Pyralis cardinalis, a charismatic new species related to *P. regalis* [Denis & Schiffermüller], 1775, first recognized in Finland (Lepidoptera, Pyralidae)

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Abstract. The informal *Pyralis regalis* complex, including species of the genus *Pyralis* Linnaeus, 1758 (Pyralidae), with a bright white or silvery pattern on the forewing, is reviewed, supplemented by observations of the externally distinguished *P. perversalis* (Herrich-Schäffer, 1849), which also exhibits similarities in genitalia and DNA barcodes.

We describe *Pyralis cardinalis* Kaila, Huemer, Mutanen, Tyllinen & Wikström, **sp. nov.**, based on specimens ranging from Denmark and Sweden in the West to Japan and South Korea in the East. A neotype is designated for the predominantly South European *P. regalis* [Denis & Schiffermüller], 1775. Lectotypes are designated for *Asopia kacheticalis* Christoph, 1893 and *Pyralis princeps* Butler, 1889. *Pyralis regalis* ssp. *sagarrai* Leraut, 2005 is considered a valid species, **stat. nov.**

Introduction

Pyralis Linnaeus, 1758 is a diverse genus of predominantly Palearctic, South-East Asian and African moths, covering 86 described species some of which remain unrevised (Nuss et al. 2003–2019). The European fauna with only seven species recognized is comparatively poor. It includes the cosmopolitan, well known pest species meal moth *P. farinalis* Linnaeus, 1758, *P. regalis* [Denis & Schiffermüller], 1775, *P. perversalis* (Herrich-Schäffer, 1849), *P. lienigialis* (Zeller, 1843), *P. kacheticalis* (Christoph, 1893), and exceptional records of the tropical pests *P. manihotalis* (Guenée, 1854) and *P. pictalis* (Curtis, 1834) (Slamka 2006). The allegedly transpalearctic *P. regalis* can be regarded as the flagship species of the genus in Europe due to its external appearance, which is one of the most striking in the Pyralidae. *Pyralis kacheticalis* (Christoph, 1893) is a species closely related to *P. regalis*, described from Transcaucasus (now Azerbaijan). It is reported to be distributed in Turkey, eastern Greece and Ukraine in Europe. Other than the recently described *P. regalis* ssp. *sagarrai*

Leraut, 2005 no taxonomic changes have been found for more than 100 years on this continent. It was therefore surprising that during DNA barcoding campaigns (FinBOL, Lepidoptera of the Alps) the European *P. regalis* was found to divide into four clusters: a northern, transpalearctic group; a central-southern European group; a south-western cluster; and a somewhat heterogeneous eastern Mediterranean cluster corresponding to *P. kacheticalis*. The taxonomy of *P. regalis* and, indeed, most of the taxa involved, has been somewhat unclear as the type specimens seemingly have not been studied for a long time, if ever after their original descriptions. Nor have suspicions regarding the taxonomy been suggested (but see Leraut 2005). Particularly, the taxonomy of *P. regalis* from northern Europe proved to be a problem that could only be resolved in a larger geographic context.

Material and methods

Specimens

In this paper we only treat those species of *Pyralis* that are characterized by a distinctive, white or silvery white pattern on the forewing. In addition to those species treated here, we are aware of one further species from Greece: Crete, and seemingly more than one SE Asian species that match this characterization, all preserved in ZMUC. We refrain from treating them further due to the paucity of material available. Leraut (2005) also included *P. perversalis* into this taxon complex; this interpretation is supported by genital morphology and common pattern of DNA barcode clustering. Therefore, we illustrate this species here as well even though its forewing pattern has no clearly white pattern.

We examined ca. 660 specimens of *Pyralis* spp. from various European collections (see below). Data for the specimens and their repositories are given for each taxon treated. The spellings of locality and collector names follow those recorded on the original labels. We list under 'Distribution' only those country records either verified by us or by other trustworthy sources.

Material was obtained from the following collections

LMK Landesmuseum Kärnten, Austria
LMNH Latvian Museum of Natural History
MGAB Grigori Antipa National Museum of Natural History, Bucharest, Romania
MZH Finnish Museum of Natural History, University of Helsinki, Finland
NHMUK Natural History Museum, London, U.K.
RCBB Research collection of Bengt Å. Bengtsson, Färjestaden, Sweden
RCJJ Research collection of Jari Junnilainen, Vantaa, Finland
RCJL Research collection of Jan Liška, Prague, Czech Republic
RCJT Research collection of Juha Tyllinen, Vantaa, Finland
RCKN Research collection of Kari & Timo Nupponen, Espoo, Finland
RCMC Research collection of Martin Corley, Faringdon, U.K.
RCMM Research collection of Marko & Tomi Mutanen, Oulu, Finland
RCMN Research collection of Marko Nieminen, Helsinki, Finland
TLMF Tiroler Landesmuseum Ferdinandeum, Innsbruck, Austria
ZISP Zoological Institute of the Russian academy of Sciences, St. Petersburg, Russia
ZMHB Museum für Naturkunde – Leibniz Institute for Research on Evolution and Biodiversity, Berlin, Germany
ZMUC Zoological Museum, Natural History Museum of Denmark, Copenhagen, Denmark.

Terminology and genital dissection

Terminology of genital structures follows Kristensen (2003). Preparation of genitalia generally follows methods outlined by Robinson (1976). Male genitalia were mounted in a standard dorso-ventral position as this orientation was considered to best show shapes of crucial structures, even though the direction of the uncus was difficult to standardize as as to point posteriorly. Sometimes it was not possible to force it into this position so it was bent anteriorly. Male genitalia were either left unstained or were stained using Eosin, female genitalia and abdominal pelts of both sexes were usually stained with Chlorazol black. Structures were embedded in Euparal. Adult images were taken with Zerene Stacker 1.04 running Canon EOS RP, Canon EF MPE-65 and Cognisys StackShot rail and a DIY flash system. Image stacks were combined with Helicon Focus 7.6.1 and final editing was done in Adobe PhotoShop CS5.5. Habitus images were photographed with a Leica DM LED. Genital images were taken using a Leica EC 4. Whenever necessary, either PhotoShop CS5.5 or Microsoft ICE 2.0.3.0 was used to assemble linear panoramas. PhotoShop was used for final editing of genital images.

DNA barcoding

DNA barcode sequences of the mitochondrial COI gene, a 658 base-pair long segment of the 5' terminus of the mitochondrial COI gene (*cytochrome c oxidase 1*), were obtained from 91 specimens of an attempted 104 specimens of *Pyralis*, including *P. regalis*, *P. sagarrai*, *P. cardinalis*, *P. kacheticalis*, *P. farinalis*, *P. lienigialis*, *P. perversalis*, and *P. princeps*. Dried legs were used as the source of DNA and the laboratory steps were carried out according to prescribed standards of the Sanger protocol of deWaard et al. (2008). Samples were processed at the Canadian Centre for DNA Barcoding (CCDB, Biodiversity Institute of Ontario, University of Guelph), and at the University of Oulu. DNA sequencing resulted in a barcode of >600 bp for 81 specimens supplemented by ten barcodes of 307-598 bp. Details of voucher specimens including geographic data, images, DNA sequences and GenBank accession numbers can be accessed in the Barcode of Life Data Systems (BOLD; Ratnasingham and Hebert 2007) in the public dataset PYRAREGA "*Pyralis regalis* species-group" https://doi.org/10.5883/DS-PYRAREGA.

Degrees of intra- and interspecific variation in the DNA barcode fragments were calculated under the P-distance model of nucleotide substitution using analytical tools in BOLD Systems v. 4.0 (http://www.boldsystems.org). A Neighbor-joining tree of DNA barcode data of selected taxa was constructed using Mega 7 (Kumar et al. 2016) (Fig. 1).

Identification success was also assessed by the Barcode Index Number (BIN) system as implemented on BOLD (Ratnasingham and Hebert 2013). This system employs a two-stage algorithm that groups all sequences >500 bp that meet defined quality criteria into operational taxonomic units (OTUs) and automatically assigns new sequences, irrespective of their previous taxonomy and origin.

Results

Key to species based on external characters

1 Forewing ground colour pale greyish brown; pale markings yellowish (Figs 20, 21) ..... ***P. perversalis***

– Forewing ground colour dark brown or purple, often with ochreous brown; with distinct white or silvery markings..... **2**

2 White/silvery transverse median fascia of forewing medially widened outwardly; hind wing with distinct purple shade, in particular in outer third, which is usually entirely purple and somewhat paler than inner parts (Figs 2, 4–7)..... ***P. cardinalis***

– White/silvery transverse median fascia parallel-sided; hindwing at most somewhat shaded with purple **3**

3 At least basal third of hindwing distinctly darker than outermost third **4**

– Hindwing entirely dark grey or with dark brown or purple (Figs 3, 8–11) **5**

4 Forewing with costal silvery marking tongue-shaped; inner fascia narrow, straight stripe that reaches costal margin; only basal third of hindwing darker than outer areas (Figs 14–17) ..... ***P. kacheticalis***

– Forewing with costal silvery marking triangular; inner fascia not narrow, nor reaching costal margin; both inner and median area of hindwing darker than outer area, without purple (Figs 12, 13).....***P. sagarrai***

5 Apex of forewing not elongate; area near apex of forewing dark purplish grey, not otherwise different from ground colour (Figs 3, 8–11).....***P. regalis***

– Apex of forewing elongate; area near apex of forewing orange-brown..... ..... ***P. princeps*, *P. joannisi* [for separation of these species see key to male genitalia]**

Key to species based on male genitalia

1 Phallus without cornuti, or occasionally with one or two very small and indistinct cornuti, but may otherwise be even densely covered by coarse spines **2**

– Phallus with at least one prominent cornutus **4**

2 Apex of phallus with no bush of distinctly long, thin spines.....***P. regalis*; *P. perversalis***

– Apex of phallus with dense bush of long, thin spines **3**

3 Apart from distal spine bush, vesica otherwise devoid of spines .....***P. princeps***

– Besides distal spine bush, vesica otherwise broadly covered by short spines....***P. joannisi***

4 Vesica with only one elongate spine-like cornutus.....**5**

– Vesica with two cornuti: one a prominent, elongate spine roughly half the length of the narrowed distal part of phallus, and another small, curved cornutus-like group formed of a dense and partially fused group of coarse spines (Fig. 22)..... ***P. cardinalis***

5 Cornutus basally smooth (Fig. 25)..... ***P. kacheticalis***

– Cornutus formed of spines that are slightly separate at base of cornutus, but solidly fused at apex (Fig. 24) ..... ***P. sagarrai***

Identification of species based on female genitalia

Material was available for *P. cardinalis*, *P. regalis*, *P. kacheticalis*, *P. perversalis* and *P. sagarrai.* Due to apparently large intraspecific variation as well as the paucity of material available we cannot currently safely state if the females of *P. regalis*, *kacheticalis*, and *sagarrai* can be unambiguously identified by their genitalia. The characterization of these species suggested below should therefore be regarded as tentative.

1 Posterior part of ductus bursae simple (Figs 29, 33) **2**

– Posterior part of ductus bursae braid-shaped (Figs 30–32) **3**

2 Inception of ductus seminalis broadened and somewhat sclerotized; ductus bursae evenly widening towards corpus bursae ..... ***P. cardinalis***

– Inception of ductus seminalis not broadened or sclerotized; posterior quarter of ductus bursae posteriorly narrow ..... ***P. perversalis***

3 Ductus bursae and corpus bursae separated distinctly with corpus bursae abruptly widening at inception of ductus bursae ..... ***P. regalis***

– Ductus bursae gradually widening and joining corpus bursae **4**

4 Braid-shaped part of ductus bursae about 1/3 length of ductus and corpus bursae (Fig. 30)..... ***P. kacheticalis***

– Braid-shaped part of ductus bursae about 2/3 length of ductus and corpus bursae (Fig. 31)..... ***P. sagarrai***

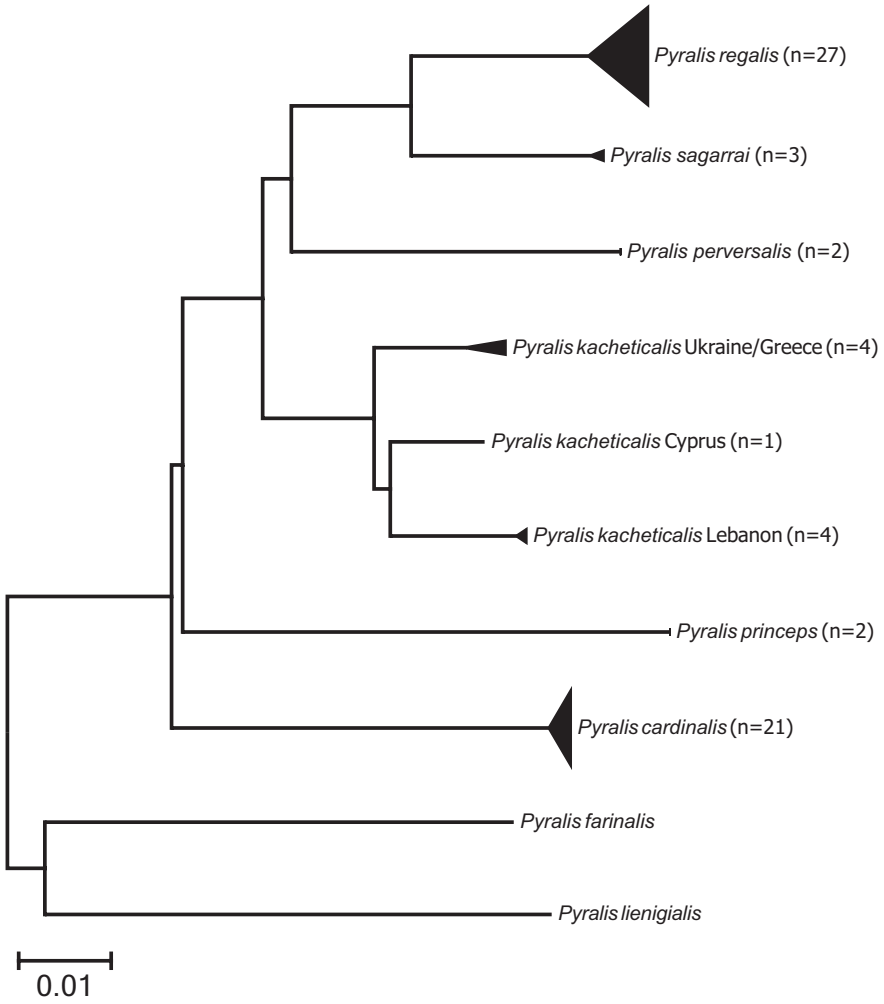


Figure 1. A Neighbor-joining tree of DNA barcode data of the *Pyralis regalis* complex.

