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Notes on the distribution and ecology of the genus *Stenelmis* Dufour, 1835 (Coleoptera: Elmidae) in the Caucasus

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Abstract

The distribution of the genus *Stenelmis* (Elmidae) of the Caucasus is reviewed based on materials collected by the authors and examined specimens stored in accessible collections. One of the two species present in this region, represented by the subspecies *Stenelmis consobrina consobrina* Dufour, 1835, is recorded for the first time in Krasnodar Krai and possibly in Armenia; *Stenelmis puberula* Reitter, 1887 is recorded for the first time in Russia (Krasnodar Krai and the Republic of Adygea) and Abkhazia.

Key words: Coleoptera, Elmidae, *Stenelmis*, fauna, ecology, new records, Caucasus

Introduction

The genus *Stenelmis* Dufour, 1835 is the most speciose in the family Elmidae. It occurs in the Palaearctic, Afrotropical, Oriental and Nearctic regions and includes over 170 species (Kodada, Jäch 2005). A total of 74 species have been recorded in the Palaearctic, but none of them was recorded in Russia, although the reported distributions of *Stenelmis consobrina consobrina* Dufour, 1835 and *Stenelmis puberula* Reitter, 1887 include ‘Caucasus’ without further details (Jäch *et al.* 2006).

This study reviews the available data on the distribution of the genus *Stenelmis* in the Caucasus, including the North Caucasus, Transcaucasia and adjacent areas of Turkey. Data on new records of species of this genus in the region are provided.

The Caucasus is traditionally understood as the region limited by the Kuma–Manych Depression in the north, borders between Transcaucasian republics and Iran/Turkey in the south, the Black Sea and Sea of Azov in the west, and Caspian Sea in the east. The southern boundary is conventional (the northern, western and eastern ones are natural); therefore, in this study we consider localities of adjacent Turkey as belonging to the Caucasus.

The Caucasus is divided into the North Caucasus and Transcaucasia. The North Caucasus includes Ciscaucasia (which occupies the area from the Kuma–Manych Depression to the foothills of the Greater Caucasus and is subdivided into three parts: Western, Middle and Eastern Ciscaucasia), the southwestern slope of the extreme northwestern Main Caucasus Range and – traditionally – the Black Sea coast of the Caucasus (the Black Sea coast of Russia to the Psou River), although in fact, relative to the Main Caucasus Range, this subregion belongs to Transcaucasia. Transcaucasia includes most of the southern slope of the Greater Caucasus, Colchis Lowland and

Kura Depression, Lesser Caucasus, Armenian Highlands, Talysh Mountains, and Lankaran Lowland (Gvozdetsky 1958, 1963). From the geographical point of view, the Caucasus should be considered as a borderline mountainous region lying between the continents of Europe and Asia (Tembotov *et al.* 2001). The administrative boundaries between regions of the Caucasus are shown in Fig. 1.

