THE TROPHIC SPECTRUM ANALYSIS OF A *PELOPHYLAX RIDIBUNDUS* POPULATION FROM SCĂPĂU LOCALITY, MEHEDINȚI COUNTY, SW OF ROMANIA

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Abstract. We analysed the feeding habits of a population of marsh frogs from Scăpău locality, Mehedinți County, in august 2008. The stomach contents revealed that most of the individuals accidentally consumed vegetal fragments, shed-skin and mineral parts. The animal content is however the most important one, being mainly represented by snails, spiders, beetles, ephemerid larvae, ants and flies. These taxa register different values regarding their amount and frequency of occurrence, depending on the size and mobility of the frogs. An interesting phenomenon is recorded by the presence of cannibalism due to the competition for food.

Keywords: *Pelophylax ridibundus*, feeding, cannibalism.

Rezumat. Analiza spectrului trofic a unei populații de *Pelophylax ridibundus* din localitatea Scăpău, județul Mehedinți, România. Am analizat compoziția spectrului trofic a unei populații de broaşte de lac din localitatea Scăpău, județul Mehedinți, în luna august a anului 2008. Conținuturile stomacale au arătat faptul că majoritatea indivizilor au consumat, accidental, vegetale, exuvie si minerale. Stomacurile cu conținut animal sunt cele mai importante, acestea fiind reprezentate de melci, păianjeni, gândaci, larve de efemeroptere, furnici şi muşte. Aceşti taxoni înregistrează valori diferite, în ceea ce priveşte ponderea şi frecvența, în funcție de mărima şi mobilitatea broaştelor. Un fenomen interesant este prezența canibalismului, datorat competiției pentru hrană.

Cuvinte cheie: *Pelophylax ridibundus*, hrănire, cannibalism.

INTRODUCTION

Various ecological studies are very important so as to underline the modifications that have occurred in the systems, as a result of the expansion of humanity. One method has been the usage of amphibians as models for studying the ecological processes that occur in the natural world (HOPKINS, 2007). Amphibians are very sensible towards environmental changes (DIAMOND, 1996), and thus, they can offer valuable information regarding habitat loss, pollution and other anthropogenic modifications that might affect the ecological systems (HOPKINS, 2007). One parameter that can be an indicator of the quality of the environment is offered by the dietary information (GUNZBURGER, 1999).

In this respect, we concentrated on analysing the food habits of the marsh frog, *Pelophylax ridibundus*. There are numerous papers dealing with this subject, carried out both in the country (COGĂLNICEANU et al., 2000; COVACIU MARCOV et al., 2000, 2005; SAS et al., 2004) and abroad (CICEK & MERMER, 2006, 2007; TOROK & CSORGO, 1992). Our study aims to contribute to this series of studies involving the trophic spectrum of this Ranid species, as a recent review (WHILES et al., 2006) emphasized the importance of quantitative information relating to the ecological role of amphibians in ecosystems.

MATERIALS AND METHODS

The study took place on the 1st of August 2009 in Scăpău locality. The habitat is situated in the far western part of the Romanian Plain, in Mehedinți County. It is represented by a long ditch, with high and relatively steep banks, situated in an opened, sunny area. Due to the flatness of the relief, the population inhabits a slow-flowing water course. The substratum is mainly composed of silt and mud, while the vegetation is very abundant, comprising algae, reed, and other species.

The analysed population is composed of an almost equal number of juveniles (26) and adults (24). Thus, due to the close numbers, the data can be accurately compared between the two forms of ontogenetic development, the difference in individuals not affecting the results.

The frogs were captured either by hand from the vicinity of the ditch, or using a long metallic handle on top of which a net was set, within the water mass. In an attempt to minimize the impact that our activity might have on them, we released the frogs soon after we had performed the stomach flushing. This technique is highly recommended by many authors (SOLE et al., 2005), as it does not imply dissecting the individuals, and as a result can greatly encourage these types of feeding studies. The stomach contents was preserved in a solution of formaldehyde and stored in sealed test tubes. The identified preys were determined in the laboratory using the microscope.

This study focused on analysing the feeding differences between the juveniles and adults, regarding the hunting strategies, the various consumed preys, the feeding intensity.

RESULTS AND DISCUSSIONS

Studies have shown that the marsh frog mostly consumes invertebrates, especially arthropods (COVACIU-MARCOV et al., 2005; ÇIÇEK & MERMER, 2006, 2007; YILMAZ1& KUTRUP, 2006). Moreover, due to their large size, they are able to eat larger preys, such as vertebrates (COVACIU-MARCOV et al., 2005; TURGAY, 2001), including their own species (ÇIÇEK & MERMER, 2007; YILMAZ1& KUTRUP, 2006). These situations are all available in our case as well. Therefore, the arthropods had the highest percentage in the diet composition (68.19%), while there were also cases of cannibalism, registered only at the adults. As a class, the insects were the most consumed preys (54.4%), due to their large number of orders and families, but considering that they are separately analysed within each order, the snails are the dominant preys taking into account the whole population, and especially the adults. Other preys are also important, such as spiders, Ephemeroptera larvae and Brahicera adults (only for the juveniles), Coleoptera and ants. These preys registered different values between the juveniles and adults, as a consequence of their distinct size and hunting techniques. Moreover, beside the animal preys, the stomach contents also revealed traces of pebbles, remains of shed-skin, and especially parts of vegetal matter.

