FOOD COMPOSITION OF SOME GREEN WATER FROG POPULATIONS FROM LIVADA FOREST, SATU MARE COUNTY, ROMANIA

DAVID Anamaria, SAS Istvan, CICORT-LUCACIU Alfred-Ştefan, LEZAU Olimpia

Abstract. The studied populations are located near Livada town, in the northern part of Satu Mare County. The most important prey categories identified in the trophic spectrum of the analyzed frogs are the Diptera-Brahicera, Hymenoptera-Formicidae, Coleoptera and Araneida. Beside invertebrate preys, we also found in the stomach content an individual of *Natrix natrix* and one of *Pelophylax ridibundus*. The highest value of the feeding diversity 2.67, was registered in the habitat situated near the road.

Keywords: *Pelophylax* kl. *esculentus* complex, habitat, feeding.

Rezumat. Compoziția hranei la unele populații de broaşte verzi din pădurea Livada, județul Satu Mare, România. Populațiile studiate se află în apropierea localității Livada, în partea de nord a județului Satu-Mare. Cele mai importante categorii de prăzi identificate în spectrul trofic al broaştelor analizate sunt Dipterele-Brahicere, Hymenopterele-Formicide, Coleopterele şi Araneidele. Pe lânga nevertebrate, în conținuturile stomacale au mai fost identificate un exemplar de *Natrix natrix* şi unul de *Pelophylax ridibundus*. Cea mai mare diversitate a hranei a fost înregistrată în habitatul situat în apropierea drumului.

Cuvinte cheie: *Pelophylax* kl. *esculentus* complex, habitat, hrănire.

INTRODUCTION

The green frogs that make up the *Rana (Pelophylax) esculenta* complex are encountered in many system types: L-E, R-E, L-E-R, or E (TUNNER & HEPPICH-TUNNER, 1991). Throughout the distribution area of these 3 forms, the L-E and R-E systems are the most common (BORKIN et al., 1986). In our research area the R-E-L system can be found (COVACIU-MARCOV et al., 2004), but the number of the *Pelophylax* kl. *esculentus* individuals is higher than the one of *Pelophylax lessonae* or *Pelophylax ridibundus*, only few individuals of this last species were found in the analyzed habitats.

Many studies regarding the feeding of the frogs from the *Pelophylax* kl. *esculentus* complex have been published in the past years: at *P. ridibundus* (COVACIU-MARCOV et al., 2003, 2005; DAVID et al., 2008), *P. lessonae* (SAS et al., 2005, 2007) and also at *Pelophylax* kl. *esculentus* (FERENȚI et al., 2007; SAS et al., 2007, 2009; DAVID et al., 2009).

Nowadays, amphibians are among the most threatened vertebrates globally declining at an alarming rate (STUART et al., 2004). The studies on the ecology of Amphibians are of great importance because they are critical components of both the aquatic and terrestrial communities; therefore anthropogenic factors that negatively affect amphibians may influence entire ecosystems (HOPKINS, 2007).

The aim of the present study was to analyze the feeding of some *Pelophylax* kl. *esculentus* complex populations from the Livada forest.

MATERIALS AND METHODS

This study focused on analysing the food composition at *Pelophylax* kl. *esculentus* complex populations. The individuals from whom the stomach contents were taken are located in a forest near Livada, Satu - Mare County (47 ° 52'0"N, 23 ° 8'0"E, 146 m asl) in northwestern Romania. The field studies were carried out in the year 2007 at the end of April, on 27 and 28 respectively in early May, on 10 and 11, when we captured 200 green frogs from six habitats. Because the male samples of the captured green frogs were in low numbers we did not treat the sexes separately.

The pond near the railroad

It is represented by a temporary puddle, with the surface of about 3 meters and a depth of only 20 to 30 cm. The pond is located at the ground level of a road, located between the forest and the railroad. Aquatic vegetation is not present in the habitat due to the fact that it is temporary drying out in the summer.

The pond near the road

It consists of a large swamp, reaching a diameter of 30 meters. In early spring, the surface is larger due to the fact that the water floods the surrounding grass areas.

The pond from the forest

The habitat is represented by a permanent pond having a surface of approximately 20 meters and 50 cm depth. This habitat is located in a beech forest a few meters from a country road. It has rich vegetation composed of grass and *Juncus* plants.

