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Data regarding the trophic spectrum of some population of *Bombina variegata* from Bacău county

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Abstract. We analyzed the trophical spectrum of three *Bombina variegata* populations, from forest ecosystems situate in Luncani, Valea Budului and Runc within Bacău County. The most abundant prey taxon in the food of *Bombina variegata* populations is represented by the species from Coleoptera order, followed by those of Diptera among insects, and by araneids among spider. The considerable number of small and gregarious species (Formicidae – Hymenoptera) emphasizes the opportunistic behavior of preying in this species, using the *sit and wait* foraging behavior. The terrestrial prey taxons prevail in comparison with aquatic organisms. Like the other amphibian species, *Bombina variegata* is a zoophagous – polyphagous species. Yellow-bellied toads eat all moving objects in their sight range that they can ingest.

Key-words: amphibians, *Bombina variegata*, trophic spectrum

Introduction

The species *Bombina variegata* belongs to the family Discoglossidae from Anura order, being a common species in Romania spread at altitudes between 200-1500 m (Cogălniceanu et. al. 2000).

The studies regarding the stomach content at *Bombina variegata* are poor in Romania. (Sas et. al. 2004). From this point of view we aim to bring new data regarding the food of this species.

The study was undertaken in August 2004 in three forest ecosystems from Bacău County (Luncani, Valea Budului and Runc). The research was focused on the taxonomic groups which represent the prey of yellow-bellied toad (both the number of species and specimens), and also, on the occurrence frequency of different categories of organisms.

Material and Metods

The samples of *Bombina variegata* were captured in the following locations:

- the area of Runc forest placed at the northern border of the Bacău county with Neamț county, close to Buhuși;
- forest ecosystem Valea Budului, in northern part of Bacău county, 10 km west from Bacău town;

- forest ecosystem Luncani, in North part of Bacău county, at 15 km west from Bacău town.

We analyzed a number of 57 samples of stomachal content belonging to the species *Bombina variegata*, all collected from 6 ponds, two for each of the three locations.

The stomachal contents were collected using the stomachal flushing method (Cogălniceanu, 1997). Thus were used a syringe with a perfusion tube at one end. Because the frog digestion takes place rapidly we tried to shorten as much as possible the period between capture and stomachal flushing. The water was injected very slowly and gradually due to the small size of the animals which could be easily wounded. This methods permits the release of sampled animal in the natural biotope avoiding the populations decrease.

The stomachal contents was collected and preserved in technical alcohol and was identified by the use of stereomicroscope and microscope, with specifically identification (Reitter, 1912, Paulian, 1971, Jeuniaux, 1996, Chinery, 1998).

Habitat description

The three forests habitats studied are placed in the northern part of Bacău County.

The firsts habitat from Luncani, placed at 15 km West from Bacău town, is a meadow and forests region on Pietricica crest, along the valley of Slatina spring, affluent of Trebeş. The altitude of this habitat is 290 m. The two permanent ponds out of which were collected the samples have a surface of approximate 4 m^2 each, silt substratum and boundary vegetation, with a depth of maximum 30 cm.

The second habitat, placed at altitude of 310 m in Valea Budului at 10 km West from Bacău County, is situated along an affluent on the right side of Trebeş spring. The ponds (2) have a surface of approximate 7 m^2 one, and the other of 3 m^2, silt substratum and boundary vegetation with a depth of maximum 30 cm.

The third habitat is placed in Runc beech forest ecosystem, on the Pietricica crest (330 m altitude). The two studied ponds have a surface of approximate 10 m^2 each, silt substratum and leaves, with boundary vegetation and a depth of maximum 40 cm.

Results and Discussions

The amphibian diet is mainly made up of invertebrates (Das 1996). Although the adults are regarded as carnivorous animals and only their larvae consume vegetal matter. The literature considers that the vegetal food is accidentally ingested along with the captured preys. Vegetal debris were, also, recorded in other amphibians species stomachs, like: *Rana ridibunda* (Covaciu – Marcov et. al. 2000), *Bombina bombina* (Sas et. al. 2003), *Rana arvalis* (Covaciu – Marcov et. al. 2001).

