

The ecology, genitalia and larval morphology of *Polythrena coloraria* Herrich-Schäffer, 1855 (Lepidoptera: Geometridae), with records of its egg parasitoid *Telenomus acarnas* Kozlov & Kononova, 1977 (Hymenoptera: Scelionidae)

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Investigations were made upon the biology and habitat demands of the larvae and adults of *Polythrena coloraria* in the Kivach nature reserve in the Republic of Karelia, Russia, close to the eastern border of Finland. In the laboratory females laid eggs only on *Ribes nigrum*, although other plants were also available. Eggs were found in the field under the leaves of this plant, too. Instead larvae were not found in the field. In the laboratory they did not eat any other plants offered. In addition, the male and female genitalia and larval morphology are described. Based on these characteristics, the systematic position of the species is discussed. A parasitoid wasp *Telenomus acarnas* (Hymenoptera, Scelionidae, Telenominae) is reported from the eggs of *P. coloraria*. It seems to be the first host record for this parasitoid wasp.

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1. Introduction

Polythrena coloraria was first found in Eastern Russian Karelia as early as the mid-1800's (Günther 1896, Kaisila 1947). Blöcker (1909) was apparently the first to discover the species when making a review of the butterflies collected

by Aleksandr Günter in Olonets province (the territory between the lakes Ladoga and Onega) in 1859–1896. Blöcker found two specimens of *P. coloraria*. Recently, the species was again collected in the Kivach Nature Reserve at a distance of 30 kilometres from the old finds (Leinonen *et al.* 2003). In this connection, a brief description

was given on the biology and larvae of the species, which had previously remained more or less unknown. The general distribution of the species is said to be the northern parts of European Russia, the Urals and the mountains of Siberia (Viidalepp 1977).

The aim of this paper is to summarize the ecology of *Polythrena coloraria*, to describe the male and female genitalia, to describe the larval morphology, and to give details of an egg parasite of *P. coloraria*.

2. Material and methods

All the observations were made by Nadesda Kutenkova in the Kivach Nature Reserve in the Republic of Karelia, Russia, about 120 km east from the Russian/Finnish border. Most of the fieldwork was done in 2002, and some earlier observations were included, too. Female individuals were taken into a laboratory, where they were observed for their egg laying habits; larval feeding on different potential food plants was also observed. Larval preparations and drawings were made by MA (the studied material is at the Zoological Museum of Oulu). Genitalia slides were made by JI (♂ slide nr. 1383 J. Itämies and ♀ slide nr. 1384 J. Itämies; in coll. Zoological Museum of Oulu). The adult material has been deposited in the private collections of R. Leinonen and N. Kutenkova and at the Zoological Museum of Oulu.

3. Results

3.1. Larval biology

In the laboratory, females laid eggs only on black currant (*Ribes nigrum*), although other plants typical of the adult sites were also available (see below). The light opalescent eggs (length 0.7 mm, breadth 0.5 mm) were laid on the undersides of leaves. In the field, eggs were also found under the leaves of food plants. In breeding experiments, larvae were moved to other plants (e.g. *Aegopodium podagraria*, *Stellaria nemorum*, *Geum rivale*, *Athyrium filix-femina*, *Filipendula ulmaria*), but they always returned to black cur-

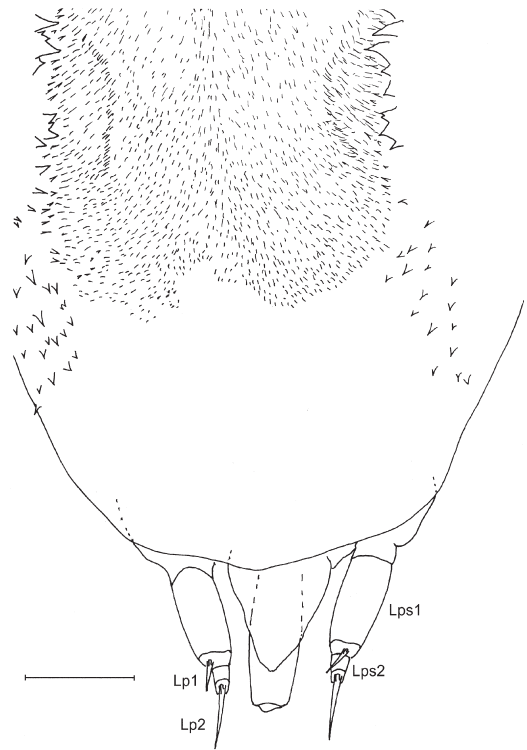


Fig 1. Hypopharynx of *Polythrena coloraria* larva.

rant. The larvae fed both during morning and in evening hours. – Although we found three eggs in the field, we did not find any larvae there.

