

Spectacled Caiman *Caiman crocodilus*

Alvaro Velasco¹ and José Ayarzagüena²

¹ Aptdo Postal 66597, Caracas 1010, Venezuela (velascoalvaro@tutopia.com)

² Fundación La Salle de Ciencias Naturales Apartado 1930 Caracas 1010 Venezuela (ayarza03@hotmail.com)

Common Names: Spectacled caiman, common caiman, baba (Venezuela), babilla (Colombia), guajipal (Nicaragua), jacare tinga (Brazil), jacare, lagarto blanco (Peru), cocodrilo, ocoroche, cascarudo, cachirre, tulisio, pololo (Mexico).

Important synonyms: *Caiman sclerops*

Range: Brazil, Colombia, Costa Rica, Ecuador, El Salvador, French Guiana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Peru, Suriname, Trinidad and Tobago, Venezuela (introduced: Cuba, Puerto Rico, United States).



Figure 1. Distribution of *Caiman crocodilus*. Populations in Florida (USA), Puerto Rico and Cuba are introduced.

Conservation Overview

CITES: Appendix II, except *C. crocodilus apaporiensis* (Appendix I)

CSG Action Plan:

Availability of survey data: Adequate, except in Central America where there is insufficient data available.

Need for wild population recovery: Low
Potential for sustainable management: High

2009 IUCN Red List: LRLc (Lower Risk, least concern, probably numbers in the millions, widely distributed throughout its range, although locally depleted or extirpated in some localities) (IUCN 2009) (last assessed in 1996).

Principal threats: Illegal hunting, habitat loss, hydroelectric dam

Introduction

Five subspecies of *Caiman crocodilus* have been recognized previously. *Caiman c. yacare*, the southern form, is distributed from southern Brazil through Bolivia, Paraguay, and Argentina, and is generally accepted that it is a full species (ie *Caiman yacare*) (see King and Burke 1989) - it is treated as such in the CSG Action Plan (CSG 2009). Busack and Pandya (2001), using morphological analysis, showed that there were no differences between the subspecies. However, recent mitochondrial DNA analysis demonstrated significant genetic structures between and within Mesoamerica and South America (Venegas-Anaya *et al.* 2008).

The most recent morphological (Busack and Pandya 2001) and DNA analyses (Amato and Gatesby 1994) suggest that *C. c. fuscus* and *C. c. chiapasius* form one natural group and *C. c. crocodilus* and *C. c. yacare* another. However, Brazaitis *et al.* (1998) recorded large differences in size distributions among populations for both *C. c. crocodilus* and *C. c. yacare* along a cline of over 1000 km in the Madeira River and its tributaries. Vasconcelos and Campos (2007), who returned to these places to quantify the variation and define geographical boundaries, pustule species and their variants. Population genetic analysis of *C. crocodilus* from South America has been related by Vasconcelos *et al.* (2006).

Ecology and Natural History

The Spectacled caiman is the most widely distributed of the New World crocodylians, ranging from southern Mexico in the North to Peru and Brazil in the South. It is also the most geographically variable species in the Americas, with four subspecies generally being recognized (Medem 1981; King and Burke 1989; see above):

- *C. c. crocodilus*, the nominate form, distributed throughout the Orinoco drainage and llanos in Venezuela, and the Amazon drainage from Colombia through Brazil north and east of Bolivia, Ecuador, Peru, Guyana and French Guiana.
- *C. c. fuscus*, from Nicaragua to Atlantic coastal drainages of Colombia (including the Magdalena River), Ecuador and into western Venezuela.
- *C. c. chiapasius*, Medem (1981, 1983) referred to distribution as Central America, Mexico to Pacific Colombia and possibly Ecuador and to the Gulf of Uruba. Over the last two decades some authorities have considered *C. c. chiapasius* to be identical to *C. c. fuscus*. Recent mtDNA work shows sufficient differences to consider *C. c. chiapasius* a valid subspecies and that its distribution is limited from Pacific coastal Oaxaca and Chiapas in Mexico to El Salvador (Venegas-Anaya *et al.* 2008).
- *C. c. apaporiensis*, a narrower snouted form restricted to the upper Apaporis River of Colombia, although a cline of narrow-snouted caimans may be present across Colombia and the Venezuelan llanos (Ayarzagüena 1984; Ayarzagüena and Castroviejo 2008; Gorzula 1994).

The Spectacled caiman is a medium-sized crocodylian (maximum length in males 2.7 m; Ayarzagüena 1983), that is extremely adaptable in terms of habitat requirements, occupying rivers, caños or creeks, lagoons, lakes, borrow pits, swamps, dams and marshes. Female Spectacled caiman reach sexual maturity at about 1.2 m and lay an average of 28-32 eggs in a mound nest, usually during the annual wet season (Thorbjarnarson 1994; Velasco *et al.* 1996). A close relationship between precipitation in certain months and the proportion of females that reproduce in that year has been reported (Ayarzagüena and Castroviejo 2008).



