Human-Crocodile Interaction in the Great Tempisque Wetland, Costa Rica

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Abstract

Due to development and urban expansion the interaction between man and wildlife has increased. Those interactions may have benefits for both parties, but also there are those that lead to conflict. Great Tempisque Wetland, habitat of the American crocodile (*Crocodylus acutus*), has been subjected to human pressure, which has dramatically reduced the habitat available for this species. However, the population of *C. acutus* has increased over the last 15 years, and the probability of encounters between crocodiles and people also increases. We evaluated the interaction between human and crocodile from a qualitative approach of social research to determine human-crocodile interaction in the communities surrounding the area. The interaction between humans and crocodiles are leading to a conflict in 22 communities. This interaction results in fatal and non-fatal attacks by *C. acutus*.

Introduction

The interactions between human being and the wildlife are increasing because of the development and urban expansion; as a result there is more human presence in wildlife habitat (Wieczorek Hudenko and Decker 2008). Although interactions may have benefits for fauna and humans, there are also negative interactions that can lead in to conflict, that must now be resolved by wildlife managers (Wieczorek Hudenko and Decker 2008).

The negative interactions can result in a conflict, and they cause negative impacts on humans in the social, cultural and economic aspect or on the conservation of populations of wildlife or the environment (WWF 2005). The conflicts between human groups and wildlife have existed over the course of time (Peña 2011), and they have become more frequent and severe in the last few decades as a result of human population growth, the extension of transport routes and the expansion of agricultural and industrial activities which together, have led to the increase of the human invasion in natural areas (Lamarque *et al.* 2009).

On the other hand, in places where nature protection has been successful, threatened wildlife may recover, and sometimes cause damage to property or human casualties in households at some distance from the wild areas or the areas that it inhabits (Treves 2007). To live near wildlife imposes a variety of significant costs to the local human population, including the depredation of domestic animals, attacks on human beings and the opportunity costs. In addition, people are deprived of economic goods (eg fish) or recreational activities (eg river rides and swimming) due to the impositions caused by the presence of wild animals or conservation areas (Dickman 2010).

Because of the pressure that crocodile populations suffered in the past by hunting and skin trading in several tropical countries, protective measures were taken by different governments. This protection has been effective in some cases and several populations of different species have recovered, increased and re-occupied parts of its historic range, leading to increased interaction between humans and crocodiles which inevitably has led to conflict in many cases.
The habitat of *Crocodylus acutus* in the Great Tempisque Wetland has been under human pressure because of human population growth, and also agricultural and urban growth (Monge-Nájera and Gomez 2007), and this has considerably reduced the habitat available for the species. This reduction has forced the crocodiles to move to areas not inhabited before, looking for prey and territory. Despite this, it has been observed that contrary to what would be expected, the population of crocodiles in GTW has grown to the point quadrupled in the last 16 years (Bolaños 2012).

The increase has experienced the crocodile population and their migration to areas where they were not present before, plus the human population growth, have increased the probability of encounter between crocodiles and people, and therefore the risk of attacks on humans. Today this situation has generated a conflict with some communities that are not satisfied with the abundance of the crocodiles.

We evaluated the interaction between humans and crocodile from a qualitative approach of social research and used semi-structured interviews to determine human-crocodile interaction in the communities surrounding the area.

**Methods**

Bolaños (2012) described the Great Tempisque Wetland (GTW). GTW is formed mostly by the Tempisque River basin, which is located in the Guanacaste Province in northwestern Costa Rica. It has an area of 5460 km$^2$ (54% of the province), equivalent to 10% of the country, making it the country's largest water system (Mora et al. 2001).

GTW has a diversity of tropical ecosystems: tropical rain forest and mountain forest; in the mouth of the Tempisque River are mangroves; and, several important wetlands such as Bolson, Riberino Zapandi and Palo Verde (Aguilar et al. 1998; Monge-Nájera and Gomez 2007). In areas with lower water levels are mixed forests, including tropical dry and riparian forest, while submerged areas are comprised of swamp vegetation (Monge-Nájera and Gomez 2007).

The main river channel has a length of 194 km (Sánchez 2001). It is navigable on the last 36 km and it is the third most important river in the country in terms of its flow (Monge-Nájera and Gomez 2007). The main factors of conversion of the natural ecosystems in GTW are draining the wetland for use in agriculture, water pollution poisons in agrochemical use, changes in natural flow of the rivers, and forest fires for agricultural use and hunting (Monge-Nájera and Gomez 2007).

We worked there between September 2012 and February 2013 in 22 communities surrounding GTW (Fig. 1). We used social approach through interviews. People interviewed was chosen under these criteria: people who interact with crocodiles due to their daily activities, people living near to the rivers, people affected by crocodiles in the past. We asked people interviewed about three topics: personal information (including age, sex, level of formal education, and the time living in the community), activities and places related to crocodiles (in order to determine interaction, basically where do they work and go for recreation), and tolerance (how many crocodiles people wants to see), this is: which scenario people prefer: 1- no crocodiles in the wetland, 2- less crocodiles than there are now, and 3- crocodiles actually living in the wetland.
Figure 1. Communities visited en Great Tempisque Wetland, Costa Rica, 2012.
Results and Discussion

We did 207 interviews, mostly with adults, with low level of formal education and living in the community all their lives (Fig. 2). People interviewed were mostly men (n= 147) and 60 women. The principal economic activities by men were related to agriculture (43.5%), cattle raising (20.4%) and fishing (13.6%). Women were dedicated mostly to domestic works (81.67%).

