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Feeding niche characteristics of a *Bombina bombina* population from Livada Plain (Satu-Mare County, Romania)

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Abstract. Along our study we analyzed the food of 87 individuals of *Bombina bombina*. The reduced number of empty stomachs indicates that there were optimal feeding conditions. In the obtained stomach contents we identified vegetal remains (χ^2_3=0.97, p=0.002), shad-skins fragments (χ^2=11.21, p=0.1) and animal type food. We identified a total number of 1498 preys belonging to 37 categories. Most of the identified preys proceed from terrestrial environment (A_{mean}=72.97 %, DS_A=45.46). The most important preys items from the diet of the studied fire-bellied toads are: Collembola (A_{mean}=28.98%; F_{mean}=31.59%, χ^2_3=23.35, p=0.13), Coleoptera's adults (A_{mean}=34.25%; F_{mean}=67.74%, χ^2_3=1.53, p=0.004) and Hymenopera Formicidae (A_{mean}=15.02%; F_{mean}=33.93%, χ^2_3=23.35, p=0.09). There was noticed an important seasonal variation at the consumed preys' level. Diet diversity presents seasonal changes (H_{mean}=1.7, SD_H=0.62). The trophic niche overlap, according to Pianka's index, presents the highest values between May and June (Q=0.87) and April-June (Q=0.967).

Keyzwords: *Bombina bombina, feeding, trophical niche*

Introduction

To understand the position of amphibians in trophic chains it is important to know their food composition which represents an indicator about the quality of the habitats occupied by them (Gunzburger 1999). The diet of amphibians is presented by several studies (e.g. Hirai & Matsui 2000, Cogălniceanu et al. 2000, Denoël & Andreone 2003, Aszalós et al. 2005, Cicort-Lucaciu et al. 2005a). In the same way, there are studies about the feeding of *Bombina bombina* species (Lác 1958, 1959, Országová 1969, Ratajskỳ & Vojtková 1971, Medvedev 1974, Gocharenko et al. 1978, Ščerbak & Ščerban 1980, Tertyshnikov & Goroyava 1982, Kovács & Török 1992, Sas et al. 2003a, 2004a). But these previous studies have only descriptive aspects, presenting the trophic elements used by the fire-bellied toads. The objective of our study was to analyze the seasonal changes of diet diversity and the relations between the trophic and temporal niche.

Materials and Methods

The locality of Livada (), that we investigated in order to study the trophic spectrum of a *Bombina bombina* population, lies in the north of Satu-Mare County, in the Livada Plain. The habitat is in humid areas in an oak forest, with a high phreatic level, with permanent water accumulations. This area is one with rich, tall, thick, grassy vegetation. Our study was performed in the period of April-July of the year 2005, analyzing 87 stomach contents. The feeding's study of *Bombina bombina* species was made accordingly to the stomach flushing method (e.g. Cogălniceanu 1997). In order to determine differences and seasonal variations in the frequency of the consumed preys, the Chi-square test was used. The temporal dependent diet diversity was estimated with Shannon-Wiener (1949) diversity index (H). Niche overlap was estimated using Pianka's index (1973).

Results

Along our study we analyzed the food of 87 individuals of *Bombina bombina* (tab. 1). Unless a single sample collected in June, all of them had stomach contents. In the obtained stomach contents we identified vegetal remains ($F_{average}$=80.3 %, DS_F=10.9; χ^2_3=0.97, p=0.002), shad-skins fragments ($F_{average}$=18.19 %, DS_F=19.3; χ^2_3=11.21, p=0.1) and animal type food (tab. 1). We identified a total number of 1498 preys belonging to 37 categories, the accidentally present preys being summarized as others (tab. 1, 2). Most of the identified preys proceed from terrestrial environment ($A_{average}$=72.97 %, DS_A=45.46), the only period when preys proceeded from aquatic environment has higher amount is April (P=95.1 %). The most important preys items from the diet of the studied fire-bellied toads are: Collembola ($A_{average}$=28.98 %, DS_A=47.01; $F_{average}$=31.59 %, DS_F=35.46; χ^2_3=23.35, p=0.13), Coleoptera's adults ($A_{average}$=34.25 %, DS_A=29.3; $F_{average}$=67.74 %, DS_F=12.46; χ^2_3=1.53, p=0.004) and Hymenopera Formicidae ($A_{average}$=15.02 %, DS_A=23.95; $F_{average}$=33.93 %, DS_F=14.94; χ^2_3=23.35, p=0.09). There is an important seasonal variation at the consumed preys' level (tab. 1, 2, fig. 1). The feeding intensity (tab. 2) suffer changes depending on the year's period and the used food resource (*average no. of preys / individual* $_{average}$=17.31, DS=20.69). Diet diversity (tab. 2) presents, in a similar way, seasonal changes ($H_{average}$=1.7, SD_H=0.62) having the lowest value in April (H=0.77) and the highest ones in June (H=2.05) and July (H=2.04). The trophic niche overlap, according to Pianka's index (fig. 2), presents the highest values between May and June (Q=0.87) and April-June (Q=0.967). The lowest value of this parameter is recorded between April and May (Q=0.50)

