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TROPHIC SPECTRUM AND FORAGING MODE OF LISSOTRITON VULGARIS IN A TEMPORARY POND OF THE CITY OF RIVNE, UKRAINE

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The article summarizes the state of research on the trophic spectrum and foraging mode of the common newt in Europe in general and in Ukraine in particular. It is concluded that the level and diversity of such studies abroad is high compared to Ukraine. The relevance of such studies in temporary ponds is determined.

The article analyzes the trophic spectrum and feeding mode of the common newt in temporary pond in Rivne. The stomach contents samples of 46 individuals of L. vulgaris were obtained, in which 2309 trophic objects were found. Food of animal origin prevails in the trophic spectrum of L. vulgaris and makes up 97%. Food objects of plant origin make up only 1% and mineral particles – 2%.

It was found that the most abundant food items are the larvae of the lake flies (Chironomidae) – 53% and crustaceans (Cladocera: Daphniidae; Chydoridae; Copepoda: Cyclopidae; Ostracoda) – 46%.

The diet of L. vulgaris is significantly dominated by objects originating from the aquatic environment – 98.2% of the total number. Individuals of this species will capture prey of quite different sizes. The smallest food objects of the studied newts are planktonic crustaceans Chydoridae: 0.3–0.5 mm, the largest are earthworms Lumbricidae: 150–200 mm.

It was found that the food spectrum of the newt changes during the season and depends on the life cycles of prey. In spring, when the trophic resources of the temporary pond are limited, crustaceans, in particular daphnia (Daphniidae) and shell crustaceans (Ostracoda), dominate in the diet of the newt. During this period, the consumption of shed skin fragments, plant fragments, grains of sand is higher and larvae of the lake flies (Chironomidae) are absent, but in the second decade of May they dominate (more than 70%) in the diet.

It was found that L. vulgaris uses different foraging mode in different periods. The predominance of crustaceans (daphnia, cyclopes) in the diet at the beginning of the season indicates that newts use active foraging tactics. In late April-May, we observed a significant predominance of larvae of the lake flies, which indicates that L. vulgaris uses sit-and-wait foraging. It was found that the foraging behavior of the newt in temporary ponds in Rivne is labile and varies depending on environmental conditions and its trophic offer.

Key words: *amphibians, temporary ponds, Lissotriton vulgaris, trophic objects, foraging mode.*

Попельницька О. В. Трофічний спектр та харчова поведінка Lissotriton vulgaris у тимчасовій водоймі м. Рівне, Україна

У статті узагальнено стан досліджень трофічного спектра та кормодобувної поведінки тритона звичайного в Європі загалом та в Україні зокрема. Зроблено висновок про високий рівень та різноплановість таких досліджень за кордоном порівняно з Україною. Визначено актуальність таких досліджень у тимчасових водоймах.

У статті проаналізовано трофічний спектр та харчову поведінку тритона звичайного в тимчасових водоймах м. Рівне. Одержано вміст шлунків 46 особин L. vulgaris, в яких виявлено 2309 трофічних об'єктів. Їжа тваринного походження переважає в трофічному спектрі L. vulgaris і становить 97%. Кормові об'єкти рослинного походження становлять лише 1 % від загальної кількості, мінеральні часточки – 2%.

Встановлено, що найбільш численними кормовими об'єктами є личинки комарів-дзвінців (Chironomidae) – 53% та ракоподібні (Cladocera: Daphniidae; Chydoridae; Copepoda: Cyclopidae; Ostracoda) – 46%.

У раціоні L. vulgaris значно переважають об'єкти походженням з водного середовища – 98,2% від загальної їх кількості. Особини цього виду захоплють доволі різнорозмірну здобич. Найменшими кормовими об'єктами досліджених особин тритонів є планктонні ракоподібні Chydoridae: 0,3–0,5 мм, найбільшими – дощові черви Lumbricidae: 150–200 мм.

