Orinoco Crocodile *Crocodylus intermedius*

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Common Names: Orinoco crocodile, Caimán del Orinoco

Range: Venezuela, Colombia

Figure 1. Distribution of *Crocodylus intermedius*.

Conservation Overview

CITES: Appendix I

CSG Action Plan:
Availability of Survey Data: Adequate.
Need for Wild Population Recovery: Highest
Potential for Sustainable Management: Moderate

2009 IUCN Red List: CR (Critically Endangered, Criteria A1c, inferred decline of >80% in 3 generations, reduced area of occurrence. C2a. Wild adult population may be less than 250 individuals, with continuing declines and fragmentation; IUCN 2009) (last assessed in 1996).

Principal threats: Limited distribution, habitat destruction, illegal hunting.

Ecology and Natural History

The Orinoco crocodile is a large, relatively long-nosed crocodile restricted to the middle and lower reaches of the Orinoco River and its tributaries in Venezuela and Colombia (Thorbjarnarson and Franz 1987). Although this crocodile was found in a wide variety of habitats, including rivers in tropical evergreen forest and piedmont streams in the foothills of the Andes, it reached its greatest numbers in the seasonal rivers of the Llanos savanna region (Medem 1981, 1983).

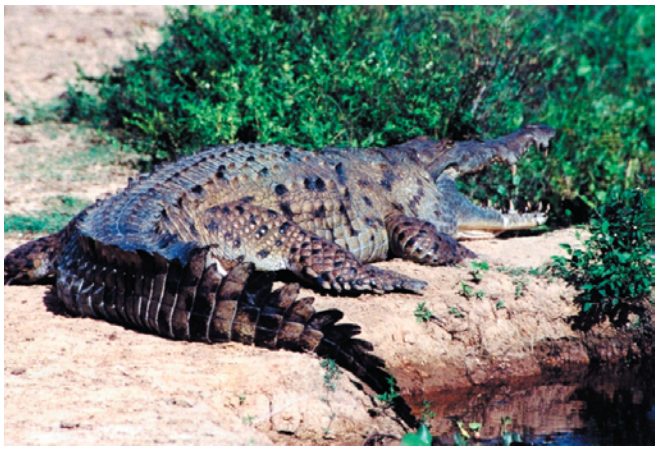

Figure 2. Male *C. intermedius* at Caño Mucuritas, El Frío Biological Station. Photograph: Daniel C. González.

The Orinoco crocodile is a hole-nesting species. The females become mature at approximately 2.5 m total length (Thorbjarnarson and Hernández 1993a), laying eggs in seasonally exposed sandbars and riverbanks early in the annual dry season (January-February). Average clutch size in wild populations varies between 38 and 44 eggs, with a reported maximum of 66 eggs (Jiménez-Oráa *et al.* 2007;

Seijas, A.E., Antelo, R., Thorbjarnarson, J.B. and Ardila Robayo, M.C. (2010). Orinoco Crocodile *Crocodylus intermedius*. Pp. 59-65 *in* Crocodiles. Status Survey and Conservation Action Plan. Third Edition, ed. by S.C. Manolis and C. Stevenson. Crocodile Specialist Group: Darwin.

Navarro 2007). Hatchlings emerge during the rise in river levels associated with the wet season (Thorbjarnarson and Hernández 1993a; Seijas and Chávez 2002; Antelo 2008). Reported dry season concentrations of these crocodiles were very dense, a factor that facilitated hunting for skins (Medem 1981, 1983). In smaller rivers that are reduced to a series of interconnected or isolated pools during the dry season, *C. intermedius* aestivate in burrows dug into riverbanks (Medem 1981; Antelo 2008).

Figure 3. Mouth of the Caño Guaritico, Apure River, during the wet season. Photograph: Rafael Antelo.

Information about ecology, population status and reproductive behavior of the Orinoco crocodile in Venezuela has been accumulating over the last 20 years (Thorbjarnarson and Hernández 1992, 1993a,b; Seijas and Chávez 2000, 2002; Llobet and Seijas 2003; Seijas 2007; Antelo 2008), whereas in Colombia knowledge on population status has improved (Bonilla and Barahona 1999; Ardila-Robayo *et al*. 2002).

