Yacare Caiman *Caiman yacare*

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Common Names: Yacaré, Jacaré, Lagarto, Yacaré negro, Yacaré tinga, jacaré-do-Pantanal, Pantanal Caiman

Important Synonyms: *Caiman crocodilus yacare* (see Velasco and Ayarzagüena 2009)

Range: Argentina, Bolivia, Brazil, Paraguay

Figure 1. Distribution of *Caiman yacare*.

Conservation Overview

CITES: Appendix II

CSG Action Plan:

- Availability of survey data: Adequate
- Need for wild population recovery: Generally low. moderate in some places
- Potential for sustainable management: Highest

2018 IUCN Red List: Lower Risk/least concern; widespread and numerous populations throughout its distribution, although in some places still in process of recovery (last assessed in 1996; CSG 1996).

Principal threats: habitat destruction, hydroelectric dam, siltation, illegal hunting in some areas

Ecology and Natural History

The Yacare caiman is found in the lowlands of northern and eastern Bolivia and western Brazil, from the Amazon southwards through the Guaporé/Madeira and Paraguay/Paraná River systems and into northern Argentina. Morphologically and ecologically, this species is similar to the common caiman (*Caiman crocodilus crocodilus*), and integrates with that subspecies along a large area (probably more than 1000 km) of the Madeira River in Amazonia. As with the common caiman, *C. yacare* is found in a wide variety of habitat types.

Figure 2. Adult *Caiman yacare.* Photograph: Jemeema Brien.

Most ecological studies have been carried out in the Pantanal region of southern Brazil (Crawshaw and Schaller 1980; Schaller and Crawshaw 1982; Cintra 1986, 1988; Campos 1993, 2003; Catto and Amaro 1994; Campos and Magnusson 1995; Campos et al. 1995, 2003, 2005, 2006a, 2006b; Santos *et al*. 1994, 1996; Pinheiro *et al*. 1997; Rebelo *et al*. 1997).

More recent studies in Bolivia included assessing the distribution and population status of the species, monitoring harvests, and gathering additional data to improve the

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national program of management (Pacheco 1993; Godshalk 1994; Rebolledo-Garin and Tapia-Arauz 1994; Llobet 1996; Llobet and Goitia 1997; Llobet and Aparicio 1999; Rios 2003; Cisneros 2005; Llobet and CIPTA 2006; Peters 2006). In Brazil, aerial surveys of caimans and nests have been carried out in the Pantanal since 1991 (Mourão *et al*. 1994, 2000; Coutinho and Campos 1996). Nesting habitats were also monitored during incubation, hatching periods (Borges and Filho 1993; Campos and Magnusson 1995), and the effect of water level on nest production and hatchling survivorship (Coutinho and Campos 1996; Coutinho *et al*. 2001). Monitoring of potential nests in the Pantanal was carried out for 28 years, and the number of nests was related to precipitation, water level and number of days with temperature below 20ºC (Campos *et al*. 2015). The main predators of eggs were carnivorous mammals, such as crab-eating foxes (*Cerdocyon thous*), coatis (*Nasua nasua*) and tayras (*Eira barbara*), although feral pigs (*Sus scrofa*) and armadillos (*Dasypus novemcinctus*) were also photographed eating caiman eggs. The lizard *Salvator merianae* was photographed eating eggs from two nests (Campos and Mourão 2015). Also predation by jaguars on caiman seems to be an important mortality factor (Azevedo and Verdade 2012).

Terrestrial movement in groups was described for caimans in the Pantanal, in response to disturbance (Campos *et al*. 2003). This behavior may make caimans vulnerable if intensive hunting were to resume (Campos 2003) without proper management program. The movement patterns of caimans were studied over a 16-year period, and females and males larger than 40 cm SVL moved maximum distances of 16 and 18 km, respectively (Campos *et al*. 2006).

The body temperature of 51 caimans in the Pantanal was monitored by radio-telemetry in cold season (dry season) and warm (dry and wet season), with a minimum of 16.9ºC and a maximum of 37.9ºC (Campos *et al*. 2006). In the cold season, caimans were exposed to the sun, and air temperatures higher than water temperatures suggesting that emergence behaviour may be due to thermoregulation. In the dry season most (66%) emergent caimans were found in the shade between 1000 and 1500 h, and body temperatures rarely exceeded water temperatures (Campos and Magnusson 2011). Campos *et al*. (2014) studied growth of caimans for 27 years, and data on known-age individuals indicated females generally reach sexual maturity between 10 and 15 years of age.

Resolution of the systematic relationships within the very widespread *C. crocodilus* complex is needed. Extensive surveys and specimen collection in southern Brazil, northern Bolivia and Paraguay suggest a very complex gradient of morphological features between *C. c. crocodilus* and the *C. yacare*. As there are no fixed differences between the two taxa, they have to be defined geographically, rather than morphologically, which obviously poses legal difficulties if an individual crosses the hypothetical line and changes "species".

