

CONFIRMATION OF THE PRESENCE OF THE STEPPE GROUND BEETLE *AMARA EQUESTRIS PASTICA* DEJEAN, 1831 (COLEOPTERA: CARABIDAE) IN BULGARIA WITH NOTES ON ITS TAXONOMIC STATUS

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Abstract. *Amara (Percosia) equestris pastica* Dejean, 1831 (Coleoptera: Carabidae) is a rare beetle found through the dry steppes of Southeastern Europe. This study represents a confirmation of this steppe ground beetle in Bulgaria. The subspecies has been initially reported in 1899 (as a distinct species), but it was subsequently excluded from the Bulgarian fauna. Recently, it was collected in June–November 2022, in pitfall traps from two localities in central-western Bulgaria, situated in the Mountains of Golo Bardo (part of the Kraishte Region) and Tri Ushi (part of the Western Stara Planina Mts.). In addition, some other members of the family, established during the same study, were also reported. A relatively low anthropogenic load in the studied habitats seems to be crucial for the survival of the vulnerable steppe fauna, *A. equestris pastica* in particular.

INTRODUCTION

Tribe Zabrinini Bonelli, 1810 is one of the largest and most diversified, widely distributed and species-rich ground beetle (Coleoptera: Carabidae) groups, and the species from the largest genus in it, *Amara* Bonelli, 1810, are often dominant in different, mostly open habitats, including agrocoenoses (e.g. Teofilova 2021). The subgenus *Percosia* Zimmermann, 1832 includes 6 species, 5 of which live in the Palaearctic (Hieke 2017). *Amara (Percosia) equestris* (Duftschmid, 1812) is the only species of this subgenus occurring in Bulgaria (Hieke 2017; Teofilova, in prep.).

Amara equestris is an open habitat species distributed in Europe, Caucasus, Transcaucasia, Kazakhstan, Near East, Middle Asia, Siberia and Western China, and it is represented by four subspecies (see further in the text) (Hieke 1978, 2004, 2017; Kryzhanovskij, unpubl.). The subspecies *pastica* Dejean, 1831 is a rare beetle found through the dry steppes of Southeastern Europe (easternmost part of Greece, southeastern Ukraine, including Crimean steppe and mountains), the South-East of Russia and Transcaucasia to Southern Transcasian areas and Central Asia (Hieke 1978, 2004, 2011, 2017; Putschkov 2012). Occasionally, *Amara pastica* is considered a separate species (e.g. Kryzhanovskij 1965; Putschkov 2018). Probably, this separation is completely

reasonable, given the established characteristics of its distribution. Further research should be conducted to confirm if *A. pastica* deserves a species rank.

In Bulgaria, *Amara equestris* (s. l.) is not very common, but widely distributed almost across the whole territory of the country, reaching 2500 m a. s. l. in the mountains (Hieke and Wrase 1988; Guéorguiev and Guéorguiev 1995; Kryzhanovskij, unpubl.; Teofilova, in prep.). The subspecies *pastica*, however, has been reported only once, as a distinct species – “*partica* Duft.”, by Ioakimov (1899: 763), with location “Rila”. After that, in their catalogue, Hieke and Wrase (1988: 108) explained that the specimens from the Rila Mountains should probably be referred to this subspecies, if there was no misidentification. Furthermore, Hieke and Wrase (1988) and Kryzhanovskij (unpubl.) suggested that the specimens from the plain inland represent the smaller nominotypical race (7.8–11.0 mm); in the mountains, mostly medium sized animals characteristic for the ssp. *dilatata* Heer, 1837 occur (9.5–12.0 mm); and on the Black Sea coast occasionally very large specimens live, which are transitional to the eastern steppe race ssp. *pastica* (11.0–15.0 mm). Subsequently, in the latest published catalogue of Bulgarian carabids, Guéorguiev and Guéorguiev (1995) remove the ssp. *dilatata* and ssp. *pastica* from the list and report only the species *equestris* as occurring in the country, without further notes on the subspecies. This is probably

the result of the confused information available about the species in Bulgaria in general.

