IUCN-SSC Crocodile Specialist Group Student Research Assistance Scheme

Report

Project title: Population ecology and social appreciation of crocodilians (Crocodylus acutus and Caiman crocodilus) in the eastern portion of the Puerto Arista Estuarine System, Chiapas, Mexico.

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Introduction:
Of the 24 species of crocodilians existing in the world (Smith and Smith, 1997, CSG, 2018), two species of crocodiles (*Crocodylus acutus* and *Crocodylus moreletii*) and one species of alligator (*Caiman crocodilus*) live in Mexico (Álvarez del Toro, 1974; Romero, 2011) and Chiapas is the only state in the Mexican Republic that has these three species (Casas and Guzmán, 1970, Álvarez del Toro, 1974, Álvarez del Toro and Sigler, 2001). They are considered key species because they maintain the structure and function of the ecosystems where they live (Martínez et al., 1997, Romero, 2011), are predatory organisms, increase and redistribute nutrients, conserve open channels for water flow and provide refuges that serve as microhabitats for other species (Brandon, 2006, Hernández, 2010, Sánchez, 2011, Vicente, 2013). For the human being, crocodilians have also been an object of interest, they have been present throughout the history of humanity and we are linked to them in different ways (historical, mystical, industrial, scientific, economic, etc.); however, the excessive use of these (poaching, illegal trade, consumption), the destruction of the habitat (due to the expansion of the urban sprawl) and the increase in human-crocodile interactions have caused populations to disappear from the environment wild, so that through knowledge and understanding we can establish its continuity (Muñiz, 2004, Cifuentes and Cupul, 2004, Aguilar, 2005, Brandon, 2006, Sánchez, 2011, García, 2013). In the Puerto Arista Estuarine System (SEPA), there is a record of two works: Sigler (2000) who conducted population monitoring of alligators in the estuary called "Estero Prieto" during 1992 and 1993 and Domínguez (2010) who reported sightings of American crocodile and alligator in wetlands of Tonalá, Costa de Chiapas, Mexico. As of 2014, the reports of "problem crocodiles" and illegal plundering of crocodilians in the SEPA became more frequent, so the objective of the study was to evaluate the population of crocodiles and alligators (*C. acutus* and *C. crocodilus*) in SEPA and describe the social appreciation of these species in areas surrounding the site.

Methods:
Five transects were established between 1.65 km and 6.60 km where monthly (February-September 2017), day and night trips were carried out.

Characterization of the habitat of the crocodilians in the SEPA
The activities were carried out in parallel with the monitoring. The general description of the types of vegetation and the taking of environmental data in each of the transects during the night counts was made. The variables that were taken were: ambient temperature, water temperature, salinity, pH and depth). The anthropic impacts and those of natural origin that have modified the habitat conditions were identified in the tours.

Identification and characterization of crocodile nesting areas in the SEPA
The nesting areas of the species under study were identified from the observations of night counts and day tours. The nests were located when detecting the groups of neonates and the visualization of traces or fresh footprints in the vegetation (Villegas et al., 2011). Once identified, we proceeded to take data to perform the characterization of these. The coordinates of the nests located, the type of nest (mound or hole), its diameter (cm), height or depth of the incubation chamber (cm), temperature of the egg chamber (°C), material were recorded of construction of the nest, distance from the nest to the water's edge (m), percentage of shadow and photographic records.

Population size and structure of crocodilians in the SEPA
The night tours were carried out between 9:00 PM and 03:00 PM the following day for each of the selected transects. Crocodiles and alligators were counted on each route by detecting the reflection of the light beam of a lamp in the tapetum lucidum. In the transects of greater amplitude (lagoons) a reflector (spot line) was used. According to the characteristics and conditions of each transect, a boat (panga) propelled with an outboard motor of 8 HP, oars or rods was used. In the case of lagoons and bodies of water of low depth the routes were made on foot. In each observation of specimens, the total length (LT) of each organism was determined visually (Thorbjarnarson, 1989) and the observed species was identified. The organisms were classified into size classes; for the case of *C. acutus* (Thorbjarnarson, 1989) five categories were established, while for *C. crocodilus* (Sigler, 1998) four categories. For both species, when it was not possible to estimate the size of the specimen, the data was recorded as eyes

Spatial distribution of crocodilians in the SEPA
Based on the structure and proportion of the population sampled, a cartographic analysis of size classes of the crocodilian populations in the Puerto Arista Estuarine System was conducted to know the current distribution of the species using a Geographic Information System (GIS) through the program (Arc Map 10.1).

Community appreciation of crocodilians in areas surrounding the study area
Tours of recognition of the site and rapprochement with the authorities of the communities (ejidal commissioners) and representatives of the cooperatives were conducted. To describe the community appreciation of crocodiles and alligators, the method of Stratified Random Sampling was used (Salkind, 1999). Three groups of interest were classified: fishermen, housewives and older adults (≥ 60 years) and the technique called "rapid rural diagnosis or rapid rural appraisal (RRA)" was used with semi-structured interviews. It was carried out from August to November 2017 in 5 communities (Vuelta Rica, Miguel Hidalgo, Paraíso, Puerto Arista and Cabeza de Toro) and work areas (cooperatives). In parallel, the interviews were recorded (118 audios) with a digital recorder (SONY ICD-PX440) with the consent of the informant so as not to lose details about the information provided. The interview format contained a section for the general data of the interviewee and 41 questions, which were divided into four sections: knowledge of the biology of the species by residents, human interaction - crocodilians, appreciation of the population: perception and assessment, protection and management Legal of Crocodilians A database was created in Microsoft Office Excel and the data analysis was done with the statistical package "Statiscal Package for the Social Sciences" (SPSS) in its version 15.0.