Taxonomy

Pyralis cardinalis Kaila, Huemer, Mutanen, Tyllinen & Wikström, sp. nov.

http://zoobank.org/81B787B5-A1B9-4E12-8E92-2E2BF7A24A61

Figs 2, 4–7, 22, 29

Pyralis subregalis Caradja, 1926: 162. Junior secondary homonym of *Pyralis subregalis* Snellen, 1895. Type locality: "Russia, Siberia".

Material studied. (in addition to material listed below, genitalia examined from 17 additional Finnish specimens from MZH and RCBW).

***Holotype*:** FINLAND • ♂; Alandia, Jomala, Ramsholm; 60.107°N, 19.8803°E [ETRS-TM35FIN 6687:8105]; 16.vii.2013; Marko Mutanen leg.; BOLD sample ID: MM26690; MZH.

Paratypes [56♂, 74♀]

FINLAND • 1♂, 1♀; Alandia, Lemland; 60.0057°N, 20.0911°E [ykj 667:311]; 23.–27.vii.2001; 31.vii.–2.viii.2004: B. Wikström & K. Vaalamo leg; RCBW.

• 1♂; Geta, Höckböle; 60.3612°N, 19.9156°E [ETRS-TM35FIN 6712:8109]; 30.vi.2009; Family M. Mutanen leg.; TLMF.

3♂, 1♀; Alandia, Finström, Prästgårdnäset; 60.3612°N, 19.9156°E [ETRS-TM35FIN 6700:8109]; 15.vii.2013; M. Mutanen leg.; ZMUO.

• 1♂; Alandia, Finström; 60.2634°N, 19.8553°E [ETRS-TM35FIN 6699:8103]; 14.vii.2015; M. Mutanen leg.; BOLD sample ID: MM26689; ZMUO.

• 1♂; Alandia, Finström, Mangelbo; 60.2385°N, 19.9785°E [ykj 6701:3111]; 11.vii.2015; M. Mutanen leg.; ZMUO.

• 1♂; Alandia, Maarianhamina, Ramsholm; 60.0853°N, 19.894°E [ETRS-TM35FIN 6684:8104]; 16.vii.2013; M. Mutanen leg.; ZMUO.

• ♂, 9♀; Regio aboensis, Dragsfjärd, Rosala; 59.8385°N, 22.4501°E [ykj 664:324]; 22.vii.–5.viii.1995, 16.–11.viii.1996, 16.–26.vii.2004; B. Wikström & P. Rautio leg.; GPBW7912; RCBW.

• 2♂, 1♀; Regio aboensis, Dragsfjärd; 59.8385°N, 22.4501°E [ykj 664:324]; 28.vii.–11.viii.1996; B. Wikström leg.; RCBW.

• 2♂, 13♀; Regio aboensis, Dragsfjärd, Hiittinen; 59.928°N, 22.4378°E [ykj 664:324]; 28.–29.vii.2005; M. Mutanen leg.; 1♀: gen. prep. Huemer, GU 11/1327 ♀ P. Huemer; TLMF, ZMUO.

• 1♂; Regio aboensis, Dragsfjärd, Taalintehdas; 60.0158°N, 22.5065°E [ykj 6664:3249]; 17.vii.2018; M. & T. Mutanen leg.; ZMUO.

2♂; Regio aboensis, Lojo; 23.–27.vii.1974; H. Krogerus leg.; http://id.luomus.fi/GD.1021, http://id.luomus.fi/GD.1023; MZH.

• 1♀; Nylandia, Inkoo; 60.0593°N, 23.8575°E [ykj 666:332]; 14.–17.vii.1993; B. Wikström leg.; RCBW.

• 2♂; Nylandia, Hanko; 59°49'N, 23°04'E [ykj 664:327]; 15.–26.vii.; 1996, B. Wikström leg.; RCBW.

• 1♀; Nylandia, Tvärminne; 59.8559°N, 22.9838°E [ykj 664:328]; 6.–18.vii.1976; J. Wettenhovi leg.; http://id.luomus.fi/GD.1025; MZH.

• 1♂; Nylandia, Porvoo mlk, Åminsby; 60°21'N, 25°30'E; 13.vii.1973; E. Suomalainen leg.; http://id.luomus.fi/GD.1022; MZH.

• 12♂, 7♀; Nylandia, Kirkkonummi, Lähteelä; 59.991°N, 24.445°E; 22.–24.vii.2010; J. Junnilainen leg.; RCJJ.

• 1♀; Nylandia, Helsinki; 60.1702°N, 24.9283°E [ykj 667:338]; 13.vii.1993; O. Nybom leg.; http://id.luomus.fi/GD.1024; MZH.

• 7♂, 3♀; Nylandia, Raasepori, Gästans; 59°54'15''N, 23°43'38''E; 30.vi.–22.vii.2019; L. Kaila leg.; http://id.luomus.fi/GD.960; GD969; MZH.

• 1♀; Nylandia, Kirkkonummi, Porkkala; 59.9814°N, 24.4026°E [ykj 665:335]; 28.–31.vii.2003; M. Mutanen leg.; TLMF.

• 1♀, Nylandia, Kirkkonummi, Porkkala; 59.9814°N, 24.4026°E [ykj 665:335]; 15.–16.vii.2001; M. & T. Mutanen leg.; TLMF.

• 1♂, 1♀; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 24.vii.1986; T. & K. Nupponen leg.; RCKN.

• 1♂; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 20.–28.vii.1988; T. & K. Nupponen leg.; RCKN.

• 2♀; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 27.–28.vii.1989; T. & K. Nupponen leg.; RCKN.

• 2♂; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 14.–24.vii.1990; T. & K. Nupponen leg.; RCKN.

• 1♀; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 2.–11.viii.1990; T. & K. Nupponen leg.; RCKN.

• 1♀; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 12.–16.viii.1990; T. & K. Nupponen leg.; RCKN.

• 2♀; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 12.–23.vii.1991; T. & K. Nupponen leg.; RCKN.

• 1♀; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 24.vii.–3.viii.1991; T. & K. Nupponen leg.; RCKN.

• 3♀; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 17.–30.viii.1991; T. & K. Nupponen leg.; RCKN.

• 6♀; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 16.–23.vii.1992; T. & K. Nupponen leg.; RCKN.

• 1♀; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 24.–26.vii.1992; T. & K. Nupponen leg.; RCKN.

• 4♀; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 1.–7.viii.1992; T. & K. Nupponen leg.; RCKN.

• 1♂, 2♀; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 30.vii.–5.viii.1993; T. & K. Nupponen leg.; RCKN.

• 2♂; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 20.–29.vii.1994; T. & K. Nupponen leg.; RCKN.

• 1♀; Nylandia, Tammisaari, Jussarö; 59.8235°N, 23.5854°E [ykj 6639:3308]; 20.–29.vii.1995; T. & K. Nupponen leg.; RCKN.

• 1♂; Nylandia, Hanko, Russarö; 59.7695°N, 22.9496°E [ykj 6635:3272]; 16.–20.vii.1988; T. & K. Nupponen leg.; RCKN.

• 1♂; Nylandia, Hanko, Russarö; 59.7695°N, 22.9496°E [ykj 6635:3272]; 5.–14.vii.1989; T. & K. Nupponen leg.; RCKN.

• 1♂; Nylandia, Hanko, Russarö; 59.7695°N, 22.9496°E [ykj 6635:3272]; 15.–29.vii.1990; T. & K. Nupponen leg.; RCKN.

• 1♀; Nylandia, Hanko, Russarö; 59.7695°N, 22.9496°E [ykj 6635:3272]; 12.–17.viii.1990; T. & K. Nupponen leg.; RCKN.

• 1♂, 1♀; Nylandia, Hanko, Russarö; 59.7695°N, 22.9496°E [ykj 6635:3272]; 11.–15.vii.1992; T. & K. Nupponen leg.; RCKN.

• 4♂, 3♀; Nylandia, Hanko, Russarö; 59.7695°N, 22.9496°E [ykj 6635:3272]; 16.–23.vii.1992; T. & K. Nupponen leg.; RCKN.

• 1♂; Nylandia, Hanko, Tvärminne; 59.8612°N, 23.1618°E [ykj 664:328], 11.vii.1983; T. & K. Nupponen leg.; RCKN.

• 1♂; Nylandia, Hanko, Tvärminne; 59.8612°N, 23.1618°E [ykj 664:328], 30.vi.–1.vii.1986; T. & K. Nupponen leg.; RCKN.

• 1♂; Nylandia, Hanko, Tvärminne; 59.8612°N, 23.1618°E [ykj 664:328], 5.–8.viii.1987; T. & K. Nupponen leg.; RCKN.

• 1♀; Nylandia, Hanko, Tvärminne; 59.8612°N, 23.1618°E [ykj 664:328], 26.vi.–3.vii.1990; T. & K. Nupponen leg.; RCKN.

• 1♂; Nylandia, Hanko, Tvärminne; 59.8612°N, 23.1618°E [ykj 664:328], 15.vii.1994; T. & K. Nupponen leg.; RCKN.

• 3♂, 3♀; Nylandia, Hanko, Tvärminne; 59.8612°N, 23.1618°E [ykj 664:328], 11.–18.viii.2019; T. & K. Nupponen leg.; RCKN.

• 1♂; Nylandia, Hanko, Tvärminne; 59.8612°N, 23.1618°E [ykj 664:328], 31.viii.–2.ix.2019; T. & K. Nupponen leg.; RCKN.

• 1♀; Nylandia, Hanko, Kolaviken; 59.8254°N, 23.0142°E [ykj 6641:3276]; 16.viii.1984; T. & K. Nupponen leg.; 1♀; same data, but 15.viii.1985; RCKN.

• 1♀; Nylandia, Espoo, Soukanniemi; 60.0779°N, 22.8821°E [ykj 66700:32708]; 25.vii.2014; T. & K. Nupponen leg.; RCKN.

• 1♂; Nylandia, Espoo, Laurinlahti; 60.1427°N, 24.6519°E [ykj 66724:33695]; 20.vii.2014; T. & K. Nupponen leg.; RCKN.

• 1♀; Nylandia, Helsinki, Hylkysaari; 60.1757°N, 24.991°E [ykj 6675:3388]; 19.–26.vi.2019; K. Nupponen & M. Nieminen leg.; RCKN, RCMN.

• 1♂; Nylandia, Helsinki, Hylkysaari; 60.1757°N, 24.991°E [ykj 6675:3388]; 19.–25.vii.2019; K. Nupponen & M. Nieminen leg.; RCKN, RCMN.

• 2♀; Nylandia, Helsinki, Hylkysaari; 60.1757°N, 24.991°E [ykj 6675:3388]; 12.–19.viii.2019; K. Nupponen & M. Nieminen leg.; RCKN, RCMN.

• 1♀; Nylandia, Helsinki, Hylkysaari; 60.1757°N, 24.991°E [ykj 6675:3388]; 28.viii.–1.ix.2019; K. Nupponen & M. Nieminen leg.; RCKN, RCMN.

• 1♀; Nylandia, Hanko; 59.8612°N, 23.1618°E [ykj 664:328]; 11.vii.2001; T. Mutanen leg.; ZMUO.

• 1♀; Nylandia, Hanko; 59.8612°N, 23.1618°E [ykj 664:328]; 20.vii.2001; T. Mutanen leg.; ZMUO.

• 1♀; Nylandia, Hanko; 59.8794°N, 24.9911°E [ykj 6642:3387]; 18.vii.2011; M., A. & N. Mutanen leg.; ZMUO.

• 1♂; Nylandia, Hanko; 59.8794°N, 24.9911°E [ykj 6642:3287]; 31.vii.2006; M. Mutanen leg.; BOLD Sample ID: MM03681; ZMUO.

• 1♀; Nylandia, Hanko, Täktom; 59.8099°N, 23.0205°E [ykj 66397:32767]; 13.vii.2018; M. & T. Mutanen leg.; ZMUO.

• 1♂, 1♀; Nylandia, Kirkkonummi, Porkkala; 59.9957°N, 24.4463°E [ykj 665:335]; 28.–31.vii.2003; M. Mutanen leg.; ZMUO.

• 1♀; Nylandia, Kirkkonummi, Porkkala; 59.9957°N, 24.4463°E [6656:3357]; 4.viii.2014; M. Mutanen leg.; ZMUO.

• 1♂, 1♀; Karelia australis, Virolahti; 60.5439°N, 27.6377°E [ykj 671:353]; 7.–13.vii.2001; 14.–21.vii.2002; P. Sundell, K. Vaalamo & B. Wikström leg.; RCBW.

• 1♂; Karelia australis, Virolahti; 60.5439°N, 27.6377°E [ykj 671:353]; 8.–24.vi.2004; B. Wikström leg.; BOLD sample ID: MM23516; RCBW.

Other material. China • 30♂, 2♀; 48°05'N, 129 85'E; NW China; alt. c. 200–500 m; Heilongjian district, Fenglin Nature Reserve, mixed *Pinus*/deciduous forest; 28.vi.–10.vii.2000; P. Sihvonen leg.; BOLD sample ID: TLMF Lep 05663, L. Kaila prep. 6190; BOLD sample ID: TLMF Lep 05664; BOLD sample ID: TLMF Lep 05665; BOLD sample ID: TLMF Lep 05666, L. Kaila prep. 6189; BOLD sample ID: TLMF Lep 05663; MZH.

Estonia • 2♂; Tartu reg., Järvselja; 3.viii.1984; M. Kruus leg.; MZH.

