FOOD OF *NEOSEPS*, THE FLORIDA SAND SKINK

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The monotypic genus *Neoseps* is endemic to the arid rosemary scrub and sandhill associations of central Florida. With reduced limbs and slender body, the small sand skink is adapted to "swim" through the loose subsurface sands in which it lives. Because of secretive habits, and the inhospitableness of its environment, this interesting lizard is seldom seen unless actively sought.

Carr's (1940) brief notes on habits and habitats constituted the only published reference to the natural history of *Neoseps reynoldsi* until Cooper (1953) gave a list of food items from four stomachs, and some notes on habitats and reproduction. Telford (1959, 1962) enlarged on the distribution, variation, and natural history, and observed that captive sand skinks seem to thrive upon a diet of termites. During his first study, Telford took occasion to assemble a collection of *Neoseps* stomachs for later analysis; that collection is the basis for the present report.

We are indebted to Robert E. Woodruff, Florida State Plant Board, and Dr. George W. Byers, University of Kansas, for the identification of certain insects, and to Dr. John McCrone, formerly of the University of Florida, for the identification of several spiders. Dr. William J. Riemer provided research facilities at the Florida State Museum.

Materials and Methods

Eighty-two digestive tracts in alcohol were available for examination. Of these, 53 were from specimens preserved in the United States National Museum, one from a specimen in the American Museum of Natural History, and 28 were from specimens in the collection of the junior author. Fifty-two of the specimens are from Auburndale, Polk County; 10 are from two additional localities in Polk County; and 20 are from five localities in Lake County. The museum specimens were collected between 1910 and 1920, Telford's specimens in 1952-1954 and in 1959. Except for two specimens from a sandhill association, the lizards were collected in areas of rosemary scrub, the principal habitat of *Neoseps*. Telford (1959) doubted that the species occurred outside of rosemary scrub, but later (1962) listed definite records from the sandhills.

Contents of the individual stomach and intestine were placed in a small container of water; food items were segregated and identified under a dissecting microscope. Only frequency of occurrence and numerical abundance of different foods were recorded. When working with tiny arthropod fragments, it is nearly useless to attempt volumetric measurements, because of the problem of accuracy and the necessity for sorting and identifying all disassociated pieces, rather than key parts only.

Results and Discussion

Representatives of two classes of arthropods occurred in the 70 stomachs containing food (table 1). The Arachnida were represented only by a solpugid and several jumping spiders. Four orders of insects were listed. Beetle larvae (62.9 per cent occurrence) and termites (12.9 per cent) were the insects which formed the bulk of the diet. The families Elateridae and Scarabaeidae were identified among the beetle larvae; undetermined larvae were very fragmentary but probably belonged to the families mentioned. At least several of the scarab larvae belonged to the genus *Phyllophaga*. The termite fragments probably represented *Prorhinotermes*. Other insects recognized were lepidopteran larvae, roachs, and adult beetles (shard fragments in four intestines). Cooper (1953) reported representatives of two additional orders of insects (Diptera, one larva; Neuroptera, one mandible) and one of arachnids (Pseudoscorpionida) in the four stomachs examined by him.

Oxyurid nematodes (*Thelandros* sp.) occurred in 30 samples, being found in both stomach and intestine, but more frequently in the latter only. The number of parasites present ranged from 1-6, with a mean of 2.3 and with 1 and 2 being the most frequent numbers. Many stomachs and intestines contained quantities of sand, which sometimes packed the colon. No other non-prey items were found.

