

# TROPHIC NICHE BREADTH AND NICHE OVERLAP BETWEEN TWO LACERTID LIZARDS (REPTILIA: LACERTIDAE) FROM SOUTH BULGARIA

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## Material and Methods

## Introduction

The Balkan Wall lizard (*Podarcis tauricus*) and the Green lizard (*Lacerta viridis*) are the two most common lizard species in the country (BESHKOV, NANEV 2002). Their diet is relatively well studied, but there are still some aspects of their feeding ecology and behavior, which is important aspect of the ecological studies, that remain fairly unknown. Currently there are no studies conducted in Bulgaria, concerning the species' trophic niche breadth and niche overlap, which can give valuable information about the possible interspecific competition relations between these two species at the places with sympatric distribution.

The aim of the current study is to supplement the data about the trophic spectrum of *Lacerta viridis* and *Podarcis tauricus*, by presenting new data about their diet, trophic niche breadth and niche overlap.

During the current study we analyzed the stomach contents of 120 specimens, belonging to the Balkan Wall lizard (*Podarcis tauricus*) and 110 specimens, belonging to the Green lizard (*Lacerta viridis*). The material was collected in the period May-September 1980-1981 from the surroundings of Purvomay Town – Bryagovo Village (UTM LG44), Dragoyново Village (UTM LG55) and Ezerovo Village (UTM LG55) and it was kept in the zoological collection of Department of Zoology, Faculty of Biology at the University of Plovdiv "Paisii Hilendarski". The stomach contents were preserved in 70% alcohol and were analyzed in laboratory by means of binocular microscope. The prey taxa were identified to the lowest possible taxon, based on its degree of composition. The systematic of the identified invertebrate taxa follows "Fauna Europaea" (Fauna Europaea Web Service (2012)).

The results were statistically processed using descriptive statistics and t-test for independent samples, to compare the numeric proportion all prey taxa between species in order to detect differences in the use of food resources. Because the data didn't have normal distribution it was normalized using the arcsine transformation (FOWLER et al. 1998). Cluster analysis (Bray-Curtis index, group average link) was used to determine the similarity between the trophic spectrum of both species during the different months (seasons). For the statistical processing of the data we used the software package "Statistica 7.0" (STATSOFT INC. 2004). For the calculations of Simpson's diversity index and the Berger-Parker index and the cluster analysis we used the computer software "BioDiversityPro" (MCALEECE et al. 1997) and for the calculation of the niche overlap we used the computer program "EcoSim 7.0" (GOTELLI, ENTSMINGER 2001).

## Results and Discussion

The analyzed stomach contents of *Podarcis tauricus* and *Lacerta viridis* contained 195 and 184 prey items, respectively (Table 1). The average number of prey items per stomach for the studied lizard species is very similar: *Podarcis tauricus* - 1.63; *Lacerta viridis* - 1.68 (Fig. 1). The qualitative and quantitative proportion of the trophic spectrum, as well as the trophic niche breadth and niche overlap of the two studied lizard species is presented in Table 2. The insects are the predominating prey in both species, as for the non-insect preys predominating are the spiders. The main food source for both lizards is insects. For *Podarcis tauricus* the predominating food type is Orthoptera (44.62%), followed by Coleoptera (14.36%) and Hemiptera (7.18%) and for *Lacerta viridis* predominating are again Orthoptera (34.05%), followed by Coleoptera (12.97%) and Hymenoptera (9.73%).

Table 1. Descriptive statistics of the diet of *Podarcis tauricus* and *Lacerta viridis* for the whole period of study.

Species	Number of stomachs	Number of prey categories	Number of prey items	Mean	Standard Deviation (SD)	Standard Error (SE)
<i>Podarcis tauricus</i>	120	19	195	10.26	19.82	4.55
<i>Lacerta viridis</i>	110		185	9.74	14.34	3.29

