CROCODILE SPECIALIST GROUP – CSG/IUCN/SSC

Student Research Assistance Scheme (SRAS)

FINAL REPORT

Project Title: Populational study and investigation of human pressures and hunting of crocodilians in Tocantins, Brazil

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1. INTRODUCTION

Crocodilians have a long history of human exploitation. Amazonian species have reports hunting since 1930, mainly *Melanosuchus niger*, which after years of extirpation has become rare (DA SILVEIRA & THORBJARNARSON, 1999). The economic incentive of the hunting came from the international export market, dictating trends and causing skin price fluctuations (MOURÃO *et al*., 1996; THORBJARNARSON, 1999) with short-term profits (THORBJARNARSON, 1999), but without recognizing its effects on populations wild.

In this sense, the Cantão State Park (CSP), study area, also has reports of hunting of *Melanosuchus niger* and *Caiman crocodilus*, however, there are not caiman populations studies in the CSP, staying unknown population status of these species in the area. Added to hunting, other increasing sources of human pressure as sprawl, intensive agriculture, deforestation and fires are reported in the area.

Thus, it is necessary to have minimum knowledge of abundance and population structure (age structure and sex ratio) (REBELO & MAGNUSSON, 1983) together with analysis of habitat selection and effects of anthropogenic impacts, in order to have

assessment of population status and encourage further studies to conservation and management. This knowledge can support decisions aimed the conservation and maintenance of the species, selection of priority areas for monitoring, management programs and also, provides information about the importance of the crocodilians fauna to riparian.

Another point additional is knowledge about hunting reports in past decades such as importance of hunting, source of income, subsistence activity, nutritional value and traditional culture (STEARMAN & REDFORD, 1992).

2. OBJECTIVE

2.1.General

This study aims to obtain data from population aspects of *M. niger* and *C. crocodilus*, and investigate crocodilians hunting reports. Such information may be useful to managers for management and conservation programs and to scientific society with over an attractive study area.

2.2.Specifics

- To evaluate the density and population structure of the species of crocodilians, seeking to discover differences between study sites (adjacent lakes and river) inserted into the boundaries of CSP;
- To verify the preference of microhabitat by species and size class;
- To assess potential humans pressures that can cause changes in abundance, the species and age groups;
- To collect information about hunting of CSP's crocodilians.

3. MATERIALS AND METHODS

3.1. Study area

The study was conducted in Cantão State Park, State of Tocantins, Brazil. The population surveys were in three locals: the Coco River (percuss marked in red), Rico Lake and Dentro Lake (UTM 22L 612383.82W 8965555.80S) (Figure 1). The Cantão

State Park is surrounding the other two Protected Areas (Araguaia National Park and Bananal Island/Cantão Environmental Protection Area), making an extent and important ecological corridor of integral protection.

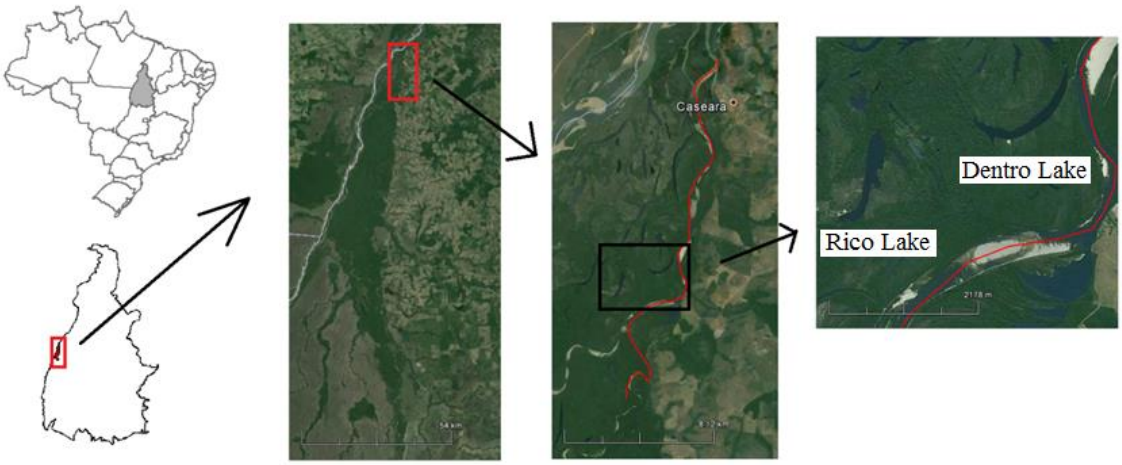


Figure 1. Study area.

