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ON THE DIET OF THE *Pelophylax ridibundus* (ANURA, RANIDAE) IN ȚICLENI, ROMANIA

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Abstract: *The diet of Marsh Frog from Țicleni includes mostly adult terrestrial arthropod preys. Among invertebrates Heteroptera is remarkable for its wide presence in the stomach contents followed by Coleoptera and Arachnida. Besides invertebrates we identified in one sample vertebrate individuals as a male and a female L. vulgaris.*

Key words: feeding, prey items, *Pelophylax ridibundus*, Romania

INTRODUCTION

Amphibians are a very diverse group of vertebrates. Mainly their feeding is opportunistic with food up to gape width being ingested. There is a relationship between the abundance of prey in the environment and in the diet of anurans (Turner 1959, Houston 1973). Numerous studies of population size, structure, and dynamics of amphibians have been made since the 1950s (Turner 1960, Pope & Matthews 2001, Richter & Seigel 2002, Watson et al. 2003). The Marsh Frog, *Pelophylax ridibundus (synonym: Rana ridibunda Pallas 1771)*, is highly riparian, being restricted to aquatic margins, and rarely moves far from water bodies. Several studies of the Marsh Frog have been conducted on various aspects of its natural history and ecology, including feeding (Das 1996, Cogălniceanu et al. 2000, Covaciu-Marcov et al. 2000, 2003, Cross & Gerstenberger 2002, Balint et al. 2008), breeding (Pagano et al. 2001, Holenweg-Peter et al. 2002), habitat use (Holenweg- Peter et al. 2001), and population fluctuations (Gokhelashvili 1998, Plenet et al. 2000, Peter 2001). In our study we present in a general way facts about the diet of the marsh frog from Țicleni, Romania

MATERIAL AND METHODS

Our study took place on the 23th of May 2009, in Țicleni, Gorj County, Romania. Țicleni city is situated in the south of Romania. Belongs to the Oltenia region, lying in the Valley of Coiana Stream, being surrounded by subcarpathian hills between Jiu and Gilort Rivers (at North), and Getic Heights (at South). The Coiana Stream is the main water flow in the city, which water is not potable and its quality is influenced by the crude oil exploitation. Here we analyzed 31 individuals of Marsh Frog, being captured by hand or using nets with handle, at daylight. The method we used to obtain the stomach contents was the stomach flushing method (Griffiths 1986, Joly 1987, Leclerc & Curtois 1993, Cogălniceanu 1997). The stomach contents were collected immediately after capturing, due to rapid prey digestion in amphibians (Caldwell 1996). As soon as the stomach contents were collected the individuals were released in the provenience biotope, our research not affecting the effective of the population. The stomach contents were placed in airtight test tubes and they were preserved with a 4% solution of formalin. Prey were sorted, and identified to the lowest taxonomic level possible, with a binocular microscope 10x40, using the literature (Radu & Radu 1967, Ionescu & Lăcătuşu 1971, Crişan & Mureşan 1999). It is important, for determining the value, that a certain taxon prey has for the analyzed species, as a consequence to the fact that an individual frog can eat not just different prey taxa but also more individuals of a certain taxon prey (Mollov 2008). The frequency can be defined as the ratio between the number of stomachs that contain a certain taxon prey and the total of analyzed stomachs, the obtained value being expressed in percentages. The amount of prey items is expressed in percentages, too.

The aim of our research was to make analysis of the trophic spectrum, determining the taxonomic affiliation of the identified preys, the variation of the maximum and average number of preys/toad, the habitat of origin of preys, and the amount and the frequency of prey items. By comparing our results with scientific literature we obtain a general view on the diet of the *Pelophylax ridibundus*.

RESULTS AND DISCUSSIONS

Comparisons of our results with those from the scientific literature on feeding of Marsh Frog show similar list of food items, but the component proportions vary. All of the analyzed stomachs contained prey, no one was

empty. The 306 consumed prey items were grouped in 37 categories. The larvae and imago for Odonata's, Plecoptera's and Lepidoptera's were regarded separately, because we considered the fact that, they represent different categories, as far as the mobility and the provenience environment are concerned.

