WHICH AQUATIC HABITAT IS BETTER FOR THE FEEDING OF A PROTECTED NEWT SPECIES (*Triturus dobrogicus*) IN CAREI PLAIN NATURAL PROTECTED AREA?

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Abstract. Feeding of three *Triturus dobrogicus* populations from Carei Plain natural protected area is influenced by human impact on habitats, particularities of habitats and sampling period. Feeding is low in the anthropogenically affected habitat where adjacent terrestrial areas are also affected. On the other hand, the most intense feeding was recorded in the most natural and less subjected to human activities habitat. Results suggest that feeding can be used as an indicator of the value of aquatic habitats for *T. dobrogicus*. In addition, the effect of impact, even if it is indirect and apparently low, of anthropogenic activities on a species of conservation interest from a protected area can be observed.

Keywords: *Triturus dobrogicus*, feeding, habitat, anthropogenic impact, protected area.

Rezumat. Care habitat acvatic este mai bun pentru hrănirea unei specii de triton protejat (*Triturus dobrogicus*) în aria naturală protejată Câmpia Careiului? Hrănirea unor populaţii de *Triturus dobrogicus* din aria naturală protejată Câmpia Careiului este influenţată de impactul antropic asupra habitatelor, de particularităţile acestora şi de perioadă. Hranirea este redusă în habitatul afectat antropic, unde şi zonele terestre învecinate sunt afectate. Din contră, hrănirea cea mai intensă se inregistrează în habitatul cel mai natural şi mai puţin influenţat antropic. Rezultatele sugerează că hrănirea poate fi folosită ca indicator al valorii habitatelor acvatice pentru *T. dobrogicus*. De asemenea, se poate observa efectul impactului, chiar dacă indirect şi aparent redus, al activităţilor antropice dintr-o arie protejată asupra unei specii de interes conservativ.

Cuvinte cheie: *Triturus dobrogicus*, hrănire, habitat, impact antropic, arie protejată.

INTRODUCTION

In Romania *Triturus dobrogicus* (KIRITZESCU, 1903) has a high conservation value, being a species of community interest (O.U.G. 57/2007) with a relatively small distribution range (COGĂLNICEANU *et al*., 2000; IFTIME, 2005). In the western part of the country it inhabits the plain strip between Western Hills and the border with Hungary (COGĂLNICEANU *et al*., 2000; IFTIME, 2005), recently being recorded from new sites (e.g. COVACIU-MARCOV *et al*., 2008a, b, c, 2010a). However, the survival of the species in the region seems to be assured by the inclusion of some areas from Western Plain into several recently established protected areas. Although the habitat characteristics of the species are known (e.g. COGĂLNICEANU *et al*., 2000; NEČAS *et al*., 1997), very little data are available about its optimal habitats in terms of feeding, for the purpose of their proper conservation. Previous data on the feeding of *T. dobrogicus* are very limited, and concern only western Romania (CICORT-LUCACIU *et al*., 2005, 2009; KOVÁCS *et al*., 2006; FERENTI *et al*., 2009). These are stationary studies, only clarifying food composition. Thus we aimed to test to what extent feeding may offer clues on the quality of the aquatic habitats populated by newts. The fact that food composition can indicate the quality of habitats has been previously observed for amphibians (GUNZBURGER, 1999). The study was conducted in Carei Plain, a protected natural area where the species is well represented (COVACIU-MARCOV *et al*., 2009).

MATERIAL AND METHODS

The study was carried out in March and April of 2011. A number of 88 newts from three aquatic habitats were analysed. These habitats are located in the north of Carei Plain protected natural area, in north-western Romania, and have a different morphology and anthropogenic disturbance. The habitat from Urziceni Pădure is a permanent pond with fish, over one metre deep, surrounded by willows, bulrush and meadows with sandy soil, located near some abandoned buildings of the border police. At present, human impact in the region is low. The habitat from Foieni is a large pond area, formed in a flooded, former sand mining pit, surrounded by sand dunes, willows, alders and sedge. The habitat is quasi-permanent with a water level of 80 cm at most and has a lot of aquatic vegetation. It is not affected by human activities. The habitat from Ciumeşti is a relatively large pond area with a maximum water depth of 70 cm, and poor aquatic vegetation. On the shores there is only herbaceous vegetation, pastures with sandy soil and acacia plantations. It is located near a village and used for cattle watering, thus being affected by human activities.

