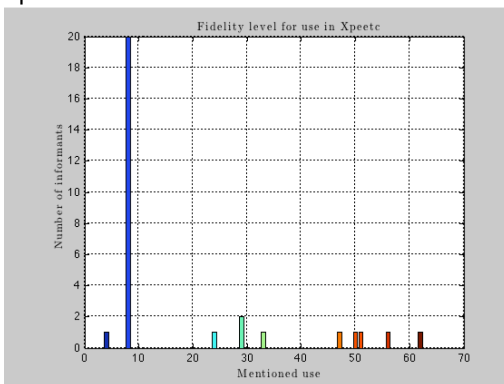
Fidelity level = 65



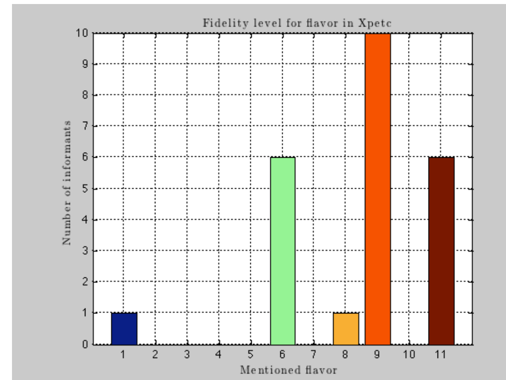
Fidelity level = 84

Appendix 5 - Fidelity level analysis results

Xpect

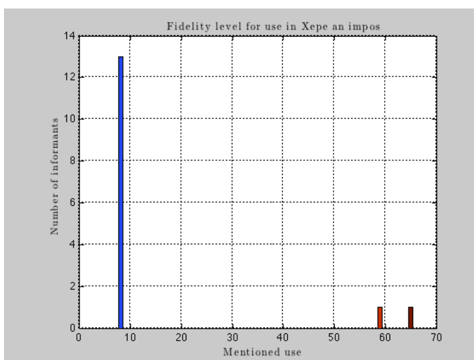


Fidelity level = 66.66

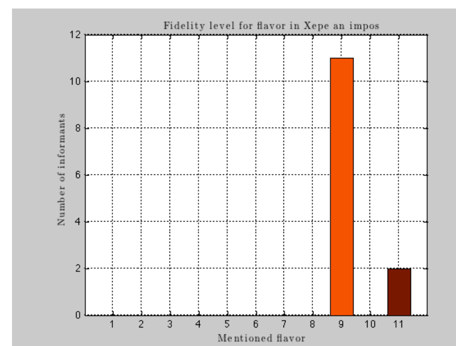


Fidelity level = 41.66

Xepe an impos



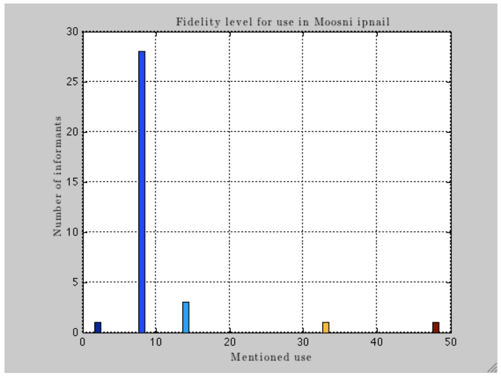
Fidelity level = 86.66



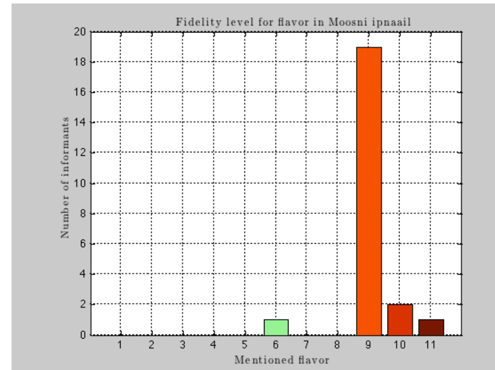
Fidelity level = 84.61

Appendix 5 - Fidelity level analysis results

Moosni ipnaail

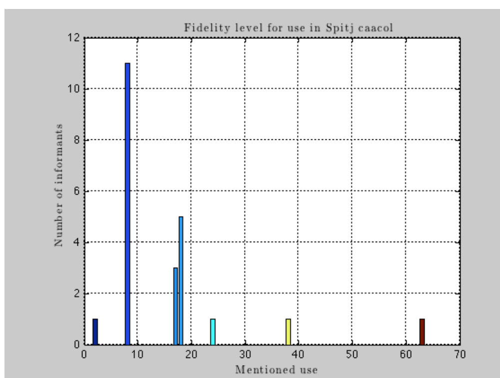


Fidelity level = 82.35

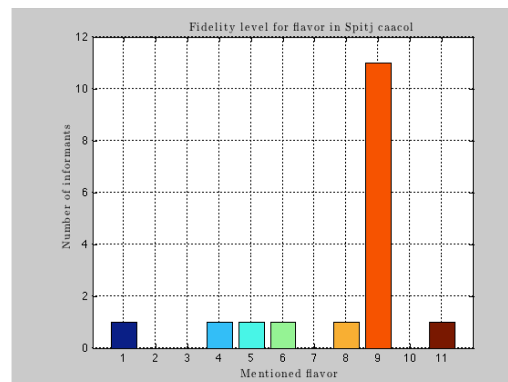


Fidelity level = 82.60

Spitj Caacöl



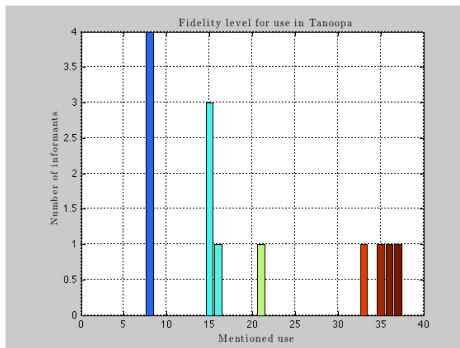
Fidelity level = 47.82



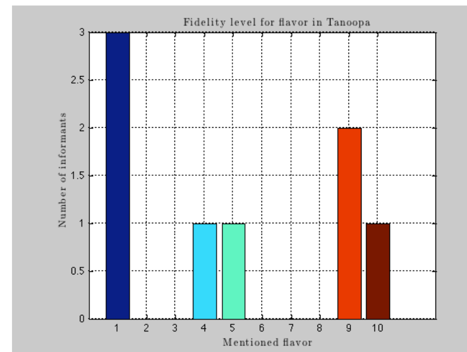
Fidelity level = 64.70

Appendix 5 - Fidelity level analysis results

Tanoopa

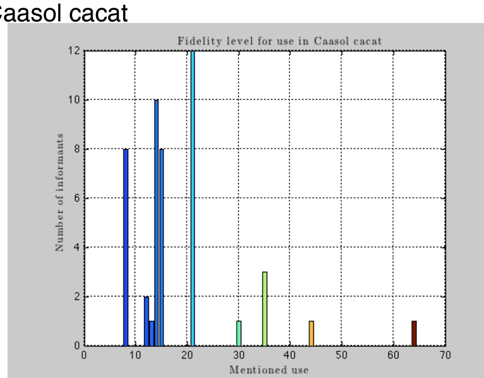


Fidelity level = 30.76

