POPULATION STRUCTURE, SPATIAL DISTRIBUTION, AND HABITAT OF THE AMERICAN CROCODILE (*Crocodylus acutus*; CUVIER; 1807) IN THE TAYRONA NATIONAL NATURAL PARK, COLOMBIAN CARIBBEAN

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ABSTRACT

It is critical to know ecological aspects about species in order to understand its place in the environment. Between October 2013 and February 2014, we assessed the population ecology of the American Crocodile (*Crocodylus acutus*) in the Tayrona National Natural Park. Spotlight surveys were conducted using transects previously standardized across beaches, coastal lagoons, and creeks. Animal size was estimated sighting and grouping them into size classes. We carried out 100 interviews in order to assess the ethno-zoological relationships between tourists and crocodiles asking questions about general knowledge (biology), conflict, and perceptions (fear, apathy, admiration). A total of 38 recordings were obtained with a total average per transect of 9.5 ± 1.6 ind/km, representing the 73 % (visible fraction) of the population. Relative abundance of *C. acutus* for the four sectors during the study period was 1.33 ± 0.80 ind/km. Los Naranjos had the highest value (2.2 ind/km) and Cinto the lowest (0.52 ind/km). Estimated population size was 13.1 ± 4.3 individuals for the 4 sectors. Population structure showed a dominance of adults over 180 cm (class IV and V), followed by Class III, Class II and Class I. The distribution of *C. acutus* in the protected area was clustered being associated to coastal lagoons and river mouths.

Key Words: *Crocodylus acutus;* American Crocodile, Colombian Caribbean

INTRODUCTION

Crocodylus acutus is catalogued as Vulnerable in the IUCN RedList (Ponce-Campos *et al*., 2012) and make part of the Appendix I of CITES (CITES ,2012). In Colombia, this species is catalogued as Critical Endangered (Castaño-Mora, 2002).

Tayrona National Natural Park is placed in the foothill of the Sierra Nevada de Santa Marta (highest coastal mountain in the world). This area has a high variety of biomes in a small area (15.000 ha, see PNNT, 2006). Currently, this park is catalogued as a Crocodile Conservation Unit by Thorbjanarson *et al*. (2006) based on its relevance for *C. acutus* conservation. However, until now just one work about this species has been released in this area (Balaguera-Reina *et al*., 2012) showing the necessity to get information about its ecology and conservation status.

OBJECTIVES

General

- ✓ Determine the demographics aspects of the American Crocodile (*Crocodylus acutus*) in the Tayrona National Park and its relationship with tourists.

Specifics:

- Establish the population structure (relative abundance and age groups) of *C. acutus* in the study area.
- Establish the spatial distribution of *C. acutus* in TNNP.
- Assess the habitat biology, taking into account the type of coverage, ecosystem, relevant vegetation and associated wildlife species under study.
- Evaluate the ethno-zoological relationships between tourists and crocodiles in the study area (biological knowledge and social relations).
- Conduct an environmental sensitization with tourists from TNNP about the ecological importance of *C. acutus*.

METHODS

Pre sampling – I was trained by Sergio A. Balaguera Reina and Nidia Farfán-Ardila in counting, sightings, and sizes classes estimation methods. We conducted night transects in the study area in order to identify places to work based on sightings reported by residents, officials, tourists, and old records (Balaguera-Reina et al., 2012). We set 4 transects in Los Naranjos, Canaveral, Arrecifes and Cinto.

Field work

From October 2013 to February of 2014 we carried out spotlight surveys throughout beaches and creeks one week per month. These sampling days were chosen based on lunar phases and logistical requirements. We used headlamp of 2600 lumens to detect the animals estimating Total Length (TL) and getting information about geo-reference, hour, habitat, environmental and water temperature, salinity, and fauna present. All individuals were classified based on five size classes (I: < 60 cm, II: 61—120 cm, III: 121—180 cm, IV: 181—240 cm, V: >240 cm, see Seijas 1988). We determined relative abundance (individuals/km) per transect, the visible fraction, and the population size (King and Messel In Cerrato, 1991). On the day, we undertook surveys looking for individuals in land and tracks that allowed us determine presence of the species. We analyzed the landscape directly (in field) and indirectly based on the Colombian marine and terrestrial ecosystems geodatabase (IDEAM *et al*., 2007) using ArcGIS 10.1 (ESRI 2012).

Ethno-zoological relationships and sensitization – We applied 100 interviews with data triangulation to tourist looking for general knowledge (population ecology and conservation status), hunting, conflicts and beliefs. We also developed workshops and forums with local people, tourist in order to sensitize about crocodiles conservation.

