“Biocultural design” as a framework to identify sustainability issues in Río San Juan Biosphere Reserve and the Fortress of the immaculate Conception, Nicaragua

Claudia Múnera-Roldán

Final Report for the UNESCO MaB Young Scientists Awards
2013-2014
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ACKNOWLEDGMENTS

The first part for this project was done as part of the Master in World Heritage and Cultural Projects for Development, and I would like to extend my gratitude to my tutors Alessio Re and Aldo Buzzio, The Scientific Committee as well as to the Secretary of the Master Ms. Cristina Leonetti for all the help provided. To Professor Giangiacomo Bravo (Università di Torino) for his help and comments regarding the Commons approach for my project and also to all my classmates for their support and for making the experience a more valuable one.

The collaboration from the Nicaraguan UNESCO Commission was very important, especially the support from Claudia Valle.

A special acknowledgement to the members of the local communities in Rio San Juan with whom I had the opportunity to dialogue about the project, especially to Alfonso Tapia, Seyla Obregon, and all of them that help with the interviews and surveys; although some names will remain anonymous, my deep gratitude will be with them*.

Thanks to all the personnel from Ministry of Environment (MARENA) in Managua and the regional MARENA office in San Carlos.

A special recognition to Dr. Julian Idrobo (University of Manitoba) for his comments, and to Dr. Anja Nygren (University of Helsinki) for her valuable comments and for sharing with me ideas and documents about interpretation of local knowledge. I also extend my gratitude also to Dr. M. Bell from The Nature Conservancy - Oceans Program Director, for his comments via email on specific questions regarding communitarian fisheries management.

I want to recognize the financial support given by The Joke Waller-Hunter Initiative for Young Environmentalists for the grant awarded to me to attend the Master, and to Brian Czech (Center for the Advancement of the Steady State Economy) for his support to the nomination to the grant and last but not least to the MaB Young Scientists Award for this opportunity.

Field work for this work was made thanks to the financial support by UNESCO MaB for Young Scientists Awards and I also received support with equipments donated by Idea Wild.

*NOTE: I receive invaluable information and comments from local communities and from all the people that I interviewed in person or via email/skype; however I want to state that I remain as the only responsible for any errors or misinterpretation of the information presented here.
LIST OF ACRONYMS

AECID - Agencia Española de Cooperación Internacional para el Desarrollo
FUNDAR – Fundación Amigos del Río San Juan
IBA – Important Bird Area
INPESCA – Nicaraguan Fishing and Aquaculture Institute
INTUR – Nicaraguan Tourism Board
IUCN – International Union for the Conservation of Nature
MaB – Man and Biosphere Reserves Programme
MARENA – Nicaraguan Ministry of Environment
NGO – Non Governmental Organizations
OEA – Organization of American States
RAMSAR – Ramsar Convention on Wetlands
UNESCO – United Nations Educational, Scientific and Cultural Organization
TTOO – Tour Operators
WHS – World Heritage Site
“Biocultural Design” as a Framework to Identify Sustainability Issues in Río San Juan Biosphere Reserve and the Fortress of the Immaculate Conception, Nicaragua

Executive Summary

I focused in the identification of biocultural products and services in the community of El Castillo (MaB Río San Juan, Nicaragua) and its relationships with current livelihoods in the area. For this I followed Biocultural Design, a framework developed for sustainable development in rural indigenous/local communities that uses a biocultural heritage approach (Davidson-Hunt et al. 2012). Using this approach the idea was to identify the most relevant issues to be considered for a sustainable development at Río San Juan Biosphere Reserve, including both cultural and natural aspects that can enhance the well-being of local communities.

The Rio San Juan Biosphere Reserve in southeast Nicaragua is part of the Mesoamerican Biological Corridor, which spans from Mexico to Panama being a vast area of biological relevance that helps to guarantee the conservation of biodiversity and the mobility of focal endangered species as Jaguar, Tapir, Green Macaw, or Tarpon among others. The reserve that is named after the San Juan River has been recognized as a RAMSAR site, due its complex of inland and marine wetlands and the river itself. The core area of the MaB, the Biological Reserve Indio Maiz has been recognized as an Important Bird Area by BirdLife International. The Fortress of the Immaculate Conception, a potential World Heritage Site (here after WHS) is located here. This proposed WHS is of great significance in the Nicaraguan history since it was the defence line against the English Crown in the 18th century.

The biocultural design framework is intended to create teams of academics, practitioners and indigenous and local communities, in order to identify and develop those aspects that may enhance a sustainable development, considering aspirations and motivations of indigenous/local communities through a product/service innovation approach, based on cultural and natural diversity of a given place. The biocultural products/services may include traditional food/crops, medicines, handicrafts, traditional activities related with nature (i.e. festivals); these products and services may generate income for communities and may help to provide incentives to preserve resources and traditional knowledge and to create awareness and appropriation towards their heritage.

The approach in the project included interviews with producers and business in the area, focusing in fish and tourism. It was observed during the interviews that natural resources of the
MaB Rio San Juan have strong links with local communities. Main livelihoods in the MaB include tourism, agriculture, fishing, all of them are based on the natural capital of the area. Fish have been an important livelihood for local communities at Rio San Juan, but now due to overfishing and some bad practices it have been declining in the last 15 years. The main targets in the river are Robalo (Snook), Tarpon, rainbow bass, mojarras, and freshwater shrimp. Robalo stock have been declining in the last years. Tarpon fishing have been forbidden at El Castillo, although it is an important species since local communities consume it as a traditional local food (chorizo de sabalo).

Biocultural products in El Castillo range from traditional foods, handicrafts, and crops, all of them linked with the culture and history of the area and the community. Artisanal fisheries, once highly abundant are now facing a deep decline, something that can be observed in detail in the actual flow of materials or food chain between households/business and the biosphere reserve, and is more evident in restaurants: they now rely more on fish from lake Nicaragua or even from the river mouth in the Caribbean, since fish are no longer abundant in the area.

Following the recommendations and guiding coordinates by Davison et al. (2012) I propose: 1) Actualization of the management plan and nomination of the WHS, 2) Capacity building program, following follow the 5C’s principles stated in the Budapest Declaration on World Heritage: credibility, capacity building, communication, conservation, community participation, 3) Through a design team, enhance local participation so the conservation measures also include the aspirations and needs of local communities, and 4) Economic development coherent with the objectives of the MaB and the biocultural heritage of the area, considering innovative approaches, new markets and business schemes instead of a business as usual model. Alongside with this, I propose here a list of activities that may serve as a basis for the solutions that the design team can implement; but it will be the decision of the local community and the design team to implement them or not.

Main biocultural products and services and its relation with local livelihoods in Río San Juan biosphere reserve
1. **INTRODUCTION: SITE IDENTIFICATION AND CONTEXT ANALYSIS**

1.1 **SITE DESCRIPTION**

<table>
<thead>
<tr>
<th>State party</th>
<th>• Nicaragua</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the site</td>
<td>• Rio San Juan Biosphere Reserve and Fortress of the Immaculate Conception (El Castillo)</td>
</tr>
<tr>
<td>Province</td>
<td>• Rio San Juan department</td>
</tr>
<tr>
<td>Category</td>
<td>• UNESCO Man and Biosphere (2003); included in the UNESCO WHS tentative list (mixed site, 1995).</td>
</tr>
</tbody>
</table>

*Figure 1. Left: Protected Areas in Nicaragua, Rio San Juan MaB in the circle. Right: detail of the biosphere reserve, location of El Castillo is circled (MARENA 2005).*

The site was recognized as a Biosphere Reserve by the UNESCO MaB program in 2003, and in 1995 was included in the tentative list of the UNESCO World Heritage Site, nominated as a mixed site (although with not clear criteria). According with the info in the UNESCO WHS tentative lists the site is described as: “The monument is a 17th century (1673) Military Campaign Fortress found within the limits of an area considered as a Biosphere Reserve (Indio-
Maiz Reserve. It is surrounded by a town (El Castillo) of approximately 1000 inhabitants, located in a promontory of the San Juan river between the Great Lake of Nicaragua and the Caribbean Sea. The site was part of the line of Spanish fortifications of the Caribbean established in order to fight against the pirate attacks. It was of utmost importance for the defence of the Province of Nicaragua which faced the interest of the English Crown which sought to dominate the Sea of the South.”

1.2. CONTEXT AND BACKGROUND

SOCIAL AND ECONOMIC CONTEXT

The biosphere reserve is located in the Department of Rio San Juan which is subdivided in six municipalities: San Carlos, San Miguelito, El Almendro, Morrito, El Castillo and San Juan del Norte. The reserve has a large (around 256,000 habitants) and culturally rich human population from different ethnic origins including Rama, Creole and mestizo groups, and each one of these groups has its own way of managing and using the resources of the area.

The municipality of El Castillo has a population of around 20,000 people including urban and rural communities distributed in several rural communities (data from the 2005 census). The Fortress of the Inmaculada Concepcion, locally known as El Castillo (the castle) is located in this municipality, where a small settlement flourished around the fortress and receive the same name: El Castillo. The study site was centered in this settlement that holds around 1500 residents.

Rio San Juan, and of course El Castillo, have been seen as a zone of extraction of natural resources for centuries. Human colonization (mestizo and white) respond to that economic pressures: rubber extraction before the 50’s, banana, and raicilla (Psycotria ipecacuana) during the 60-70’s and more recently cattle ranching and monocrops. During the Sandinista revolution and subsequent war (1979-1990) the region faced a depopulation period, when many of the local people emigrate to Costa Rica (Nygren 2000). However, at the same time new settlements were created as a consequence of the war and there is how Buenavista, Los Chiles, La Esperanza, Las Azucenas and many other small settlements flourished with people

1 http://whc.unesco.org/en/tentativelists/484/
2 http://www.unesco.org/mabdb/br/brdir/directory/biores.asp?mode=all&code=NIC+02
that arrive to fight during the war or attracted with opportunities around the Sandinista “land reform” (Rabella I Vivés s.f.).

The main economic activities in Rio San Juan and El Castillo nowadays are agriculture, forestry, livestock production, fishing and more recently ecotourism. According to OEA (1997), in the Nicaraguan portion of the Rio San Juan Basin, the majority of producers are subsistence farmers, followed by small producers and commercial/agro industrial producers. Domestic and wild crops are used in the region, including subsistence crops (e.g., maize, beans, fruits), and also commercial crops and wood (for building, boat construction, firewood). Local communities at El Castillo settlement are mainly small scale agriculture farmers and fishermen in lesser scale. Modern commercial crops include cocoa, oil palm and oranges (OEA 1997, Fundación del Río 2001). Cattle ranching have been also an important activity. There are no roads, so the main transportation system is by boats through the river and its tributaries. Ecotourism activities, including flora and fauna observation and sport fishing (Tarpon, *Megalops atlanticus*) are some of the main tourist activities. Rio San Juan is included in the main tourist routes promoted by the Nicaraguan government⁴.

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Cultural Context

Before the Spanish colonisation the area was inhabited by indigenous communities, mainly from the etnia Ramas (Kjaerby 2011). The area has great relevance due its environmental and historic contexts, since the fortress was part of the defence line of Spanish against the British crown attacks it is an important historical site in the region and the country. In the Biosphere reserve the main communities are “colonos” (white and indigenous origin), and in less proportion indigenous Ramas, and afro descendant communities (Kriol). In the settlement around the Monument, known as El Castillo, the inhabitants are mainly from mixed “mestizo” origin. Rio San Juan Biosphere Reserve include also an important cultural site: the archipelago of Solentiname, a complex of 36 inland islands in the Lake Nicaragua that have an outstanding relevance not only for being a sacred place for the indigenous peoples, but also due the great biodiversity and cultural richness.