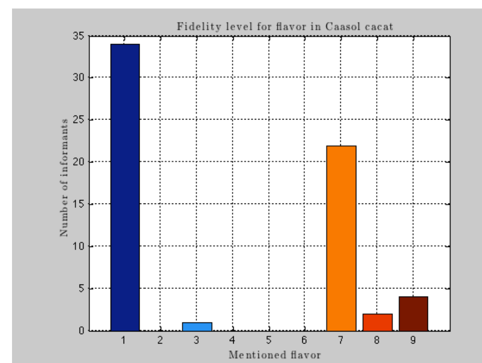


Fidelity level = 37.50

Caasol cacat



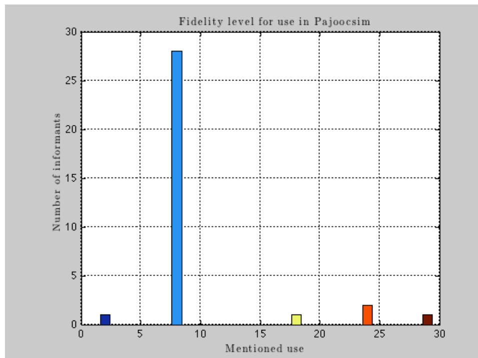
Fidelity level = 25.53



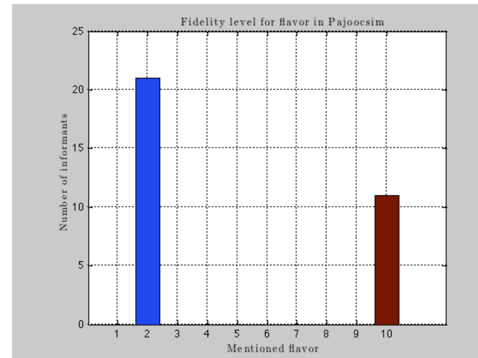
Fidelity level = 53.96

Appendix 5 - Fidelity level analysis results

Pajóocsim

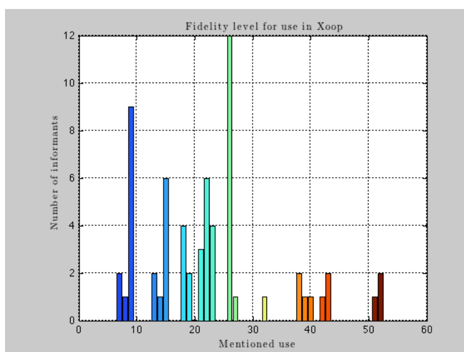


Fidelity level = 84.84

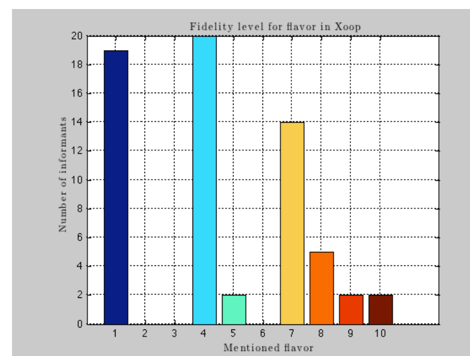


Fidelity level 65.62

Xoop



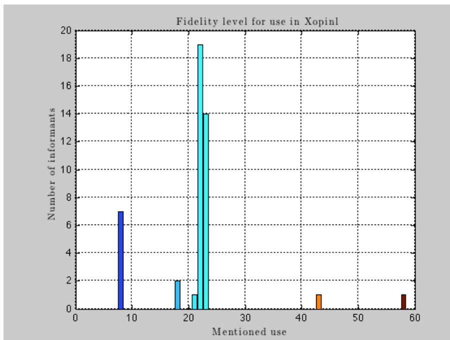
Fidelity level = 18.75



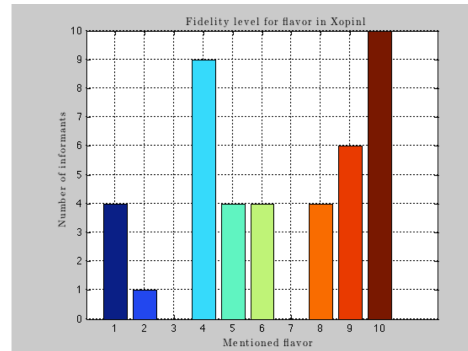
Fidelity level = 31.25

Appendix 5 - Fidelity level analysis results

Xopinl

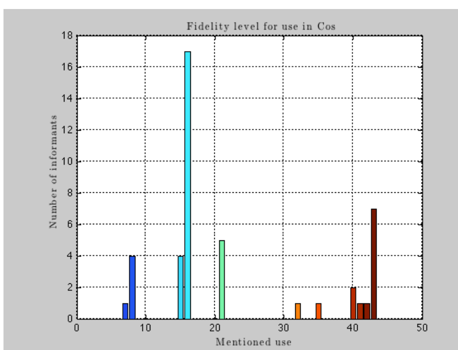


Fidelity level = 42.22

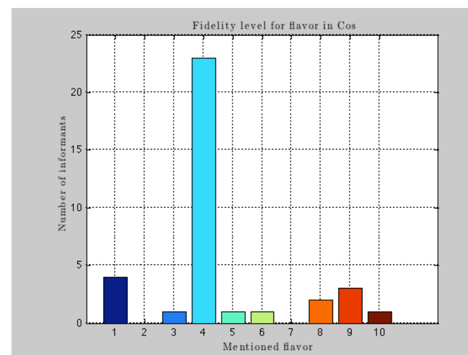


Fidelity level = 23.80

Cos



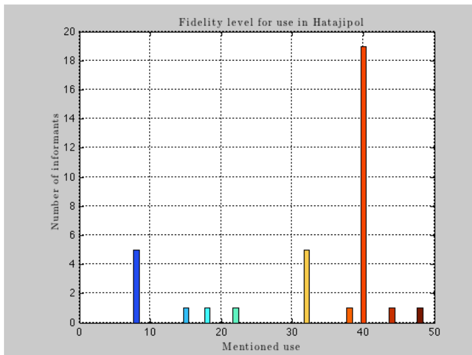
Fidelity level = 38.63



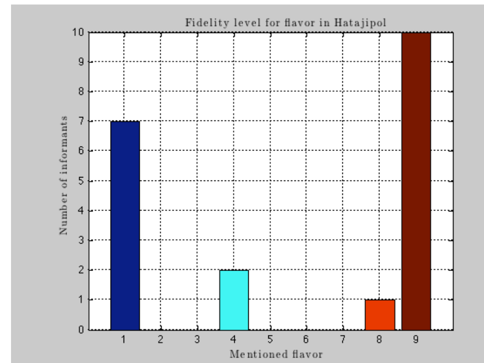
Fidelity level = 63.88

Appendix 5 - Fidelity level analysis results

Hatajípol

