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The Great Crested Newt, *Triturus cristatus* (Laurenti 1768) (Caudata, Salamandridae), near the Eastern Limit of Its Distribution Area in the Middle Urals

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Abstract—Updated information on the distribution and studied populations of *T. cristatus* on the eastern macro-slope of the Urals (Middle and Southern Urals) is provided. Based on tagging with recapture, the number of reproductive individuals of the populations, the sex ratio, and the morphological specificity are estimated for the first time. From the standpoint of assessing the physicochemical features of the habitat environment, possible limiting factors (thermal and moisture availability, geochemical characteristics, climate continentality, and the presence of natural enemies and invasive species) that affect the distribution and abundance of the great crested newt near the northeastern limit of the range are discussed.

Keywords: distribution, numbers, Red Data Book, water chemistry, morphological specificity

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INTRODUCTION

The crested newt is predominantly a European species. On the territory of Russia, it is distributed in the central regions of the European part (where the northern border of its range passes). The eastern limit of its distribution includes the western macroslope of the Ural Mountains. In Perm oblast, it occurs mainly in the middle and southern parts (Chashchin and Solovieva, 1969), the northernmost find was made in the vicinity of the city of Solikamsk (Khazieva and Bolotnikov, 1972). Although *T. cristatus* has the status of LC in the International Red Book, a species that causes the least concern in terms of population decline (Arntzen et al., 2009), it is listed in the Red Books of Latvia, Lithuania, and Estonia. At the border of its range, the species is endangered and certainly deserves protection (Terhivuo and Mannerkoski, 2010). It has been established that the abundance of the crested newt in Europe is declining everywhere (Denoël, 2012). In Russia, it is included in the regional Red Books: Arkhangelsk, Bryansk, Vologda, Ivanovo, Kursk, Leningrad, Lipetsk, Moscow, Tambov, Tver, Ulyanovsk, Chelyabinsk, Sverdlovsk, and Kurgan oblasts, the cities of Moscow and St. Petersburg, and the Republics of Bashkortostan, Karelia, Tatarstan, and Chuvashia. It is believed that on the eastern slope of the Urals the border of the range passes in the Southern Trans-Urals through the Chelyabinsk and Kurgan regions, where it is very rare (Kuzmin, 2012). Deforestation, urbanization, pollution with pesticides, and clearing of ponds have a negative impact on the distribution of the crested newt (Sharygin and Ushakov, 1979; Manteifel and Bastakov, 1989; Lada and Sokolov, 1995; Kuzmin, 2012). Under anthropogenic transformation of habitats, it dies out faster than other species of syntopic amphibians, due to the high sensitivity to the quality of hydrochemical parameters (Kuzmin, 2012). The presence of fish in spawning ponds and disruption of the exchange between individual metapopulations of the crested newt can pose a threat to the reproduction of the species (Vuorio et al., 2016). The appearance of an invasive species like the Amur sleeper (*Perccottus glenii* (Dybowski 1877)) can have a significant impact on the distribution and abundance of *T. cristatus* (Reshetnikov, 2003).

In 1996 *T. cristatus* was included in the Red Book of the Middle Urals, category III, as a rare, small species on the periphery of the range. In the Red Book of Sverdlovsk oblast (Vershinin and Berzin, 2018), the status of the crested newt is category II.

The availability of information on *T. cristatus* outside the European part of the range needs broad revision. Studies to clarify the status and distribution of the crested newt have shown that the presence of the species in the Polevskoi and Sysert districts of Sverdlovsk oblast (Toporkova, 1973), as well as information on a number of locations in Chelyabinsk oblast (Lagunov et al., 2006; Perepelkin, 2016; Vandyshev, 2019; Gashek and Krasutskii, 2020), but, unfortunately, have not received actual confirmation. Errors in a number of reports cannot be ruled out (Perepelkin, 2016); it is also possible that since the observations of *T. cristatus* in these areas, there have been changes in its range. At the same time, there are individual publications on finds confirming the existence of a number of populations of the crested newt in Krasnoufimskii district of Sverdlovsk oblast (Ishchenko, 2018; Polyakov et al., 2018). To save the species and clarify the status of *T. cristatus* in territories where it has a protected status, as well as on the border of the range, data on abundance and population structure are needed. This study was carried out in order to study the specifics of the populations and get an idea of the status of the crested newt on the eastern border of its distribution.

MATERIALS AND METHODS

The material was collected on the eastern periphery of the range of the crested newt in habitats located on the territory of the northwestern part of the Nyazepetrovskii district, in the village of Shemakha, Chelyabinsk region (56°15′2.58″ N, 59°16′36.18″ E; h = 257 m), as well as in the southwestern part of Krasnoufimskii district of Sverdlovsk region, in the village of Bolshoe Koshaevo (56°50′26.33″ N, 57°33′13.68″ E; h = 239 m) and the village of Upper Irga (56°48′13″ N, 57°34′57.30″ E; h = 245 m). The material was collected in the spring–summer period of 2016–2021. The total number of animals studied is 383 specimens (253 adults, 23 juveniles, 13 underyearlings, and 94 larvae). The total spring trapping of animals was carried out using a blind trawling water net; in the summer, underyearlings were caught by hand.