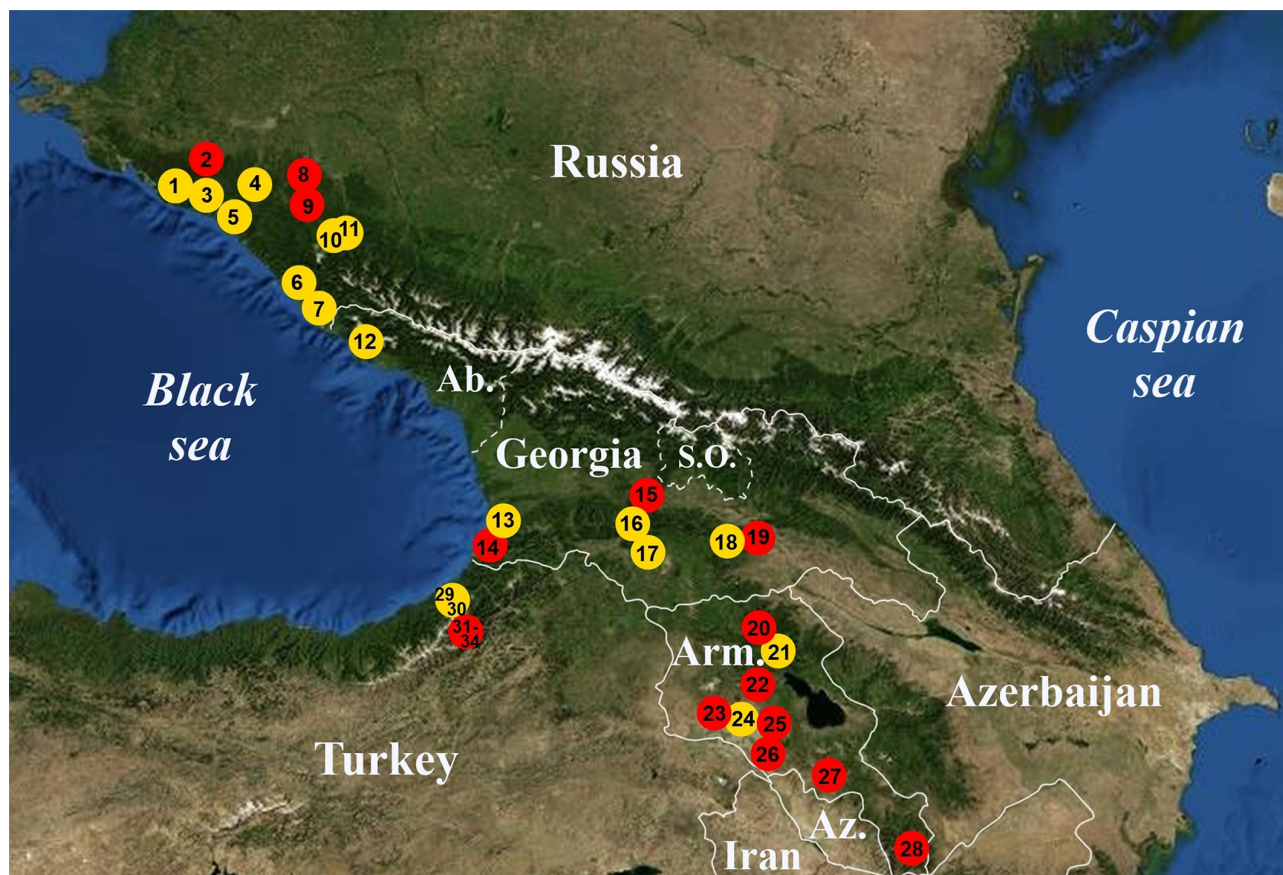


FIGURE 1. Known localities of species of the genus *Stenelmis* in the Caucasus: *S. consobrina consobrina* (red circle), *S. puberula* (yellow circle). Ab., Abkhazia; S.O., South Ossetia; Arm., Armenia; Az., Azerbaijan.

Material and methods

The material was collected in Russia in Krasnodar Krai and the Republic of Adygea (in 2003–2013 by M.I. Shapovalov, A.A. Prokin, and D.M. Palatov), Georgia and Abkhazia (in 2013 by D.M. Palatov), Armenia (in 2012 by D.M. Palatov), and Turkey (in 2011, 2012, and 2014 by D.M. Palatov).

Material stored in the Zoological Institute, Russian Academy of Sciences, St. Petersburg (ZISP) was examined by A.V. Kovalev; material stored in the Zoological Museum, Lomonosov Moscow State University, Moscow (ZMUM) was examined by A.A. Prokin. Material collected by the authors is stored in the personal collections of M.I. Shapovalov in Maykop (CMS), and D.M. Palatov in Moscow (CDP).

