

## On the Diet of the Marsh Frog (*Rana ridibunda*) in the Sura and Moksha Watershed, Mordovia.

Alexandr B. RUCHIN and Maxim K. RYZHOV

Department of Biology, Mordovian State University, Bolshevitskaya Ul., Saransk 430000 Russia

*Accepted 27 December 2002*

**Резюме:** О питании озерной лягушки (*Rana ridibunda*) в междуречье Суры и Мокши, Мордовия. А.Б. Ручин, М.К. Рыжов. По материалам, собранным в 2001 – 2002 гг., в пище озерной лягушки встречаются около 200 различных видов животных, среди которых преобладают бесхвостые земноводные, что указывает на довольно сильный развитый каннибализм. В диету также входят различные виды рыб и млекопитающих.

**Abstract:** Based on material collected in 2001 – 2002, The diet of *R. ridibunda* in Mordovia included 200 different species. Arthropoda (Insecta, Arachnida) were common. Among vertebrates, the consumption of tailless amphibians and fish indicate well-developed cannibalism in this species. Mammals were also a part of the diet.

### Introduction

In central Russia, the Marsh Frog (*Rana ridibunda* Pallas, 1771) is one of the largest amphibian species. According to Garanin (1983), the food of this species includes aquatic and terrestrial animals and both vertebrates and invertebrates. This species consumes organisms in the environment relative to their abundance (Medvedev, 1974; Low and Torok, 1998), Dushin (1974) showed the influence of Lake and Pool Frogs in the fish industry of Mordovia, but he did not find any negative effects on fish try. Astradamov (1975) studied the Marsh Frog food in floodplain lakes near the Sura river (Mordovia, Bolshebereznikovskii District), but these authors did not contain certain details. We studied the diet of Marsh Frog in different habitats of the Moksha-Sura watershed.

### Materials and Methods

The study conducted in the Republic of Mordovia (Bolshebereznikovskii, Romodanovskii, Ruzayevskii, Ichalkovskii, Krasnoslobodskii, Bolsheignaovskii, Temnikovskii, Chamzinskii, and Kochkurovskii districts and Saransk City) and the Alatyrskii District, Republic of Chuvashia. Material was collected in 2001 – 2002 from April to September. River habitats (Sura, Moksha, Alatyr, Bolshaya Atma, Tavla, and

Insar rivers), floodplain lakes, ponds, and cut-off lakes in the Sura and Moksha river basins were studied. We examined stomachs of 101 specimens of 42-105 mm SVL. Most frogs were fixed just after being caught, but we also sampled from live frogs (Pisarenko and Voronin, 1976). Species of vertebrates and invertebrates were identified with published keys (Kheysin, 1962; Bannikov et al., 1977; Dinets and Rotshild, 1996; Gornostaev, 1998), and we calculated the relative number of different food objects in the diet.

## Result and Discussion

Comparisons of our results with those from Garanin (1983) based on frogs from the Volga-Kama region show a similar array of food items, but the component proportions vary. In June-July the frogs from lakes on the left bank of the Volga River more often consume aquatic than terrestrial organisms. In often frogs, terrestrial animals make up about 75% of the today prey items (Shlyaktin and Zavyalov, 1997). In the middle part of the Sura region, the food spectrum consists mainly of beetles, flies, and worms (Astradamov, 1975; Kuznetsov et al., 2000). In fisheries there is a considerable number of tadpoles, juveniles, and predatory diving beetles and their larvae (Dushin, 1974; Pisarenko, 1980). In the Seversky Donets the Marsh Frog food includes more than 74 species (Medvedev, 1974). The greater of the Marsh Frog food in the Medveditsa River floodplain is amphibian larvae, coleopterans, dipterans, and bugs (Shlyaktin, 1985). According to Belimov and Sedalischev (1980), the frogs introduced to Yakutsk prey mainly upon aquatic invertebrates, such as larval dragonflies, beetles, mosquitoes and caddisflies. In the Volga Delta, Marsh Frog mainly eat beetles, bugs, and fish (Markuze, 1964; Lapin, 2002).

