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The common wall lizard *Podarcis muralis* (Reptilia: Lacertidae) shows diverse food preferences and intraspecific differences: a study case from Bulgaria

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Abstract: The Common wall lizard (*Podarcis muralis*) has the largest range among the genus *Podarcis*. Although there are a number of studies on its diet, data on regional level remains insufficient, particularly from a purely ecological perspective. We investigated 194 individual faecal samples of *P. muralis* obtained from two localities in western Bulgaria with the aim of clarifying the composition of the trophic spectrum of the species, as well as the intra-population characteristics in terms of age and sex. In one study site, we compared the realized trophic niche (prey items from the faecal pellets) with the fundamental (invertebrates collected via pit-fall traps exposure). We confirmed that *P. muralis* is an opportunist in terms of feeding and has a very wide trophic spectrum including several taxa, which have not been reported until now as a part of the species' diet. We revealed differences in feeding behavior between subadults and adults, as well as between males and females. Adults have higher diversity in the food spectrum compared to subadults. According to sexes, females have more varied diet. We also report for the first time for the species six cases of keratophagy. Also, we identified a relatively frequent occurrence of saurophagy (n = 16), including in females and subadults, for which this phenomenon has not been recorded so far.

Key words: Autophagy, sauria, diet, feeding, saurophagy, keratophagy.

1. Introduction

The food spectrum of a carnivorous species is influenced by various aspects of the biology and ecology of both the species and its prey. In European lizards each species utilizes particular groups of invertebrates determined by their functional characteristics such as size (Díaz and Carrascal, 1990, 1993; Castilla et al., 1991; Pérez-Mellado et al., 1991; Gil et al., 1993; Carretero and Llorente, 1993; 2001; Carretero et al. 2006; Cascio and Pasta, 2006; González-Suárez et al., 2011), hardness and mobility (Vanhooydonck et al., 2007; Edwards et al., 2013; Runemark et al., 2015; Donihue et al., 2016), as well as by their abundance and distribution in the environment (Heulin, 1986; Domínguez and Salvador, 1990; Díaz and Carrascal, 1991; Maragou et al., 1996; Adamopoulou and Legakis, 2002; Pérez-Mellado et al., 2003; Bonacci et al., 2008; Cascio and Capula, 2011). Some studies show selectivity towards invertebrates, regardless of their abundance and temporal presence (Cascio and Capula, 2011). In addition, some groups of invertebrates are less attractive to lizards and are rarely present in their diet despite their abundance, possibly due to the presence of various repulsive secretions and their visual recognition

by the lizards (Cascio and Capula, 2011). A number of environmental factors influence food selection such as seasonality (Rocha 1996), temporal abundance of invertebrates (Simon, 1975; Adamopoulou et al., 1999; Pérez-Mellado and Corti, 1993; Dendi et al., 2019) or temperature (Van Damme et al., 1991).

The genus *Podarcis* Wagler 1830 is among the richest genera of the family Lacertidae, represented by 27 species occurring in Europe and parts of North Africa and Asia Minor (Uetz et al., 2023). The Common wall lizard *Podarcis muralis* (Laurenti, 1768) is the species with the largest range among the genus *Podarcis* (Gasc et al., 1997; Sillero et al., 2014). It inhabits diverse habitats, but mostly sunlit and with less vegetation (Covaciu-Marcov et al., 2006; Žagar, 2016; Vacheva et al., 2020). It also occurs in anthropogenically affected habitats (Covaciu-Marcov et al., 2006) and successfully colonizes new territories (Gherghel et al., 2009; Mackey, 2010; Mole 2010; Maletzky et al., 2011; Michaelides et al., 2013; Santos et al., 2019; Oskyrko et al., 2022). In Bulgaria, *P. muralis* is widespread, but its distribution is mainly in mountainous areas (up to 2100 m), in contrast, its presence in plains and lowlands is sporadic (Stojanov et al., 2011).

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The diet of *P. muralis* has been studied in different parts of the range (e.g., Mou, 1987; Capula et al., 1993; Bombi and Bologna, 2002; Scali et al., 2015), but most studies have focused only on the composition of the food spectrum, while the ecological features of the diet are still poorly studied. Specifically for Bulgaria, the diet of the species has been studied on the basis of the stomach content of 150 individuals (Angelov et al., 1966; 1972; Kabisch and Engelmann, 1969; Mollov and Petrova, 2013;).

The aim of this study was to analyze the diet of *P. muralis* in populations of Bulgaria using a noninvasive method with a focus on: (1) composition of the food spectrum; (2) differences (if any) in the diet in regard to age and sex; (3) comparison between consumed prey and the available food resources.

