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Agonum (Sericoda) quadripunctatum (DE GEER) — a pyrophilous beetle
and its immature stages (Coleoptera, Carabidae)

[With 45 Text-figures]

Abstract. *Agonum (Sericoda) quadripunctatum* (DE GEER) is a pyrophilous beetle that occurs only at sites where forest or peat has been burnt. Adults of this species are certainly attracted to various fires, probably by the smell of smoke from distant places, and stay on a conflagration sites for a short period only. The immature stages of *A. (S.) quadripunctatum* are described and figured for the first time.

Sericoda KIRBY (1837) is a small subgenus of *Agonum* BONELLI (1810) containing five species recorded from Palearctic, Nearctic and Neotropical regions. It is classified in the tribe *Platynini* (HABU 1978). All the species are found in burnt forest areas and are often taken abundantly on stumps and branches of dead burn trees (LINDROTH 1966). EVANS (1971) has introduced a term "pyrophilous" to describe insects attracted to fires.

Prior to this study the immature stages of any species of *Sericoda* were undescribed, and very little was known of the biology of this species other than that adults could be found in some numbers in burnt forest areas (SAALAS 1917, HORION 1941, LINDROTH 1945, 1966, WAGNER 1949, PALM 1955, 1959, HOLLIDAY 1984, LUNDBERG 1984). Field-collected larvae, pupae and adults were successfully reared in the laboratory. The method of rearing, the life-cycle, the food preference and the geographical distribution of this species were described in my earlier paper (BURAKOWSKI 1986).

The adults and larvae were collected by the author during summer vacations (July 1964, 1966, June 1967) in the West Beskidy Mts from the following

sites: Kubalonka Pass near Istebna, Czarna Wisielka Valley and Biała Wisielka Valley. My thanks are due to Halina and Franciszek OLSZÓWKA, Katowice, for making of favourable conditions of laboratory work in their summer-home in Wisła-Głębiec. All material on which the paper is based is kept in the collection of the Institute of Zoology, Polish Academy of Sciences Warsaw.

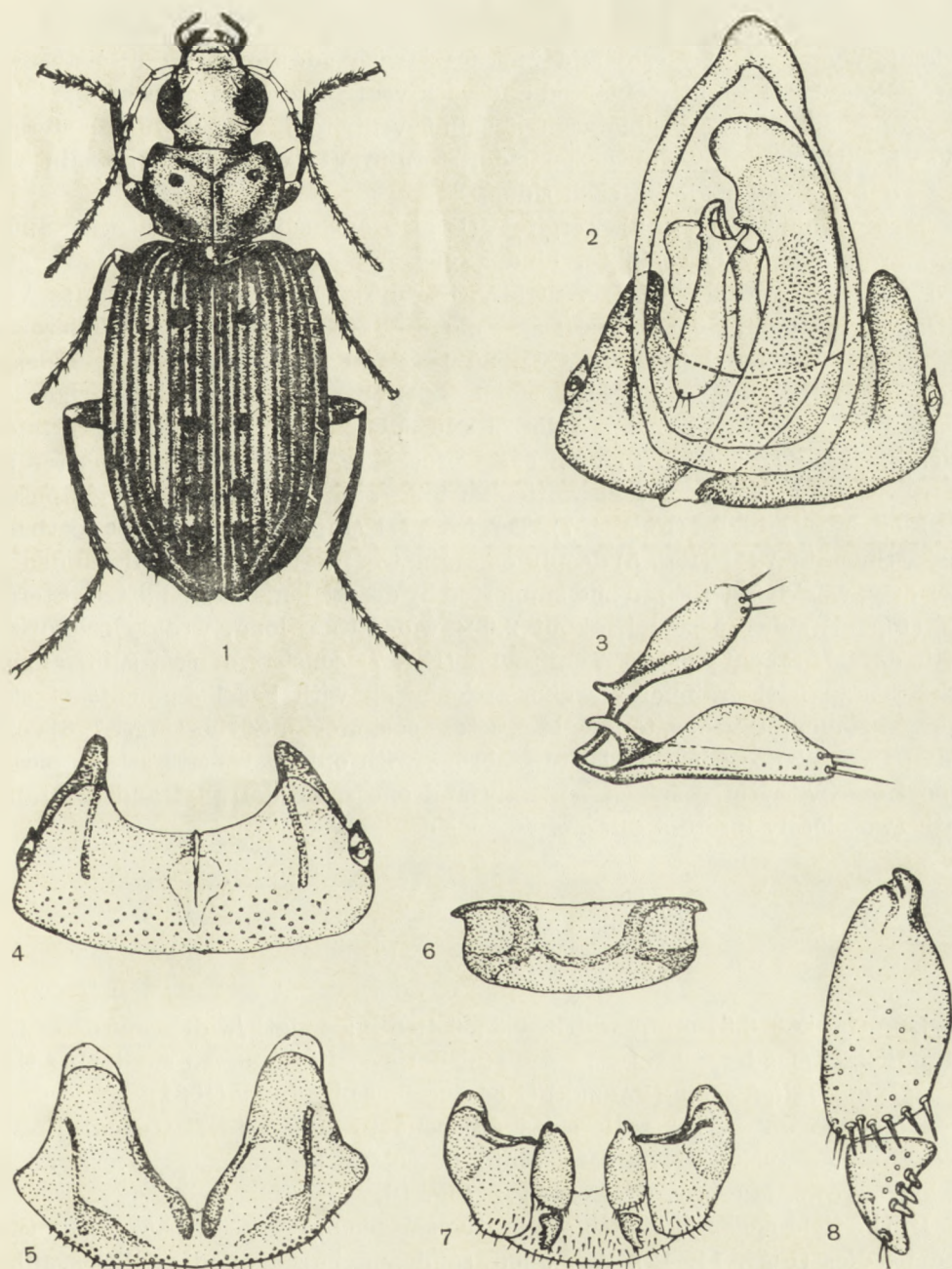
Adult (Figs. 1-8)

