

Review of the genus *Rhingia* SCOPOLI, 1763 (Diptera: Syrphidae) in Poland

Robert ŻÓRALSKI^{id}, Anna KŁASA^{id}, Łukasz MIELCZAREK^{id}

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Abstract. Data on the morphology, biology and distribution of three species of the genus *Rhingia* SCOPOLI occurring in Poland are presented. Specimens from this genus deposited in Polish museums and private collections are evaluated. A key to the species *Rhingia borealis*, *R. campestris* and *R. rostrata* is given, along with unpublished photographs of males and females and their terminalia.

Key words: hoverflies, faunistics, distribution in Poland, identification key.

✉ Robert ŻÓRALSKI, Norwida 9, 84-240 Reda, Poland.

E-mail: robert@insects.pl

Anna KŁASA, 32-047 Ojców 66, Poland.

E-mail: anna_klasa@wp.pl

Łukasz MIELCZAREK, Zarząd Zieleni Miejskiej w Krakowie, Reymonta 20, 30-059 Kraków, Poland.

E-mail: lukasz@insects.pl

I. INTRODUCTION

Hoverflies from the genus *Rhingia* (Diptera, Syrphidae) occur in all zoogeographic regions, apart from Australasia and the Antarctic (SSYMANK *et al.* 2021). To date, 37 species from this genus have been described, three of which occur in Europe: *R. borealis* RINGDAHL, 1928, *R. campestris* MEIGEN, 1822 and *R. rostrata* (LINNAEUS, 1758), all of which are present in Poland. They are medium-sized hoverflies (7-10 mm), with a distinctive long ‘snout’ (mala) and, at least in the European species, an oval, orange or red abdomen. The mala houses and protects its exceptionally long proboscis, a mouthpart that is adapted in flies for sucking. When extended, the proboscis can be almost as long as the whole insect (Fig. 1D), and gives access to the nectar of flowers with deep-lying nectaries. The *Rhingia* species visit flowers from various families, e.g. *Lamiaceae*,

Brassicaceae, *Caryophyllaceae* and *Scrophulariaceae* (RÖDER 1990). Data relating to the *Rhingia* species in Poland has been published in a great many papers mentioned in this review, and the relevant taxa have been placed on two national species lists (SOSZYŃSKI 1991, 2007). The *Rhingia* species have been reported as occurring in a number of physico-geographical regions in Poland, e.g. Nida Valley, Sudety Mts., Bieszczady Mts., Pieniny Mts. and the Białowieża Primeval Forest (BAŃKOWSKA 1961, 1964, 1971, 1976, 1995). A key to the identification of Polish Syrphidae was compiled by BAŃKOWSKA (1963). *Rhingia* species are rather difficult to identify, owing to the variable colouration of their abdomen and legs. Females of *R. rostrata* and *R. borealis* are especially likely to be confused (VAN STEENIS 1998). The present work presents data on the *Rhingia* species in Poland on the basis of several private Pol-

ish collections and those accessible in Polish museums, supplemented by new information on their morphology and biology. In addition, earlier misidentifications of species have been rectified.

II. MATERIALS AND METHODS

This study of the genus *Rhingia* in Poland is based on an analysis of voucher specimens deposited in the institutional and private collections listed below. Information passed on by Jan Krzysztof KOWALCZYK and the late Bogusław SOSZYŃSKI from their personal records has been also taken into account in this section and in the analyses.

Collections:

ASPC – Andrzej Szlachetka Private Collection
 ATPC – Adam Tofilski Private Collection
 CBPC – Cezary Bystrowski Private Collection
 ISEZ PAN – Institute of Systematics and Evolution, Polish Academy of Sciences (PAN), Kraków
 LMPC – Łukasz Mielczarek Private Collection
 MIZ – Museum of the Institute of Zoology, Polish Academy of Sciences (PAN), Warszawa
 MNHW – Museum of Natural History Wrocław University, Wrocław
 MNHL – Natural History Museum University of Łódź, Łódź
 ONP – Ojców National Park, Ojców
 RZPC – Robert Żóralski Private Collection
 USMB – Upper Silesian Museum, Bytom
 WNP – Wigry National Park, Krzywe
 ZMPC – Zbigniew Mocarski Private Collection.

This analysis covers material and data relating to 952 hoverfly specimens of the genus *Rhingia* originating from Poland. All of these records are listed below in the ‘Material Examined’ sections.

The material has been classified (with slight modifications) in accordance with the division of Poland into physiographic regions, as given by TYKARSKI (2011), which in turn is based on the regionalisation of Poland by KONDRACKI (2002) that is commonly in use in entomology and zoogeography. The records of the individual species have been grouped chronologically and their localities placed in 10×10 km squares in the UTM (Universal Transverse Mercator) coordinate system. The only deviations from this rule are those localities where material was

obtained on many occasions; in these cases, all the dates are given in chronological order by the designation of the locality. The Mapa UTM ver. 5.1 program (GIERLASIŃSKI 2025) was used to generate the distribution maps.

For the visualisation purposes in this paper, microscope slides were produced based on some representative specimens. The terminalia (genitalia) and other body parts were macerated in cold 10% KOH (potassium hydroxide) for 24 h, then rinsed in distilled water. Spermathecae were additionally stained in chlorazol black and rinsed in distilled water. All the preparations were mounted using Marc André fluid, made according to the instructions after CHRISTIANSEN (1990). Slides were prepared from the following materials: *R. borealis* ♂ and ♀: Bieszczady, 27 V 2014, leg. R. Żóralski; *R. rostrata* ♂ and ♀: Kraków-Las Mogilski, ♂: 24 IV 2014, ♀: 6 V 2014, leg. Ł. Mielczarek; *R. campestris* ♂ and ♀: Ojców, ♂: 19 VI 1997, ♀: 16 VI 1997, leg. A. Klasa, coll. ONP.

The descriptions and morphological references use the terminology given by VAN STEENIS et al. (2023). The phrase ‘spermathecal bulbs’ comes from the publication by THEODOR (1983).

Acronyms used for the collectors are as follows: AK – Anna Klasa, AS – Andrzej Szlachetka, AT – Adam Tofilski, CB – Cezary Bystrowski, JKK – Jan Krzysztof Kowalczyk, LM – Łukasz Mielczarek, RB – Regina Bańkowska, RZ – Robert Żóralski, SB – Sabina Bał, ZM – Zbigniew Mocarski.

III. REVIEW OF RHINGIA SPECIES IN POLAND

Genus: *Rhingia* SCOPOLI, 1763

Diagnosis. The lower part of the head of these medium-sized flies (7–10 mm) is extended into a characteristic long ‘snout’ (mala). The oval abdomen of European species is coloured orange or red, sometimes with black vittae and fascia. The structure of the male terminalia of the *Rhingia* species is quite complex, with the postgonites partially modified into comb-like hooks (Fig. 5M, N, O). This characteristic is also found in other genera within the tribe Rhingiini, such as *Psarus* LATREILLE, 1804, *Pelecocera* MEIGEN, 1822 (GLUMAC 1960) and in a few monotypic hoverfly genera in the Palaearctic, e.g. *Ischyroptera* POKORNY, 1887, *Katara* VUJIĆ & RADENKOVIĆ, 2018, *Portevinia* GOFFE, 1944 and

Psarochilosia STACKELBERG, 1952 (VUJIĆ et al. 2019; VAN STEENIS et al. 2025).

The structure of the spermathecae in *Rhingia* resembles that found in all other Syrphidae (MIRANDA & MORAN 2017). Two long ducts emerge from the genital chamber, one of which bifurcates. The spermathecal ducts are intertwined and lead to three spermathecal bulbs. Similar to one another, these are slightly larger than the spherical cercus, which is ca 300 µm in diameter, strongly sclerotised and has weakly granulated walls. This sculpture is visible under high magnification only. The spermathecal ducts are not sclerotised, and have a wavy structure and thick walls, which are indicative of their function of pumping sperm into the spermathecae (although the ducts lack transverse striations). Two accessory glands are of a delicate build, membranous and not sclerotised.

Comment. The structures of the abdomen and genitalia of females in Syrphidae have been rarely studied and the literature is sparse (NAYAR 1965; SHATALKIN 1981; BORISOVA 1980, 1982, 1983, 1984; HIPPA 1986; JILONG & ZHIHUA 1992; MIRANDA & MORAN 2017). It is worth noting that MIRANDA and MORAN (2017) visualised and described, among other species, the abdomen and genitalia of a female *Rhingia nigra* MACQUART, 1846, occurring in the Neotropical region; however, regarding spermatheca they only mentioned that it is globular. The spermathecae in Syrphidae are very poorly known, since they were usually not considered to be of any diagnostic importance (THOMPSON & ROTHERAY 1998: 84: ‘Three spermathecae present, small, apparently of little taxonomic significance, but so far not well investigated.’), in contrary to some other Diptera families (YEATES 1994; THEODOR 1976, 1983). However, in the genus *Milesia*, they were recognised as taxonomically significant (HIPPA 1990).

Rhingia borealis RINGDAHL, 1928

(Fig. 1A, 1B, 2A, 2B, 3, 4A, 5A, 5D, 5G, 5J, 5M, 6A, 6C, 6F)

Rhingia austriaca MEIGEN, 1830: KOWALCZYK et al. 1996

Rhingia rostrata: BAŃKOWSKA 1964 (misidentification); BAŃKOWSKA 1971 (misidentification); KLASA et al. 2000 (misidentification)

Material examined: 121 specimens (68 ♂♂, 53 ♀♀): **Eastern Lakelands (Pojezierza Wschodnie):** Augustów Forest: Starożyn nature reserve [FE57], 28 V 1978, 1 ♀, leg. BS; **Podlasie:**

Białowieża Forest: Białowieża [FD85], 14 VI 1989, 1 ♀, leg. BS, coll. RZPC; **Małopolska Upland (Wyżyna Małopolska):** Świętokrzyskie Mountains: Huta Szklana [EB03], 1 VI 1984, 1 ♂, leg. JKK, coll. MNHL (ŻÓRALSKI et al. 2017); **Sudety Mts. (Sudety):** no date, 1 ♂, coll. MNHW, ex coll. Scholz; Śnieżnik Mtn. [XR36], 17 VII 1956, 2 ♀♀, leg. A. Riedel, coll. MIZ (BAŃKOWSKA 1964, *R. rostrata*); Karpacz, Jelenia Góra district [WS52], 8 VII 1980, 1 ♀, leg. T. Zatwarnicki, coll. USMB; **Beskid Mts. and Foothills (Beskidy i Pogórza):** Rytro [DV77], 7 VII 1976, 1 ♀, leg. M. Wanat, coll. RZPC; Młodów [DV77], 11 VII 1976, 2 ♀♀, leg. M. Wanat, coll. RZPC; Krynica [DV97], 4 VI 1977, 1 ♀, 6 VI 1977, 1 ♀, leg. BS, coll. RZPC; Babia Góra: Górny Płaj [CV99], 12 VI 1997, 1 ♂, 30 V 1998, 1 ♂, leg. AK, coll. RZPC (PALACZYK & KLASA 2003); Powroźnik [DV96], 22 V 2010, 1 ♂, leg. K. Ruszkiewicz, coll. LMPC, 22 V 2010, 1 ♀, leg. LM, coll. LMPC; Krynica: Czarny Potok [DV97], 22 V 2010, 1 ♂, leg. LM, coll. LMPC; Gorce Mts.: Turbacz [DV38], 8 VII 2015, 1 ♀, leg. LM, coll. LMPC. **Orawa-Podhale (Obszar Orawsko-Podhalański):** Zakopane: Księży Las [DV25], 18 VI 1995, 1 ♂, leg. JKK (KOWALCZYK et al. 1996); **Eastern Carpathians (Karpaty Wschodnie):** Bieszczady: Ustrzyki Górne [FV23], 11-18 VI 1966, 1 ♀, leg. SB, coll. MIZ (BAŃKOWSKA 1971, as *R. rostrata*); Bereżki [FV24], 25 VIII 1968, 4 ♀♀, 14 VI 1970, 2 ♂♂, 2 ♀♀, leg. RB, coll. MIZ (BAŃKOWSKA 1971, as *R. rostrata*), 26 V 2014, 3 ♂♂, 3 ♀♀, 27 V 2014, 5 ♂♂, 29 V 2014, 1 ♂ (Fig. 1A, B), 1 ♀ (Fig. 2A, B), leg. RZ, coll. RZPC, 26 V 2014, 2 ♀♀, leg. LM, coll. LMPC, 27 V 2014, 2 ♂♂, 1 ♀, 29 V 2014, 1 ♀, leg. AS, coll. ASPC; Terebowiec Valley [FV23], 10 VII 1969, 1 ♀, leg. BS, coll. RZPC; Bukowe Berdo [FV24], 17 VII 1969, 1 ♀, leg. BS, coll. RZPC; Szeroki Wierch [FV23], 6 VIII 1970, 2 ♀♀, leg. J. Wojnarowicz, coll. MIZ (BAŃKOWSKA 1971, as *R. rostrata*); Pszczeliny [FV24], 20 VIII 1971, 1 ♀, leg. BS, coll. RZPC; Suche Rzeki [FV15], 12 VII 1974, 1 ♀, 15 VII 1974, 1 ♀, leg. BS, coll. RZPC, 27-31 V 2013, 7 ♂♂, 1 ♀, leg. ZM, coll. ZMPC, 28-29 V 2013, 4 ♂♂, 2 ♀♀, leg. & coll. AT, 29 V 2013, 9 ♂♂, 2 ♀♀, leg. AS, coll. ASPC, 29 V 2013, 9 ♂♂, 2 ♀♀, leg. BS, coll. RZPC, 24-29 V 2015, 1 ♂, 1 ♀, leg. LM, coll. LMPC, 28 V 2015, 2 ♂♂, leg. RZ, coll. RZPC; Wołosate [FV23], 11 VIII 1975, 1 ♀, 12 VIII 1975, 2 ♀♀, leg. BS, coll. RZPC, 5 VI 1999, 1 ♀, leg. R. Dobosz, coll. USMB, 27 V 2014, 1 ♂, 1 ♀,