Environmental Context

The Rio San Juan Biosphere Reserve (hereafter RS-MaB) in southeast Nicaragua covers 1.392.900 ha, being a vast area of biological relevance that helps to guarantee the conservation of biodiversity and the mobility of focal endangered species as Jaguars, tapirs, green macaws, among others. The reserve is named after the San Juan River, although in a strict sense it is not a river, but a natural drain for Lake Nicaragua into the Caribbean. The RS-MaB covers an important variety of tropical humid forest and wetland ecosystems, being an important sanctuary for several focal and endangered species of flora and fauna. This area is also of relevance due the great variety of plant genetic resources of the Meso-American tropics. The area has been recognized also as a RAMSAR site⁵, due its complex of inland and marine wetlands and the river itself. The Biological Reserve Indio Maiz (the core area of the RS-MaB) has been recognized as an Important Bird Area by BirdLife International⁶ (Morales et al. 2009).

Rio San Juan department covers an altitudinal range of approximately 30 – 200 m; weather is mainly hot and humid tropical with an annual precipitation of 4000–6000 mm, being one of the wettest regions of Central America (Campbell & Lamar 1989). The topography is a mixture of rolling hills and flat areas, crossed by meandering streams; soils are composed mainly of red clays. The margins of the San Juan River mostly consist of swampy areas that vary seasonally in their degree of inundation. Natural vegetation is mainly evergreen tropical wet forest of the Caribbean lowland (Múnera-Roldán et al. 2007). The biosphere reserve is home of several

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species relevant for conservation and still has important remnants of forests, habitat of endangered species such as Jaguar (*Panthera onca*), Tapir (*Tapirus bairdii*), Green Macaw (*Ara ambiguus*) among others. Through the river other endangered species, as the Tarpon (*Megalops atlanticus*) can be seen.

**HISTORIC CONTEXT**

The Fortress of the Immaculate Conception (known locally as El Castillo) is a Military Fortress built by the Spanish in the 17th century (Figure 3). It is located in Rio San Juan Biosphere Reserve and very close to Indio-Maiz Biological Reserve. The fortress was part of the defence line of the Spanish colonies against the British crown attacks (including a famous attempt made by Cap. Nelson in 1779), and is an important historical site in the region and the country. The Rio San Juan was also very important in the colonial era, since it was explored as a possible pass from the Caribbean to the Pacific, and was an important commercial route for the Spanish Empire and later also for the British Empire, whom tried to invade the Nicaraguan territory through the river.

In the figure 4 and table 1, a short summary of the main events in the region is showed, as an effort that may help to understand the social framework of Rio San Juan.

*Figure 3. Fortress of the Immaculate Conception*
Figure 4. Diagram depicting in short 500 years of the history of Rio San Juan.
# Recent history

*Table 1. Main events in the recent history of Rio San Juan (last 60 years)*

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Key Event</th>
<th>Remarkable features / consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre 1950 – 60's</td>
<td>Rubber</td>
<td>Around the 50’s rubber and chicle extraction along with precious timber extraction were the main livelihood. This was complemented with small scale agriculture, hunter and gathering resources from the forests.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Remarkable features / consequences</strong></td>
</tr>
<tr>
<td>60’s &amp; 70’s</td>
<td>Fishing, agriculture,</td>
<td>New colonization from the Pacific for cattle ranching and cotton plantation (Nygren 2000) Begining of Raicilla (Ipecuana) crops, small scale agriculture, fishing and forest harvesting main livelihood activities. Robalo (Snook) fishing was an important commercial activity. Fish was abundant, and took place between December and March (sometimes April) during the Robalo migration up the river, elders mentioned that there was a cooperative that regulate that all fishermen had opportunities to catch the fish. Almost all the town of El Castillo took part in the activity of fishing and drying, men, women and young people. Fishermen sold the product to middle men from Guatemala or El Salvador.</td>
</tr>
<tr>
<td>End of 70’s- 1990</td>
<td>The war and Sandinista revolution</td>
<td>Livelihood uncertainty, new arrangements for economic development. New colonization: with the war new towns were created (Buenavista, La Esperanza, Las Azucenas, Los Chiles) At the same time some farmers emigrate to Costa Rica.</td>
</tr>
<tr>
<td>Time Period</td>
<td>Key Event</td>
<td>Remarkable features / consequences</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 1980 – ca. 2000   | Territorial organization                                                  | Introduction of sustainable development for the development of the region (declared as area of sustainable development)  
Establishment of protected areas, biosphere reserves, and national monument (fortress)  
Parks for the peace (SIAPAZ): the creation of protected areas was an effort to reconcile the region and former combatants in a new development for the region |
| 1990 – 2008       | International Cooperation: Integral development project for Rio San Juan  | Shifting agriculture, fishing and forest harvesting main sources of food  
Capacity building for local business (tourism and service providers)  
Management plans for the protected areas  
Outputs locally consumed, traded in small quantity  
Restoration of El Castillo  
Increased awareness toward the local natural and cultural heritage  
Emergence of tourism economy                                                                 |
|                   | (Araucaria – AECID)                                                       |                                                                                                                                                                                                                                    |
| 1990 – today      | Monocrops / land concentration & new economic opportunities and changes in | Small farmers sell their plots, colonisation of new areas in the protected areas  
Changes in land cover  
Shift in perception, taste and needs (fish more than food, less shifting agriculture and forest harvesting)  
Shift in livelihoods and diet / prohibition of tarpon fishing (2013)  
Fishing not profitable  
Restrictions to shifting agriculture and forest harvest  
Tourism jobs and introduction of tourism as livelihood  
New markets for fish: tourism and restaurants  
Store bought staples (beans and rice)  
Cocoa crops reintroduced as cash crop  
Access to cash - Improvement of living conditions (Cocoa) |
|                   | management                                                                |                                                                                                                                                                                                                                    |
1.3. SUMMARY OF QUALITIES CHARACTERIZING THE SITE

According with IUCN, biosphere reserves are those sites where human communities integrate conservation and sustainable use of natural resources (Bridgewater 2002, Dudley 2008). The Man and the Biosphere (MaB) biosphere reserves were created recognizing the relevance of promoting sustainability around a core of highly protected portions of land and/or water. With this in mind,
UNESCO accepts that humans are part of the biodiversity, so they will need to be part of the conservation programs.

In the other hand, article 4 of the World Heritage Convention states that each State Party has ‘the duty of ensuring the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage’ (UNESCO 1972). Following this recommendation, Nicaragua as State Party nominate in 1995 the monument and part of what is now the biosphere reserve as a potential World Heritage Site. The recognition as a Biosphere Reserve became effective in the year 2003.

Although the area is considered a reserve, human disturbance and colonization have been happening. There are still great parts of primary forest with minimal human intervention, inside and close by the Biological Reserve Indio-Maiz, but in the buffer zone to the west (El Castillo) there is an increasing degree of disturbance, mainly because cattle ranching and farming along the Rio San Juan borders. A growing “export” economy (products from Rio San Juan to the rest of the country) have been taking place in the buffer area of the biosphere reserve, as the establishment of huge oil palm and orange monocrop farming stands. Illegal hunting and illegal logging have been common, as well as overfishing.

1.4. Present Management

Management is mainly around the conservation of environmental issues through the MARENA (Nicaraguan Ministry of Environment), however the current management plan for the biosphere reserve (MARENA 2005) and the Monument (MARENA 2003) might not be fully operational mainly due lack of financial, technical and human resources. In the other hand, cultural issues have not been fully integrated in the management of the region, and are not integrated with the environmental conservation.

Conservation of natural resources by local communities should not be in detriment of sustainability. Since local communities inhabit a biosphere reserve it is important to address the conservation problems such as deforestation and degradation of wetlands that may affect the sustainability of the region. The concept of biosphere reserves admits that humans are an important component in this protected area management category, but the conservation problems of the area may affect its long-term sustainability. In this way, this project may help to enhance the adaptive capacity of local communities so the development in the region is not against the natural and cultural resources of the area. At the same time the project may add to the empowerment of local communities towards their habitat and that they address the challenges they may face if the fortress is fully designated as a WHS.
2. PROJECT DESCRIPTION

2.1. GENERAL OBJECTIVE

Identify the most relevant issues to be considered for a sustainable development at Río San Juan Biosphere Reserve, including both cultural and natural aspects that can enhance the well-being of local communities, considering their needs, aspirations and motivations through a product/service innovation approach.

The main target group was local communities living close the Fortress of the Immaculate Conception at El Castillo settlement.

2.2. STRATEGIES AND PRIORITIES

The project is based on the Biocultural design framework (Davidson-Hunt et al. 2012), designed to help to profile the natural and cultural resources available in the study area and to identify stakeholders (beneficiaries) in the area. According with Davidson-Hunt et al. (2012), biocultural design is based on the creativity of people, considering that rural/indigenous communities have their own knowledge, perceptions, values and skills that allow them to shape their everyday lives and therefore to adapt to their environment. With this in mind, biocultural heritage is a source of innovation for sustainable development in rural indigenous and local communities, which consider people’s motivations, aspirations and needs.

Biocultural design is based in the concept co-design, a term that was created by “design thinkers” as well as the work of Sen (1999). Biocultural design is therefore a collective and collaborative process by which individuals from rural/indigenous communities can engage in a dialogue, interchange their knowledge and skills towards a creative process of designing products and/or services.

2.3. BIOCULTURAL HERITAGE

Biocultural Heritage makes reference to the knowledge and practices of rural and indigenous communities, and how they use their biological resources (Figure 5). It also includes the diversity of genetic varieties of crops and the way they interact and shape their landscapes. Biocultural
products/services include traditional food/crops, medicines, handicrafts, traditional activities related with nature (i.e. festivals).

These products and services may generate income for communities, may help to deal with long term food security, provide incentives to preserve resources and traditional knowledge and to create awareness and appropriation towards their heritage. Identify the biocultural services present in RS-MaB may help to promote the conservation of those resources that are vital for the survival of rural/indigenous communities.

![Figure 5. Scheme of biocultural heritage](http://biocultural.iied.org/)

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3. METHODOLOGY

3.1. LITERATURE REVIEW

A literature review was made to identify documents reporting traditional knowledge, useful plants and animals in the reserve. With this I create a list of resources that may help to verify the information gathered during the surveys in order to map the relationships between business, households and local producers/collectors. This also helped to understand how local communities and business made use of the natural resources harvested in the area, the institutions and actors involved, the ecology and in general the relationships between each level. The framework for the list followed the VITEK\textsuperscript{8} model. Secondary information regarding flora/fauna exists in reports and the management plans, however I focused on data published in scientific articles, scientific databases or reports from experts, not merely flora/fauna list. Literature review about useful biodiversity in Rio San Juan is listed in Table 1.

