

## Four alien fruit-feeding sap beetle species (Coleoptera: Nitidulidae) from Sakar Mts, Bulgaria

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**Abstract.** Four alien sap beetle species – *Carpophilus hemipterus* (Linnaeus, 1758), *C. marginellus* Motschulsky, 1858, *Phenolia picta* (W. S. MacLeay, 1825) and *Stelidota geminata* (Say, 1825) (Coleoptera: Nitidulidae) are reported from rural area in Sakar Mts, SE Bulgaria. A single male of *P. picta* was collected at UV light and larvae of the same species were found feeding on fallen fruits of *Ficus carica*. The remaining species were collected under fallen figs in the field or emerged from the same fruits after laboratory rearing. *Phenolia picta* seems to be successfully established in the country, including the inland territory.

**Key words:** Nitidulidae, alien species, Bulgaria, Sakar Mts

### Introduction

The biology of the sap beetles of the family Nitidulidae, and in particular the abundance of species feeding on fruits and stored products, subject of international trade, facilitates the introduction and the subsequent naturalization of alien species (Montagud & Orrico 2015, Jelínek *et al.* 2016). According to Montagud & Orrico (2015) more than 10% of all European species of Nitidulidae represent alien species. Jelínek *et al.* (2016) report 32 sap beetle species introduced in historical times to Europe and the Mediterranean region. Of these, 26 species are found on ripening, rotten or dried fruits (Jelínek *et al.* 2016), as at least for part of them the frugivory is combined with saprophagy or mycophagy (Tomov *et al.* 2009; Denux & Zagatti 2010; Martynov *et al.* 2019).

Ten alien species of sap beetles have been reported so far for Bulgaria: *Carpophilus bifenestratus* Murray, 1864, *C. dimidiatus* (Fabricius, 1792), *C. hemipterus* (Linnaeus, 1758), *C. marginellus* Motschulsky, 1858, *C. mutilatus* Erichson, 1843, *C. nepos* Murray, 1864, *Urophorus humeralis* (Fabricius, 1798), *Epuraea luteola* Erichson, 1843, *Stelidota geminata* (Say, 1825) and *Glischrochilus quadrisignatus* (Say, 1835) (Jelínek & Audisio 2007; Tomov *et al.* 2009; Tomov & Trencheva 2013; Guéorguiev 2018). Of these, the species of genus *Carpophilus* Stephens, 1830, as well as the species *Urophorus humeralis* appear to have Palaeotropical origin while *Epuraea luteola*, *Stelidota geminata* and *Glischrochilus quadrisignatus* – Oriental, Southern Nearctic–Neotropic and Nearctic origins, respectively (Jelínek & Audisio 2007; Jelínek *et al.* 2016). All reported for Bulgaria alien sap beetle species can feed on fruits, although some of them exhibit more diverse food preferences (Tomov *et al.* 2009; Jelínek *et al.* 2016; Martynov *et al.* 2019).

No indigenous or alien species of the family Nitidulidae have been reported for the Sakar Mountains so far. In the present work we provide data on distribution and biology of four alien to Europe species from this region of Bulgaria.

## Materials and Methods

The material was collected at the end of July and the beginning of September 2024 in the residential area of Ustrem Village (Haskovo Province), Sakar Mountains. The studied sites are located about 100 meters from the bank of Manastirska reka River. The material was collected using a light trap (portable lamp with 8W black tube, powered by 12V battery), as well as by hand under fallen figs (*Ficus carica* L.) (Fig. 1). The surface soil layer (up to 5 cm depth) under fallen figs was also examined for adult beetles. In addition, decaying figs were collected from the study sites in September for laboratory rearing of the larvae. In the laboratory the fruits were placed in plastic containers on moistened clean river sand (300–400 µm grain size) and examined for beetle emergence in about a month and a half after collection.

The photographs of the habitat and those of the larvae in fruits were taken with Canon EOS 250D digital camera (Figs 1, 3 A, B). The photographs of the beetles in Fig. 2 and the pupa in Fig. 3 were taken with Olympus SZ61 stereomicroscope, equipped with Canon EOS 2000D digital camera. Genital structures were photographed with Canon EOS 2000D digital camera, adapted to Olympus BX41 microscope (Fig. 2 C) and Olympus SZ61 stereomicroscope (Fig. 2 F–H). The collected specimens are preserved in the Zoological Collection of Sofia University “St. Kliment Ohridski”, Faculty of Biology (BFUS).