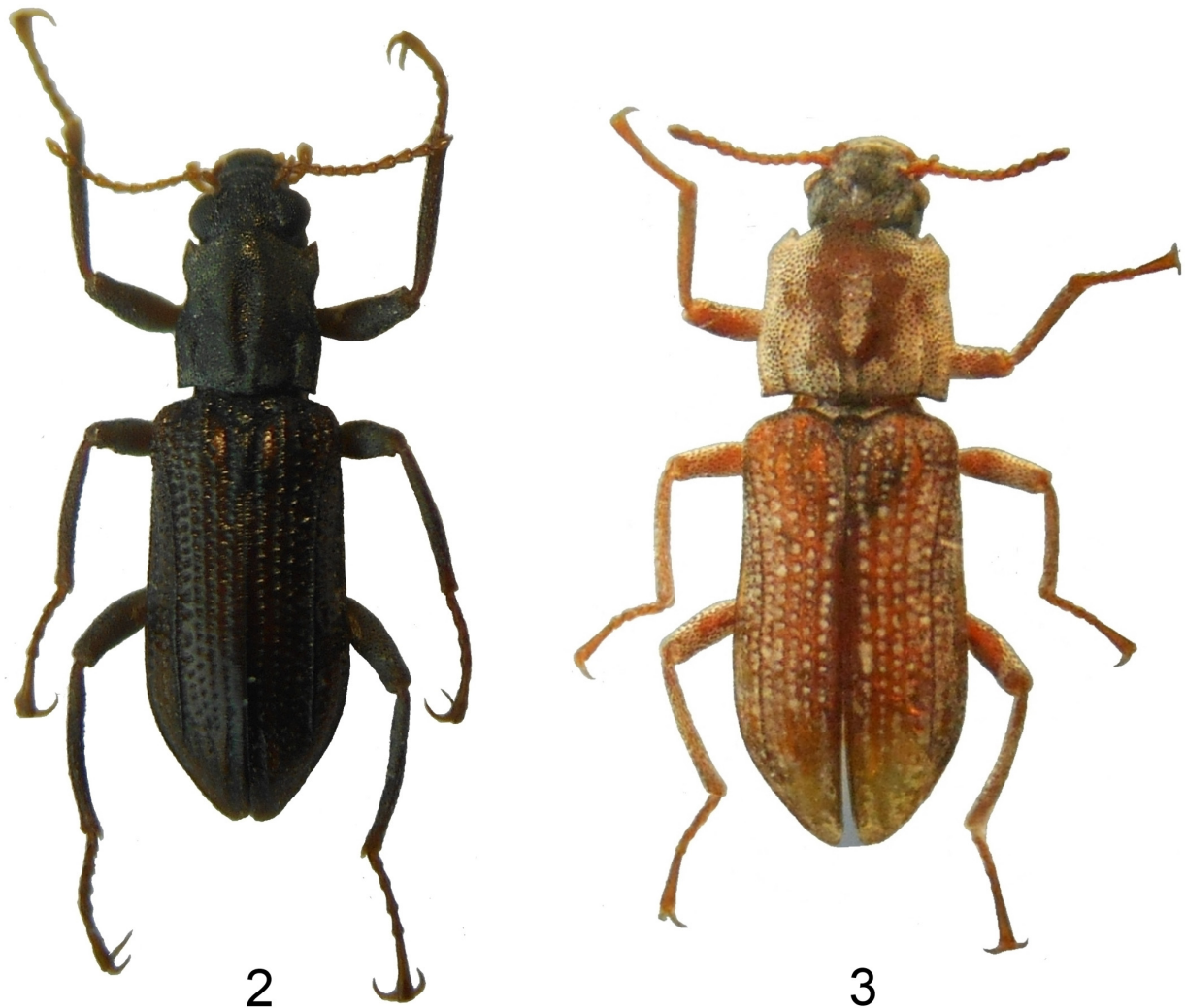
The numbers of localities in the annotated checklist refer to particular administrative units: 1–7, Krasnodar Krai; 8–11, Republic of Adygea; 12, Abkhazia; 13–19, Georgia; 20–28, Armenia; 29–34, Turkey. The following data are provided: geographical coordinates (for localities in which material was collected by the authors), date of collecting, number of specimens collected, and collection in which the material is stored. Descriptions of environmental conditions in habitats of each species are given under numbers of the localities. The following abbreviations are used: H, width of part of watercourse, m; l, depth of part of watercourse, m; v, current velocity, m/s; T, water temperatures, °C. The distribution of each species is characterized from published data supplemented by the material studied by the authors.

