

Dirección de Fauna y Flora – Autoridad CITES Argentina. Secretaría
CITES, FUCEMA, CICuR.

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at Iberá marshes, Corrientes, Argentina. Proyecto INCO/DC – El Uso
Sustentable de los Recursos de Humedal en el MERCOSUR – Informe
inédito – página web – publicación en preparación.

EVALUATION OF WILD POPULATIONS AND HABITATS OF AMERICAN CROCODILE (*Crocodylus acutus*) IN VENEZUELA

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ABSTRACT

The American crocodile ranges from southern Florida to northern Peru. In Venezuela, the historic range extent along the northern Caribbean coast. It inhabits brackish and freshwater habitats, preferring mangrove-lined coasts and also freshwater inland habitats. The species suffered loss of habitat due to coastal development. Since commercial hunting has been severely reduced, habitat issues are expected to dominate efforts for conservation. The American crocodile (*Crocodylus acutus*) in Venezuela is considered an endangered species included in CITES Appendix I. Government is developing a Conservation Program, which includes population surveys and ranching for reintroduction. Abundance and size structure of wild populations, and a characterization of occupied and potential habitats were carried out, in order to choose better reintroduction areas. Venezuelan proposal made by authors of the present paper is coincident with the management program derived from Conservation Priority-Setting Workshop for American Crocodiles, held at Gainesville USA in 2002. These proposals were presented to Venezuelan Government for its development.

RESUMEN

El Caimán de la Costa (*Crocodylus acutus*) se distribuye desde el sur de Florida al norte de Perú. Habita aguas salobres y habitats dulceacuícolas, con preferencia en manglares. La especie ha sufrido pérdida de habitats por el desarrollo costero en su área de distribución. La cacería comercial está severamente reducida y los esfuerzos para la conservación se dirigen hacia el manejo de hábitat. En Venezuela, la especie es considerada como amenazada e incluida en el Apéndice I de CITES. El Gobierno está desarrollando un Programa de Conservación que incluye censos de poblaciones y la cría en cautiverio para reintroducción. Se realizó una estimación de abundancias y tamaños poblacionales y una caracterización de hábitat

potenciales para determinar las mejores áreas de reintroducción. Las propuestas de los autores coinciden con los programas de manejo derivados del Taller de Conservación para el Caimán de la Costa realizado en Gainesville USA en 2002. Estas propuestas fueron presentadas al Gobierno Venezolano para su desarrollo.

INTRODUCTION

The American crocodile (*Crocodylus acutus*) is widely distributed from Florida to northern Peru. The historic range in Venezuela occupies the Caribbean coast, frequently found in mangrove forests, coastal lagoons and estuaries, and also freshwater river mouths and reservoirs (Seijas 1986, 1990; Thorbjarnarson 1989; Arteaga 1997). A reduction of its population was experienced by commercial hunt, which is by now practically stopped due to national laws and international trade restrictions. Habitat loss is identified as the main factor affecting populations (Mazzotti 1999, Garrick 1986). In Venezuela, the species is considered endangered and included in Appendix I of CITES. A program of reintroduction of ranched animals, directed by the Venezuelan Government, is helping for the recovery of wild populations in some areas. Even so, in general the wild populations remain small due to human factors or habitat limitations (Ross 1998, Thorbjarnarson 1999, Thorbjarnarson & Velasco 1999).

In Venezuela, the Ministry of Environment and Natural Resources (MARN) started in 1993 the National Program for Conservation of the American Crocodile (Velasco *et. al.* 2000), with the collection and ranching of hatchlings from Turiamo Bay (Aragua State) and Fundo Agropecuario Masaguaral (Guárico State), to be released after one year of raising at the Cuare Wildlife Refuge (Falcón State) (Velasco & Lander 1998). This approach is based on scientific information that analyzed spatial and temporal condition of the existing populations and the evaluation of new sites for introduction of ranched juveniles, with the aim of protection and recovery. This national program needs to be inside a planning which encompasses the entire range of the species.

The Conservation Priority-Setting Workshop for American Crocodiles, (Thorbjarnarsson *et al.*, not published), addressed range-wide conservation needs of the species pointing out several goals: 1) assess the state of knowledge about ecology, distribution, and status, 2) prioritize current threats to the crocodile's survival and create a framework for assessing and alleviating these threats, and 3) identify priority areas for American crocodile conservation efforts, topics for further research, and key essential themes to ensure American crocodile conservation.

