Zoodiversity, **56**(5): 385–402, 2022
DOI 10.15407/zoo2022.05.385

UDC 598.112.11:001.8(477-25)

TO REGISTRATIONS OF BOTTOM MACROINVERTEBRATES, FISH, AMPHIBIANS AND REPTILES OF THE UPPER TSKHENISTSKALI RIVER BASIN (GEORGIA, LOWER SVANETIA)

O. Yu. Marushchak[1], S. A. Afanasyev[2*], O. M. Lietytska[2], O. O. Golub[2]

[1] Schmalhausen Institute of Zoology NAS of Ukraine,
vul. B. Khmelnytskogo, 15, Kyiv, 01030 Ukraine
[2] Institute of Hydrobiology NAS of Ukraine
**Corresponding author*
E-mail: safanasyev@ukr.net

O. Yu. Marushchak (https://orcid.org/0000-0001-9380-5593)
S. O. Afanasyev (https://orcid.org/0000-0002-5247-3542)
O. M. Lietytska (https://orcid.org/0000-0001-7026-4093)

To Registrations of Bottom Macroinvertebrates, Fish, Amphibians and Reptiles of the upper Tskhenistskali River Basin (Georgia, Lower Svanetia). Marushchak, O. Yu., Afanasyev, S. A., Lietytska, O. M., Golub, O. O. — This paper contains information on the records of bottom macroinvertebrates, fish, amphibians and reptiles collected during a field expedition to the valley of the river Tskhenistskali (in the vicinities of town of Lentekhi and village of Sasashi) in April 2018. According to the results of the study, three fish species (Actinopterigii) of three families (Salmonidae, Cyprinidae and Nemacheilidae) inhabits three studied rivers (Kheledula, Devashi and Tskhenistskali Rivers). Seven species of reptiles (Squamata: Anguidae — 1, Colubridae — 1, Viperidae — 1, Lacertidae — 4), and five species of amphibians (Anura: Hylidae — 1, Bufonidae — 1, Ranidae – 2; Caudata: Salamandridae — 1) were registered within the investigated area. Around Lentekhi town three species of the genus *Darevskia* Arribas, 1999, namely *Darevskia rudis svanetica* (Darevsky & Eiselt, 1980), *Darevskia brauneri brauneri* (Mehely, 1909) and *Darevskia derjugini abchasica* (Bischoff, 1982) were found to live almost sympatrically, with only river serving as a natural barrier between the species. The paper also contains descriptions of habitats characteristic of the region for the species found and the results of route surveys with *D. d. abchasica* and *P. ridibundus* being the most numerous species of herpetofauna (sensu lato) — up to 35 and 20 individuals per 100 m of route. In order to illustrate the feeding base of the registered vertebrates, the study of species composition (n = 114) of bottom macroinvertebrates, that form the main component of food source for them. The recorded invertebrates belong to 16 taxonomic groups of the higher rank (up to 98.1 % of all benthic invertebrates appeared to be insects, including Ephemeroptera — 51 %, Plecoptera — 17.4 % Chironomidae — 14.2 %, Trichoptera — 11.5 %, Diptera — 3 %). Other groups, namely Turbellaria, Nematoda, Oligochaeta, Araneida, Acarina, Collembola, Heteroptera, Coleoptera, in total form a little less than 3 % of all recorded species. Registrations of fauna from mountain regions will help to update actual maps of natural ranges of the species within the country and tend to be a valuable addition to the data that can be potentially used in GIS-modelling of species' distribution according to predicted climate changes.

Key words: Georgia, bottom macroinvertebrates, fish, herpetofauna, species distribution, mountain rivers, Lower Svanetia, rivers, Tskhenistskali River basin.

Introduction

Actually, such groups of animals as macroinvertebrates, fish, reptiles and amphibians are extremely sensitive to the habitat loss, anthropogenic transformation and pollution. Some populations become extinct even before being discovered by scientists. Ecosystems of mountain rivers and their valleys remain the most preserved and at the same time the most vulnerable, while they are still poorly studied (Afanasyev et al., 2013). The impact on these watercourses is determined both by global climatic processes and by increased anthropogenic impact due to human economic, recreational and mining activities (Afanasyev, 2003; Afanasyev et al., 2014; Afanasyev et al., 2020). Therefore, collecting every possible data from such spots is a key factor for both tracking, monitoring and saving biodiversity on local level and global scale (Vasyliuk et al., 2022).

Intensification of anthropogenic pressure is a big threat to native biodiversity, especially in regions, that are difficult to reach thanks to their geographic position (Milius, 2010; Keil et al., 2015; Bjorkland & Bjorkland, 2021).

The scope of work covers biodiversity surveys and assessment, including invertebrates' abundance and diversity study; fish abundance and diversity study; study of semi-aquatic species diversity (frogs); study of reptiles' diversity.

The purpose of the following work is to highlight records of fauna (aquatic invertebrates, fish, amphibians and reptiles) from one of Caucasus mountain area that is hard to reach due to its geographical peculiarities. Therefore, such published data are a good addition to knowledge of seasonal numbers of populations adding new points to distribution maps of species of Georgian fauna.

Material and methods

The field surveys were conducted in April 2018. Surveys covered parts of the three rivers within the study area.

The Kheledula River, the largest tributary in the upper course of the Tskhenistskali River. It enters the Tskhenistskali at 110 r-km from its mouth. The total length of the river is 34 km; the catchment area is 315 km^2, the annual average flow here is 14.74 m^3/s. The river was studied from confluence with the Tskhenistskali River up to 1.5 km and one monitoring point 23 km from the source. There were two monitoring stations along the river: 1) Kheledi village (42.787194 N 42.652722 E); 2) 1.5 km upstream confluence with the Tskhenistskali River (42.791383 N 42.710458 E).

The Devashi River is a right bank tributary of the Tskhenistskali River six km below which there is a conditional boundary between the upper and middle parts of the basin. It enters the Tskhenistskali downstream confluence with the Kheledula at 108 r-km from the mouth. The total length of the river is 17.3 km, the annual average flow here is 3.18 m^3/s. The river was studied from confluence with the Tskhenistskali River up to 2.1 km. There were three monitoring stations along the river: 3) 2.1 km upstream confluence with the Tskhenistskali River (42.773106 N 42.708169 E); 4) 1 km upstream confluence with the Tskhenistskali River (42.771450 N 42.714211 E); 5) 0.7 km upstream confluence with the Tskhenistskali River (42.772094 N 42.718594 E).

The Tskhenistskali River that has its source is in the main range of the Caucasus Mountains, in the easternmost part of the Lentekhi municipality, lower Svanetia. It is a tributary of the Rioni River, being 176 km

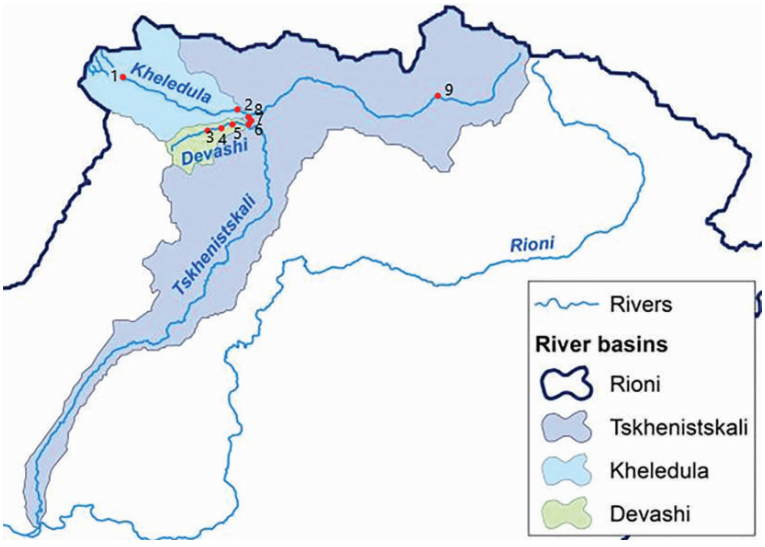

Fig. 1. Study area and sampling station.

long, and has a drainage basin of 2.120 km^2. Our studies on the riverbed and in its valley were carried out in the area of Lentekhi town and one monitoring point in upper reach (35 km from the source) (fig. 1). There were 4 monitoring stations along the river: 6) 0.05 km upstream confluence with the Devashi River (42.775539 N 42.725897 E); 7) 0.6 km upstream confluence with the Devashi River (42.778781 N 42.722631 E); 8) 1.2 km upstream confluence with the Devashi River (42.782731 N 42.722222 E); 9) 35 km from the source (Sasashi village) (42.792044 N 42.997658 E).

