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Original research

New data and notes on the *Protorhoe* Herbulot, 1951 (Lepidoptera, Geometridae, Larentiinae) species in Turkey with first report of *Protorhoe centralisata* (Staudinger, 1892)

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Abstract: *Protorhoe centralisata* (Staudinger, 1892), a new record from Turkey, is reported. Distribution, phenology, habitat and larval food-plant of all known *Protorhoe* Herbulot, 1951 species in Turkey are given: *P. corollaria* (Herrich-Schäffer, [1848]); *P. unicata* (Guenée, [1858]); *P. centralisata* (Staudinger, 1892); *P. beshkovi* Rajaei, Stadie & Hausmann, 2017; *P. drechseli* Rajaei, Stadie & Hausmann, 2017 and spread area of the species are shown on a map. Also, figures of *P. centralisata* (Staudinger, 1892) and *P. drechseli* Rajaei, Stadie & Hausmann, 2017 are illustrated and new data on their distribution, phenology and habitat are discussed.

Keywords: New record, *Protorhoe, Protorhoe centralisata,* Geometridae, Lepidoptera, Turkey

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Introduction

The genus *Protorhoe* was described by Herbulot (1951) on the type species *Melanippe unicata* (Guenée, 1858) as two sister genera of *Catarhoe* Herbulot, 1951 and *Epirrhoe* Hübner, 1825. Hausmann and Viidalepp (2012) presented six species from the Palearctic region in this genus. Rajaei et al. (2017) described two new species, *Protorhoe beshkovi* Rajaei, Stadie & Hausmann, 2017 and *Protorhoe drechseli* Rajaei, Stadie & Hausmann, 2017 from Turkey. Hovewer, they revised the genus as follows: "*Cidaria avetianae* Vardikian, 1974 was synonymized with *Protorhoe unicata* (Guenée, 1858). *Cidaria unicata centralisata* Staudinger, 1892 was raised from subspecies to species rank, and *P. tangaba* (Wiltshire, 1952) was transferred from *Catarhoe* Herbulot, 1951 to the genus *Protorhoe* Herbulot, 1951". And, as a result, they reported nine *Protorhoe* species: *P. unicata* (Guenée, 1858); *P. centralisata* (Staudinger, 1892); *P. corollaria* (Herrich-Schäffer, 1848); *P. turkmenaria* (Shchetkin, 1956); *P. crebrolineata* (Kuznetsov, 1960); *P. tangaba* (Wiltshire, 1952); *P. drechseli* Rajaei, Stadie & Hausmann, 2017; *P. tadzhikaria* (Shchetkin, 1956) and *P. beshkovi* Rajaei, Stadie & Hausmann, 2017. In this instance, known four *Protorhoe* species in Turkey are: *P. corollaria* (Herrich-Schäffer, [1848]); *P. unicata* (Guenée, [1858]); *P. drechseli* Rajaei, Stadie & Hausmann, 2017 and *P. beshkovi* Rajaei, Stadie & Hausmann, 2017.

In this paper, *P. centralisata* (Staudinger, 1892) is reported from Turkey for the first time. Distribution of all known *Protorhoe* Herbulot, 1951 species in Turkey are illustrated on a map. New data on the habitat, phenology and distribution of *P. centralisata* (Staudinger, 1892) and *P. drechseli* Rajaei, Stadie & Hausmann, 2017 are presented.

Material and Methods

The materials were gathered between 2016 and 2018, on the territory of Batman and Siirt Provinces from south-eastern Anatolia, Turkey. Moths were caught in an entomological UV light trap, killed by ethyl acetate and pinned with a suitable insect needle. Specimens were prepared, labelled, and deposited according to standard entomological methods. For the exact identification, male genitalia of the species were prepared. The materials are stored in the special collection of the author in Batman Province.

Results and Discussion

Protorhoe Herbulot, 1951

Protorhoe unicata (Guenée, [1858])

Synonym(s). *unicata* Guenée, [1858]; *avetianae* Vardikyan, 1974.