3.2. Description of larva

The terminology of chaetotaxy follows Hinton (1946) and that of mouth parts Beck (1999).

Morphology of mouthparts. Hypopharyngeal complex with a spinneret shorter than the labial palps, about 2.5 times as long as broad, tubular, its lower lip slightly elongated (Fig. 1). Lps1 of the labial palpus about 2.5 times as long as broad, 4/5 as long as the spinneret. Lps2 and seta Lp1 equal in length, seta Lp2 about twice as long as Lp1. Distal region of the hypopharynx with sparse, rather stout lateral spines but no medial spines. Transverse cleft absent between the distal and posterior regions. Proximolateral lobe with a row of lateral teeth. Posterior part of the hypopharynx covered with tiny spines. Stipular setae (Fig. 2) short, about as long as the seta Lp1 of the labial

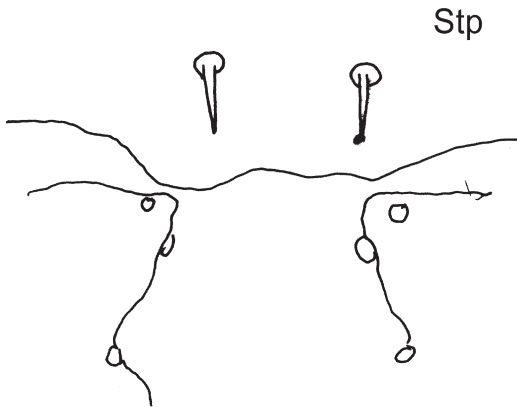


Fig. 2. Stipular setae of *Polythrena coloraria* larva.

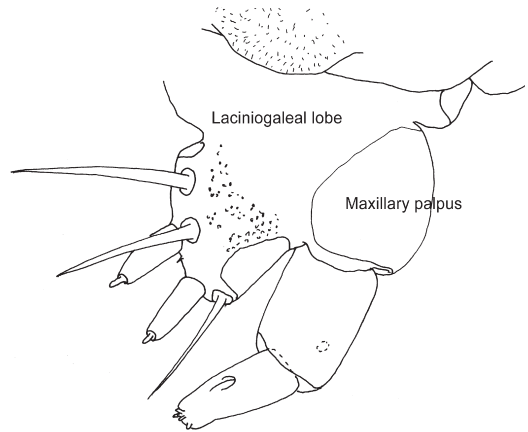


Fig. 3. Maxillary palpi of *Polythrena coloraria* larva.

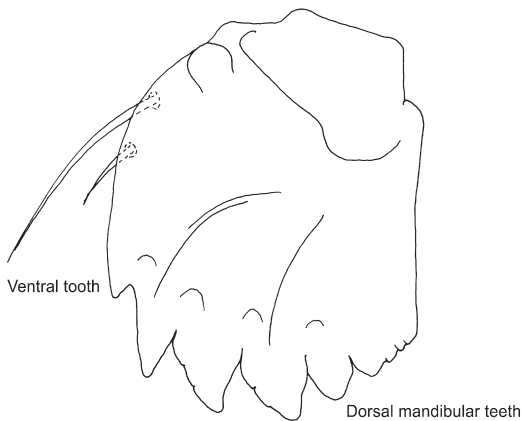


Fig. 4 Mandible of *Polythrena coloraria* larva.

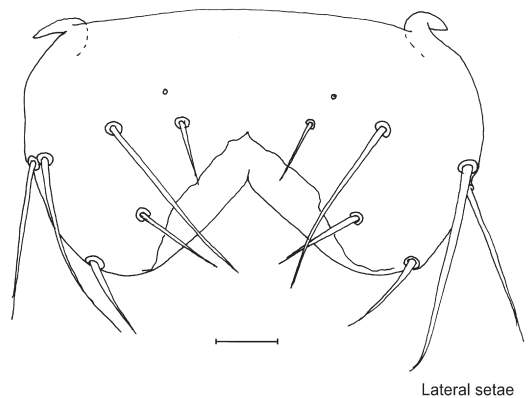


Fig. 5. Labrum of *Polythrena coloraria* larva.

palps, located in the prementum, distance between the setae longer than the length of the seta. Maxillary palpi (Fig. 3) with an elongated 3rd segment, more than 2 times as long as broad, the 2nd segment slightly longer than broad. Galeal lobe absent, three sensilla trichodea present on the same laciniogaleal lobe with two sensilla styloconica. Surface of stipes smooth except for the short and tiny spines on the low stipital sack.

