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DIET COMPOSITION OF *LIOLAEMUS BIBRONII* (IGUANIA: LIOLAEMIDAE) IN SOUTHERN RIO NEGRO PROVINCE, ARGENTINA

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The new world lizard genus *Liolaemus* is very diverse in the southern part of South America, where approximately 170 species have been described (Cei, 1986, 1993; Etheridge, 1995; Avila *et al.* 2000). In spite of this diversity, the biology and ecology of only a few species have been studied. Vitt & Zani (1996) commented on the need to collect basic natural history data on neotropical lizards because they are very important in our understanding of the ecological relationships between species. This information is also important for the formulation of realistic and testable hypotheses, and for the design of appropriate experiments for studying species interactions in the complexity of ecological systems. Additionally, this basic information can be useful in the evaluation of the conservation status of some poorly known species (Reca *et al.*, 1994).

Liolaemus bibronii (Bell, 1843) is a small lizard, widely distributed within Andean habitats of mid-west and Patagonian habitats of southern Argentina as well as a small portion of Chilean Patagonia. The only study on the diet of this species was made by Videla (1983), in sub-andean habitat of Mendoza province, near the northernmost edge of its distribution. The purpose of this study is to describe the diet of *Liolaemus bibronii* in a typical, cold desert habitat of Patagonia, in the central part of its distributional range.

Lizards were collected in Ingeniero Jacobacci, (41°18´ S, 69°36´ W), 25 de Mayo Department, Río Negro Province, Argentina. Phytogeographically, the area is included in the Provincia Patagónica (Cabrera, 1994), and the study site was a shrub-dominated slope of a basaltic plateau. Representative elements of the flora are *Mullinum spinosum*, *Nassauvia axillaris*, *Prosopis patagonica*, *Verbena tridactyllites*, *Berberis empetrifolia*, *Colliguaya intergerrima*, *Stipa patagonica* and *Poa bonariensis*. The climate is dry; annual precipitation is less than 200 mm, and most falls as snow. The annual mean temperature is 9.3 °C and the monthly mean temperatures range from 16.8 °C (January) to 2.2 °C (July). This is one of the coldest and windiest areas of Patagonia.

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Thirty-three lizards were collected by hand between November 1991 and March 1992. Because of their small size and the likely stress involved in handling, we decided not to attempt the evacuation of stomach contents of live lizards. To minimize the effect of sampling on the study population, only a small sample of lizards was collected to provide a representative sample of dietary composition (Maury, 1981). These were killed humanely in the laboratory, fixed in 20% formaldehyde, transferred to 70% ethanol, and deposited in the herpetological collections at the Instituto de Herpetología, Fundación Miguel Lillo (San Miguel de Tucumán) and LJAMM collection (CRILAR-CONICET), Anillaco (Argentina).

Stomachs were later removed for diet analysis and stored separately in 70% ethanol in small vials. Whole stomachs were dissected and contents were examined using a stereoscopic microscope, identified, counted, and placed into food resource categories. Prey items were identified to the lowest practicable taxonomic level – usually family – based on entire items or identifiable fragments. We only considered items found in the stomachs themselves as these were the least digested. The developmental stage of prey was recorded (e.g. larvae, adults) and percentages of each prey type (by item number, volume and occurrence) were calculated. Volume was estimated by measuring length and width of each item to the nearest 0.1 mm with a dial calliper, and approximating the prey body to a prolate spheroid, following Dunham (1983). Trophic diversity was calculated with Shannon's Index, and breadth of the trophic niche was calculated with Levins' index (Krebs, 1989). Four lizards had empty stomachs, but a sample of 20 to 25 stomachs was considered sufficient to stabilize the diversity curve (H=2.05) and show the diet composition of *Liolaemus bibronii*.