The percentage of stomachs with vegetal debris out of the total umber of 57 samples is of 29,82% and the percentage of the stomach with egg laying fragments is of 21,05 (tab.1).

The relation established between the animal and vegetal contents of the stomach is obvious. We haven't identified any stomach only with vegetal content so we can draw the conclusion that vegetal debris are accidentally ingested along with the animal prey.

Considering that amphibians are predators (Cogălniceanu et. al. 2000), the most part of the analyzed stomach, with the exception of four, contain animal food. The invertebrates where assorted in 12 groups and 17 categories (tab. 2).

The preys that we identified in the stomachal contents are determined to family level. In some specimens it was possible the identification at genus level and even at species level We separated the immature forms (larva and pupae, in the case of Culicida family) from adults for the orders Coleoptera, Diptera, Lepidoptera, Homoptera. We made a distinction between the preys with aquatic and terrestrial life environment. The differentiation of these categories is made concerning their movements and the environment in which they were captured.

Specimens from Gasteropoda class were recorded only in the material sampled from Luncani and Valea Budului. The snails identified in the stomach of the *Bombina variegata* populations studied presented only the shell without the soft body. The gasteropods are important components of amphibians diet being often identified in their stomachal contents analyzes (Holzinger et al. 1996).

The arachnids are a well represented group in the food of the species *Bombina variegata*. Among this class we identified specimens belonging to the following orders: Acarina, Araneea and Opiliones. Out of these three orders the most abundant were the specimens belonging to Aranea order. There were identified an order (Isopoda) from Crustacea class and two from Miriapoda class: Diplopoda and Chilopoda. Both of these classes are poor represented in the stomachal contents analyzed, these species live in the superficial horizons of the soil and under litter, thus representing preys which are not available food.

Most of the preys identified in the stomachal contents of yellow-bellied toad belong to the class Insecta. The order Heteroptera is well represented in the diet of the studied population of *Bombina variegata*, there were identified specimens belonging to the genus *Berytinus* and the species *Pentatoma rufipes*.

Out of Coleoptera order we identified both adults and larvae, representing the most part of the prey consumed by yellow-bellied toad. In the analyzed stomachs we identified specimens belonging to 11 families: Hydrophilidae, Carabidae, Staphylinidae, Aculidae, Scarabeidae, Lampyridae, Chrysomelidae, Ptiliidae, Elateridae, Curculionidae, Coccinelidae. In some specimens it was possible the identification at genus level – *Helophorus* sp., *Pentamoneczes* sp., *Ontophagus* sp., *Lampyrus* sp. and even at species level – *Staphylinius olens, Mordela fasciata, Hololepta plana, Dalopius marginatus*.

Among the hymenopterans we identified the families Formicidae, Tenthredinidae, Cynipidae and Ichneumonidae. There was identified at species level only *Formica rufa*.

Both adults and larvae were identified in the case of some families like: Stratiomyidae, Culicidae, Bibionidae, Ephydridae, Tipulidae and Mycetophylidae belonging to the Diptera order which is well consumed by the populations of *Bombina variegata* analyzed by us.

We, also, identified mature and immature stages of specimens from the following orders: Colembola, Dermaptera, Lepidoptera and Homoptera.

The number of taxons identified in the stomachal content of the studied populations reach a total of 151 and is distributed as following: 63 for the population studied in the Luncani area (fig. 1), 55 for the samples collected in forests ecosystem from Valea Budului (fig. 2) and 33 for the yellow-bellied from Runc forest (fig. 3).

The most of prey consumed by the studied populations of *Bombina variegata* belong to Coleoptera order – 23 % of samples (fig. 4). According to the references coleopterans are important prey for yellow-bellied toad (Kuzmin 1990). The second group from the number of specimens point of view is order Diptera – 31 specimens (21 % out of total prey). These data emphasize that the species from this order represents important preys for analyzed *Bombina variegata* populations.

Considering the number of prey, the third important group includes species of Aranea order – 20 specimens, representing 13% out of the total number of samples.

