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Food Composition of the Marsh Frog, *Rana ridibunda* Pallas, 1771, in Thrace

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Abstract: The purpose of this investigation was to determine the feeding habits of the marsh frog, *Rana ridibunda*, populations inhabiting Turkish Thrace. Analysis of the stomach contents of 53 (19 ♂♂, 34 ♀♀) adult individuals was performed. The frog diet consisted of a wide variety of arthropods; Diptera (42.62%) and Coleoptera (21.84%) were especially prominent. Aquatic forms did not contribute much to the frog diet. The prey items identified indicate that individuals of this species, like other ranids, are generalist opportunistic predators whose diet is most strongly influenced by prey availability.

Key Words: Marsh frog, *Rana ridibunda*, food analysis, Thrace, Turkey

Trakya'daki, Bataklık Kurbağası, *Rana ridibunda* Pallas, 1771'ın Besin İçeriği

Özet: Bu çalışmanın amacı, bataklık kurbağası, *Rana ridibunda*'nın Trakya Bölgesi populasyonunun beslenme alışkanlığın belirlemektir. 53 (19 ♂♂, 34 ♀♀) ergin bireyin mide içeriği incelenmiştir. Bu kurbağanın besinini geniş oranda çeşitli eklembacaklılar oluşturmaktadır. Bu grup içinde de Diptera (% 42,62) ve Coleoptera (% 21,84) özellikle göze çarpan gruplardır. Sucul formlar türün beslenmesinde çok fazla katkıda bulunmamaktadır. Bireylerden tespit ettiğimiz besin içerikleri, bu türün diğer ranidler gibi beslenmesinin büyük oranda avın bulunuşu ile ilgili olduğu diğer bir deyişle genel fırsatçı avcılar olduklarını göstermektedir.

Anahtar Sözcükler: Bataklık kurbağası, *Rana ridibunda*, besin analizi, Trakya, Türkiye

Introduction

Understanding feeding relationships in amphibian communities is of fundamental interest to herpetologists and ecologists because of the pivot role that amphibians may play in aquatic ecosystems (Hirai and Matsui, 1999). Different studies suggest that food is an important factor that explains the structure of anuran communities in different parts of the world (Duellman, 1967, 1978; Inger and Colwell, 1977; Toft and Duellman, 1979, Toft, 1980). The family Ranidae contains more than 600 species and is distributed worldwide (Duellman and Trueb, 1986). Ranids are considered to be generalist predators (e.g., Houston, 1973; Premo and Atomowidjojo, 1987) and to change their diets in response to natural fluctuations of prey availability (Tyler and Hoestenbach, 1979; Hirai and Matsui, 1999). *Rana ridibunda* is highly riparian, being restricted to aquatic margins and rarely moves far from water (Başoğlu and Özeti, 1973). Diets of marsh frogs have been studied by many researchers from various regions of the world (e.g., Popovic et al., 1992; Simic et al., 1992; Cogãlniceanu et al., 2000; Ruchin and Ryzhov, 2002).

Although morphological, genetic and systematic studies have been performed on the species (e.g., Bodenheimer, 1944; Yılmaz, 1984; Olgun and Baran, 1988; Ayaz et al., 2004), there are few ecological studies, and those of food habits are anecdotal or associated with the Anatolian population, in Turkey (Atatür et al., 1993; Turgay, 2001; Çiçek, 2005).

In the present study, we conducted an extensive analysis of the stomach contents of the marsh frog from Turkish Thrace. These data would also be useful in understanding the predatory role of frogs in Turkish Thracian wetlands, where they are the dominant vertebrate.

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Materials and Methods

We examined 53 (19 ♂♂, 34 ♀♀) preserved adult specimens of *Rana ridibunda* deposited in the Zoology (ZDEU) Museum of Ege University. Frogs were collected at 3 sites in Thrace: (1) Kücükçekmece, İstanbul, 13 (8 ♂♂, 5 ♀♀); (2) Lake Büyükdöllük, Edirne, 23 (8 ♂♂, 15 ♀♀); and (3) Lake Gala, Enez-Edirne, 17 (3 ♂♂, 14 ♀♀) (Figure). Collections were conducted during daylight between 10:00 h and 12:00 h on 24, 25 and 26 June 1990. All frogs were killed with anesthetic ether, within 30 min of collection, and were then fixed with 4% formaldehyde and 70% ethanol injection (1:3) and kept in 70% ethanol. For all individuals, we measured snout-vent length (hereafter SVL) to the nearest 0.01 mm with a dial caliper. The stomachs were dissected in petri dishes and items identified under a stereomicroscope.

