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ORIGINAL ARTICLE

Ecological aspects of *Rhinoclemmys punctularia punctularia* (Testudines: Geoemydidae) in two localities in northern Brazil

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ABSTRACT

Rhinoclemmys punctularia punctularia is the only turtle of the family Geoemydidae with part of its range in Brazil. The species is semi-aquatic and widely distributed across the Amazon basin but is still poorly studied. We evaluated aspects of the population structure, habitat use, seasonal activity, and diet of the species during one year, from the beginning of the rainy season to the end of the dry season, in two headwater localities in the Tocantins and Tapajós river basins, in the state of Pará, Brazil. We captured 45 individuals, 14 in the Tocantins basin and 31 in the Tapajós basin. The size-class frequency distributions of captured individuals did not differ between the two samples. The turtles were most frequently captured in first-order streams, followed by lentic (third-order dammed streams) and second-order streams. The capture rate did not vary significantly between sampling periods (start and peak of the rainy season; start and end of the dry season). The trapping effort to capture a single individual was much higher in the Tapajós basin (1,215 trap-hours) than in the Tocantins basin (136 trap-hours). Overall, the low capture rates confirm the secretive nature of the species in Amazonia and its apparent rarity. The individuals analyzed in this study consumed mainly plants.

KEYWORDS: diet, freshwater turtle, population ecology, seasonality, Amazon basin

Aspectos ecológicos de *Rhinoclemmys punctularia punctularia* (Testudines: Geoemydidae) em duas localidades no norte do Brasil

RESUMO

Rhinoclemmys punctularia punctularia é o único quelônio da família Geoemydidae com parte de sua distribuição no Brasil. A espécie é semi-aquática e amplamente distribuída na bacia amazônica, mas ainda é pouco estudada. Avaliamos aspectos da estrutura populacional, uso do habitat, atividade sazonal e dieta da espécie ao longo de um ano, desde o início da estação chuvosa até o final da estação seca, em duas localidades de cabeceira nas bacias dos rios Tocantins e Tapajós, no estado do Pará, Brasil. Capturamos 45 indivíduos: 14 na bacia do Tocantins e 31 na bacia do Tapajós. A distribuição de frequências por classe de tamanho dos indivíduos capturados não diferiu entre as duas amostras. Os quelônios foram mais frequentemente capturados em riachos de primeira ordem, seguidos por riachos lênticos (riachos de terceira ordem represados) e de segunda ordem. A taxa de captura não variou significativamente entre os períodos de amostragem (início e pico da estação chuvosa; início e fim da estação seca). O esforço de armadilhagem para capturar um único indivíduo foi muito maior na bacia do Tapajós (1.215 horas-armadilha) do que na bacia do Tocantins (136 horas-armadilha). No geral, as baixas taxas de captura confirmam a natureza discreta da espécie na Amazônia e sua aparente raridade. Os indivíduos analisados neste estudo consumiram principalmente plantas.

PALAVRAS-CHAVE: dieta, quelônios aquáticos, ecologia populacional, sazonalidade, Bacia Amazônica

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INTRODUCTION

Rhinoclemmys punctularia punctularia (Daudin, 1801) is currently the only species of the family Geoemydidae with part of its known distribution in Brazil (Rhodin *et al.* 2017). It is a relatively small-sized freshwater turtle with up to 260 mm carapace length and semi-aquatic behavior (Rueda-Almonacid *et al.* 2007). Its known geographic range comprises about 3,000,000 km^2 (Ferrara *et al.* 2017), from eastern Venezuela to the Brazilian states of Amazonas, Amapá, Roraima, Pará, Tocantins, and Maranhão (Dornas *et al.* 2011; Silva *et al.* 2011; 2016; Ferrara *et al.* 2017). Although generally inhabiting rivers of the Amazon basin, individuals of this species were recently recorded in the Atlantic Forest, in the Brazilian states of Bahia, Rio Grande do Norte, and Rio de Janeiro. However, these records have been questioned and alternatively attributed to introduced individuals (Siciliano *et al.* 2014; Valle *et al.* 2016), to a relictual population (Siciliano *et al.* 2014), or to a new species (Ferrara *et al.* 2017), because of the discontinuity in the distribution of known populations (Valle *et al.* 2016).