3.2. Methods

3.2.1. Information about hunting crocodilians

The search for information about hunting crocodilians was made in period from February to June of 2014 in three ways:

1) Records in official environmental agencies (federal and state) obtained from the Assessment Notices and Seizures Terms emitted by the Superintendence of the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) in the state of Tocantins and by the Tocantins Nature Institute (NATURATINS), allowing the characterization of caiman specimens and hunting areas;

2) If some evidence of game such as dead individuals, parts, carcass or skins of caiman is found, these will be measured to estimate the size and, when possible, the sex will be identify (REBELO & MAGNUSSON, 1983; MOURÃO *et al*., 1996);

3) Through semi-structured interviews conducted using the snowball sampling (POUPART *et al*., 2008; BIERNACKI & WALDORF, 1981; LEITE *et al*., 2012) technique with 16 riverine, such as hunters, fishermen and other people of municipalities Caseara and Pium in Tocantins that they have some linkage with hunting practices.

It was established an age criteria from 50 years old in order to be interviewed what would allow the evidence of experience and knowledge of hunting activity. The age of the interviewees varied between 51 to 93 years old, with a mean age of 67 years old. This research was registered the Ethics Committee of the Federal University of Tocantins with nº. 224/2013.

Reports of hunting had a qualitative and descriptive analysis through information collected: species, size and sex; period and hunting areas; hunting methods, prices, quantities and destinations of products and importance nutritional, social and economic of hunting for riverine.

3.2.2. Populational aspects

The population surveys was done in the Coco River (percuss of 76 km), Rico Lake (4.6 km) and Dentro Lake (4.9 km) in months of August, October and November of 2013 and August, September and October of 2014.

As Rebelo & Lugli (2001), it was observed the encounter rate (individuals/ km), the species and animals size. Additionally, it was recorded the microhabitat of the animal (bed, floating vegetation, riparian vegetation, beach, ravine and rocks, adapted of Malvasio & Salera Junior (2006)).

The identification of individuals was made through the morphological characteristics of head shape, jaw pattern and body color (REBÊLO & LUGLI, 2001). The animals were categorized by total length according to species: *C. crocodilus* - Class I < 50 cm, Class II = 50 - 140 cm, Class III = 140 - 180 cm, and Class IV ≥ 180 cm; *M. niger* - Classe I < 50 cm, Class II = 50 - 190 cm, Class III = 190 - 210 cm, and Class IV ≥ 210 cm. For analisys, the Class I for both species was excluded.

The animals were captured for sex determination, weighing, biometry (variables: total length, snout-vent length, head and skull) and analysis of sex ratio as the proportion of males and females. Marking was made by cutting the tail crests (RUEDA-ALMONACID *et al*., 2007). After handling, individuals were released at the same location capture.

3.2.3. Human impact

The populational surveys performed in the Coco River was used to analyse of human disturbance, however with data related to route of bed of Coco River, but excluding recesses and river branches, comprising a total of 24 km. Such mileage

allowed a comparison between transects of varying degrees of human disturbance (traffic riparian, presence of ports, ships and houses on the banks). As the relative distance from the balneary region of Caseara in the River Coco, it was divided percuss into three transects of eight (8) kilometers each, categorized in levels of human disturbance: high, medium and low due to the general characteristics observed (adapted of CONWAY-GÓMEZ, 2007) (Figure 2; Table 1).

