

Cuban Crocodile *Crocodylus rhombifer*

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Common Names: Cuban crocodile

Range: Cuba



Figure 1. Distribution of *Crocodylus rhombifer*.

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 A2cde. Inferred population decline of >80% in 3 generations in extent of occurrence; reduction of habitat quality; effects of illegal exploitation and hybridization; IUCN 2009) (last assessed in 2008).

Principal threats: Limited distribution, habitat disruption, illegal hunting, hybridization with *Crocodylus acutus*

Ecology and Natural History

The Cuban crocodile has the smallest known distribution of any extant crocodylian, and is currently restricted to Zapata Swamp (mainland Cuba) and Lanier Swamp (Isla de la Juventud) (Rodríguez-Soberón *et al.* 2000; Ramos 1989; Varona 1976, 1983). In the recent past the species was more widely distributed on the main island of Cuba (Gundlach

1880; Varona 1966). Skeletal material shows that this species was present on the Cayman Islands (Morgan *et al.* 1993) and in the Bahamas (Franz *et al.* 1995).

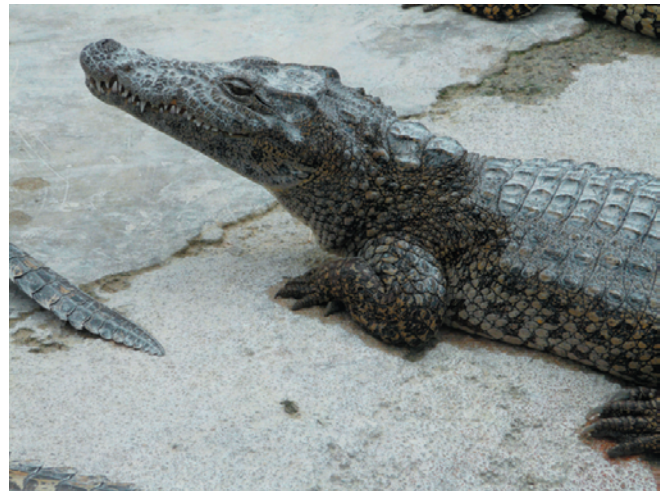


Figure 2. *Crocodylus rhombifer*. Photograph: Tom Dacey.

Zapata Swamp, with an approximate area of 657,900 ha, is located on the Zapata Peninsula, south of Matanzas Province, western Cuba. Most of this territory has protected area status, under the categories of Protected Area of Managed Resources, Wildlife Refuge, and National Park. The Zapata Swamp Biosphere Reserve was established in 2000, and since 2001 has been designated a Ramsar Site. The Zapata Peninsula also holds the status of Special Region of Sustainable Development (Decree 197/96, Plan Turquino-Manati).

The Cuban crocodile population of Zapata Swamp is restricted to a small area of approximately 300 km², on the southwestern portion of the peninsula (Ramos *et al.* 1994; Ramos 2000), where the species is sympatric with the American crocodile (*Crocodylus acutus*).

Lanier Swamp is a small wetland of approximately 100 km², situated on a west-east axis, across the central portion of Isla de la Juventud. Several hundred *C. rhombifer* have been released in Lanier Swamp since 1994, as part of an ongoing restocking program carried out by the Empresa Nacional para

la Protección de la Flora y la Fauna (ENPFF) - Ministry of Agriculture (Rodríguez-Soberón *et al.* 1996). Although the local *C. acutus* population prefers the brackish and saltwater habitats such as mangrove swamps, coastal lagoons and estuarine watercourses, individuals occasionally venture deep into the freshwater habitats of Lanier Swamp, enabling hybridization with *C. rhombifer* to occur. Also a relatively large population of the introduced Spectacled caiman (*Caiman crocodilus fuscus*) is in Lanier Swamp (Berovides *et al.* 2000; Varona 1976, 1983). Other than Varona's finding of young *C. rhombifer* in the stomach contents of adult *C. crocodilus* at the Isla de la Juventud, no other evidence of negative impacts on *C. rhombifer* by caimans has been reported (Rodríguez-Soberón 2000; Varona 1983).