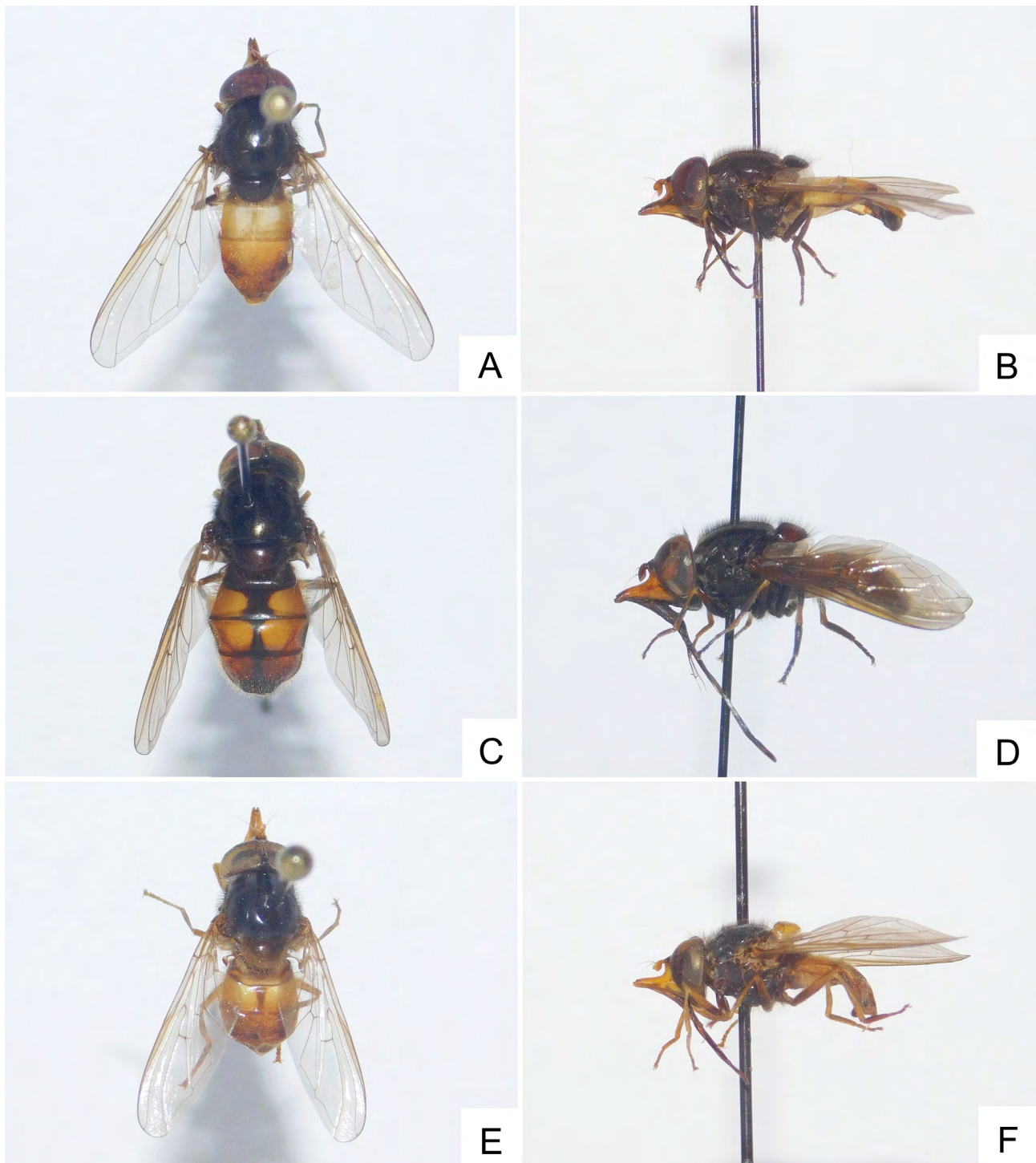


Fig. 1. Male, general appearance. A, B – *Rhingia borealis* (Poland, Bereżki in the Bieszczady Mts.); C, D – *R. campestris* (Poland, Malinowo near Działdowo); E, F – *R. rostrata* (Poland, Zakopane).

leg. A. Witek, coll. LMPC, 28 V 2014, 2 ♂♂, 2 ♀♀, leg. RZ, coll. RZPC; Zatwarnica [FV15], 25 V 2013, 8 ♂♂, 1 ♀, leg. RZ, coll. RZPC, 26 V 2013, 3 ♂♂, leg. & coll AT; Rozsypaniec [FV23], 27 V 2014, 1 ♂, leg. LM, coll. LMPC; Moczarnie [FV14], 26 V 2015, 1 ♂, leg. AK, coll. ONP; Wołosatka Valley [FV23],

29 V 2015, 1 ♀, leg. AK, coll. ONP; **Tatra Mts. (Tatry):** Strążyska Valley [DV25], 11 VIII 1995, 1 ♀, leg. JKK; Kościeliska Valley, Glade Smytnia [DV15], 17 VI 2014, 1 ♀, leg. AK, coll. ISEZ.

Description. The smallest European species: 6-9 mm. The general appearance of the male is as in

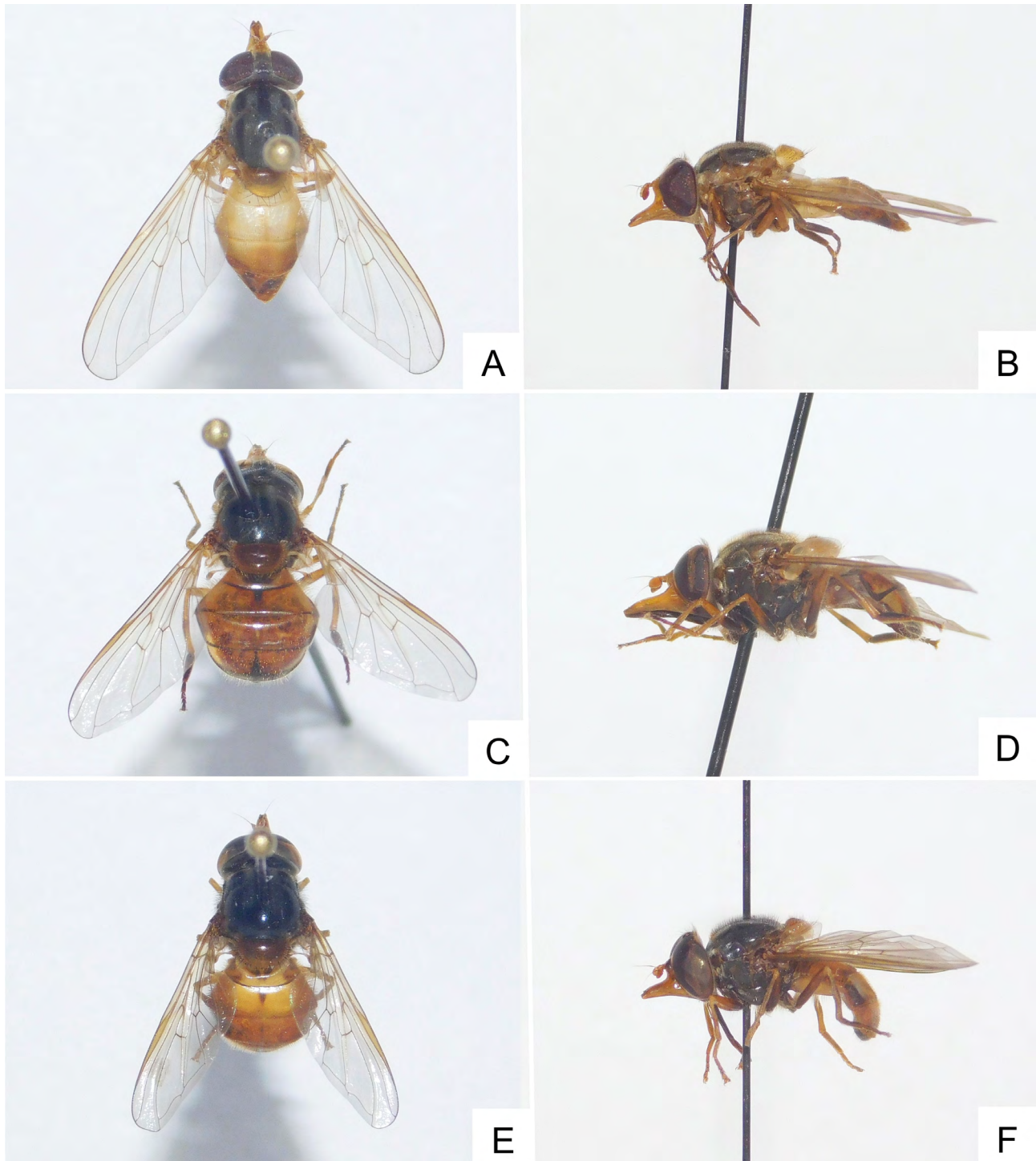


Fig. 2. Female, general appearance. A, B – *Rhingia borealis* (Poland, Bereżki in the Bieszczady Mts.); C, D – *R. campestris* (Poland, Reda-Pieleszewo); E, F – *R. rostrata* (Poland, Duszniki-Zdrój).

Fig. 1A, B, while that of the female as in Fig. 2A, B. The long pile on the arista readily distinguishes this species from the others (Fig. 3). In the other two species occurring in Poland, the lengths of the pile do not exceed $\frac{1}{2}$ of the broadest diameter of the arista. The aristal pile in *R. borealis* appears to be longer

in females than in males (VAN DE MEUTER 2011). The femora of all the legs in *borealis* males are completely black (Fig. 1B), though distally they may be brown. The inner surfaces of the profemora in both males and females bear patches of setulae (Fig. 6A), similarly to that in the tribe Eristalini.



Fig. 3. *Rhingia borealis*, male, antennal aristae.

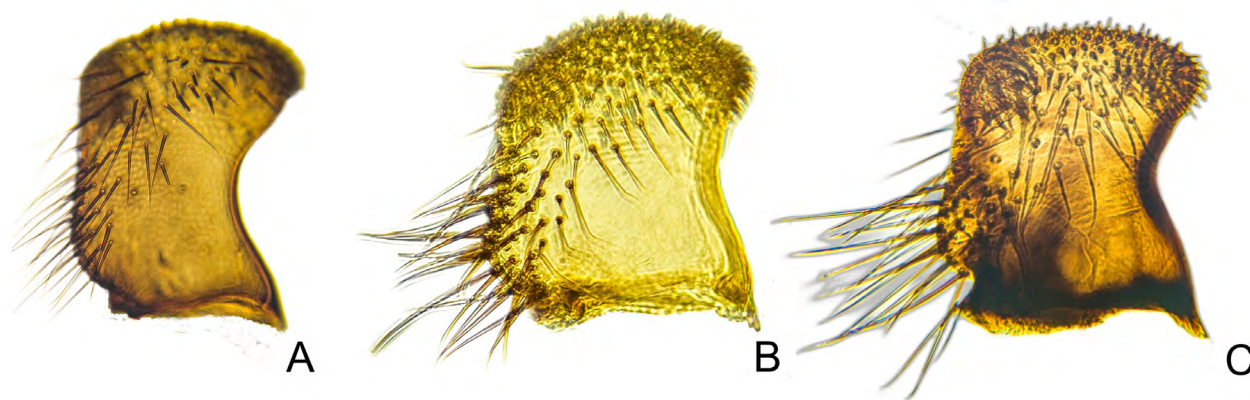


Fig. 4. Male terminalia, surstylus. A – *Rhingia borealis* (Bieszczady Mts., Bereżki); B – *R. campestris* (Ojców), C – *R. rostrata* (Kraków-Las Mogilski).

Terminalia. Male. The shape and pilosity of the surstylus of *R. borealis* are as shown in Fig. 4A. It is longer in relation to its width than that of the other two species, (Fig. 4A, B, C). The length-to-width ratio of the surstylus at the narrowest point is 1.85 (it is 1.30 in *R. campestris* and 1.44 in *R. rostrata*). The other parts of the male terminalia are illustrated in Fig. 5A, D, G, J, M. The ejaculatory apodeme is rather weakly sclerotised compared with the other two species. The illustrations of the surstyli of all three species by BARKEMEYER (1986) are identical to the specimens that we analysed. Female. Some components of the female terminalia

in *R. borealis* are shown in Fig. 6C, F. In contrast to the other two species, the cerci are cone-shaped.

Biology. *Rhingia borealis* prefers shady spots with herbaceous and shrub vegetation alongside streams in mountains and foothills. The insects fly low in the undergrowth; for example, under the leaves of butterbur *Petasites*, and are active even during overcast or rainy weather. If the species occurs, it is usually seen in larger numbers. They have also been sighted, for example, on the flowers of red campion *Melandrium rubrum*, *Cardamine* sp., *Geranium phaeum*, *Taraxacum* sp. (author's own observations).

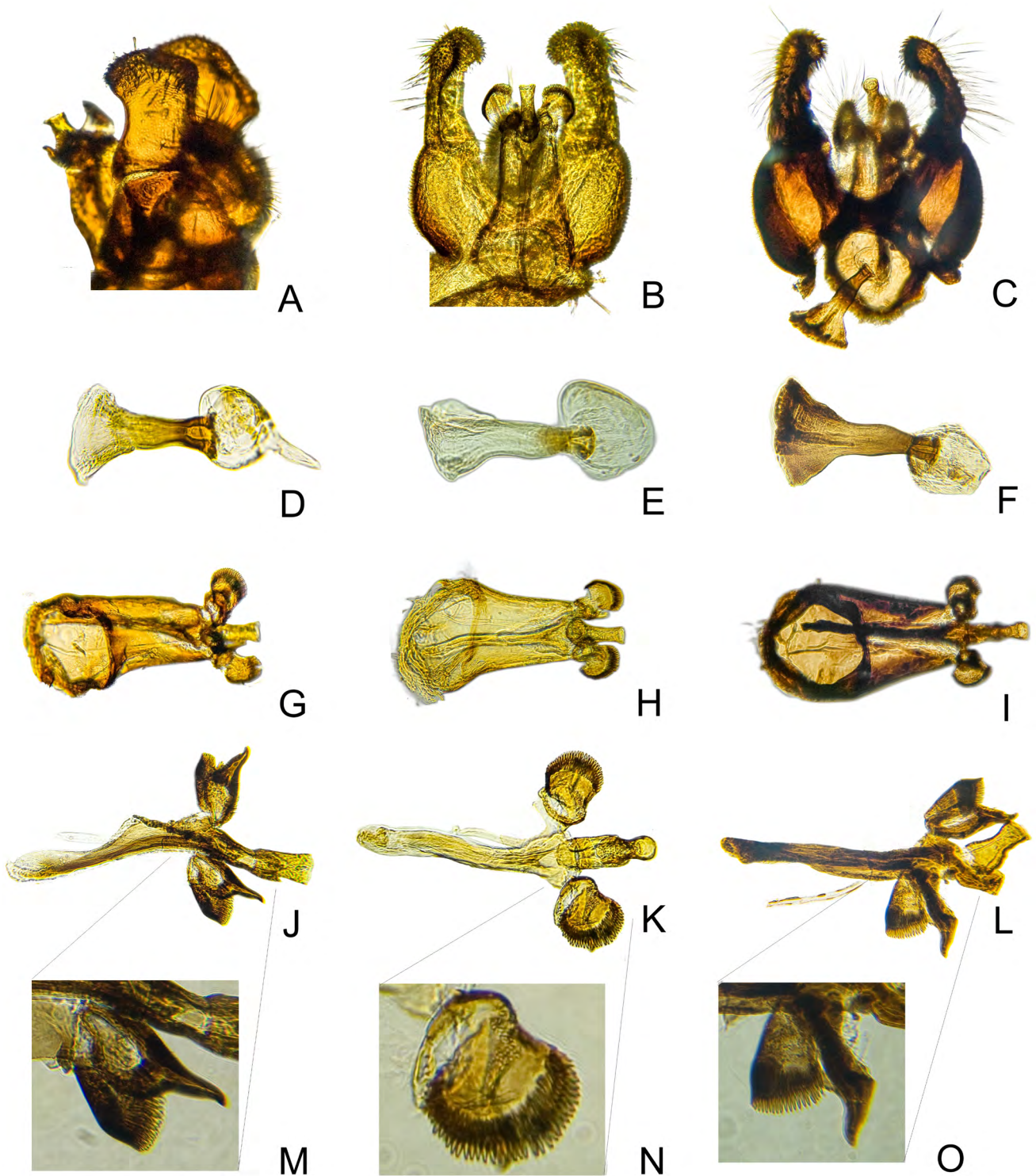


Fig. 5. Male terminalia: A-C – overall appearance, A – oblique side view, B – dorsal view, C – ventral view; D-F – ejaculatory apodeme, lateral view; G-I – hypandrium containing phallus; J-L – phallus and postgonites; M-O – postgonites metamorphosed in part into comb-like hooks; A, D, G, J, M – *Rhingia borealis* (Bieszczady Mts., Bereżki); B, E, H, K, N – *R. campestris* (Ojców), C, F, I, L, O – *R. rostrata* (Kraków-Las Mogilski).