The low proportion of empty stomachs and the medium values of the feeding intensity rate suggest that the habitat presents good feeding conditions for the whole population, regarding both the juveniles and adults. As a result, over 90% of the individuals from both categories fed at the moment of the study. Moreover, the average number of prey/individual, the maximum number of consumed preys and the total number of preys register similar values to the data from other studies regarding this species (FERENȚI et al., 2009; COVACIU-MARCOV et al., 2005). The maximum number of preys consumed by an individual is mostly due to the abundance of snails in the habitat. All of these values are higher in the case of the adults, which can be explained by their larger size, and thus their ability to capture more preys.

The habitat plays a very important role in the frogs' consumption of vegetal, mineral, and shed-skin parts. Thus, due to the presence of abundant vegetation, this element was highly ingested by both adults and juveniles. Regardless of the fact that the individuals hunted in or near the water, both environments have plenty of vegetation, therefore the frogs have high chances to accidentally ingest a leaf together with the followed prey. Moreover, the muddy substratum of the ditch and of the surrounding terrain makes it highly impossible to accidentally swallow a small pebble, the substratum not being a rocky one, like in other cases (DAVID et al., 2008, where even 66.67% of the analysed population swallowed gravel parts). However, the values of the shed-skin consumption are relatively high and raise questions. One answer could be given by the fact that this population did not find enough trophic resources, and thus had to recycle their epidermis (WELDON et al., 1993) in order to satisfy their energetic needs. In addition, this population has shown to consume their own individuals and other unidentified frogs, and maybe the shed-skin was ingested as a missed attack on another individual.

However, regardless of the fact that these elements appear in the stomach contents, they do not represent a trophic basis, being accidentally ingested and occurring in most studies regarding the feeding of amphibians (DAVID et al., 2008; SAS et al., 2005; CICORT-LUCACIU et al., 2003).

Table 1. Number of analysed individuals. Frequency of stomachs with vegetal, mineral, and shed-skin contents. Maximum and average number of preys/individual; total number of preys. Number of empty stomachs.
Tabel 1. Numărul de indivizi analizați. Frecvența stomacurilor cu vegetale, minerale şi exuvie. Numărul maxim şi mediu de prăzi/ individ. Numărul de stomacuri goale.

	Adults	Juveniles	Total
Number of analysed individuals	24	26	50
% vegetal remains	87.5	88.46	88
% shed-skin	16.67	15.38	16
% mineral material	-	3.85	2
Maximum no. of preys	23	12	23
Average no. of preys/individual	6.37	4.15	5.22
Total no. of preys	153	108	261
Number of empty stomachs	2	2	4

The most important component of the stomach contents is represented by the animal one. The stomach contents revealed the presence of both vertebrate and invertebrate preys. Although the majority of the analysed population hunted invertebrate preys, some pursued to capture other frogs from their species. Cases of cannibalism have also been registered at other amphibian populations (COGĂLNICEANU et al., 2000; ÇIÇEK & MERMER, 2007; RUCHIN & RYZHOV, 2002). In our case, it might be connected to the aspect of the habitat (the ditch is quite narrow in width and the vegetation is very abundant) and its position in a dry, sunny area. Therefore, due to the climatic factors and the increased frog density, some individuals might attempt to reduce the competition for food (NEWMAN, 1987) and increase their changes of survival (POLIS, 1981; CRUMP, 1992) and the free space in their habitat (ÇIÇEK & MERMER, 2007).

Although the evidence of cannibalism is very interesting, the population consumed mainly invertebrates. If we compare the preys captured by the adults and juveniles, it is obvious that the adults consumed mainly snails, the other preys registering very low amounts, while the juveniles hunted in an almost equal degree both snails, spiders, Ephemeroptera larvae and Brahicera. While the juveniles are constrained by their size to hunt only some types of preys, the adults can focus on just one type of prey if it is abundant enough. Moreover, due to their larger size, there are cases in which only adults consumed snails and juveniles did not (FERENTI et al., 2009)

Table 2. The amount and frequency of occurrence of the consumed preys (A% - amount; F% - frequency; t. – terrestrial; aq.-aquatic; L.-larvae; A.-adult).
Tabel 2. Ponderea şi frecvenţa taxonilor consumaţi (A% - ponderea; F% - frecvenţa; t. – terestru; aq.-acvatic; L.-larve; A.-adult).