The pond at the base of the hill

It is represented by a 100 m long channel, located at 150 m altitude. The channel is located inside the forest area at the lower limit of Mujdeeni hillock at the margin of a forest road. Since it is located inside the forest, in a shaded

area, this habitat does not have any aquatic vegetation. The water has a maximum width of 0.5 m and a depth of 20 to 30 cm, drying in summer. The channel's substrate is rough, being supplied by torrents from mountainsides but also several permanent springs.

The pond from the quarry 1

It consists of a series of temporary ponds, without vegetation, formed in an abandoned quarry. The main pond is represented by a depression formed in a mining area, now flooded. On the edge of the swamps, into the woods there are found a series of small temporary ponds. The main pond has a diameter of 50 meters and perhaps a depth of several meters.

The second pond from the quarry

It comprises both large pools, representing former flooded mining plants and small pools, supplied by springs. The pools from the first category exceed several meters in diameter and are permanent ponds, but the small ones dry in summer. The vegetation is represented by *Juncus* and reed, found on the shores. The stomach contents were collected using the stomach flushing method (SOLE et al., 2005) and stocked in separate airtight test tubes containing a 4% solution of formaldehyde. The preys were subsequently identified in the laboratory under a binocular microscope. Food composition was evaluated by percentage abundance (% a) and frequency of occurrence (% f). To estimate the feeding intensity we calculated the maximum and average number of preys / individual of *Phelophylax* kl. *esculentus*.

RESULTS AND DISCUSSIONS

In the spring of the year 2007 we analyzed the trophic spectrum of 200 green water frogs, collected from six habitats. We identified a total number of 2,414 animal preys. Beside invertebrate preys, vegetal fragments were identified in the stomach contents of the individuals from all the habitats, the highest quantity being registered in the pond near the road. None of the investigated specimens had ingested only plant fragments, this emphasizes the fact that the vegetal matter appear accidentally in the trophic spectrum of the frogs.

The shed skin fragments are considered to have some nutritional value (WELDON et al., 1993), but in our case the frequency of occurrence is not very high, the trophic offer meeting the needs of the frogs, thus they do not have to find alternatives to enrich their diet. In the pond where the frequency of this category was the highest, the feeding process was intense, so the shed skin fragments could have been ingested together with other preys.

The maximum number of prey consumed by a single individual was 53, this being captured from the pond situated in the forest. The large number of preys is due to the fact that 49 of the preys were Collembola, which have small size, so they can be eaten in high quantities. The medium number of preys varies from a value of 5.41 in the habitat from the quarry to 14.85 in the pond from the forest (Table 1). The value of this parameter depends upon the abundance in the habitats of the small sized preys like Collembola, which had the highest amount in the pond from the forest, this leading to the increase of the medium number of preys.

Table 1. The frequency of stomach with vegetal fragments, shed skin and minerals. The number of analyzed individuals. The maximum and average number of preys per individual. The total number of preys. The feeding diversity (H).
Tabel 1. Frecvența stomacurilor cu vegetale, exuvie și mineral. Numărul de indivizi analizați. Numărul maxim și mediu de prăzi pe individ. Numărul de prăzi. Diversitatea hrănirii (H).

	P. railroad	P. road	P. forest	P. hill	P. quarry 1	P. quarry 2
% stomachs with vegetal parts	28	85.1	50	25	62.5	62.5
% stomachs with shed-skin	2	10.6	7.1	10	8.33	-
% stomachs with mineral	2	-	-	-	4.7	12.5
No. of analyzed individuals	64	46	28	20	24	16
Max. no. of prey/individual	18	24	53	12	13	15
Aver. no. of prey/individual	8.5	8.13	14.85	6.8	5.41	3.37
The total no. of preys	544	374	416	136	130	54
Feeding diversity (H)	1.51	2.67	1.73	2.1	2.58	2.28

The Diptera Brahicera registers the highest amount, 66.7% (Table 2), in **the pond near the railroad**. This prey category has a constant presence in all the habitats from Livada, but the highest quantity was recorded in this pond. Most of the individuals consumed Diptera-Brahicera, which have a frequency of 98%; this prey category is the most important one for the frogs which inhabit this pond, being accessible to almost all the individuals from this habitat. This pond has poor vegetation, the water level being low, thus the frogs can more easily capture the flies. Since the Brahicera have a very high amount, the other prey taxa present in the frogs' stomachs have lower amounts. The Formicidae, which occupy second place, have a value ratio of only 5.15%. The undeterminated Coleopterans have an amount of 5.7%, preys which are found in all habitats, in this pond the frequency of consumption being 44%.