The Cuban crocodile is a medium-sized crocodylian whose maximum reported length is 4.9 m, but as a rule does not exceed 3.5 m (Varona 1966). It is normally restricted to freshwater habitats (sawgrass swamp, marshes, lagoons, natural and man-made water courses such as rivers and canals, freshwater mangrove swamp, and water pockets on flooded limestone plateaus).

Although *C. rhombifer* is smaller than *C. acutus*, when maintained together the Cuban crocodile is almost always the behaviorally dominant species (Varona 1966). The Cuban crocodile has a pugnacious disposition and a well-deserved reputation as a good jumper.

Unlike the other three species of New World crocodiles, *C. rhombifer* does not dig burrows in the wild. During periods of drought, Cuban crocodiles move into deeper lakes or other sections of the swamp (Gundlach 1880). One possible cause for the alleged lack of burrowing activity is the absence of suitable places, such as soft river banks, in a habitat mostly made of extensive marshes bordered by flat terrain, or water pockets limited by hard rocky edges. In captivity Cuban crocodiles can show intense burrowing activity if enclosure conditions are favorable (R. Rodríguez-Soberón, pers. obs.; Andrew Odum, pers. comm.).

Mean size at maturity for 100 females hatched and raised in captivity was 190.6 ± 19.6 cm TL. Most females began reproducing when they were either 6 (62%) or 7 (35%) years of age. Males are also thought to become sexually mature at 6 years, and a mean size of 197 ± 8.1 cm TL (Ramos 2000). Growth in the wild in the Zapata Swamp appears to be slower than in captivity, so that time to sexual maturity may be longer (R. Ramos, pers. comm.).

The Cuban crocodile has an annual reproductive cycle with its timing affected by factors such as rainfall, water level and environmental temperatures. Adult males are polygamous and territorial. Courtship and mating extend from November to May, when the water level in the marsh is lowest. Nesting coincides with the beginning of the rainy season and extends from mid-April to the beginning of August, peaking in late May and early June, when rains increase (Ramos 2000).

There has been considerable debate over whether the Cuban

crocodile is a hole or a mound nesting species. Gundlach (1880) provides a description of a nesting *C. rhombifer* digging a trench or hole, and after egg-laying, covering up the eggs with the excavated material. Varona (1966) indicated that while some mounding may occur, the Cuban crocodile nested principally in holes excavated in the ground. However, subsequent work at the Zapata Farm and observations of wild nests in Zapata and Lanier Swamps indicate that species constructs a mound, usually made of peat. In captivity, females will scrape on the ground surface, piling together soil and leaves and twigs, to make a mound up to 1 m high and 2.7 m in diameter. Mean clutch size is 25.4 eggs (1-51) in captivity, and 14.5 eggs (8-32) in the wild. Hatching takes place in August and early September (Ramos 2000).



Figure 3. Captive juvenile *C. rhombifer*. Photograph: Grahame Webb.

A variety of prey make up the diet of *C. rhombifer* of different ages, including fish [minnows (*Gambusia*, *Cubanichtis* and *Girardinus*), bajiaca (*Chichlasoma tetracanthus*), gar (*Atractosteus tristoechus*), and the invasive, recently introduced *Clarias gariepinus*], crustaceans [land crabs (*Cardisoma* sp.), jaiba (*Calinectes* sp.)], gastropods [apple snail (*Pomacea* sp.)]; reptiles [hicotea (*Pseudemys decussata*)], birds (Varona 1966), mammals [hutia (*Capromys pilorides*)], feral pigs (*Sus scrofa*) and dogs (*Canis familiaris*) (De Sola 1930; Ramos 1999). Minor components include a variety of insects and other invertebrates, especially in the juvenile age classes. A series of anatomical and behavioral characteristics, such as comparatively long and robust extremities, the long distance high-walking and leaping abilities, characterize the Cuban crocodile as a remarkably terrestrial crocodylian, which is consistent with its highly terrestrial diet.