• 4♂; Abruka island, Pitkanina; dry meadow; 29.–31.vii.1984; K. Mikkola leg.; MZH.

Japan • 1♂; Odawa Pass, Arimine Toyama; 21.vii.1979; H. Yamanaka leg.; L. Kaila prep. 6310; ZMUC;

• 1♂; Odawa Pass, Arimine Toyama; 25.viii.1984; H. Yamanaka leg.; ZMUC.

Latvia • 1♂; Rīga distr., Carnikava; 13.vii.2011; by light trap; N. Savenkov leg.; LMNH.

• 1♀; Daugavpils distr., Silene (Ilgas); 8.–9.vii.2014; N. Savenkov leg.; LMNH.

Russia • 1♀; Isthmus Karelia, Repino [Kuokkala]; 11.viii.1938; E. Lankiala leg.; MZH.

• 1♀; Seiskari; 60.034°N, 28.360°E; 24.vii.1993; J. Junnilainen leg.; RCJJ.

• 3♂; Belgorod oblast, Borisovka, Makeshkino, Stenki; 503800°N, 355800°E; 8.–15.vii.2009; 17.–30.vi.2013; K.-E. Lundsten & B. Wikström leg.; GPBW7720, GPBW7913, GPBW7935; RCMW.

• 4♂; Belgorod oblast, Borisovka, 40 km N. Makeshkino, Stenki; 503811°N, 374904°E; 12.–14.vii.2011; K.-E. Lundsten & B. Wikström leg.; GPBW7930, GPBW7939; RCBW.

• 4♂; 40 km N. Irkutsk, steppe sloppe; ad luc, 1.–3.viii.1984; K. Mikkola & M. Viitasaari leg.; BOLD sample ID: TLMF Lep 05674, BOLD sample ID: TLMF Lep 05675; MZH.

• 1♂; Dauria, Onon river valley, lower Tshanrey; 15.vi.1992; M. Kostjuk leg.; BOLD sample ID: TLMF Lep 05667; MZH.

• 2♂; Novosibirsk, Akademogorodok; 14.–16.viii.1982; K. Mikkola leg.; MZH.

• 2♂, 1♀; SW Udmurtia, Kilmez; 57°00'N, 51°05'E; 8.–11.vii.2002; BOLD sample ID: TLMF Lep 0756, BOLD sample ID: TLMF Lep 0757; K. Mikkola leg.; MZH.

1♂; Buryatia, pr. Ulan Ude; alt. 700 m; steppe hill; 17.vii.1996; J. Jalava & J. Kullberg leg.; BOLD sample ID: TLMF Lep 05676; MZH.

• 19♂, 2♀; Barguzin valley, Maisky village; 54°35'N, 110°48'E; alt. 500 m; sandy yard; 2.–7.vii.1996; J. Jalava & J. Kullberg leg.; BOLD sample ID: TLMF Lep 056769, BOLD sample ID: TLMF Lep 05670; MZH.

4♂, 2♀; Primorje, Gonota juznoe; 1979; M. Kruus leg.; coll. MZH.

• 2♂; Anisimovka; 43°10'N, 132°46'E; alt. 300 m; 24.–28.vii.1997; J. Kullberg & J. Kaare leg.; MZH;

• 3♂; S. Primorje Ussurijsk Res.; 43°38'N, 132°33'E; alt. 250 m; 29.–31.vii.1996; J. Kullberg & J. Kaare leg.; MZH.

• 1♂; S. Primorje, Lazovski Res.; 43°16'N, 134°08'E; alt. 180 m; 5.–9.viii.1996; J. Jalava, J. Kullberg & J. Kaare leg.; BOLD sample ID: TLMF Lep 05668; MZH.

South Korea • 1♂, 1♀; South Korea, Jeollanam, E, Heuksan Isl; alt. 2 m; 344'45.28''N, 125°26'15.54''E; 17.–18.vi.2010; K. Mikkola leg.; http://id.luomus.fi/GK.2801, http://id.luomus.fi/GK.2837; L. Kaila prep 6294 (♂); MZH.

Diagnosis. *Pyralis cardinalis* is unique among other focal species as having two cornuti in the male genitalia; their structure is detailed below. It differs externally from *P. regalis*, *P. sagarrai*, *P. kacheticalis*, *P. princeps* and *P. joannisi* by the shape of the inner, silvery fascia: its outer margin is somewhat broadened medially, while the fascia is entirely or nearly parallel-sided in the other species. It can sometimes also be outwards slightly broadened in *P. regalis* and may thus taken alone not always be adequate for correct identification. Unlike other species the outer area of the hindwing of *P. cardinalis* is deep purple, that of other species is either dark brown (*P. regalis*, *P. princeps*, *P. joannisi*, *P. regalis* may also have brown or purple tinge), or pale yellowish grey, or suffused with pale grey (*P. sagarrai*, *P. kacheticalis*), but without purple. The inner silvery fascia is narrow and reaches the dorsal margin in *P. kacheticalis*, unlike other species. The median area of the hindwing is paler in *P. kacheticalis* and *P. sagarrai* than in the other species, as noted in the key. In the male genitalia, *P. cardinalis* differs from all other related species by its vesica which is devoid of coarse spines. It shares with *P. kacheticalis* and *P. sagarrai* the presence of one long, prominent, more or less straight cornutus, but has another smaller, curved cornutus formed of fused coarse spines.

The large cornutus can sometimes also be outwards slightly broadened in *P. regalis* and may thus alone not always perfectly support correct identification. The vesica of *P. regalis* has one tiny cornutus that is often hard to decipher among spines (see, however, *Remarks* under that species). In the female genitalia, the inception of the ductus seminalis is broadened and somewhat sclerotized; this trait distinguishes it from all other species treated. The ductus bursae widens evenly towards the corpus bursae, it is similar only in the externally different *P. perversalis*,

Description. External appearance (Figs 2, 4–7). Forewing length ♂: 8–9.5 mm, ♀: 8–11 mm. Labial palpus ascending, length of second segment 1.3 as long as diameter of eye; third segment short. Maxillary palpus 1/3 as long as labial palpus; head and these appendices, scape and pecten yellow. Head rough-scaled; collar yellow, intermixed with purple. Flagellum purple, male with thin cilia length of which is twice diameter of shaft; female antenna with very short ciliation. Thorax

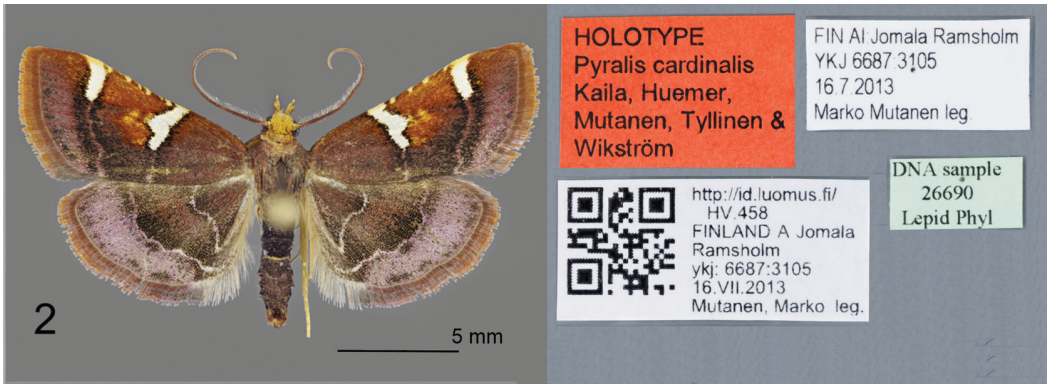


Figure 2. *Pyralis cardinalis* sp. nov., holotype, ♂, habitus.

purple; abdomen varying from purple to lead-grey. Legs pale ochre. Forewing: basal third, distal quarter, and often area of distal quarter between fold and dorsal margin purple, near margin sometimes variably intermixed with dark grey scales; at 2/5 of wing length white fascia extending from costa to fold towards which it narrows, medially outwardly widened; similarly colored, elongate spot from distal 4/5 wing length from costa to 1/3 wing width towards middle; from both white areas to costal margin narrow, purple string both inwardly and outwardly narrowly bordered with dark grey. Between white areas wing colour orange brown, costa variably annulated by yellow, grey or alternating spots of both colour. Fringe brown, except in dorsal corner dark grey. Hindwing: divided by off-white stripes into three almost equally wide areas; stripes approaching each other towards anal margin. Basal and median area purple, sometimes variably intermixed with dark grey scales; distal area somewhat paler, purple. Fringe brown, except in anal corner silvery. Underside: forewing yellowish grey, area corresponding with outer white area of upper side pale ochre. Costal margin annulated by black and yellow, somewhat elongate spots; hindwing lead-grey, with evenly bent pale grey band along outer 2/3.

Male genitalia (Fig. 22). Uncus hat-shaped, weakly sclerotized medially with triangular, distally tapered as a sparsely setose, blunt-tipped lobe; uncus articulated from tegumen; tegumen narrow, broadest laterally, tapered as narrow band touching uncus. Gnathos articulated from tegumen, formed of arms being near base and medially broad, somewhat narrowed between, mesially formed as narrow, triangular lobe terminating with abruptly bent, narrow, fused hook-shaped apex, median part of gnathos twice as long as uncus. Valva 1.5–2 times as long as wide, width varying to some extent, valvae connected to each other anteriorly; dorsal margin of basal part of valva sclerotized, distal area formed of articulated square lobe; costa convex, weakly sclerotized. Transtilla laterally shortly sclerotized, median part articulated, membranous. Juxta scobinate, convex, broad tongue-shaped. Anellus connected to vinculum, nearly membranous, in lateral view bent as s-shaped, posteriorly connected to apex of phallus; easily severed during dissection from genital capsule and attached to phallus. Vinculum short, broad, v-shaped. Phallus 3 times as long as wide apart from distal 1/4 which is narrowed towards apex, and incised with ventrally directed distal opening. Vesica with two cornuti: one narrow spine, length of which is roughly half of the narrowed distal part of phallus, and another small, curved cornutus-like group formed of dense group of coarse, partly fused spines; vesica otherwise indistinctly spinose.

Female genitalia (Fig. 29). Papillae anales dorsally fused, relatively narrow, somewhat bent; densely setose. Ostium bursae situated at posterior margin of sternum 8, membranous, bowl-shaped, width ¾ distance between posterior apophyses in dorsoventral projection. Posterior apophysis straight and slender; anterior apophysis somewhat longer, bent and basally stouter than apophysis posterioris. No antrum present between ostium and the distinctly sclerotized colliculum; colliculum as long as wide. Ductus seminalis incepted anterior to colliculum, at the inception ductus somewhat broadened and weakly sclerotized. Otherwise ductus bursae membranous, evenly widened towards corpus bursae without clear limit to the latter. Length of ductus bursae and corpus bursae about 7.5 times length of posterior apophysis. No signum or granulation in corpus bursae, but membrane with minute lens-shaped formations.

Molecular data. BIN: BOLD:AAF5806. The intraspecific mean divergence of the barcode region is 0.21%, the maximum divergence 0.70% (N = 21). The minimum distance to the nearest European neighbour, *P. sagarrai*, is 7.43%. However, an unrevised species from China is only 4.23% apart from *P. cardinalis*.

Biology. Life history is not known. Adults have been observed at sugar bait as well as in light traps over a long period, spanning from the end of June to the end of August. The peak of the flight period is during July, and no evidence of more than one yearly generation seems to exist.

Distribution. China, Denmark, Estonia, Finland, Japan, Latvia, Russia (European part, southern Siberia, Far East), South Korea, Sweden.

Remarks. We have intentionally delimited the type series of this transpalearctic species to a limited geographical area. As such we selected Finland from where an exceptionally rich material is available. As *P. cardinalis* is nowadays common in the southern part of Finland, we selected for the type series only a representative subset of known specimens, and list here only the type specimens. *P. cardinalis* is expanding in northern Europe; probably the first confirmed records from Baltic countries and Fennoscandia are from 1930s. The first documented and still existing specimen is from Repino [then Kivennapa] in Isthmus Karelia from 1931. There are records from Finland and apparently from Latvia from the later 1930s (Karvonen 1937; N. Savenkov, pers. comm.). Since 1970s it has become ever more abundant in the Baltic countries and Finland. *P. cardinalis* [as *P. regalis*] was first recorded 1996 in Denmark and is now established in the island of Bornholm (Buhl et al. 2020). Bengtsson (2020) outlined its recent expansion in Sweden [as *P. regalis*]. The origin of the contemporary distribution is not possible to estimate as all barcodes examined throughout its range are virtually identical. The specimen illustrated as *P. princeps* by Leraut (2005, Fig. 33) is actually *P. cardinalis.*

Pyralis regalis [Denis & Schiffermüller], 1775

Figs 3, 8–11, 23, 30

Pyralis regalis [Denis & Schiffermüller], 1775: 124.
Pyralis pulchellalis Millière, 1873: 221; synonymized by Rebel (1901: 45; species 841).

Material examined. (with 16♂, 6♀ genital dissections). **Type material.** • ***Neotype*** ♀; A/N: Oberloiben, Höhereck; 48°23'N, 15°32'E; ca. 300 m; 30.6.2015; P. Buchner leg.; BOLD Sample ID: TLMF Lep 27053; coll. TLMF; here designated.

Other material. Specimens preserved in MZH have museum identifier codes from http://id.luomus.fi/HV.257 to http://id.luomus.fi/HV.355.

Albania. 1♀, Kelmend, Tarnarja, Milsilschlucht, 1200 m, 12.viii.1994, leg. B. Plössl (TLMF).

