THE FEEDING OF *TRITURUS CRISTATUS* POPULATION FROM THE NORTH-WEST OF ARAD COUNTY, ROMANIA

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Abstract. *After analyzing the food composition of the crested newts from near the village of Prunisor, Arad County, it is noticeable that the main categories of prey taxa are the aquatic Isopodas, the Ephemeroptera larvas and the Nematocera larvas. The study took place in the breeding season of the species, a period in which the newts live in the water and as such the aquatic preys had a quota of 96.54% out of the entire 1826 number of total preys. The directions of our research were the analysis of the trophic spectrum of the crested newts, taking into consideration the sampling period and also the sex of the newts. In the stomach contents we've identified shad skin, vegetal remains and spawn, too, while in the stomach of 4 individuals we found specimens of Lissotriton vulgaris. All along out study, we only had one single specimen with an empty stomach, the analyzed population having optimum feeding conditions.*

Keywords: *Triturus cristatus, feeding, period, aquatic.*

Rezumat. Hrănirea unei populaţii de *Triturus cristatus* din nord vestul judeţului Arad, România. *În urma analizei spectrului trofic al tritonului cu creastă de lângă localitatea Prunişor din judeţul Arad, se observă că* majoritatea *taxonilor pradă sunt izopode acvatice, larvele de efemeroptere şi larvele de nematocere. Studiul a avut loc în perioada de hrănire a acestor specii, perioadă în care tritonii trăiesc în apă astfel ponderea prăzilor terestre era de 96,54% din cele 1821 de prăzi în total. Scopul studiului nostru era analiza spectrului trofic al tritonului cu creastă, ţinând cont de perioada hrănirii respectiv de sexul tritonilor. În conţinuturile stomacale am identificat exuvie, fragmente de vegetale şi pontă, în timp ce în stomacul a 4 indivizi am găsit exemplare de Lissotriton vulgaris. Pe parcursul studiului numai un singur individ era fără conţinut stomacal, populaţia analizată având condiţii de hrănire optime.*

Cuvinte cheie: *Triturus cristatus, hrănire, perioada , acvatic.*

INTRODUCTION

This study is important because the amphibians, through the trophic elements that they utilize, can be very good indicators of any environmental changes (KOVÁCS & TÖRÖK, 1992), offering information about the habitats they occupy. Amphibians have the role of predators, being situated on top of the trophic pyramids (COGĂLNICEANU et al., 2000). In Romania, this species is not endangered, having a vast distribution, but in other countries from Europe many crested newt populations are in decline (BREDE et al., 2000).

In their breeding season, the newts live in water and at its end, they return to the terrestrial environment. This fact leads to a pronounced sexual dimorphism, in their aquatic period the males displaying a well developed crest on their back (MALMGREN & THOLLESSON, 1990), a detail that will lead to certain differences in the trophic spectrum of the two sexes.

In Romania, the studies about the food composition of *Triturus cristatus* appeared in the beginning of 2000, presenting at first the feeding of some populations from Bihor County (COVACIU – MARCOV et al., 2001, 2002a, 2002b, 2002c, 2002d), but subsequently other research followed about the trophic spectrum of the crested newt (CICORT – LUCACIU et al., 2004, 2005a, b, 2006, 2007a, b; DOBRE et al., 2007). In the European specialty literature there is little information about the particularities of the feeding of *Triturus cristatus* (DOLMEN D, KOKSVIK, 1983; FASOLA & CANOVA, 1992).

In this study we will describe the composition of the trophic spectrum related to the sexes and to the period of sampling.

MATERIAL AND METHODS

The study took place between the 10th of March and the 5th of May 2007, period in which we made five field trips and in which we sampled the stomach contents of 168 *Triturus cristatus* specimens – 79 female and 89 male.

The investigated habitat is situated near the village of Prunisor from the western part of Arad County and is represented by a puddle of about $5m^2$ and with a depth of about 0.6 m. The bottom of this pond is covered by mud, while the vegetation is represented by green algae, grass and clubrush.

In capturing the newts we used round nets mounted on round metallic frames which in turn were fixed on long metallic poles.

The utilized method for sampling the stomach contents was the stomach flushing method, one full of advantages mostly because it does not affect the animals, allowing thus the release of the newts after collecting the contents back into their habitat of origin. For this purpose, we used a syringe on which we mounted a thin i.v. tube.

Once extracted, the stomach contents were collected in sealed test tubes, tagged with the sex of each specimen and conserved with 4% formalin.

Identifying the preys found in the stomach contents was done afterwards, in the lab, under a binocular magnifying glass. In order to determine the consumed prey taxa, we used the specialty literature (STEINBACH et al., 2000).