Rhinoclemmys p. punctularia occurs in both lotic (rivers, streams) and lentic waterbodies (lakes, temporary ponds, swamps) (Rueda-Almonacid *et al.* 2007; Vogt 2008; Vogt *et al.* 2009; Wariss *et al.* 2012; Pereira *et al.* 2013; Ferrara *et al.* 2017). Despite its wide distribution and ecological plasticity, the species appears to have low population density throughout its range and much of its biology remains poorly known (Vogt 2008; Ferrara *et al.* 2017), similarly to other species of *Rhinoclemmys* (Butterfield *et al.* 2020; Folt 2020). Most papers on *R. p. punctularia* in Brazil are notes on distribution (Dornas *et al.* 2011; Silva *et al.* 2011; Siciliano *et al.* 2014: Silva *et al.* 2016; Valle *et al.* 2016) or natural history (Vogt *et al.* 2009; Cunha *et al.* 2019).

The conservation status of *Rhinoclemmys p. punctularia* is considered to be as Least Concern in the Brazilian list of threatened fauna (Vogt *et al.* 2016) and by Rhodin *et al.* (2018), but its global status has not yet been officially determined by the International Union for Conservation of Nature – IUCN (https://www.iucnredlist.org/en). There is evidence of consumption of *R. p. punctularia* by indigenous people in the states of Amazonas and Roraima (Souza-Mazurek *et al.* 2000; Ferrara *et al.* 2017). Considering the rapid growth of human-induced impacts in the Amazon region (Phillips *et al.* 2008; Fagundes *et al.* 2018), it is important to obtain more information on the population structure and ecology of this species, specially in the more degraded areas of southeastern Amazonia. In this context, we sampled *R. p. punctularia* in two headwater localities in southeastern Brazilian Amazonia and analyzed their habitat use, population structure, seasonal activity, and diet.

MATERIAL AND METHODS

Study areas

Our study was conducted in two localities in the state of Pará, Brazil: one in the municipality of Itupiranga, in a headwater area of the Tocantins River (henceforth Tocantins basin), and another in the municipality of Itaituba, in the headwater areas of the Tapajós and Jamanxin rivers (henceforth Tapajós basin) (Figure 1). The Euclidean distance between the two sampling areas is about 800 km, while the hydrologic distance is about 1,900 km.

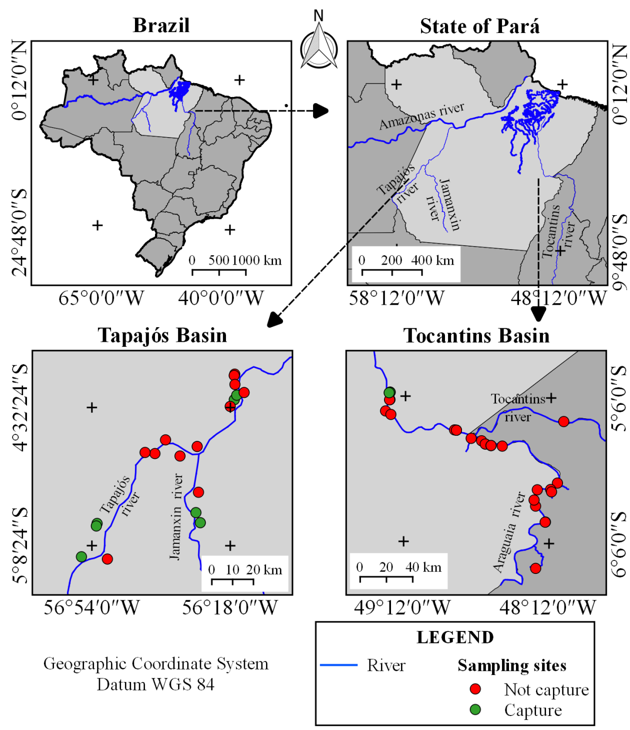

Figure 1. Study areas of *Rhinoclemmys p. punctularia* in the state of Pará, in the southeastern Brazilian Amazon, detailing the sampling sites in headwater regions of the Tocantins and Tapajós river basins. This figure is in color in the electronic version.