Macroinvertebrates were sampled using European Union (EU) the AQEM sampling method to be applied in software STAR (Schmidt-Kloiber et al., 2006). Based on the samples taken, the specifics of invertebrates composition of each of three investigated rivers was identified to the taxon level of family or higher.

Fish surveys were conducted in several places along the rivers within the study area. In total, 92 attempts were done using casting net (24 at Kheledula and Tskhenistskali confluence and 68 at Devashi), 25 attempts by landing net. In total, 12 adult fish specimen and 16 juvenile fish specimens were caught. The caught fish was measured; several scales were taken with purpose of the age identification and released. The only exemptions were two brown trout *Salmo trutta* Linnaeus, 1758 specimen and two Angora loaches *Barbatula (Oxynoemacheilus) angorae bureschi* (Steindachner, 1897) who got trauma during catching. They were fixed with formalin and transported to the laboratory of the Institute of Hydrobiology of National Academy of Sciences for further studies.

The registration of herpetofauna (amphibians and reptiles) took place in the Tskhenistskali River valley. Investigation area included the near-water areas of the Kheledula and Devashi Rivers near Lentekhi town, areas adjacent to the Tshenitshali River banks near Sasashi village. For all representatives of the herpetofauna found on the routes, the registration points were recorded (using GPS-recording in MapsMe mobile app v. 4.3.0) and then visualized in Google Earth 7.1.8.3036 (32-bit). All animals were studied in vivo using the route method (the width of the counting trail was 4 m (2 m on the right + 2 m on the left). The animals were photographed using an Olympus SP570UZ digital camera and released at the place of capture. Animals were registered visually, according to specific audial signals (Hylidae species) and as a result of survey of the local people with demonstrating of the animals' pictures. Species were identified according to the literature (Bannikov et al., 1977; Kuzmin, 2012) published morphological keys and remarkable features, and using resources available online (https://www.lacerta.de/AS/Home.php). Additionally, for identification of rock lizards from Darevskia complex literature resources highlighting key distinguishing features of folidosis and general morphology were used (Eiselt, Darevsky, 1991; Doronin et al., 2013; Doronin, 2017). Identification of morphological anomalies was made following the work of V. Vershinin (Vershinin, 2015).

Results

Macroinvertebrates

A total of 114 species of macroinvertebrate were registered within the studied rivers, belonging to 16 taxonomic groups of the higher rank. Among them, insects dominate, accounting for up to 98.1 % of all benthic invertebrates, including Ephemeroptera — 51 %, Plecoptera — 17.4 % Chironomidae — 14.2 %, Trichoptera — 11.5 %, Diptera — 3 %. Other groups (Turbellaria, Nematoda, Oligochaeta, Araneida, Acarina, Collembola, Heteroptera, Coleoptera) in total a little more than 3 % (fig. 2).

The largest number of species was recorded for the larvae of caddisflies, nymphs of stoneflies and mayflies.

The caddisflies (Trichoptera) are represented by 28 species from 10 families, of which endemics and subendemics to the Caucasus are: *Agapetus oblongatus* Martynov, 1913; *Agapetus comatus* Pictet, 1834; *Apatania subtilis* Martynov, 1909; *Diplectrona juliarum* Grigorenko & Ivanov, 1991; *Glossosoma capitatum* Martynov, 1913; *Hydropsyche sciligra* Malicky, 1977; *Micrasema bifoliatum* Mart., 1925; *Philocrena trialetica* Lepneva, 1956; *Ptilocolepus colchicus* Martynov, 1913; *Plectrocnemia latissima* Martynov, 1913; *Polycentropus mazdacus* Schmid, 1959; *Stenophylax permistus* (MacLachlan, 1895); *Rhyacophila cupressorum* Martynov, 1913; *Rhyacophila* subovata Martynov, 1913; *Rhyacophila subnubila* Martynov, 1913; *Silo proximus* Martynov, 1913; *Trianodes internus* McL, 1877.

Eleven species of stoneflies' (Plecoptera) nymphs from 7 families were found, of which the endemics and subendemics to the Caucasus are: *Perla caucasica* Guérin-Méneville, 1838*; Perla pallida* Guérin-Méneville, 1838; *Isoperla caucasica* Balinsky, 1950; *Protonemura bifida* Martynov, 1928; *Taeniopteryx caucasica* Zhiltzova, 1981.

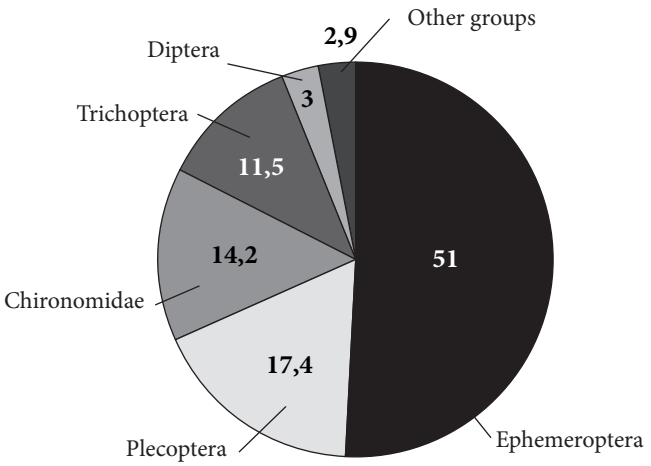

Fig. 2. Composition of invertebrates' communities within all studied monitoring stations.

Twelve species from three families are represented by mayflies (Ephemeroptera). Seven species have been reliably identified, of which three are endemic to the Caucasus, namely *Rhithrogena caucasica* Braasch, 1979; *Epeorus caucasicus* (Tshernova, 1938); *Baetis baksan* Soldán, 1977. Based on the samples taken, the specifics of invertebrates' composition of each of three investigated rivers are identified:

- in the Kheledula, the key invertebrates' community is Ephemeroptera, while Trichoptera, Diptera and Plecoptera (most of which are represented by Perlididae) are subdominant;
- in the Devashi the key invertebrates' community is Ephemeroptera; subdominant are Plecoptera (including large species such as Perlididae) and Diptera, actively developing in algae colonies of *Hydrurus* C. Agardh, 1824; there were much less Trichoptera fixed;
- in the Tskhenistskali, dominating communities included Ephemeroptera, Trichoptera and Plecoptera (as well as some large species of Perlididae); Diptera (predominantly Tabanidae, Ceratopogonidae & Athericidae) representatives were massively registered in few colonies of *Hydrurus*.

Based on the samples taken, the following indicators of abundance and biomass of bottom invertebrates were counted (table 1). It shows that the biomass is increasing downstream the rivers. The only exemption is in the mouth of the Devashi. In general,

Table 1. Number of individuals and biomass indicators for the groups of macroinvertebrates registered within the 9 monitoring stations during the field research

Monitoring station	1	2	3	4	5	6	7	8	9
Taxonomic group	Kheledula River		Devashi River			Tskhenistskali River			
Turbellaria	5	0	5	0	5	0	0	5	0
Nematoda	0	5	0	0	0	0	5	5	0
Oligochaeta	5	35	25	20	60	25	10	15	5
Amphipoda	0	0	0	0	0	0	0	5	0
Arachnida	5	0	0	0	5	0	0	0	0
Acarina	0	5	5	0	5	5	5	5	0
Collembola	0	0	0	5	5	0	0	0	0
Ephemeroptera	230	235	1815	2001	1960	1065	365	515	100
Plecoptera	28	105	600	415	770	250	210	320	135
Heteroptera	0	5	10	0	5	0	0	0	0
Neuroptera	0	0	0	0	5	5	5	0	0
Coleoptera	0	5	5	0	5	0	0	0	0
Trichoptera	10	295	120	245	330	300	250	355	70
Chironomidae	115	175	475	450	450	115	115	465	20
Simuliidae	0	5	35	0	5	0	5	25	5
Other Diptera	25	85	65	70	75	35	65	45	25
Number individuals/m^2	423	955	3160	3206	3685	1800	1035	1760	360
Biomass, gram/m^2	1.5	3	5.5	9	10.8	6.2	3.5	6	0.5

compared to other rivers of Svanetia (Afanasyev et al., 2022) abundance was at the same level, however, the biomass of invertebrates was slightly higher, mainly due to the large size of stoneflies Perlididae.

