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A key to the Central European species of the genus *Rhithrogena* (Ehemeroptera: Heptageniidae)

Klíč k určování larev středoevropských druhů rodu *Rhithrogena* (Ephemeroptera: Heptageniidae)

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Key, species-groups, distinguishing characters, list of species, distribution, synonymy, Ephemeroptera, Heptageniidae, *Rhithrogena*, Central Europe

Abstract. The genus *Rhithrogena* Eaton, 1881 comprises more than 100 predominantly Holarctic species. Of the 73 West Palaearctic species, 37 species have been found in Central Europe so far. With the exception of a single case of sibling species and two species having unknown larval stage, larvae can be determined according to 7 formal "species-groups" (*R. alpestris* - 7 spp., *R. hercynia* - 5 spp., *R. hybrida* - 10 spp., *R. germanica* - 1 sp., *R. semicolorata* - 9 spp., *R. loyolaea* - 3 spp. and *R. diaphana* - 2 spp.) regardless the fact that these groups are artificial and do not reflect true interspecific phylogenetic relationships. Simple distinguishing characters apparent under the light microscope obtained mainly by study of material from the Labe basin are keyed and illustrated. Synomymy of Central European species is summarized.

INTRODUCTION

The genus *Rhithrogena* Eaton, 1881 consists of more than 100 species mostly distributed in Palaearctic (about 85 species) and Nearctic regions (about 22 species, see e.g., Edmunds & Jensen 1976). One or two species extending deeply into the Indomalayan region represent an exception (Braasch & Soldán 1986). This genus exhibits the highest species diversity in western part of the Palaearctic region - 73 species have been described so far. Larvae show very high oxygen demands and represent, without any exception, highly rheophilous forms distributed mostly at montane biotopes of the epirhithon zone. They descend into larger submontane rivers (epipotamon) only exceptionally (e.g., *Rhithrogena germanica*, *R. beskidensis*, *R. savoiensis*) inhabiting streamline or exposed riffle habitats here as well. Larvae are often very common or even of the mass occurrence at these biotopes. Consequently, the species of *Rhithrogena* are mentioned in numerous ecological papers on aquatic insects or hydrobiological contributions. However, the individual species are often left undetermined or treated as wider species-groups (e.g., *Rhithrogena* sp., *Rhithrogena* spp., *R. semicolorata* species-group etc.).

Actually, determination of larvae of the genus *Rhithrogena* belongs to the most complicated ones within the order Ephemeroptera in general and thanks to relative isolation of some mountain populations and very low vagility of mayflies often also so called "reliable" characters vary in a great extent. This situation is complicated also with sibling species (*R. iridina, R. picteti*), strongly vicariant species (*R. hercynia, R. grischua*) and species with so far undescribed larvae (*R. henschi, R. fonticola*). Moreover, contemporary careful taxonomic revisions showed that every of original "species" (perhaps with the exception of *R. germanica*) actually represents a com-

plex of mostly several true species. These considerable taxonomic shifts discriminate earlier keys to Central European *Rhithrogena* (e.g., Landa 1959, 1969 or Zelinka 1980) which, consequently, are quite obsolete at present. On the other hand, validity of some of these taxonomic shifts is at least doubtfull and further taxonomic treatment is badly needed. Till present, only a little attention has been paid to precise determination of *Rhithrogena* larvae. Sophisticated keys published so far (e.g., Studemann et. al. 1992, Bauernfeind 1995 and Krno & Deván 1996) are unfortunately strongly limited since they cover local faunas only (Switzeland, Austria, Slovakia in the papers cited above).

The objective of this paper is to present a basic determination key to all the Central European species described so far which is, according to our opinion, urgently needed not only for taxonomical but also for numerous limnological and ecological studies.

METHODICAL REMARKS

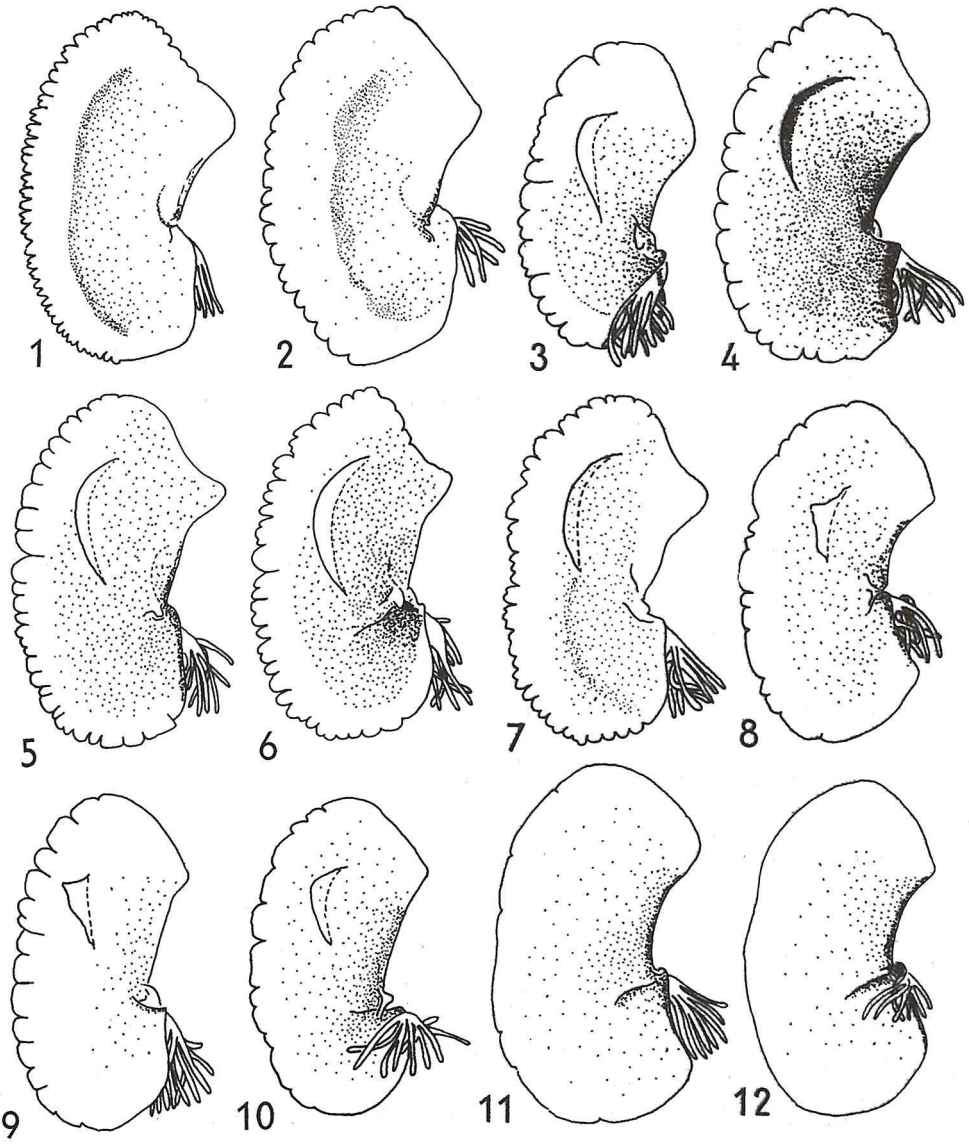
Since any other mayfly genus than *Rhithrogena* is not mentioned in this paper, the generic abbreviation (*R.*) is not presented everywhere (e.g., when introducing species-groups). For better keying, Central European species of *Rhithrogena* are arranged into 7 formal "species-groups" (cf. Sowa 1984, Sowa & Soldán 1986, Sowa & Degrange 1987a, Sartori & Oswald 1988). Remaining West Palaearctic groups, namely the *R. sowai* (Mediterranean) and the *R. znojkoi* (Turkey, Asia Minor and the Caucasus) are most probably not distributed in Central Europe at all. Species-groups of the genus *Rhithrogena* represent rather arbitrary clusters of species defined mostly on the basis of morphological similarity and usually do not reflect true phylogenetical relationships. Moreover, morphological differentiation seems to be rather vague in some cases (e. g. the *R. hercynia* and *R. hybrida* species-groups). These species-groups are involved in keys and the numbers of species contained in are enumerated in the respective key theses and antitheses.

