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Note on the food composition of a *Pelophylax ridibundus* (Amphibia) population from the Dubova locality region, south-western Romania

Alfred-Ştefan CICORT-LUCACIU*, Carmen PELLE and Ioana Teodora BORMA

University of Oradea, Faculty of Sciences, Department of Biology, Universităţii str. 1, Oradea 410087, Romania.
* Corresponding author, A.Ş. Cicort-Lucaciu, E-mail: cicort.alfred@yahoo.com

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Abstract. We detected 303 preys pertaining to 29 prey taxa, predominantly terrestrial, within the diet of a *Pelophylax ridibundus* population from the region of Dubova locality. The most important prey taxa existent in the diet of this population was represented by ants. The food of the juveniles was less divers compared to the food of the adults. The diet of juveniles consists of a slightly reduced number of preys, pertaining to a small number of taxonomic prey types. In the case of the juveniles the ant consumption was way higher compared to the adults.

Key words: feeding, marsh frog, size, diversity, ants.

Introduction

Although the food compounds of green frogs is fairly known (eg: Cogălniceanu et al. 2000a, Covaciu-Marcov et al. 2000, Cicek & Mermer 2006, Balint et al 2010, Mollov 2008, Mollov et al. 2010, Cicort-Lucaciu et al. 2011, Bogdan et al. 2012, 2013), even in the late years there are recent information on their predator behavior, that indicates new research possibilities and directions (see in: Jablonski & Vlcek 2012). *Pelophylax ridibundus* is a common amphibian in Romania, specific to lowlands and hills, residing in large aquatic habitats (Cogălniceanu et al. 2000b). Nevertheless, the species is well represented in the Danube Gorge area, where even if the altitude is low, the habitats are characteristic to the one from higher area, a fact that allow the existence of some mountain amphibian species at their lower altitude from Romania (see in: Covaciu-Marcov et al. 2009).

Hence, the current research investigates the food composition of a *P. ridibundus* population from a habitat less typical to this species, represented by a mountain stream with a low flow and rocky substratum. Furthermore, we tried to analyze the differences between the feeding of the adults and juveniles.

Figure 1. General aspects of the studied habitat, near Dubova locality, Mehedinti county, Romania.

Materials and Methods

The field activity was realized in August 2011. The amphibians were captured from a small stream (Fig. 1), situated near Dubova locality. Dubova is located in the south-western Romania, in Mehedinţi County, in the Danube Gorge. After crossing the locality and its industrial abandoned buildings, the stream is surrounded by forested sides. The flow of the stream is reduced, its width usually reaching the upper limit of 1 meter, and its depth oscillating between 30 and 50 centimeters. The substratum presents multiple rocks, in some regions the water contains algae blankets, while on the banks there is a reduced amount of bulrush and generally, herbaceous vegetation. In the area were the amphibians were captured the banks of the stream are surrounded by grasslands.

The frogs were captured either by hand, or by using a net. Due to the rocks, a lot of frogs could not be captured, managing to capture only 56 individuals. The captured amphibians had been collected in buckets with some water, the adults and juveniles being separated. There was an approximately equal number of adults and juveniles (27 adults and 29 juveniles) which permitted the segregated analysis of their feeding. The stomach contents have been collected by using the stomach flushing method (Sole et al. 2005), the frogs being subsequently released in the stream. The stomach content of each individual was collected in a distinct test tube, preserved in formaldehyde solution and analyzed in the laboratory. After the prey were successfully determined, we calculated more parameters of the feeding, as well as percentage abundance (%A) and frequency of occurrence (%f), for each prey taxa. Moreover, we calculated the diversity of the food by using the Shannon-Wiever diversity index (1949) and the similarity of the food with the Sorensen index. We also calculated the average number of prey per individual and the balance of the prey originated from the aquatic or terrestrial environment.

Results

Overall, the *P. ridibundus* population from Dubova consumed 303 preys pertaining to 29 prey taxa (Tables 1 and 4), all 56 analyzed individuals presenting certain stomach contents. In addition to the prey of animal origins, we found vegetal residue, shed skin remnants and various inorganic elements (Table 2). The majority of preys were terrestrial (96.69%) The average numbers of preys / individual was 5.41, while the maximum number of prey / individual was 16 (Table 3). The most important preys for this *P. ridibundus* population were ants (Table 4). The ants were followed, according to percentage abundance, by the gastropods, and according to frequency by the gastropods and araneidae. The majority of the prey taxa identified in the stomach contents registered low value of percentage abundance and frequency of consumption.

Table 1. The total number of prey items. The maximum and average number of prey items / individuals.