Despite the fact that Marsh Frog is considered to be the most aquatic of the Amphibians from our county (Fuhn 1960), the majority of the preys had a terrestrial origin (97.22%) (Table 2), a fact that has been documented by other scientists (Covaciu-Marcov et al. 2000, Çiçek & Mermer 2006, 2007, Mollov 2008, Balint et al. 2008, Ferenti et al. 2009) and it has been documented in other species of Amphibians that are linked to the aquatic environment, too (Lőw et al. 1990, Sas et al. 2003, 2005, 2004). The average number of prey items per stomachs is 9,87 and the maximum number of prey items per stomachs is 45. Table 1 presents the frequency and amount of prey items. According to our data spiders and bugs prevail in the food of Marsh Frog, followed by butterflies. Most frequently in the stomach contents we found Heteropteans, Coleopterans, Araneida, Carabida followed by Lepidopterans larvae. Taking in consideration the amount of preys Araneida, Coleopterans, Lepidopterans larvae, Carabidae and Heteropterans have been consumed in large amounts. We can notice the high frequency of a certain taxa, which had a lower amount value. Heteropterans had a significant value but their frequency is much higher. We noticed too, that spiders were consumed in the largest amount while their frequency was lower. Çiçek and Mermer (2006) related similar facts from Lake Çavuşçu. The frequency of certain preys and their amount is not similar in many cases, for example Lepidopterans larvae, Scarabeidae, Coccinelidae, Formicidae. 11 prey taxons with different size (Isopoda, Diplopoda, Plecoptera imago, Trichoptera, Staphilinida, Tabanida, Cicindelida, Tenebrionida, Lampirida, Odonata larvae, Opilionida) were found in very few stomach contents in very low amounts. Each prey was captured by different individuals. For amphibians needing live feed the prey size is important so this phenomenon may appear as a result of preys size and their high energetic content. The appearance of larger preys (*Gryllotalpa gryllotalpa*, Coleopterans) together with smaller ones (Cicadinae) suggest an opportunistic feeding behavior, capturing all the moving preys which have a suitable size for consumption (Török & Csörgő 1992). The balance between consumptions and metabolic rates has a profound effect on frog, growth and development.

Lipids are important in amphibian diet both in their quantity and quality. Insects range from less than 10% to more than 30% fats on a fresh amount basis, and are relatively high in essential fatty acids. Coleopterans and

Lepidopterans larvae are particularly high in these lipids (Brooks et al. 1996). The essential fatty acids, provide precursors for the hormone-like compounds needed for localized metabolic regulation in many tissues, to regulate cellular lipid metabolism, are required for growth (Dadd 1983), and regulate the fluidity of the membranes in thermo/conforming organisms (Stanley-Samuelson et al. 1988). These facts may explain why the Marsh Frog and other Amphibians mostly feed with insects, and why feeding studies of different scientist's have similar results, concerning frog's insect intake.

Proteins are also important in food composition. Insectivorous amphibian's diet will naturally be 30% to 60% protein (McWilliams 2008). We found shed-skin in the stomachs of 4 individual's. The swallowing of the exuvia fragments is considered by some authors as a way of recycling the epidermal proteins (Weldon et al. 1993) or an additional food in unfavorable conditions (Sas et al. 2003, Cicort Lucaciu et al. 2006, Kovács et al. 2006). This low value of shed skin may indicate high food sources of the environment, so frogs don't relay on shed skin intake.

Rather often, we found Chrysomelidae, fact also documented by Ruchin and Ryzhov (2002). Four other Coleopteras families were minor components of the diet: Cicindelidae, Staphilinidae, Lampyridae, Tenebrionidae,.

Plant remains were abundant (in 24 stomach contents) being ingested accidentally during foraging. Besides vegetal remains we found minerals in 3 individual's stomach contents, which, like in the case of plant remains, were ingested only by accident, capturing them at the same time with preys.

Besides invertebrates, a vertebrate group was recovered from the stomachs. A Marsh Frog individual swallowed two *Lissotriton vulgaris,* a male and a female, besides other preys like Odonata larvae, Coleoptera, Heteroptera, *Gryllotalpa gryllotalpa*, and Araneida.

Various researchers reported that they identified besides invertebrates other vertebrate preys, as fish, amphibians, turtles, snakes, mammals in the stomach content of Marsh Frog (Turgay 2001, Ruchin & Ryzhov 2002, Covaciu-Marcov et al. 2005). This showed that the Marsh Frogs did not limit their diet to the Class Insecta. They could easily consume many different prey groups too. We didn't find Marsh Frog individuals in the stomachs, but many researchers reported cannibalism in the family Ranidae in their studies like: Kovachev 1979, Tomov 1989, Hódar et al. 1990, Covaciu-Marcov et al. 2005, Ruchin & Ryzhov 2002.