Body moderately elongate, subdepressed, entirely black except trochanters and mandible apices which are ferruginous, and tibiae sometimes dark-brownish; surface shiny; dorsum and venter microsculptured. Length 4.4-5.5 mm, width 1.25-1.8 mm ($n = 25$).

Head moderately convex, shiny, finely punctate; head width including eyes 0.9-1.1 mm. Temple moderately oblique with several minute hairs. Eyes large and convex, adjoining buccal fissures. Neck slender. Frontal impression shallow, two pairs of supraorbital pores, posterior ones on level of hind margins of eyes. Antenna long, reaching basal fifth of elytra, filiform; antennomeres I, II each with single seta, III with a few setae apically, IV-XI densely pubescent. Labrum subtrapezoidal with 6 setae anteriorly; mandibles short; mental tooth prominent, simple; submentum bisetose on either side, outer pair of setae very small. Maxillary palps slender, sparsely pubescent, apical palpomere about $1.4 \times$ as long as penultimate one; apical labial palpomere about as long as preceding one.

Pronotum transverse, subtrapezoidal, weakly convex with distinct depressions (Fig. 1). Pronotal length 0.8-1.0 mm, width 1.15-1.40 mm ($n = 25$). Disk transversely rugose, microsculpture isodiametric. Anterior margin shallowly emarginate; anterior angles rounded, slightly prominent; sides arcuate anteriorly, fairly contracted posteriorly, distinctly sinuate just before hind angles; hind angles obtuse; pronotal base moderately rounded medially; basal foveae wide and moderately deep, merged with lateral groove. Disk with pair of foveiform depressions, two pairs of marginal setigerous pores and fine median line.

Elytra oblong, weakly convex, widest about middle, $1.5-1.6 \times$ as long as wide. Shoulder fairly advanced and convex, angles obtusely rounded; sides regularly arcuate, deeply sinuate apically, apex rounded. Elytral striae fine, deeper at base and apex, indistinctly punctulate or crenulate; intervals slightly convex, microsculptured, microsculpture of transverse or oblique meshes; scutellary striole deep, basal pore present; interval 3 with four pores, each in large deep fovea, first pore extending into interval 4, others into interval 2; preapical pore on stria 7 before apex; apical pore situated on marginal groove near apex of stria 2; marginal groove with 13-15 pores. Wings well developed. Ventral side of thorax smooth. Prosternal process glabrous, slightly carinate.



Figs. 1-8. *Agonum quadripunctatum*, adult. 1 — dorsal view; 2 — abdominal sternite VIII, segment IX and aedeagus; 3 — parameres; 4 — abdominal tergite VIII; 5 — sternite VIII; 6 — sternite IX; 7 — tergites IX and X with styluses; 8 — left stylus, ventral. 1-3 — male; 4-8 — female.

Legs slender; tarsi glabrous dorsally, ventrally with row of setae on each side, tarsomere I of meso- and metatarsi with additional setae; males with tarsomeres I–III slightly enlarged and with ventral adhesive pubescence.

Abdomen with 7 visible ventrites but ventrite I and II fused; sternites IV–VI with single seta on either side, sternite VII with single seta in male or two setae in female on each side.

Male terminalia (Fig. 2). Tergite VIII glabrous, subtrapezoidal with anterior margin deeply emarginate, hind angles broadly rounded and strengthened with longitudinal listels ventrally. Sternite VIII similar to tergite VIII. Segment IX composed of two fused narrow, arcuate and weakly sclerotized parts, antero-ventral (sternite IX) and postero-dorsal (tergite IX). Aedeagus moderately arcuate, basal lobe small, apex narrowly rounded, surface not rugose; opening of internal sac dorsal and subapical; internal sac with microtrichia. Parameres (Fig. 3) with basal processes, right paramere shorter and narrower than left one, each with one long and two shorter setae apically.