Recently ongoing faunal and ecological studies appear quite productive and are resulting in many additions and contributions to the knowledge about the ground beetles in Bulgaria (e.g. Teofilova et al. 2020; Teofilova 2021; Teofilova and Kodzhabashev 2022). The goal of this study is to present the steppe ground beetle *Amara (Percosia) equestris pastica* and to confirm its presence in Bulgaria, as well as to add some new data to the knowledge of its distribution, ecology and habitats conservation significance.

MATERIALS AND METHODS

The material for this study came from a field work carried out in two regions in central-western Bulgaria. The localities are situated in the Golo Bardo Mountain (part of the Kraishte Region) and Tri Ushi Mountain (part of the Western Stara Planina Mts.) (Figure 1). The specimens were collected throughout June–November 2022 via pitfall trapping. The traps were made of cut 2 L plastic bottles, buried at the level of the ground surface, and filled with 8% formaldehyde. Six traps were set in each sampling site. The specimens were determined by the author and are stored in the author's collection in the Institute of Biodiversity and Ecosystem Research of the Bulgarian Academy of Sciences, Sofia.

The main identification features of the subsp. *pastica* are: body length; chaetotaxy of the middle femora, prosternal process and sternites; shape and characteristics of the pronotum; punctuation of the elytral striae (Kryzhanovskij 1965, unpubl.; Hieke 1978, 2004, 2011; Putschkov 2012, 2018).

RESULTS AND DISCUSSION

Two female specimens of the ground beetle *Amara equestris pastica* were found in two sites in central-western Bulgaria, thus confirming the presence of this subspecies in the country.

Systematics:

Family: Carabidae Latreille, 1802

Subfamily: Harpalinae Bonelli, 1810 (or Pterostichinae Bonelli, 1810 in some classifications)

Tribe: Zabrini Bonelli, 1810

Genus: *Amara* Bonelli, 1810 (Sun beetles)

Sugenus: *Percosia* Zimmermann, 1832

Species: *Amara (Percosia) equestris* (Duftschmid, 1812)