Figure 2. Adult *C. c. fuscus*. Photograph: Matt Brien.

Ayarzagüena and Castroviejo (2008) summarise the species' ecology and behavior in detail. They comment that the genus *Caiman*, along with *Alligator*, shows the most elaborate behaviors known in crocodylians. Spectacled caiman behavior includes complex sound signals: "warning calls" emitted by female to the young; "distress call" emitted by juveniles; and, "group cohesion calls" emitted by all individuals. Males display social behaviours: "vertical tail" and "arch tail" with

sub-audible vibrations, bark and visual displays, similar to behaviors described by Vliet (1989) in *A. mississippiensis*. Another important characteristic is that hatchling and juvenile groups remain together under female care for 12-18 months.



Figure 3. Tail arching and "flank vibrating" by *C. crocodilus*. Photograph: Andres Seijas.

Investigations into feeding behavior indicate many unique hunting techniques and that the amount of prey items taken varies according to time of year, sex, and size of the caiman (eg Allsteadt and Vaughan 1994). Information is available on: aspects of the ecology of the species in the Venezuelan Llanos (Staton and Dixon 1975; Seijas 1984, 1986; Gorzula 1987); group fishing (Thorbjarnarson 1993); relationship between clutch and egg size and female size (Staton and Dixon 1977; Thorbjarnarson 1994); parasites, injuries, growth and diet in Brazilian Amazonia (Magnusson 1985; Magnusson and Sanaiotti 1995; Magnusson *et al.* 1987; Da Silveira and Magnusson 1999); and various other parameters (eg habitat selection, wariness, migration, etc.; eg Allsteadt and Vaughan 1992; Bolaños *et al.* 1997; Cerrato 1991; Chiriví 1973; Escobedo 2006, 2008; Martínez-Ibarra *et al.* 1997; Ouboter and Nanho 1987, 1988; Pacheco 1990; Ron *et al.* 1998; Perez 2001).

Conservation and Status

Owing to the extensive development of ventral osteoderms (bone inclusions), caiman belly skins are of inferior commercial quality compared to those of crocodiles and the American alligator, and usually only the flanks are used from large animals. Because of the low value of the skin, caiman exploitation did not begin until the 1950s when stocks of the more valuable classic crocodile species had dwindled. However, since the 1950s, millions of caiman have been harvested and *C. c. fuscus* and *C. c. crocodilus* continue to supply the vast majority of skins on the international market (Velasco 2005).

Caiman appear to have been quite resilient to commercial hunting for a number of reasons, but particularly because they reproduce at a relatively small size, and hunting in many areas seems to have been concentrated on larger adult males. Another important factor has been the near extirpation of larger, sympatric species of crocodylian of greater commercial value. For example, caiman in Brazilian Amazonia occupy habitats that were formerly dominated by *Melanosuchus niger* (Magnusson 1982). Furthermore, in areas such as

the llanos of Venezuela and Colombia, the proliferation of man-made water bodies (eg borrow pits) has increased the carrying capacity for caiman populations in these habitats. Although they may be locally depleted, present populations may be larger than they were historically. The ecological adaptability of the Spectacled caiman is evidenced through its rapid population growth where it has been introduced, both accidentally and deliberately. Introduced (feral) populations are established in the United States (especially Florida), Puerto Rico (Watlington 2002), Cuba (under harvest since 1995; Berovides *et al.* 2000) and Colombia (San Andres Island; Forero *et al.* 2006).

Over the last 12 years, various populations across the species' range have been evaluated.

Brazil: Caiman populations, especially in the Amazon area, have been evaluated through several studies indicating wild populations are stable or continuing to grow (Marioni *et al.* 2008; Da Silveira *et al.* 2008; Vasconcelos *et al.* 2006; Da Silveira *et al.* 1997; Rebelo and Lugli 2001). Campos *et al.* (2008) showed that size distributions of breeding females in the Central Amazon vary greatly between populations and legal size limits will be more effective if based on data from local populations. A captive breeding program is in place for *C. c. crocodilus* (Coutinho and Luz 2008).

Colombia: Colombia is the largest producer of *C. c. fuscus*, with export of over 7.8 million skins between 1995 and 2007 (Medrano and Gómez 2008). Farms are based on closed-cycle captive breeding of *C. c. fuscus* and *C. c. crocodilus*.

Recent surveys of *C. c. fuscus* in Cispata Bay (Ulloa and Cavanzo 2003; Cavanzo 2004) and Via Parque Isla de Salamanca (Balaguera and Reina 2009) report population size structure is dominated by hatchlings and juveniles, and that densities are lower than those reported previously by Rodriguez (2000).