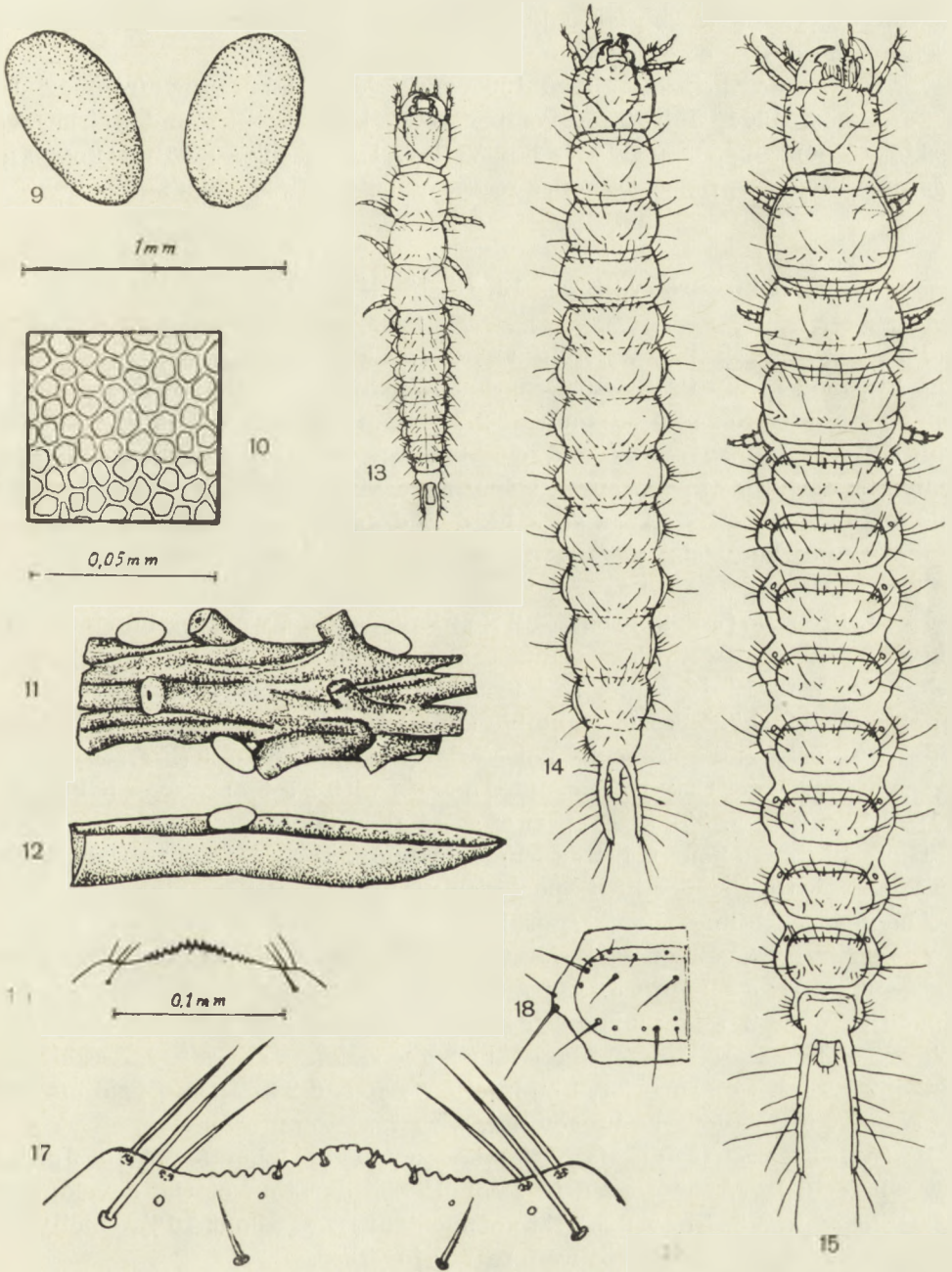
Female terminalia (Figs. 4–7). Tergite VIII (Fig. 4) very similar to that of male. Sternite VIII (Fig. 5) deeply emarginate anteriorly, obtusely rounded posteriorly, weakly sclerotized and supported by dorsal, longitudinal listels. Sternite IX (Fig. 6) subtrapezoidal, about $2.6 \times$ wider than long, weakly sclerotized, with dorsal, arcuate listels. Tergite IX (Fig. 7) consists of two subtriangular sclerites with their inner margins articulating with basal segments of styli. Tergite X membranous, tongue-like, setose posteriorly. Stylus (Figs. 7, 8) consists of two sclerites; basal sclerite glabrous with only 9 ventral setae apically, apical one with three spines ventrally and one spine dorsally, and a foramen with two closely inserted setae on inner side.

Egg (Figs. 9–12)

Length 0.68–0.87 mm, width 0.38–0.40 mm; length/width ratio = 1.87; adult length/egg length ratio = 6.6, and both coefficients are similar to those of *Agonum fuliginosum* (PANZER) (1.84 and 6.55) by LUFF (1981).

Shape roughly oval with sides adjacent to substrate flattened. Freshly laid shiny, translucent, creamy-white in colour becoming yellowish as the embryo grows. Microreticulation as in Fig. 10.

In the field eggs are laid singly on the surface of charred spruce or fir twigs and needles (Figs. 11, 12). Ash-wood, sand and burnt wood particles adhere to the horizon making the eggs difficult to find. In the laboratory eggs were laid singly either in moistened filter-paper or in soil at a depth of 3–10 mm below surface, or on particles of burnt litter. The postembryonic development may last 7–10 days. Prior to hatching a coiled, creamy larva is visible through a



Figs. 9-18. *Agonum quadripunctatum*. 9 - eggs; 10 - microsculpture of egg; 11 - eggs on burnt twig of fir; 12 - egg on burnt needle of fir; 13-15 - larva, dorsal view; 16-17 - clypeus and anguli frontales; 18 - abdominal tergite I. 13, 16, 18 - instar I; 14 - instar II; 15, 17 - instar III.

translucent egg shell. The larva leaves the egg by cutting through one of its poles by the means of its egg bursters.

Material examined: about 100 eggs laid in laboratory from 12 July to 20 August 1964, July 2, November 1966, by females found in the West Beskid Mountains, Czarna Wiselka Valley, leg. et cult. B. BURAKOWSKI; 7 eggs preserved, the remaining ones reared until the first stage larvae.