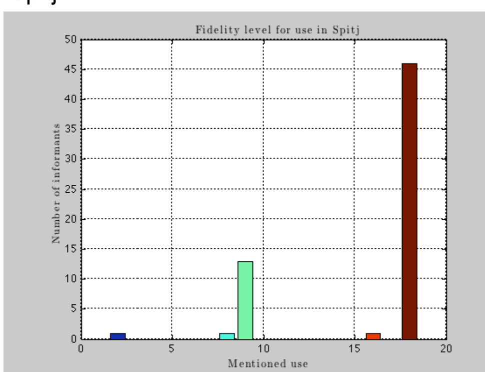


Fidelity level = 54.28

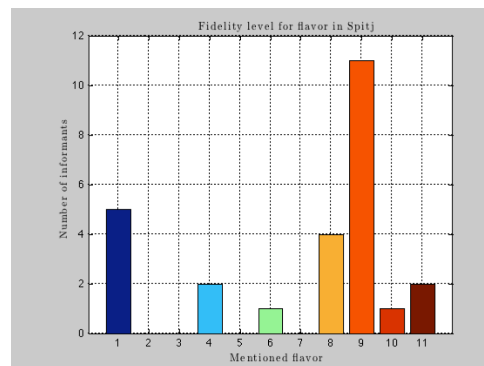


Fidelity level = 46.1538

Spitj



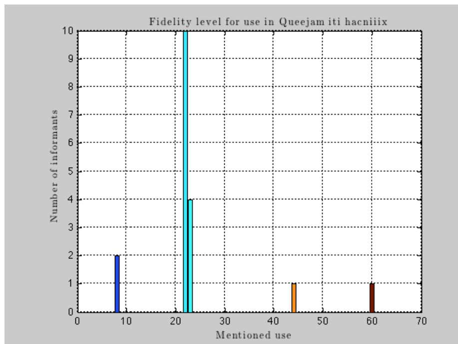
Fidelity level = 74.19



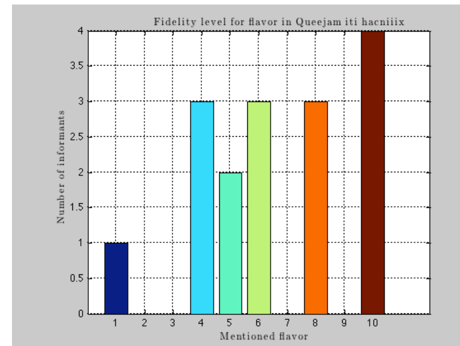
Fidelity level = 42.30

Appendix 5 - Fidelity level analysis results

Queejam iti hacniiix

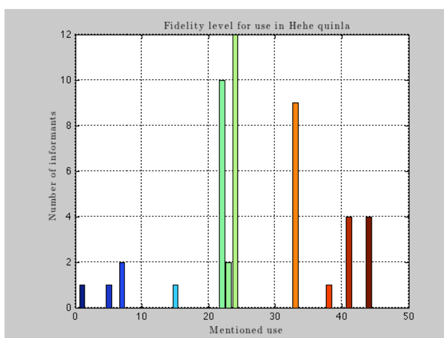


Fidelity level = 52.63

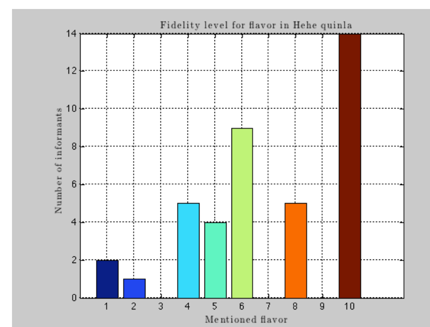


Fidelity level = 25

Hehe quinla



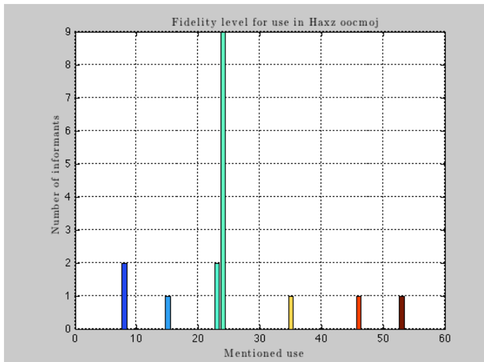
Fidelity level = 25.53



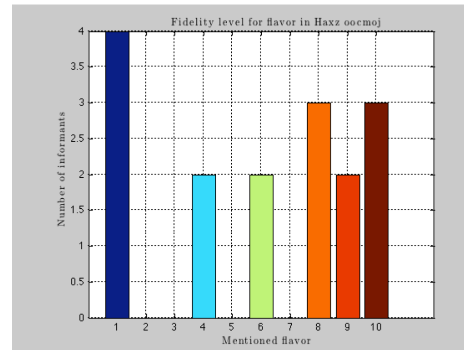
Fidelity level = 35

Appendix 5 - Fidelity level analysis results

Haxz oocmoj

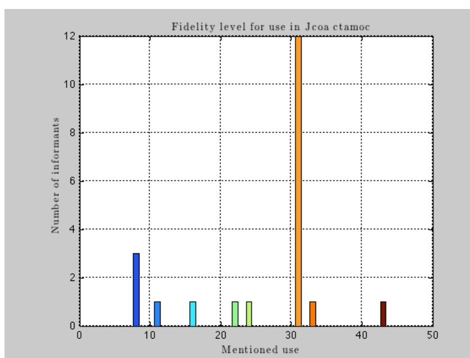


Fidelity level = 52.94

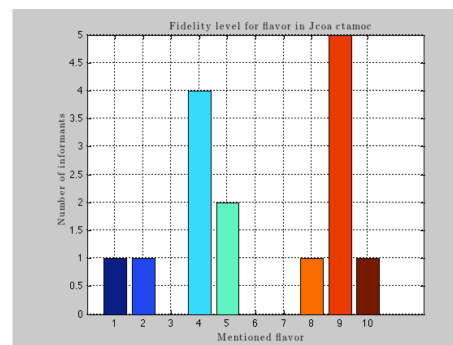


Fidelity level = 51.42

Jcoa ctamöc



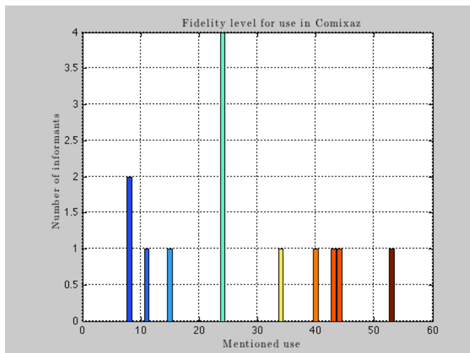
Fidelity level = 57.14



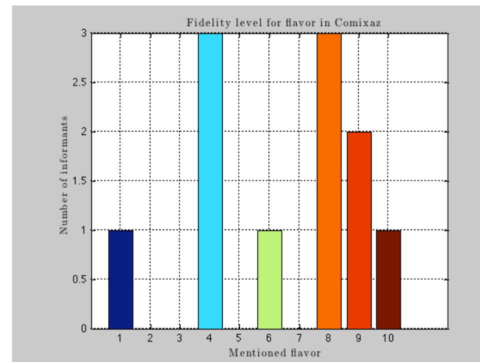
Fidelity level = 33.33