A comparison of the Venezuelan Conservation Program of American Crocodile with these general aims is presented in this work, looking for coincidences and proposals that serve as basis for other national programs on this species.

METHODS

The Workshop adapted a range-wide methodology (Sanderson *et al.* 2002), considering the historical range, habitat associations at regional scale (bioregions), information on wild populations, data on areas where the species status is known ("known areas") or presently found ("current range"); and areas important for the species' conservation ("conservation units").

The Workshop defined a standard habitat within the historic range and the known range, to propose "Crocodile Conservation Units" (CCU) and "extirpated points" (EP), in which the populations disappeared in historical times.

The population density was estimated in each CCU based on field studies and classified in numeric categories for non-hatchling crocodiles and nests/year. CCU included information on habitat quality, habitat connectivity, habitat destruction, the potential for sustainable use, hunting, and its legal condition as protected area (PA). Different types of PAs were distinguished on the basis of the effectiveness of wildlife protection within it: fully effective (F) in implementing management and protection regulations, partially effective (P) or ineffective (I).

The assessment on population size and habitat quality in Venezuela was performed in 2002, at several locations on or near the Caribbean coasts of the country including mangrove areas, coastal lagoons, river mouths, channels and reservoirs; 23 locations within the historical distribution area of the species were visited, observing a total of 402 adult crocodiles. The global size structure was 99 hatchlings, 257 juveniles, 72 small-sized adults, 44 adults, and 29 large adults (De Sola et al. 2002).

RESULTS

Crocodile Conservation Units

From the first 5 CCUs defined for Venezuela as a result of the 2002 Workshop, 11 CCUs are proposed in the present work, based on the results of the survey performed by the authors (Table 1).

Two of these new CCUs were derived from one more extensive CCU, as in the case of the marine coastal Morrocoy National Park – Cuare Wildlife Reserve, and the freshwater systems Tacarigua – Jatira reservoirs, Tocuyo and Tucurere Rivers, included all of them previously in the CCU Yaracuy – Aroa Rivers (Thorbjarnarsson et al., not published).

The isolated areas of Burro Negro Reservoir, Cumaripa Reservoir and Hueque River are proposed as new CCUs. Another new CCU is proposed for the Eastern Coast of the country, including Neveri and Unare Rivers, the coastal lagoons of Piritu and Uchire, and a complex of caños and canals located on this area.

The remnant CCUs are Los Olivitos and Pueblo Viejo Reservoir, already defined in the Workshop.

From the 11 proposed CCUs, 8 are within protected areas, all of them qualified as fully protected except Turiamo Bay, a naval base.

Extent of crocodile knowledge

Accordingly to the Workshop criteria, it was impossible for the authors to quantify this parameter. But it is important to say that the scientific works in Venezuela up to date cover only about 25% of the historic range of the species, varying considerably between the proposed CCUs. The greatest extent of knowledge was found in the Tacarigua Lagoon and Rio Chico canals, Turiamo Bay, Morrocoy - Cuare, Los Olivitos, Rivers Yaracuy and Aroa, and Reservoirs of Jatira and Tacarigua. Rest of the CCUs needs more information on population status and habitat conditions.

Extirpations in the American crocodile range

Using our own criteria, American crocodiles have been extirpated from almost 75% of their historical range. Extirpations are largely localized in wide coastal areas, reflecting habitat loss and other human impacts.

Crocodile Point Observations

For the present work, a total of 18 point observations from 23 sites was reported by De Sola et al. (2002), ranging from 1 a 120 animals. Densities (individuals per kilometer) were also reported, but are rough and comparative estimation of crocodile population size. The largest point observation was Rio Tocuyo (120 ind) and Jatira Reservoir (52 ind), with significant numbers also in Tacarigua Reservoir (23 ind) and Burro Negro Reservoirs (22 ind), all of them freshwater environments. The CCU with more point observations was Eastern Coast (6 points), reflecting a wide area occupied by this CCU.

DISCUSSION AND CONCLUSION

The Workshop produces a good approach for wide range crocodile conservation with a new spatial, habitat-based perspective and assessment for the national conservation planning. The application of the Workshop methodology with the data of the present work produced the identification of 11 Crocodile Conservation Units in Venezuela, compared with the previously 5 reported for Venezuela in 2002 during the Gainesville meeting.