First-instar larva (Figs. 13, 15, 18, 21, 24, 27, 30, 33, 41)

Body slender, feebly tapering anteriorly and more strongly posteriorly (Fig. 13), moderately flattened. Length 1.75–2.37 mm, cranial width 0.33–0.37 mm; length just prior to first moulting 2.75 mm. Colour after emergence creamy-whitish, mandibular apices and egg bursters yellowish, appendages paler, stemmata dark-brown; a whitish colouring darkens after 12 hours, becoming yellow-brownish with ferruginous head and paler appendages and venter. In relation to body size setae are comparatively longer than in subsequent instars.

Head. Frontale (Fig. 21) about $1.2 \times$ as long as wide, with egg bursters consisting of 2 rows of spaced, short spinules, 5–7 in each row. Nasale (Fig. 16) weakly prominent, with 12–16 acute, fine teeth. Length ratio of antennomeres I–IV (Fig. 27) as: 0.9: 0.7: 1.2: 1.0. Mandible (Fig. 24) $2.6 \times$ as long as wide at base; blade anteriorly and retinaculum posteriorly serrate. Stipes (Fig. 30) $2 \times$ as long as wide, shorter than palpus, outer margin with 2 setae; ratio of palpomeres — 1:1.6:1.2:1.2 (Fig. 33); apical part of galea about as long as penultimate one.

Thorax length about $0.4 \times$ as length of body. Legs similar to third-instar, but femora with 4 spines in its posterior part.

Abdomen equalling about $\frac{2}{5}$ of body length, gradually tapering towards apex. Tergite I (Fig. 19) on each side with 5 long and 5 short setae, and 5 pores; tergites II–VIII, each with 5 long and 3 short setae and 5 pores on each side; epipleurite with 2 setae; hypopleurite without setae; other sternal sclerites with one or two setae. Urogomphi about $2.5 \times$ as long as tergite IX, each with 6 setae: 2 lateral, 1 on superior, 1 on inferior face, and 2 at apex. Pygidium slender, about $0.5 \times$ as long as urogomphi, with 7 setae on each side.

Material examined: Many larvae reared in laboratory, 15 July–25 September; 10 larvae preserved in alcohol. The duration of the development of this instar was 3–4 days; the rate of mortality was about 10%, chiefly due to cannibalism, when the larvae were reared together.

Remark. The described larva is very similar to that of *A. (Idiochroma) dorsale* (PONTOPPIDAN) by HURKA and SMRŽ (1981), except the size and the nasale of the later with two large lateral teeth.

Second-instar larva (Figs. 14, 22, 25, 28, 31, 34, 40)

Body length 4.0–5.5 mm; head width 0.50–0.55 mm coefficient of cephalic capsule growth in relation to first-instar larva — 1.5. Body (fig. 14) similar to that of first-instar, but thorax about $0.25 \times$ as long of body, and abdomen about $\frac{3}{5}$ of body length.

The absence of the egg bursters, the presence of 5 setae on abdominal epipleurite, 2 setae on hypopleurite, 4 additional setae on urogomphi and a larger number of leg spines on anterior and posterior faces of femora distinguish larvae of the second-instar from those of the first-instar.

Frontale (Fig. 22) about $1.1 \times$ as long as wide. Length ratio of antennomeres — 1.2:1.0:1.6:1.2 (fig. 28). Mandible (Fig. 25) about $2.4 \times$ as long as wide at base, with blade smooth. Stipes (Fig. 31) $2.4 \times$ as long as wide, and about as long as palpus; outer margin with 4 setae; length ratio of palpomeres — 1.1:2.0:1.1:1.0 (Fig. 34). Urogomphi (Fig. 40) about $3.5 \times$ as long as tergite IX, each with 10 setae.

Material examined: 57 larvae reared in laboratory and 9 specimens collected in field on 13 July 1964; 10 specimens preserved in alcohol. This stage lasts about 6–8 dyas.

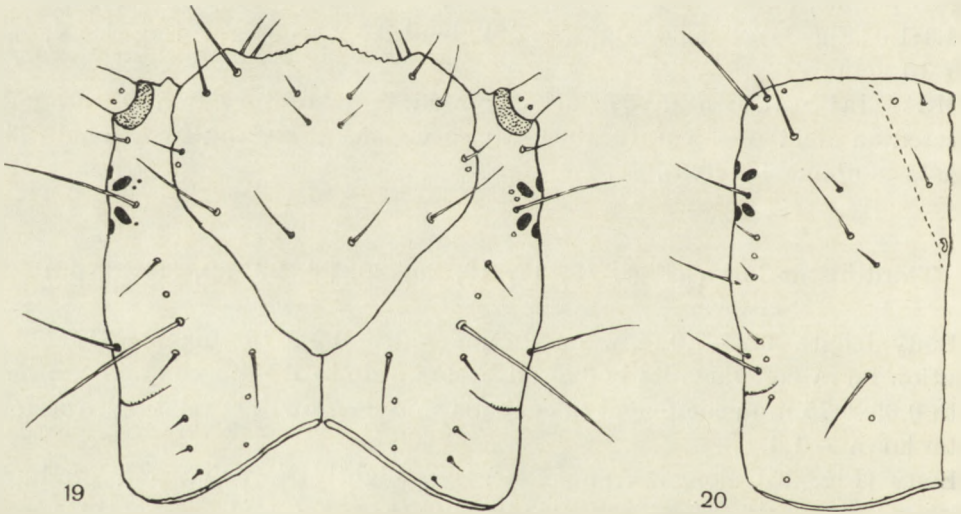
Third-instar larva (Figs. 15, 17, 19, 20, 23, 26, 29, 32, 35–40, 43)

Body length 6.25–7.0 mm, maximum width 0.9–1.15 mm; shortly before pupation larva contracts its body and becomes up to 1.0–1.5 mm shorter; head width 0.65–0.75 mm; coefficient of cephalic capsule growth in relation to second-instar larva — 1.4.