Distribution in the world: South-eastern Europe, Turkey, Caucasia, north-western Iran, Crimea, Cyprus, Levant countries? and Oman? (Viidalepp, 1996; Hausmann, 1991; Hausmann et al., 2009; Okyar, 2009; Hausmann and Viidalepp, 2012; Rajaei et al., 2017).

Distribution in Turkey: Adana, Adıyaman, Amasya, Ankara, Antalya, Bolu, Çanakkale, Çankırı, Çorum, Denizli, Diyarbakır, Düzce, Erzurum, Gaziantep, Hakkari, Mersin, Karaman, Kırıkkale, Kayseri, Konya, Manisa, Nevşehir, Osmaniye, Siirt, Şırnak, Van (Rajaei et al., 2017; Koçak and Kemal, 2018) (Fig. 1).

Phenology: It is usually univoltine and on the wing from April to June. Under good conditions emerging from late March. At higher elevation in eastern Europe also in July and early August. Besides, it flies in Israel across September to November (Hausmann and Viidalepp, 2012).

Habitat: Occurring in dry, stony grassland, steppe and on sunny slopes, xerothermophilous (Hausmann and Viidalepp, 2012). From 0 m up to 1900 m above sea-level (Rajaei et al., 2017).

Larval food-plant: Possibly, the larvae of *unicata* are oligophagous on Rubiaceae (Hausmann and Viidalepp, 2012). Under captivity, it feeds on *Asperula cypria* and, the larvae accept *Galium verum*, which is to be regarded also as a potentially natural host plant of the species (Rajaei et al., 2017).

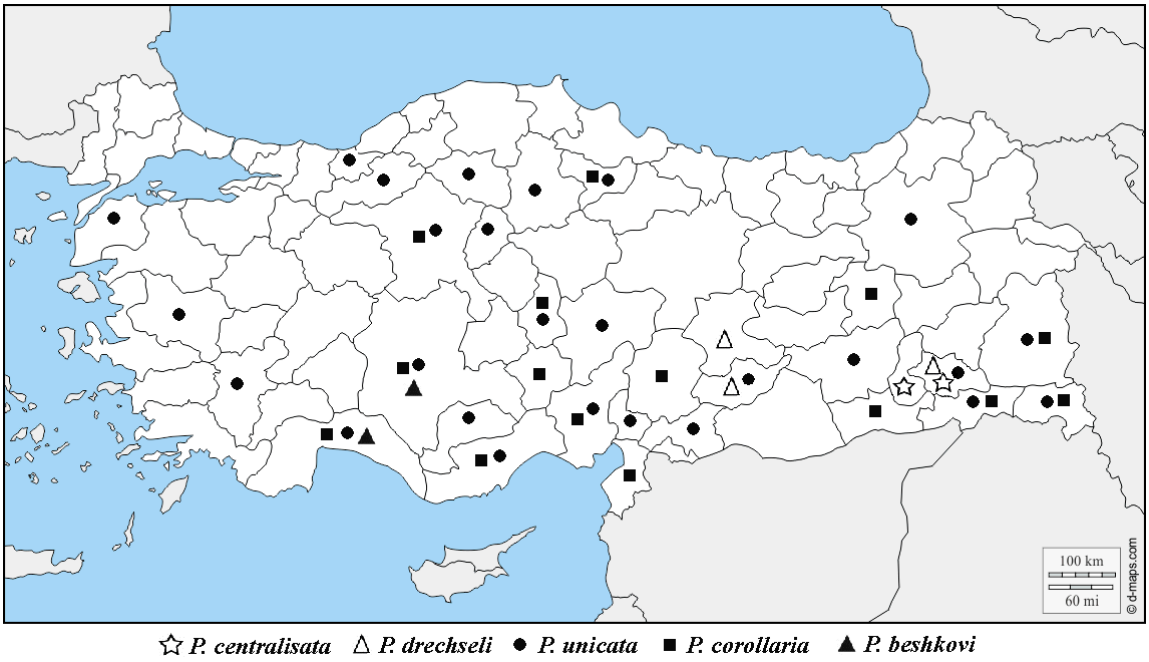


Figure 1. Distribution locations of *Protorhoe* species in Turkey

Protorhoe corollaria (Herrich-Schäffer, [1848])

Synonym(s). *corollaria* Herrich-Schäffer, [1848]; *noacki* Draudt, 1935.