Twenty-four categories of prey comprising 556 prey items were found in the stomachs, and these reveal that *Liolaemus bibronii* had fed mainly on small leafhoppers and ants. Table 1 shows the number, volume and frequency of each prey category in terms of total number and percentage. Numerically, Cicadellidae (45%), Formicidae (18%) and Coccoidae (11%) were most important. In terms of volume, Cicadellidae and Formicidae were again predominant (26% and 20%, respectively), followed by Scarabaeidae (13%), Lepidoptera (11%) and Curculionidae (9%). Cicadellidae provided 59 % of items taken, followed by Ixodidae (31%) and Formicidae/Salticidae (28%).

Of the 556 prey items, 213 were active insects and 343 were motionless or very slow moving arthropods, larvae or plant material. Of the latter, 150 Cicadellidae – a slow-moving type of insect – were found in a single stomach. The mean number (±SD) of prey items per stomach was 19.17±50.02; range = 1–163, with only two individuals containing a single prey category. Aver-

TABLE 1. Diet composition of *Liolaemus bibronii* (*N*=29), with prey categories presented as percentage by frequency (*n*=number of lizards whose stomach contained one or more prey; %= percentage of the lizards sampled), number (number of prey items and % of the total number of prey) and volume (in mm^3 and percentage of volume total).

	Frequency		Number		Volume	
	n	%	*n*	%	mm^3	%
HYMENOPTERA						
Formicidae	8	27.59	101	18.17	459.35	20.05
COLEOPTERA						
Scarabaeidae	4	13.79	12	2.16	296.14	12.92
Curculionidae	5	17.24	13	2.34	216.96	9.47
Carabidae	4	13.79	5	0.90	90.31	3.94
Chrysomelidae	1	3.45	3	0.54	48.39	2.11
Larvae	5	17.24	5	0.90	124.27	5.42
HEMIPTERA						
Lygaeidae	3	10.34	2	0.36	3.12	0.14
HOMOPTERA						
Cicadellidae	17	58.62	253	45.50	588.43	25.68
Coccoidae	3	10.34	62	11.15	34.43	1.50
Aphididae	6	20.69	5	0.90	76.42	3.33
DIPTERA						
Staphylinidae	1	3.45	2	0.36	0.05	0.00
Tabanidae	1	3.45	1	0.18	0.60	0.03
Stratiomyidae	1	3.45	1	0.18	0.47	0.02
Larvae						
LEPIDOPTERA	2	6.90	2	0.36	254.15	11.09
ACARI						
Ixodidae	9	31.03	43	7.73	23.98	1.05
Oribatidae	2	6.90	2	0.36	0.52	0.02
ARACHNIDA						
Salticidae	8	27.59	10	1.80	58.87	2.57
Tomicidae	2	6.90	2	0.36	0.86	0.04
OTHERS						
Pupae	1	3.45	1	0.18	5.81	0.25
Eggs	1	3.45	1	0.18	0.16	0.01
Unidentified larvae	1	3.45	1	0.18	0.25	0.01
PLANT MATERIAL						
Fruits	3	10.34	10	1.80	5.70	0.25
Seeds	4	13.79	12	2.16	0.03	0.00
Flowers	1	3.45	7	1.26	0.65	0.03
Vegetative parts	7	24.14			1.63	0.03

age prey length was 4.05±0.7; range = 0.7–19.4 and mean prey volume was 107.9±83.1 mm^3. Twenty-four lizards were found to have eaten active insects, 28 had eaten slow-moving arthropods and 14 had eaten non-mobile prey. One lizard contained only plant materials (volume = 153.45 mm^3).