Newts were captured with nets with long metallic handle. At least 25 newts were captured in each habitat (Table 1). In order to obtain stomach contents we used the stomach flushing method (SOLÉ *et al*., 2005). Following sampling, the newts were released in their habitat. Samples were placed in test tubes, preserved with formalin and examined in the laboratory using a binocular magnifier. Data were later processed by calculating percentage abundance (% A) and frequency of occurrence (% f). Dietary diversity was estimated with the SHANNON-WIEVER (1949) diversity index (H). Mann-Whitney U-test (ZAR, 1999) was used to determine if differences between the feeding of the three populations are significant.

RESULTS

Food composition is highly different between the three populations. All newts had stomach contents represented by animal preys, as well as by other types of contents such as plant materials, shed-skins, eggs of Ranidae and inorganic items. Of the last four categories, only plant materials and shed-skins were consumed by all three populations. The frequency of occurrence of these types of stomach contents showed great variations between habitats (Table 1). Nevertheless, plant materials had the highest value in each habitat.

Table 1. Number of studied newts, frequency of occurrence of vegetal fragments, shed-skin, eggs of Ranidae and inorganic items in the three habitats. / Tabel 1. Numărul tritonilor studiaţi, frecvenţa fragmentelor vegetale, a exuviilor, a pontei de Ranidae şi a elementelor anorganice în cele trei habitate.

Sampling place	**Urziceni Pădure**	**Foieni**	**Ciumeşti**
Period	March	April	April
No. of newts	34	25	29
Vegetal fragments	61.76	40	79.31
Shed-skin	70.58	20	17.24
Eggs of Ranidae	-	-	3.44
Inorganic items	2.94	-	-

Animal prey items belonged to 23 taxa, of which the highest number, 15 taxa, was identified at Foieni (Table 2). Importance of prey taxa varies between the three populations (Table 2). However, concerning a certain habitat, usually the same taxa had the highest values both as percentage abundance and frequency of occurrence. There are habitats in which small sized preys such Crustacea Ostracoda prevailed in the food of newts, but also habitats where newts mainly fed on large sized preys, such as earthworms.

The highest number of preys (45 items) was consumed by a newt at Foieni (Table 3). Both the maximum and the average number of preys / individual differ between the three habitats, the lowest values being recorded at Urziceni Pădure (Table 3). The average number of preys / individual is usually much lower than the maximum, the highest difference being recorded also at Urziceni Pădure. All three *T. dobrogicus* populations consumed mainly aquatic preys (Table 3). However, if at Foieni and Ciumeşti terrestrial preys represented less than 2% of the total items, at Urziceni Pădure these comprised more than one third of the total preys (Table 3). The highest dietary diversity was recorded at Urziceni Pădure and the lowest one at Ciumeşti (Table 3). Significant differences were recorded only between the diet of the populations from Ciumeşti and Urziceni Pădure ($p=0.04$); the differences between those from Foieni and Ciumeşti ($p=0.09$), and Foieni and Urziceni Pădure ($p=0.08$) were not significant.

Table 2. Percentage abundance (A%) and frequency of occurrence (f%) of prey taxa in the three habitats. / Tabel 2. Ponderea (A%) şi frecvenţa (f%) taxonilor pradă în cele trei habitate.

