Behaviour, time management, and foraging modes of a West Indian Racer, *Alsophis sibonius*

LAUREN A.WHITE[1], PETER J. MUELLEMAN[2], ROBERT W. HENDERSON[3], and ROBERT POWELL[4]

[1] *Environmental Science Program, Oklahoma State University, Stillwater, Oklahoma 74078, USA*

[2] *Department of Biology, Truman State University, Kirksville, Missouri 63501, USA*

[3] *Section of Vertebrate Zoology, Milwaukee Public Museum, Milwaukee, WI 53233, USA*

[4] *Department of Biology, Avila University, Kansas City, MO 64145, USA*

[4] Corresponding author: robert.powell@avila.edu

ALSOPHIS sibonius (Fig. 1), formerly considered a subspecies of *Alsophis antillensis* (Hedges *et al.*, submitted), is a West Indian Racer endemic to Dominica, Lesser Antilles.

Common habitat associations include rain forest, rain forest edges, coastal scrub, mountain pastures, mangrove edges, deciduous forests, and orchards/plantations. High densities appear to occur in areas with abundant rocks (Schwartz & Henderson, 1991). These snakes are predominantly diurnal, with activity peaks at mid-morning and late afternoon (Malhotra & Thorpe, 1999; Muelleman *et al.*, submitted). Henderson & Sajdak (1996) indicated that species of *Alsophis* primarily consume lizards, particularly anoles, but eat other vertebrates including frogs, other snakes, birds, and rodents.

Snakes in the genus *Alsophis* once were known to occur on more than 100 islands from the Bahamas through Dominica in the Lesser Antilles (Henderson & Sajdak, 1996). Due to habitat degradation, human persecution, and the introduction of invasive Indian mongoose (*Herpestes javanicus*) and Black rat (*Rattus rattus*), they have undergone 'more extirpations and extinctions than any other reptilian or amphibian genus in the region' (Barun *et al.*, 2007).

Several Lesser Antillean species, including *Alspohis antiguae*, *Alsophis rijgersmaei*, and *Alsophis rufiventris*, are considered threatened or endangered (Daltry *et al.*, 2001; Henderson & Powell, 2009). Despite the wide distribution of these snakes, little is known about their daily activity and time management.

The purpose of this study was to investigate the daily activity, time allotment, and foraging modes of *A. sibonius*.

METHODS AND MATERIALS

From 6–24th June 2008, we conducted focal animal observations along established trails in Cabrits National Park, Dominica. The area was clear-cut by British troops during the 18th and 19th centuries for the construction and occupation of Fort Shirley. Since 1850, the fort has been largely abandoned, and the forest has recovered to form a xeric woodland. The annual average temperature is 26 ºC, with average rainfall of 1870 mm. January through June is classified as the dry season. The canopy is moderately dense, with little sunlight reaching the forest floor except during the dry season, when the deciduous trees that dominate the area shed their leaves. At least 40 species of trees have been identified within the park, with *Lonchocarpus latifolius* the most common. The polychrotid lizard *Anolis oculatus* is abundant, especially near ruins and rock outcrops. Although *Anolis* lizards of Cabrits are well adapted to the forest environment and utilize trees for escape, they frequently forage on the forest floor.

Habitats along trails provided visibility that facilitated observations of snakes without disturbing them (Heinz *et al.*, 2004). Once a snake was identified and clearly had not responded to the observer, we conducted focal observations of 5–22 min. Observations were terminated after 15 min or when the snake was lost from view or reacted to the observer's presence. When snakes were

Figure 1. Dominican Racer (*Alsophis sibonius*) adult (top) and juvenile (below). Photographs by Jeffrey W. Ackley and Robert Powell.

engaged in recognizable feeding or foraging behaviour, observation times were extended. We recorded time using an iPod (Apple, Inc., Cupertino, California 95014, USA) stopwatch feature capable of separately monitoring movements and stationary periods within a single session.