Appendix 5 - Fidelity level analysis results

Comíxaz

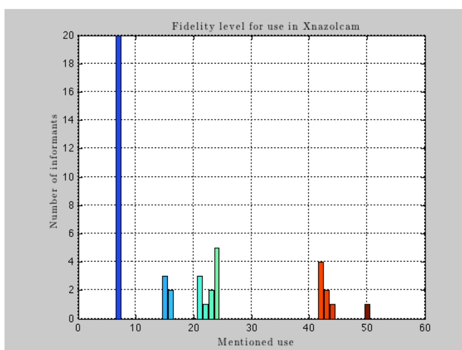


Fidelity level = 30.76

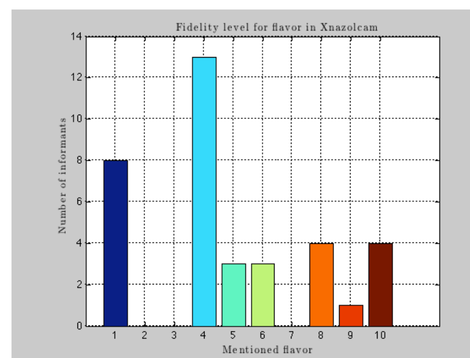


Fidelity level = 27.27

Xnazolcam



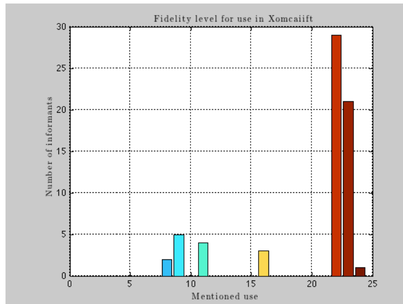
Fidelity level = 45.45



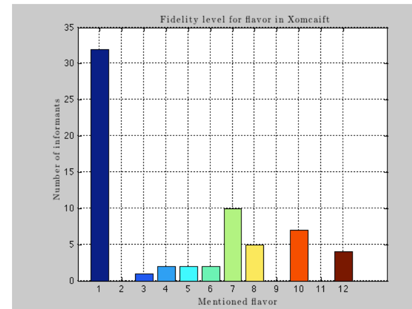
Fidelity level = 36.1111

Appendix 5 - Fidelity level analysis results

Xomcahíift

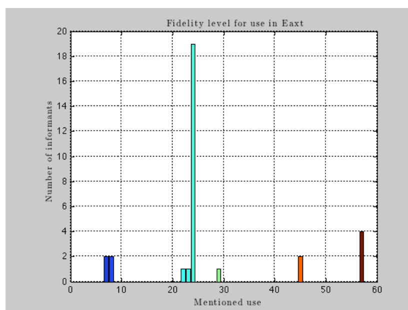


Fidelity level = 44.61

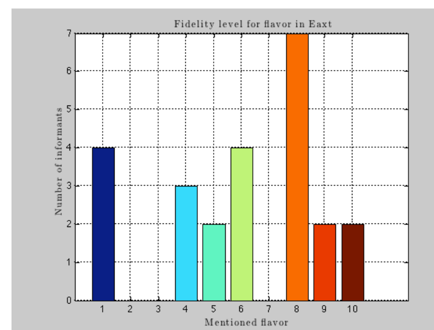


Fidelity levle = 49.23

Eaxt



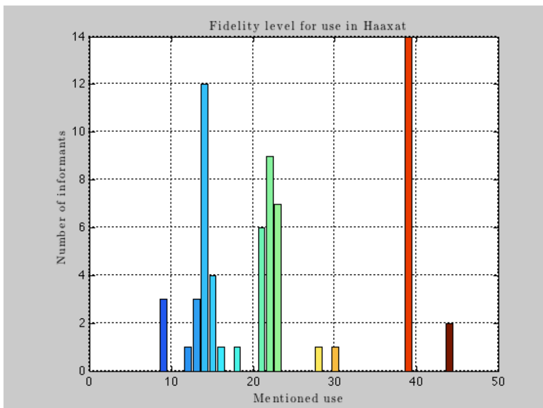
Fidelity level = 59.37



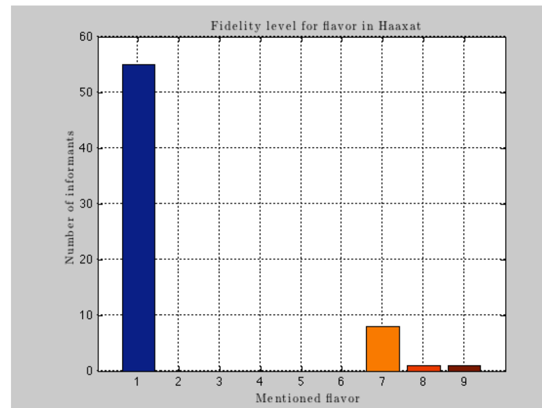
Fidelity level = 29.16

Appendix 5 - Fidelity level analysis results

Haaxat



Fidelity level = 21.53



Fidelity level = 84.61

APPENDIX VI Collection Permits

COMISION NACIONAL DE ACUACULTURA Y PESCA
DIRECCIÓN GENERAL DE ORDENAMIENTO PESQUERO Y ACUICOLA
DGOPA/08042/240709.- 2427

conapesca