According to our data (Table 1) collected in different seasons, Diptera, Hymenoptera and Coleoptera prevail in the food of Marsh Frog from the Sura-Volga watershed (21.2, 19.8, 18.7%, respectively). As a whole, the diet of Marsh Frog includes more than 200 taxa of vertebrates and invertebrates. Among invertebrates, the Coleoptera is remarkable for its species diversity: 51 – 52 species from 14 families. Carabidae (23.1%, 10 species: Fig.1), Dytiscidae (18.3%, 8 species) and Chrysomelidae (19.5%, 5 species) were common. The carabid *Agonum sexpunctatum* was a typical part of their diet. Among Dytiscidae, the frogs eat mainly imagoes (2.4%) which they catch from the water surface. Other water beetle families (Halipilidae, Hydrophilidae) are seldom found in the food of Marsh Frog. This situation may be explained by the fact that diving beetles are more common in comparison with other water beetles.

Rather often we found Chrysomelidae in the food of Marsh Frog, including forms living on water plants (*Donacia aquatica*, *Donacia* sp.) or near water or on willows (*Chrysomela populi*). We also found imagoes of *Leptinotarsa decemlineata* as did Rudnyak (1976). Ten other families were minor components of the diet.

Table 1. The species diversity of nutrition objects in the ration *Rana ridibunda* from the Sura-Moksha watershed.

Taxa	Stages	Number	% of occurrence	Number in taxon
<b>ANNELIDA</b>				
<b>Oligochaeta</b>				2
<i>Tubifex tubifex</i> Mull.		4	0.4	
<i>Lumbricus</i> sp.		5	0.5	
<b>Hirudinea</b>				3
<i>Glossiphonia complanata</i> L.		3	0.3	
<i>Erpobdella octoculata</i> L.		4	0.4	
<i>Haemopsis sanquisuga</i> L.		1	0.1	
<b>MOLLUSCA</b>				
<b>Gastropoda</b>				8
<i>Planorbis complanatus</i> L.		4	0.4	
<i>Segmentina nitida</i> Mull.		4	0.4	
<i>Physa fontinalis</i> L.		7	0.8	
<i>Physa acuta</i> Drap.		9	1.0	
<i>Bithynia leachi</i> Shepp.		1	0.1	
<i>Limnea pereger</i> Mull.		1	0.1	
<i>Succinea putris</i> L.		8	0.9	
<i>Agrolimax agrestis</i> L.		3	0.3	
<b>ARTHROPODA</b>				
<b>Crustacea</b>				3
<i>Gammarus</i> sp.		2	0.2	
<i>Lepidurus</i> sp.		3	0.3	
<b>Arachnida</b>				19–21
Aranei (18–20)*		68	7.4	
Hydracarina		1	0.1	
<b>Myriapoda</b>		2	0.2	2
<b>Insecta</b>				
Diplura		1	0.1	1
Odonata				7
Calopterygidae	im.	1	0.1	
<i>Calopteryx virgo</i> L.	im.	2	0.2	
<i>Lestes dryas</i> Kirby	im.	2	0.2	
<i>Aeshna</i> sp.	l.	2	0.2	
<i>Gomphus</i> sp.	l.	3	0.3	
<i>Libellula</i> sp.	l.	2	0.2	
<i>Anax</i> sp.	l.	2	0.2	
Ephemeroidea (2)	l.	17	1.9	2

