

Immature Stages of *Rugilus rufipes* Germar (Coleoptera, Staphylinidae), with Notes on Biology

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Abstract. The immature stages of *Rugilus rufipes* Germar are described and illustrated. Descriptions are based on material collected in the deciduous forest litter in northern Poland (Niedwiady Forest District), and reared in the laboratory. The life-cycle and notes on biology of the species are also provided.

Key words: Coleoptera, Staphylinidae, *Rugilus*, immature stages, bionomy.

INTRODUCTION

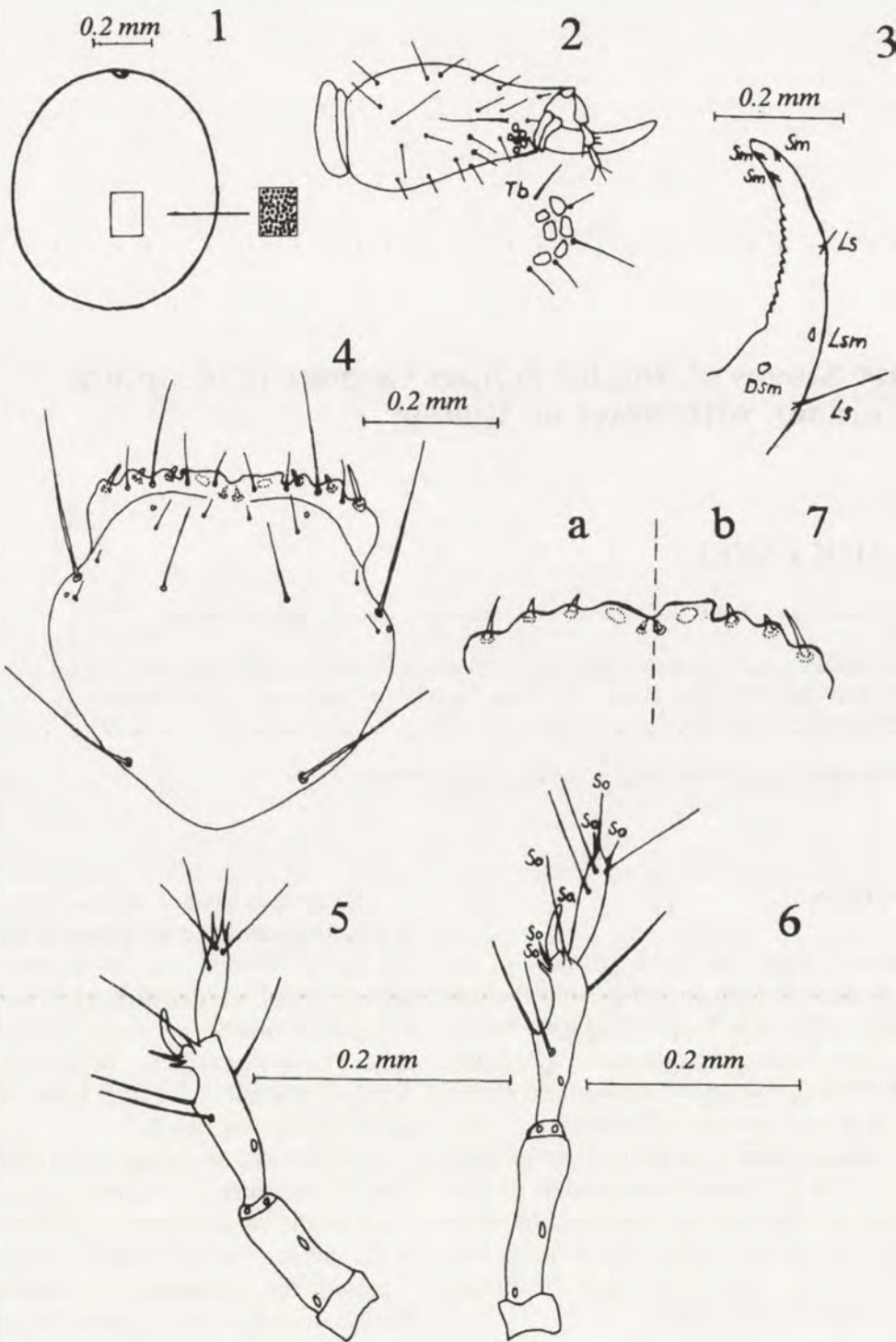
The immature stages and biology of most of the species of Paederini remain unknown. Paulian (1941), Kasule (1970) and Topp (1978) gave fundamental characters for *Rugilus orbiculatus* (Paykull), while Frania (1986) gave a more detailed account of the chaetotaxy of some genera of Paederini including *Rugilus* sp. among them. His characteristics were mostly based on the first instar larvae, and he tried to bring together the ideas already published by Ashe (1984), Ashe and Watrous (1984), and Wheeler and Pakaluk (1983). The chaetotaxy maps by Frania (1986) are followed in this paper.

The mature larva of *Rugilus rufipes* Germar was briefly illustrated and described by Potockaja (1967), but her description was not complete and did not include important diagnostic features. Also, though the authors mentioned above gave brief accounts of either *Rugilus orbiculatus* or *R. rufipes*, there is no detailed description of the larva or pupa of any European *Rugilus* Leach.