2. Material and methods

2.1. Study area and sampling

We examined faecal samples collected from lizards caught in the field, as well as potential invertebrate prey from pit-fall traps set at the same sites. The field work was conducted in two sites, situated in NW and S Bulgaria, respectively: the coastal area of the Ogosta Reservoir (N43.3739°, E23.2086°, 180–240 m a.s.l.), and the area of Gabrovitsa Village in the Sredna Gora Mts. (N42.2602°, E23.9208°, 430–570 m a.s.l.). Fifty-three field days were implemented, respectively 28 in Ogosta (in May–September 2013–2016) and 25 in Gabrovitsa (April–October 2017–2018). For a detailed description of the two sites see Vacheva et al. (2020).

Lizards were captured by hand, measured [snout-vent length (SVL), using a transparent ruler to the nearest 1 mm], and placed in separate plastic boxes. After defecation (within 1–2 days) the animals were released at the place of capture. The faecal pellets were preserved in separate Eppendorf tubes with 75% ethanol. In Gabrovitsa, we used 24 pit-fall traps (plastic containers, 9.5 cm wide and 12 cm deep, filled with propylene glycol) for collecting invertebrates in order to assess the potential food resource for *P. muralis*. The traps were situated in different microhabitat types (four series, each of six traps, 10 m apart) and were exposed for 23 and 17 days in April–June (in 2017 and 2018 respectively), and for 16 and 23 days in July–October (2017 and 2018).

2.2. Data processing and statistics

Captured lizards were divided into two age groups according to Tzankov (2007): adults (SVL > 47 mm) and immatures (including both juveniles and subadults) (SVL < 47 mm). Sex was determined only in adults. Collected material (prey remains in the faecal pellets and invertebrates, caught in the pit-fall traps) was examined under a stereomicroscope (magnification 10–40×), identified to the lowest possible systematic level, and grouped into “operational taxonomic

units” (from here on as OTUs). In addition to taxonomic affiliations, the identified invertebrates were categorized according to their evasiveness (sedentary, intermediate, and evasive, abbreviated respectively as E1, E2, and E3) and hardness (soft, intermediate, and hard – respectively H1, H2, and H3) according to Verwajen et al. (2002) and Vanhooydonck et al. (2007).

The taxonomic diversity of the prey remains in the faecal pellets was analysed via Rényi's index family (diversity profiles), which has been considered one of the most useful methods for ordering samples according to their diversity (Tóthmérész, 1995). Food selection was analyzed by comparing the relative abundance of the OTUs from the faecal samples with those from the pit-fall traps, using the electivity index of Vanderploeg and Scavia (1979) (E^*), which represents a modification of the Ivlev's forage ratio, but has better theoretical justification (Lechowicz, 1982). The index takes values from -1 to $+1$, and it can be interpreted as a measure of the deviation from random feeding ($E^* = 0$); here, the index range was divided into three parts and the OTUs were conditionally categorized as preferred ($E^* > 0.5$), neutral ($0.5 \geq E^* \geq -0.5$) or avoided ($E^* < -0.5$) [the OTUs, represented by low abundance (below 5 individuals), were excluded, because according to Lechowicz (1982) the index is vulnerable to sampling errors for food types that are rare]. Spearman's rank correlation coefficient (Rho) was used to test for correlation between abundance and frequency of the prey items, found in the faecal pellets. Chi-square (χ^2) test was used for comparison between the age groups and between sexes, regarding the categories of evasiveness and hardness of the prey items. Statistical procedures were performed using PAST 4.07 (Hammer et al. 2001), except for the electivity index, which was calculated in Microsoft Excel (2010) after manual input of the respective formulas.

3. Results

Faecal samples were collected from 194 *Podarcis muralis* (28 males, 20 females, and 9 immatures from Ogosta and 41 males, 60 females, and 36 immatures from Gabrovitsa). The determined invertebrate remains were attributed to 788 individual invertebrate specimens, respectively 287 from Ogosta and 501 from Gabrovitsa. The average number of individual remains found in the faecal pellets was 4.09 (4.98 for Ogosta and 3.66 for Gabrovitsa), and the maximum was 15 for Ogosta and 13 for Gabrovitsa.