Trichoptera				2
<i>Hydropsiche</i> sp.	l.	2	0.2	
<i>Glyphotaelius</i> sp.	l.	1	0.1	
Homoptera				4
Cicadellidae (2)	im.	3	0.3	
<i>Philaenus spumarius</i> L.	im.	1	0.1	
Aphidinea (1)	im.	18	2.0	
Orthoptera				3
Tettigoniidae (2)	im.	2	0.2	
Acrididae	im.	1	0.1	
Hemiptera				12
Pentatomidae (2)	im.	2	0.2	
<i>Dolycoris baccarum</i> L.	im.	3	0.3	
<i>Ilyocoris cimicoides</i> L.	im.	8	0.9	
<i>Gerris</i> sp.	l., im.	45	4.9	
<i>Palomena prasina</i> L.	im.	1	0.1	
<i>Aphelochirus aestivalis</i> Fabr	im.	6	0.7	
<i>Eurydema oleracea</i> L.	im.	1	0.1	
<i>Notonecta glauca</i> L.	im.	2	0.2	
<i>Nepa cinerea</i> L.	l., im.	8	0.9	
<i>Eurygaster</i> sp.	im.	1	0.1	
<i>Corixa</i> sp.	im.	12	1.3	
Coleoptera				51–52
Carabidae (5)	im.	12	1.4	
<i>Carabus granulatus</i> L.	im.	4	0.4	
<i>Agonum sexpunctatum</i> L.	im.	14	1.6	
<i>Harpalus</i> sp.	im.	4	0.4	
<i>Pterostichus</i> sp.	im.	4	0.4	
<i>Brachinus crepitans</i> L.	im.	1	0.1	
<i>Haliphus fluviatilis</i> Aube	im.	1	0.1	
<i>Haliphus</i> sp.	l.	1	0.1	
<i>Agabus</i> sp.	im.	3	0.3	
<i>Rhanthus notatus</i> F.	im.	3	0.3	
<i>Colymbetes striatus</i> L.	im.	4	0.4	
<i>Ilybius</i> sp.	im.	6	0.7	
<i>Acilius</i> sp.	l.	2	0.2	
<i>Acilius sulcatus</i> L.	im.	2	0.2	
<i>Platambus</i> sp.	l.	2	0.2	
<i>Platambus maculatus</i> L.	im.	2	0.2	
<i>Graphoderes cinereus</i> L.	im.	2	0.2	
<i>Dytiscus</i> sp.	l.	4	0.4	
<i>Dytiscus lapponicus</i> Gull.	im.	2	0.2	

<i>Hydrochara caraboides</i> L.	im.	2	0.2
<i>Hydrous</i> sp.	l.	1	0.1
<i>Staphylinus caesareus</i> Ced.	im.	1	0.1
Silphidae	l.	1	0.1
<i>Silpha obscura</i> L.	im.	4	0.4
<i>Lampyrus noctiluca</i> L.	im.	1	0.1
<i>Cantharis fusca</i> L.	im.	3	0.3
Scarabaeidae	im.	1	0.1
<i>Rhizotrogus solstitialis</i> L.	im.	2	0.2
<i>Lagria hirta</i> L.	im.	3	0.3
Elateridae (2)	im.	3	0.3
<i>Athous</i> sp.	im.	1	0.1
<i>Agryphus murinus</i> L.	im.	1	0.1
<i>Ctenicera cuprea</i> F.	im.	1	0.1
Coccinellidae	l.	1	0.1
<i>Coccinella semipunctata</i> L.	l., im.	3	0.3
<i>Propylea quatuordecimpunctata</i> L.	im.	4	0.4
Curculionidae (4–5)	im.	29	3.2
Chrysomelidae	l., im.	2	0.2
<i>Chrysomela populi</i> L.	im.	6	0.7
<i>Donacia</i> sp.	im.	3	0.3
<i>Donacia aguatica</i> L.	im.	12	1.3
<i>Leptinotarsa decemlineata</i> Say	im.	10	1.1
<i>Strangalia</i> sp.	im.	1	0.1
<i>Oberea oculata</i> L.	im.	1	0.1
Hymenoptera			
Tenthredinidae (7)	im.	15	1.7
Braconidae (5)	im.	14	1.6
<i>Chrysis ignita</i> L.	im.	1	0.1
Ichneumonidae	im.	10	1.1
Vespidae	im.	5	0.5
<i>Vespula vulgaris</i> L.	im.	2	0.2
<i>Sphex</i> sp.	im.	1	0.1
<i>Bembix rostrata</i> L.	im.	1	0.1
<i>Andrena cineraria</i> L.	im.	5	0.5
Anthophoridae	im.	2	0.2
Apidae (5)	im.	20	2.2
<i>Bombus silvarum</i> L.	im.	4	0.4
<i>Bombus lapidarius</i> L.	im.	3	0.3
<i>Apis mellifera</i> L.	im.	10	1.1
Formicidae (4)	im.	39	4.5
Camponotus sp.	im.	14	1.6