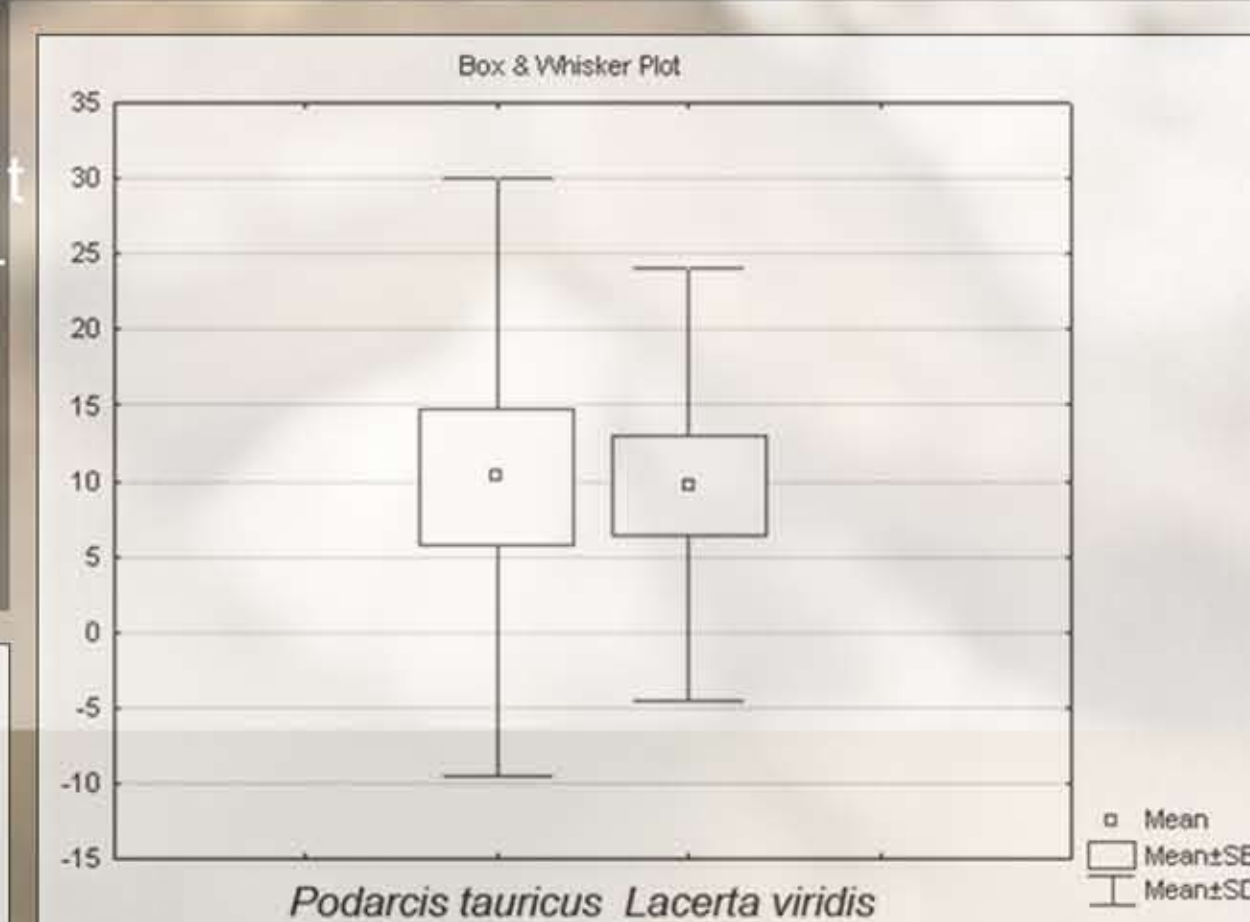


Fig. 1. Box & Whiskers plots of the diet of *Podarcis tauricus* and *Lacerta viridis* for the whole period of study.

Table 2. Qualitative and quantitative contents of the diet of *Podarcis tauricus* and *Lacerta viridis* for the whole period of study. Legend: n – number of prey items; n % - numeric proportion; f % - frequency of occurrence.

Prey taxa	<i>P. tauricus</i>			<i>L. viridis</i>		
	n	n %	f %	n	n %	f %
Gastropoda	1	0.51	0.83	2	1.08	1.82
Crustacea	2	1.03	1.67	3	1.62	2.73
Aranei	11	5.64	7.50	10	5.41	7.27
Myriapoda	0	0.00	0.00	2	1.08	1.82
Insecta						
Insecta (larvae)	2	1.03	0.83	3	1.62	1.82
Apterigota	3	1.54	2.50	0	0.00	0.00
Orthoptera	87	44.62	57.50	63	34.05	32.73
Dermaptera	0	0.00	0.00	1	0.54	0.91
Hemiptera	14	7.18	10.00	4	2.16	3.64
Hymenoptera – undet.	8	4.10	5.00	18	9.73	10.00
Formicidae	13	6.67	6.67	9	4.86	4.55
Diptera	9	4.62	5.83	15	8.11	12.73
Coleoptera – undet.	28	14.36	19.17	24	12.97	12.73
Carabidae	5	2.56	3.33	8	4.32	5.45
Scarabaeidae	2	1.03	1.67	5	2.70	3.64
Cerambycidae	0	0.00	0.00	4	2.16	0.91
Histeridae	1	0.51	0.83	7	3.78	2.73
Lepidoptera	4	2.05	3.33	2	1.08	1.82
Lepidoptera (larvae)	5	2.56	4.17	5	2.70	3.64
Sampling adequacy (Lehner's index)	0.875			0.945		
Berger-Parker index	0.446			0.341		
Niche breadth (1/Simpson)	4.261			6.403		