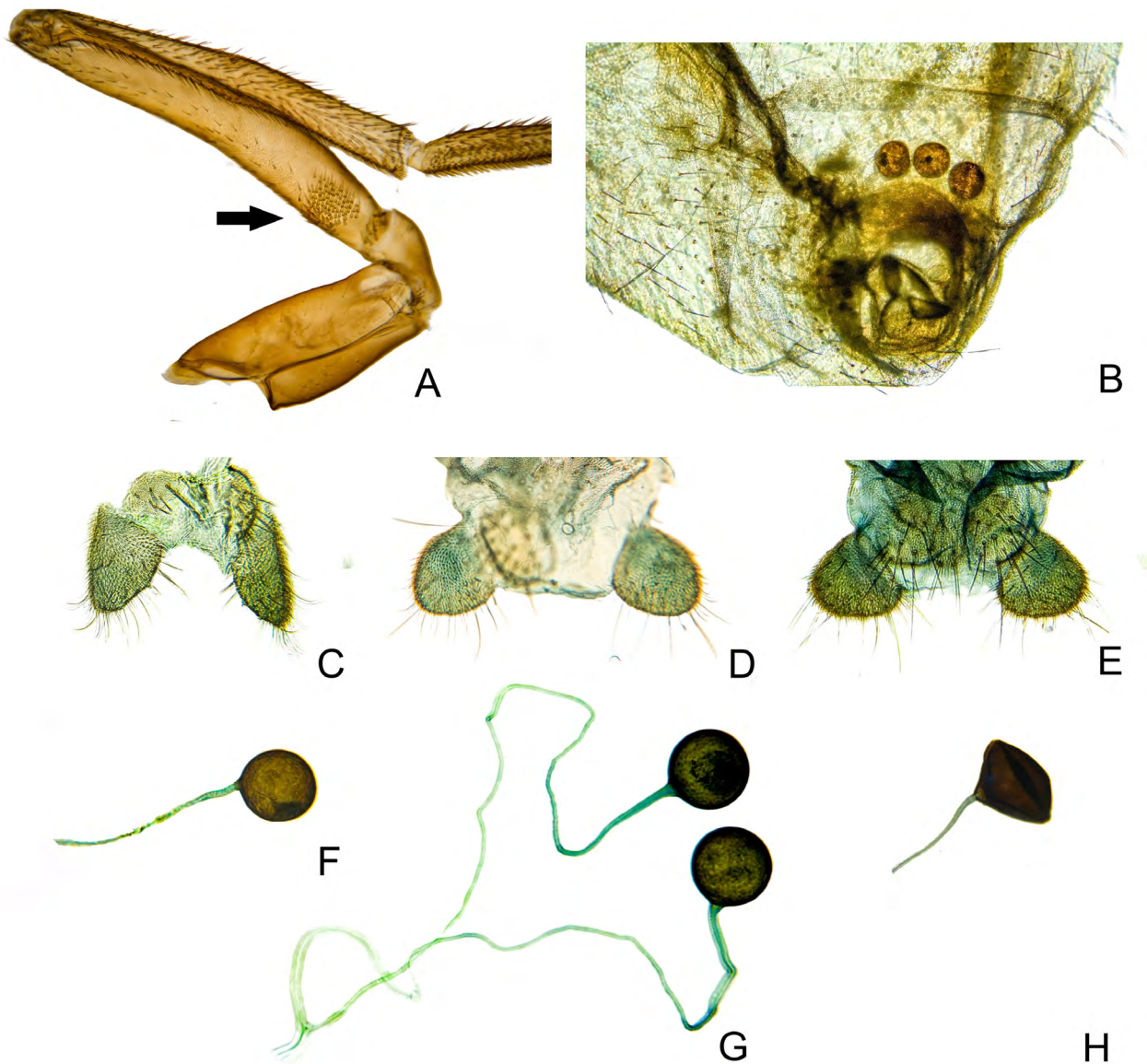


Fig. 6. Female: A – proleg, posterior view, with the femoral patch of setulae marked; B – end of the female abdomen with visible cerci and three spermathecal bulbs; C-E – cerci; F-H – example view of the spermathecal bulbs (in *R. rostrata* collapsed during the preparation); A, C, F – *Rhingia borealis* (Bieszczady Mts., Bereżki); B, D, G – *R. campestris* (Ojców); E, H – *R. rostrata* (Kraków-Las Mogilski).

Dynamics of its occurrence in Poland. The earliest annual record of *R. borealis* in the material was on 22 May, with the latest one on 25 August and with the occurrences peaking in May (Fig. 7A). Although rarely caught, the first records from Poland date from 1956. The higher numbers of records in the decade 2010-2020 are an effect of the greater intensity of the fieldwork.

Distribution. In the Palaearctic, *Rhingia borealis* inhabits montane regions and the boreal

zone; it is very rarely seen in lowland regions (VAN STEENIS 1998; VAN DE MEUTTER 2011). In Poland, it has been recorded in 16 UTM (10x10 km) squares and occurs locally and abundantly in the arc of the Carpathians, from the Babia Góra massif to the Bieszczady Mts., as well as in the higher parts of the Sudety Mts. (Śnieżnik massif) (Fig. 8). Boreal localities of this species were found in the Augustów and Białowieża Forests in north-eastern Poland, with a few isolated ones in the Świętokrzyskie Mts. It is

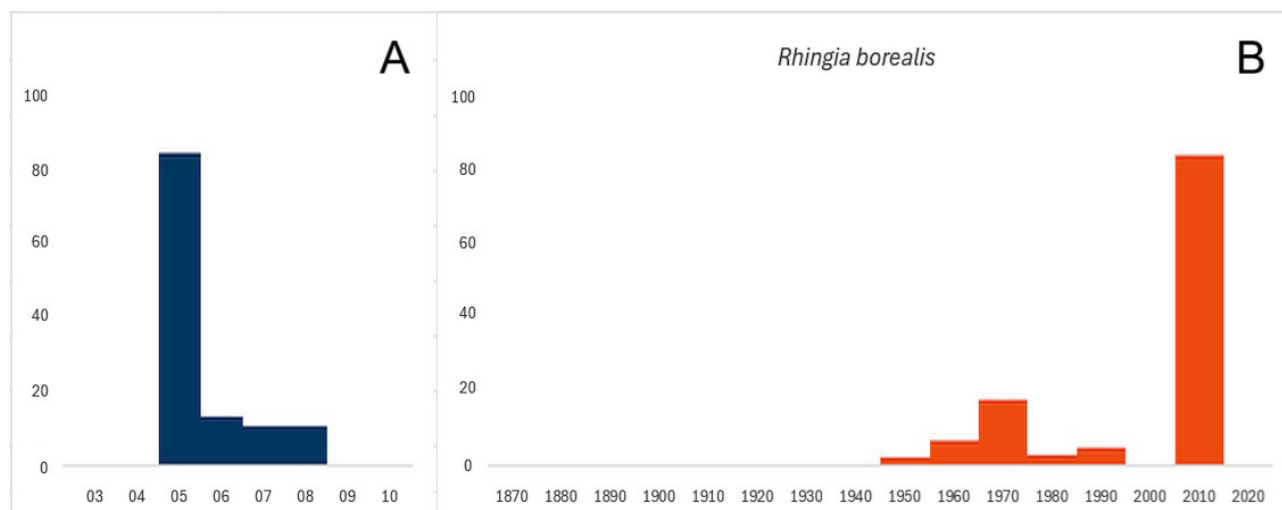


Fig. 7. Records of *Rhingia borealis* (n=120): A – phenology (sum over the years in particular months); B – records per decade.

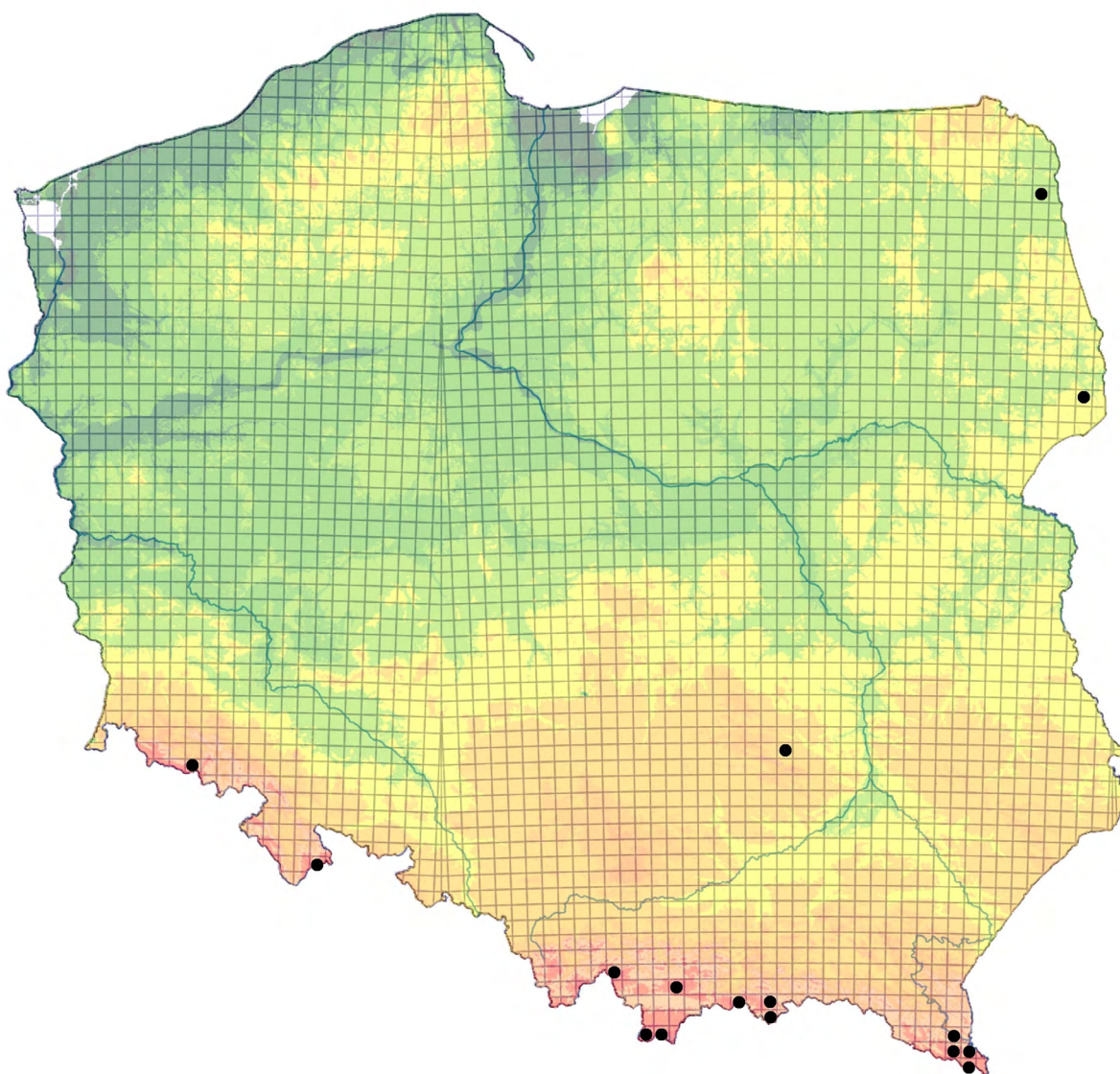


Fig. 8. *Rhingia borealis* RINGDAHL, 1928 – distribution in Poland.

anticipated that further exploration will reveal new localities in the abovementioned regions.

Threats and conservation. This species is included on the Red List of Endangered Species in Poland in the LC (least concern) category (PALACZYK et al. 2002). Its montane localities lie within the boundaries of four national parks, Babia Góra, Bieszczady, Gorce and Tatra National Parks, where there are no signs of it decreasing. On the other hand, the presence of the species in the lowlands of north-eastern Poland and the uplands has not been confirmed for decades, despite research being conducted (e.g. ŻÓRALSKI et al. 2016, 2017b), which may indicate that the species is critically endangered in these regions or is extinct there.

Rhingia campestris MEIGEN, 1822

(Fig. 1C, 1D, 2C, 2D, 4B, 5B, 5E, 5H, 5K, 5N, 6B, 6D, 6G)

Rhingia austriaca MEIGEN, 1830: BAŃKOWSKA 1995 (part misidentification)

Material examined: 683 specimens (302 ♂♂, 353 ♀♀, 28 specimens of unspecified sex): **Baltic Coastlands (Pobrzeże Bałtyku):** ‘Stettin’ = Szczecin [VV72], no date, 1 ♀, 31 V 1908, 1 ♂, 18 V 1910, 1 ♀, 20 V 1910, 1 ♂, leg. G. Schroeder, coll. MIZ (SCHROEDER 1909); ‘Stettin, Julio’ = Szczecin, Leśne Wzgórze [VV72], 13 VI 1908, 1 ♀, leg. G. Schroeder, coll. MIZ (SCHROEDER 1909); ‘Kl. Strellin’ = Strzelinko near Słupsk [XA24], 18 V 1911, 1 ♂, 19 V 1912, 1 ♂, 21 V 1913, 2 ♀♀, leg. O. Karl, coll. MIZ (KARL 1935); ‘Reitz’ = Redzikowo near Słupsk [XA33], 6 VI 1912, 1 ♀, leg. O. Karl, coll. MIZ (KARL 1935); Kolberg, Ostsee’ = Kołobrzeg [WA30], VII 1939, 1 ♀, leg. O. Lüdeke, coll. MIZ; Jarosławiec near Sławno [WA94], 16 VII 1957, 1 ♂, leg. R. Trojan, coll. MIZ (TROJANOWA-BAŃKOWSKA 1959); Unieście, Lake Jamno [WA71], 5 VII 1980, 1 ♀, leg. & coll. J. Kurzawa; Dębki [CF17], 15 VII 1997, 1 ♂, leg. BS; Słone Łąki nature reserve near Władysławowo [CF37], 1 IX 1997, 1 ♀, leg. BS; Jastrzębia Góra [CF27], 09 V 1998, 1 ex., 4 VI 1999, 1 ex., leg. BS; Karwia [CF27], 10 V 1998, 1 ex., leg. BS; Rozewie nature reserve [CF27], 10 V 1998, 1 ♀, leg. BS; Władysławowo [CF37], 11 V 1998, 1 ex., leg. BS; Białogóra nature reserve [XA97], 30 IV 2000, 1 ex., leg. BS; Trójmiejski Landscape Park: Widowo nature reserve [CF17], 06 V 2000, 1 ex., leg. BS, 20 V 2017, 1 ♂, leg. RZ, coll. RZPC; Łebcz [CF27], 19 V 2001, 1 ex., leg.