RESULTS AND DISCUSSION

During five months of sampling I sighted a total of 38 records of which five were classified as "eyes only" with a total average per transect of 9.5 ± 1.6 ind/km. The lowest value was recorded in Cinto 0.52 ind/km, followed by Arrecifes with a relative abundance of 0.76 ind/km; Canaveral sector recorded a value of 1.90 ind/km and Los Naranjos 2.12 ind/km.

Table 1. Relative abundance of *C. acutus* in the fields of study in the Tayrona NNP Oct/ 2013 and Feb/ 2014.

Sectors	**Naranjos**	**Cañaveral**	**Arrecifes**	**Cinto**
Km of each transect	0.47	1.47	3.65	2.55
Individuals observed Σ 5 monthly transects	5/5= 1	14/5= 2,8	14/5= 2,8	4/3= 1,3
Relative abundance (ind/km)	2.12	1.90	0.76	0.52

Visible fraction

The visible fraction of the population of *C. acutus* in the Tayrona National Park, was calculated using the proposed method Messel *et al*. (1981). Obtaining a value for the visible fraction of **P**: 71%.

Based on the second method the maximum value of the number of individuals observed proposed by King & Messel in: Cerrato (1991), the visible fraction of the population showed a value of **P** = 73%.

Population Size*:*

This value was estimated base on the visible fraction according to Messel *et al*. (1981). The population size **N** with a confidence interval of 95%, showed a value of **N** = 13.01 ± 3.43 crocodiles.

Demographic Structure

The population structure of *C. acutus* was dominated by individuals of the Class V (13), followed by Class IV (11); (seven) Class III; (two) and Class II (five) records called Eyes Only (SO), which could not be grouped within a size Class. (Figure 1).

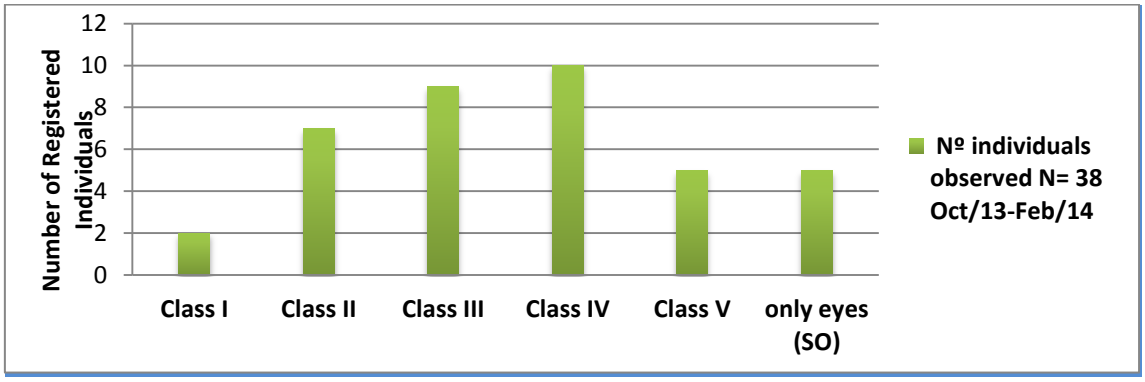


Figure 1. Demographic structure registered in the TNNP from *C. acutus* October/2013–february/2014. According size classes given by Seijas (1988).

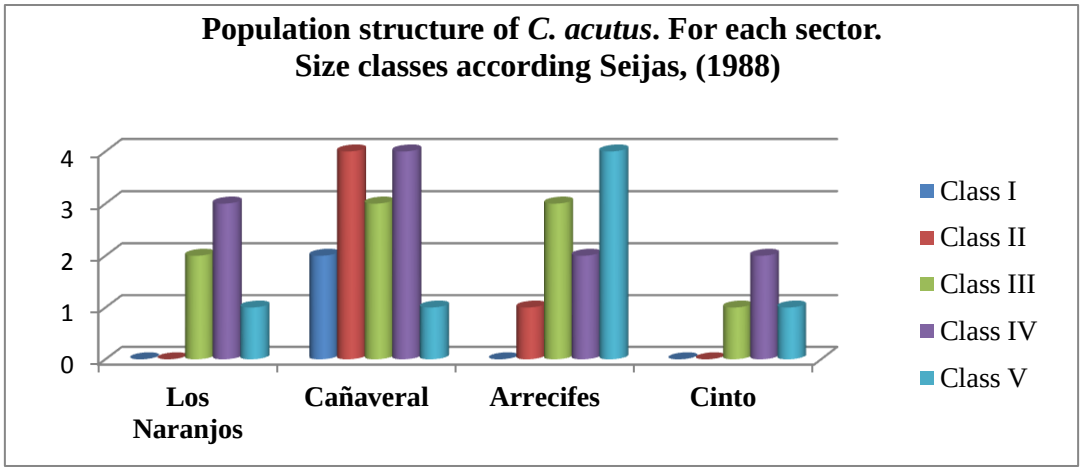


Figure 2. Demographic structure of *C. acutus*, in the TNNP oct/13–feb/14 according size classes given by Seijas (1988).