Except for dammed streams (see below), sampled streams were classified following Horton's scale modified by Strahler (Petts 1994), which ranks streams according to their size and branching hierarchy from the water source. In the Tocantins basin, we sampled 18 waterbodies (three waterbody types): two first-order, three second-order, and 13 third-order streams. In the Tapajós basin we sampled 17 waterbodies (five waterbody types): three first-order, three second-order, five third-order small streams, one sixth-order, and five lentic streams (Figure 2). These latter correspond to third-order streams dammed during the building of the federal highway BR-230 (known as the Transamazônica Highway, a former attempt of the federal government to promote regional development accross Brazilian Amazonia).

Figure 2. Examples of streams where individuals of *Rhinoclemmys p. punctularia* were captured in headwater regions of the Jamanxim and Tapajós rivers (Tapajós River basin) and the Tocantins River basin, Pará state, Brazil. A – stream 2; B – stream 4; C – stream 5; D – stream 8 (see Table 2 for details on the streams). This figure is in color in the electronic version.

Sampling followed the general technical guidelines and criteria determined by the federal environmental agency (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis – IBAMA) for the environmental licensing of the Marabá Hydroelectric Power Plant and São Luiz do Tapajós Hydroelectric Power Plant, which potentially impact the local biota in the Tocantins and Tapajós basins, respectively. In the Tocantins basin, we sampled each waterbody on three occasions, in 2010: at the peak of the rainy season (March) and at the beginning (June) and the end (September) of the dry season. In the Tapajós basin, we sampled each waterbody on four occasions: at the beginning of the dry season (June/July), end of the dry season (September/October) and beginning of the rainy season (November/December) in 2012, and at the peak of the rainy season (March/April) in 2013.

Turtle trapping and data collection

Turtles were captured using single-chamber funnel traps (1 m long × 0.45 m external diameter × 0.20 m entrance diameter; plastic mesh 5 × 1 mm). As it was a prospective study, designed for multi-species capture, we used fresh fish as bait (Balestra *et al.* 2016), placed inside a sealed plastic bottle with tiny holes, so that trapped animals had no access to the bait. On each sampling occasion we installed between 10 and 15 traps (depending on stream size) on the margins or in the center of each stream. In lotic streams, we installed the traps at an average distance of 50 m from each other over a 500-m stretch. Traps were operated for five continuous 24-h periods and checked daily, in the morning. Two individuals opportunistically found while moving on land were manually captured (Tapajós basin only).

We marked each captured individual with a combination of notches in the marginal scutes (Ferner 1979). Sex was ascertained by visual inspection of the tail. Individuals with a longer and thicker tail were classified as males (Balestra *et al.* 2016). Specimens that were too small for sex identification were classified as juveniles. For each individual, we measured straight-line carapace length (SCL), maximum carapace width (MCW), maximum plastron length (MPL), and maximum plastron width (MPW) with a 300-mm Vernier calliper to the nearest 0.1 mm, and obtained body mass with a 2.5-kg spring scale, to the nearest 5.0 g. Individuals captured in the Tocantins basin were kept in plastic boxes with water at ambient temperature for 24 hours to obtain feces samples for diet analysis. We also obtained a spontaneous regurgitation (considered to be stomach contents) from a single individual. Feces and regurgitation samples were preserved in 70% ethanol. After handling, all turtles were released at the point of capture.