<i>Formica</i> sp.	im.	32	3.7	
Neuroptera				1
<i>Chrysopa carnea</i> Steph.	im.	1	0.1	
Mecoptera				
<i>Panorpa communis</i> L.	im.	1	0.1	
Lepidoptera				8
Pyralidae	im.	1	0.1	
Sphingidae	l.	2	0.2	
Geometridae	l.	13	1.5	
Zygaenidae	im.	1	0.1	
Pieridae	l.	10	1.1	
<i>Pieris brassicae</i> L.	im.	1	0.1	
<i>Gonepteryx rhamni</i> L.	im.	1	0.1	
Nymphalidae	im.	1	0.1	
Diptera				33
Tupulidae	l.	5	0.5	
Tipulidae (3)	im.	30	3.4	
<i>Tipula paludosa</i> Mg.	im.	12	1.3	
Culicidae	l.	14	1.7	
<i>Culex</i> sp.	im.	29	3.3	
<i>Chironomus</i> sp.	im.	15	1.7	
<i>Chironomus</i> sp.	l.	25	2.9	
Ceratopogonidae	l.	4	0.4	
<i>Chrysops caecutiens</i> L.	im.	2	0.2	
<i>Tabanus</i> sp.	l.	2	0.2	
<i>Tabanus bovinus</i> Loew	im.	3	0.3	
<i>Stratiomys</i> sp.	l.	2	0.2	
<i>Stratiomys chamaeleon</i> De Geer	im.	1	0.1	
<i>Asilus</i> sp.	im.	1	0.1	
<i>Bombylius</i> sp.	im.	1	0.1	
Syrphidae	im.	12	1.3	
<i>Eristalis</i> sp.	l.	12	1.3	
Muscidae (2)	im.	3	0.3	
Tachinidae (5)	im.	11	1.2	
<i>Tachina fera</i> L.	im.	2	0.2	
<i>Liriope</i> sp.	l.	5	0.6	
<b>CHORDATA</b>				
<b>Pisces</b>				2
<i>Carassius auratus</i> Bloch		10	1.1	
<i>Barbatula barbatula</i> L.		1	0.1	
<b>Anura</b>				3
<i>Pelobates fuscus</i> Laur.	l.	1	0.1	

<i>Rana arvalis</i> Nilsson	l.	20	2.2	
<i>Rana arvalis</i> Nilsson	juw	1	0.1	
<i>Rana ridibunda</i> Pall.	eggs	20	2.2	
<i>Rana ridibunda</i> Pall.	l.	6	0.7	
<i>Rana ridibunda</i> Pall.	juw	1	0.1	
<b>Mammalia</b>				4
<i>Apodemus</i> sp.		1	0.1	
<i>Sorex</i> sp.		1	0.1	
<i>Sorex minutes</i> L.		1	0.1	
<i>Microtus</i> sp.		1	0.1	
<b>SUM</b>		913	100	207-211

Among Hemiptera, we found that aquatic species (*Ilyocoris cimicoides*, *Gerris* sp., *Aphelochiris aestivalis*, *Notonecta glauca*, *Nepa cinerea*, *Corixa* sp.) were more common than terrestrial ones (8.1% 0.8% respectively).

