

A Study on the Feeding Biology of *Laudakia (=Agama) stellio* (L. 1758) (Lacertilia: Agamidae) Populations in the Antalya Region*

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Abstract: The feeding biology of *Laudakia (=Agama) stellio* (L. 1758) was studied using 91 specimens collected from the Antalya region over two consecutive years (1995 and 1996). A total of 1224 prey items were identified and their frequency of occurrence and percent of diet were tabulated. The majority of the diet consisted of the class Insecta (99.18%), and within this class, Hymenoptera (72.21%) was the major order represented, primarily by the families Formicidae (49.83%) and Apidae (16.74%). In addition to insects, *L. stellio* feeds on plant material, insect larvae and eggs, and even snails, showing opportunist feeding behavior.

Key Words: *Laudakia (=Agama) stellio*, Feeding Biology, Antalya Region, Prey

Antalya Yöresi *Laudakia (=Agama) stellio* (L. 1758) (Lacertilia: Agamidae) Populasyonlarında Beslenme Biyolojisi Üzerinde Bir Araştırma

Özet: Bu çalışmada Antalya yöresinden 1995-1996 yılları arasında toplanan 91 *Laudakia (=Agama) stellio* (L. 1758) örneğinde beslenme biyolojisi çalışıldı. Tespit edilen 1224 av parçası tanımlanıp, bunların kertenkelenin diyeti içinde bulunma frekansları ve yüzdeleri tablo halinde sunulmuştur. Diyette ağırlıklı grup Insecta (%99,18) sınıfıdır, bu sınıf içinde ağırlıklı olarak Hymenoptera ordosu %72,21 oranında temsil edilmektedirken, Formicidae (%49,83) ve Apidae (%16,74) familyaları ön sıralarda gelmektedir. *L. stellio* böceklerin dışında bitkisel materyal, böcek larva ve yumurtaları hatta kara salyangozlarıyla da beslenerek oportunist beslenme davranışı göstermektedir.

Anahtar Sözcükler: *Laudakia (=Agama) stellio*, Beslenme Biyolojisi, Antalya Yöresi, Av

Introduction

The species *Laudakia (=Agama) stellio* (L.1758) is distributed in North Africa, Southeast Asia, Aegean Islands, Southeast Europe and Turkey (except the northern and eastern regions) (1). In Turkey it is represented by two subspecies, *Laudakia stellio stellio* and *Laudakia stellio daani* (2-4). All the material collected for this study is from the subspecies *L. stellio daani*, found mostly in West and South Anatolia.

Numerous studies have been done on *L. stellio* in terms of its morphology, taxonomy, and ecology (2-4), its parasites (5-7) and its physiology (8). Only a few studies have been published on its feeding biology (9, 10).

The purpose of this study was to investigate the feeding biology of *Laudakia stellio* at four locations in Antalya (Turkey) through analysis of stomach contents.

Materials and Methods

A total of 91 *L. stellio* were collected either by hand or with a long forceps from four locations in Antalya in 1995 and 1996, between April and September. The collection sites are shown in Figure 1. Sampling was done in the morning (08⁰⁰-11⁰⁰) following the assumption that the species generally feeds more during this period and digestion is not yet advanced.

Once caught, the lizards were anesthetized in ether-filled glass containers, labeled, frozen at -20°C, and stored. Later, after thawing, guts were dissected out using surgical scissors and forceps. The weight of each gut was measured on an analytical balance (0.01 g). The material from each gut was used to determine total food volume by measuring the displacement in graduated cylinders filled with distilled water (11). The ratio of food volume to full gut volume was used to calculate the

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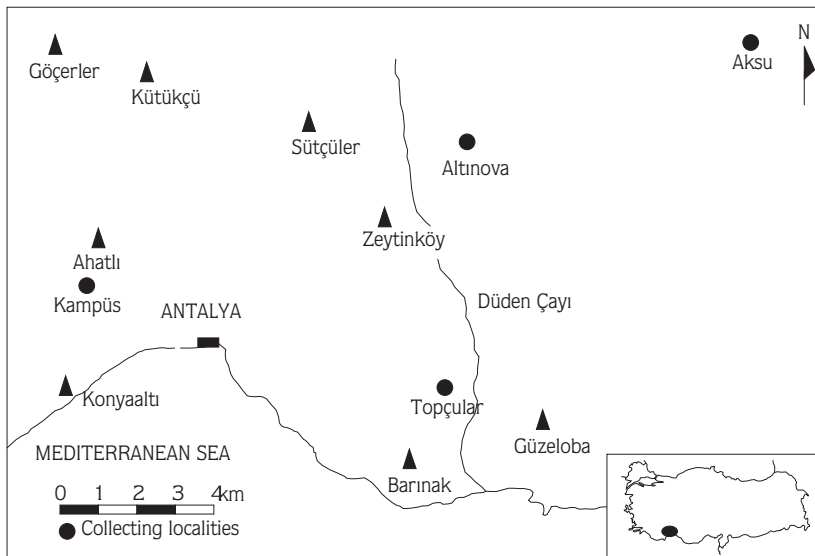