In the pond near the road, as in the first habitat, the analyzed individuals consumed a large amount of Brahicera - 20.9% of the total identified prey taxa, but the amount is much lower than in the pond next to the railroad.

This pond is located in the forest, also presenting rich vegetation, so that the flies can not penetrate the ground or in the low vegetation where they can be caught by the frogs. The majority of the individuals consumed Brahicera; this prey category also occupies first position in this habitat, their frequency being 68.1%. In the previous study performed in this habitat (SAS et al., 2007) this prey category had been consumed in low quantities, thus the different environmental conditions affect the elements which compose the diet of the frogs.

The Hymenoptera-Formicidae had a frequency of 53.2% in the stomach contents taken from this pond, this being the second frequency value of the ants, the largest one being registered in the pond from quarry 1, but the difference between them is very small. Once again the Hymenoptera - Formicidae occupy second place with an amount of 13.9%. The ants are present in all the investigated habitats, the frequency value is quite high, these invertebrates that are not dependent on strict habitat conditions being widely spread in nature. Coleopterans were also consumed by a large number of individuals, having a frequency of 48.9%, but the amount is only 8.56%. Arahnida - Araneida have a frequency of 42.6% and an amount of 9.09%, which is higher than in the first habitat.

The Araneida, Coleoptera, Lepidoptera larvae and Hymenoptera Formicidae were also the most important prey taxa categories identified in the trophic spectrum of the population analyzed in 2004 (SAS et al., 2007). The aquatic Heteroptera represented 7.75% of the total number of preys, in the remaining habitats they were consumed in smaller numbers.

In this habitat from **the forest** the Collembola have the highest amount, 37%. These were consumed in large numbers because of their low nutrient value and small size, thus the frogs have to eat a large number of individuals, this leading to the increase of the amount. The Collembola are present only in this habitat and in the one near the railroad, but they register a small percentage. It can be observed that the Collembolans have favourable life conditions only around this habitat. Diptera - Brahicera are also present in this habitat with an amount of 28%. The Crustacean - Isopoda occupy the third place, with an amount of 19%. The following categories have low amounts: Arahnida - Araneida 2.6%, beetles 2.4%, Lepidoptera larvae 2.2%.

Concerning the frequency of consumption, 96% of the frogs consumed Brahicera, which is similar to the first two habitats, where most of the individuals also ingested, flies. With a frequency of 43% the aquatic Crustacean – Isopods register the second place in this habitat, but this is the highest frequency value from the six investigated habitats; in the other habitats the frequency value decreases. It can be observed that the aquatic Crustaceans are present in higher quantities only in the large habitats, thus the pond particularities can determine some differences in the diet of the analyzed populations. The Coleopterans were ingested by 32% of the individuals. In this habitat the Collembola had the highest value of frequency, because the pond is located in the forest where there are several humid places, which are appropriate for the development of these preys. Beside this habitat, the Collembola have been identified only in the pond near the railroad, but here these preys were consumed by a small number of frogs. We found in the stomach samples Lepidoptera larvae in proportion of 25%, this being a category of taxa easy to catch and with a high nutritional value.

In the pond **from the foot of the hill,** the Brahicera also record the first place with an amount value of 45.6%; in this habitat all the individuals have eaten flies. The Diptera-Nematocera come afterwards, registering a higher amount than in the other studied habitats, this being the first habitat in which this taxon occupies this position, also having a higher frequency (40%) than in the other habitats. In this habitat the Coleoptera have a higher value (8.08%), these preys registering a constant presence throughout the study in all of the examined habitats. The Arahnida - Araneida also records the same amount value. The following preys are the Hymenoptera - Formicidae and Apidae that were consumed in smaller quantities, representing 3.68% of the total consumed preys. The Apidae have in this habitat the highest amount, in the remaining habitats their amount being lower. The Lepidoptera have an amount of 2.94%, being present only in the stomachs of the individuals from the first habitat and the one from the quarry. The same value is obtained by the aquatic Crustacean – Isopods, which will not be found in the other two analysed habitats. In this habitat it has been observed that absolutely all individuals have consumed Brahicera. Also the frequency value of the Araneida remains fairly high - 35%. The Araneida were also found in many stomach contents at the *Pelophylax* kl. *esculentus* population from Igneşti, Arad County (FERENŢI et al., 2007). It is noted that in this habitat the individuals have consumed Hymenoptera-Apidae with a frequency of 20%, this prey category being identified only in three of the six habitats from which the samples were taken.