Several conservation programs have been initiated, with the participation of communities, private enterprises and environmental authorities. In 2004 a pilot program was designed, which included the harvesting and incubation of eggs and breeding of caimans by fishing communities. Later, the hatched individuals were raised for a year and released in different swamps of the Canal del Dique (Bolívar State), in the same areas where the eggs were originally harvested. The study finished in 2006 (Fundación Biodiversa 2005).

Based on the successful experiences of the Canal del Dique program, a larger program was implemented in the State of Atlántico in 2005 (eg Palencia *et al.* 2006; Rojano and Velasco 2006). This program involved the reintroduction of over 15,000 yearling and sub-adult individuals, which comprised the repopulation quotas of the closed-cycle breeding farms, into the wetlands where the species had been almost totally removed. This program continues, and reintroduced populations have shown rapid growth (Rueda *et al.* 2007; Medrano and Rojano 2009). Another conservation program based on reintroduction of *C. c. fuscus* from private

farms is also underway, where populations will be monitored in collaboration with local communities in south of Bolívar (Mercado and Palacios 2006; Palacios *et al.* 2008) and in Cispata Bay (Ulloa *et al.* 2005).

The distribution and status of *C. c. apaporiensis* is unknown, and its evaluation through surveys and habitat characterization remains a high priority.



Figure 4. Farmed *C. c. fuscus* in Colombia. Photograph: Matt Brien.

Costa Rica: Small areas have been studied, showing a reduced population but improved status from earlier reports (Cabrera *et al.* 2003). Escobedo and González (2006, 2008) reported that caiman populations were male-biased in the Sierpe River (southern Pacific coast) and Caño Negro National Wildlife Refuge (NWR) located at northern Caribbean coast. The Sierpe River population had reduced numbers in the reproductive size classes (over 120 cm), probably in response to overexploitation, while in Caño Negro NWR the population size and structure do not appear to have been impacted as much as the latter.

El Salvador: Escobedo *et al.* (2004) report the first crocodylian surveys in El Salvador, with a very depleted population for *C. crocodilus*; only four caimans were recorded at 9 sites. Recent studies in RAMSAR-designated Laguna el Jocotal (Martínez 2005), The Natural Conservation Area Santa Rita and el Zanjón el Chino (Martínez and Dueñas 2007) reported small *C. crocodilus* populations.

Guyana: A program based on the harvest of wild *C. crocodilus* populations is in place.

Honduras: Detailed information on caiman population status is not available, although some research has been undertaken (eg Trujillo Bay Conservation Area with small caiman population; Cerrato 2002).

Mexico: Flores (2002, 2005) reported a stable population of *C. c. chiapasius* in Chiapas State, and Aguilar-Galindo *et al.* (2005) monitored caiman populations in Chiapas State and reported good status.

Nicaragua: A recent *C. crocodilus* population survey was conducted in 2009, indicating populations in the Caribbean watersheds are stable and tending to increase, but still facing several human pressures (Buitrago 2009).

Panama: Panamanian authorities are preparing the first national census of *C. crocodilus* (and *C. acutus*). Currently, the National Secretary of Science and Technology, Smithsonian Institution (SI), and Texas Tech University (TTU) are developing a long-term study on population dynamics and population genetics using molecular and telemetry tools. The Panamanian Government in collaboration with SI and TTU are designing the Panama Canal management plan of conservation and sustainable use of *C. acutus* and *C. crocodilus*. Panama also has collaborative research with most of the Central American and Caribbean countries on the systematic and geographic history of *Caiman* and *Crocodylus* lineages (M. Venegas-Anaya, pers. comm.). A captive breeding program has been implemented in Panama.

Venezuela: Since 1983, Venezuela has operated the largest cropping program for any species of crocodylian, based on controlled hunting by private landowners. The system allows private landowners to harvest up to 20% of caiman above 1.8 m total length each year, effectively restricting the harvest to adult males. Quotas were initially established based on census data from each property, provided by licensed surveyors engaged by the property owners. Annual exports average 70,000-90,000 skins. The program also includes a rigorous system of licensing of producers and processors, centralized inspection and storage of skins and careful monitoring of tanneries and exports.

Annual evaluations of the program and independent surveys in 1991-1992 suggested overexploitation in some areas (Velasco and Ayarzagüena 1995). In 1994, a new method of assigning harvest quotas was established, and the annual export quota was set at 70,000 skins. Currently, quotas are assigned on the basis of regional surveys, ecological region and the size of the property, and restricted to 15% of the class IV (1.8 m length) individuals (Velasco *et al.* 1995). The values generated are compared with the regional average values derived independently by the CITES Management Authority, and adjustments to the estimated population and harvest quota are calculated (De Sola and Velasco 1994). The program offers an unparalleled opportunity to establish experimental harvesting regimes in conjunction with population studies.