Nomenclature of morphological characters follows that by Landa (1969). Plica is a cuticular duplicature in the anterior part of the first gill plate (Figs. 3-10). As far as tracheal gills of the genus *Rhithrogena* are concerned, only plates and never bundles of filaments are considered in keys. Like individual abdominal segments, also tracheal gills (always 7 pairs in the genus *Rhithrogena*) are numbered with Roman letters to distinguish the references to individual theses, antitheses and figures. If the integument of respective body segment is differentiated into sclerites, then the term sclerites is used. If not, the respective surface parts of individual body segments are termed as terga or sterna. Not differentiated, long macrotrichia are termed as bristles (Figs. 27, 28, 30, 31). Specialized, short and flattened macrotrichia on the dorsal surface of femora (Figs. 53-62 and 74-82) are termed as femoral spatules. Not articulated cuticular structures are termed as denticles (small, microscopical structures) or teeth (larger structures easily seen under very low magnification). Outer incisors are always longer and pointed anterolateral projections of mandibles, inner incisors are smaller and usually triangular or apically rounded inner anterolateral projections of mandibles (prosthecas). Denticles of lacinial scrapes should be counted on the fourth or fifth scape from the anterolateral top of maxilla, denticles on the posterior margin of abdominal terga on segments III or IV. If these structures are counted at different places their number can vary considerably. Any character of femora mentioned here (coloration or spatules) concerns femora of fore legs, if not explicitly stated otherwise (like in theses 3, 8, 9, 10 and 47). Since true cerci and paracercus (terminal filament) are morphologically nearly indentical in the genus *Rhithrogena*, all these structures are simply termed as "cerci". All the mouthparts are desribed and figured from dorsal view with the exception of labial glossae figured from ventral view (Figs. 48-52). As far as the individual theses and antitheses are concerned we have tried to arrange morphological characters presented in the sequence of their importance.

Naturally, it was not possible to figure all the structures mentioned in keys in all the species keyed. The abbreviation "cf. Fig." means that the structure (structures) in question is very similar or indentical in two or several species or even two or several species-groups or that this structure is identical with the respective structure of quite different species presented in quite remote key thesis. Simple abbreviation "Fig." refers to the actual species of the respective thesis or antithesis.

Other abbreviations used (in alphabetical order): abd. = abdominal; ant. = anterior, anteriorly; apic. = apical, apically; anterolat. = anterolateral, anterolaterally; auct. = auctorum, bas. = basal, basally; cf. = compare (con forme); dist. = distal, distally; dors. = dorsal, dorsally; lat. = lateral, laterally; marg. = margin, marginal, marginally; med. = medial, medially; nec = and not; pl. = plate, plates; post. = posterior, posteriorly; p. p. = part (partim, pro parte); posterolat. = posterolateral, posterolaterally; seg. = segment, segments; sp. = species (singular); spp. = species (plural); submarg. = submarginal, submarginally; venrolat. = ventrolateral, ventrolaterally.

International abbreviations of Central European countries are used in distributional notes (A = Austria, CH = Switzerland, CZ = Czech Republic, D = Germany, F = France, LUX = Luxemburg, I = Italy, PL = Poland, SK = Slovakia, UKR = Ukraine).



Figs. 1-12: gill I, dorsal view. 1 - *R. delphinensis*; 2 - *R. landai*; 3 - *R. gorganica*; 4 - *R. zelinkai*; 5 - *R. hercynia*; 6 - *R. circumtatrica*; 7 - *R. degrangei*; 8 - *R. germanica*; 9 - *R. semicolorata*; 10 - *R. carpatoalpina*; 11 - *R. savoiensis*; 12 - *R. beskidensis*.
Obr. 1-12: žaberní plátek I, dorsální pohled.

KEY TO DETERMINE CENTRAL EUROPEAN *RHITHROGENA* LARVAE

1 (46) Pl. VII (and mostly pl. II-VI as well) crenulated, their margins at least with 5 apparent rounded lobes (cf. Figs. 13-15, 22, 23, 25, 26). If only 1-3 open, less apparent rounded incisions on marg. of pl. VII (Fig. 16) present then abdominal nerve ganglia conspicuously pigmented, well apparent under transparent sternal cuticle and spatules on femora circular, approximately as long as wide (Fig. 53).

2 (11) Pl. I smooth without plica on dors. side (cf. Fig. 1,2,11, 12), submarg. bristles on both poster. and anter. marg. of femora (cf. Figs. 27-29). Distance between lat. sternites of abd. sternum I apparently smaller than their width (cf. Fig. 35). Seg. of cerci nearly smooth in their dist. part, without any conspicuous bristles and denticles (the *R. alpestris* species-group: 5 + 1 spp.).[1)]

3 (8) Only fore femora with row of submarg. bristles on the inner marg. (cf. Fig. 27), inner marg. of middle and hind femora without bristles, at most with several short spines or spatules (cf. Figs. 30-32).

4 (5) Claws of legs with 2-3 denticles (cf. Fig. 108), labrum triangular with rounded posterolat. lobes (Fig. 89)(west Alps: F, CH). ..... *R. intermedia* Metzler, Tomka et Zurwerra, 1987

5 (4) Claws of legs smooth, without any denticles, labrum irregularly quadrangular, laterally produced into rounded, approximatelly right angled lobes (cf. Fig. 84).

6 (7) Lacinial scrapes with 10-13 denticles (Fig. 68), inner incisors approximately of the same length and width (cf. Fig. 106). Spatules elongated, approximately three times longer than wide (Fig. 55), rusty brown spots in the middle of femora (Fig. 41)(Alps: F, A, CH). ..... *R. vaillanti* Sowa et Degrange, 1987

7 (6) Lacinial scrapes with less than 10 denticles (Fig. 67). Inner incisors narrow, 2.5 - 3 times longer than wide (cf. Fig 104), spatules short, oval, ratio length : width about 2:1. Femora without rusty brown spot in the middle, only with dark framed bright central field (cf. Figs. 43, 47)(Alps: A, CH, F, Šumava - Bohemian Forest Mts., Krkonoše - Giant Mts.: CZ). ..... *R. landai* Sowa et Soldán, 1984

8 (3) Row of submarg. bristles of femora well apparent on all three pairs of legs (cf. Figs. 28 29).