In the **first habitat from the quarry,** the Brahicerans are also on the first place concerning the amount, but this is the lowest value registered during the study, 18.5%.

A decrease of the total number of preys can be observed in this habitat, this being represented by a pond with steep margins and with little vegetation. The Coleopterans occupy second place with a value of 15.4%, which is the largest amount of this taxon encountered in these habitats. Formicidae have an amount of 13.8%, and the value of this parameter at the Arahnidae – Araneida was of 12.3% from the total number of identified preys Unlike the habitats described above, in this one the most frequently consumed prey taxa are the Hymenoptera – Formicidae and Arahnida-Araneida which were consumed by more than half of the individuals living in this habitat. Diptera-Brahicera have a frequency value of 41.7%, the Coleopterans were found in 35% of the examined stomachs, being situated on the third place. Another study on the feeding of the *Pleophylax* kl. *esculentus* complex carried out in the Central Taurus Region, TURGAY (2001) reported that the classes Hymenoptera, Diptera and Coleoptera were the most widely consumed prey groups within the class Insecta.

Table 2. The amount and the frequency of occurrence of the prey taxa (aq. - aquatic; t. - terrestrial; L. - larvae).
Tabel 2. Ponderea şi frecvența taxonilor pradă (aq. - acvatic; t. - terestru; L. - larve).

