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SHORT COMMUNICATION

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# Potential egg predators of the dwarf caiman *Paleosuchus palpebrosus* at the southern limit of the species' range in Brazil

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Egg predation poses a significant threat to small crocodilians that either lay few eggs or have few nesting sites (Amoah et al., 2021; Campos et al., 2015). This is the case for the dwarf caiman *Paleosuchus palpebrosus* that is known to lay only about 14 eggs per nest, in the mountains surrounding the Pantanal (Campos et al., 2022; 2015). This small clutch size is aggravated by a long incubation period, which in *P. palpebrosus* is 90 to 100 days (Medem, 1983; Magnusson, 1992); for most South American crocodilians it is around 60 to 70 days (Medem, 1983). Thus the nests of the dwarf caiman are exposed to a longer period in which they may be predated than nests of many other caiman species. Camera traps have been used previously to identify the potential predators of crocodilian eggs (Barboza et al., 2012; Campos & Mourão, 2014; Torralvo et al, 2017; Gonzáles-Desales et al., 2020) and to document the defense behaviour of females against egg predators (Campos et al., 2016).

Female *P. palpebrosus* remain close to their nests throughout the incubation period, often hiding in holes next to their nests (Campos et al., 2015). When in the proximity of potential predators females adopt a defensive posture, typically climbing on top of their nests (Campos & Sanaiotti, 2006). However, until this study, there was no photographic record of females taking care of their nests by streams around the Pantanal. This study reports the number of nests found in these areas during the nesting seasons of 2016 and 2017 and identifies the potential egg predators that visited these nests. Also, we recorded the behaviour of females attending their nests by the streams of the region Serra do Urucum. This area is located in the southern Pantanal, close to the southern limit of the species' distribution.

During the month of February in 2016 and in 2017 in the region Serra do Urucum, we searched on foot for *P. palpebrosus* nests in the riparian forests of the streams Pedras (19° 13'11" S, 57° 39'3" W), Banda Alta (19° 09'16" S, 57° 7'40" W) and Lajinha (19° 07'40" S, 57° W). The streams have narrow rocky bottoms and cold water, as described by Campos et al. (1995). In February 2016 and 2017, we installed digital camera traps, model Brushwell Trophy Cam, near four of the nests found each year. The cameras were programmed to take three photos at a time, triggered by motion sensors in continuous periods of 24 hours. The cameras were removed from the site after predation or egg hatching. In order to avoid any increase in predation rate that might result from our disturbance of the nests, we did not open nests and neither were eggs counted. The photos obtained were images of potential predators and/or defensive behaviour and nest opening by the female caimans.


**Figure 1**. Camera-trap photographs taken while monitoring the nests of *Paleosuchus palpebrosus* by streams of the southern Pantanal in Brazil – **A.** Nine-banded armadillo *Dasypus novemcinctus* on top of a nest, **B.** Female *P. palpebrosus* defends her nest against a feral pig *Sus scrofa*, **C.** Coati *Nasua nasua* on top of a nest, **D.** Female *P. palpebrosus* opening a nest

In 2016, we located two nests of *P. palpebrosus* in the streams of Pedras, one in the Banda Alta stream and another in the Lajinha stream. Nest 1 was attacked by a nine-banded armadillo *Dasypus novemcinctus* on 2 June 2016 at 00:05 h and again at 04:53 h, when it remained in the nest for 10 minutes (Fig. 1A; Table 1).

At nest 2, a nine-banded armadillo was photographed above the nest on 2 April 2016 at 03:24 h. A group of four capuchin monkeys *Sapajus cay* was recorded on 10 February 2016 at 14:21 h in the vicinity of the nest, one of which remained longer observing the nest, which until then had not been predated. The first appearance of the female caiman on top of the nest was on 11 February 2016 at 00:18 h, remaining there for 18 minutes. However, on 12 February 2016 at 23:09 h the camera recorded the presence of a nine-banded armadillo turning over the nest. In the photo, fragments of eggshells appear, indicating that possibly the nine-banded armadillo had access to the eggs. On 13 February 2016 at 03:11 h three or four pigs *Sus scrofa* were recorded close to the nest. The female *P. palpebrosus* was again recorded on