In 1996, Venezuela implemented a complete halt to caiman harvesting to allow detailed analysis of the effect on populations (Quero and Velasco 1995). Harvest re-opened in 1997 based on the results of extensive re-evaluation of wild populations. Evaluation of harvest effect determines which caiman populations will be harvested (Velasco *et al.* 2003). Caiman populations under wild harvest were continually evaluated (Velasco *et al.* 1997; Colomine *et al.* 2000; Villarroel *et al.* 2002), and a healthy status reported (Velasco *et al.* 2003).

Historically, illegal trade in caiman skins has been an issue in Latin America, but in recent years there have been few reports. Legal production of caiman skins exceeds one million skins per year (Velasco, in press), and improved enforcement and CITES implementation appears to have reduced the flow of illegal skins.



Figure 5. Introduced (feral) *C. crocodilus* in Florida, USA. Photograph: Jemeema Carrigan.

Priority Projects

High priority

- 1. Taxonomic study of the *Caiman crocodilus* complex:** The relationships among the *C. crocodilus* complex are still poorly understood. This has created conservation problems due to the inability to recognize sub-species that may differ in trade restrictions. Investigation of the southern *C. crocodilus* - *C. yacare* relationship is underway but remains inconclusive. In the near future such research should include the use of genetic tools, such as DNA analysis, to determine phylogenetic relationships within the *C. crocodilus* complex.
- 2. Survey of Apaporis River caiman in Colombia:** *Caiman c. apaporiensis* is believed to be present only in the upper and middle Apaporis River, and some adjacent areas, in southern Colombia. No recent information on the status of these populations is available, and surveys are urgently needed to determine it.
- 3. Ecology and population dynamics:** Research into ecology, population dynamics and population genetics in regions under commercial use regimes (eg wild cropping, captive breeding, ranching) is needed. Evaluation of size classes, surveys, land occupation patterns and harvest effects are areas of interest. Long-term projects using molecular and geographic data on population dynamics and home range, integrating all small projects currently in progress, are needed. Establish the distribution boundaries and hybridization zones for the *C. crocodilus* lineage.

Moderate priority

4. **Population surveys in Guyana and Nicaragua:** Wild *C. c. crocodilus* in Guyana and Nicaragua are harvested through an annual quota. Research on population status and the impact of the harvest are needed.

Acknowledgements

Fabio Buitrago, Zilca Campos, Sergio Medrano-Bitar, Miryam Venegas-Anaya, Armando Hiram Escobedo Galva, Luciano Verdade and Juan Bolaños provided valuable input into this plan.