Austria. 1♀, Burgenland, Umg. Rechnitz, Gemärk, 3.viii.1990, leg. H. Habeler (TLMF); 1♂, Niederösterreich, 2.5 km SSW Hainburg, 300 m, 48°07'N, 16°56'E, 18.vi.2008, leg. P. Buchner, BOLD sample ID: TLMF Lep 05166 (TLMF); 1♂, Niederösterreich, 2.5 km W Bad Fischau, 430 m, 47°49'N, 16°08'E, 18.vii.2004, leg. P. Buchner, BOLD sample ID: TLMF Lep 05713 (TLMF); 1♀, same data, but 1.viii.2004, BOLD sample ID: TLMF Lep 05714 (TLMF); 1♂, 3♀, Niederösterreich, Wachau, Dürnstein, 18.vii.1988, leg. F. Lichtenberger; 2♀, same data, but 6.viii.1988; 3♂, same data, but 17.vi.1971; 1♂, same data, but 1.vi.1990; 1♂, same data, but 13.vi.1990; 3♂, same data, but 14.vi.1990; 1♂, 1♀, same data, but 19.vii.1991, leg. J. Ortner; 2♀, same data, but 14.viii.1991; 1♂, same data, but 19.vi.1985, leg. F. Hofmann; 1♀, same data, but 31.viii.2005; 1♂, same data, but 14.vi.1969, leg. A. Moser; 1♀, Niederösterreich, Wachau, Unterloiben, 7.vi.1990, leg. Petz; 1♀, Niederösterreich, Kleinpöchlarn, 340 m, 48°13'34''N, 15°13'36''E, 17.viii.2006, leg. F. Lichtenberger; 1♂, Niederösterreich, Weinviertel, Pulkau, Steinbruch, 5.viii.2005, leg. R. Leimlehner; 2♂, 2♀, Steiermark, Herberstein, Buchberg, 500 m, 26.vi.2001, leg. H. Habeler; 1♀, same data, but 8.vii.2003 (all TLMF).

Bulgaria. 2♂, 1♀, 41.763, 23.170 Blagoevgrad district, Stara Kresna, 800 m, 17.–30.ix.2017, leg. J. Junnilainen (RCJJ); 1♀, 41,962°N, 23,102°E, 5 km S Blagoevgrad, 28.vii.2013, leg. B. Å. Bengtsson (RBB); 5♂, 2♀, 42°39'N, 23°23'E, Sofia, Družba, 5.–21.ix.1976 leg. K. Mikkola, L. Kaila prep. 6182, 6183 (MZH); 1♂, 2♀, 41.527°N, 23.583°E, Southern Pirin, 1100 m, 10 km SW Popovi Livadi, 21.vi.2013, leg. J. Junnilainen (RCJJ); 4♀, 41.652°N, 23.248°E, Slavianka, 1000 m, 24.vii.2013, leg. J. Junnilainen, L. Kaila prep. 6303 (RCJJ); 1♂, 41.597, 23.225 Struma river valley, Sandanski meadow, 16.vii.2014, leg. J. Junnilainen (RCJJ); 1♀, 41.652, 23.248 Struma river valley, Ilidentsi, 650 m, 23.–25.vii.2013, 1♂, 10.vii.2014, leg. J. Junnilainen (all RCJJ); 8♂, 6♀, 41.65°N 23.33°E, Strumjani, Ilidenci, leg. B. Wikström (RCBW); 1♀, Katunzi, Pavlovo, Goleshovo, 10.viii.2013, DNA sample 23514, leg. N. Ryrholm & B. Wikström (RCBW).

Croatia. 2♀, Porec, 28.vi.1986, leg. H. Popp; 1♂, Istria, Rovinj, Vestra, 20 m, 20.vii.2000, leg. H. Deutsch; 1♂, 1♀, Cres isl., Stivan, 30–150 m, 29.vii.–1.viii.1998, leg. H. Brandstetter; 2♀, same data, but 30.v.–2.vi.1998, leg. J. Ortner; 1♀, same data, but 6.–8.viii.1997; 1♀, Krk isl., Punat env., 18.vi.1984, leg. H. Habeler; 1♀, same data, but 20.ix.1987; 2♂, same data, but 17.vi.1986; 2♂, 1♀, same data, but 18.vi.1986; 1♂, same data, but 19.vi.1986; 1♀, same data, but 1.ix.1986; 1♂, 1♀, same data, but 7.ix.1986; 1♂, same data, but 8.vii.1987; 1♀, same data, but 5.vi.1989; 1♀, same data, but 4.ix.1990; 1♂, 1♀, same data, but 8.vi.1992; 1♀, same data, but 24.ix.1992; 3♂, same data, but Pyrigraben, 8.vi.2003 (all TLMF).

France. 1♀, 43°56'N, 7°15'E, Alpes maritimes, Vallée de la Vésubie, 9.vi.1998, leg. K. Silvonen (MZH); 1♀, Dep. Alpes-Maritimes, Bonson, 500 m, 29.vi.1962, leg. F. Dujardin; 2♀, Dep. Alpes-Maritimes, St. Blaise, 26.–30.v.1982, leg. De Pieri; 1♂, same data, but 7.ix.1981, leg. F. Dujardin; 3♂, Dep. Alpes-Maritimes, 16.vii.1978, leg. F. Dujardin; 1♂, Dep. Pyrénées-Orientales, Jujols, Le Sola, 850 m, 26.vi.1992, leg. S. Peslier; 1♀, Corse, Asco valley, early vi.1979, 250 m, leg. F. Zürnbauer (all TLMF); 8♂, 15♀, Corse, Patrimonio, 16.–30.vi.2007, GPBW7914, GPBW7934; 2♂, 1–10.vii.2012 leg. B. Wikström., GPBW7908, leg. B. Wikström (RCBW); 1♂, Gard, St Jean du Gard, 16.–30.vi.2007, BOLD sample ID: MM 23515, leg. B. Wikström (RCBW).

Greece. 1♂, 2♀, 40°58'N, 25°47'E, Alexandropolis, Kirki, 24.–26.vii.1981, leg. P. Grotenfelt (MZH); 6♂, 12♀, 39°32'N, 19°55'E, Corfu, Benitses, 3.–14.vi.1978, leg. V. Varis, L. Kaila prep. 6181, 6186 (MZH); 1♀, 39°34'N, 19°54'E, Corfu, Perama, 1.vi.1977, leg. H. & M. Koponen (MZH); 1♂, 39°46'N, 21°10'E, Epirus, Mestsovo, 23.vii.1991, leg. P. Somerma & R. Väisänen (MZH); 1♂, 4♀, 39°52'N, 20°51'E, Epirus (Zagoria), Tsepelovo, 1200 m, 27.vi.1991, leg. P. Somerma & R. Väisänen (MZH); 1♂, 1♀, 38°57'N, 20°45'E, Epeiros, Preveso Kanalion, 1985, leg. P. Grotenfelt (MZH); 1♂, 39°52'N, 20°51'E, Epirus (Zagoria) Skamneli Timfi, Goura, 2200m, 24.vii.1991, leg. P. Somerma & R. Väisänen, BOLD sample ID: TLMF Lep 05680 (MZH); 2♂, 5♀, 40°40'N, 21°09'E, Florina, Vatochorion, 15.–16.vii.1985, leg. P. Grotenfelt (MZH); 1♂, 39°08'07''N, 26°26'08''E, Lesvos, NE Keramia, organic olive orchard, 3.vi.2009, leg. L. Kaila & J. Kullberg, BOLD sample ID: TLMF Lep 05744 (MZH); 1♂, 39°21'19''N, 26°17'57''E, Lesvos, Sikaminia, pasture, 520 m, 13.ix.2008, leg. L. Kaila & J. Kullberg, BOLD sample ID: TLMF Lep 05741 (MZH); 1♂, 39°01'50''N, 26°22'34''E, Lesvos, 2 km NNE Megalochori, *Quercus*/meadow, 11.x.2008, leg. L. Kaila & J. Kullberg, L. Kaila prep. 6180, BOLD

sample ID: TLMF Lep 05743 (MZH); 1♂, 40°43’N, 23°42’E, Ma. Thessaloniki, Asprovalta, 2.x.1977, leg. P. Grotenfelt (MZH); 1♀, 37°33’N, 22°20’E, Peloponisos, Arkadia, Tekn. Ladona, 25.vi.1981, leg. P. Grotenfelt (MZH); 1♀, 24.vi.1981, 37°40’N, 22°10’E, Peloponisos, Arkadia Vitina, 13.ix.1980, leg. P. Grotenfelt (MZH); 17♂, 14♀, 37°42’N, 21°34’E, Peloponisos, Ilia, Loutra Kilini, 6.–20.ix.1980, leg. P. Grotenfelt, L. Kaila prep. 6182, 6195, 6196, 6299 (MZH); 1♂, 3♀, Pindos Konitsa, Pades, 6.vii.1981, leg. P. Grotenfelt (MZH); 1♀, Pindos Katana, 4.vii.1981, leg. P. Grotenfelt (MZH); 1♂, 1♀, Thesprothia, Paramithia 30.viii.1987, leg. P. Grotenfelt, L. Kaila prep. 6179 (MZH); 1♀, Thessaly, Skiathos, 24.vi.1991, leg. P. Somerma & R. Väisänen; same locality, 3.viii.1991, leg. P. Somerma & R. Väisänen (MZH); 1♂, Thessaly, Pelion Makrinitsa, 500 m, 31.vii.1991, leg. R. Väisänen (MZH); 2♂, Epirus, Prov. Ioannina, Thesprotia, Pindos, Mt. Smolika, Agias Paraskevi, 700 m, 23.vi.2006, leg. A. E. Rau, BOLD sample ID: TLMF Lep 04993, BOLD sample ID: TLMF Lep 04994 (LMK); 1♀, Igoumenitsa; Korytiani env., 30.v.2002, leg. J. Ortner; 1♂, Macedonia, Meteora, 420 m, mid viii.1977, leg. F. Zürnbauer, gen. slide PYR 345♂, P. Huemer; 2♀, Agii Pantes, 800 m, 26.vi.2009, leg. K. Freytag; 1♂, same data, but Filates env., 27.vi.2009, leg. W. Caesar; 1♀, Lakonia, Mani, Aeropolis, Cholasia, 350 m, 14.v.2005, leg. M. Tschinder & L. Hassler; 1♀, Kalamata, 3.–10.vi.1997, leg. J. Wimmer; 1♀, 40°00’45’’N, 20°53’00’’E, Epirus, Vrisochori, bridge river Aoos, 740 m, 9.vii.2005, leg. T. Mayr; 1♀, 35°24’N, 23°53’E, Epirus, Prov. Theosprotia, Argyrotopos, 25 m, 8.–17.v.2002, leg. A.E. Rau (all TLMF); 5♀, Nidri Lefkada, 15.–17.viii.1995, leg. J. P. Baungaard (ZMUC).

Hungary. 1♂, Aggtelek NP., Aggtelek, 400 m warm oak forest & chalk grasslands, 19.vi.1996, leg. K. Mikkola (MZH); 1♀, Balaton, Balatonakali, 1.viii.1996, leg. J. Ortner; 1♀, same data, but 24.–26.vii.1994 (all TLMF).

Italy. 1♂, 46°41’51’’N, 10°30’59’’E, Prov. Südtirol, Vinschgau, Schleiser Leiten, 1350 m, 18.viii.2013, leg. P. Huemer; 1♂, Prov. Südtirol, Naturns, Sonnenberg, 1000 m, 31.vii.1996, leg. T. Mayr; 1♂, 1♀, Prov. Südtirol, Naturns, 660 m, late vi.1965, leg. F. Zürnbauer; 1♀, same data, but late vii.1965; 1♂, Prov. Südtirol, Schnalstal, 800 m, early vii.1967, leg. F. Zürnbauer; 1♂, 1♀, same data, but late viii.1967; 1♂, same data, but early ix.1971; 1♀, Prov. Südtirol, Bozen, Etsch-Eisackmündung, 2.vii.2003, leg. P. Huemer; 1♀, Prov. Südtirol, Bozen, Sand, 450 m, 9.ix.1992, leg. B. Bosin; 1♂, Prov. Südtirol, Bozen, St. Johann, 280 m, 2.ix.1988, leg. B. Bosin; 1♀, Prov. Südtirol, Montiggl, Kl. Priol, 600 m, 14.vii.1993, leg. P. Huemer; 2♂, same data, but 22.vii.2010, BOLD sample ID: TLMF Lep 2207, BOLD sample ID: TLMF Lep 2208; 3♂, same data, but 30.vi.2010; 1♂, Prov. Südtirol, Pfatten, Mitterberg, NO-Hang, 400 m, 12.vii.1991, leg. P. Huemer; 1♀, Prov. Südtirol, Kalterer See, 216 m, 26.vi.1990, leg. P. Huemer; 1♂, 2♀, Prov. Südtirol, Auer, 31.v.1957, leg. K. Burmann; 1♀, same data, but 29.vi.–1.vii.1957; 1♀, same data, but 1.vii.1957; 1♀, same data, but 14.–16.vi.1958; 2♂, 3♀, same data, but 21.vi.1957, leg. A. Hernegger; 1♀, same data, but 2.viii.1957; 1♀, Prov. Südtirol, Margreid, Fenner Schlucht, 460 m, 46°17’16’’N, 11°12’05’’E, 25.vi.2013, leg. P. Huemer; 4♀, Prov. Trento, Rovereto N, Pomarolo, 3.viii.2000, leg. J. Wimmer; 1♂, same data, but 1.ix.2000; 2♀, Prov. Trento, Pietramurata, 250 m, late viii.1962, leg. F. Zürnbauer; 1♂, same data, but late vi.1968; 1♂, Prov. Trento, Villamontagna, 600 m, leg. K. Burmann; 1♀, 13.ix.1982, Prov. Verona, Pai di Sopra, 100 m, 1.–10.vii.1986, leg. H. Gutweniger; 1♀, same data, but 11.–20.vii.1986; 1♀, Prov. Verona, Navene, 17.v.1976, leg. W. Pavlas; 3♀, Prov. Verona, Garda, early – mid v.1977, leg. W. Pavlas; 1♂, 1♀, Prov. Verona, San Ambrogio di Valpolicella, Monte, 300 m, 45°34’N, 10°50’55’’E, 27.viii.1987, leg. P. Morass, BOLD sample ID: TLMF Lep 05047, BOLD sample ID: TLMF Lep 05048; 3♀, same data, but 24.vii.1984, leg. K. Burmann, gen. slide PYR 342 ♀ P. Huemer; 1♀, same data, but 2.viii.1984; 1♀, same data, but 6.ix.1988; 1♀, same data, but 27.vi.1992; 1♂, 1♀, but 18.ix.1993; 1♂, same data, but 25.vi.1987; leg. K. Burmann, P. Huemer & G. Tarmann, gen. slide PYR 341 ♂ P. Huemer; 1♀, same data, 24.vii.1985, leg. K. Burmann & P. Huemer; 1♀, same data, but 4.vi.1999, leg. J. Ortner; 1♀, same data, but 17.ix.1991, leg. H. Deutsch; 1♂, same data, but 5.vi.2015, leg. H. Deutsch & E. Bendikt; 1♂, 3♀, same data, but 22.vii.1995, leg. T. Mayr; 2♀, same data, but 20.vi.1992, leg. S. Plattner; 3♂, same data, but 200 m, early viii.1978, leg. F. Zürnbauer, gen. slide PYR 343 ♂ P. Huemer; 2♂, 1♀, Prov. Verona, San Ambrogio di Valpolicella, Monte, 410 m, 45°34’N, 10°49.9’E, 20.–22.v.2001, leg. P. Huemer, gen. slide PYR 344 ♂ P. Huemer; 1♂, Prov. Verona, Soave, 100 m, 19.vi.1976, leg. K. Burmann; 1♀, Prov. Udine, Trasaghis, Tagliamento, 200 m, 22.vii.1997, leg. H. Deutsch; 1♀, Prov. Udine, Cavazzo, Palude Vituarbis, 280 m, 31.vii.2008, leg. H. Deutsch; 1♂, Prov. Udine, Peonis – Avasinis, 250 m, 23.vii.2004, leg. H. Deutsch; 1♀, Prov. Trieste, Fernetti, Mt.