Five CCUs are predominantly euryhaline coastal habitats and lagoons fringed by mangrove swamps. These habitats are patchily or continuously along the coast, with the greatest amount of mangrove associated with the mouths of rivers or streams, coastal lagoons or bays. Conservation of these coastal areas is complicated by the overlapping of terrestrial and marine ecological processes in highly productive environments, frequently used for tourism and other human activities like commercial fisheries and industries. Mangroves are refuges of many wild fauna, fishes and invertebrates species and also used for fishing, villages, tourism and in some cases small industries and agriculture. The other six CCUs are natural freshwater flows and inland reservoirs with suitable nesting areas and adequate habitat for adult and juvenile crocodiles.

A mentioned factor in habitat occupation by the American crocodile in Venezuela, is the presence of caiman (*Caiman crocodilus*), but relatively few interactions have been noted with this species (Seijas 1988).

Using the approach proposed by the Workshop, the new CCUs were identified by the description of habitat conditions and density evaluation, also considering the legal status of the sites. Eight of the eleven Venezuelan CCUs are located on protected areas. From these, Tacarigua Lagoon and Morrocoy are National Parks, Cuare and Los Olivitos are Wild Life Refuges. The reservoirs are protected by special law restricting hunt and habitat use for urbanism, offering a full and effective protection for the species. A suggestion for the Venezuelan authorities includes the surveillance and protection norms for habitat protection in the areas which are not still protected and are suitable for repopulation management.

Proceedings de la Reunión Regional de América Latina y el Caribe del Grupo de
Especialistas en Cocodrilos (CSG/SSC/IUCN).
Santa Fe, Argentina 17 -20 de Mayo 2005

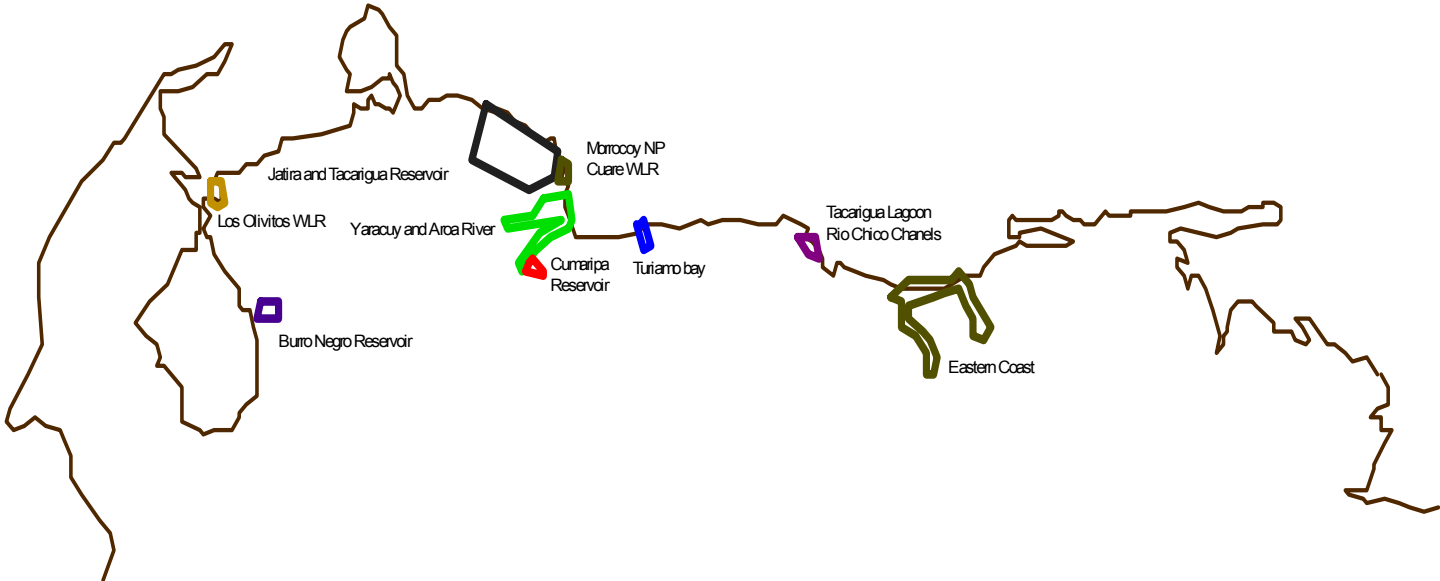
Areas for future work were also identified. Reintroduction sites are now proposed with specific attention to ecological condition, human conflicts, and protection as part of the Venezuelan Government Program for Conservation. Additional survey work is needed in specific areas with presence of American crocodiles but the population status is still unknown.