The illustrations were prepared using the following equipment provided by institutions indicated in brackets: Nikon Eclipse 50i light stereomicroscope with digital camera (Papanin Institute for Biology of Inland Waters,

Russian Academy of Sciences, Borok); Mikromed MC-2-ZOOM var. 2CR light stereomicroscope with digital camera (Adyghe State University, Maykop).

Results

Two species of the genus *Stenelmis* Dufour, 1835 have been recorded in the studied region: *Stenelmis consobrina consobrina* (Fig. 2) and *Stenelmis puberula* (Fig. 3). The annotated checklist of these species is given below. The checklist contains indications of localities, brief descriptions of environmental conditions in the habitats (for material collected by the author), and summarized data on geographical distribution.



FIGURES 2–3. Habitus of species of the genus *Stenelmis*. 2. *S. consobrina consobrina*. 3. *S. puberula*.

Family ELMIDAE Curtis, 1830

Genus *Stenelmis* Dufour, 1835

Stenelmis consobrina consobrina Dufour, 1835

(Fig. 2)

Material. *Russia*. Krasnodar Krai: 2. Seversky District: Ubinskoye Forestry, 19 June 1970, 3♂, *ibid.*, 9–11 August 1973, 3♂, 4♀, *ibid.*, 4 August 1973, flight to UV light, 3♀ (ZMUM). Republic of Adyghea: 8. 1 km from Krasny

Most village, Kurdzhips River, 44°32'2"N, 40°6'29"E, 230 m above sea level, 18 May 2013, 1♀, 1♂ (CMS). **9.** 1.5 km upstream of Dagestanskaya village, Kurdzhips River, 44°21'47"N, 39°59'45"E, 302 m above sea level, 19 September 2012, 1♀ (CMS).

Georgia. **14.** Adjara: Batumi, garden of biolaboratory, in flight, 29 July 1971, 1♂, Zagulyaev (ZISP). **15.** Borjomi, Akhaldaba, 19 July 1997, 17 ind., Danilevsky (ZMUM); **18.** Manglis (Manglisi), 1879, 1♂ (ZISP); **19.** Tiflis (Tbilisi), 1878, 1♂, *ibid.*, 8 July 1879, 1♀, *ibid.*, 28 June 1880, 1♂, Sivers (ZISP), *ibid.*, 18 June 1916, 1♀, Zaitzev (ZISP);

Armenia. Lori Province: **20.** Sorbulag River, 40°55'14"N, 44°43'39" E, 1200 m above sea level, 26 August 2011, 2♂, 1♀ (CDP); Aragatsotn Province: **22.** 3 km upstream of Korchlu village, Korchlu River, 40°34'6.04"N, 44°34'20.17"E, 1900 m above sea level, 2 September 2011, 1♂ (CDP); Ararat Province: **23.** left-hand tributary of the Goght River, 40°8'9"N, 44°48'56"E, 1500 m above sea level, 5 September 2011, 1♂ (CDP); Kotayk Province: **25.** Goght River, 40°8'10.69"N, 44°48'54.33"E, 26 July 2014, 1♂, 4♀ (CDP); **26.** Goravan, 9 July 1996, 2♀, Kalashian (ZMUM); **27.** Khosrov, 17 July 2002, 5♂, Kalashian (ZMUM). **28.** Syunik Province: 3 km upstream of Tzav village, Tzav River, 39°3'1.64"N, 46°25'19.43"E, 1200 m above sea level, 20 July 2014, 1♀ (CDP);

Turkey. Rize Province: Fındıklı District: **31.** 2,8 km from Gürsu village, tributary of the Büyükdere River, 41°9'54" N, 41°13'41"E, 760 m above sea level, 22 August 2012, 1♂ (CDP); **32.** environs of Yaylacılar, tributaries of the Kokasor Deresi River, 41°10'36" N, 41°11'27"E, 460–1030 m above sea level, 22 August 2012, 2♀, *ibid.* 23 August 2012, 3♀ (CDP); Ardeşen District: **33.** Fırtına River, left source upstream of confluence of sources, 41°3'5" N, 41°17'4"E, 1730 m above sea level, 27 August 2012, 1♂, 1♀ (CDP); *ibid.* 27 August 2012, 1♀ (CDP); **34.** right-hand tributary of the Fırtına River, 41°6'6"N, 41°12'4"E, 850 m above sea level, 28 August 2012, 1♀ (CDP).