9 (10) Submarginal bristles of femora of the same lenght and density on inner and outer femora marg. (Fig. 29). Bas. part of labrum narrowed, labrum lat. produced into wide, rounded lobes (Fig. 86). Dors. part of abd. seg. conspicously coloured with brown violet smudges (Alps: F). ..... *R. delphinensis* Sowa et Degrange, 1987

10 (9) Submarg. bristles on inner margins of femora longer and more densely inserted than those on outer margins (Fig. 28). Bas. part of labrum nearly not narrowed, rounded (Fig. 85). Dors. part of abd. seg. nearly unicolorous, without brown violet smudges (Alps: A, CH, D, I, F). ..... *R. alpestris* Eaton, 1885

11 (2) Pl. I with apparent plica (cf. Figs. 3-7), submarg. bristles solely on poster. marg. of fore femora (cf. Fig. 30-32). Distance between lat. sclerites of abd. sternum I apparently longer than their width (cf. Fig. 33). Dist. half seg. of cerci with numerous bristles or denticles on their poster. margins.

12 (17) Pl. I with obtusely angled plica, or the axes of fore and lateral plical marg. approximately right angled (Figs. 3, 4). Lat. sclerites of abd. seg. I quadrangular, oriented backwards, sharp angles between their axes and longitudinal axis of body (cf. Fig. 34). Distal half seg. of cerci with denticles on their marg. Ventral abd. nerve ganglia always conspicuously pigmented, femoral spatules circular or oval (cf. Figs. 53, 56) (the *R. loyolaea* species group: 3 spp.).

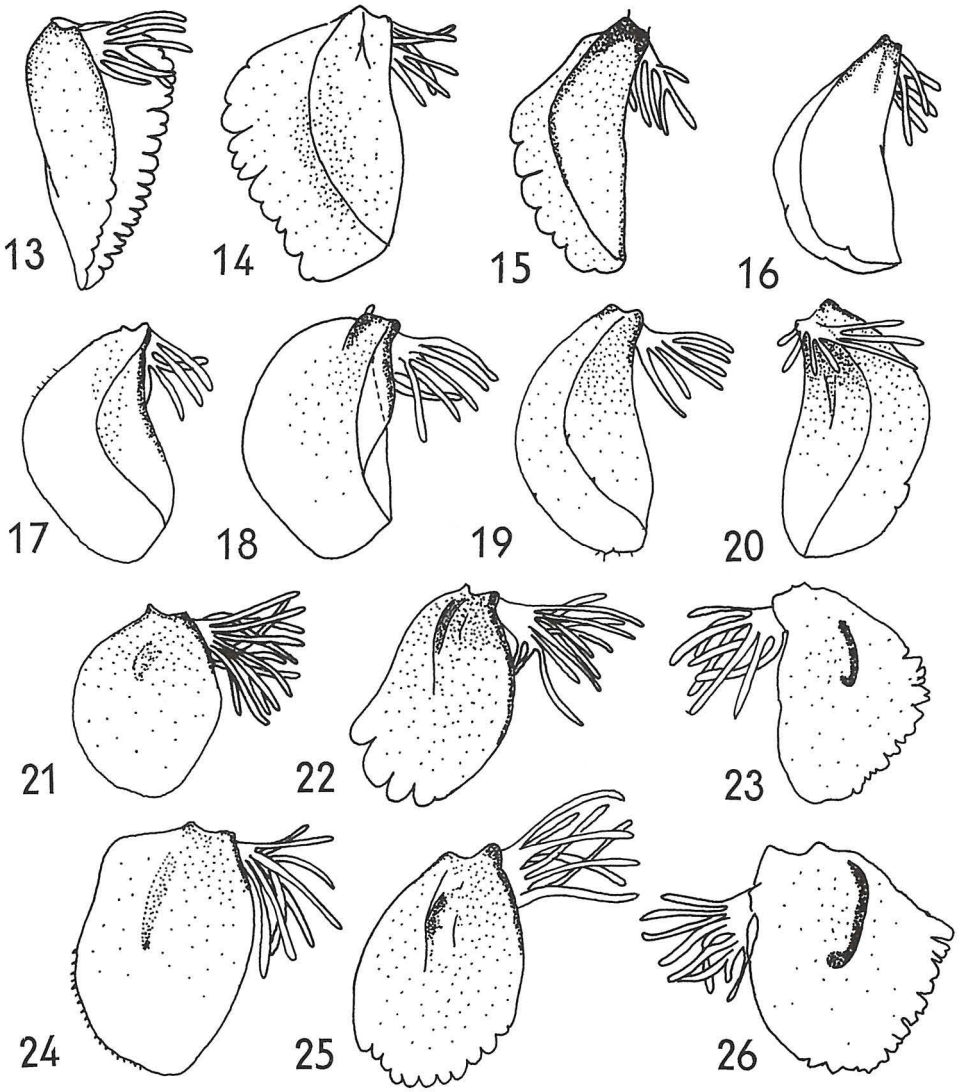
13 (14) Pl. II-VII nearly smooth, not crenulated or at most with 1 - 3 shallow incisions (Fig. 16). Labrum robust, ratio length: width 1 : 2.8-3.0. Glossae bluntly pointed, with straight or concave anterolat. marg. (Fig. 48). Femoral spatules circular, ratio lenght width 1 : 1.0-1.3 (Fig. 53)(Outer Carpathians, Low Beskid Mts.: PL, Poloniny Mts.: UKR, highly endemic). ..... *R. gorganica* Klapálek, 1905

14 (13) Pl. II-VII apparently crenulated, at least with 5 deeper, well visible incisions (Figs. 22, 25). Labrum short and very wide, ratio length : width 1 : 3.5-4.0 (cf. Fig. 87). Glossae oval or ellipsoidal, ratio lengt : width 1 : 2.0-3.0 (Fig. 56).

15 (16) Inner inscisor triangular, reaching about one third of the length of outer one (cf. Fig. 106). Pl. II-VII oval, slightly extended apic., with convex lat. margins and 10 - 15 marg. incisions (Fig. 25). Femora without rusty brown spot, only with lighter fiel in darker frame (Fig. 47)(Pyrenées, Alps: A, CH, D, F, I, Šumava - Bohemian Forest Mts.: CZ, Carpathians: SK, PL, Pyrenées: F). ..... *R. loyolaea* Navás, 1922

16 (15) Inner incisor elongated, rounded or oval, reaching a half of the length of outer one (cf. Fig. 102). Pl. II-VII with apically slightly convergent lateral marg., and straight or concave fore marg. and 5-6 marginal incisions (Fig. 22). Femora with diffused central spots in pale field (Alps: A, Krkonoše - Giant Mts.: CZ, High Tatra Mts.: SK). ..... *R. zelinkai* Sowa et Soldán, 1984

[1)] Larvae of the species *R. henschi* Klapálek, 1906 belonging to this group as well (Sowa 1984) are still unknown. Type specimen (adult male) is labelled "Kesmark, 5. 8. 91, Dr. Hensch" (means 1891), type locality is situated in Slovakia. However, this species most probably does not live in Central Europe at all, the type material is confused with that collected in Balcan, Croatia (for more details see Puthz 1975 or Landa & Soldán 1989). Mature male larvae of remaining species of this group should be distinguished by elogated, simply triangular, pointed titilator of pharate imago (cf. Fig. 91). Males of *R. henschi* possess quadrangular titilators with always several pointed teeth on the poster. margins (Figs. 92, 93).



