NOTES ON THE MOVEMENTS OF SOME NEOTROPICAL SNAKES (REPTILIA, SERPENTES)

Henderson et al. (1976) demonstrated that radio telemetry was a feasible means of studying the movements of Neotropical rainforest snakes, and discussed potential problems with this method. We herein present the methods and results of another short term project and elaborate on the feasibility and desirability of the technique. Animals studied were *Leptophis depressirostris* and *Bothrops asper* in Costa Rica and *Spilotes pullatus* in Belize.

**Materials and Methods.**—Materials were essentially those used by Henderson et al. (1976), except that transmitters and batteries were encapsulated with acrylic. The weight of an entire package was 2.5-9.0 g depending on the size of the battery. Transmitter packages never exceeded 5% of the snake’s body weight and usually comprised only 2.3% of body weight. Transmitters were force-fed to the snakes.

Body temperature of the *Spilotes* was monitored with a temperature-sensitive transmitter (Model L: Mini-Mitter Co., Inc., Indianapolis, Ind.) broadcasting at just over 27 MHz. A 3-channel Lafayette HA 420 walkie-talkie modified with a Mini-Mitter Beat Frequency Oscillator acted as the receiver in conjunction with an AP directional antenna.

Activity areas were plotted to scale as convex polygons on graph paper and the number of enclosed squares counted. Although both the *Spilotes* and *Leptophis* moved in three dimensions, we only calculated the activity range of the *Leptophis* as a volume. Two methods were used. First, we constructed a 3-dimensional scale (1 in = 1 m) model of the snake’s activity range. A 0.5 in.-thick piece of balsa wood was cut to scale in the shape of the convex polygon utilized by the snake in its horizontal movements. Then all vertical points, represented by 3 mm wooden dowels, at which the animal was monitored, were inserted into the balsa wood base at the appropriate sites. Strings were then attached to the outermost vertical points in order to make a volume connecting the outermost points in three dimensions. The volume was then divided into geometric forms (e.g., prisms and pyramids) for which formulae were known. The volume of each of these forms was determined and summed to give the volume of the snake’s activity range. The second method also utilized the scale model described above. Pieces of thin cardboard were cut into shapes so that the model became an enclosed multi-sided volume in the shape of the convex form used by the snake. It was then covered with a thin layer of plastic and submerged into a cylinder of water. The volume of displaced water was determined and simple conversions gave us the volume of the snake’s activity range in m³.

**Results and Discussion.**—*Leptophis depressirostris*: A male *L. depressirostris* (SVL = 68.4 cm; wt. = 54.8 g) was captured on 15 Jan 1977 and released on 16 Jan. The study site
was in a heavily disturbed ravine along "Quebrada Grande" at the N edge of Puerto Viejo, Heredia, Costa Rica. The snake was active in an isolated stand of shrubs and small trees clustered around stumps of 2 or 3 large trees 40 m from other similar stands. Between 16 and 21 Jan the snake moved frequently, but all noted movements were of relatively short distances (Fig. 1). Transmission was lost 24 Jan; however, on the night of 26 Jan a male *L. depressirostris* of identical size and with a similar scar, but without a transmitter, was discovered on the branch of initial collection. Total recorded horizontal movement was 22.4 m and total recorded vertical movement was 12.2 m. There was no apparent correlation between movements, either horizontal or vertical, with time of day, temperature or rainfall, although from 21 to 24 Jan when temperatures were cool and there were frequent misting rains, the snake remained under cover in the root system of a tree stump. The total area utilized by the snake was 9.0 m² (measured as a convex polygon) and the 3-dimensional activity range was 19.4 m³ by water displacement and 19.9 m³ by geometry. Although we have probably determined accurately the known activity volume used by the snake, any additional point outside of the horizontal boundaries of the area or vertical points above those already plotted would alter, possibly to a considerable degree, our final figure. Thus, a theoretical 3-dimensional home range model, such as the ones proposed by Koeppel et al. (1977) or Meserve (1977) are probably more realistic approaches.

*Leptophis* are primarily frog predators (Oliver, 1948) and, although primarily diurnal, may be found active at almost any time (Henderson et al., 1977). This is supported by our data. Movements took place at various times of the day and night. There was a great deal of vertical movement and this is not unexpected for a "diurnal" snake that forages for nocturnal prey. Henderson and Nickerson (1977) found that under simulated natural conditions some arboreal snakes may have greater vertical than horizontal movements. Inclement weather had some effect on resting sites; during periods of rain the snake would often seek cover under large leaves and prolonged rain and cool weather forced the snake into proportionally longer inactive periods.

Several observations of juveniles were made during afternoons in pastures along the margins of brooklets and open permanent water ponds which harbored substantial broad leaf aquatic vegetation. They escaped into thick vegetation or the bases of trees and stumps in racer-like fashion. All observed were either on the ground or on matted, aquatic vegetation on shallow water. These juveniles had light coppery dorsums and were almost cryptic against soil and dead plant material. None were observed in trees. This habitat was shared with *Drymobius margaritiferus*, *Kinosternon angustipons* and *Geomys funeris*.