Subspecies: *Amara (Percosia) equestris pastica* Dejean, 1831

Synonym: *mandli* Jedlička, 1963

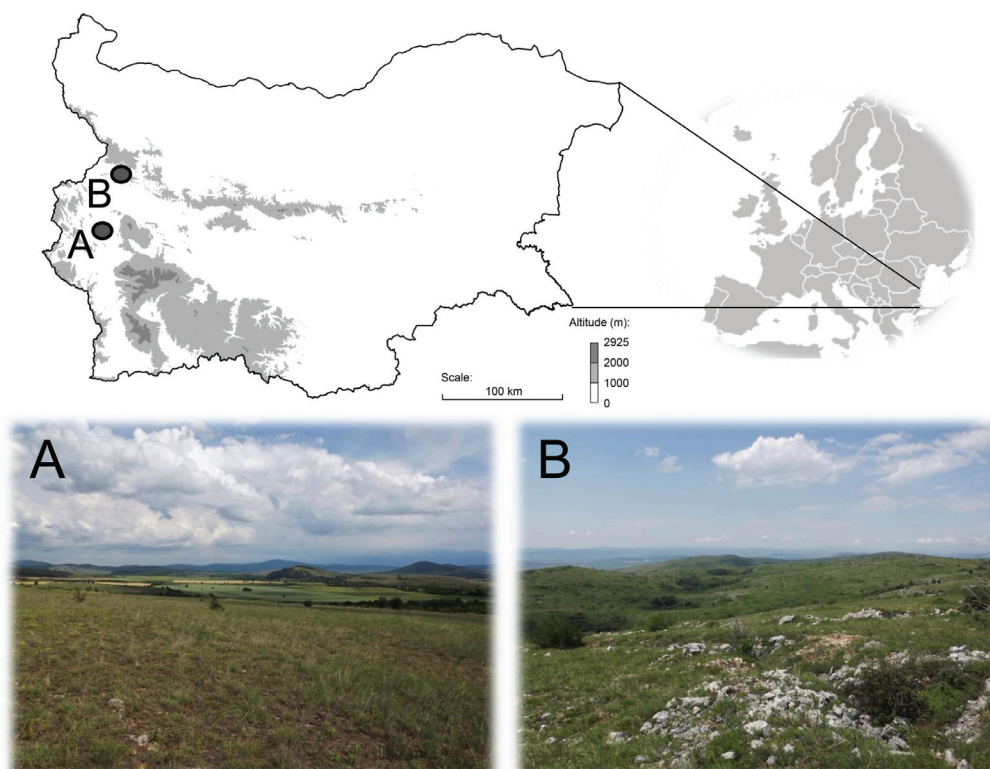


Figure 1. Location and view of the sampling sites where *Amara equestris pastica* was collected: A – Golo Bardo Mountain, 760 m a. s. l.; B – Tri Ushi Mountain, 925 m a. s. l.

New data:

1) Golo Bardo Mountain, NW Drugan Vill., 42°29'53.9"N, 23°03'31.9"E, 760 m, stony meadow with steppe elements and single bushes (*Rosa*, *Crataegus*, *Ulmus*), surrounded by cultivated lands (Figure 1A), 1♀, 14 June – 25 August 2022;

2) Tri Ushi Mountain, N Bezden Vill., 42°54'49.3"N, 23°06'51.6"E, 925 m, stony steppe-like habitat with *Amygdalus nana*, *Syringa vulgaris*, *Thymus* spp. and steppe grasses (Figure 1B), 1♀ (Figure 2), 22 August – 19 November 2022.

The identified specimens possess all taxonomic characteristics specific to their subgenus and species: plump beetles with dark brown to brown-black convex body; underside, antennae and legs red-brown (femora and tarsi sometimes darkened); pronotum strongly constricted towards anterior margin, with two deep and punctured basal fovea and straight, slightly rounded at the top hind angles; lateral margin of the pronotum, especially posteriorly, strongly beaded (with swelling lateral edge); prosternal process margined and with several (4–12) setae; posterior margin of mesofemora with 4–8 (rarely 3) setae; abdominal sternites 3 and 4 usually with 2 setiferous punctures (Hieke 1978, 2004, 2011; Putschkov 2012, 2018; Kryzhanovskij, unpubl.).

Amara equestris is quite a distinct species, and it is not very likely to be misidentified. Very similar to *A. equestris* are two species, which it could be mistaken with:

A. (Percosia) infuscata Putzeys, 1866 (8.6–12.0 mm long; with a slightly lower number of setae on the middle legs and on the prosternal process; only weakly beaded lateral margin of the pronotum; extremely disjunct distribution in the high altitudes of the Western Alps, the cold steppes of Yakutia, Buryatia, Mongolia, the Sayan Mountains, the Altai and the northern mountain ranges of the Tien Shan) (Hieke 2004), and *A. (Parapercosia) taurica* (Motschulsky, 1844) (10.0–14.0 mm long; with indistinct fovea on the pronotum; short and broad, barely narrowed anteriorly pronotum, which base and lateral margin are densely punctate and posterior angles are slightly obtuse and rounded; small, almost rectangular shoulder denticle; abdominal sternites with 3–6 pores in the middle; distributed on the virgin steppes of Southeastern Europe, Caucasus, Turkey, Kazakhstan and the south of Western Siberia (Hieke 2011; Putschkov 2012).

Along its relatively large range *A. equestris* is represented with four subspecies (Kryzhanovskij 1965; Hieke 1978, 2004, 2017; Putschkov 2012, 2018; Putschkov and Brygadyrenko 2018, 2022):

- *equestris* (Duftschmid, 1812): small (8.0–10.8 mm) Western Palaearctic (from southern England in the west to the Baikal region in the east and from southern Scandinavia to the middle of the Iberian Peninsula, northern Italy, Greece, Turkey, Caucasus, Kazakhstan and northern Central Asia) nominotypical race; mesofemora with