Figs. 13-26: gills III, VI and VII, dorsal view. 13-20 - gill VII; 21, 24, 26 - gill III; 22, 23, 25 - gill VI. 13 - *R. delphinensis*; 14 - *R. circumtatrica*; 15, 22 - *R. zelinkai*; 16 - *R. gorganica*; 17 - *R. semicolorata*; 18 - *R. beskidensis*; 19 - *R. carpatoalpina*; 20 - *R. puytoraci*; 21 - *R. semicolorata*; 23, 26 - *R. nivata*; 24 - *R. germanica*; 25 - *R. loyolaea*.
Obr. 13-26: žaberní plátky III, VI a VII, dorsální pohled. 13-20 - plátek VII; 21, 24, 26 - plátek III; 22, 23, 25 - plátek VI.

17 (12) Pl. I with semilunar plica, axes of its lateral and fore marg. at obtuse angle (cf. Figs. 5-7). Lat. sternites of abd. seg. I quadrangular, their axes and longitudinal axis of body right angled (cf. Fig. 33). Distal half segments of cerci with numerous bristles on their post. marg. Abd. nerve ganglia slightly pigmented only in some specimens. Femoral spatules never circular, mostly oval or cut in apical part (cf. Figs. 57-62, 73, 78).

18 (27) Rusty brown or brown violet spots situated in paler field with usually olive green frame well apparent in the centre of femora (cf. Figs. 36-39) (the *R. hercynia* species group).

19 (20) Centr. femoral spots conspicuous with dissolved marg., occupying nearly the whole pale field, its length equal to about 1/3 of the femur length (Fig. 39). Teeth on the poster. marg. of abd. terga conspicuously pigmented basally (Fig. 101) (Hercynian mountain system: A, CZ, D; Carpathians, very rarely: CZ, SK, Alps: CH). ..... *R. hercynia* Landa, 1970

20 (19) Central femoral spots smaller with sharply bordered margins, its length diameter equal at most to 1/5 or 1/6 of the femur length, pale field in darker frame well apparent (cf. Figs. 36-37). Teeth on poster. marg. of abd. seg. without bas. pigmentation (cf. Figs. 95, 111).

21 (24) Lacinial scrapes with 6-9 denticles (cf. Figs. 64, 65, 71). Terga VII-IX unicolorous, at most with diffuse darker smudges.

22 (2) Teeth on poster. marg. of abd. terga approximately of the same lengt and bluntly pointed (cf. Fig. 99). Femoral spatules moderately elongated, approximately three times longer than wide (Fig. 60)(Alps: CH, F). ..... *R. gartianopolitana* Sowa, Degrange et Sartori, 1986

23 (22) Teeth on poster. marg. of abd. terga conspicuously inequal in length and sharply pointed (cf. Figs. 97, 98). Femoral spatules shorter and wider, approximately twice longer than wide (Fig. 61) (Carpathians, High and Low Tatras: PL, SK). ..... *R. podhalensis* Sowa et Soldán, 1986

24 (21) Lacinial scrapes with 11-14 denticles (cf. Figs. 63, 68, 70). Abd. terga VII-IX with a pair of large lateral spots, medially separated with darker band (cf. Fig. 111).

25 (26) Rusty brown femoral spots oval, as long as about 1/4 of the femur length (Fig. 38). Poster. marg. of abd. terga with triangular, bluntly pointed teeth, terga with numerous submarg. denticles (cf. Fig. 98) (Alps: CH). ..... *R. grischua* Sartori et Oswald, 1988

26 (25) Rusty brown femoral spots circular, in diameter shorter than 1/6 of the femur length (Fig. 37). Poster. marg. of abd. terga bluntly pointed or tongue-shaped and apically rounded, submarg. denticles on terga very rare (Fig. 99) (Krkonoše-Giant Mts. and Jeseníky Mts., probably endemic: CZ). ..... *R. corcontica* Sowa et Soldán, 1986

27 (18) Femora without conspicuous darker rusty brown spots, at most with slight darker smudge in pale central field bordered with dark frame (cf. Figs. 43, 46,47)(the *R. hybrida* species group: 10 + 1 spp.).[2)]

28 (29) Pl. I-VI with very conspicuous bright violet J-shaped or open L-shaped spots in the middle. This pigmentation is well apparent also in long-term alcohol conserved specimens. Marg. of Pl. VI and VII gently and irregularly crenulated with at least 15-20 incisions (Figs. 23, 26)(Alps: A, CH, F, I). ..... *R. nivata* Eaton, 1871

29 (28) Pl. II-VI unicolorous, whitish, at most with diffused darker pigmentation in the bas. half (cf. Figs. 21, 22, 24, 25). Marg. of pl. VI-VII regularly and more roughly crenulated, with at most 15 incisions (cf. Figs. 14, 15, 22).

30 (31) Inner incisor wider than long, reaching about 1/4 of the length of outer one, outer incisor narrow, more than three times longer than wide (cf. Fig. 106). Denticles of lacinial scrapes apically rounded (Alps: CH). ..... *R. puthzi* Sowa, 1984

31 (30) Inner incisor longer than wide, reaching about 1/2-1/3 of the length of outer one, outer incisor wider, less than three times longer than wide (cf. Figs. 103-105). Denticles of lacinial scrapes apically sharply pointed (cf. Figs. 63-68, 70-72).

32 (35) Abd. nerve ganglia rusty or violet brown pigmented, well apparent under transparent cuticle of abd. sterna.

33 (34) Body length of larvae (without cerci) smaller than 7.5 mm. Abd. terga dark brown. Lacinial scrapes with 7-9 teeth (Fig. 65). Labrum 3.5 times broader than long (cf. Figs. 83, 87). Femoral spatules roughly rectangular with nearly parallel margins (cf. Fig. 79)(Alps: CH). ..... *R. endenensis* Metzler, Tomka et Zurwerra, 1985

34 (33) Body length of larvae (without cerci) 8.5-12.5 mm. Abd. terga pale, yellowish or whitish. Lacinial scrapes with 9-12 teeth (Fig. 63). Labrum three times broader than long. Femoral spatules oval or ellipsoidal (cf. Fig. 58, 62) (Alps: F). ..... *R. dienensis* Sowa et Degrange, 1987