SECRETARÍA DE AGRICULTURA, GANADERÍA, DESARROLLO RURAL, PESCA Y ALIMENTACIÓN SAGARPA

Mazatlán, Sin., a 23 de julio de 2009.
"2009, año de la Reforma Electoral"

OCEAN. NEMER EDUARDO NARCHI NARCHI
CERRO DE LA ESTRELLA No. 335
COLONIA: CAMPESTRE CHURUBUSCO
C.P. 04200 DELEGACIÓN COYOACAN, MEXICO, D.F.

Hago referencia al escrito de fecha 14 de junio del año 2009, mediante el cual el Ocean. Nemer Eduardo Narchi Narchi, Responsable técnico y Titular del permiso de pesca de fomento No. DGOPA.00964.040209.0279 de fecha 4 de febrero de 2009, para desarrollar el proyecto de investigación científica denominado **"Empapando la etnobiología; las interacciones etnobiológicas de los recursos marinos y terrestres entre los Comcáac de Sonora, México"**, en aguas marinas de jurisdicción federal del Océano Pacifico, solicita se amplié el número de especies a colectar en el permiso de pesca de fomento.

Sobre particular, tomando en cuenta la opinión técnica emitida por el INAPESCA mediante oficio No. HOO/INAPESCA/DGOPPN/ 0857 de fecha 20 de julio, le comunicamos a usted que esta Dirección General no tiene inconveniente de acceder a su petición, razón por la cual, con fundamento en lo dispuesto en los artículos 1o, 2o, 3°, 64°, de la Ley General de Pesca y Acuacultura Sustentables; 5°, 9°, 30 fracción I inciso b), 31 fracción II inciso c), 34, 69 y 71 de su Reglamento; artículos 3 fracciones XXI y XXII de la Ley Orgánica de la Administración Pública Federal; así como los artículos 37 y 39 fracciones III, VIII y XIII del Reglamento Interior de la Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación; así como en el artículo 191-A fracción II inciso c) de la Ley Federal de Derechos, esta Dirección General modifica la cláusula 3 fracción 1 donde indica el número y las especies de organismos a colectar del pesca de fomento mencionado, para quedar como sigue:

Nombre Común	Nombre científico	Nombre Común	Nombre Científico
Algas verdes	***Enteromorpha acanyhophora***	Pastos marinos	***Zostera marina***
	Codium simulanus		
	Codium amplivesticulatum		
Algas rojas	***Digenea simples***	Halófitas	***Salicornia bigelovii***
	Holymenia coccinera		***Sesurium portulacastrum***
	Cryptonemia aborata		***Abronia maritima***
	Padina durvillaei		***Batis mantina***
	Rhodymenia divaricada		***Atriplex barclayana***
			Suaeda nigra
Algas pardas	***Colpomenia tuberculata***		
	Galaxaura arborea	Moluscos	***Leucetta losangelensis***
Poliquetos	Eorothoé complanata	Crustáceos	***Artemia salina***
	Cloeia viridians		
Equinodermos	Luidia phragma	Moluscos	***Turbo sp.***
	Ophioderma panamenoe		***Madiolus capax***
	Phataria unifacialis		***Octopus sp.***
	Encope grandis		***Olivilla dama***
	Equinaster tenispinula		***Ptenia sp.***
	Strongylocentrolus purpuratus		***Perigliphtas sp.***

La colecta de 4 ejemplares durante todo el proyecto de cada una de las siguientes 32 especies.

Av. Camarón Sábalo S/N. Esq. Tiburón. Fracc. Sábalo Country. Mazatlán, Sin. 82100
Tel. (55) 9183 1000 Ext.1505, www.conapesca.sagarpa.gob.mx

ESTADOS UNIDOS MEXICANOS

SECRETARIA DE MEDIO AMBIENTE Y RECURSOS NATURALES

SUBSECRETARÍA DE GESTIÓN PARA LA PROTECCIÓN AMBIENTAL
DIRECCIÓN GENERAL DE VIDA SILVESTRE

OFICIO NÚM. SGPA/DGVS/ 08424 **/08**

MÉXICO, D. F., A 19 NOV 2008

"2008, Año de la Educación Física y el Deporte"

M. EN C. NEMER EDUARDO NARCHI NARCHI
UNIVERSIDAD DE GEORGIA
CERRO DE LA ESTRELLA No. 335,
COL. CAMPESTRE CHURUBUSCO,
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nnarchi@uga.edu

Considerando que ha dado cumplimiento a los requisitos establecidos para efectuar investigación y colecta científica de flora y fauna silvestres en territorio mexicano y con fundamento en el Artículo 32 Bis fracciones I, III, XXII, XXXIX de la Ley Orgánica de la Administración Pública Federal; Artículo 31, fracción VI del Reglamento Interior de la Secretaría de Medio Ambiente y Recursos Naturales; 79, 80 fracción I, 82, 83 y 87 párrafo cuarto de la Ley General del Equilibrio Ecológico y la Protección al Ambiente; Artículos 9º. Fracción XII, 97 y 98 de la Ley General de Vida Silvestre; 12, 123 Fracción III y 126 del Reglamento de la Ley General de Vida Silvestre; Artículo 85, Artículo 88, fracciones I y II, Artículo 105, frac3ciones II y III del Reglamento de la Ley General del Equilibrio Ecológico y la Protección al Ambiente en Materia de Áreas Naturales Protegidas (ANP´s); las disposiciones relativas de la Norma Oficial Mexicana NOM-126-SEMARNAT-2000, por la que se establecen las especificaciones para la realización de actividades de colecta científica de material biológico de especies de flora y fauna silvestres y otros recursos biológicos en el territorio nacional; la Norma Oficial Mexicana NOM-059-SEMARNAT-2001, protección ambiental-especies nativas de México de flora y fauna silvestres-categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-lista de especies en riesgo, la Dirección General de Vida Silvestre **autoriza** la licencia de colecta científica por proyecto, para desarrollar las siguientes actividades:

- Colecta de hasta cuatro (04) ejemplares por especie de **"escarabajos" de la Familia Versperidae (Orden Coleoptera)** y hasta cuatro (04) ejemplares por especie de **"mariposas" de la Familia Psychidae (Orden Lepidotera)**.

Con respecto, a las especies de hongos y flora que solicita colectar, mismas que no están en categoría de riesgo de conformidad con la Norma Oficial Mexicana NOM-059-SEMARNAT-2001, le comunico que con fundamento en el Artículo 1º. de la Ley General de Vida Silvestre, dicha solicitud queda fuera del ámbito de competencia de la Dirección General de Vida Silvestre, motivo por el cual deberá tramitar la solicitud ante la Dirección General de Gestión Forestal y Suelos, ubicada en Av. Progreso No. 3, Edif. 3, Planta Alta, Col. del Carmen, Coyoacán, Deleg. Coyoacán, C.P. 04100, México, D. F. Tel. 01 (55) 5484 35 68. e-mail: **dgforestal@semarnat.gob.mx**, para su autorización correspondiente

Las actividades se llevarán a cabo en **la Comunidad Comcáac (Seri), con ubicación en Punta Chueca, Municipio de Hermosillo y El Desemboque, Municipio de Pitiquito e Isla Tiburón, Estado de Sonora**. Esta autorización tendrá una vigencia de un (01) año a partir de la emisión de la presente autorización.