We identified stomach contents to the lowest possible taxon. Several of the suitable references (Locket and Millidge, 1951, 1953; Bristowe, 1958; Riedl, 1970; Lodos, 1982, 1984, 1989, 1991, 1993; Parker, 1982; Geldiay and Balık, 1988; Chinery, 1992, 1993) were used in taxon determinations. Plant material found in the stomach contents included moss, seeds, and small leaves and was most likely ingested accidentally during foraging. Unidentified arthropods in this study usually consisted of a wing, leg, or body segment, which may indicate that either the frog was unable to capture the entire prey item or the remaining portion of the prey item was not detected because it had passed through the digestive system at a different rate.

We classified each prey item as either terrestrial or aquatic on the basis of the habitats in which it typically occurs, and classified pond snails (Lymnaeidae, Planorbidae), freshwater shrimps (Gammaridae), dragonflies (Odonata), Corixidae, water beetles (Dytiscidae, Dryopidae), maggots (Diptera larvae), Cyprinidae and Ranidae as aquatic preys.

We compared SVL, frequencies of occurrence and numeric proportion by Mann-Whitney U-test between sexes and, in order to detect intraspecific differences in the use of food resources among localities, we compared frequencies of occurrence and numeric proportions of all prey taxa by Friedman test when the data were not normally distributed (Zar, 1996).

Results

The stomach contents of 53 (19 ♂♂, 34 ♂♂) specimens were analyzed. In all, 861 prey items belonging to 54 prey categories were identified. Two invertebrate (Mollusca, Arthropoda) and 2 vertebrate (Osteichthyes, Amphibia) groups were recovered from the stomachs.

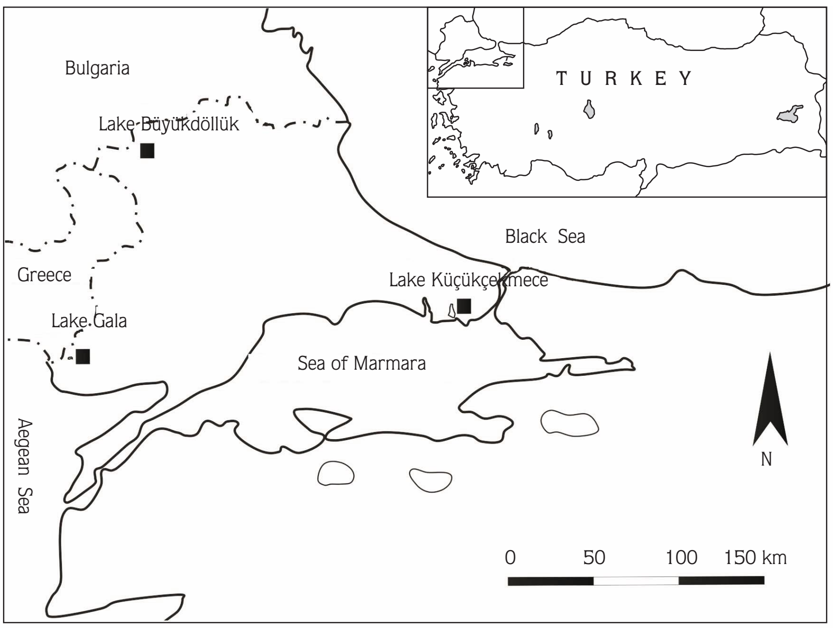

Figure. Map showing the examined *Rana ridibunda* specimens' localities.

Arhrodopda included 3 classes (Crustacea, Arachnida, and Insecta), which occupied more than 97.32% in number of the total prey items. Insecta included 10 orders and made up 88.15% in number.

Among the prey taxa shown in the Table, coleopterans (86.79%), dipterans (62.26%), homopterans (39.62%), hymenopterans (35.85%) and spiders (Araneae) (22.64%) were frequently found in the stomachs

Table. Food composition of the marsh frog from Turkish Thrace: f %: frequency of occurrence, n%: numeric proportion.