We conducted focal observations during 'peak activity times' in the morning and late afternoon (Malhotra & Thorpe, 1999; Muelleman *et al.*, submitted). For each observation, we recorded habitat, initial posture, time spent moving, distance moved, presence or absence of tongue-flicking, and foraging behaviours. For habitat, we noted the level of disturbance, insolation, and substrate. Disturbance levels were ranked 1–5, with 1 indicating the least disturbed situations (no signs of human activity, generally occurred >10 m from even the smaller trails), 2–4 representing various intermediate stages of human disturbance considering factors such as trail width and extent of human traffic, and 5 being the most disturbed, which in this study was a paved sidewalk entrance traversed by everyone entering or leaving the park (Fig. 2). Insolation was classified as shade, sun-shade mosaic, or direct sun. Substrates included leaf litter, rock, soil, ruins (generally consisting of old rock walls and buildings), and trees or fallen trees. Movements were classified as stationary or moving, and then narrowed into sub-categories, sprawled ('stretched along substrate, with no part of the body touching another'; Heinz *et al.*, 2004) or loosely coiled for stationary snakes (no snakes were tightly coiled) and traveling slowly (no tongue-flicking, slow movement, possibly scanning

intermittently), traveling (no tongue-flicking, steady rapid movement), and actively foraging (rooting in leaf litter or moving while tongue-flicking). Snakes assuming a foraging posture at the base of a tree were categorized as "sprawled" because the 'foraging' category was originally designated for active foraging behaviours, and because of the difficulty in determining whether a snake was resting or exhibiting a sit-and-wait ambush foraging strategy.

RESULTS AND DISCUSSION

We recorded a total of 267 min of focal animal observations on 19 snakes from 0719–1115 h and 1613–1732 h. Although we have relatively few observations, this study was conducted in conjunction with a survey on snake activity and habitat associations (Muelleman *et al.*, submitted), enabling observers to select focal subjects that were farther from the trail and less likely to be disturbed. If a snake responded noticeably to an observer's approach or at any time during the observation, focal time was stopped and we moved to the next snake. This method ensured that behaviour of animals considered in the study accurately represented 'typical' behaviour.