Orsario, 325–330 m, 20.vi.2014, leg. H. Deutsch; 1♀, Prov. Gorizia, Monfalcone, 100, 26.v.1992, leg. H. Deutsch; 1♀, same data, but 1.viii.1986, leg. T. Mayr; 1♂, Prov. Cuneo, Valdieri, RN *Juniperus phoenicea*, 900–1000 m, 44°17'1''N, 7°23'52''E, 1.viii.2010, leg. P. Huemer; 1♀, Prov. Cuneo, Dronero, 6.viii.1970, leg. F. Dujardin; 1♂, Prov. Imperia, Diano Arentino, 4.vii.1999, leg. W. Arnscheid; 1♂, 1♀, Prov. Imperia, Lucinasco, 25.vi.1999, leg. W. Arnscheid; 1♀, Prov. Imperia, Conio, 1.vii.1999, leg. W. Arnscheid; 1♀, Prov. Imperia, Ville S. Pietro, 30.vi.1999, leg. W. Arnscheid; 1♀, Prov. Imperia, Regio Marra, Isolabona, 580 m, 21.ix.2011, leg. M. Tschinder & L. Hassler; 1♀, Prov. Savona, Andora, 30.vi.2008, leg. R. Leimlehner; 1♂, Prov. Rieti, Monte Terminillo, 1700–1900 m, 30.vii.–6.viii.2003, leg. A.E. Rau; 5♂, Prov. Chieti, PN della Majella, Taranta Peligna, Pian di Valle, 770 m, 42°01'34''N, 14°09'43''E, 20.vii.2011, leg. P. Huemer, BOLD sample ID: TLMF Lep 05054, BOLD sample ID: TLMF Lep 05044, BOLD sample ID: TLMF 05045; 2♂, same data, but leg. T. Mayr; 2♂, same data, but 21.vii.2011, leg. B. Wiesmair; 2♀, Prov. Messina, Monte Soro, 1500 m, 7.vii.1992, leg. Bruer (all TLMF); 13♂, 13♀, Tuscany, Cortona, 1.–10.vii.2018, leg. B. Wikström, GPBW7929, GPBW7928, GPBW7925 (RCBW); 5♂, 6♀, Tuscany, Montaione, Umbria, mt. Subasio, 1.–10.vii.2012, leg. B. Wikström (RCBW); 8♂, 5♀, 43.06.8880, 12.68.0208, Umbria, Assisi, Mt. Subasio, 1280 m a.s.l., 1. –10.vii.2015, leg. B. Wikström (RCBW).

MACEDONIA. 5♂, 40.97234. 20.87707, Ohrid, Galicica, Stenje slope, 1206 m a.s.l., 20.–25.vi.2015, leg. B. Wikström (RCBW).

PORTUGAL. 1♂, Trás-os-Montes, R. Tua, Fiolhal, 26.vii.2006, leg. M. Corley P8213 (RCMC).

ROMANIA. 1♀, Orsova, Herkulesbad, 1.ix.1997, leg. C. Wieser, BOLD sample ID: TLMF Lep 04995; 1♀, Dobrogea, Macin mts., Greci, 100–300 m, 14.vi.2006, leg. C. Wieser, BOLD sample ID: TLMF Lep 04996; 1♂, Aries valley, Rimetea, 20.vii.1998, leg. Wieser, BOLD sample ID: TLMF Lep 05000 (all LMK).

RUSSIA. 2♂, Belgorod Oblast; Borisovka, Makeshkino, Stenki, 503800'N 355800'E; 3♂, Makeshkino, Stenki, 503811'N, 374904'E; 2♂, 27.–30.vi.2011, 12.–14.vii.2011, 14.–30.vi.2013, GPBW7935, leg. K.-E. Lundsten & B. Wikström; 2♂, 17.–23.vi.2013, leg. K.-E. Lundström & B. Wikström, 24.–30.vi.2013, GPBW7935; 17.–23.vi.2013, leg. K.-E. Lundström & B. Wikström, 12.–14.vii.2011, GPBW7939 (RCBW); 1♂, 503811'N, 374904'E, (all RCBW).

SERBIA. 1♂, Golubac, 7.vii.2016, leg. P. Jakšić (TLMF).

SLOVENIA. 1♀, Brestovica, Komenskem krasu, 25–35 m, 10.vi.2012, leg. H. Deutsch; 1♀, same data, but 1.vii.2011; 2♂, same data, but 16.vi.2010; 1♂, Presnica, 400 m, 24.vi.2005; 2♂, Smarje pri Jelsah, Podsreda, Cerkev Sv. Marija Zalosti, 310 m, 46°4'9''N, 15°35'38''E, 13.vi.2015, leg. B. Wiesmair; 1♀, Nanos, 400 m, 18.vii.1988, leg. H. Deutsch; 1♀, same data, but 20.vi.1995 (all TLMF); 3♀, Granska Gora, 28.–30.v.2015, leg. B. Wikström, GPBW7936, GPBW7941, BOLD sample ID: MM 26358 (RCBW).

SWITZERLAND. 1♂, 1♀, 46°01'N, 8°37'E Brissago, vii.1974, leg. P. Stöcklin, L. Kaila prep. 6295 (MZH); 2♂, Ticino, Mergoscia, Casa Naef, 720 m, 10.viii.1971, leg. R. Müller (TLMF).

UKRAINE. 1 spec., Donetsk region, Lyman (DON) with Torsko, 20.–23.vi.1919, BOLD sample ID: MM26688, leg. Zhakov, A. (RCBW); 1♂, 1♀, Zaparohye region, Melitopol district, with. Danilo-Ivanivka, 7.viii.2019, leg. A. Zhakov (RCBW); 1♀, m city of Zaparozhyd, Khortytsia island. 2.viii.2019, leg. A. Zhakov (RCBW).

Diagnosis. *Pyralis regalis* is in general appearance darker than other European species; especially the hindwings are more intermixed with dark grey, sometimes also with purple to a varying extent, though never as strongly as in *P. cardinalis*. In the hindwings, in particular, the outer third is markedly purple in *P. cardinalis*, but usually dark grey in appearance in *P. regalis*. Hindwings of *P. kacheticalis* are dark only in the basal third. In *P. sagarrai* they are dark only in the basal and medial thirds, the purple tinge is lacking in both these species. Genital characteristics between males are noted in the key, and in the diagnosis of *P. cardinalis* above.

Redescription. External appearance (Figs 3, 8–11). Forewing length: ♂: 9–11 mm, ♀: 9–12 mm; size varying both within and among populations. Labial palpus ascending, second segment 1.3× as long as diameter of eye; third segment short. Maxillary palpus 1/3 length of labial

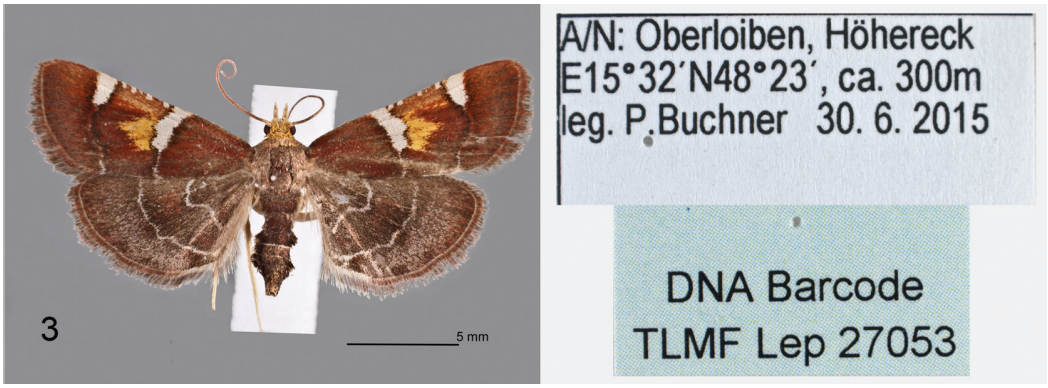
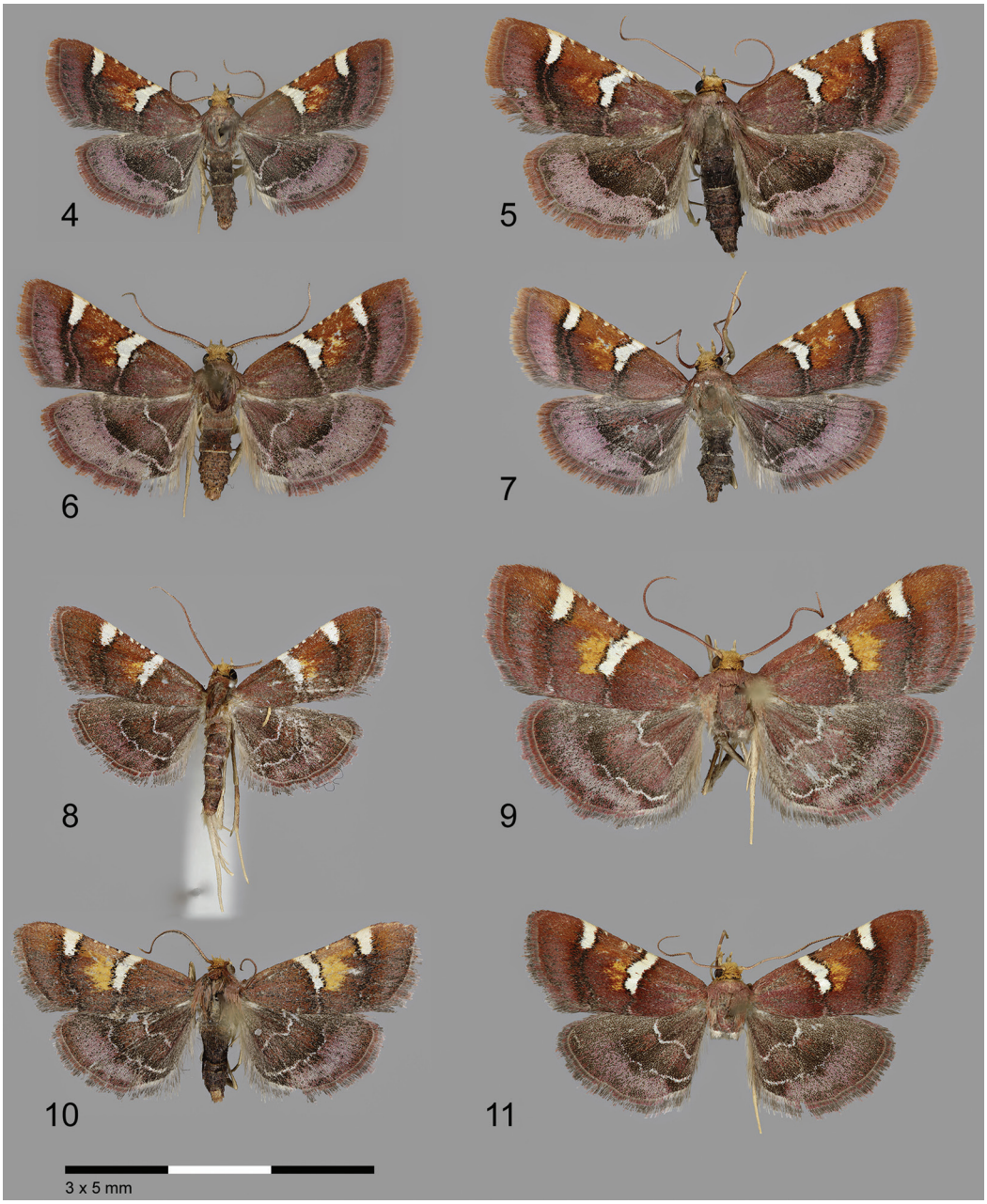


Figure 3. *Pyralis regalis* ([Denis & Schiffermüller]), neotype, ♂, habitus.

palpus; head and these appendices, scape and pecten yellow. Head rough-scaled; collar yellow, intermixed with purple. Flagellum purple, male with thin cilia, length of each cilium twice diameter of shaft; female antenna with very short ciliation. Thorax purple; abdomen varying from purple to lead-grey. Legs pale ochre. Forewing: basal third, distal fourth, and area around distal fourth of dorsal margin to fold usually brown, but colour often varies towards dark grey , usually more or less with purple tinge, near margin sometimes intermixed with dark grey scales; at 2/5 of wing length white fascia extending from costa to fold, not tapered towards fold, its outer margin medially sometimes slightly widened, similarly colored, elongate spot from distal 4/5 wing length from costa to 1/3 wing width towards middle; from both white areas to costal margin narrow, purple line, both inwardly and outwardly narrowly bordered with narrow dark grey. Between white areas wing colour orange-brown except broadly along costa brown, costa with several small, white spots. Fringe brown except in dorsal corner dark grey. Hindwing: divided by white stripes into three almost equally wide areas; stripes approaching each other towards anal margin. Colour variable; basal and median area brown with purple tinge, intermixed with dark grey scales to varying extent, to entirely dark grey; distal area varying from dark grey to nearly purple. Fringe brown except in anal corner silvery. Underside: forewing yellowish grey, area corresponding to outer white area of upper side pale ochre; hindwing lead-grey, with evenly bent pale grey band along outer 2/3. Costal margin annulated by black and yellow, somewhat elongate spots.

