STUDY OVER THE FOOD SPECTRUM OF TWO *Bombina variegata* POPULATIONS IN TURT BAI AREA

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Abstract. During May – June 2005 we have studied the feeding process of 99 *Bombina variegata* types. As we analyzed the stomach contents, we have observed some differences according to sex and biotope. The Hymenopterous species – the Formicids and the Coleopteras are the most frequent taxons. Also, there is a noticeable difference in the feeding way between males and females, the latter using the sit-and-wait hunting technique, which allows them to catch the quicker prays. We have also noticed that the yellow belly toads are 'selfish' feeding animals.

Key words: feeding, prey taxa, *B. variegata*

Rezumat. Studiul spectrului trofic a două populaţii de Bombina variegata din regiunea Turţ Băi. În perioada mai – iunie 2005 am studiat hrănirea la 99 de exemplare de *Bombina variegata.* Pe parcursul analizei conţinuturilor stomacale am urmărit diferenţele în funcţie de sexe şi de habitate. Taxonii cu ponderea şi frecvenţa maximă sunt Hymenopterele – Formicide şi Coleopterele. Se observă diferenţă în hrănire între masculi şi femele, cele din urmă folosind tehnica de vânare sit-and-wait, care le permite capturarea prăzilor mai mobile. Am constatat că buhaii de baltă cu burtă galbenă sunt animale cu hrănire oportunistă.

Cuvinte cheie: hrănire, taxoni pradă, *B. variegata*

INTRODUCTION

The studies in different parts of the world have showed that the food structure is an important factor in understanding not only the relations but also certain behaviour aspects as far as the amphibian populations are concerned (DUELLMAN, 1967, INGER & COLWEL 1977). This is important as the amphibians play a great role in the aquatic biotopes (HIRAI & MATSUI 1999).

Bombina variegata (LINNAEUS 1761) is one of the most common amphibian species in Romania, living at an altitude of 1870 m (STUGREN & GHIRA 1978) till 140 m (COVACIU-MARCOV et al, 2000). This species has a nocturnal activity (STUGREN & RUSU 1978), and is more connected to the terrestrial area as opposed to a similar species, Bombina bombina (MADEJ 1973).

There are some data concerning the yellow belly toads' feeding way in Romania (SARBU 1876, SAS et al 2004, NEMES & PETRASS 2003, GHIURCA & ZAHARIA 2005, PETER et al 2005, etc). The present work has the role of bringing extra information, referring to the feeding process differences according to sex and biotope.

MATERIALS AND METHODS

During May-June 205 we have analyzed the various feeding spectrum of two *Bombina variegata* populations from Turt Bai area (the district of Satu-Mare, Romania). Two trips took place during our research, in which we caught 99 *Bombina variegate* types (33 males, 64 females and 2 youngs).

The types we analyzed were caught in two ponds, named here Pond 1 and Pond 2. Between the 2 ponds there is a distance of 500 m, but still a lot of differences can be observed. Pond 2 is an artificial one, near the road, 1-1,5 m deep, and has a small surface, about 6 m^2. The pond ground is covered by mud, and has a semi thick vegetation. This pond water is fairly polluted, and there is a pipe line passing right in the middle. Pond 3 is about 500 m away from the previous one, near a forest. This one is 1 m deep and has about 6 m^2. It has a thick vegetation, and its ground is always covered by leaves and rotten branches. There is a muddy area close to this pond, having a little surface – this is where most of the types were caught.

We collected the stomach contents by using the method called stomach lavage (LEGLER & SULLIVAN 1979, OPATRNY 1980), which allowed us to analyze the content without harming the animal (COGALNICEANU et al 2000). This has been done by using a syringe, 20-30 cm perfusion tube at one end, and its thickness is suitable to the frogs' size. We tried to reduce the time between the *Bombina variegata* types' catching and the effective lavage process, as it is a well known fact that the Amphibians' digestion is very quick, which can interfere with the results (CALDWELL 1996). The respective samples were immediately preserved in test glasses – 4% formol -, and after that labeled with the respective type's sex. The stomach samples were analyzed in laboratory, with the help of a stereomicroscope and also reference material. (IONESCU et al 1971, RADU & RADU 1972, MOCZAR et al 1950).