The main standard body measurements for caudate amphibians were carried out (Terentiev and Chernov, 1949; Bannikov et al., 1977). Morphometry was performed using a Kraftool digital caliper (Germany) with a division value of 0.01 mm. The stage of development, sex, and the presence of external morphological anomalies were also noted, which were determined in accordance with modern classifications (Vershinin, 2015; Henle et al., 2017). The frequency of anomalies was compared using the χ^2 criterion (corrected by Yeats).

The counts of the number of adults of the crested newt (2018 and 2019) were carried out using a mass mark (amputation of one finger in whole or in part) with repeated captures in the spring during the water phase of the life cycle. In caudate amphibians, this mark is clearly visible for 2–3 months (regeneration after labeling lasts more than six months) (Griffith, 1984). After tagging, the animals were released into the habitat from which they were captured. The number of mature individuals was calculated using the Petersen–Lincoln formula (Petersen, 1896) modified by Bailey (Bailey, 1951):

$$N = r(n+1)/(m+1),$$

where r is the number of animals caught, tagged, and released on the first day; n is the number of animals caught on the second day; and m is the total number of tagged animals caught on the second day.

To estimate the abundance correctly, the Bailey standard error formula was used:

$$SE = [r^2(n+1)(n-m)/((m+1)^2(m+2))]^{1/2}.$$

The study of the chemical composition of spawning water bodies of the crested newt was carried out in the laboratory of engineering and environmental testing of AquaSolum LLC. To assess the state of water bodies, the following indicators were used: total mineralization, pH, and chemical oxygen demand (COD).

Statistical processing was carried out using the applied statistical packages Microsoft Excel and Statistica for Windows 7.0.

RESULTS AND DISCUSSION

A check of information on the distribution of the crested newt in the Middle Urals showed that the species is present on the western macroslope in the Krasnoufimskii district of Sverdlovsk oblast, where it was recorded in two habitats, as well as in Chelyabinsk oblast near the border with Sverdlovsk oblast (Fig. 1).

An analysis of the literature has shown that over the past 20 years, due to cross-citation of old sources, a significant amount of unverified, erroneous, and outdated information about the distribution of the crested newt on the Eastern macroslope of the Urals has been replicated from year to year. Use of survey data on the distribution of *T. cristatus* is another reason for the appearance of unreliable information due to the erroneous definition of the species by respondents who mistake males of the common newt for males of the crested newt. To date, information about all points located east of 57°–59° E has not been confirmed by any actual material evidence (collection collections of larvae, underyearlings, mature individuals, or their photographs) and cannot be considered as relevant modern data (Fig. 1). Thus, a number of the habitats cited with reference to data from the publication by Sabaneev (1874) are of no value other than historical. In general, out of the 16 sites cited by a number of authors (Kuzmin, 2012; Chibilev, 2003, 2005; Vershinin, 2007; Litvinchuk and Borkin, 2009), only two of them were confirmed by actual material on mature individuals (in the area of the Nizhne-Irginskaya oak forest, 114 specimens were found, and in the city of Krasnoufimsk, one specimen). In addition, one new point was found in the northwestern part of Chelyabinsk oblast (139 specimens).

Spawning reservoirs in Sverdlovsk oblast are located in the forest–steppe zone on the outskirts of the villages of Bolshoe Koshaevo and Verkhnyaya Irga, along the riverbed of the Irgina River. Of the other vertebrates in water bodies, there are the Prus-