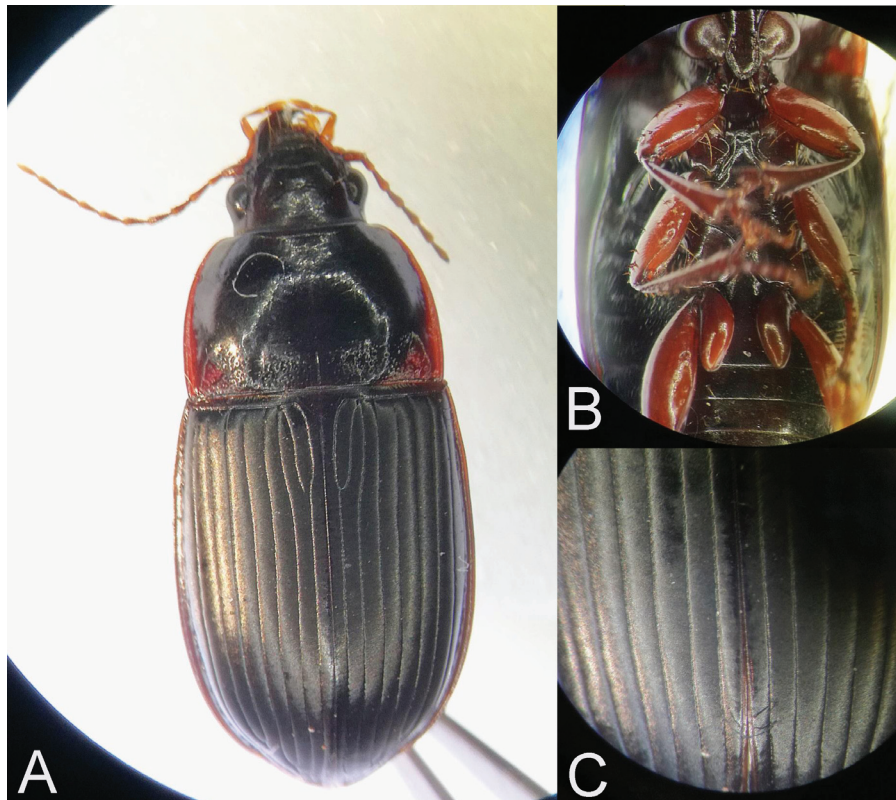


Figure 2. Habitus (A), ventral view with chaetotaxy of the middle femora (B) and elytral striae (C) of the female specimen of *Amara equestris pastica* from the site near Bezden Vill.

4 setae; base of pronotum strongly punctate, its posterior angles not rounded; shoulders of the elytra with a sharply acuminate denticle; striae weakly but clearly punctate, usually deeper at apex; in moderately dry places;

- *zabroides* Dejean, 1828: larger (10.0–12.0 mm) and strikingly wide, occurring in the French and Italian Maritime Alps, sporadically as far as northeastern Spain and southern Switzerland;

- *dilatata* Heer, 1837: medium (9.5–11.0 mm) race occupying an intermediate position in body size and shape between the previous subspecies, dominant in the area of the Western Alps;

- *pastica* Dejean, 1831: very large (10.5–14.5 mm), but with more parallel-sided zabroid body; mesofemora with numerous setae; base of pronotum faintly punctate, its posterior angles slightly rounded at apex; shoulders of the elytra with a small rectangular denticle; striae without distinct punctures, barely deeper at apex; in dry steppes of Azerbaijan, Armenia, Greece, south European territory of Russia, the far southeast of Ukraine, Iran, Kyrgyzstan, Kazakhstan, Tajikistan, Turkmenistan, Turkey, Uzbekistan, West Siberia.

The range of *A. equestris pastica* is generally limited to the Eurasian steppe zone, and in this respect the populations from Greece and Bulgaria seem isolated, but further studies are needed in that aspect. Probably it is the availability of preserved steppe refugia that is the most important factor for the distribution of this beetle.