38 measurements were performed during the study; I did not find statistically significant differences between environmental variables measured (T ° water Tº environment, relative humidity and salinity) in space and time and the values of relative abundance (Kruskal-Wallis test p-value was found:> 0.05).

Table 2. Records environmental variables recorded in each of the fields of study; los Naranjos Cañaveral Arrecifes and Cinto.

Sector	**T° Water**	**T ° Environment**	**Relative Humidity**	**Salinity ups**
Naranjos	28°	27,3°	84%	2%
Cañaveral	28°	27,3°	84%	2%
Arrecifes	27,63°	26,6°	84%	3%
Cinto	28,5°	26,72°	77,25%	3,20%

Spatial distribution

The use of micro-habitat recorded for *C. acutus* in TNNP, is dominated by the records in coastal lagoons, followed by hidden among the vegetation with a value of 24% specimens sightings were also recorded on land at 21% and to a lesser extent the specimens hidden among the rocks with 16% for fields of study the protected area. (Figure. 4)

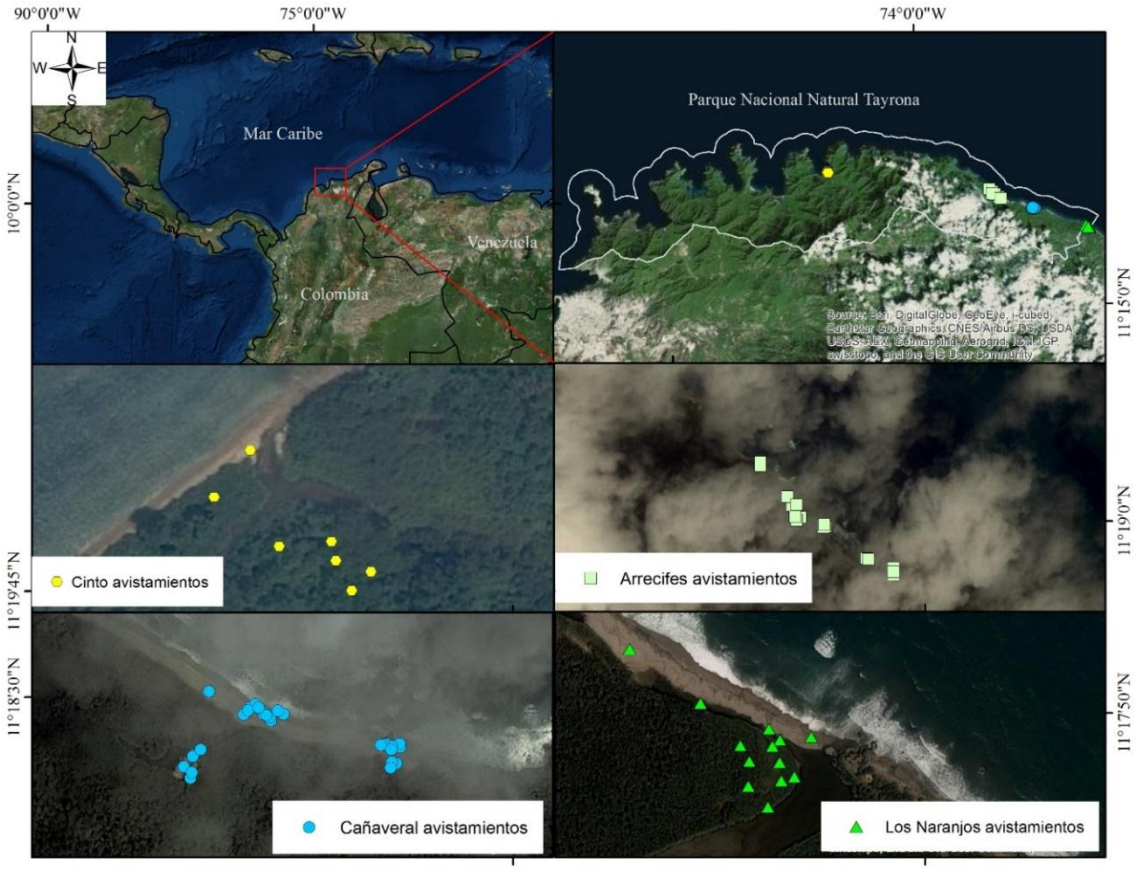


Figure 3. Location of the study area; fields of study with the presence of the species in the protected area. Taken and modified: Balaguera-Reina, *et al.*, 2014.