Sampling place	**Urziceni Pădure**		**Foieni**		**Ciumeşti**	
	A%	f%	A%	f%	A%	f%
Nematoda	-	-	0.24	4.00	-	-
Oligochaeta	32.89	47.05	0.73	12.00	0.47	6.89
Hirudinea	-	-	-	-	0.23	3.44
Gastropoda	1.31	2.94	15.51	40.00	3.83	20.68
Bivalvia	-	-	0.24	4.00	-	-
Crustacea - Cladocera	2.63	2.94	6.89	8.00	11.99	34.48
Crustacea - Copepoda	14.4	8.82	1.23	4.00	2.63	13.79
Crustacea - Ostracoda	-	-	-	-	39.8	65.51
Crustacea - Isopoda	3.94	8.82	0.49	8.00	-	-
Ephemeroptera (larvae)	-	-	26.6	72.00	26.61	89.65
Odonata (larvae)	3.94	8.82	4.43	56.00	-	-
Heteroptera	-	-	-	-	1.91	13.79
Trichoptera	-	-	0.24	4.00	-	-
Coleoptera - Carabidae	-	-	0.24	4.00	-	-
Coleoptera - Dytiscidae (larvae)	9.21	17.64	4.67	44.00	0.47	3.44
Coleoptera - Curculionidae	1.31	2.94	-	-	-	-
Coleoptera undetermined (imago)	1.31	2.94	0.24	4.00	0.47	6.89
Coleoptera undetermined (larvae)	1.31	2.94	-	-	-	-
Diptera - Nematocera (larvae)	23.68	8.82	37.43	76.00	10.79	58.62
Diptera - Nematocera (imago)	-	-	-	-	0.23	3.44
Diptera - Brachycera (imago)	2.63	5.88	-	-	-	-
Diptera - Brachycera (larvae)	1.31	2.94	-	-	-	-
Anura - Ranidae (larvae)	-	-	0.73	12.00	0.47	6.89
No. of prey taxa	13		15		13	

Table 3. Maximum and average number of preys / individual; percentage abundance of terrestrial and aquatic preys; prey diversity in the three habitats. / Tabel 3. Numărul maxim şi mediu de prăzi / individ, ponderea prăzilor terestre şi acvatice; diversitatea prăzilor în cele trei habitate.

Sampling place	Urziceni Pădure	Foieni	Ciumeşti
Maximum no. of preys / individual	12	45	28
Average no. of preys / individual	2.23	16.24	14.37
Percentage abundance of terrestrial preys	38.15	1.23	1.19
Percentage abundance of aquatic preys	61.84	98.75	98.8
Diversity (H)	1.60	1.57	1.54

DISCUSSIONS

Feeding of the three *T. dobrogicus* populations from Carei Plain is similar to that of previously studied populations (CICORT-LUCACIU *et al.*, 2005), but the number of consumed prey taxa is higher, suggesting the existence of a diverse trophic offer. All newts had stomach contents. This attests that substantial trophic offer was available for newts and they hunted intensely. Amphibians with empty stomachs suggest unfavourable trophic conditions, whereas situations when the entire population had fed imply optimal feeding circumstances (e.g. SAS *et al*., 2009; BALINT *et al*., 2010). This is important for the population from Urziceni Pădure where the samples were collected in early spring. In other newt populations a similar sampling period revealed individuals which did not feed due to meteorological conditions (COVACIU-MARCOV *et al*., 2010b, c). This result shows that in the three habitats from Carei Plain *T. dobrogicus* has favourable feeding conditions, indicating good perspectives of the species in a protected area. However, although the overall trophic conditions seem suitable, there are significant differences between the feeding of the populations from the three habitats. The population from Urziceni Pădure had the most distinct feeding, but the highest feeding intensity, number of preys and prey taxa were registered at Foieni. The differences between the feeding of the two populations are a consequence of the period and characteristics of the habitats. Seasonal variations of amphibian food composition was frequently recorded (e.g. SAS *et al*., 2003; YU *et al*., 2009; KOVÁCS *et al*., 2007; MOLLOV *et al*., 2010). The population from Foieni benefited from the most natural and less anthropogenically affected habitat. Differences between feeding of some amphibian populations from different habitats have been previously reported (e.g. KUTRUP *et al*., 2005; KOVÁCS *et al*., 2010; ÇIÇEK, 2011), including *T. dobrogicus* (CICORT-LUCACIU *et al*., 2005).