BS; Piekiełko at the Zagórska Struga Valley [CF24], 24 VII 2000, 1 ♀, leg. JKK (CIECHANOWSKI et al. 2001b); Bielawskie Błota [CF27], 21 V 2001, 1 ex., 22 V 2001, 1 ex., 23 V 2003, 1 ex., leg. BS; Żarnowiec [CF17], 30 IV 2000, 1 ex., leg. BS; Kąty Rybackie [CF82], 25 VII 2005, 2 ♂♂, 5 VIII 2005, 2 ♂♂, 9 VIII 2009, 3 ♂♂, 2 ♀♀, 14 VIII 2009, 4 ♂♂, 10 VIII 2010, 2 ♂♂, 3 ♀♀, 14 VIII 2010, 1 ♂, 2 ♀♀, 1 VIII 2011, 3 ♂♂, leg. MS; Godkowo [DE29], 05 V 2006, 1 ♂, leg. M. Byk; Reda: Moście Błota [CF35], 30 V 2010, 5 ♂♂, 1 ♀, 27 IV 2014, 5 ♂♂, leg. RZ, coll. RZPC; Beka nature reserve [CF35], 6 VI 2010, 1 ♂, leg. JKK; Reda Pieszewo [CF25], 15 V 2013, 1 ♀ (Fig. 2C,D), leg. RZ, coll. RZPC (ŻÓRALSKI & KOWALCZYK 2015); Rzućewo [CF36], 23 V 2015, 1 ♂, leg. RZ, coll. RZPC; Szary Dwór [CF17], 24 V 2015, 1 ♂, 20 V 2017, 1 ♀, leg. RZ, coll. RZPC; Mrzezino: River Reda [CF35], 16 V 2015, 16 ♂♂, 1 ♀, 15 VIII 2015, 4 ♂♂, leg. RZ, coll. RZPC; Gdynia-Redłowo: Polanka Redłowska [CF44], 25 V 2015, 1 ♂, leg. JKK (ŻÓRALSKI & KOWALCZYK 2017); Trójmiejski Landscape Park: Przebrno [CF92], 06 V 2016, 1 ♂, leg. LM, coll. LMPC, 11 VIII 2017, 1 ♂, leg. MS, coll. RZPC; Marszewska Valley [CF34], 11 V 2016, 1 ♀, leg. JKK; Czarny Młyn [CF27], 24 VIII 2017, 2 ♂♂, 3 ♀♀, leg. RZ, coll. RZPC; Gdynia-Redłowo: Arka Tennis Club [CF44], 13 V 2018, 1 ♂, leg. JKK; Łęg nad Sweliną nature reserve [CF43], 19 V 2018, 1 ♂, leg. RZ, coll. RZPC (ŻÓRALSKI & KOWALCZYK 2019); Trójmiejski Landscape Park: Reda [CF25], 11 V 2019, 1 ♀, 15 V 2020, 1 ♀, 21 V 2020, 1 ♂, leg. RZ, coll. RZPC; Kartoszyń [CF16], 12 V 2023, 1 ♂, 28 V 2023, 1 ♀, 3 VI 2023, 2 ♀♀, 17 VI 2023, 1 ♀, leg. RZ, coll. RZPC; **Pomeranian Lakeland (Pojezierze Pomorskie):** Mirachowska Struga [CF03], 5 V 1998, 1 ♂, leg. JKK (CIECHANOWSKI et al. 2004); proposed nature reserve ‘Przyjaźń’ [CF32], 19 VI 1999, 1 ♂, leg. JKK (CIECHANOWSKI et al. 2001); Trątkownica near Kartuszy [CF21], 3 X 2015, 1 ♂, leg. RZ, coll. RZPC; Garcz [CF12], 6 VIII 1998, 1 ♀, 1 V 2002, 1 ♂, leg. JKK; **Eastern Lakelands (Pojezierze Wschodnie):** Przerwanki near Giżycko [EE59], 2 VII 1957, 1 ♀, 16 VII 1957, 1 ♂, leg. P. Trojan, coll. MIZ; Uroczysko Stara Hańcza [FF11], 27 VIII 1957, 1 ♀, leg. E. Kostrowicka, coll. MIZ; Kretowiny near Morąg [DE37], 10 VIII 1966, 1 ♀, leg. B. Pisarski, coll. MIZ; Augustów Forest: Gruszki [FE67], 22 VI 1977, 1 ♀, leg. BS, coll. ISEZ; Augustów Forest: Rubcowo [FE66], 11 VIII 1977, 1 ♂, leg. BS; Leśnictwo Krzy-

we [FE39], 8 VI 1989, 1 ♀, leg. L. Krzysztofiak, coll. WNP; jez. Rydwan near Łowicz [DC16], 20 V 1990, 1 ex., leg. BS; Walik nature reserve [FE39], 24 V 1990, 1 ♀, leg. A. Krzysztofiak, coll. WNP; Wigierski National Park: meadow [FE39], 25 VIII 1990, 1 ♀, coll. WNP; Leszczewo [FE39], 4 V 1991, 2 ♂♂, 6 V 1991, 2 ♂♂, leg. K. Makowski, coll. WNP; Parzeń near Płock [DD03], 27 V 1996, 1 ♂, leg. JKK; Brudzeń Duży [CD93], 27 V 1996, 2 ♂♂, 1 ♀, leg. JKK, coll. MNHL (ABRASZEWSKA-KOWALCZYK & KOWALCZYK 2002); Brudzeńskie Jary [DD03], 6 V 1997, 2 ♂♂, leg. JKK, coll. MNHL (ABRASZEWSKA-KOWALCZYK & KOWALCZYK 2002); Biskupice near Płock [DD02], 12 V 1997, 1 ♀, leg. JKK; Rosochaty Róg [FE39], 09 V 2001, 1 ♂, 1 ♀, leg. A. Krzysztofiak, coll. WNP; Królówek [FE39], 19 V 2002, 1 ♂, 1 ♀, leg. A. Krzysztofiak, coll. WNP; Romincka Forest Landscape Park: Mechacz Wielki [EF92], 04 VI 2005, 1 ♀, leg. BS, coll. RZPC; Romincka Forest Landscape Park: Żytkiejmy [EF02], 05 VI 2005, 1 ♀, leg. BS, coll. RZPC; Romincka Forest Landscape Park: 'Porosty' nature trail [FF02], 1 VIII 2005, 1 ♂, coll. WNP; Wiatrołuża [FF30], 24 V 2015, 1 ♂, leg. LM, coll. LMPC; Wigierski National Park: Krzywe [FE39], 24 V 2016, 1 ♀, leg. RZ (ŻÓRALSKI et al. 2016); Smolniki [FF21], 22 V 2015, 4 ♂♂, 1 ♀, leg. LM, coll. LMPC; Wigierski National Park: Nowa Wieś - River Maniówka [FE39], 24 V 2016, 2 ♂♂, 1 ♀, leg. RZ (ŻÓRALSKI et al. 2016); Wigierski National Park: Wiatrołuża nature reserve [FF30], 24 V 2016, 1 ♂, 2 ♀♀, leg. RZ (ŻÓRALSKI et al. 2016); Wigierski National Park: Wiatrołuża 3 nature reserve [FE39], 24 V 2016, 1 ♂, leg. RZ (ŻÓRALSKI et al. 2016); Suwalski Landscape Park: Sidorówka [FF21], 22 V 2016, 1 ♀, leg. RZ, coll. RZPC; Suwalski Landscape Park: Smolniki [FF21], 22 V 2016, 1 ♂, 3 ♀♀, leg. RZ, coll. RZPC; Leszczewek Siedl. [FE39], 16 VI 2017, 1 ♂, leg. RZ (ŻÓRALSKI et al. 2017b); River Drwęca near Gibała (E7) [DE43], 13 V 2017, 1 ♀, leg. RZ, coll. RZPC (ŻÓRALSKI 2022); Górzno, River Górzanka [DD09], 29 IV 2019, 2 ♂♂, leg. LM, coll. LMPC; Suwalski Landscape Park: Gulbieniszki [FF21], 30 IV 2023, 1 ♂, leg. M. Miłkowski, coll. RZPC; Wielkopolska-Lubusz (Obszar Wielkopolsko-Lubuski): Łódź: Łagiewnicki Forest [CC94], 25 V 1994, 1 ♂, 7 VI 1994, 1 ♀, leg. BS, coll. RZPC (SOSZYŃSKI et al. 2010); Żabiczki [CC83], 15 VI 1971, 1 ♀, leg. BS, coll. RZPC; Jeziorsko [CC33], 10 VII 1972, 2 ♀♀, leg. BS, coll. RZPC (SOSZYŃSKI

& SOSZYŃSKI 1975); Burzenin [CC40], 17 VIII 1973, 1 ♂, 3 ♀♀, leg. BS, coll. RZPC; Grądy near Linda nature reserve [CC84], 18 V 1986, 1 ex. obs., leg. BS; Łódź: Botanical Garden [CC93], 3 V 1988, 1 ♂ obs., leg. JKK; Łódź: Lublinek Forest [CC83], 20 V 2005, 1 ♀, 12 V 2011, 1 ♂, 1 ♀, leg. BS (SOSZYŃSKI & SOSZYŃSKA-MAJ 2011), 4 V 2007, 1 ♀, leg. BS, coll. RZPC (SOSZYŃSKI & SOSZYŃSKA-MAJ 2011); Solec Kujawski [CD18], 3 V 2012, 3 ♂♂, leg. RZ, coll. RZPC; Gołuchów [YT04], 21 VII 2015, 1 ♂, leg. P. Żurawlew, coll. P. Trzciński (TRZCIŃSKI et al. 2023), 7 VI 2016, 1 ♀, leg. LM, coll. LMPC (TRZCIŃSKI et al. 2023); Prusinów [XT86], 16 V 2015, 2 ♀♀, leg. P. Żurawlew, coll. P. Trzciński (TRZCIŃSKI et al. 2023); Gołuchów - arboretum [YT04], 1 VI 2016, 1 ♀, leg. LM, coll. LMPC; Jodły Łaskie nature reserve near Łask [CC61], 16 V 2013, 1 ♂, leg. BS; Piła [YT05], 6 V 2015, 1 ♂, leg. E. Markiewicz, coll. P. Trzciński (TRZCIŃSKI et al. 2023), 9 V 2015, 1 ♂, leg. E. Markiewicz, coll. LMPC (TRZCIŃSKI et al. 2023); Mazovia (Mazowsze): Sochaczew-Trojanów [DC48], 12 V 1955, 1 ♂, leg. A. Mońko, coll. MIZ (TROJANOWA-BAŃKOWSKA 1959); Płochocin near Warszawa [DC88], 23 VIII 1958, 5 ♂♂, 7 ♀♀, leg. B. Pisarski, coll. MIZ; Wiączyn near Łódź [DC03], 25 V 1965, 1 ♂, 25 V 1969, 1 ♂, leg. BS, coll. ISEZ; Warszawa-Ursynów [EC07], 5 V 1966, 3 ♂♂, 1 ♀, leg. RB, coll. MIZ, 5 V 1966, 1 ♂, leg. SB, coll. MIZ; Sochaczew [DC48], 25 V 1968, 1 ♀, leg. A. Draber-Mońko, coll. MIZ; Andrespol near Łódź [DC03], 8 VI 1969, 1 ♀, leg. BS, coll. ISEZ; Łomna near Warszawa [DD80], 12 V 1973, 1 ♀, leg. RB, coll. MIZ; Łódź-Bałuty [CC94], 28 V 1973, 1 ♀, leg. BS, coll. RZPC; Rogów: Arboretum [DC24], 3 VI 1974, 1 ♂, 1 ♀, 9 V 1975, 1 ♀, leg. BS, coll. RZPC; Rogów: Popień nature reserve [DC23], 6 VI 1974, 1 ♀, leg. BS, coll. RZPC; Rogów: River Mroga [DC14], 4 VIII 1975, 1 ♀, 10 VI 1976, 1 ♀, leg. BS, coll. RZPC; Piotrków Trybunalski [DB19], 21 VIII 1985, 1 ♀, leg. & coll. J. Kurzawa; Gałków near Piotrków nature reserve [DC13], 15 V 1988, 1 ♀, leg. JKK, 20 V 1992, 1 ex., leg. BS; Dobieszków near Łódź [DC04], 5 VI 1991, 1 ♀, 17 V 1994, 1 ♂, leg. JKK; Uroczysko Janinów near Łódź [DC04], 26 V 1992, 2 ♀♀, leg. JKK; Justynów [DC03], 13 V 1993, 1 ♀, leg. JKK; Inowłódz [DC40], 27 V 1994, 1 ♀, leg. & coll. J. Kurzawa; Widzew near Łódź [DC03], 5 VI 1994, 2 ♂♂, 2 ♀♀, leg. JKK; Niesułków [DC04], 17 VIII 1994, 1 ♀, leg. JKK; Bolimowski Landscape Park: River Chojnatka