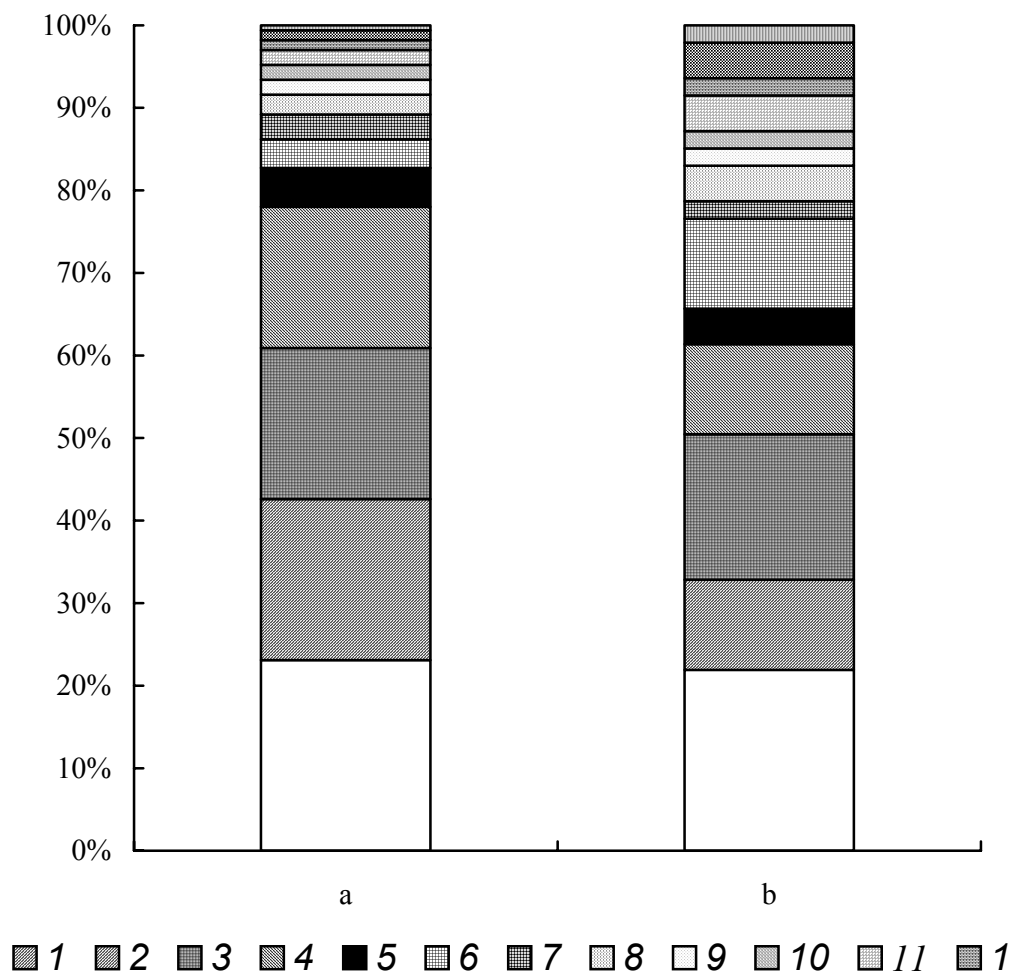


Fig 1. Proportions by specimens numbers (a) and species numbers (b) of imaginal stages of Coleoptera from different families in food of *Rana ridibunda*. 1 - Carabidae, 2 - Chrysomelidae, 3 - Dytiscidae, 4 - Curculionidae, 5 - Coccinellidae, 6 - Elateridae, 7 - Silphidae, 8 - Cantharidae, 9 - Hydrophilidae, 10 - Lagriidae, 11 - Scarabaeidae, 12 - Haliplidae, 13 - Cerambycidae, 14 - Staphylinidae.

Oligochaeta (*Tubifex tubifex*), different species of Hurudinea, Crustacea, Arachnida: Hydracarina, Odonota, Ephemeroidea and Trichoptera were found.

Terrestrial *Lumbricus* sp. Were a minor component of the diet at the end of April. In summer the number of Hymenoptera (37 species) in the Marsh Frog diet increased, and imagoes (13.5%) and larval (7.8%; mainly culicids, chironomids, and syrphids) Diptera were present. The presence of larval *Eristalis* sp. and *T. tubifex* indicate that the water in the brook flowing near Saransk is not clean.

The percentage of vertebrates was 7.1% (Table 1). We have found 10 Goldfish fry (18 – 20 mm) in one frog (82 mm SVL), and several authors indicate considerable cannibalism by Marsh Frog (Markuze, 1964; Dushin, 1974; Pisarenko, 1980; Garanin, 1983; Pisarenko and Ushakov, 1985; Shlyakhtin, 1985; Lyapkov, 1989). We found conspecific eggs, larvae, and froglets and other amphibian species in three frogs. Marsh Frogs also forage on small mammals (Markuze, 1964; Rastyapin, 1974, Melkumian, 1991), and we found 4 mammal species from 2 orders: Insectivora (*Sorex* sp., *S. minutes*) and Rodentia (*Microtus* sp., *Apodemus* sp.).

## Acknowledgments

The work was supported by the Russian Federal State Program “Integration” (grant no. E – 0121).

