Habitat use and behaviour of Schneider's Dwarf Caiman (Paleosuchus Trigonatus Schneider 1801) in the Nouragues reserve. French Guiana

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Latin America and the Caribbean

French Guiana

HABITAT USE AND BEHAVIOUR OF SCHNEIDER'S DWARF CAIMAN (*PALEOSUCHUS TRIGONATUS* SCHNEIDER 1801) IN THE NOURAGUES RESERVE. FRENCH GUIANA. Amongst the 9 genera of existent crocodilians, two are known to display very different ecological habits compared to the others: *Paleosuchus* in South America and *Osteolaemus* in West and Central Africa (Merchant, Shirley *et al*. 2016). Both genera include species inhabiting mainly small streams or forest ponds in closed canopy rainforests (Magnusson and Lima 1991; Eaton 2010; Campos and Magnusson 2013). The ecological particularities of those two convergent genera lead them to display adaptations for habitats unsuitable for other crocodilians, given that they live mainly in forest environments where they have few basking opportunities. For example, Campos and Magnusson (2013) show that *P. palpebrosus* mean body temperature is maintained between 20.1°C and 25.6°C all year around, whereas other species' preferred body temperature (PBT) is above 30°C.

Forest dwelling crocodylians are difficult to study in the field and their biology and ecology remain largely unknown (Magnusson *et al*. 2010). *Paleosuchus trigonatus* is the least studied of the two species of *Paleosuchus*, with few studies conducted in the field, often on small sample sizes, and most of them focusing on the Amazon Basin (Magnusson *et al*. 1985; Magnusson and Lima 1991; Magnusson *et al*. 1997; Morato *et al*. 2011). The present work is a preliminary study aiming to get the first data about habitat use of *P. trigonatus* in this undisturbed region of primary forest in French Guiana. Our goals were: to obtain qualitative and quantitative data about its behavior and habitat use during day and night; and, to record how the species move along the stream during a 10-week period in the rainy season (7 April-15 June 2016).

The study took place in two phases, in the northeast quarter of the Nouragues Natural Reserve in French Guiana (4°05' N, 52°41'W), where a 9500-ha area is dedicated to an international research station managed by the French National Centre for Scientific Research (CNRS). Firstly, caimans were captured, measured and marked with temporary and permanent marks (see below), and released. Secondly, behavior and habitat use observations were was carried out mainly on four individuals which were followed over three weeks. This study focuses on animals living along the mainstream of the "Inselberg Camp", called "Crique Nouragues" (Fig. 1).

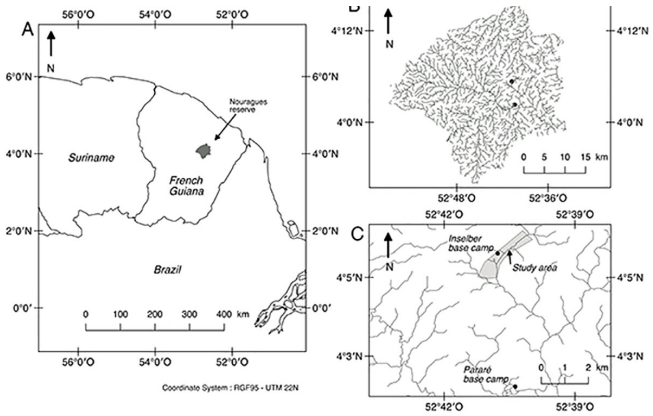

Figure 1. Study area: a) location of Nouragues Reserve in French Guiana; b) location of the two scientific base camps; c) location of study area.

During the period of study, water temperature and water depth were recorded every 10 minutes and once a day, respectively. Air temperature and relative humidity were recorded every 30 minutes.

As foraging activity occurs mostly at night (Grigg and Kirshner 2015), caimans were located by eyeshine using a Scurion® 1500 head lamp. Crique Nouragues was searched by walking a path along a 1200-m section of this forest stream. Searches were carried out between 1945 and 0015 h. When a caiman was detected, it was captured by hand or with a noose on a 2-m pole. We used the dorsal scalation between the posterior limbs as the best criterion to distinguish between the two *Paleosuchus* species - there are 4 rows scales for *P. palpebrosus* and 2 for *P. trigonatus* (Dewynter *et al*. 2016). Only *P. trigonatus* were sighted and/or captured.