[DC55], 02 VI 1999, 1 ♂, leg. JKK, coll. MNHL (KOWALCZYK 2002); Łódź Hills Landscape Park: Borchówka [DC04], 23 V 2006, 1 ♀, leg. JKK (SOSZYŃSKI et al. 2010); Spalski Landscape Park: Skieblewo [FE56], 18 VI 2006, 1 ♀, coll. WNP; Bolimowski Landscape Park: Polana Siwica nature reserve [DC46], 2 IX 2007, 1 ♀, leg. JKK, coll. MNHL; Ceteń [DC50], 3 V 2010, 1 ♂, 1 V 2012, 1 ♂, 15-18 V 2015, 1 ♂, 1 ♀, leg. MS, 27 IV 2015, 1 ♂, 25 V 2015, 1 ♀, leg. LM, coll. LMPC, 9 V 2015, 1 ♂, 2 V 2016, 1 ♀, leg. MS, coll. RZPC; Budy Prywatne [ED18], 26 V 2011, 1 ♀, leg. RZ, coll. RZPC; Kalisko [ED19], 31 V 2013, 1 ♂, leg. RZ, coll. RZPC; Baranowo [ED29], 10 V 2013, 1 ♀, leg. RZ, coll. RZPC; Łyse [EE31], 28 IV 2015, 1 ♂, leg. RZ, coll. RZPC; Malinowo near Działdowo [DE40], 2 V 2016, 2 ♀♀, 5 V 2018, 2 ♂♂ (Fig. 1C,D), 1 ♀, leg. RZ, coll. RZPC (ŻÓRALSKI 2022), 21 VI 2023, 1 ♀, leg. RZ, coll. RZPC; Purgałki [DD59], 27 V 2016, 2 ♀♀, leg. RZ, coll. RZPC; Orzół near Baranowo [ED19], 2 V 2017, 1 ♂, 13 V 2017, 1 ♂, leg. RZ, coll. RZPC; **Podlasie**: Białowieża [FD94], 6 VI 1960, 1 ♂, leg. P. Trojan, coll. MIZ, 3 IX 1969, 1 ♀, leg. RB, coll. MIZ (BAŃKOWSKA 1995, as *R. austriaca*), 11 VIII 1983, 1 ♀, 25 V 2010, 2 ♀♀, 29 V 2010, 1 ♀, leg. R. Dobosz, coll. USMB; Białowieża Forest [FD84], 24 V 1966, 3 ♀♀, 25 V 1966, 9 ♀♀, 28 VII 1970, 1 ♀, leg. SB, coll. MIZ (BAŃKOWSKA 1995, as *R. austriaca*), 24 V 1966, 1 ♀, 25 V 1966, 6 ♀♀, 28 VII 1970, 1 ♀, leg. RB, coll. MIZ (BAŃKOWSKA 1995, as *R. austriaca*); Białowieża Forest: Palace Park [FD94], 27 V 1966, 1 ♀, leg. RB, coll. MIZ (BAŃKOWSKA 1995, as *R. austriaca*); Białowieża Forest: square 398 [FD84], 30 V 1970, 1 ♀, leg. Inst. Zool. PAN, coll. MIZ; Białowieża Forest: Czerlonka [FD84], 7 V 1977, 1 ♂, leg. BS, coll. RZPC; Topiło, oddz. 598 [FD73], 2-6 VIII 1993, 1 ♂, leg. RB, coll. MIZ; Budy, most na Łutowni [FD84], 29 V 2010, 1 ♀, leg. CB, coll. CBPC, 29 V 2010, 5 ♀♀, leg. R. Dobosz, coll. USMB; Puszcza Białowieska: oddz. 601C [FD83], 11 V 2011, 1 ♀, leg. CB, coll. CBPC; Puszcza Białowieska: oddz. 670 [FD83], 25 V 2011, 1 ♂, leg. CB, coll. CBPC; Dolina Łutowni: oddz. 306Bb [FD84], 10 VII 2011, 1 ♂, leg. CB, coll. CBPC; Białowieża Forest: Zielona Tryba, oddz. 575A [FD83], 16 VII 2013, 1 ♂, leg. R. Banul, coll. CBPC; Lipnicka Kępa near Tykocin [FD29], 11 V 2002, 1 ♀, leg. CB, coll. CBPC; Biebrza National Park: Grobla Honczarowska [FE00], 12 VI 2007, 2 ♂♂, leg. J. Sawoniewicz, coll. RZPC; Biebrza Na-

tional Park: G. Załaz [FE13], 5 VIII 2021, 1 ♀, leg. M. Wanat, coll. RZPC; Leś. Dąbrowa Białostocka [FE54], 7 IV - 25 V 2009, 1 ♂, 2 ♀♀, leg. CB, coll. RZPC; **Lower Silesia (Dolny Śląsk)**: no date, 1 ♂, 1 ♀, leg. coll. Scholz, coll. MNHW, ex coll. Scholz; Malkovitz?, V 1934, 1 ♀, coll. MNHW, ex coll. Scholz; Ząbkowice Śląskie [XS20], 13 V 1948, 1 ♀, 17 V 1948, 1 ♀, 24 V 1957, 1 ♀, leg. M. Kłapacz, coll. MIZ (BAŃKOWSKA 1964); Muszkowice near Wrocław [XS31], 19 IV 1953, 2 ♂♂, leg. A. Mońko, coll. MIZ (TROJANOWA-BAŃKOWSKA 1959); Stolec near Ząbkowice Śląskie [XS30], 22 V 1954, 1 ♂, coll. ISEZ; Wrocław [XS46], 15 VIII 1980, 1 ♂, leg. T. Zatwarnicki, coll. USMB; Dziewin [XS09], 14 V 2011, 1 ♀, leg. AS, coll. ASPC; Proboszczów near Złotoryja [WS55], 5 VIII 1979, 1 ♂, leg. T. Zatwarnicki, coll. USMB; Grodziec near Chojnów [WS56], 9 VI 1980, 1 ♀, 29 VI 1995, 1 ♂, leg. T. Zatwarnicki, coll. USMB; Zimna Woda [WS78], 23 IV 2011, 2 ♂♂, 1 ♀, 8 V 2012, 2 ♂♂, 1 ♀, leg. AS, coll. ASPC; Łęgi Źródłiskowe near Przemków [WT50], 29 IV 2011, 2 ♀♀, leg. AS, coll. ASPC; Wąwóz Myśluborski [WS75], 21 V 2011, 1 ♀, leg. AS, coll. ASPC; Wierceń [WS78], 08 V 2012, 1 ♀, leg. AS, coll. ASPC; Lipa [WS74], 19 V 2012, 1 ♀, leg. AS, coll. ASPC; Orsk [WT91], 28 IV 2012, 1 ♂, leg. AS, coll. ASPC; Myślubórz [WS75], 30 IV 2014, 1 ♀, leg. AS, coll. ASPC; Pieńsk [WS07], 23 VIII 2014, 1 ♂, 1 ♀, leg. & coll. G. Pennards. **Upper Silesia (Górny Śląsk)**: Paniowy [CA46], 3 VI 1996, 1 ♀, leg. J. Grzywocz, coll. USMB; Lake Świerkianiec [CB50], 28 V 2010, 1 ♀, leg. W. Szczepański, coll. USMB; **Kraków-Wieluń Upland (Wyżyna Krakowsko-Wieluńska)**: Ojców National Park: near Muzeum, Prądnik Valley [DA16], 7 V 1998, 2 ♂♂, 1 ♀, leg. R. Dobosz, coll. USMB; ONP: Sąpowska Valley [DA16], 4 IX 2013, 1 ♂, leg. AK, coll. ONP; ONP: Sąpowska Valley – upper part [DA16], 12 V 2015, 1 ♀, leg. AK, coll. ONP; Będowska Valley [DA15], 18 VI 2002, 1 ♂, leg. AK, coll. RZPC; Biały Kościół, Dolina Kluczwoły [DA15], 4-5 VI 2007, 1 ♀, leg. LM, coll. LMPC; Miękinia (Stawiska) [CA95], V 2022, 1 ♂, leg. LM, coll. LMPC; **Małopolska Upland (Wyżyna Małopolska)**: Brzesko [DA73], no date, 1 ♂, 1 ♀, coll. ISEZ; Jędrzejów [DB50], VI 1955, 1 ♂, leg. J. Karczewski, coll. MIZ (TROJANOWA-BAŃKOWSKA 1959); Grabowiec near Pińczów [DA69], 15 VI 1956, 1 ♀, leg. Ekpa I.Z.PAN, coll. MIZ (BAŃKOWSKA 1961); Las Dębina near Pińczów

[DA69], 15 VI 1956, 2 ♀♀, 17 V 1957, 2 ♂♂, leg. Ekpa I.Z.PAN, coll. MIZ (BAŃKOWSKA 1961); Sulejów [DB29], 26 V 1970, 1 ♂, 28 V 1970, 1 ♀, leg. BS, coll. ISEZ; Podklasztorze near Sulejów [DB29], 20 VII 1971, 1 ♀, leg. BS, coll. ISEZ; Świętokrzyski National Park: Glade Bielnik [EB03], 04 V 1978, 1 ex. obs., 18 V 1978, 1 ♀, 20 V 1978, 1 ex. obs., 11 V 1979, 1 ex. obs., 18 V 1982, 3 ex., leg. JKK (ŻÓRALSKI et al. 2017), 18 V 1979, 1 ♂, leg. JKK (ŻÓRALSKI et al. 2017); Świętokrzyski National Park: Góra Chełmowa [EB03], 28 V 1978, 2 ex. obs., leg. JKK (ŻÓRALSKI et al. 2017); Świętokrzyski National Park: Święty Krzyż [EB03], 31 V 1978, 2 ex. obs., 16 V 1983, 1 ex. obs., leg. JKK (ŻÓRALSKI et al. 2017), 26 V 1979, 1 ♀, leg. JKK (ŻÓRALSKI et al. 2017), 8 V 1986, 2 ♂♂, 1 ♀, leg. JKK, coll. MNHL (ŻÓRALSKI et al. 2017); Przedborski Landscape Park: Chojny [DB25], 2 V 1995, 1 ♂, 2 V 1998, 1 ♂, leg. BS, coll. RZPC; Sulejowski Landscape Park: Bąkowa Góra [DB26], 11 V 1995, 1 ex., 19 V 1996, 1 ex., leg. BS; Sulejowski Landscape Park: Jawora [DB16], 19 V 1996, 1 ♂, 1 ♀, leg. BS, coll. RZPC; Przedborski Landscape Park: Oleszno [DB34], 8 VI 1997, 1 ♀, leg. BS; Włoszczowa [DB23], 23 V 2006, 3 ♂♂, leg. LM, coll. LMPC; Ciekoty [DB84], 2 VI 2006, 1 ♀, leg. LM, coll. LMPC (ŻÓRALSKI et al. 2017); Żytno, Dębowiec nature reserve [DB14], 21 V 2007, 1 ♀, leg. LM, coll. LMPC; Murawy Dobromierskie [DB25], 06 V 2008, 1 ♀, leg. T. Osicki; Zwleczka near Włoszczowa [DB12], 1 V 2007, 2 ♂♂, leg. LM, coll. LMPC; Grabowiec nature reserve [DA79], 21 V 2011, 1 ♀, leg. LM, coll. LMPC; Sulejowski Landscape Park: Błogie [DB29], 29 V 2011, 2 ♀♀, leg. BS; Wojciechów [DB44], 5 VIII 2011, 1 ♀, 4 V 2012, 4 ♂♂, 7 ♀♀, leg. LM, coll. LMPC; Łachów: Klekot [DB13], 21 IV 2014, 1 ♀, leg. LM, coll. LMPC; Miechów district: Giebułtów [DA48], 7 V 2015, 1 ♀, leg. CB, coll. RZPC; Miechów district: Cybowa Góra [DA48], 8 V 2015, 1 ♂, leg. CB, coll. RZPC; Borzęcin [DA74], 10 V 2015, 24 ♂♂, 16 ♀♀, leg. AT, coll. ATPC; Pstroszyce: Dziadówki near Miechów [DA38], 16 V 2015, 2 ♂♂, 1 ♀, leg. LM, coll. LMPC; Łachów [DB23], 1 IX 2015, 1 ♂, leg. LM, coll. LMPC; Młodzawy Duże: Polichno [DA69], 14 V 2022, 1 ♂, 1 ♀, leg. CB, coll. RZPC; **Lublin Upland (Wyżyna Lubelska)**: Puławy [EB69], no date, 1 ♂, leg. I.K. Tarnani, coll. MIZ; 'N. Aleksandria' = Puławy [EB69], 22 V 1910, 1 ♂, leg. A.I. Iliinskyj, coll. MIZ; **Sudety Mts. (Sudety)**: 'Jaworek' near Ząbkowice Śląskie [XR26], 9 V

1947, 1 ♂, leg. M. Kłapacz, coll. MIZ; Opolnica near Ząbkowice Śląskie [XR29], 12 VII 1950, 1 ♂, leg. M. Kłapacz, coll. MIZ (BAŃKOWSKA 1964); Lewin Kłodzki near Kudowa [WR98], VIII 1954, 1 ♂, 1 ♀, leg. R. Trojan, coll. MIZ (TROJANOWA-BAŃKOWSKA 1959); Domaszków near Bystrzyca Kłodzka [XR16], 17 VII 1956, 1 ♂, leg. A. Riedel, coll. MIZ (BAŃKOWSKA 1964); Srebrna Góra near Ząbkowice Śląskie [XS10], 3 VI 1958, 1 ♀, leg. A. Riedel, coll. MIZ (BAŃKOWSKA 1964); Radomierz near Jelenia Góra [WS63], 25 VII 1961, 1 ♂, leg. E. Kierych, coll. MIZ; Międzyzlesie [XR15], 21-24 VIII 1962, 1 ♀, leg. A. Riedel, coll. MIZ (BAŃKOWSKA 1964); Wilkanów [XR26], 8 V 1981, 1 ♀, leg. T. Zatrwarnicki, coll. USMB; Podgórzyn [WS43], 18 V 1983, 1 ♀, leg. T. Zatrwarnicki, coll. USMB; Rybnica Leśna [WS91], 9 VI 2010, 1 ♂, 1 ♀, 6 V 2014, 2 ♂♂, 1 ♀, leg. AS, coll. ASPC; Ponikwa [XR16], 4 VI 2012, 1 ♀, leg. & coll. G. Pennards; **Northern Subcarpathia (Podkarpacie Północne)**: Niepołomska Forest: Gawłówek near Bochnia [DA64], 9 VI 1872, 1 ♀, leg. B. Kotula, coll. ISEZ; Oleszyce [FA45], 2 V 2010, 5 ♂♂, 5 ♀♀, leg. LM, coll. LMPC; Podlesie Dębowe-Grobla near Żabno [DA95], 23 VIII 2011, 1 ♀, leg. T. Huflejt, coll. MIZ; **Beskid Mts. and Foothills (Beskidy i Pogórza)**: Przydonica [DA80], 9 VII, 1 ♀, coll. ISEZ, ex coll. Król; Ponice near Rabka [DV29], 17 VIII 1997, 1 ♀, leg. W. Żyła, coll. USMB; Krynica Zdrój [DV97], 12 V 2008, 1 ♂, 2 ♀♀, 15 V 2010, 1 ♂, 1 ♀, leg. LM, coll. LMPC; Raba Wyżna [DV19], 31 VII 2005, 1 ♀, leg. & coll. G. Pennards; Muszynka [EV06], 14 V 2010, 1 ♂, 2 ♀♀, leg. LM, coll. LMPC; Krynica: Jaworzyna [DA38], 22 V 2010, 1 ♂, leg. LM, coll. LMPC; Obrożyska nature reserve, Muszynka [DV96], 23 V 2010, 2 ♀♀, leg. LM, coll. LMPC; Beskid Sądecki: Powroźnik [DV96], 20 V 2011, 1 ♀, leg. LM, coll. LMPC; Buczkowice [CA61], 14 V 2017, 1 ♀, leg. G. Dubiel, coll. RZPC (ŻÓRALSKI & DUBIEL 2020); Cisiec near River Soła [CV69], 9 VIII 2023, 1 ♂, 1 ♀, leg. RZ, coll. RZPC; **Orawa-Podhale (Obszar Orawsko-Podhalański)**: Witów [DV16], 18 VII 2005, 1 ♂, leg. CB, coll. CBPC; Przybojce peat bog near Koniówka [DV17], 24 V 2014, 1 ♀, leg. RZ, coll. RZPC; Koniówka [DV17], 25 V 2014, 2 ♀♀, leg. RZ, coll. RZPC, 25 V 2014, 1 ♀, leg. LM, coll. LMPC; **Eastern Carpathians (Karpaty Wschodnie)**: Bieszczady: Dwernik [FV15], 20 V 1963, 2 ♂♂, 2 ♀♀, 22 V 1963, 1 ♀, 25 V 1963, 1 ♂, 2 ♀♀, leg. RB, coll. MIZ (BAŃKOWSKA 1971); Zatrwarnica