Prey Taxon	Whole Population		Küçükçekmece		Lake Büyükdöllük		Lake Gala	
	f %	n %	f %	n %	f %	n %	f %	n %
Gastropoda	9.43	0.81	7.69	2.91	17.39	1.67	0.00	0.00
Basommatophora	9.43	0.81	7.69	2.91	17.39	1.67	0.00	0.00
*Lymnaeidae	7.55	0.70	7.69	2.91	13.04	1.25	0.00	0.00
*Planorbidae	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Arachnida	22.64	2.90	0.00	0.00	26.09	7.92	35.29	1.16
Araneae	22.64	2.90	0.00	0.00	26.09	7.92	35.29	1.16
Araneidae	7.55	1.74	0.00	0.00	8.70	4.17	11.76	0.97
Aculepeira sp.	1.89	0.70	0.00	0.00	4.35	0.42	0.00	0.00
Araneus sp.	1.89	0.70	0.00	0.00	4.35	0.42	11.76	0.97
Agelenidae	1.89	0.70	0.00	0.00	4.35	2.50	0.00	0.00
Agelena sp.	1.89	0.70	0.00	0.00	4.35	2.50	0.00	0.00
Linyphidae	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Philodromidae	1.89	0.12	0.00	0.00	0.00	0.00	5.88	0.19
Tonotus sp.	1.89	0.12	0.00	0.00	0.00	0.00	5.88	0.19
Salticidae	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Tetragnathidae	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Pacignatha sp.	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Thomisidae	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Xysticus sp.	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Crustacea	9.43	6.27	7.69	41.75	17.39	4.58	0.00	0.00
Amphipoda	3.77	1.05	0.00	0.00	8.70	3.75	0.00	0.00
*Gammaridae	3.77	1.05	0.00	0.00	8.70	3.75	0.00	0.00
Gammarus sp.	3.77	1.05	0.00	0.00	8.70	3.75	0.00	0.00
Isopoda	5.66	5.23	7.69	41.75	8.70	0.83	0.00	0.00
Oniscidae	3.77	0.00	0.00	0.00	8.70	0.00	0.00	0.00
Porcellio sp.	3.77	0.23	0.00	0.00	8.70	0.83	0.00	0.00
Philosciidae	1.89	4.99	7.69	41.75	0.00	0.00	0.00	0.00
Philoscia sp.	1.89	4.99	7.69	41.75	0.00	0.00	0.00	0.00
Insecta	98.11	88.15	92.31	51.46	100.00	82.08	100.00	98.26
larvae	3.77	0.12	7.69	0.97	4.35	0.00	0.00	0.00
Collembola	7.55	7.32	0.00	0.00	0.00	0.00	23.53	12.16
*Odonata	9.43	0.58	7.69	0.97	8.70	0.83	11.76	0.39
Subordo: Zygoptera	1.89	0.12	7.69	0.97	0.00	0.00	0.00	0.00
Orthoptera	3.77	0.23	0.00	0.00	4.35	0.42	5.88	0.19
Gryllotapidae	3.77	0.23	0.00	0.00	4.35	0.42	5.88	0.19
Gryllotapa gryllotalpa	3.77	0.23	0.00	0.00	4.35	0.42	5.88	0.19
Heteroptera	13.21	1.28	7.69	0.97	17.39	3.33	11.76	0.39
Cimicidae	1.89	0.12	7.69	0.97	0.00	0.00	0.00	0.00
Coreidae	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
*Corixidae	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
**Corixa* sp.	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Lygaeidae	3.77	0.46	0.00	0.00	8.70	1.67	0.00	0.00

Table. (Contunued).