Twelve of the 82 digestive tracts were empty, or contained only traces of unidentifiable matter in the intestine. Data are too few to demonstrate any possible correlation between individuals with empty stomachs and season of collection. Data also are not suitable for an analysis of seasonal variation in foods, since

73 per cent of the lizards were collected in the period December-March, and over a span of years. Suffice it to note that *Neoseps* feeds actively throughout the year, and that its principal foods (beetle larvae and termites) are eaten in all seasons. Certainly, however, there must be seasonal differences in availability and utilization of most foods. Mount (1963) found seasonal variation in the diet of *Eumeces egregius,* a lizard which occurs in much the same situations as *Neoseps.*

TABLE 1

Food of 70 *Neoseps reynoldsi,* Lake and Polk counties, Florida

Food	Stomachs No.	Food items No.	Frequency Per cent
Insecta	63	218	90.0
Coleoptera	46	57	65.7
Adults	4	4	5.7
Larvae	44	53	62.9
Elateridae	22	29	31.4
Scarabaeidae	9	10	12.9
Undetermined	13	14	18.6
Isoptera (Rhinotermitidae)	9	143	12.9
Lepidoptera (Tortricidae)	2	3	2.9
Orthoptera (Blattidae)	2	2	2.9
Undetermined	13	13	18.6
Arachnida	4	4	5.7
Araneida (Salticidae)	3	3	4.3
Solpugida	1	1	1.4
Undetermined matter	11	—	15.7

Neoseps reynoldsi, like most insectivorous poikilotherms, includes a variety of hard- and soft-bodied arthropods in its diet. Nevertheless, its food is limited primarily to coleopteran larvae and termites. All other food groups, judged from this study, are important only in a collective and supplemental sense. The dietary patterns of many predators are similar in showing primary utilization of only a few out of a wide spectrum of acceptable foods. For a lizard, however, *Neoseps* has a highly restricted diet. Two factors suggest that in this case availability of prey is more important than selectivity: 1) Sand skinks do feed upon a variety of prey types. Assuming, therefore, that *Neoseps* feeds to the extent of its awareness of and ability to take potential food, the high utilization of only a few kinds of prey can be explained by the following. 2) The sand skink has specialized habits and occupies a narrow and well defined microhabitat within restricted and xeric macrohabitats (Cooper, 1953; Telford, 1959, 1962). It is quite reasonable therefore to suppose that a relatively limited variety of suitable prey is available to *Neoseps,* with only a few kinds available consistently.

Mount (1963, pp. 364-366) examined the digestive tracts of 460 (257 with food) *Eumeces egregius,* another small "sand-swimming" skink that lives in the same habitats as *Neoseps. E. egregius* readily eats termites and elaterid beetle larvae in captivity, but these insects occurred, respectively, in only 0.8 per cent and 4.7 per cent of the sample. Mount did not state whether the sample includes all specimens or only those with food, but we presume the latter. Roaches, spiders, and crickets (41.0, 36.2, and 20.2 per cent occurrence, respectively) are the primary foods of *E. egregius.* In marked contrast, *Neoseps* feeds mainly on beetle larvae and termites and takes the other items only on occasion (table 1). Mount (p. 365) concluded that *E. egregius* feeds mostly in sheltered situations, as in pre-existing subterranean passages, and implied that *Neoseps,* which is a more specialized burrower, feeds in different situations. Telford (1959) observed that captive sand skinks feed mostly below the ground surface. Certainly, the large quantities of sand in the digestive tracts of many *Neoseps* suggest that prey is frequently seized while the lizard is in the actual process of burrowing.

Because of the sheer abundance and availability of arthropods, competition for food perhaps is not often important in the ecology of generalized insectivorous animals (i.e., those not overly specialized and hence capable of taking a wide variety of insects and other arthropods); in most environments, other factors are likely to limit populations before food supply becomes critical. We have no idea of carrying capacity of the microhabitats occupied by the specialized *Neoseps* and *E. egregius,* but venture to speculate that food competition between these two would limit one or both populations, and that natural selection has been instrumental in reducing such competition. It seems quite clear that similar structural, behavioral, and probably physiological adaptations allow *Neoseps* *reynoldsi* and *Eumeces egregius* to occupy the same spatial microhabitat, but that different degrees, not kinds, of adaptation (see Mount, 1963, p. 364) allow for slightly different habits and hence exploitation of different foods within the microhabitat.

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