Hybridization has been reported between *C. rhombifer* and *C. acutus*, both in the wild and in captivity (Varona 1966; Brazaitis 1973; Gonzalez 1975; Ramos 1987), resulting not only in the risk of losing a unique evolutionary lineage, but also a species considered morphologically and ethologically distinct in the genus *Crocodylus* (Thorbjarnarson, pers. comm. 2007). R. Ramos (pers. comm.) reports fertile hybrids from the crossing of male *C. acutus* with female *C. rhombifer*, and has obtained viable offspring from the crossing of male *C.*

rhomboifer with female *C. acutus* (Ramos 1994), but it is still unknown whether the latter are fertile or not.

The recent utilization of molecular techniques for the genetic characterization of crocodiles in Cuba has supplied powerful evidence of hybridization of wild Cuban and American crocodiles that is underway in Zapata Swamp (Milián *et al.*, in litt). A *C. rhombifer* x *C. acutus* hybrid was recently found in Cancun, México (Cedeño 2008). Hybridization with *C. porosus* (Fitzsimmons *et al.* 2002) and *C. siamensis* (Thang 1994; Fitzsimmons *et al.* 2002) has also been reported in Cambodia and Vietnam (Jelden *et al.* 2005, 2008), raising concerns for the critically endangered *C. siamensis*.

Conservation and Status

The status of *C. rhombifer* in Zapata Swamp has been subject of research since 1976 (Ramos 1987, 1999, 2000, 2006, 2008; Ramos *et al.* 1994; Rodríguez-Soberón *et al.* 2000), and in Lanier Swamp since 1986 (Rodríguez-Soberón *et al.* 1986, 2000). Assessments of status and trends were carried out in the Population and Habitat Viability Analysis (PHVA) Workshop at the Isla de la Juventud in 2000 (Rodríguez-Soberón *et al.* 2000), and more recently in two National Workshops on the Status of the Cuban Crocodile in Zapata Swamp in 2006 and 2008 (Ramos 2006; Ramos 2008, unpubl.). In November 2008, The Crocodile Specialist Group conducted a review with recommendations on crocodile conservation and management in Cuba in 2008 (Larriera *et al.* 2008).

There is no evidence of recent reduction in the distribution of *C. rhombifer*. At one time the species was more widely distributed on Cuba and the surrounding islands. Today, its range in the wild appears to be restricted to the Zapata and the Lanier Swamps. While the Lanier Swamp population was virtually extirpated during the first half of the 20th Century, the range in Zapata Swamp was reduced by half during the same time.

In Zapata Swamp, *C. rhombifer* was abundant on both the eastern and the western portions. Before 1959 significant, though undetermined numbers of crocodiles, were killed for commercial purposes, and large sectors of marsh, mangrove and hardwood tropical forest were transformed (canal digging, forest clearing, land drainage, roads). This was followed by the capture of several hundred adults that were relocated to the newly constructed crocodile farm at Laguna del Tesoro in 1959 and 1960. As a result of these actions, by the early 1960s the wild *C. rhombifer* population had been drastically reduced. After 1959 the eastern portion of Zapata Swamp and the northern periphery of the western portion, were almost totally transformed into agricultural and grazing land (Ramos 2006); This meant an irreversible loss of more than 30% of the habitat for both Cuban and American crocodiles in the Zapata area, but the western portion of the Swamp remained almost untouched, becoming the core area of distribution for the species.