	Adults	Juveniles	Total
No of prey items	175	128	303
Maxim no. of preys /individual	16	12	16
Average no. of preys /individual	6.48	4.41	5.41

Table 2. The frequency of occurrence of non-animal stomach contents.

	Adults	Juveniles	Total
% vegetal remains	74.07	48.28	60.71
% shed skin	22.22	24.14	23.21
% anorganic remains	14.81	13.79	14.29

Table 3. The percentage abundance of aquatic and terrestrial preys.

	Adults	Juveniles	Total
% terrestrial preys	95.42	98.43	96.69
% aquatic preys	4.57	1.56	3.30

There are several distinctions between the diet of adults and juveniles, regarding the number of prey taxa, the number of consumed preys as well as the food diversity or vegetal consumption, etc.. Thus, in the case of juveniles the food diversity was more reduced compared to the food of adults (juveniles H = 1.81 / adults H= 2.25) (Table 5). Likewise, the adults consumed more prey taxa than the juveniles (24 compared to 20), and also more preys (6.48 preys / individual for adults up against only 4.41 preys / individual for juveniles). The differences between adults and juveniles can also be noticed in regards to the percentage abundance and frequency of consumption of the main taxonomic prey types (Table 4).

Discussions

The food of the *P. ridibundus* population from Dubova mainly consists of ants. Due to the predominance of this prey taxa, the diet of this population seems to be more similar to the food of *Bombina variegata* or *Epidalea viridis*, for whom ants are very important (e.g Groza et al. 2008, Kovacs et al. 2010, Ferenti et al. 2009, Covaciu-Marcov et al. 2010a, 2011, 2012), than to the food of other conspecific populations (e.g. Cicek & Mermer 2006, Balint et al. 2010, Mollov 2008). However, as long as generally any trophic preferences have not been noticed in the case of *P. ridibundus* and the green frogs, demonstrating the existence of trophic opportunism (e.g. Cicek & Mermer 2006, Paunovic et al. 2010), the abundance of ants in the food of the *P. ridibundus* population from Dubova probably does not represent the result of their selectivity in relation to ants, being only the result of ant abundance near the stream. Nevertheless, an increased percentage abundance and frequency of consumption of ants had been previously noticed in the food of a *P. ridibundus* population from an artificial habitat, where the frogs consumed numerous terrestrial preys (Cicort-Lucaciu et al. 2011).

The marsh frogs from Dubova were most likely forced to hunt in the terrestrial environment due to the reduced size of their habitat. This fact determined the categorical predominance of terrestrial preys in their food, because in specific circumstances the green frogs had consumed aquatic preys more frequently (Covaciu-Marcov et al. 2000, Mollov 2008, Sas et al. 2009). Thereby, the aquatic preys in Dubova represented only 3.30% of the total number of consumed preys (Table 3). The amount of aquatic preys is reduced regarding both the number of prey taxa, as well as the number of preys from those taxa. A large part of the small amount of aquatic preys was represented by larvae or adults of the own species, as well as in other cases (e.g. Cogălniceanu et al. 2000a, Mollov 2008).

Unlike the adults, the *P. ridibundus* juveniles display a less various and intense feeding. Thus, they consumed a slightly reduced number of preys, from a slightly reduced number of prey taxa. The absence of certain prey taxa from the food of juveniles had been presumably determined by the great size of that preys that could not be swallowed by the juveniles. Hereby, the Diplopoda or the Orthoptera sometimes have the sizes of the *P. ridibundus* juveniles. The larvae and especially other specimens of *P. ridibundus* are not included in the diet of the juveniles, due to the same reasons. The differences between the diet of the adults and the diet of the juveniles have been explained in the case of other amphibian species as well through their different sizes (eg: Cogălniceanu et al. 2000a, Ferenti & Covaciu-Marcov 2011, Polymeni et al. 2011). Meanwhile, the size differences determined the existence of important distinctions in the food composition or certain species of amphibians in the same habitat (eg: Cogălniceanu et al. 2000a, Arroyo et al. 2008, Covaciu-Marcov et al. 2012b).

Yet, the absence of some prey taxa from the stomachs of the juveniles cannot be explained through their sizes in all of the circumstances. Thus, for example, the snout beetles reach sizes that can allow their consumption by *P. ridibundus* juveniles; however this kind of prey is not present in the diet of juveniles. It is also possible that the adults can travel on larger distance than the juveniles, dislodging to a greater distance from their aquatic habitat. Therefore, the increased mobility of the adults could explain their exclusive Orthoptera consumption as well. In regards to other species of amphibians, Orthopteras have been consumed more often by

Table 4. The percentage abundance (A%) and the frequency of occurrence (f%) of the consumed preys. L.- larvae, aq- aquatic.