Prey Taxon	Whole Population		Küçükçekmece		Lake Büyükdöllük		Lake Gala	
	f %	n %	f %	n %	f %	n %	f %	n %
Pentatomidae	1.89	0.12	0.00	0.00	0.00	0.00	5.88	0.19
Reduviidae	5.66	0.35	0.00	0.00	8.70	0.83	5.88	0.19
Reduviius sp.	1.89	0.12	0.00	0.00	0.00	0.00	5.88	0.19
Homoptera	39.62	3.72	30.77	5.83	39.13	4.58	47.06	2.90
Cicadellidae	24.53	2.09	23.08	4.85	30.43	3.75	17.65	0.77
Delphacidae	1.89	0.12	7.69	0.97	0.00	0.00	0.00	0.00
Miridae	1.89	0.12	0.00	0.00	0.00	0.00	5.88	0.19
Coleoptera	86.79	21.84	61.54	22.33	91.30	35.42	100.00	15.44
larvae	5.66	0.58	0.00	0.00	8.70	1.25	5.88	0.39
Buprestidae	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Cantharidae	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Carabidae	33.96	3.02	30.77	3.88	34.78	5.42	35.29	1.74
Carabus sp.	9.43	1.16	15.38	1.94	8.70	1.67	5.88	0.77
Brachinus sp.	1.89	0.12	0.00	0.00	0.00	0.00	5.88	0.19
Cerambicidae	5.66	0.58	0.00	0.00	13.04	2.08	0.00	0.00
Cleridae	7.55	0.81	0.00	0.00	17.39	2.92	0.00	0.00
Coccinellidae	35.85	4.41	15.38	1.94	26.09	3.33	64.71	5.41
Abnatis sp.	3.77	0.35	0.00	0.00	0.00	0.00	11.76	0.58
Coccinella sp.	13.21	1.16	0.00	0.00	4.35	0.83	35.29	1.54
Curculionidae	16.98	2.44	7.69	3.88	17.39	5.00	23.53	0.97
*Dytiscidae	22.64	1.97	30.77	4.85	21.74	2.50	17.65	1.16
Dytiscus sp.	3.77	0.58	7.69	2.91	4.35	0.83	0.00	0.00
*Dryopidae	3.77	0.46	0.00	0.00	8.70	1.67	0.00	0.00
Elateridae	3.77	0.23	0.00	0.00	0.00	0.00	11.76	0.39
Melalontidae	1.89	0.70	0.00	0.00	0.00	0.00	5.88	1.16
Gnorimus sp.	1.89	0.23	0.00	0.00	0.00	0.00	5.88	0.39
Melalonhta sp.	1.89	0.46	0.00	0.00	0.00	0.00	5.88	0.77
Staphylinidae	3.77	0.23	0.00	0.00	4.35	0.42	5.88	0.19
Scarabaeidae	15.09	0.93	23.08	2.91	8.70	0.83	17.65	0.58
larvae	1.89	0.12	7.69	0.97	0.00	0.00	0.00	0.00
Tenebrionidae	16.98	1.97	0.00	0.00	21.74	4.58	23.53	1.16
Tenebrio sp.	3.77	0.12	0.00	0.00	0.00	0.00	11.76	0.19
Crypticus sp.	1.89	0.12	0.00	0.00	0.00	0.00	5.88	0.19
Mecoptera	1.89	0.12	0.00	0.00	0.00	0.00	5.88	0.19
Lepidoptera	16.98	3.60	23.08	3.88	17.39	9.58	11.76	0.77
larvae	3.77	2.32	0.00	0.00	8.70	8.33	0.00	0.00
Noctuidae	13.21	1.05	23.08	2.91	13.04	1.25	5.88	0.58
Diptera	62.26	42.62	23.08	7.77	60.87	14.58	94.12	62.55
**larvae*	9.43	0.81	0.00	0.00	13.04	2.08	11.76	0.39
Asilidae	1.89	0.12	0.00	0.00	0.00	0.00	5.88	0.19
Culicidae	50.94	20.33	15.38	6.80	39.13	10.00	94.12	27.80
Muscidae	26.42	4.65	0.00	0.00	13.04	1.67	64.71	6.95
Syrphidae	18.87	10.69	0.00	0.00	4.35	0.42	52.94	17.57
Tephyritidae	3.77	0.23	0.00	0.00	0.00	0.00	11.76	0.39
Hymenoptera	35.85	4.76	15.38	6.80	43.48	8.33	41.18	2.70
Eumenidae	1.89	0.12	0.00	0.00	0.00	0.00	5.88	0.19
Formicidae	26.42	3.25	15.38	6.80	39.13	7.08	17.65	0.77
Ichneumonidae	9.43	0.70	0.00	0.00	8.70	0.83	17.65	0.77

Table. (Contunued).

Prey Taxon	Whole Population		Küçükçekmece		Lake Büyükdöllük		Lake Gala	
	f %	n %	f %	n %	f %	n %	f %	n %
Mutillidae	1.89	0.12	0.00	0.00	0.00	0.00	5.88	0.19
Pompilidae	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Vespidae	1.89	0.12	0.00	0.00	0.00	0.00	5.88	0.19
Osteichthyes	5.66	1.05	0.00	0.00	13.04	3.75	0.00	0.00
Cypriniformes	5.66	1.05	0.00	0.00	13.04	3.75	0.00	0.00
*Cyprinidae	5.66	1.05	0.00	0.00	13.04	3.75	0.00	0.00
Gambusia sp.	3.77	0.23	0.00	0.00	8.70	0.83	0.00	0.00
Amphibia	3.77	0.23	0.00	0.00	8.70	0.83	0.00	0.00
Anura	3.77	0.23	0.00	0.00	8.70	0.83	0.00	0.00
*Ranidae	3.77	0.23	0.00	0.00	8.70	0.83	0.00	0.00
Rana ridibunda (tadpole)	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Rana ridibunda	1.89	0.12	0.00	0.00	4.35	0.42	0.00	0.00
Unidentified	11.32	0.81	30.77	3.88	0.00	0.00	11.76	0.58

* Aquatic and semi-aquatic preys.

