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The Diet of the Hispaniolan Snake *Antillophis parvifrons* (Colubridae)

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Snakes of the xenodontine colubrid genus *Antillophis* occur on Cuba, several of its satellite islands (*A. andreae*), and on Hispaniola and many of its satellite islands (*A. parvifrons*); in addition, a single specimen of *A. parvifrons* has been taken on Little Inagua Island in the Bahamas (Schwartz and Thomas, 1975). Both species of *Antillophis* are geographically and ecologically widespread and have differentiated into a number of subspecies (six in *A. andreae* and nine in *A. parvifrons*).

Antillophis parvifrons is the most widespread (rivaled only by the arboreal *Uromacer catesbyi*) and abundant species of colubrid on Hispaniola. It is one of the smallest Hispaniolan colubrids: mean snout-vent length (SVL) in our sample was 366 ± 6 mm (range 153–557), and it is similar to some North American garter snakes (*Thamnophis*) in general habitus.

Antillophis parvifrons is an active forager that is diurnal and ground-dwelling. It is ubiquitous in habitat, ranging from lush tropical forest to xeric scrub. It has been taken at altitudes from sea level to 1708 m (Schwartz, 1980). The most recent taxonomic review is that by Thomas and Schwartz (1965); Maglio (1970) discussed skull morphology, zoogeography and origin. Photographs of juvenile and adult *A. parvifrons* appear in Sajdak and Henderson (1982); a photograph of an adult *A. andreae* appears in Schwartz and Henderson (1985).

Despite its wide distribution and relative abundance on Hispaniola, little is known about the natural history of *A. parvifrons*. Franz and Gicca (1982) provided information on diet and reproduction for a collection of snakes from Ile de la Gonâve, Haiti; and Sajdak and Henderson (1982) added a note on clutch size, description of hatchlings and defensive behavior for animals from Isla Saona, Dominican Republic. In this paper, we present information on the diet of *A. parvifrons* based on examination of 649 specimens, and discuss diet in terms of foraging mode, prey size, relative prey abundance, and geography.

Five hundred and sixty specimens of *Antillophis parvifrons* from three collections were necropsied at the Milwaukee Public Museum, and we have incorporated the results of the necropsy of 89 specimens by Franz and Gicca (1982). Specimens from collections at the American Museum of Natural History (AMNH), the Museum of Comparative Zoology at Harvard University (MCZ), and the Milwaukee Public Museum (MPM) were examined; the Franz and Gicca material is stored at the Florida State Museum at the University of Florida (FSM). Details of methods used for necropsies and determination of prey volumes appear elsewhere (Henderson 1982, 1984*a*). The *Antillophis* were collected throughout the year at many localities throughout Hispaniola (including satellite islands) over a span of about 70 years.

We compared snake size (SVL), prey size and diet composition for five localities/regions. Localities in Haiti were: 1) Dept. Sud: St. Croix; (N = 14 specimens/8 prey items) 2) Dept. L'Ouest: Tiote (11/8) and 3) Savane Zombi; (12/12) 4) Ile de la Gonâve (several sites) (22/6); 5) we lumped specimens from several localities in the Barahona Peninsula of the Dominican Republic (30/18).

Data were analyzed using one-way analysis of variance (ANOVA), analysis of covariance (ANCOVA), Student's *t* test and regression. Differences among group means were determined with Student-Newman-Keuls (SNK) test. Prey species volume data were logarithmically transformed prior to analysis to normalize their distribution. All analyses were performed using the Statistical Analysis System (SAS) package.

The 649 *Antillophis parvifrons* yielded 199 prey items identifiable to genus; of those, 89 were reliably identified to species. Table 1 provides a list of prey species and their contributions to *A. parvifrons* diet, and Fig. 1 compares percentages of frequency vs volume contributions of selected prey genera and species.

Anolis lizards predominate in the diet of *A. parvifrons* in frequency of occurrence (70.9%) and percent of total prey volume (61.8%). The next most common prey genus is *Eleutherodactylus* frogs (12% frequency, 15.9% volume), followed by *Sphaerodactylus* lizards (4.6% frequency, 1.1% volume) and *Ameiva* (4.6% frequency, 6.5% volume). No invertebrates were encountered in our sample.