	Adults		Juveniles		Total	
	A%	f%	A%	f%	A%	f%
Nematomorpha (aq.)	1.14	7.41	0.00	0.00	0.66	3.57
Annelida – Oligochaeta	0.57	3.70	0.78	3.45	0.66	3.57
Gastropoda undet.	24.00	55.56	8.59	27.59	17.49	41.07
Arachnida – Araneae	8.00	44.44	9.38	37.93	8.58	41.07
Arachnida – Acaria	0.00	0.00	2.34	10.34	0.99	5.36
Diplopoda	0.57	3.70	0.00	0.00	0.33	1.79
Orthoptera	10.86	55.56	0.00	0.00	6.27	26.79
Odonata (l., aq.)	1.71	7.41	0.78	3.45	1.32	5.36
Odonata	0.00	0.00	0.78	3.45	0.33	1.79
Homoptera – Cicadinea	2.86	14.81	0.78	3.45	1.98	8.93
Heteroptera	7.43	40.74	10.16	31.03	8.58	35.71
Lepidoptera (l.)	1.14	7.41	0.78	3.45	0.99	5.36
Lepidoptera	1.71	11.11	0.00	0.00	0.99	5.36
Coleoptera – Carabidae	4.57	25.93	1.56	6.90	3.30	16.07
Coleoptera – Staphylinidae	0.00	0.00	0.78	3.45	0.33	1.79
Coleoptera – Scarabaeidae	0.57	3.70	0.00	0.00	0.33	1.79
Coleoptera – Elateridae	1.14	3.70	1.56	6.90	1.32	5.36
Coleoptera – Curculionidae	2.86	14.81	0.00	0.00	1.65	7.14
Coleoptera undet. (l.)	0.57	3.70	1.56	6.90	0.99	5.36
Coleoptera undet.	3.43	7.41	6.25	20.69	4.62	14.29
Diptera – Nematocera	0.57	3.70	0.00	0.00	0.33	1.79
Diptera – Brachycera (l., aq.)	0.00	0.00	0.78	3.45	0.33	1.79
Diptera – Brachycera (l.)	0.00	0.00	0.78	3.45	0.33	1.79
Diptera – Brachycera	0.57	3.70	3.13	10.34	1.65	7.14
Hymenoptera – Formicidae	20.00	51.85	46.09	58.62	31.02	55.36
Hymenoptera – Apidae	1.71	7.41	0.78	3.45	1.32	5.36
Hymenoptera undet.	2.29	14.81	2.34	3.45	2.31	8.93
Anura (l., aq.)	1.14	3.70	0.00	0.00	0.66	1.79
Anura – *P. ridibundus* (aq.)	0.57	3.70	0.00	0.00	0.33	1.79

Table 5. The food diversity and similarity.

	Adults	Juveniles	Total
Shannon index	2.25 ± 0.14	1.81 ± 0.16	2.25 ± 0.12
Sorensen index (mean value)	0.31	0.23	0.25

adults (e.g. Ferenti & Covaciu-Marcov et al. 2011). In this manner, the adults that are more voluminous and movable are capable of capturing Orthopteras fairly easy compared to the juveniles. There are probably certain taxonomic prey types whose exclusive presence in the diet of one of the size categories is purely coincidental.

Probably, the most obvious discrepancy between the diet of the adults and the diet of the juveniles lays in the ant consumption. Hence, in the case of juveniles, ants present more than a double percentage abundance compared to the adults, whether the ant consumption frequency is alike between adults and juveniles. Perhaps this discrepancy between percentage abundance and frequency of occurrence points to the fact that ants have been uniformly distributed and widespread in the habitat, being accessible for adults as well as juveniles. However, only the juveniles consumed high quantities of ants. Again, this fact is likely a result of the size differences between adults and juveniles. The adults that could reach big-sized preys were no longer bound only to the ants.

Despite the ant consumption, the feeding of the juveniles was not more intense than the feeding of the adults. In this manner, the offspring did not counterbalance the reduced attainability towards the large prey through the increased number of small prey consumed. Reduced diversity as well as the reduced number of consumed prey was noticed in the case of the juveniles of other amphibian species compared to the adults (Kovacs et al. 2010b, Polymeni et al. 2011). Perhaps, as a consequence of the intense feeding process too, the adults consume the vegetal remnants more often than the juveniles, these being usually swallowed accidentally with the targeted prey (e.g. Mollov 2008, Covaciu-Marcov et al. 2010a). Unlike the vegetal remnants, the differences between the shed skin and inorganic element consumption do not differ almost at all between adults and juveniles. Probably, these elements display a homogenous dispersion in the hunting area of the amphibians.

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