Table 2. List of references about useful biodiversity in Rio San Juan

<table>
<thead>
<tr>
<th>Biocultural products</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants</td>
<td>Coe &amp; Anderson 1996</td>
</tr>
<tr>
<td></td>
<td>Coe &amp; Anderson 1999</td>
</tr>
<tr>
<td></td>
<td>Coe 2008</td>
</tr>
<tr>
<td></td>
<td>Noguera &amp; Balslev 2005</td>
</tr>
<tr>
<td></td>
<td>Grijalva 2006</td>
</tr>
<tr>
<td>Shrimp</td>
<td>Jordi Pascual</td>
</tr>
<tr>
<td>Fish</td>
<td>Bussing 1976</td>
</tr>
<tr>
<td></td>
<td>Camacho y Gadea 2005</td>
</tr>
<tr>
<td></td>
<td>Bigelow et al. 1976</td>
</tr>
<tr>
<td></td>
<td>Pérez-Moreno 2001</td>
</tr>
<tr>
<td></td>
<td>Guindon 2011</td>
</tr>
<tr>
<td></td>
<td><a href="http://www.fishbase.org/summary/1079">http://www.fishbase.org/summary/1079</a></td>
</tr>
<tr>
<td></td>
<td>MARENA-INPESCA Acuerdo internistitutional No. 001.11.13</td>
</tr>
<tr>
<td>Birds</td>
<td>Múnera-Roldán, pers. Obs.</td>
</tr>
<tr>
<td></td>
<td>Birds of Costa rica Stiles &amp; Skutch</td>
</tr>
<tr>
<td></td>
<td>Morales et al. 2009</td>
</tr>
</tbody>
</table>

\textsuperscript{8} http://www.terralingua.org/vitek/
3.2. INTERVIEWS AND SURVEYS

Two different approaches was made, one using an online survey and other for the field work. The online survey was made in 2013, it was directed to experts and decision makers with the aim to evaluate institutional arrangements and perceptions around the management of the Biosphere reserve, the awareness around the site as a tentative World Heritage Site and the project in general. The survey was posted online through an online survey service for two months in 2013.

The field work consisted of semi-structured interviews, informal meetings, daily conversations and participant observations with local communities and local people from El Castillo and other relevant stakeholders from the environmental sector.

Interviews were directed to business and producers to understand the relationships of the biocultural products in the study zone, although during the field work some questions were modified to adjust them to the circumstances or person surveyed. To create the surveys and frame the results in a co-design process but considering the biocultural framework I followed the Human Centered Design Toolkit (IDEO 2013) and a document by FAO (2006).

Although there are many services and products in the area I focused on the main services that include the bigger amount of biocultural products. The decision making considered:

1. the sector has links with more than one product / service
2. the service has therefore links with more than one product
3. the products represent an important livelihood for local communities (businesses and collectors/producers)
4. the services and products are related with their culture and is in risk
5. the services and products are representative of the biosphere reserve

Once the sector for the interviews was selected, the steps were:

1. interviews with business, and ask them about their providers
2. interviews with providers (local producers)
3. interviews with experts and decision makers

The selection of actors for the interviews at the business level were supported at the beginning by approaching a local leaders that knows the people from their community and the main problems they face, they made the initial recommendations for the stakeholder map. This individual interview enabled me to understand the needs of the community and how appropriate technologies/solutions may benefit the community.
After that, I made interviews with local business to ask them for help to contact their local suppliers (or local guides in the case of tourism) or recommendations to interview other people with relevant knowledge. A presentation letter explaining the project was always presented to them asking for permit for the interviews and only those who accepted was interviewed. Due a difficulty to contact local fishermen, a local man that was fishing alone in the river was a key contact that help me to approach the other fishermen in the community. During the interviews I asked to everybody to identify the season harvest for each product/service evaluated to create a calendar for the biocultural products/services.

Following Davidson et al. 2012, experts are those persons with a great knowledge of the local situation, either from the academy or a local member of the community that plays a role as leader in the local community. Decision makers were mainly from the local/national government agencies. Some experts were consulted via internet, other were consulted directly and decision makers were consulted informally in 2013.

For the analyses of the information local knowledge from local communities is understood as valid as scientific knowledge. However, it is also important to understand the heterogeneity of this knowledge especially in a multidimensional context were different cultural, environmental,
economic and socio-political factors play a role to shape the local knowledge as explained by Nygren (1999).

The Human Centered Design Toolkit (IDEO 2013) suggest to follow a process of three phases: Hear, Create and Deliver. Although in this case I focused mainly in the Hear and Create phases, the Deliver phase was partly socialized with local people and especially with those that helped with information during the interviews, discussing with them the suggested solutions in order to validate if those proposals were considering their needs. However, I strongly suggest that this process should be carried on by them.

4. RESULTS AND DISCUSSION

4.1. ONLINE SURVEY

A total of 33 people answered the survey (of 70 requests made), of which only 5 persons admit to live in the Biosphere Reserve, the rest said they visit the place temporarily due work or tourism. When asked about the UNESCO MaB Programme and UNESCO WHS Programme, only 5 person didn’t understand what those programs are and 10 people didn’t knew about the UNESCO WHS Programme. More relevant, was that 66% of the respondents didn’t knew that the Monument of the Immaculate Conception was nominated as a tentative UNESCO WHS in 1995, since they believe that the recognition as an UNESCO MaB Biosphere Reserve is the same as a WHS.

When asked about the possible factors that affect the recognition of the site as WHS by UNESCO, the majority answered that it is due a lack of capacity to manage the nomination (9%) and a lack of interest from government agencies to work in the nomination (8%). Other possible factors was lack of interest from local communities (4%) and some believe that the site don’t meet the requirements for the recognition (4%). However, considering that the majority of respondents were unaware of the nomination, these responses could not be considered as conclusive. 62% answered that they would be interested in the recognition of the whole Rio San Juan MaB as an UNESCO World Heritage site, and 25% answered that only the historic Monument should be recognized as such.

The main cultural issues of the reserve recognized by the respondents include the indigenous communities (Rama and Rama-Kriol), the historic events that occurred there and the potential for
ecotourism activities. And among the main nature related issues in the reserve, people highlighted the rich biodiversity, the presence of endangered and focal species for conservation.

Figure 7. A sign at El Castillo: Rio San Juan Biosphere Reserve is a world heritage site, we have to preserve it. Indio Maiz Biological Reserve holds 679 species of fauna, please help to protect them.

About the relation of available information and the current management of the reserve in relation with cultural/natural issues, monitoring and socioeconomic issues, the majority of respondents believe that with better and more information available to the public in general it will help to improve the management of the reserve and the historic monument.

68% answered that they agree with the proposal of establishing a design team to have a better management of biocultural heritage, 9% didn’t agree and 22% are not sure. However, 50% of the people say that they are not sure ¿in joining the design team. About gender equality and participation of young people, 38% believe that there is not enough opportunities for their
participation in the decision making process, 28% don’t have enough information, 19% believe it is fair and 14% very good.

Figure 8. Activities that should be necessary to strengthen or to be created to improve environmental and economic sustainability of the region, according with the survey. PES: payment for environmental services.

Box 1. Highlighted comments from the surveys

“as I remember there is no valid management plan and all information available confound Indio Maiz Biological Reserve with the Biosphere Reserve” /// Todo: De lo que me acuerdo no existe un plan de manejo válido y toda información accesible confunde entre la reserva biológica Indio Maiz y la reserva de biosfera

“the management plan is likely to be available, but it may require more publicity on electronic media available to schools. Information about wildlife should be available on a national node of GBIF, which is yet to be built. About zoning and maps, is required to be available for easy interpretation so people may understand what activities are allowed or not and where” /// el plan de manejo probablemente este disponible, pero falta mas publicidad sobre medios electronicos disponibles a las escuelas. Informacion de fauna y flora debería de estar disponible sobre un nodo nacional de GBIF, que esta todavía por construir. En caso de reglamentos y mapas de zonificacion, lo que debe de estar disponible de facil interpretacion es que significa para cada persona, que puede o no hacer y donde
Among the activities that people believe should be necessary to strengthen or to be created to improve environmental and economic sustainability of the region, the main concern was about to improve control over the use of natural resources, an improvement in ecotourism and cultural issues, and the protection of watersheds (Figure 8). The majority of respondents believe that is necessary to improve some services especially education, health and communication, to help to improve the wellbeing of the communities in the reserve.

**Box 2. Highlighted comment from the surveys**

Several actions relevant for the history of Nicaragua took place in the area. The fort is a legacy of hundreds of years built by Nicaragunas (or slaves?) this gives guidelines for anthropological research on the early settlers of the area. Other cultural and historical fact is that the area was a famous route related with the history of gold in the U.S. and there are traces of explorers and pirates like Nelson. In modern times the area was the scene of treaties and agreements between the governments of Nicaraguan and the U.S. governments. The area is a place with a great cultural and historical burden that deserves to be known and protected for humanity /// Sitio donde se realizaron acciones que marcaron la historia de Nicaragua. La fortaleza es una herencia de cientos de años construida por manos nicas o esclavos? esto da pauta para hacer investigaciones antropológicas sobre los primeros pobladores de esa zona. Otro hecho cultural e histórico es que el área está en lo que fue la famosa ruta del tránsito, ligada a la historia del oro en los EEUU y hay vestigios de exploradores y piratas como Nelson. Tambíen en la época contemporánea la zona fue escenario de tratados y acuerdos entre los gobiernos de turno nicaraguenses y estadounidenses. LA zona es un lugar con una gran carga cultural e histórica que merece ser conocida y protegida para la humanidad.

### 4.2. Field Interviews

In the Tourism sector three business levels were identified: local tour operators, restaurants and handicrafts business. In the diagram below (Figure 9) is described the value chain relationship between business and producers followed during the interviews.

Tourism was the sector selected as it represent better the relationship between business and local producers/collectors. Inside tourism I worked mainly with fishing and tourism guiding/interpretation as it represents an important relationship between local products and livelihoods; in a lesser scale I made interviews with handicrafts business and cocoa growers (agriculture) since it have been gaining an important place in the livelihoods of the local communities and also has links with tourism (i.e. cocoa tours and chocolate making).
At El Castillo there are around 15 hotels/restaurants, two tour operators (although some local guides act as informal tour operators), one handicrafts store and one cocoa cooperative. Of these, 6 businesses agree to make the interview (two men, four women): four were tourism businesses (restaurants/hotels/tour operator), one a handicrafts seller (and also producer), and the cocoa cooperative. It is important to point here that in some cases the business man/women were at the same time producers.

All of them, except the handicraft business, accept that their commercial activities are dependent on natural resources from the biosphere reserve and consider that if they don’t have access to the resources their activity will be badly affected. However, and especially in the food service sector, they don’t depend completely from products harvested at El Castillo. Tour operators consider that the area is important due the biodiversity and the rich history. The main reason for doing the current business is the economic profits they receive. The main market segment in the tourism sector are foreigners tourists (mainly European and from North America). When asked about the critical points for the business to operate the answers were diverse but in general they agree that energy, water and transportation are the main factors they need to run successfully their business.
At the producer level I made interviews to 10 people (three women, seven men), including fishermen, local guides, a fish intermediary and a cocoa producer. All of them said that their livelihood depends on the natural resources of the biosphere reserve, and although the elders are not directly dependent of them at this moment they accept their livelihood used to be based on the harvest of products from the area (four of them are more than 60 years old). The main resources that are or have been used by the people interviewed are fish and shrimp (from the river and tributaries), fruits (from local farms), bush meat (forest), timber/wood (forest); interpretation of nature is another form of using local resources for local tourism (biological reserve and the river).

About the decision making process in the area and spaces for participation there used to be a local cooperative of fishermen and a local association for tourism, neither of them are active now. Many of the producers are not really aware about how the decision making in the reserve is made, since they are only informed by local/national authorities about new regulations. However they accept that sometimes they have been invited to take part in the process but usually they don’t participate. The main institutions in charge of the management and regulations of the reserve are MARENA (natural resources), INTUR (tourism licenses), army (regulation of boats), INPESCA (fish permits, and the municipality (taxes).