	P. railroad		P. road		P. forest		P. hill		P. quarry 1		P. quarry 2		Total	
	%a	%f	%a	%f	%a	%f	%a	%f	%a	%f	%a	%f	%a	%f
Anelida-Oligocheta	-	-			-	-	0.74	5	-	-	-	-	0.06	0.52
Gasteropoda-snails	-	-	3.21	14.9	-	-	-	-	-	-	-	-	0.73	3.66
Crustacean-Gammarida	-	-	2.14	10.6	-	-	-	-	-	-	-	-	0.48	2.62
Crustacean-Isopoda (aq.)	2.02	3	7.49	25.5	19	43	2.94	15	-	-	-	-	7.26	15.2
Crustacean-Isopoda (t.)	0.37	3	1.07	6.38	0.2	3.6	0.74	5	-	-	-	-	0.48	3.66
Arahnida-Acarian	-	-	-	-	0.2	3.6	1.47	10	-	-	-	-	0.18	1.57
Arahnida-Araneida	3.49	25	9.09	42.6	2.6	29	8.09	35	12.3	54.2	16.7	62.5	6.05	36.1
Myriapoda-Chilopoda	0.37	2	-	-	-	-	-	-	-	-	-	-	0.12	0.52
Myriapoda-Diplopoda	-	-	1.6	8.51	-	-	-	-	3.85	20.8	3.7	12.5	0.79	5.24
Collembola	0.18	2	-	-	37	25	-	-	-	-	-	-	9.37	4.19
Ephemeroptera (L.)	-	-	0.8	6.38	-	-	-	-	4.62	25	-	-	0.54	4.71
Odonata (L.)	0.18	2	1.6	12.8	-	-	0.74	5	0.77	4.17	-	-	0.54	4.71
Orthoptera	0.18	2	1.07	8.51	0.2	3.6	-	-	1.54	8.33	-	-	0.48	4.19
Plecoptera (L.)	-	-	0.27	2.13	-	-	-	-	-	-	-	-	0.06	0.52
Heteroptera (aq.)	-	-	7.75	19.1	0.2	3.6	2.94	20	5.38	20.8	-	-	2.48	9.95
Heteroptera (t.)	2.21	17	5.08	31.9	0.2	3.6	-	-	0.77	4.17	1.85	12.5	2.06	15.2
Homoptera-Afidina	-	-	0.27	2.13	-	-	-	-	-	-	-	-	0.06	0.52
Homoptera-Cicadina	0.18	2	0.27	2.13	0.5	7.1	-	-	0.77	4.17	-	-	0.3	2.62
Lepidoptera (L.)	-	-	4.28	21.3	2.2	25	1.47	10	1.54	8.33	7.41	37.5	2	12.6
Lepidoptera	1.84	14	-	-	-	-	2.94	10	0.77	4.17	-	-	0.91	6.28
Coleoptera-Dytiscidae (L.)	0.37	3	0.27	2.13	0.5	7.1	0.74	5	0.77	4.17	13	25	0.85	4.71
Coleoptera-undet.	5.7	44	8.56	48.9	2.4	32	8.09	35	15.4	37.5	11.1	50	6.65	41.9
Coleoptera-Carabidae	1.65	14	1.6	10.6	0.5	7.1	0.74	5	2.31	12.5	7.41	25	1.51	11.5
Coleoptera-Crysomelidae	-	-	0.8	6.38	-	-	0.74	5	-	-	-	-	0.24	2.09
Coleoptera-Coccinelidae	-	-	0.8	6.38	-	-	0.74	5	0.77	4.17	-	-	0.3	2.62
Coleoptera-Curculionidae	0.92	6	0.53	4.26	0.2	3.6	-	-	3.85	20.8	-	-	0.79	6.28
Coleoptera-Scarabeidae	0.18	2	0.8	6.38	0.5	3.6	-	-	1.54	8.33	-	-	0.48	3.66
Coleoptera-Elateridae	0.37	3	2.14	12.8	0.2	3.6	0.74	5	1.54	8.33	-	-	0.85	6.28
Coleoptera-Stafilinidae	2.21	13	-	-	0.2	3.6	2.21	5	-	-	-	-	0.97	5.24
Coleoptera-Cantharidae	-	-	-	-	-	-	-	-	1.54	8.33	-	-	0.12	1.05
Coleoptera-Cerambycidae	-	-	-	-	-	-	-	-	0.77	4.17	-	-	0.06	0.52
Diptera-Nematocera (L.)	-	-	0.27	2.13	-	-	-	-	-	-	-	-	0.06	0.52
Diptera-Nematocera	2.02	14	2.41	19.1	1.9	14	9.56	40	5.38	25	3.7	25	3.02	19.9
Diptera-Brahicera (L.)	-	-	-	-	-	-	-	-	0.77	4.17	-	-	0.06	0.52
Diptera-Brahicera	66.7	98	20.9	68.1	28	96	45.6	100	18.5	41.7	11.1	37.5	39.3	81.2
Hymenoptera-undet.	1.84	14	1.07	8.51	2.2	25	1.47	10	-	-	1.85	12.5	1.57	12
Hymenoptera-Formicidae	5.15	33	13.9	53.2	1.2	14	3.68	25	13.8	54.2	18.5	50	7.13	37.7
Hymenoptera-Apidae	1.65	14	-	-	-	-	3.68	20	-	-	1.85	12.5	0.91	7.33
Panorpata	0.18	2		-	-	-	-	-	0.77	4.17	1.85	12.5	0.18	1.57

In the **second pond from the quarry,** the Hymenoptera - Formicidae have the largest amount in the analyzed stomach contents (18.5%). Arahnida - Araneida also have a value close to that of the Formicidae, 16.7%. Spiders also had an important value for a population of *Pelophylax KL. esculenta* which is located in the forest of Foieni, Satu Mare County (SAS et al., 2009). Dytiscida larvae have an amount of 13%, in the rest of the habitats being consumed in very small quantities. The Diptera - Brahicera, which were consumed in large quantities in the other habitats, register only 11.1%, in this habitat, being the fourth taxon depending on the amount. The undetermined Coleoptera have the same value. Lepidoptera larvae and Coleoptera - Carabidae have an amount of 7.41%.

In this habitat, the Arahnida - Araneida were the most frequently consumed preys, 62.5% of the individuals presented in the stomach content this prey category. Hymenoptera – Formicidae and undetermined Coleoptera occupy the second place regarding the frequency, being consumed by half of the frogs from this pond. The Diptera - Brahicera occupy the third position with a frequency of 37.5%, this being its lowest value, in other habitats being consumed by a higher number of individuals. The fact that food groups in the six examined populations are different from one another shows that the members of the species are opportunistic feeders.