Antennae with a rather long second segment, about twice as long as broad, and a rather high third segment with three sensillae.

Mandible (Fig. 4) with six teeth in the cutting margin, the ventral tooth rather small, the margin of the dorsal tooth serrated. Inner surface of the mandible with two ridges. Two setae present on the outer surface, the one farthest from the front very short.

Labral notch sharp with straight edges, the middle setae forming an acute angle, all lateral setae rather long (Fig. 5).

Chaetotaxy. P1 setae of the head situated at the level of AF2, the distance P2–P2 is lightly shorter than P1–P1 (Fig. 6). Position of setae F1 high on frons, approximately at the level of A2, setae A1. A2 and A3 form a triangle. Seta O1 closer to the 3rd ocelli, seta SO2 located between the 5th and 6th ocelli. Setae D1 and D2 separated on the thorax, D1 situated slightly in front of D2. Seta SD1 strongly ventrocephalad from SD2 on the meso- and metathorax (Fig 7). Setae SD1 and L2 hair-like on the prothorax, seta SD1 short but not weak in the meso- and metathorax. SV setae bisetose on the prothorax, unisetose on the meso- and metathorax. Thoracic microsetae MDX1 of the prothorax and MD1 of the mesothorax close

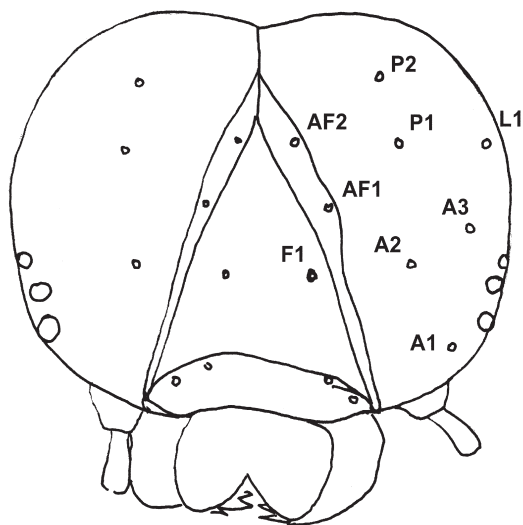


Fig. 6. Head of *Polythrena coloraria* larva.

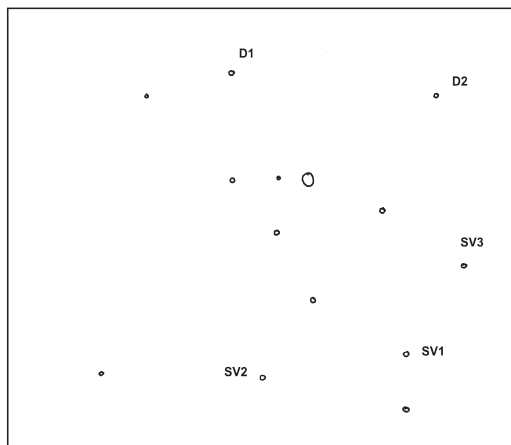


Fig. 8. Ab2 of *Polythrena coloraria* larva.

together. Setae D1 and D2 (Fig. 8) far from each other in the abdominal segments 1–5, distance D1–D1 only slightly shorter than that of D2–D2 but shorter in the segments 6–9. Seta SD1 located cephalad or dorsocephalad from the spiracle in all abdominal segments. The L group of setae consist of three setae in the abdominal segments 1–5 and 8, of four setae in the segments 6–7 and of one seta in segment 9. The SV group of setae is bisetose in segment 1, unisetose in the segments 7–9, trisetose in the segments 2–5 and with six setae on the outer surface of the ventral proleg in segment 6 (Figs. 9–10). The abdominal setae situated below the spiracle of the segments 1–5 do

not form rows but are widely scattered. The setal distance D1–D1 of the anal shield is about three times as long as that of D2–D2 and situated posterior to the level SD2–SD2 (Fig 11).

