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Podocnemis erythrocephala Nests in the Lower Tapajós River, Central Amazonia, Brazil

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ABSTRACT. – We found 36 nests of *Podocnemis erythrocephala* in the lower Tapajós River in central Amazonia during 3 consecutive nesting seasons, from 2006 to 2009. The species nested from the end of the dry season to the start of the rainy season, nesting far from the water in savanna vegetation. Mean clutch size was 7 eggs (range, 5–11), mean incubation time was 66.8 days (range, 62–87), and hatching success rate was 0.69 (range, 0.27–1.0).

Podocnemis erythrocephala is the smallest and least studied species of the family Podocnemididae. Published studies that focused on this species are restricted to the Negro Basin (Castano-Mora et al. 2003; Batistella and Vogt 2008). This turtle is intensely used as a food source and is regularly sold in communities along the Rio Negro (Vogt 2001; Batistella and Vogt 2008) despite Brazilian law forbidding consumption of the native fauna. In the Tapajós River basin, there is only limited information on the presence and nesting of this species (Rebêlo 1991; Vogt et al. 1991). In this article, we present data on nests of *P. erythrocephala* in the Tapajós River, a clear-water tributary of the Amazon River.

Methods. — The study was conducted near the village of Alter do Chão, on the eastern side of the Lower Tapajós River, Pará, Brazil (lat 2°31′S, long 55°00′W). The mean annual temperature is 27.5°C, and the mean annual rainfall is 1950 mm. Climate is seasonal, with most rain falling between December and May. Vegetation cover in the area consists of a mosaic of forests and savannas (Carvalho et al. 2008). *Podocnemis* nest in the dry season, when the river level drops and many potential nesting habitats become exposed.

Field work was conducted in the nesting seasons of 2006–2007, 2007–2008, and 2008–2009. We monitored 7 beaches in the 2006–2007 nesting season (1 on the Tapajós River, 1 on Piranha lake, and 5 at Lago Verde), and 5 beaches (all at Lago Verde) in the subsequent nesting seasons.

Monitoring started on 20 September 2006, 10 November 2007, and 15 November 2008 for each nesting season. We surveyed beaches every 2 to 3 days to detect new nests. The position of located nests was recorded with a global positioning system device, and the nests were marked with small wooden stakes placed at a distance of 0.5 m from the nest and partially buried in the ground to avoid its detection and collection by villagers.

For most nests, we recorded the following data: date of oviposition, straight-line distance from nest to water, elevation of the nest above the water level the next day after nesting, the distance from nest to the edge of vegetation line (including negative values, which corre-

Table 1. Characteristics of nests of *Podocnemis erythrocephala* in the lower Tapajós River, Brazil (2006–2008).

Parameter	Mean (SD)	Range	*n*
Distance to water (m)	47.75 ± 25.08	8–96	32
Elevation above water (m)	3.28 ± 2.10	0.63–8.66	20
Distance to vegetation line (m)	1.54 ± 23.05	−60 to 31	24
Soil cover over the nest (%)	31.5 ± 25.7	0–78	19
Nest depth (cm)	12.8 ± 1.83	10.5–15.5	8
Clutch size	6.95 ± 1.39	5–11	22
Incubation time (d)	66.8 ± 7.2	62–87	11
Hatching success (all nests)	0.39 ± 0.41	0–1.0	19
Hatching success (only successful nests)	0.69 ± 0.29	0.27–1.0	11

spond to nests laid inside the vegetation), and percentage of cover on the soil over the nest. To do this, we placed a 80 × 80-cm^2 grid with grid lines spaced at 10-cm intervals over the center of the nest, and assigned for each grid intersection (n = 64) if the soil was bare or if there was any kind of cover (e.g., leaf litter, twigs, grass). Soil cover was the percentage of grid intersections with any kind of cover.

In the 2006–2007 nesting season, we monitored marked nests until hatching. We started visiting nests approximately 40 days after oviposition, returning twice a week to evaluate their status. For these nests, we recorded the number of eggs, hatching success (defined as the proportion of eggs that successfully hatched in a given nest), and causes of nest loss. A sample of hatchlings was kept in captivity until complete yolk absorption, after which they were weighed, measured (straight line carapace length), and released.