The invertebrate remains detected from the faecal pellets were assigned to 21 OTUs for Ogosta and 22 OTUs for Gabrovitsa (Appendix 1). In the sample from Ogosta, the OTUs with the highest frequency and abundance were Araneae and Hymenoptera (other than Formicidae), and in the one from Gabrovitsa—respectively Araneae and Formicidae (Figure 1). The correlation between the

abundance and frequency of occurrence of OTUs in the faecal pellets was positive and statistically significant in both sample sites (Rho > 0.87, p < 0.001). Cases of saurophagy and keratophagy were found only from Gabrovitsa (Appendix 1). Saurophagy was recorded in 16 individuals (11.7% of the individual faecal pellets) from Gabrovitsa [respectively in 8 (19.5%), 6 (10%), and 2 (5.6%) of the males, females, and immatures], but it should be noted that 4 of these records referred to females, whose tails were severed unintentionally during capture, and ingestion of the severed tails was observed during transport which can be defined as autophagy (the severed tail parts were kept in the same containers in which the lizards were transported). Keratophagy was recorded in 4.38% of the faecal pellets from Gabrovitsa (respectively in 4.9%, 5%, and 2.9% of the males, females, and immatures). Plant material were recorded both from Ogosta and Gabrovitsa, with a different frequency: in 3.5% of the faecal pellets from Ogosta (in males only) and in 11.7%

– from Gabrovitsa (respectively in 17%, 13%, and 2.9% of the males, females, and immatures).

Regarding diversity of the food remnants in the faecal pellets, the Rényi's profiles showed that it is higher in adult than in immature lizards, and specifically in adults – in females than in males (Figure 2). This applied to both studied sites, but was more pronounced for Gabrovitsa, where the sample size was larger.

In the sample from Ogosta, the most frequently recorded OTUs in the faecal pellets of adult lizards were Hymenoptera (excl. Formicidae) (in 50% of the individual faecal pellets) and Araneae (41.7%), and in these of immatures–Araneae (66.7%), Heteroptera (44.4%), and Hymenoptera (excl. Formicidae) (44.4%); there were 6 OTUs found only in adults, and 4–only in immatures (see Appendix 1). In the sample from Gabrovitsa, the most frequently recorded OTUs in adults were Formicidae (48.5%) and Araneae (47.5%), and in immatures–Araneae (66.7%) and Auchenorrhyncha (33.3%); there were seven OTUs found only in adults, but no OTU found only in immatures (Appendix 1).

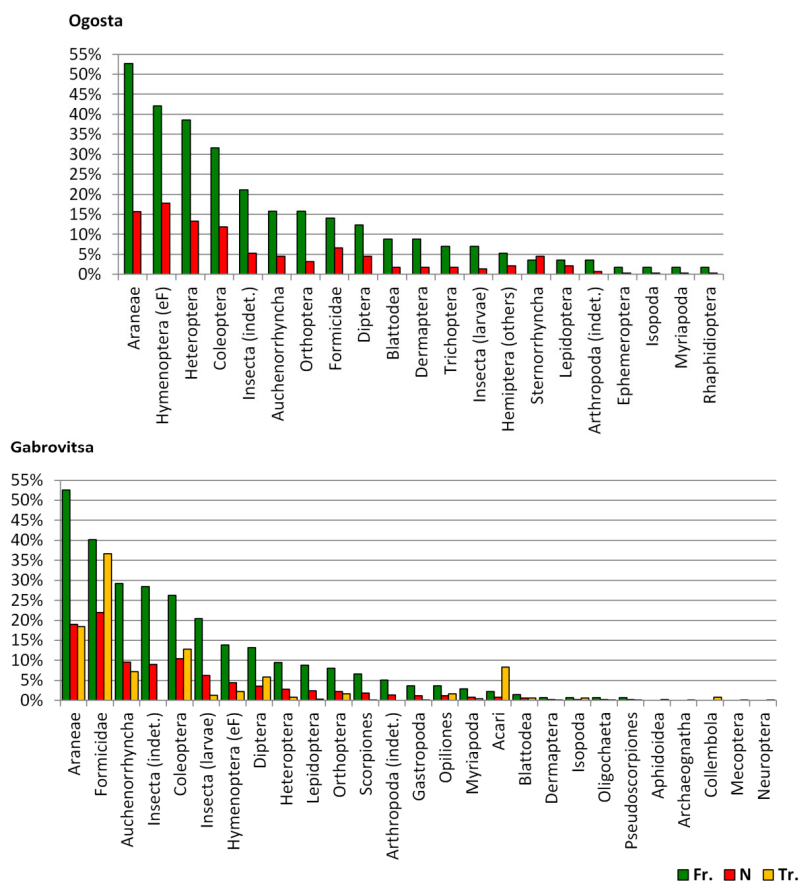


Figure 1. Percentage share of the OTUs according to: number of faecal samples of *P. muralis* in which the OTU was found (Fr.); number of specimens registered in the faecal samples (N); number of specimens, collected by pit-fall traps (Tr.).

