SRAS Final Report: From Reproductive Ecology to Local Ecological Knowledge of a Crocodilian, the Broad-snouted Caiman (*Caiman latirostris*)

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[The research results presented here highlight findings from a doctoral thesis that investigated the reproductive ecology, ethnozoology and bioacoustics of the Broad-snouted caiman (*Caiman latirostris*), from which some publications have already been published or under review (Barboza *et al.* 2024, 2025a,b,c; Silva *et al.* 2025), or in preparation.]

Abstract

The first part of the study investigated how anthropogenic disturbances influence nesting behavior and parental care of Broad-snouted caiman (*Caiman latirostris*) females. Over four years, 44 nests were monitored in Brazil: 36 in a non-disturbed area and 8 in a disturbed area. Nest density was significantly higher in the non-disturbed area (1.31 nests per linear km) than in the disturbed area (0.25 nests per linear km). However, parental care behavior was more frequent in disturbed areas (86%) than in non-disturbed areas (34%). Clutch size, egg biomass, hatching success, and female size did not differ significantly between areas. These findings suggest that while females prefer nesting in non-disturbed environments, increased parental care in disturbed areas compensates for environmental stressors. This study highlights the importance of preserving undisturbed habitats for the conservation and welfare of *C. latirostris*.

The second part of the study examined how factors influence Local Ecological Knowledge (LEK) about *C. latirostris*, an apex predator in northeastern Brazil. The variables analyzed include emotion, contact, age, education, and knowledge transmission mode. A total of 61 adults, aged 19-79 years, were interviewed. The mean LEK score was 5.1 ± 2.9 on a scale of 0 to 10.5. Younger participants (<30 years) and those with higher education levels showed significantly higher LEK scores. Contrary to expectations, emotion and contact had no significant effect on LEK, although negative emotions were predominant (72%). Television was the primary knowledge transmission mode (43%), followed by horizontal transmission (33%). These findings suggest that modernization and urbanization shape LEK while highlighting the importance of incorporating traditional knowledge into conservation strategies.

Introduction

Crocodilians exhibit complex reproductive behaviors, including parental care, which is essential for hatchling survival (Lance *et al*. 2009). Anthropogenic activities, such as habitat modification and agricultural practices, can disrupt these behaviors by altering habitat quality and availability (Campos *et al.* 2020; Mosse *et al*. 2023). For species like *C. latirostris*, nesting site selection and parental care are critical for reproductive success (Murray *et al.* 2020). This aspect of the study examines the effects of anthropogenic disturbances on the reproductive ecology of *C. latirostris* in northeast Brazil. The objectives were to compare nest density, parental care, and reproductive parameters (e.g., clutch size, egg biomass, hatching success) between disturbed and non-disturbed areas, hypothesizing that females would show a preference for undisturbed environments and adjust parental care behavior in response to disturbance.

Local Ecological Knowledge (LEK) is vital for understanding human-animal interactions and shaping conservation efforts. Defined as a body of knowledge, practices, and beliefs developed through adaptive processes, LEK is transmitted primarily through cultural means such as oral traditions (Berkes 1999; Berkes *et al*. 2000). In the case of crocodilians like the Broad-snouted caiman, LEK is

particularly relevant due to the species' ecological and cultural importance, alongside its history of coexistence and conflict with humans (Barboza *et al*. 2021; Verdade *et al*. 2010). Despite the growing body of research on LEK, few studies explore the predictors that influence it, particularly for crocodilians (Zamudio *et al*. 2013; Pooley 2016). Previous works have focused on descriptive accounts of LEK without hypothesis testing (Balaguera-Reina & González-Maya 2010; Ojeda-Adame *et al.* 2023). This study fills this gap by investigating how emotion, contact, age, education, and knowledge transmission affect LEK about the biology and ecology of *C. latirostris*, with a particular emphasis on reproduction. We hypothesized that extreme emotions (positive or negative) and increased contact would correlate with higher LEK. Furthermore, we expected older participants with higher education levels to exhibit greater LEK, with knowledge predominantly transmitted vertically within families and secondarily through mass media.

Methods

Nesting

The research was conducted around Tapacurá Reservoir in Pernambuco, Brazil, from 2018 to 2022. The region includes remnants of the Atlantic Forest and supports diverse activities such as agriculture, fishing, and cattle farming (Moura *et al.* 2012). Two areas were defined: a non-disturbed area with native vegetation and limited human activity, and a disturbed area with agricultural activities, cattle, and domestic animals (Moura *et al*. 2012). Forty-four nests were monitored: 36 in the non-disturbed area and 8 in the disturbed area. Data collected included nest density (nests per linear km), clutch size, egg dimensions (length, width, and mass), hatching success (percentage of eggs hatched), and female size (snout-vent length, SVL). Parental care behavior was assessed through direct observation and camera traps, focusing on evidence of nest maintenance and protective behaviors.

