Population dynamics of two troglobitic *Troglorhopalurus* Lourenço Baptista & Giupponi, 2004 (Scorpiones: Buthidae) scorpions from Brazil

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Introduction

Studies concerning populational dynamics raise data about fluctuations in the number of individuals as well as species intrinsic ecological features such as fertility, birth and death rates. Knowledge about natural history of species provides better conservation strategies, mainly handling with obligatory subterranean species.

Most common populational studies on cave arachnids in Brazil are about Opilionids, since they are easy to manipulate and there are many species of all subterranean ecological-evolutionary categories, but populational studies were conducted with cave Pseudoscorpiones and Amblypygi too.

The aims of this study were to investigate natural history as longevity, growth and reproductive biology and population parameters as size and sazonality through mark and recapture method for two troglobitic scorpions from Brazil.

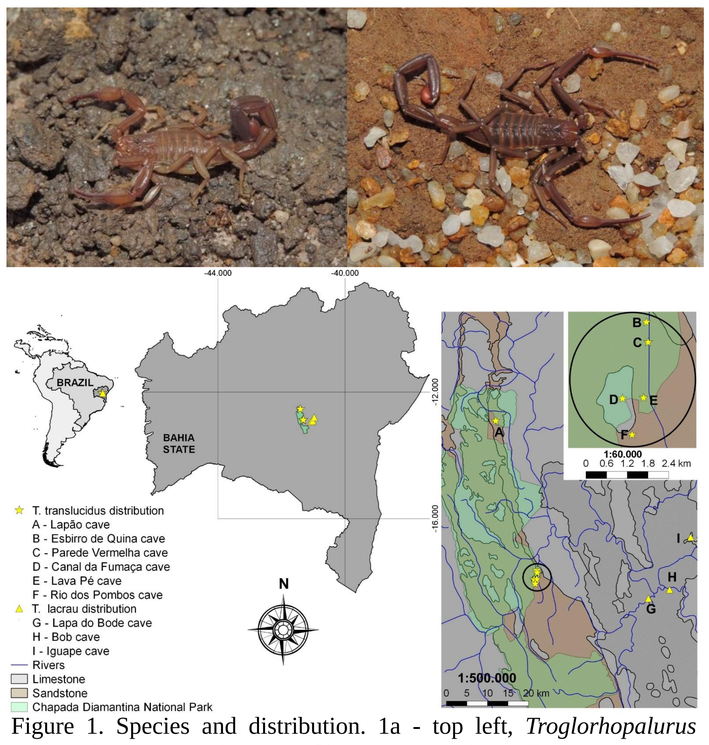

Figure 1. Species and distribution. 1a - top left, *Troglorhopalurus lacrau* (pop. study in cave G); 1b - top right, *Troglorhopalurus translucidus* (pop. studies in caves D, E e F); 1c - bottom, distribution of both scorpions.

Material & Methods

Troglorhopalurus lacrau (Lourenço & Pinto-da-Rocha, 1997) (Figure 1a) lives in limestone caves and *Troglorhopalurus translucidus* Lourenço, Baptista & Giupponi, 2004 (Figure 1b) lives in sandstone caves, both from Chapada Diamantina, Bahia state, northeastern Brazil (Figure 1c). Despite both species were recorded in a couple of caves, we choose the type-locality for *T. lacrau* and three caves for *T. translucidus*, those ones that favor capture and handling the scorpions.

Individual marks were made with automotive paint (nitrocellulose-based lacquers) (Figure 2a) and we measured lenght of chela and lenght of prosoma of each specimen (Figure 2b, c). We used Jolly-Seber model with POPAN (population analysis) formulation to perform populational data (Figure 3), using three variables, constant (~1); time (~time) and a severe flood in january 2016 (~Flood). Population analysis and ANCOVA were carried out in R RMARK .

