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# Biometrics of neonates and characterization of the Amazon Turtle (*Podocmenis expansa*) nests in the Crixás-açu river, Mundo Novo, Goiás, Brazil

# Biometria de neonatos e caracterização de ninhos de Tartaruga-da-Amazônia (*Podocmenis expansa)* no rio Crixás-açu, Mundo Novo, Goiás

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ABSTRACT

The objective of this study was to evaluate newborn biometrics and characterization of *Podocnemis expansa* turtle nests in the Crixás-Açu rivers, municipalities of Mundo Novo, Goais, Brazil. It consists of evaluating the newborns and the characterization of the nests after hatching. There was no statistical difference between eggs with oil, predatory nests, dead newborns, un hatched eggs, shell (total number of eggs counted within a nest), as well as hatching and survival rates for the distance of 30 meters from the river course. Animal weight, hoof length, hoof width, plastron length, plastron width or number of shields were obtained statistically significant considering the same fixed distance of 30 or greater than 30 meters from the river bank. In the eggshell analysis, there was a statistical difference regarding the amount of the element "Carbon" found, unlike the samples of pH, "phosphorus", "potassium", "hydrogen", "aluminium", "calcium", "magnesium" and matter. Organic. As for the particle size analysis of the sand extracted from the nests, there was a statistical difference in two sizes; 1 and 2 millimeters. This study shows that nests near vegetation are more successful in hatching.

*Palavras-chave:*
Neonatos
Vegetação
Eclosão

RESUMO

Objetivou-se avaliar biometria de neonatos e caracterização de ninhos de Tartaruga *Podocnemis expansa* nos rios Crixás Açu, municípios de Mundo Novo/GO. Estudo foi realizado no rio Crixás-Açu, município de Mundo Novo/GO, Nova Crixás. Consiste em avaliar os neonatos e a caracterização dos ninhos após a eclosão dos ovos. Foram avaliados 20 ninhos e 10% de seus neonatos em pontos diferentes ao longo da tábua de desova e durante o período de setembro a novembro de 2015. Não ocorreu diferença estatística entre ovos com óleo, ninhos predados, neonatos mortos, ovos não eclodidos, casca (número total de ovos contados dentro de um ninho), bem como as taxas de eclosão e sobrevivência quanto à distância de 30 metros do curso do rio. O peso do animal, comprimento do casco, largura do casco, comprimento do plastrão, largura do plastrão ou quantidade de escudos foi obtido diferença estatística, considerando a mesma distância fixa de 30 ou maior que 30 metros de distância da margem do rio. Na análise da casca dos ovos houve diferença estatística referente à quantidade do elemento "Carbono" encontrada, diferentemente das amostras de pH, "fósforo", "potássio", "hidrogênio", "alunínio", "cálcio", "magnésio" e matéria orgânica. Quanto à análise granulométrica da areia extraída dos ninhos, houve diferença estatística em dois tamanhos; 1 e 2 milímetros. Esse estudo mostra que os ninhos próximos a vegetação tem mais sucesso na eclosão.

## INTRODUTION

Brazil has the highest species richness of chelonians, with 36 species (CANTARELLI; VERDADE, 2014). They are represented by four orders: Crocodilia, Rhynchocephalia, Squamata and Testudines (POUGH et al., 2003), the latter, also called the order of the Chelonians, consists of 12 families, 90 genera and about 280 species, of which, approximately, 20% occur in South America (SOUZA, 2004).The Brazilian territory is home to 36 different species of turtles, 5 of which are marine, 31 are continental turtles and of these, 5 belong to the Podocnemididae family, which in turn is divided into: *Podocnemis erythrocephal*a (Spix, 1824), *Podocnemis expansa* (Schweigger, 1812), *Podocnemis sextuberculata*

(Cornalia, 1849), *Podocnemis unifilis* (Troschel, 1848), *Peltocephalus dumerilianus* (Schweigger, 1812) (COSTA et al., 2021). The turtles of the species *Podocmenis expansa*, popularly known as the Amazon Turtle, since the time of the discovery of Brazil, have suffered from predatory hunting, sale of hooves and, the capture of eggs to use the oil. It is estimated that since the colonization of Brazil until the early years of the twentieth century, more than 200 million eggs have been collected to manufacture oil for lighting European cities (IBAMA, 2022).