We didn't analyze the relationship among the morphological characters and the feeding behavior, but we observed a tendency in the stomach

Table 1.
Frequency of occurrence (%f) and amount (%A) of the consumed prey items.

	(%f)	A%
Crustacea - Isopoda	3.22	0.65
Arachnida - Araneida	48.38	10.86
Arachnida - Opilionida	3.22	0.32
Myriapoda-Diplopoda	3.22	0.32
Odonata (larvae)	3.22	0.32
Odonata	12.9	2.34
Plecoptera	3.22	0.99
Ortoptera	12.9	1.32
Ortoptera - *Gryllotalpa gryllotalpa*	9.67	0.99
Blattodea	12.9	1.32
Trichoptera	3.22	0.32
Homoptera - Cicadelloidae	29.03	5.51
Heteroptera	51.61	7.34
Coleoptera - undet.	51.61	8.12
Coleoptera - Cicindelidae	3.22	0.32
Coleoptera - Carabidae	45.16	7.74
Coleoptera - Staphilinidae	3.22	0.32
Coleoptera - Lampyridae	3.22	0.32
Coleoptera - Cantharidae	9.67	0.99
Coleoptera - Elateridae	22.58	3.37
Coleoptera - Coccinelidae	29.03	6.99
Coleoptera - Tenebrionidae	3.22	0.32
Coleoptera - Scarabeidae	22.58	4.08
Coleoptera - Cerambycidae	12.9	1.32
Coleoptera - Chrysomelidae	6.45	0.65
Coleoptera - Curculionidae	12.9	1.32
Mecoptera	12.9	3.37
Lepidoptera (larvae)	35.48	8.12
Lepidoptera	9.67	0.99
Diptera - Typulidae	9.67	0.99
Diptera - Culicidae	6.45	0.65
Diptera - Tabanidae	3.22	0.32
Diptera - Muscidae	32.25	4.43
Hymenoptera - undet.	25.8	4.08
Hymenoptera - Formicidae	16.12	1.66
Hymenoptera - Apidae	9.67	0.99
Urodela (*Lissotriton vulgaris* ♂)	3.22	0.32
Urodela (*Lissotriton vulgaris* ♀)	3.22	0.32

Table 2.
Average and maximum number of preys/toad, amount of stomach with vegetation, minerals and shad-skin

Average number of preys	9.87
Maximum number of preys	45
% stomachs with vegetal remains	77.41
% stomachs with minerals	9.67
% stomachs with shed-skin	12.9
% of aquatic preys	2.78
% of terrestrial preys	97.22

contents: we identified stomach contents whit small and few preys next to stomach contents with a plenty of large preys. This may indicate what we have read in the scientific literature: the larger an individual is, the wider range of food it has (Çiçek & Mermer 2006).

Many articles report back on a positive connection between the size of the captured prey and the size of the frogs, e.g. Altig & Brodie 1971, Freed 1988, Çiçek & Mermer 2006.

Some Insecta individuals found in the food content are agricultural pests. By feeding on these living beings *Pelophylax ridibundus* help decrease or counterbalance the insect population in the area. Atatür et al. (1993) in his study stated that this species could contribute to biological struggle for pest/control due the fact that *Gryllotalpa gryllotalpa* was the predominant species in the diet of the population they examined.

Though we found mole cricket in 3 individual's stomach content, its low presence in the food composition does not allow establishing a direct role in biological struggle. Nevertheless, its indirect contribution to biological struggle is a fact that cannot be denied (Çiçek & Mermer 2006).

CONCLUSIONS

The present study confirms that *Pelophylax ridibundus* mainly feeds with invertebrates, especially on terrestrial adult arthropods. The feeding of the species mostly occurs on land.

We did not find empty stomachs indicating a positive energy balance. The 306 consumed prey items grouped in 37 categories (terrestrial and aquatic) and the presence of vertebrate individuals in the samples suggests that the studied Marsh Frog population did not limit their diet to the

Arthropods. They consume many different prey groups to be sure that their diets contain the right calcium/phosphorus ratio and lipid/protein ratio. Due to the low value of shed skin consumption we could say as a conclusion that the environment has high food sources. Capturing agricultural pests *Pelophylax ridibundus* has a certain contribution to biological struggle. There can be seen an ecological adaptability/plasticity of these frogs. They are using the most accessible food resources, depending on the environment conditions, similarly to other species of Amphibians.

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