Встановлено, що харчовий спектр тритона звичайного змінюється впродовж сезону і залежить від життєвих циклів здобичі. Навесні, коли трофічні ресурси водойми є обмеженими, в кормовому раціоні тритона звичайного переважають ракоподібні, зокрема дафнії (Daphniidae) та черепашкові рачки (Ostracoda). В цей період більша частка споживання фрагментів злинялої шкіри, рослинних фрагментів, піщинок та відсутні личинки комарів-дзвінців (Chironomidae), проте в другій декаді травня вони домінують (більше 70%) в кормовому раціоні.

З'ясовано, що L. vulgaris у різні періоди використовує різну кормодобувну поведінку. Переважання в харчовому раціоні ракоподібних (дафній, циклопів) на початку сезону вказує на використання тритонами тактики активного кормодобування («active foraging»). Наприкінці квітня–травня спостерігаємо значне переважання личинок комарів-дзвінців, що свідчить про використання L. vulgaris вичікувального кормодобування («sit-and-wait foraging»). Встановлено, що кормодобувна поведінка тритона звичайного в тимчасових водоймах м. Рівного є лабільною і змінюється залежно від умов середовища та його трофічної пропозиції.

Ключові слова: *земноводні, тимчасові водойми, Lissotriton vulgaris, трофічні об'єкти, кормодобувна поведінка.*

Introduction. The study of biotic diversity for the purpose of its conservation is one of the most important environmental issues. Amphibians deserve special attention, as the decline in the number and extinction of many of their species has been observed in all ecosystems in recent decades [1; 2; 8]. To ensure the long-term existence of amphibian populations in nature, there is a need for large-scale research. The study of trophic relationships of tailed amphibians is of great importance for understanding the trophic niche and role of these animals in both natural and human modified ecosystems.

The common newt (*Lissotriton vulgaris*, L., 1758) is widespread throughout most of Europe. In Ukraine *L. vulgaris* occurs in western, central, northern, and eastern regions [14]. The common newt is most often associated with forest regions, although it can also be found in other habitat types, including in the place of logged forests (shrubbery, parks, gardens, meadows) and even settlements. Newts are also found in temporary ponds (puddles in fields, road ditches) [14; 15].

Information on the nutrition of the common newt is presented in the monograph by M.M. Shcherbak and M.I. Shcherban (1980), which concerns the Carpathian region [15]. With the emergence of a bloodless method of extracting stomach contents, such studies have become especially popular in Europe [6; 7]. These articles consider both the nutrition of individual species (*T. vulgaris* [3; 9], *T. dobrogicus* [3], *T. cristatus* [3; 6]), comparison of their diets [5; 6], and comparison of newts' trophic spectra with the trophic offer of the environment they inhabit [3; 5]. In Ukraine, the number of such studies remains insignificant, and the available studies are devoted to the Red Data Book species of newts [7; 11]. Along with the study of the trophic spectrum of tailed amphibians, researchers are studying their foraging mode [4; 6]. It is worth mentioning, that most studies are conducted in natural reservoirs, and the peculiarities of trophic spectra and foraging behavior of newts in temporary reservoirs are not considered.

Thus, based on the analysis of the literature, we can conclude that the level of research on the newt in Europe is high and that the research itself is diverse. In the European ecological literature, a significant number of scientific papers are devoted to the nutrition of the newt, while in Ukraine their number remains insignificant. In the Rivne region, there are no such studies at all.

The aim of the article is to study the trophic spectrum and foraging mode of the common newt (*L. vulgaris*) in temporary ponds of Rivne.

Materials and methods. Common newts were captured from a temporary artificial pond in Taras Shevchenko Park in Rivne. A total of 46 individuals of *L.vulgaris* (16♂, 30♀) were captured and 46 trophic samples were collected. All captured newts were returned to the wild in accordance with all bioethical requirements. Food items were collected using the lifetime stomach flushing method [12]. Trophic samples were collected in 50 ml airtight containers and fixed with 4% formalin solution. To analyze the food composition, the contents of the container were poured in parts into a Bogorov chamber, which was placed under a binocular (KONUS Delta-plus 5831). Smaller trophic objects were examined under a microscope (МИКМЕД-5). The taxonomic affiliation was determined using specialized literature to the level of genus and family, and, where possible, to the species [10]. The variety, taxonomy, quantity, size and occurrences in samples of trophic objects captured by newts were analyzed.