References

- Aguilar-Galindo, A. (2005). Evaluación del estado de conservación del *Caiman crocodilus fuscus* (Mertens, 1943) durante el año 2003-2004, en el sistema lagunar de Chantuto, Reserva de la Biosfera la Encrucijada, Chiapas, México, Unpublished BSc Thesis, UAM, México DF.
- Allsteadt, J. and Vaughan, C. (1992). Dry season habitat selection of *Caiman crocodilus* (Crocodylia: Alligatoridae) in Caño Negro, Costa Rica. *Brenesia* 38: 65-69.
- Allsteadt, J. and Vaughan, C. (1994). Food habits of *Caiman crocodilus* in Caño Negro, Costa Rica. *Vida Silvestre Neotropical* 3: 24-29.
- Amato, G. and Gatesby, J. (1994). PCR assays of variable nucleotide sites for identification of conservation units. Pp. 215-226 in *Molecular Ecology and Evolution, Approaches and Applications*, ed. by B. Schierwater, G.P. Wagner and R. DaSalle. Birkauser Verlag: Basel.
- Ayarzagüena, J. (1984). Ecología del caimán de anteojos (*Caiman crocodilus* L.) en los Llanos de Apure (Venezuela). *Doñana Acta Vert.* 10(3): Seville, Spain.
- Ayarzagüena, J. and Castroviejo, J. (2008). La baba (*Caiman crocodilus*) en la Estación Biológica El Frío (Estado Apure). Llanos del Orinoco, Venezuela. Pp. 181-294 in *Contribución al Conocimiento del Género Caimán de Suramérica*, ed. by J. Castroviejo, J. Ayarzagüena and A. Velasco. Publ. Asoc. Amigos de Doñana 18: Seville, Spain.
- Balaguera-Reina, S. and González-Maya, J. (2009). Estructura poblacional, abundancia y uso del hábitat de *Caiman crocodilus fuscus* (Cope, 1868) en la Vía Parque Isla Salamanca, Caribe Colombiano. *Revista de Biología Marina y Oceanografía* 44(1): 145-152.
- Berovides V., Méndez, M. and Soberón, R. (2000). Análisis de la explotación del caimán común o babilla (*Caiman crocodilus*) en la Isla de la Juventud. Pp. 249-261 in *Crocodyles*. Proceeding of the 15th Working Meeting of the IUCN-SSC Crocodile Specialist Group, IUCN: Gland.
- Bolaños, J., Sánchez, J. and Piedra, L. (1997). Inventario y estructura poblacional de crocodílidos en tres zonas de Costa Rica. *Revista de Biología Tropical* 44(3)/45(1): 283-287.
- Buitrago, F., Torres, N., Medina, A. and Arroliga, O. (2009). Censo de los Crocodylia del Caribe y Río San Juan, Nicaragua 2009. MARENA, Programa DR-CAFTA/Paso Pacífico: Managua, Nicaragua.
- Busack, S. and Pandya, S. (2001). Geographic variation in *Caiman crocodilus* and *Caiman yacare* (Crocodylia: Alligatoridae): systematic and legal implications. *Herpetologica* 57: 294-312.
- Cabrera, J., Quesada, M., Urriola, M. and Cubero, R. (2003). Distribución y abundancia de *Caiman crocodilus* en el Refugio Nacional de Vida Silvestre Caño Negro, Costa Rica. *Rev. Biol. Trop.* 51(2): 571-578.
- Campos, Z., Magnusson, W., Sanaiotti, T. and Coutinho, M. (2008). Reproductive trade-offs in *Caiman crocodilus crocodilus* and *Caiman crocodilus yacare*: implications for size-related management quotas. *Herp. J.* 18: 91-96.
- Cavanzo, D. (2004). Caracterización y diagnóstico de las poblaciones de *Caiman crocodilus fuscus* y su hábitat natural. Bahía de Cispatá, Departamento de Córdoba. Unpublished BSc Thesis, Pontificia Universidad Javeriana.
- Cerrato, C. (1991). Composición y tamaño de las poblaciones silvestres de caimanes (*Caiman crocodilus chiapasus*) y cocodrilos (*Crocodylus acutus*) de la costa Caribe de Honduras, Centro América. Unpublished MSc Thesis (Manejo y Conservación de Vida Silvestre). Programa Regional en Manejo de Vida Silvestre para Mesoamérica y el Caribe. Universidad Nacional, Heredia.
- Cerrato, C. (2002). Inventory of crocodiles in the Trujillo Bay Conservation Area. *Crocodyle Specialist Group Newsletter* 21(2): 16.
- Colomine, G., Velasco, A., De Sola, R., Villarroel, G., Lander, A., Vázquez, W., Pino, T. and Corazzelli, J. (2000). Evaluation of the density and structure of size class of the Spectacled caiman (*Caiman crocodilus*) in the Alto and Bajo Apure ecological regions, Venezuela. Pp. 304-309 in *Crocodyles*. Proceeding of the 15th Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland.
- Coutinho, M. and Luz, V. (2008). Política Nacional para la conservación y manejo de *Caiman yacare* en Brasil. Situación de la especie, seguimiento, investigaciones y regulaciones actuales. Pp. 71-82 in *Contribución al Conocimiento del Género Caiman de Suramérica*, ed. by J. Castroviejo, J. Ayarzagüena and A. Velasco. Publ. Asoc. Amigos de Doñana 18: Seville, Spain.