**CURRENT LIVELIHOODS**

According with the interviews, literature review and direct observation, the main livelihoods in Rio San Juan include:

- **Fishing:** in the river with nets and rods. Their main targets are Tarpon, robalo (several species), Bass (several species), mojarra, in less degree cat fish, Gaspar, machaca. Freshwater shrimp was very important but it was over harvested and now it is very rare to find around El Castillo (restaurants buy it from San Juan del Norte, in river mouth)
- **Agriculture:** here we have staple crops such as maize, beans, rice, plantain, cassava (from shifting agriculture) and cash crops such as cocoa. Also cattle ranching for milk and derivatives. At home gardens they collect fruits and vegetables, Pejibaye (*Bactris gassipaes*) and other plants such as coconut and bread fruit.
- **Forest products:** including timber for construction, fuel wood, palm leaves (roofs), fruits and seeds (i.e. Almendro seeds for handicrafts), rattan (now prohibited). Bush meat was mentioned although it is highly regulated; among the bush meat they used to consume there is wild boar (*Tayassu pecari*), guatusa (*Dasyprocta punctata*), Danta (*Tapirus terrestris*) and even Manati (*Trichechus manatus*).
Tourism: interpretation of nature is made mainly in the trails at the biological reserve (Indio Maiz), and observation of flora and fauna in general. Among some specific tours for observe fauna may be the most important are the night tour to spot caiman (*Crocodylus acutus*) and sport fishing (*Tarpon-Megalops atlanticus*). The history and local culture is also highlighted in the tours offered, including the fortress and the transit route. Recently a cocoa tour have been included as part of the tourism attractions.

According with the people interviewed, local communities in El Castillo are aware that they live in a protected area and a cultural monument, they recognize that their livelihoods are related with the products and services derived from the biodiversity and historic monument. However, they also recognize some problems that limit the fulfilment of their needs and aspirations as it is a limited education, lack or deficiencies in basic services such as water and electricity, limited internet and mobile access, deficiencies in transportation and problems with local organization (i.e. associations or cooperatives).

Local communities perceive the local resources as potential sources of food, potential sources of economic revenue and their wellbeing. However, access to those resources and biocultural products is linked with the availability of the resources both in time and location, as well as with the institutions that influence access to the resources, including permits or licenses for fishing or tourism, or tax collection.

In general the main sources have both spatial and temporal organization, and depending on the service provided it could be related with land (i.e. tourism at the Biological Reserve Indio Maiz, food from farms), or the river (food, tourism, transportation).

The river itself is maybe the most important issue in the area, and local communities have adapted themselves and their culture around it (Figure 10, 11). Of course, livelihoods have adapted around the river, and for example transportation is mainly by boat. Boats for personal use are made now from Fibre glass skiffs but there are also dugout canoes and although motorboats are widely used, there are still rows or paddles made from wood (Laurel or Cedro).
Finally, technology is seen as something that can or cannot facilitate access to resources. We can see in Table 3 and Table 4 how the outcomes are influenced by these factors and their interactions and of course we need to consider it to understand access to food and resources through the way it is harvested, consumed or exchanged. In Figure 12 and Table 3, there is a description of the main livelihood activities related with biocultural products according with the information from this work and focused on the three business level identified. Below I will focus in those services and products more related with those business: fishing, tourism and handicrafts.
Figure 12. Food sources in El Castillo and relationships with households and business.
**FISHING**

Fish and shrimp are recognized as an important product not only for businesses level but also as part of the diet of local communities (households). However, according with the answers in the interviews fish is more and more scarce in comparison with the abundance 10 or even 20 years ago. They also recognize that shrimp was overharvested and now there is very few or no shrimp in the area. For both fish and shrimp, several businesses accept that they buy the fish from San Carlos (at lake Nicaragua) or even San Juan del Norte (river mouth in the Caribbean) since there is less fish nowadays at El Castillo.

After talking with local people especially the elder members of El Castillo, it is evident how the local diet has changed in the last years, from a diet based mainly on fish / bush meat / local fruits & vegetables, to a poultry / pork / cattle / imported vegetables diet. Fish consumption is made mainly by restaurants and less in households (Figure 12, Table 3 and Table 4). Fishermen prefer to sell the product to restaurants. Many of the elders accept that they don’t eat fish anymore because it is now scarce and expensive and that sometimes local fishermen prefer to sell first to local restaurants instead of local people. Some fishermen interviewed accept that they sell at higher prices to the restaurants but not to local people. Other fishermen recognize that they fish because they like the activity, they like to eat fish and because is cheaper than buy meat or poultry. They usually fish for themselves and immediate family.

**Box 3. Changes in fish activity over time: The case of Snook (Robalo) and the cooperative**

During the interviews it was mentioned very often how between the 50’s until approx. the end of the 90’s, Robalo fishing was an important economic activity for local communities. Both elders and young people mentioned how during the Robalo season (November-March, see figure 18) all the town worked in catching, drying and selling of fish (people from neighbour countries such as El Salvador or Guatemala came to buy the fish). In those days Robalo was very abundant, and they decide to organize themselves in a cooperative in order to allow all fishermen to have the same opportunities. The rotation was simple: they were organized in couples, and there was 6 fishing points in the rapids in front of the town. A couple of fishermen select a record in a draw, so they can start in the first fishing point, after a while they have to move to the following point and the next couple can move to the first point, and so on. With this system all the fishermen were able to go through all the fishing points and has the same opportunities. A single fisherman was able to catch between 50-70 robalos in a day (of around 1 meter each); nowadays in a good fishing day 10 robalos is the media. According with the people interviewed, in those times there was around 120 fishermen, now there are only around 36. In the fishing activity there were clear gender roles: men was in charge of fishing, while women were in charge of the cleaning, salt and drying. Sometimes children help women in this.
According with Camacho & Gadea (2005) 150 artisanal fishermen were recorded in the year 2002, of them around 80 were organized in the Cooperative COOPAC (Cooperativa de Pesca Artesanal de El Castillo), however according with local people and fishermen the cooperative was never legalized under Nicaraguan law and it does not exist nowadays (Box 4); there are less than 40 fishermen now at El Castillo. At this moment commercial fishing activity is very low and almost restricted to the migration of Robalos between November and March (Figure 18). During the interviews it was mentioned how fishing has declined deeply in the area, mainly because the war (during the 70’s-80’s) and a severe drought around 12 years ago (Box 5). However other external causes were mentioned as the use of fishing nets in the river mouth at both Nicaragua and Costa Rica branches of San Juan’s delta.

Box 4. The dry season and the “chayules” plague, or how the fish disappear in Rio San Juan.

According with local people at El Castillo around 12 years ago there was a strong drought season and the river level was very low. At the same time a large plague of what is locally known as “Chayules” (an insect from the family Chironomidae) started. They recall that the chayules were so abundant all over Rio San Juan that people had to sweep the dead insects in the streets and collect them with shovels. They claim that due the chayules the oxygen in the river decrease and that’s why the fish started to die; many of the local fishermen claim that after that the fishing in the river were no longer abundant. Pascual Sala (2005) in his report about the shrimps in Rio San Juan, witnessed this event in 2003. They observe how the algae get stick in the gelatinous film of the “chayules” eggs, forming a mass that covered the river bottom and floating vegetation, and because the large abundance of that mass of eggs it cause a drop in oxygen levels that might be related with the high fish mortality observed during that period. However, there have been no more studies about that event or the causes of the plague.

Tarpon is one of the most appreciated fish in the area. It has strong relations with local culture, local gastronomy, local economy (i.e. sport fishing and handicrafts) and food security (households). Tarpon has both monetary and cultural value for people at El Castillo. It is highly linked with local customs and traditions, local dishes (Chorizo de Sabalo), elaboration of handicrafts and geography (i.e. Sabalos river is one of the tributaries to San Juan river). Tarpon is also an endangered species listed by the IUCN as a Vulnerable species\(^9\), mainly because consumptive fishery, habitat degradation, by catch mortality, and recreational fisheries along its range. Due these, there is a big concern about the stability of long-term Tarpon populations, plus the lack of information and studies about Tarpon populations in its distributional range.

\(^9\) [http://www.iucnredlist.org/details/summary/191823/0](http://www.iucnredlist.org/details/summary/191823/0)
As mentioned previously, Tarpon is one of the target species of sport trophy fishing in the area. During the interviews it was mentioned how some years ago there was an incident related with bad practices of Tarpon sport fishing that caused the death of some individuals. It is not clear how, but after that incident, Tarpon fishing for local consumption was banned in the area of El Castillo. However, sport fishing is still allowed all year round in other locations\textsuperscript{10,11} and of course during the fishing tournament in September (with the correct permits and licenses). Commercial fishing is also allowed in the lake and according with the regulations the minimum size for commercial fishing of Tarpon is 120 cm, with restrictions between April 1 – June 30 and between August 1 – October 31 (Acuerdo Ministerial Marena)\textsuperscript{12}.

The festival that is now in its 54th edition is co-organized by the Nicaraguan Tourism Board, National Fisheries Institute (INPESCA), local fishing tourism operators and the municipality. According with information from the interviews, during the Tarpon fishing festival (that last for two days) around 100 boats with fishermen can be seen along the river between San Carlos and El Castillo, although according with official bulletins and websites the number of boats during the festival is around 40. In the last editions all Tarpon captured were measured in a weighing station, practice that means that the fish will be killed, after that the meat is distributed among local people by the National Army. According with a personal communication from professional fishermen in the area, those rules were modified just before the fishing tournament this year (2014), in which now all Tarpons will have to be released and was prohibited to collect trophies. Unfortunately it wasn’t possible to check the new law.

Trophy fishing can have negative impacts in the stock of fish when targeting and removing selectively the largest individuals that are the eldest, more fertile and experienced individuals in a population (Sutter et al. 2012, in Shiffman et al. 2014). So, considering the small knowledge of Tarpon stocks in Rio San Juan this practice during the tournament can have negative consequences unless there are more information regarding the behaviour of the species in the area. Shiffman et al. (2014) recently reported a list of endangered species reported in the IUCN Red List and subject to recreational trophy-fishing around the world according with the IGFA\textsuperscript{13} suggesting how stopping the practice of killing individuals for issuing size records, can have positive impacts while reducing the pressure on the largest individuals of those threatened species.

Catch-and-release is understood to be a good practice in sport fishing, since it is assumed that when made properly the individuals will return unharmed to the water. There are no studies

\textsuperscript{10} http://www.nicaraguafishing.com/pagina_nueva_1.htm
\textsuperscript{11} http://www.nicaraguafishing.com/english%202.htm
\textsuperscript{12} http://www.mific.gob.ni/LinkClick.aspx?fileticket=rkqQeLWOfME%3D&tabid=671&language=es-NI
\textsuperscript{13} International Game Fish Association www.igfa.org/
regarding Tarpon catch-and-release in Rio San Juan, but according to a study in Florida (USA), Guindon (2011) find that catch-and-release mortality rate of Tarpon was around 13% in estuarine systems, the main cause of mortality was shark predation after releasing; excluding predation, mortality rate was 5% and mainly related with poor handling and related physiological damage from angling.

Finally, is important to note that tarpon fishing in the lake Nicaragua is also done using fishing nets, this suggest that many more Tarpons can be caught daily during the legal season than those that may be caught at El Castillo. This is apparently a well known costume since it was mentioned that is possible to find Tarpon meat in the local markets at Granada or Chontales. Considering the cultural relevance of Tarpon for local communities the prohibition of Tarpon fishing at El Castillo should be reconsidered in order to take into account the local use of this species and a better management of the species along the river and lake.

Material access and uses

Fishing arts varied according with the target species and includes fishing line, hooks, fishing rods and lures, nets and harpoon (Table 3). Fishing line and hooks were the most used in the early years (see Box 4); hooks were homemade until they were able to buy commercial hooks. Fishing rods and lures have been used more recently. Fishing nets are handmade locally, they buy the thread in Costa Rica or Managua. The making of a net can take from 5-10 days and with normal use they last for one year or one fishing season. The net is closed at the end with an iron chain for the weight (Figure 13).