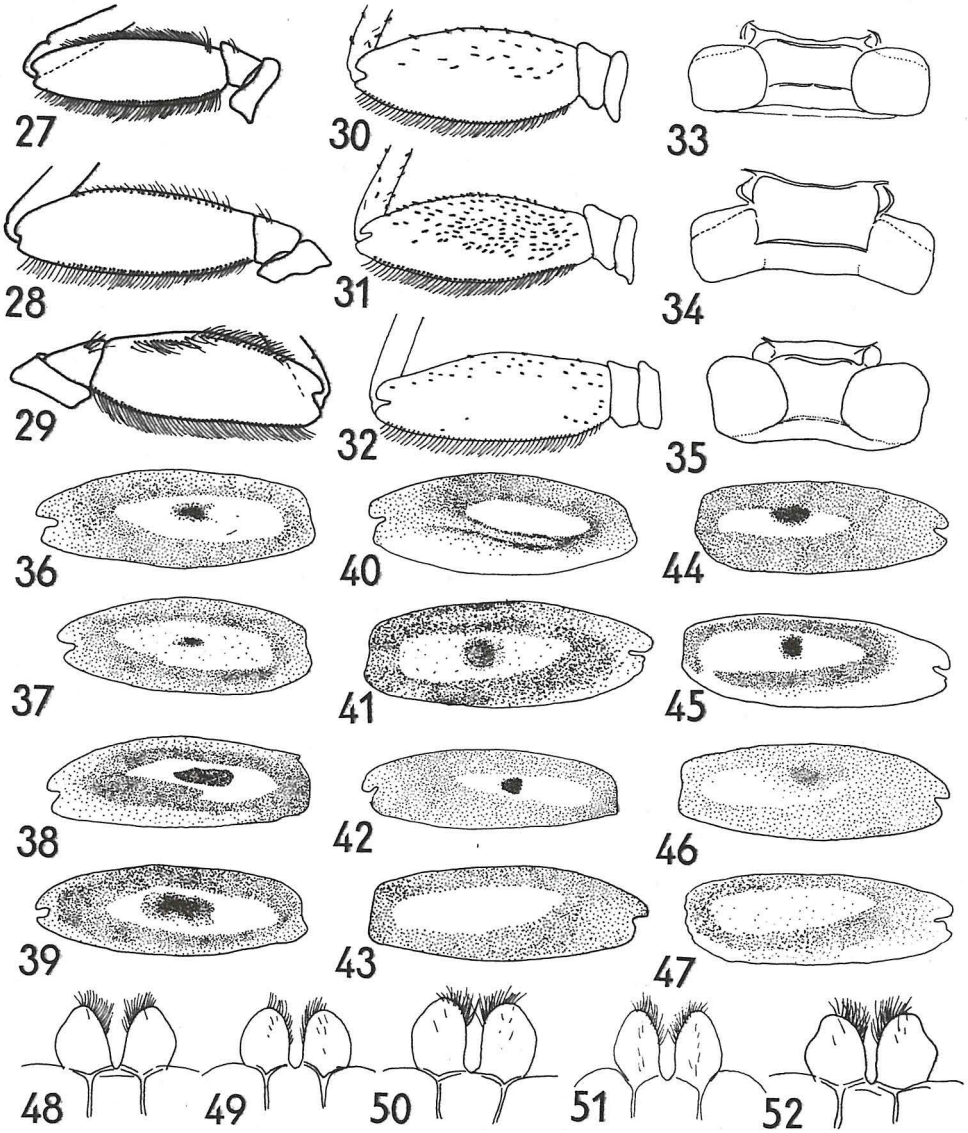
35 (32) Abd. nerve ganglia pale, without any pigmentation. If apparent under abd. cuticle, they are whitish or yellowish.

36 (37) Maxillar lacinia with 10-11 scrapes, at least some of them with 11-15 denticles (Fig. 70). Lat. marg. of femoral spatules apically rounded, never suddenly cut (Fig. 57)(Alps: CH, F). ..... *R. degrangei* Sowa, 1969

37 (36) Maxillar lacinia with only 7-9 scrapes, none of them with more than 10 denticles (cf. Figs. 67, 71). Femoral spatules with parallel lat. marg. If these marg. divergent, spatules suddenly apic. cut. (cf. Fig. 59).

38 (39) Body length of mature larvae less than 7.5 mm (cerci excluded). Lacinial scrapes with 9-10 denticles. Marg. teeth on the poster. marg. of abd. terga with concave lat. margins, submarg. teeth as long as about one third of the length of marg. ones (Fig. 94)(Alps: A). ..... *R. austriaca* Sowa et Weichselbaumer, 1988

[2)] *R. fonticola* Sowa et Degrange, 1987 described from the vicinity of Drôme in the French Alps according to a single specimen (imago male) belongs to this species-group as well. Male, subimago and larva remain still unknown. Differential diagnosis is based on exochorional structures of eggs (for details see Sowa & Degrange 1987b).



Figs. 27-52: 27 - fore femur, distribution of submarginal bristles; 28, 29 - hind femur, distribution of submarginal bristles; 30-32 - hind femur, distribution of submarginal bristles and femoral spines; 33-35 - shape and position of sclerites of abdominal sternum I; 36-47 fore femur, colour patterns, dorsal view; 48-52 - labial glossae. 27, 28 - *R. alpestris*; 29 - *R. delphinensis*; 30, 50 - *R. hybrida*; 31, 46 - *R. wolosatkae*; 32 - *R. carpatoalpina*; 33 - *R. degrangei*; 34, 48 - *R. gorganica*; 35 - *R. intermedia*; 36 - *R. podhalensis*; 37 - *R. corcontica*; 38 - *R. grischua*; 39 - *R. hercynia*; 40, 52 - *R. mariaedominicae*; 41 - *R. vaillanti*; 42 - *R. puytoraci*; 43 - *R. circumtatrica*; 44 - *R. picteti*; 45 - *R. semicolorata*; 47, 49 - *R. loyolaea*; 51 - *R. beskidensis*.

Obr. 27-52: 27 - přední stehno, rozmístění submarginálních brv; 28, 29 - zadní stehno, rozmístění submarginálních brv; 30-32 - zadní stehno, rozmístění submarginálních brv a tyčinek; 33-35 - tvar a pozice abd. sterna I; 36-47 přední stehno, barevné vzory, dorsální pohled; 48-52 - labiální glosy.

39 (38) Body length of mature larvae 8.0-14.0 mm (cerci excluded). Lacinial scrapers with usually 5 - 8, exceptionally with 9 denticles. Marg. teeth on the poster. marg. of abd. terga with straight marg. (cf. Figs. 95-102, submarg. teeth apparently smaller than one third of the lenth of marg. ones.

40 (41) Glossae with concave outer marg., stout, bluntly pointed (Fig. 52). Pale femoral field very narrow, dark frame with light band near the poster. marg. (Fig. 40). Femoral spatules elongated and never cut apic. (Fig. 58)(Alps: F). .... *R. mariaedominicae* Sowa et Degrange, 1987

41 (40) Glossae with convex or straight outer marg., elongated and rounded (cf. Figs. 50, 51). Pale femoral field broad, wider than a half of the femur width (cf. Figs. 43, 46, 47), darker frame without pale band. Femoral spatules roughly oblong-shaped with divergent lat. margins, apic. cut or widely rounded (cf. Figs. 75, 77, 78).

42 (43) Poster. marg. of abd. terga with numerous submarg. teeth arranged into 2-3 irregular rows (Fig. 98). Femoral spatules with convex lat. marg., most of them apic. rounded (Fig. 75). Abd. tergum X pale, of the same colour as terga VIII and IX (Tatra Mts.: PL). ..... *R. circumtatrica* Sowa et Soldán, 1986

43 (42) Poster marg. of abd. terga with not numerous or rare submarg. teeth arranged at most into a single irregular row (cf. Fig. 97). Femoral spatules with straight lat. marg., apic. straight and suddenly cut (Figs. 77, 78). Abd. tergum X always darker than terga VIII and IX.