- Da Silveira, R. and Magnusson, W. (1999). Diets of spectacled and black caiman in the Anavilhanas Archipelago, Central Amazonia, Brazil. *J. Herpetol.* 33(2): 181-192.
- Da Silveira, R., Magnusson, W. and Campos, Z. (1997). Monitoring and distribution, abundance and breeding areas of *Caiman crocodilus* and *Melanosuchus niger* in the Anavilhanas Archipelago, Central Amazonia, Brazil. *J. Herpetol.* 31(4): 514-520.
- Da Silveira, R., Magnusson, W. and Thorbjarnarson, J. (2008). Factors affecting the number of caiman seen during spotlight surveys in Mamirauá Reserve, Brazilian Amazonia. *Copeia* 2008(2): 425-430.
- De Sola, R. and Velasco, A. (1994). Commercial harvest of caimans in Venezuela 1993 and 1994 seasons. *Crocodile Specialist Group Newsletter* 13(3): 16-18.
- Escobedo, A.H. (2006). Temperature variation in nest of *Caiman crocodilus* (Crocodylia: Alligatoridae). *Acta Herpetologica* 1(2): 131-134.
- Escobedo-Galván, A.H. (2008) Estructura poblacional y proporción de sexos en *Caiman crocodilus* en Caño Negro, Costa Rica. *Iheringia Sér Zool* 98(4):489-492
- Escobedo, A.H., Dueñas, C. and Martínez, C. (2004). Notes on crocodiles in El Salvador. *Crocodile Specialist Group Newsletter* 23(3): 14.
- Escobedo, A. and Gonzalez Maya, J.F. (2006). Estructura poblacional y proporción de sexos del Caimán (*Caiman crocodilus*) en el río Sierpe, Costa Rica. *Acta Zoologica Mexicana* 22(2): 151-153.
- Escobedo, A. and Gonzalez Maya, J.F. (2008). Estado poblacional del Caimán, *Caiman crocodilus*, en el Refugio Nacional de Vida Silvestre Caño Negro, Costa Rica. *Yu'am: Revista Mesoamericana de la Conservación* 1(1): 15-22.
- Flores, C. (2002). Estado actual de la población del *Caiman crocodilus chiapasius* en El Castaño, Chiapas. COMACROM: Mexico.
- Flores, C.G. (2005). Caracterización de una población del *Caiman crocodilus chiapasius* en El Castaño, Reserva de la Biosfera La Encrucijada, Chiapas, México. Unpublished BSc Thesis, Universidad Nacional Autónoma de México, México D.F.
- Forero-Medina, G., Castaño-Mora, O.V. and Rodríguez-Melo, M. (2006). Ecología de *Caiman crocodilus fuscus* en San Andrés isla, Colombia: Un estudio preliminar. *Caldasia* 28(1): 115-124.
- Fundación Biodiversa (2004). Desarrollo de un proyecto para determinar la relación entre conservación y uso de la especie *Caiman crocodilus fuscus* por parte de la zoonría en ciclo cerrado y las comunidades para el desarrollo de un sistema mixto de producción en la ecoregión canal del dique. Mimeografiado 50 pp.
- Gorzula, S. (1994). A longirostrine *Caiman crocodilus* from central Venezuela. *Crocodile Specialist Group Newsletter* 13(3): 16.
- IUCN (2009). IUCN Red List of Threatened Species. Ver. 2009.1 (www.iucnredlist.org; viewed 30 September 2009).
- King, F.W. and Burke, R.L. (1989). *Crocodilian, Tuatara and Turtles Species of the World. A Taxonomic and Geographic Reference.* Assoc. Systematics Collections: Washington, DC.
- Magnusson, W. (1982). Biological aspects of the conservation of Amazonian crocodilians. Pp. 108-116 *in* *Crocodiles. Proceedings of the 5th Working Meeting of the IUCN-SSC Crocodile Specialist Group.* IUCN: Gland.
- Magnusson, W.E. (1985). Habitat selection, parasites and injuries in Amazonian crocodilians. *Amazoniana* 2: 193-204.
- Magnusson, W.E., Da Silva, E.V. and Lima, A.P. (1987). Diets of Amazonian crocodiles. *J. Herpetol.* 21: 85-95.
- Magnusson, W.E. and Sanaiotii, T.M. (1995). Growth of *Caiman crocodilus crocodilus* in Central Amazonia, Brazil. *Copeia* 1995:498-501.
- Marioni, B., Da Silveira, R., Magnusson, W. and Thorbjarnarson, J. (2008). Feeding behavior of two sympatric caiman species, *Melanosuchus niger* and *Caiman crocodilus*, in the Brazilian Amazon. *J. Herpetol.* 42(4): 768-772.
- Martínez, C.C. (2005). Distribución, abundancia y composición por tallas de las poblaciones de crocodrilianos presentes en el sitio Ramsar, Laguna El Jocotal, Departamento de San Miguel, El Salvador. Unpublished Thesis, Universidad de El Salvador, San Salvador, El Salvador.
- Martinez-Ibarra, J.A., Naranjo, E. and Nelson, K.C. (1997). Las poblaciones de cocodrilos (*Crocodylus acutus*) y caimanes (*Caiman crocodilus*) en una zona pesquera de la reserva de la biosfera La Encrucijada, Chiapas, México. *Vida Silvestre Neotropical* 6: 21-28.
- Martínez, C. and Dueñas, C. (2007). Observaciones preliminares de *Caiman crocodilus* en el Área Natural Protegida Santa Rita y El Zanjón El Chino, El Salvador. *Mesoamericana* 10: 38-41.
- Medem, F. (1981). Los Crocodylia de Sur América. Vol I. Los Crocodylia de Colombia. Colciencias: Bogotá.
- Medrano, S. and Gómez, A. (2008). Conservación y

