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The Common Newt (*Triturus vulgaris* L.) in Urban Ecosystems

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Abstract—Characteristics of the distribution, numbers, and morphology of the common newt from populations exposed to various degrees of anthropogenic impact are reported. Some features of adaptive importance are noted. The common newt is a species that can potentially inhabit small urban bodies of water and be used for bioindication of environmental quality.

The widespread occurrence of the common newt (*Triturus vulgaris* L.) in urban and suburban territories received attention long ago (Sharleman", 1917). This species is common for small ponds in city parks and gardens in Great Britain. In terms of its frequency in urban territories, it usually ranks next to moor frogs (*Rana arvalis* Nilss. and *R. temporaria* L.) (Banks and Laverick, 1986; Beebee, 1973; King, 1979; Mathias, 1975). In London, populations of the common newt effectively reproduce under conditions where frogs and toads have already disappeared (Beebee, 1973). In rural areas, it is the most widespread species of amphibians (Beebee, 1981) and quite easily adapts to anthropogenic changes in the environment (Arnold, 1983; Cooke, 1977). Data on the occurrence of the common newt in Russia point indicate that it is generally found in recreational forests and the suburbs (Kuranova, 1989; Lebedinskii, 1981, 1984; Pliss and Khudolei, 1979; Toporkova, 1973).

According to my data, the common newt ranks next to the marsh frog (*Rana ridibunda* Pall.), the moor frog, and the grass frog (Vershinin, 1980, 1983) in terms of its resistance to anthropogenic impact and its occurrence in urban Ekaterinburg and has high ecological flexibility as compared to another species of tailed amphibians, the Siberian salamander (*Salamandrella keyserlingii* Dyb.).

The distribution of the common newt and some salamander species is known to be influenced by the availability of the ground plant layer (Orser and Shure, 1972; Frazer, 1978; Beebee, 1979), which creates favorable microclimatic conditions. Moreover, it is not the species composition of plant communities that matters, but the height and thickness of the herbage (Garanin and Popov, 1958). The frequency of newts also depends on the acidity of bodies of water. Newts were found in ponds with pH 6.0–9.0 (Beebee, 1981), but never occurred at pH < 6.0 (Beebee, 1983), although some individuals were found at pH 5.8 (Arnold, 1983). At pH < 3.9, common newts are entirely absent, and invertebrates are scarce (Frazer, 1978). The optimum ionic number is around 380 ions/10^6, although the tolerance limits range between 150 and 1750 ions/10^6 (Beebee, 1981).

For spawing, the common newt chooses small ponds with rich aquatic vegetation abundant in urban bodies of water that are polluted with metal ions (Cooke and Frazer, 1976). The availability of fish in bodies of water has a negative impact on its numbers and reproduction (Beebee, 1981; Banks, 1986; Dolmen, 1987). The catching of newts by collectors and children and the cleaning of ponds also adversely affect the numbers of newts in urban areas (Beebee, 1979). Industrial emissions and anthropogenic loads resulting in herbage failure, soil erosion, and, consequently, a decrease in the air–ground interface humidity and the disappearance of food substantially undermine newt populations (Beshkov, 1978; Simms, 1969). The application of herbicides, though not responsible for their disappearance, nevertheless significantly decreases the reproductive fitness of newts in bodies of water (Cooke, 1977). Moreover, chemicals, heavy metal pollution, and just the substantial deterioration of the chemical background of the environment bring about an increase in morphological anomalies in newts (Vershinin, 1982; Taban *et al.*, 1982; Roberts and Verrell, 1984). The skin of tailed amphibians, particularly, that of newts, is well known to be very sensitive to carcinogens (Pliss and Khudolei, 1979; Rose and Harshberger, 1977), and is employed in ecological monitoring. Newt skin can be affected by fungal infection (Litton, 1962). Morbidity may also likely depend on pH and the chemical composition of the environment (Frazer, 1978). A comparatively wide distribution of newts in urban areas (despite their relatively low numbers) and the sensitivity of this species to changes in the chemical composition of the environment make them an interesting subject for population studies.

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MATERIALS AND METHODS

Materials were collected within the city of Ekaterinburg and in the suburbs in 1977–1990 (in 1980–1981, data were obtained in the city of Chelyabinsk). Estimation of numbers was carried out by individual marking, namely, by cutting off a digit (for the postmarking regeneration lasts more than six months) (Griffith, 1984) and surveying at test areas. The animals were measured with sliding callipers and then released. Notes were taken also of the sex (of mature animals), morphological anomalies, and fungal disease. The dates of reproduction and development were recorded. Larval density and weight were recorded. The hydrochemical characteristics of the bodies of water were studied, and analyses were performed at the planning and technological bureau of the Ural Research Institute of Water Management.