## Results and Discussion

### Family Nitidulidae Latreille, 1802

#### Subfamily Carpophilinae Erichson, 1842

#### Genus *Carpophilus* Stephens, 1830

#### Subgenus *Carpophilus* Stephens, 1830

#### *Carpophilus (Carpophilus) hemipterus* (Linnaeus, 1758)

Material examined: Sakar Mts, Ustrem Vill., 42°01.345'N 26°27.391'E, 95 m a.s.l., street side vegetation (Fig. 1 A, C), 10.ix.2024, 1 ♀ (BFUS-COL000001), emerged 10.ix.–15.x.2024 from decaying figs, D. Gradinarov & Y. Petrova leg. (Fig. 2 A).

*Carpophilus hemipterus* is a cosmopolitan species (Jelínek & Audisio 2007) with Paleotropical origin, introduced in the Mediterranean probably in the Roman Age (Jelínek *et al.* 2016). The species has been repeatedly reported from Bulgaria by various authors (Tomov & Trencheva 2013) but is omitted for the country in the Catalogue of Palaearctic Coleoptera (Jelínek & Audisio 2007).

#### *Carpophilus (Carpophilus) marginellus* Motschulsky, 1858

Material examined: Sakar Mts, Ustrem Vill., 42°01.341'N 26°27.385'E, 95 m a.s.l., backyard of a house (Fig. 1 B, D), 07.ix.2024, 1 ♂ (BFUS-COL000002), under decaying figs, after sunset, D. Gradinarov & Y. Petrova leg. (Fig. 2 B, C).

The species *C. marginellus* is of Paleotropical origin, but presently has a cosmopolitan distribution (Jelínek & Audisio 2007; Jelínek *et al.* 2016). In Europe, the species was first recorded in Great Britain in 1938 (Denux & Zagatti 2010). For Bulgaria, *C. marginellus* has been repeatedly cited without specified localities (Jelínek & Audisio 2007; Tomov *et al.* 2009; Denux & Zagatti 2010; Tomov & Trencheva 2013; Martynov *et al.* 2019). This species apparently can use a wide range of food sources besides fruits, being found in grains, compost, on tree sap and on flowers (Denux & Zagatti 2010; Martynov *et al.* 2019).





**Fig. 1.** Habitats of the alien Nitidulidae species with fallen fruits of *Ficus carica* in Ustrem Village, Bulgaria. A, C – street side vegetation – habitat of *Phenolia picta* and *Carpophilus hemipterus*; B, D – backyard of a house – habitat of *C. marginellus*, *P. picta* and *Stelidota geminata*.

### **Subfamily Nitidulinae Latreille, 1802**

#### **Genus *Phenolia* Erichson, 1843**

#### **Subgenus *Lasiodites* Jelínek, 1999**

#### ***Phenolia (Lasiodites) picta* (W. S. MacLeay, 1825)**

Material examined: Sakar Mts, Ustrem Vill., 42°01.334'N 26°27.383'E, 95 m a.s.l., house yard, 27.vii.2024, 1 ♂ (BFUS-COL000003), at light (UV) (21:00–21:30 p.m.), D. Gradinarov & Y. Petrova leg. (Fig. 2 E – H); Sakar Mts, Ustrem Vill., 42°01.341'N 26°27.385'E, 95 m a.s.l., backyard of a house (Fig. 1 B, D), 08.ix.2024, 1 ♂ (BFUS-COL000004), emerged 08–30.ix.2024 from decaying figs, D. Gradinarov & Y. Petrova leg.; idem, 08.ix.2024, 3 ♀♀ (BFUS-COL000005, BFUS-COL000006, BFUS-COL000007), emerged 08.ix.–14.x.2024 from decaying figs, D. Gradinarov & Y. Petrova leg.; Sakar Mts, Ustrem Vill., 42°01.345'N 26°27.391'E, 95 m a.s.l., street side vegetation (Fig. 1 A, C), 10.ix.2024, 2

♀♀ (BFUS-COL000008, BFUS-COL000009), emerged 10.ix.–14.x.2024 from decaying figs, D. Gradinarov & Y. Petrova leg.

Larvae of *P. picta* were observed in decaying fruits of *F. carica* in the first half of September (Fig. 3 A, B). Two to three weeks after fruit collection, the larvae pupated in the sand (Fig. 3 C–E), and by mid-October several adults emerged (Fig. 3 F).