(frequency of occurrence >20%). No particular prey taxa predominated in the diet. The 2 most frequently consumed food items were dipterans (42.62%) and coleopterans (21.84%) numerically (>20%).

Diptera, mainly Culicidae (20.33%), were a significant source of food for most frogs. The other 2 taxa, Syrphidae (10.69%) and Muscidae (4.65%), also were prominent. The Lake Gala population (94.12%) consumed dipterans more frequently than did the other populations. Ingested beetles included various taxonomic groups: ladybug (coccinellid; 4.41% of the total prey items), ground (carabid; 3.02%), snout (curculionid; 2.44%), (tenebrionid; 1.97%), predaceous diving (dytiscid; 1.97%), scarab (0.93%), checkered (clerid; 0.81%), darkling melanontid (0.70%) and longhorn (cerambicid; 0.58%) beetles were prominent (>0.5%), and long-toed water (dryopid; 0.46%), click (elaterid; 0.23%), rove (staphylinid; 0.23%), slider (cantharid; 0.12%) and jewel (buprestid; 0.12%) beetles also occurred but in lower numeric proportions. Küçükçekmece populations (61.54%) consumed coleopterans less frequently than did those of the other localities.

Aquatic preys were as follows: 7 pond snails (Basommatophora: Gastropoda), 9 amphipods, 5 dragonflies, a corixid, 17 dytiscids, 4 dryopids, 7 dipteran larvae, 9 cyprinids, and 2 ranids. Aquatic taxa did not make a large contribution, making up 7.08% in number. Comparing among sites, at Lake Büyükdöllük (17.15%) more aquatic preys were consumed than at Küçükçekmece (8.73%) and Lake Gala (1.55%).

Besides invertebrates, 2 vertebrate families (1.28%) were found. We found 9 cyprinids, a tadpole and a newly metamorphosed froglet in the stomachs.

Mean SVL did not significantly differ between males (mean ± CI) (68.08 ± 3.960 mm, range = 56.60-84.57 mm) and females (65.85 ± 4.153 mm, range = 52.22-99.67 mm) (U-test, W = 404.0 P = 0.135). Diet compositions were quite similar between males and females, as indicated by high dietary overlap but females appear to take more prey (median ± CI) (34 ± 34.5, range = 3-54) than males (19 ± 21, range = 1-65), although the difference was not significant (U-test, W = 246.5 P = 0.152). The frequency of all prey taxa occurring in the stomachs did not differ significantly between the sexes (U-test, W = 155.5 P = 0.295, P > 0.05 for all prey taxa).

There was a significant difference in mean number of prey items (Friedman test, P = 0.001) and frequency occurrence among sites (Friedman test, P = 0.02). Moreover, no significant difference was detected in numeric percentages among sites (Friedman test, P = 0.09).

Discussion

The present study revealed that adult marsh frogs, *Rana ridibunda*, in Turkish Thrace consumed a wide variety of invertebrates, mainly terrestrial arthropods. In our other field observations, we seldom found frogs obtaining food in the water. These findings suggest that they catch prey on the ground. The individuals were mainly foraging on the edge of a puddle.

According to our data, Diptera (42.62%) and Coleoptera (21.74%) prevail in the food of marsh frogs in Turkish Thrace. Comparisons of our results with those reported by Atatür et al. (1993), Turgay (2001) and Çiçek (2005), which were based on frogs from Anatolian populations, show a similar array of food items, but the component proportions vary. According to earlier studies on the populations of *R. ridibunda* outside Turkey, arthropods comprised 90.1%-93.4% in number of the total prey items in the diet (Popovic et al., 1992; Simic et al., 1992; Cogãlniceanu et al., 2000; Ruchin and Ryzhov, 2002); the value obtained in our study (97.32%) is above this range.