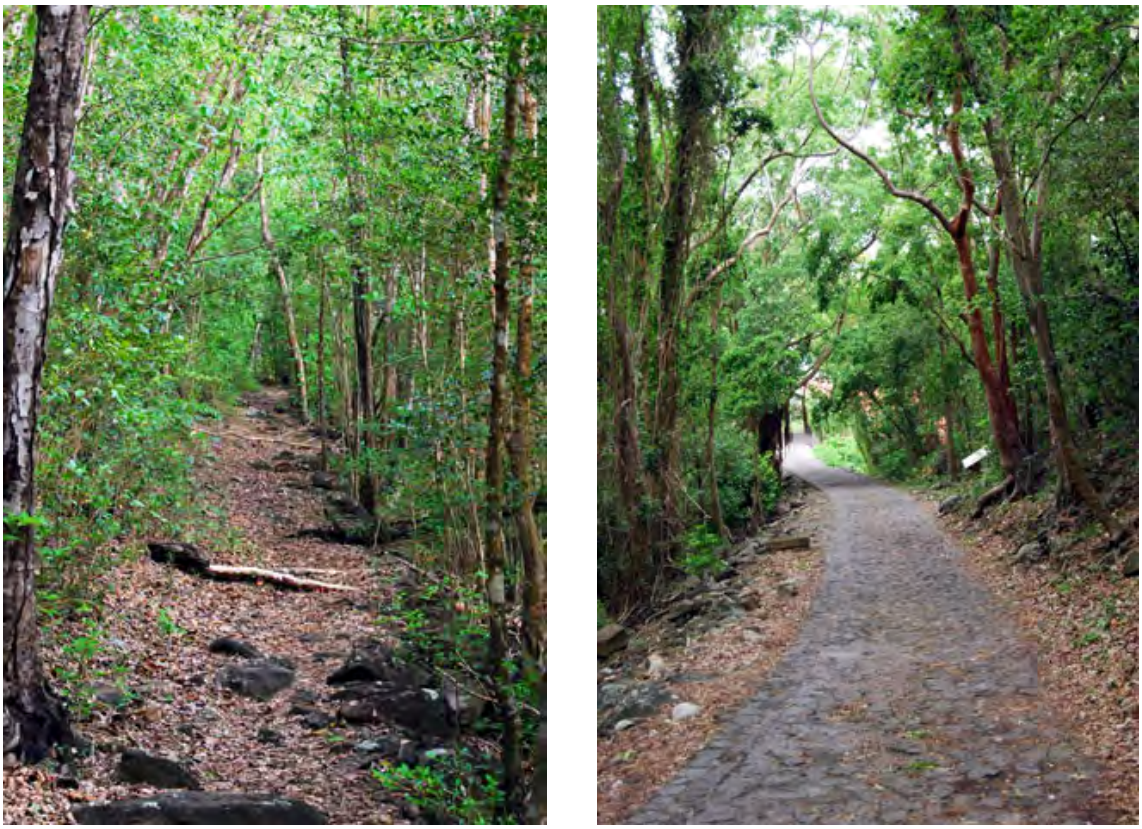

Figure 2. Trails showing 'disturbance'; disturbance level 3 (moderate impact; left), and disturbance level 5 (most disturbed of areas sampled during this study). Photographs by Lauren A. White.

Individual snakes often spent extended periods or even entire focal periods engaged in a single activity or posture. Collectively, snakes spent the greatest percentage of time foraging (32.3%), traveling (30.6%), and sprawled (28.2%) (Table 1, Fig. 3). Very little time was spent moving slowly, and this category was exhibited only after extended stationary periods. Only one snake was "coiled," and it was loosely coiled. Because focal observations were conducted at peak activity times, large percentages of time devoted to traveling and foraging were not unexpected. Little sunlight penetrated the relatively contiguous canopy in the park and 17 of 19 snakes observed were in full shade. Most of the ground was covered with leaf litter and 13 snakes were sighted initially

either wholly or partially on leaf litter. Every one of these snakes was in contact with leaf litter at some point during the observation.

Heinz *et al.* (2004) examined behaviour and time allotment of *A. rufiventris* on St. Eustatius, and found snakes traveling 21 %, foraging 28 %, and sprawled 35 % of the time (in various degrees of insolation). Barun *et al.* (2007), during a study of *A. portoricensis anegadae* on Guana Island (British Virgin Islands), noted that 40.4 % of snakes were moving when first seen, 47.8 % were sprawled and 11.7 % were coiled. Those data are generally comparable to ours, although snakes on St. Eustatius and Guana moved less and were stationary (sprawled, 'scanning', and coiled) more frequently than snakes on Dominica. However, those differences may be attributable largely to the fact that observations made during those other

Number	**Habitat**			**Moving**			**Stationary**	
(time)	Substrate	Disturbance	Insolation	Travel Slowly	Travel	Foraging	Sprawled	Coiled
1 (7)	2	4	3	-	-	-	7	-
2 (10)	1	3	3	-	-	10	-	-
3 (15)	1	3	2	-	-	15	-	-
4 (16)	1,4	3	3	-	-	-	16	-
5 (15)	3	4	3	-	-	14	-	-
6 (15)	3	4	3	3.5	-	6.5	5	-
7 (10)	3	4	3	-	-	-	6	-
8 (5)	3	4	3	1	-	-	3	-
9 (15)	1,3	3	2	1	-	-	11	-
10 (16)	1	3	3	-	-	-	16	-
11 (15)	1	3	3	-	-	-	15	-
12 (22)	2	3	3	-	-	-	22	-
13 (17)	1	3	3	2	-	-	15	-
14 (14)	1,2	3	3	-	-	8	1	-
15 (18)	1	3	3	-	-	12	5	1
16 (16)	1	3	3	-	-	-	-	-
17 (15)	1	3	3	-	-	-	15	-
18 (10)	1	3	3	-	7	-	3	-
19 (16)	1	3	3	-	12	-	4	-

Table 1. Data collected on 19 *Alsophis sibonius* during focal animal observations at Cabrits National Park in Dominica.

studies were not restricted to peak activity periods.