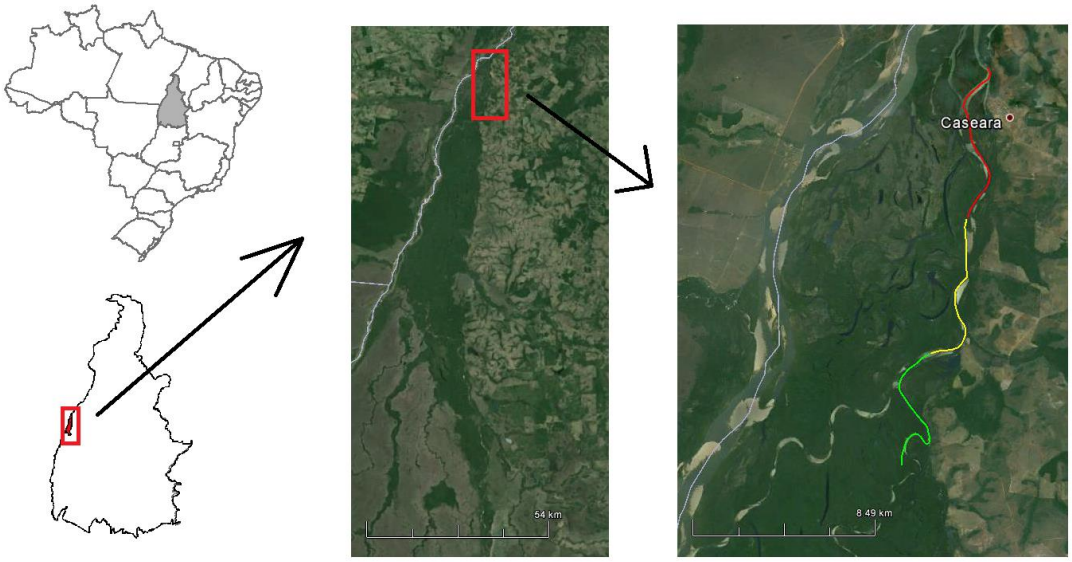


Figure 2. Percuss performed in the Coco River as the human disturbance level: red transect – high; yellow transect – medium; green transect – low.

Table 1. Description of characteristics of transects conform the disturbance level.

Disturbance level	Characteristics
High	Transect with greater intensity of traffic riparian; Link channel between the Araguaia River and the municipality of Caseara; Region with the presence of urban areas with a population of 4,601 inhabitants; Presence of fishing colony; Region used as a recreational area on beaches and fishing; It has two recesses connected to transect, both with great extension and vegetated margins, but with evidence of waste (garbage).
Medium	Transect with medium intensity of traffic riparian; Region with rural aspect; It has riparian houses and a village (Araguaçuí) on its margin; It has three recesses connected to transect with small extent and vegetated margins.
Low	Transect with minimum intensity of traffic riparian; Stretch protected by environmental NGO Araguaia Institute, with prohibition of entry of unauthorized persons and fishers; Absence of urban area; It has a recess connected to the route of small extent and vegetated margins; It has a portion of the stretch with rocks in the river bed with a high degree of danger.

The evaluation was made by data of encounter rate (individuals / km), detecting differences between human disturbance levels for caimans in general, *C. crocodilus* and *M. niger*.

4. RESULTS

4.1. Information about hunting crocodilians

In interviews with ancient hunters, hunting focused on the removal of skins of *C. crocodilus* and *M. niger*, the latter being the most popular. According riparian reports, during the dry months, each hunter group felled 30 caimans daily, making underestimates said of 4,000 skins the end of the season.

The size ranges of the exploited caimans differed between species, *C. crocodilus* had range of extraction between 0.75 m 1.2 m. *M. niger* only had the minimum size of 0.75 m, focusing on animals above three meters. At the end of the hunting, neonates (> 0.5 m) of both species were also listed.

The local culture of exploitation of caimans only aimed the skin, there was no local commerce of the meat and other parts of animal. Moreover, nests and eggs were left intact in nature, without collect of eggs for your consumption.