Although at Urziceni Pădure all newts had stomach contents, the influence of sampling period was obvious. At this habitat shed-skin fragments had the highest frequency of occurrence. Usually, shed-skin fragments are consumed more frequently in periods and habitats in which feeding is improper (COVACIU-MARCOV *et al*., 2010b; KOVÁCS *et al*., 2010). Number of prey taxa and preys / individual was also lower than in other habitats. At the same time, earthworms, which had low values for the other populations, were very important at Urziceni Pădure. The consumption of these terrestrial preys underlines the importance of conservation of terrestrial habitats for amphibians feeding (MAHAN & JOHNSON, 2007). The population from Urziceni Pădure had also consumed other terrestrial preys, which led to a high dietary diversity despite the lower number of prey taxa than at Foieni. It is possible that at Urziceni Pădure newts stay near the pond banks because of fish, which negatively affects amphibians (HARTEL *et al*., 2007). Staying near banks, newts reach more easily terrestrial preys. Consumption of terrestrial preys during the aquatic period has been reported in other newt species as well (e.g. FASOLA & CANOVA, 1992; DENOËL *et al*., 1999; COVACIU-MARCOV *et al*., 2010b, c), denoting their trophic plasticity.

The population from Foieni consumed the highest number of preys and prey taxa. Both the maximum and average number of preys/individual are higher than in the other populations. This may seem a consequence of the different sampling period when comparing with Urziceni Pădure. However, the samples from Foieni were collected in the same day with those from Ciumeşti, but the differences between the feeding of the two populations are obvious, at Ciumeşti feeding being more reduced. Despite this low feeding, the differences between the two populations are not significant. The fact is probably a consequence of the initial similarity of habitats. These had the same original aspect and were surrounded by similar terrestrial habitats. However, the habitat from Foieni and its neighbouring terrestrial areas are not anthropogenically affected whilst at Ciumeşti the human impact is obvious. The cattle of locals alter the terrestrial habitat by overgrazing. The aquatic habitat, used for cattle watering, is also affected since cattle step on aquatic vegetation and leave faeces in the water. Thus, compared to Foieni, the diet of the population from Ciumeşti lacks two aquatic prey taxa and the feeding intensity is lower. Both populations focus on consuming trophic resources of the aquatic habitat. Hence, the trophic offer of the aquatic habitat from Ciumeşti seems also acceptable. In the case of a poor trophic offer of an aquatic habitat, newts consume terrestrial preys (COVACIU-MARCOV *et al*., 2010b). But at Ciumeşti this is difficult due to alteration of the terrestrial habitat. Besides the less intense feeding, the population from Ciumeşti also consumed less food. For both populations, mayfly larvae (large sized preys and trophically important) are on the second place as percentage abundance with almost identical values. At Foieni the first place is taken by Nematocera larvae, but at Ciumeşti by Ostracoda. Although Nematocera larvae are also smaller preys than mayfly larvae, Ostracoda, which are the trophic basis at Ciumeşti, are much smaller. Ostracods have a low trophic significance for other amphibians as well, even if they are ingested in large amounts (MEASEY, 1998). A decreased feeding of newts in anthropogenically affected habitats has also been reported in other species (COVACIU-MARCOV *et al*., 2010b). The rule cannot, however, be generalized within anurans as well, since there were related situations in which the

anthropogenic alteration of the habitat did not affect feeding (SOLÉ *et al*., 2009). This is a consequence of the fact that anurans can more easily compensate the low trophic offer of an aquatic habitat by foraging in terrestrial environment (CICORT-LUCACIU *et al.*, 2011). The future of the population from Ciumeşti is thus threatened by the alteration of the terrestrial habitat as well. At present, the population seems to be able to supply its trophic needs from the habitat, but ongoing anthropogenic activities will limit trophic offer even more. On the contrary at Foieni, the terrestrial habitat is not affected and there are no immediate threats in the area. These data emphasize the importance of terrestrial habitats for the survival of newts (e.g. MÜLLNER, 2001; DENOËL & LEHMANN, 2006; GUSTAFSON *et al*., 2011).