We observed several unusual behaviours during focal observations. We saw snakes rooting and digging in loose soil and probing small holes in a fashion similar to that described by Heinz *et al.* (2005) for *A. rufiventris.* During one observation, an adult *A. sibonius* was probing in leaf litter and a small hole for approximately 10 min, after which the snake was seen swallowing an unidentified object. Subsequently, three other snakes were observed swallowing small eggs, most likely deposited in the litter by the lizard *Anolis oculatus*. On 11 June at 1634 h, we saw a snake with approximately 8–10 cm of its head and anterior body elevated and adpressed against a tree trunk. For 15 min, the snake was completely motionless with no tongue-flicks. At 1827 h, the snake was seen again in the same pose, presumably not having moved during the interim. An anole on the tree at a height of approximately 80 cm was doing push-ups movements in the snake's general direction. The lizard was clearly alarmed, but the snake did not respond in any way. At 1835 h, the snake abandoned this posture and circled the tree, where it tongue-flicked the trunk and base of the tree, then left and was lost from view. Subsequently, four other snakes were observed assuming or in this position, above two of which we observed anoles. One snake made an unsuccessful strike at

an adult anole from this position on the side of a large rock on which the anole was eating an insect. Powell & Henderson (2008) described and illustrated a similar posture assumed by a snake at the base of a tree after dark on which anoles regularly extended their activity to forage for insects attracted to the light. The 'sprawled' posture abundantly documented in our data, despite our study being conducted primarily at peak activity times, suggests that these snakes employ both active and ambush foraging strategies for arboreal anoles and their eggs. Ambush behaviour also is common in *A. antiguae* (Daltry *et al.*, 2001).

During another encounter, a focal was initiated but quickly discontinued because the snake became aware of and increasingly alarmed by the observer, who then slowly approached the snake, almost touching it near the head with the end of a pencil.

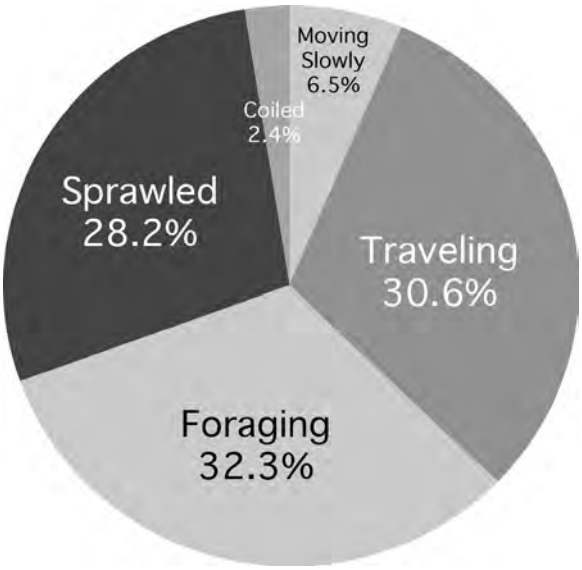

Figure 3. Percent time allotted to various activities and postures by 18 *Alsophis sibonius* during focal animal observations at Cabrits National Park on Dominica.

At that point, the snake fled approximately 1 m, assumed a sprawled position facing away from the observer, and proceeded to move the tip of its tail (ca. 5–6 cm) in a slow, apparently intentional wriggling motion with its head turned as if monitoring the threat. Similar behaviours have been observed in other snakes, for which it has been associated with ambush foraging and caudal luring (Heatwole & Davison, 1976). Because we observed it in only one animal, we cannot attribute any motive to the behaviour, although it appeared to function as a means of enticing a predator to direct its attack to the tail instead of the head, rather than serving a foraging or luring role (Green, 1988).