Morphological and genetic analyses to resolve the relationships between these taxa are incomplete and inconclusive, mainly because data from the zone of hybridization between the two taxa was not included (Brazaitis *et al*. 1998; Busack and Pandya 2001). Researchers from the Federal University of Amazonas, Instituto Nacional de Pesquisa da Amazônia and Embrapa Pantanal have returned to the Pantanal-Guaporé-Madeira region to quantify the variation and define the geographical boundaries of the postulated species and their variants (Vasconcelos and Campos 2007; Hrbek *et al*. 2008). This study on morphological and genetic variation still has not resolved the issue.

Caiman yacare is still, and always has been, listed technically as a full species (Medem 1983). Some authors do not recognize it as being distinct from the common caiman and use the subspecies *C. c. yacare*. Recent molecular data (Godshalk 2006, 2008a,b) provide evidence for long-term biological separation of large populations of caimans in Central and South America, which may require a new approach to the systematics of the caiman group. The historic forces, driven largely by plate tectonics, have subdivided this neotropical species complex into at least four evolutionarily significant units (ESUs) that are reproductively isolated, except for *C. yacare* and *C. c. crocodilus*. The Andes, in conjunction with a rugged desert coastline, have effectively isolated *C. c. fuscus* to the west and north through Central America to Honduras. Two similar but reproductively separate basin populations of *C. c. crocodilus* have evolved in the Orinoco and Amazon River drainages, and *C. yacare* populates the Paraguay-Parana basins southern Amazon and the Amazon, where it is syntopic with *C. c. crocodilus* (Godshalk 2008a; Hrbek *et al*. 2008). Ojeda *et al*. (2017) reported evidence of multiple paternity in Argentina.

More work is needed to map the boundaries of the various caiman populations and to characterize their phylogeography. Contact zones between the populations may prove particularly valuable in resolving some taxonomic issues, not only between the four major source populations, but also the fringe populations along the Atlantic coast from Guyana to Brazil or the border between Peru and Bolivia.

Figure 3. Hatchling *Caiman yacare*. Photograph: Charlie Manolis.

Yacare caiman are mound nesters, with egg-laying usually peaking in the middle of the wet season, from December to February, at higher latitude egg-laying presents a shorter period, from mid-December to mid-January. Clutch size typically consists of 22-35 eggs, with a maximum of 42 eggs. It seems that habitat type could influence clutch size (Campos 1993; Zambrana *et al*. 2008). The natural tendency of females to guard their nests is apparently influenced by human hunting pressure (Crawshaw 1987), which results in decreased nest attendance and a lower hatching success. Patterns of vocalization of hatchlings and females of caimans were studied in the Pantanal (Sicuro *et al*. 2013).

Conservation and Status

Most of what is written about the conservation of the common caiman applies equally well to *C. yacare*. Basic survey information is available for this species in all countries where it occurs. This information has resulted principally from programs using the species since late 1990s in Bolivia. Some basic information for these programs resulted from a series of CITES-sponsored surveys in southern Brazil, Bolivia, and Paraguay, as well as surveys sponsored by local governments, scientific institutions and NGOs working within these countries. During the early 1990s, populations of Yacare caiman were considered to be somewhat depleted in all four Range States, principally due to widespread illegal hunting during the 1970s and 1980s. Poaching is no longer a problem throughout much of this species' range, but habitat destruction, construction of hydroelectric dams, and siltation of rivers continue to affect caiman populations, particularly in Brazil.

Due to its small size at maturity, ability to adapt to a wide variety of habitat types, and learned wariness, *C. yacare* is particularly resilient to hunting pressure. Studies in Brazil suggest that illegal hunting did not seriously impact populations (Mourão *et al*. 1996; Campos 2009). Farias *et al*. (2013) made an assessment of the risk of extinction of the species. Surveys in Paraguay (Scott *et al*. 1990; King *et al*. 1994) and Argentina (Siroski 2004; Piña *et al*. 2008) indicate that extensive populations remain or have recovered from previous exploitation, since the closure of uncontrolled hunting and implementation of export controls.

Commercially-oriented management programs are in place in three of the four Range States for *C. yacare*. Paraguay suspended its national program in 2003. Cropping is permitted in Bolivia, where hides are currently exported under a CITES quota (50,000 skins).

The conservation and use program for *C. yacare* in Bolivia began in 1997 with few evaluations of its population, and a small experimental harvest. During the following years, between 30,000 (1999) and 59,000 (2003) individuals were harvested annually through a management model based on eco-regional population sizes. From 2004, a large group of institutions and specialists participated in the re-design of the program to adapt it to the national reality, and strengthen the regulatory and administrative framework by means of a monitoring plan. In addition, standardized sampling protocols were designed; monitoring of harvests commenced, and a new classification of water bodies was made. Additionally, a new basis of technical data (counts, harvests, habitats) and administrative data (users, farms, quotas history, contraventions) was developed, and geographically assessed together through a GIS. This database is continuously updated with new information. Parallel to this activity, management plans were developed in Indigenous Lands (TCOs = Spanish acronym) and Protected Areas to increase local community participation in Yacare caiman use, and a group of activities directed to strengthen local communal structures were carried out.