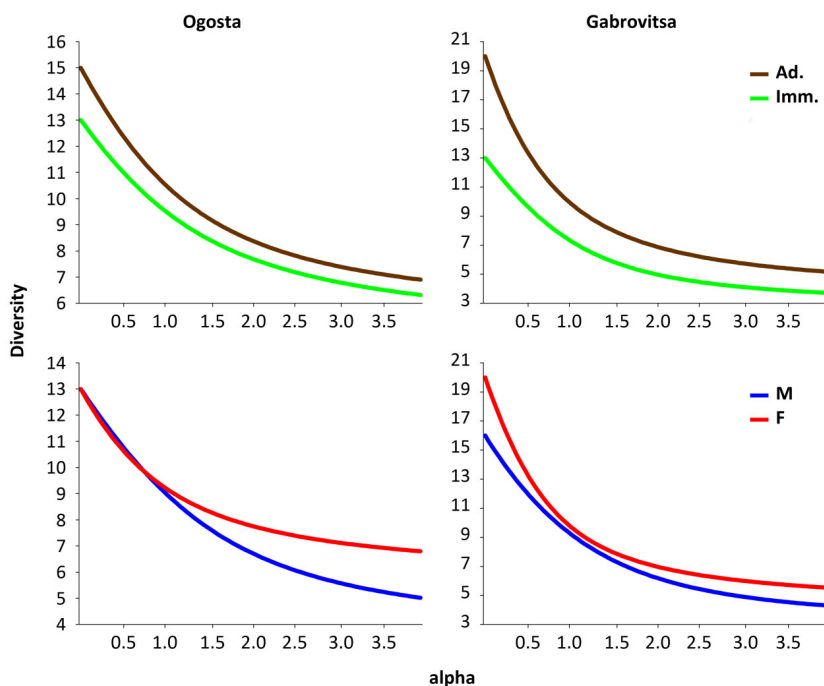


Figure 2. Diversity profiles of the diet of *P. muralis* based on the faecal samples from the study sites (Ad. = adults; Imm. = immatures; M = males; F = females).

When comparing the frequency of presence of OTUs in the faecal pellets, grouped by sex, in the sample from Ogosta the most frequently recorded OTUs in males were Araneae (in 50% of the individual faecal pellets) and Hymenoptera (excl. Formicidae) (43%), and in females – Heteroptera (55%) and Araneae (50%); there were 2 OTUs found only in males, and 1–only in females (see Appendix 1). In the sample from Gabrovitsa, the most frequently recorded OTUs in males were Formicidae (49%) and Araneae (39%), and in females–Araneae (53.3%) and Formicidae (48.3%); there was no unique OTU for males, but four OTUs were found only in females (Appendix 1).

In the pit-fall traps from Gabrovitsa, there were registered 10,000 invertebrates, which were assigned to 25 OTUs (Appendix 2). Twenty of the OTUs recorded in the traps were the same as those from the lizard faecal pellets, and the remaining five (Aphidoidea, Archaeognatha, Collembola, Mecoptera, and Neuroptera) were not found in the faecal pellets; on the other hand, almost all of the OTUs recorded in the faecal pellets were also found in the traps, except Scorpiones. The most abundant OTUs in the traps, as well as in the faecal pellets, were Formicidae and Araneae (Figure 1).

According to the electivity index values (Table 1) three of the OTUs were categorized as preferred prey (Lepidoptera, Gastropoda, and insect larvae) and the rest – as neutral. In adults, the preferred OTUs were also Lepidoptera, Gastropoda, and insect larvae while in

immatures they were Auchenorrhyncha, Araneae, and Diptera. Regarding sex, Lepidoptera and insect larvae were categorized as preferred both in males and females, while Heteroptera and Hymenoptera (except Formicidae) were specific for males and females respectively.

Regarding the evasiveness of the prey, the three categories were presented with similar values in the sample (as a whole) from Ogosta, while in that from Gabrovitsa, the sedentary prey items predominated (Figure 3). In the adults from Ogosta, the sedentary prey had the lowest abundance at the expense of the other two categories, but in the immatures, the evasive prey had the lowest abundance, while in the sample from Gabrovitsa, there was an equalization of the abundance of sedentary and intermediate categories in adults, but in immatures–predominance of sedentary prey. In the males from Ogosta, the most abundant was the evasive prey, and in females–the intermediate category, while in the sample from Gabrovitsa the ratio between the three categories was similar in both sexes. The test showed a statistically significant difference between adults and immatures in both sample sites (Ogosta: $\chi^2 = 6.807$, $df = 2$, $p = 0.0333$ and Gabrovitsa: $\chi^2 = 18.305$, $df = 2$, $p = 0.0001$), and between the sexes–only for Ogosta ($\chi^2 = 4.636$, $df = 2$, $p = 0.0004$).

In terms of the hardness of the prey items, the number of soft and hard invertebrates was almost equal, and the intermediate category had the least participation, and

Table 1. Vanderploeg & Scavia index values for the Gabrovitsa sample; symbols [>] and [=] denote preferred and neutral prey, respectively (see material and methods).