Dietary assessment

The dietary samples (feces and regurgitation) were examined under a stereoscopic microscope. Food items were quantified and identified to the lowest possible taxonomic level, based on consultation with experts. Items were classified into plant material (leaf fragments, seeds, flowers, stems, and unidentified plant material), animal material (fish scales), periphyton (algae), and unidentified materials. The volume of each item was determined by water displacement, using 1-ml syringes with 0.01-ml graduations.

Due to the low number of dietary samples collected, we pooled the samples from all individuals (males, females, and juveniles, all captured in the same first-order stream in the Tocantins basin), from all three sampling periods. For each food category, we calculated the frequency of occurrence (percentage of the total number of samples in which a given food category occurred), numerical frequency (percentage of each food item relative to the total number of food items per category), and relative volume (percentage of the volume of each food category in relation to the total food volume) (Hyslop 1980; Marrero 1994).

Statistical analysis

We used a chi-square test to determine whether the sex ratio of turtles sampled from each basin differed from 1:1 (Zar 1996). We used a Shapiro-Wilk test to check if straight-line carapace length (SCL) followed a normal distribution, and a Kolmogorov-Smirnov test to compare the SCL distributions between basins. We used a Kruskal-Wallis test to assess if SCL differed between males and females in the Tapajos and Tocantins basins, and to test if within-basin abundance differed among sampling periods (three in the Tocantins and four in the Tapajós basin). In the Tapajós basin, we also used a Kruskal-Wallis test to assess if abundance differed among first-, second-, and third-order streams (Sokal and Rohlf 1995). For this analysis we pooled the data on number of captures in all third-order streams (dammed and not dammed). The adopted significance level for the statistical tests was 0.05. We performed all statistical analyses using the "stats" package in the R software (R Development Core Team 2021).

RESULTS

We captured 14 individuals of *R. p. punctularia* (Figure 3) in the Tocantins basin and 29 in the Tapajós basin. Two additional individuals were found fortuitously during the fieldwork in the Tapajós basin, on two different occasions, while we were walking along forest trails, on the way to the trap sites. Other chelonian species were captured alongside *Rhinoclemmys p. punctularia*, in smaller numbers: *Mesoclemmys raniceps* (Gray, 1856), in both the Tocantins and Tapajós basins; *Mesoclemmys gibba* (Schweigger, 1812) and *Kinosternon scorpioides* (Linnaeus, 1766), in the Tapajós basin only.

The total capture effort in the Tocantins basin was 4,010 trap-hours (818 trap-hours in the peak of the rainy season, 1,149 trap-hours in the beginning of the dry season, and 2,043 trap-hours at the end of the dry season). In the Tapajós basin, the capture effort was 77,760 trap-hours (19,440 trap-hours in each sampling period). The mean capture rate was higher in the Tocantins basin: one individual per 286 trap-hours. In the Tapajós basin, the mean capture rate was one individual per 2,681 trap-hours (excluding the two individuals found on land). There were no recaptures during the study period.

Among the 14 individuals from the Tocantins basin, there were seven females (50%), six males (43%), and one juvenile (7%); among the 31 individuals from the Tapajós basin, there were 12 females (39%), 15 males (48%), and four juveniles (13%) (Figure 4). The sex ratio was 1.16:1 in the Tocantins basin, and 1.25:1 in the Tapajós basin, and both did not differ significantly from a 1:1 ratio (χ^2 = 0.07, df = 1, P = 0.78; χ^2 = 0.33, df = 1, P = 0.56, respectively). Females were, in general, larger than males in both localities (Tapajós basin: H = 6.68, P = 0.009; Tocantins basin: H = 4.30, P = 0.038; Table 1). The smallest juveniles captured in the Tocantins and Tapajós basins measured 71.0 and 77.8 mm SCL, respectively, and both were captured during the peak of the rainy season (March/April). SCL distribution did not vary significantly between the two areas (D = 0.25; P = 0.57) and tended towards normality in the Tapajós basin (W = 0.98; P = 0.79), where most captured individuals had SCL between 160 and 199 mm (Figure 5). SCL frequency distribution in the Tocantins basin did not approach normality (W = 0.86; P = 0.03; Figure 5).