*Phenolia picta* is widely distributed in south-west Indian Ocean Islands (Seychelles, Madagascar, Nossi-Bé, Réunion), Indo-Malayan and Australian regions, Eastern Palaearctic region (e.g. Pakistan, Japan, Korea and China) and Hawaii (Kirejtshuk & Kvamme 2002; Kirejtshuk 2005). For Europe and Mediterranean areas, the species was firstly reported in 2014 from southern Spain as *P. limabata tibialis* (Boheman, 1851) (Viñolas *et al.* 2014; Jelinek *et al.* 2016), later from eastern Spain (Montagud & Orrico 2015), southern France, Asian Türkiye (Jelinek *et al.* 2016), Greece (Kalaentzis *et al.* 2020), Italy (Sicily and Sardinia) (Sparacio *et al.* 2020; Rattu *et al.* 2021), South Caucasus (Khryapin 2022) and Iran (Serri *et al.* 2023). Data on the presence of *P. picta* in Bulgaria have not been published so far, but occurrence data for the species from the citizen-science platform iNaturalist ([www.inaturalist.org](http://www.inaturalist.org)) are present in Global Biodiversity Information Facility (GBIF.org 2024).

It is noteworthy that all known records of the species within the invasive range came from coastal regions, up to 30 km from the seashore and in many cases in proximity to rivers. The observations from 2023 in Bulgaria, presented in GBIF are as well from the coastal regions (Varna and Primorsko, the Black Sea coast). According to Kirejtshuk & Kvamme (2002) the highest species diversity within the subgenus *Lasiodites* has been recorded for mountains and tropical rainforest. In accordance with the subgenus preferences, *P. picta* seems to prefer areas or habitats with a wetter climate in the newly occupied territories. This corresponds well with our findings of the species, where the studied sites are located near a river, the larvae develop in fallen fruits in habitats with more or less constant temperature and humidity – enclosed backyard and shaded street margin. However, the locality in Sakar is situated in significant distance from the closest seashore (more than 100 km) which probably is a result of subsequent spreading of the species. Apparently, the species is successfully established at least in the southeastern region of Bulgaria.

In its invasive range, *P. picta* feeds on rotting fruit fallen on the ground (*Phoenix dactylifera*, *Opuntia* sp., *F. carica*, *Vitis vinifera*, *Citrus* spp., *Pyrus communis*, *Prunus* spp., *Diospyros kaki*) and does not appear to be economically important pest (Viñolas *et al.* 2014; Montagud & Orrico 2015; Rattu *et al.* 2021; Serri *et al.* 2023).

### **Genus *Stelidota* Erichson, 1843**

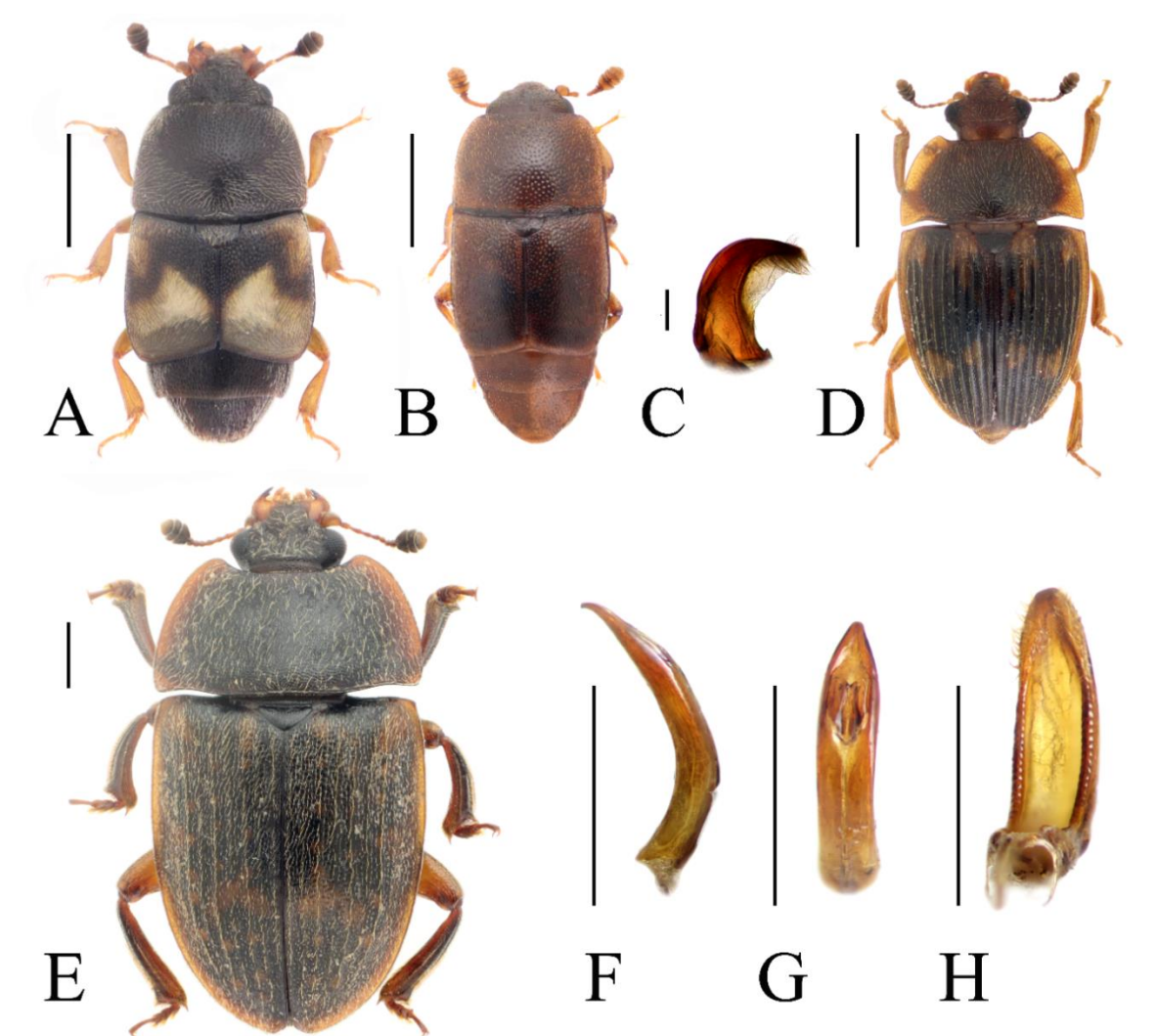
#### ***Stelidota geminata* (Say, 1825)**