Liolaemus bibronii is predominantly insectivorous and in our study area it fed largely on Cicadellidae, Ixodidae, Formicidae, Curculionidae and Scarabaeidae, with plant material as the other major dietary component. The high frequency of plant material can be attributed to accidental ingestion when lizards caught their prey, because plant material volume is very low. Some dietary items add a large amount in volume (Lepidoptera) but they are eaten in very low frequency. Other items are very important in number or frequency, but their contribution in volume is very small and less important (Ixodidae or Salticidae). The generalization in the diet reflects, in part, a sedentary foraging strategy, as the diversity of arthropods in the diet is characteristic of sit-and-wait predators (Schoener, 1969, 1971; Huey & Pianka, 1981). This seems to correspond with the secretive behaviour of *L. bibronii* (Acosta *et al.*, 1996*b*), as this lizard is frequently found under stones and close to small thorn bushes, where it forages and thermoregulates. Nevertheless, the high frequency of slow-moving prey could also indicate a strategy of actively searching for food. *L. bibronii* may possibly

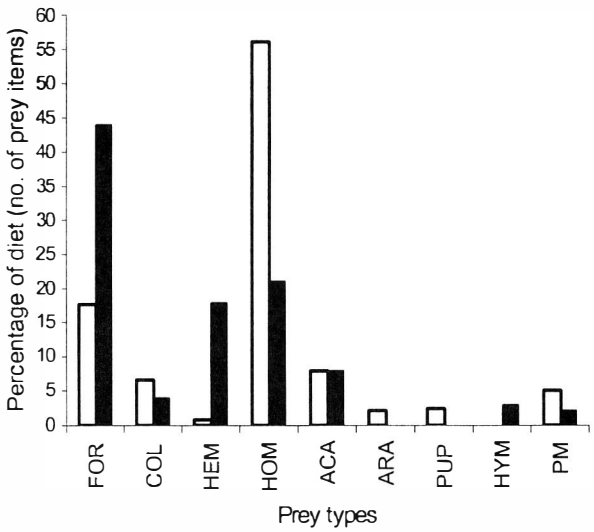

FIG 1. Comparison of the diet of *Liolaemus bibronii* in this study [open bars] and that reported by Videla (1983) [filled bars].The percentage of the diet made up by each prey category is shown on the basis of numbers of prey items. FOR = Formicidae, COL = Coleoptera, HEM = Hemiptera, HOM = Homoptera, ACA = Acari, ARA = Arachnida, PUP = pupae, HYM = Hymenoptera, PM = plant materials.

change its foraging strategy according to food availability, like other lizards in the genus. Data not presented here indicate that *L. bibronii* is an opportunistic predator (Levins' index = 4.5), taking the most abundant prey item found in its habitat.

Ingestion of plants by lizards is often regarded as an accidental consequence of the capture of arthropod prey within vegetation. However, the fact that plant parts (leaves, flowers, fruits and seeds) were found in 48% of stomachs suggests that ingestion was not entirely accidental. According to the literature, the use of plant material as a significant part of the diet is not common within small species of lizards. Pough (1973, 1983) suggested that, because of morphological and physiological constraints, small lizards are usually insectivorous whereas larger species are carnivorous, omnivorous or herbivorous. However, this suggestion may not be apply in cold habitats, such as those at high altitudes or in cold deserts like Patagonia. The consumption of plants by *Liolaemus bibronii* agrees with the suggestion of Rocha (1989) that ingestion of plant material by small lizards may be more widespread than previously believed. In these habitats, food items such as invertebrates can sometimes be very scarce. In *L. boulengeri*, a sympatric species, Acosta *et al.* (1996*a*) found a significant volume and frequency of plant materials, and – in the previous study of *L. bibronii* – Videla (1983) found a small portion of vegetable matter, while Formicidae was the most important food category. In some habitats, such as at Videla's (1983) study site, ants can be very common and comprise an important part of total biomass. Fig. 1 shows a comparison between the main items found by Videla (1983) and in this study.

In summary, our analysis indicates that *Liolaemus bibronii* has a generalist diet but that a few prey categories are very important; these features of its foraging behaviour can be viewed as adaptations to the variability of food resources in a highly unpredictable desert environment (Maury, 1995) – in this case, an arid and cold steppe desert, the Patagonian.

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