Figure 3. Adult female of *Rhinoclemmys p. punctularia* captured in stream 8 (Table 2) in the Tocantins River basin in Pará state, Brazil. A – general view; B – detail of the head. This figure is in color in the electronic version.

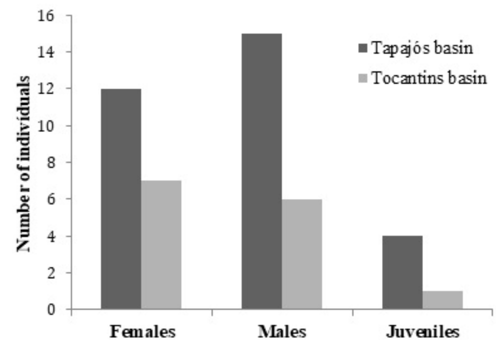

Figure 4. Number of males, females, and juveniles of *Rhinoclemmys p. punctularia* captured in headwater areas of the Tocantins and Tapajós river basins in Pará state, Brazil.

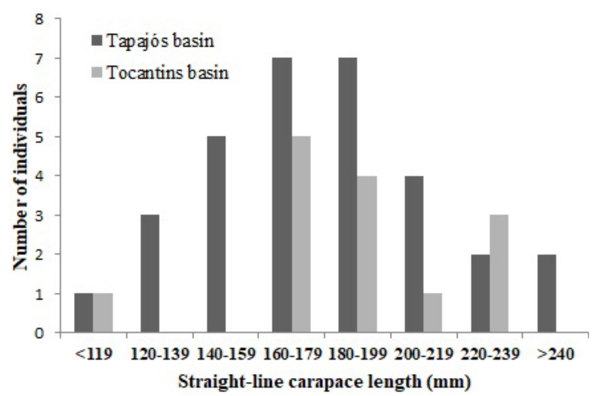

Figure 5. Frequency distribution of straight-line carapace length (SCL) interval classes of *Rhinoclemmys p. punctularia* captured in headwater areas of the Tocantins and Tapajós river basins in Pará state, Brazil.

Table 1. Morphometrics of male, female, and juvenile *Rhinoclemmys p. punctularia* captured in headwater areas of the Tocantins and Tapajós river basins, state of Pará, Brazil. Values are the mean ± standard deviation; N = sample size.

Morphometrical variable	Females	Males	Juveniles
Tocantins River basin	**N = 7**	**N = 6**	**N = 1**
Straight-line carapace length (SCL) (mm)	204.6 ± 25.9	172.2 ± 13.9	71
Maximum plastron length (MPL) (mm)	151.8 ± 12.9	134.3 ±19.8	67
Maximum carapace width (MCW) (mm)	196.3 ± 30.4	161.3 ±11.7	66
Maximum plastron width (MPW) (mm)	126.3 ± 10.8	109.3 ±13.3	51
Mass (g)	1343 ± 480	690 ± 166	50
Tapajós River basin	**N = 12**	**N = 15**	**N = 4**
Straight-line carapace length (SCL) (mm)	204.0 ± 36.0	171.8 ± 15.1	108.7 ± 24
Maximum plastron length (MPL) (mm)	148.4 ± 25.6	127.4 ± 10.9	85.8 ± 14.9
Maximum carapace width (MCW) (mm)	192.9 ± 32.7	157.3 ± 14.2	100.8 ± 22.7
Maximum plastron width (MPW) (mm)	123.9 ± 19.7	104.6 ± 9.4	70.7 ± 13.4
Mass (g)	1040 ± 513	606 ± 159	174 ± 95

In the Tocantins basin, all captures occurred in a first-order stream (Table 2). In the Tapajós basin, 44% of captures occurred in first-order streams, 31.5% in third-order streams (dammed and not dammed), and 20% in second-order streams, while 4.5% of the turtles were moving on land. There was no significant difference in the number of individuals captured in each waterbody type in the Tapajós basin (H test statistic = 5.38; df = 4; P = 0.07).