	Adults		**Juveniles**		**Total population**	
	A%	**F%**	**A%**	**F%**	**A%**	**F%**
Lumbricida	0.65	4.17	-	-	0.38	2
Gasteropoda	40.52	70.83	14.81	46.15	29.89	58
Araneida	11.76	45.83	12.04	34.62	11.88	40
Isopoda (t.)	1.31	8.33	2.78	11.54	1.92	10
Ephemeroptera (L.)	3.92	8.33	16.67	26.92	9.20	18
Odonata (A.)	0.65	4.17	-	-	0.38	2
Orthoptera	0.65	4.17	-	-	0.38	2
Homoptera – Aphida	-	-	2.78	11.54	1.15	6
Homoptera – Cicadina	4.58	12.50	0.93	3.85	3.07	8
Heteroptera	1.31	8.33	4.63	19.23	2.68	14
Heteroptera (aq.)	5.23	25.00	1.85	7.69	3.83	16
Coleoptera -undet.	6.54	25.00	8.33	23.08	7.28	24
Coleoptera – Carabidae	5.23	25.00	-	-	3.07	12
Coleoptera - Dytiscidae (A.)	0.65	4.17	-	-	0.38	2
Coleoptera - Dytiscidae (L.)	-	-	4.63	19.23	1.92	10
Panorpat	-	-	0.93	3.85	0.38	2
Lepidoptera (A.)	1.31	8.33	-	-	0.77	4
Lepidoptera (L.)	0.65	4.17	0.93	3.85	0.77	4
Trichoptera (L.)	0.65	4.17	-	-	0.38	2
Hymenoptera - Formicida	5.88	25.00	8.33	23.08	6.9	24
Hymenoptere - Apida	3.92	16.67	-	-	2.3	8
Hymenoptera - other	-	-	0.93	3.85	0.38	2
Diptera - Nematocera	-	-	2.78	3.85	1.15	2
Diptera - Nematocera (L.)	-	-	0.93	3.85	0.38	2
Diptera - Brahicera (A.)	1.96	8.33	15.74	38.46	7.66	24
Amphibian - Anura	1.31	8.33	-	-	0.77	4
Amphibian - *P. ridibundus*	1.31	4.17	-	-	0.77	2

The analysed population consumed more adult insects (77%) than larvae forms (23%), fact that suggests that it primarily catches active prey. However, differences between the adults and juveniles can be observed within the population. Therefore, the juveniles captured almost three times more larvae forms (33%) than the adults did (12%). This increase in larvae is a result of the high consumption of Ephemeroptera, which are very important preys for the juveniles. Thus, it might be said that they select their preys to a certain extent. The preference for these types of insect larvae can be regarded as a way of obtaining energy in a quickly, easy and profitable manner, as the juveniles have higher energy requirements for their development process. Other studies performed on this species have also shown that juveniles supplement their diet with Ephemeroptera larvae (FERENTI et al., 2009). Moreover, some authors affirm that larvae are richer in lipid, thus having a higher nutritive content than the adult insects have (BROOKS et al., 1996). Due to their smaller size and slower mobility, juveniles can easily capture larvae, which are also less active in comparison to the adult insects. On a whole, the preference for adult insects is a general one for anurans, where the eye is regarded as an important sensory organ for hunting (STEBBINS & COHEN, 1995). Thus, adult insects can be more easily spotted due to their higher mobility. This ratio between the adult insects and their larvae forms was also recorded at other frog populations as well (ÇIÇEK & MERMER, 2007; FERENTI et al., 2009).

The frequency of certain preys is not always similar with their amount. While the amount of a prey indicates its importance for one or several individuals, its frequency of occurrence presents its importance for the entire population. Thus, a prey must be analysed regarding both parameters. Generally, the larger preys, such as spiders,

beetles are consumed by many individuals, but in small numbers, because they can satisfy the energetic needs of the frogs without having to be consumed in large proportions. However, this fact can also be observed at the smaller preys as well, such as ants, aphids, isopods, ephemerid larvae, which merely prove their existence in the habitat.

Generally, the frogs do not seem to select their preys, with some exceptions, capturing all the mobile preys that come in sight and have a proper size to be consumed (TÖRÖK & CSÖRGŐ, 1992; MOLLOV, 2008). This fact can be suggested by the consumption of both larger (Coleoptera, Gasteropoda, Orthoptera, Anurans) and smaller preys (Isopoda, Afida, Formicida). However, the exceptions are a consequence of the restrains imposed by the size of the frog and consequently of its mouth. For example, despite the fact that the juveniles consumed beetles, which are of various sizes, they were unable to capture carbids, which are large and have a strong exterior body. Thus, only the adults managed to hunt these large beetles.

CONCLUSIONS

Considering the relatively high proportion of shed-skin consumption and the presence in the stomach contents of individuals from their own species, we can suggest that these elements consisted additional food source in unfavourable conditions. While the epidermis is consumed in almost the same amount by both adults and juveniles, cannibalism is registered only in the case of the adults due to their larger size. This could have been caused by the habitat conditions and by the competition for survival between the frogs.

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