Population monitoring of black caiman (*Melanosuchus niger*) and spectacled caiman (*Caiman crocodilus*) in the Amazonian basin of Ecuador

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INTRODUCTION

Current crocodilians are semi-aquatic reptiles inhabiting tropics and subtropics, and being on top of food webs are considered key species in the maintenance and regulation of the habitats they occupy (Ross, 1998). Generally, they have large body size, long reproductive periods and oviparity (Thorbjarnarson, 1996). In Ecuadorean Amazonia the order is represented by four species, all in the Alligatoridae family: Melanosuchus niger, Caiman crocodilus crocodilus, Paleosuchus trigonatus and Paleosuchus palpebrosus (Asanza, 1985).

The black caiman Melanosuchus niger is the largest member in Alligatoridae, with males reaching 4-5 meters in total length (Thorbjarnarson, 2010), being the largest continental predator in America. It is found throughout the Amazon basin and in the peripheral areas of northern Amazonia as the Guianas (Thorbjarnarson, 2010). Preferentially it inhabits flooded forests, lakes and rivers with slow current without rocky banks (Thorbjarnarson, 2010). Melanosuchus niger is in Appendix I of the Convention for International Trade of Endangered Species (CITES), except in Ecuador and Brazil where is in Appendix II, subject to management (Villamarín-Jurado, 2006; Thorbjarnarson, 2010).

Caiman crocodilus is a widely distributed species in Neotropics with significant morphological (Busack & Pandya, 2001) and genetic variation (Farias et al., 2004, Vasconcelos et al., 2006). In Ecuador two subspecies are recognized: C. c. chiapensis in the Coastal region and C. c. crocodilus in the Amazon basin (Groombridge, 1987; Ross, 1998). Adult males can reach up to 2.7 meters in total length (Velasco y Ayarzagüena, 2010). It have habitat (Herron, 1994; Da Silveira et al., 1997; Rebêlo & Lugli, 2001) and food preferences (Da Silveira et al., 1999) similar to M. niger. There is spatial segregation where they coexist and M. niger has not been hunted (Herron, 1994). The species is in Appendix II for CITES (Velasco y Ayarzagüena, 2010).

Melanosuchus niger and Caiman crocodilus populations have been monitored at Reserva de Producción Faunística Cuyabeno (RPFC) in Ecuador since the mid 1980s and have been threatened by oil spills, illegal hunting and habitat destruction in this zone. The latest population data (Dueñas-Serrano, 2008) suggests that both species populations are fluctuant and M. niger populations have recovered in some lakes. Estimating the population size is an important parameter to understand the role and dynamics of a species in its ecosystem, and how environmental changes affect them (Ron, 1995).
This study is a continuation of previous studies in these species within the RPFC (e.g. Asanza 1985, Ron, 1995; Dueñas-Serrano, 2008) which will provide important data to determine long-term population trends.

OBJECTIVES

- Determine current relative abundance of *Melanosuchus niger* and *Caiman crocodilus* in three lakes at the Reserva de Producción Faunística Cuyabeno.
- Determine population structure by species, size and sex at each lake studied.

MATERIALS AND METHODS

**Research Support:** in October 2010, the first author was granted as participant for a field workshop on caiman research at the Mamirauá Sustainable Development Reserve, Amazonia Central, Brazil. The course was launched for the fifth time by the Research Program in Conservation and Management of Caimans of the Mamirauá Sustainable Development Institute to contribute to develop of caiman research in South America. The workshop was conducted by Dr. Ronis Da Silveira and M.Sc. Robinson Botero-Arias and was comprised of students from various countries and support personal (Figure 1). The workshop was important for the scientific development of the author and to implement improvements in this research.

![Figure 1. Team of V Workshop of Caiman Research in the Mamirauá Sustainable Development Reserve, Brazil.](image)
With the economic support of Crocodile Specialist Group’s SRAS, Pontificia Universidad Católica del Ecuador and Idea Wild it was possible the purchase of a 5 meter fiber glass canoe and an 5 hp outboard motor (Figure 2), all specially designed for caiman research.

**Figure 2.** Research team with the fiber glass canoe and outboard motor used for caiman research in Reserva de Producción Faunística Cuyabeno, Ecuador.

