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Herpetological Review, 2002, 33(3), 174–175.

Microhabitat Selection in *Porthidium nasutum* (Serpentes: Viperidae) in Costa Rica, with Comments on Ontogenetic Variation

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The rainforest hognosed pitviper, *Porthidium nasutum*, is an inhabitant of the humid tropical lowlands of Middle America and northwestern South America, belonging to the Eastern Mesoamerican Complex of Savage (1966) and the Humid Tropical Assemblage of Duellman (1966). The range of *P. nasutum* includes most of the lowland rainforests of Middle America as well as Colombia and Ecuador (see Campbell and Lamar 1989, for detail). Throughout its range, this species occurs from near sea level to about 900 m in elevation, but is generally found below 600 m (Porras et al. 1981).

Despite its relatively high abundance in Costa Rica (pers. obs.), little has been reported on the behavior and ecology of this species. According to Porras et al. (1981), *Porthidium nasutum* is terrestrial and nocturnal, although specimens can be found basking by day. Based on a review of previous work on the species, Porras et al. (1981) report specimens having been found inside cavities in the trunks of trees, underneath roots of trees or rocks, under logs, among loose rocks of archaeological ruins, or lying on the forest floor. Campbell (1998) stated that while this species is considered nocturnal, it is most often found in the early mornings crossing jungle paths or roads, or lying coiled in leaf litter in small patches of sunlight. He stated that encounters are most frequent in primary forest or in small patches of secondary forest surrounded by primary forest. In this study, microhabitat preferences and activity patterns of *P. nasutum* were investigated by examining environmental features and behavior of this species in a wet tropical forest in northeastern Costa Rica.

Methods.—Snakes were located through visual encounters along trails in the three major forest tracts of Estación Biológica La Suerte (Limon Province, northeastern versant of Costa Rica) in July of 1999. These tracts are a mosaic of primary and secondary tropical wet forest. The age class of each snake was recorded as adult (> 30 cm) or sub-adult (< 30 cm) based on overall body length. Individuals (N = 6; 3 adults, 3 sub-adults) were uniquely identified based on color pattern. Observations were conducted during daylight hours as well as at night (using a low luminosity red lamp).

The area immediately surrounding each individual snake was surveyed for characteristics possibly influencing microhabitat selection. The distance from the snake to the trunk of the nearest buttressed tree (> 0.5 m in diameter) was recorded to the nearest 0.5 m. The area within a 0.5 m radius of the snake was surveyed for placement of woody structure of debris (> 5 cm in height). Leaf litter depth was recorded in close proximity to each individual by measuring 5 randomly selected points within 0.5 m of each snake. The location of each snake was plotted on maps of the forest and used to identify the closest stream to each occurrence. The estimated snake-to-stream distance was later ground-truthed to the nearest meter in the field. The data collected for leaf litter depth, snake-to-stream distance, and snake-to-buttressed tree distance were analyzed using a Mann-Whitney U test to determine significant differences between age classes. The presence or absence of woody structure within a 0.5 meter radius was analyzed using a sign test. Results of the microhabitat measurements were summarized as means with standard errors and are presented in Table 1.

TABLE 1. Summary of quantitative habitat/microhabitat selection data for *Porthidium nasutum*. Microhabitat measurements for sub-adults, adults, and overall are reported as means ± standard error. (* Indicates statistically significant differences between adults and sub-adults).

	Adult	Sub-adult	All	Sub-adult vs. Adult P-value
Distance from nearest buttressed tree (m)	1.8 ± 0.88	7.3 ± 1.76	4.3	0.513
Leaf litter + humus depth (cm)	1.7 ± 0.53	1.3 ± 0.33	1.5	0.421
Percentage of snakes with woody structure present within 0.5 m radius	33.3%	100.0%	66.6	0.480
Distance from nearest stream (m)	43.3 ± 3.33	22.7 ± 2.33	33	0.043*

Results and Discussion.—The results of this study demonstrate the first quantitative microhabitat data reported for this species (Table 1), which includes previously unreported ontogenetic variation in microhabitat selection. While the first three tests were not significant, the data show a significant ontogenetic difference relative to distancing from streams (Table 1). On average, sub-adult snakes were found 15.6 m closer to streams than were adults. Similar ontogenetic shifts in snake to stream distance have been reported in *Bothrops atrox* in Venezuela and are thought to be linked to the micro-geographic structuring of prey communities at varying distances from these streams (Reinert 1993, Sexton 1957).

Several ontogenetic differences associated with the morphology of this species give reason to suspect ontogenetic differences in microhabitat choice. Porras et al. (1981) reported that specimens show ontogenetic shifts in color pattern, with juveniles being more distinct and brightly colored than adults, especially with regard to the mid-dorsal stripe which fades or disappears in adults (Porras et al. 1981). Increasing size also leads to the fragmentation of blotches that often gradually divide into two portions, laterally displaced from the mid-dorsal line (Porras et al. 1981). Such apparent morphological differences might represent adaptive features which facilitate ontogenetic microhabitat shifts reported in this study.

To date, information on the diet of this species is available only as anecdotal accounts. Campbell (1998) stated that adults of this species in Guatemala feed mostly on frogs and lizards as well as small rodents, while juveniles are known to feed on invertebrate prey. Porras et al. (1981) reported the diet to include lizards and mice, in addition to juveniles eating earthworms in captivity. Greene (1997) reported that juveniles of this species commonly feed on frogs and lizards while adults consume mostly mammals and the occasional bird. Additionally, *Porthidium yucatanicum* and *Cerrophidion godmani* (members of the "*Porthidium* group" sensu Burger 1971), show a similar ontogenetic shift as juvenile diets focus on invertebrates, frogs and lizards, while adults of both species shift to mammalian prey (Campbell and Solórzano 1992; McCoy and Censky 1992). The preliminary data on microhabitat partitioning in *Porthidium nasutum* presented here might be associated with such ontogenetic shifts in diet.

Acknowledgements.—I would like to thank Chuck Cohout, Rick Constantino, Ron Bonnet, and Chaz Gilbert for help in the field, and Ron Bonnet, Tiffany Doan, Tom LaDuke, Walter Schargel, and Eric Smith for discussion of the results and comments on early drafts.

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