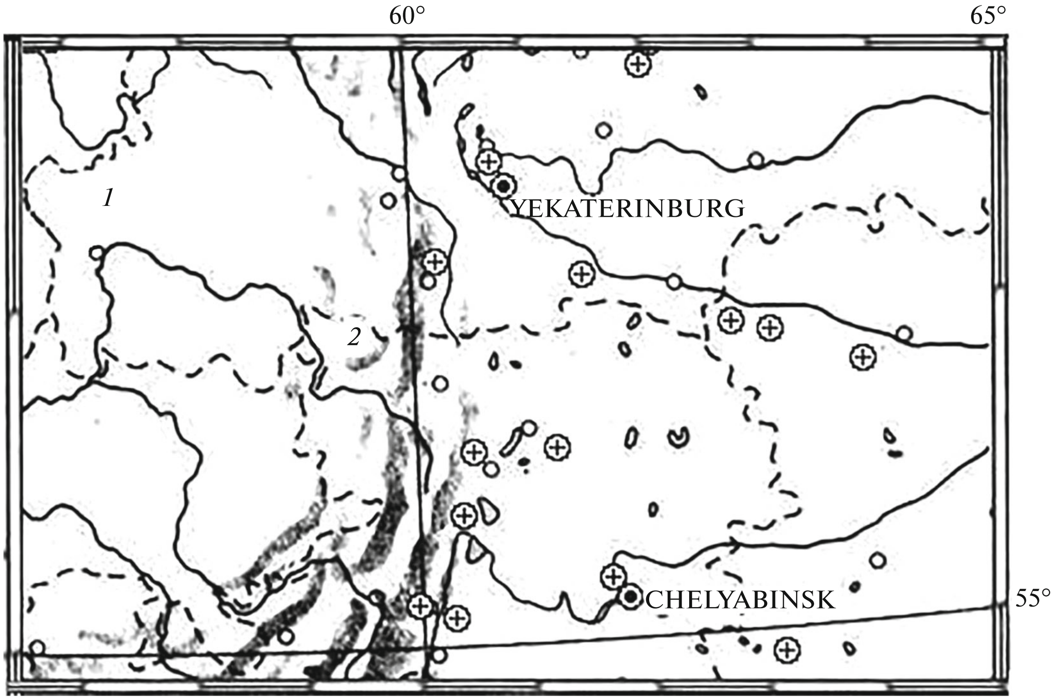

Fig. 1. Distribution of the crested newt on the northeastern border of the range: (*1*) Sverdlovsk oblast, Krasnoufimskii district, village of Big Koshaevo; (*2*) Chelyabinsk oblast, Nyazepetrovskii district, village of Shemakha. Dark circles are finds updated with actual data (collection materials); light circles with a cross are points not confirmed by actual material, but indicated in the literature.

sian carp (*Carassius gibelio* (Bloch 1782)), the common frog (*Rana temporaria* (L. 1758)), the moor frog (*Rana arvalis* (Nilsson 1842)), and the smooth newt (*Lissotriton vulgaris* (L. 1758)). The habitat is a series of karst funnels, some of which are inhabited by fish, *P. glenii* and *C. gibelio*. All ponds are moderately overgrown with aquatic vegetation. In Sverdlovsk oblast the crested newt is found in water bodies with a slightly alkaline pH and moderate mineralization (Table 1).

In Chelyabinsk oblast *T. cristatus* lives in a sloping pond (a reservoir that is built in the ravines and upper reaches of the valleys characterized by great depth) (Zhitin and Parakhnevich, 2003) of technogenic origin, which is located 5 m from the country road in the floodplain of the Shemakha River. Other amphibians include *R. arvalis*. The soil in the reservoir is clayey, peaty. The waters are eutrophic, rather mineralized, with a slightly alkaline pH (Table 1). Contamination with domestic waste is not ruled out, since the pond is adjacent to low-rise buildings and is often visited by farm animals. The reservoir is filled with abundant aquatic vegetation, among which there are star duckweed (*Lemna trisulca* (L. 1753)), common duckweed (*Lemna minor* (L. 1753)), and common bladderwort (*Utricularia vulgaris* (L. 1753)). Along the banks and on the surface of the water, there are clumps of sphagnum (*Sphagnum* sp.).

Nearby is a vast swampy area (more than 1000 m long) where the crested newt has also been recorded.

In many parts of its range, the distribution of the crested newt is mosaic. So, in Chelyabinsk oblast, out of ten reservoirs surveyed that are located in the terri-

Table 1. Physical and hydrochemical parameters of spawning water bodies

Region	*t*, °C	pH	COD, mg/L	Mineralization, mg/L	Max depth, m	Area of the water body, m^2	Origin
Chelyabinsk (*n* = 5)	18.6 ± 1.2 15.0–22.0	7.3 ± 0.2 7.0–7.8	22.3 ± 3.8 13.2–34.8	375.6 ± 148.3 132.0–960.0	1.8	1522.0	Technogenic
Sverdlovsk (*n* = 5)	16.0 ± 1.1 13.0–18.0	7.6 ± 0.2 7.1–7.9	13.2 ± 4.4 5.6–25.2	186.3 ± 50.9 90.0–330.0	4.0	472.0	Karst

n is the number of samples, COD is the chemical oxygen demand. For the characteristics of the aquatic environment: the top line is the mean ± the error of the mean, and the bottom line is the limits.

Table 2. The population of *T. cristatus* in the populations studied

Oblast	Adults, specimens	Larvae, specimens	Presence of other vertebrates
Chelyabinsk (Pond 1)	187 ± 103 (2018)	873 ± 292 (2017)	*R. arvalis*
Sverdlovsk (Pond 1)	42 ± 21 (2019)	No data	*C. gibelio, P. glenii, R. temporaria, L. vulgaris, R. arvalis*
Sverdlovsk (Pond 2)	49 ± 19 (2019)	No data	*R. temporaria, R. arvalis, L. vulgaris*

tories adjacent to the find site, *T. cristatus* was found in one, and in Sverdlovsk oblast, it was found in four reservoirs out of 25 surveyed. For two of the spawning ponds studied, for the first time in the Ural region, data on the number of the reproductive core of the populations were obtained (Table 2).