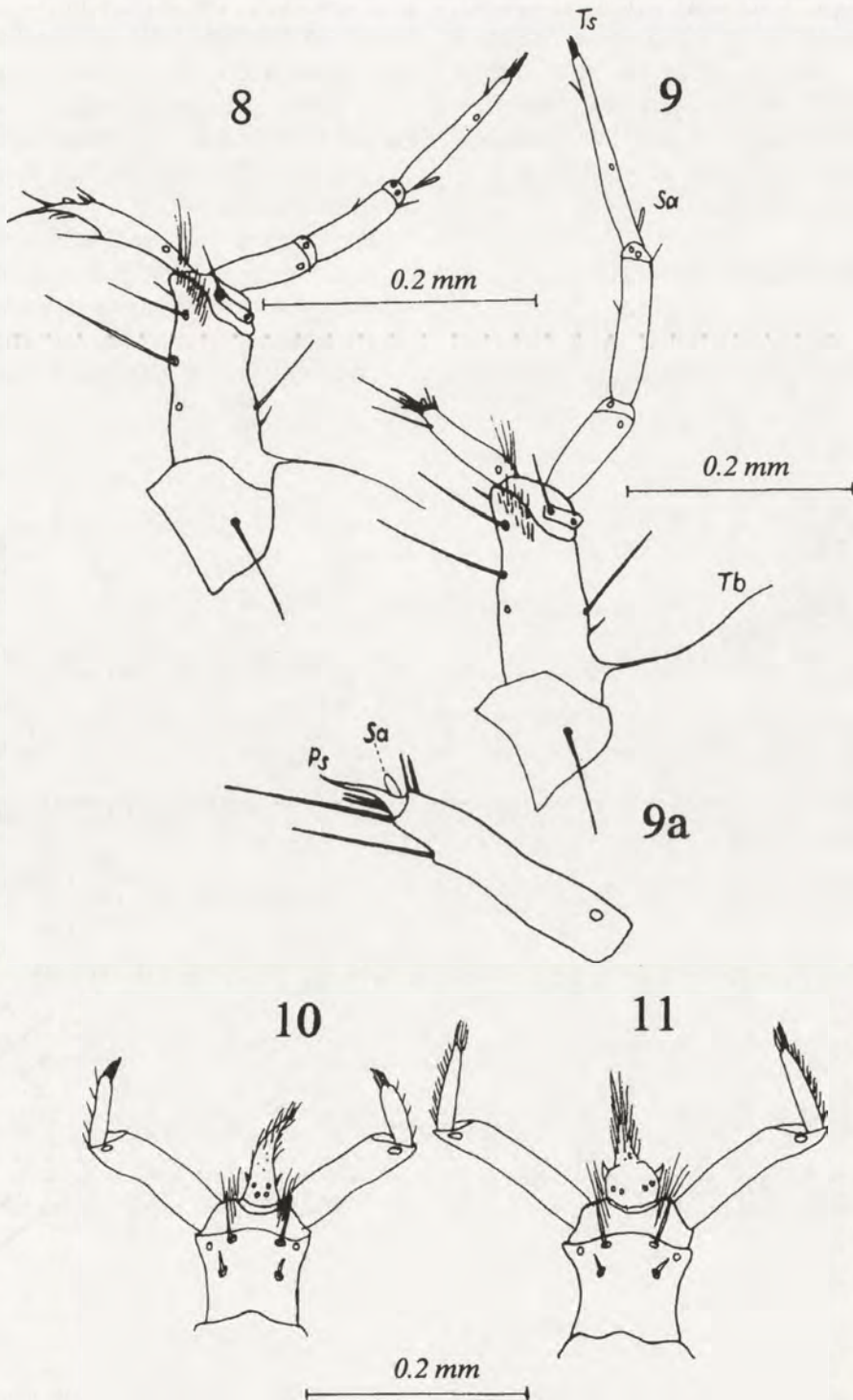
The purpose of this paper is to describe and illustrate all immatures of *Rugilus rufipes*, and to provide notes on the natural history and habits of immatures of the species. This description is intended to provide a pattern for descriptions of additional species of *Rugilus*, to help identify characters that are useful in separating the species.

Rugilus rufipes is a widely distributed European species reported as far north as Karelia (Scandinavia) and going south-east to the Caucasus. The beetle probably occurs in all major areas of Poland, in both

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Figs 1-7. *Rugilus rufipes*: 1, egg. 2-7, larva. 2, arrangement of stemmata (2nd instar). 3, mandible, dorsal (2nd instar). 4, frontal region and nasale, dorsal (2nd instar). 5, antenna, dorsal (1st instar). 6, antenna, dorsal (2nd instar). 7, anterior margin of nasale, dorsal: a, larva of 1st instar; b, larva of 2nd instar. Dsm, dorsal sensillum; Ls, lateral seta; Lsm, lateral sensillum; Sa, sensory appendage; Sm, sensillum; So, solenidium; Tb, trichobothrium.



Figs 8–11. *Rugilus rufipes*, larva: 8, maxilla, ventral (1st instar). 9, maxilla, ventral (2nd instar). 9a, mala, ventral (2nd instar). 10, labium, ventral (1st instar). 11, labium, ventral (2nd instar). Ps, palpiform sensillum; Sa, sensory appendage; Tb, trichobothrium; Ts, terminal sensilla.

