

POPULATION STRUCTURE, DENSITY, AND HABITAT OF *CROCODYLUS ACUTUS* CUVIER 1807 IN THE VIA PARQUE ISLA DE SALAMANCA, MAGDALENA DEPARTMENT, COLOMBIA

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Abstract: Information about population structure and density is key part of conservation planning for crocodiles, yet little is known about *Crocodylus acutus* within its area of distribution and in the country in general. Population structure, density and habitat of this species were studied between September and December of 2006 in the Via Parque Isla de Salamanca (VIPIS), Magdalena Department, Colombia. A total of 14 individuals were sighted in one creek and one lagoon complex out of the 14 marshes, 10 creeks, and one lagoon complex surveyed that comprise 8% of total of flooded and aquatic habitats in the VIPIS. An estimated density of 7.78 ind/km was calculated for creeks and 2.56 ind/ha for lagoons. The population structure was eight individuals (61.54%) for Class I, one individual (7.69%) for Class II, four (23.08%) for Class III, none for Class IV, and one (7.69%) for Class V. The size distribution found is considered unbalanced due to the low number of individuals sighted and their restricted distribution.

Key Words: *Crocodylus acutus*, Population structure, density, habitat, Via Parque Isla de Salamanca.

Resumen: S.A. Balaguera-Reina y J.F. González-Maya. "Estructura poblacional, densidad y hábitat de *Crocodylus acutus* Cuvier 1807 en la Via Parque Isla de Salamanca, Departamento de Magdalena, Colombia". La información acerca de estructura poblacional y densidad es un elemento clave de la planificación de conservación para cocodrilos. Entre septiembre y diciembre de 2006 se llevó a cabo la determinación de la estructura poblacional, densidad y hábitat de *Crocodylus acutus* en la Via Parque Isla de Salamanca (VIPIS), departamento de Magdalena, Caribe colombiano. Se avistaron un total de 14 individuos en un caño y un complejo lagunar (8% del área muestreada) de un total de 14 ciénagas, 10 caños y un complejo lagunar. Se determinaron valores de densidad de 7.78 ind/km para caños y 2.56 ind/ha para ciénagas. Se observaron ocho individuos de clase I (61,54%), uno perteneciente a la clase II (7,69%), cuatro clase III (23,08%), no se registraron organismos clase IV y un único de clase V (7,69%). La estructura poblacional encontrada presenta un posible desequilibrio dada la baja cantidad de avistamientos y la distribución restringida de la especie en el área.

Palabras Clave: *Crocodylus acutus*, estructura poblacional, densidad, hábitat, Via Parque Isla de Salamanca.

INTRODUCTION

Information about population structure and density is necessary for conservation planning about crocodilians (Velasco and Ayarzagüena 1995, Ulloa-Delgado and Sierra-Diaz 2002). Colombia and Brazil represent the countries with the richest diversity of crocodilian species in the world; however, historical and continued use of these species in Colombia threatens their populations across the country, making it crucial to consider the impact of over-exploitation and extraction in designing conservation strategies (Medem 1981, Rodriguez 2000, Ulloa-Delgado and Sierra-Diaz 2002). Protected areas that include these species have shown continued use by local communities, representing an important economic resource (Ulloa-Delgado and Sierra-Diaz 2002). In addition, information regarding species such as *Crocodylus acutus* (Fig. 1) is scarce, resulting in poorly developed conservation plans for these species (Rodriguez 2002). Via Parque Isla de Salamanca (VIPIS) is an important protected area on the

Caribbean coast of Colombia. It represents one of the most important habitats for crocodilians, and particularly for *Crocodylus acutus* (Sánchez-Páez *et al.* 2004). However, the current status of this species in the area is still unknown. The present study represents the first systematic approach to evaluate the *C. acutus* population in VIPIS, and one of the first for the Caribbean coast of Colombia.

MATERIALS AND METHODS

Study Area

Parque Nacional Natural Via Parque Isla de Salamanca is located in the Magdalena department, in the Caribbean coast of Colombia. The park occupies approximately 56200 ha, and is composed of a complex of lagoons and creeks that covers approximately 75% of the entire park. The protected area is located between 11°07'19"-10°53'07"N and 74°20'34"-74°51'00"W, approximately 15 km from Barranquilla, capital of

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Atlántico department. Regionally, the VIPIS is part of the Ciénaga Grande de Santa Marta eco-region and is protected under the RAMSAR Convention (Moreno-Bejarano and Alvarez-León 2003).