Sajdak discovered three *L. depressirostris* eggs in a terrestrial bromeliad within a dense secondary forest 0.7 km N of Puerto Viejo, Heredia. One hatched on 15 Jan; the other two were preserved 17 Jan (MMP 14540). Hatching occurred over five months prior to previous dates and they averaged 245 mm TL (range 240-252 mm TL) or 54 mm longer than those hatched by Dundee and Liner (1974). Their hatchlings also had light copper dorsums while ours
were dark greyish-brown. Rand (1969) found that hatchlings of *L. ahaetulla* were also greyer than adults on Barro Colorado Island, Panama Canal Zone.

*Spilotes pullatus*: A male *S. pullatus* (SVL = 230.0 cm; wt. = 670 g) was captured 5 May 1977 on the outskirts of the British Army's Airport Camp, 19.2 Km N of Belize City, Belize District, Belize. It was fitted with temperature and movement transmitters and released where captured on 10 May at 1230 h. By 1655 h it had moved 65 m and had ascended 5-10 m into a thicket of scrub palms in a swamp forest. From 10-14 May the snake remained in the clump of palms, but moved amongst them, never being located in exactly the same place twice. The clump of palms was at the edge of the swamp forest where the snake could move into and out of sunlight on the branches and fronds and was thus able to behaviorally thermoregulate. Mean air temperature (MAT) during body temperature determination (5 determinations) was 30.8 C (28.8-32.0) while mean body temperature (MBT) was 32.5 C (30.5-33.8). The MBT-MAT was 1.8 C (0.8-3.8). In the early morning of 15 May much rain fell and at 1200 h the snake could not be accurately located, but it had descended to the ground and moved about 25 m from the clump of palms. Signal strength indicated that the snake probably went underground. On 16 May at 1030 h both transmitters were found disgorged at the forest edge 60 m from the clump of palms and 45 m from the approximate subterranean location. The snake’s known activity range represented a convex polygon of 1238 m².

*Spilotes* is a habitat generalist (e.g., Dixon and Soini, 1977), but is frequently associated with open forest or edge situations. Our individual was never located away from forest edge and appeared to thermoregulate in sun-shade mosaics. A “large” *Spilotes* On Barro Colorado Island, Panama Canal Zone had, at 1015 h, a body temperature of 24.6 C while air and soil temperatures were 27.2 and 24.0, respectively, (Brattstrom, 1965). Thus, in this case, body temperature was lower than air temperature but closely approximated that of the substrate.

*Bothrops asper*: A male *B. asper* (SVL = 89.0 cm; wt. = 259 g) was captured on 22 Jan as it crossed a road 4.0 km W of Puerto Viejo, Costa Rica. Heavily grazed pastures were on either side of the road. The pastures had short, closely cropped grass and scattered stumps and logs, some surrounded by taller (up to 0.5 m) broadleaf herbaceous vegetation. An abandoned banana finca and poorly grazed pasture were about 100 m N of the road. The snake was released on 23 Jan at the side of the road. It stayed under a clump of vegetation at the roadside during the day of 24 Jan but moved into the pasture at night and crawled under a log where it spent the day of 25 Jan. At 0100 h on 26 Jan it was coiled outside of the log yet sheltered by broad-leaved plants, but by 0640 h it was back underneath. About half of these broad-leaved plants were cut mid-day on 27 Jan. At 1822 h on 27 Jan the snake was discovered in the open pasture. By early morning of 28 Jan it had moved 104 m N into the poorly grazed pasture, similar to that depicted by Janzen (1973: Fig. 3), and crawled into a stump. At 1830 h it was again out moving and was collected. Its movements were almost a straight line and no attempt was made to determine an activity area. The transmitter was passed 6 Feb and the snake fed the first time food was offered 7 Feb.

The major drawback to studies of many neotropical snake species, especially lowland rainforest forms, is low population densities. It is not difficult to capture snakes and insert transmitters, but it is unlikely that enough individuals of most species will be found in a “feasible” time period to make productive studies possible (there are exceptions; see Greene, 1975, and papers cited therein). Many months may be required to gather sufficient data to allow for accurate assessment of the activity range and habitat utilization of a given species. As an example, most of the points at which we radiolocated animals were at the boundaries of the convex polygons suggesting that if the snakes have defined home range boundaries they had not had time to reach them.

Another potential problem is habitat destruction. Although it is neither necessary nor possible to visually locate a “marked” animal each time it is radiolocated, it is necessary to accurately locate the tree, stump, log, etc. in which the animal is harbored. To do this it is frequently necessary to maneuver through dense vegetation and modify the habitat via trampling or machete.
In conclusion, we suggest that although radio telemetry is probably the most feasible means of studying tropical forest snake activity, it cannot completely overcome the problem of low population densities. A valid analysis of activity range and habitat utilization of most tropical snake species may require more prolonged field work than would be necessary for most temperate forms.

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LITERATURE CITED


MAX A. NICKERSON, RICHARD A. SAJDAK, ROBERT W. HENDERSON, Vertebrate Division, Milwaukee Public Museum, Milwaukee, Wisconsin 53233 and SHERMAN KETCHAM, Milwaukee County Zoo, Milwaukee, Wisconsin 53226 USA (Present address of Sajdak, Milwaukee County Zoo).