OTU	Entire sample	Adults	Immatures	Males	Females
Araneae	-0.128 [=]	-0.239 [=]	0.750 [>]	-0.329 [=]	0.085 [=]
Auchenorrhyncha	0.003 [=]	-0.139 [=]	0.823 [>]	-0.021 [=]	0.068 [=]
Coleoptera	-0.244 [=]	-0.245 [=]	0.365 [=]	-0.185 [=]	-0.003 [=]
Diptera	-0.370 [=]	-0.486 [=]	0.649 [>]	n/a	-0.178 [=]
Formicidae	-0.379 [=]	-0.356 [=]	-0.065 [=]	-0.199 [=]	-0.206 [=]
Gastropoda	0.698 [>]	0.681 [>]	n/a	n/a	n/a
Heteroptera	0.443 [=]	0.428 [=]	n/a	0.657 [>]	n/a
Hymenoptera (eF)	0.206 [=]	0.217 [=]	n/a	0.060 [=]	0.517 [>]
Insecta (larvae)	0.584 [>]	0.589 [>]	n/a	0.566 [>]	0.752 [>]
Lepidoptera	0.739 [>]	0.765 [>]	n/a	0.831 [>]	0.820 [>]
Opiliones	-0.303 [=]	-0.248 [=]	n/a	n/a	n/a
Orthoptera	-0.010 [=]	-0.051 [=]	n/a	0.272 [=]	n/a

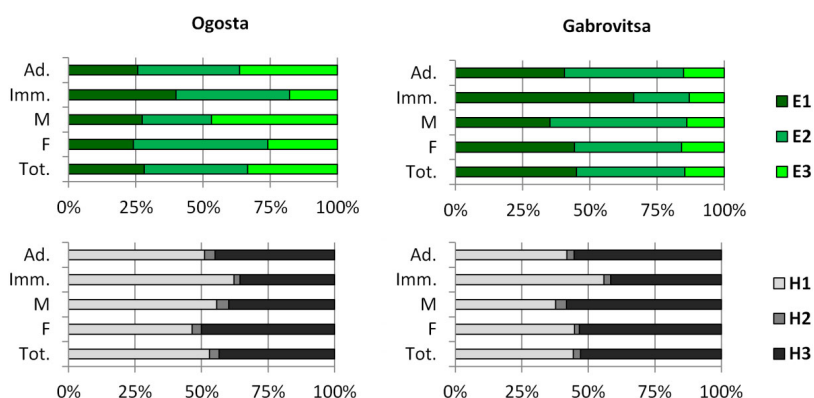


Figure 3. Percentage share of the categories of evasiveness (E1, E2, and E3) and hardness (H1, H2, and H3) according to the number of categorized prey items from the faecal samples of *P. muralis* (Ad. = adults; Imm. = immatures; M = males; F = females; Tot. = the entire sample).

this applies to both samples (Figure 3). No significant differences were detected between age categories or sex.

4. Discussion

Podarcis muralis appears to be an active predator which uses a large number of invertebrate groups for food. Registered feeding activity was comparatively high with an average number of ingested individual prey items of 4.09 per lizard, i.e. almost twice as high as that indicated in previous studies in Bulgaria (between 2.1 and 2.8 according to Angelov et al. 1966, 1972). No clear prevalence of specific OTUs was observed regarding relative abundance in the faecal pellets, and in regard to frequency of occurrence, only Araneae exceeded 50%. In this sense, *P. muralis* can be defined as a generalist and opportunist, what was also confirmed by the comparison of the realized with the fundamental trophic niche (done for the sample from Gabrovitsa), according to which, only

three OTUs appeared as positively selected prey, and all others-neutral.

Regarding diversity (in quantitative terms), our data showed that the bulk of the species' diet consisted of representatives from the orders of Araneae, Coleoptera, Hemiptera, Heteroptera, and Hymenoptera. To a large extent, this is consistent with previous studies on the feeding of *P. muralis*, both from Bulgaria (Angelov et al., 1972 found the highest abundance of ingested invertebrates from the orders of Coleoptera and Araneae) and other parts of the range (e.g., Mou, 1987; Capula et al., 1993; Scali et al., 2015). However, other studies show a different picture, which confirms the thesis that this species is opportunist in terms of feeding. For example, flying insects, which according to other authors predominate in numbers in the food of *P. muralis* (Capula et al., 1993; Kabisch and Engelmann, 1969; Scali et al., 2015), were also prevalent in one of the our samples, but poorly represented

in the other (respectively ca. 64% and ca. 36% from the identified prey items). Kabisch and Engelmann (1969) indicated a very high abundance of Diptera (52%) in the diet of *P. muralis* from Balchik (NE Bulgaria), while in the other studied population from Varna (ca. 30 km south of Balchik), Amphipoda have been the most abundant prey (43%). In this case, the presence of Amphipoda in the diet is not a surprise, because the habitat of the studied population from Varna was the very shore of the sea and that of Balchik—a park in the interior of the town (see Kabisch and Engelmann, 1969). This indicates that the food spectrum of *P. muralis* is mainly determined by the available resources in the habitat of the particular population, confirmed by our data.