According with the interviews, shrimps were so abundant that they used to capture them by hand at the river edge, or using a simple trap with meat bait using a very singular technique described by one of the elder women interviewed: she used to go rowing in a boat and tie a long line holding several threads with a bait at the end of each thread, then the person will try with its bare hands one by one of the threads, if a shrimp was eating the meat then she allowed it to “walk up her hand” and them quickly she put out the hand throwing the shrimp inside the boat. It was in the last 10-12 years that shrimp became an important commercial product and the capture techniques changed and now they catch shrimp using traps along the river.

During the interviews is was also mentioned that now Tarpon is only consumed by locals during that festival, although it was observed that there is still some captures for local consumption at El Castillo since as was mentioned by many of them, the Chorizo de Sabalo is highly valued by local communities and they accept it is part of their culture. The prohibition of fishing Tarpon for local communities is at the end controversial especially if there are no formal studies of the stocks in the area and how local consumption for the traditional dish is really affecting or not the population, in comparison with the sport fishing.
Figure 13. Making fishing nets by a local fishermen at El Castillo.
Fish and river products are consumed in different ways (Table 4) by households and restaurants. For example, mojarras, guapote and snook are consumed fried, grilled or in soup (with coconut) in the households. Restaurants only offer snook, guapote or sometimes common seabream (from San Juan del Norte). Catfish is consumed fried, but only by those households with strong links with fishermen, it is not consumed by restaurants and not recognized as an edible species. Fish such as mojarras or Bass, are fished all year round using fishing line in the river border, wetlands and at the mouth of small tributaries. These species are captured mainly for local consumption in the households.

One of the most representative products in the area is the Chorizo de Sabalo, or Tarpon chorizo. According the local recipe it took up to 2 days to prepare (even more). Once the fish was killed they took out the scaled with the paddle, then they took out the meat and soak it with water and lemon for two days. After that the meat was seasoned and cooked. The bones and head of the tarpon are used for made soup, the scales are collected for handicrafts. Tarpon is only consumed in households and not included in the restaurants menus. Nowadays is really rare to observe consumption of chorizo de Sabalo due the law that prohibit to fish Tarpon. This product and the traditional knowledge around its preparation maybe in risk of disappear if that prohibition continues.

Shrimp is consumed fried or in soup as well as crabs were made in soup. At this moment there is no longer shrimp or crabs in the area. Shrimps were overharvested for tourism (restaurants) and now they have to import shrimps from San Juan del Norte at the river mouth (in the Caribbean).

As recorded in literature of fish species in Rio San Juan (Table 2), some fishermen and elders mentioned that sharks (Tintorera or Carcharhinus leucas) used to swim up the river to the lake and it was a common sight in the river. During the 50’s-60’s they catch some sharks since there were a market for the liver and fins. They even mention the casualty of a local man due a fishing accident with a shark.
Table No. 3 Description of main activities in Rio San Juan area (El Castillo).

Ecology: Season and location; material access: Equipment necessary to undertake the given activity; Human actors: Individuals involved (gender, age, class); Access: Formal and informal institutions, Policies, Protected areas, landing sites, fishing agreements; Outcomes: Resources and their destinations (what is consumed, exchanged, sold).

<table>
<thead>
<tr>
<th>Activity</th>
<th>Natural resources</th>
<th>Ecology</th>
<th>Material Access</th>
<th>Human actors</th>
<th>Access</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td>Fishing</td>
<td>Robalo</td>
<td>- River (rapids)</td>
<td>Nets, fishing line, boat (motor or paddle)</td>
<td>Local fishermen and middlemen - Men: fish - Women: cleaning and drying, cooking - Age: mainly below 50, elders are not fishing anymore</td>
<td>MARENA INPESCA</td>
<td>Households: food security, consumed in soup or fried. Also income for selling to restaurants or households Tourism: consumption in restaurants (deep fry or stewed), sport fishing</td>
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<tr>
<td></td>
<td></td>
<td>- November-March</td>
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<tr>
<td>Tarpon</td>
<td></td>
<td>- River</td>
<td>Nets, harpoon, boat (motor)</td>
<td>Local fishermen - Men: fish - Women: cleaning and drying, cooking (chorizo is made by women, mainly elders) - Age: mainly below 50, elders are not fishing anymore.</td>
<td>MARENA INPESCA</td>
<td>Households: food security, consumed in soups and transformed as “chorizo de Sabalo” (local dish). Tourism: sport fishing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Year round</td>
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</table>

Now it is prohibited to fish year round for local consumption at El Castillo, except for tours and festivals.
<table>
<thead>
<tr>
<th>Activity</th>
<th>Natural resources</th>
<th>Ecology</th>
<th>Material Access</th>
<th>Human actors</th>
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<th>Outcomes</th>
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<tbody>
<tr>
<td>Guapote</td>
<td>River (wetlands) and lake - Year round</td>
<td>Fishing rod, fishing line Boat (motor or paddle)</td>
<td>Local fishermen and middlemen - Men: fish - Women: cleaning and cooking - Age: all age classes</td>
<td>MARENA INPESCA</td>
<td>Households: food security, consumed in soup or fried. Also income for selling to restaurants or households. Tourism: consumption in restaurants (deep fry), sport fishing.</td>
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<tr>
<td>Mojarra</td>
<td>River (wetlands and lake) and lake - Year round</td>
<td>Nets, fishing line Boat (motor or paddle)</td>
<td>Local fishermen and middlemen - Men: fish - Women: cleaning and cooking - Age: all age classes</td>
<td></td>
<td>Households: food security, consumed in soup or fried.</td>
<td></td>
</tr>
<tr>
<td>Sardina</td>
<td>River (wetlands and lake) and lake - Year round</td>
<td>Nets, fishing line Boat (motor or paddle)</td>
<td>Local fishermen and middlemen - Men: fish - Women: cleaning and cooking - Age: all age classes</td>
<td></td>
<td>Households: food security, consumed in soup or fried.</td>
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<tr>
<td>Machaca</td>
<td>River - Year round</td>
<td>Nets, fishing line Boat (motor or paddle)</td>
<td>Local fishermen and middlemen - Men: fish - Women: cleaning and cooking - Age: all age classes</td>
<td></td>
<td>Households: food security, consumed in soup or fried.</td>
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</tr>
<tr>
<td>Gaspar</td>
<td>River - Year round</td>
<td>Fishing line Boat (motor or paddle)</td>
<td>Local fishermen - Men: fish</td>
<td>MARENA INPESCA</td>
<td>Households: food security, consumed in soup or fried.</td>
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<tr>
<td>Activity</td>
<td>Natural resources</td>
<td>Ecology</td>
<td>Material Access</td>
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<tr>
<td>Catfish</td>
<td>- River - Year round</td>
<td>Fishing line</td>
<td>Boat (paddle)</td>
<td>Local fishermen - Men: fish - Women: cleaning and cooking - Age: all age classes</td>
<td>MARENA INPESCA INTUR</td>
<td>Households: food security, consumed fried.</td>
</tr>
<tr>
<td>Shrimp</td>
<td>- River - Seasonal (changing)</td>
<td>Traps</td>
<td>Boat (paddle)</td>
<td>Local fishermen and middlemen - Men: fish - Women: cleaning and cooking - Age: all age classes</td>
<td>MARENA INPESCA</td>
<td>Households: food security, consumed in soup or fried. Also income for selling to restaurants or households Tourism: consumption in restaurants (deep fry)</td>
</tr>
<tr>
<td>Recreation - sport fishing</td>
<td>Tarpon Guapote Snook (robalo)</td>
<td>River</td>
<td>Fishing rods, fishing lures</td>
<td>TTOO, local guides, tourists, Local fishermen Only men</td>
<td>MARENA INPESCA INTUR</td>
<td>Fishing tours</td>
</tr>
<tr>
<td>Recreation</td>
<td>Landscape flora and fauna</td>
<td>Primary forest</td>
<td>Rubber boots, binoculars, raincoats</td>
<td>Local guides, tourists Men and women equally</td>
<td>INTUR MARENA</td>
<td>Fauna and flora observation: kayaking</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Cocoa plants (Theobroma cacao)</td>
<td>Farms and secondary forest</td>
<td>Tools</td>
<td>Men and women equally</td>
<td>Cooperative Municipality</td>
<td>Cocoa beans for sale (international market) Income and cash flow through the supply chain Artisan transformation (chocolates and pinol)</td>
</tr>
</tbody>
</table>
Table 4. Domestic consumption in households.

Resource: What’s being consumed?; Types of transformation: what kind of processing do resources go through? (immediate consumption – cooking, temporality, storage – freezing, drying, curing, caning); Processing arenas (when and where processing happens?); Human actors (gender, age, class); Knowledge and institutions shaping preferences; Outcomes (food security, well-being).

<table>
<thead>
<tr>
<th>Resource</th>
<th>Types of transformation</th>
<th>Processing arenas</th>
<th>Human actors</th>
<th>Knowledge and institutions shaping preferences</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tarpon</td>
<td>Chorizo de Sabalo – processing the meat for 2-3 days</td>
<td>Households</td>
<td>Mainly women</td>
<td>Traditional knowledge</td>
<td>Food security</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td>Robalo</td>
<td>Drying</td>
<td>Households</td>
<td>Both male and female</td>
<td>Traditional knowledge Fishermen cooperative</td>
<td>Food security</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td>Robalo</td>
<td>Either: immediate consumption (cooking – deep fried, soup, etc.) Freezing for later use</td>
<td>Restaurants</td>
<td>Both male and female</td>
<td>Traditional knowledge Tourism</td>
<td>Well-being</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Households</td>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td>Camaron</td>
<td>Either: immediate consumption (cooking – deep fried, soup, etc.) Freezing for later use</td>
<td>Restaurants</td>
<td>Both male and female</td>
<td>Traditional knowledge Tourism</td>
<td>Well-being</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Households</td>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td>Cocoa</td>
<td>Fermenting and drying</td>
<td>Cooperative</td>
<td>Mainly male</td>
<td>International Cooperation Coopérative</td>
<td>Fine cocoa</td>
</tr>
<tr>
<td>Cocoa</td>
<td>Roasting, grinding and processing of cocoa beans</td>
<td>Cooperative group of women</td>
<td>Women</td>
<td>International Cooperation Coopérative</td>
<td>Chocolate</td>
</tr>
<tr>
<td>Cocoa and maize</td>
<td>Dry, roasting, grinding cocoa beans and maize</td>
<td>Households</td>
<td>Women</td>
<td>Traditional knowledge Coopérative</td>
<td>Pinolillo (traditional</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cooperative group of women</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TOURISM

Tourism in El Castillo is managed mainly by local residents (often rural, poor and economically marginalised). They take care of the general services including provision of overnight accommodation, food services and guiding, therefore we can describe it as a Community-based tourism.

Tourism become an important economic activity in El Castillo thanks to the Araucaria Project from mid 90’s and the first decade of 2000 (Spanish Cooperation). This project not only aid to create local capacity for touristic business and local guides but also supported the restoration of the town and the monument.

Figure 14. Cocoa tour as promoted in the area.

Tourism in the area is closely related with natural resources and scenery of Rio San Juan and the title of “biosphere reserve” is used for promotion of the ecotourism activities. The history mainly around the fortress and the transit route is the other relevant issue to promote the area. Rural tourism have been gaining relevance, for example in the cocoa tours promoted in which tourists can visit a cocoa farm and learn how to make artisanal chocolate with local women (Figure 14). Finally sport fishing is another important activity, although it has some restrictions.

Among the topics that they recognize as the most important to improve the conservation of biocultural services, and the same time the promotion of tourism in the area, it was mentioned:

- the need to have technical assistance for the management of tourism,
- capacity building around tourism management,
- training in flora and fauna id for the new guides

Also it was mentioned both in the interviews and the electronic surveys, about the difficulties they have with the communication services (mobiles and internet) in Río San Juan. They consider this is a critical point for them to promote their business and the area in general.