44 (45) Pale field in the middle of femora unicolorous, without darker smudges (cf. Fig. 43). Femoral spatules relatively rare (Fig. 30), roughly rectangular, at least 3-4 times longer than broad (Fig. 77). Teeth on poster. marg. of abd. terga approximately of the same length (Fig. 102). Lacinial scrapes with 5-6 denticles (Fig. 73)(Alps: A, CH, D, F, I, Hercynian system: CZ, Carpathians: CZ, PL, SK, UKR). ..... *R. hybrida* Eaton, 1885

45 (44) Pale field in the middle of femora with apparent darker smudge near their anter. marg. (Fig. 46). Femoral spatules numerous (Fig. 31) with divergent marg., twice longer than broad (Fig. 78). Teeth on poster. marg. of abd. terga different in legth (Fig. 97). Lacinial scrapes with 6-8 denticles (cf. Fig. 71)(Carpathians: PL, SK). ..... *R. wolosatkae* Kłonowska, 1987

46 (1) Pl. VII (and mostly also pl. II-VI) with smooth marg., without crenulations. If inconspicuously crenulated with open 1-3 incisions (Figs. 19, 20) then ventral abd. nerve ganglia never pigmented. If apparent under sternal cuticle they are whitish or pale yellowish. Femoral spatules at least twice longer than broad (cf. Figs. 54-72, 74-79).

47 (50) Dors. surface of pl. I smooth, without plica, marg. of pl. I smooth (Fig. 12) or with inconspicuous irregular and very shallow incisions (Figs. 11, 12). Very conspicuous rusty browm central spot apparent not only on dors. but also on ventr. side of femora. Larvae of characteristic slim body shape with relatively narrow head (the *R. diaphana* species-group).

48 (49) Lacinial scrapes with 10-13 denticles (cf. Fig. 66). Bristles on lat. marg. of cerci seg.inserted regularly (Fig. 109). Lat. marg. of labrum cut, parallel (Fig. 89). Abd. tergum X conspicuously darker than other terga (found in submontane running waters of hyporhithron and epipotamon all over Central Europe). ..... *R. beskidensis* Alba-Tercedor et Sowa, 1987

49 (48) Lacinial scrapes with only 5-7 denticles (cf. Fig. 71). Bristles on lat. marg. of cerci segments inserted in goups (Fig. 110). Lat. marg. of labrum convergent (Fig. 90). Abd. tergum X of the same colour as other terga (distribution same as in previous species). ..... *R. savoiensis* Alba-Terceder et Sowa, 1987

50 (47) Dors. surface of pl. I always with conspicuous plica an apparently regularly or irregularly crenulated (cf. Figs. 8-10). Rusty red central spot apparent solely on the dors. surface of femora or absent. Body of larvae robust, characteristic for the genus *Rhithrogena* (the *R. germanica* (1 sp.) and *R. semicolorata* (9 spp.) species groups).

51 (56) Plica of pl. I with apparently concave anter. marg. anterolat. produced into pointed or finger-like projection (cf. Figs. 8, 9).

52 (55) Claws of legs with 2-3 teeth (cf. Fig. 108). Dors. surface of femora with well apparent, elongated rusty brown spots (cf. Figs. 44, 45).

53 (54) Pl. II-III spatulated, twice longer than broad (Fig. 24). Inner incisor longer than a half of the length of outer one (Fig. 104). Poster. marg. of abd. terga with teeth of different length (cf. Fig. 97). Femoral spatules rectangular, more that 2.5 times longer than broad (rare in submontane rivers all over Central Europe). ..... *R. germanica* Eaton, 1885

54 (53) Pl. II-III roughly quadrangular (ratio length : width smaller than 1.3, Fig. 21). Inner incisor at most as long as a half of the length of outer one (Fig. 103). Poster. marg. of abd. terga approximately of the same length (cf. Fig. 102). Femoral spatules broadly oval, at most twice longer than wide (Fig. 80)(all over Central Europe, very abundant or common). .... *R. semicolorata* (Curtis, 1834)

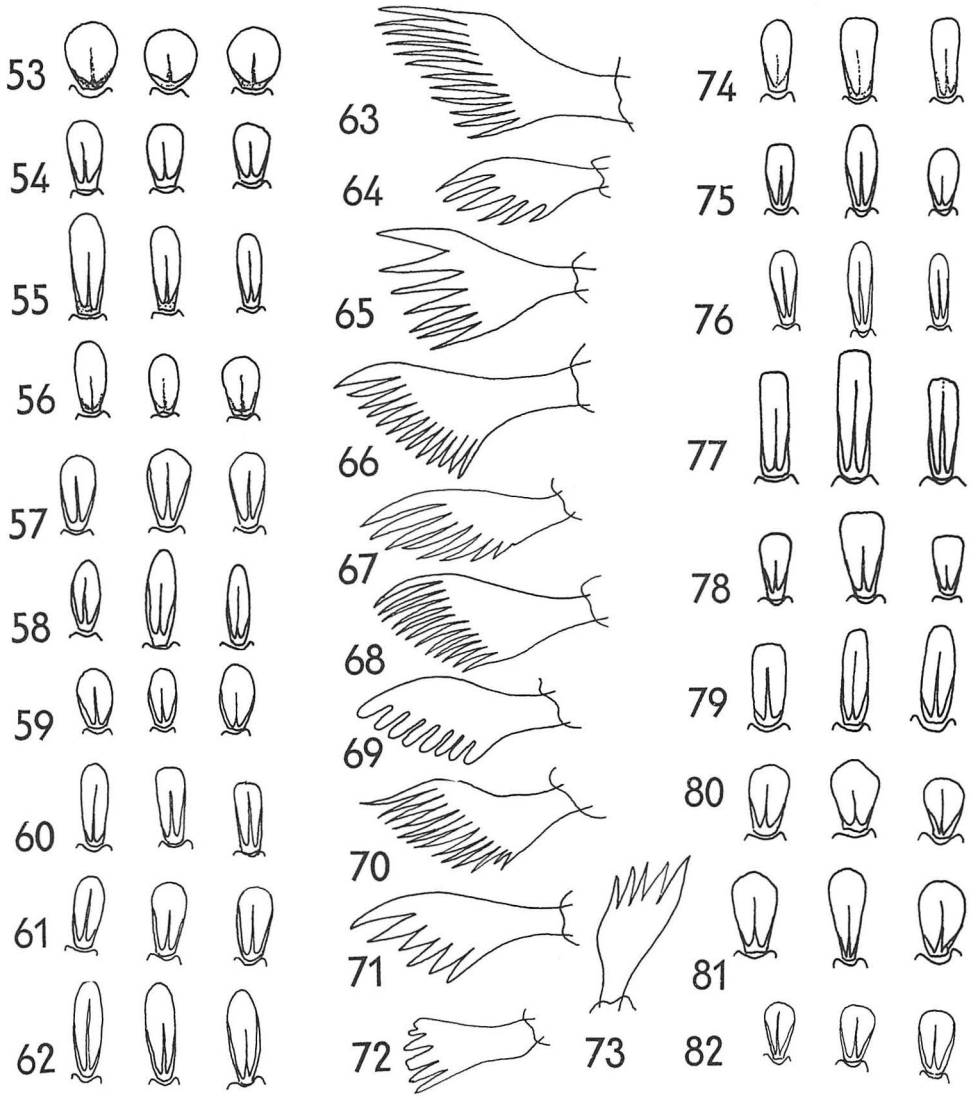
55 (52) Claws of legs smooth, without any teeth. Femora with only pale field in darker frame, no rusty brown spots present (cf. Fig. 43)(Alps: CH, F). ..... *R. dorieri* Sowa, 1971

56 (51) Plica of Pl. I obtuse angled or arcual, anterolaterally rounded or obtusely pointed, without any projections.