Currently, there are 14 management plans in operation in indigenous territories and protected areas, which are updated every five years. These plans cover some 8.5 million ha of the *C. yacare* distribution in Bolivia (Llobet *et al*. 2004; Llobet and Bello 2008). Between 1999 and 2016, more than 640,000 individuals were harvested within the framework of management plans. The initial national export quota (1999) was established at 36,500 individuals, but it fluctuated between 45,000 and 50,000 animals per year between 2001 and 2007. Over the last six years, the harvesting quota authorized under the National Programme for Conservation and Sustainable Use of *Caiman yacare* has varied between 41,578 individuals in 2011 to 38,446 individuals in 2016. Additional to the harvesting program, since 2015 a few small breeding centers have been authorized for indigenous communities as a pilot for a communal ranching program.

Figure 4. Captive adult *Caiman yacare* in Bolivia. Photograph: Charlie Manolis.

In Brazil, hunting of wild animals is not permitted. However, ranching and farming are allowed (Coutinho *et al*. 1998), and new legislation for the management of the Pantanal caiman - including a head-starting program - is under evaluation by the Federal and State Governments. The aim is to implement an adult caiman harvesting quota in the Brazilian Pantanal. This program is based principally on proposals by Coutinho (2000). So far there is one ranching operation working in the Brazilian Pantanal region.

In Argentina, three ranching programs are utilizing *C. yacare* (Larriera *et al*. 2008); two in Formosa Province, and one in Corrientes Province. Together, they produce around 15,000 skins per year. However, the Corrientes program and one of the Formosa programs have not harvested *C. yacare* eggs in the last few years.

Priority Projects

High priority

1. **Strengthen the monitoring of wild populations and harvesting in Bolivia**. The development of a series of management plans has already produced more reliable data on the species. However, it is important to ensure comprehensive monitoring programs to follow the implementation of these plans, and to make corrections through an adaptive management approach. This should include follow up on pilot communal breeding centers

2. **Reassessment and implementation of a management program in Paraguay**. Following the self-imposition of a CITES moratorium on Paraguay in 2003 a reassessment of the Paraguay National Program and the design of a reliable monitoring program for harvesting of wild *C. yacare* are considered important to ensure the sustainable use of the species, especially now that the partial lifting of the moratorium was implemented. Even though Paraguayan *C. yacare* populations do not depend on a management program for their conservation, a weak management program could affect those populations and other programs for the species in the region.

3. **Study of *Caiman* systematics.** The aim is to clarify the complex taxonomic situation of *C. yacare*, develop a map with boundaries for the various caiman populations and to characterize their phylogeography. If an arbitrary geographic definition is maintained, a zone with a low density of caimans should be selected as the limit to reduce the problem of individuals changing taxa as they cross the line. For enforcement purposes, it would be useful to be able to distinguish the taxon via observable meristic characteristics that can be seen in commercial skins, even if this results in two taxa co-existing in the same population in some areas areas (as is probably the case in the border between Peru and Bolivia). Studies of morphological and genetic variation in Brazil and others countries should clarify the issues in the near future.

Moderate priority

4. **Control of illegal trade**. Management national programs for the species need to improve law enforcement and enhance the controls in border areas to avoid illegal trade between countries.

5. **Quantification of *C. yacare* distribution on the border between Peru and Bolivia**. The border between Peru and Bolivia appears to be the limit of Yacare caiman distribution from the south and also the limit for *C. crocodilus* distribution from the north. No studies have been carried out to assess the northwestern distribution limits for *C. yacare*, or the existence of a sympatric area for both species in this region between Peru and Bolivia, including possible hybridization between the two species.

6. **Long-term ecological studies in the Pantanal, Brazil**. Like the llanos of Venezuela and Colombia, the Pantanal is a large seasonally inundated savanna that offers excellent research opportunities for the study of caiman population dynamics. Monitoring programs of the populations via aerial survey and radio-telemetry have been made in the Pantanal region, and habitat destruction, such as deforestation, siltation, hydroelectric dams, agriculture, and mining have been evaluated in the medium-term. This part of the research and conservation of caiman in Brazil should be continued and implemented in other countries (Bolivia, Paraguay and Argentina). The analysis of the effects of global climate change on the biology of the caimans in the Pantanal will be made in the near future. The large population of caiman in the area is a function of the quality of the wetlands habitat, and changes to the flooding regime will affect the distribution and abundance of the species.

7. **Implementation of ranching programs in Bolivia, Paraguay and Brazil**. Brazil has undertaken a very rapid development of captive breeding (farming) of caiman similar to that in Colombia. In the Pantanal of Brazil there are management of model ranching of the *C. yacare*. A number of facilities are registered with the Government and CITES as captive breeding facilities, and are producing skins for export. However, since ranching offers greater positive impact than farming for effective conservation of species and habitats, it is recommended that a ranching model be implemented, initially on an experimental basis. The results would serve to assess the feasibility of ranching programs on a national scale.

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