As evidenced in other Amazonian regions, populations of caimans, mainly *M. niger*, were depletioned in the Cantão region. The different magnitude and intensity of hunting and intrinsic biological factors of species, such as reproductive characteristics, nesting strategies, sexual maturity and growth rate, brought changes in the dynamics of populations of caimans when recovering (REBÊLO & MAGNUSSON, 1983; THORBJARNARSON, 1996; VILLAMARIN *et al*., 2011). As reported by the interviewees, a new distribution pattern was made with *C. crocodilus* in great abundance in all water bodies and *M. niger* in smaller numbers and restricted to certain preserved environments.

Today, caiman hunting is characterized as seasonal, selective and practiced throughout the state of Tocantins. From 80 Assessment Notices consulted the Federal and State environmental agency (IBAMA, NATURATINS), between 1992 and 2014, were confiscated a total of 134 animals, with average annual seizure of 5.83 individuals. Arising from these animals were also collected 223.800 kg of meat and only one caiman skin was apprehended and identified as *C. crocodilus* of one meter (total length).

It was identified that poachers operate in periods of low water and dry of water bodies, where there is the presence of a larger number of caimans in these environments - second half of the year. The hunting locals are the main rivers in the state of Tocantins with easy navigation and access, such as rivers: Tocantins, Araguaia, Javaés, Coco,

Santa Tereza, Manoel Alves, among others. However, the region encompassed by Bananal Island, Cantão State Park and surrounding municipalities concentrates the largest number of tax assessments and seized animals.

Overall, only two species have been described in the records, *C. crocodilus* and *M. niger*, with 32 and five specimens, respectively. Through the records were verified that 23 specimens had body measurements described or estimated with average body of 1.50 m, ranging from 0.6 to 4 m in total length.

The discovery of caimans hunting is, in most part, by road inspection. The federal highway (BR-153 and 242) and state (TO-070, 080, 255, 373 and 374) are also regarded as wildlife illegal trafficking routes, characterized by products or by-products. In another conception, the apprehensions show that PAs are potential targets of illegal use of wildlife, local delimited to the preservation and conservation of wildlife being used as the basis for hunting or illegal trafficking of animals.

4.2. Populational aspects

The encounters rates observed in water bodies showed differences (Table 1). Comparatively between lotic environments, Dentro Lake stood out on the Rico lake ($t = -3.339$; $DF = 10$; $p = 0.007$).

Table 1. Descriptive analysis of the encounter rates of caimans in the sites (ind./km). U = unidentified caiman.

	Coco River			
	U	*C. crocodilus*	*M. niger*	Total
Mean	4.0	4.8	0.3	9.1
Minimum	2.4	2.8	0.2	5.4
Maximum	4.7	6.4	0.5	11.4
Standard deviation	0.9	1.2	0.1	2.1
	Rico Lake			
Mean	3.0	2.5	1.6	7.1
Minimum	2.0	1.3	0.9	4.1
Maximum	3.9	4.3	2.4	9.3
Standard deviation	0.7	1.2	0.6	1.8
	Dentro Lake			
Mean	6.7	7.6	0.2	14.5
Minimum	2.7	4.3	0.0	7.6
Maximum	9.2	13.1	0.6	22.2
Standard deviation	2.7	3.1	0.2	5.1

Of the sites surveyed, *C. crocodilus* had encounter rates higher than *M. niger* on the Coco River ($t = 8.8619$; GL = 10; $p < 0.01$) and Dentro Lake ($t = 3.816$; DF = 10; $p < 0.01$), except for the Rico Lake ($t = 1.7161$; DF = 10; $p = 0.116$).

In general, the distribution of size classes was uneven in each species (Table 2), with Class II corresponding to 80% of the C. crocodilus population ($G = 28.07$; DF = 10; $p < 0.01$), however not representative in *M. niger* (61%; $G = 8.83$; DF = 10; $p = 0.54$). Regarding the population of *M. niger* at each site (Table 2), although Class II is superior in both lakes, followed by the Class IV and absence of observations of individuals Class I, the population structure was normal (Rico Lake: $G = 12.27$; DF = 10; $p = 0.904$; Dentro Lake: $G = 6.788$; DF = 10; $p = 0.74$). For Coco River, age distribution of *M. niger* was more uniform ($G = 10.69$; DF = 10; $p = 0.38$), however the Class II had the highest frequency. For individuals with smaller than 50 cm (Class I), the occurrence was not detected.