It was found that in the surveyed habitat in Chelyabinsk oblast the abundance of the crested newt is 3.5 times higher than in Sverdlovsk oblast. The noted differences can be due to both physical (differences in temperature) and biotic (food supply, the presence of predatory fish) reasons.

The presence of the Amur sleeper has a significant effect on the distribution and abundance of *T. cristatus,* negatively affecting the abundance of, first of all, tailed amphibians (Reshetnikov, 2003). According to the information received from the residents of the village of Bolshoye Koshaevo, from 1992 to 2019 the Amur sleeper settled in 20 nearby water bodies, which led to the disappearance of the crested newt from these habitats. Captures carried out a year later showed the elimination of crested and common newts as a result of the invasion of the Amur sleeper at the confluence of sinkholes during the spring flood of 2021.

Water in the technogenic pond of Chelyabinsk oblast warms up well. The high mineralization of water promotes the development of aquatic vegetation and a large number of aquatic invertebrates as potential food objects (Table 1). These factors determine the successful habitation and reproduction of *T. cristatus* in the conditions of the sharply continental climate of the Middle Urals.

It has been established that the sex ratio in the reproductive core of the population is slightly shifted towards the predominance of females (in Sverdlovsk oblast at 58% and in Chelyabinsk oblast at 51%). Analysis of the main morphological features of the crested newt at the eastern border of the distribution (Table 3, Fig. 2) showed that, in general, females, in comparison with males, have a significantly longer body length (by more than 5 mm) ($F_{(1, 250)} = 44.294$, $p = 0.00001$), absolute head size ($F_{(1, 250)} = 16.476$, $p = 0.00007$), and tail length (6 mm more) ($F_{(1, 249)} = 69.923$, $p = 0.00001$). Accordingly, there were gender differences in the relative head size ($F_{(1, 250)} = 20.831$, $p = 0.00001$) and relative tail length ($F_{(1, 249)} = 7.9432$, $p = 0.05$).

The body length of underyearlings is significantly ($F_{(1, 11)} = 28.312$, $p = 0.00024$) greater in Sverdlovsk oblast. The length of the head is also longer ($F_{(1, 11)} = 20.558$, $p = 0.00085$), as are the tail ($F_{(1, 11)} = 48.016$, $p = 0.00002$) and relative tail ($F_{(1, 11)} = 19.492$, $p = 0.00104$) lengths.

Immature animals are significantly larger ($F_{(1, 21)} = 16.028$, $p = 0.00064$) in the population from Chelyabinsk oblast by 8 mm, and, accordingly, the absolute length of the tail ($F_{(1, 21)} = 17.931$, $p = 0.0004$) and head ($F_{(1, 21)} = 12.817$, $p = 0.002$), but not their respective indices.

The absolute sizes of the animals of the studied populations (and the limits of their variability) are generally similar to those in other parts of the species range (Table 4). As a rule, the body length of females *T. cristatus* exceeds the body length of males. The large body size of females is positively associated with fertility, which is typical for most amphibian species. The established differences in the proportions of the body of males and females should be associated with their identification value for mature animals during the breeding season (Table 3, Fig. 2). There were no interpopulation differences in the main morphometric parameters of adult animals.

Unusual for the studied populations was the high frequency and the wide range of morphological abnormalities, which differ from the data for northwestern Russia (7.5% ($n = 40$) and three variants of anomalies in mature animals) (Litvinchuk, 2014). The occurrence of anomalies is higher in the population of Sverdlovsk oblast compared with Chelyabinsk oblast, both in underyearlings with 66.7 versus 38.5%, and in adults at 43.2 versus 16.3% ($\chi^2 = 9.42$, $p = 0.002$), respectively. Moreover, if in Chelyabinsk oblast the frequency of anomalies in males (15.3%) and females (13.4%) does not differ significantly ($\chi^2 = 0.00$, $p =$