Beside the abundance of prey taxons another important parameter for the stomachal content study is represented by the frequency of prey. This index is defined as the rapport between the number of analyzed stomach with a specifical prey taxon and the total number of studied stomachs, resulting in a percentile value.

For the population from Luncani forest ecosystem the highest frequency of consumed prey belongs to Aranea order with 20 %, followed by Formicidae – Hymenoptera with 14,28 %. This situation is probably due to the high frequencies of spiders in forest ecosystems and to the gregarious way of life recorded in ants, which can explain the possibility of capturing more specimens of the same species (tab. 2).

For the three studied populations we can affirm that the most frequent prey belong to the species from Diptera order with 38,56 % followed by Arahnida order with 36,83 %. Although high frequencies were recorded for the specimens belonging to the orders Hymenoptera and Aranea, with 28,06 % and 24,56 % (tab. 2). The large amount of these taxonomical groups' specimens is related with the high abundance of specimens in forests ecosystem for ground beetles and spiders and for diptera species due to the preferences for moist microhabitats.

An important parameter is the life environment of the prey taxons consumed by *Bombina variegata,* which is a species related to the aquatic ecosystems (Fuhn 1960), thus is explain the prevalence of the aquatic organism in its diet.

We identified preys both from aquatic and terrestrial environments in the analyzed stomachs (tab. 2). The terrestrial organisms prevailed in this species diet in all three sampled populations of *Bombina variegata* (fig. 4). This is due to the fact that the material was collected in August when the temperatures were higher (25-30 °C) and the ponds were almost dried out leading to limitations of aquatic possible prey.

Conclussions

Out of the total number of analyzed stomachs only one was empty, this lead us to the conclusion that the life conditions from the studied areas are favorable to the feeding of the yellow-bellied toad populations from this region.

We identified a large number of stomachs with vegetal debris. The most probable explanation is that they were accidentally ingested along with the animal prey, this is proved by the fact that the number of stomachs with vegetal debris rises along with feeding frequency.

The most abundant prey taxon in the food of *Bombina variegata* populations is represented by the species from Coleoptera order, followed by those of Diptera and by araneids. The considerable number of small and gregarious species (Formicidae – Hymenoptera) emphasizes the opportunistic behavior of preying in this species, using the *sit and wait* foraging method (Perry & Pianka 1997).

The terrestrial prey taxons prevail in comparison with aquatic organisms. The small amount of aquatic prey is due to the sampling period (August) when the ponds were dried out because of the high temperature (25-30 °C). Thus the populations of aquatic organism were small and the most available food was reprezented by the terrestrial organisms.

Like the other amphibian species, *Bombina varigata* is a zoophagous – polyphagous species. Yellow-bellied toads eat all moving objects in their sight range that they can ingest. This species does not show any preferences towards prey, with the

conditions of observing the prey and of good-sized for being swallowed.

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Table 1 The percentage of stomachs with: vegetal debris, only with vegetal matter, with egg laying fragments, only with egg laying fragments, and with animal food

	Number of analyzed stomachs	Percent of stomachs with vegetal matter	Percent of stomachs with egg laying fragments	Percent of stomachs only with egg laying fragments	Percent of stomachs with animal food
Total	57	29,82%	21,05%	1,75%	92,98%