Local Ecological Knowledge

The part of the study was also conducted in the Tapacurá Reservoir area. A total of 61 adults, aged 19-79 years, were selected using frame-based sampling. Participants resided within a 1.5 km radius of the reservoir and were individually interviewed (Escamilla *et al.* 2014). Semi-structured interviews included questions about participants' socioeconomic characteristics, emotions toward caimans, contact, education level, and modes of knowledge transmission (Costa *et al*. 2023). LEK scores were calculated based on responses to questions about biology and ecology of broad-snouted caiman. LEK scores were analyzed using statistical tests, including ANOVA and logistic regression, to examine the effects of the predictor variables. Data normality and homogeneity were assessed using Shapiro-Wilk and Bartlett tests.

Results

Nesting

Nest density was significantly higher ($p= 0.009$) in the non-disturbed area (1.31 nests per linear km) compared to the disturbed area (0.25 nests per linear km), but parental care behavior was more frequent ($p= 0.04$) in the disturbed area (86%) than in the non-disturbed area (34%) (Figures 1 and 2). No significant differences were found between the two areas regarding clutch size, egg biomass, hatching rate, or female size.

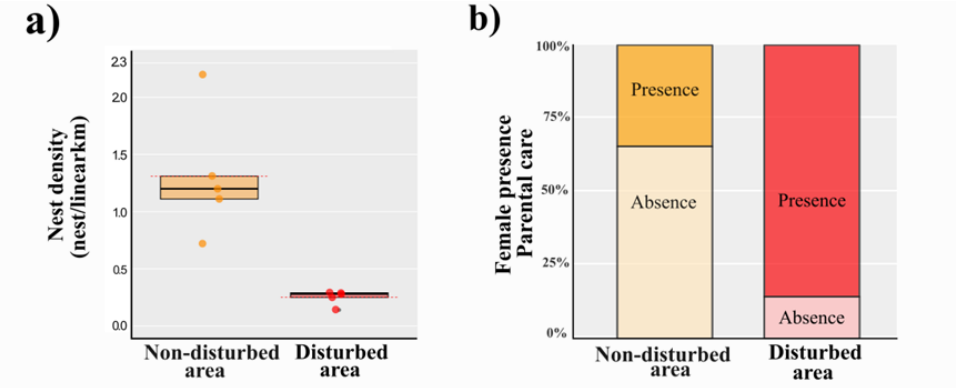


Figure 1. Showing (a) graphic representation of nest density of *Caiman latirostris* in a disturbed and a non-disturbed area (n= 10; the dashed line represents the mean; * denotes Mann-Whitney; P= 0.009) and (b) representation of the presence of *C. latirostris* females performing parental care in nests within the disturbed and the non-disturbed area (n= 39; * denotes Chi-squared test; P= 0.04, with Yates correction).

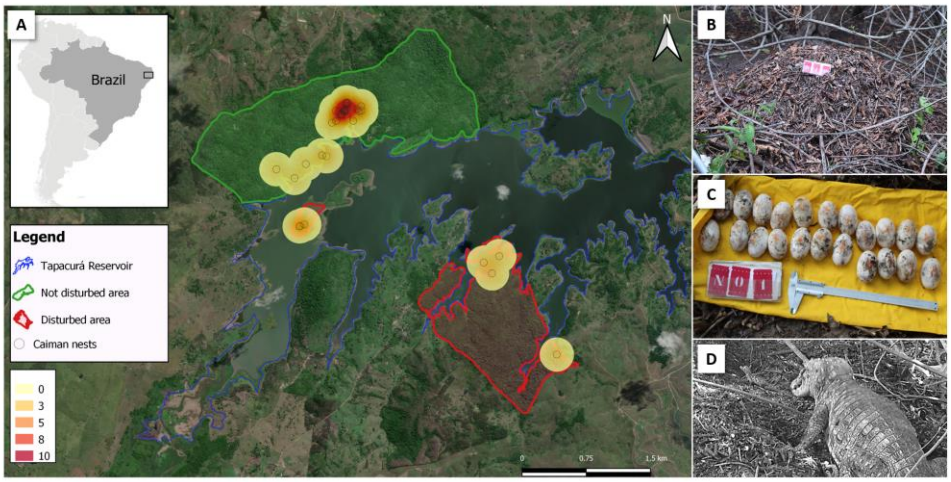


Figure 2. (A) Map showing the spatial distribution of nests (n= 44) of the Broad-snouted caiman (*Caiman latirostris*) in the sample areas studied (2018-2022) around the Tapacurá Reservoir, Pernambuco, Brazil (Bing Satellite images). The images depict: (B) a nest, (C) eggs measured for biometrics, and (D) a female assisting a hatchling (dashed circle in yellow), recorded by a camera trap.