Discussions

We identified in those 87 stomach contents vegetal remains, shed-skins fragments and animal preys. Only a single sample had no stomach content. The consumption level of animal preys and diet diversity suffer seasonal changes along the studied period.

The reduced number of empty stomachs indicates that there were optimal feeding conditions. The

consumption of vegetal materials we may consider to be accidentally as well as at the other species of amphibians from Romania (e.g. Sas et al. 2003b, Covaciu-Marcov et al. 2005). The consumption of molted skin is considered accidentally by some researchers (Sas et al. 2005a) or as a way to recycling the epidermal proteins (Weldon et al. 1993).

The seasonal variations at the level of animal preys' consumption is due in first instance to the seasonal changes of the prey items in question, as well as to the accessibility of preys in the habitat (e.g. Covaciu-Marcov et al. 2002a). It can be observed that in the first studied period (April) the most important food item is represented by Collembola. In the following months the consumption of this insects diminishes, their place being taken by Coleoptera (May, June) and Hymenoptera Formicidae in July (tab. 1, 2). The high consumption of Collembola in April has major influence on every parameters of the trophic spectrum: amount, frequency, diet diversity, feeding intensity. This is due to the fact that the Collembolas are small insects with a gregarious life-style. A single sample of *Bombina bombina* has to swallow many Collembollas in order to cover its energetic needs. Such influences on the trophic spectrum's parameters caused by the consumption of a large number of small sized prey items and with gregarious life-style was observed at other amphibian species too, both at caudate (e.g. Covaciu-Marcov et al. 2002b, Cicort-Lucaciu 2005b) and anurans (e.g. Sas et al. 2003a, 2005b).

Table 1. The number of analysed samples, the frequency of the stomachs with vegetal remains and shad-skin, animal contents (presented the most important prey categories)
(chi^2: n.s.-difference not significant, $p > 0.05$; Significant differences: ** - $p < 0.01$)

	IV	V	VI	VII	***Mean***	***SD***	chi^2 (d.f.=3)
No. samples	22	24	27	14	-	-	-
% vegetal remains	86.36	70.83	92.59	71.42	80.3	10.9	0.97**
% shad skin	45.45	12.5	14.81	0	18.19	19.3	11.21 n.s.
Araneida (a)	18.18	25	18.51	21.42	20.78	3.16	0.34**
Izopoda (a)	50	12.5	22.22	7.14	22.97	19.07	9.15 n.s.
Collembola (a)	77.27	41.66	7.4	0	31.59	35.46	23.35 n.s.
Homoptera (a)	0	12.5	25.92	35.71	18.54	15.6	8.05 n.s.
Coleoptera (l)	72.72	20.83	3.7	21.42	29.67	29.86	21.48 n.s.
Coleoptera (a)	50	79.16	70.37	71.42	67.74	12.46	1.53**
Lepidoptera (l)	45.45	16.66	3.7	28.57	23.6	17.76	10.26 n.s.
Diptera (a)	13.63	20.83	22.22	21.42	19.53	3.97	0.53**
Hymenoptera-Formicida (a)	13.63	25	18.51	78.57	33.93	30.12	14.94 n.s.