Table 2 The amount and frequency of prey taxons for each sample area

Group	Samples area						Total		Life environment
	Luncani		Valea Budului		Runc				
	Nr.	Freq.	Nr.	Freq.	Nr.	Freq.	Nr.	Freq.	
Gasteropoda – unid.	**4**	**7,01 %**	**1**	**1,75 %**			**5**	**8,76 %**	**aquatic**
Crustacea - total	**1**	**1,75 %**			**1**	**1,75 %**	**2**	**3,5 %**	**terrestrial**
Crustacea – unid.	1	1,75 %					**1**	1,75 %	**terrestrial**
Isopoda					1	1,75 %	**1**	1,75 %	**terrestrial**
Miriapoda – total	**1**	**1,75 %**	**1**	**1,75 %**			**2**	**3,5 %**	**terrestrial**
Diplopoda	1	1,75 %					**1**	1,75 %	**terrestrial**
Chilopoda			1	1,75 %			**1**	1,75 %	**terrestrial**
Arahnida – total	**14**	**21,05 %**	**15**	**14,03 %**	**1**	**1,75 %**	**30**	**36,83 %**	**terrestrial**
Arahnida – unid.	4	7,01 %					**4**	7,01 %	**terrestrial**
Acarina	**1**	1,75 %					**1**	1,75 %	**terrestrial**
Araneea – total	**8**	**12,28 %**	**12**	**12,28 %**			**20**	**24,56 %**	**terrestrial**
Araneea – unid.	1	1,75 %	5	5,26 %			**6**	7,01 %	**terrestrial**
Lycosidae	6	8,78 %	7	7,01 %			**13**	15,79 %	**terrestrial**
Dysderidae	1	1,75 %					**1**	1,75 %	**terrestrial**
Opiliones – total	**1**	**1,75 %**	**3**	**5,26 %**	**1**	**1,75 %**	**5**	**8,76 %**	**terrestrial**
Opiliones – unid.			3	5,26 %	1	1,75 %	**4**	7,01 %	**terrestrial**
Opilionidae	1	1,75 %					**1**	1,75 %	**terrestrial**
Cls. Insecta – total							***111***		
Heteroptera – total	**3**	**5,26 %**	**4**	**5,26 %**	**1**	**1,75 %**	**8**	**12,27 %**	**terrestrial**
Heteroptera – unid.			3	3,5 %			**3**	3,5 %	**terrestrial**
Pentatomidae	2	3,5 %			1	1,75 %	**3**	**5,26 %**	**terrestrial**
Berytidae	1	1,75 %					**1**	1,75 %	**terrestrial**
Miridae			1	1,75 %			**1**	1,75 %	**terrestrial**
Colembola – total	**2**	**3,5 %**	**6**	**3,5 %**			**8**	**7 %**	**terrestrial**

Colembola – unid.			6	3,5 %			**6**	3,5 %	**terrestrial**
Siminthuridae	2	3,5 %					**2**	3,5 %	**terrestrial**
Coleoptera – total	**18**	**28,07 %**	**12**	**17,52 %**	**5**	**7,01 %**	**35**	**52,6 %**	
Coleoptera – unid.	3	3,5 %					**3**	3,5 %	**terrestrial**
Coleoptera -larvae					1	1,75 %	**1**	1,75 %	**terrestrial**
Hydrophilidae	3	5,26 %					**3**	5,26 %	**aquatic**
Hydrophilidae - larvae					1	1,75 %	**1**	1,75 %	**aquatic**
Carabidae	1	1,75 %					**1**	1,75 %	**terrestrial**
Carabidae - larvae	2	3,5 %	4	5,26 %	2	1,75 %	**8**	10,52 %	**terrestrial**
Staphylinidae	1	1,75 %					**1**	1,75 %	**terrestrial**
Staphylinidae – unid.	2	3,5 %	3	5,26 %			**5**	8,78 %	**terrestrial**
Staphylinidae - larvae			1	1,75 %			**1**	1,75 %	**terrestrial**
Aculidae	1	1,75 %					**1**	1,75 %	**terrestrial**
Scarabeidae	1	1,75 %					**1**	1,75 %	**terrestrial**
Lampyridae	1	1,75 %					**1**	1,75 %	**terrestrial**
Crysomelidae	1	1,75 %					**1**	1,75 %	**terrestrial**
Halticinae	1	1,75 %					**1**	1,75 %	**terrestrial**
Ptiliidae	1	1,75 %					**1**	1,75 %	**terrestrial**
Elateridae			1	1,75 %			**1**	1,75 %	**terrestrial**
Elateridae – unid.			2	1,75 %			**2**	1,75 %	**terrestrial**
Curculionidae			1	1,75 %			**1**	1,75 %	**terrestrial**
Coccinelidae					1	1,75 %	**1**	1,75 %	**terrestrial**
Hymenoptera – total	**8**	**12,28 %**	**3**	**5,26 %**	**5**	**10,52 %**	**16**	**28,06 %**	**terrestrial**
Hymenoptera – unid.	1	1,75 %	1	1,75 %	1	1,75 %	**3**	5,26 %	**terrestrial**
Formicidae	3	5,26 %					**3**	5,26 %	**terrestrial**
Formicidae – unid.	3	5,26 %	1	1,75 %	1	1,75 %	**5**	7,01 %	**terrestrial**
Tenthredinidae - larvae	1	1,75 %					**1**	1,75 %	**terrestrial**
Cynipidae			1	1,75 %	2	3,5 %	**3**	5,26 %	**terrestrial**
Ichneumonidae					1	1,75 %	**1**	1,75 %	**terrestrial**
Diptera – total	**6**	**10,52 %**	**8**	**14,01 %**	**17**	**14,03 %**	**31**	**38,56 %**	
Diptera – unid.	2	3,5 %	3	5,26 %			**5**	8,76 %	**terrestrial**
Diptera - larvae					4	5,26 %	**4**	5,26 %	**terrestrial**
Stratiomydae - larvae	2	3,5 %					**2**	3,5 %	**terrestrial**
Culicidae	1	1,75 %			1	1,75 %	**2**	3,5 %	**aquatic**
Culicidae - larvae					9	1,75 %	**9**	1,75 %	**aquatic**
Culicidae - pupae					1	1,75 %	**1**	1,75 %	**aquatic**
Bibionidae - larvae	1	1,75 %					**1**	1,75 %	**terrestrial**
Ephydridae			2	3,5 %			**2**	3,5 %	**terrestrial**
Muscidae			1	1,75 %			**1**	1,75 %	**terrestrial**
Tipulidae			2	3,5 %	1	1,75 %	**3**	5,26 %	**aquatic**