[FV15], 28 V 1963, 2 ♂♂, 7 ♀♀, leg. RB, coll. MIZ (BAŃKOWSKA 1971), 25 V 2013, 1 ♂, 3 ♀♀, leg. RZ, coll. RZPC, 25 V 2013, 5 ♂♂, 2 ♀♀, leg. & coll. AT; Wołosatka Valley [FV23], 29 V 1963, 1 ♂, 30 V 1963, 2 ♂♂, 4 ♀♀, leg. RB, coll. MIZ (BAŃKOWSKA 1971), 29 V 2015, 1 ♀, leg. A. Klasa; Ustrzyki Górne [FV23], 29 V 1963, 2 ♂♂, 11-18 VI 1966, 1 ♂, 22-23 VI 1967, 1 ♂, 8 V 1968, 2 ♀♀, leg. RB, coll. MIZ (BAŃKOWSKA 1971), 23-24 VI 1967, 1 ♀, 12 VI 1970, 1 ♀, leg. SB, coll. MIZ (BAŃKOWSKA 1971), 14 VI 1970, 1 ♂, leg. B. Pisarski, coll. MIZ (BAŃKOWSKA 1971), 21 VIII 1971, 1 ♂, leg. BS, coll. ISEZ, 21 VIII 1971, 1 ♂, leg. BS, coll. RZPC, 24-27 V 1996, 1 ♀, leg. H. Szoltyś, coll. USMB; Rożki [EV94], 13 V 1966, 2 ♂♂, leg. J. Wojnarowicz, coll. MIZ; Wołosate [FV23], 14 V 1966, 1 ♂, leg. J. Wojnarowicz, coll. MIZ (BAŃKOWSKA 1971); Szeroki Wierch [FV23], 12 VI 1966, 1 ♂, leg. RB, coll. MIZ (BAŃKOWSKA 1971), 16 V 1968, 1 ♂, leg. SB, coll. MIZ (BAŃKOWSKA 1971); Kosowiec [FV24], 17 VIII 1966, 1 ♂, 1 ♀, leg. J. Wojnarowicz, coll. MIZ (BAŃKOWSKA 1971); Wetlina [FV04], 21 VIII 1966, 1 ♀, leg. A. Draber-Mońko, coll. MIZ (BAŃKOWSKA 1971); Bukowe Berdo [FV24], 30 VII 1967, 1 ♀, 9 VIII 1969, 3 ♂♂, 1 ♀, leg. SB, coll. MIZ (BAŃKOWSKA 1971), 23 VIII 1971, 1 ♂, 26 VIII 1971, 2 ♂♂, 1 ♀, leg. BS, coll. ISEZ, 26 VIII 1971, 1 ♂, 1 ♀, leg. BS, coll. RZPC; Zwór Valley [FV24], 1 VIII 1967, 2 ♂♂, 1 ♀, leg. RB, coll. MIZ (BAŃKOWSKA 1971); Bereżki [FV24], 4 VIII 1967, 1 ♂, 21 V 1968, 1 ♂, 2 ♀♀, 4 VII 1968, 1 ♀, 5 VII 1968, 1 ♀, 15 VIII 1969, 1 ♀, 9 VI 1970, 1 ♂, 1 ♀, 11 VI 1970, 2 ♂♂, 3 ♀♀, 14 VI 1970, 1 ♂, 2 ♀♀, 16 VI 1970, 1 ♀, leg. RB, coll. MIZ (BAŃKOWSKA 1971), 17 V 1968, 2 ♂♂, 11 ♀♀, 13 VI 1970, 1 ♀, 14 VI 1970, 4 ♀♀, leg. SB, coll. MIZ (BAŃKOWSKA 1971), 19 V 1970, 1 ♂, leg. E. Kierych, coll. MIZ (BAŃKOWSKA 1971), 26 V 2014, 1 ♀, 28 V 2014, 1 ♂, leg. RZ, coll. RZPC, 27 V 2014, 2 ♂♂, 1 ♀, leg. AS, coll. ASPC; Hulske [FV15], 9 V 1968, 3 ♀♀, leg. RB, coll. MIZ (BAŃKOWSKA 1971), 9 V 1968, 1 ♀, leg. SB, coll. MIZ (BAŃKOWSKA 1971); Krywe [FV15], 9 V 1968, 1 ♂, 1 ♀, leg. RB, coll. MIZ (BAŃKOWSKA 1971), 9 V 1968, 1 ♂, 1 ♀, leg. SB, coll. MIZ (BAŃKOWSKA 1971); Pszczeliny [FV24], 5 VII 1968, 1 ♂, leg. B. Pisarski, coll. MIZ (BAŃKOWSKA 1971), 20 VIII 1971, 1 ♂, leg. BS, coll. RZPC; Widelki [FV24], 9 VIII 1969, 2 ♂♂, 2 ♀♀, leg. SB, coll. MIZ (BAŃKOWSKA 1971); Suche Rzeki [FV15], 28-29 V 2013, 6 ♂♂, 4 ♀♀, leg. &

coll. AT, 29 V 2013, 2 ♂♂, 4 ♀♀, leg. AS, coll. ASPC, 29 V 2013, 5 ♀♀, leg. BS, coll. RZPC, 24-29 V 2015, 2 ♂♂, 1 ♀, leg. LM, coll. LMPC; Bystre [FV26], 23 VI 2015, 1 ♀, leg. LM, coll. LMPC, 23 VI 2015, 1 ♀, leg. A. Witek, coll. LMPC, 23 VI 2015, 2 ♀♀, leg. ZM, coll. ZMPC; Bieszczady: Bukowiec-Terka [FV06], 24 VI 2015, 2 ♀♀, leg. A. Witek, coll. LMPC; Łopienka [FV05], 24 VI 2015, 1 ♂, 2 ♀♀, leg. LM, coll. LMPC; Bieszczady: Baligród [EV96], 25 VI 2015, 3 ♀♀, leg. ZM, coll. ZMPC; Rabe [EV96], 26 VI 2015, 2 ♀♀, leg. LM, coll. LMPC; Bieszczady: Duszatyn [EV85], 1 VIII 1986, 1 ♂, leg. & coll. J. Kurzawa; Bieszczady: Terbowiec Valley [FV23], 19 VIII 1971, 1 ♀, leg. BS, coll. ISEZ; Sine Wiry [FV05], 26 V 2013, 1 ♀, leg. RZ, coll. RZPC; Stadnina Tabun [FV16], 17 VIII 2014, 1 ♀, leg. & coll. AT; **Pieniny Mts. (Pieniny):** Rówieńki [DV67], 9 VI 1960, 1 ex., leg. K. Małski, coll. ISEZ; Lesko [EV98], 12 VI 1960, 1 ♂, 17 VI 1960, 1 ♀, leg. RB, coll. MIZ; near the Ociemny stream [DV57], 19 V 1972, 1 ♀, leg. A. Draber-Mońko, coll. MIZ (BAŃKOWSKA 1976); **Tatra Mts. (Tatry):** Olczyńska Valley [DV25], 8 VII 1920, 1 ♀, coll. ISEZ, ex coll. Król.

Description. Size: 8-11 mm. The appearance of the male is as in Fig. 1C, D, while that of the female as in Fig. 2C, D. Arista is with a short pile, not exceeding $\frac{1}{2}$ of the broadest diameter of the arista. In most males of *R. campestris*, the abdomen is bordered black and has a black vitta medially (Fig. 1C). In females, the brownish to black patterns are less distinct and are limited to the lateral and posterior margins of the abdominal tergites (Fig. 2D), while in many cases, these markings are scarcely perceptible (Fig. 2C). The mesonotum is wholly black and shiny, and only the bases of the femora of all the legs are black. In addition, *R. campestris* has the longest mala among the three Polish species (Fig. 1D, 2D). The abdominal pile (especially of the fourth tergite) is pale (yellowish-white), although a small patch of dark-brown to black pile may be present in some specimens.

Terminalia. **Male.** The shape and pilosity of the surstylus are as in Fig. 4B. The other components of the male terminalia are illustrated in Fig. 5B, E, H, K, N. The ejaculatory apodeme is exceptionally weakly sclerotised in this species. **Female.** Some terminalia components of the female *R. campestris* are as shown in Fig. 6B, D, G. The regularly semicircular shape of the cerci is characteristic of this spe-

cies. The spermathecae are placed at the end of the abdomen, as described in the diagnosis of the genus.

Biology. A synanthropic species, *R. campestris* is often abundant in the vicinity of pastures. Larvae have been raised from cow dung (COE 1942). Wherever cattle are now kept indoors the whole year round, as in northern France and northern Italy, the species has declined (SPEIGHT 2013). In 2015, the first-named author observed in the neighbourhood of Reda (N Poland) a swarm of more than 20 males hovering above the edge of a shadow, under a single bush (some were caught). The bush was growing close to the margins of a pasture covered with cattle dung, so the presence of these flies could have been associated with their trophic preferences, as mentioned above, i.e. the excreta of herbivorous vertebrates. During our fieldwork, however, we often came across single specimens of *R. campestris* far away from pastures, in natural landscapes such as river valleys and in woodland glades and rides. It is very likely that this hoverfly is capable of developing in other microhabitats that are rich in plant fragments (ROTHERAY 1994; SPEIGHT 2013).

Imagines were found on the flowers of water avens *Geum rivale* L. (SCHROEDER 1909), an observation that we confirmed, and also on devil's bit scabious *Succisa pratensis*, common fleabane *Pulicaria dysenterica* and marsh woundwort *Stachys palustris* (GREEN 2001). We also recorded it on the flowers of hawthorn *Crataegus monogyna* Jacq., spotted dead-nettle *Lamium maculatum* L., *Geranium* spp., black-thorn *Prunus spinosa* L. and common lilac *Syringa vulgaris* L.

Dynamics of its occurrence in Poland. The earliest annual record of imago in Poland was made on 19 April, with the latest on 4 September and with its abundance peaking in May (Fig. 9A). The number of generations is not known. The exceptionally long flight season suggests that *R. campestris* may have more than one generation during the growing season, or that imagines hatch successively during a period of four months. Our analysis of the long-term changes in the abundance of this species has revealed the paucity of publications and museum specimens dating from before the Second World War (Fig. 9B). This is partly because flies were seldom studied in central and northern Poland at that time, and partly because the collections from these regions were lost as a result of wartime destruction. The dynamic and continuous increase in the *R. campestris* population during the 1950s, 1960s and 1970s was most probably due to the recovery of the numbers of cattle in Poland, from 3 million head in 1945 to 13 million in 1975 (WĘGLARZ & SZAREK 2023). During those times, cattle were allowed to graze freely on large areas of pastureland belonging to state-owned farms and farm production cooperatives, as a result of which the number of microhabitats all over the country, which are suitable for the development of this species, rose very rapidly. The largest number of individuals was recorded in the decade after 2010, which coincided with an increased intensity of fieldwork. However, we do not know whether, and to what extent, the negative impact of the use of endectocides or antibiotics in cattle populations on coprophagous insects (HUSSAIN et al. 2021) could also have affected the Polish populations of *Rhingia campestris* over the years.

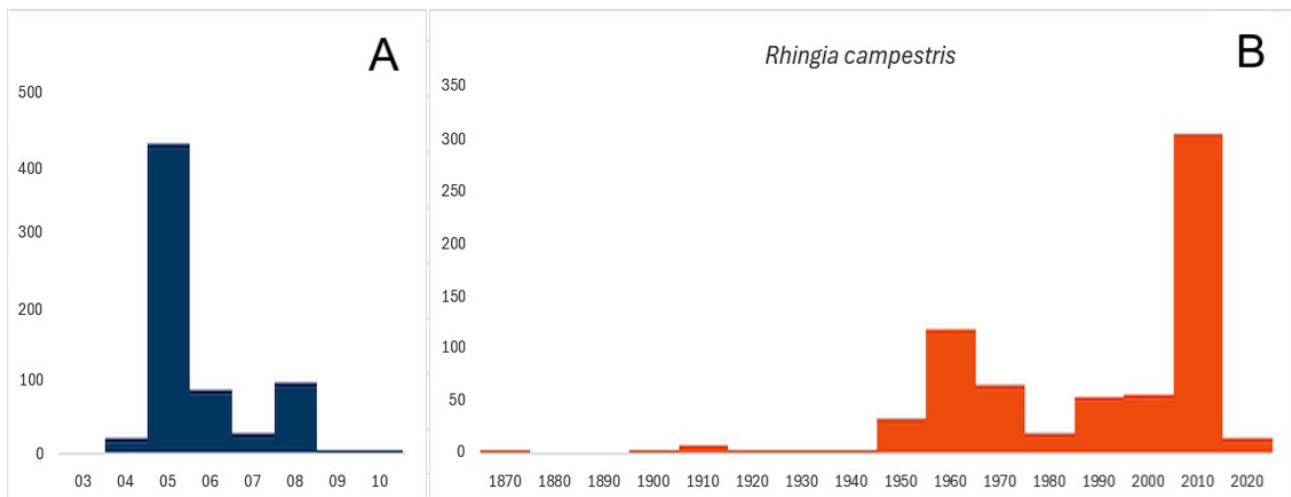


Fig. 9. Records of *Rhingia campestris* (n=676): A – phenology (sum over the years in particular months); B – records per decade.