Habitats. **8.** River, H ≈ 9.0 m, l = 0.1–0.4 m, v = 0.1–0.3 m/s, T = 21.5°C; collected in current on lower surface of stones, in microcrevices; **9.** River, H ≈ 12.0 m, l = 0.2 m, v = 0.2–0.5 m/s; collected on stones overgrown with filamentous algae, T = 21°C; **20.** River in the forest zone, H = 3.0–5.0 m, l = 0.15–0.3 m, v = 0.3–0.8 m/s, silted stones in the ripal zone. **22.** River in the forest zone, H = 3.0–4.0 m, l = 0.15–0.3 m, v = 0.3–0.7 m/s, T = 15°C, stones, pebbles, gravel. **23.** Brook, H = 1.5–2.0 m, l = 0.1–0.3 m, v = 0.2–0.7 m/s, T = 14°C, stones, pebbles, sand. **25.** River in deep canyon-like valley, H = 3.0–4.0 m, v = 0.1–0.7 m/s, large stones overgrown with filamentous algae. **28.** River in deep forest valley, H = 1.5–2.5 m, l = 0.1–0.2 m, v = 0.2–0.8 m/s., prevailing substrate: stones without overgrowth, silt accumulations under bank. **31.** Brook, S = 0.7–1.2 m, l = 0.05–0.15 m, v = 0.1–0.4 m/s, pebbles, detritus, litter, overgrowth. **32.** River, H = 3.0–5.0 m, l = 0.2–0.5 m, v = 0.5–1.2 m/s, T = 15°C, stones, in places pebbles, sand, litter. **33.** River, H = 4.0–7.0 m, l = 0.2–0.5 m, v = 0.6–1.2 m/s, T = 12°C, large stones with abundant overgrowth. **34.** Coastal part of river, shaded with shrubs and trees, S = 3.0–4.0 m, l = 0.2–0.4 m, v = 0.6–1.2 m/s, T = 16°C, stones, pebbles.

Distribution. Described from Saint-Sever, southwestern France, Landes department. According to the Palearctic catalog, present in the following areas: Europe: Bosnia and Herzegovina, Czech Republic, France, Germany, Greece, Italy, Spain, Switzerland, "Caucasus"; North Africa: Morocco; Asia: Israel, Syria, Turkey, Turkmenistan (Jäch *et al.*, 2006). In addition, reported from the "Araks valley," which could mean areas of Turkey, Armenia, Azerbaijan, and Iran, and from Khevsureti, *i.e.*, "Kaukasus, Chewsurien" (Georgia) (Berthélemy 1979); Hungary (Csabai, Sár 2007), and Russia (Adygea) (Nikitsky *et al.* 2010).

Recorded for the first time in Krasnodar Krai and, possibly, Armenia.

***Stenelmis puberula* Reitter, 1887**

(Fig. 3)