Table 3. Morphological features of *T. cristatus*

Oblast	L, mm lim	Lc, mm lim	Lcd, mm lim	L-Lc/Lc Lim	L/Lcd lim	Pa/Pp lim	Sex	*N*
Chelyabinsk	63.9 ± 0.7 49.8–73.9	13.1 ± 0.1 11.2–15.2	55.4 ± 0.7 43.2–61.9	3.9 ± 0.04 2.8–4.6	1.2 ± 0.01 0.9–1.4	1.0 ± 0.2 0.8–1.2	Males	67
	68.3 ± 0.7 56.1–81.3	13.5 ± 0.1 11.4–15.8	62.3 ± 0.7 40.0–83.0	4.1 ± 0.04 3.1–4.8	1.1 ± 0.01 0.8–1.4	1.0 ± 0.1 0.8–1.3	Females	72
	30.3 ± 0.5 28.1–33.1	8.2 ± 0.1 7.8–8.9	23.5 ± 0.4 21.7–25.9	2.7 ± 0.0 2.6–2.9	1.3 ± 0.0 1.2–1.4	1 ± 0.0 0.9–1.1	Underyearlings	10
	45.8 ± 1.1 43.4–55.5	11.0 ± 0.1 9.9–11.6	41.6 ± 0.9 37.0–49.7	3.2 ± 0.1 2.9–3.8	1.1 ± 0.0 1.0–1.2	1.0 ± 0.0 0.8–1.1	Juveniles	16
Sverdlovsk	61.7 ± 0.9 49.1–73.2	12.9 ± 0.1 11.3–15.1	52.8 ± 0.9 44.5–60.1	3.8 ± 0.05 3.0–4.3	1.2 ± 0.01 1.0–1.3	1.4 ± 0.2 0.9–1.0	Males	47
	67.5 ± 0.7 48.0–86.1	13.6 ± 0.1 11.4–18.8	58.9 ± 0.7 41.5–77.0	4.0 ± 0.04 2.2–4.6	1.2 ± 0.01 1.0–1.5	1.0 ± 0.2 0.8–1.1	Females	67
	34.7 ± 0.1 34.5–34.9	9.1 ± 0.1 9.0–9.2	31.5 ± 2.1 28.6–34.6	2.8 ± 0.0 2.8–2.9	1.1 ± 0.1 1.0–1.2	1.1 ± 0.1 1.0–1.2	Underyearlings	3
	37.9 ± 1.7 33.0–42.4	9.9 ± 0.4 8.8–11.0	34.0 ± 1.8 28.5–39.6	2.8 ± 0.1 2.5–3.1	1.1 ± 0.0 1.0–1.2	1.0 ± 0.0 0.9–1.1	Juveniles	7

For each indicator, the top line is the mean ± the error of the mean; the bottom line is the limits.

Table 4. Morphological indicators of *T. cristatus* for other parts of the range

Place of research	Sex	L, mm	Lcd mm	L/Lcd mm	Pa/Pp	Author
Western Balkans	Males	No data	No data	No data	No data	Furtula et al., 2008
	Females	60.1–80.7				
France	Males	64.8 62.3–67.0	No data	No data	No data	Arnzen, 2000
	Females	73.9 71.2–76.5				
Norway	Males	67.3 64.8–69.8	No data	No data	No data	Arnzen, 2000
	Females	59.3 56.8–61.7				
Russia and neighboring countries	Males	59.8 ± 5.6 47.0–77.0	50.4 ± 4.6 37.0–67.0	1.19 ± 0.08 0.97–1.56	0.96 ± 0.07 0.73–1.26	Litvinchuk and Borkin, 2009
	Females	65.1 ± 6.7 50.0–89.8	57.0 ± 5.5 43.2–80.0	1.14 ± 0.06 0.96–1.44	0.98 ± 0.06 0.82–1.26	

0.945), then in Sverdlovsk oblast, the incidence of anomalies in males (46.8%) is significantly ($\chi^2 = 5.54$, $p = 0.02$) higher than in females (23.9%). In adult animals, in general, the spectrum includes 11 variants of deviations: ectrodactyly, syndactyly, schizodactyly, oligodactyly, polydactyly, ectromelia, anophthalmia, pigmented deviations, neoplasms, thickening of the bones of the limbs, and anomalies of the swimming fold (ten variants in Chelyabinsk oblast and 11 in Sverdlovsk oblast). Anomalies of the distal parts of the limbs predominate: extra-, schizo-, and syndactyly. It is possible that a significant proportion of deviations is due to the fact that the studied populations are the limit of the distribution of the crested newt in the northeast, where habitat conditions are far from optimal for this Central European species. The higher frequency of deviations in the population of Sverdlovsk oblast is probably due to its more northerly position, as well as the syntopic habitation of newts with fish (Litvinchuk, 2014) during the breeding season.