We found that human-crocodile interactions were produced by human economics and recreational activities related directly and indirectly to the rivers and wetlands. We considered activities with direct relationship those that people do inside or in the shore of rivers and wetlands as: a) extraction of river products (fish, clams, sand), b) touristic trips by the rivers, c) swim, d) movement of cattle through wetlands. Likewise, the activities with indirect relationship are those which are not made in the rivers, but near to them, as: a) working in agricultural fields, b) trips to rivers or wetlands, and c) daily activities made by the riverside.

People interview reported that human-crocodile interactions had resulted in 18 non-fatal attacks, of which 10 were on people fishing in the water, 5 on people swimming, 2 on people sitting by the riverside, and one on a person crossing the wetland on horseback. Also people recognized 4 fatal attacks, three of them on people swimming and one on a woman (the only woman attacked) who was walking by the riverside (Fig.
The reaction after a crocodile attack, was that people sometimes killed one or more crocodiles while looking for “the guilty” one. 101 of the interviewed people said that they know about some cases where crocodiles are killed because of their attacks on people or domestic animals and cattle. In general, people think that crocodiles are dangerous, and represent a risk for humans. But curiously, when we asked people about why crocodiles attack, most of the people mentioned the human imprudence as the main cause (Table 1).

The ideal scenario for people interviewed was one with presence of crocodiles, (69.1% if we add people who wants less crocodiles than actually are and those who want the current scenario). People who want a scenario without crocodiles were mostly those who had no interaction with them, especially housewives (Table 1).
Table 1. What people tell us about how many crocodiles they prefer and why crocodiles attack.

<table>
<thead>
<tr>
<th>Item</th>
<th>Answer</th>
<th>No. Interviewed</th>
<th>% Interviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>No crocodiles</td>
<td>64</td>
<td>30.9</td>
</tr>
<tr>
<td></td>
<td>Less crocodiles than now</td>
<td>79</td>
<td>38.2</td>
</tr>
<tr>
<td></td>
<td>Current situation</td>
<td>64</td>
<td>30.9</td>
</tr>
<tr>
<td>Why crocodiles attack</td>
<td>Imprudence</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>They are aggressive</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>There is no food</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Defence of hatchlings</td>
<td>8</td>
<td>10.7</td>
</tr>
<tr>
<td></td>
<td>Defence of territory</td>
<td>4</td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td>Reproductive season</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Not all the human population living in GTW had contact with crocodiles, and either interacts with them. It is clear that interaction between humans and crocodiles are enhanced by activates carried out by people in the river and wetlands. In GTW it is possible to find people who works at home or in places out of the wetland and then their visits to the rivers are null, as well their interaction with crocodiles.

Most of people interviewed said that attacks to people are the principal affectation they’re suffered from crocodiles, and also attacks on domestic animals. This is the worst manifestation of interaction and it is the cause of the conflict. This occurs besides most of the people did not experience an attack, they just known someone attacked or listen about the attacks. However it is a real problem for them.

Barrantes (2010) indicated that between 1990 and 2009 there were 40 attacks on people in Costa Rica, 29 of which were non-fatal and 11 which were fatal. Most of those attacks were on the Pacific coast of the country (77.5%) and the crocodiles involved were larger than 3 m (3.4 m 57%, 4.5 m 30%, 5-6 m 13%). Barrantes (2010) said that frequency of crocodile attacks is increasing in Costa Rica. That is the same that is happening in GTW, where crocodile population is also increasing over the last 20 years (Bolaños 2012).

Lamarque et al. (2009) list several reasons why crocodile attacks are common: 1) the number of crocodiles is high and its distribution range is wide (which happens with protected populations when are recovering, 2) crocodiles can live near to people and are cryptic, this give them the possibility of attack without be seen. The crocodile population of GTW is protected and data suggest that it has recovered quickly in the last 20 years (Bolaños 2012). To the reasons listed by Lamarque et al. (2009), we add the imprudence of people and the feeling of familiarity that people have towards crocodiles and their habitat, because this creates a scenario for more attacks.

Some of the people interviewed mentioned that crocodile population in GTW need to be managed in order to improve the relationship between humans and crocodiles. They proposed: take out all of the big
crocodiles and just keep the sizes that do not represent a risk for humans, and relocation of problematic crocodiles.

**Recommendations**

We need to create a management committee, made up of officials from conservation areas, representatives of affected communities and researchers, in order to manage the conflict as a whole and not in parts.

Establish an Attack Assistance Protocol, or similar, involving both SINAC and the Costa Rican Social Security Service (CCSS). Enabling the SINAC take actions such as moving the animal involved to a wildlife refuge or even kill the crocodile. In addition to the CCSS do accompaniment from professionals in the field of psychology to treat PTSD and prevent future sequels to those affected and the community in the GTW.

Develop a Crocodile module in the environmental education programs of the conservation areas located into GTW to promote more positive attitudes towards crocodiles. The content should highlight the benefits and importance of the presence of crocodiles in the environment, information on the species related to their biology, and behavior. Also, include a high content of the damages and the danger it brings the presence of crocodiles in the area, providing information that what should be done in case of attack and how to avoid it.

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**References**