Among the anoles, *Anolis cybotes* was vastly more common in the diet than any other species (34.8% frequency and 42.4% volume); *A. coelestinus* was the next most commonly eaten (14.6% frequency and 17.7% volume). *Eleutherodactylus abbotti* and *Osteopilus dominicensis* were the anurans most frequently eaten, but four of the five *O. dominicensis* were froglets consumed by a single snake, and thus *Osteopilus* contributed little to total prey volume.

Fig. 2 illustrates the relationship between snake SVL and prey taxa and prey size. Prey size (volume) consumed depends on snake SVL (Fig. 2, $F = 6.8$, $P < 0.01$). Small *A. parvifrons* (<30.0 cm SVL) ate frogs and lizards that are small as adults (i.e., *Eleutherodactylus* and *Sphaerodactylus*) and juveniles of species with larger adult sizes (e.g., *Anolis coelestinus*). Larger *A. parvifrons* (>30.0 cm SVL) continue to eat small prey items, but also include larger items of a fairly wide

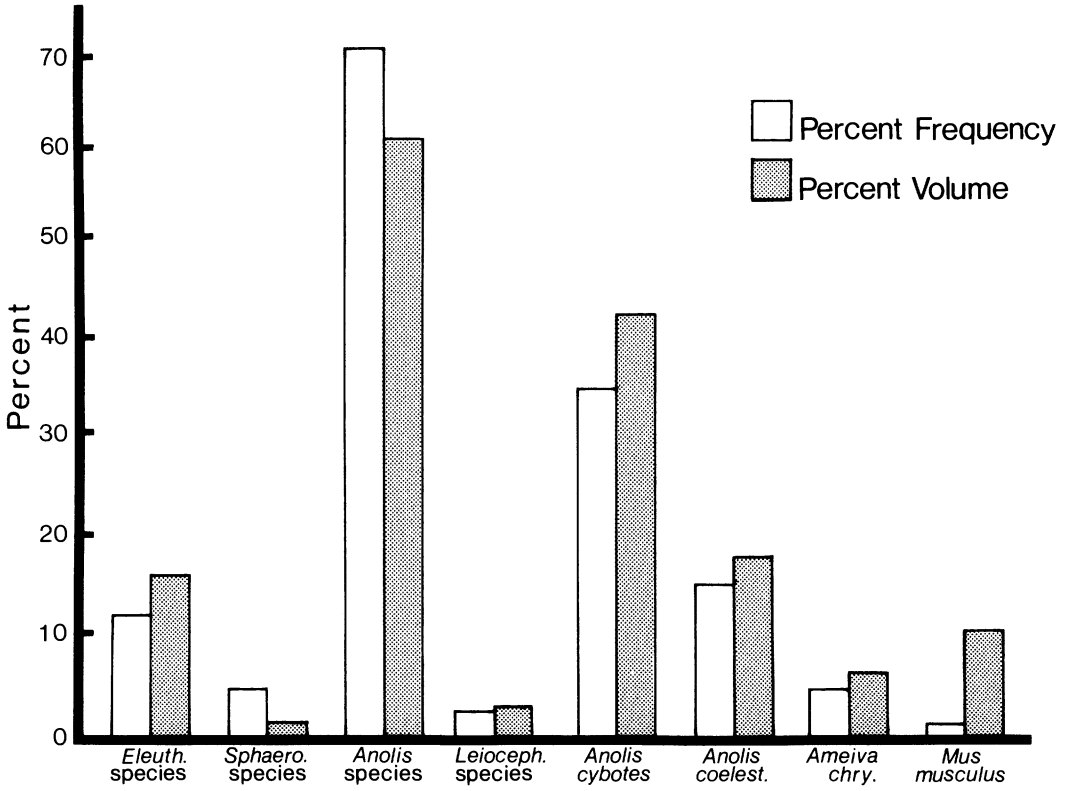

FIG. 1. Percent contribution by frequency and volume of selected prey genera and species. Percentages for genera were calculated separately from percentages for species. Contributions of genera (e.g., *Eleutherodactylus* species) should be compared against other genera, and contributions of species (e.g., *Anolis cybotes*) should be compared against other species. Abbreviations used are: *Eleuth.* = *Eleutherodactylus*; *Sphaero.* = *Sphaerodactylus*; *coelest.* = *coelestinus*; *Leioceph.* = *Leiocephalus*; *chry.* = *chrysolaema*.

taxonomic diversity, and of a size (>2.0 cm^3) that small *A. parvifrons* are perhaps unable to subdue or swallow.