RESULTS AND DISCUSSIONS

In the stomach contents of the 168 captured newts we identified a total of 1826 preys which were later on grouped in 18 prey taxa categories. Only one specimen (a female) didn't have any stomach content, it being captured in the first period of our research. The latter fact may be due to the unfavorable environment conditions, although the number of preys is rather large in this period but it is the males that consumed 83.37% of the total amount of preys, having access to a greater number of preys than the females. The largest number of preys consumed by a single specimen was found at a male – 52 preys – the greater majority of these being Cladoceras. The average number of preys/individual is 10.83, a rather high value that indicates sufficient conditions to ensure the necessary energy resources to develop all the physiological processes. Alongside animal preys in the stomachs of the newts, vegetal fragments, shad skin, spawn and 4 *Lissotriton vulgaris* specimens were also found.

Table 1. The number of analyzed specimens. The total, average and maximum number of preys. The amount of aquatic and terrestrial preys.

Tabel 1. Numărul exemplarelor analizate. Numărul total, mediu şi maxim de prăzi. Ponderea prăzilor acvatice şi terestre.

	Males	Females	Total
Nr. of analyzed preys	89	79	168
Nr. of preys	962	859	1821
Average number	10.80	10.87	10.83
Maximum number	52	48	52
% aquatic preys	97.71	95,22	96.54
% terrestrial preys	2.28	4.77	3.45

Vegetation was identified in 54.8% of the analyzed stomach contents (Tab. 1.) from the entire period of the study and from both sexes. They were consumed accidentally, being swallowed together with the animal preys (WHITAKER et al., 1977). The fact that no specimen had a stomach filled exclusively with vegetal remains supports this statement (ASZALÓS et al., 2005, SAS et al., 2005).

Stomachs that contained spawn were only encountered in the first four periods. In the beginning of May, no individual was found having consumed spawn, a fact due to the absence of this category from the habitat. 28.3% of the total specimens ate spawn, the feeding with such elements being efficient because it needs a small amount of energy to procure while having a high nutritional value. This is also why the females, with their reduced mobility, consume in greater numbers this food category, in comparison to the males. The consumption of spawn in the periods in which it is found abundantly in the habitat indicates that the newts have an opportunistic type of feeding (COVACIU – MARCOV et al., 2002c).

For what concerns the consumption of shad skin, some authors consider that these elements are consumed willingly, due to the amphibian's capacity to recycle their epidermal proteins (WELDON et al., 1993). Cases of eaten shad skin were previously signaled at other amphibian species (ASZALÓS et al., 2005, SAS et al., 2005). When talking about the population we investigated here, shad skin was consumed by a small number of newts. This is why we consider that its consumption appears as a consequence of failed tries to capture other individuals of the population, tries triggered by the movement of other newts or by mistaking them with potential preys that swim in the water.

In the analyzed stomach contents we managed to identify a total of 1826 preys. The males consumed a greater number of preys (962) than the females (859), fact caused by their greater mobility provided by their large dorsal crest and the shape of their bodies.

Out of these preys, Isopodas have the greatest amount and frequency, consumed all along our study by both sexes with a frequency of 79.2%, being uniformly distributed in the habitat and thus being accessible to most specimens. Ephemeroptera larvas have an important role in the food of the crested newts from this biotope, their amount and frequency rising together with the temperature and reaching a frequency of 100% in May (Table 2.).

Another taxon identified in the analyzed stomach contents is Cladoceras. This has an important role for some individuals, especially in the first period of our study, because of their gregarious way of life and thus being accessible to the males that are able to swim in the entire volume of the water from their habitat. Cladoceras were consumed in large quantities in the beginning of May by the males; because of their small sizes, the newts have to eat a greater quantity in order to satisfy their energy needs. In the last periods, this category has a lower amount and frequency since the appearance and numeric growth of other prey taxa categories.

Amphibian larvae weren't consumed in the first periods because they weren't present in the habitat yet, spawn being laid in early spring. However, in the second period they already appear as consumed by 47.1% of the specimens, and representing an amount of 51.2% (Table 3.). Towards the end of our study, tadpoles represent a small amount out of the stomach contents because they grow and therefore can not be swallowed by the newts anymore.

Table 2. The frequency of stomachs with vegetal fragments, shad skin and spawn.The frequency of the identified prey taxa in the analyzed stomach contents.

Tabel 2. Frecvența stomacurilor cu vegetale, exuvie şi ponte. Frecvența taxonilor pradă identificați în conținuturile stomacale prelevate.