RESULTS AND DISCUSSION

The specified data on the occurrence of the common newt in the city of Ekaterinburg showed that, at present, this species ranks immediately after brown frogs in terms of their distribution, but, not long ago (in 1984–1985), it was even more numerous than the frogs. This change was due to the extermination of several habitats of newts in the course of human activities. As a rule, the numbers of the urban populations are not great; sometimes, however, they may be considerable even in habitats significantly transformed by man (Table 1), i.e., the occurrence of the common newt in cities of the Urals concurs with that in Great Britain. The relatively wide occurrence of the common newt in urban areas is probably due to the biological characteristics of this species.

The common newt's small size and reclusive way of life make these animals less vulnerable to humans, and their ability to reproduce in small bodies of water allows them to reproduce under urban conditions. Unlike another local species of tailed amphibians, the Siberian salamander, which lives and reproduces only in suburbs and recreational forests, the common newt is less selective as to the illumination and temperature of bodies of water, changes in the chemical composition of the environment, and the species composition of plant communities. In habitats with stable populations of the Siberian salamander, they are generally more numerous than the common newt (see Table 1). In more transformed habitats, the relationship changes in favour of newts. Estimation of the species composition in the area of the Nizhnii Tagil metallurgical works in 1988 showed that newts were first found 14 km from the industrial sites, compared to 25–27 km for Siberian salamanders. A survey of adult newts proved that the body length of animals inhabiting highrise housing areas is greater than that of suburban populations, especially that of the females (Table 2).

The body size increase in animals from urban populations also noted in other species of amphibians (Bugaeva,1983;Vershinin,1982;Gogoleva,1985;Ivanova,1982; Misyura, 1989; Ushakov *et al.*, 1982) must be due to a better survival rate of large animals amidst pollution. The sex ratio in all investigated populations was shifted toward females, which is probably caused by a significant death of males. The same correlation was noted for populations of the common newt in London (Griffith, 1984). There were extreme cases of females outnumbering males 16 : 1; this could be due to the disproportionate capture of males to be sold because of their more attractive spawing livery.

Another characteristic of populations inhabiting areas of highrise apartments is a longer aquatic period in adult animals. Some newts stay underwater until the middle of August (Table 3), whereas, in natural populations, adults emerge onto dry land in July (Toporkova,

Table 1. Sizes of common newt and Siberian salamander populations in urban and suburban areas

Habitat	Newt numbers	Last year of reproduction	The year of the population loss	Siberian salamander numbers
Ol'khovka River	430	1980	1985	0
ul. Krylova	138	1989	1990	0
Central Recreational Park	17	1977	1982	0
ul. Kuibysheva	44*	1989	1990	0*
ul. Belinskogo	30*	1991	1992	0*
ul. Samoletnaya	154	1991	1992	30
Shartashskii Recreational Forest	95	1992	–	361
Kalinovskii Recreational Forest	217	1992	–	303
Southwest Recreational Forest	98*	1992	–	180*
City pine forest (Chelyabinsk)	195	1992	–	70
Suburban population	44	1992	–	132

Note: Generally, data from 1981 are presented; data from 1986 are asterisked; ul. – street (Russian abbr.).

1973). This phenomenon is most likely connected with the smaller area of land habitats, restricted resources, and attempts to adequately disperse the population.

The dates of reproduction and development of newts in urban areas and suburbs are different (see Table 3). Reproduction starts and ends earlier, as well as the appearance of the first brood of the year, which is associated with the early warming of spawing bodies of water in urban areas (Lebedinskii, 1981). The total minimum development period is significantly longer in urban areas than in the suburbs. This must be due to an inhibiting impact of pollutants and was noted in other species of amphibians (Lebidinskii, 1984). The variability of the growth rate and development of newts in nature is also controlled to a great extent by external factors (Ishchenko, 1984).

Regression analysis of the larval body mass before metamorphosis and the density of the population showed that there was no distinct relationship between these parameters ($r = 0.163$). At high density values, the biggest larvae occurred in populations living in highrise areas (see Table 2). The total length ($L. + L.\ cd.$) of the brood in areas of highrise and lowrise housing and in recreational forests approximated 40.2 ± 0.5 *mm* and 38.7 ± 0.56 mm, respectively, as compared to the control value of 36.4 ± 0.85 mm. For the newt population in the suburbs of the town of Talitsa (Ishchenko, 1984), the average values of the total length of the brood were 38.2, 29.9, and 27.3 mm, respectively. The size increase in the brood in the populations most affected by the anthropogenic impact was caused, in my opinion, by the better survival of large individuals in polluted ponds probably related to the change in the surface–volume ratio. It is known that living conditions, rather than isolation, are of crucial importance for the divergence of newt populations (Ishchenko, 1966).