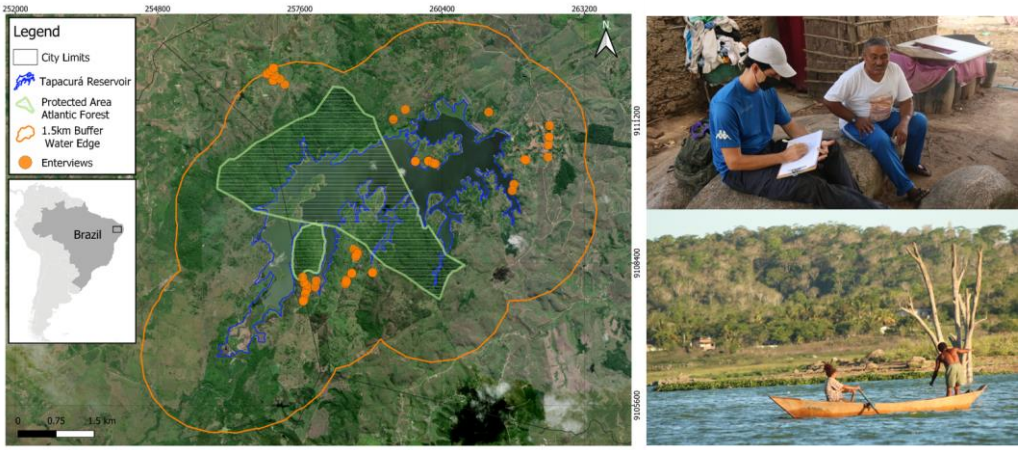


Figure 3. Map of the study area with sampling delimitation (orange line) employing frame-type sampling in 2022, Brazil (Bing satellite images); interview with resident; and environment with representation of residences in the background and one of the main economic activities in Tapacurá Reservoir - fishing (Map and Images: Barboza, RSL).

Local Ecological Knowledge

The mean LEK score was 5.1 ± 2.9. Younger participants (<30 years) scored higher (mean: 6.62 ± 1.97) than middle-aged (4.56 ± 3.01) and older adults (4.33 ± 3.02; Figure 4A). Those with high school education exhibited significantly higher LEK (6.73 ± 2.51) compared to participants with elementary education (4.65 ± 2.81; Figure 4B). Emotion and contact did not significantly influence LEK. Negative emotions predominated (72%; Figure 5), often rooted in cultural perceptions rather than direct experiences. Television was the primary knowledge source (43%; Figure 6), particularly for younger individuals, while older adults relied more on horizontal transmission (33%; Figure 7).

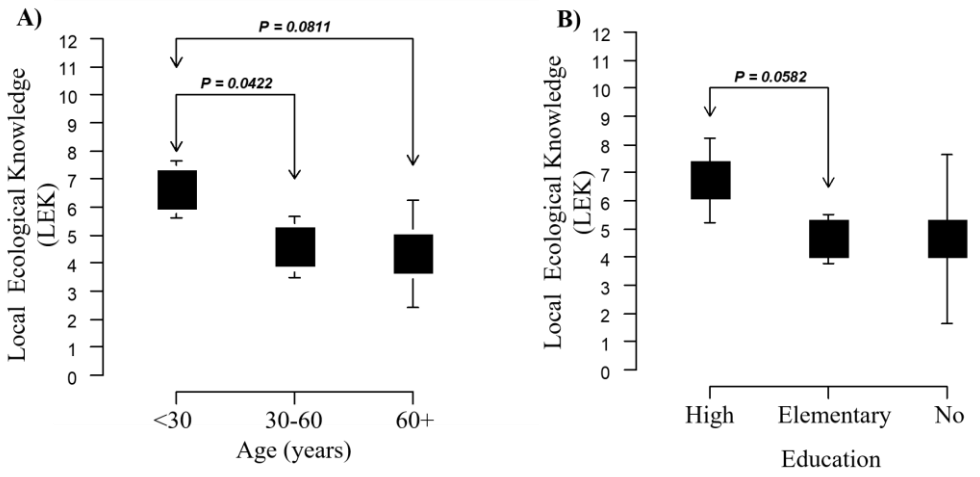


Figure 4. Influence of variables A) age and B) education on local ecological knowledge (LEK) of residents around Tapacurá Reservoir, Brazil, on the Broad-snouted caiman (ANOVA + Tukey's Post-hoc).