According to Ramos (2000) and Ramos *et al.* (1994), by

the final decade of the 20th century, the wild *C. rhombifer* population in Zapata Swamp was distributed within a core area of approximately 360 km², situated on the southwestern portion of the peninsula. The population size was estimated as a minimum of 3000 individuals, with a high probability of being between 5000 and 6000 individuals and with a breeding component of around 1000 breeding females. In the PHVA Workshop in 2000 (Rodríguez-Soberón *et al.* 2000), this population was considered to be “viable, stable and healthy”.

Population surveys conducted in Zapata Swamp by Ramos and collaborators between 1994 and 2000 (Ramos 2000; Ramos *et al.* 1996) indicated that the *C. rhombifer* population remained stable over that period, with a slight shift in size structure towards larger animals, an average density of 18.1 km⁻¹ (14.19-26.76), and a slight increase in the presence of hybrids (Ramos 2000). The current situation in this area is unknown.

In the period 1992-2008, a sample of 1437 crocodiles captured in the southwestern portion of Zapata Swamp showed 74.6% animals with phenotypic characteristics of *C. rhombifer*, 15.8% with phenotypic characteristics of *C. acutus*, and 9.6% with clear appearance of “mixturados” (obvious hybrids) (Ramos, pers. comm.). DNA analysis of these individuals may yield a different rate, with a higher proportion of hybrids.

In 2000, *C. rhombifer* density of 14 km⁻¹ was reported in a previously undocumented 4-km² spot of brackish water habitat in the southwestern portion of the swamp (Ramos, pers. comm.). Surveys conducted between 2002 and 2007 in a 60 km² area on the northern periphery of the core area indicated a very low densities, and 59.2% of captured individuals were obvious hybrids. The surveys also found evidence of a considerable increase in poaching (Ramos 2006, 2008); (Ramos 2006, 2008); these results provide evidence of a change in population status as evaluated in the PHVA Workshop in 2000 (Rodríguez-Soberón *et al.* 2000).

The Lanier Swamp population has not been evaluated recently, but is known to be much smaller than that in Zapata Swamp. The total wild population of Cuban crocodiles by the end of the 20th century was likely to be 4000-6000 individuals (Ramos *et al.* 1996; Rodríguez-Soberón *et al.* 2000).

The farm operation at Lanier Swamp (Cayo Potrero Crocodile Farm; see later) is the result of a restocking program initiated in 1985. The first 600 farm-bred individuals of different age classes were released into the natural area surrounding the farm in 1994 (Rodríguez-Soberón *et al.* 1997). Monitoring of the restocked population between 1994 and 2004 showed that the reintroduced crocodiles settled down and reproduced successfully, despite the strong pressure of illegal hunting exerted on this population by local people. The main threats to the habitat in Lanier Swamp are alteration of the hydrologic regime due to damming and increasing pollution of the creeks and rivers that discharge into the northern edge of the swamp, and the alteration of the natural fire regime. Both factors together bring about an increasingly rapid sedimentation of

the swamp basin and reduction in the water surface. There is no evidence of negative interactions with the sympatric populations of *C. acutus* and the Spectacled caiman in this territory (Rodríguez-Soberón *et al.* 2000).

The persistence of *C. rhombifer* is entirely due to the activities of Cuban authorities, and continuation of active protection, monitoring and community outreach will be a vital component of the species' future survival. Relaxation or abandonment of these activities might quickly lead to severe decline.

Captive Management

Captive management of *C. rhombifer* through captive breeding began in the Zapata Swamp crocodile farm in 1959, where hundreds of wild-caught adults of both *C. rhombifer* and *C. acutus* were confined. When the crocodiles were first placed in pens in 1959, *C. rhombifer* were mixed with *C. acutus*, resulting in hybridization. Since 1976, the two species have been separated and presumably pure *C. rhombifer* have been isolated. The degree of genetic introgression remaining in the captive Cuban stock remains unknown.