Hydrochemical analysis showed that the pH of the water in the urban areas ranged within the optimum limits, between 6.0 and 8.4, whereas the total mineralization and the content of lead and surface-active agents in the water were far in excess of the values measured in the control bodies of water, particularly, in areas of highrise apartments (Table 5).

The frequency of morphological anomalies in adults varied in different years from 6.7 to 28.6% near highrise apartments versus 0.56% in suburban populations. The absolute values also reached their maxima in urban areas. For comparison, the frequency of anomalies in newts in London made up 4.56% (Roberts and Verrell, 1984). Conversely, the proportion of individuals affected by fungal infection was larger in recreational forests and suburban populations. This may be due to

Table 2. Average body length of common newts, *mm*

Area	Males		Females		The brood	
	$\bar{x} \pm \bar{S}_x$	n	$\bar{x} \pm \bar{S}_x$	n	$\bar{x} \pm \bar{S}_x$	n
Highrise housing	37.2 ± 0.34	57	39.8 ± 0.29	99	20.9 ± 0.66	43
Lowrise housing	36.7 ± 0.7	28	38.2 ± 0.6	39	19.5 ± 0.87	17
Recreational forests	36.8 ± 0.74	20	37.0 ± 0.65	40	19.5 ± 0.4	56
Suburban populations	36.4 ± 1.7	5	36.9 ± 0.87	13	17.8 ± 1.4	7

Table 3. Periods of reproduction and development in the common newt

Area	Beginning of spawing	Hatching of the first brood	Minimum periods of development, days	End of the aquatic period of adults
Highrise housing	25.04–3.06	12.07–6.08	62–99	14.08
Lowrise housing	13.05–26.05	3.08–25.08	69–99	19.06
Recreational forests	21.04–1.06	27.07–12.08	56–86	28.06
Suburban populations	22.05–20.06	7.08–14.08	47–77	4.07

Table 4. Average weight (mg) and the density of the population of common newt larvae before metamorphosis (larvae/l)

Area	1980		1981	
	larvae/l	mg	larvae/l	mg
Highrise housing	0.005	480	0.001	600
Lowrise housing	0.03	344	0.01	329
Recreational forests	0.001	355	0.002	225
Suburban populations	0.02	250	0.02	272.5

Table 5. Range of variation hydrochemical indicies in bodies of water

Area	pH	Surface-active agents, mg/l	Lead, mg/l	Total mineralization, g/l
Highrise housing	6.0–8.4	0.18–0.79	0.03–0.19	0.4198–0.8157
Lowrise housing	6.0–8.3	0.12–0.62	0.02–0.08	0.3174–0.5668
Recreational forests	5.2–8.2	0.18–0.64	0.03–0.37	0.0714–0.4867
Suburban populations	5.8–8.2	0.08–0.4	0.03–0.06	0.1236–0.1584

Table 6. Frequency of morphological abnormalities and diseases in adult common newts, %

Area	Diseases	Abnormalities	Number of individuals
Highrise housing	6.4	8.3	156
Lowrise housing	7.46	4.48	67
Recreational forests	16.7	1.7	60
Suburban populations	27.7	5.6	18

higher resistance in urban populations as well as greater rarity of such diseases in urban isolates (Table 6). Malformations and fungal infections in the brood were only found in urban habitats. The frequency of malformations was 2.3% in the area of highrise housing, 6.25% in that of lowrise housing, and the morbidity rate was 2.3 and 75%, respectively. Additionally, the 1988 brood of a population near highrise housing was completely wiped out due to a fungal disease (probably *Saprolegnia* sp.).

Thus, a number of characteristics of both adaptive and negative natures develop in populations of the common newt under urban conditions. The body size increase the long aquatic period of adult individuals, and probably the strong resistance of adult newts to fungal diseases can be considered adaptive features. The increased frequency of morphological abnomalities, the disturbance of reproduction, and drastic changes in the sex ratio appear to be negative features. The common newt is a species that has the ability to inhabiting ponds in urban parks and gardens and serve as an indicator of environmental quality. The place occupied by the common newt in urban ecosystems and the characteristics of its populations are determined by species characteristics, its relative tolerance to changes in chemical composition of the environment, and its ecological flexibility, accompanied by a number of general regularities typical for urban isolates of amphibians as a whole.

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