Very similar behaviour was observed in *A. rufiventris* (Heinz *et al.*, 2004), although whether that snake was responding to an observer (i.e. a threat) is unclear.

ACKNOWLEDGMENTS

We thank Seth Rudman and Ruthie Carter for help in the field. Arlington James, Forest Officer, Forestry, Wildlife, and Parks Division, Ministry of Agriculture & the Environment and Commonwealth of Dominica was instrumental in issuing permits to conduct research in Dominica and facilitated our efforts in myriad ways. Fieldwork was funded by a grant from the National Science Foundation (USA) to Robert Powell (DBI-0242589).

REFERENCES

Barun, A., Perry, G., Henderson, R. W. & Powell, R. (2007). *Alsophis portoricensis anegadae* (Squamata: Colubridae): Morphometric characteristics, activity patterns, and habitat use. *Copeia* **2007**, 93–100.

Daltry, J. C., Bloxam, Q., Cooper, G., Day, M. L.,

Hartley, J., Henry, M., Lindsay, K. & Smith, B. E. (2001). Five years of conserving the 'world's rarest snake', the Antiguan Racer *Alsophis antiguae*. *Oryx* **35**, 119–127.

Greene, H. W. (1988). Antipredator mechanisms in reptiles. In: *Biology of the Reptilia. Volume 16. Ecology B*, pp. 1–152. C. Gans & R. B. Huey (Eds). New York: Alan R. Liss.

Heatwole, H. & Davison, E. (1976). A review of caudal luring in snakes with notes on its occurrence in the Saharan Sand Viper, *Cerastes vipera*. *Herpetologica* **32**, 332–336.

Hedges, S. B., Cruaud, C. & Vidal, N. (Submitted). Molecular phylogeny, classification, and biogeography of West Indian racers of the tribe *Alsophiini* (Squamata, Dipsadidae, Xenodontinae).

Heinz, H. M., Maley, A. J., Savit, A. Z., Henderson, R. W. & Powell, R. (2004). Behavior and time allotment in the West Indian snake *Alsophis rufiventris* (Colubridae). *Herpetological Bulletin* **89**, 22–25.

Heinz, H. M., Savit, A. Z., Maley, A. J., Henderson, R. W. & Powell, R. (2005). *Alsophis rufiventris*. Foraging and diet. *Herpetological Review* **36**, 186–187.

Henderson, R. W. & Powell, R. (2009). *Natural History of West Indian Amphibians and Reptiles*. Gainesville: University Press of Florida.

Henderson, R. W. & Sajdak, R. A. (1996). Diets of West Indian racers (Colubridae: *Alsophis*): Composition and biogeographic implications. In *Contributions to West Indian Herpetology: A Tribute to Albert Schwartz*, pp. 327–338. R. Powell & W. R. Henderson (Eds.). Ithaca, New York: Society for the Study of Amphibians and Reptiles, Contributions to Herpetology, Volume 12.

Malhotra, A. & Thorpe, R.S. (1999). *Reptiles & Amphibians of the Eastern Caribbean*. London: Macmillan Education Ltd.

Muelleman, P. J., White, L. A., Henderson, R. W. & Powell, R. (Submitted). Activity patterns of *Alsophis sibonius* and *Liophis juliae* in Cabrits National Park, Dominica, West Indies.

Powell, R. & Henderson, R. W. (2008). Exploitation of the night-light niche by a Dominican Racer. *Iguana* **15**, in press.

Schwartz, A. & Henderson, R. W. (1991). *Natural History of West Indian Amphibians and Reptiles: Descriptions, Distributions, and Natural History*. Gainesville: University of Florida Press.