The Zapata Swamp crocodile farm has mastered important aspects of captive crocodile management, with achievements on physiology, ethology, hematology, animal husbandry and veterinary science. The farm also provided the founding stock for the Lanier Swamp restocking program. The farm is registered as a CITES captive breeding operation (since 1994), but commercial operations to date have been very minor. Farm production has comprised almost exclusively of crocodile meat and stuffed animals, with the skins remaining unexploited. The farm has a fluctuating population of 3000-4000 individuals, including 150 (1M:3F) breeding stock.



Figure 4. Adult *C. rhombifer* at the Zapata Swamp Crocodile Farm. Photograph: Tom Dacey.

The ENPFF established the Cayo Potrero Crocodile Farm at the Isla de la Juventud in 1986, with the primary objective of providing farm-bred *C. rhombifer* for restocking program in Lanier Swamp (Rodríguez *et al.* 1997). This facility began

operating with 50 stock donated by the Havana Zoo and 650 adults and 80 sub-adults from the Zapata farm. Captive breeding began in 1987, and has remained uninterrupted since then, despite many disruptions, escapes and destruction caused by hurricanes on several occasions. The Cayo Potrero farm currently holds 86 *C. rhombifer* (4 adults, 21 sub-adults, 61 juveniles).

The main threats to the wild *C. rhombifer* population are associated with the limited distribution of the species. Habitats are affected by water pollution from chemical run-off, habitat transformation due to changing water regimes, uncontrolled fires, construction of roads, introduction of invasive alien species of fish and plants and climate change (temperature, precipitation and sea level). Issues of concern at the species level include genetic integrity of the species by hybridization with *C. acutus*, increased poaching and global climate change. In addition, conservation efforts are hampered by; lack of recognition of the conservation status of *C. rhombifer*, poor protection, lack of opportunities for community involvement, insufficient knowledge on population biology, and shortage of human and material resources for research, management and protection.

Priority Projects

High priority

1. **Current status in Zapata and Lanier Swamps:** New surveys are needed to review the current population status of *C. rhombifer* in both locations, in order to assist the development of conservation strategies and management programs. Regular monitoring is needed in order to assess the restocking program in Lanier Swamp.
2. **Long-term ecological studies:** Ecological and population genetics studies on *C. rhombifer* and *C. acutus*, in Zapata and Lanier Swamps, and *C. acutus* in areas where there is no contact with *C. rhombifer*, are essential to confirm or discard the hypothesis that hybridization between *C. acutus* and *C. rhombifer* occurs naturally in the wild. If hybridization does occur in the wild as a natural event, its past, present and future potential impacts on *C. rhombifer* need to be assessed, particularly in light of its reduced distribution. This information is vital in developing solutions to the threat posed by hybridization, and establishing proper management programs. The nature of the ecological interactions between *C. crocodilus*, *C. rhombifer* and *C. acutus* also merits investigation.
3. **Protection of the wild population:** Due to increased illegal hunting of crocodiles for local meat consumption and commercialization, effective mechanisms of control need to be identified and implemented, along with programs for community education and activism that include the community participation in sustainable use.
4. **Captive breeding:** The captive population of *C. rhombifer* is extremely important to ensure the future of the species,

but the extent of mixing with *C. acutus* within it is unknown. Genetic screening for all adults in the short-term would allow a population of confirmed “pure” breeding stock to be established. It is also necessary to improve farming technologies to increase and optimize production, and to seek ways to integrate local communities with the farm and conservation efforts.

Moderate priority

5. **International captive breeding programs:** Other captive populations of *C. rhombifer* exist in the USA, UK, Czech Republic, Denmark, Vietnam, Thailand, Sweden and Cambodia. Assessment of the extent of introgression due to hybridization in these captive populations, and coordination between countries to ensure optimum genetic diversity, is warranted. In Cambodia and Vietnam, hybridization of *C. rhombifer* with *C. siamensis* and/or *C. porosus* also threatens the genetic integrity of these endemic species in those countries (see Jelden 2005, 2008).

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