Male genitalia (Fig. 23). Uncus hat-shaped, weakly sclerotized, medially with triangular, distally tapered as sparsely setose, blunt-tipped lobe; uncus articulated from tegumen; tegumen narrow, broadest laterally, tapered as narrow band touching uncus. Gnathos articulated from tegumen, formed of arms being near base and medially broad, somewhat narrowed between, mesially formed as narrow, triangular lobe terminating with abruptly bent, narrow, fused hook-shaped apex; median part of gnathos twice as long as uncus. Valva 1.5–2 times as long as wide, width varying to some extent, valvae connected to each other anteriorly; dorsal margin of basal part of valva sclerotized, distal area formed of articulated square lobe; costa convex, weakly sclerotized. Transtilla laterally shortly sclerotized, median part articulated, membranous. Juxta scobinate, convex, broad tongue-shaped. Anellus connected to vinculum, nearly membranous, in lateral view bent as s-shaped, posteriorly connected to apex of phallus; easily severed during dissection from genital capsule and attached to phallus. Vinculum short, broad, v-shaped. Phallus 3 times as long as wide apart from



Figures 4–11. *Pyralis* sp., habitus. **4–7.** *P. cardinalis* sp. nov., **4.** ♂, Finland, V, Kemiönsaari, leg. J. Tyllinen. **5.** ♀, A, Lemland, leg. B. Wikström & K. Vaalamo; **6.** ♂, Finland, U, Kirkkonummi, leg. J. Junnilainen; **7.** ♂, Finland, U, Raasepori, leg. L. Kaila. **8–11.** *P. regalis.* **8.** ♂, Greece, Lesvos, leg. L. Kaila & J. Kullberg. **9.** ♀, Slovenia, Granska Gora, leg. B. Wikström; **10.** ♂, Italy, Tuscany, Cortona, leg. B. Wikström. **11.** Bulgaria, 5 km S. Blagoevgrad, ♀, leg. B. Å. Bengtsson.

distal 1/4 which is narrowed towards apex, incised with ventrally directed distal opening. Vesica usually devoid of cornuti (see Remarks); coarsely granulose.

Female genitalia (Fig. 30). Papillae anales dorsally fused, relatively narrow, somewhat bent; densely setose. Ostium bursae situated in posterior margin of sternum 8, membranous, bowl-shaped, width ¾ distance of that between posterior apophyses in dorsoventral projection. Posterior apophysis straight and slender; anterior apophysis somewhat longer, bent and stouter. No antrum present between ostium and distinctly sclerotized colliculum; colliculum 1.5 times as long as wide. Ductus seminalis incepted anterior to colliculum with no swelling or sclerotization; posterior third to half of the length of ductus bursae braid-shaped, granulose; otherwise membranous, evenly widened towards corpus bursae which it joins indistinctly. Corpus bursae elongate, oval. Length of ductus bursae + corpus bursae about 6 times length of posterior apophysis. No signum in corpus bursae, but the membrane of both ductus and corpus bursae with minute lens-shaped formations.

Molecular data. BIN: BOLD:AAP5668. The intraspecific mean divergence of the barcode region is 0.44% and the maximum divergence 1.83% ($N = 28$). The minimum distance to the nearest neighbour, *P. sagarrai*, is 3.96%.

Distribution. Widely distributed in South Europe at least to Austria and Switzerland in the north. As the southwestern limit of the distribution range of *P. cardinalis* is not very far from the closest records of *P. regalis* the identity of some records from, e.g., Germany, require re-examination. *Pyralis regalis* and *P. cardinalis* are sympatric at least in Russia: Belgorod.

Remarks. The collection of Denis & Schiffermüller was deposited in the "Hof-Naturalien-Kabinett" in Vienna but destroyed by fire during the Vienna Rebellion of 1848 (Hoffmann 1952). Despite a personal search by PH we found no potential type material and conclude that the syntypes are lost or destroyed. As this taxon is part of a species complex, designation of a neotype is necessary to preserve the stability of nomenclature (ICZN 1999). The type locality is presumably in Lower Austria, where the majority of the material of Denis & Schiffermüller was collected, and as indicated by the title of the original description (Denis and Schiffermüller 1775). We therefore designate as neotype a female specimen from this province with label data mentioned above and figured in Fig. 3.

According to collecting dates ranging from late May to October, it seems likely that at least two generations occur in southern Europe.

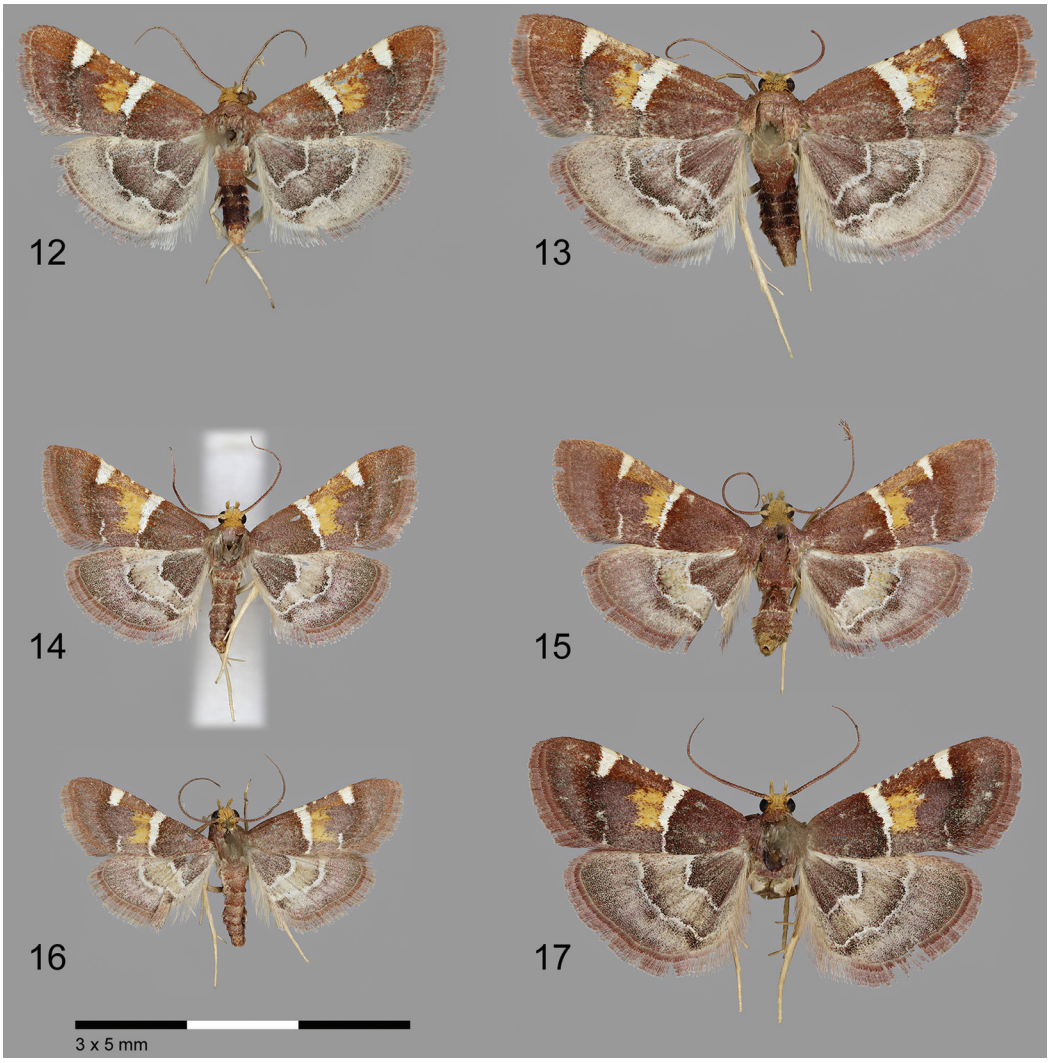
We follow Leraut (2005) regarding the status of *P. pulchellalis* Millière.

Pyralis sagarrai Leraut, 2005, stat. nov.

Figs 12, 13, 24, 31

Pyralis regalis ssp. *sagarrai* Leraut, 2005: 78

Material examined. France. 14♂, 7♀, 42°8'39"N, 2°18'39"E, 950 m a.s.l., Pyrenees or. Jujols, 17.vi.2017, leg. J. Junnilainen, GPBW7938, GPBW8144 (RCJJ, 1♀ with genital slide L. Kaila prep 6301 in MZH, http://id.luomus.fi/HV.357); 10♂, 3♀, 42°33'32'N, 2°16'36"E, Olette, 650m a.s.l., 17.vi.2017, leg. J. Junnilainen, GPBW7938, GPBW8142, GPBW8143, GPBW8148 (RCJJ); 1♂, 1♀, 40°49'N, 2°27'55"E, Perpignan Salsenes, 0 m a.s.l., 18.vi.2017, leg. J. Junnilainen (RCJJ); 1♂, 42°23'N, 2°00'E Osseja, Route Forestiere, 1850 m a.s.l., 29.vi.2003, leg. J. Junnilainen (RCJJ).



Figures 12–17. *Pyralis sagarrai* Leraut, stat. nov., habitus. **12.** ♂, France, Pyrenees or., Olette, leg. J. Junnilainen; **13.** ♀, France, Pyrenees or., Olette, leg. J. Junnilainen. **14–17.** *P. kacheticalis* (Christoph), habitus. **14.** ♂, Lebanon, Kesrouan, leg. J. Kullberg & T. Lievonen; **15.** ♀, Cyprus, Pafos district, leg. J. Junnilainen **16.** ♂, Ukraine, Zaporozhye region, leg. A. Zhakov; **17.** ♂, Greece, Lesvos, leg. J. Tyllinen.

Portugal. 1♂, 39°18'36"N, 7°21'43"W, Portalegre, Alto Alentejo, São Mamede, 8.vii.1973, leg. P. Grotenfelt, http://id.luomus.fi/HV.356 (MZH); 1♂, Trás-os-Montes, Serra da Coroa, Moimenta, 6.ix.2002, leg. M. Corley P6650; 1♂, Trás-os-Montes, Boticas, Beça, 23.ix.2003, leg. M. Corley P7106 (both RCMC).

Spain. 1♀, 40°95'12"N, 1°08'16"E, Aragon, Teruel, Olalle, 1300 m a.s.l., 24.vi.2017 leg. J. Junnilainen (RCJJ); 1♀, 39°52.56'N, 00°22.94'W, Prov. Valencia, Sierra d´Espadan, SE Almedjar, Mosquera, 600 m, 19.v.2004, leg. P. Huemer; 3♂, 7♀, Prov. Girona, Vidreras, 6.–15.vi.1993, leg. J. Wimmer; 1♂, 2♀, 42°09.23'N, 00°43.49'E, Prov. Lleida, Puente de Montanana, 670 m, 15.vii.2012, leg. P. Huemer & T. Mayr, BOLD sample ID: TLMF Lep 08576, BOLD sample ID: 08577 (all in TLMF).

Diagnosis. Distal area of the hindwing is distinctly pale without a purple tinge, and the hindwing in general is also somewhat paler than in *P. regalis*. In *P. kacheticalis* only the basal third of the hindwing is pale. The phallus is similarly coarsely granulose as in *P. regalis* and the externally quite different *P. perversalis*, the vesica of which is devoid of a cornutus. There is a distinctive spine-like cornutus in the vesica of *P. sagarrai*, *P. kacheticalis* and *P. cardinalis*, and a minute one in *P. regalis*; it is considerably smaller in *P. sagarrai* than in *P. kacheticalis* and *P. cardinalis*, and basally distinctly formed as a fusion of smaller spines, while the cornutus is entirely smooth in the other species; in *P. cardinalis* there is another, smaller and curved cornutus as well. The caecum of the phallus is wider, and joined with an obtuse angle to the distal part of phallus, which is a diagnostic difference with *P. regalis*. This difference, however, is easily hidden depending on the position of the phallus. The female of *P. sagarrai* seems to be readily differentiated from *P. regalis* as having a long and evenly widening ductus bursae that joins the corpus bursae without limit. Together with the diagnostic external characters, the differences in the female genitalia and the significant difference in the barcodes we consider this taxon to merit status of a valid species even though the female genital differences are not firmly established. The separation of this species from *P. princeps* and *P. joannisi* is explained in the key.

Molecular data. BIN: BOLD:ADS1090. The intraspecific mean divergence of the barcode region is 0.18% and the maximum divergence 0.31% ($N = 3$). The minimum distance to the nearest neighbour, *P. regalis*, is 3.96%.

Distribution. France, Portugal, Spain.

Pyralis kacheticalis (Christoph, 1893)

Figs 14–17, 25, 32, 34, 35

Asopia kacheticalis Christoph, 1893: 96.
Pyralis imperialis Caradja, 1916: 17; synonymized by Leraut 2005: 78.

Material examined. Type material. ***Lectotype*** (*Asopia kacheticalis*), here designated, labelled: [blue round label]; M T[??] Eldar; Kol. Vel. Kn. Nikolaja Mihakhailovidza; *Pyralis kacheticalis* (Christoph, 1893); Syntypus; in underside of one label: 25–7–86 [and something illegible] Kacheticalis (ZISP). [See remarks]. Photograph of ***lectotype*** of *Pyralis imperialis*, with labels: Amasia; *imperialis* Caradja; ***lectotype*** *Pyralis imperialis* DES ♀ Car. Dr. A Popescu-Gorj (MGAB). Photograph of a specimen labelled as ***paralectotype*** of *P. imperialis* with record made by Mihai Stănescu: "Owner: Muzeul National de Istorie Naturală "Grigore Antipa" – Bucuresti. Domain: Stiintele naturii; accession number 177830; Type. Pyralis imperialis. Subtype *Pyralis imperialis* (Caradja, 1916), Dimensions: AA=21 mm; Discovery area. Amasia, Turcia; Listing order 2043/27.01.2011 – Tezaur." (MGAB).