Results. — We found 36 nests of *P. erythrocephala*: 19 in 2006–2007, 10 in 2007–2008, and 7 in 2008–2009. The nests were found from 22 November 2006 to 20 January 2007, 27 November 2007 to 15 January 2008, and 19 November 2008 to 8 December 2008. The mean date of oviposition was 22 December, 14 December, and 27 November for each nesting season. Data on the nests of *P. erythrocephala* are summarized in Table 1. Most nests we found were laid far from the water, in savanna vegetation (89.5%), and only occasionally did we find nests in sandy beaches near the water (10.5%). We monitored the fate of the nests from the 2006–2007 nesting season. Eight of 19 nests (42.1%) did not come to term: 3 were raided by humans, 3 were depredated by unknown animals, and 2 were flooded. When considering only the 11 surviving nests, hatching success was 0.69 ± 0.29 (range, 0.27–1.0). The mean mass for 25 hatchlings was 11.05 ± 1.2 g (range, 9.5–13.8 g), and the mean carapace length was 39.9 ± 2.8 mm (range, 37–46 mm).

Discussion. — The number of *P. erythrocephala* nests found was relatively small. However, beaches were not visited daily and as a consequence some nests may have been overlooked. Harvesting of *P. erythrocephala* nests in our study area was lower than for *Podocnemis unifilis*, probably because *P. erythrocephala* nests were laid in the savanna where they were very difficult to find.

Nesting of *P. erythrocephala* occurred from the end of the dry season to the start of the rainy season, as reported by Rebêlo (1991) who stated that *P. erythrocephala* is the last turtle to nest in the study area, only after the onset of the first rains, but, contrary to Castano-Mora et al. (2003), who reported nesting of *P. erythrocephala* immediately after the subsiding of river levels in Colombia. This is somewhat unexpected, because previous studies have reported an extended nesting season for this species, with some females laying multiple clutches in a single season (Vogt 2001). However, it is unlikely that turtles were already nesting before the start of our study, because beach monitoring preceded nesting by more than a month. Most nests were laid in savanna vegetation, far from the water and at higher elevations in relation to the water level in comparison with *P. unifilis*. Distances from the vegetation line usually assumed negative values, because nests were laid up to 60 m inside open vegetation. Nesting in open areas, such as savannas, campinas, or caatingas is characteristic for this species and have been consistently reported in previous studies (Mittermeier and Wilson 1974; Rebêlo 1991; Vogt 2001; Castaño-Mora et al. 2003; Batistella and Vogt 2008). Distances from nest to water were much greater than the 3.14 m reported by Castaño-Mora et al. (2003) but smaller than the maximum distances of 200 m reported by Vogt (2001). Elevation of nests above water level was high (up to 8.5 m). *Podocnemis erythrocephala* seems to select nesting sites that minimize the chances of flooding of the nests that would occur with the rising water level that accompanies the rainy season. This is an important factor for a turtle that nests at the onset of the rainy season, when considering that flooding by rising river levels is the most important natural cause of nest losses in the Amazon basin for podocnemids (Foote 1978; Alho 1982; Von Hildebrand et al. 1988; Mitchell and Quinones 1994; Pezzuti and Vogt 1999; Batistella and Vogt 2008).

Clutch size for *P. erythrocephala* in the study area was within the range reported by previous studies (Mittermeier and Wilson 1974; Castaño-Mora 1997; Castaño-Mora et al. 2003; Batistella and Vogt 2008), and the same is true for hatchling size and mass (Castaño-Mora et al. 2003; Batistella and Vogt 2008). However, incubation time in this study (mean, 66.8 days; range, 62–87 days) was much lower than that reported by Castaño-Mora et al. (2003) (mean, 90 days; range, 81–102 days), especially when considering that Castaño-Mora et al. (2003) presented underestimated values. The reason for

this difference is not clear but may be related to the greater distances of the nests to the water (and associated higher elevation of nests) in this study, which resulted in a higher temperature and lower humidity in nest chambers, and, consequently a faster incubation time. Another possibility is nest shading; in the present study, the nests were deposited in open savannas, probably less shaded than in the nesting sites in Colombia. Furthermore, the dry season in our study site is more pronounced than in the western Amazon basin. Additional studies on the effects of environmental conditions on incubation of *P. erythrocephala* eggs are needed to elucidate these questions.

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