Actinopterygii

A total of three species of fish (Salmonidae — 1, Cyprinidae — 1, Nemacheilidae — 1) were registered within the investigated area.

Brown trout *Salmo trutta* (Linnaeus, 1758) (IUCN: LC (Least concern); Georgian Red List: VU (Vulnerable)) is a typical representative of mountainous rivers of Caucasus. It was caught at the confluence of the Kheledula and in the mouth reach of the river downstream Lentekhi village at the confluence with the Tskhenistskali (fig. 3, 6). In the Devashi River, the brown trout was found along the completely surveyed river reach (from mouth for 4 km upstream). Upper limit of the brown trout distribution reached 2500 m a. s. l. This if migratory species, which react on the change of water temperature. Normally in the upper Tskhenistskali the spawning takes place in autumn (October–November), when the water temperature is +4 +8 °C. Taking into account the water temperature variability depending on the year (hot / cold), spawning period should be defined each year. The spawning takes place in shallow places (25–65 cm deep with small fraction sediments (e. g. gravel) and flow velocity 0.8–1.5 m/s. The larvae grow during 4.5–6 months depending on the water temperature. The row turns into fries in the first decade of January; fry development until juvenile fish, which can downgrade lasts until the first decade of March. In case of severe winters, this period can be prolonged (Afanasyev et al., 2016, 2018, 2019). The wintering, spawning and fattening habitats for the brown trout were identified. Fattening of the fish takes place along the all investigated rivers. Wintering most probably takes in the Tskhenistskali River.

Colchic barbel *Barbus escerichia* (Steindacher, 1897) (IUCN: LC; Georgian Red List: VU) was represented by only one specimen had been caught in the mouth of Kheledula in the drift sample (fig. 4, 6). Its favorite habitats are grooves behind the boulders. According to our observations on other rivers of Svaneti the barbel can live up to 1100 m a. s. l. This species is one of the few ones, which got used to the rapid floods in the mountainous rivers. It was noted that barbel feds intensively during rain floods. The spawning period of colchic barbel is start of May until July. Barbel normally spawns at sandy–gravel riverbeds, when the water temperature is +11 °C. Juvenile barbel gradually downgrades from spawning grounds downstream to warmer places. Wintering of barbel takes place in grooves in the lower reaches of rivers (Afanasyev et al., 2016, 2018, 2019). It is absent in the Devashi, but most probably is present in the Kheledula.

Angora loach *Barbatula (Oxynoemacheilus) angorae bureschi* (Steindachner, 1897) (IUCN: LC). The juvenile angora loach was caught in the mouth of the Kheledula River

Fig. 3. Caught specimens of the brown trout (*S. trutta*).

Fig. 4. Caught specimens of the Colchic barbel (*B. escerichia*).

Fig. 5. Caught Angora loach *B. a. bureschi.*

and at the confluence with the Tskhenistskali River (fig. 5, 6). It lives in rivers and lakes. It spawning period is from May to June. The preferable spawning locations are shallow sandy or gravel riverbeds.

Amphibia

A total of 5 species of amphibians (Anura: Hylidae — 1, Bufonidae — 1, Ranidae — 2; Caudata: Salamandridae — 1) were registered within the investigated area.

Marsh frogs *Pelophylax ridibundus* (Pallas, 1771) (IUCN: LC; BC (Bern convention): Annex III) were found in the valleys of all three studied rivers. In particular, they were registered in the lower reaches of the Heledula and Devashi Rivers, along the entire length of the Tskhenistskali River, starting from Sasashi village (fig. 7, table 2). Their habitats included the floodplain part of mountain rivers, choosing well-heated areas of small floodplain water bodies with stagnant or weak-flowing water, overgrown with vegetation (grasses and shrubs). These reservoirs are extremely important for the reproduction of this species, as they are well suited for tadpoles' proper development. The species adapts well to anthropogenic pressure, being synanthropic in many places of its range. *Pelophylax ridibundus* tadpoles were observed en masse in all studied sites. Near Sasashi village, both tadpoles and adults were observed on a small plateau with mineral springs. The number was 15–20 adults per 100 m of the route. One individual were caught near a spring with iron-rich mineral water had an obvious morphological anomaly — anophthalmia (complete absence of an eye (Vershinin, 2015)) on the right side of the head (fig. 8, table 2).

Fig. 6. Map of records of the caught fish species: yellow — *S. trutta,* blue — *B. angorae;* red — *B. escerichia.*

Fig. 7. *P. ridibundus,* its habitat and registration points near Lentekhi town, Lower Svanetia; specimens are also shown in the table of records (table 2).

Long-legged wood frogs *Rana macrocnemis* Boulenger, 1885 (IUCN: LC; BC: Annex III) were found on the altitudes of up to 2400 m a. s. l. in deciduous, mixed and coniferous forests, bogs, mountain and foothill forests and alpine meadows near permanent water bodies: lakes, rivers, streams, etc., usually surrounded by dense herbaceous and shrubby vegetation. Although the species was found in the vicinity of human settlements, no representatives of the species were found within the borders of the settlements. *R. macrocnemis* individuals were found in the lower part of the Devashi River, in the studied points along the Tskhenistskali River in the area of the Lentekhi town and of Sasashi village (fig. 9, table 2). The mass of tadpoles was noted, and individual clutches of eggs (apparently late) were recorded. Several individuals were met sympatrically with *P. ridibundus*. In the breeding

Fig. 8. *P. ridibundus* with anophthalmia found near Sasashi village; specimens are also shown in the table of records (table 2).

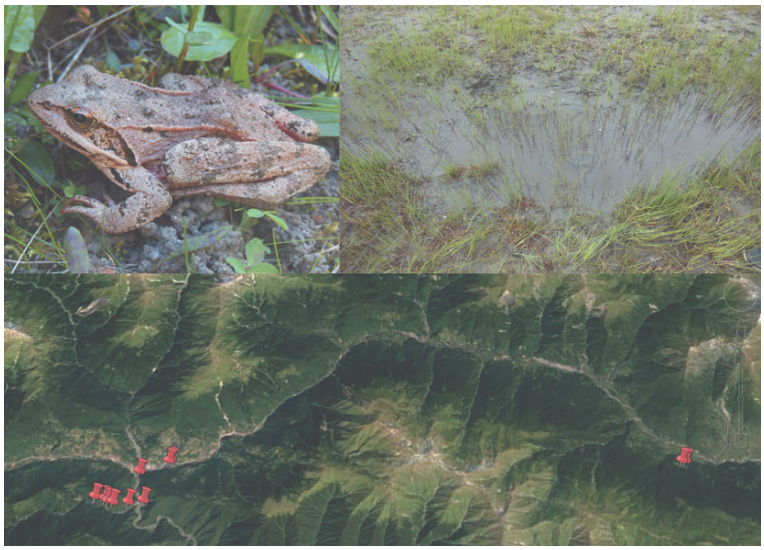

Fig. 9. *R. macrocnemis,* registration points and habitat in the vicinity Lentekhi town and Sasashi village, Lower Svanetia; specimens are also shown in the table of records (table 2).

ponds (Sasashi village, near the mineral spring), the number reached 8–10 individuals per 100 m of the route (continued spawning, males in the breeding coloration).