According to Hieke (1978), *Amara equestris* is very variable and there are zones with intermediate characteristics between the subspecies, including the nominotypical subspecies and *A. equestris pastica*. However, the specimens presented in this study are quite specific. Both specimens we found are very akin to each other and differ (by size, chaetotaxy and elytral striae punctuation) from the other *Amara equestris* beetles collected during the same study in other regions of western Bulgaria (e.g. near the villages of Seslavtsi, Ponor and Reselets). Both are 11.5 mm long; their head and pronotum are shiny, lustrous, and elytra are more matt, with faintly punctate and weakly depressed striae; the posterior angles of the pronotum are rounded. The prosternal process is margined and has 7 visible setae in the specimen from Golo Bardo and 11 setae in the specimen from Tri Ushi. The posterior margin of mesofemora has 7 setae in the specimen from Golo Bardo and more than 5 visible setae in the specimen from Tri Ushi. Abdominal sternites have 2 setiferous punctures in the specimen from Golo Bardo and 3 in the specimen from Tri Ushi.

Some authors consider *Amara pastica* a separate species (e.g. Kryzhanovskij 1965; Putchkov 2018), and the characteristics of its distribution and habitat preferences indicate the reason for this separation. Most likely, this

taxon indeed deserves a species rank, given the fact that the ranges of *A. equestris* subspecies are not well separated, at least in Bulgaria. The distributional areas of both already known subspecies in Bulgaria seem to overlap to some extent (*A. e. equestris* has been reported both from the Kraishte Region and Stara Planina Mts.), and it is generally considered that two subspecies of one species do not co-occur. Besides, the available material shows clear differences from the herein studied specimens. Therefore, we should rather detach them, or at least revise their taxonomy. However, the actual taxonomic rank of *A. pastica* should be confirmed after further detailed and targeted research of many more specimens and regions.

According to the literature, *Amara equestris* is a megathermophile, broad mesophile and meadow-steppe dweller found mostly in steppe biotopes on warm, loose soil, and also in dry grasslands, mesoxerophytic meadows or thinned wood stands. In the mountains it reaches the belt of beech forests, and in cultivated landscapes it is more often found in pastures, rarely in orchards, vineyards, and occasionally in field crops (Putchkov 2018; Putchkov and Brygadyrenko 2018, 2022). Both *equestris* and *pastica* subspecies are nocturnally active zoophytophagous mesoxerophilic elements with spring-summer activity and overwintering imago, whereas *A. pastica* is restricted to the steppes (Putchkov 2012). Our findings agree with these patterns as we collected both specimens in open low- and middle-mountain areas. The site near Drugan (at 760 m) represents a dry stony meadow with some steppe herbaceous elements and single bushes (*Rosa*, *Crataegus*, *Ulmus*). It is surrounded by cultivated lands, but the adjacent territory seems quite unaffected by anthropogenic activities. The site near Bezden (at 925 m) represents a typical xerothermophytic karst steppe with many steppe grasses and bushes (*Amygdalus nana*, *Syringa vulgaris*, *Thymus* spp.). It is exposed to a minimal human impact since it is located within the boundaries of a territory with restricted access. The low anthropogenic load in the studied habitats seems to be crucial for the survival of the vulnerable steppe fauna and *A. equestris pastica* in particular, since it is known that the decline in its population may be due to arable farming in natural steppes, as it is proved for the steppe fauna as a whole, including most of the rare and protected steppe species (Shapovalov et al. 2011; Putchkov and Brygadyrenko 2018, 2022; Teofilova and Kodzhabashev 2022).

During the current study, another 15 carabid species were captured in the pitfall traps (12 species in the site near Drugan and only 6 species in the site near Bezden), of which only 3 species were found in both sites (Table 1). This fact probably reflects the different periods of sampling and environmental conditions in the two studied habitats and indicates once more the hemistenotopic

Table 1. Carabid species collected together with *Amara pastica* in the same sampling sites and periods: near Drugan (14 June – 25 August 2022) and near Bezden (22 August – 19 September 2022).