Other material. Azerbaijan. 3♂, 1♀, 41°15'15"N, 47°02'44"E, Greater Caucasus Mts., 350 m, 15 km NW Sheki, 3.vi.2019, leg. K. Nupponen & R. Haverinen; 1♂, Caspian Sea shore, 41°22'22"N, 49°03'08"E, -36 m, Chaygaragasly, 5.vi.2019, leg. K. Nupponen & R. Haverinen (all RCKN).

Cyprus. 2♂, Moniatis N. Limassol, 850 m, 23.–29.vi.1997, leg. D. Nilsson, A. Madsen, M. Fibiger & P. Svendsen (ZMUC); 1♂, Fasouri, 15 km W. Limassol, 5 m, 25.vi.1997, leg. P. Svendsen, D. Nilsson & M. Fibiger (ZMUC); 1♀, N. Limassol, Platres, 1150 m, 6.viii.1985, leg. P. Svendsen (ZMUC); 3♂, 34.735, 32.592, Pafos distr., Nikokleva, 100 m.a.s.l., 34.735, 32.592, 21.v.2017, leg. J. Junnilainen (RCJJ); 2♂, 34.826, 33.285, Larnaka district, Vavla, 472 m.a.s.l., 28.v.2017, leg. J. Junnilainen (RCJJ).

Greece. 1♂, 39°09’82’’N, 26°18’00’’E, Lesvos, 6.V.2007 exp. MZH, leg. L. Kaila & J. Kullberg, L. Kaila prep. 6188, BOLD sample ID: TLMF Lep 05742 (MZH); 1♂, 39°19’05’’N, 26°09’17’’E, Lesvos, 6.vi.2014, leg. J. Tyllinen, GPBW7942 (RCJT).

Lebanon. 2♂, 34°10’29’’N, 35°15’25’’E, 1530 m, Batroun, Tannourine al Fawca, Bala’a, 23.viii.2010 leg. J. & A. Kullberg , L. Kaila prep. 6187, BOLD sample ID: TLMF Lep 05671, http://id.luomus.fi/HV.363, http://id.luomus.fi/HV.367 (MZH); 2♀, 34°00’04’’N, 35°45’04’’E, Kesrouane, 940 m, Mt. Jebel Musa, Mar Geryes, open forest, 28.viii.2010, leg. J. & A. Kullberg, BOLD sample ID: TLMF Lep 05672, BOLD sample ID: TLMF Lep 05745, http://id.luomus.fi/HV.362, http://id.luomus.fi/HV.366 (MZH); 1♂, 34°3’25.63’’N, 35°43’2.28’’E, Kesrouan, 850 m, Ghbele, 5.–6.vi.2012 leg. J. Kullberg & T. Lievonen, http://id.luomus.fi/GK.8123 (MZH); 1♂, 33°43’57’’N, 35°47’15’’E, Beqaa, 860 m, Aammique marshes nr. Ketraya, 2.ix.2010, leg. J. & A. Kullberg, http://id.luomus.fi/HV.364 (MZH); 1♂, 33°43’31’’N, 35°41’29’’E, Choul, 175 m, Baruq Mts., 31.viii.2010, leg. J. & A. Kullberg, http://id.luomus.fi/HV.365 (MZH).

Turkey. 1♂, Prov. Kayseri, Incesu, 1100 m, 14.–vi.1996, leg. F. Schepler, 1♂, 28.vii.1996, leg. K.E. Stovgaard (ZMUC); 2 spec., 5 km E Ürgüp ,3.ix.1997, leg. K. Nupponen & J. Junnilainen, GPBW8145 (RCJJ).

Ukraine. 18♂, 2♀ Zaporozhye region, Melitopol district, with Danilo-Ivanivka, 2.–7.viii.2019, leg. Kovalyov & A. Zhakov (RCBW); 1 spec., Zaporoshye region, Yakimov district with Radivonovka, 2.viii.2019, leg. Kovalyov (RCBW); 1 spec., Hersonskaja Obl. 03 oz, Sivasho Kyhjuk-Tuk, 11.viii.1999, leg. A. Zhakov (RCBW); 1♂, 3♀, Zap. Obl. Melitopol region, Danilo-Ivanovka, r. Tashenak, leg. Kovalev, 1.v.–6.viii.2019, leg. Kovalev (RCBW.); 1♂, Donetsk region, Lyman nr. Torsko, 20.–23.vi.2019, leg. A. Zhakov (RCBW).

Diagnosis. *Pyralis kacheticalis* differs from other related species apart from *P. sagarrai* by the pale hindwings, and the shape of the white fascia on the forewing being very narrow, straight and extended to the costal margin. The male genitalia are close to those of *P. sagarrai* from which they are distinguished by the shape of the cornutus: it is entirely smooth in *P. kacheticalis*, basally wide and formed as fusion of coarse spines in *P. sagarrai*. The female genitalia of these species seem to be identifiable with some reservations (see key), but may be indistinguishable from *P. regalis.* The separation of this species from *P. princeps* and *P. joannisi* is explained in the key.

Molecular data. BIN: BOLD:ABA8506, BOLD:ABA9291. Genetically variable species clustering into two BINs and a third distinct cluster presently lacking the BIN assignment. The intraspecific mean divergence of the barcode region is 2.18% and the maximum divergence 3.67% ($N = 9$). The minimum distance to the nearest neighbour, *P. sagarrai*, is 5.5%.

Distribution. Azerbaijan, Cyprus, Greece, Iran, Lebanon, Syria, Ukraine, Turkey.

Remarks. In the original description of *P. kacheticalis* it is indicated that the number of specimens on which the species is described is more than one, so no holotype exists. We herewith designate a lectotype for the taxon (Fig. 34) in order to fix the identity of the species and conserve nomenclatural stability. *Pyralis imperialis* Caradja was originally described based on two specimens. Although Popescu-Gorj (1991) designated a lectotype for this taxon, the specimen (Fig. 35) does not differ in any way from *P. kacheticalis*. We therefore follow Leraut (2005) in regarding *P. imperialis* with *P. kacheticalis* as synonyms.

Specimens from Cyprus, Lebanon and Ukraine/Greece form three distinct barcode clusters. Externally, there is some variation between specimens, but the variation observed in, e.g., the shape of median area of hindwing, seems not to correlate with barcode clusters. Also, the genitalia are identical among all specimens that we have examined. We refrain from making taxonomic conclusions due to the paucity of material at our disposal, and with evidence from barcodes alone.

An endemic population, externally closest to *P. kacheticalis* that occurs in Crete, seems to form its own entity, possibly deserving species status. This note is based on an unpublished barcode that deviates strongly from others, as well as external features (genitalia not studied). Due to the paucity of material we exclude this taxon from the present contribution.

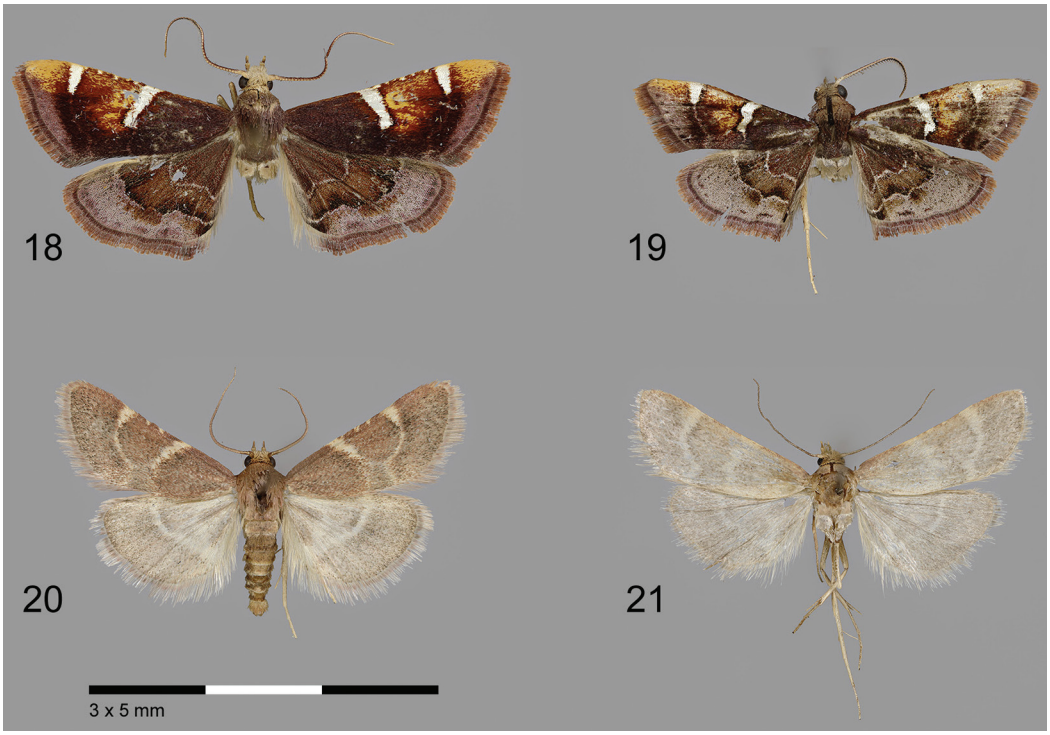
Pyralis princeps Butler, 1889

Figs 18, 26

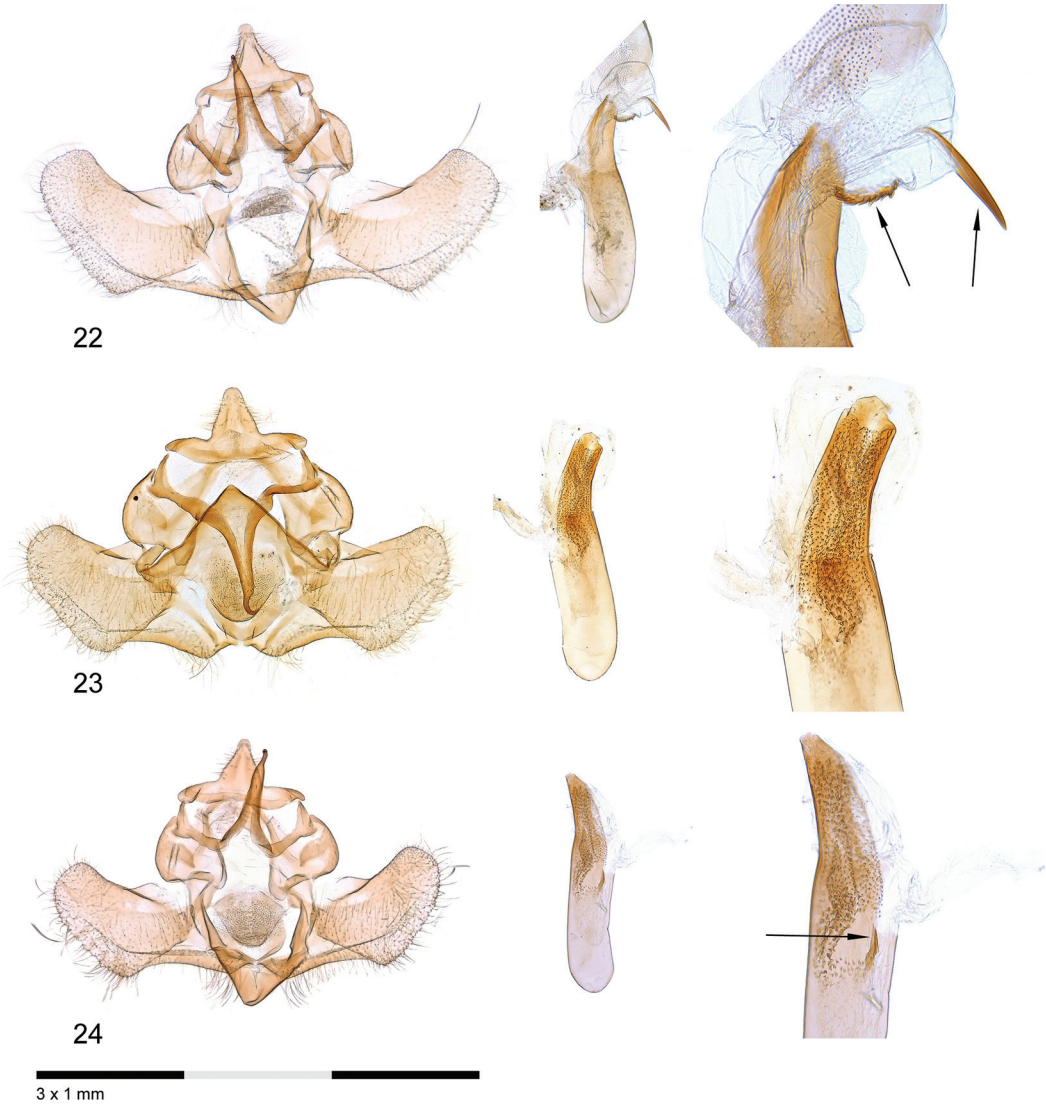
Pyralis princeps Butler, 1889(7): 91, pl. 134, fig. 12.

Material examined. Type material. ***Lectotype***, here designated: India, Dharamshala, Photograph of ***lectotype*** of *Pyralis princeps* made available by David Lees, labelled: LECTO-TYPE [blue round label]; MANUSCRIPT LECTOTYPE; Type locality India Dharmsala; Lectotype *Pyralis princeps* det. M. Shaffer 1985[]; stat. n. [abdomen in capsule] (NHMUK).