For the whole period of study The Balkan Wall lizard shows highest feeding activity in the autumn (September), while the Green lizard – during the summer (July-August). The results registered by ANGELOV et al. (1966) and DONEV (1984a) showed that the trophic spectrum of *Podarcis tauricus* is much more diverse during the spring with predominating Coleoptera, while during the summer this species prefers Hemiptera and Orthoptera. ANGELOV et al. (1972a) reported similar results for *Lacerta viridis* – the diet of the Green lizard is much more diverse in the spring, consisting of beetles and larvae of Lepidoptera, with lower feeding activity among the lizards. During the summer the predominating food are beetles ants and spiders and the authors noted a higher feeding activity among the lizards, which they explain with the higher temperatures during that season. Similar results were reported by DONEV (1984b). None of the above mentioned authors conducted studies on the trophic spectrum of these two species, which extend to the autumn season. According to our results *Podarcis tauricus* shows the highest feeding activity and most diverse diet in September. That's probably why September differs in separate cluster with approximately 55% similarity (Fig. 2). May (the spring season) is separated next with about 60% similarity and July and August (summer season) are grouped together with about 75% similarity. The reason for the high feeding activity in the autumn is perhaps the need of this species to accumulate nutrients before the winter hibernation. The green lizard on the other hand exhibited highest feeding activity during the summer, according to our results, as it was also pointed out by ANGELOV et al. (1972a) and DONEV (1984b). The results from the cluster analysis showed a grouping of May and September with about 55% similarity and the summer season (July-August) at about 60% similarity (Fig. 3).