Mycetophylidae					1	1,75 %	**1**	1,75 %	**terrestrial**
Dermaptera – total	**4**	**7,01 %**	**2**	**3,5 %**	**1**	**1,75 %**	**7**	**12,26 %**	**terrestrial**
Dermaptera – unid.			1	1,75 %			**1**	1,75 %	**terrestrial**
Forficulidae – unid.	4	7,01 %	1	1,75 %	1	1,75 %	**6**	10,52 %	**terrestrial**
Lepidoptera – total	**1**	**1,75 %**	**1**	**1,75 %**			**2**	**3,5 %**	**terrestrial**
Lepidoptera - larvae			1	1,75 %			**1**	1,75 %	**terrestrial**
Peridae - larvae	1	1,75 %					**1**	1,75 %	**terrestrial**
Homoptera - total			**2**	**3,5 %**	**1**	**1,75 %**	**3**	**5,25 %**	**terrestrial**
Homoptera – unid.			1	1,75 %			**1**	1,75 %	**terrestrial**
Homoptera - larvae					1	1,75 %	**1**	1,75 %	**terrestrial**
Aphrophoridae			1	1,75 %			**1**	1,75 %	**terrestrial**

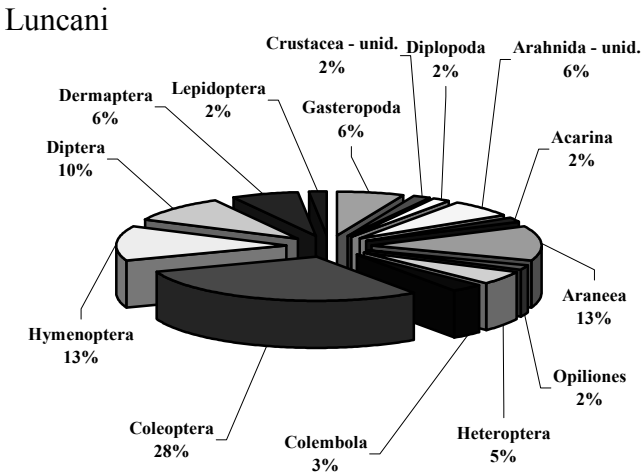

Figure 1. Quantitative variations of the prey taxons for yellow-belly toad population from Luncani