Conservation and Status

The Orinoco crocodile is one of the most endangered New World crocodilians. Commercial overexploitation started at the end of the 1920s, both in Colombia and Venezuela. Hunting was particularly intense from 1930 to 1935 (Mondolfi 1965) and continued in the following decades until the populations were completely decimated by the 1960s (Medem 1981, 1983).

Colombia: Explicit legal resolutions to protect the species were enacted at the end of the 1960s (Alberto Donadío, in Medem 1981) and through the 1970s. Medem (1981) surveyed the Colombian llanos in 1974 and 1976, and found evidence of only 280 adult *C. intermedius* throughout a large part of the drainages of the Arauca, Casanare, Meta and Vichada Rivers - the same rivers in that country where the species reached its highest densities in the past. Surveys conducted in 1994-1995 (Lugo 1996) indicated that the situation of the species had worsened compared to previous reports by Medem. In that study, four areas with relict populations of the species were identified: 1) drainages of the Lipa, Cuiloto, Ele and Cravo Norte Rivers; 2) Santo Domingo, Duda, Lozada and Alto Guayabero Rivers (Macarena hills); 3) middle reaches of the Meta River; and, 4) the Vichada River. The total number of adults in these four areas was estimated to be 123. Barahona and Bonilla (1999) re-surveyed the first mentioned area (1. above), and found only 29 crocodiles but estimated a total of 51, most of which were adults. Ardilla-Robayo *et al*. (2002), based on more recent surveys (2000-2001), confirmed the depleted situation of the population in the Arauca River, with only 54 individuals remaining.

On 21 July 1997 *C. intermedius* was declared a species "endangered of extinction" in Colombia, according to Decree 0676 of the Ministry of the Environment (Ministerio del Medio Ambiente; MMA). This Governmental institution, together with the Humboldt Institute, the Universidad Nacional de Colombia (UNC) and other public and private organizations, prepared in 1998 the "Programa Nacional para la Conservación del Caimán Llanero" (PROCAIMAN). The goal of this program was, over a 10-year period, to prevent the extinction of the species in Colombia and to promote its recovery and integrate it into regional economical and cultural systems. Some of the proposed actions of the program were to:

a. rescue eggs and hatchlings in the wild;
b. increase to 2500 individuals the rearing capacity of the breeding-rearing facilities in the country;
c. identify potential habitats for reintroductions;
d. define protocols for reintroduction;
e. monitor reintroduced populations; and,
f. promote international exchange.

Few of the goals have been achieved, with the greatest effort being devoted to breeding and rearing the species in captivity. As of December 2007 there were approximately 220 captive *C. intermedius* in Colombia, most of them at the Estación de Biología Tropical Roberto Franco (EBTRF), in Villavicencio, under the direction of Professor María Cristina Ardila from UNC. No captive-reared crocodiles have been released into the wild, and problems of public order make work in the field risky. Well-intentioned approaches between the environment authorities of Colombia and Venezuela have not translated into any concrete action to integrate the conservation programs of the two countries.

Since mid-2008, the EBTRF, in a cooperative effort with regional Corporations (CORMACARENA and CORPORINOQUIA) and in conjunction with the Ecosystem Division of the Ministry of the Environment, have initiated systematic surveys of wild populations to determine status and to identify suitable release sites for captive-reared individuals, begining in areas where Colombia and Venezuela could work together and taking into account limitation imposed by public security problems. Genetic studies have been initiated by UNC (Bogotá) and the Smithsonian Institution (Panama).

