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Natural nests of the false-coral snake *Oxyrhopus guibei* in southeastern Brazil

Henrique Braz*[1, 2] and Daniel De Granville Manço[3]

In oviparous reptiles, nest site location has received increasing interest from evolutionary ecologists because it may affect fitness in several ways. For example, hatchling phenotypes linked to survival are strongly influenced by thermal and hydric conditions of nests (e.g. Madsen and Shine, 1999; Brown and Shine, 2004). These variables are directly dependent on nest characteristics as level of sun exposure, nest depth, type of soil and type of nest (Burger, 1976; Shine, Barrott and Elphick, 2002). Moreover, hatching success may be precluded by predation or fungal attack (Andrews, 1982; Moreira and Barata, 2005) and, therefore, mothers need to provide a safe nest for their eggs. Thus, knowing the types of microhabitat utilized by oviparous females to lay their eggs is central for understanding snake nest ecology besides providing important knowing to conservation of breeding sites. Nevertheless, nest-sites of Neotropical snakes are poorly known and there are only sparse reports of natural nests in Brazil (e.g. Albuquerque and Ferrarezzi, 2004; Travaglia-Cardoso, 2007; Braz, Franco and Almeida-Santos, 2008). Mostly, this reflects the difficult task of finding snake nests in nature only by visual search.

Oxyrhopus guibei (Hoge & Romano, 1978) is a medium-sized, terrestrial and nocturnal xenodontine snake (Sazima and Abe, 1991). It is an abundant species in forest edges and open areas in southeastern Brazil that feeds on rodents and lizards (Sazima and Abe, 1991; Andrade and Silvano, 1996). Egg-laying occurs throughout the year with peak from August through April and clutch size averages 10.9 eggs (Pizzatto and Marques, 2002). Herein, we describe two natural nests (microhabitat, nesting areas and nest types) of the false-coral snake, *Oxyrhopus guibei* in southeastern Brazil.

The first nest was found on April 17, 2008, in an open area at 'Serra do Japi' region (23°14' S, 46°58' W), municipality of Jundiaí, São Paulo State. A clutch of nine eggs was directly deposited on the soil within a chamber (nearly 15 cm in length, 15 cm in width and 20 cm in height) formed by several rocks (Figures 1A and 1B). Only one rock covered the eggs. All eggs were adhered to each other and some showed slight signs of dehydration (Figure 1B). Nest was located at the edge of a rural road near the entrance gate of a small farm (Figure 1A). Surroundings consisted of some pasture sites and a few forested fragments belonging to other rural proprieties. Clutch was taken to laboratory and placed in a plastic box with moistened soil until hatching for identification of the hatchlings. On August 21, 2008 the first eggs had hatched and 7 days later all babies had emerged from the eggs. Hatchlings were identified as *Oxyrhopus guibei* and were subsequently released near their nest of origin.

The second nest was found by a farmer on April 4, 2010, at 'Três Anjos' Ranch, municipality of Nazaré Paulista (23°10'51" S, 46°23'42" W), São Paulo State. Nest-site was located in a house backyard inside an enclosure in which domestic animals such as chickens and rabbits were bred. A clutch of ten eggs, which were adhered to each other, was found inside an abandoned rabbit burrow (~ 30 cm in diameter) at a depth of nearly 40 cm in an open area which enabled direct sunlight exposure. Surroundings consisted of some fragments of densely forested areas mingled with open areas belonging to other rural proprieties. Eggs were donated to Butantan Institute on April 8, 2010 and incubated in plastic containers with moistened vermiculite and temperature averaging 25 °C. On April 14, 2010 hatchlings started to emerge from the eggs and only one egg failed to hatch. Hatchlings were identified as *Oxyrhopus guibei* and were subsequently deposited in the "Herpetological Collection Alphonse Richard

1 Laboratório de Ecologia e Evolução, Instituto Butantan, Avenida Dr. Vital Brazil, 1500, CEP 05503-900, São Paulo-SP, Brazil; e-mail: hbbraz@gmail.com

2 Pós-Graduação em Anatomia dos Animais Domésticos e Silvestres, Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, Brazil;

3 Photo in Natura, Rua do Buriti, 770, CEP 79290-000, Bonito-MS, Brazil.

* Corresponding author.

