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Is synchronized ecdysis in wild ratsnakes (*Pantherophis alleghaniensis*) linked to humidity?

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Abiotic conditions play an important role in shaping the behavior of wild reptiles and amphibians. Temperature has received perhaps the most attention in reptiles, primarily in the context of thermoregulation (Bogert, 1949). Though little studied, humidity may also be an important environmental factor influencing the behavior of wild reptiles (Nicholson et al., 2005). In lizards, humidity can affect hormone levels (Summers and Norman, 1988) and evaporative water loss rates through skin (Kattan and Lillywhite, 1989). Perhaps for these reasons, inappropriate humidity levels are a common cause of dysecdysis (incomplete or problematic shedding) in captive reptiles (White et al., 2011). We could thus expect shedding in wild reptiles to be influenced by environmental conditions as well.

It has been anecdotally reported that ecdysis in the tropical viper *Calloselasma rhodostoma* occurs when humidity is high (Daltry et al., 1998). Humidity may be important during ecdysis to prevent dehydration, a risk of the increased activity required for shedding and potentially increased rates of cutaneous water loss (Daltry et al., 1998). However, there is yet little known about the role of humidity in ecdysis cycles in natural populations of reptiles. We here report an aggregation of Eastern Ratsnakes (*Pantherophis alleghaniensis*, formerly *Elaphe obsoleta*) that exhibited synchronized ecdysis, apparently linked to humidity. The thermal ecology of *P. alleghaniensis* has been relatively well described (e.g. Blouin-Demers and Weatherhead, 2001b), but we know of no existing information on the role of humidity in behavior, nor of any occurrence of synchronized ecdysis in wild populations.

Our observations were made at Penn State University's Russell E. Larson Agricultural Research Center at Rock Springs, Centre Co., Pennsylvania, USA. This approximately 800 ha property consists mostly of agricultural fields with small patches of trees and brush. It borders Rothrock State Forest, at the base of the northern slope of the Tussey Mountain Ridge. Beginning on 17 May 2013, we first noticed *P. alleghaniensis* in the rafters of an old, simple barn (approx. dimensions 14 m x 6 m) located on the edge of the forest (40.710° N, 77.941° W). Over the next 11 days, *P. alleghaniensis* were observed in the barn on most days, appearing to be absent only during particularly hot or cool weather. We noted several sites within the barn where snakes could have sheltered without being observed (e.g., a pile of boards in the rafters, gaps in the wall). As many as six *P. alleghaniensis* were observed at one time, mostly restricted to a 6 m x 4 m area at the western end of the barn. They were usually motionless, coiled up, or stretched along a beam. We noticed that many *P. alleghaniensis*, when viewed from a short distance, exhibited cloudy, bluish eyes and/or dull body coloration, indicative of the onset of ecdysis.

On 29 May, shed skins (but no snakes) were found in the barn, and no recent skins had been found before this date. After collecting each skin we could find, we determined that they were from at least four individuals based on the number of heads represented and the total length of the skins. No other snake species besides *P. alleghaniensis* occur at this location consistent with the size and scalation on the shed skins. An examination of weather records from the nearest weather station (archived at http://www.wunderground.com) indicated that this large number of shed skins appeared after a day characterized by a high peak in humidity and a significant rain event during the observation period

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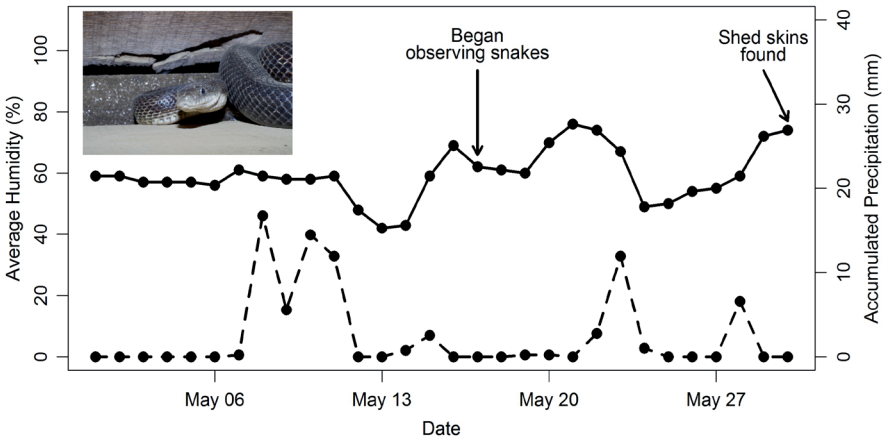

Figure 1. High humidity (solid line) and rain (broken line) appear to have preceded a synchronized ecdysis event in *Pantherophis alleghaniensis* aggregating in a barn (inset).

(Fig.1). This was preceded about one week earlier by elevated humidity and rainfall as well. We do not have any data available to verify the humidity within the barn.

Multiple wild individual snakes undergoing ecdysis within less than 24 h of each other is, to the best of our knowledge, a previously undescribed phenomenon. This strengthens previous suggestions of synchronized shedding in wild snakes (Moler, 1985). Furthermore, it suggests that these ratsnakes took refuge at the same (and potentially environmentally favorable) site for ecdysis (as noted by Blouin-Demers and Weatherhead, 2001a) until some environmental factor may have triggered ecdysis. The most probable cause appears to be favorable levels of humidity coupled with rainfall, which may have been potentiated by an earlier period (19–23 May) of elevated humidity and rain (Fig. 1). We cannot, however, rule out other environmental factors or that shedding occured a certain period after the snakes emerged from hibernacula or in preparation for ovipositing (Lourdais et al., 2008), though in the latter cases it seems unlikely that each snake would be so precisely synchronized with others given the inter-individual variability of the duration of the shedding process (based on reports from a related species, *Orthriophis taeniurus*; Maderson, 1965). Nonetheless, we cannot exclude this possibility. The 'humidity hypothesis' appears to be best supported, as it is consistent with the known importance of humidity for proper skin shedding in captive reptiles (White et al., 2011). Humidity may play an underappreciated but significant role in the behavior and ecology of reptiles and deserves additional attention in field studies.

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