We captured most individuals (64%) in the dry season (21 in the Tapajós basin and eight in the Tocantins basin; Figure 6), but there was no significant difference in capture rates among sampling periods, in both localities (Tapajós basin: H = 1.65, df = 3, P = 0.64; Tocantins basin: H = 0.53, df = 2, P = 0.76). The overall capture rate in the dry season was one individual per 1,851 trap-hours in the Tapajós basin and one individual per 399 trap-hours in the Tocantins basin. In the Tapajós basin, we obtained the lowest capture rate (one individual per 9,720 trap-hours) at the peak of the rainy season, while in the Tocantins basin we obtained the lowest capture rate (one individual per 2,043 trap-hours) at the end of the dry season.

We obtained fecal samples from 10 individuals in addition to one spontaneous regurgitation. The most frequently consumed food items (frequency of occurrence) were of plant origin, mainly seeds of Myrtaceae (91%) and *Inga* sp. (82%), in addition to Lecitidaceae flowers (36%). The greatest relative volume also corresponded to Myrtaceae seeds (43%) and *Inga* sp. seeds (30%). In the regurgitation, we detected items of animal origin (fish scales), which were not present in the fecal samples (Table 3).

DISCUSSION

Our results suggest that *Rhinoclemmys punctularia punctularia* is an uncommon species in the sampled areas—as it appears to be throughout its distribution area in the Amazon basin, despite its extensive range and the diversity of aquatic habitats it occupies (Vogt 2008; Ferrara *et al.* 2017). *Rhinoclemmys p. punctularia* is common in coastal lentic habitats along parts of the northern Brazilian coast (Siciliano *et al.* 2014). However, most captures during our study occurred in first-order streams, which are small, shallow, clear-water streams. Some of these ran through monodominant palm-tree stands of *Mauritia flexuosa* L.f. and *Euterpe oleracea* Mart. (regionally known as *buritizais* and *açaizais*, respectively), which are commonly found in the headwater areas in the Amazon region (Pezzuti and Chaves 2009). Streams in these areas are lotic but rarely have strong currents, differing considerably from the floodplain forests and lentic coastal lakes inhabited by *R. p. punctularia* on the coast of Pará (Wariss *et al.* 2012). They also differ from the *restingas* (coastal sand dune plains) where several individuals of an apparently new species of the same genus were found in Espirito Santo (Oliveira *et al.* 2018).

The non-normal size distribution of the turtles sampled in the Tocantins basin probably was due to the small sample size, with 89% of our sample corresponding to adult individuals. The capture of low numbers of very small or very large individuals is a common occurrence in freshwater turtle studies (Wariss *et al.* 2012; Brito *et al.* 2018; Butterfield *et al.* 2020; Folt 2020). Turtle samples are usually composed primarily of adult individuals due to the combination of low survival rates and the higher difficulty in capturing juveniles, which use habitats different from those typically used by the adults and have a more subtle behavior (Armstrong *et al.* 2018). The

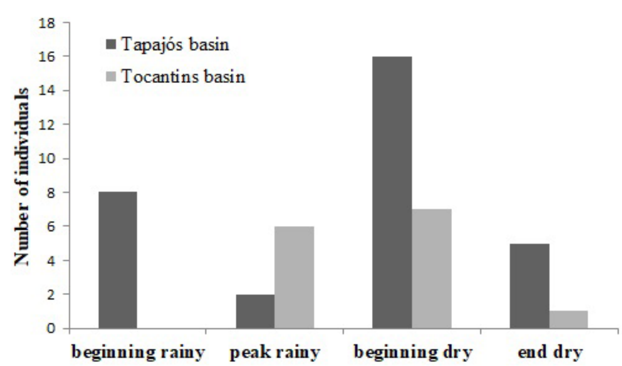

Figure 6. Number of *Rhinoclemmys p. punctularia* individuals captured in headwater streams in the southeastern Brazilian Amazon in each of three (Tocantins River basin) and four (Tapajós River basin) sampling periods. Sampling periods were beginning of the rainy season, peak of the rainy season, beginning of the dry season and end of the dry season.