Results. After analyzing the stomach contents of 46 (30♀, 16♂) individuals of the common newt, we identified 2309 trophic objects (Table 1).

Trophic objects found in newt stomachs can be divided into four groups: 1 – invertebrates; 2 – plants; 3 – skin fragments and amphibian eggs; 4 – mineral objects. The stomachs of *L. vulgaris* are dominated by food of animal origin (97%), including invertebrates (92%) and skin fragments and amphibian eggs (5%). Food objects of plant origin make up only 1% of the total, mineral particles – 2%, which obviously indicates that they are captured by chance when collecting animal objects.

Among the objects of animal origin, four groups can be distinguished: 1 – larvae of the lake flies (*Chironomidae*); 2 – crustaceans (*Crustacea*); 3 – insect adults; and 4 – larvae of other insects. The most numerous food objects are the larvae of the lake flies (*Chironomidae*) – 53% and crustaceans (*Cladocera: Daphniidae; Chydoridae; Copepoda: Cyclopidae; Ostracoda*) – 46% (Fig. 1).

Larvae of diptera (*Diptera: Chironomidae*) and crustaceans predominate in the stomachs of newts.

Table 1

Trophic spectrum of *L. vulgaris* in temporary ponds (n = 46)

Tropchic objects	Quantity of trophic objects, n	Percentage of the trophic object, %	The frequency of occurrence, %
Animals in general:	2180	92.51	100
Phylum Annelida			
Oligohaeta:	2	0.09	4
Lumbricidae	2	0.09	4
Phylum Arthropoda			
Crustacea:	824	35.69	100
Ostracoda	338	14.64	46
Cladocera	372	16.11	52
Daphniidae	345	14.94	48
Chydorydae	27	1.17	17
Copepoda	117	5.07	52
Cyclopidae	117	5.07	52
Arachnida	2	0.09	4
Aranei	1	0.04	2
Hydroacarina	1	0.04	2
Insecta:	1185	51.32	100
Odonata, larv.	2	0.09	4
Trichoptera, im.	3	0.13	4
Lepidoptera, larv.	2	0.09	4
Hemiptera	5	0.22	9
Notonectidae larv.	4	0.17	7
Cicadellidae, im.	1	0.04	2
Coleoptera, im.	2	0.09	2
Diptera	222	40.84	100
Chironomidae	942	40.80	59
– larv.	920	39.84	59
– pup.	22	0.95	20
Tipulidae, pup.	1	0.04	2
Unidentified insects	7	0.30	13
– im.	3	0.13	4
– larv.	2	0.09	4
– exuv.	2	0.09	4
Phylum Chordata			
Amphibia	6	0.26	7
– eggs	6	0.26	7
– skin fragments	62	4.85	28
Plants (fragments)	25	1.08	22
Inorganic objects	36	1.56	28