Figure 1. Sample collecting localities.

gut fullness ratio (Gut fullness ratio = Food volume / Full gut volume). The prey items obtained from each specimen was stored in 10 cc bottles containing 70% ethanol.

Dried pieces from both undigested and partially digested prey were placed on microscope slides and held in place with cellophane tape. These pieces consisted of whole body, wing(s), thorax with abdomen, head, and mouth parts. Through this approach, identification to the lowest taxonomic level was attempted, usually to the family level. Samples were examined using a Nikon stereomicroscope with 10-25 X magnification. Prey items were identified and grouped utilizing methods described elsewhere (12-17).

Results

The analysis was based on 91 specimens. No comparisons were made between the four locations sampled due to unequal sampling. Therefore, the data concerning body measurements, volumes of full and empty guts, food volumes and weights, and gut fullness ratios are not shown in this paper. Only the ranges of gut fullness ratios are given for each station with minimum and maximum values: 37.50-87.50% at Altınova, 33.30-80.00% at Topçular, 44.44-81.81% at Campus, and 33.33-84.41% at Aksu with station averages of 63.38%, 56.40%, 62.25%, and 57.37%, respectively. The overall average was 59.70%.

The digestive tract is composed of a long esophagus, an oval stomach midway through the abdomen, an intestine that is twice as long as the stomach, and a short sac-like rectum. Of the 91 dissected digestive guts, all except one were either full or partially full of food. The stomach and proximal end of the intestine contained more identifiable prey than the distal end of the intestine and the rectum.

Based on the analysis of stomach contents (Table), invertebrates and plants were the major and minor food sources, respectively. Other non-food materials, such as small pebbles, sand grains and pieces of feather, possibly ingested during prey capture, were also present.

Although a large number of prey fragments was found in dissected guts, most of them were digested to such an extent that they were unidentifiable. Only 1224 prey items were identified. The Table presents the digestive tract contents with respect to prey groups (their taxonomic grouping, number of prey items, and percentages of preyers). Of the 1224 items, the number and their percentages for each major group were as follows: Insecta 1214 (99.18%), Arachnida 4 (0.33%), Myriapoda 3 (0.25%), Gastropoda 2 (0.16%), and Isopoda 1 (0.08%).

Insects were identified to the ordinal level. The total number of preys and their percentages were as follows: hymenopters 890 (72.71%), coleopters 163 (13.31%), homopters 83 (6.78%), hemipters 45 (3.67%), dipters

Item	Number of Item	Percentage of Total	Number of Lizards	Percentage of Lizards which Contain Item
Gastropoda	2	0.16	2	2.20
Crustaceae	1	0.08	1	1.09
Isopoda	1	0.08	1	1.09
Myriapoda	3	0.24	3	3.29
Chilopoda	3	0.24	3	3.29
Scolopendridae	1	0.08	1	2.20
Geophilidae	2	0.16	2	1.09
Arachnida	4	0.32	4	4.40
Araneae	3	0.24	3	3.29
Pisauridae	3	0.24	3	3.29
Insecta	1214	99.18		
Orthoptera	9	0.74	8	8.80
Tettigonidae	3	0.24	3	3.29
Acrididae	6	0.49	5	5.49
Blattoptera	2	0.16	1	1.09
Blatellidae	2	0.16	1	1.09
Heteroptera (Hemiptera)	45	3.67	36	39.56
Lygidae	6	0.48	6	6.59
Reduviidae	9	0.73	7	7.69
Miridae	18	1.46	12	13.18
Homoptera	83	6.78	24	26.37
Cicadidae	2	0.16	2	2.20
Jassidae (Cicadellidae)	57	4.64	8	8.79
Psyllidae	4	0.32	2	2.20
Aphididae	20	1.63	12	0.98
Coleoptera	163	13.31	59	64.83
Carabidae	2	0.16	2	2.20
Cicindellidae	1	0.08	1	1.09
Lampyridae	4	0.32	3	3.29
Coccinellidae	26	2.12	17	18.68
Buprestidae	9	0.73	6	6.59
Elateridae	2	0.16	2	2.20
Lucanidae	3	0.24	3	3.29
Scarabeidae	4	0.32	4	4.39
Chrysomellidae	1	0.08	1	1.09
Curculionidae	1	0.08	1	1.09
Hymenoptera	890	72.21	85	93.40
Cynipidae	6	0.49	4	4.39
Ichneumonidae	7	0.57	7	7.69
Pteromalidae	4	0.32	3	3.29
Leucaspidae	1	0.08	1	1.09
Chrysididae	1	0.08	1	1.09

Table. Composition of the gut contents of *Laudakia stellio* collected from the Antalya region during 1995-1996, food item number and percentage of stomach contents, and number of lizard stomachs containing type of prey and percentage of lizard containing prey type.