Variable toad *Bufotes sitibundus* (Schneider, 1799) (syn. *Bufotes variabilis* (Pallas, 1769) (IUCN: DD (Data deficient)) (Dufresnes et al., 2019) is represented by only three finds in Lentekhi town and its surrounding areas (fig. 10, table 2). Toads were found under stones, in the afternoon, in the town and in the floodplain part of the Devashi River claiming its high level of synanthropization along with other representatives of the genus (Kuzmin, 2012). This species has recently been isolated from the common green toads *Bufotes viridis* Laurenti, 1768 based on molecular studies. The distribution of the species in Georgia and the boundaries of the ranges are poorly studied. According to the latest molecular studies, the Caucasus Mountains are a natural barrier between the habitats of *B. viridis* and *B. sitibundus*. According to cartographic data based on molecular studies of

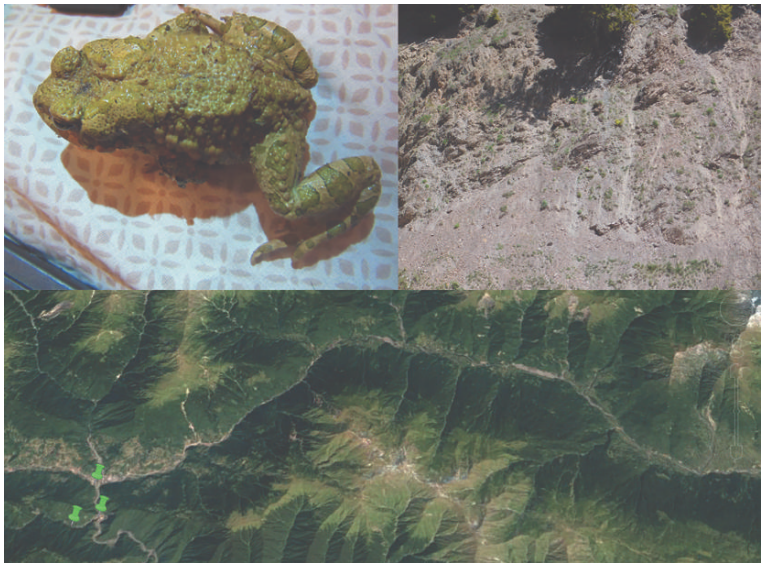

Fig. 10. *B. sitibundus,* registration points and habitat in the vicinity Lentekhi town, Lower Svanetia; specimens are also shown in the table of records (table 2).

Fig. 11. Places of registrations of audial signals from *H. orientalis* males, Lentekhi town, Lower Svanetia; specimens are also shown in the table of records (table 2).

samples from Turkey, Georgia, Russia and other countries (Özdemir et al., 2014; Dufrenes et al., 2019) we assume that our samples belong to the species *B. sitibundus* based on their location and coloration patterns.

Eastern tree frog *Hyla orientalis* (Linnaeus, 1758) (IUCN: LC; BC: II) was registered seven times (fig. 11, table 2) in the surroundings areas of Lentekhi town. All records were made following male mating calls near the banks of the Heledula and Tskhenistskali Rivers where this species uses floodplain reservoirs for reproduction. Individuals were not visually noted, but judging by the responses of local people such signals are quite common in their area and our registrations are just the beginning of the mating season. Typically, number of vocalizing males increases almost to several hundred till the end of May and therefore it can be assumed that a fairly large population is present in the study area. According to the literature data on the distribution of this species (Hosseinian et al., 2015) and character of vocalization, it is exactly *H. orientalis* that is found in the research area. Although additional studies using molecular methods could clarify the presence of this species in this area.

Presence of *Mertensiella caucasica* Waga, 1876 (IUCN: VU (Vulnerable); BC: III) in the research area was confirmed only by local residents. This information is considered to be true because such species as *M. caucasica* has no other similar-looking species in Georgia to be misinterpreted with.

Reptilia

A total number of seven species of reptiles (Squamata: Anguidae — 1, Colubridae — 1, Viperidae — 1, Lacertidae — 4) were registered during the investigation period.

Grass snake *Natrix natrix*, Linnaeus, 1758 (IUCN: LC; BC: III) was the only Colubridae species registered within the investigated territory. This species here inhabits coastal areas with sparse vegetation, shrubs and forests using this area both for hunting and laying eggs. *Natrix natrix* was found in large numbers in the upper reaches of the Tskhenistskali River (Sasashi village, 7–8 individuals per 100 m) and in the valley of the Devashi River (3–4 individuals per 100 m) (fig. 12, table 2).

Dinnik's viper *Vipera dinniki* Nikolski, 1913 (IUCN: VU; BC: III; Red data Book of Georgia: VU) was found only once (two individuals) in the valley of the Devashi River (fig. 13, table 2) at a distance of 1.4 km from its mouth. It inhabits subalpine being generally bounded to overgrown slopes of mountain rivers in highlands with open woodland. This herpetofagous species apparently thrive in the capture area due to numerous populations of *D. d. abchasica*.

Fig. 12. Places of registrations *N. natrix,* the species biotope and map of findings, Tshenitshali River, Georgia, Lower Svanetia; specimens are also shown in the table of records (table 2).

Eastern slowworm *Anguis colchica* (Nordmann, 1840) (BC: III) was registered twice: two specimens were found at a distance of 1200 meters from the mouth of the Devashi River upstream (fig. 14, table 2). A predator most likely killed one. The habitat of this species in Caucasus Mountains includes forests, slopes overgrown with low vegetation, in forest meadows and in an open steppe with shrubs. The lizard usually choose shaded, humid places, but it can crawl out in the sun or on a dry place, but not far from its shelter.

Sand lizard *Lacerta agilis grusinica* Peters 1960 (IUCN: LC; BC: II) was registered only in the mountain areas near Sasashi village (fig. 15, table 2). Ten individuals per 100 m of the route were found on the territory of the Tskhenistskali River floodplain near flowing streams with shrubs and rare woody vegetation. These lizards were found along with *N. natrix,* occupying the same basking places. Also, several individuals (n = 7) were recorded on a hill

Fig. 13. Places of registrations *V. dinniki,* the species biotope and map of findings, Devashi River, Georgia, Lower Svanetia; specimens are also shown in the table of records (table 2).

Fig. 14. Places of registrations of *A. colchica,* the species biotope and map of findings, Tshenitshali River, Georgia, Lower Svanetia; specimens are also shown in the table of records (table 2).

with a source of mineral water near Sasashi village, in an ecotone with a coniferous forest.

Artvin lizard *Darevskia derjugini abchasica* (Bischoff, 1982) (IUCN: NT (Near Threatened); BC: III) was the most numerous species of Lacertidae family registered during the expedition. The species was found along the entire right bank of the Tskhenistskali River from the mouth of the Devashi River to the mouth of the Heledura River (fig. 16, table 2); also these lizards were found on the entire left bank of the Devashi River up to 1400 m from the mouth. Inhabited rock taluses on mountain slopes, on stone piles closer to the river, on well-warmed slopes with sparse vegetation, as well as in dry coastal wood where Brauner's lizard (*D. b. brauneri* (Mehely, 1909)) bordered it. The data on numbers of the lizards was collected using the route method.

On the left bank of the Devashi River on stony dry slope with minimal vegetation

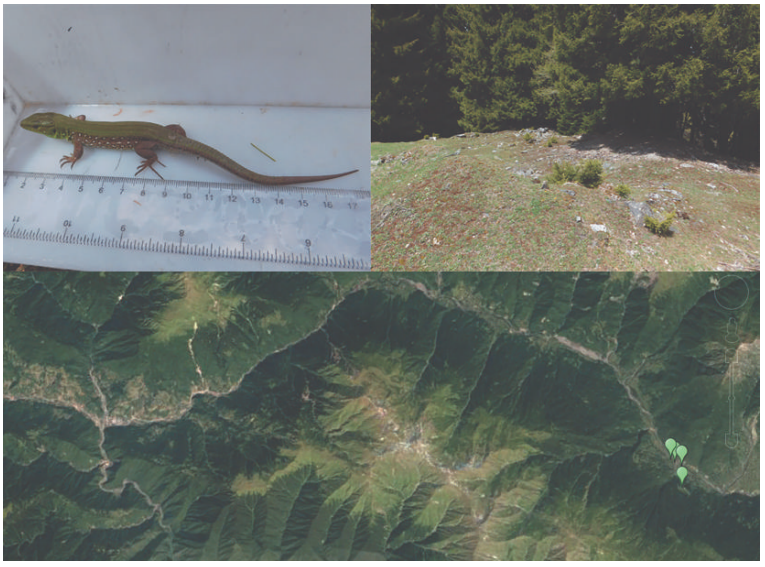

Fig. 15. Places of registrations *L. agilis grusinica,* the species biotope and map of findings, Tshenitshali River, Georgia, Lower Svanetia; specimens are also shown in the table of records (table 2).