Material examined: Sakar Mts, Ustrem Vill., 42°01.341'N 26°27.385'E, 95 m a.s.l., backyard of a house (Fig. 1 B, D), 09.ix.2024, 1 ♀ (BFUS-COL000010), in soil under decaying figs, D. Gradinarov & Y. Petrova leg. (Fig. 2 D).

According to Jelinek *et al.* (2016) *S. geminata* originated from Southern USA and has been introduced in Italy at the end of the 20th century, rapidly expanding its range in continental Europe. In the USA, this species is considered a serious pest of strawberries, but it is also known to develop on other fruits and vegetables (Jelinek *et al.* 2016; Martynov *et al.* 2019; Zhekova 2020). In Bulgaria, the species is firstly reported by Guéorguiev (2018) on a single finding with a pitfall trap at Chelopech Village, Sofia Province and subsequently by Zhekova (2020) from Chervena voda Village, Ruse Province. The second author also reports damages on the fruits of the strawberry, apricots and tomatoes, caused by this species (Zhekova 2020). A single male specimen of *S. geminata* from Bulgaria (Stara Zagora Province) is also preserved in the BFUS collection, labelled “Bulgaria: Sarnena Gora Mts, 3



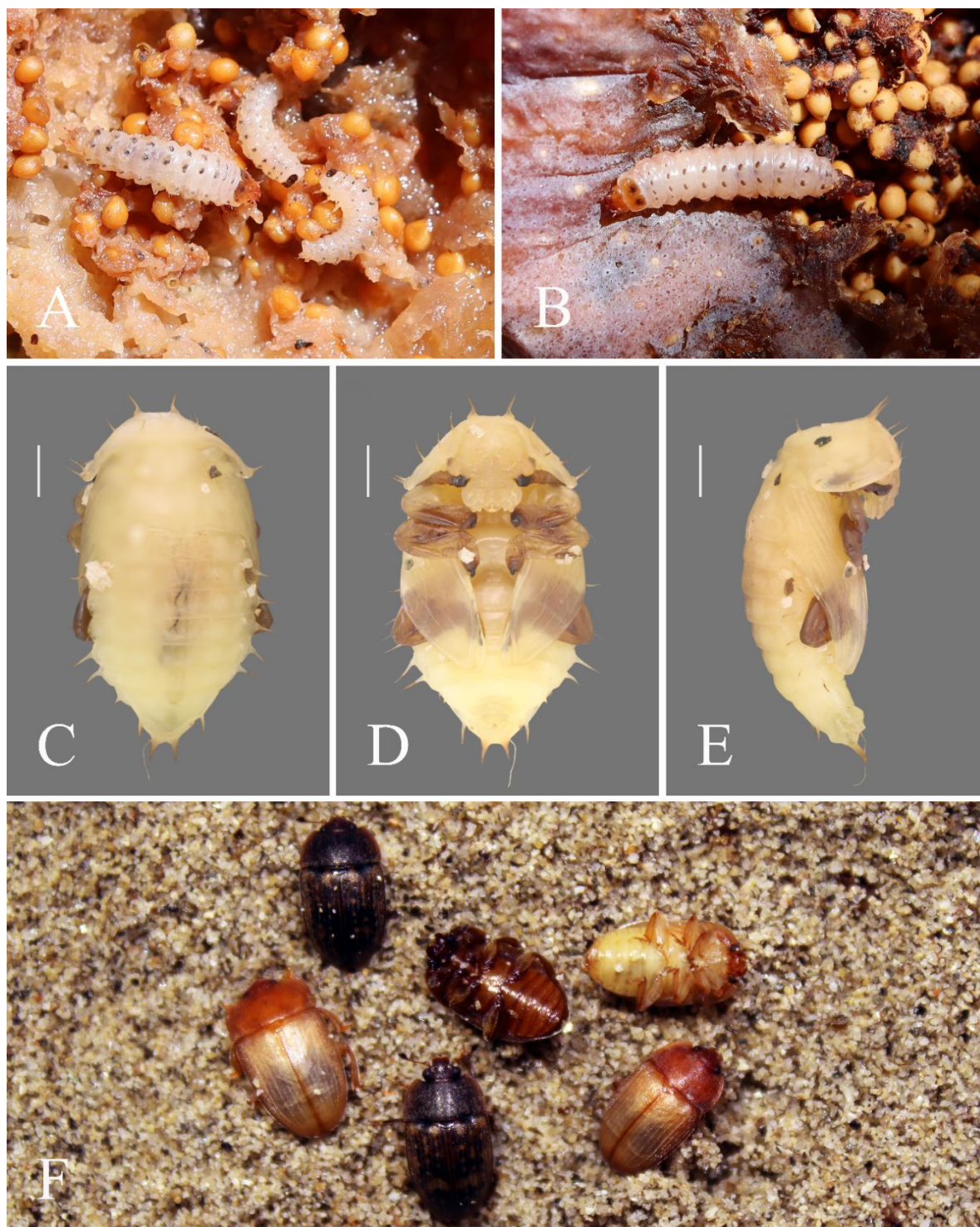
km NW Gorno Novo Selo Vill., 42°28.393'N 25°13.241'E, 800 m a.s.l., oak forest, 22.vii.–26.viii.2018, pitfall traps, D. Gradinarov & Y. Petrova leg. (BFUS-COL000011). It seems that the species is successfully established and presently widespread in Bulgaria.