Figure 1. Nest-site and nest area of *Oxyrhopus guibei* at Serra do Japi, Jundiaí, São Paulo. (A) View of the nesting area with arrow pointing the nest-site. (B) Clutch of *O. guibei* after removing the rock that covered the eggs. Photographs: (A) Antonio Silveira and (B) Nelson Traldi.

Hoge", at Butantan Institute (IB 78359).

Nest sites and nesting areas are largely unknown for Neotropical snakes. In Brazil, there are only punctual data for some species on fortuitous encounters in nature (e.g. Albuquerque and Ferrarezzi, 2004; Travaglia-Cardoso, 2007; Braz, Franco and Almeida-Santos, 2008). For the genus *Oxyrhopus*, for example, we found only two reports of nest-sites in the literature (Table 1). One female of *O. petola* laid a clutch of eight eggs beneath a pile of fronds of African Palm in a palm plantation, in Colombia (Lynch, 2009) and hatchlings

Table 1. Summary of nest characteristics known to date for the genus *Oxyrhopus*.

Species	Nest type (microhabitat)	Nest use	Nesting areas	Reference
Oxyrhopus guibei	Pre-formed (under rocks)	Singly (one clutch of 9 eggs)	Open area among forested fragments	Present study
Oxyrhopus guibei	Pre-formed (rabbit burrow)	Singly (one clutch of 10 eggs)	Open area among forested fragments	Present study
Oxyrhopus petola	Pre-formed (under pile of fronds)	Singly (one clutch of 8 eggs)	African palm plantation	Lynch, 2009
Oxyrhopus rhombifer	Pre-formed (tree hollow)	Singly (three hatchlings)	Not reported	Berkunsky and Kacoliris, 2008

of *O. rhombifer* were found within a tree hollow in Argentina (Berkunsky and Kacoliris, 2008). Although this type of data impairs identifying species-specific patterns of microhabitat use by nesting snakes, it allows outlining some considerations. Firstly, snake nests in general, are frequently found in open areas (clearing or forest edges) instead of densely vegetated ones (e.g. Fowler, 1966; Burger and Zappalorti, 1986; Albuquerque and Ferrarezi, 2004; Braz, Franco and Almeida-Santos, 2008; present study). Mothers appear to search for these places because they may allow direct sunlight exposure and thus providing higher thermal incubation conditions (Magnusson and Lima, 1984; Shine, Barrott and Elphick, 2002). However, such consideration deserves caution because it may simply reflect a higher human activity in these areas than in densely vegetated ones. Secondly, *Oxyrhopus* spp. as well as most snake species seems to be unable to construct a nest and thus rely on pre-existing sites for egg-laying. Such sites may be under rocks, logs, within preformed subterranean chambers or any other surface cover (Riley, Stimson and Winch, 1985; Packard and Packard, 1988; Braz, Franco and Almeida-Santos, 2008). Thirdly, despite communal nests being a common trend in squamate reptiles (reviewed by Doody, Freedberg and Keogh, 2009) and for some species is a recurrent phenomenon (e.g. *Sibynomorphus mikanii*: Albuquerque and Ferrarezi, 2004; Braz, Franco and Almeida-Santos, 2008), to date only single nests are known for the genus *Oxyrhopus* (Berkunsky and Kacoliris, 2008; Lynch, 2009; this study). Both communal and single nests have advantages and disadvantages (Doody, Freedberg and Keogh, 2009). The adoption of one type of nest against the other suggests that fitness benefits resulting from the trade-offs between them vary among species.

Evidently, more effort is necessary to find and know nest-site locations in Neotropical snakes. Several reports of ant and termite nests use as nesting site by gravid snakes have been published (e.g. Riley, Stimson and Winch, 1985; Travaglia-Cardoso, 2007). Regular surveys on this kind of microhabitat may be helpful in clarifying how species use these sites. In addition, radio-telemetry has revealed a powerful tool in finding nesting snakes in nature (Parker and Brown, 1972; Plummer, 1990) and should also be considered when studying nesting ecology of Neotropical snakes.

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