- aprovechamiento de la baba o babilla (*Caiman crocodilus*, Linnaeus 1756) en Colombia. Pp. 23-69 in Contribución al conocimiento del Género *Caiman* de Suramérica, ed. by J. Castroviejo, J. Ayarzagüena and A. Velasco. Publ. Asoc. Amigos de Doñana, 18: Seville, Spain.
- Medrano-Bitar, S.A. and Rojano, A.M. (2009). Conservation program, sustainable use and management of some wetlands in the State of Atlántico, Phase II Corporación Regional del Atlántico (CRA). Pp. 94-99 in Crocodiles. Proceedings of the 19th Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland.
- Mercado, A. and Palacios, I. (2006). Plan de acción para la conservación de la especie Babilla (*Caiman crocodilus fuscus*) en jurisdicción de la Corporación Autónoma Regional del Sur de Bolívar - CSB, Colombia. Pp. 231-236 in Crocodiles. Proceedings of the 18th Working Meeting of the IUCN-SSC Crocodile Specialist Group, IUCN: Gland.
- Outbater, P.E. and Nanhoë, L.M. (1987). Notes on nesting and paternal care in *Caiman crocodilus crocodilus* in northern Suriname and an analysis of crocodilian nesting habitats. *Amphibia-Reptilia* 8: 331-348.
- Ouboter, P.E. and Nanhoë, L.M.R. (1988). Habitat selection and migration of *Caiman crocodilus crocodilus* in a swamp and swamp-forest habitat in northern Suriname. *J. Herpetol.* 22: 283-294.
- Pacheco, L. (1990). Wariness of caiman populations and its effect on abundance estimates. *J. Herpetol.* 30: 123-126.
- Palacios, I., Gómez, J., Lagares, P., Tecillo, A., Zambrano, R., Hoyos, J. And Ruiz, M. (2008). Plan de acción para la conservación de la especie babilla (*Caiman crocodilus fuscus*) en el complejo cenagoso B15, municipios de Achí, Altos del Rosario, Barranco de Loba, Pinillos, San Martín de Loba y Tiquisio, en jurisdicción de la Corporación Autónoma Regional del Sur de Bolívar - CSB. Ministerio de Ambiente Vivienda y Desarrollo Territorial: Bogotá.
- Palencia, L.T., Rojano, A.M. and Bedrano-Bitar, S.A. (2006). Return of the "babilla" (*Caiman crocodilus fuscus*): a key species in the conservation and sustainable use of wetlands in the Department of Atlántico (Colombia). *Crocodile Specialist Group Newsletter* 25(3): 15-17.
- Pérez, T. (2001). Incubación artificial de huevos de baba (*Caiman crocodilus crocodilus*). *Zootecnia Tropical* 19(2): 151-164.
- Quero, M. and Velasco, A. (1985). Ecological pause for caiman harvest. *Crocodile Specialist Group Newsletter* 14(4): 14-15.
- Rebello, G. and Lugli, L. (2001). Distribution and abundance of four caiman species (Crocodylia: Alligatoriadea) in Jaú National Park, Amazonas, Brazil. *Rev. Biol. Trop.* 49(3-4): 1095-1109.
- Rodríguez, M. (2000). Estado y distribución de los Crocodylia en Colombia. Ministerio del Medio Ambiente and Instituto Alexander von Humboldt: Colombia.
- Rojano, A. and Velasco, A. (2006). Repopulation of babillas in Tocagua Swamp. *Crocodile Specialist Group Newsletter* 25(2): 9-10.
- Ron, R.S., Vallejo, A. and Andanza, E. (1998). Human influence on the wariness of *Melanosuchus niger* and *Caiman crocodilus* in Cuyabeno, Ecuador. *J. Herpetol.* 32(3): 320-324.
- Rueda Almonacid J.V., Carr, J.L., Mittermeier, R.A., Rodríguez-Mahecha, J.V., Mast, R.B., Vogt, R.C., Rhodin, A.G.J., de la Ossa-Velasquez, J., Rueda, J.N. and Mittermeier, C.G. (2007). Las Tortugas y los Cocodrilianos de los Países Andinos del Trópico. Serie de Guías Tropicales de Campo N° 6. Conservación Internacional, Editorial Panamericana, Formas e Impresos: Bogotá, Colombia.
- Seijas, A.E. (1984). Estimaciones poblacionales de babas (*Caiman crocodilus*) en los Llanos occidentales de Venezuela. Ministerio del Ambiente y de Recursos Naturales Renovables (PT) Serie Informes Técnicas DGSIIA/IT/165,1-23.
- Seijas, A. (1986). Estimaciones poblacionales de babas (*Caiman crocodilus*) en los llanos occidentales de Venezuela. *Vida Silvestre Neotropical* 1(1): 24-30.
- Staton, M.A. and Dixon, J. (1975). Studies on the dry season biology of *Caiman crocodilus crocodilus* from the Venezuelan llanos. *Society Ciencias Naturelaza La Salle* 35: 237-266.
- Staton, M.A. and Dixon, J. (1977). Breeding biology of the spectacled caiman, *Caiman crocodilus crocodilus* in the Venezuelan llanos. *Wildlife Research Report (U.S. Fish and Wildlife Service)* 5: 1-21.
- Thorbjarnarson, J.B. (1993). Fishing behavior of spectacled caiman in the Venezuelan Llanos. *Copeia* 1993: 1166-1171.
- Thorbjarnarson, J.B. (1994). Reproductive ecology of the spectacled caiman (*Caiman crocodilus*) in the Venezuelan llanos. *Copeia* 1994(4): 907-919.
- Ulloa, G. and Cavanzo, D. (2003). Conservación, manejo y uso sostenible de la babilla (*Caiman crocodilus fuscus*) en la Bahía de Cispata. Etapa I: caracterización y diagnóstico de las poblaciones de *Caiman crocodilus fuscus* y su hábitat natural. Corporación Autónoma Regional de los Valles del Sinu y de San Jorge (CVS): Departamento de Córdoba.
- Ulloa, G., Sierra, C. and Cavanzo, D. (2005). Proyecto de