Other material. Nepal. 2♂, 27°40'N, 85°25'E, Godavari, 15 km SE Kathmandu, 1500 m, 8.–9.v. 1996 leg. Exp. A. Albrecht, O. Biström, K. Mikkola & A. Wikberg, L. Kaila prep. 6296, BOLD sample ID: TLMF Lep 05678, BOLD sample ID: TLMF Lep 05679, http://id.luomus.fi/HV.369 (MZH).



Figures 18–21. *Pyralis* spp., habitus. **18.** *P. princeps* Butler, ♂; Nepal, Godawari nr. Kathmandu, leg. exp. Albrecht et al. **19.** *P. joannisi* Leraut, ♂; Vietnam, Bac Kan province, leg. A. Wikström. **20, 21.** *P. perversalis* (Herrich-Schäffer), habitus. **20.** ♂, Czech Republic, Bohemia sept., leg. J. Liška; **21.** ♀, S. Ural, Cheliabinsk district, leg. T. Nupponen.



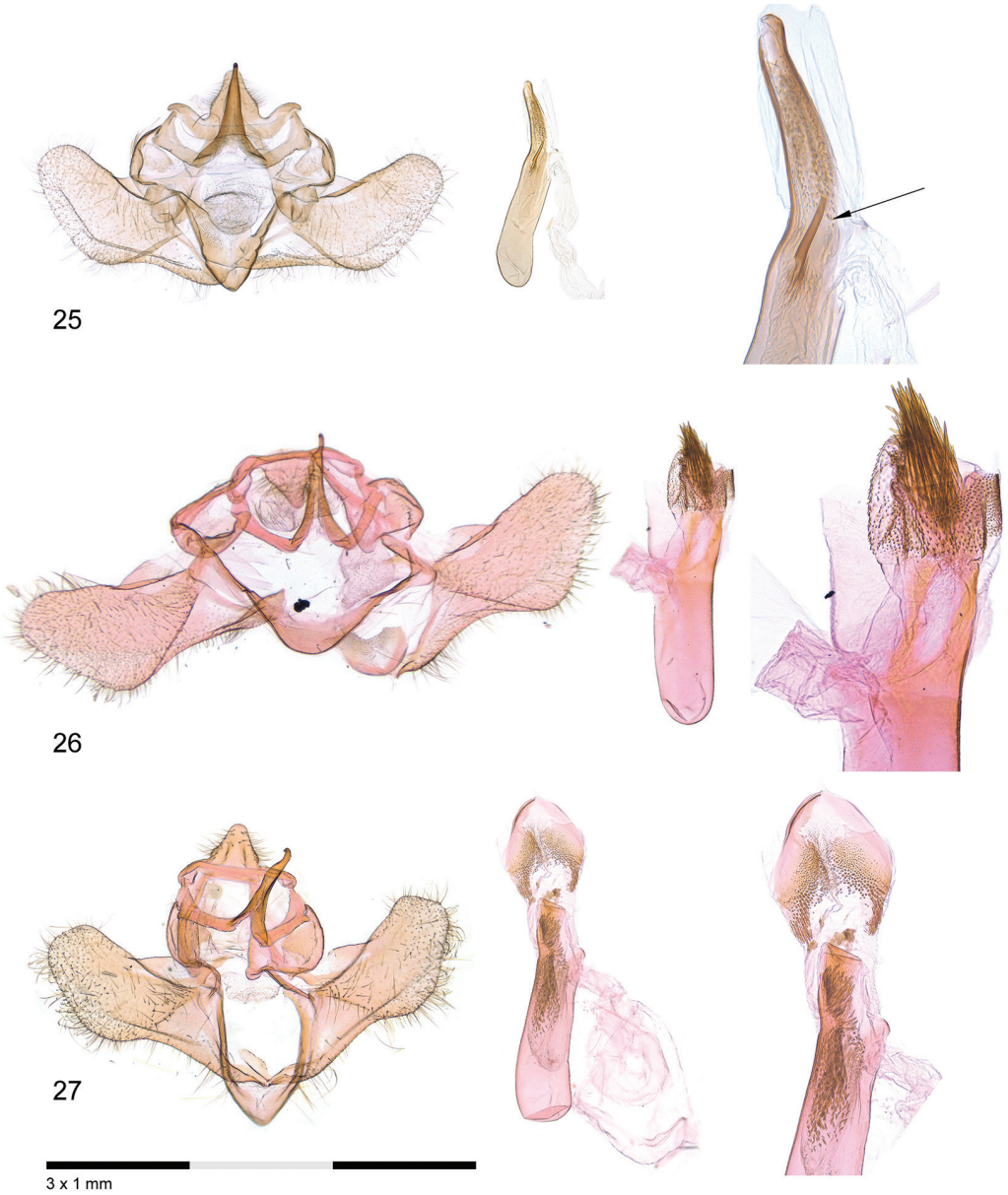
Figures 22–24. ♂ genitalia of *Pyralis* spp. **22.** *P. cardinalis* sp. nov., GPBW7913, Belgorod oblast, Makeshino Stenki. **23.** *P. regalis* ([Denis & Schiffermüller]), GPBW7908, France, Corse, Patrimonio. **24.** *P. sagarrai* Leraut, GPBW8148, France, Pyrenees or., Olette.

Diagnosis. The separation of this species from other species is explained in the key. In the genitalia, the dense bush of long spines at the posterior end of vesica is characteristic, and the genital characters readily separate it from the externally similar but smaller *P. joannisi*; see the key for further details.

Molecular data. BIN: BOLD:ABA8505. The intraspecific mean and maximum divergence of the barcode region is 0% ($N = 2$). The minimum distance to the nearest neighbour, *P. kacheticalis*, is 8.26%.

Distribution. India, Nepal.

Remarks. *Pyralis princeps* was described from four specimens collected in India (Himachal Pradesh, Dharamshala [Dharmsala]) and two from "Yezo" [region from Northern Japan to Kam-



Figures 25–27. ♂ genitalia of *Pyralis* spp. **25.** *P. kacheticalis* (Christoph), GPBW7942, Greece, Lesvos, Anaxos. **26.** *P. princeps* Butler, L. Kaila prep. 6296, Nepal, Godawari, **27.** *P. joannisi* Leraut, L. Kaila prep. 6297, Vietnam, Bac Kan Prov.

chatka] (Butler, 1889). However, the latter two are misidentifications of *P. cardinalis*, this interpretation also supported by our examination of some Japanese and South Korean specimens. Following ICZN (1999), a lectotype from Dharamshala [Dharmsala], already labelled as such by M. Shaffer in NHMUK, is here designated in order to fix the identity of the species and conserve nomenclatural stability.We have examined photographs of the specimen and its labels which confirm

Figure 28. ♂ genitalia of *P. perversalis* (Herrich-Schäffer), GPBW8402, Czech Republic; Bohemia sept.

our interpretation. Outside Europe, the name *P. princeps* Butler has been somewhat inconsistently used for the East Palearctic populations. E.g. Shibuya (1928), in his treatment of Japanese species of *Pyralis* and related genera, only recognized *P. regalis* of the relevant taxa to occur there. Inoue *et al.* (1982), plate 46: Figs 4, 5 illustrated Japanese specimens that seem identical to *P. cardinalis* and whose occurrence in Japan is verified in the present study. Neither of these authors mention other species, but they consider *P. princeps* a synonym of *P. regalis*.

Pyralis joannisi Leraut, 2005

Figs 19, 27

Pyralis joannisi Leraut, 2005: 80

Material examined. Vietnam. 1♂, Bac Kan Prov., Cho Don distr., 300 m, mixed tropical bushland/forest, 19.iii.1993 leg. A. Wikström, L. Kaila prep. 6297 (MZH).

Diagnosis. The separation of this species from others is explained in the key.

Molecular data. Unavailable.

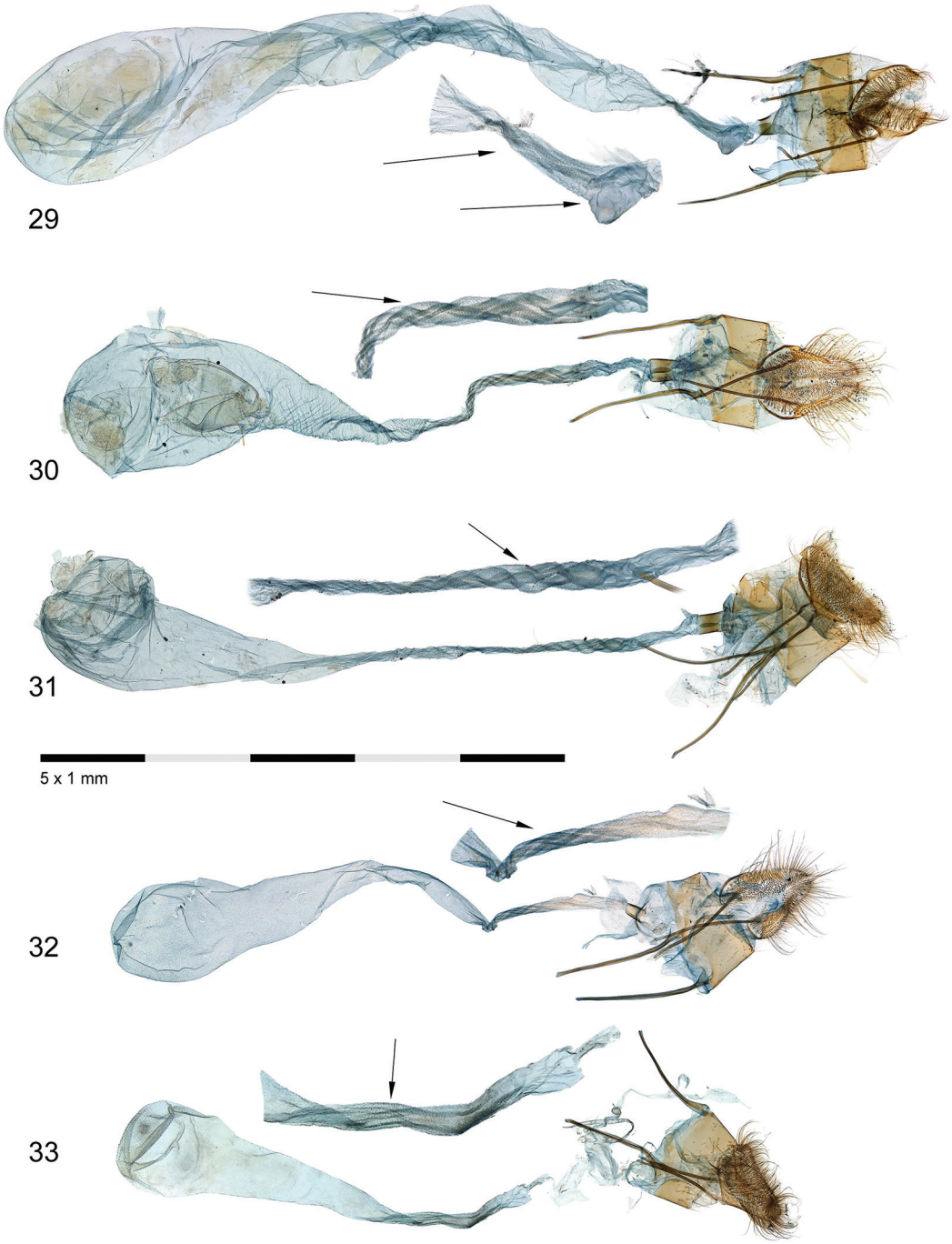
Distribution. Vietnam.

Remarks. We have seen in ZMUC single specimens of further SE Asian taxa close to species included in this paper, which appear to be currently unnamed. We refrain from treating them more closely due to the paucity of material available.

Pyralis perversalis (Herrich-Schäffer, 1849)

Figs 20, 21, 28, 33

Asopia perversalis Herrich-Schäffer, 1849: 123



Figures 29–33. ♀ genitalia of *Pyralis* spp. **29.** *P. cardinalis*, GPBW7939, Belgorod obl., Borisovka.; **30.** *P. regalis*, GPBW7941, Slovenia, Granska Gora. **31.** *P. sagarrai*, GPBW8151, France, Pyrenees or., Olette. **32.** *P. kacheticalis* (Christoph), L. Kaila prep. 6305, Lebanon, Koura. **33.** *P. perversalis* (Herrich-Schäffer), GPBW8403, S. Ural, Cheliabinsk oblast.

Figure 34. *Pyralis kacheticalis*, lectotype, ♂, habitus and labels. Letters **a** and **b** denote upperside (**a**) and underside (**b**) of the same label.

Figure 35. *Pyralis imperialis* Caradja, lectotype, ♂, habitus and labels.

Material examined. Czech Republic. 3♂, Bohemia sept., Ceske Stfedoholi Bivany-Pisecny v, 20.vii.1994, leg. J. Liška & B. Wikström, GPBW8402, (RCJL); 1♂, same collection data, BOLD sample ID: MM26361l. (RCJJ).

Russia. 1♀, S. Ural, Cheliabinsk oblast, 15 km S. Kizilskoye nr. Ural River, 26.vii.2000 leg. T. Nupponen; GPBW8403 (RCKN).

Ukraine. 1♂, Hersonskaja oblast, oz Sivash o. Kujuk-Tuk, 13.viii.1999, leg. A. Zhakov (RCBW); 1♂, Zapovednik oblast Melitop region nr. Danilo-Ivanovka, Tashenak, 16.viii.1999, leg. I. V. Kovalev (RCBW).

Diagnosis. Externally *P. perversalis* differs from other species treated here by the forewing colour which is pale greyish brown with pale yellowish grey markings. The male genitalia are as those of *P. regalis.* The female genitalia resemble those of *P. cardinalis* in being devoid of the braid-shaped ductus bursae. Unlike *P. cardinalis*, the inception of the ductus seminalis is not broadened or sclerotized; posterior quarter of the ductus bursae is not narrow posteriorly.

Molecular data. BIN: BOLD:AAX9987. The analyzed specimens show no intraspecific variability in the DNA barcode region ($N = 2$). The minimum distance to the nearest neighbour, *P. kacheticalis*, is 6.57%.

Distribution. Czech Republic, Hungary, Romania, Russia (European part to S. Urals), Ukraine, Slovakia (Nuss et al. 2004–2020), Central Asia and Mongolia (Slamka 2006).

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