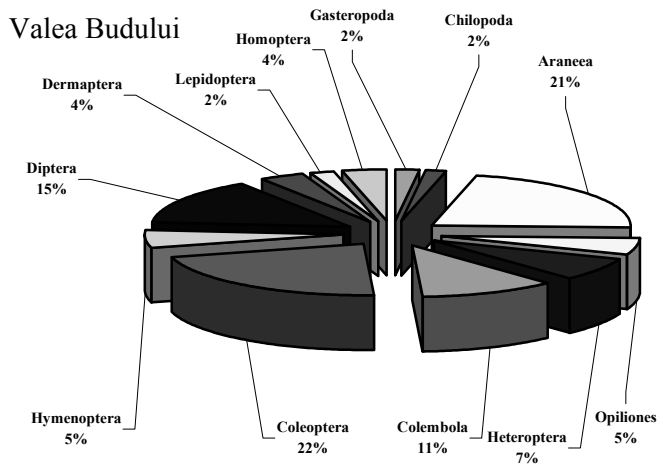

Figure 2. Quantitative variations of the prey taxons for yellow-belly toad population from Valea Budului

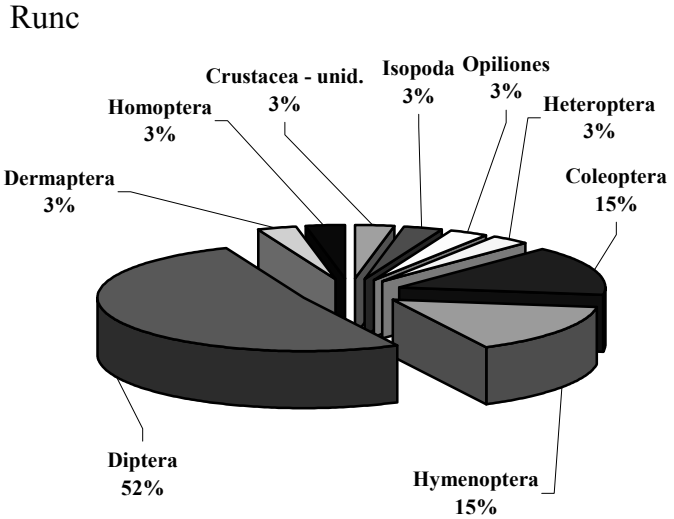

Figure 3. Quantitative variations of the prey taxons for yellowbelly toad population from Runc

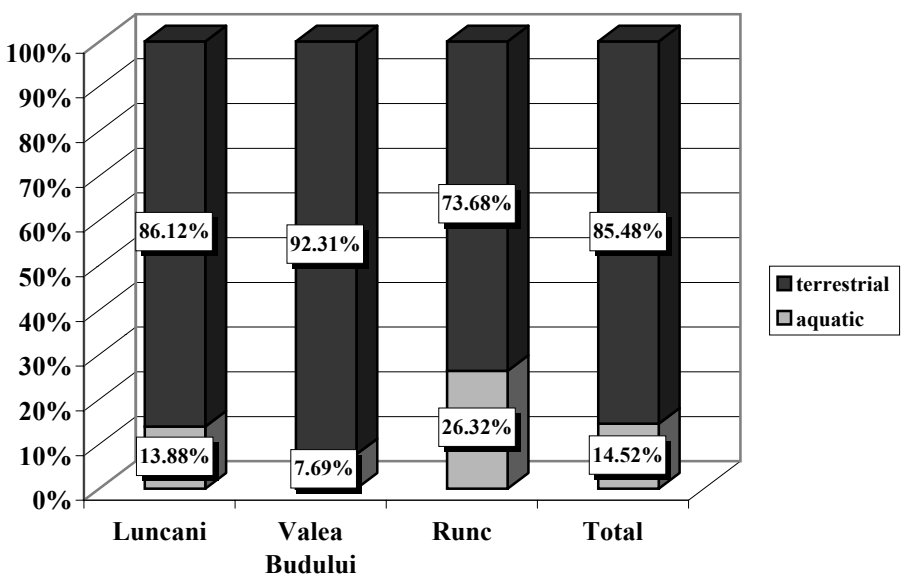

Figure 4. Numerical variation regarding the aquatic and terrestrial preys