Regarding this last point it was mentioned in different interviews with local guides, restaurants and tour operator, that there is a local association for tourism (AMEC), however it has never been legalized and currently is not completely active (Box 6).

**Box 5. Tourism association of El Castillo**

AMEC was created with the aim to centralize and organize all the tourism business so all the stakeholders can share the benefits. According with one of the leaders in charge of the association, it has been difficult to organize because people does not want to support it either with fees or participating in the meetings. They had a system in which all local guides take turns for guiding tours and can attend the touristic information centre. However the guides was not happy with the system since it wasn’t functional. Now, many of the guides have become independent and even formed their own business. In spite of this, AMEC has been trying to establish a fee system to visit the new trail in Indio Maiz, in order to help with the maintenance of the trail, help to cover the salary for a person in the information centre and a percentage to support MARENA with the expenses for patrolling the reserve. The leader claim that MARENA does not respond about this point, however when I asked him if it was legal for MARENA to receive part of the shares for the fees he doesn’t know about this. During the interviews some people mentioned about this new fee system and also mentioned that the trail is now closed for visitors (May-June), many of them wasn’t sure about this fee.

Touristic services range from tour operators, lodging and food services. Of these services those with a more direct relation with local biocultural products are tour operators (promotion of
sightseeing and scenery of the biosphere reserve, cocoa tours) and restaurants (fish and local crops and fruits).

Although the area is visited mainly by foreigners (main market niche) there is an agreement between the people in the interviews about the lack of promotion and marketing of Rio San Juan as an international destination. They also mentioned the need to enforce the law for the protection of the biosphere reserve and the need to strengthen the current local organizations.

Native species and a sense of place

As discussed by Forristal et al. (2012), native species has the potential to become a viable option for promote a destination if a particular species has a strong biological links with the natural environment and local history and culture, and of course it there is a potential for tourists to interact with it, in this way creating what is known as a sense of place.

We observe that this links already exists in El Castillo and Río San Juan in general, since there are several species that play an important role in the area, either for conservation programs or as the case of Tarpon, has strong links with local culture, or even the cocoa crops that are gaining an important place in the area.

The ecotourism activities promoted in the area include trekking in the jungle for a general interpretation of local fauna and flora (this is made mainly in the reserve Indio Maiz). There are also specialized tours that target specific fauna or flora groups, for example the nocturnal tour to spot crocodiles (*Crocodylus acutus*) or the birding tours with local guides (that have been trained in that activity some years ago). Regarding birdwatching, the main target species in the area is the Great Green Macaw (*Ara ambiguus*), also a flagship species for conservation in the area^15^.

Rio San Juan have been gaining fame as a sport fishing destination, including tarpon fishing, at national and international level. The target species include Bass, Tiger bass, Rainbow bass, Alligator Gar, and Tarpon. This activity require adequate licenses (tourism and inpesca). Tarpon fishing at El Castillo is only allowed during the fishing festival (September) although in other parts (close to San Carlos and in the lake) it is allowed under a catch and release procedure. Some of the local fishermen at El Castillo are also guides for sport Tarpon fishing.

As a possible promotion strategy in the area, they can identify together the best species that can describe better the sense of place in Rio San Juan. This is an exercise that should be done with the participation of the community and local authorities.

^15^ [http://www.fundaciondelrio.org/campanas/1](http://www.fundaciondelrio.org/campanas/1)
AGRICULTURE: COCOA CROPS

Cocoa have been traditionally consumed in Nicaragua since pre-Columbian times. According with Coe (2008) cocoa (Theobroma cacao) was a plant with roots with the Rama culture, locally known as *kuuk* in the Rama language; other cocoa relative was the *pataste* (T. bicolor). Both *kuuk* and *pataste* were used by indigenous Ramas to elaborate a sacred drink *kukalkine*. Nowadays, Nicaraguans made a popular beverage called *pinolillo*, made with roasted cocoa and maize.

Farmers in Río San Juan are having a go at organic cocoa production. A Cocoa plantation is usually established as an agro forestry system, in association with subsistence crops and/or other cash crops. Cocoa farming is maybe a good example of how a certain amount and certain types of economic activity are compatible with the natural resources and conservation objectives of a biosphere reserve, that may also help the conservation of biocultural heritage of the region.

According with the interviews, cocoa crops have existed in the area since the 70’s, however it was mainly planted for consumption in the households. It was in the 80’s when the Araucaria (AECID) project began to support the production to transform it into a commercial crop. That’s when the cooperative started to organize local production. Araucaria supported the formation of the cooperative and promoted the cultivation of cocoa as a friendly product with the environment. At that time they were given 615 plants to grow per acre however the yields were very low since the
farmer didn’t receive enough technical assistance and they paid little care to the crops. During that time the cooperative had around 90 producers associated, number that has changed through time due the ups-and-downs of the cocoa sector in the area. It was until the year 2008 that the cooperative acquired legal status and at this moment there are around 41 producers that are receiving more support and technical advice for their crops and therefore the quality and yields have improved.

Now the local cocoa cooperative at El Castillo (Coodeprosa), buy the cocoa produced by the local producers, after that the cocoa is fermented, dried and packed at the cooperative’s storage centre (Figure 15) to sell to the international markets (the German company Ritter Sport is the main buyer of their cocoa). The cooperative have promoted entrepreneurship in the local women, whom are producing artisanal chocolates and pinolillo to sell locally through products labeled “las hijas del cacao” (cocoa daughters) (figures 16 and 17).

Figure 16. Artisanal chocolates, pinolillo and cinnamon produced by the group of women

Figure 17. Artisanal production: roasting cocoa in comal (left) and cocoa grounding with mortar (right)
HANDICRAFTS

At this moment only one artisan is working and selling the handicrafts in the town and was the only one interviewed. According with the interview with the local artisan, there were several local artists and artisans in the town during the Araucaria project (International Cooperation), which created a local store to sell the handicrafts made by all the artisans (La Casa del Artesano, or the Craftsman House). However many of them lost interest and stopped working in the activity claiming that they didn’t receive enough incomes.

It is difficult to establish if there have been cultural changes, however I assume that there is in fact a cultural change since for example natural dyes are not used, natural fibers are rare and there are very few local materials used in the elaboration of handicrafts, and with few exceptions most of the crafts are made with brand new-modern materials, including fabric and acrylic paintings that are purchased outside the biosphere reserve (and come from Managua). Nygren (1999) mentions that during the 90’s Rattan extraction to elaborate furniture was an important economic activity in the area, however it is not the case anymore since it was prohibited.

Table 5. Biocultural products used in the elaboration of handicrafts in Río San Juan (following Torri 2014)

<table>
<thead>
<tr>
<th>Local name</th>
<th>Scientific name</th>
<th>Preparation method</th>
<th>Part used</th>
<th>Product obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almendro</td>
<td>Dypterix panamensis</td>
<td>Collecting in the forest; washing and drying; paint and barnish</td>
<td>Seed</td>
<td>Key rings, ear rings</td>
</tr>
<tr>
<td>Sabalo</td>
<td>Megalops atlanticus</td>
<td>Washing the scales; drying (at least six months)</td>
<td>Scales</td>
<td>Ear rings, jewelry</td>
</tr>
<tr>
<td>Canela</td>
<td>Cinnamomum zeylanicum</td>
<td>Cleaning and drying pieces after collecting the bark</td>
<td>Wood</td>
<td>Napkin holder, ring holder</td>
</tr>
<tr>
<td>Coco</td>
<td>Cocos nucifera</td>
<td>Cleaning and drying, polishing</td>
<td>Seed</td>
<td>Ear rings, jewelry</td>
</tr>
<tr>
<td>Balso*</td>
<td>Ochroma pyramidales</td>
<td>Wood</td>
<td>Wood</td>
<td>Wood sculptures, Napkin holder</td>
</tr>
</tbody>
</table>

*Balso handicrafts are originally made in Solentiname archipelago, that also belongs to the biosphere reserve but located in lake Nicaragua; handicrafts from balso are not made in El Castillo, only traded.

The local materials from plants used in the handicrafts are collected in the forest and farm directly by the artisan or by the family or local guides during tours to the reserve. It was interesting to observe the use of materials from the farms, for example when cinnamon is collected and transported to the town, pieces of wood remain after processing it and the artisan is using this...
pieces to create her work. The materials that are from animal origin (specifically Tarpon scales) are collected now during the fishing festival once a year.

Figure 15. Above, key rings made with Almendro seeds (Dipteryx panamensis) and illustrated with local fauna. Below. Almendro seeds collected for the elaboration of handicrafts.

In the case of the artisan in El Castillo, this is the main and only economic activity of the person interviewed, however her family are involved in farming and tourism services. The products are described as unique, because they are made by hand and each piece is different from the other.
although similarities in the patterns. The use of species (parts) relevant for conservation or the relation with local identity with biocultural products is mentioned as a purpose of the economic activity in the elaboration of some items such as the almendro seeds, a tree very important for the Great Green Macaw, a local symbol of conservation that sometimes is also illustrated in the designs. At least two species relevant for conservation, the Almendo (*Dypterix panamensis*) and Tarpon (*Megalops atlanticus*), are used directly and other species are illustrated in the designs of the crafts (Figures 15 and 16). She mentions the importance of recycling as an important consequence of her economic activity.

The Araucaria Project was very important to promote entrepreneurship around crafts, however some people wasn’t able to have a commercial livelihood activity based on the elaboration/selling of crafts and art for tourism (Box 7).

**Box 6. Highlighted comment:** “During the Araucaria project, artists and craftsmen from El Castillo and Solentiname gathered in the Craftsman House (it was around 25-30 artists). It was a nice project and they used to sold a lot but then because as the crafts is related with the tourist season if there were not sales people were no more motivated and stop making the crafts, and at the end it did not reach to pay the person in charge and the store was closed after 6 months. In my case I understand that during the low tourism season I need to prepare materials and be ready for the high season, since this is my main economic activity and I do not want to change it”.

This narrative shows how the external support from international cooperation was very important but at the same time show the various limitations on human capabilities for a successful local entrepreneurship process, mainly because specific contexts and realities are different. This could be happening for two reasons: first, the economic expectations around the process were too high and second, the tourism activity wasn’t big enough to have enough clients for their production. The interview also showed a possible disconnection with nature and the sustainability of the activity. According with the interview, when asked about the dependance of the activity on biocultural resources the answer was:

**Box 7. Highlighted comment:** “Only a partial dependence, for example the seeds come from the forest, some pieces of wood are from the cocoa farms, some crafts as some jewerly are made with Tarpon scales and I also use stones from the river, I think that around 40% of my materials are from nature, and the rest are purchased outside the town. I think that my activity will not be affected if I have no more access to those resources from nature since I can find other products to replace and have new designs”.

So, although she recognize the use of biocultural resources for her business, there is a perception that those resources can be replaced with new materials, even from other outside the reserve. The harvesting of biocultural resources for crafts is apparently not making a big pressure on
natural resources since the resources are collected occasionally and randomly (seeds that are already on the forest floor, or scales collected when a Tarpon is caught during the fishing festival).