57 (58) Claws of legs smooth, without any denticles (cf. Fig. 107). Femora without rusty brown spots, only with pale field in darker frame (cf. Figs. 43, 48). Seg. of cerci with long and fine bristles (well apparent especially in the phase contrast). Lacinial scrapes with only 5 - 6 apically cut or rounded denticles (Alps: CH, F). .... *R. colmarsensis* Sowa et Degrange, 1984

58 (57) Claws of legs with 2-3 denticles (cf. Fig. 108). Rusty brown femoral spots well apparent (cf. Figs. 44, 45). Seg. of cerci without long fine bristles. Lacinial scrapes with 6 or mostly more poited denticles (cf. Figs. 63-71).

59 (60) Rusty brown femoral spots conspicuously large, oblong-shaped, as long as 1/4 of the length of femora (cf. Fig. 39) and widely fused with darker olive-brown frame. Pl. I very sparsely and irregularly crenulated, with about 5-7 very shallow



Figs. 53-82: 53-62 and 74-82 - dorsal femoral spines; 63-73 - denticles of laccinial scrapes. 53 - *R. gorganica*; 54, 67 - *R. landai*; 55, 68 - *R. vaillanti*; 56 - *R. loyolaea*; 57, 70 - *R. degrangei*; 58 - *R. mariaedominicae*; 59 - *R. austriaca*; 60 - *R. gratianopolitana*; 61 - *R. podhalensis*; 62 - *R. corcontica*; 63 - *R. dienensis*; 64 - *R. gratianopolitana*; 65 - *R. endenensis*; 66 - *R. beskidensis*; 69 - *R. puthzi*; 71 - *R. savoiensis*; 72, 76 - *R. colmarsensis*; 73, 77 - *R. hybrida*; 74 - *R. germanica*; 75 - *R. circumtatrica*; 78 - *R. wolosatkae*; 79 - *R. iridina*; 80 - *R. semicolorata*; 81 - *R. carpatoalpina*; 82 - *R. puytoraci*.
Obr. 53-82: 53-62 a 74-82 - tyčinky na povrchu stehen; 63-73 - zuby na škrabce lacinie.

incisions (cf. Fig. 11). Inner incisor of mandible shorter than 1/2 of the outer one, its anteromed. part pointed (Alps: A). ..... *R. taurisca* Bauernfend, 1992

60 (59) Rusty brown femoral spots relatively small, circular or oval, not reaching more than 1/5 of the length of femora (cf. Figs. 42, 45) and at most partially fused with olive brown frame (cf. Fig. 44). Pl. I deeply and nearly regularly crenulated, with more than 8 incisions (cf. Figs. 9, 10).

61 (64) Femoral spatules with parallel or slightly convergent lat. marg. (cf. Figs. 60, 79), dist. part never broader than bas. one. Abd. tergum X of the same colour as terga III-V or only slightly lighter.

62 (63) Poster. marg. of abd. terga with large marg. teeth and much small submarg. teeth and denticles (cf. Fig. 100). Labrum anter. rounded (cf. Fig. 85). Lacinial scrapes with 8-12 denticles (cf. Fig. 68). More than 15 plumose setae near the base of inner mandibular incisor. Femoral rusty red spots not fused with darker frame (Alps: A). ..... *R. rolandi* Weichselbaumer, 1995

63 (62) Poster marg. of abd. terga only with large marg. teeth, submarg. denticles absent (cf. Fig. 95). Labrum anter. flat or slightly incurved (cf. Figs. 88-90). Lacinial scrapes with 5-9 denticles. Less than 15 (usually 10-12) plumose setae near the base of inner mandibular incisor. Femoral rusty red spot fused with darker frame (Fig. 44)(abundant in epirhithral running waters all over Central Europe but mainly at higher altitudes than *R. semicolorata*). .... *R. iridina* (Kolenati, 1839) and *R. picteti* Sowa, 1971[3)]

64 (61) Femoral spatules with divergent lat. marg., dist. part always broader than bas. one (cf. Figs. 81, 82). Rusty red femoral spots with sharp borders, situated in the middle of central pale field (cf. Fig. 42). Abd. tergum X conspicuously paler than terga III-V.

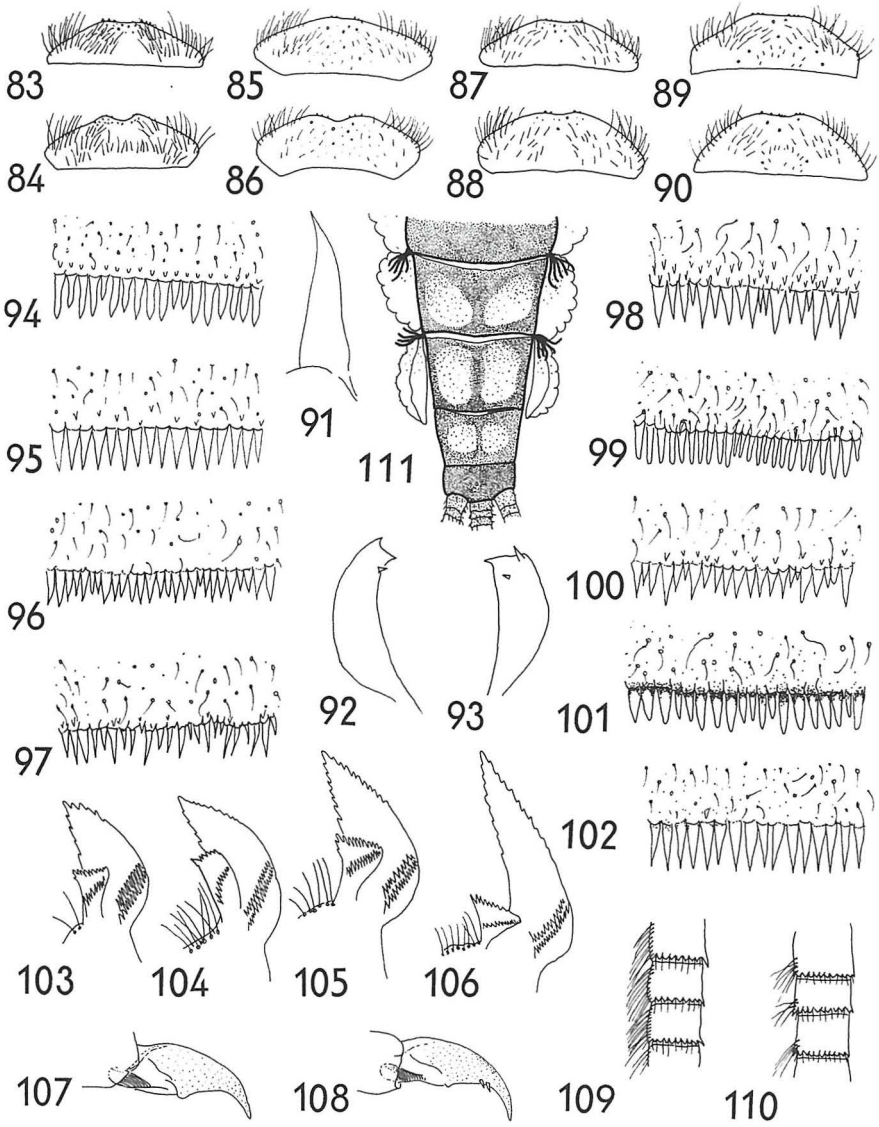
65 (66) Poster. marg. of abd. terga only with teeth, submarg. denticle or teeth absent (Fig. 96). Femoral spatules only near the basis and anter. marg. of femora (Fig. 32). Lacinial scrapes with 6-8 denticles (Fig. 64). Pl. II-VII smooth, without any incisions. Ventral nerve ganglia invisible. (running waters of rhithron all over Central Europe). .... *R. carpatoalpina* Kłonowska, Olechowska, Sartori et Weichselbaumer, 1987