Other characteristics. Head and body skin smooth, anterior abdominal segments with 6 annulets. Thoracic claws with obtuse-angled notch. Crochets of ventral prolegs bi- or triordinal in two groups, 17–18 in number. Larvae are slender, with the abdominal segments 1–5 prolonged and the segments 6–10 much shorter.

Habitus. Larva greenish in colour. Black transverse stripe present on the head running from the vertex to genae caudad from P2 and L1

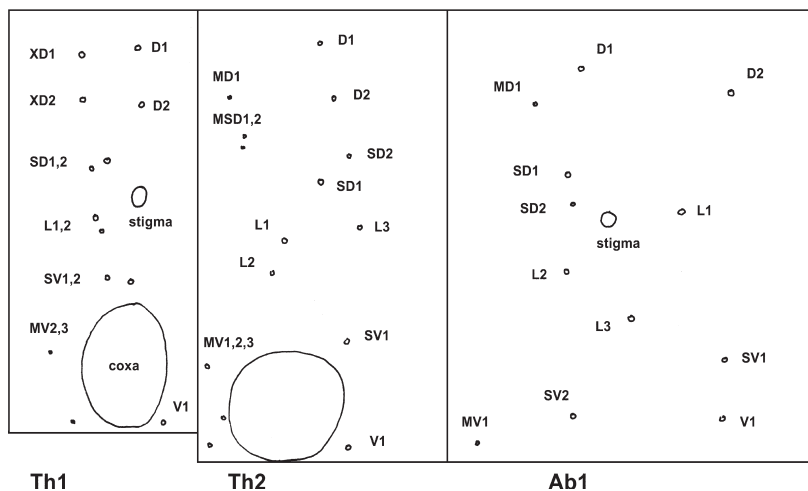


Fig. 7. Meso- and metathorax of *Polythrena coloraria* larva.

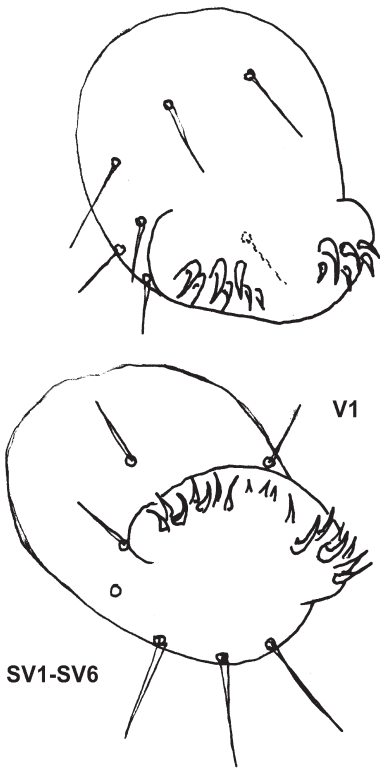


Fig. 9. Proleg of *Polythrena coloraria* larva.

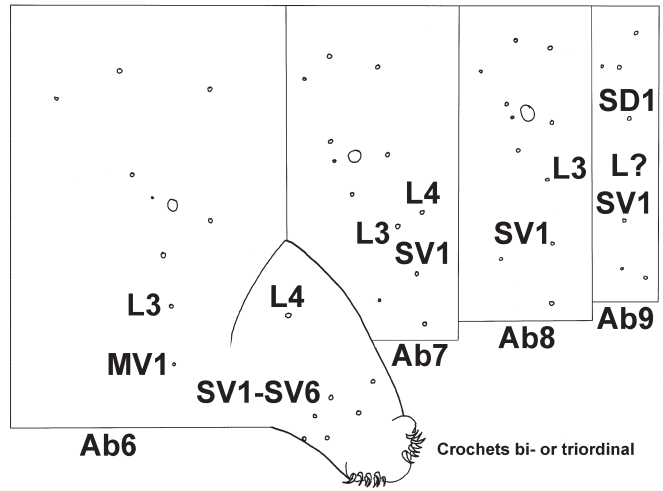


Fig. 10. Ab6–Ab9 of *Polythrena coloraria* larva.