Table 2. The no of preys, the average and maximum no. of prey / samples, the amount of the prey items and the niche breath (*H*)

	IV	V	VI	VII	***Mean***	***SD***
No. of preys	1063	151	164	120	-	-
Mean no. of preys / ind.	48.31	6.29	6.07	8.57	17.31	20.69
Max no. of preys / ind.	142	25	24	17	52	60.1
% aquatic preys	95.1	7.28	4.87	0.83	27.52	45.46
% terrestrial preys	4.89	92.7	95.1	99.2	72.97	45.46
Araneida (a)	0.37	5.29	3.04	2.5	2.8	2.02
Izopoda (a)	3.01	1.98	8.53	0.83	3.58	3.41
Collembola (a)	83.3	0.66	3.04		28.98	47.01
Homoptera (a)		4.63	11	10.8	8.81	3.62
Coleoptera (l)	7.8	4.63	0.6	2.5	3.88	3.08
Coleoptera (a)	2.16	60.3	57.9	16.7	34.25	29.3
Lepidoptera (l)	0.09	2.64	1.21	5	2.23	2.11
Diptera (a)	0.28	4.63	6.7	3.33	3.73	2.68
Hymenoptera-Formicida (a)	0.37	4.63	4.26	50.8	15.02	23.95
Others	0.64	9.93	3.03	3.32	4.23	3.985
H (Shannon)	0.77	1.95	2.05	2.04	1.7	0.62

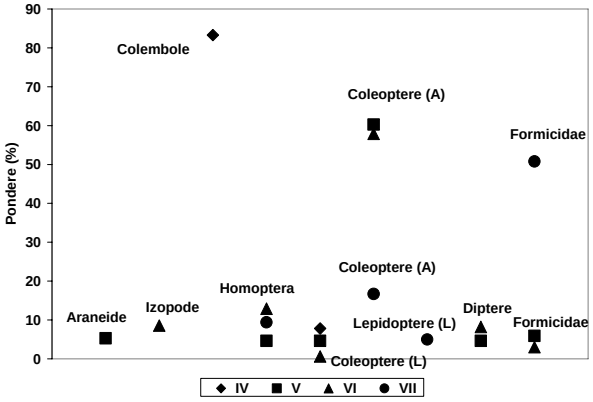

Fig. 1 Seasonal variation of the most important food items

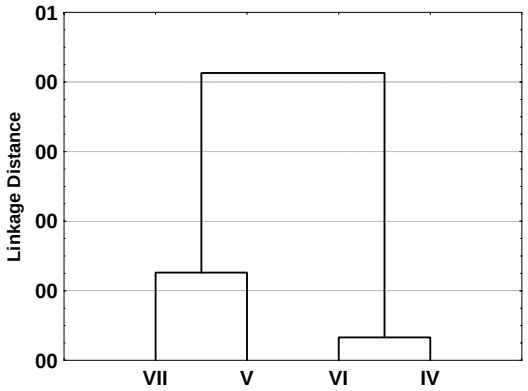

Fig. 2 Trophical niche overlap between the studied months

The observed diet diversity at the studied *Bombina bombina* population is more similar to that recorded at a population from Hungary (*H*=1.81, Kovács & Török 1997). For another *Bombina bombina* population from Romania it was observed a pretty high value of diet diversity (*H*=2.93, Cogălniceanu et al. 2000). For a Romanian *Bombina variegata* population, there was recorded a food diversity of 3.79 (Sas et al. 2005c). This is due to the difference in the two *Bombina* species habitat structure. *Bombina variegata* occupies aquatic habitats of small dimensions (Fuhn 1960) therefore it is obliged to hunt in terrestrial environment (leaving not much access to preys that live in groups); the feeding niche becoming more divers. This statement is also justified for the *Bombina bombina* population studied by us. In April when the water's level is high in the investigated pond, the frogs feed especially on Collembolas captured from water's glisten. After May, due to the high temperatures (per. obs.) the pond dries up the toads being forced to feed preponderant from terrestrial environment (tab. 2). In the specialty literature there are studies which indicate that the *Bombina bombina* species forages in the first instance in aquatic habitats (Kovács & Török 1997, Sas et al. 2003a), while the vicarious species *Bombina variagata* uses terrestrial food resources (Kuzmin 1990, Nemes & Petrásss 2003, Ghiurcă & Zaharia 2005, Sas et al. 2005c, d).

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