Concerning the living environment of the prey taxa, 85.73% are terrestrial. The aquatic preys are represented by the Crustaceans, Ephemeroptera larvae, Odonata and Plecoptera larvae, aquatic Heteroptera and Dytiscidae and Nematocera larvae. The fact that the frogs from the *Pelophylax* kl. *esculentus* complex forage mainly on land was reported by other researchers as well (TOROK & CSORGŐ, 1992; DAVID et al., 2008), which found in the stomach contents of *Pelophylax esculentus* many aquatic preys like Crustacean (Amphipoda, Decapoda), Lamelibranhiata, Heteroptera, and fishes.

Exceptionally, in the stomach of a female we identified a 22 cm long *Natrix natrix* and in the same frog another 6 prey categories. This capture was accidental caused by the movement of the snake which triggered the attack of the frog.

In the same habitat we also found a *Pelophylax* kl. *esculentus* which had eaten a *Pelophylax ridibundus* individual of 7.1 cm. Vertebrates were also identified in the diet of other green frog populations (OPATRNÝ, 1968) and also other frogs (CICEK & MERMER, 2006; SAS et al., 2009).

Diversity is influenced by habitat features and quality, the highest diversity of consumed preys was recorded in the pond near the road (2.67), this pond is large, with rich vegetation, the frogs having a large hunting territory and thus access to different groups of preys. A similar diversity was observed in the diet of the individuals, which populate the pond from quarry 1, with the value of 2.58. The smallest variety of preys was in the pond near the railroad (1.51), which is a small ephemeral pond, artificially affected, in this habitat few invertebrate species were able to adapt, individuals consuming a larger number of preys from the same group. Also a small diversity of preys was recorded in the pond from the forest. The species in the *Pelophylax esculentus* complex have a large range of body sizes, continuous activity and use habitats of high diversity, these factors leading to the large variety of the prey captured by them (COGĂLNICEANU et al., 2000).

CONCLUSIONS

The food composition is influenced by the environmental conditions, which can affect the development of the preys, thus determining the composition of the trophic spectrum.

Diptera Brahicera and Formicidae represented important food categories for individuals in all six habitats, but the amount and frequency values differ more or less from one habitat to another. Habitat features also have, in some measure, influence on the development of the invertebrate; a particular type of habitat may be suitable for the development in large numbers of a certain type of preys (eg Collembola). Our results show that the *Pelophylax* kl. *esculentus* complex have a general way of feeding. The frogs do not actively search for prey, but rather use the *sit and wait* method. Thus, the frogs do not have to specialize in the active search of food with high energy content. TÖRÖK & CSÖRGŐ (1992) consider that the frogs from the complex *Pelophylax esculentus* are opportunistic predators, using the "sit-and-wait" feeding method and also "active-foraging", eating the preys with low mobility, with or without grouped distribution (HUEY & PIANKA, 1981).

REFERENCES

BORKIN L. J., CAUNE I. A., PIKULIK M. M., SOKOLOVA M. 1986. *Distribution and structure of the green frog complex in the USSR*. In: Studies in Herpetology (ed. Roczek, Z.): 675-678.

ÇIÇEK K. & MERMER A. 2006. *Feeding Biology of the Marsh Frog, Rana ridibunda Pallas 1771, (Anura, Ranidae)*. In Turkey's Lake District. North Western Journal of Zoology. Oradea **2**(2): 57-72.

COGĂLNICEANU D., PALMER M. W., CIUBUC C. 2000. *Feeding in Anuran communities on islands in the Danube floodplain*. Amphibia-Reptilia. **22**: 1-19.

COVACIU-MARCOV S. D., CUPŞA DIANA, SAS I., ZSURKA RENATA, CICORT-LUCACIU A. Ş. 2003. *Spectrul trofic al unei populaţii nehibernante de Rana ridibunda (Amphibia) din apele termale de la Chişlaz, Judeţul Bihor*. Analele Universităţii din Oradea. Fascicula Biologie. Oradea. **10**: 97-109.

COVACIU-MARCOV S. D., GHIRA I., SAS I. 2004. *Contribuţii la studiul Herpetofaunei zonei Oaşului (Judeţul SM, Romania)*. Environment & Progress. Cluj-Napoca. **2**: 107-112.

COVACIU-MARCOV S. D., SAS I., CUPŞA DIANA, BOGDAN H., LUKACS JULLIANA. 2005. *The seasonal variation of the food of a nonhibernated Rana ridibunda Pallas 1771 population from the thermal lake 1 Mai Spa, Romania.* Analele Universităţii din Oradea. Fascicula Biologie. Oradea. **12**: 77-85.