Table 2. Number of individuals of *Rhinoclemmys p. punctularia* (N) captured in each of the headwater streams sampled in the Tapajós and Tocantins river basins in Pará state, Brazil, and characteristics of each stream. (%) = percentage of the total number of captures. Stream order follows Horton's scale modified by Strahler.

Stream	N (%)	Drainage basin	Stream order	Habitat	Coordinates	Riparian vegetation
Stream 1	1 (2)	Jamanxim/Tapajós	First	Lotic	04°59'40"S, 56°27'04"W	Forest
Stream 2	9 (21)	Jamanxim/Tapajós	Second	Lotic	05°02'16"S, 56°26'10"W	Forest
Stream 3	2 (5)	Tapajós	Third	Lotic	05°03'08"S, 56°52'25"W	Forest
Stream 4	1 (2)	Tapajós	First	Lotic	05°03'13"S, 56°52'45"W	Forest/palm stands
Stream 5	1 (2)	Tapajós	Third	Lentic (dammed)	04°30'20"S, 56°17'02"W	Altered forest
Stream 6	11 (26)	Tapajós	Third	Lentic (dammed)	04°29'11"S, 56°16'24"W	Altered forest
Stream 7	4 (9)	Tapajós	First	Lotic	05°11'24"S, 56°56'24"W	Forest/palm stands
Stream 8	14 (33)	Tocantins	First	Lotic	05°04'25"S, 49°18'24"W	Forest

Table 3. Dietary items identified in 10 fecal samples and one regurgitation of 11 individuals of *Rhinoclemmys p. punctularia* captured in a headwater area of the Tocantins River basin, in southeastern Brazilian Amazonia. Items marked with an asterisk (*) were identified in the regurgitation (fish scales occurred exclusively in this sample). N samples = number of samples containing the item; N items = total number of items found in all samples.

Food items	N samples	Frequency of occurrence (%)	N items	Numerical frequency (%)	Absolute volume (ml)	Relative volume (%)
Plant material						
Leaf fragments*	1	9.0	1	1.0	2.8	2.3
Seeds						
Myrtaceae	10	90.9	59	62.7	50.6	43.1
Inga sp.	9	81.8	19	20.2	35.2	30.0
Unidentified seeds	3	27.2	3	3.1	0.8	0.6
Flowers (Lecitidaceae)	4	36.3	4	4.2	14.3	12.2
Stems	3	27.2	3	3.1	0.3	0.2
Unidentified plant material	2	18.1	2	2.1	0.2	0.1
Animal material						
Fish scales*	1	9.0	1	1.0	0.1	0.0
Periphyton						
Algae	1	9.0	1	1.0	12.0	10.2
Unidentified items	1	9.0	1	1.0	0.8	0.6

presence of relatively few juveniles in our samples needs to be further investigated to determine whether it is owed to a lack of recruitment, which may lead to population decline (e.g., Howell *et al.* 2019).

Although capture rates were higher during the dry season in both sampled river basins, the difference between seasons was not significant. Higher capture rates during the dry season were observed in a population of *R. p. punctularia* from Algodoal-Maiandeua Island, Pará (Wariss *et al.* 2012), and in a population of *R. melanosterna* (Gray, 1861) in the extreme northwestern region of Ecuador, near Colombia (Carr *et al.* 2014). Captures rates of other Amazonian freshwater turtles that live in large lakes, rivers, and seasonally flooded habitats, e.g., *Podocnemis sextuberculata* Cornalia, 1849 and *P. unifilis* Troschel, 1848, are also usually higher in the dry season, due to the aggregation of individuals in the remaining waterbodies. Besides, some species reproduce during the dry season and can aggregate in the vicinities of nesting sites (Fachín-Terán and Vogt 2004; Bernardes *et al.* 2014). *Rhinoclemmys p. punctularia* has a long, intermittent nesting period (March-April and September-December; Vogt 2008; Cunha *et al.* 2019), and smaller streams in the headwater areas are subject to less dramatic seasonal variation in water level. Both factors probably contributed to the fact that the distribution and activity rates of this turtle in our study areas (and therefore their capture probability) were similar throughout the year.