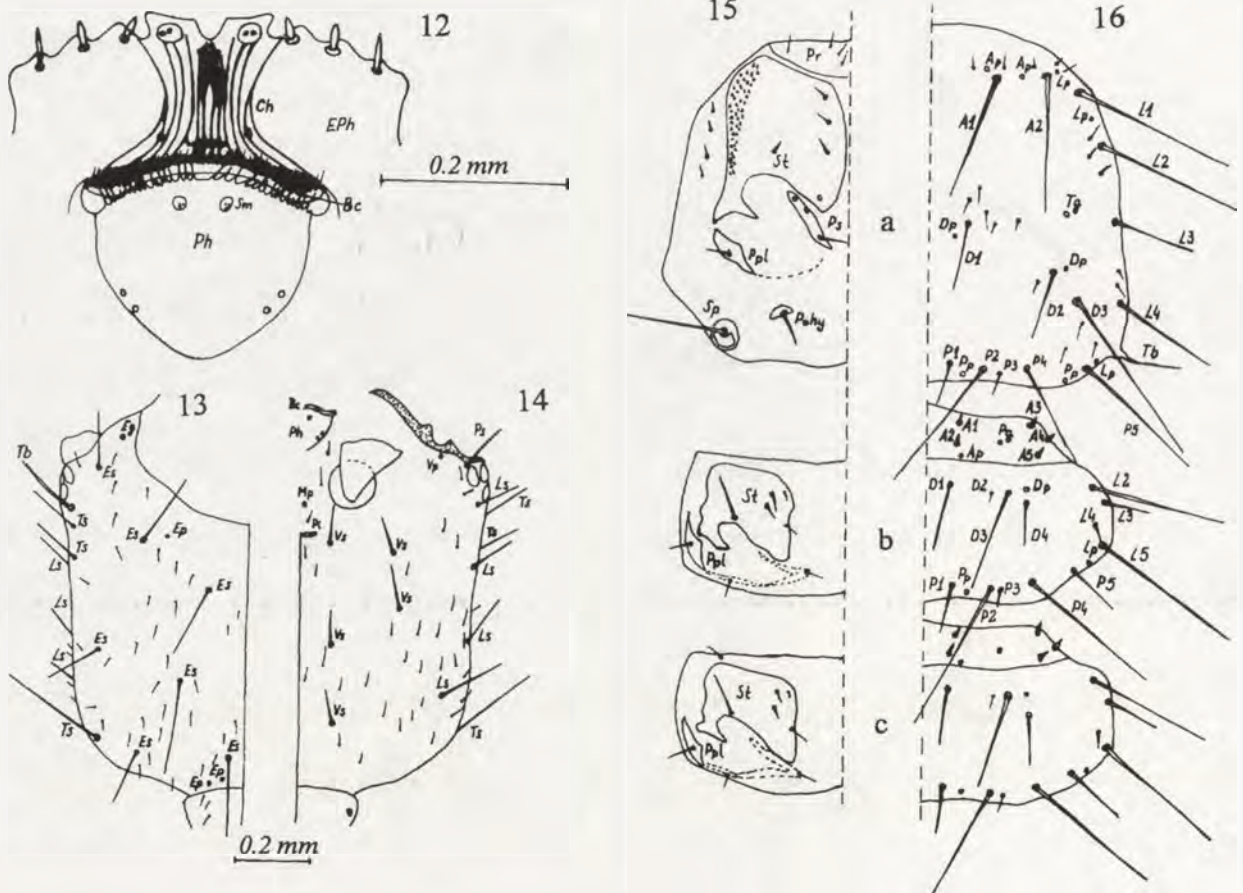
forested and open habitats (Szujecki 1965; Burakowski et al. 1979). In forest environments it prefers relatively damp localities, living in a thick layer of leaf litter. Although occurring regularly, it is not an abundant species with a rather low population density, which in the investigated area was about 1 specimen per 1 square meter.