The most favourable habitat for *T. dobrogicus* is that from Foieni. This provides, by its own resources, an adequate trophic basis for newts during the aquatic period. Therefore, feeding can be used as an indicator of the quality of the aquatic habitats inhabited by *T. dobrogicus*. As, usually, newts are opportunistic predators which consume the available food according to its accessibility (e.g. FASOLA & CANOVA, 1992; CICORT-LUCACIU *et al*., 2005; COVACIU-MARCOV *et al*., 2010c; IFTIME & IFTIME, 2011), the trophic offer of populated habitats is very important for them. Survival of the species in the protected area seems to be conditioned by the existence of some trophically favourable habitats. These habitats will have to be identified and conserved. It was recently emphasized the need to identify small isolated wetlands because of their importance for biodiversity (PITT *et al*., 2012). In the same time, anthropogenic activities that affect the habitats of *T. dobrogicus* from the area must be stopped. The measures will ensure the survival of this conservatively important species in Carei Plain.

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REFERENCES

BALINT N., INDREI C., IANC R., URSUT A. 2010. *On the diet of the Pelopylax ridibundus (Anura, Ranidae) in Ticleni, Romania*. South-western Journal of Horticulture, Biology and Environment. Edit. Universitaria, Craiova. **1**(1): 57-66.

ÇIÇEK K. 2011. *Food composition of Uludağ frog, Rana macronemis Boulenger, 1885 in Uludağ (Bursa, Turkey).* Acta Herpetologica. Firenze University Press. **6**(1): 87-99.

CICORT-LUCACIU A. Ş, CUPSA DIANA, GHIRA I., BOGDAN H., POP A. 2005. *Food composition of some Triturus dobrogicus Kir. 1903 population from north-western Romania.* Anelele Universitatii din Oradea, Fascicula Biologie. University of Oradea Publishing House: 12: 71-76.

CICORT-LUCACIU A. Ş., DIMANCEA NICOLETA, BLAGA-LUNGULESCU R. M., HODIȘAN O., BENKO A. 2009. *Diet composition of a Triturus dobrogicus (Amphibia) population from Arad county, western Romania.* Biharean Biologist. University of Oradea Publishing House. **3**(1): 77-82.

CICORT-LUCACIU A. S., CUPSA DIANA, ILIES D., ILIES A., BAIAS S., SAS I. 2011. *Feeding of two amphibian specieis (Bombina variegata and Pelophylax ridibundus) from artificial habitats from Padurea Craiului Mountains (Romania*). North-Western Journal of Zoology. University of Oradea Publishing House**. 7**(2): 297-303.

COGĂLNICEANU D., AIOANEI F., BOGDAN M. 2000. *Amfibienii din România, Determinator*. Ars Docendi, Bucharest: 1-99.

COVACIU-MARCOV S.-D., SAS I., CICORT-LUCACIU A.-ŞT., BOGDAN H. V., KOVÁCS E. H., MAGHIAR C. 2008a. *The Herpetofauna of the Natural Reservation from the Inferior Course of the Tur River And its Surrounding Areas*. In: Sike, T., & Mark Nagy, I. (Eds.). Biharean Biologist – Supplement: Flora si Fauna Rezervatiei Naturale "Raul Tur" / The Flora and Fauna of the Tur River Natural Reserve: 111-129.

COVACIU-MARCOV S.-D., BOGDAN H. V., PAINA C., TOADER S., CONDURE N. 2008b. *The herpetofauna of the north-western region of Bihor County, Romania.* Biharean Biologist. University of Oradea Publishing House. **2**: 5-13.

COVACIU-MARCOV S.-D., SAS I., LAZĂR V., SZEIBEL N., COVACI R. 2008c. *The herpetofauna in the plain area from the western Satu Mare county, Romania.* Oltenia. Studii şi comunicări. Ştiinţele Naturii. Muzeul Olteniei Craiova. **24**: 161-166.

COVACIU-MARCOV S. D., SAS I., CICORT-LUCACIU A. Ş., KOVACS E. H., PINTEA C. 2009. *Herpetofauna of the Natural Reserves from Carei Plain: zoogeographical significance, ecology, statute and conservation*. Carpathian Journal of Earth and Environmental Sciences. North. University of Baia-Mare. **4**(1): 69-80.