Methods

Between September and December 2006, a total of 20 systematic night spotlight-surveys were conducted inside the VIPIS, following five established routes during each sampling night. The samplings were done by boat with an out-board engine at a maximum speed of 7 km/h (Ulloa-Delgado and Sierra-Díaz 2002) in creeks, and by foot in one lagoon; in both cases using a 200000 candels flashlight. All the surveys were conducted between 19:00 and 02:00 h, excluding full moon nights, which diminish the probability of observation for *C. acutus* (Medem 1981, Cerrato 1991) although it does not appear to have an effect on other crocodilians (Da-Silveira *et al.* 2008). Every sighted animal was hand-captured or approached as close as possible, a maximum of two meters away, in order to determine its size (Chabreck 1966, Salas 1985, INDERENA 1994, Medem 1981). Size classification for all the individuals was based on Seijas (1988) that proposed ranges according to the total length (TL) as follows: Class I (TL < 60 cm), Class II (TL = 61-120 cm), Class III (TL = 121-180 cm), Class IV (TL = 181-240 cm), and Class V (TL > 241). This classification system was selected because of the similarity between the two survey areas, and because other systems do not necessarily represent the status of the present population (Platt *et al.* 2004). No statistical analyses were performed due to the small size of the sample. An unbalanced structure of the population, following the proposition by Velazco and Ayarzagüena (1995) for *Caiman crocodilus crocodilus* in the Venezuelan savannas, can be determined where the frequencies histogram show a pyramidal distribution (more numbers of subadults in relation to adults and young) showing



FIG. 1. *Crocodylus acutus* from Via Parque Isla de Salamanca, Magdalena department, Colombia.

Crocodylus acutus de la Via Parque Isla de Salamanca, Departamento del Magdalena, Colombia.

a demographic structure altered by anthropic or stochastic events.

Abundance was calculated as number of individuals/km for each creek and density as number of individuals/ha for each lagoon, when presence of the species was confirmed. Calculations of areas and lengths were made using ArcView 3.3 (ESRI, Inc., Redlands, CA) software, based on the Ciénaga Grande Santa Marta Geographical Database provided by Instituto de Investigaciones Marinas y Costeras "Jose Benito de Andreis", INVEMAR. Habitat classification was done according to vegetation composition and dominance, and a Chi-square test was used to test the relationship between crocodile abundances and habitat.

RESULTS

A total of 119.02 km were surveyed in the area, covering approximately 2394 ha for lagoons and a total distance of 23.62 km for creeks. A total of 14 individuals were observed in one creek (Caño Clarín Viejo) and one lagoon complex (Los Cocos) out of the 14 marshes, 10 creeks, and one lagoon complex surveyed, representing 8% of the total flooded and aquatic environments at the VIPIS. Class distribution was unbalanced (following Ulloa-Delgado 1998), with eight individuals (61.54%) for Class I, one individual (7.69%) for Class II, four (23.08%) for Class III, none for Class IV and one (7.69%) for Class V. Population structure was different for creeks and lagoons (Fig. 2). An estimated abundance of 7.78 ind/km was calculated for creeks and a density of 2.56 ind/ha for lagoons (Table 1), which is considerable higher than those found for *Caiman crocodilus fuscus* in the same area (1.00-2.73 ind/km for creeks and 0.1691-0.0035 ind/ha in lagoons; Balaguera-Reina and Gonzalez-Maya unpub. data).

Three habitat types were determined: 1) forest-like habitats: composed of live mangrove trees and floating macrophytes, dominated by *Avicennia germinans*, *Rhizophora mangle* and *Laguncularia racemosa*; 2) low vegetation habitats: composed mainly of small plants and floating species, dominated by *Mayaca fluviatilis*, *Eichornia crassipes*, *Typha domingensis*, *Lemna sp.* and *Echinochloa polystachya*; and 3) open water habitats: habitats with no associated vegetation.

There were no significant differences among the distribution of sightings across the habitat types ($p=0.17$). However, there were differential observation frequencies within the types: forest-like habitats (61.5%), low vegetation habitats (30.76%), and open water habitats (7.69%).

DISCUSSION

The results indicate a restricted distribution of the population in the VIPIS and an unbalanced population structure. The density found in this study is considered low, compared to previous reports from sites near the study area where heavy human exploitation has been recorded (Bahía de Cispatá; Ulloa-Delgado and Sierra-Díaz 2002). However, this study found similar densities to those reported in the Ermitaño river (middle