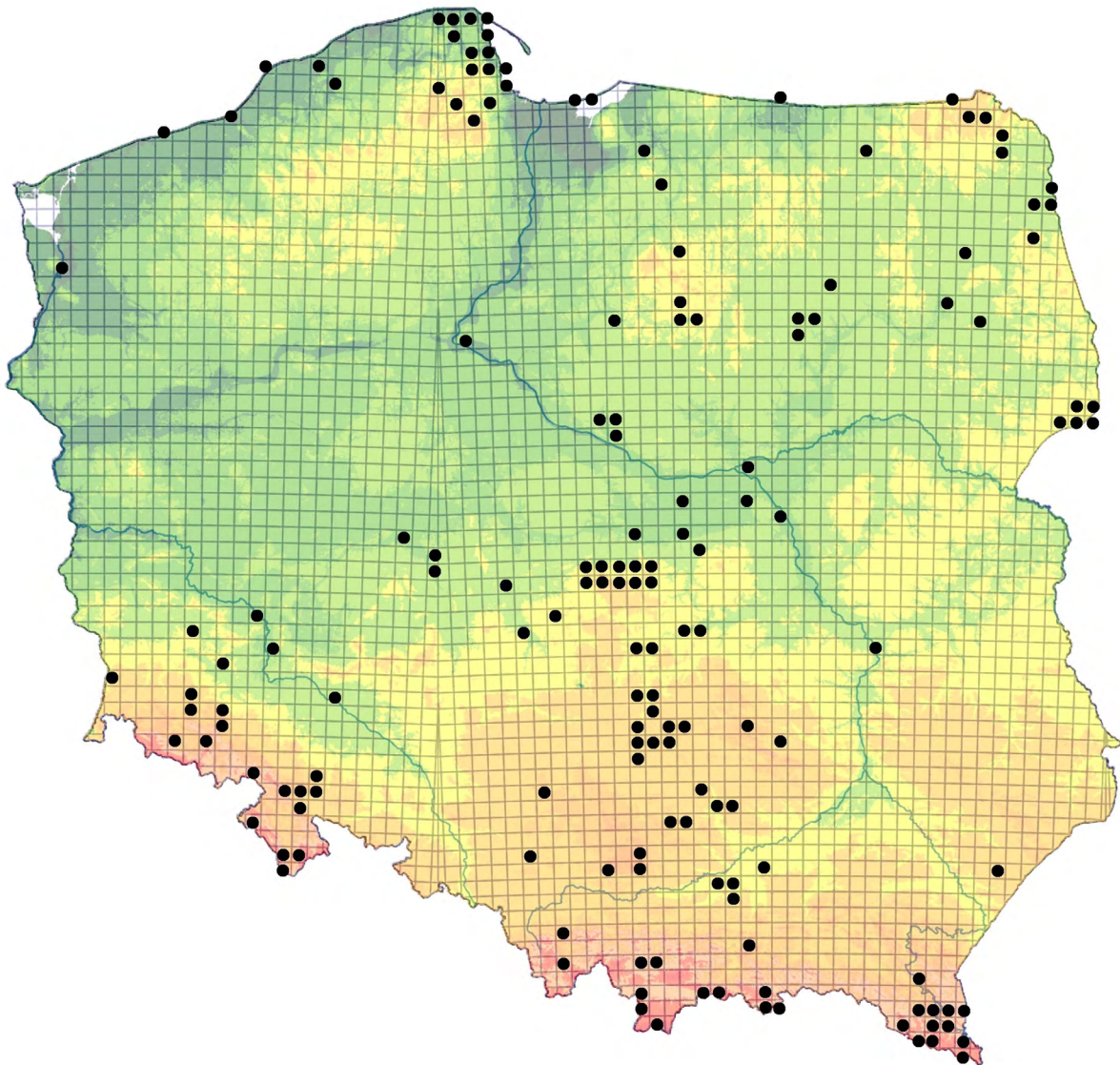


Fig. 10. *Rhingia campestris* MEIGEN, 1822 – distribution in Poland.

Distribution. *Rhingia campestris* is widely distributed in the Palaearctic and is frequently recorded. In Poland, it has been found in most of the localities where hoverflies have been studied. The material analysed comes from 160 UTM (10×10 km) squares (Fig. 10), confirming that this species is present in the majority of physiographic regions. There are no records (voucher specimens) from the regions of Roztocze and Polesie (E Poland), and from two other small regions in E Poland, i.e. the Wołyń Upland and Eastern Podkarpacie. The visible gap in western Poland between the Baltic Coastlands and Silesia (Fig. 10) applies to large areas of the Pomeranian Lakeland and Wielkopolska-Lubusz, but

from these regions the species is present (although from a small number of locations). Future fieldwork is expected to reveal the presence of this species at further localities in the whole country.

Threats and conservation. This species is common throughout Poland, but as the breeding and free grazing of cattle has ceased in most of the country, as well as the use of endectocides and antibiotics in cattle populations, its numbers are expected to fall and some local populations may become extinct. Nevertheless, it does not require any specific forms of conservation. Biological cattle raising helps to maintain the species.

***Rhingia rostrata* (LINNAEUS, 1758)**

(Fig. 1D, 1E, 2D, 2E, 4C, 5C, 5F, 5I, 5L, 5O, 6E, 6H)

Material examined: 148 specimens (67 ♂♂, 81 ♀♀): **Baltic Coastlands (Pobrzeże Bałtyku):** ‘Frauendorf’ = Szczecin-Golęcino [VV72], no date, 3 ♀♀, 20 VII 1904, 1 ♂, 21 VII 1904, 1 ♂, leg. G. Schroeder, coll. MIZ (SCHROEDER 1909); ‘Stettin’ = Szczecin [VV72], no date, 13 ♂♂, 4 ♀♀, 13 VI 1908, 1 ♀, leg. G. Schroeder, coll. MIZ (SCHROEDER 1909); ‘Stettin, Julio’ = Szczecin, Leśne Wzgórza [VV72], 4 VI 1904, 1 ♂, 6 VI 1909, 1 ♂, 7 VI 1912, 1 ♂, leg. G. Schroeder, coll. MIZ (SCHROEDER 1909); Gdynia-Redłowo: Polanka Redłowska [CF44], 15 VI 2009, 1 ♀, 19 IX 2009, 1 ♀, 18 VI 2012, 1 ♂, 9 VIII 2012, 1 ♂, 2 IX 2012, 3 ♂♂, 25 V 2015, 1 ♂, leg. JKK (ŻÓRALSKI & KOWALCZYK 2017); Gdynia-Redłowo: Arka Tennis Club [CF44], 8 IX 2013, 1 ♀, leg. JKK (ŻÓRALSKI & KOWALCZYK 2017); Łęg nad Sweliną nature reserve [CF43], 27 V 2017, 1 ♂, 10 VI 2017, 2 ♀♀, leg. JKK (ŻÓRALSKI & KOWALCZYK 2019), 16 V 2018, 2 ♀♀, 19 VII 2018, 1 ♀, leg. RZ, coll. RZPC (ŻÓRALSKI & KOWALCZYK 2019); **Wielkopolska-Lubusz (Obszar Wielkopolsko-Lubuski):** Łódź: Julianów [CC94], 15 VII 1967, 1 ♂, leg. JKK (MARKOWSKI et al. 1998); **Lower Silesia (Dolny Śląsk):** Weitz?, no date, 1 ♀, coll. MNHW; no date, 3 ♂♂, 2 ♀♀, leg. Scholtz, coll. MNHW, ex coll. Scholz, no date, 6 ♂♂, 4 ♀♀, coll. MNHW; Dingenau?, VII 1849, 1 ♂, leg. Scholtz, coll. MNHW, ex coll. Scholz; Paczków near Nysa [XR49], 21 VIII 1957, 1 ♀, leg. D. Dziadosz, coll. MIZ (BAŃKOWSKA 1964); **Upper Silesia (Górny Śląsk):** Chelmek [CA75], 30 III 1883, 2 ♀♀, leg. S. Stobiecki, coll. ISEZ; Ujków Stary [CA97], 2 V 2014, 1 ♀, leg. A. Witek, coll. LMPC, 16 VIII 2015, 2 ♀♀, leg. LM, coll. LMPC (MIELCZAREK et al. 2021); Sławnikowice [WS16], 19 VIII 2014, 1 ♀, leg. & coll. G. Pennards; Dąbrowa Górnicza, Jamki [CA77], 3 VI 2021, 2 ♀♀, leg. LM, coll. LMPC; **Kraków-Wieluń Upland (Wyżyna Krakowsko-Wieluńska):** Krzeszowice [DA05], 21 V 1965, 2 ♀♀, coll. ISEZ, 31 VIII 1966, 1 ♂, 20 V 1968, 1 ♀, coll. ISEZ; Biały Kościół, Dolina Kluczwoły [DA15], V 2015, 1 ♀, leg. LM, coll. LMPC; Kraków: Garlica Murowana [DA25], 29 VIII 2014, 1 ♀, leg. AT, coll. ATPC; Młoszowa [CA95], 25 VI 2011, 2 ♂♂, leg. R. Celadyn, coll. LMPC; Miękinia (Stawiska) [CA95], V 2022, 1 ♂, leg. LM, coll. LMPC, 20 V 2023, 2 ♀♀, observation of oviposition, leg. LM, coll. LMPC; **Małopolska**

Upland (Wyżyna Małopolska): Żegiestów [DV86], 13 VIII 1920, 1 ♂, 1 ♀, 15 VIII 1920, 1 ♀, coll. ISEZ; Moczydło near Miechów [DA49], 26 VII 2011, 1 ♂, leg. LM, coll. LMPC; Miechów district: Giebułtów [DA48], 21 VII 2015, 1 ♂, leg. CB, coll. RZPC; **Lublin Upland (Wyżyna Lubelska):** Puławy [EB69], no date, 1 ♀, 7 V 1894, 1 ♂, 6 VII 1894, 1 ♀, leg. I.K. Tarnani, coll. MIZ, no date, 1 ♀, leg. Schmol?, coll. MIZ; **Sudety Mts. (Sudety):** Lewin Kłodzki near Kudowa [WR98], VIII 1954, 4 ♂♂, 2 ♀♀, leg. R. Trojan, coll. MIZ (TROJANOWA-BAŃKOWSKA 1959, jako *R. campestris*); Duszniki-Zdrój [WR98], 24 VII 2021, 1 ♂ (Fig. 2E, F), leg. RZ, coll. RZPC; **Northern Subcarpathia (Podkarpacie Północne):** Żak?, 31 VII, 1 ♀, 03 VIII, 1 ♀, 19 VIII, 1 ♂, coll. ISEZ; Kraków: na Błoniach [DA24], 18 V 1878, 1 ♀, 12 VI 1878, 1 ♀, leg. S. Stobiecki, coll. ISEZ; Kraków: Wola Justowska, “na Sikorniku na krzakach” [DA14], 24 V 1878, 1 ♀, leg. S. Stobiecki, coll. ISEZ; Kraków: Zwierzyniec Sikornik, “ponad wąwozem na ścianie pochyłej trawą zarosłej” [DA14], 20 X 1878, 1 ♀, leg. S. Stobiecki, coll. ISEZ; Kraków, Podgórze, “na Krzemionkach na lewo od kościoła i na skałach” [DA24], 16 V 1879, 1 ♀, leg. S. Stobiecki, coll. ISEZ; Kraków: Krzemionki Dębnie [DA24], 19 V 1920, 1 ♂, 30 V 1920, 4 ♀♀, 5 VI 1920, 2 ♂♂, 5 ♀♀, 26 VI 1920, 2 ♂♂, 4 VIII 1920, 1 ♀, 5 V 1921, 1 ♀, coll. ISEZ; Kraków: Przegorzały [DA14], 6 V 1923, 1 ♀, coll. ISEZ; Kraków: Mogilski Forest [DA34], 1 V 2014, 3 ♂♂, 2 ♀♀, 6 V 2014, 1 ♂, 1 ♀, 8 V 2020, 1 ♀, leg. LM, coll. LMPC; **Beskid Mts. and Foothills (Beskidy i Pogórza):** Beskid Sądecki: Krynica [DV97], 1876, 1 ♀, coll. ISEZ; Bednarka near Gorlice [EV29], 25 VII 1943, 1 ♂, leg. M. Kłapacz, coll. MIZ; Lanckorona [DA02], 14 VIII 1965, 1 ♂, coll. ISEZ; Beskid Zachodni: Ponice near Rabka [DV29], 27 VII 1998, 1 ♂, leg. D. Żyła, coll. USMB; Bielsko-Biała [CA51], 1 VIII 2005, 1 ♂, leg. & coll. G. Pennards; Obrożyska nature reserve, Muszyna [DV96], 23 V 2010, 1 ♀, leg. LM, coll. LMPC; Bystra near Wilkowice [CA61], 23 VII 2014, 1 ♀, leg. G. Dubiel, coll. RZPC (ŻÓRALSKI & DUBIEL 2020); Krościenko nad Dunajcem, Kłodne [DV57], VI 2017, 1 ♂, 3 ♀♀, leg. LM, coll. LMPC; Sobkówka [CV67], 9 IX 2017, 1 ♀, leg. G. Dubiel, coll. RZPC (ŻÓRALSKI & DUBIEL 2020); **Orawa Podhale (Obszar Orawsko-Podhalański):** Żywcańskie (currently a district in Zakopane) [DV25], 1903, 1 ♀, coll. ISEZ; Zakopane [DV26], 10 IX 1992,

1 ♀, leg. JKK, 17 VIII 2009, 1 ♂ (Fig. 1E, F), leg. RZ, coll. RZPC; **Pieniny Mts. (Pieniny)**: Pieniny [DV57], no date, 1 ♀, leg. Sitowski, coll. ISEZ; Łącko [DV58], 24 VIII 1952, 1 ♂, leg. R. Trojan, coll. MIZ (BAŃKOWSKA 1976); **Tatra Mts. (Tatry)**: Tatry, Dolina ku Dziurze [DV25], 28 VIII 1970, 1 ♀, leg. A. Riedel, coll. MIZ; Małej Łąki Valley [DV25], 17 IX 1992, 1 ♂, 1 ♀, leg. JKK.

Description. Size: 8-9.5 mm. The general appearance of the male is as in Fig. 1E, F, while that of the female is as in Fig. 2E, F. In *R. rostrata* the abdomen is uniformly orange, without a distinct border, the mesonotum is matt with grey pruinosity, and the femora are completely grey-brown. Irregular shading may occur on the abdomen. The abdominal pile is black, with this colour often being dominant. The pile on the arista is clearly visible, but is distinctly shorter than in *R. borealis* (VAN DE MEUTTER 2011), not exceeding $\frac{1}{2}$ of the broadest diameter of the arista. The drawing in VAN STEENIS (1998) shows a virtually bare arista, which does not reproduce this characteristic correctly.

Terminalia. **Male.** The shape and vestiture of the surstylus are as in Fig. 4C. The other components of the male terminalia are as illustrated in Fig. 5C, F, I, L, O. The ejaculatory apodeme is exceptionally strongly chitinised. **Female.** Some components of the female terminalia are illustrated in Fig. 6E, H. The shape of the cerci is characteristic: on the lateral surface they are straight, but on the medial surface they are semicircular, unlike in the other two species. The structure of the spermathecae is as described in the diagnosis of *Rhingia*. Two long ducts emerge from the genital chamber, one of which bifurcates at around $\frac{1}{3}$ of the length from the chamber exit. The total length of a single duct in this species to the spermatheca is 2.2 mm. The other characteristics of the spermathecae are as in the diagnosis of the genus.