- conservación del *Crocodylus acutus* (Curvier, 1807) y su hábitat natural - Bahía de Cispatá, Departamento de Córdoba - Colombia. Pp. 118-126 in Reunión Regional de América Latina y el Caribe del Grupo de Especialista en Cocodrilos (CSG/SSC/IUCN). IUCN: Gland. (CD Publication).
- Vasconcelos, W.R., Hrbek, T., Da Silveira, R., De Thoisy, B., Marioni, B. and Farias, I.P. (2006). Population genetic analysis of *Caiman crocodilus* (Linnaeus, 1758) from South America. *Genetics and Molecular Biology* 29(2): 220-230.
- Vasconcelos, W. and Campos, Z. (2007). Geographic variation between Pantanal caiman (*Caiman crocodilus yacare*) and Amazonian caiman (*Caiman crocodilus crocodilus*): First Phase. *Crocodile Specialist Group Newsletter* 26(4): 6-7.
- Velasco, A. (2009). Crocodile management, conservation and sustainable use in Latin America. Pp. 72-88 in *Crocodiles. Proceedings of the 19th Working Meeting of the IUCN-SSC Crocodile Specialist Group*. IUCN: Gland.
- Velasco, A. and Ayarzagüena, J. (1995). Situación actual de las poblaciones de baba (*Caiman crocodilus*) sometidas a aprovechamiento comercial en los llanos venezolanos. Publicación de la Asociación de Amigos de Doñana. No 5. 71 pp.
- Velasco, A., Colomine, G., De Sola, R. and Villarroel, G. (2003). Effects of sustained harvest on wild populations of *Caiman crocodilus crocodilus* in Venezuela. *Interciencia* 28(9): 544-548.
- Velasco, A., Colomine, G., Villarroel, G., Camacaro, O., De Sola, R., León, N., Oropeza, E., Pérez-Hernandez, R., Pino, T., Quero, M., Ramos, J., Ramos, S., Sanchez, G. and Vázquez, W. (1996). Surveying nest of spectacled caiman (*Caiman crocodilus*) in ecological areas of Venezuelan llanos. In *Crocodiles. Proceedings of the 13th Working Meeting of the IUCN-SSC Crocodile Specialist Group*, IUCN: Gland.
- Velasco, A. and De Sola, R. (2005). Exportaciones de pieles de cocodrilos desde Latino América y el Caribe. Pp. 127-143 in *Reunión Regional de América Latina y el Caribe del Grupo de Especialistas en Cocodrilos (CSG/SSC/IUCN)*. IUCN: Gland. (CD Publication).
- Velasco, A., De Sola, R. and Quero, M. (1995). Programa de manejo de la baba (*Caiman crocodilus*) de Venezuela. Pp. 213-220 in *La Conservación y el Manejo de Caimanes y Cocodrilos de América Latina*, ed. by A. Larriera and L. Verdade. Fundación Banco Bita: Santa Fe, Argentina.
- Velasco, A., De Sola, R., Colomine, G., Villarroel, G., Cordero, G., León, N., Miranda, R., Oropeza, E., Ochoa, A., Pino, T., Quero, M., Silva, M., Vázquez, W. and Corazzelli, J. (1997). Monitoreo de las poblaciones de baba (*Caiman crocodilus*) por regiones ecológicas: I. Situación actual de la densidad y estructura de tamaños. Pp. 221-227 in *Memorias de la 4ta Reunión Regional de Especialistas en Cocodrilos de América Latina y del Caribe*. Centro Regional de Innovación Agroindustrial S.C.: Villahermosa, Tabasco.
- Venegas Anaya, M., Crawford, A.J., Galván, A.H.E., Sanjur, O.I., Densmore III, L.D. and Bermingham, E. (2008). Mitochondrial DNA phylogeography of *Caiman crocodilus* in Mesoamerica and South America. *J. Exp. Zool.* 309A(10): 614-627.
- Villarroel, G., Velasco, A., Colomine, G., De Sola, R., Lander, A., Pino, T., Vázquez, W. and Corazzelli, J. (2002). Monitoring wild populations of *Caiman crocodilus* (babas) in Guárico and Llanos Boscosos Ecological Regions. Pp. 224-230 in *Crocodiles. Proceedings of the 16th Working Meeting of the IUCN-SSC Crocodile Specialist Group*. IUCN: Gland.
- Vliet, K.A. (1989). Social displays of the American alligator. *Amer. Zool.* 29(3): 1019-1031.
- Watlington, F. (2002). Stranger in a lost paradise: *Caiman crocodilus*, Puerto Rico's own aliengator. Pp. 239-243 in *Crocodiles. Proceeding of the 16th Working Meeting of the IUCN-SSC Crocodile Specialist Group*. IUCN: Gland.