	10.03			**25.03**			**5.04**			**21.04**			**5.05**		
	M	***F***	***T***	***M***	***F***	***T***	***M***	***F***	***T***	***M***	***F***	***T***	***M***	***F***	***T***
% stom. with vegetal remains	53.3	55.6	54.2	47.06	65.2	57.5	41.18	70	56.8	53	68.8	59.1	25	54.5	39.1
% stom. with shad skin	-	-	-	5.88	8.7	7.5	29.41	5	16.2	17.9	12.5	15.9	16.7	9.09	13
% stom. with spawn	26.7	11.1	20.8	58.82	52.2	55	29.41	35	32.4	3.57	-	2.27	-	-	-
% stom. with animal preys															
Oligochetae	6.67	22.2	12.5	5.88	4.35	5	-	5	2.7	-	-	-	-	-	-
Gastropoda(a)	-	22.2	8.33	17.6	26.1	22.5	5.88	10	8.11	10.7	31.3	18.2	-	-	-
Cladocera	66.7	22.2	50	-	13	7.5	11.8	5	8.11	3.57	6.25	4.55	25	27.3	26.1
Copepoda	6.67	11.1	8.33	11.8	-	5	-	15	8.11	3.57	6.25	4.55	25	9.09	17.4
Izopoda (t)	-	-	-	5.88	21.7	15	11.8	5	8.11	3.57	-	2.27	-	-	-
Izopod (a)	80	77.8	79.2	70.6	87	80	58.8	80	70.3	78.6	81.3	79.5	91.7	90.9	91.3
Araneida	-	-	-	-	4.35	2.5	-	-	-	-	6.25	2.27	-	-	-
Efemeroptere (L)	46.7	11.1	33.3	29.4	56.5	45	35.3	55	45.9	39.3	25	34.1	100	100	100
Odonate (L)	6.67	-	4.17	5.88	-	2.5	23.5	10	16.2	3.57	31.3	13.6	16.7	18.2	17.4
Heteroptere	-	-	-	-	-	-	-	-	-	3.57	6.25	4.55	-	18.2	8.7
Lepidoptere (L)	-	-	-	5.88	8.7	7.5	-	-	-	-	6.25	2.27	-	-	-
Trihoptere (L)	33.3	22.2	29.2	5.88	17.4	12.5	5.88	5	5.41	14.3	18.8	15.9	-	-	-
Dytiscida (L)	13.3	11.1	12.5	11.8	26.1	20	35.3	25	29.7	-	12.5	4.55	8.33	-	4.35
Coleoptera-undet	-	-	-	-	-	-	11.8	10	10.8	21.4	18.8	20.5	8.33	9.09	8.7
Coleoptera (t)	-	-	-	-	-	-	-	-	-	-	6.25	2.27	-	-	-
Nematocera (L)	26.7	22.2	25	47.1	21.7	32.5	23.5	25	24.3	35.7	25	31.8	58.3	81.8	69.6
Nematocera	-	-	-	-	4.35	2.5	-	5	2.7	-	-	-	-	-	-
Amphibans (L)	-	-	-	52.9	43.5	47.5	47.1	30	37.8	3.57	18.8	9.09	16.7	45.5	30.4

Another category that represents an important role for the analyzed newts are Diptera Nematocera larvas, which were consumed constantly during the entire length of our research by both sexes, with a frequency of 34.5%.

It is noticeable that once with the warm season comes a growth in the number of preys but also in the diversity of the trophic spectrum, due to the fact that more and more invertebrates become active.

In the stomachs of 4 crested newts – 3 of which being females - we identified *Lissotriton vulgaris* individuals. They could be swallowed because of their small size, being captured using the "sit and wait" strategy. On April 21st, common newts were found in a male and a female, both of which had also other preys in theirs stomachs.

For what the environment of origin for the preys is concerned, 96.45% of the preys are, as expected, aquatic, taking into consideration that the newts live in the water in their breeding season. The terrestrial preys have a very low amount, falling accidentally into the water and afterwards being eaten by the specimens from that habitat. The differences that appear between the sexes, when talking about feeding, are caused by the fact that the females consumed more terrestrial preys like: Arachnidas, Coleopterans, Nematoceras while the Annelid Oligochetas were consumed by both sexes.

Table 3. The amount of the identified prey taxa in the analyzed stomach contents.

Tabel 3. Ponderea taxonilor pradă identificați în conținuturile stomacale.