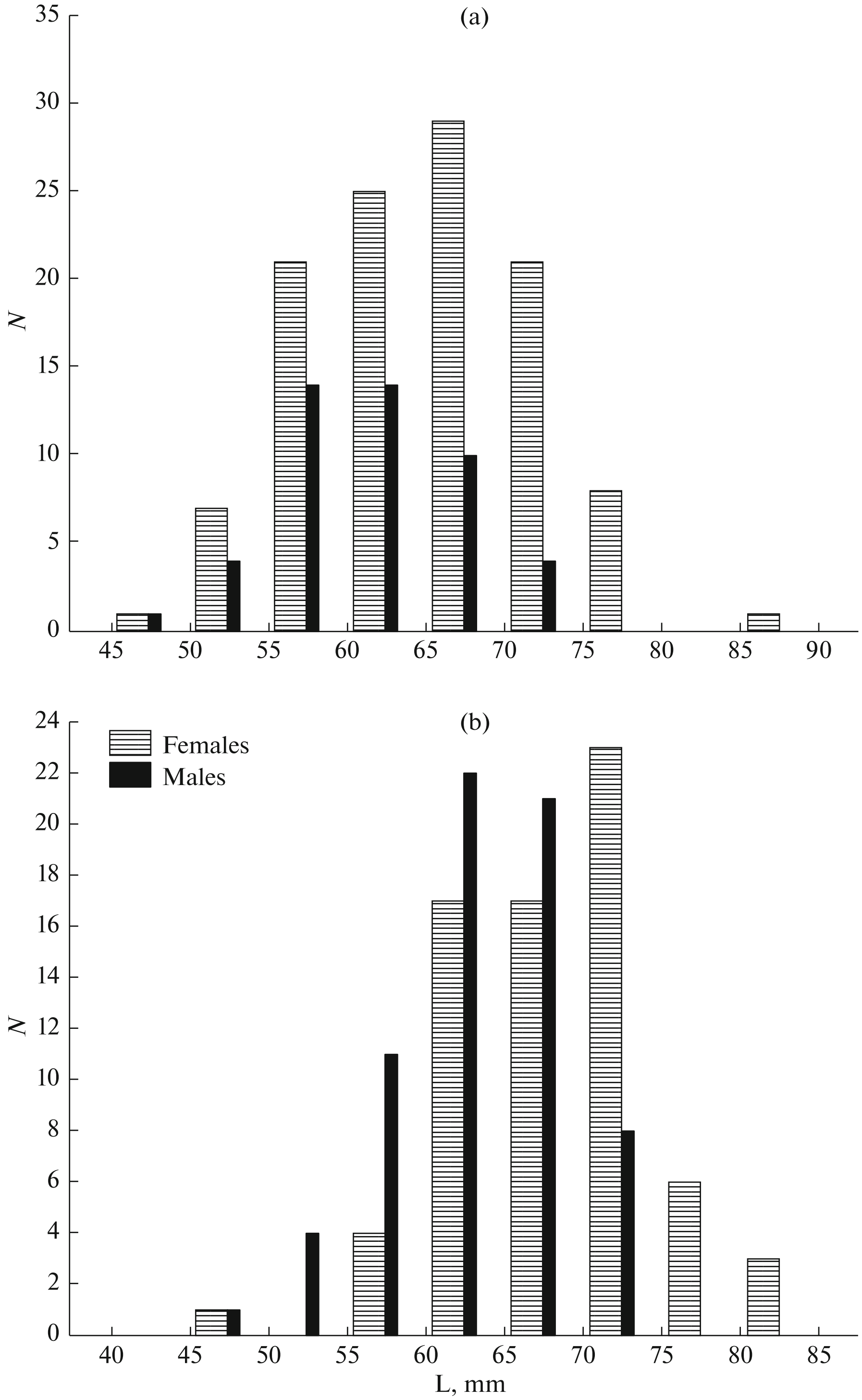

Fig. 2. Distribution along the length of the body of sexually mature individuals: (a) Sverdlovsk oblast; (b) Chelyabinsk oblast.

In the conditions of the mountainous country of the Urals, from west to east, there is an increase in the continentality of the climate, which is expressed in a decrease in heat and moisture supply. Thus, the eastern macroslope of the Urals has a low hydrothermal coefficient, 1.26 versus 1.5–1.6 on the western side (Dyachenko, 1997).

The distribution of the crested newt on the eastern border of the range depends on a combination of a complex of favorable and limiting factors. Favorable factors include the presence of sufficiently deep (more than 2 m) water bodies acceptable for spawning, an alkaline pH of the environment, the presence of aquatic vegetation, and places for wintering in the form of karst cavities with stable positive winter temperatures. The limiting factors are the continentality of the climate, the presence of predatory fish in spawning waters, primarily the Amur sleeper, and the anthropogenic transformation of habitats (Petrovsky, 2021).

T. cristatus in the Middle Urals is rare and was initially distributed in a mosaic pattern (Litvinchuk and Borkin, 2009; Vershinin and Berzin, 2018) due to the physical and geographical features of the territory. Currently, there is a reduction in the range of *T. cristatus* associated with the dispersal of the invasive species *P. glenii*, as well as the increased degradation of the state of the environment.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interests. The authors declare that they have no conflict of interest.

Statement on the welfare of animals. All applicable international, national, and/or institutional guidelines for the care and use of animals have been followed.

REFERENCES

Arntzen, J.W., A growth curve for the newt *Triturus cristatus, J. Herpetol*., 2000, vol. 34, no. 2, pp. 227–232.

Arntzen, J.W., Kuzmin, S., Jehle, R., Beebee, T., Tarkhnishvili, D., Ishchenko, V., Ananjeva, N., Orlov, N., Tuniyev, B., Denoël, M., Nyström, P., Anthony, B., Schmidt, B., and Ogrodowczyk, A., *Triturus cristatus*, IUCN Red List of Threatened Species. Version 2012.2, Short citation: Jan Willem Arntzen et al., e.T22212A9365894. Updated December 7, 2021.
https://doi.org/10.2305/IUCN.UK.2009.RLTS.T22212A9365894

Bailey, N., On estimating the size of mobile populations from recapture data, *Biometrika*, 1951, vol. 38, pp. 293–306.