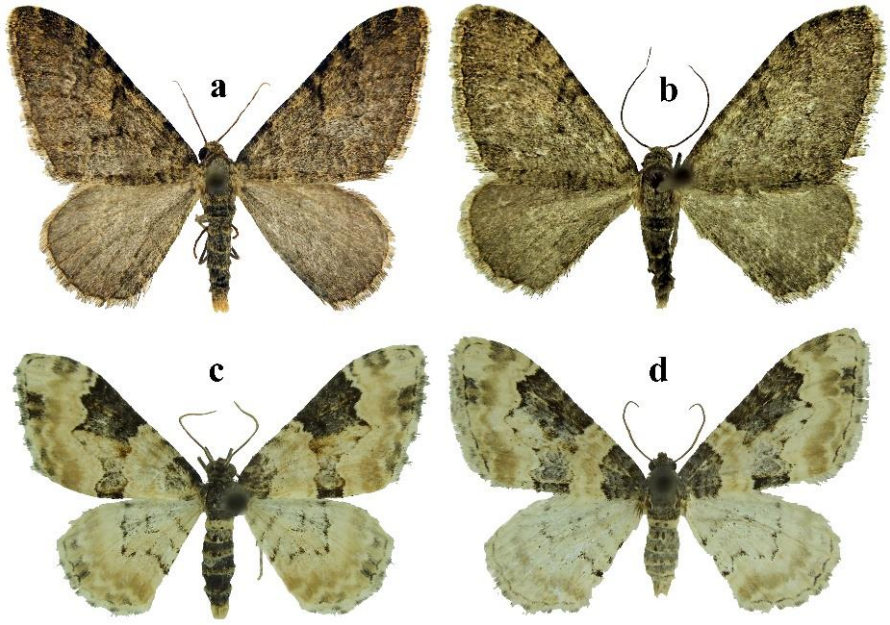
Distribution in the world: Spain, south-eastern France, north-western Italy, Balkan peninsula, Crete to Crimea and eastern Ukraine, Turkey, Syria, Georgia and Armenia (Hausmann and Viidalepp, 2012).

Distribution in Turkey: Adana, Amasya, Ankara, Antalya, Bingöl, Hakkari, Hatay, Mersin, Konya, Kahramanmaraş,

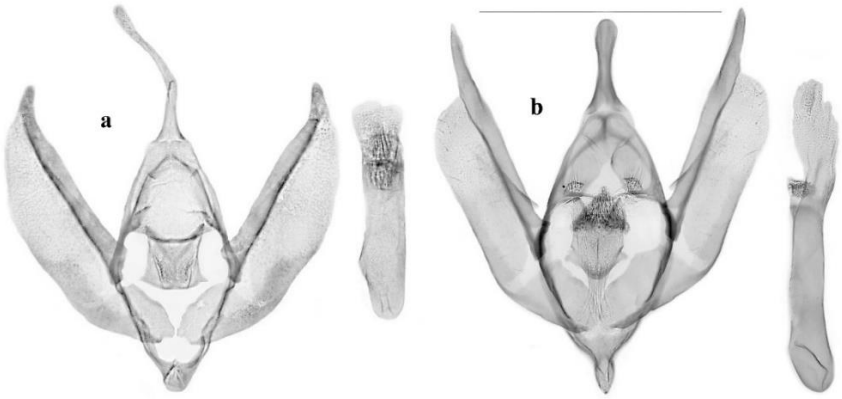
Mardin, Nevşehir, Niğde, Şırnak and Van (Rajaei et al., 2017; Koçak and Kemal, 2018) (Fig. 1).
Phenology: It is univoltine and flies from March to June (Hausmann and Viidalepp, 2012).
Habitat: Occurring in grassland, steppe and dry scrubland, sun-exposed slopes, on limestone, xerothermophilous (Hausmann and Viidalepp, 2012). It flies from 150 m up to 2800 m above sea-level (Rajaei et al., 2017).
Larval food-plant: Larvae monophagous on *Galium* or oligophagous on Rubiaceae, reared on *Galium verum* (Hausmann and Viidalepp, 2012; Rajaei et al., 2017).