Five OTUs, detected by this study, have not been reported so far as components of the *P. muralis* diet (at least to our knowledge): Ephemeroptera, Trichoptera, Acari, Opiliones and Pseudoscorpiones. The presence of scorpions (found in 7% of the individual faecal samples from Gabrovitsa) can be defined as unusual since most lacertid species rarely resort to such a dangerous food source. For European lacertids, there are only a few documented cases for the presence of scorpions in the diet, and most of them are based on single observations (Castilla et al., 2008, 2009; Žagar et al., 2011; Vacheva, 2023). The consumption of dangerous invertebrates (stinging insects, millipedes, scorpions, etc.) by lacertids is considered an extreme feeding behavior and moreover, in some of these invertebrates, there are established cases of feeding on lizards, for example in scorpions (Castilla, 1995b; Castilla et al., 2009) and centipedes (Zimić and Jelić, 2014; De Luna, 2016).

The remains of lizard body parts found in the faecal samples of *P. muralis* from Gabrovitsa prove the presence of saurophagy, but it remains unclear whether it is predicated on cannibalism, as other lizard species are also present in study site (see Vacheva et al., 2020), and the remains found did not allow identification to species level. Saurophagy and in particular cannibalism have been observed in a number of species of the genus *Podarcis*: e.g., in *P. erhardii* (Bedriaga, 1882) (Madden and Brock 2018), *P. filfolensis* (Bedriaga, 1876) (Carretero et al., 2010), *P. gaigae* (Werner, 1930) (Adamopoulou et al., 1999), *P. liolepis* (Boulenger, 1905) (Castilla and Van Damme, 1996; Castilla, 1995a), *P. milensis* (Bedriaga, 1882) (Adamopoulou and Legakis, 2002), *P. pityusensis* (Boscá, 1883) (Dappen, 2011), *P. siculus* (Rafinesque-Schmaltz, 1810) (Capula and Aloise, 2011; Grano et al., 2011), and *P. virescens* Geniez et al. 2014 (Dias et al., 2016), but most of these species occur on islands with high lizard density and limited food resources. Specifically for *P. muralis*, lizard remains in the food have been documented in Greece, Bulgaria, Serbia and Slovenia (Andriopoulos and Pafilis, 2019; Kabisch

and Engelmann, 1969; Simović and Marković, 2013; Žagar and Carretero, 2012; this study). The cited sources only report single observations of sexually mature males, while our results showed that the saurophagy occurs more often and is not limited to adults or a single sex. Also of interest was the observed ingestion of the own tails in 4 adult females from the Gabrovitsa sample. Autotomy is an effective way to avoid predators (Maginnis, 2006), but tail loss reduces an individual's mobility (Martín and Salvador, 1997), reproductive ability (Martín and Salvador, 1993) and social status (Fox and Rostker, 1982). Consuming one's own tail (autophagy) probably compensated for these losses through direct energy intake (Clark, 1971), but so far such feeding behavior does not appear to have been documented in *P. muralis*.

A previously unrecorded feeding behavior for *P. muralis* was the ingestion of the shed skin (keratophagy). Keratophagy is defined as a partial or complete ingestion of the epidermal layer of the skin and has been found in a number of lizard species (Weldon et al., 1993; Mitchell et al., 2006 and references therein), but for the European members of the family Lacertidae, this phenomenon has been recorded only for *Lacerta agilis* Linnaeus, 1758 (Gvoždík, 1997, pers. data), *Zootoca vivipara* (Lichtenstein, 1823) (Vacheva, 2018), and *Darevskia praticola* sensu lato (Eversmann, 1834) (Vacheva and Naumov, 2022).

Plant residues in the food of *P. muralis* was registered by us in both study sites (9.28% of the faecal pellets in total), but with a greater frequency in Gabrovitsa (i.e. the larger sample). Such percent value suggests nonaccidental ingestion, even more so that the presence of plant food in the dietary spectrum has been reported for many species of the genus *Podarcis* (e.g., Carretero, 2004; Pérez-Mellado and Corti, 1993).

A complementary view on lizard feeding can be obtained by analyzing some physical characters of the prey. In this regard, our research showed that in terms of evasiveness, a predominant part of the prey of *P. muralis* includes OTUs with slow and medium mobility (at least in the larger of the two samples), and in terms of hardness, soft and hard prey have a similar proportional participation (in both study sites). In view of the latter, it can be assumed that the prey hardness is not as relevant for this species.