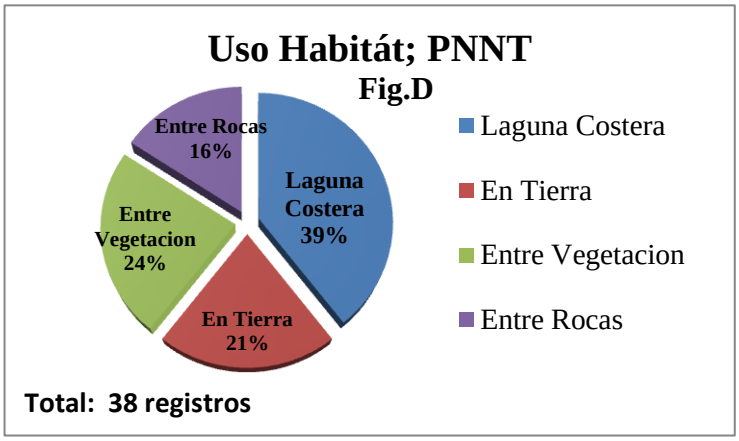


Figure 4. Habitat used of *C. acutus* in the Tayrona Park in each of the areas of study.

Ethno-zoological relationships and sensitization

100 surveys were conducted to tourists visiting the National Park; three main themes in content: biological knowledge, perceptions and social conflicts; of the 100 interviewed 65% were male and 35% female.

As for perception of *C. acutus* by tourists, stands the fact that 78% of respondents claim to be afraid of the species, since they are aggressive (42%; Fig. 5). A large majority of respondents fear them, to see them as aggressive animals, which generate some kind of danger, a small portion of respondents have them show respect and love for the species

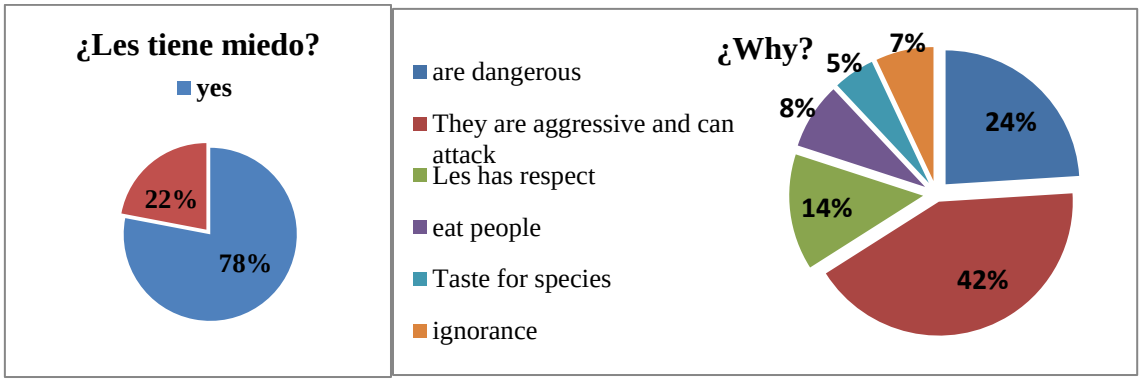


Figure 5. People perception about crocodiles in the TNNP. (fear, apathy, admiration, indifference) to the species in the Park area

Campaigns of sensitization

We performed 15 environmental education forums, talk entitled "Knowing our Biodiversity" (Fig. 6), an initiative focused on teaching and changing perceptions towards crocodiles and other species of the Protected Area. In those talks tourists, workers, and residents of the area were involved (Fig. 6).



Figure 6. A. Campaigns of sensitization`` Knowing Our Biodiversity ´´; B. Assistants to the forums.

CONCLUSIONS

1. The estimated population of *C. acutus*, according to the size classes proposed by Seijas (1988) in the TNNP between October 2013 and February 2014; presented a dominance of adult forms of the classes V and IV. In each of the four areas of

study Tayrona NNP the population of *C. acutus* reflect a demographic imbalance marked by the absence and the low number of individuals in categories or size classes I and II.

2. Sectors and los Naranjos Canaveral showed high relative abundance over time of study, showing relevance level habitat for populations in the park. This relative abundance consistent with nationally registered to date values.

3. The results of this study show that there is a spatial separation, by type of micro habitat and food resources used in the protected area. According to the size class, *C. acutus* is distributed in the ecosystem by a differential use of resources, being mostly individuals of classes IV and V, in bodies of water, while the other kinds of size, found associated with the protection afforded by the vegetation of the shore.

4. Key environmental characteristics that make *C. acutus* habitat in Tayrona Park in each of the sectors, no significant variations between measurements recorded were analyzed were found.

5. The quality and composition of habitat and microhabitat used by the species, habitat *C. acutus* found in good condition, despite presenting different problematics in the fields of TNNP was evaluated.

6. The analysis of the ethno-zoological relations human-crocodile, is fundamental to the understanding of biological knowledge factor, perceptions and beliefs that may have with respect *C. acutus*, all this affects the perception one has positive or negative species.

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