The largest prey species was *Mus musculus* taken by snakes from Ile de la Gonâve, Haiti; we have estimated the mouse volumes to be 12–14 cm^3. Surprisingly, the next largest prey items were two large species of *Eleutherodactylus* (*E. inoptatus*, 11.0 cm^3; *E. hypostenor*, 8.0 cm^3). *Ameiva chrysolaema* followed with a mean volume of 6.5 cm^3. The most frequently eaten species of *Eleutherodactylus* and *Sphaerodactylus* had volumes ranging from 0.1 to 1.0 cm^3. *Anolis cybotes* and *A. coelestinus* had mean volumes of 3.1 cm^3 and 3.4 cm^3, respectively.

There were geographic differences in *Antillophis parvifrons* SVL (ANOVA, $F = 10.8$, $P < 0.0001$). Snakes from Ile de la Gonâve have a mean SVL significantly larger than those from the four other localities/regions with adequate sample sizes (SNK, $P < 0.05$). The Gonâve snakes averaged at least 10 cm longer than those from other geographic samples. Likewise, *A. parvifrons* from Gonâve ate prey items with a mean volume larger than those from other localities, but the difference was significant only in comparison with those snakes from the Barahona Peninsula sample (ANOVA, $F = 3.52$; $P < 0.01$; SNK, $P < 0.05$). Gonâve snakes were the only ones to eat mice (N = 2 snakes) and took more *Ameiva* than did snakes from other localities; if the *Mus* are eliminated from the Gonâve sample, prey size is no longer significantly different from that in the Barahona sample.

With the exception of *Darlingtonia haetiana*, which feeds almost exclusively on *Eleutherodactylus* (Henderson and Schwartz, 1986), the diet of *Antillophis parvifrons* is, in general, similar to those of other Hispaniolan colubrids (Henderson, 1984*a*): it preys predominantly on lizards of which a high percentage is *Anolis*; in fact, among Hispaniolan colubrids, only *U. oxyrhynchus* takes a greater proportion of *Anolis* than *A. parvifrons* (Henderson et al., 1987*b*). However, although taking a large proportion of anoles, *A. parvifrons* also exploits more prey taxa than any other species of Hispaniolan boid (Henderson et al., 1987*a*) or colubrid snake for which adequate samples exist. This excludes the extremely rare species of Hispaniolan *Alsophis*, a genus of snakes that, at least in the Greater Antilles and Bahamas, is very catholic in diet (Henderson, 1984*a*; unpubl.).

TABLE 1. Summary of prey species eaten by *Antillopis parvifrons*. If the number of prey items used to determine mean prey volume is different than the frequency of occurrence, that number appears in parentheses in the first column of numbers. Mean size (volume in cm^3) is followed by ± standard error of the mean.

Prey species	Frequency of occurrence	Percent occurrence in total sample	Mean size (range of sizes)
Frogs			
Osteopilus dominicensis	5 (4)	5.5	0.2 ± 0.0 (0.2)
Eleutherodactylus sp.	12	—	—
E. abbotti	5	5.5	0.95 ± 0.05 (0.8–1.0)
E. alcoae	1	1.1	2.0
E. hypostenor	1	1.1	8.0
E. inoptatus	1	1.1	11.0
E. ruthae	1	1.1	4.0
Lizards			—
Sphaerodactylus sp.	1	—	—
S. altavelensis	1	1.1	0.2
S. copei	1	1.1	0.2
S. difficilis	4	4.4	0.3 ± 0.1 (0.1–0.5)
S. elegans	1	1.1	0.4
Anolis sp.	65	—	—
A. armouri	2	2.2	2.7 ± 2.4 (0.3–5.0)
A. caudalis	5 (1)	5.5	1.5
A. chlorocyanus	3 (1)	3.3	2.0
A. christophei	1	1.1	1.0
A. coelestinus	13 (11)	14.6	3.4 ± 0.7 (0.5–7.5)
A. cybotes	31 (29)	34.8	3.1 ± 0.5 (0.2–10.0)
A. distichus	1	1.1	0.5
A. hendersoni	1	1.1	0.2
A. semilineatus	2	2.2	0.6 ± 0.4 (0.2–1.0)
Leiocephalus sp.	3	—	—
L. personatus	1	1.1	0.9
Ameiva sp.	3	—	—
A. chrysolaema	4	4.4	6.5 ± 0.5 (6.0–7.0)
A. lineolata	1	1.1	—
Celestus costatus	1	1.1	1.3
Wetmorena haetiana	1	1.1	—
Mammals			
Mus musculus	2	2.2	13.0 ± 1.0 (12.0–14.0)