Bannikov, A.G., Darevskii, I.S., and Ishchenko, V.G., *Opredelitel' zemnovodnykh i presmykayushchikhsya fauny SSSR* (Identification Guide to Amphibians and Reptiles of the Fauna of the USSR), Moscow: Prosveshchenie, 1977.

Chashchin, S.P. and Solov'eva, N.S., Reptiles, amphibians, and fish of the Perm region, in *Kalendar'-spravochnik Permskoi oblasti na 1970 g.* (Calendar-Reference Book of the Perm Region for 1970), Perm, 1969, pp. 176–180.

Chibilev, E.A., Batracho- and herpetofauna of the city of Chelyabinsk and its environs, in *Materialy 1 Mezhdunar. nauch.-prakt. konf.* "*Zhivotnye v antropogennom landshafte*" (Proc. 1 Int. Sci.-Pract. Conf. "Animals in the Anthropogenic Landscape"), Astrakhan: Astrakhan. Gos. Univ., 2003, pp. 73–76.

Chibilev, E.A., Data on the herpetofauna of the Chelyabinsk region taking into account the findings of the 2005 season (with distribution maps). http://www.steppe.ru/article-topic-3.html.

D'yachenko, A.P., *Flora listostebel'nykh mkhov Urala* (Bryopsida Flora in the Urals), Yekaterinburg: Ural. Gos. Univ., 1997, part 1.

Denoël, M., Newt decline in Western Europe: highlights from relative distribution changes within guilds, *Biodiversity Conserv*., 2012 vol. 21, no. 11, pp. 2887–2898.

Furtula, M., Ivanović, A., Džukić, G., and Kalezić, M. L., Egg size variation in crested newts from the western Balkans (Caudata, Salamandridae, *Triturus cristatus* superspecies), *Zool. Stud*., 2008, vol. 47, no. 5, pp. 585–590.

Gashek, V.A. and Krasutskii, B.V., Records of rare species of amphibians and reptiles in the Chelyabinsk region, *Fauna Urala Sib*., 2020, no. 1, pp. 48–50.

Griffith, R.A., Seasonal behaviour and intrahabitat movements in an urban population of a smooth newts, *Triturus vulgaris* (Amphibia: Salamandridae), *J. Zool*., 1984, vol. 5, no. 2, pp. 241–251.

Henle, K., Dubois, A., and Vershinin, V., Commented glossary, terminology, and synonymies of anomalies in natural populations of amphibians, *Mertensiella*, 2017, vol. 25, pp. 9–48.

Ishchenko, V.G., To the distribution of amphibians and reptiles in the Sverdlovsk region, *Fauna Urala Sib*., 2018, no. 2, pp. 72–74.

Khazieva, S.M. and Bolotnikov, A.M., Amphibians of the Perm region, *Uch. Zap. Perm. Gos. Pedagog. Inst*., 1972, vol. 107, pp. 54–61.

Kuz'min, S.L., *Zemnovodnye byvshego SSSR* (Amphibians of the Former USSR), Moscow: KMK, 2012.

Lada, G.A. and Sokolov, A.S., Rare amphibians of the Central Chernozem region, in *Materialy Ros.-Ukr. Nauchn. Konf. "Problemy sokhraneniya raznoobraziya prirody stepnykh i lesostepnykh regionov"* (Proc. Ross.-Ukr. Sci. Conf. "Problems of Preserving the Diversity of the Nature of the Steppe and Forest-Steppe Regions"), Moscow: KMK, 1995, pp. 231–232.

Lagunov, A.V., Veisberg, E.I., Zakharov, V.D., Kulikov, P.V., and Chichkov, B.M., Specially protected natural areas of the forest-steppe zone of the Chelyabinsk region, in *Stepi i lesostepi Zaural'ya: materialy k issledovaniyam* (Steppes and Forest-Steppes of the Trans-Urals: Materials for Research), Chelyabinsk: Krokus, 2006, pp. 97–131.

Litvinchuk, S.N., Anomalies in two species of newts in the northwest of Russia: a comparative analysis, in *Materialy mezhdunar. shkoly-konf. "Anomalii i patologii amfibii i reptilii: metodologiya, evolyutsionnoe znachenie, vozmozhnost' otsenki zdorov'ya sredy"* (Proc. Int. School-Conf. "Anomalies and Pathologies of Amphibians and Reptiles: Methodology, Evolutionary Significance, the Possibility of Assessing the Health of the Environment"), Yekaterinburg: Ural. Univ., 2014, pp. 127–135.

Litvinchuk, S.N. and Borkin, L.Ya., *Evolyutsiya, sistematika i rasprostranenie grebenchatykh tritonov (Triturus cristatus complex) na territorii Rossii i sopredel'nykh stran* (Evolution, Taxonomy, and Distribution of Crested Newts (*Triturus cri-*

status Complex) in Russia and Neighboring Countries), 2009.