Material. **Russia.** Krasnodar Krai: **1.** Gelendzhiksky District: 3 km from Divnomorskoye village, Mezyb River, 44°31'57"N, 38°9'31"E, 18 July 2008, 1♂, 1♀ (CMS); **3.** Tuapsinsky District: Arkhipo-Osipovka village, Teshebs River, 3 August 1963, 15♂♀ (ZISP); **4.** Tuapsinsky District: brook Krasnaya Shchel', 44°25'36"N, 39°11'17"E, 14 June 2004, 1♀; **5.** Tuapsinsky District: 1.5 km upstream of Agoy village, Agoy River, 44°9'18"N, 39°3'12"E, 17 April 2006, 3♀; **6.** 1 km from Krasnaya Volya village, Kudepsta River, 28 June 2011, 1♂, 2♀ (CMS); **7.** Adler, 13, 16, and 18 June 1909, 3♀, Sumakov (ZISP). Republic of Adygea: **10.** Khamyshki village, Khamyshinka River, tributary (left-hand) of the Belaya River, 44°5'30"N, 40°7'29"E, 550 m above sea level, 5 October 2011, 1♀, 1♂ (CMS); **11.** Khamyshki village, Lipovaya River, tributary (left-hand) of the Belaya River, 44°4'47"N, 40°8'16"E, 560 m above sea level, 7 May 2011, 1♀ (CMS).

Abkhazia. 12. Gagra, August 1930, 1♀, Minoran[sky] (ZISP).

Georgia. Adjara: Kobuleti District: 13. Kobuleti village, Kentrisi River, 41°48'17.30"N, 41°46'52.45"E, 29 January 2013, 1♀ (CDP); 16. Borzhom (Borjomi), 14 July 1939, 1♀, Sagovsky (ZISP); 17. Baraleti [Akhalkalaki Municipality, Samtskhe-Javakheti], June–July 1916, 1♂, 1♀ (ZISP).

Armenia. Lori Province: 21. Ahnidzor River, 40°50'52.66"N, 44°50'39.99"E, 1950 m above sea level, 25 August 2011, 2♂, 2♀ (CDP); 24. Goght village, 7 June 1997, 1♀, Melnik (ZMUM).

Turkey. Rize Province, Fındıklı District: 29, 30. tributary of the Çağlayan (Büyük) River, 41°9'56"N, 41°20'20"E, 700–880 m above sea level, 17 August 2012, 1♂, 3♀, *ibid.* August 2012, 2♂, 3♀ (CDP).

Habitats. 1. River, H = 8.0 m, l = 0.1 m, v = 0.1–0.2 m/s, T = 22°C; stones and pebbles. 4. Brook in forest area, H = 2.0–3.0 m, l = 0.1–0.3 m, v = 1.0–2.0 m/s, stones, pebbles with weak overgrowth. 5. Brook in river floodplain, v = 0.1–0.5 m/s; collected from stones in medium-strong and weak current. 6. River, H = 12.0 m, l = 0.3–0.4 m, v = 0.2–0.5 m/s, T = 21°C, in shaded areas, stones and pebbles. 10. River, S = 3.0 m, l = 0.1–0.3 m, v = 0.1 m/s, T = 11.3°C; collected at rapids, on lower surface of rather small stones, in microcrevices. 11. River, H = 4.0 m, l = 0.1–0.3 m, v = 0.1 m/s, T = 12°C; collected at rapids, medium-sized stones. 13. River in wide and flat valley, H = 6.0–8.0 m, T = 12°C; v = 0.01–0.3 m/s, collected from stones. 21. Brook running through mountain meadow area, H = 1.2–1.7 m, l = 0.1–0.15 m, v = 0.2–0.5 m/s, T = 9°C, stones, pebbles, detritus. 29. River in narrow rocky gorge, H = 2.0–4.0 m, l = 0.1–0.3 m, v = 0.3–1.5 m/s, T = 13°C, stones c detritusom in crevices.

Distribution. Described from a single specimen from Manglisi, Georgia (Reitter 1887). According to the Palearctic catalog, present in the following areas: Europe: Armenia, Bosnia and Herzegovina, Slovakia, Ukraine (Transcarpathia), “Caucasus”; Asia: Israel, Lebanon, Syria, Turkey, Iran, Turkmenistan (Kodada *et al.* 2004; Jäch *et al.* 2006).

Recorded for the first time in the Northwestern Caucasus, Russia (Krasnodar Krai and Adygea), and Abkhazia.