The examples of *P. expansa* can measure from 75 to 107 cm in length by 50 to 75 cm in width (RODRIGUES, 1992) and reach a weight greater than 60 kg (IBAMA, 2022) which makes them the largest freshwater species of South America (RODRIGUES, 1992). The reproductive activity of the turtles is strongly linked to climatic conditions, with rainfall and water and air temperature determining factors in the animals' behavior (SOUZA, 2004). Amazonian turtles are elective as to where the eggs lay in comparison to *P. unifilis*, (CASTRO et al., 2008) prefer finer sand banks, with little gravel and free of vegetation. They make deeper nests of about 50 to 70 cm, in which 40 to 160 eggs are laid (IBAMA, 2022). Knowing, defining reproductive, biological, and behavioral patterns of these animals is extremely important to guarantee the protection and preservation of the species, avoiding that they are no longer a name on the list of endangered beings. The objective of this study was to evaluate the biometry of neonates and the characterization of nests of *Tartaruga Podocnemis* expansa in Crixás Açu rivers, in the municipalities of Mundo Novo, Goias.

## MATERIAL AND METHODS

The present study was carried out in the Crixás-Açu river (13 ° 32 '45.2 "13.5459 ° south 50 ° 15' 19.9" 50.2555 ° west), which is a tributary of the right bank of the Crixas açu River and in the municipality of Mundo Novo, in the state of Goiás, Brazil. The beaches of this river are abundant in the months of November and have a spawning history of the Amazonian turtle. It consisted of two stages: Second stage: to evaluate the neonates and the characterization of the nests after hatching of the eggs.

Nests opening: Twenty nests and 10% of their newborns were evaluated at different points along the spawning board during the period from November, 2015. The nests were measured with tape measure, evaluated for depth and width, distance between nest and riverbank, distance between nest and vegetation, thermal conditions, humidity and the soil in which the eggs meet. 10% of the animals from each nest were randomly chosen and weighed on a precision scale, measured with digital calipers for the length and width of the hull, length and width of the plastron, and the presence of irregular pattern of hooves as well as the amount of shells and conformation of the carapace and the plastron (SALERA JUNIOR et al., 2009).

Sand samples were collected from the bottom and surface of 22 nests in November. The samples had approximately 500 g each, were frozen at 253,15 K and taken to the soil physics laboratory of the Faculty of Agronomy and Veterinary Medicine (FAV) of the UnB to submitted granulometric analysis (Folk 1974). The granulometric analysis was performed by sieving with the size of the segments divided into fractions of: 4mm; 2mm; 1mm; 0.5 mm; 0.25 mm and bottom portion (amount passed in all sieves).

Mineralogical analyzes were also performed in the soil physics laboratory and demonstrated the concentration of calcium, aluminum, phosphorus and pH of the sand samples. For such mineralogical characterization of mineral species, fragments and concretions, the stereoscope microscope (magnifying glass), petrographic microscope and occasionally X-ray diffraction were used for the granules of a dubious or altered nature. Chemical microtests are used for manganese and carbonates when present in mineralogical constituents (EMBRAPA, 2009).

The analysis of the reproductive parameters of the Turtle of the Amazon in relation to the distance in which their respective nests were of the vegetation present in the beach was tested from the Pearson Correlation (r), obtained by Excel 2007. The pearson correlation index the degree of linear correlation between two quantitative variables and the meaning of this correlation (CRESPO, 2002).

In order to define the correlation intensities, we applied the proposal of Dancey and Reidy (2006) that disposed of the following way: ($0 < | r | < 0{,}40$) weak correlation, ($0{,}40 \leq | r | < 0$ , 7) moderate and ($0{,}70 \leq | r | \leq 1$) strong correlation.

## RESULTS AND DISCUSSION

In the present study, no disparities were observed in the characterization of nests of *Podocnemis expansa* neonates (Table 1). There was no statistical difference between eggs with oil, predated nests, dead hatchlings, eggs that did not hatch, shell (total number of eggs counted within a nest), as well as hatching and survival rates for the distance of 30 meters from the river course. For depth and width of the nest opening, a statistical difference was observed at 5% probability. It is possible that the choice of spawning site was related to the height of the beach and also close to vegetation where temperatures and humidity are ideal. Some studies show that turtles spawn close to vegetation due to the greater success in excavating the nests because the plant roots would allow a better structure and also because it is a higher location from the beach (BUSTARD; GREENHAM, 1968, LIMA, 2007; NAVARRO; ALVES, 2021).

**Table 1**. Characteristics of *Podocnemis expansa* nests, grouped by distance from the river bank, verified in the Crixás-Açu river, in the municipality of Mundo Novo, Goiais

| Variable | Up to 30 meters | Greater than 30 meters | CV (%) |
|---|---|---|---|
| Depth (cm) | 63,73 ± 14,40 [b] | 74,93 ± 3,77 [a] | 15,15 |
| Largura (cm) | 25,14 ± 4,66 [b] | 34,90 ± 10,17 [a] | 26,34 |
| Eggs with oil | 1,30 ± 2,00 [a] | 0,50 ± 1,00 [a] | 170,93 |
| Predated nests | 0 | 0 | 0 |
| Dead neonates | 1,00 ± 2,00 [a] | 2,25 ± 5,00 [a] | 245,14 |
| Eggs not hatched | 8,40 ± 12,00 [a] | 4,90 ± 6,00 [a] | 144,55 |
| Bark | 86,30 ± 14,00 [a] | 91,10 ± 13,00 [a] | 15,61 |
| Survival rate (%) | 87,09 ± 18,75 [a] | 94,37 ± 5,66 [a] | 15,27 |
| Hatch rate (%) | 85,83 ± 20,72 [a] | 91,60 ± 7,85 [a] | 17,66 |

* The averages followed by different letters differ statistically. The Tukey test was applied at the level of 5% probability.