We have followed such parameters of the trophic spectrum as: taxonomic belonging, weight, frequency and the pray taxons' origin according to the types' sex and the origin biotope.

RESULTS

Our study has taken place during the hot period of the year 2005, in May and June. We went on two trips and we caught 99 *Bombina variegata* types, of which 33 types were males, 64 females and 3 youngs.

Except for one type, all of them had stomach contents. Here we found vegetal stuff, skin remainders, minerals, but also animal prays.

In point of the vegetal content frequency, this had quite a great value – 63,63%. However, differences appear according to the biotope. For example, Pond 2 individuals are higher in vegetal stomach contents. Another example is the Pond 3 individuals, especially females, which have a higher degree of remainders in their stomachs. The minerals are more frequent in males and Pond 2 individuals.

The animal prays are represented by the invertebrates, and the 722 prays are grouped into 23 categories. There are some prays that appear accidentally, such as the Ephemeropteras, the Gordiaceas, the Hymenopteras – undetermined, the Hymenopteras – Ihneumonidaes, the Myriapodas – Diplopodas and Ortopteras.

The maximum number of prays per stomach (20 prays) was found in a male, in May, in Pond 2. The medium number is 7,18. In point of the taxons in females, the first place is taken by the Hymenopteras – Formicids, then the Coleopteras and the Arachnids. In males we found again Hymenopteras – Formicids (on the first place), followed by Coleopteras and Dypterus – Nematoceras. Besides these one can notice a high number of Tyzanuras and Heteropteras in males, and a high number of Plecopteras in females (table 1).

The differences appear also in point of the biotope. As far as the frequency is concerned, in Pond 2, following the Hymenopteras – Formicids and the Coleopteras, we can observe some Dipteras – Nematoceras, and in Pond 3 on the third place we have the Plecopteras, mostly larvae but also adults.

The Lepidopteras, Plecopteras and Trychopteras larvae are to be found in great number in the toads' feeding spectrum, most of all in Pond 3, in the females' case. The most frequent pray taxons in the individuals' stomachs are the Coleopteras, followed by the Hymenopteras – Formicids, Arachnids, Lepidopteras – larvae and Dipteras (table 2)

As far as the males' favourites are concerned, we can enumerate the Formicids, then the Coleopteras and the Dipteras, while in females, the Coleopteras come first, then the Formicids and the Arachnids. The Coleopteras, the Gastropodas and the Lepidopteras and Plecopteras larvae are higher in Pond 3. In Pond 2 the most frequent are the Formicids and the Dipteras – Nematoceras, and the Dipteras – Brachyceras, respectively.

Table 1. The % abundance of animal preys
Tabel 1. Ponderea procentuală a prăzilor animale

	Males	Females	Pond 2	Pond 3	Total
Annelids	1.079	1.142	1.724	0.549	1.123
Arachnids	8.271	10.899	10.919	8.24	9.689
Colembolas	0.719	0.710	0.862	0.549	0.702
Tizanuras	3.956	0	3.160	0	1.544
Coleopteras	12.946	17.529	14.94	17.306	16.147
Crustaceas	3.236	4.264	2.011	5.494	3.488
Dipteras– Nematoceras	12.949	6.160	11.781	6.043	8.707
Dipteras – Brahiceras	6.474	4.027	6.321	4.120	5.196
Gastropodas	1.797	1.894	0.287	3.571	1.965
Heteropteras	3.237	0	2.586	0	1.264
Hymenopteras – Formicids	29.856	23.696	33.333	18.956	25.983
Homopteras	3.597	2.131	4.597	0.823	2.668
Lepidopteras – larvae	4.316	5.924	2.298	8.241	5.337
Lepidopteras – adults	0	0.473	0.287	0.274	0.280
Plecopteras – larvae	0.719	8.056	0	10.164	5.196
Plecopteras – adults	1.438	7.109	0.574	8.791	4.775
Trichopteras – larvae	3.237	2.369	2.586	2.747	2.668
Trichopteras – adults	0.359	1.184	0.287	1.373	0.842
Others	1.797	2.365	1.435	2.744	2.103

DISCUSSIONS

Our results reveal that the yellow belly toads have different feeding ways, according to the sex and biotope.