Species	Drugan	Bezden
<i>Amara (Amara) aenea</i> (DeGeer, 1774)	1 ex.	
<i>Calathus (Calathus) distinguendus</i> Chaudoir, 1846	18 ex.	61 ex.
<i>Calathus (Neocalathus) ambiguus</i> (Paykull, 1790)	1 ex.	
<i>Calathus (Neocalathus) cinctus</i> Motschulsky, 1850	3 ex.	1 ex.
<i>Carabus (Pachystus) cavernosus</i> I. Frivaldszky von Frivald, 1838		6 ex.
<i>Carabus (Procrustes) coriaceus</i> Linnaeus, 1758		4 ex.
<i>Carabus (Tomocarabus) bessarabicus</i> Fischer von Waldheim, 1823		1 ex.
<i>Harpalus (Harpalus) pumilus</i> Sturm, 1818	1 ex.	
<i>Harpalus (Harpalus) subcylindricus</i> Dejean, 1829	2 ex.	
<i>Laemostenus (Pristonychus) terricola</i> (Herbst, 1784)	2 ex.	3 ex.
<i>Microlestes minutulus</i> (Goeze, 1777)	1 ex.	
<i>Ophonus (Hesperophonus) azureus</i> (Fabricius, 1775)	4 ex.	
<i>Ophonus (Hesperophonus) cribricollis</i> (Dejean, 1829)	4 ex.	
<i>Zabrus (Pelor) spinipes</i> (Fabricius, 1798)	1 ex.	
<i>Zabrus (Zabrus) tenebrioides</i> (Goeze, 1777)	1 ex.	

biocenotic specialization of *A. e. pastica*, as noted by Putschkov and Brygadyrenko (2018).

In both sites where *A. pastica* was collected, *Calathus distinguendus* was superdominant, and another xerophilous species, *Calathus cinctus*, was present, along with the bothrobiont *Laemostenus terricola*. A very interesting fact is that at the site near Drugan none of the *Carabus* species were found – all three representatives of this genus were collected in the steppe site near Bezden. The most remarkable of them was the steppe indicator *Carabus bessarabicus*, just recently reported for the Bulgarian fauna from an adjacent steppe-like habitat in the Chepan Planina Mountain (Teofilova and Kodzhabashev 2022). In the same thermophilic karst refugium in the Chepan Planina, the steppe stenobiont *Carabus hungaricus* Fabricius, 1792 was also found, and the natural steppe habitats 62A0, 6210, 6110 and 40A0* (*important orchid habitats) were registered as its habitats (Teofilova and Kodzhabashev 2022). This probably marks some common habitat patterns with the studied sampling sites.

Amara e. pastica is considered rare, and usually it is rarely encountered, with single specimens counting less than 1% of the total numbers of the carabids in the studied coenoses (Putschkov 2012). In our study it represented 2.6% of the 39 specimens collected at the site near Drugan where *C. distinguendus* had 46% of all specimens, and 1.3% of the 76 specimens in the site near Bezden where *C. distinguendus* had 80% of all specimens. These results, however, should not be decisive for any ecological conclusions, because of the single, and different, periods of research.

The two specimens of *A. equestris pastica* were col-

lected from 14 June to 19 November 2022. This is a rather long period of time, and precise phenological conclusions would be highly speculative, but the results coincide with the data from the literature noting the activity of the species from late March (more often in May–June) until mid-September (Putschkov 2018; Putschkov and Brygadyrenko 2022).

CONCLUSIONS

Recently conducted or ongoing faunal and ecological research have brought many additions and contributions to the knowledge of ground beetles in Bulgaria. This study confirms the presence of the steppe ground beetle *Amara equestris pastica* in Bulgaria and provides insight regarding its geographical and biotopic distribution. The characteristics of its distribution and habitat preferences should be considered when discussing the subspecies/species rank of this beetle. Most likely, this taxon indeed deserves a separate species rank, given the fact that the geographical ranges of *A. equestris* subspecies are not well separated, at least in Bulgaria. However, further research is needed to establish whether *A. e. pastica* is a true species or not. The new findings of rare or stenotopic animals, such as the one presented here, are particularly important and could aid their conservation. The survival and preservation of the vulnerable steppe fauna (as a whole, not only the ground beetles) seems strongly dependant on the preservation of the peculiar steppe refugia which in Bulgaria are very scattered, but still existing in some areas with low or no anthropogenic load. Therefore, these refugia should be of prime conservational importance.

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