Biology. Most records of *Rhingia rostrata* in Europe (STUBBS & FALK 1983) come from deciduous woodlands. GRUNIN (1939) described the way that a female lays her eggs on the undersides of leaves or branches, in clutches of around 100, directly above vertebrate excreta which she has previously located. This strategy safeguards the eggs from the attention of predators within the substrate, such as the rove beetle *Staphylinidae*. At the same time, GRUNIN sug-

gested that *Rhingia rostrata* prefers a dried-out substrate, from which other coprophages are absent.

During the fieldwork, one of the authors (ŁM) was able to confirm and document photographically and on short films this strategy of laying eggs above the substrate and not in it (Fig. 11A), and also the hatching of the larvae and their dropping down into the food resource (Fig. 12). In this particular case, the larval microhabitat was a compost heap under the crown of a Scots pine *Pinus sylvestris* L. in the village of Miękinia near Krzeszowice (S Poland). The compost contained not only fruit, mowed grass and vegetable waste and twigs, but also cat excreta. Interestingly, further females laid eggs in a common clutch (Fig. 11B) on the underside of a branch that lay about 30 cm above the substrate. The larvae hatched within one week. The use of grass compost by the larvae of *R. rostrata* was recently observed in the UK, where the larva used a very wet substrate in an artificial microhabitat (ROTHERAY 2025).

The laying of eggs in one place is not a common occurrence among dipterans. Such behaviour has been described in the genus *Atherix* MEIGEN, 1803 (Athericidae) and recently in *Tabanus fairchildi* STONE, 1938 (Tabanidae) (CONNER & THOMAS 2024). Compost heaps imitate the conditions that arise within natural accumulations of detritus, such as branches and leaves, mixed with the sediments of rivers along their banks. In the case in Poland described above, a microhabitat such as this occurred naturally on the bank of the nearest stream, a mere 50 m or so from the site where the egg laying was observed. Such sites, like compost heaps, are characterised by very high levels of humidity and elevated temperatures. Microhabitats like these may be the natural environment in which *Rhingia rostrata* larvae can develop. In later seasons, egg laying by *Rhingia* in compost heaps at the same site was not seen. In addition, further attempts to observe feeding larvae and their leaving the compost heaps were unsuccessful, even though imagines had been sighted in the vicinity. This may imply that the compost heap in question could have been an ecological trap for females searching for the most suitable egg-laying site, rather than providing a suitable reproductive habitat. The most desirable substrate for larval development could also have been mammalian excreta, which made up part of the matter that was accumulating in the compost heap.

Imagines of *R. rostrata* have been found on the flowers of the water avens *Geum rivale* L. (SCHROEDER



Fig. 11. *Rhingia rostrata*: A – female laying eggs; B – clutches of eggs from several females.



Fig. 12. *Rhingia rostrata*: red arrows – hanging larva, just before dropping on to the substrate; green arrows – a lot of empty egg casings from which larvae have emerged.

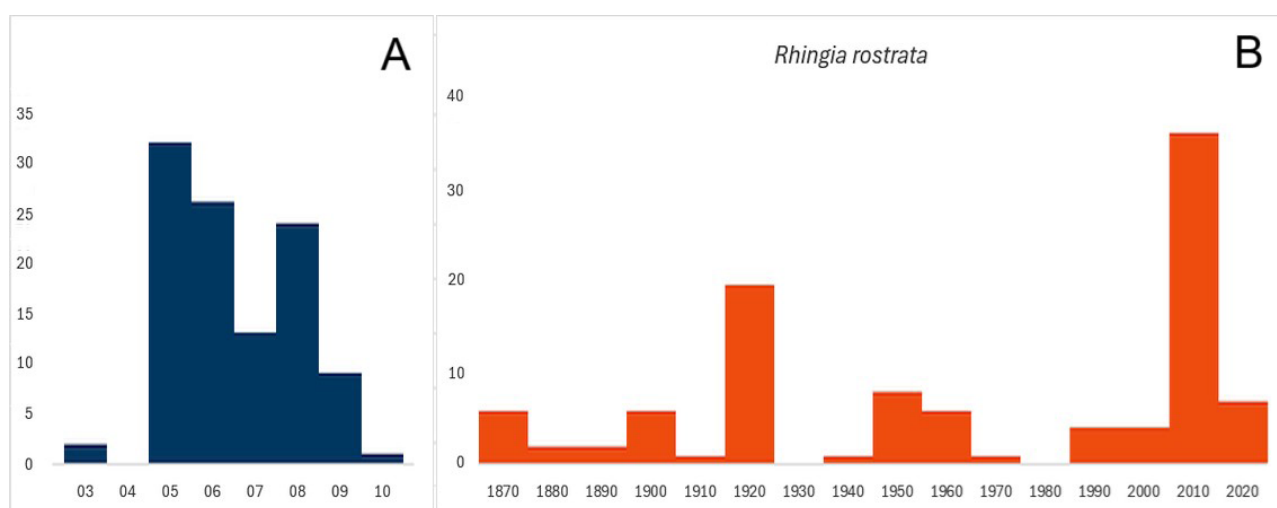


Fig. 13. Records of *R. rostrata* (n=105): A – phenology (sum over the years in particular months); B – records per decade.

1909), and also on the red campion *Silene dioica* (L.), herb-Robert *Geranium robertianum* L., hedge mustard *Sisymbrium officinale* (L.) (ILIFF 2000), devil's bit scabious *Succisa pratensis* MOENCH (GREEN 2001) and the wood spurge *Euphorbia amygdaloides* L. (CLEMONS 2001).

Dynamics of its occurrence in Poland. In Poland, *R. rostrata* occurs in two generations, chiefly in May and August (Fig. 13A). In the period of 1870-1930, it was frequently and regularly recorded (Fig. 13B), principally in the Kraków area, and was more abundant than *R. campestris*, a situation reflected by our analysis of the museum specimens. In contrast, after 1950, *R. campestris* became more common and has remained so, now being

found around ten times more often than *R. rostrata*. In some countries in western Europe, *R. rostrata* can be locally abundant in some years, after which it disappears for a longer or shorter period of time (STUBBS & FALK 1983). Such long-term fluctuations in its occurrence have also been confirmed by data from Poland: during two decades – the 1930s and the 1980s – not a single individual of *R. rostrata* was recorded. One important factor affecting our perception of such changes in the abundance of *R. rostrata* is the variable intensity of the fieldwork over the decades. This is reflected by the similar shapes of the occurrence histograms for all three *Rhingia* species during certain decades (the 1950s), and in particular the decade 2010-2020, when the research on Syrphidae

was particularly intense (Fig. 7B, 9B, 13B). Based on the entirety of the data from the last 150 years, one can state unequivocally that *R. rostrata* is a native, permanent component of the fauna of southern Poland. The recent discovery of isolated population of this species in Gdynia (Baltic Coastlands, N Poland) has turned out to be stable, as is confirmed by systematic observations in the years 2009–2018 (ŻÓRALSKI & KOWALCZYK 2017, 2019).

Distribution. Historically, this species has been reported from the Tatra Mts. (LOEW 1870; NOWICKI 1873; BOBEK 1890; MALSKI 1959), Nowy Sącz basin (GRZEGORZEK 1872) and the area of the present day ‘Tri-City’ (Gdańsk, Sopot, Gdynia)

(CZWAŁINA 1893). In recent times, *R. rostrata* has again been recorded in many of these localities (see above). On the other hand, the recording from the Warsaw area (SZNABL 1881) has not been confirmed by any contemporary data and probably refers to a misidentification of *R. campestris*. Most contemporary records from Poland are concentrated in the Małopolska Upland and Western Beskid regions (Fig. 14). Beyond these areas, there are just a handful of usually isolated localities, e.g. in the Baltic Coastlands and the Sudety Mts. A quite rare species, it has been recorded in 31 UTM (10x10 km) squares.

Threats and conservation. *Rhingia rostrata* has been placed on the Red List of Endan-

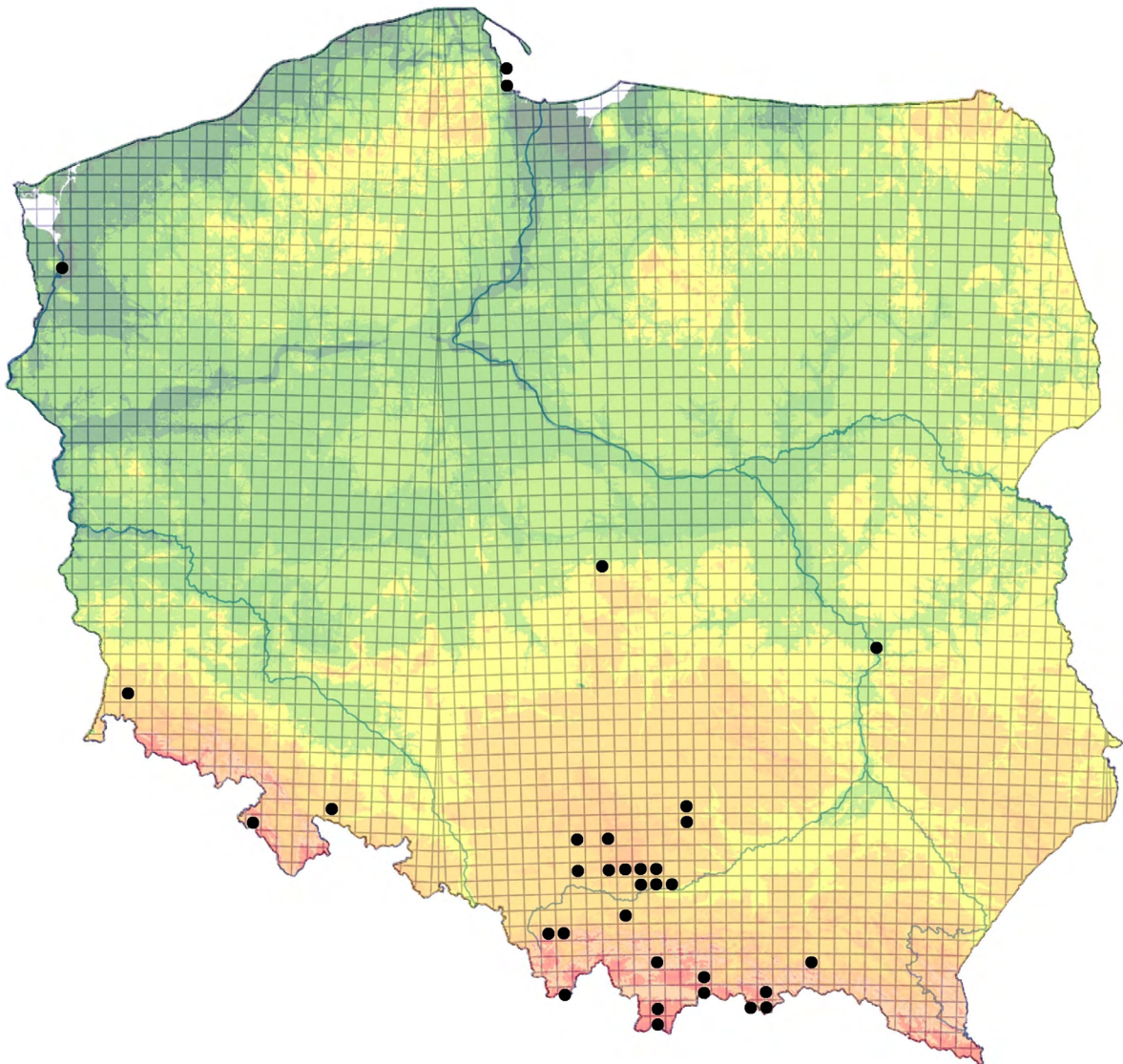


Fig. 14. *Rhingia rostrata* (LINNAEUS, 1758) – distribution in Poland

gered Species in Poland in the DD (data deficient) category (PALACZYK et al. 2002). Recent findings show that the species occurs both in natural and more urbanised habitats with no signs of a decline, so it should be listed as Least Concern (LC). A warm-adapted species, it occurs in Poland mainly in the south of the country. The northern boundary of this species' continuous range crosses Poland. The records in the northernmost localities, in the extreme south of Sweden and a scattering of others in Denmark, concern single sitings. Until recently, *R. rostrata* was regarded as critically endangered or even extinct in many countries, e.g. Denmark, Sweden, the Netherlands, Great Britain, northern Germany and France (BREE et al. 2013). But the first records for more than 50 years have been gradually appearing throughout north-western Europe (LIFF 2000, 2001; GREEN 2001; PALMER 2004; VAN DE MEUTTER et al 2010; VAN DE MEUTTER 2011). Subsequent information about *R. rostrata* from Great Britain (LIFF 2004; JONES 2006) showed a sudden and considerable increase in the abundance of the existing populations. This species is very probably availing itself of changes taking place in the environment. It is unclear whether it is making use of ubiquitous compost heaps, but the warming climate may well be a factor that is helping to restore the Polish population. Further positive factors include the considerable increases in the populations of large game animals and forest cover, as well as the various approaches to the upkeep of domestic animals.

IV. KEY TO THE IDENTIFICATION OF *RHINGIA* SPECIES

Key to the identification of the European species of the genus *Rhingia*:

1. Arista pilose; with the pile as long as or longer than the diameter of the arista (Fig. 3). Male: scutellum black; femora completely black or distally slightly paler, brownish-black *Rhingia borealis* RINGDAHL, 1928
 - Arista with the pile much shorter than the diameter of the arista; it can even be bare. Males: scutellum orange or dark brown; femora darkened in the first half, if at all 2
2. Males (eyes holoptic, abdomen with a genital capsule) 3

- Females (eyes dichoptic, abdominal apex pointed, without a capsule) 4
3. Tergum 4 covered with a white-yellow pile. Metatibia with a central black vitta. Terga 2-4 with dark-brown to black margins; this blackening is usually also present in the posterior parts of the terga and in the form of a medial vitta. Thorax black, with four shiny longitudinal vittae (not pruinose) on the pronotum. Mala twice as long as the eye *Rhingia campestris* MEIGEN, 1822 (male)
 - Tergum 4 densely covered with a black pile. Metatibia pale, without a black stripe. Terga 2-4 with orange-red margins. If blackening is present, it occurs exclusively on the posterior parts of the terga. Thorax with silvery pruinosity and four matt vittae (not pruinose). Mala up to 1.5 times longer than the eye *Rhingia rostrata* (LINNAEUS, 1758) (male)
4. Bases of the femora darkened. Tibiae usually with central black stripes *Rhingia campestris* MEIGEN, 1822 (female)
 - Femora completely pale. Tibiae without central black stripes or with stripes that are faint and have blurred margins *Rhingia rostrata* (LINNAEUS, 1758) (female)

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VI. CONFLICT OF INTEREST

The authors declare no conflict of interest.

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