Body (Fig. 15) elongate, subcylindrical, slightly flattened and gradually tapering posteriorly. Head capsule, mandibles, prae- and mesonotum ferruginous-brown; metatergum, tergites of abdomen yellow-brown; appendages, pleurites, sternites, and spiracles yellowish; intersegmental integument creamy-whitish; setae brown.

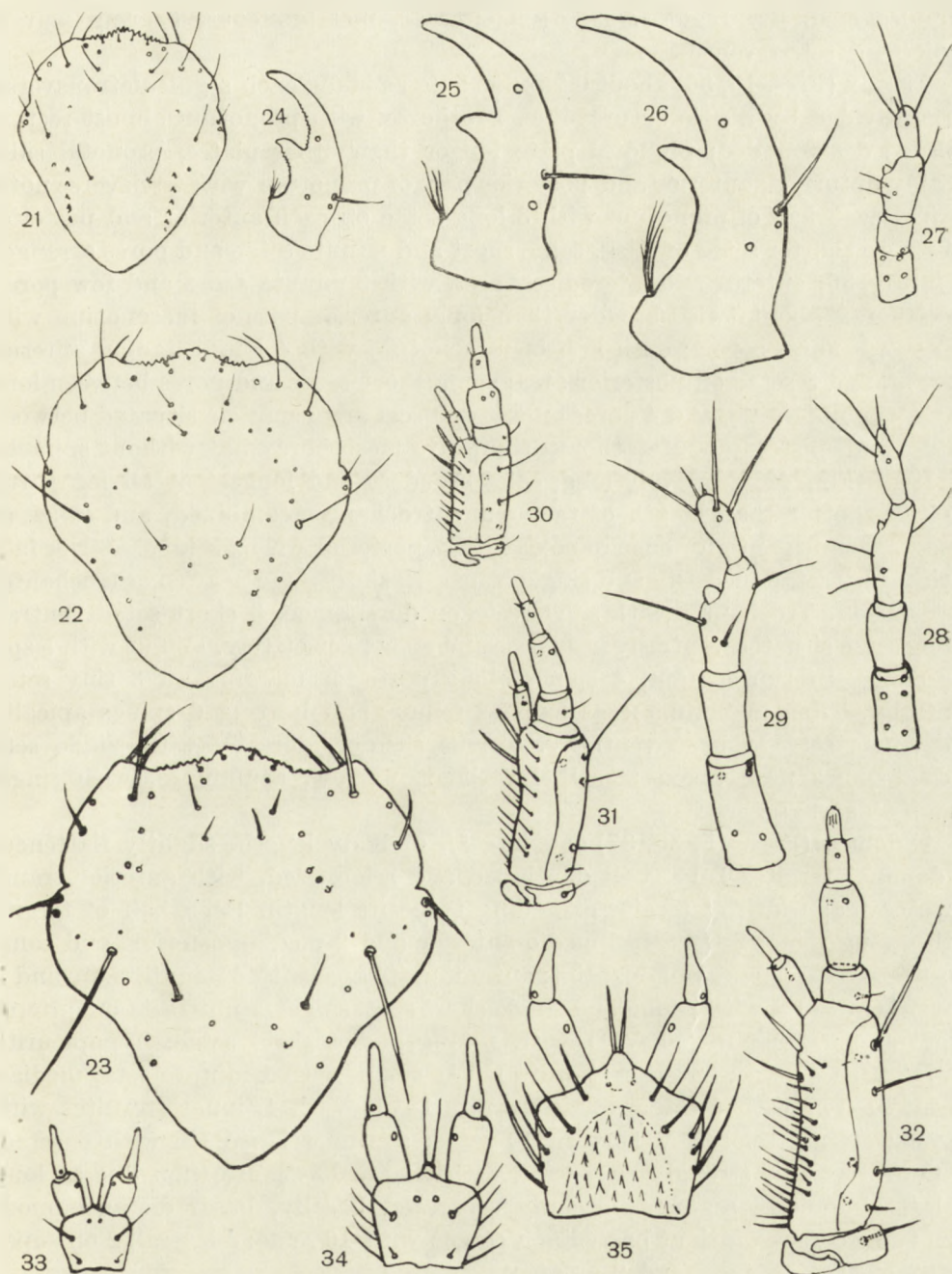
Head (Figs. 19, 20) subquadrangular, with sides slightly converging posteriorly and maximal width at about middle. Neck surface concave posteriorly, hind margin arcuate and ridged; neck suture semicircular; frontal suture distinctly curved; epicranial suture short, about $\frac{1}{5}$ as long as length of frontale. Frontale (Fig. 23) slightly longer than wide, frontal margin arcuate, disk with 7 setae and 6 pores on each side; posterior part obtuse. Nasale (Fig. 17) broad, arcuate, slightly protruding, without lateral tubercles, with 18–20 short, obtuse teeth; basal part of nasale with 4 setae; anguli frontales well developed, obtusely elevated with their apices slightly lower than nasale, with 2 setae arising from ventral