**Study Area:** this research was conducted in three black water lakes (Mateococha, Canangüeno and Laguna Grande) belonging to Sistema Lacustre Río Cuyabeno (SLRC) at Reserva de Producción Faunística Cuyabeno (RPFC) (Figure 3) during January and February 2011 (annual dry season). The RPFC is located between Sucumbíos and Orellana provinces, northern Amazonia of Ecuador. The studied localities are strongly influenced by the fluctuation of water level, for this reason it was important carry out this research in that period.

**Figure 3.** Left: RPFC in Ecuador, red dot correspond to SLRC. Right: lakes studied in SLRC.
Spotlight Surveys and Capture: we conducted night counts in canoe, following the shore line of each lake. Caimans were detected by eye’s reflection using a head lamp. At the lowest distance the species identification and size estimation were done. Simultaneously, we captured all animals as was possible by hands or using steel snares (Figure 4a). Then we took measures of each animal as: total length, head length, snout-cloaca length (Figure 4c). We identify the sex by cloaca inspection (Figure 4b) and marked each animal with a passive internal microchip with a unique number which is read by a scanner. Also we marked each animal by caudal scales amputation. Finally we released the animal in the capture site. Additionally, we recorded environmental variables at beginning and end in each night survey, it included: water level, air and water temperature, moon phase, cloudiness, wind and rain. With data we determine the population structure by species, sex and size distribution, as well as relative abundance index for both species.

Figure 4. A) capture, B) identification of sex and C) biometry of caimans. A) and C) Caiman crocodilus, B) Melanosuchus niger.
RESULTS

Population structure by species: in Mateococha and Canangüeno lakes, *M. niger* and *C. crocodilus* were recorded in sympatry; whereas in Laguna Grande lake we only recorded *C. crocodilus* during samples (one sampling occasion = one lap around the lake shore). In Mateococha the species composition was: 92.9% for *C. crocodilus* and 7.1% for *M. niger* (n = 7 samples; 145 records). In Canangüeno the composition was: 71.8% for *C. crocodilus* and 28.2% for *M. niger* (n = 1 sample; 71 records). In Laguna Grande 100% of observations correspond to *C. crocodilus* (n = 1 sample; 25 records); however, at beginning of dry season we saw sporadically *M. niger* in this lake. When we compare these proportions with those presented by Ron (1995) and Dueñas-Serrano (2008) we noticed that *C. crocodilus* has been the dominant species over *M. niger* during the three studied periods, but in 1993-1994 (Ron, 1995) there is a significant higher proportion of *C. crocodilus* over *M. niger* (Table 1).

![Table 1. Summary of population composition by species in three lakes at RPFC.](image)

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<td>Laguna Grande</td>
<td>100</td>
<td>0</td>
<td>1 : 0</td>
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Population structure by size: we use all records of observed caimans to elaborate size class distribution curves. For this, we use the real length of captured animals to calibrate the estimated size using a linear regression for each species. For *Caiman crocodilus* we found peaks in size class (total length) of 61-90 cm: 41.2% (n = 136 records) in Mateococha (Figure 5a); in size class of 91-120 cm: 34.5% (n = 58 records) in Canangüeno (Figure 6a); and in size class of 31-60 cm: 25% (n = 28 records) in Laguna Grande (Figure 7). For *Melanosuchus niger* we found peaks in size class of 121-150 cm, both in Mateococha 55.5% (n = 9 records) (Figure 5b) as in Canangüeno: 55% (n = 20 records) (Figure 6b). In general terms, that peaks correspond to juvenile and sub-adult individuals for both species. The frequency of size classes decrease with increase in length; however, neonate records were scarce.
Figure 5. Population size class distribution in Mateococha: A) *Caiman crocodilus* and B) *Melanosuchus niger*.

Figure 6. Population size class distribution in Canangüeno: A) *Caiman crocodilus* and B) *Melanosuchus niger*.

Figure 7. Population size class distribution in Laguna Grande for *Caiman crocodilus*
Population structure by sex: we use data of captured caimans with a total length > 60 cm, and we didn’t use data of recaptured animals. We achieve 33 captures in Canangüeno, 13 in Mateococha and 5 in Laguna Grande. The proportion of sexes (males : females) for *Caiman crocodilus* was male-biased in Mateococha: 1,6 : 1 (n = 13 captures); in Canangüeno: 2 : 1 (n = 27 captures); and in Laguna Grande: 4 : 1 (n = 5 captures). While in *Melanosuchus niger*, the proportion of sexes was female-biased in Canangüeno: 1 : 5 (n = 6 captures).