Results:

Characterization of the habitat of the crocodilians in the SEPA
The mangrove was the main type of predominant vegetation. We located 11 cavities with the presence of crocodilians and 8 nests in three transects.

Identification and characterization of crocodile nesting areas in the SEPA
Six hollow-type nests and two mound-type nests were located in three transects (Las Manzanas, La Laguna and Estero Prieto). The nests were located by the visualization of traces, remains of shells in the nests and group of neonates / offspring. Although some nests were active, productivity was low, as nests were found predated and probably looted.

Population size and structure of crocodilians in the SEPA
Of the eight samplings made in the five established transects, crocodiles (*C. acutus*) were observed in each of these, while alligators (*C. crocodilus*) were only observed in three of the transects. We counted 331 individuals, 184 of *C. acutus*, 136 of *C. crocodilus* and 11 recorded as eyes. The registered encounter rates for crocodiles ranged from 0.15 individuals/km (La Laguna) to 3.12 individuals/km (Estero Prieto, without offspring) and for alligators from 0.12 individual/km (Rich Return) to 6.26 individuals/km (Estero Prieto) during the eight samples taken. The lowest estimated crocodile (N) population was 1.67 in La Laguna and the highest of 53.63 in Estero Prieto. For alligators, the lowest estimated population (N) was 1.23 in Rich Vuelta and the highest of 54.26 in Estero Prieto.

Spatial distribution of crocodilians in the SEPA
Two species, represented by all stages, were observed in two of the transects, while the other transects were only observed in *C. acutus*, with subadult stages, adults and adult reproducers, which preferred open and deep waters, while the rest They stayed at the water's edge. The alligators were observed in between the roots or shore of the mangrove. More than 50% of the individuals presented an elusive behavior.

Community appreciation of crocodilians in areas surrounding the study area
There were 10 interviews per group (60.60% fishermen and 30.30% housewives) and 15 interviews to older adults (9.10% $\geq$ 60 years) as key actors, having a universe of 165 interviews and 118 audios, highlighting that the interviewed people have extensive knowledge of the biology of species, common names and morphology; they recognize for alligators a medicinal use and in crocodiles only as food. 46% of the interviewees recognized knowing of attacks of crocodilians to domestic fauna or to people; of them, 61.84% said they could have been avoided. Regarding the human-crocodilian interactions, it was manifested with myths and differential perceptions among localities about the danger, use and management of the species. 73.94% answered that they would participate in projects with crocodilians and 26.06% would not participate (due to fear)

Conclusions:
The status of the populations of crocodilians, *C. acutus* and *C. crocodilus*, in the SEPA can be considered as critical, since the encounter rates are low in comparison with the area and the available habitat. Added to this, the population structure is not proportional in all transects, so it does not allow the replacement of one stadium to another, reducing the chances of reaching the reproductive stage. In spite of having located eight nests (six of pit type and two of type mound) and that these were active, the productivity was low, since nests were found predated and possibly looted. The distribution and abundance of crocodilians in the SEPA is a function of the conditions and habitat use, the basic biological requirements of the species and the fishing activity, since in places where there is greater human pressure the sighting is lower. Although the sites have been affected by natural and anthropic factors, the highest encounter rate of crocodilians was observed in the Estero Prieto and La Laguna transects, as well as the population structures best represented, since individuals from all stages were observed. Undoubtedly, the habitats in these transects (Estero Prieto and La Laguna) satisfy their basic biological requirements and show the best conditions for both species, since despite the drought presented during the year 2017, several interconnected canals and caves were observed. They maintained the flow of water, effective strategies for the

survival of these species when using them as refuge and thermoregulation areas, besides that these structures also serve as microhabitats for other species.

For the people interviewed it is common to observe crocodiles and alligators during their daily activities. They have extensive knowledge about the biology of the species, acquired through observations, since they identified the species (*C. acutus* and *C. crocodilus*) through common names and their morphology. The villagers over estimate the number of individuals, since they associate the size of crocodilians with the increase of individuals, affirming that there are many because they have observed individuals with a length of more than 5 m. Villagers identify particular characteristics in crocodilians, which is why they have been assigned different uses. In the case of alligators they are of medicinal use and for crocodiles as food, situations that have influenced the looting of wild populations. Of the 22 forms of preparation of the crocodile meat, it was interesting that the greatest number of recipes was provided by fishermen, followed by housewives and the elderly. It is also relevant that the population associates certain interactions of crocodilians with the domestic fauna through myths. The human-crocodile interactions, if they have impacted on the perception of crocodilians, since there are differences between each of the localities surrounding the site in terms of the danger, use and management of the species. However, for them it is important to conserve them for the environmental function, since the presence of these specimens benefits them in the abundance of fish and the depth of the estuaries

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