The data from fecal samples point to the exclusive consumption of plant items along the entire sampling period in the same stream, although the regurgitation suggests the consumption of fish, as prey or carrion. *Rhinoclemmys p. punctularia* is generally reported as omnivorous (Ernst and Barbour 1989; Vogt 2008; Ferrara *et al.* 2017), with a tendency to herbivory (Vogt 2008). Omnivorous turtles are opportunistic feeders, consuming items according to their availability, as the abundance of more nutritious plant materials (such as fruits and flowers) and animal prey varies in space and time. Plants are generally an important component of freshwater turtle diets, and some species consume a great amount of fruit, such as *Rhinoclemmys funerea* (Cope, 1975) (Moll and Jansen 1995), *Mesoclemmys raniceps* (Fachín-Terán *et al.* 1995), and *Rhinemys rufipes* (Spix, 1824) (Lima *et al.* 1997; Caputo and Vogt 2008). Seeds of many plant species, both terrestrial and aquatic, can resist digestion and be efficiently dispersed by turtles (e.g., Tol *et al.* 2017; Falcón *et al.* 2019), including species of *Rhinoclemmys* (Moll and Jansen 1995). Therefore, the high number of seeds in the fecal samples could be related to their lower digestibility (Hailey 1997), leading to an overrepresentation relative to other consumed items. It is possible that some food items of animal origin, which are easier to digest and harder to detect in the faeces, had been completely digested, thus being undetectable in the fecal samples (Caputo and Vogt 2008). The small fish scales present in the spontaneous regurgitation were possibly from fish attracted to and preyed upon inside the traps. The turtles captured during our study could have been attracted either by the fresh fish bait or by trapped live fish, which would support the notion that *R. p. punctularia* is omnivorous.

Rhinoclemmys p. punctularia occurred in syntopy with the chelids *M. gibba* and *M. raniceps* and the kinosternid *K. scorpioides*, being the most abundant species in all waterbodies sampled (except for stream 01, a first-order stream at the Tapajos River basin). In the Amazon River basin, *R. p. punctularia* occurred in sympatry with other three species of freshwater turtles, *K. scorpioides*, *M. gibba*, and *Platemys* *platycephala* (Schneider, 1792), in first-order streams and shallow pools amidst *buritizal* palm stands, and was the most abundant species in the sample (Vogt *et al*. 2009), as in our study. Niche overlap among syntopic species occurs along several dimensions (Pianka 1982), from which diet is the most important (Sabagh and Carvalho-e-Silva 2008). Although the species co-occurring with *R. p. punctularia* also are omnivores, *K. scorpioides* and *M. gibba* tend to carnivory (Vogt 2008; Ferronato *et al.* 2013), which likely reduces competition for food resources with *R. p. punctularia,* which tends towards herbivory (Vogt 2008; this study).

CONCLUSIONS

Rhinoclemmys p. punctularia, the only geoemidid occurring in Brazil, is one of the least known Amazonian freshwater turtles, from a biological point of view. At our study sites, in the headwaters of the Tocantins and Tapajós basins, capture rates of individuals of the species were higher in first-order, lotic streams. However, even higher capture rates have been reported for lentic coastal habitats in other parts of the species' distribution area in Brazil, which points to the need of additional studies on habitat use by *R. p. punctularia* throughout its range. The occasional finding, during our study, of two individuals wandering on land, possibly while crossing interfluves, also points to the need of studies addressing movement between aquatic habitats. Although spatially restricted and based on a relatively small sample, our preliminary findings on the diet of the species point to plant material as the most frequently consumed food items, which should also be investigated further, in distinct habitats and sites as well.

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