Venezuela: The Orinoco crocodile is legally protected in Venezuela (Resolución No. 95, 1979, Presidential Decree 1.486, 1996). In the early 1990s members of the Venezuela Crocodile Specialist Group delineated the Orinoco Crocodile Action Plan (OCAP) for the country (FUDENA 1992; PROFAUNA 1994). The Ministry of Environment (MARN) also developed an Action Plan for the conservation of *C.*

Figure 4. Adult female *C. intermedius* guarding her nest at La Ramera Lagoon, El Frío Biological Station. Photograph: Rafael Antelo.

intermedius (Velasco 2003). In general, the OCAP stressed the need to:

a. assess the current status of wild populations and their habitats;
b. identify and legally protect areas containing viable wild populations;
c. promote the establishment of protected areas on private lands;
d. promote more in-depth bio-ecological studies;
e. optimize the functioning of the captive breeding centers and establish a long-term strategy for the reintroduction and restocking of crocodiles;
f. promote environmental education and community participation programs; and,
g. strengthen inter-institutional cooperation and coordination of work.

The final goal of this plan was to consolidate, in 15 years, at least 10 viable *C. intermedius* populations. The degrees to which these goals have been achieved are discussed below.

1. The current status of *C. intermedius* in Venezuela is relatively well known. Surveys covering 3500 km of river in the late 1970s (Godshalk 1978, 1982) reported the presence of at least 273 adult crocodiles, most of them (81%) in just three rivers (Cojedes, Capanaparo and Meta Rivers, with 76, 78 and 67 adults respectively). In the 1980s, surveys by Franz *et al.* (1985), Ramo and Busto (1986), Ayarzagüena (1987) and Thorbjarnarson and Hernández (1992) confirmed the depleted situation of the species in the country, and the relative importance of the Cojedes and Capanaparo Rivers.

The population in the Cojedes River has been repeatedly surveyed since 1996 (Seijas and Chávez 2000; Chávez 2000; Mendoza 2003; Navarro 2007; Ávila 2008). The non-hatchling population in this river was estimated to be around 547 individuals, but analysis of recent data indicates that numbers may be declining (Seijas *et al.* 2008). Most nesting females are concentrated in one branch of the Cojedes River, Caño de Agua, where at least 29 successful nests were located in 2006 (Ávila 2008).

The last evaluation of the Capanaparo River population was in 2000 (Llobet 2002; Llobet and Seijas 2003) with an estimate of 536 non-hatchlings, very similar to the estimates reported by Thorbjarnarson and Hernández (1992) 10 years earlier. The number of nesting females was estimated to be 28 over the 279 km of the Capanaparo River in Venezuela.

In the case of Meta River, in the section that defines the border with Colombia, the last surveys were conducted in 1998 (Rios and Trujillo 2004). During spotlight surveys that covered 60.5 km, they observed only two crocodiles. However, according to interviews with local inhabitants, there were 24 adults over 290 km of river - well below the 67 reported by Godshalk (1982), and indicating a severe decline of the population. It is interesting to note that Godshalk (1978) mentioned that the Spectacled caiman (*Caiman crocodilus*) population in the Meta River had been decimated by commercial hunters, and only 4 *C. crocodilus* were observed during 10 hours of night surveys. In contrast, Ríos and Trujillo (2004) observed 335 *C. crocodilus* in 60.5 km, a river length that could be easily traveled in a fraction of the time employed by

Godshalk (1978). It could be concluded that in the Meta River, whereas the Orinoco crocodile population has declined and the caiman population has increased.

There is a small *C. intermedius* population in the Manapire River (Guárico State). This locality has been intensively surveyed over the last 8 years (Jimenez-Oráa 2002; Heredia 2005). Thirty crocodiles, most of them sub-adults or adults, are scattered in different parts of the river. The population is under a heavy pressure, because people collect crocodile eggs when looking for nests of the river turtle *Podocnemis unifilis*. As will be detailed later, there is an ongoing project of egg collection for conservation purposes in the Manapire River (Jimenez Oráa *et al*. 2007). Other isolated *C. intermedius* populations are known to exist in areas of low human population density and at least two smaller *C. intermedius* populations are in reservoirs (Thorbjarnarson and Hernández 1992; Seijas *et al*. 2002). Neither appears to offer suitable habitat for the long-term survival of crocodile populations.