Relative abundance: for this study, the average relative abundance recorded in Mateococha was: 10,7 caimans/km (10 *C. crocodilus*/km and 0,7 *M. niger*/km) (n = 7 samples); in Canangüeno was: 16,7 caimans/km (12 *C. crocodilus*/km and 4,7 *M. niger*/km) (n = 1 sample); and in Laguna Grande was: 9.17 *C. crocodilus*/km (n = 1 sample). The relative abundance values of Ron (1995), Dueñas-Serrano (2008) and this study are indicated in Table 2.

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<td>Mateococha</td>
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<td>Laguna Grande*</td>
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<td>-</td>
<td>9.17</td>
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*In this lake all records correspond to *C. crocodilus*. Table was modified of Dueñas-Serrano (2008)

**DISCUSSION**

Dominance relationships of *Caiman crocodilus* over *Melanosuchus niger* have been maintained in Sistema Lacustre Río Cuyabeno (SLRC) for 19 years. Ron (1995) reported a nearly absolute dominance of *C. crocodilus* over *M. niger* in SLRC (28,4 : 1), but Dueñas-Serrano (2008) reported an apparent increased in *M. niger* proportions. However, the current proportions (in 2011) were similar to that reported by Dueñas-
Serrano (2008), but the proportion for *C. crocodilus* was slightly higher in 2011 (Table 1). Apparently, the proportions of *C. crocodilus* over *M. niger* in SLRC can be dynamic through time. Population curves for *C. crocodilus* (in Mateococha, Canangüeno and Laguna Grande), and for *M. niger* (in Canangüeno) reflects a typical crocodilian populations: a high number of juvenile and sub-adult individuals which decreases with increase in length. It’s important to note that for both species there is high number of sub-adults, what might encourage the recruitment of them to adult population. However, the proportion of neonate—juvenile size classes for *C. crocodilus* (total length: 31-60 cm) and for *M. niger* (total length: 31-60, 61-90 cm) was low. It could be related to that study time (dry season) could be coincided to nesting period but was different to hatching period. But principally it could be related to habitat preference of that size classes: they prefers low-water and vegetated sites, where we couldn’t access during nocturnal spotlights. Similar population curves were reported by Ron (1995) and Dueñas-Serrano (2008) on them studied periods.

The proportion of sexes (males : females) for *Caiman crocodilus* has been maintained male-biased in Mateococha during time: Ron (1995) reported a dominance relationship of 2 : 1 (n = 64); Dueñas-Serrano (2008) reported 4,2 : 1 (n = 26); and in this study (2011) was 1,6 : 1 (n = 13). In Canangüeno there was the same male-biased relationship for *C. crocodilus*: Dueñas-Serrano (2008) reported 1,5 : 1 (n = 15); and in this study (2011) was 2 : 1 (n = 27). In spite of the sample size was different in the three studied periods, it’s clear that samples of the populations were clearly male-biased in all studies. Generally, the relative abundance index are the first steps in conservation plans and in order to develop other topics as nesting and diet as example. In Mateococha we identified an important demographic decreasing change in the number of caimans (relative abundance). Both, in Ron (1995) and in this study (2011) were evaluated the abundance of caimans in Mateococha using a capture-recapture experiment. During both studies there were seven consecutive samples occasions during the dry season, where the level of water was of about one and a half meters. Ron (1995) found, as average of the seven samples, a relative abundance of 24,8 caimans/km; and a maximum of 34,1 caimans/km in his first sample night. In the present study (2011), as average of the seven samples, we found a relative abundance of 10,7 caimans/km; and a maximum of 14,4 caimans/km in the first sample night. This decrease in the number of caimans could be related to pollution history, illegal fishing and hunting that are present in this lake. By other hand, in Canangüeno we recorded the highest value of relative abundance for each species and
in group, in spite that we couldn’t access to all sites by extensive grass. This lake is virtually protected against hunting, pollution and tourism, so the caiman populations in this lake could be increasing. Also we have strong support for consider this lake as important for reproduction of *M. niger*. Finally, long-time monitoring programs and studies on nesting and bioaccumulation in these and other localities in Ecuador are needed to determine population changes, clarify them ecological relationships and implement conservation plans.

REFERENCES