Item	Number of Item	Percentage of Total	Number of Lizards	Percentage of Lizards which Contain Item
Scoliidae	10	0.81	8	8.79
Sapygidae	6	0.49	6	6.59
Formicidae	610	49.83	66	72.52
Pompilidae	1	0.08	1	1.09
Eumenidae	2	0.16	2	2.20
Vespidae	11	0.89	10	10.98
Sphecidae	25	2.04	17	18.68
Apidae	205	16.74	61	67.03
Diptera	18	1.47	11	12.08
Tabanidae	2	0.16	1	1.09
Dolichophodidae	1	0.08	1	1.09
Syrphidae	2	0.16	1	1.09
Calliphoridae	4	0.32	4	4.39
Lepidoptera	4	0.32	4	4.39
Sphingidae	1	0.08	1	1.09
Pieridae	1	0.08	1	1.09

Table Cont.

18 (1.47%), orthopters 9 (0.73%), lepidopters 4 (0.32%), and blattarians 2 (0.16%). Two families of hymenopterans accounted for the most commonly observed prey, Formicidae (49.83%) and Apidae (16.74%) (Figure 2).

The Table also provides data on the prey preferences of 91 *L. stellio* specimens, with the numbers and percentage of individuals containing each prey category. Only a few specimens contained classes other than Insecta, e.g., gastropods were eaten by two lizards. Insects were the preferred prey of all 91 lizards: hymenopters 85 (93.40%), coleopters 59 (64.83%),

heteropters 36 (39.56%), homopters 24 (26.37%), dipters 11 (12.08%), and lepidopters 4 (4.39%). Especially Formicidae and Apidae were the major prey of the lizards, 66 (72.52%) and 61 (67.03%) respectively. Lizards consuming these prey ate 3 to 9 items each. Among the 91 specimens dissected, 13 and 7 contained insect larvae and eggs, respectively. In addition to the invertebrate prey, it was observed that *L. stellio* feeds (28 out of 91) on plant material as well. The identified plant parts were from the following families in decreasing order of frequency of occurrence: Asteraceae (57.14%), Poaceae (10.71%), Araceae (7.14%), Vitaceae (3.57%), Moraceae (3.57%), and Lamiaceae (3.57%).

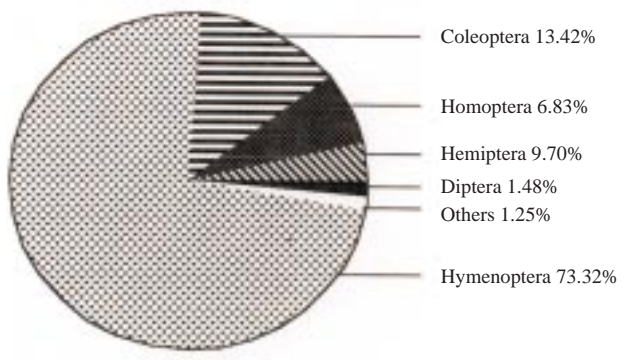


Figure 2. Distribution of the insect groups regarding numerical percentages.

Discussion

This research was conducted to learn more about the feeding biology of *L. stellio* in Antalya/Turkey. The results show that *L. stellio* feeds heavily on hymenopteran insects, particularly species of the families Formicidae and Apidae. In addition to insects, we observed that they consume plant material as well. The presence of plant material in the diet of *L. stellio* was also noted by Dor (1965) and Werner (1966) (cited in 9). Although bird eggs and hatchlings were reported as food items for *L. stellio* by Kopan and Yom-Tov (9), such items were not

found among our specimens. In another study, Mienis (10) noted that snails are consumed by *L. stellio*. This is consistent with our results (2 out of 91 specimens). In addition to the prey items above, insect larvae and eggs were also encountered in this study. All these findings suggest that *L. stellio* is an opportunist feeder preying on diverse forms. This situation is related to the type of habitat they live in and the abundance of prey species in the vicinity.

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