MATERIALS AND METHODS

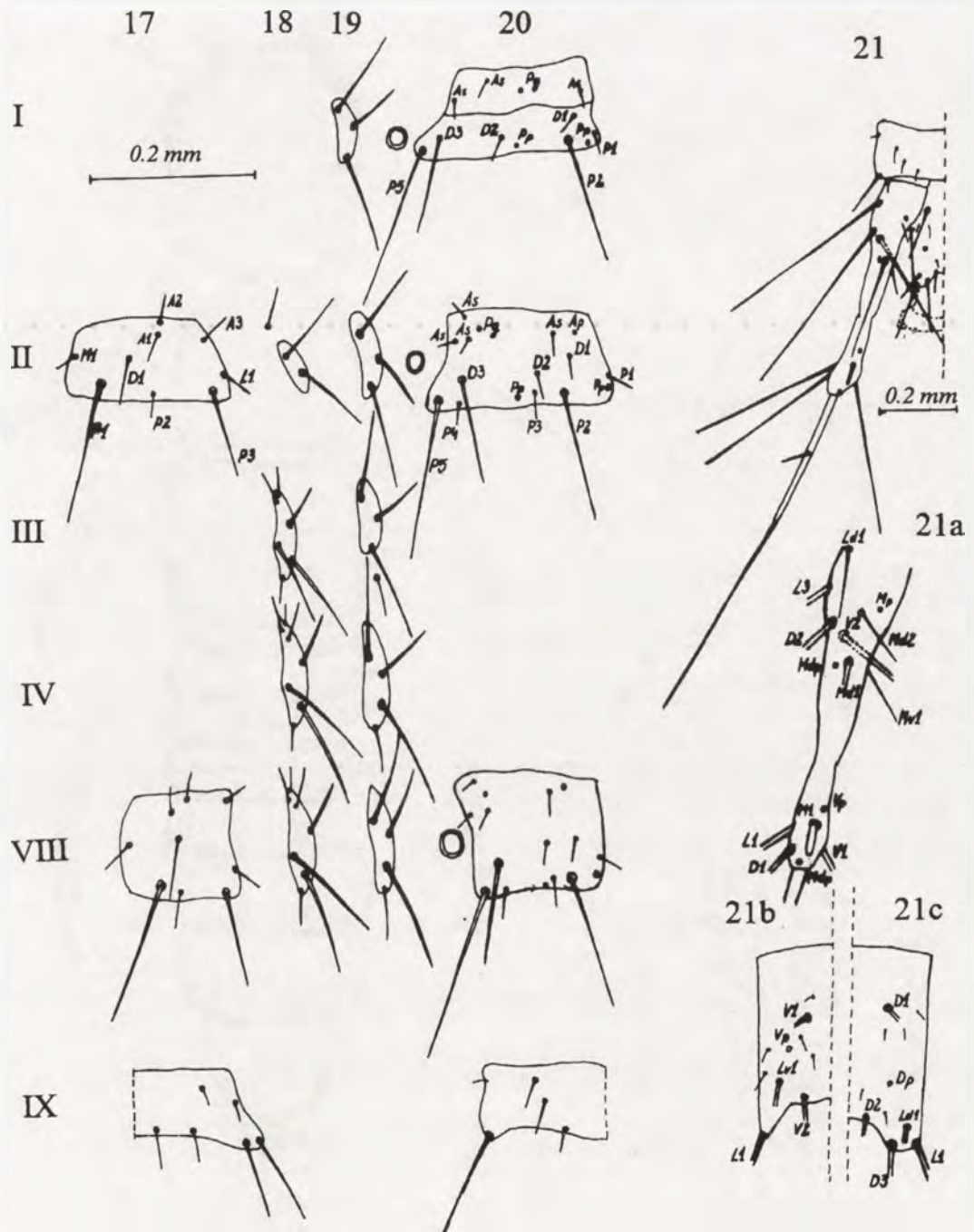
Adult specimens for laboratory rearing were collected in the Niedwiady Forest District, near Miastko

from deciduous forest litter in the period from late March to July 8th 1991. The collected specimens were transferred to the laboratory and were kept in a small closed glass jars (60 mm in diameter, 30 mm high) with a thin layer of ground peat. The conditions provided included darkness, high moisture and a temperature about 14–16°C.

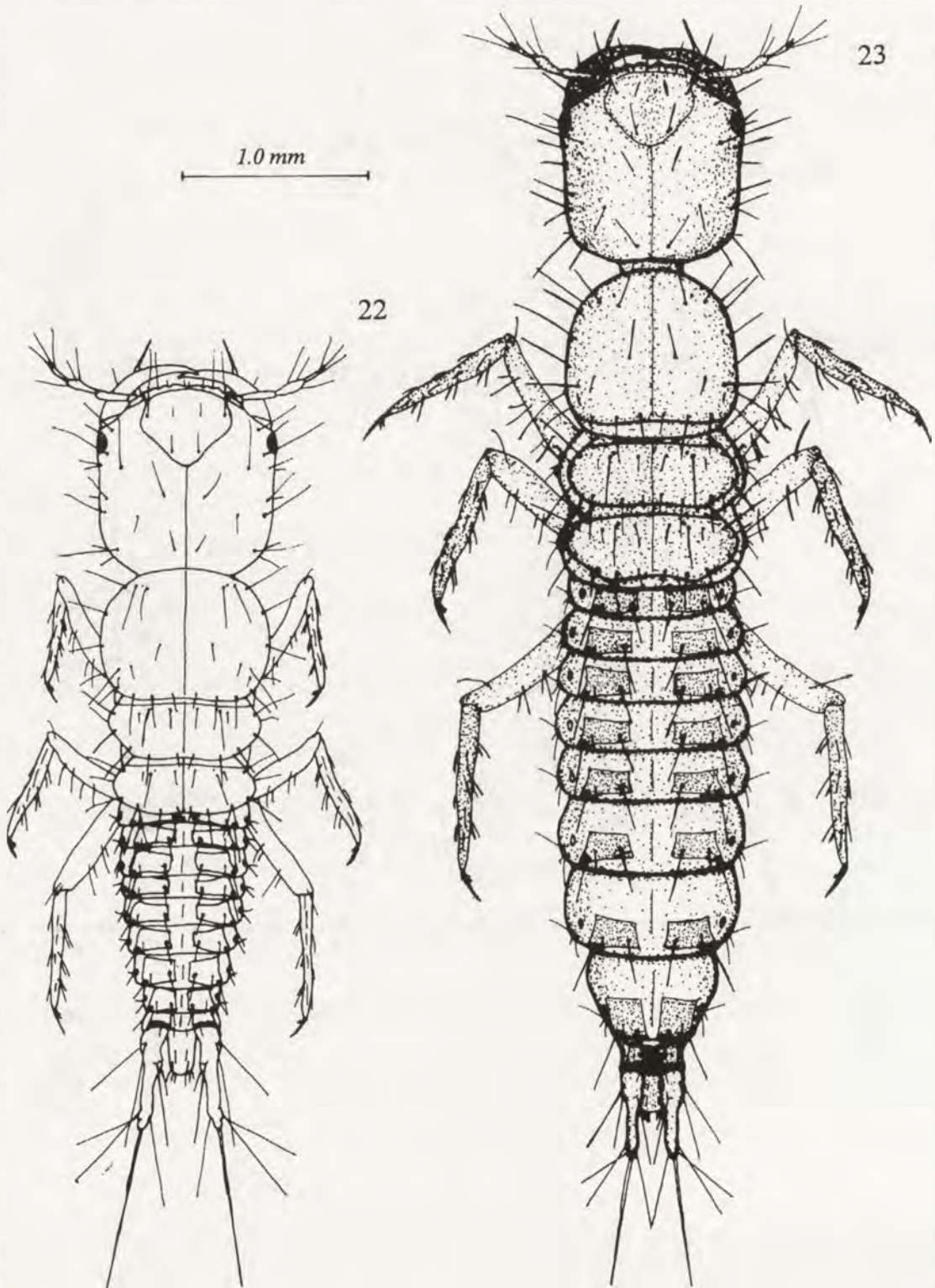
The breeding pairs were kept separately and were inspected, ventilated and fed every other day. During a period of oviposition eggs were collected and placed individually on ground-up peat in closed glass containers (25 mm in diameter and 60 mm high). The