Figure 16. Above, Handicrafts made with Cinnamon wood. Below, ring ears made with Tarpon scales
Figure 17. Food chain: flow of materials at El Castillo, Río San Juan
Figure 18. Calendar of availability/use of biocultural products and services in El Castillo, Río San Juan
5. RECOMMENDATIONS

Following the recommendations in the guiding coordinates suggested by Davison et al. (2012), I am going to point those that may be the most important to help the sustainability in the area and look as the most practical in El Castillo:

- **DESIGN TEAM**: the framework suggest that the design team should be formed ideally by local NGOs, local governments and representatives of the community. There are some local organizations in the area such as the former fishermen cooperative or the tourism association AMEC, however it may be better to create a new figure for the design team with new rules (operation principles) approved by all beneficiaries. This design team can have representatives of those organizations as well as other members of the community. A proposal for a design team in El Castillo is illustrated in the figure 19. As Davidson et al. (2012) explain it is important that the design team is based on the principle of *Seven Generations*, so they can consider the transmission of knowledge among new generations as well as a fair distribution of benefits, risks and responsibilities of all members of the community in the long term, something that have not been included in the current model or at least is note evident.

![Figure 19. Suggestion for the design team in El Castillo, Rio San Juan](image-url)
• **Participation:** this is a crucial point in the area since the spaces exist but are not working adequately. Apparently the participation arenas are only for share information or communicate a decision made by the local authorities, but not to consider the opinion, motivations or local knowledge in the decision making process. The tourism association mentioned above (AMEC) is not active, but it could be the basis to create this design process space, since members of it include businesses and local guides present in El Castillo. If AMEC is reorganized it could be a good start point for the design team, being an opportunity to consider self-determination and necessities of all beneficiaries. Other alternative is the reactivation of the fishing cooperative to improve participation of local fishermen in the design process regarding fish.

The participation of local communities is of the most importance for a real and sustainable process. For this, the establishment of the design team as explained above will be crucial to identify the best, innovative solutions, considering the biocultural heritage of the area, identifying the products/services that may help to address the aspirations of the community and the network of beneficiaries.

• **Political and Institutional Support:** another crucial point that must be addressed in the area is to establish a good relationship with political leaders and relevant institutional actors to promote their participation and support in the Biocultural design approach. As mentioned above and in the interviews, decision making by local authorities at this moment do not consider local knowledge or an adequate socialization/dialogue between all the stakeholders. If the design team is looking to strengthen cultural identity, it will be important in the design process to consider local cultural values, knowledge, traditions and identity. At this moment the predominant language is that from the government, which in many cases does not consider local knowledge, aspirations and needs, showing an environmental resource conflict in the area. It was also observed by Nygren (2000) during her work in Rio San Juan. In other paper Nygren (1999) explain how we can observe different knowledge from different and “multiple social actors, that are differentially empowered and move in a terrain characterized by contradictory, competitive and complementary relations” and how this different languages may become a constraint for designing participatory solutions in a community, but at the same time is a challenge to understanding and include all those knowledge, visions and repertoires, as is the case in the biocultural codesign process.

• **Foundation and Building Blocks:** socialization among all beneficiaries about existing capabilities, capitals and rights amongst the design team so everyone understands the process, limits and challenges.

• **Network of Beneficiaries:** as was described in this report, the biocultural products/services at El Castillo has a clear distribution in the value chain. The design team will need to create local capacity, so people may carry out projects as culture and ecological tourism, fisheries, agro-forestry farms and home gardens for example. The
process will need to be flexible and permit the evaluation of goals and inclusion of future necessities.

- **Cultures of innovation**: Sustainability in the biosphere reserve will rely on the combined work of environmental authorities and local communities (including women and youth groups), in order to create awareness of the cultural and natural richness of the area and the conservation challenges of the area, so they understand their local reality and the negative impacts on their social system and ecosystems. This require looking for innovative process that may help to identify new ways of doing business (or improve the existing ones).

**Framework of Management plan and nomination of WHS**

It would be important to review the nomination submitted to the UNESCO WHC in 1995 in order to update the information, establish clear criteria and define the best category to nominate the area. Accordingly, the management plan should be reviewed and updated so it includes activities for the conservation of both cultural and natural resources. It is suggested to evaluate the different management plans (El Castillo, Rio San Juan, Solentiname) as well as the current municipal management plans. However, as was observed in the electronic survey, there is confusion between the UNESCO programmes MaB Biosphere Reserve and UNESCO World Heritage Site. It is possible that a first entrance point could be to explain further the differences and benefits offered by each one.

In the case of Río San Juan Biosphere Reserve, being a UNESCO Biosphere Reserve that is also included on the Ramsar List and an Important Bird Area for BirdLife International (Morales et al. 2009), the potential of being fully recognized as a World Heritage Site by UNESCO will allow to have a more integral approach to guarantee its safeguarding. UNESCO and the Ramsar Secretariat have closely collaborated, taking part in a number of joint missions and sharing information. BirdLife International is the official advisor for IUCN regarding birds, so the recognition as an Important Bird Area (IBA) is without doubt an important input that may generate opportunities for conservation and birdwatching tourism in the area.

The IUCN is also working alongside with UNESCO to improve the knowledge of terrestrial biodiversity in MaB but especially in WHS, with the aim to promote the conservation of important areas in the heritage global list (Bertzky et al. 2013). In a recent paper by Le Saout et al. (2013), Río San Juan Biosphere Reserve was highlighted as one of the 137 irreplaceable protected areas at worldwide level that should be also recognized as a World Heritage Site to help in the conservation of the *in situ* biodiversity; this is a scientific proof of the Outstanding Universal Value of Río San Juan, as defined by the UNESCO WHC.
CAPACITY BUILDING

Capacity building is not only about educating the personnel in charge of a site, is about empowering countries toward their sites, improving the management and conservation, enhancing financial capacity, strengthening collaboration networks at national, regional or global level, and improving the monitoring of the sites in order to respond on any situation. An important challenge is to address culture in the process, so it may include the vision of indigenous and local communities and their territories, and at the same time link culture with the environment. That is why it is suggested to follow the 5C’s principles stated in the Budapest Declaration on World Heritage: credibility, capacity building, communication, conservation, community participation.\(^{16}\)

Communication (divulgation) should take into account different audiences, including divulgation to the public in general and local communities so people can learn and appreciate the efforts made to conserve a MaB and the potential WHS, and why the site is of relevance at a global and national level. The communication process may have to consider also a more specialized public (i.e. scientists and academy), that will expect scientific information for example in academic journals, and also policy makers that will require more technical information. Basic tools in visual marketing and internet penetration can help local communities so they can promote themselves the destination. This will require the improvement of ICT in the area, including internet and mobile infrastructure.

PARTICIPATION

The biocultural design requires a participatory process to consider people needs, aspirations and motivations. For this, the design team will play a central role to include people from different sectors and with different knowledge, that reflect the network of beneficiaries and that have the capacity to create new networks or to strengthen the existing ones. This participatory process may include if necessary the creation or updating of public policies and will look to include the perceptions of local communities towards the Biosphere Reserve and the potential World Heritage Site.

In order to create a proper participation of local communities, it will be important to identify the mechanisms and options for participation to involve people in the elaboration of management plans. One approach could be for example, working together in the management objectives and

involving them in monitoring processes or the identification of indicators to measure the success of the program. This should be clear, flexible and adaptable to changing conditions.

Bio-cultural community protocols is maybe the first stage for local communities to empower them around the negotiation of the resources in their areas actually help to generates the local environmental and social goals they are looking for, so they can guarantee culturally appropriate livelihoods without compromising the conservation objectives (Natural Justice 2009).

**ECONOMIC DEVELOPMENT**

Conservation of natural resources is the main purpose when a protected area is established. However in many cases the aim of conservation is excluding the ability of local/indigenous communities to adapt themselves and their livelihoods to the new circumstances as mentioned by Hay-Edie et al. (2012). That’s how the biocultural design process may help to identify the products and services under negotiation that are coherent with the objectives of the MaB and the potential WHS, looking for innovative solutions, identifying new markets and business schemes that may help to create employment and economic development without compromising the effectiveness of the MaB.

The area of the Rio San Juan Biosphere Reserve have a great potential to establish an Ecomuseum, as an economic alternative that may help to preserve, engage and manage the biocultural heritage through the involvement of local communities and tourists in certain activities characteristic of the area, for example, fishing, storytelling, nature interpretation, etc. (Davis 2011).

Innovative market schemes should be identified, for example, the establishment of **Payment for Ecosystem Services mechanisms**, or through the identification of the more relevant **biocultural products** of the region that may enter into a negotiation process. This may require also to identify the more relevant **Intellectual/tradable Property Rights** (IPR) for those products as suggested by Dutfield (2011) and biocultural community protocols as recommended by Natural Justice (2009). IPR, such as trademarks and geographical indications can help to protect and promote the biocultural products and services in the area, and may contribute to increase their incomes and promote sustainable development (Dutfield 2011).

**PROPOSED SOLUTIONS**

These solutions are proposed for consideration of the design team, most of these and are based also in the comments from the interviews:
Fishing:

- **Reactivation of the fishing cooperative**: Since the former cooperative was apparently functional and its model was fair for all members, its reactivation may help to empower local fishermen so they can address environmental and socio-economic problems, it may also help them to have a voice and a vote in the decision making process in the area regarding Vedas, licenses, prices, markets, or even may facilitate access to financial services, as pointed by a report by FAO. Of course, it will require to be legally formalized under Nicaraguan laws, so the government recognize it and then the cooperative can claim access to a set of fishing grounds or a given species; this is important since if the benefit doesn’t go to the cooperative, and instead anyone is allowed to dip their net in the water – then there’s no real incentive to take on new management measures and there’s a high likelihood that all new productivity will just be harvested down again. With the cooperative they may also be able to define fishing rights or territorial fishing rights, and secure revenues from their activity.

- **Carrying capacity studies for artisanal fisheries and Tarpon (local consumption and sport fishing)**: understanding the size of the fishing stocks may help to create sustainable fisheries and establish fishing quotas for the cooperative (or individual fishermen in case they are not organized) and the government so there is a consensus on the optimal amount of fish to be harvested. It will also help to address if the local consumption of Tarpon is really affecting the populations in order to make recommendations for local consumption and sport fishing.

- **Market studies – business plans for fisheries restaurants, tourism enterprises**: as was pointed here, fishing in Rio San Juan has a strong relationship with markets (food and/or tourism markets). An strictly biological conservation approach may be failing in understand the problem of sustainability of the fishery sector where there is a strong interaction between social issues, fishing activity, market organisation and of course the environment. Policies and regulations should consider how fishermen, market operators and consumers are interacting among them and how they adapt their choices (fishing choices, market distribution choices, and consumer decisions). It is assumed that fisheries can be regulated efficiently if the relationship with markets is taken into account.

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18 Personal communication by M. Bell, The Nature Conservancy - Oceans Program Director.
interesting initiative in Canada called Ocean Wise\textsuperscript{21} show how when consumers, chefs and fisheries work together it is possible to have sustainable markets. Considering these points, I suggest that the creation of market studies and collaboration within fishers, restaurants and TTOO may help to find the best solutions for sustainable fishing in Rio San Juan.

- **Freshwater shrimp farming:** in the study made by Pascual-Sardi (2005) about freshwater shrimp he made important recommendations for the conservation and use of this species, including shrimp farming and market studies, so I am just going to call the attention again to that study since it is worth to implement those recommendations.

- **Slow Food nomination – Tarpon chorizo:** Slow Food through its program the Ark of Taste, is an initiative that try to call the attention into products, flavours, recipes related with native species that has roots in local culture and history with the aim to rescue those products that are in risk of disappear\textsuperscript{22}. This initiative may help to protect traditional products either by promotion of local consumption, supporting producers or in the case of endangered species promoting a sustainable consumption or in the contrary suggesting to not consume it. A first measure to nominate the Chorizo de Sabalo was made with the staff from The Ark of Taste, and they are interested in hear more about this product and help to include it in the Ark of Taste.