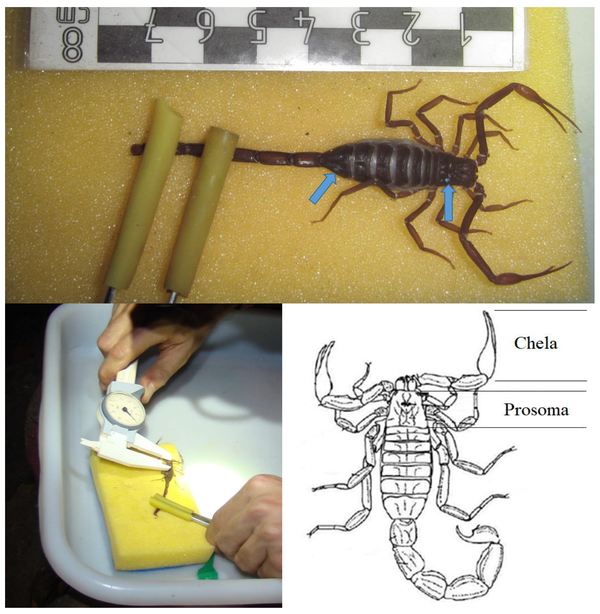

Figure 2. Mark and recapture method and measurements. 2a - top, specimen with individual marks; 2b - bottom left and 2c bottom right, measurements taken during fieldwork.

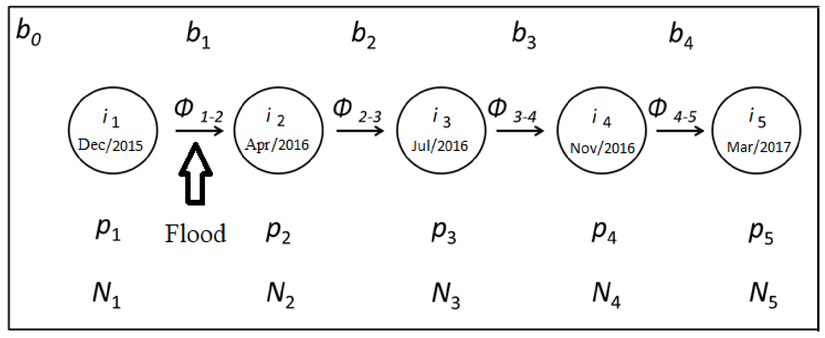

Figure 3. Process model for Jolly-Seber with POPAN parameterization experiments. **p***i* represents the probability of capture at occasion *i*; **ϕ***i* represents the probability of an animal surviving between occasions *i* and *i*+1; and **b***i* represents the probability that an animal from the super-population (N) would enter the population between occasions *i* and *i*+1 and survive to the next sampling occasion *i*+1 (modified from Schwarz & Arnason, 2018) .

Results & Discussion

Longevity could not be exactly estimated since there was no observation from litter to maturity, however, indirect observations such as duration of some instars allow us to state that longevity for both scorpions are higher than Neotropical epigean buthids.

Troglorhopalurus lacrau presents six instars and all of them, except instar 2, were captured in populational studies (Figure 4) unlike *T. translucidus* that presents seven instars, all of them captured (Figure 4). The number of instars are according to Buthidae Family that ranges from four to seven (Polis, 1990).

The litter size was 28±3 (n=4) for *T. lacrau* and 41±2 (n=3) for *T. translucidus* (Figure 5a). These numbers are similar compared to related genera as *Rhopalurus* and *Jaguajir*, but higher compared with *Tityus* (Outeda-Jorge, 2009). Iteroparity and cannibalism (Figure 5b) were registered for both species and reproductive period occurs in the rainy season for both species.

Both scorpions presentes high population estimates (Figure 6), even when compared with Neotropical epigean scorpions. *Troglorhopalurus lacrau* was not affected by flood and the fitted model was with all parameters constant (Figure 6a), in contrast to *T. translucidus* since surviving probability varied over time and probability of capture varied over flood (Figure 6b).

Una river, near Lapa do Bode cave (type-locality of *T. lacrau*) presentes cyclical floods in rainy season and this species could be more adapted to floods in rainy season whereas *T. translucidus* is more affected by floods.

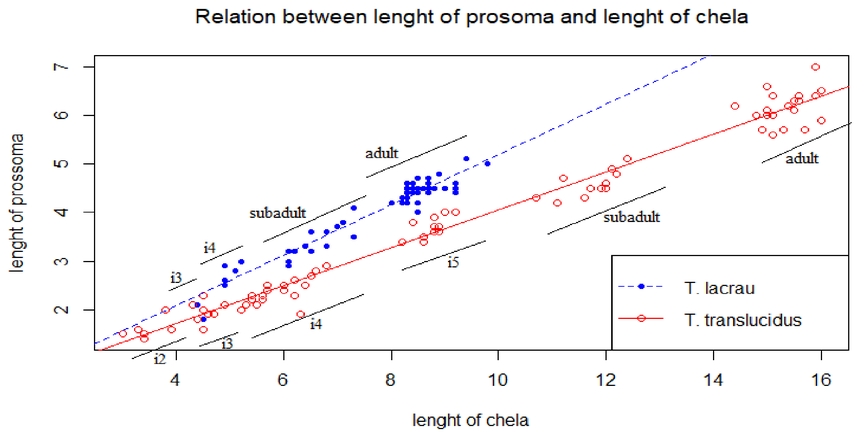

Figure 4. Relation between lenght of prosoma and lenght of chela for both species. *Troglorhopalurus lacrau* presentes six instars while *T. translucidus* presentes seven. i = instar.