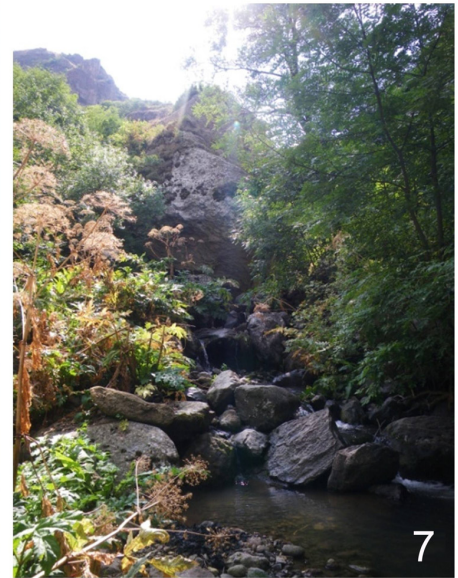
Discussion

Species of the genus *Stenelmis* recorded in the studied region are distributed over considerable ranges of elevations. On the side of the northern macroslope of the Main Caucasus Range, species of this genus have been recorded only in the Western Ciscaucasia, at low elevations. In watercourses of mountain systems of the Eastern Transcaucasia (e.g., in the Talysh Mountains) no representatives of this genus have been found, although this area was studied for several years (in 2012, 2014, and 2015).

Records of *Stenelmis puberula* at the Black Sea coast include elevations of 15–230 m above sea level (Krasnodar Krai and Abkhazia) and 700–880 m above sea level in Transcaucasia (Turkey); on the side of the northern macroslope of the Main Caucasus Range (Adygea) the records include elevations of 500–560 m above sea level. In Transcaucasia the records include elevations of 1200–1950 m above sea level (Georgia, Armenia).

Stenelmis consobrina consobrina has been recorded at elevations of 4–274 m above sea level at the Black Sea coast (Krasnodar Krai) and 230–310 m above sea level on the side of the northern macroslope of the Main Caucasus Range (Adygea). In Transcaucasia it has been recorded at elevations of 460–1730 m above sea level in Turkey and at middle and high elevations (1200–1950 m above sea level) in Armenia. It is interesting that in spite of the overlapping ranges of species of the genus *Stenelmis* in the study area, no biotopes have been found in which both of them live together. However, we found in ZISP one specimen of *Stenelmis consobrina consobrina* Dufour, 1835 from Manglisi, the type locality of *Stenelmis puberula* Reitter, 1887, probably giving evidence that the species can live syntopically.

According to the ecological classification of hydrobionts, adults and larvae of *Stenelmis* are typical litho-rheophiles. In the Caucasus and Transcaucasia they live in various watercourses of the mountain type with considerable water discharge, strong current, and mainly stony substrates (Figs. 4–9). These watercourses are usually small or middle-sized rivers, less often large rivers (l = 3–10 m) of forested areas at low elevations with an average water temperature of 12–16°C. They are also common in watercourses of the mountainous Transcaucasia, where at elevations of about 2000 m above sea level relatively high summer water temperatures in watercourses is retained (as a result of the open steppe landscapes). At the same time, representatives of the genus *Stenelmis* have not been recorded in cold subalpine watercourses of the Greater Caucasus, in which average water temperatures in summer are low (5–8°C).



FIGURES 4–9. Habitats of species of the genus *Stenelmis*: (4) Krasnodar Krai, the Mezyb River; (5) Republic of Adygea, the Lipovaya River; (6) Krasnodar Krai, the Agoy River; (7) Armenia, left-hand tributary of the Goght River; (8) Turkey, right-hand tributary of the Çağlayan (Büyük) River; (9) Turkey, source (left-hand) of the Fırtına River.

The preferred biotopes of *Stenelmis* have stony substrates, in which they live mostly on the lower surfaces of stones or in crevices between them, sheltering them from the strong currents in which both adults and larvae are found, often among aggregations of other litho-rheophilic elmids of the region: *Limnius* spp., *Elmis* spp. and *Grouvellinus caucasicus* (Motschulsky, 1839).

It appears extremely interesting to continue this study by further investigations in central regions of the Caucasus and in Transcaucasia, especially Azerbaijan.

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