	10.03			**25.03**			**5.04**			**21.04**			**5.05**		
	M	***F***	***T***	***M***	***F***	***T***	***M***	***F***	***T***	***M***	***F***	***T***	***M***	***F***	***T***
Oligochetae	0.33	10	2.03	0.71	0.43	0.73	-	0.57	0.33	-	-	-	-	-	-
Gastropoda(a)	-	1.67	0.55	4.29	3.43	4.9	1.52	1.72	2.13	4.03	6.78	6.75	-	-	-
Cladocera	77.4	33.3	55.4	-	9.01	5.63	16.7	2.87	14.3	4.03	5.08	6	6.67	10.9	9.66
Copepoda	1.66	3.33	2.4	4.29	-	2.76	-	6.9	3.92	10.7	6.78	13	9.17	2.02	7.04
Izopoda (t)	-	-	-	0.71	5.15	3.68	3.79	1.72	3.85	2.01	-	1.88	-	-	-
Izopod (a)	8.31	38.3	15.6	20.7	33	34	21.2	33.3	35	37.6	39	52.3	30.8	19.4	29.7
Araneida	-	-	-	-	0.43	0.27	-	-	-	-	0.85	0.37	-	-	-
Efemeroptere (L)	7.31	1.67	8.4	5.71	10.3	10.1	8.33	20.7	18.1	20.1	7.63	22.1	42.9	65.2	59.7
Odonate (L)	0.33	-	0.37	0.71	-	0.46	3.03	1.15	2.95	0.67	11	5.49	0.83	1.21	1.13
Heteroptere	-	-	-	-	-	-	-	-	-	0.67	0.85	1	-	0.81	0.39
Lepidoptere (L)	-	-	-	0.71	0.86	1	-	-	-	-	0.85	0.37	-	-	-
Trihoptere (L)	1.66	3.33	2.4	0.71	2.15	1.8	0.76	0.57	0.9	2.68	4.24	4.38	-	-	-
Dytiscida (L)	1	1.67	1.38	1.43	3	2.8	5.3	2.87	5.65	-	1.69	0.75	0.42	-	0.28
Coleoptera-undet	-	-	-	-	-	-	1.52	1.15	1.8	4.7	2.54	5.5	0.42	0.4	0.47
Coleoptera (t)	-	-	-	-	-	-	-	-	-	-	0.85	0.37	-	-	-
Nematocera (L)	1.99	5	3.05	7.86	3.43	7.2	5.3	5.17	6.96	11.4	9.32	14.8	7.5	8.91	9.24
Nematocera	-	-	-	-	0.43	0.27	-	1.15	0.65	-	-	-	-	-	-
Amphibans (L)	-	-	-	52.1	28.3	51.2	32.6	18.4	35.2	1.34	2.54	2.38	1.25	2.02	1.8

Table 4. The amount and the frecvency of the identified prey taxa for the whole study.
Tabel 4. Ponderea şi frecvenţa taxonilor pradă identificaţi pe parcursul studiului.

	Amount			Frequency		
	M	***F***	***T***	***M***	***F***	***T***
Oligochetae	0.21	0.93	0.55	2.25	5.06	3.57
Gastropoda(a)	1.46	2.44	1.92	7.87	19	13.1
Cladocera	28.8	9.2	19.5	18	12.7	15.5
Copepoda	5.09	3.14	4.17	7.87	7.59	7.74
Izopoda (t)	0.94	1.75	1.32	4.49	7.59	5.95
Izopod (a)	22	29.3	25.5	75.3	83.5	79.2
Araneida	0	0.23	0.11	0	2.53	1.19
Efemeroptere(L)	18.1	26.9	22.2	46.1	50.6	48.2
Odonate(L)	0.94	2.1	1.48	10.1	11.4	10.7
Heteroptere	0.1	0.35	0.22	1.12	3.8	2.38
Lepidoptere(L)	0.1	0.35	0.22	1.12	3.8	2.38
Trihoptere(L)	1.14	1.51	1.32	12.4	12.7	12.5
Dytiscida (L)	1.35	1.75	1.54	12.4	17.7	14.9
Coleoptera-undet	1.04	0.7	0.88	10.1	7.59	8.93
Coleoptera (t)	0	0.12	0.05	0	1.27	0.6
Nematocera(L)	6.13	6.17	6.15	37.1	31.6	34.5
Nematocera	0	0.35	0.16	0	2.53	1.19
Amphibans (L)	12.6	12.3	12.5	22.5	30.4	26.2

CONCLUSIONS

Throughout this study we've identified 1821 preys in the stomach contents of the 168 analyzed crested newts, aside which vegetal fragments, shad skin and spawn could also be found.

In this habitat, the newts have optimal feeding conditions, only one specimen lacking in stomach content, while the average number of preys/individual was rather high.

The strategies used for hunting are "active foraging", capturing smaller preys, and "sit and wait", the newt attacking a mobile prey as soon as it enters its visual field.

We can conclude that *Triturus cristatus* in its breeding season acts like an aquatic predator, one that doesn't present any preference in prey. Thus, it will eat food with both low and high energy values, feeding especially on preys that are more abundant in the habitat.

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