2. In Apure State, crocodile habitat has been set aside in the Santos Luzardo National Park (also known as Cinaruco-Capanaparo NP) and in the Wildlife Refuge of Caño Guaritico. There are also two protected areas in Guárico State - the Aguaro-Guariquito NP and the Esteros de Camaguán Wildlife Refuge. Only in the former area was there a viable *C. intermedius* population prior to its declaration as "protected". Although captive-reared crocodiles have been released in all these areas, no management plan has yet been implemented for the species and the areas are severely understaffed. There are plans to declare a portion of the Cojedes River as a protected area for its Orinoco crocodile population (Seijas 2008).

3. There are several medium and large cattle ranches in the Venezuelan llanos with good habitat for crocodiles, which have functioned as very efficient wildlife refuges. Captive-reared crocodiles have been released in three ranches (El Cedral, El Frío, Garza). The integrity of these ranches is currently under threat from Government plans to reduce the amount of land in private hands.

4. The knowledge on population status, ecology and social behavior of *C. intermedius* has increased substantially in the last 20 years, although much of the information remains unpublished.

5. There are 7 breeding/rearing facilities in Venezuela, although only 6 of them are currently devoted to the production of individuals that will eventually be released into the wild (Hernández 2007; Babarro 2008). To date, 3 facilities (Masaguaral, Puerto Miranda and UNELLEZ) have their own adult breeding stock, and produce most of the individuals reared. The facility in El Frío Biological Station rears hatchlings from wild-collected eggs, from females that were released on the same ranch more than 10 years ago. FUDECI facility (Puerto Ayacucho, Amazonas State), SINCOR (Guárico State), and Estación Biológica de Rancho Grande (Maracay, Aragua State) are rearing hatchlings collected from the wild, mostly from the Cojedes, Manapire and Capanaparo Rivers (Babarro 2008). If properly managed, those facilities could rear, if needed, up to 3793 one-year-old individuals per year (Hernández 2007). However, some of them are experiencing administrative problems (eg Puerto Miranda) or are in need of major repairs (eg UNELLEZ). Estación Biológica de Rancho Grande is outside the historical distribution of the species and is in a locality that is too cold for part of the year, which translates into reduced growth and the production of smaller individuals.

As of July 2008, more than 6000 *C. intermedius* had been released into the wild (see Table 1). All crocodiles released into the Capanaparo River were derived from eggs and juveniles collected in that locality. Individuals released in other localities come from different facilities or places of origin.

A high proportion (35.7%) of crocodiles released have been at El Frío Biological Station (that includes the 620 km2 of El Frío Ranch) and in the adjacent Caño Guaritico Wildlife Refuge. Recent population surveys have confirmed the success of these reintroductions (Ayarzagüena *et al*. 2007; Antelo 2008; Velasco *et al*. 2008), with estimates of an established population of over 400 non-hatchlings that includes at least 31 wild breeding females, most of them at El Frío Biological Station. Some of their nests were collected as part of the conservation program. However since April 2009, the facilities and the land of El Frío Biological Station have been expropriated and now are under the control of the Venezuelan Government. So the future of the new population and the conservation program in this area is uncertain.

Even though a large number of crocodiles have been released in Aguaro-Guaritico NP, there is no indication of population establishment. However, there has been insufficient monitoring of this area, as is the case for most of the localities listed in Table 1. A year-long radio-telemetry study of released crocodiles was carried out by Muñoz and Thorbjarnarson (2000) in the Capanaparo River, and the results of this study suggest that reintroduction can

Figure 5. Radio-tracked *C. intermedius*. Photograph: Andres Seijas.

be a viable management technique to speed population recovery, as has been demonstrated in El Frío Biological Station and Caño Guaritico Wildlife Refuge.

6. Probably the most important flaw of the Orinoco Crocodile Action Plan has been the lack of an environmental education program and the limited participation of local communities. In general, people who live in the areas where crocodiles have been released are not directly involved, and many of them are probably against the recovery program, which limits its success.