For each animal captured, we recorded GPS coordinates of the capture site (Garmin64® GPS, precision <3 m), however, because of the density of the canopy the accuracy of the measurements was closer to 10 m. The date and time of capture, as well as air temperature were recorded. Each animal was brought to basecamp for biometric data collection and then released back at the capture site. Weight was measured using a portable scale up to 40 kg (± 10 g) or a precision scale up to 300 g (± 0.001 g). A measuring tape was used to measure snout-vent length (SVL), from the tip of the muzzle to the middle of the cloaca and total length (TL) to the nearest mm. Sex was assessed by cloacal palpation for sub-adult and adult animals (ie individuals with a minimal TL of 75 cm; Ziegler and Olbort 2007). For smaller animals, a soft pressure exerted by two fingers from either side of the cloaca can sometimes allow the penis to stand out from the cloaca, but this methodology can lead to gender misidentification in young animals (Ziegler and Olbort 2007). In case of doubt, we recorded the gender as "undefined". The approximate age of the animal was estimated based on the theoretical growth curve (Magnusson *et al*. 1997).

Each caiman was marked with a temporary number, written on the cranial platform with a white marker (Posca®) and covered by colourless varnish (Tenue&Strong, Gemey-Maybelline). The aim of this marking was to be able to recognize individuals after their release and collect data on behavior without having to recapture them. In addition, during the capture/release period, this marking makes it possible to avoid recapturing the same individuals twice. Each caiman was also implanted with a microchip (Biomark PIT) inside the muscle on the right side of the tail. This marking is a backup identification in case of disappearance of the temporary marking and will also allows future long-term monitoring of the caimans. To ensure the regular recording of several individuals we equiped 7 of them with radio-transmitters so that they could be found systematically over several weeks. Transmitters weighed 9 g (<1% of weight of caiman) and had 12 months of standard life (Holohill Ltd., SI-2). The transmitter was taped to a nylon tie that was attached around the waist of the animal. For logistical reasons, transmitters had to be removed after 60 days because we were not able to stay longer in the field. The radio-receiver was a Sika with a Yagi flexible antenna (Biotrack Ltd.).

The animals were tracked twice a day: once during the day (0900-1130 h or 1400-1730 h, depending on weather conditions) and once at night (approximately 2000-2330 h). As the animals did not tend to flee but rather to stop moving at the surface or under the water, for most visual contacts we were able to record the number written on the head or the frequency of its transmitter (if one was attached). We also recorded the time, GPS coordinates, rain (yes/no), and water depth for each sighting. The behavioral units of habitat use were recorded as follows: at the surface/under the water/out of the water; in open water/hidden in vegetation/hidden in a burrow or under branches or trunks; moving/motionless; basking (ie exposed to direct sunlight); eating (yes/no); or, alone/in group. The length of stream used by each caiman was estimated with QGIS software.

The frequency of the behavioral units observed and the graphs were done using R software (3.2.4 version, R Core Team (2017)). The mapping and the formatting of spatial data were done with QGIS software (QGIS version 2.18) in order to have maps comparable to Magnusson and Lima (1991). The proportion of overlap of area used between the caimans was defined as the percentage of overlap of linear metre of river occupied between two animals. This proportion was calculated with QGIS software.

Table 1. Size, sex, estimated age (based on Magnusson *et al*. 1997), number of observations and length of stream used for 16 *P. trigonatus*. * total area could not be calculated.

No.	Sex	Est. Age (y)	SVL (cm)	TL (cm)	Weight (g)	Start Date	Finish Date	Day Obs.	Night Obs.	Total Obs.	Stream Used (m)
TRIG01	?	<1	18.5	33.5	130	-	-	0	1	1	-
TRIG02	?	<1	19	34	126.70	-	-	0	2	2	-
TRIG03	?	<1	17	30	95.88	-	-	1	1	2	-
TRIG04	?	<1	17.5	30.7	105.30	-	-	0	1	1	-
TRIG05	F	7	52	91.4	3000	-	-	0	1	1	-
TRIG06	F	4	40	70.6	1250	10 Apr	15 Jun	53	19	72	1788 (± 10)
TRIG07	M	3	28	50.6	500	-	-	0	3	3	-
TRIG08	F	20	66	113.6	4700	16 Apr	15 Jun	49	29	78	522 (± 8) *
TRIG09	F	5	45	79.5	2000	16 Apr	16 Jun	51	29	80	276 (± 7)
TRIG10	F	20	68	120	6750	-	-	5	1	6	-
TRIG11	?	<1	16.5	29	75.68	-	-	0	2	2	-
TRIG12	M	5	42	74	1600	9 May	15 Jun	20	7	27	1725 (± 10)
TRIG13	?	<1	20	36.8	173.64	-	-	0	2	2	-
TRIG14	F	3	33	59.6	840	-	-	0	1	1	-
TRIG15	M	4	31	56.5	660	-	-	0	1	1	-
TRIG16	?	<1	19	35.1	118.26	-	-	0	1	1	-

During the study, 95% of the values of air temperature varied between 22.8°C and 31.2°C and relative humidity between 61.4% and 100%. Water temperature in Crique Nouragues varied between 23.4°C and 25.7°C. The depth along the stream varied between 1 and 90 cm. The maximum amplitude of variation of water depth between two days at the same place was 42 cm.