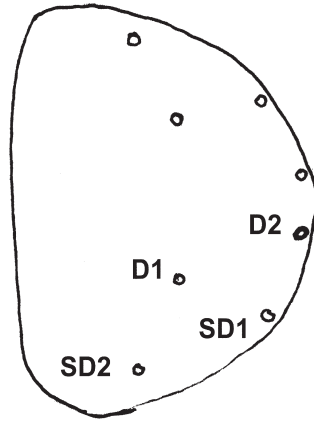


Fig. 11. Anal shield of *Polythrena coloraria* larva.

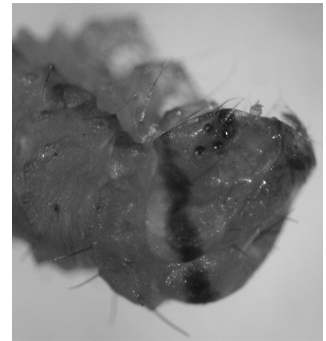


Fig. 12. Overview of head of *Polythrena coloraria* larva.

setae (Fig. 12). Thorax also with a broad blackish longitudinal stripe on the level L3 seta.

3.3. Adult habitats

Polythrena coloraria is a day-active moth that makes short flights in sunny weather. While sitting on leaves, it is clearly visible; the adult has orange-yellow wings with black marks (Fig. 13). When the weather gets cloudy, the moths rapidly hide. Once we observed a swarming flight around the crowns of trees at about eight metres. N. Kutenkova has found this species on wings between the 6th of June and the 13th of July.



Fig. 13. Adult of *Polythrena coloraria*.



Fig. 14. Biotope of *Polythrena coloraria* in Russian Karelia.

To our knowledge, there are four separate sites of occurrence of this species around Kivach. All of them are rather close to a brooklet. All sites are dominated by Norwegian spruce (*Picea abies*) and, regarding the bush layer, black currant. Other characteristic trees are *Tilia cordata*, *Populus tremula*, *Betula pubescens*, *Salix caprea*, *Alnus incana*, *Prunus avium* and *Sorbus aucuparia*. In the bush layer the following plants were abundant: *Rubus idaeus*, *Rosa acicularis*, *Daphne mezereum* and *Lonicera xylosteum*. The following ground layer plants characterise the sites: *Actaea spicata*, *Polygonatum odoratum*, *Tussilago farfara*, *Geum rivale*, *Aegopodium podagraria*, *Calamagrostis arundinacea*, *Oxalis acetosella*, *Filipendula ulmaria*, *Trollius europaeus*, *Paris quadrifolia* and *Pyrola major*. Thus, the preferred habitat seems to be a lush brookside grove (Fig 14).

3.4. Genitalia

Male genitalia (Fig. 15). Valva smooth, easily wrinkled in preparation, roundish, with long hairs, costa and saccus not remarkably thickened or chitinated. Uncus moderate, not very long, slender, sharply pointed. Aedeagus rather thick, equals the length of valva, without any conspicuous chitinous cornuti, weak short ridges at the orifice. Anellus lobes wide, thickly covered



Fig. 15. Male genitalia of *Polythrena coloraria*.

with long hairs. Juxta squared with small roundish hairy corners. Saccus evenly curved, roundish.

Female genitalia (Fig. 16). Ostium weak. Antrum chitinated. Ductus bursae very short. Bursa elongate, weak ridges in the upper portion. Two signums, one elongate narrow chitinous plate more or less twofolded, the other a pocket-like chitinous bag. Bursa covered by small chitinous teeth. Papillae anales short, smooth, hairy. In the apophyses the posteriores much longer than the anteriores.



Fig. 16. Female genitalia of *Polythrena coloraria*.

**3.5. Egg parasitoid *Telenomus acarnas*
Kozlov & Kononova, 1977 (Hymenoptera:
Scelionidae: Telenominae)**

Three eggs of *P. coloraria* were found in the wild in Kivach. A small black telenomine parasitoid emerged from one egg. The egg parasitoid runs in the key of Kozlov & Kononova (1983) to the genus *Telenomus* Haliday, 1833 and further to the subgenus *Aholcus* Kieffer, 1913 (the female has eight flagellomeres) and further to the species *T. (A.) acarnas* Kozlov & Kononova, 1977. The species has been described from the Russian Far East on the basis of three females (Kozlov & Kononova 1977). In the original description, its body length is 0.8–0.9 mm. The female from Kivach was 0.66 mm, with its fore wing 0.73 mm. Body black. Fore wing with long submarginal, short marginal and long post-marginal veins ca. 2 times as long as the stigmal vein. Antennae geniculate, 10-segmented, inserted low down on the face. The distal 5 segments of the antenna expanded to form a distinct club. Antenna is similar to the picture in Kozlov & Kononova (1983: figure 658). The specimen is different from the females of *Telenomus (Aholcus) dalmanni* (Ratzeburg), which have been reared from eggs of *Orgyia antiqua* (L.) in Southern Finland. It has not been possible to compare the specimen of Kivach with the type specimens from Russian Far East.