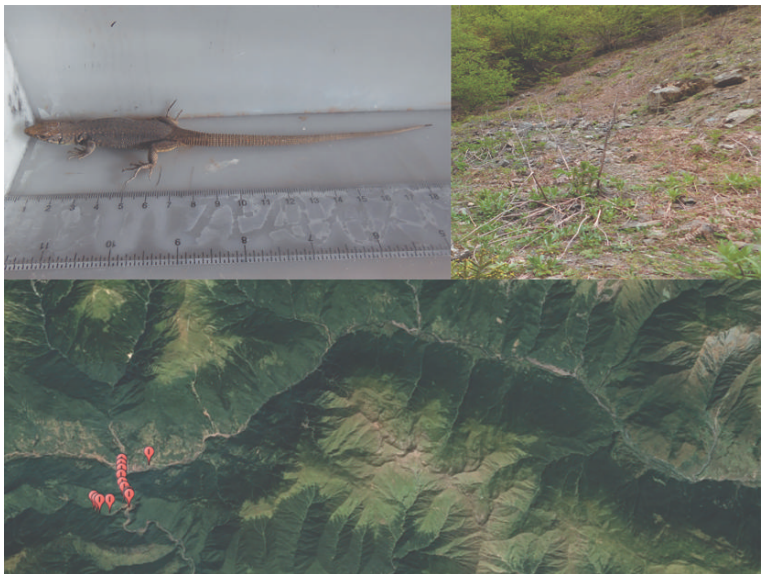

Fig. 16. Places of registrations *D. d. abchasica,* the species biotope and map of findings, Devashi River, Georgia, Lower Svanetia; specimens are also shown in the table of records (table 2).

descending to the water lizards were recorded. Total route length is about 700 m (from the bridge over the river upstream to the first strip of deciduous forest). There are 52.5 individuals per 100 m were registered.

On the left bank of the mountain river Devashi (from the bridge to the confluence with the Tskhenistskali River). The habitat included stony walls and rocks, coastal timber. Average of 30 individuals per 100 m were registered.

On the right bank of the Tskhenitskali River from the confluence of the Devashi River to Lentekhi town (along the road on both sides) 25 individuals per 100 m of the route were recorded.

Georgian lizard *Darevskia rudis svanetica* Darevsky et Eiselt, 1980 (IUCN: LC; BC:

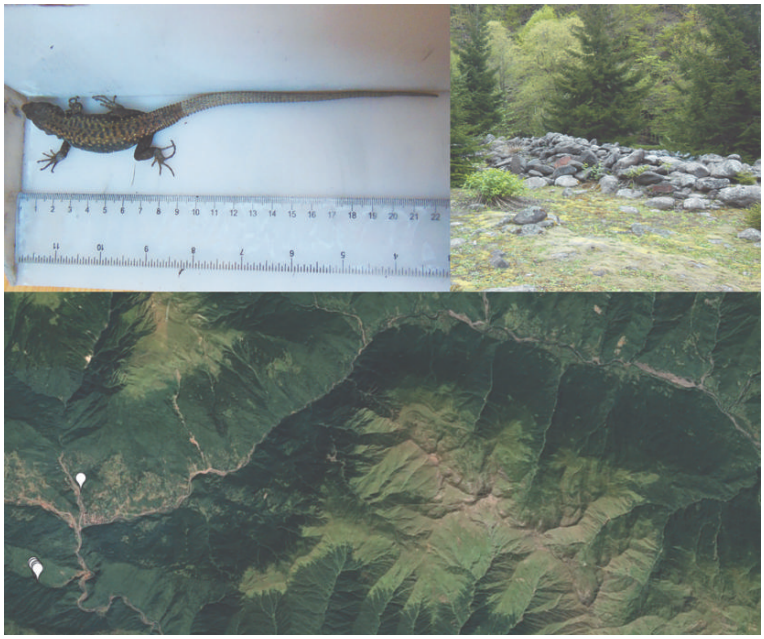

Fig. 17. Places of registrations *D. r. svanetica,* the species biotope and map of findings, Devashi River, Georgia, Lower Svanetia; specimens are also shown in the table of records (table 2).

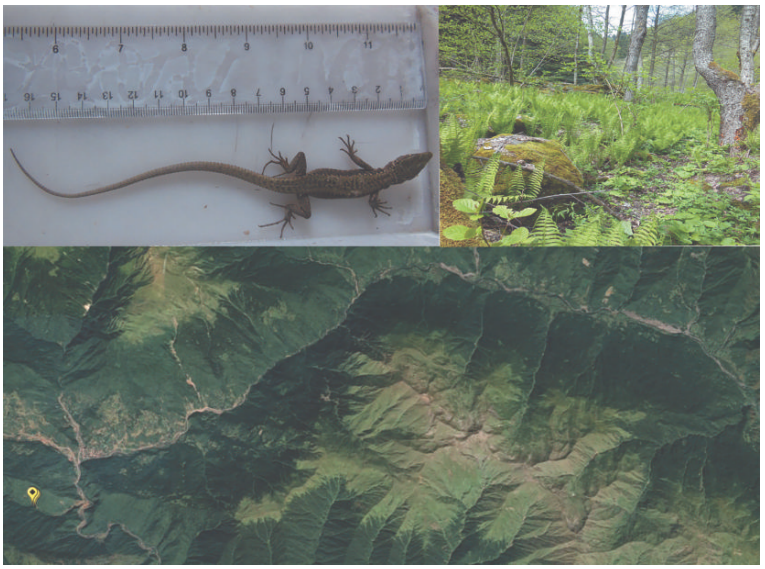

Fig. 18. Places of registrations *D. b. brauneri,* the species biotope and map of findings, Devashi River, Georgia, Lower Svanetia; specimens are also shown in the table of records (table 2).

III) was registered on the right bank of the Devashi River (fig. 17, table 2) occupying gentle slopes overgrown with conifers between the stones, rocks and cracks, which they use both as reliable hides and basking places. There are 17.5 individuals per 100 m of the route were seen basking on the stones. The species was also found in Lentekhi town, on the territory of a spring with water rich in iron. The subspecies lives in small number of known localities in Svanetia (Doronin, 2017).

Brauner's rock lizard *Darevskia brauneri brauneri* (Méhely, 1909) (IUCN: LC; BC: III) was found upstream on the left bank of the Devashi River upper than 1400 m a. s. l. inhabiting (fig. 18, table 2) a slope overgrown with trees, rich in leaf litter, a wooded area with rocks where they hide. The habitat is located close to the water. Twenty individuals per 100 m of the route were registered.

Discussion

Table 2. Records of batracho- and herpetofauna within the Tskenitskali, Devashi and Heledula Rivers

Species	Date	Latitude	Longitude	Locality
L. a. grusinica	24.04.2018	42.795686	42.989795	Sasashi village
L. a. grusinica	24.04.2018	42.793030	42.994940	Sasashi village
L. a. grusinica	24.04.2018	42.792298	42.995849	Sasashi village
L. a. grusinica	24.04.2018	42.791921	42.996721	Sasashi village
L. a. grusinica	24.04.2018	42.789662	42.985646	Sasashi village
D. b. brauneri	23.04.2018	42.773448	42.707202	Devashi River
D. b. brauneri	23.04.2018	42.773155	42.707978	Devashi River
D. b. brauneri	23.04.2018	42.772947	42.708359	Devashi River
D. r. svanetica	22.04.2018	42.795550	42.720066	Lentekhi town
D. r. svanetica	22.04.2018	42.772685	42.708150	Devashi River
D. r. svanetica	22.04.2018	42.773138	42.707712	Devashi River
D. r. svanetica	22.04.2018	42.772143	42.708952	Devashi River
D. r. svanetica	22.04.2018	42.771727	42.709388	Devashi River
V. dinniki	21.04.2018	42.776239	42.695928	Devashi River
B. sitibundus	21.04.2018	42.786499	42.718499	Heledula River, Lentekhi town
B. sitibundus	25.04.2018	42.774607	42.723403	Devashi River
B. sitibundus	22.04.2018	42.771070	42.711971	Devashi River
A. colchica	21.04.2018	42.772627	42.708876	Devashi River
A. colchica	23.04.2018	42.771100	42.713112	Devashi River
D. d. abchasica	24.04.2018	42.789910	42.732793	Tskenitskali River