side of nasale. Parietale (Figs. 19, 20) covering greater part of head from above, ventrally and laterally with 19 primary setae. Mandible (Fig. 26) heavily sclerotized, about $2.3 \times$ as long as wide at base, in form of moderately broad sickle with triangular base; one long seta and 3 pores on outer face; retinaculum short and obtuse; penicillus slender, markedly longer than retinaculum and brush-like. Antenna (Fig. 29) with antennomere I longest, subcylindrical, $2.4 \times$ longer than wide, with 5 pores; II antennomere about $1.1 \times$ as long as IV, with single sensillum; III markedly widened anteriorly and obliquely truncate, as long as I, with small, conical sensory appendage and 3 long setae; IV narrowest, with single pore, and 4 setae and 3 minute sensillae apically. Maxilla (Fig. 32) slightly longer than antenna, exteriorly arcuate; cardo unisetose; stipes $2.7 \times$ as long as wide, and $1.2 \times$ as long as palpus, with 3 strong setae



Figs. 19-20. *Agonum quadripunctatum*, larva of instar III. 19 — head, dorsal. 20 — half of head, ventral.

near outer and 2 setae near inner edge, dorsal surface with numerous hairs, while ventral side with rigid setae; galea 2-segmented, $0.4 \times$ as long as stipes, basal segment club-like with single seta distally, second segment elongate, with 2 setae and several apical sensory processes. Palpi 4-segmented, slightly shorter than stipes, first palpomere shorter than long, with one seta; palpomere II $3 \times$ as long as I, with 2 pores; III $1.5 \times$ as long as I, with 2 setae and single pore; IV very small, with several sensillae. Labium with prementum subtrapezoidal (Fig. 35), weakly constricted basally, lower surface with two pores anteriorly, two setae caudad to base of palpomere and single seta posteriorly on each side; dorsal surface with 4 setae laterally and densely situated conical



Figs. 21-35. *Agonum quadripunctatum*, larva. 21-23 — frontale; 24-26 — mandible; 27-29 — antenna; 30-32 — maxilla; 33-35 — labium. 21, 24, 27, 30, 33 — instar I; 22, 25, 28, 31, 34 — instar II; 23, 26, 29, 32, 35 — instar III.

spinules medially. Ligula small, semicircular, membraneous, bearing pair of projecting setae ventrally.

Thorax (Figs. 15, 36) about $0.25 \times$ as long as body; each segment transverse; terga divided by a pale sutural line. Prothorax with pronotum almost rectangular, sides rounded; pronotal plate longer than other plates; pronotal sides weakly upturned; anterior and posterior part of pronotum with transverse notal carina; each half of pronotum with 3 long setae on each anterior and posterior area, two shorter setae on disk, some short and minute setae and pores arranged as in Fig. 36; antero- and laterodiscal area with 3 minute setae and few pores. Mesothorax about twice broader than long; anterior part of mesonotum with transverse notal carina; each half of mesonotum with 4 long setae on anterior margin, and 3 setae on posterior area; some short setae and pores between long setae; 4 minute setae and 4 pores on anterodiscal area; spiracle situated between notum and episternum. Metathorax similar to mesothorax but without spiracle.

Legs (Fig. 42) relatively long; coxa broadest and longest of all leg parts, slightly shorter than length of femur and trochanter combined, and twice as broad as femur; anterior edge of coxa with 3, posterior with 2 setae, anterior face with 2 tiny setae medially and single at base, 2 short setae near coxa-trochanter articulation. Trochanter with single seta on dorsal face, 3 short setae ventral, 2 long setae situated ventrally near base and apex respectively. Femur with 5 spines along anterior margin, 4 spines along posterior margin and 3 tiny setae ventrally. Tibia about $0.5 \times$ as long as femur, and bearing 6 spines apically and single seta at base ventrally. Tarsus slender, dorsally with single seta and 2 spines near apex; tarsal claw bent, narrow, acuminate, with single tiny seta at base.

Abdomen (Figs. 15, 36, 37) equaling $\frac{3}{5}$ of body length, slightly flattened. Abdominal tergites I-IX well developed and sclerotized, with anterior transverse carina; width of tergite exceeding twice its length. Each half of tergite with 6 long setae: 2 lateral, 2 medio-anterior and 2 medio-posterior, and some short setae and pores along margins; anterotergite area with 4 minute setae and 3 pores. Tergite IX with 2 long and single short seta, single minute seta on anterotergal area. Epipleurite I-VIII with 1 long and 4 short setae; hypopleurite I-VIII with 4 setae; anterior sternite I-VII small, with 1 minute seta; median sternite I-VII with 6 setae; outer sternite I-VII with 4, inner sternites with 3 setae; sternal sclerite VIII with 10 setae; sternal sclerite IX with 6 setae.

Cerci straight, strongly connected with tergite IX, more than $3 \times$ as long as last abdominal segment, broadly separated basally, basal distance more than twice cercus width at base. Each cercus with 10 setae: 4 lateral, 2 on superior, 2 on inferior face, and 2 at apex.

Pygidium (Fig. 43) $2.5 \times$ as long as tergite IX, directed obliquely and helps larva movement by supporting its body; setation of pygidium consists of 8 setae on each side: 3 superior, 4 lateral and 1 inferior, all barely visible; apex with numerous spinules.