La presente se expide en apoyo a las actividades inherentes al desarrollo del proyecto denominado "**Empapando la Etnobiología: las interacciones etnobiológicas de los recursos marinos y terrestres entre los Comcáac de Sonora, México**", que llevará a cabo la Universidad de Georgia y la Facultad de Ciencias Marinas de la Universidad Autónoma de Baja California, **debiendo sujetarse obligatoriamente a las siguientes condiciones**:

1.- **Cumplir con las disposiciones Administrativas, Fiscales y de Sanidad exigibles por las autoridades competentes.**

1 de 3

Av. Revolución 1425, Nivel 1, Col. Tlacopac San Ángel,
Delegación Álvaro Obregón, C. P. 01040, México, D. F.
Teléfono 01(55) 56-24-33-09, Fax 01(55)56-24-36-42

APPENDIX VI (continued)

Ejido Desemboque, Sonora, a 29 de Mayo de 2009

A quien corresponda:

El 29 de Mayo de 2009 se discutió dar autorización de utilizar las medicinas tradicionales de la comunidad al C. Nemer Eduardo Narchi Narchi.

El C. Nemer Eduardo Narchi Narchi ha realizado una junta comunal abierta a todo el público con fecha 10 de Mayo de 2009. En esta junta ha explicado su proyecto a los asistentes, les ha informado de sus intenciones y ha hecho hincapié en los derechos que como comunidad e individuos tienen con respecto a sus recursos naturales y conocimiento tradicional.

Por medio de este documento, se acuerda:

1. Que el Comisariado Ejidal, por medio de este documento, autoriza al C. Nemer Eduardo Narchi Narchi a utilizar plantas medicinales **previamente colectadas por medicos tradicionales** por todos conocidos en nuestro ejido con el fin de usarlas como material de elicitación cognoscitiva para su tesis doctoral titulada **"Empapando la etnobiología: las interacciones etnobiológicas de los recursos marinos y terrestres entre los Comcaac de Sonora, México"**
2. Que las plantas pertenecen y se mantendrán dentro del ejido antes, durante y después de la prueba.
3. Que el C. Nemer Edurdo Narchi Narchi podrá transportar las plantas libremente y como mejor convenga mientras se encuentre dentro del Ejido Desemboque y su Anexo Punta Chueca.
4. Que al cabo de la investigación, las plantas serán devueltas a los medicos tradicionales que las colectaron y las que no sean aceptadas, serán depositadas en nuestra escuela primaria "Simón Bolivar" con el fin de que nuestros niños aprendan los usos y costumbres que se nos reconocen por derecho consuetudinario como es dispuesto por el Artículo 2 de la Constitución Política de los Estados Unidos Mexicanos.
5. Que el C. Nemer Eduardo Narchi Narchi se compromete a utilizar las plantas de que le hemos provisto con fines meramente académicos y sin fin de lucro o comercialización, sea esta de partes o para fines biotecnológicos. De faltar a este entendido, se procederá de manera legal y como mejor convenga en contra del arriba mencionado.
6. Que el C. Nemer Eduardo Narchi Narchi se compromete a entregar copia de todo documento resultante de esta investigación a los participantes de la misma, al comisariado ejidal, consejo de ancianos y gobierno tradicional Comca'ac.

Así, se autoriza al C. Nemer Eduardo Narchi Narchi a utilizar las plantas colectadas por nuestros médicos tradicionales, para que este las ocupe como material de estímulo a los informantes siempre y cuando las entrevistas se realicen dentro del Ejido Desemboque y su Anexo Punta Chueca, del cual no deberá salir el material en cuestión. El listado de plantas se encuentra anexo a esta hoja.

Israel Molina Romero
Presidente del Comisariado Ejidal

EJIDO
NACIÓN INDÍGENA COMCAAC
DESEMBOQUE
Y SU ANEXO PUNTA CHUECA
REGISTRO DFYFS-CR-EX-0412-SON
SONORA, MÉXICO

APPENDIX VI (continued)

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Este documento hace constar que el SR Nemer Eduardo Narchi Narchi depositó en la escuela primaria Guadalupe Victoria del Desemboque de los Seris, sonora, las plantas medicinales colectadas por medicos Tradicionales diversos dentro de la comunidad. Lo anterior con base en el Articulo 2 Constitucional y con el fin de que nuestros niños conozcan su herencia culteral.

SEC

Elisa Lorenia Romero Montaño.

ESC. "GUADALUPE VICTORIA"
CLAVE 26DPB0048X
EL DESEMBOQUE, PITIQUITO, SO.

Eliza Lorenia Romero
Directora