The small number of the individuals that had empty stomachs is probably due to the favourable feeding conditions. There is a big number of individuals whose stomachs was empty, for instance the Urodela: *Triturus cristatus* (COVACIU-MARCOV et al 2001), but also the Anuras: *Rana arvalis* (SAS et al 2003), or *Bombina variegata* populations (PETER et al 2005), where all the individuals presented stomach content.

In the stomachs of the individuals we caught we have identified vegetal remainders. It is a well known fact that the Amphibians are pray animals (COGALNICEANU 2000), and they mostly eat mobile prays (ZIMKA 1966). We have only one species whose not only the larvae but also the adults eat vegetal food, namely *Rana hexadactylia*, because the vegetal food is low in nutrients (DAS 1996).

Throughout our study we have found only 3 individuals whose stomach content was made of vegetals, skin remainders or minerals. This can be explained by the fact that the vegetals are swallowed accidentally together with the animal prays, as the reference literature also suggests. (WHITAKER et al 1977) Such cases were also observed in other *Bombina variegata* populations (PETER et al 2006), and in Amphibians: *Bombina bombina* (SAS et al 2004), *Rana lessonae* and *Rana kl. esculenta* (SAS et al 2007), Rana ridibunda (COVACIU-MARCOV et al 2005), etc.

Table 2. The % occurence of animal preys
Tabel 2. Frecvenţa procentuală a animalelor pradă

	Males	Females	Pond 2	Pond 3	Total
Vegetals	60.60	64.06	71.11	57.40	63.63
Skin remainders	24.24	31.25	24.44	33.33	29.29
Minerals	15.15	3.12	11.11	3.70	7.07
Anelidas	9.09	7.81	13.33	3.70	8.08
Arachnids	36.36	43.75	42.22	38.88	40.40
Colembolas	6.06	3.125	6.66	1.85	4.04
Tizanuras	12.12	0	8.88	0	4.04
Coleopteras	54.54	65.62	57.77	66.66	62.62
Crustaceas	15.15	20.31	13.33	22.22	18.18
Dipteras – Nematoceras	42.42	17.18	31.11	20.37	25.25
Dipteras – Brahiceras	36.36	20.31	31.11	22.22	26.26
Gastropodas	9.09	10.93	2.22	18.51	11.11
Heteropteras	3.03	0	2.22	0	1.01
Hymenopteras – Formicids	63.63	57.81	71.11	50	59.59
Homopteras	12.12	18.18	15.55	5.55	10.10
Lepidopteras – larvae	24.24	28.12	11.11	40.74	27.27
Lepidopteras – adults	0	3.12	2.22	1.85	2.02
Plecopteras – larvae	3.03	25	0	33.33	18.18
Plecopteras– adults	6.06	20.31	2.22	25.92	15.15
Trichopteras – larvae	3.03	4.68	2.22	5.55	4.04
Trichopteras – adults	3.03	6.25	2.22	7.40	5.05
Others	15.15	12.5	11.11	14.81	13.13

In the stomach contents one can also notice skin remainders. Even more, some stomach contents have skin remainders from fellow individuals, which is explained by some researchers as an aspect of the trophic spectrum, caused by the epidermis proteins' recycling. (WELDON et al 1993). In the research literature we can also find other cases of dermatophagia, for example in the *Bombina variegata* (Sas et al 2005) or the *Bombina bombina* (SAS et al 2003)' cases. However, we believe the skin remainders' presence in the yellow belly toads' stomachs is an accidental one, as they swallowed it together with other animal prays.