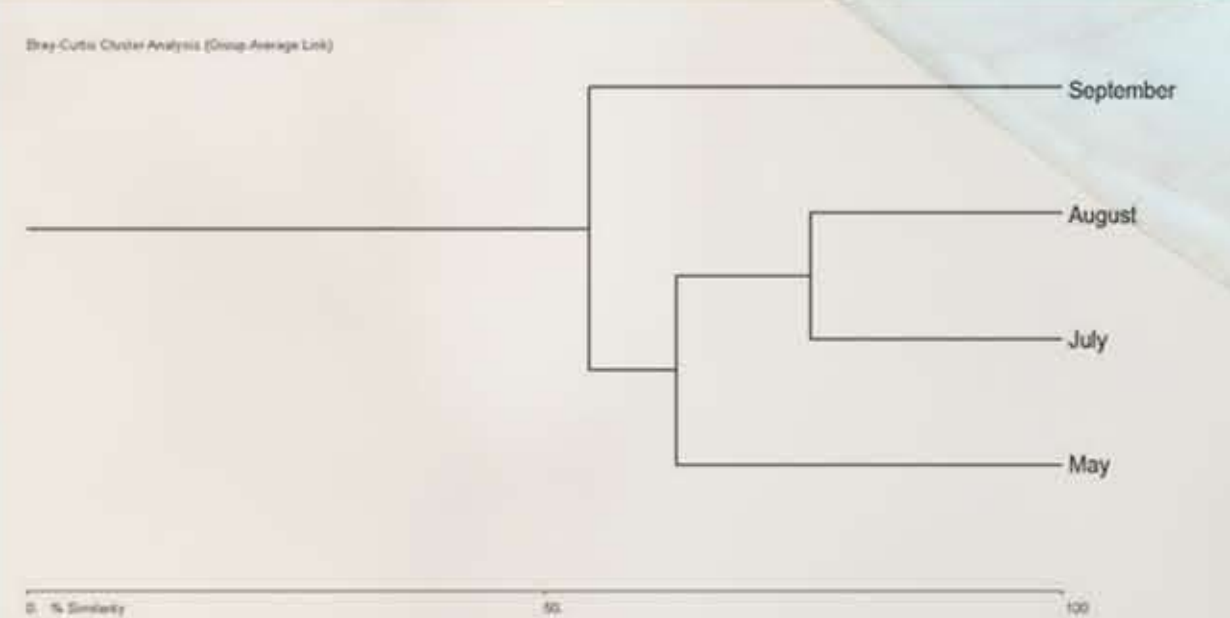


Fig. 2. Cluster analysis of the seasonal distribution of the trophic spectrum of *Podarcis tauricus* for the whole period of study (Bray-Curtis index, group average link).

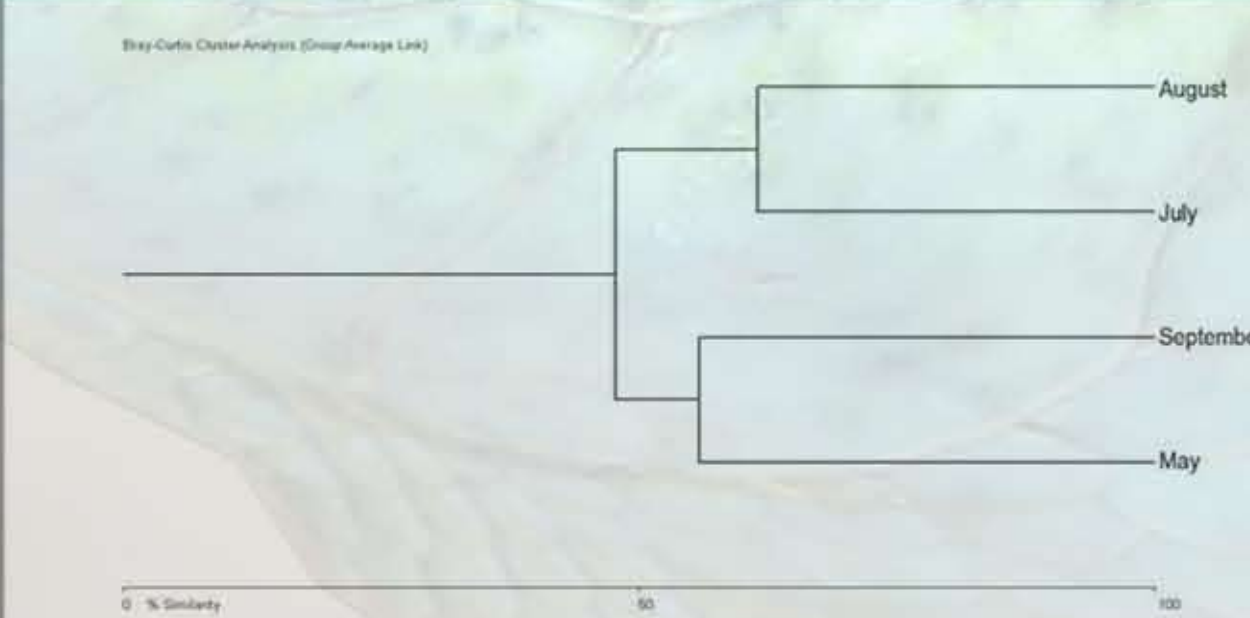


Fig. 3. Cluster analysis of the seasonal distribution of the trophic spectrum of *Lacerta viridis* for the whole period of study (Bray-Curtis index, group average link).

## Acknowledgements

We would like to express our sincerest gratitude to Prof. DSc. Blagoy Gruev and Assoc. Prof. Dr. Vasil Tomov for the given data and their insights used in this manuscript and Mr. Peter Ganev for his help during the field work and the laboratory analysis.

Although we registered a slight preference of both species towards Orthoptera, the Berger-Parker index showed a moderate to low value (Table 2). The niche breadth for both species showed a low value for *P. tauricus* and moderate value for *L. viridis* (Table 2). In our opinion both species should be considered polyphages with slight preference towards Coleoptera and other taxa, depending on the season and habitat. We calculated a niche overlap between the two species of 82.30%. The t-test for independent samples also showed no statistically significant differences in the diet of the two species ( $t=0.45$ ,  $p=0.66$ ). According to our results there should be a considerable competition for food between *Podarcis tauricus* and *Lacerta viridis* at the places with sympatric distribution.