In *C. crocodilus*, the age structure constituted mostly of Class II at all sites (Table 2), being representative for the River Coco ($G = 22.18$, DF = 10; $p = 0.014$), however, for the Dentro Lake and Rico Lake, the distribution difference of classes was not decisive (respectively, $G = 4.79$; DF = 10; $p = 0.90$ e $G = 17.21$; DF = 16; $p = 0.069$)

Table 2. Abundance of caiman by size class, species and site.

Local	*C. crocodilus*				*M. niger*			
	Class I	Class II	Class III	Class IV	Class I	Class II	Class III	Class IV
Coco River	274	1770	120	34	0	91	6	53
Rico Lake	0	46	22	1	0	27	1	16
Dentro Lake	0	194	40	5	0	4	1	2
Total	274	2010	182	40	0	122	8	71

To check the sex ratio, 91 caimans were captured, being 66 specimens of *C. crocodilus* and 25 specimens of *M. niger* (Table 3). The size of individuals of *C. crocodilus* ranged from 18 to 94.5 cm SVL (snout-vent length), mean = 54.84 ± 17.74 cm SVL. Individuals of *M. niger* reached the minimum of 22.5 cm SVL and maximum of 153.5 cm, mean of 58.03 ± 28.5 cm SVL. The proportion of males by females in each species was males-biased, *M. niger* reached an mean sex ratio of 7.3 males to one

female (χ^2 = 1.159; DF = 2; p = 0.56) and *C. crocodilus* with sex ratio of 2.5 males to one female (χ^2 = 0.093; DF = 2; p = 0.95).

Table 3. Number of animals captured by sex in *C. crocodilus* and *M. niger* and their respective sex ratio in sites.

Local	*C. crocodilus*		Sex ratio	*M. niger*		Sex ratio
	Males	Females		Males	Females	
Coco River	34	13	2.6	15	3	5.0
Rico Lake	2	1	2.0	6	0	
Dentro Lake	11	5	2.2	1	0	
Total	47	19	2.5	22	3	7.3

The appearance of captured specimens were diversified, most showed the amputated tail or with caudal regeneration. Some specimens had ectoparasites (ticks) in parts of higher bloodstream as behind the limbs and neck. The presence of injuries as the absence of digits, scarring, cuts and injuries on the dorsum were observed. Possibly many of these injuries are taken by fighting among individuals in territorial behavior.

The caimans distributed by various types of microhabitat quantified at each site investigated (Figure 3). The greater occurrence of caimans in the marginal vegetation was representative in all sites surveyed (Rico Lake: G = 49.79, DF = 15; p <0.01; Dentro Lake: G = 28.02; GL = 15; p = 0.021; Coco River: G = 205.66; DF = 25; p < 0.01).