D. d. abchasica	24.04.2018	42.786755	42.719858	Tskenitskali River
D. d. abchasica	24.04.2018	42.784941	42.720104	Tskenitskali River
D. d. abchasica	24.04.2018	42.783179	42.720584	Tskenitskali River
D. d. abchasica	24.04.2018	42.780887	42.720650	Tskenitskali River
D. d. abchasica	24.04.2018	42.778140	42.721524	Tskenitskali River
D. d. abchasica	24.04.2018	42.776584	42.722592	Tskenitskali River
D. d. abchasica	24.04.2018	42.774831	42.724733	Tskenitskali River
D. d. abchasica	24.04.2018	42.774197	42.725006	Tskenitskali River
D. d. abchasica	24.04.2018	42.773933	42.725234	Tskenitskali River
D. d. abchasica	21.04.2018	42.771592	42.716776	Devashi River
D. d. abchasica	21.04.2018	42.771368	42.712108	Devashi River
D. d. abchasica	21.04.2018	42.771728	42.710773	Devashi River
D. d. abchasica	21.04.2018	42.772505	42.709286	Devashi River
N. natrix	24.04.2018	42.795908	42.988770	Sasashi village
N. natrix	24.04.2018	42.794716	42.991250	Sasashi village
N. natrix	24.04.2018	42.793677	42.993566	Sasashi village
N. natrix	24.04.2018	42.792402	42.995563	Sasashi village
N. natrix	23.04.2018	42.773034	42.705122	Devashi River
N. natrix	23.04.2018	42.773190	42.707260	Devashi River
N. natrix	21.04.2018	42.772983	42.707490	Devashi River
N. natrix	23.04.2018	42.772408	42.708345	Devashi River
N. natrix	21.04.2018	42.771072	42.714327	Devashi River
R. macrocnemis	24.04.2018	42.787119	42.986354	Sasashi village
R. macrocnemis	24.04.2018	42.787111	42.988021	Sasashi village
R. macrocnemis	22.04.2018	42.788497	42.735043	Lentekhi town
R. macrocnemis	22.04.2018	42.787932	42.734254	Lentekhi town
R. macrocnemis	21.04.2018	42.783809	42.720582	Tskenitskali River
R. macrocnemis	25.04.2018	42.772576	42.724947	Tskenitskali River
R. macrocnemis	25.04.2018	42.771980	42.717904	Devashi River
R. macrocnemis	25.04.2018	42.772017	42.710519	Devashi River
R. macrocnemis	25.04.2018	42.772401	42.707994	Devashi River
R. macrocnemis	25.04.2018	42.773244	42.706605	Devashi River
R. macrocnemis	25.04.2018	42.774260	42.702091	Devashi River
R. macrocnemis	25.04.2018	42.774176	42.701475	Devashi River
P. ridibundus	24.04.2018	42.786577	42.987295	Sasashi village
P. ridibundus	24.04.2018	42.792467	42.995522	Sasashi village
P. ridibundus	24.04.2018	42.793941	42.987305	Sasashi village
P. ridibundus	24.04.2018	42.795874	42.985496	Sasashi village
P. ridibundus	24.04.2018	42.840285	42.877048	Tskenitskali River
P. ridibundus	22.04.2018	42.793515	42.755202	Tskenitskali River
P. ridibundus	22.04.2018	42.789097	42.734386	Tskenitskali River
P. ridibundus	22.04.2018	42.794220	42.720726	Lentekhi town
P. ridibundus	22.04.2018	42.787195	42.719486	Heledula River, t. Lentekhi
P. ridibundus	22.04.2018	42.786389	42.719805	Heledula River, t. Lentekhi
P. ridibundus	22.04.2018	42.774478	42.724258	Devashi River

Since, due to a complex of specific abiotic conditions (the type of the flow, low water temperatures, high turbidity), autochthonous zooplankton and phytoplankton of watercourses at altitudes above 1000 m are almost absent, the biological resources of rivers and streams within the Central Caucasus are composed mostly of benthic macroinvertebrates and ichthyofauna. The amphibians and reptiles of the river valleys play a special role, providing constant interconnections between aquatic and terrestrial biotopes (Afanasyev et al., 2013).

Bottom macroinvertebrates serve as a unique model object that meets all the requirements of an integrated approach to the biological monitoring of aquatic ecosystems. They are of great importance in hydro-ecological and faunal studies of mountain rivers, as they play a significant role in the flow of matter and energy, serve as a food resource for fish, participate in the formation of water quality, and are used to determine changes and integrity of lotic ecosystems (Afanasyev et al., 2019). Today there is a relatively small amount of literature resources presenting data on distribution of fauna of Caucasus mountain from

Georgian side (Bischoff, 2003; Bakradze & Chhikvadze, 2001; Kalyabina et al., 2001; Bosch & Bischoff, 2004; Ananjeva et al., 2004; Tuniyev, 2008; Tuniyev et al., 2021). There scientific data on water invertebrate composition in the studied area is insufficient as well (Afanasyev et al., 2022). Additionally some fragmental data is available for some reaches of the Kura basin and some rivers of Adjara (Godunko et al., 2015).

In this study, we have registered more than a hundred species of invertebrates, most of which are representatives of Insecta class. The highest degree of endemism was noted for Trichoptera, Plecopreta and Ephemeroptera with endemics and subendemics to the Caucasus representing 60 %, 45 % and 42 % of the registered species within the mentioned orders respectively.

One of the most vulnerable groups of animals inhabiting mountain rivers and in particular the rivers of the Caucasus are Actinopterygii. This is due to the fact that, along with the usual set of anthropogenic impacts, they are in the center of the consumer interest of the local human population. Fish, in addition to being of high importance as a food source for humans, also serve as a good bioindicator. In particular, fish are recommended by the European Water Framework Directive (EWFD) for assessing hydromorphological disturbances. Moreover, being the top step in the trophic pyramid of the river, fish ensure its normal functioning.

In general, within Georgia, the ichthyofauna has been quite fully studied (Ninua et al., 2008). However, given the complexity of the mountainous landscape, the isolation and different geological histories of the various river basins, there are still many unexplored gorges that may be the habitat of unknown species and/or subspecies (Roman et al., 2022). The three fish species we found, of which two (*S. trutta* and *B. escerichia*) are red-listed in Georgia (Vulnerable) (Resolution N 190 of 2014 of Georgian Government on the "Red List" of Georgia); these two species are widely represented in almost all rivers of Georgia. Here it should be noted that the systematic position of some *Barbus taxa* are still discussable. According to different schools of ichthyologists, it refers either to an independent species of *B. escerichii* or to one of subspecies of the Crimean barbel *Barbus tauricus escerichii* (Kessler, 1877). Based on the fact that *Barbus tauricus* (Kessler, 1877) lives in the rivers of the Black Sea region (not connected with each other), it is quite possible to find morphological forms that differ from the nominative subspecies. The assumption of the presence of new species in these rivers seems quite probable to us. As early as the end of the 19th century, Kamensky described a variation of the Crimean barbel *Barbus tauricus var. rionica* Kamensky, 1899 (Kamensky, 1899) that was no longer been found. Bogutskaya and Naseka suggest the existence of a so far undescribed separate species related to the Colchis barbel (Bogutskaya & Naseka, 2001). This statement is partially confirmed in the work of D. Turan (Turan et al., 2009) who, in addition to *Barbus oligolepis* Bl, 1853, also indicates a similar taxon for the rivers of Turkey (Nilufer River) — *Barbus sp*. It is quite possible that a species which lives in the basin of the Rioni River is new to science as well. These data also require more detailed research and the collection of additional materials.

Amphibians and reptiles demonstrate tendencies to declining of their populations, sometimes with subsequent extinction of species due to habitat destruction, smuggling (Phillips, 1999), spreading of alien invasive species and disease-causing agents (Pupina et al., 2018), climate change (Nekrasova et al., 2021) and many other teratogenic factors (Alroy, 2015). Some of such example is *M. caucasica* Waga, 1876, a species considered vulnerable according to IUCN categorization. Current state of many species (actual distribution, numbers, and habitats) especially in mountain regions, due to difficult access to the areas and complicated ways of receiving material, remain unknown for science. Especially subspecific diversity and distribution of certain species and subspecies due to lack of modern registrations makes the ways of saving these species and conservation of their natural habitats much complicated (Tarkhnishvili, 2012). What is more lack of modern registrations makes it harder to assess real actual state of Georgian populations

of amphibians and reptiles it terms of modern molecular research that highlights new species even from relatively isolated mountain populations or bigger populations divided by mountain ridges as natural barriers. For example, it can be connected with distribution of representatives of rock lizards (*Darevskia* Arribas, 1999) complex (Tarkhnishvili et al., 2002; Ciobanu et al., 2003), sand lizards (*Lacerta* Linnaeus, 1758) (Andres et al., 2014), slow worms (*Anguis* Linnaeus, 1758) (Jablonsky et al., 2021) and green toads (*Bufotes* Rafinesque, 1815) (Özdemir et al., 2014; Dufresnes et al., 2019).