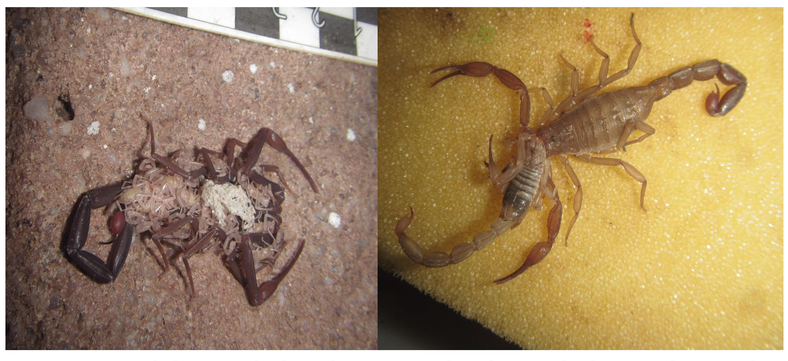

Figure 5a - left, *Troglorhopalurus translucidus* with litter; 5b - right, *Troglorhopalurus lacrau* with cannibalistic behaviour.

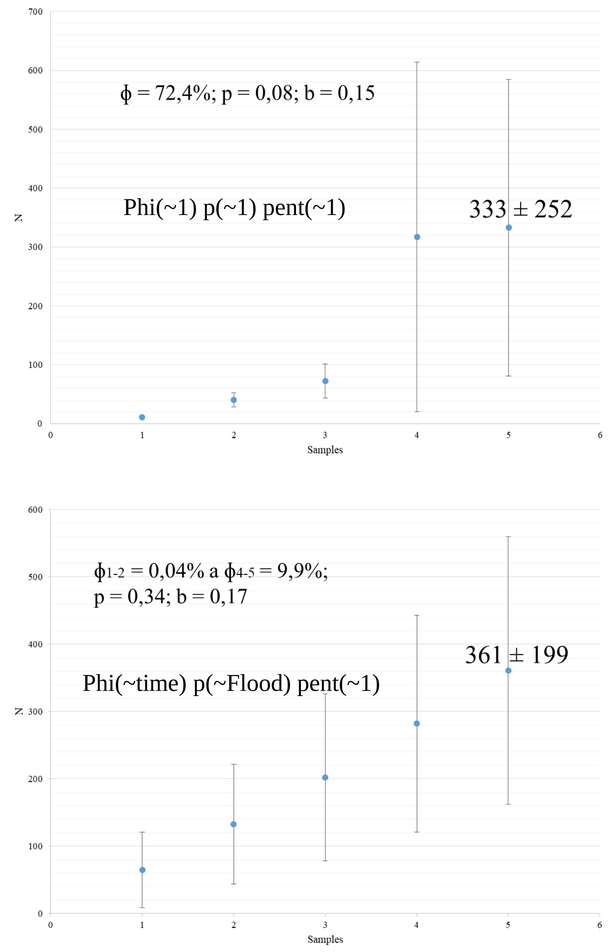

Figure 6. Population estimates for both scorpions. 6a - top, *Troglorhopalurus lacrau* with best fitted model with all parameters constant; 6b - bottom, *T. translucidus* with best fitted model varying with time and flood.

Bibliography:
Outeda-Jorge, S.; Mello, T.; Pinto-Da-Rocha, R. (2009). Litter size, effects of maternal body size and date of birth in South American scorpions (Arachnida: Scorpiones). Zoologia, 26 (1): 43-53.
Polis, G. A. (1990). Ecology. Pp. 247–293. In: Polis, G. A. (ed.). The Biology of Scorpions. Stanford University Press, Stanford University Press, Stanford, 594p.
Schwarz, . J.; Arnason, A. L. (2018). Jolly-Seber models in MARK. In: Cooch E.G. & White G.C (Eds.). Program MARK: a gentle introduction. Colorado State University, Colorado, USA.

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