DAVID ANAMARIA, DIMANCEA NICOLETA, PAL A., CSERVID KATALIN. 2008. *The analysis of the trophic spectrum of a Pelophylax ridibundus population from Vadu area, Constanta County, Romania*. Herpetologica Romanica. Oradea. **2**: 21-26.

DAVID ANAMARIA, CUPŞA DIANA, SAS I., DIMANCEA NICOLETA, NAGY DENISA. 2009. *The trophic spectrum of a Pelophylax kl. esculentus (Amphibia) population from Hinova area, Mehedinți County, Romania*. Analele Universității din Craiova. Seria Biologie. Craiova. **14**: 463-468.

FERENȚI SARA, SAS I., KOVACS EVA HAJNALKA, DAVID ANAMARIA, LAZA ANCA. 2007. *The trophic spectrum of two populations of Pelophylax kl. esculentus Linnaeus 1758 from the Teuz River Valley*. Analele Universității din Craiova. Seria Biologie. Craiova. **12**: 175-180.

HOPKINS A. W. 2007. *Amphibians as models for studying environmental change*. ILAR Journal. **48**(3): 270-277.

HUEY R. B.& PIANKA E. R. 1981. *Ecological consequences of foraging mode*. Ecology. **62**: 991-999.

OPATRNY E. 1968. *Příspěvek k poznání potravy, našich vodních skokanû (Rana ridibunda PALLAS, Rana esculenta LINNÉ)*. Acta Universitatis Palackianae Olomucensis Facultas Rerum Naturalium. **28**: 133-138.

SAS I., COVACIU-MARCOV S. D., CUPŞA DIANA, CICORT-LUCACIU A. ŞT., ANTAL B. 2005. *Food habits of Rana lessonae and Rana arvalis in Covasna County (Romania).* Environment & Progress. Cluj-Napoca. **5**: 359-367.

SAS I., COVACIU-MARCOV S.-D., STRUGARIU A., DAVID ANAMARIA, ILEA CRISTINA. 2009. *Food habit of Rana (Pelophylax) kl. esculenta females in a new recorded E-System population from a forested habitat in North-Western Romania*. Turkish Journal of Zoology. **33**: 1-5.

SAS I., KOVACS EVA HAJNALKA, COVACIU-MARCOV, S. D., STRUGARIU AL., COVACI RAMONA, FERENȚI SARA. 2007. *Food habits of a Pool Frog Pelophylax lessonae - Edible Frog Pelophylax kl. esculentus population from North-Western Romania.* Biota, Journal of Biology and Ecology. **8**: 71-28.

SOLE M., BECKMANN O., PELZ B., KWET A., ENGELS. 2005. *Stomach flushing for diet analysis in anurans: an improved protocol evaluated in a case study in Araucaria forests, southern Brazil*. Studies on Neotropical Fauna and Environment. **40**: 23-28.

STUART S., CHANSON J. S., COX N. A., YOUNG B. E., RODRIGUE A. S. L., FISCHMAN D. L., WALLER R. W. 2004. *Status and trends of amphibian declines and extinctions worldwide*. Science. **306**: 1783-1786.

TÖRÖK J.& CSÖRGŐ T. 1992. *Food composition of the three Rana species in Kis-Balaton Nature reserve*. Opuscula Zoologica. **25**: 113-123.

TURGAY F. 2001. *Feeding Biology of Central Taurus Region (between 33rd.-36th E meridians of longitude) Ranid Frog (Anura: Ranidae) and Its Role in Biological Control*. Ege University Institute of Applied Sciences, PhD. Thesis.

TUNNER H. G.& HEPPICH-TUNNER S. 1991. *Genome exclusion and two strategies of chromosome duplication in oogenesis of a hybrid frog*. Naturwissenschaften. **78**: 32-34.

WELDON P. J., DEMETER B. J., ROSSCOE R. 1993. *A survey of shed skin-eating (dermatophagy) in amphibians and reptiles*. Journal of Herpetology. **27**: 219-228.

David Anamaria, Sas Istvan, Cicort-Lucaciu Alfred-Ştefan, Lezau Olimpia
University of Oradea, Faculty of Sciences, Department of Biology, Oradea, România.
Universitatii str. 1, Oradea 410087, Romania
E-mail: ana_david_07@yahoo.com

Received: April 26, 2010
Accepted: August 29, 2010