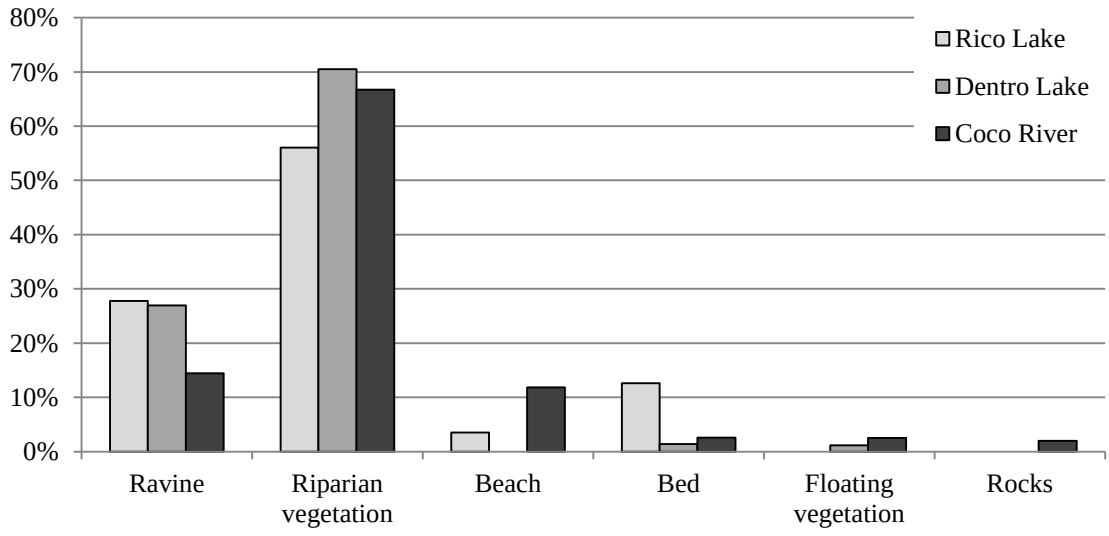


Figure 3. Percentage of caimans by microhabitat in the sites studied.

At species level, the size of classes had variations in the number of animals in each microhabitat. Predominantly, the size classes of *C. crocodilus* had higher proportions in the marginal vegetation. In *M. niger*, the distribution of individuals in microhabitats varied according to the size: higher occurrences of Class I were on the beach, for Class II were in marginal vegetation. The Class III, the distribution was divided, with occurrences on the beach, bed and ravine. The Class IV focused on bed microhabitat.

4.3. Human impact

The encounter rates presented in their transects according to human disturbance degrees - Table 4 - showed that the transect with a low level of disturbance had greater highlight for all caiman ($H_{2;18}$ = 9.61; p = 0.0082) and *C. crocodilus* ($H_{2;18}$ = 7.46; p = 0.0239), but for *M. niger*, this transect just showed the highest encounter rate ($H_{2;18}$ = 0.795; p = 0.671). Differences between low and medium degree was evidenced.

Tabela 4. Encounter rate on the transects according the human disturbance degree, total number of caimans, *C. crocodilus* and *M. niger*. Encounter rate expressed in individuals/km (standard deviation) *. (*) The degrees with the same letter did not differ statistically, p> 0.05.

Disturbance degree	Geral	*C. crocodilus*	*M. niger*
High	9.81 (1.96) ^{a}	3.00 (0.90) ^{x}	0.39 (0.12) ^{m}
Medium	6.37 (1.65) $^{a, b}$	2.52 (1.14) $^{x, y}$	0.50 (0.28) ^{m}
Low	16.31 (5.89) $^{a, c}$	7.06 (2.83) $^{x, z}$	0.62 (0.49) ^{m}

The characteristic of each transect was possibly one of the factors indicated to this result. Stretches located in regions with recesses enabled refuges / sources of caimans to the corresponding stretch, emphasizing the characteristics of each recess - predominance of vegetation, extension, conservation of riparian vegetation - present in the transect. Another possible factor is the actual human disturbance degree arising out boats traffic intensity where closer metropolitan areas, greater the boats traffic, in consequence, greater the wariness behavior and lower the number of caimans.

Lastly, it observed that not only the delimitation of preservation and conservation areas is essential for the maintenance of the population of caimans, but it is also necessary that these areas encompass regions with the highest number of recesses.

The recesses favor the maintenance of the populations of caimans, being regions with resource availability and refuge.

5. EXPENDITURE OF CSG FUNDS

The funds of the Student Research Assistance Scheme at the Crocodile Specialist Group (1000,00 US$) were fully used in the expenditures of field activities. The field expenses encompassed batteries, ropes, rope loops of steel, dynamometers, tapes and especially fuel and food.

The Instituto Natureza do Tocantins – NATURATINS, which is the state agency for environmental responsibility and manager of the Cantão State Park, collaborated in the field activities, providing infrastructure support with stay, boat and gasoline (even in small amounts). The Ecology and Zoology Laboratory of Federal University of Tocantins with the CROQUE research group (Grupo de Pesquisa de Crocodilianos e Quelônios da Região Norte – CROQUE) contributed with human resources capable of performing the work. Also, the Federal University of Tocantins provided technical support of transport for execution this work.

This project had SISBIO federal license n.41029-1 and NATURATINS state license n.4587-2012-V.

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