Protorhoe beshkovi Rajaei, Stadie & Hausmann, 2017
Synonym(s). *beshkovi* Rajaei, Stadie & Hausmann, 2017.
Distribution in the world: Turkey (Rajaei et al., 2017).
Distribution in Turkey: Antalya (Korkuteli, Taurus Mts. and Bey Mts.) and Konya (Beyşehir Lake) (Rajaei et al., 2017) (Fig. 1).
Phenology: Probably univoltine. From mid-April to early June (Rajaei et al., 2017).
Habitat: Open area, xerethermophilous, dry stony sun-facing slope. The area contains Anatolian Pine tree forest and some *Quercus* trees with herbaceous plants of *Inula*, *Phlomis*, *Galium*, *Thymus* and *Trifolium*. From 500 m up to 1100 m above sea-level (Rajaei et al., 2017).
Larval food-plant: Unknown.

Protorhoe drechseli Rajaei, Stadie & Hausmann, 2017 (Figs 1. a, b)
Synonym(s). *drechseli* Rajaei, Stadie & Hausmann, 2017.
Distribution in the world: Turkey (Rajaei et al., 2017).
Distribution in Turkey: Adıyaman (Nemrut Mt.), Malatya (Nemrut Mt.) (Rajaei et al., 2017) and Siirt (Seven, 2018) (Fig. 1).
Material examined: Turkey, 4♂♂, 2♀♀, Siirt Prov., Şirvan district, Akgeçit, 1190 m, 01.V.2016, 38°04'12"N-42°12'32"E (leg. and coll. E. Seven).
Diagnosis: (Fig. 2. a, b). Wingspan 24–25 mm. Forewing greyish-brown. Discal spot of forewing distinct and streak-shaped. Transverse lines clear, considerable darker at costa. Basal, ante- and postmedial strips darker. Terminal line brownish. Fringes slightly paler than ground color. Hindwing grey-brown, paler than forewing. Discal spot of hindwing almost absent. Transverse lines unclear.
Male genitalia: (Fig. 3. a). Uncus long and thin, apically rounded, spoon-shaped. Costa of valva elongate with strongly sclerotized, distal protrusion of costa tapering and slightly arcuate. Ventral part of valva weakly sclerotized, membranous, not reaching the tip. Saccus short, rounded. Aedeagus almost straight with so little spines near the tip.



Figures 2. Adults. a-b. *Protorhoe drechseli*, a. male, b. female, c-d. *Protorhoe centralisata*, c. male, d. female



Figures 3. Male genitals (Scale bar: 1 mm). a. *Protorhoe drechseli,* (Slide No. GP592), b. *Protorhoe centralisata,* (Slide No. GP591)

Phenology: Univoltine and flies from late April to late May.

Habitat: The species inhabits north- and east-facing, steep escarpments and outcrops, covered with xeromontane herb-rich vegetation from 1400 m up to 2100 m (Rajaei et al., 2017). In south-east of Turkey, it inhabits in wetland area with woody plants and spring herbaceous (Fig. 4a).

Larval food-plant: Under captive condition larvae fed on *Asperula* species with white flowers (Rajaei et al., 2017).