The studies provide modern data on distribution of some Anamnia representatives that are the indicators of state of environment and play important role in ecological connections of local ecocenoses and therefore are potentially the most vulnerable against global climate changes and anthropogenic environment transformation. Moreover, the macroinvertebrate composition of local habitats consisting of 114 species dominating by Ephemeroptera representatives (50 % <) was studied representing the main component of potential feeding base for local fish species (3 species registered), amphibians and most of the reptiles, showing the base for local trophic nets.

According to the research of all the reptiles of the rock lizard (*Darevskia*) complex encountered, *D. r. svanetica* accounted for 27.1 %, *D. d. abchasica* — 56.6 %, *D. b. brauneri* — 16.3 %. Meanwhile of all the amphibians found in the area of the Lentekhi town (Heledula and Devashi Rivers) *P. ridibundus* accounted for 61.9 %; *R. macrocnemis* — 31.0 %; *B. variabilis* — 7.1 %. In the upper reaches of the Tshenitshali River *P. ridibundus* accounted for 58.33 %; *R. macrocnemis* — 41.67 %. It is shown that marsh and Iranian long-legged frogs are the most numerous in the study area occupying the majority of water reservoirs for spawning. The most numerous representatives of reptiles were *D. derjugini*, outnumbering other representatives of the genus. It should be noted that more detailed studies using molecular research approaches are needed to clarify the species composition of rock lizards from *Darevskia* genus. DNA studies will help to distinguish among closely morphologically similarly-looking species that inhabit the territory of our research.

Conclusions

The work represents records of more than 100 species of 16 groups of macroinvertebrates, three fish, five amphibian and seven reptile species within the vicinities of Lentekhi town and Sasashi village situated along the Tskhenistskali River and its tributaries. These registrations have a great importance in terms of studying of native biota of particular areas of Caucasus Mountains that due to their geographical position tend to be so-called "blind spots" of biodiversity studies.

The benthic invertebrates are mainly represented by nymphs and larvae of amphibiotic insects, of which Ephemeroptera reached the greatest development, accounting for more than half of the number of recorded benthic invertebrates. About a quarter of all species belonged to Trichoptera, for which the highest degree of endemism was also noted — 60 % endemics and subendemics to the Caucasus from all identified species. Also, a high degree of endemism was noted for Plecopreta (45 %) and Ephemeroptera (42 %). Two of three recorded fish species are listed in the "Red List" of Georgia as "Vulnerable".

Most of the reptiles and amphibians registered during the study were found in anthropogenic territories: amphibians 3/5 and reptiles 3/7 indicating that these species at certain level of urbanization can adapt to cohabiting with human beings. Additionally due to planned constructing activities in the investigated territories the needs of these species as part of native biota of Georgia, should be taken into consideration as surrounding areas of Lentekhi town and Sasashi village as well as valleys of the three studied rivers are of great nature conservation potential due to wide fauna diversity and set of species that can also be found on these territories following the information provided in literature resources.

Thus, it can be concluded that fauna representatives spotted during the research make

great contribution to the nature conservation potential of this area.

Registrations of fauna from mountain regions will also help to update actual maps of natural ranges of the species within the country and tend to be a valuable addition to the data that can be potentially used in GIS-modelling of species' distribution according to predicted climate changes.

References

Afanasyev, S. O. 2003. Reaction of the biota of mountain rivers to volley pollution releases. *Hydrobiological Journal*, **39** (2), 3–11.

Afanasyev, S. O., Lietytska, O. M. 2019. Structure of dominance/diversity of benthic macroinveretebrate communities in the Carpathian rivers. *Hydrobiological Journal*, **55** (4), 3–15.

Afanasyev, S. O., Lietytska, O. M., Manturova, O. V. 2013. Altitude distribution and structural organization of hydrobionts' communities in the rivers of the mountainous part of the Tisa river basin. *Hydrobiological Journal*, **49** (4), 16–25.

Afanasyev, S., Lietytska, O., Marushevska, O. 2014. River re-naturalisation in the Tisza River basin after forest cutting activities. *Acta Zoologica Bulgarica*, **66** (7), 57–62.

Afanasyev, S., Golub, O., Iarochevitch, O., Konovalenko, O., Lietytska, O., Marushevska, O., Mudra, K. 2016. *Lukhuni 2 — hydropower project, Georgia. Supplementary Aquatic Biodiversity Assessment: Field Works and Action Plan*. Final report, Kyiv, 1–68.

Afanasyev, S., Lietytska, O., Golub, O., Iarochevitch, O., Danko, K., Mudra, K., Marushevska, O. 2018. *E&S Due Diligence — category B Svaneti small HPPs, Basic Aquatic Biodiversity Assessment: Field works and action plan — precommissioning works*. Final report, Kyiv, 1–68.

Afanasyev, S., Lietytska, O., Golub, O., Iarochevitch, O., Danko, K., Mudra, K., Marushevska, O. *Nenskra Hydropower Project, Development and implementation of aquatic biodiversity action plan in part of ecological monitoring.* Final report, Kyiv, 1–59.

Afanasyev, S. O., Lietytska, O. M., Roman, A. M., Iaroshevitch, O. Y., Konovalenko, O. S., Mudra, K. V., Golub, O. O., Marushevska, O. G. 2022. Hydromorphology, bottom macroinvertebrates and ichthyofauna of the mountain river in the area of Arsenic Deposits (Western Georgia). *Hydrobiological Journal*, **58** (2), 3–20.

Afanasyev, S., Lyashenko, A., Iarochevitch, A., Lietytska, O., Zorina-Sakharova, K., Marushevska, O. 2020. Pressures and impacts on ecological status of surface water bodies in Ukrainian part of the Danube River basin. *In*: Bănăduc, D., Curtean-Bănăduc, A., Pedrotti, F., Cianfaglione, K., Akeroyd, J., eds. *Human Impact on Danube Watershed Biodiversity in the XXI Century. Geobotany Studies*. Springer, Cham., 327–358.

Ananjeva, N. B., Orlov, N. L., Khadikov, R. G., Darevskij, I. S., Ryabov, S. A., Barabanov, A. V. 2004. *Atlas of reptiles of Northern Eurasia (taxonomic diversity, geographical distribution and conservation status)*. Zoological institute of RAS, Saint-Petersburg, Russia, 1–232 [In Russian].

Andres, C., Franke, F., Bleidorn, C., Bernhard, D., Schlegel, M. 2014. Phylogenetic analysis of the *Lacerta agilis* subspecies complex. *Systematics and Biodiversity*, **12** (1), 43–54.

Alroy, J. 2015. Extinction rates of reptiles and amphibians. *Proceedings of the National Academy of Sciences*, **112** (42), 13003–13008.

Bakradze, M. A., Chhikvadze, V. M. 2001. List of herpetofauna of Georgia. *Questions of Herpetology*, 24–25 [In Russian].

Bannikov, A. G., Darevskiy, I. S., Ishchenko, V. G., Rustamov, A. K., Shcherbak, N. N. 1977. *Identificator of amphibians and reptiles of USSR fauna*. Education, Moscow, Russia, 1–416 [In Russian].

Bischoff, W. 2003. Die Eidechsenfauna Georgiens — Teil II: Die Gattung Darevskia. *Die Eidechse*, **14** (3), 65–93.

Bjorkland, R., Bjorkland, R. 2021. Reversing global biodiversity declines: Mainstreaming biodiversity conservation into decision-making at national and local scales. *MIT Science Policy Review,* **2**, 31–39.