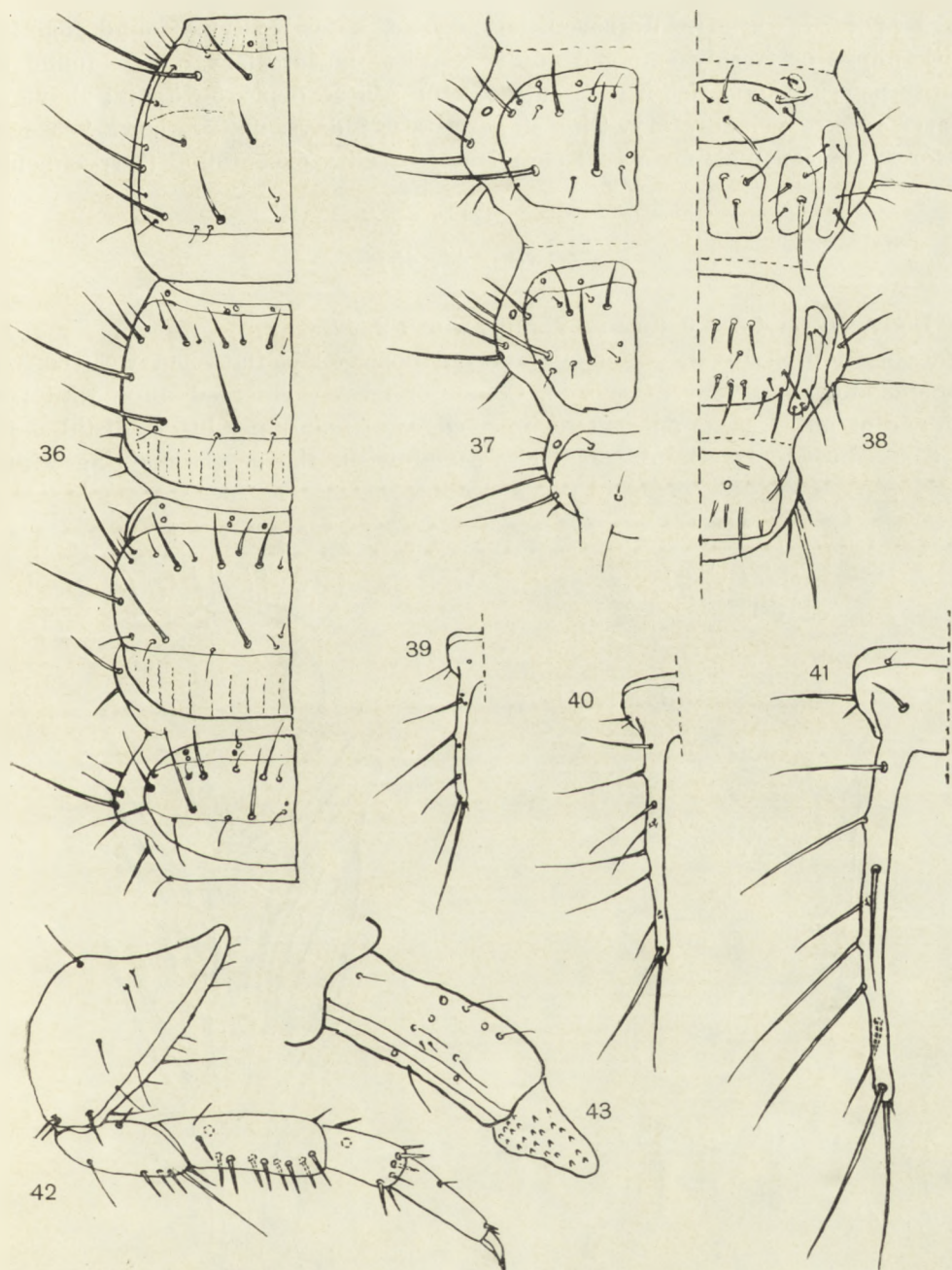


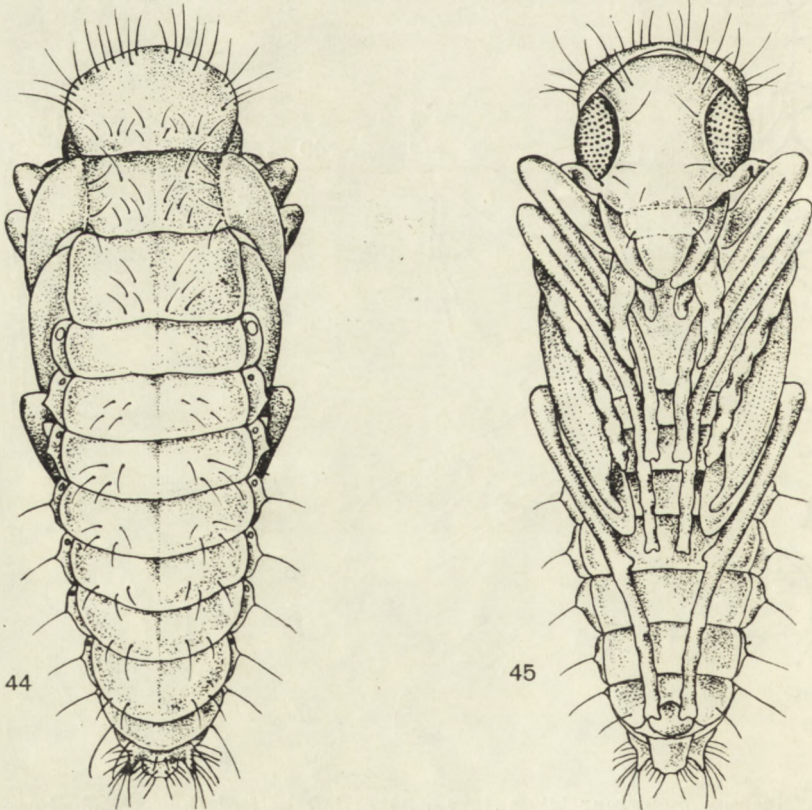
Fig. 36-43. *Agonum quadripunctatum*, larva. 36 - left half of thorax and abdominal segment I, dorsal; 37 - half of abdominal segments VII-IX, dorsal; 38 - same, ventral; 39-41 - left urogomphus, dorsal; 42 - left middle leg, frontal view; 43 - pygidium, lateral; 39 - instar I; 40 - instar II; 36-38, 41-43 - instar III.