For depth and width of the nest opening, a statistical difference was observed at 5% probability (Table 2). Animal weight, hoof length, hoof width, plastron length, plastron width or number of scutes were statistically different, considering the same fixed distance of 30 or more than 30 meters from the river bank.

The loss of *Podocnemis expansa* (giant tortoise or Amazonian tortoise) nests by natural predators is an unknown episode in the bibliography, unlike overlapping postures and repiquet flooding. This is due to the sudden rise in the river level. The other, through gregarious behavior, which consists of spawning eggs in clusters at the highest points on the beach called trays. It is an adaptation to unpack the sand by the first females to spawn on beaches, which ends up facilitating later spawning. The result is a shorter time of exposition of the matrices to predators on one side and the loss of nests on the other, according to Lima (2007).

The weight, length and width of the hull and the length and width of the neonatal plastron showed no significant difference between them considering the distance from the river, which may be a confirming indicator of the behavior of clustered spawning. Contrary to expectations (chicks with very close averages), the shallower the nest, the higher the average weight of the newborns. Ferreira Júnior and Castro (2006) state that the temperature of the nest as a function of the influence of solar heat is controlled by the depth of the egg chamber, that is, the depth of the nests may be helping to keep the temperature controlled and ideal for a good environment. of puppy development.

**Table 2**. Summary of characteristics of the puppies of *Podocnemis expansa*, grouped by distance from the river bank, verified in the Crixás-Açu river, in the municipality of Mundo Novo, Goais

| Variable | Up to 30 meters | Greater than 30 meters | CV (%) |
|---|---|---|---|
| Mass of the animal (g) | 26,00 ± 1,65 [a] | 25,50 ± 1,50 [a] | 11,87 |
| Hull length (cm) | 4,97 ± 0,27 [a] | 5,00 ± 0,24 [a] | 6,81 |
| Hull width (cm) | 4,29 ± 0,35 [a] | 4,45 ± 0,35 [a] | 10,03 |
| Plastron length (cm) | 4,20 ± 0,23 [a] | 4,42 ± 0,30 [a] | 6,42 |
| Plastron width (cm) | 2,10 ± 0,09 [a] | 2,00 ± 0,08 [a] | 6,13 |
| Number of shields | 24,00 ± 0 [a] | 24,05 ± 0 [a] | 0,47 |

*Podocnemis* tortoises are small to medium-sized, with the exception of *P. expansa*, which is one of the largest continental tortoises in the world. Its size is reflected in the dimensions of the nests; wider, deeper and with a greater number of eggs in relation to those of *P. unifilis* and *P. sextuberculata*. The preference for spawning sites higher and closer to the beach gives success to the high survival rate. In the present study, the observed survival rate was higher in nests more than 30 meters away. Nests further away from the water are more successful in hatching because they prevent the nests from being flooded (FERREIRA-JÚNIOR et al., 2003; FOLEY et al., 2006).

When analyzing the sediments of the nests, a statistical difference was found between pH and "hydrogen" and "aluminium". On the other hand, "calcium" and "magnesium", "potassium", "phosphorus" and organic matter; do not do. Analyzing “aluminium” in isolation was impossible due to the constant measurements (Table 3 and Table 4).

**Table 3**. Analysis of the shell of *Podocnemis expansa* eggs, grouped by distance from the river bank, verified in the Crixás-Açu river, in the municipality of Mundo Novo, Goais.