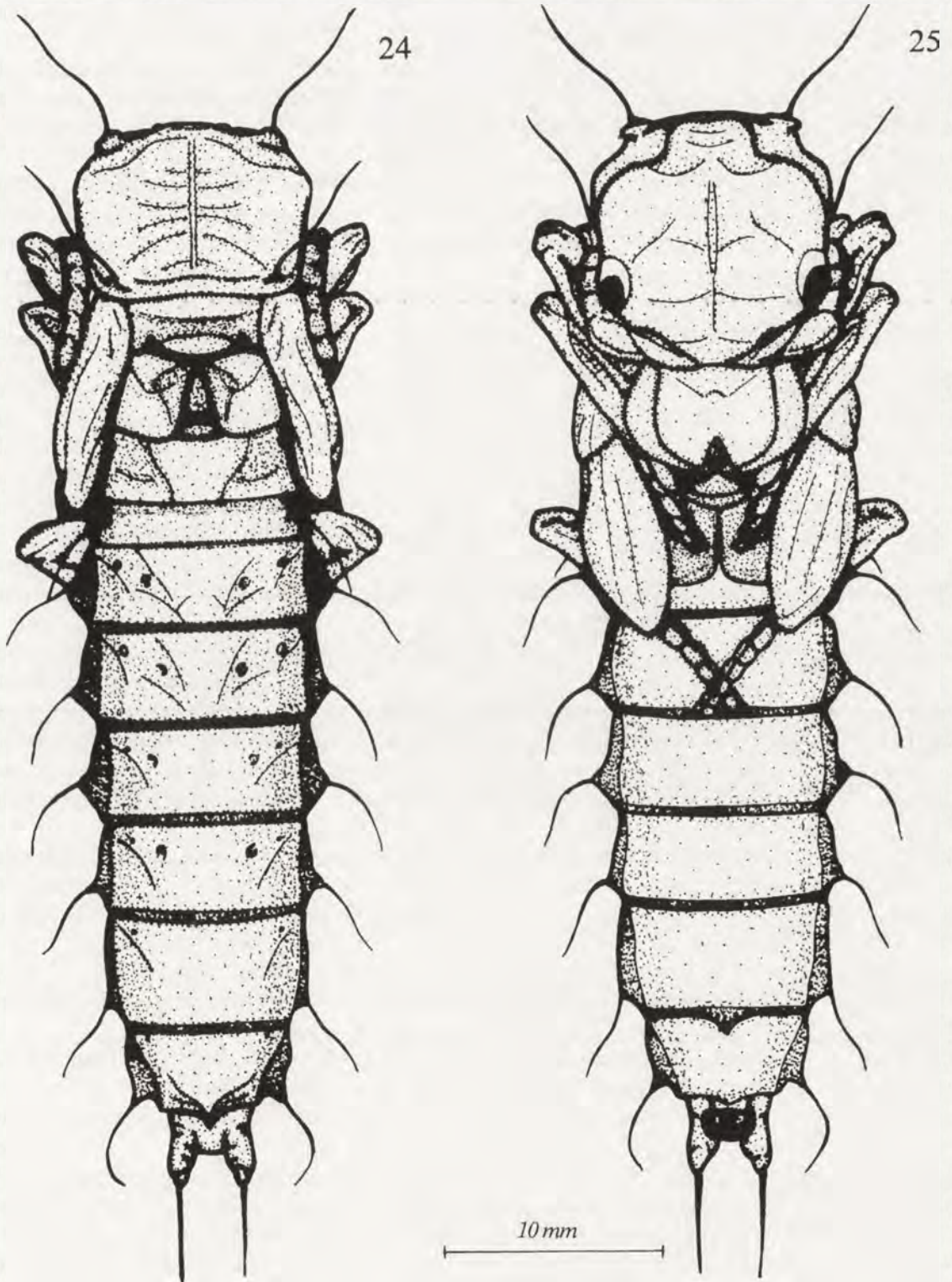
Figs 12–16. *Rugilus rufipes*, 2nd instar larva: 12, nasale, ventral. 13, head, dorsal. 14, head, ventral. 15–16, thorax: a, prothorax; b, mesothorax; c, metathorax. 15, thorax, ventral. 16, thorax, dorsal. A, anterior seta; Ap, anterior pore; Bc, buccal cavity; Ch, channels; D, discal seta; Dp, discal pore; Eg, epicranial gland; Ep, epicranial pore; Es, epicranial seta; EPh, epipharynx; L, lateral seta; Lp, lateral pore; Ls, lateral seta; Mp, mental pore; P, posterior seta; Pg, paratergal gland; Ph, pharynx; Pi, tentorial pit; Pohy, posthypopleuron; Pp, posterior pore; Ppl, propleuron; Pr, presternum; Ps, preocular seta (head); Ps, precoxal sclerite (thorax); Sm, sensillum; Sp, spiracular sclerite; St, sternum; Tb, trichobothrium; Tg, tergal gland; Ts, temporal seta; Vp, ventral pore; Vs, ventral seta.