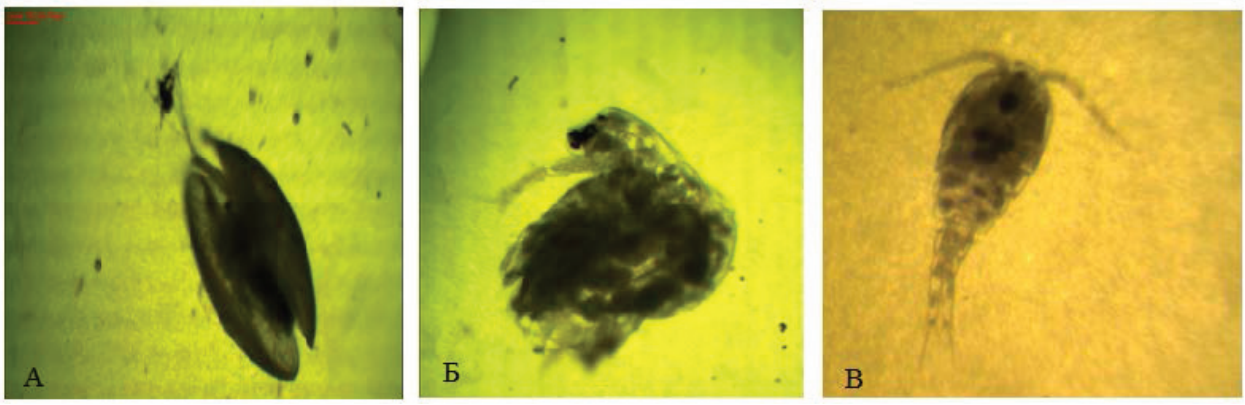

Fig. 1. Crustaceans found in trophic samples of *L. vulgaris*: A – shell crustaceans (*Ostracoda*); B – daphnia (*Daphniidae*); C – cyclopes (*Cyclopidae*) (Scale 100.00 Pixel)

The proportion of insects captured by newts from the water surface is insignificant, amounting to 13%, and mineral particles to 26%. Other groups are less common in the samples.

On average, 50 food objects per individual were found in the stomachs of newts, with a maximum number of 130. No newts with empty stomachs were found.

The diet of *L. vulgaris* is significantly dominated by objects originating from the aquatic environment – 98.2%. Individuals of common newts capture prey of quite different sizes. The smallest food objects of the studied newts are planktonic crustaceans *Chydoridae*: 0.3–0.5 mm, the largest are earthworms *Lumbricidae*: 150–200 mm.

In general, it can be stated that the common newt in temporary ponds is a predator and planktivore, the basis of its diet being crustaceans and larvae of the lake flies.

The type of prey is usually also the result of seasonal changes and environmental conditions, in particular, temperature. For example, in spring, when trophic resources of the reservoir are limited, crustaceans, in particular daphnia (*Daphniidae*) and shell crustaceans (*Ostracoda*), dominate the diet of the newt (Fig. 2).

During this period, newts cannot be selective in what they consume. This is indicated by a higher proportion of consumption in the first period (I) of such prey category as “other trophic objects”. This category includes fragments of shed skin, plant fragments, grains of sand, etc. The consumption of shed skin is not random, as it occurs with high frequency, especially during periods of lack of significant amounts of

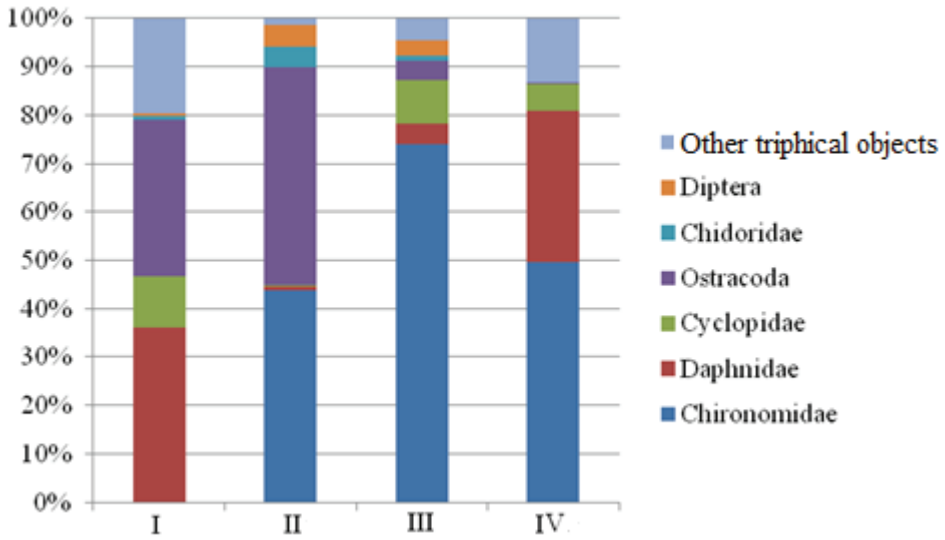

Fig. 2. Dynamics of the common newt’s (*L. vulgaris*) foraging diet Periods: I – 18.04; II – 26.04; III – 20–21.05; IV – 28.05

food. In addition, according to the researchers, shed skin is consumed to reuse epidermal proteins that have a high nutritional value. It is also worth noting that the food spectrum of this period does not include larvae of the lake flies (*Chironomidae*), but in the second decade of May they dominate (more than 70%) in the food diet. Feeding on such objects is more efficient, as it does not require significant energy consumption. Thus, it can be argued that the spectrum of the common newt's diet is also influenced by the life cycles of prey.