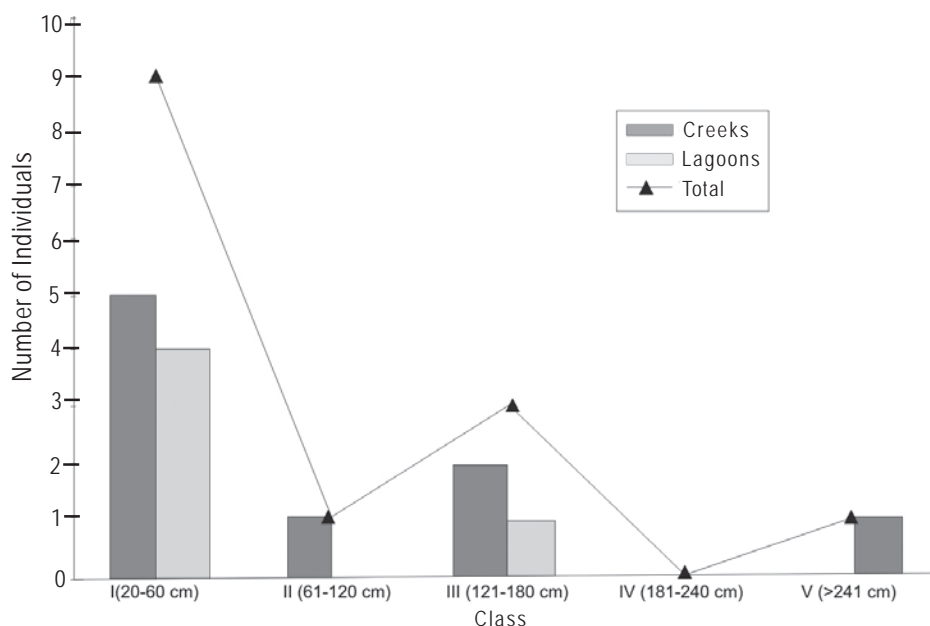


FIG. 2. Class distribution frequencies within creeks and lagoons, compared with total.
Distribución de frecuencias por clases entre caños y lagunas, comparado con totales.

basin of Magdalena River) by Barrera (2004) and Barahona *et al.* (1996) which are higher than population studies from other countries (Escobedo and Mejia 2003, Platt *et al.* 2004, Carvajal *et al.* 2005). The representativeness of the current results indicates that populations across the Caribbean coast

of Colombia are unevenly distributed across the area. This differential occurrence is probably related to human pressure and isolation of populations; although it seems that human pressure is not as high as in other countries (e.g. Ecuador and Peru) (Carvajal *et al.* 2005).

TABLE 1. Distribution and densities of *Crocodylus acutus* for the surveyed creeks and lagoons.
TABLA 1. Distribución y densidades de Crocodylus acutus para caños y lagunas muestreadas.

Route	Type	Names	Perimeter (km)	Area (ha)	Individuals	Size Class	Density Ind/ha	Abundance Ind/km
1	Lagoon	Dársena, Poza Verde, Loro.	36.10	931.91	0			
	Creek	Torno, Baco, Limón, Loro, Almendros	3.60	4.68	0			
	Total	8	39.70	936.59	0			
2	Lagoon	Playa del Perro, Lirial, Las Moras,	37.80	456.79	0			
	Creek	Marchena, Buchá, Suiches de Marchena	1.70	0.34	0			
	Total	6	39.5	457.13	0			
3	Lagoon	Medio, Atascosa.	10.40	233.91	0			
	Creek	Dedo, Las Lachas, Clarín Viejo	3.10	3.00	7	I, II, III		7.78
	Total	6	13.50	236.91	7			
4	Lagoon	Cuatro Bocas, Manatíes.	12.80	743.37	0			
	Creek	Palmitas, Manatíes, Clarín Nuevo.	14.42	19.44	0			
	Lagoon Complex	Los Cocos	0.80	2.73	7	I,III,V	2.56	
	Total	6	28.02	765.54	7			
TOTAL			120.72	2396.57	14		2.56	7.78

While no significant difference in habitat preference was found, unequal usage patterns are similar to those previously reported for the species in Colombia and South America. These differences are probably related to the high availability of resources in these ecosystems, and the use of these areas for refuge and foraging (Chiriví 1973, Medem 1981, Barahona *et al.* 1996, Sánchez-Páez *et al.* 2004, Carvajal *et al.* 2005).

The distribution of sightings followed previous reports related to hierarchy of sizes and ages (Sánchez-Páez *et al.* 2004, Ulloa-Delgado *et al.* 2005). The population distribution among size classes is not considered ideal for population growth, and probably it is the result of extraction of high size classes and habitat loss in the area (Sánchez-Páez and Álvarez-León 1997, Sánchez-Páez *et al.* 2004).

The species has not been reported in the VIPIS previously until this year (Balaguera-Reina and González-Maya 2008), but it has been reported in the eco-region (Barahona *et al.* 1996, Rodríguez 2002); therefore, we consider it is another worrying signal of the population status within and around the VIPIS. Even when *C. acutus* populations are considered to be isolated (Rodríguez 2000), sampling methodology should be also considered, since this species has shown to be elusive under heavy human pressure which could alter the results of surveys.

CONCLUSIONS

The results indicate that the population of *Crocodylus acutus* in VIPIS may be under severe pressure from local communities where pollution, hunting, and human-wildlife conflict are common. Despite the relatively high densities reported here, the patchy distribution, unbalanced population structure and low absolute population of *C. acutus* make it vulnerable to human exploitation and habitat loss. Therefore, urgent action is needed to ensure the survival of these populations in the park. Expanding surveys in the area will provide a better understanding of the current status and the impacts of human pressures on the species, allowing the development and implementation of strategic conservation plans. Legal farming or ranching and sustainable extraction could be encouraged by authorities to reduce exploitation of wild populations, and stronger policies should be enforced against illegal hunting to maintain healthy populations of this top predator in these important habitats of Colombia.

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