Proceedings de la Reunión Regional de América Latina y el Caribe del Grupo de Especialistas en Cocodrilos (CSG/SSC/IUCN).
Santa Fe, Argentina 17 -20 de Mayo 2005

Crocodile Conservation Units (CCUs)	Area	Score	Rank	Habitat Quality	Nesting Habitat	Population Size	Connectivity	Habitat Destruction	Potential for Sustainable Use	Killing of Crocodiles	% Protected Area	Effectiveness
Eastern Coast (Neveri River, Piritu lagoon, Uchire Lagoon, Caño Sur, Caño Camaronera, Unare River)				Poor	Poor	<10	Moderate	High	Low	Some	0	
Tacarigua Lagoon and Rio Chico Canals	477	193	1	High	Adequate	10 -50	Moderate	Moderate	Low	Little	50	F
Turiamo	179	91	3	Poor	Adequate	10 - 50	Low	Low	Low	Some	100	P
Yaracuy River, Aroa River, Caño Paují, Caño Las Pabas II	2,012	119	2	Adequate	Adequate	10 -50	Low	High	High	Some	0	
Morrocoy NP, Cuare WLR				Adequate	Adequate	<10	Moderate	Moderate	Moderate	Low	100	F
Tacarigua and Játira Reservoir, Tocuyo River, Tucurere River				Adequate	Adequate	100–500	Moderate	High	High	Low	100	F
Burro Negro Reservoir				High	Good	10–50	Little	High	Moderate	Little	0	F
Los Olivitos WLR	231	102	3	High	Poor	10-50	Little	Moderate	Moderate	Little	100	F
Hueque River				Poor	Poor		Little	High	Moderate	Little	0	
Cumaripa Reservoir				High	Adequate		Little	High	Moderate	Little	100	F
Pueblo Viejo Reservoir	288	118	2	Adequate	Poor	50-100	Little	Little	Moderate	Some	100	F

Table 1. Crocodile conservations units proposed to Venezuela. Data of Area, Score and Rank originals from Workshop.

Map 1. Crocodile Conservation Units proposed for Venezuela.



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ANÁLISIS DEL MANEJO DE LA POBLACIÓN *EX SITU* DEL CAIMÁN LLANERO O COCODRILO DEL ORINOCO, *Crocodylus intermedius* (Graves 1819) EN COLOMBIA

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INTRODUCCIÓN

El Programa Nacional de Conservación del caimán llanero en Colombia (PROCAIMAN), establecido desde el año 2000, por el Ministerio del Medio Ambiente hoy Ministerio de Ambiente, Vivienda y Desarrollo Territorial de Colombia, tiene dentro de sus acciones la recuperación de huevos y neonatos mediante el criterio de maximizar la producción *ex situ* al producir neonatos en condiciones controladas por zootecnia institucional y privada. La zootecnia institucional se refiere a la Estación de Biología Tropical “Roberto Franco” de la Facultad de Ciencias de la Universidad Nacional de Colombia que desde 1966 inició la conservación del *Crocodylus intermedius* en cautiverio liderado por el doctor Federico Medem. Es por esto que la población *ex situ* del caimán llanero está a cargo de la institución anteriormente nombrada. Si embargo, desde 1991 cuando se produjeron los primeros nacimientos en cautiverio (F1), el número de individuos no ha aumentado, no hay generación F2 como se ha referenciado en varias publicaciones y hasta agosto de 2004 se encontraron 117 animales, lo que dificulta cumplir con uno de los objetivos del Programa, preservar y aumentar el número de individuos para realizar las futuras reintroducciones en el medio silvestre y así aumentar el número en las poblaciones naturales y evitar la extinción de esta especie de cocodrilo que únicamente se distribuye en la cuenca del río Orinoco en Colombia y Venezuela y que actualmente se encuentra catalogada por Rodríguez y Ramírez (2002) en el Libro Rojo de Reptiles de Colombia, en categoría global CR de acuerdo a la UICN y en el Apéndice I de CITES desde 1975.

Este trabajo se realizó con el objetivo de evaluar el manejo actual, la información disponible y los procedimientos aplicados en la especie *Crocodylus intermedius* en cautiverio en Colombia, sus resultados pretenden servir de guía para una acertada toma de decisiones que permitan establecer los lineamientos del plan de manejo *ex situ* bajo un sistema de criterios e indicadores, de manera coordinada y a tenor de