**Fig. 2.** Alien Nitidulidae species from Ustrem Village, Bulgaria. *Carpophilus hemipterus*, female (A): habitus; *C. marginellus*, male (B, C): B – habitus; C – tegmen, lateral view; *Stelidota geminata*, female (D): habitus; *Phenolia picta*, male (E–H): E – habitus; F – penis trunk, lateral view; G – penis trunk, dorsal view; H – tegmen, ventral view. Scale bars: A, B, D, E–H: 1 mm; C: 0,1 mm.

The alien nitidulid species in our study coexist in distinct microhabitat (decaying figs). Apart of the aforementioned four species, several specimens of *Carpophilus*, subgenus *Myothorax* Murray, 1864, were also obtained from collected fruits (figs and apples) from the same localities. The complicated taxonomy of this subgenus (de Benedetta *et al.* 2022; Semeraro *et al.* 2023), however, does not allow currently their identification to species level. Coexistence of *P. picta* on decaying dates with two other alien sap beetles in Europe – *U. humeralis* (Fabricius, 1798) and *E. luteola* Erichson, 1843 is reported by Viñolas *et al.* (2014). Montagud & Orrico (2015) report coexistence of *P. picta* with another alien *Phenolia* species – *P. (L.) tibialis* (Boheman, 1851), on fallen fruits of *F. carica* and *Opuntia* sp., as well as coexistence with unspecified indigenous nitidulids. It appears that the competition for

resources (if present) among the frugivorous sap beetle species in these cases is balanced in a way that allows their coexistence in the natural habitats.



**Fig. 3.** Developmental stages of *Phenolia picta* from Ustrem Village, Bulgaria. A, B – larvae in decaying fruits of *Ficus carica*, 08.ix.2024; C – pupa, reared on decaying fruits of *F. carica*, 08–24.ix.2024, dorsal view; D – the same, ventral view; E – the same, lateral view; F – adults, emerged from decaying fruits of *F. carica*, 08–10.ix.–15.x.2024. Scale bars (C–E): 1 mm.



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