Figs 17–21. *Rugilus rufipes*, 2nd instar larva: 17, sternites, ventral. 18, parasternites, lateral. 19, paratergites, lateral. 20, tergites, dorsal. 21, urogomphus and pygopod, dorsal. 21a, urogomphus, dorsal. 21b, pygopod, ventral. 21c, pygopod, dorsal. I–IX, numbers of abdominal segments; Ap, anterior pore; As, anterior seta; D, discal seta (tergites, sternites); D, dorsal seta (urogomphus and pygopod); Dp, dorsal pore (urogomphus and pygopod); L, lateral seta; Ld, laterodorsal seta; Lv, lateroventral seta; M, medial seta; Md, mediodorsal seta; Mdp, mediodorsal pore; Mp, medial pore; Mv, medioventral seta; P, posterior seta; Pg, paratergal gland; Pp, posterior pore; V, ventral seta; Vp, ventral pore.



Figs 22–23. *Rugilus rufipes*, larva: 22, 1st instar, dorsal. 23, 2nd instar, dorsal.



Figs 24–25. *Rugilus rufipes*, pupa: 24, dorsal. 25, ventral.

food for adults and larvae were diverse specimens of Collembola, Thysanoptera and eggs and larvae of Diptera.

The specimens used for the above descriptions were killed in 75 per cent ethanol, some then were processed into slides in Swan's solution to be used with a compound microscope.

In total 36 eggs, 23 first-instar larvae, 23 second-instar (mature) larvae, 2 pupae and 2 teneral adults were obtained from cultures started with 12 pairs.

IMMATURE STAGES OF *RUGILUS RUFIPES*

Egg (Fig. 1)

Length 0.8–0.9 mm, width 0.7–0.8 mm; roughly oval, circular in cross section; color white (sterile) to honey-yellow. Surface of chorion covered with very fine micropunctures, these separated by less than one times their diameter.

Mature larva (Figs 2–4, 6, 7b, 9, 9a, 11–21, 23)

Length 5.5–7.5 mm. Length ratios of head : thorax : abdomen : urogomphi as 1.0:1.5:2.5:1.3. Body elongate, widest anteriorly and gradually tapering posteriorly. Thoracic and abdominal terga tawny to slightly darker, head capsule and its appendages as well as thoracic appendages honey-yellow to straw-colored.

Head: about 1.15 x as long as wide, weakly narrowing posteriorly; lateral margin rounded, covered by a fine reticulate microsculpture. Chaetotaxy of dorsal and ventral surfaces as in Fig. 13 and 14. Stemmata 6, arranged as in Fig. 2.

Frontal region (Fig. 4) as long as wide. Nasale (Fig. 7b) with 8 teeth along anterior margin; each tooth with single peg seta on its ventral side; internal teeth biggest, blunt, slab-shaped with their peg setae smaller and hidden; external teeth poorly developed with their peg setae bigger and exposed beyond the anterior margin of the nasale. Epicranial stem 1.4 x as long as frontal region. Epipharynx as in Fig. 12, with many narrow channels.

Antenna (Fig. 6) about as long as mandible, 4 segmented. Length of antennomeres I:II:III:IV as 1.0:4.4:4.4:2.7; sensory appendage on inner side of antennomere III, narrow and about 0.5 x as long as IV. Antennomere II with 4 pores, III with 3 long setae and 3 apical solenidia (one of these very long); IV

with 3 long setae and 3 apical solenidia (one of these very long).