Amphibians have two behavioral mechanisms for foraging: sit-and-wait foraging and active foraging [13]. Species that use sit-and-wait behavior catch larger prey, while species that actively forage catch smaller and often more mobile prey. The latter consume a larger amount of prey and at the same time expend much more energy. According to their ability to move, we divided all types of prey into four groups: mobile, sedentary, conditionally mobile, and immobile. The proportion of mobile prey, which includes dragonfly and cyclops larvae, reaches 5%, the proportion of sedentary prey (daphnia, chironomids, caddisflies, chironomid larvae, and other dipterans) is 92%, the proportion of conditionally mobile objects (dead insects on the water surface, earthworms that can passively move due to water movement) is 1%, and immobile objects (amphibian eggs, plant fragments) is 2%.

In the temporary ponds of Rivne, consumption of small prey (*Crustacea: Cladocera, Copepoda*) by *L. vulgaris*, which is available in sufficient quantities, indicates that newts use active foraging (gathering) behavior. The use of this behavior by newts is somewhat conditional, since the main share (92%) of trophic objects belongs to the group of sedentary ones.

The diet of the common newt includes large prey: insects, their larvae and pupae, earthworms, plant fragments, shed skin, and amphibian eggs. Consumption of large prey, in our opinion, indicates that newts also use wait-and-see foraging mode to obtain food.

In addition to large-sized prey, small-sized food objects were also found in the diet of the newt. Since the consumption of small prey requires much more effort, we believe that the predominance of crustaceans in the stomach contents of newts should be considered as an indicator of the lack of trophic resources in the respective environment. This is also pointed out by other researchers [3].

Summarizing the results of the research, we can say that the newt mainly consumes prey that is most often found in the aquatic environment. In particular, this applies to crustaceans and larvae of the lake flies, which prevail in the newt's diet both in terms of frequency and quantity.

After analyzing the data on the diet of *L. vulgaris*, we see that the newt uses different foraging tactics in different periods. In the first period, crustaceans (daphnia, cyclopes) prevail. In the second, third, and fourth periods, we observe a significant predominance of the lake flies. This indicates that in late April–May, the common newt uses a wait-and-see foraging behavior.

Thus, we can conclude that the foraging mode of the common newt in the urban hydroecosystem of Rivne is labile and varies depending on environmental conditions and its trophic effer.

Conclusions. Summarizing the results of experimental studies of the food spectrum and foraging mode of the common newt (*Lissotriton vulgaris*, L. 1758) in temporary ponds of Rivne, we can draw the following conclusions:

– The diet of the common newt is dominated by food of animal origin (97%), which includes animals from 3 phylums (*Annelida, Arthropoda, Chordata*), 5 classes (*Oligohaeta, Crustacea, Arachnida, Insecta, Amphibia*) and 17 families;

– The most abundant food items are crustaceans (*Cladocera: Daphniidae, Chydoridae; Copepoda: Cyclopidae; Ostracoda*) – 53% and larvae of the the lake flies (Chironomidae) – 46%;

– The smallest food objects of *L. vulgaris* are planktonic crustaceans Chydoridae: 0.3–0.5 mm, the largest are earthworms *Lumbricidae*: 150–200 mm;

– The common newt is a predator, planktophagous, and, to some extent, polyphagous in terms of its feeding habits. Their diet is based on planktonic crustaceans and insect larvae.

– The type of prey of the newt is the result of seasonal changes and environmental conditions, in particular, temperature. The dynamics of the diet is influenced by the life cycles of trophic objects.

– The foraging behavior of the newt in temporary ponds in Rivne is labile and varies depending on environmental conditions and its trophic offer.

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