7. The implementation of the conservation program for *C. intermedius* in Venezuela was the result of a joint enterprise of non-Government organizations, including; FUDENA, the Wildlife Conservation Society, the Agencia Española de Cooperación and, more recently the Fundación para el Desarrollo de las Ciencias (FUDECI), the University of the Llanos (UNELLEZ), El Frío Biological Station, private individuals, cattle ranch owners (including the recently deceased Tomás Blohm) and many others. This joint-venture formed the Venezuela Crocodile Specialist Group, which makes recommendations to the Ministry of Environment about the implementation of the conservation program - advice that is not necessarily taken into account.

   In general, it could be said the conservation program for the Orinoco crocodile in Venezuela has had limited success. The good news is that there is a better understanding of the ecology and population status of the species; thousand of individuals have been released into the wild and a new population has been "created" in El Frío Biological Station and surroundings areas. But there are signs of population declines in the Meta and Cojedes Rivers. The Cojedes River is severely threatened by contamination from agricultural residues and urban sewage, and plans are also being developed to dam an upstream section. Crocodiles have been released in areas with good habitat and legal protection, but without wildlife officials to enforce this protection. In many places crocodiles have been released and the fate of the animals has not been evaluated. In short, we are far from the main goal of consolidating 10 viable populations in the country.

   In 2007, a new conservation plan was prepared - the "National Strategy for the Conservation of the Orinoco Crocodile and its Action Plan". Its main goal is to design and implement a set of actions that will increase the number and size of the *C. intermedius* populations and to restore its ecological, economical and cultural values.

Priority Projects

<u>High priority</u>

1. **Identify areas for reintroduction of crocodiles in Colombia**: There are a relatively large number of *C. intermedius* at Estación de Biología Tropical Roberto Franco and other breeding facilities, ready to be released into the wild. Areas need to be identified for trial releases and monitoring. A team coordinated by Joaquín Clavijo has identified some in Arauca, but this work is still pending in Casanare, Meta, Vichada and Guaviare.

2. **Initiate a program of head starting program in Colombia**: Some small populations have been identified, where eggs and hatchlings should be collected. Juveniles produced through this effort should be released back into the wild and a few retained to increase genetic variability in conservation breeding centers. This program must be implemented in conjunction with activities of environmental education and effective protection of adult crocodiles. Local communities should receive economic incentives for their participation.

3. **Strict protection of the species in National Parks and Wildlife Refuges in Venezuela**: Natural areas where crocodiles have been released, particularly parks and wildlife refuges, do not have or lack completely, the personnel for effective surveillance against poaching or other illegal activities that affect wildlife in general and crocodiles in particular. A comprehensive plan to solve this problem should be prepared and implemented in the short-term.

4. **Monitoring of populations of released crocodiles in Venezuela**: Crocodiles have been released into 14 areas. Monitoring of these crocodiles has been sporadic. A better coordinated system of follow-up surveys needs to be developed to assess the efficacy of these releases as a conservation tool.

5. **Encourage participation of local people in conservation programs**: In some areas, significant threats to the species include the collection of eggs for human consumption, capture of hatchlings for sale as pets, killing of large animals as a source of food, and accidental death of individuals entangled in fishing nets. The most direct way to reduce these negative factors is to involve local people, particularly those directly responsible for these activities, in the conservation program. It is necesary to intensify environmental education activities focused directly on people living around areas with remaining populations of *C. intermedius* or where captive-reared crocodiles are released. Ideally, those programs should be in the hands of local people (eg school teachers or communal leaders).

<u>Moderate priority</u>

6. **Conduct surveys in peripheral parts of the species' range in Venezuela**: Surveys have covered much of the llanos region looking for remnant crocodile populations. Additional surveys need to be conducted to look for unknown populations.

7. **Analysis of genetic diversity within and among populations**: Many of the conservation plans for this

species depend on restocking and reintroduction programs. However, nothing is known about genetic variation among populations. Since many of the remaining populations exist in peripheral habitats, the possibility of genetic differentiation should be explored as part of an overall conservation plan.

8. **Urge the Ministry of Environment of Venezuela to implement adequate treatment of industrial and urban sewage**: Although this is a general problem it is particularly accentuated in the Cojedes River system.

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