Bogutskaya, N. G., Naseka, A. M. 2001. On the restoration of the species status of the Korean minnow and Kuban barbel (Pisces: Cyprinidae) described by L. S. Berg. Academician L. S. Berg — 125 years old. *Proceedings of scientific articles, Bendery: Biotica*, 54–58 [In Russian].

Bosch, H. A. J., Bischoff, W. 2004. Remarks on the herpetofauna of the Caucasian Republic of Georgia, with special reference to the Lacertidae. *Podarcis*, **5** (2), 28–57.

Ciobanu, D. G., Grechko, V. V., Darevsky, I. S. 2003. Molecular evolution of satellite DNA CLsat in lizards from the genus *Darevskia* (Sauria: Lacertidae): correlation with species diversity. *Russian Journal of Genetics*, **39** (11), 1292–1305.

Doronin, I. V. 2017. Overview of typical examples of rock lizards of the complex *Darevskia* (*rudis*) (Sauria: Lacertidae). Proceedings of Zoological institute of RAS, **321** (3), 339–361 [In Russian].

Doronin, I. V., Tuniyev, B. S., Kukushkin, O. V. 2013. Differentiation and taxonomy of the rock lizards *Darevskia (saxicola*) complex (Sauria: Lacertidae) according to morphological and molecular analyses. *Proceedings of the Zoological Institute of the Russian Academy of Sciences*, **317** (1), 54–84.

Dufresnes, C., Mazepa, G., Jablonski, D., Oliveira, R. C., Wenseleers, T., Shabanov, D. A., Auer, M.,

Ernst, R., Koch, C., Ramírez-Chaves, H. E., Mulder, K. P., Simonov, E., Tiutenko, A., Kryvokhyzha, D., Wennekes, P. L., Zinenko, O. I. Korshunov O. V., Al-Johany, A. M., Peregontsev, E. A., Masroor, R., Betto-Colliard, C., Denoël, M., Borkin, L. J., Skorinov, D. V., Pasynkova, R. A., Mazanaeva, L. F., Rosanov, J. M., Dubey S., Litvinchuk, S. 2019. Fifteen shades of green: The evolution of *Bufotes* toads revisited. *Molecular Phylogenetics and Evolution,* **141**, 106615.

Eiselt, J., Darevsky, I. S. 1991. *Lacerta rudis chechenica* ssp. n. aus dem Kaukasus (Reptilia: Lacertidae). *Annalen des Naturhistorischen Museums in Wien*, **92B**, 15–29.

Godunko, R. J., Palatov D. M., Martynov, A. V. 2015. Mayflies of the Caucasus Mountains. III. A new representative of the subgenus *Rhodobaetis* Jacob, 2003 (Baetidae: Baetis) from the South-Western Caucasus. *Zootaxa,* **3948** (2), 182–202.

Jablonski, D., Sillero, N., Oskyrko, O., Bellati, A., Čeirāns, A., Cheylan, M., Cogalniceanu, D., Crnobrnja-Isailovic, J., Crochet, P.-A., Crottini A., Doronin, I., Džukić, G., Geniez, P., Cetin, I., Ruben, I., Jandzik, D., Jelić, D., Litvinchuk, S., Ljubisavljević, K., Lymberakis, P., Mikulicek, P., Mizsei, E., Moravec, J., Najbar, B., Pabijan, M., Pupins, M., Sourrouille, P., Strachinis, I., Szabolcs, M., Thanou, E., Tzoras, E., Vergilov, V. S., Vörös, J., Gvoždík, V. 2021. The distribution and biogeography of slow worms (Anguis, Squamata) across the Western Palearctic, with an emphasis on secondary contact zones. *Amphibia–Reptilia*, **42** (4), 519–530.

Kalyabina, S. A., Milto, K. D., Ananjeva, N. B., Legal, L., Joger, U., Wink, M. 2001. Phylogeography and systematics of Lacerta agilis based on mitochondrial cytochrome b gene sequences: first results. Russian Journal of Herpetology, 8 (2), 149–158.

Kamensky, S. N. 1899. Die Cypriniden der Kaukasusländer und ihrer angrenzenden Meere. Kaukasischen Museums, Germany, 1–157.

Keil, P., Storch, D., Jetz, W. 2015. On the decline of biodiversity due to area loss. *Nature Communications*, **6** (1), 8837.

Kuzmin, S. L., 2012. *Amphibians of the former USSR* (2nd ed.). Society of scientific publishers, Moscow, Russia, 1–370. ISBN 978-5-87317-871-1 [In Russian].

Milius, S. 2010. Losing life's variety: 2010 is the deadline set for reversing declines in biodiversity, but little has been accomplished. *Science News*, **177** (6), 20–25.

Nekrasova, O., Marushchak, O., Pupins, M., Skute, A., Tytar, V.,˘Ceirans, A. 2021. Distribution and potential limiting factors of the European pond turtle (*Emys orbicularis*) in Eastern Europe. *Diversity*, **13**, 280.

Ninua, N., Japoshvili, B. 2008. Check list of fishes of Georgia. *Proceedings of the Institute of Zoology*, **2**3, 163–177.

Lortkipanidze, B. 2010. Brown bear distribution and status in the South Caucasus. *Ursus,* **21** (1), 97–103.

Özdemir, N., Gül, S., Poyarkov, N. A., Kutrup, B., Tosunoğlu, M., Doglio, S. 2014. Molecular systematics and phylogeography of *Bufotes variabilis* (syn. *Pseudepidalea variabilis*) (Pallas, 1769) in Turkey. *Turkish Journal of Zoology,* **38**, 412–420.

Phillips, C. 1999. Are Amphibian and Reptile Populations Declining? *The Illinois Steward*, **8**, 25–28.

Pupina, A., Pupins, M., Nekrasova, O., Tytar, V., Kozynenko I., Marushchak, O. 2018. Species Distribution Modelling: *Bombina bombina* (Linnaeus, 1761) and its Important Invasive Threat *Perccottus glenii* (Dybowski, 1877) in Latvia under Global Climate Change. *Environmental Research Engineering and Management,* **74** (4), 79–86.

Roman, A., Afanasyev, S., Golub, O., Lietytska, O. 2022. *Capoeta svanetica* (Teleostei, Cyprinidae), a new species from the Luchunis River (Rioni River drainage) in Georgia. *Zoodiversity*, **56** (2), 117–134.

Schmidt-Kloiber, A., Graf, W., Lorenz, A., O. Moog. 2006. The AQEM/STAR taxalist — a pan-European macro-invertebrate ecological database and taxa inventory. *Hydrobiologia*, **566**, 325–342.

Tarkhnishvili, D., Kandaurov, A., Bukhnikashvili, A. 2002. Declines of amphibians and reptiles in Georgia during 20th century: virtual vs. actual problems. *Zeitschrift fuer Feldherpetologie*, **9**, 89–107.

Tarkhnishvili, D. 2012. Evolutionary History, Habitats, Diversification, and Speciation in Caucasian Rock Lizards. *In*: Jenkins, O. P., ed. *Advances in Zoology Research*, 2. NOVA Science Publishers, UK.

Tuniyev, B. S. 2008. Results of thirty-year investigations of herpetofauna in the Caucasian reserve. *Proc. of Caucasian State Nature Biosphere reserve*, **18**, 99–115 [In Russian].

Tuniyev, B., Koval, A. G., Vargovitsh, R. S. 2021. Amphibians and reptiles in the caves of the Greater Caucasus. *Nature Conservation Research*, **6** (1), 1–16.

Turan, D., Kottelat, M., Ekmekçi, F. G. 2009. *Barbus niluferensis*, a new species of barbel (Teleostei: Cyprinidae) from Nilüfer River, Turkey, with re-description of *B. oligolepis*. *Zootaxa*, **1981** (1), 15–28.

Vasyliuk, O., Prylutskyi, O., Marushchak, O., Kuzemko, A., Kutsokon, I., Nekrasova, O., Raes, N., Rusin, M. 2022. An extended dataset of occurrences of species listed in Resolution 6 of the Bern Convention from Ukraine. *Biodiversity Data Journal*, **10**, e84002.

Vershinin, V. L. 2015. *Fundamentals of Methodology and Research Methods of Anomalies and Pathologies of Amphibians: a Training Manual*. Publishing House of Ural University, Ekaterinburg, Russia, 1–80 [In Russian].

Received 29 July 2022
Accepted 28 October 2022