Manteifel', Yu.B. and Bastakov, V.A., Amphibians of the Lake Glubokoe Nature Reserve: abundance and behavior, in *Zemnovodnye i presmykayushchiesya Moskovskoi oblasti* (Amphibians and Reptiles of the Moscow Region), Moscow, 1989, pp. 70–80.

Perepelkin, O.N., Finds of crested newt and Siberian salamander in the Kusinsky district of the Chelyabinsk region, in *Aktual'nye voprosy sovremennogo estestvoznaniya Yuzhnogo Urala* (Topical Issues of Modern Natural Science of the Southern Urals), Chelyabinsk, 2016, pp. 152–156.

Petersen, C.G.J., The yearly immigration of young plaice into Limfjord from the German Sea, *Rep. Biol. Stn.*, 1896, vol. 6, pp. 1–48.

Petrovskii, A.B., The current state of amphibians in the territory of the "old" Moscow, in *Voprosy gerpetologii. Progr. i tez. dokl. VIII c"ezda Gerpetol. obshchestva im. A.N. Nikol'skogo "Sovremennye gerpetologicheskie issledovaniya Evrazii"* (Issues of Herpetology, VIII Congr. Nikolsky Gerpetol. Soc. "Modern Herpetological Studies of Eurasia," Program and Abstracts of Papers), Moscow, 2021, pp. 22–23.

Polyakov, V.E., Gurin, A.E., and Eremenko, I.N., New records of protected species of amphibians and reptiles in the Sverdlovsk region, *Fauna Ural Sib.*, 2018, no. 2, pp. 75–77.

Reshetnikov, A.N Effect of Amur sleeper *Perccottus glenii* on amphibians in small water bodies, *Extended Abstract of Cand. Sci. (Biol.) Dissertation*, Moscow, 2003.

Sabaneev, L.P., *Pozvonochnye Srednego Urala i geograficheskoe rasprostranenie ikh v Permskoi i Orenburgskoi guberniyakh* (Vertebrates of the Middle Urals and Their Geographical Distribution in the Perm and Orenburg Provinces), Moscow, 1874.

Sharygin, S.A. and Ushakov, V.A., Amphibians and reptiles in large cities, in *Ekologo-faunisticheskie issledovaniya v nechernozemnoi zone RSFSR* (Ecological and Faunal Research in the Non-Chernozem Zone of the RSFSR), Saransk, 1979, no. 2, pp. 83–96.

Terent'ev, P.V. and Chernov, S.A., *Opredelitel' presmykayushchikhsya i zemnovodnykh* (Identification Guide to Reptiles and Amphibians), Moscow: Sovetskaya Nauka, 1949.

Terhivuo, J. and Mannerkoski, I., Reptiles and amphibians, in *The 2010 Red List of Finnish Species*, Rassi, P., Hyvärinen, E., Juslén, A., and Mannerkoski, I., Eds., Helsinki: Ympäristöministeriö and Suomen ympäristökeskus, 2010, pp. 332–335.

Toporkova, L.Ya., Amphibians and reptiles of the Urals, in *Fauna evropeiskogo Severa, Urala i Zapadnoi Sibiri* (Fauna of the European North, Urals, and Western Siberia), Sverdlovsk, 1973, pp. 84–117.

Vandyshev, D.I., Tailed amphibians of the water bodies of Chelyabinsk: a study of their population reduction, in *Proba pera. Sbornik tezisov dokl. shkol'nikov – uchastnikov XXVI Mezhdunar. nauch. konf. "Lomonosov-2019"* (First Attempt at Writing: Schoolchildren–Participants of the XXVI Int. Sci. Conf. "Lomonosov-2019," Collection of Abstracts), Sevastopol, 2019, pp. 27–30.

Vershinin, V.L., *Amfibii i reptilii Urala* (Amphibians and Reptiles of the Urals), Yekaterinburg: Ural. Otd. Ross. Akad. Nauk, 2007.

Vershinin, V.L., *Osnovy metodologii i metody issledovaniya anomalii i patologii amfibii* (Fundamentals of Methodology and Methods for Studying Anomalies and Pathologies in Amphibians), Yekaterinburg: Ural. Univ., 2015.

Vershinin, V.L. and Berzin, D.L., Crested newt *Triturus cristatus* (Laurenti, 1768), in *Krasnaya kniga Sverdlovskoi oblasti: Zhivotnye. Rasteniya. Griby. Ekaterinburg* (Red Data Book of the Sverdlovsk Region: Animals, Plants, and Fungi), Voronezh: Mir, 2018.

Vuorio, V., Reunanen, P., and Tikkanen, O.P., Spatial context of breeding ponds and forest management affect the distribution and population dynamics of the great crested newt, *Ann. Zool. Fenn.*, 2016 vol. 53, nos. 1/2, pp. 19–34.

Zhitin, Yu.E. and Parakhnevich, T.M., *Landshaftovedenie: uchebnoe posobie* (Landscape Science: Textbook), Voronezh: Voronezh. Gos. Agrar. Univ., 2003.