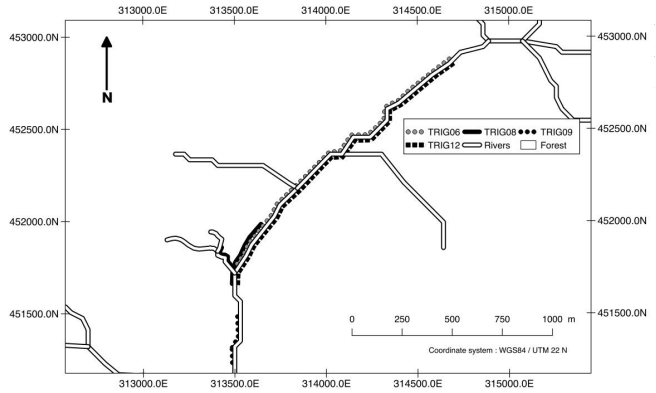

Figure 2. Length of stream used by four radio-tracked *P. trigonatus* during the rainy season between April and June 2016.

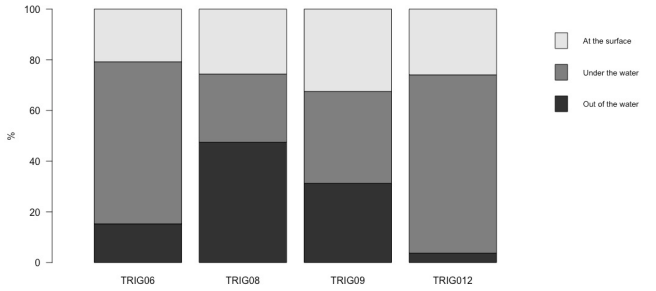

Figure 3. Proportion of observations relative to position in the water for four *P. trigonatus* during the rainy season between April and June 2016.

Observations and radio-tracking lasted for 63 days, during which 290 observations were made. Two of the 7 caimans with transmitters lost them, and one transmitter stopped transmitting after 6 days. As expected, caimans not equipped with radio-transmitters were very difficult to follow, and only 4 radio-tracked animals gave meaningful data (Table 1).

TRIG09 (sub-adult female) stayed in a restricted portion of stream (276 ± 7 m), compared to TRIG06 (sub-adult female; 1788 ± 10 m) and TRIG12 (sub-adult male; 1725 ± 10 m). The area used by TRIG08 was on the periphery of the study area and we could not determine the total area used. The proportion of overlap of area used, was very different between pairs of individuals, ranging from 93% between TRIG06 and TRIG12, to 49% between TRIG06 and TRIG08 and 70% between TRIG08 and TRIG12.

Of the 161 daytime observations: 57.8% were in a burrow or under dead vegetation out of the water; 9.9% were on the bank in open areas; 29.8% were among aquatic vegetation; and, 2.5% were in open water. Of the 84 night-time observations: 9.5% were in a burrow or under decaying vegetation out of the water; 6.0% were on the bank in an open areas; 50.0% were in aquatic vegetation; and, 34.5% were in open water.

Animals were mostly expressing no specific activity (96.9% of observations). Basking was only observed 9 times (3.3% of observations). The four radio-tracked caimans varied with respect to time spent in/out of the water (Fig. 3).

Discussion

According to Magnusson and Lima (1991), adult *P. trigonatus* often use terrestrial retreats sometimes quite far from the stream (eg 5-90 m from the stream). In our case, only one individual was observed using a cave formed by fallen rocks close to the water as a shelter during the day. Studied animals were sub-adults, which spent the majority of their time in the water with a mean temperature of 24.4°C. Typically, they were hidden in aquatic vegetation or under fragments of decaying vegetation or fallen tree trunks.

There are very few basking opportunities in the forest and despite some local sun spots we rarely observed individuals directly exposed to the sun. These observations are in line with observations made on *P. palpebrosus* showing very low temperature requirements compare to other crocodilians species with a body temperature varying between 20.1°C and 25.6°C (Campos and Magnusson 2013).

Tracking data suggest that the caimans do not use the stream in the same way. Upstream movements were observed by Magnusson and Lima (1991) to be the main dispersal direction for hatchling *P. trigonatus*. Our study provides preliminary data, which need to be extended over longer periods and different seasons of the year.

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