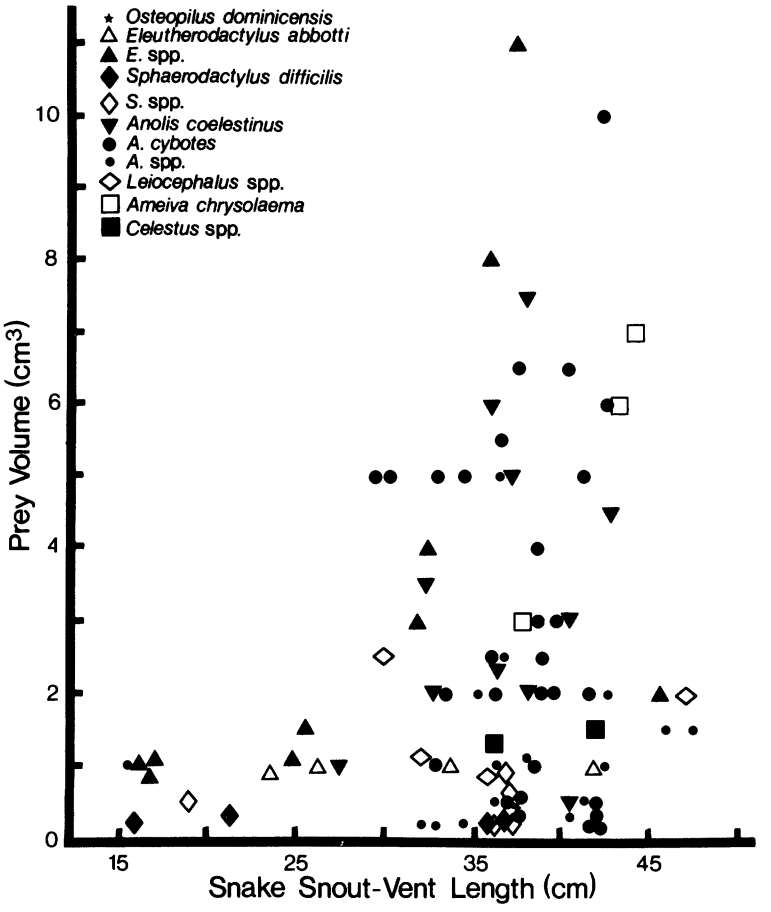

FIG. 2. Relationship between snake size (SVL), prey size (cm^3), and prey taxon.

Antillophis parvifrons takes the diminutive, secretive geckos, *Sphaerodactylus*, more frequently than any other Hispaniolan colubrid, and they may be an important food source for hatchling to subadult snakes. Similarly, various species of *Eleutherodactylus* are important food items for small *Antillophis*, and larger snakes (>40 cm SVL) occasionally eat them; the large *E. hypostenor* and *E. inoptatus* were among the largest prey items taken by *A. parvifrons*.

Terrestrial *A. parvifrons* takes prey that is either scansorial (*Anolis*, most *Eleutherodactylus*, most *Sphaerodactylus*) or ground-dwelling (*Leiocephalus*, *Ameiva*, *Celestus*, *Wetmorena*). The only other Hispaniolan colubrid (again exclusive of *Darlingtonia*) that feeds to such a large extent on ground-dwelling taxa is the heavy-bodied, diurnal, sit-and-wait forager *Hypsirhynchus ferox*. It exhibits a diet shift (correlated with snake size) from predominantly *Anolis* to the more robust *Leiocephalus* and *Ameiva* (Henderson, 1984*b*).