COVACIU-MARCOV S. D., CICORT-LUCACIU A. Ş., DIMANCEA NICOLETA. 2010a. *Triturus dobrogicus (Kiritzescu, 1903) in Caras Severin County: status and conservation implications.* Carpathian Journal of Earth and Environmental Sciences. North. University of Baia-Mare. **5**(1): 127-130.

COVACIU-MARCOV S. D., CICORT-LUCACIU A. Ş., SAS I., CUPŞA DIANA, KOVÁCS É. H., FERENȚI SARA. 2010b. *Food composition of some low altitude Lissotriton montandoni (Amphibia, Caudata) populations from north-western Romania.* Archives of Biological Sciences, Belgrade. Inst. Bioloska Istrazivanja Sinisa Stankovic. **62**(2): 479-488.

COVACIU-MARCOV S. D., CICORT-LUCACIU A. Ş., MITREA I., SAS I., CĂUŞ A. V., CUPŞA DIANA. 2010c. *Feeding of three syntopic newt species (Triturus cristatus, Mesotriton alpestris and Lissotriton vulgaris) from Western Romania.* North-Western Journal of Zoology. University of Oradea Publishing House. **6**(1): 95-108.

DENOËL M. & LEHMANN A. 2006. *Multi-scale effect of landscape processes and habitat quality on newt abundance: Implications for conservation.* Biological Conservation. Elsevier. **130**: 495-504.

DENOËL M., JOLY P., PONCIN P. 1999. *Facultative paedomorphosis in the Alpine newt, Triturus a. alpestris: feeding habits and habitat use in an Alpine lake*. In: Miaud & Guyetant (Eds.), Current studies in Herpetology. Societas Europaea Herpetologica, Le Bourget du Lac: 89-94.

FASOLA M. & CANOVA L. 1992. *Feeding habits of Triturus vulgaris, T. cristatus and T. alpestris (Amphibia, Urodela) in the northern Apennines (Italy).* Bolletino di Zoologia. Taylor & Francis Group. **59**(3): 273-280.

FERENTI SARA, CICORT-LUCACIU A. Ş., GABOR G. V., SÁRKÖZI K. C. 2009. *The food composition of a Triturus dobrogicus populations (Amphibia) from the northern part of the Western Plain, Romania.* Analele Universitatii din Craiova, Biologie. **14**: 481-486.

GUNZBURGER M. S. 1999. *Diet of the Red Hills Salamander Phaeognathus hubrichti*. Copeia. American Society of Ichthyologists and Herpetologists. **2**: 523-525.

GUSTAFSON D. H., MALMGREN J. C., MIKUSINSKI G. 2011. *Terrestrial habitat predicts use of aquatic habitat for breeding purposes - a study on the great crested newt (Triturus cristatus).* Annales Zoologici Fennici. Finnish Zoological Botanical Publishing Board. **48**(5): 295-307.

HARTEL T., SZILÁRD N., COGALNICEANU D., ÖLLERER K., SCHWEIGER O., MOGA C. I., DEMETER L. 2007. *The effect of fish and aquatic habitat complexity on amphibians.* Hydrobiologia. Springer. **583**: 173-182.

IFTIME A. 2005. *Amfibieni*. In: Botnariuc & Tatole (Eds.), Cartea Roşie a Vertebratelor din România. Edit. Academiei Române, Bucureşti. 197-214.

IFTIME A. & IFTIME O. 2011. *Triturus cristatus (Caudata: Salamandridae) feeds upon dead fishes*. Salamandra. Deutsche Gesellschaft Herpetologie Terrarienkunde. **47**(1): 43-44.

KUTRUP B., ÇAKIR E., YILMAZ N. 2005. *Food of the Banded Newt, Triturus vittatus ophryticus (Berthold, 1846) at Different Sites in Trabzon.* Turkish Journal of Zoology. Tubitak Scientific & Technical Research Council Turkey. **29**: 83-89.

KOVÁCS E. H., CICORT-LUCACIU A. Ş., CUPSA DIANA. 2006. Food of the danube crested newt, *Triturus dobrogicus* in a forested habitat (Livada, Satu Mare county, Romania). Studii şi comunicări. Seria Ştiinţe Naturale. Satu Mare. **6**: 61-67.