Relatively little is known about intra-population differences in the dietary habits of *P. muralis*. Differences in food preferences between adults and juveniles have been inferred by Mou (1987) for populations from western France, and our data confirmed the existence of such distinction (lower diet diversity and preference for slower moving prey in immatures, as well as a difference between adults and immatures in positively selected OTUs: see Table 1). As expected (on the basis of the similarity in body size), the differences found between males and females

in their food preferences were less pronounced than those between adults and immatures. However, the sexes could be distinguished in terms of diet diversity, which was higher in females (in both populations studied), and partially by the abundance of fast-moving prey (higher in males, but only in one of the two samples). These differences could be due to sexual dimorphism in head size and body proportions (Tzankov, 2007; Žagar et al., 2012, and personal data) and on a stronger bite in males (Herrel et al., 2001). We speculate that there is another explanation: the higher dietary diversity found in females is due to a necessity of more multifarious food in the period of pregnancy, while between males and non gravid females probably no differences exist.

5. Conclusion

It can be argued that *Podarcis muralis* is an active forager with a wide trophic spectrum and opportunistic and generalist feeding behavior. The diet of adults is more varied than that of immatures, and adult females probably have a wider food spectrum than males. For a more detailed elucidation of the feeding behavior at intra-population level, further studies are needed, especially

based on large samples which imply a greater chance of recording rare prey (e.g., phenomena such as keratophagy and saurophagy were recorded by us only in Gabrovitsa, where the sample size was more than twice in proportion to Ogosta).

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Conflict of interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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Appendix 1

Distribution of the material from the faecal samples of *Podarcis muralis* per OTU [E = evasiveness (E1, E2, and E3 refer to sedentary, intermediate, and evasive, respectively); H = hardness (H1, H2, and H3 refer to soft, intermediate, and hard, respectively)]; N = number of identified individual remnants; Fr: = number of the faecal samples in which the OTU occurs.

Ogosta:

Phylum: Class	OTU	Total (n = 57)		Males (n = 28)		Females (n = 20)		Immatures (n = 9)	
		N	Fr.	N	Fr.	N	Fr.	N	Fr.
Arthropoda	Arthropoda (indet.)	2	2	–	–	2	2	–	–
Arthropoda	Myriapoda [E2; H1]	1	1	–	–	–	–	1	1
Arthropoda: Arachnida	Araneae [E1; H1]	45	30	19	14	16	10	10	6
Arthropoda: Insecta	Auchenorrhyncha [E1; H3]	13	9	–	–	7	6	6	3
Arthropoda: Insecta	Blattodea [E3; H1]	5	5	2	2	3	3	–	–
Arthropoda: Insecta	Coleoptera [E2; H3]	34	18	10	9	21	7	3	2
Arthropoda: Insecta	Dermaptera [E2; H1]	5	5	3	3	2	2	–	–
Arthropoda: Insecta	Diptera [E3; H1]	13	7	5	4	6	2	2	1
Arthropoda: Insecta	Ephemeroptera [E3; H1]	1	1	–	–	–	–	1	1
Arthropoda: Insecta	Formicidae [E2; H3]	19	8	4	3	13	3	2	2
Arthropoda: Insecta	Hemiptera (others) [E2; H1]	6	3	2	2	–	–	4	1
Arthropoda: Insecta	Heteroptera [E2; H1]	38	22	10	7	20	11	8	4
Arthropoda: Insecta	Hymenoptera (eF)* [E3; H3]	51	24	31	12	15	8	5	4
Arthropoda: Insecta	Insecta (indet.)	15	12	6	6	3	3	6	3
Arthropoda: Insecta	Insecta (larvae) [E1; H1]	4	4	2	2	1	1	1	1
Arthropoda: Insecta	Lepidoptera [E3; H1]	6	2	5	1	1	1	–	–
Arthropoda: Insecta	Orthoptera [E3; H2]	9	9	5	5	4	4	–	–
Arthropoda: Insecta	Rhaphidioptera [E2; H1]	1	1	–	–	–	–	1	1
Arthropoda: Insecta	Sternorrhyncha [E1; H1]	13	2	10	1	3	1	–	–
Arthropoda: Insecta	Trichoptera [E3; H1]	5	4	5	4	–	–	–	–
Arthropoda: Malacostraca	Isopoda [E1; H2]	1	1	–	–	–	–	1	1
	plant material		2		2		–		–

* eF = except Formicidae

Gabrovitsa:

Phylum: Class	OTU	Total (n = 137)		Males (n = 41)		Females (n = 60)		Immatures (n = 36)	
		N	Fr.	N	Fr.	N	Fr.	N	Fr.
Annelida: Clitellata	Oligochaeta [E1; H1]	1	1	–	–	1	1	–	–
Arthropoda	Arthropoda (indet.)	7	7	2	2	4	4	1	1
Arthropoda	Myriapoda [E2; H1]	4	4	1	1	2	2	1	1
Arthropoda: Arachnida	Acari [E1; H1]	4	3	2	1	1	1	1	1
Arthropoda: Arachnida	Araneae [E1; H1]	95	72	19	16	48	32	28	24
Arthropoda: Arachnida	Opiliones [E1; H1]	6	5	4	3	2	2	–	–
Arthropoda: Arachnida	Pseudoscorpiones [E1; H1]	1	1	–	–	1	1	–	–
Arthropoda: Arachnida	Scorpiones [E1; H1]	9	9	4	4	3	3	2	2
Arthropoda: Insecta	Auchenorrhyncha [E1; H3]	48	40	14	12	18	16	16	12
Arthropoda: Insecta	Blattodea [E3; H1]	3	2	1	1	2	1	–	–
Arthropoda: Insecta	Coleoptera [E2; H3]	52	36	18	15	28	16	6	5
Arthropoda: Insecta	Dermaptera [E2; H1]	1	1	–	–	1	1	–	–
Arthropoda: Insecta	Diptera [E3; H1]	18	18	3	3	9	9	6	6
Arthropoda: Insecta	Formicidae [E2; H3]	110	55	50	20	53	29	7	6
Arthropoda: Insecta	Heteroptera [E2; H1]	14	13	8	7	4	4	2	2
Arthropoda: Insecta	Hymenoptera (eF)* [E3; H3]	22	19	5	4	15	13	2	2
Arthropoda: Insecta	Insecta (indet.)	45	39	7	6	26	22	12	11
Arthropoda: Insecta	Insecta (larvae) [E1; H1]	31	28	9	7	19	18	3	3
Arthropoda: Insecta	Lepidoptera [E3; H1]	12	12	6	6	6	6	–	–
Arthropoda: Insecta	Orthoptera [E3; H2]	11	11	6	6	3	3	2	2
Arthropoda: Malacostraca	Isopoda [E1; H2]	1	1	–	–	1	1	–	–
Mollusca: Gastropoda	Gastropoda [E1; H3]	6	5	1	1	4	3	1	1
	saurophagy		16		8		6		2
	keratophagy		6		2		3		1
	plant material		16		7		8		1
	inorganic particles		4		1		2		1

* eF = except Formicidae

Appendix 2

Distribution of the material, collected by the pit-fall traps in Gabrovitsa, per OTU [E = evasiveness (E1, E2, and E3 refer to sedentary, intermediate, and evasive, respectively); H = hardness (H1, H2, and H3 refer to soft, intermediate, and hard, respectively)]; N = number of specimens.

Phylum: Class	OTU	N
Annelida: Clitellata	Oligochaeta [E1; H1]	10
Arthropoda	Myriapoda [E2; H1]	42
Arthropoda: Arachnida	Acari [E1; H1]	832
Arthropoda: Arachnida	Araneae [E1; H1]	1839
Arthropoda: Arachnida	Opiliones [E1; H1]	168
Arthropoda: Arachnida	Pseudoscorpiones [E1; H1]	2
Arthropoda: Insecta	Aphidoidea [E1; H1]	22
Arthropoda: Insecta	Archaeognatha [E1; H1]	9
Arthropoda: Insecta	Auchenorrhyncha [E1; H3]	714
Arthropoda: Insecta	Blattodea [E3; H1]	55
Arthropoda: Insecta	Coleoptera [E2; H3]	1281
Arthropoda: Insecta	Collembola [E1; H1]	83

Appendix 2 (Continued.)

Arthropoda: Insecta	Dermaptera [E2; H1]	4
Arthropoda: Insecta	Diptera [E3; H1]	586
Arthropoda: Insecta	Formicidae [E2; H3]	3661
Arthropoda: Insecta	Heteroptera [E2; H1]	81
Arthropoda: Insecta	Hymenoptera (eF)* [E3; H3]	217
Arthropoda: Insecta	Insecta (larvae) [E1; H1]	122
Arthropoda: Insecta	Lepidoptera [E3; H1]	27
Arthropoda: Insecta	Mecoptera [E2; H1]	1
Arthropoda: Insecta	Neuroptera [E2; H1]	3
Arthropoda: Insecta	Orthoptera [E3; H2]	168
Arthropoda: Insecta	Trichoptera [E3; H1]	2
Arthropoda: Malacostraca	Isopoda [E1; H2]	57
Mollusca: Gastropoda	Gastropoda [E1; H3]	16

* eF = except Formicidae