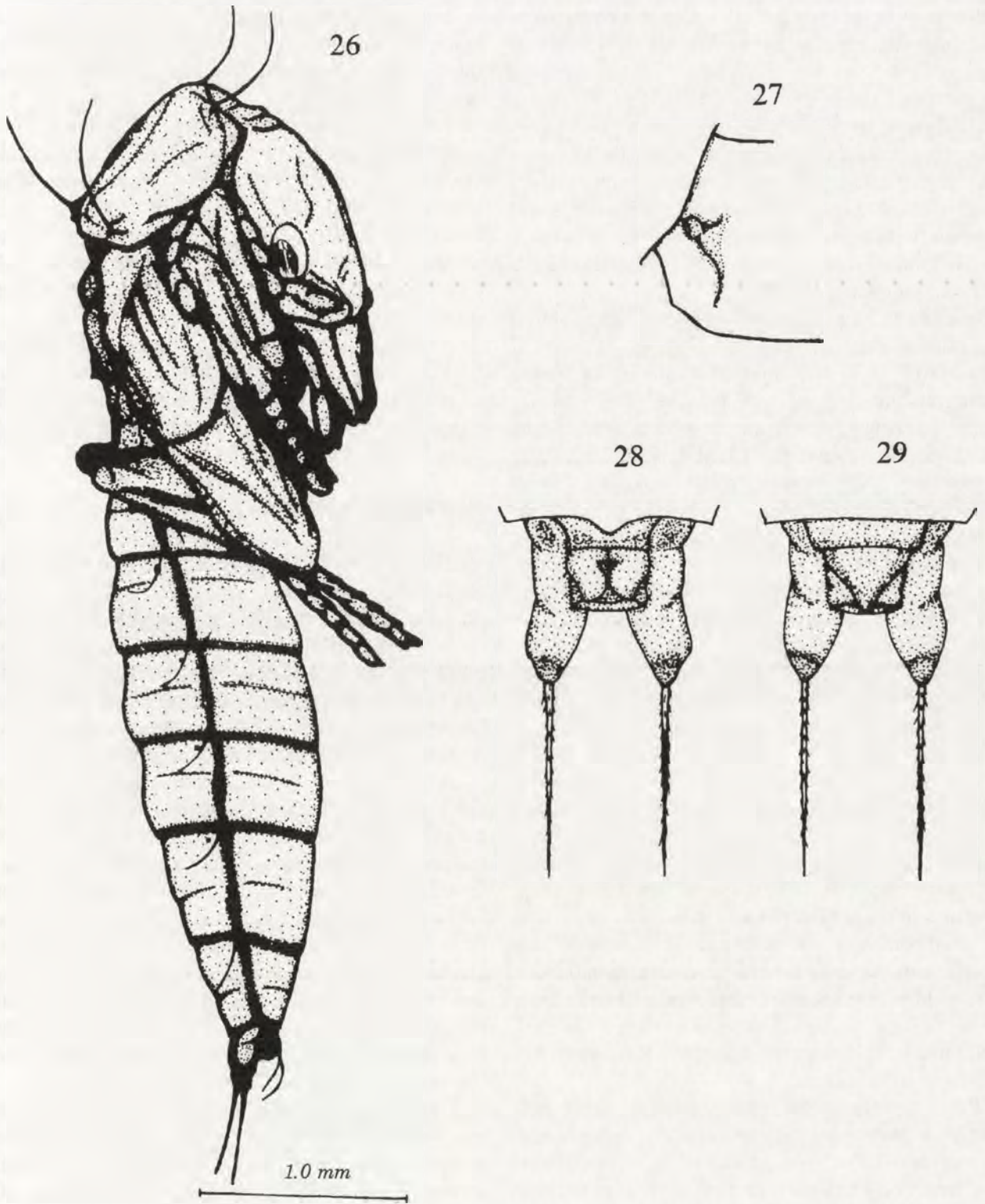
Mandible (Fig. 3) with inner margin finely serrate; outer margin with one short and one long seta; dorsal surface with 2 large sensilla near base and 3 smaller ones apically.

Maxilla (Fig. 9, 9a). Cardo without prominence on ventroapical margin, with single seta ventrally near middle. Stipes with trichobothrium near base, single pore and 5 setae (3 long and 2 short) near margins. Palpifer rectangular with single long seta and one pore. Palps 3-segmented with relative lengths as 1.0:1.5:2.0; palpomere I with 2 pores; palpomere II with 2 contiguous pores and 2 setae (one medial and one apical); palpomere III with sensory appendage, single seta and pore, terminal sensilla. Mala slightly narrower and longer than palpomere I, bearing 1 pore, 2 long setae ventrally, moderately long sensillum, 4 setae and a sensory appendage at apex.

Labium (Fig. 11). Prementum as long as wide, its ventral sclerite with one pair of long, one pair of short setae and two pores anteriorly; tufts of long microtrichia above sclerite near palp bases; dorsal surface of prementum with long microtrichia along midline and palp bases. Ligula elongated, slightly shorter than palpomere I, with sclerotized ring basally; its basal third spherical, with pair of stout setae and 2 pairs of ventral pores; the apical part tapered and with long microtrichia. Labial palps 2-segmented; palpomere I 1.6 x as long as II, with single apical pore, palpomere II with row of short microtrichia on outer margin and tuft of short sensilla apically.

Thorax (Fig. 23): pronotum as long as wide; mesonotum and metanotum each 0.5 x as long as wide. Chaetotaxy of thoracic dorsal and ventral plates as in Figs 15 and 16.