An interesting fact is the high frequency of the female stomachs having skin remainders. These ones tend to eat more proteins in the reproduction period. Generally, as far as other *Bombina variegata* populations are concerned, the males are the ones eating skin remainders more often. Females having more vegetal and skin remainders stomachs than males is a result of the fact that the former ones feed themselves more than males.

Pond 2 is lower in point of the stomachs having skin remainders. This is due perhaps to the fact that the population has a smaller number of members, and therefore, they eat less. Similar cases have been observed in other *Bombina variegata* populations (PETER et al 2006).

Besides vegetals and skin remainders, a lot of mineral fragments can appear, but only accidentally. On the other hand, this may be explained as the individuals hunt not only on the water surface, but also on its ground. Such examples can be found at some *Rana ridibunda* species (VANCEA et al 1961), but also other *Bombina variegata* populations (SAS et al 2004)

The most important part of the yellow belly toads' feeding spectrum is made of animal prays, which is a normal fact for the Amphibians as pray animals (COGALNICEANU et al 2000).

The terrestrial invertebrates are also present, such as the Hymenopteras _Formicids, the Coleopteras and the Arachnidas. They appear in large numbers, which cannot be explained by their accidentally falling in the water, but also the fact that *Bombina variegata* individuals hunt on ground too, although *Bombina variegata* is considered a water species (COGALNICEANU et al 2000b).

On the other hand terrestrial animals are easy to find on the plants too (flying insects), on the water surface (different spiders), or the pond ground. We have observed other Amphibians related to water, whose food is made of terrestrial invertebrates (LOW et al 1990, SAS et al 2004, PETER et al 2006, CICEK et al 2006).

The females' feeding process is a way of saving the reproduction energy as well as possible. A higher frequency in eating Coleopteras and Arachnidas is observed, as well as larger invertebrates. The fewer prays, the higher the energy, but at the same time the pray is bigger. On the contrary, males catch more prays, but smaller in size (LOW & TOROK, 1998).

Also, the individuals seem to prefer larvae more. Some researchers think that the holometabola insects' larvae are richer in lipids, having a higher nutrient value than the adults (BROOKS et al 1996).

The fact that the individuals seem to prefer quicker prays (the Coleopteras, the Plecopteras), suggests their sit-and-wait hunting technique, which allows them catching quicker prays, on one hand, and on the other hand, they save more energy (PERRY & PIANKA 1997).

In point of males, they prefer smaller size prays (Hymenopteras – Formicids, Dipteras, Colembolas, Tyzanuras, etc), and slower ones, which suggests their active-foraging hunting technique (Perry & Pianka 1997). This because males do not need the same amount of energy as the females. Also, we can admit that the males are the ones feeding more often with water prays, as we found even Heteropteras in their trophic spectrum. This fact was observed also in other populations of *Bombina variegata* (SAS et al 2004).

Pond 2 and Pond 3 are quite different, and that is why their individuals' stomach contents are different. The Plecopteras' presence in Pond 3 is really interesting. In Pond 2 their frequency is lower. This is because the latter has witnessed a lot of anthropic changes, unfavourable for the Plecopteras that prefer clean and oxygenated water (RADU & RADU 1967). These conditions are proper to Pond 3, whose one side is always apart from UV rays.

Also most of the Lepidopteras and Trichopteras larvae live in Pond 3, as this one is near the forest. In this way, there is a side that is always apart from UV sunrays, offering the best conditions for insects to lay eggs.

To sum up, we can state that yellow belly toads are 'selfish' pray animals, eating almost all types of Invertebrates they can find (COGALNICEANU et al 2000) However, there are some differences between males and females, according to their biotope.

Generally males use the active-foraging hunting method, eating slow prays. As opposed to females they tend to hunt more in the water area.

Females use the sit-and wait technique, and in this way they have access to bigger and quicker prays, thus being reproduction energy-saving. The prays vary according to each biotope conditions. Thus, the most sensitive ones are to be found solely in Pond 3 where the water is more oxygenated and UV protected.

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