KOVÁCS É.-H., I. SAS, COVACIU-MARCOV, S.-D., HARTEL, T., CUPŞA DIANA, GROZA M. 2007. Seasonal variation in the diet of a population of *Hyla arborea* from Romania. Amphibia-Reptilia. Brill. **28**: 485-491.

KOVÁCS I., BODENCIU E., BODENCIU C., NAGY R., PINTEA C. 2010. *Data upon the feeding of some newt populations (Triturus cristatus and Lissotriton vulgaris) from Almas-Agrij Depression, Salaj County, Romania.* South-Western Journal of Horticulture, Biology and Environment. Edit. Universitaria, Craiova. **1**(1): 29-55.

MEASEY G. J. 1998. *Diet of feral Xenopus laevis (Daudin) in South Wales, U.K.* Journal of Zoology. Wiley-Blackwell. **246**: 287-298.

MAHAN R. D. & JOHNSON J. R. 2007. *Diet of the Gray Treefrog (Hyla versicolor) in Relation to Foraging Site Location.* Journal of Herpetology. Society for the Study of Amphibians and Reptiles. **41**(1): 16-23.

MOLLOV I. A., BOYADZHIEV P., DONEV A. 2010. *Trophic role of the marsh frog Pelophylax ridibundus (Pallas, 1771) (Amphibia: Anura) in the aquatic ecosystems.* Bulgarian Journal of Agricultural Science. Scientific Issues Natl. Centre Agrarian Sciences. **16**(3): 298-306.

MÜLLNER A. 2001. *Spatial patterns of migrating Great Crested Newts and Smooth Newts: The importance of the terrestrial habitat surrounding the breeding pond.* Rana. Natur Text Verlagsgesellschaft Mbh. **4**: 279-293.

NEČAS P., MODRÝ D., ZAVADIL V. 1997. *Czeh Recent and Fossil Amphibians and Reptiles*. Edit. Chimaira, Frankfurt am Main. 1-94.

PITT A. L., BALDWIN R. F., LIPSCOMB D. J., BROWN B. L., HAWLEY J. E., ALLARD-KEESE C. M., LEONARD P. B. 2012. *The missing wetlands: using ecological knowledge to find cryptic ecosystems.* Biodiversity and Conservation. Springer. **21**: 51-63.

SAS I., COVACIU-MARCOV S. D., CUPSA DIANA, ASZALOS L., KOVACS E. H., TELCEAN I. 2003. *Data about the trophic spectrum of a population of Rana arvalis of the Andrid area (Satu-Mare County, Romania)*. Studii şi Cercetări Ştiinţifice, Seria Biologie. Universitatea Bacău. **8**: 216-223.

SAS I., COVACIU-MARCOV S. D., STRUGARIU A., DAVID ANAMARIA, ILEA C. 2009. *Food Habit of Rana (Phelophylax) kl. esculenta Females in a New recorded E-System Population from a Forested Habitat in North-Western Romania.* Turkish Journal of Zoology. Tubitak Scientific & Technical Research Council Turkey. **33**: 1-5.

SHANNON C. E. & WIEVER W. 1949. *The mathematical theory of communication*. University Illinois Press, Urbana: 1-144.

SOLÉ M., BECKMANN O., PELZ B., KWET A., ENGELS W. 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. Taylor & Francis. **40**(1): 23-28.

SOLÉ M., DIAS I. R., RODRIGUES E. A. S., MARCIANO-JR E., BRANCO S. M. J., CAVALCANTE K. P. & RÖDDER D. 2009. *Diet of Leptodactylus ocellatus (Anura: Leptodactylidae) from a cacao plantation in southern Bahia, Brazil.* Herpetology Notes. University Pisa, Society Europaea Herpetologica. **2**: 9-15.

YU T. L., GU Y. S., DU J., LU X. 2009. *Seasonal variation and ontogenetic change in the diet of a population of Bufo gargarizans from the farmland, Sichuan, China.* Biharean Biologist. University of Oradea Publishing House. **3**(2): 99-104.

ZAR J. H. 1999. *Biostatistical analysis, 4nd Edition.* New Jersey, Prentice Hall: 1-663.

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