Abdomen (Figs 17–21, 23). Tergites I–VIII medially divided, I–VII transverse, VIII square, IX undivided. Sternite I membranous, sternites II–VII weakly transverse, widely divided, VIII elongate, IX not divided. Paratergites present on segments I–VIII, and parasternites on II–VIII. Spiracles visible on segments I–VIII, placed between tergites and paratergites. Chaetotaxy of the particular plates as in Figs 17–20. Pygopod (Fig. 21) 0.7 x as long as first segment of urogomphus. Urogomphus 2-segmented with strong terminal seta, the ratios of segments and seta



Figs 26–29. *Rugilus rufipes*, pupa: 26, lateral. 27, spiracle on tergum II. 28, gonotheca of female. 29, gonotheca of male.

as follows I:II:seta = 1.0:0.6:1.1. Chaetotaxy of pygopod and urogomphi as in Fig. 21a–c.

First instar larva (Figs 5, 7a, 8, 10, 22)

Body length of freshly emerged larva 2.0–3.5 mm. The proportions of head: thorax: abdomen: urogomphi as 1.0:0.9:0.7:1.4. Head and its appendages honey-yellow, thorax and abdomen whitish, legs and anterior part of pronotum slightly darker.

This stage is generally similar to the mature larva with the following exceptions:

- base of the head with two patches of short spines (Frانيا 1986);
- nasale (Fig. 7) with internal tooth similar to the external ones;
- antenna (Fig. 5) with antennomeres stouter, the ratio of antennomeres I:II:III:IV as 1.0:2.6:3.9:2.1;
- maxillary palps stouter, with ratios as follows 1.0:1.3:2.0; mala (Fig. 8) 1.3 x as long as palpomere I with sensillum longer than setae on ventral margin;
- segments of labial palps stouter; ligula conical without spherical base, bearing microtrichia on apical third only (Fig. 10);
- abdominal paratergites and parasternites weakly visible, the two first ones poorly developed.

Pupa (Figs 24–29).

Length 4.5–5.0 mm, width across pronotum 1.0–1.1 mm; colour white. Exarate, body dorsally convex; abdomen weakly flattened dorsoventrally, slightly narrowed posteriorly. Cuticle densely micropunctate. All solitary setae are stout, long, brownish and finely spinulose.

Head bent ventrally, as long as wide, entirely concealed from above by pronotum; neck region 0.4 x as wide as head; eyes large, conspicuous; labrum large, 0.5 x as long as head, anteriorly deeply incised. Antennae bent backwards, encircling legs, which are appressed to the venter.

Pronotum transverse, weakly concave along midline; each corner seta set up on a distinct tubercle. Mesonotum 0.35 x as long as wide, transversely concave, anteriorly hidden under pronotum, posteriorly convex. Metanotum longer than mesonotum; partially split by a median, triangular incision reaching from posterior margin throughout the entire sclerite.

Elytra and wings fitting obliquely at both sides of body; elytra about 0.5 x as long as wings and reaching level of hind femora; wings extending beyond first visible sternum.

Abdomen weakly narrowing posteriorly. First abdominal tergum indented along midline; tergum II the shortest, tergites III–VI and VIII about the same length, VII slightly longer. Segments II–VIII with long singular, pleural setae, which grow out of pleural tubercles. Spiracles visible on segments I–VIII, those on segments I–IV well developed, placed on small tubercles (Fig. 27), while the remaining ones are strongly atrophied and nonfunctional. Tergum VIII and sterna VII and VIII with short postero-medial projections; tergum IX with well developed pupal urogomphi each with single terminal seta; gonotheca of male as in Fig. 29, that of female as in Fig. 28.

NOTES ON BIONOMY

The first copulation was observed on 6.IV.1991, the first egg was seen on 19.IV.1991, and the last egg on 4.VII.1991, but most of the eggs were laid in June (about 70%). In most cases a single female laid no more than 10 eggs, 1–2 eggs per day. Eggs were usually dug into the peat, and this stage lasted 5–9 days. Depending on a period of oviposition, the adults lived for a short period, and all were dead by early July.

A hatching larva tears open the chorion along the egg length and remains motionless for another 2–3 hours in which period it becomes fully pigmented. Of the prey offered, first instar larvae of *R. rufipes* preferred small specimens of Collembola, whereas older larvae preferred larger prey, mostly larvae of Diptera. Both instars were stimulated by prey movements, especially after a period of non-feeding. If given only dead prey, both adults and larvae died after a short period of time. The mature larva before pupation digs itself into the substrate, makes a pupal chamber, and remains motionless for 1–2 days before pupation.

Duration of the stages and instars were as follows: egg 5–9 days, I-instar 5–8 days, II-instar 15–19 days and pupal stage 10–12 days. The complete cycle from an egg to the teneral adult lasted approximately 40 days.

Field observations in the beetles' natural habitats were conducted simultaneously and their results con-

firmed results obtained from the laboratory cultures. In the conditions of northern Poland the maximum abundance of adults occurs from late April to the first half of June, and the second period from late August to the end of October. In July no alive adult specimens of *R. rufipes* were observed, which seems to be the period in which the population consists only of larvae and pupae (first teneral specimen was caught on 7 August 1991) from the second generation, which then overwinter. Oviposition therefore appears to take place in late May and in June.

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