Among the *Anolis*, *A. cybotes* is by far the most frequently taken. It is the most ubiquitous of Hispaniolan anoles, and small individuals are frequently active on the ground. All Hispaniolan colubrids taken together prey most frequently on *A. cybotes*, followed by *A. distichus* (Henderson, unpubl.), a more arboreal species and one that is rarely consumed by *A. parvifrons*; *A. coelestinus* ranks third. *A. parvifrons* takes *A. cybotes* of a mean volume comparable to that of three species of slender *Uromacer* (Henderson et al., 1987*b*), but smaller than that taken by stout-bodied *H. ferox* (Henderson, unpubl.).

There is little geographic variation in *A. parvifrons* diet with two exceptions. 1) Geographically restricted prey species (e.g., *Anolis christophei*, *A. hendersoni*, *Wetmorena haetiana*) appear infrequently in the diet. Because our sample was geographically widespread, the limited presence of these prey species in the diet is not surprising. 2) *Ameiva chrysolaema* occurs more often in the diet of *A. parvifrons* from Ile de la Gonâve, Haiti, than from elsewhere in its wide range. *Antillophis parvifrons* on Gonâve average considerably longer (SVL) than those from our other samples. They are, in turn, consuming larger and different prey items (*Ameiva*, *Mus*) than those snakes on the main island. Similarly, a high frequency of *A. chrysolaema* appears in the diet of *Uromacer frenatus* from Ile de la Gonâve (Henderson et al., 1987*b*), and these vine snakes attain a greater size on Gonâve than elsewhere.

Antillophis parvifrons, as a geographically wide-

spread species that is an active forager, has, over its wide range, the "opportunity" to exploit a large number of prey species. It does consume more prey taxa than any other Hispaniolan colubrid, but, like other Hispaniolan colubrids, it preys largely on *Anolis*, particularly *A. cybotes*. Somewhat surprisingly, no invertebrates were found in *A. parvifrons* digestive tracts. However, examination of ca. 2500 boid, tropidophiid, and colubrid snakes collected on islands from the Bahamas south to Dominica has failed to yield a single invertebrate prey item! It is possible that the ubiquitous distribution of anoles throughout most habitats, in a wide range of sizes and frequently in high densities, precludes invertebrate exploitation. Only the satellite island of Ile de la Gonâve produced distinct trophic differences from the main island sample, but larger sample sizes from other satellite island localities may show similar divergences.

In summary, *Antillophis parvifrons* is a diurnal, ground-dwelling, active forager that, over its wide geographic range on Hispaniola, encounters and consumes a wide variety of prey species, but predominantly lizards of the genus *Anolis*. It differs trophically from other Hispaniolan colubrids in the wide variety of prey taxa eaten, and more specifically, in its exploitation of *Eleutherodactylus* and *Sphaerodactylus*, especially by young (i.e., small) individuals. It is similar to other studied Hispaniolan colubrids in that it consumes most frequently those prey species that are the most geographically and ecologically widespread, and that occur in the highest relative abundances (Henderson, 1984*a*; Henderson and Schwartz, 1986; Henderson et al., 1987*b*).

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Predation by *Loxocemus bicolor* on the Eggs of *Ctenosaura similis* and *Iguana iguana*

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Loxocemus bicolor is a primitive snake of uncertain phylogenetic relationships (Greene and Burghardt, 1978). Recently it was considered to belong to the Loxocemidae (McDowell, 1975), Boidae (Willard, 1977), Xenopeltinae (Dowling and Duellman, 1978), and Pythonidae (Alvarez del Toro, 1982). Moreover, little is known of its natural history. *Loxocemus bicolor* is primarily fossorial (Alvarez del Toro, 1982) and all I have observed were seen at night. Mora and Robinson (1984) reported predation by *L. bicolor* on the eggs of the olive ridley turtle (*Lepidochelys olivacea*), and Greene (1983) found two teiid lizards and two rodents in the stomachs of museum specimens. Here I report that the eggs of large iguanid lizards may be seasonally important in its diet, based on observations made at Rafael Lucas Rodríguez Caballero Wildlife Refuge, Palo Verde, Guanacaste Province, Costa Rica.

Iguana iguana and *Ctenosaura similis* often share nesting tunnels at this site (Mora, unpubl. obs.). On separate occasions, two *L. bicolor* were seen entering nesting tunnels of *C. similis* in March 1983 (A. Villareal, pers. comm.). Trails thought to be made by this snake were found in three tunnel entrances of *C. similis* nests