Previous studies of ranids reveal that they predominantly feed on terrestrial preys (Berry, 1965; Jenssen and Klimstra, 1966; Beschkov, 1970; Whitaker et al., 1981; Hirai and Matsui, 1999; 2001a). Our study indicates that, in the frog diet, terrestrial animals make up about 92.82% of the prey items. However, according to Ruchin and Ryzhov's (2002) findings, in June-July the frogs from Sura and Moksha Watershed (Mordovia) more often consume aquatic rather than terrestrial organisms. It is pointed out that the species could change its feeding habits according to biotope conditions.

More adult insects (84.20%) were eaten than larvae (3.95%), indicating that *R. ridibunda* primarily seizes active preys. The feeding habits of this species include a number of small invertebrates associated with aquatic and moist habitats but its diet is not entirely selective. Furthermore, the Carska Bara (Yugoslavia) population of marsh frogs feed on adult insects rather on larvae (Popovic et al., 1992). Feeding mechanisms of most anurans involve detection of prey by visual cues followed by capture and retrieval with the tongue (Stebbins and Cohen, 1995). This difference is associated with larvae being less motile than adult insects.

Dietary studies of ranid frogs indicate that prey choice reflects prey availability as well as habitat characteristics (Berry and Bullock, 1962; Jenssen and Klimstra, 1966; Houston, 1973; Whitaker et al., 1981; Duellman and Trueb, 1986; Popovic et al., 1992; Kovács and Török, 1995; Werner et al., 1995; Das, 1996; Hirai and Matsui, 1999; 2001b). In addition, according to Medvedev (1974) and Low and Török (1998), the marsh frog consumes organisms in the environment relative to their abundance. As a result, prey shifts may be expected in these opportunistic generalist predators. Although we did not measure prey availability, the changes in total and mean number of prey items found in frog stomachs among localities may have been caused by prey availability. However, the diverse diet of *R. ridibunda* adults is reflective of a generalist and opportunistic predator.

Sexual size dimorphism, with larger females than males, is generally seen in anurans (Shine, 1979). In our samples, although females were larger than males, the difference was not significant. Diet compositions were quite similar between males and females, indicated by a high dietary overlap. The cause of this dietary overlap is that males and females use the same microhabitat for foraging (Lima and Moreira, 1993; Measey, 1998; Hirai and Matsui, 2000; Cross and Gerstenberger, 2002; Parker and Goldstein, 2004).

When diet composition is compared among populations, diet variation within a population should be considered. Nevertheless, even if this kind of variation is considered, diet composition may differ among localities. These local variations strongly suggest that the food habits of *R. ridibunda* are generalized, and that the frog changes its diet flexibly in response to local variations in the frequency of available prey items (e.g., Berry and Bullock, 1962; Jenssen and Klimstra, 1966; Houston, 1973; Whitaker et al., 1981; Popovic et al., 1992; Kovács and Török, 1995).

Marsh frogs forage on fish, amphibians (Angelov and Bacvarov, 1972; Çiçek, 2005), turtles (Turgay, 2001) and small mammals (Ruchin and Ryzhov, 2002). Moreover, we observed juvenile *Natrix natrix* in the diet of İzmir (Turkey) populations (unpublished data). The Thracian population also consumed available vertebrate preys (1.28%) occurring in their habitat.

It is noteworthy that *R. ridibunda* consumed a tadpole and a newly metamorphosed froglet in Lake Büyükdöllük. Habitat drying can reduce the time available for development and can further lead to increased competition for food due to increased density and decreased food availability (Newman, 1987, 1989). Under these conditions, cannibalism (intraspecific predation) provides a mechanism that can enhance individual survival (Polis, 1981; Crump, 1992; Pfennig, 1992). Cannibalism has been documented in several species of anurans (Berry, 1965; Polis and Myers, 1985; Crump, 1986, 1992; Hodar et al., 1990; Cogãlniceanu et al., 2000; Ruchin and Ryzhov, 2002). In *R. ridibunda*, cannibalism could be seen and one of the causes might be for habitat partitioning.

Diverse food items found in the stomachs illustrate the ability to utilize a wide variety of taxa. *R. ridibunda* occurs extensively in central and southern Europe and western Asia (Tok et al., 2000) and occurs in many habitats from urban areas to high mountain regions (Tarkhnishvili and Gokhelashvili, 1999). This wide distribution might be associated with its wide range of feeding habits, and the habits might also partially account for the worldwide success of the family Ranidae.

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