| Variable | Up to 30 meters | Greater than 30 meters | CV (%) |
|---|---|---|---|
| pH (Água) | 6,59 ± 0,26 [a] | 6,14 ± 0,31 [a] | 4,39 |
| P (mg) | 10,81 ± 4,87 [a] | 9± 3,21 [a] | 41,65 |
| $K^+$ ($dm^{-3}$) | 64,77± 34,98 [a] | 71,47 ± 28,13 [a] | 46,60 |
| C (mg $g^{-1}$ ) | 0,98 ± 1,54 [b] | 2,62 ± 1,82 [a] | 93,55 |
| $H^+ Al^{3+}$ ($cmol_c$ $dm^{-3}$) | 0 | 0 | 0 |
| $Al^{3+}$ (cmolc $dm^{-3}$) | 0 | 0 | 0 |
| $Ca^{2+} + Mg^{2+}$ ($cmol_c$ $dm^{-3}$) | 2,81 ± 3,41 [a] | 4,45± 4,02 [a] | 102,74 |
| $K^+$ ($cmol_c$ $dm^{-3}$) | 0,16 ± 0,08 [a] | 0,18± 0,07 [a] | 46,63 |
| SB ($cmol_c$ $dm^{-3}$) | 2,97 ± 3,44 [a] | 4,63 ± 4,06 [a] | 98,92 |
| t ($cmol_c$ $dm^{-3}$) | 2,97 ± 3,44 [a] | 4,63 ± 4,06 [a] | 98,92 |
| T ($cmol_c$ $dm^{-3}$) | 2,97 ± 3,44 [a] | 4,63 ± 4,06 [a] | 98,92 |
| M.O. ($cmol_c$ $dm^{-3}$) | 0,23 ± 0,35 [a] | 0,55± 0,34 [a] | 89,57 |

* The averages followed by different letters differ statistically. The Tukey test was applied at the level of 5% probability.

**Table 4**. Sediment analysis of *Podocnemis expansa* nests, grouped by distance from the river bank, verified in the Crixás-Açu river, in the municipality of Mundo Novo, Goais.

| Variable | Up to 30 meters | Greater than 30 meters | CV (%) |
|---|---|---|---|
| pH | 6,41 ± 0,26 [b] | 6,80 ± 0,31 [a] | 3,11 |
| H + Al (mL) | 1,80 ± 0,53 [b] | 2,66 ± 0,42 [a] | 9,59 |
| Al | 1,00 ± 0,00 | 1,00 ± 0,00 | - |
| Ca + Mg (mL) | 4,16 ± 2,88 [a] | 4,25 ± 3,72 [a] | 81,60 |
| K | 3,65 ± 1,61 [a] | 3,00 ± 1,30 [a] | 43,24 |
| P | 0,13 ± 0,06 [a] | 0,13 ± 0,04 [a] | 44,15 |
| Mat. Org. (mL) | 20,18 ± 0,58 [a] | 20,55 ± 0,53 [a] | 2,85 |

* The averages followed by different letters differ statistically. The Tukey test was applied at the level of 5% probability.

As for the granulometric analysis of the sand extracted from the nests, there was a statistical difference in two sizes; 1 and 2 millimeters (Table 5). However, when looking at the total portion, 4 millimeters, 0.5 millimeters, 0.25 millimeters and the rest there was no difference.

For depth and width of the nest opening, a statistical difference was observed at 5% probability. Animal weight, hoof length, hoof width, plastron length, plastron width or number of scutes were statistically different, considering the same fixed distance of 30 or more than 30 meters from the river bank.

**Table 5.** Granulometric analysis of the sand from *Podocnemis expansa* nests, grouped by distance from the river bank, verified in the Crixás-Açu river, in the municipality of Mundo Novo, Goais.

| Variable | Up to 30 meters | Greater than 30 meters | CV (%) |
|---|---|---|---|
| Total | 159,54 ± 20,51 [a] | 154,46± 17,23 [a] | 12,00 |
| 4mm | 1,67 ± 1,02 [a] | 0,87 ± 1,01 [a] | 76,38 |
| 2mm | 5,95 ± 2,32 [a] | 2,79 ± 2,03 [b] | 36,38 |
| 1mm | 54,24± 12,88 [a] | 39,77 ± 15,76 [b] | 28,17 |
| 0,50mm | 68,68± 12,40 [a] | 76,95 ± 11,6 [a] | 15,40 |
| 0,25mm | 23,35± 7,52 [a] | 26,56 ± 2,96 [a] | 25,90 |
| Remaining | 5,67 ± 3,49 [a] | 7,49 ± 3,65 [a] | 52,43 |

* The averages followed by different letters differ statistically. The Tukey test was applied at the level of 5% probability.

The loss of *Podocnemis expansa* (giant tortoise or Amazonian tortoise) nests by natural predators is an unknown episode in the bibliography, unlike overlapping postures and repiquet flooding. This is due to the sudden rise in the river level. The other, through gregarious behavior, which consists of spawning eggs in clusters at the highest points on the beach called trays. It is an adaptation to unpack the sand by the first females to spawn on beaches, which ends up facilitating later spawning. The result is a shorter time of exposition of the matrices to predators on one side and the loss of nests on the other, according to Lima (2007).

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## CONCLUSION

The nests of *Podocnemis expansa* close to vegetation are more successful in hatching. This shows the importance of preserving the vegetation close to the river.

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