## References

- Astradamov V.I. 1975 [The role of amphibians in the Sura river plain forests]. – In: Materialy Vtoroi Itogovoi Konferentsii Zoologov Volzhsko-Kamskogo Kraja. Kazan: 94 – 98 (in Russian).
- Bannikov A.G., Darevsky I.S., Ishchenko V.G., Rustamov A.K. and Szszerbak N.N. 1977. [Guide to Amphibians and Reptiles of the USSR Fauna]. Moscow: Prosveshchenie Publ., 414 p. (in Russian)
- Belimov G.T. and Sedalischev V.T. 1980 [Marsh Frog in water bodies of Yakutsk City]. – Vestnik Zoologii (3): 74 – 75 (in Russian)
- Dinets V.L. and Rotshild E.V. 1996. Zveri [Animals]. Moscow: ABF, 344 p. (in Russian)
- Dushin A.I. 1974. Food of two frog species in piscicultural ponds of Mordovskaya ASSR. – Ekologiya (6): 87 – 90 (in Russian)
- Garanin V.I. 1983. Zemnovodnye I Presmykayushchiesya Volzhko-Kamskogo Kraja [Amphibians and Reptiles of Volga-Kama Region]. Moscow: Nauka Publ., 175 p. (in Russian)
- Gornostaev G.N. 1998 Nasekomye [Insects]. Moscow: ABF, 560 p. (in Russian)
- Kheysin V.A. 1962. Kratkii Opredelitel Presnovodnoj Fauny [Brief Guide to Freshwater Fauna]. Moscow, 148 p. (in Russian)
- Kuznetsov V.A., Vechkanov V.S. and Ruchin A.B. 2000. Amphibii i Reptilii Mordovii [Amphibians and Reptiles of Mordovia]. Saransk, 32 p. (in Russian)
- Lapin A.V. 2002 [Feeding of Marsh Frog (*Rana ridibunda* Pallas) in the Volga Delta]. – In: Biologiya Vnutrennikh Vod: Problemy Ekologii i Bioraznoobraziya. Borok: 81 – 82 (in Russian)



- Low P. and Torok J. 1998 Prey size selection and food habits of Water Frog and Moor Frogs from Kis-Balaton, Hungary (Anura: Ranidae). – *Herpetozoa* 11 (1 – 2): 71 – 78.
- Lyapkov S.M. 1989 [Eating of tadpoles and this year broods by green frogs]. – In: *Zemnovodnye i Presmykayushchiesya Moskovskoy Oblasti*. Moskow: 156 – 162 (in Russian)
- Markuze V.K. 1964 *Rana ridibunda* Pallas and it's role in spawning and fishery agements in the Volga Delta. – *Zoologicheskyy Zhurnal* 43(10): 1511 – 1516 (in Russian)
- Medvedev S.I. 1974 Data on study of amphibians food in the region of middle flow of the Seversky Donets River. – *Vestnik Zoologii* (1): 50 – 59 (in Russian)
- Melkumian L.S. 1991. On feeding the Marsh Frog high-mountained population with voles. – *Biologicheskii Zhurnal Armenii* 44(4): 313 – 315 (in Russian)
- Pisarenko S.S. 1980 Feature of ecology of *Rana ridibunda* in reservoirs of Sukhinichi fishery of Kaluga district. – *Ekologia (Sverdlovsk)* (5): 101 – 103 (in Russian)
- Pisarenko S.S. and Ushakov V.A. 1985 [Cannibalism of tailless frogs: extent and kinds]. – In: *Voprosy herpetologii*. Leningrad: 165 – 166 (in Russian)
- Pisarenko S.S. and Voronin A.A. 1976 [Method of food study in live anurans]. – *Ekologiya (Sverdlovsk)* (6): 87 – 90 (in Russian)
- Rastyatin J.T. 1974 [Frog smallows mouse]. – *Priroda (Moscow)* (8): 125 (in Russian)
- Shlyakhtin G.V. 1985. Trophic niches of the co-residing species of anurous amphibians. – *Ekologiya (Sverdlovsk)* (5): 24 – 31 (in Russian)
- Shlyakhtin G.V. and Zavyalov E.V. 1997 [Dynamics of Marsh Frog food spectrum in different variants of ecosystems “water/land”]. – In: *Problemy Izucheniya Kraevykh Structur Biotsenozov*. Saratov: 27 (in Russian)