66 (65) Poster. marg. of abd. terga with teeth and numerous small submarg. teeth and denticles (Fig. 95). Femoral spatules cover basal half of femora. Lacinial scrapes with 8-12 denticles (cf. Fig. 67). Pl. II-VII mostly with 1-3 shallow incisions (cf. Fig. 20). Ventral nerve ganglia spotted with violet (Alps: A, CH, F, D, I, LUX, Hercynian system: A, CZ, Carpathians: PL, Pyrenées: F). ..... *R. puytoraci* Sowa et Degrange, 1987

[3)] R. *iridina* and *R. picteti* are sibling species however not evidently vicariant: type specimen of the former was collected in the Jeseníky Mts. that of the latter in the Polish Carpathians. Larvae of *R. iridina* posess claws with 3 denticles more often and 6-15 spines on hind tibiae, those of *R. picteti* have usually only 2 denticles on claws and 11-15 spines on hind tibiae. However, these characters are hardly reliable and these species, originally considered as subspecies (Sowa 1971), mostly should not be distinguished in the larval stage. Precise differential diagnosis is based on minute differences in morphology of male genitalia and on different structure of exochorion of eggs (for details see Sowa 1971, 1987).

REVIEW OF SYNONYMY OF CENTRAL EUROPEAN SPECIES OF THE GENUS *RHITHROGENA*

Valid name	**Synonymy and references**
R. alpestris Eaton, 1885	*R. brenneriana* Klapálek, 1905
	R. alpicola Navás, 1936
R. beskidensis Alba-Tercedor et Sowa, 1987	*R. diaphana* Navás, 1917 (p. p.)
	R. diaphana auct. (nec Navás, 1917, p. p.) (e.g., Zelinka 1980, Landa & Soldán 1985, 1989)
	R. aurantiaca auct. (nec Burmeister, 1837, p. p.) (e.g., Bogoescu 1958, Grandi 1960, Landa 1969)
R. carpatoalpina Olechowska, Klonowska, Sartori et Weichselbauer, 1985	*R. ferruginea* Navás, 1905 (p. p.)
	R. ferruginea auct. (nec Navás, 1905, p. p.) (e.g., Sowa 1971, 1987, Landa & Soldán 1985, 1989).
	R. semicolorata auct. (nec Curtis, 1834, p. p.) (e.g., Klapálek 1909, Schoenemund 1930, Bogoescu 1958, Grandi 1960, Landa 1969, Zelinka 1980)
R. circumtatrica Sowa et Soldán, 1984	*R. hybrida* Eaton, 1885 (p. p.): Landa 1969
R. germanica Eaton, 1885	*R. haarupi* Esben-Petersen, 1909
R. intermedia Metzler, Tomka et Zurwerra, 1987	*R. allobrogica* Sowa et Degrange, 1987



Figs. 83-111: 83-90 - labrum, dorsal view; 91-93 - titilator of adult; 94-102 - hind margin of abdominal terga; 103-106 - incisors of mandible; 107, 108 - claw of fore leg; 109, 110 - basal half segments of cerci, dorsal view; 111 - distal part of abdomen (terga VI-VIII). 83 - *R. intermedia*; 84 - *R. landai*; 85 - *R. alpestris*; 86 - *R. delphinensis*; 87 - *R. endenensis*; 88 - *R. dienensis*; 89 - *R. intermedia*; 90, 110 - *R. savoiensis*; 91 - *R. alpestris*; 92, 93 - *R. henschi*; 94 - *R. austriaca*; 95 - *R. podhalensis*; 96 - *R. carpatoalpina*; 97 - *R. wolosatkae*; 98 - *R. circumtatrica*; 99, 111 - *R. corcontica*; 100 - *R. puytoraci*; 101 - *R. hercynia*; 102 - *R. hybrida*; 103, 108 - *R. semicolorata*; 104 - *R. germanica*; 105 - *R. endenensis*; 106 - *R. puthzi*; 107 - *R. dorieri*; 109 - *R. savoiensis*. Obr. 83-111: 83-90 - labrum, dorsální pohled; 91-93 - titilátor dospělce; 94-102 - zadní okraj abd. tergitů; 103-106 - řezáky mandibuly; 107, 108 - drápek přední nohy; 109, 110 - články v basální polovině štětů, dorsální pohled; 111 - distální část abdomenu (terga VI-VIII).

R. iridina (Kolenati, 1839)	*R. iridina* auct. (nec Kolenati, 1839, p. p.) (e.g., Landa et Soldán 1985, 1989).
	R. semicolorata auct. (nec Curtis, 1834, p. p.) (e.g., Klapálek 1909, Grandi 1960, Bogoescu 1958, Landa 1969, Zelinka 1980)
R. landai Sowa et Soldán, 1984	*R. alpestris* (nec Eaton, 1885): Landa 1969 (imago, nec larva)
R. loyolaea (Navás, 1922)	*R. tatrica* Zelinka, 1953
	R. tatrica auct. (e.g., Landa 1969, Zelinka 1980)
	R. nivata: Grandi, 1960
R. puytoraci Sowa, 1987	*R. ferruginea* Navás, 1905 (p. p.)
R. savoiensis Alba-Tercedor et Sowa, 1987	*R. diaphana* Navás, 1917 (p. p.)
	R. diaphana auct. (nec Navás, 1917, p. p.) (e.g., Landa & Soldán 1984, 1989, Zelinka 1980)
	R. aurantiaca auct. (nec Burmeister, 1837, p. p.) (e.g., Bogoescu 1958, Grandi 1960, Landa 1969)
R. semicolorata (Curtis, 1834)	*R. semicincta* (Pictet, 1853)
	R. vulpecula Klapálek, 1905
	R. grisoculata Bogoescu, 1958
	R. semicolorata auct. (nec Curtis, 1834, p. p.) (e.g., Klapálek 1905, 1909, Schoenemund 1930, Bogoescu 1958, Grandi 1960, Landa 1969)

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SOUHRN

Rod *Rhithrogena* Eaton, 1881 zahrnuje více než 100 převážně holarktických druhů. Ze 73 západopalearktických druhů bylo doposud 37 druhů nalezeno ve střední Evropě. S výjimkou jednoho případu podvojného druhu a dvou druhů, u nichž larvy doposud popsány nebyly, mohou být larvy určovány podle 7 formálních „druhových skupin" (skupina *R. alpestris* - 7 spp., *R. hercynia* - 5 spp., *R. hybrida* 10 spp., *R. germanica* - 1 sp., *R. semicolorata* - 9 spp., *R. loyolaea* - 3 spp. and *R. diaphana* - 2 spp.) bez ohledu na to, že tyto skupiny jsou většinou umělé a neodrážejí skutečné interspecifické fylogenetické vztahy.

V klíči jsou uvedeny a ilustrovány jednoduché znaky dostupné pomocí světelné mikroskopie, které byly získány hlavně na základě studia materiálu z povodí Labe. Práce rovněž shrnuje rozšíření a synonymii středoevropských druhů.