Most females of the *Telenomus* species have 11-segmented antennae. The other Fennoscandian species with 10-segmented antennae, viz.

T. dalmanni (Ratzeburg) and *T. pentatomus* (Thomson), differ in having a larger body (body length 1.0–1.1 mm).

4. Discussion

According to McGuffin (1958), the following characteristics differentiate larvae of Larentiinae from the other subfamilies of Geometridae: Seta L4 absent from the abdominal segments 2–5, body without ridges or tubercles and vestigial prolegs absent from abdominal segments. The larva of *P. coloraria* fits well into this group. The larvae of Larentiinae are divided into two groups based on the presence of six setae in the first abdominal segment in the L, SV and V groups. This is also true of *P. coloraria* larvae. The tribes of this branch of Larentiinae are Asthenini, Eudulini and part of Hydriomenini. Asthenini larvae have a long spinneret and an acute angle of the thoracic claw, both characteristics that do not occur in *P. coloraria*. On the contrary, some characteristics of Eudulini are close to *P. coloraria*:

- Larvae long and slender
- Spinneret shorter than the labial palpi
- Notch of the thoracic claws obtuse
- Setae of the anterior abdominal segments scattered
- Crochets on the ventral proleg in two groups.

The number of segmental annulets, the cuticle of the head, the arrangement of labral setae and the

bulging molar lobe of the mandible are, however, different.

Some differential characteristics of Hydriomenini compared to Eudulini are close to *P. coloraria*:

- Anterior abdominal segments with less than 8 annulets
- Cuticle of the head smooth
- Labral setae not in line from seta M3 to L3
- Molar lobe of the mandible almost flat.

This group of Hydriomenini consists of a few genera, including *Rheumaptera* Hübner, 1822 and *Coryphista* Hulst, 1896. Larval shape is, however, different.

There are only a few groups on the other Larentiinae branch with seven setae in the L, SV and V groups of the first abdominal segment, which could resemble the characteristics of *P. coloraria*. The genus *Eulithis* (Hübner, 1821) is probably the only one because the number of setae on the side of the ventral proleg is between 5 and 10, the paraprocts are short, and crochets number 16–30.

The species *P. coloraria* is placed between the genera *Perizoma* Hübner, 1825 and *Eupithecia* Curtis, 1825 by Mikkola et al. (1985).

The larvae of *P. coloraria* did not fit exactly the tribes classified by McGuffin (1958). Its closest relatives could be in the genus *Eubaphe* Hübner, 1823 (Hodges 1983, Scott 2003) of the tribe Eudulini.

P. coloraria was earlier assumed to live on rock meadows, where it occurs among *Dracocephalum* (Mikkola 1985). This plant is rare in the Kivach area, as it grows at much drier sites. In Kivach, adult moths were only seen at very humid sites in brookside groves, which led us to seek the food plant among the plants typical of that kind of habitat. Laboratory observations verified the food plant to be black currant. The daytime activity of adult moths was already described by Seitz (1915), based on observations made at Altai and eastern Siberia.

P. coloraria is deposited between the genera of *Eulithis* and *Cosmorhoe* (Viidalepp 1996). The male genitalia agree well with the general appearance in this group (e.g. Pierce 1967). They are easily differentiated from *Eulithis* by the anellus

lobes, which are more prominent in *Eulithis*, and these species also have abundant cornuti in aedeagus. *Cosmorhoe ocellata*, on the other hand, has a curved aedeagus. Female genitalia seem to be quite specific and hardly to be mixed with any other geometrid moth in this group.

In genus *Telenomus*, there seems to be very few breeding observations concerning the hosts of these parasitoids. Forsius (1915) and Vikberg (pers. obs.) have reared *Telenomus dalmanni* from eggs of *Orgyia antiqua* (Lepidoptera: Lymantriidae). The present observation, *T. acarnas* parasitising the eggs of *P. coloraria*, seems to be the first host recorded for this parasitoid wasp.

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