Remarks: The type locality of *drechseli* is Mount Nemrut, south-eastern Anatolia (Rajaei et al., 2017). Seven (2018) reported this species from Siirt Prov., Şirvan district, Akgeçit, which is approximately 400 km away from Mt. Nemrut. However, Rajaei et al. (2017) expressed that all known specimens were caught in late May and most of the reared specimens under captivity emerged in April. In south-eastern Anatolia, the species flies from late April to early May, most probably because of the warmer weather conditions.

It is known that larvae of *drechseli* feeds on flowers of *Asperula* (Rubiaceae) species under captive terms (Rajaei et al., 2017). In the study area, it determined in the habitat where *Quercus-Paliurus* and *Astragalus* species are intense with some herbaceous plants in the Rubiaceae, Fabaceae and Brassicaceae families.

Protorhoe centralisata (Staudinger, 1892) (Fig. 2. c, d)

Synonym(s). *centralisata* Staudinger, 1892.

Distribution in the world: Kirghizstan, Tajikistan, Uzbekistan, Turkmenistan, Iran (Kopet Mountains), Israel, Jordan (Rajaei et al., 2017) and Turkey (new record).

Figure 4. Habitats. a. *Protorhoe drechseli*, Şirvan district (Prov. Siirt), 1200 m, 29.IV.2017; b. *Protorhoe centralisata,* Batman, Batı Raman, 530 m, 25.IV.2018

Distribution in Turkey: Batman and Siirt (Fig. 1).

Material examined: Turkey, 3♂♂, 1♀, Siirt, Akyamaç, 660 m, 27.IV.2017, 1♂, 2♀♀, same data, 03.V.2018, 38°01'14"N-42°56'06"E; 2♂♂, 1♀, Şirvan, Centre, 1015 m, 06.VI.2017, 38°03'45"N-42°01'48"E; 1♂, 2♀♀, Şirvan, Nergizli, 630 m, 2♂♂, same data, 20.IV.2017, 38°01'23"N 41°55'19"E; 3♂♂, 2♀♀, Batman, Batı Raman, 500 m, 24.IV.2016, 1♀, same data, 07.V.2018, 37°46'18"N-41°04'22"E (leg. and coll. E. Seven).

Diagnosis: (Fig. 2. c, d). Wingspan 20–21 mm. Wings brownish-yellow. Basal and medial strips on forewing dark brown. Subterminal line brownish, with a small dark brown subapical patch. Hindwing paler and without basal line. Fringes creamy mixed with dark brown scales. Terminal area of forewing and hindwing matt-brown, basal- and medial strips distinctly darker.

Male genitalia: (Fig. 3. b). Uncus apically rounded. Valva well developed. Costa of valva elongated with strongly sclerotized and exceeding tip of valva. Saccus slim, elongated. Juxta apically jagged. Aedeagus short and without cornuti.

Phenology: In central Asia from early May to late June. In the Levant emerging from early April and flying also from September to November (Rajaei et al., 2017). In Turkey, it is on the wing from late April to early June.

Habitat: In south-east of Anatolia, the species inhabits in wetlands areas with *Quercus-Astragalus* and *Paliurus*. It flies from 500 m up to 1800 m above sea-level.

Larval food-plant: Unkonwn.

Remarks: Rajaei et al. (2017) specified that *unicata* misdiagnosed or confused with by *centralisata* in Levant countries (Hausmann, 1991; Hausmann and Viidalepp, 2012) and Oman (Hausmann et al., 2009). Besides, Hausmann and Viidalepp (2012) are stated that *unicata* replaced by *centralisata* in Central Asia and Kopet Mountains in Turkmenia and north-eastern Iran. It seems that *centralisata* likewise confused with *unicata,* in east and southeast of Anatolia.

Also, *centralisata* is usually on the wing at higher elevations than *unicata*, from 1000 m up to 1800 m above sea-level in Central Asia (Rajaei et al., 2017). But, in southeast of Turkey *centralisata* mostly caught at elevations below 1000 m.

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