- **Information services (mobile phones or other technologies) for restaurants and fishermen to learn about Vedas, fish availability, also for tourism (transportation schedules, guides, etc). It could be as simple as SMS or more sophisticated using apps or other devices.**

**Tourism:**

- **Capacity building:** It is recognized the relevance of tourism, especially well-designed and managed tourism programs, to improve local livelihoods, as well as the need to support not only sustainable tourism activities but also capacity building programs in order to help to promote environmental awareness and empowerment of local communities towards biological and cultural diversity\textsuperscript{23}. Araucaria project made a very good job around capacity building and community empowerment, but very few efforts have been made since then, and during the interviews it was a constant request the need to have similar capacity building programs, for new generations but also to update knowledge on the former community members. Some of the possible programs include:

\textsuperscript{21}http://www.oceanwise.ca/
\textsuperscript{22}http://www.slowfoodfoundation.com/ark
\textsuperscript{23}http://sustainabledevelopment.un.org/index.php?menu=1267
- Programs in biodiversity and ecology, to improve the capacity of local guides around the correct identification of flora and fauna
- Programs in ecotourism, including access to markets, destination branding, business planning
- Graphic/Photography lessons to improve marketing of the site, including basic marketing tools to help them in use internet and social networks efficiently, improve contents on local websites/social networks pages
- Social networking, to develop skills for using social networks as a marketing tool

• **Re-organization of tourism association**: as suggested with the fishing cooperative, it would be important to propose a new organization and reactivate the association of tourism, since it may help to empower local business and local guides towards the challenges they are facing. It could be a good space so tourism can gain a voice and vote in the decision making process and can help local them to access financial services if the organizations is legalized under Nicaraguan laws. This legalization could be either a cooperative or a local tourism board.

**General**

- **Capacity building around design team and human centered design**: Human-centered design is a process that helps to understand and hear the needs of the people and communities they’re designing for, in order to create innovative approaches to meet these needs, and deliver solutions that work in specific cultural and economic contexts. As proposed here, the design team will be responsible for leading the process and to include potential producers/providers of the different product and services as well as the potential consumers. The design team may help to guarantee an informed participation and decision making process around the use and promotion of biocultural products/services. However local communities will need to understand the design process, how to involve all key stakeholders and how to listen, understand and include the aspirations and needs of relevant community members, considering the conservation objectives of the biosphere reserve. There are useful tools for this, including the Human Centered Design toolkit (IDEO 2013) that has options in Spanish and the online toolkit (in English).

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26 [http://www.hcdconnect.org/](http://www.hcdconnect.org/)
• Intellectual Property Rights - IPR: tools of intellectual property rights such as geographic indication, trademarks, denomination of origin, traditional specialty guaranteed can help to protect and promote those products related with biocultural heritage (Dutfield 2011). For example, geographical indications for the cocoa produced in the area, or the creation of specific trademarks for the chocolate products made by the group of women, can help the local cooperative to receive more profits for their products and therefore may have impacts in promote the establishment of more agro forestry cocoa systems instead of cattle ranching farms and help to preserve cultural values. Another benefit could be for tourism, for example in the development of destination branding, creation of trademarks for local business, copyrights for specific designs (i.e. souvenirs), and etc.  

This however, requires a strong organisational and institutional structures, participation of both producers and enterprises, a good relationship between market partners who can help in the promotion and marketing of biocultural products/services, and last but not least, an effective legal protection at the domestic level (Giovannucci et al. 2009, cited by Dutfield 2011).

Table 6. Summary and recommendations (a tentative road map)

<table>
<thead>
<tr>
<th>Category</th>
<th>Actions</th>
<th>Timing</th>
<th>Impact /outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation</td>
<td>• Design team</td>
<td>1-2 years</td>
<td>• Informed participation and decision making</td>
</tr>
<tr>
<td></td>
<td>○ Operational principles</td>
<td></td>
<td>• Increased participation</td>
</tr>
<tr>
<td></td>
<td>○ Obtain political / institutional support</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>○ Identify network of beneficiaries</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Reactivation of the fishing cooperative</td>
<td>1-2 years</td>
<td>• Strengthened participation in the decision making process in the</td>
</tr>
<tr>
<td></td>
<td>○ Address the needs of local fishermen</td>
<td></td>
<td>area regarding Vedas, licenses, prices, markets.</td>
</tr>
<tr>
<td></td>
<td>○ Address local consumption</td>
<td></td>
<td>• Facilitate access to financial services</td>
</tr>
<tr>
<td></td>
<td>○ Address conservation objectives</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Update the tourism cooperative/association</td>
<td>1-2 years</td>
<td>• Local business and local guides empowered.</td>
</tr>
<tr>
<td></td>
<td>○ Address needs of local tourism businesses</td>
<td></td>
<td>• Participatory space for the decision making process</td>
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<tr>
<td></td>
<td></td>
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<td>• Facilitate access to financial</td>
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<table>
<thead>
<tr>
<th>Category</th>
<th>Actions</th>
<th>Timing</th>
<th>Impact /outcome</th>
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</thead>
</table>
|                  | Bio-cultural community protocols                                         | 2 years | • Local communities empowered and with knowledge around the negotiation of the resources in their areas  
|                  | • Address the needs and aspirations of local communities               |         | • Culturally appropriate livelihoods without compromising the conservation objectives  
|                  | • Identify markets options                                              |         |                                                                                  |
|                  | Research on carrying capacity for artisanal fisheries and Tarpon      | 1-2 years | • Sustainable fisheries  
|                  | • Training Programs in biodiversity and ecology                        |         | • Fishing quotas for local consumption and sport fishing                         |
|                  | Training Programs in ecotourism                                        | 1-2 years | • Strengthen local tourism businesses  
|                  | • diversifying services and products available for tourists           |         | • Strengthen environmental awareness and local communities empowerment  
|                  | • access to markets                                                    |         | • Sustainability                                                                  |
|                  | • destination branding                                                 |         |                                                                                  |
|                  | • business planning                                                    |         |                                                                                  |
|                  | Training programs in Graphic/Photography                               | 6 months | • Improved business environment                                                  |
|                  | Training programs in social networking                                 | 6 months | • Improved business environment                                                  |
|                  | Market studies – business plans for fisheries restaurants, tourism enterprises | 1-2 years | • Improved business environment  
|                  | • Address the needs of providers                                       |         | • Improved supply chain efficiency  
|                  | • Address the needs of end users                                       |         | • Sustainability                                                                  |
|                  | Freshwater shrimp farming                                              | 2 years | • Improved supply chain efficiency  
|                  | • Slow Food nomination – Tarpon chorizo                                | 1-2 years | • Address cultural traditions  
<p>|                  |                                                                         |         | • Improved governance                                                             |</p>
<table>
<thead>
<tr>
<th>Category</th>
<th>Actions</th>
<th>Timing</th>
<th>Impact /outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management plan/nomination WHS</td>
<td>• Socialization about WHS and MaB programs and its possible impacts in the area</td>
<td>1 year</td>
<td>• Improved governance</td>
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<tr>
<td></td>
<td>• Review and update nomination to UNESCO WHS</td>
<td></td>
<td>• Improved governance</td>
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<tr>
<td></td>
<td>o Establish clear criteria</td>
<td></td>
<td>• Improved governance</td>
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<tr>
<td></td>
<td>o Define category to nominate the site</td>
<td></td>
<td>• Improved conservation</td>
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<tr>
<td></td>
<td>o Socialize with local communities</td>
<td></td>
<td>• Improved local participation</td>
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<td></td>
<td></td>
<td>2-3 years</td>
<td>• Improved governance</td>
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<td></td>
<td></td>
<td></td>
<td>• Improved conservation environment regarding biocultural heritage</td>
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<td></td>
<td></td>
<td></td>
<td>• Improved local participation</td>
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</tbody>
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6. CONCLUSIONS

- The Human Centered Design toolkit (IDEO 2013) is a very useful tool for this kind that are looking to promote communitarian involvement. One of the first steps is to identify the design challenge, and although for this stage my design challenge was focused on identify sustainability issues of the biocultural products and services in Rio San Juan area, it is expected that once a design team is established, they can identify themselves a design challenge and work together in looking for the solutions. The toolkit can guide the design team in thinking in the social process. In this case I only focused in the Hear and Create steps of the toolkit, and listed a series of possible solutions that should be considered in the Deliver step by the design team (IDEO 2013), however they can identify other activities.

- Management plans are one of the implementation indicators suggested by UNESCO and therefore an update of the management plan for Rio San Juan as proposed here, can have positive impact for the conservation and management of the area.

- Having a comprehensive management plan that address the needs and expectations of rural/indigenous communities, will be an important step of Nicaragua and will demonstrate the accomplishment of its commitment in the international agenda. In this way the management plan will help to contribute to the needs of the national society in relation with a sustainable future plan will help the country and the world.

- UNESCO MaB Programme is looking to strengthen the global network of Biosphere reserves as a strategy to reconcile conservation of biodiversity and biological resources with their sustainable use. In order to achieve this, the Seville Strategy for Biosphere
Reserves highlights the importance to have effective management plans or policies in place at all biosphere reserves 28.

• Biocultural heritage would be an important focus to achieve local sustainable development since it address how livelihoods are shaped around natural resources and how local culture is influenced by it. Therefore, a management plan that consider the biocultural products and services that are central for local communities in the biosphere reserve so their aspirations and needs are not excluded in the process will be an important step for sustainable development.

• Artisanal fishing is recognized as one of the most important activities for river-marine communities that may help to get incomes but also due its importance in food security. Fishing used to be one of the most relevant livelihoods in the area but now it is decreasing in importance as other livelihoods are adopted, however it is not clear how these changes will affect food security in the area.

• One of the most controversial issues is around the Tarpon fishing prohibition at El Castillo in comparison with the sport fishing. Tarpon is recognized as an important product with links in local culture, gastronomy, livelihood and traditions and it will be prudent to make a review of the current management of this species.

• Local communities and indigenous populations are making a living and thriving by growing traditional crops, creating handcrafts, traditional foods that are founded on the local environment and framed in Nicaraguan history and culture.

• As in other parts of Nicaragua, local communities at El Castillo are embracing ecotourism as a sustainable livelihood, taken advantage of the landscape and rich biodiversity in their areas. However, changes in the ecosystem is threatening this activity considering that tourists would like to visit Rio San Juan Biosphere Reserve if it haven't been converted to palm oil plantations or cattle farms.

• Protecting the biosphere comes down to making sure enough ecosystems around the globe maintain their structures and functions. A strong appreciation of biocultural heritage is a key to doing this job, especially in the face of pressures from ongoing economic growth. Local economies in which people maintain a sense of place and a sense of their ecological and cultural limits provide an alternative and resilient model to the traditional economic development.

7. BIBLIOGRAPHIC AND DOCUMENTARY REFERENCES


http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1010&context=ichthynicar


Fundación del Río 2010. Impacto y propuesta de delimitación del cultivo de palma africana en el municipio de El Castiello. Informe del proyecto “Delimitación de la expansión de la palma africana en la zona de amortiguamiento de la reserva biológica Indio Maíz en el municipio de El Castiello, Río San Juan”. Managua, Nicaragua.


Rabella I Vivés s.f Cartilla desarrollo poblacional y económico de Río San Juan. Proyecto Araucaria-MARENA. Nicaragua.


**Legal framework**

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<th>Marena–Inpesca</th>
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| Law 217: |
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| Councils for citizen participation: |
|----------------|---------------------------|

**8. PHOTOGRAPHIC ANNEX (ELECTRONIC)**

[https://www.flickr.com/photos/clau_munera/sets/72157647260989509/](https://www.flickr.com/photos/clau_munera/sets/72157647260989509/)