Figure 5. Word cloud related to the representation of people's emotions about caimans in the surroundings of Tapacurá Reservoir, Brazil. The size of the words represents the frequency of citations, and the color represents the type of emotion (red = negative; black = indifferent; blue: positive).

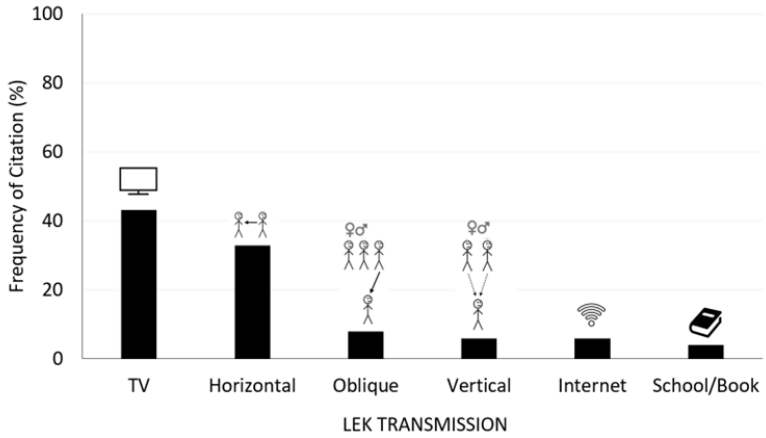


Figure 6. Citation frequency of transmission modes of local ecological knowledge (LEK) related to the Broad-snouted caiman (*Caiman latirostris*) for residents around Tapacurá Reservoir, Brazil.

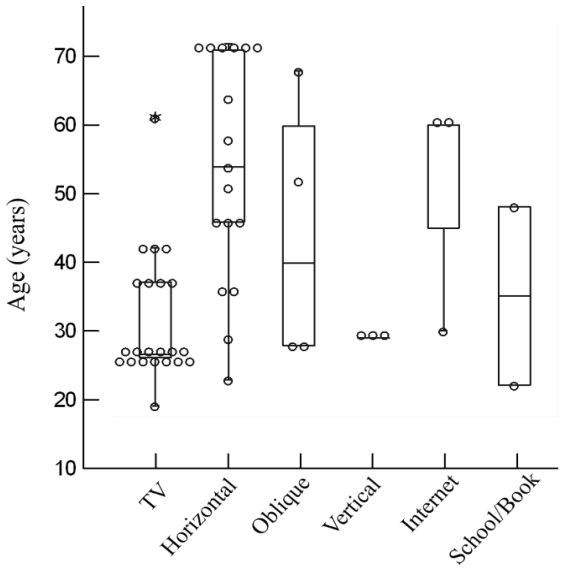


Figure 7. Relationship between age and transmission mode of local ecological knowledge related to the Broad-snouted caiman (*Caiman latirostris*) among residents living around Tapacurá Reservoir, Brazil.

Discussion

The preference for non-disturbed habitats underscores the importance of habitat quality in the reproductive success of *C. latirostris*. Non-disturbed areas likely offer better conditions for nesting, including reduced predation risk. The higher frequency of parental care in disturbed areas suggests an adaptive response to increased environmental risks. Similar compensatory behaviors have been observed in other crocodilian species under stressful conditions (Lance *et al*. 2009). However, the energetic costs associated with increased parental investment could have long-term effects on female health and future reproductive success (Barão-Nóbrega *et al*. 2016).

While clutch size, egg biomass, and hatching success remained consistent between areas, the increased parental care effort in disturbed areas highlights the resilience of *C. latirostris*. This behavioral plasticity enables the species to cope with environmental changes but also emphasizes the importance of protecting undisturbed habitats to ensure long-term conservation.

This study highlights the dynamic nature of LEK in the context of modernization and urbanization. The finding that younger individuals with higher education levels exhibit higher LEK challenges traditional assumptions that LEK is solely rooted in age and direct experience (Reyes-García *et al*. 2016). Instead, it underscores the role of education and mass media in shaping ecological knowledge.

Negative emotions toward caimans, while prevalent, were not linked to LEK. This may reflect cultural narratives that emphasize fear and danger over coexistence (Barboza *et al*. 2021). Similarly, the limited impact of contact on LEK suggests that caimans hold less direct importance for the community, likely due to urbanization and reduced reliance on natural resources (Mascarenhas-Junior *et al*. 2024).

The dominance of television as a knowledge transmission mode demonstrates the potential of mass media as an important tool. However, this shift away from traditional vertical transmission highlights the need for strategies that integrate modern and traditional knowledge systems to ensure cultural and ecological sustainability.

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