Material examined: seven larvae and a few exuviae found together with pupae or freshly emerged adults. Several mature larvae were found on burnt places in galleries in the substrate or soil at depth 5–15 mm; about 60 larvae reared in laboratory. This stage lasts 6–8 days; mature larva 2–3 days before pupation makes a pupal chamber. Mortality exceptional (2 specimens).

Pupa (Figs. 44, 45)

Body length 4.8–6.0 mm; maximum width 2.3–2.6 mm.

Longitudinally-oval, abdomen tapering posteriorly, flattened with convex dorsum and concave ventral side. Colour of freshly emerged pupa white; at the end of pupal stage apices and inner edges of mandibles black, distal parts of tibiae brown, tarsi and tarsal claws yellowish, the rest remaining white.



Figs. 44–45. *Agonum quadripunctatum*, pupa. 44 – dorsal; 45 – ventral.

Head strongly declined ventrally and completely hidden from above. Labrum linguliform, covering almost completely other mouth-parts. Eyes convex, well visible. Head with 7 setae on each side: 2 temporal, 1 preocular, 2 preantennal, 1 preclypeal and 1 clypeal.

Pronotum almost trapezoidal with anterior angles reaching ocular area; $0.66 \times$ as long as wide, and about $0.6 \times$ as long as meso- and metanotum combined; disk with 17 setae on each side: 6 on anterior margin, 5 lateral and 6 along posterior margin of pronotum. Mesonotum almost rectangular with 9 setae on each side: 4 lateral and 5 median area. Metanotum slightly longer than mesonotum, about $0.5 \times$ as long as wide, with 8 setae in median part.

Anterior wings fitting obliquely at both sides of body and passing to the underside where they fit between median and posterior legs: shallowly sinuate apically but rounded at extreme apex reaching abdominal sternum III. Posterior wings partly visible and reaching sternum IV.

Legs. Anterior and median femora directed obliquely upward, posterior ones concealed beneath posterior wings. Posterior tarsi strongly elongate, reaching beyond posterior edge of abdominal sternite VIII.

Abdomen equalling $\frac{3}{5}$ of total length, consists of 9 segments; tergites I–VI subequal, VII longest, almost as long as mesonotum, VIII $0.5 \times$ as long as preceding; IX very short, with rudimentary cerci and anal cone beneath them. Each tergite with shallow, median groove and long setae; tergites I–IV with 4 setae on each half of tergite, V with 3 setae and VI–IX with 2 setae on each side of tergite. Anal cone between cerci and sternite IX; apex with 5 pairs of setae: 2 dorsal and 3 pairs of lateral setae.

Ventral side (Fig. 45) with only 8 sternites visible. Sternites I–II fused, III–VII semirectangular, VIII in male with posterior margin shallowly emarginate, straight in female. Gonothea in male single, subtriangular, situated within emargination of sternite VIII. Female gonothea paired, symmetrical, conical, with obtuse apices directed somewhat outward.

Material examined: 3 pupae collected in the field on July and several reared in the laboratory. The pupal period lasts 5–7 days; mortality minor, only 3 specimens.

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STRESZCZENIE

[Tytuł: *Agonum (Sericoda) quadripunctatum* (DE GEER) — chrząszcz pirofilny i jego stadia rozwojowe (Coleoptera, Carabidae)]

W pracy opisano po raz pierwszy stadia rozwojowe pirofilnego biegacza *Agonum (Sericoda) quadripunctatum* (DE GEER). Gatunek ten zaliczany jest do podrodzaju *Sericoda* KIRBY, liczącego 5 gatunków rozmieszczonych w Holar-

kyce i Obszarze Neotropikalnym. Wszystkie te gatunki są nomadami związanymi z wypalonymi obszarami leśnymi lub torfowiskami, na które nalatują masowo ze znacznych odległości.

РЕЗЮМЕ

[Заглавие: *Agonum (Sericoda) quadripunctatum* (DE GEER) — пирophilный жук и его стадии развития (*Coleoptera, Carabidae*)]

В работе впервые описаны стадии развития пирophilной жуужелицы *Agonum (Sericoda) quadripunctatum* (DE GEER). Этот вид причисляется к подроду *Sericoda* КИРВУ, насчитывающему 5 видов, размещенных в Голарктике и Неотропической области. Все эти виды являются мигрирующими, связаны с выжженными лесными территориями или торфяниками, на которые совершают массовые налеты.