**Table 1**. Summary of the data obtained of potential predators visiting eight nests of *Paleosuchus palpebrosus* in streams of the southern Pantanal in Brazil, monitored using camera-traps during the nesting seasons of 2016 and 2017

| Nest | Locality | Date | Time | Nest status | Recorded predators |
|---|---|---|---|---|---|
| 1 | Pedras | 02-06-2016 | 00:05 | predated | *Dasypus novemcinctus* |
| | | | 04:53 | | |
| 2 | Pedras | 10-02-2016 | 14:21 | predated | *Sapajus cay* |
| | | 12-02-2016 | 23:09 | | *Dasypus novemcinctus* |
| | | 13-02-2016 | 03:11 | | *Sus scrofa* |
| | | 05-03-2016 | 09:42 | | *Sus scrofa* |
| | | 25-02-2016 | 02:15 | | *Nasua nasua* |
| 3 | Banda Alta | 29-03-2016 | 06:46 | predated | *Dasypus novemcinctus* |
| | | 30-03-2016 | 08:10 | | *Nasua nasua* |
| | | 30-03-2016 | 08:31–09:33 | | *Nasua nasua* |
| 4 | Lajinha | 04-03-2016 | 00:04 | predated | *Dasypus novemcinctus* |
| | | | 21:04 | | |
| 5 | Pedras | 27-04-2017 | 21:01 | predated | *Procyon cancrivorus* |
| | | 03-05-2017 | 23:12 | | *Nasua nasua* |
| 6 | Pedras | 30-05-2017 | 23:33 | predated | *Dasypus novemcinctus* |
| 7 | Pedras | 30-04-2017 | 04:38 | hatched | |
| 8 | Pedras | 25-04-2017 | 16:54 | predated | *Dasyprocta azarae* |
| | | 27-04-2017 | 23:00 | | *Procyon cancrivorus* |

5 March 2016 in the morning (09:42 h), defending her nest from the pigs (Fig. 1B). On 25 February 2016 at 02:15 h a coati *Nasua nasua* was recorded turning over the nest, which apparently had already been opened by previous predators (Fig. 1C).

Nest 3, located in the Banda Alta stream, began to be preyed upon by a nine-banded armadillo, recorded on the top of the nest on 29 March 2016 at 06:46 h. However, a group of four coatis were eating the eggs on 30 March 2016 around 08:10 h and again between 08:31 to 09:33 h; they completely destroyed the nest. Nest 4, in the Lajinha stream, was predated by nine-banded armadillos on 4 March 2016 at 00:04 h and returning at 21:04 h.

In 2017, five nests were found by the Pedras stream, and four of these nests were monitored by camera, resulting in photos of predators in three of these nests. Nest 5, supported by a dry trunk and the presence of termites, was preyed upon by a crab-eating raccoon *Procyon cancrivorus* on 27 April 2017 at 21:01 h, which remained for about 10 minutes on top of the nest. Coatis *N. nasua* also visited the top of this nest on 3 May 2017 at 23:12 h. Nest 6 was predated on 30 May 2017 at 23:33 h by a nine-banded armadillo *D. novemcintus* that remained on top of the nest for 10 minutes. Nest 7, after 105 days of incubation, the female was photographed opening the nest, moving her hind legs (Fig. 1D). Nest 8 was preyed on by an Azara's agouti *Dasyprocta azarae* and a crab-eating raccoon. The nest 9, which was not monitored using a camera trap, was not predated.

The predation rate of *P. palpebrosus* nests in the streams of region Serra do Urucum appears to be high, as seven of the nine nests monitored in this study were predated. The nests were visited by several mammal species including nine-banded armadillo, pigs, coati, Azara's agouti, lesser and giant anteaters, capuchin monkeys, raccoon and possibly others. The nine-banded armadillo was the most frequent in the nests, as it was photographed in six out the eight nests, followed by the coati, which visited three out the eight monitored nests. The photographic records of the nine-banded armadillo preying on the eggs were all at night, between 18:55 to 04:53 h, while the coati were diurnal between 09:31 to 14:14 h.

In the Amazon, nests of *P. trigonatus* are known to be predated by two species of Cingulata, the giant armadillo *Priodontes maximum* and the nine-banded armadillo (Campos et al., 2016). In the Pantanal, Campos & Mourão (2014) recorded both the nine-banded armadillo and six-banded armadillo *Euphractus sexcinctus* eating eggs of the Pantanal caiman *Caiman yacare*. Parental care is important in reducing egg predation and also in increasing hatching success among crocodilians (Lang, 1987). We recorded females protecting their nests against predators and *P. palpebrosus* is known to protect hatchlings for up to 21 months (Campos et al., 2012), one of the longest periods of parental care among crocodilians. Despite this it would seem that *P. palpebrosus* is unable to offer significant protection against egg predators.

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