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Bolesław BURAKOWSKI

Development, distribution and habits of *Trixagus dermestoides* (L.), with notes on the *Throscidae* and *Lissomidae* (*Coleoptera, Elateroidea*)

[With 48 text-figures and 1 map]

Approximately 200 species of the family *Throscidae* have been described, the majority of which belong to the genus *Trixagus* KUGELANN and *Aulonothroscus* HORN, however, little information has been published on its immature stages and biology. The American species, possibly *Aulonothroscus constrictor* SAY, is the only representative of the family known in the larval stage. This species is figured by BÖVING and CRAIGHEAD (1930: p. 249, pl. 81, figs. A–D). Moreover an unidentified species of *Trixagus* has been briefly described by GILJAROV (1964).

The present paper is devoted to the morphology and bionomics of immature stages of *Trixagus dermestoides* (L.). During the past 10 years large numbers of larvae and pupae of this species have been examined. The descriptions are based on the material collected mostly in Poland, furthermore in Bulgaria and USSR. Some specimens were reared by the author in the laboratory until the imaginal stage. Biological and ecological observations were obtained either in the laboratory or in the field. All material on which the present paper is based, belongs to and is kept at the Institute of Zoology of the Polish Academy of Sciences in Warszawa.

Description of the mature larva

General: The larva (Fig. 1 and 2) is well characterized by its whitish, soft-skinned body, scarse hairs, structure of head and prothorax, short legs, and the shape of the ninth abdominal segment. Body elongate, spindle-shaped, slightly flattened, tapering feebly anteriorly and posteriorly, constricted between segments that are broader than long. Dimensions: Body length of fully grown,

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distended larvae varying from 4.5 to 6.3 mm, greatest breadth about 1.3 mm. Shortly before the pupation the larva is robustest and contracts its body, thus becoming up to 0.5–1.5 mm shorter. Head-width approximately 0.30–0.35 mm; coefficient of cephalic capsule breadth in relation to length of body varying from 16 to 20. Colouring: body milky-whitish, feebly sclerotized except parts of head, presternal plate, longitudinal scleromes on ventral part of prothorax, cerci, spiracles, ungula and setae, which are yellowish and moderately sclerotized; mandibles and processes on inner arm of sclerome of ventral part of prothorax, pale brownish and firmly sclerotized.

Head (Figs. 5, 6) flattened, moderately transverse, widest in the posterior part, considerably narrower than prothorax. Frontoclypeal region large, fused with epicranial plates, their lateral margin bearing 7 setae, anterior part triangular, strongly produced anteriorly. Labrum semicircular in outline, fused with clypeus and frons, forming an immovable unit. Epicranial plates covering chiefly posteroventral parts of head capsule; dorsal surface with three short setae on posterolateral part; ventral surface strongly sclerotized and pigmented, bearing two pairs of lateroepicranial setae. Eye-spot lacking.

Antennae (Fig. 8) three-segmented; basal articulating membrane very characteristic, large, cupola-shaped, with six long setae near their base, four situated dorsally and two ventrally; basal joint ring-shaped; prebasal joint membraneous, with three setae; apical joint conical, three time as long as thick, its apex provided with one long and three small setae; accessory process well developed, in shape of an incurved finger.

Mandibles (Fig. 7) well sclerotized and pigmented, flattened, semicircular in outline, fused with cephalic capsule, immovable, with two short setae at base situated ventrolaterally.

Maxillae (Fig. 6) slender, well developed. Stipes subtriangular, anteriorly with two prominent setae. Maxillary mala (Fig. 9) triangular, differentiated into an inner and an outer lobe, which bear two short setae on ventral side. Maxillary palpi three-segmented; the basal joint one-half as long as wide, with one seta; the second joint wider than long, with two setae; the terminal one subcylindrical, two times as long as thick, with two small pores and terminating in membraneous process, bearing five minute sensory papillae, one long setaceous hair and five short setae on apex.

Labium (Figs. 6, 10) consisting of postmentum and prementum. Postmentum elongate with arcuate sides, bearing three setae laterally. Prementum subquadrangular, with one seta at each angle. Labial palpi two-jointed, basal joint cylindrical, as long as prementum, with one long seta and four minute papillae on apex; terminal joint small, without setae. Ligula reduced to a small, membraneous protuberance bearing one pair of minute papillae.

Prothorax (Figs. 1, 2, 13) approximately trapezoidal in outline, with arcuate sides; each half of pronotum with about 20 setae arranged in two irregular, transverse rows. Prosternal area (Fig. 13) trapezoidal, wider anteriorly, with

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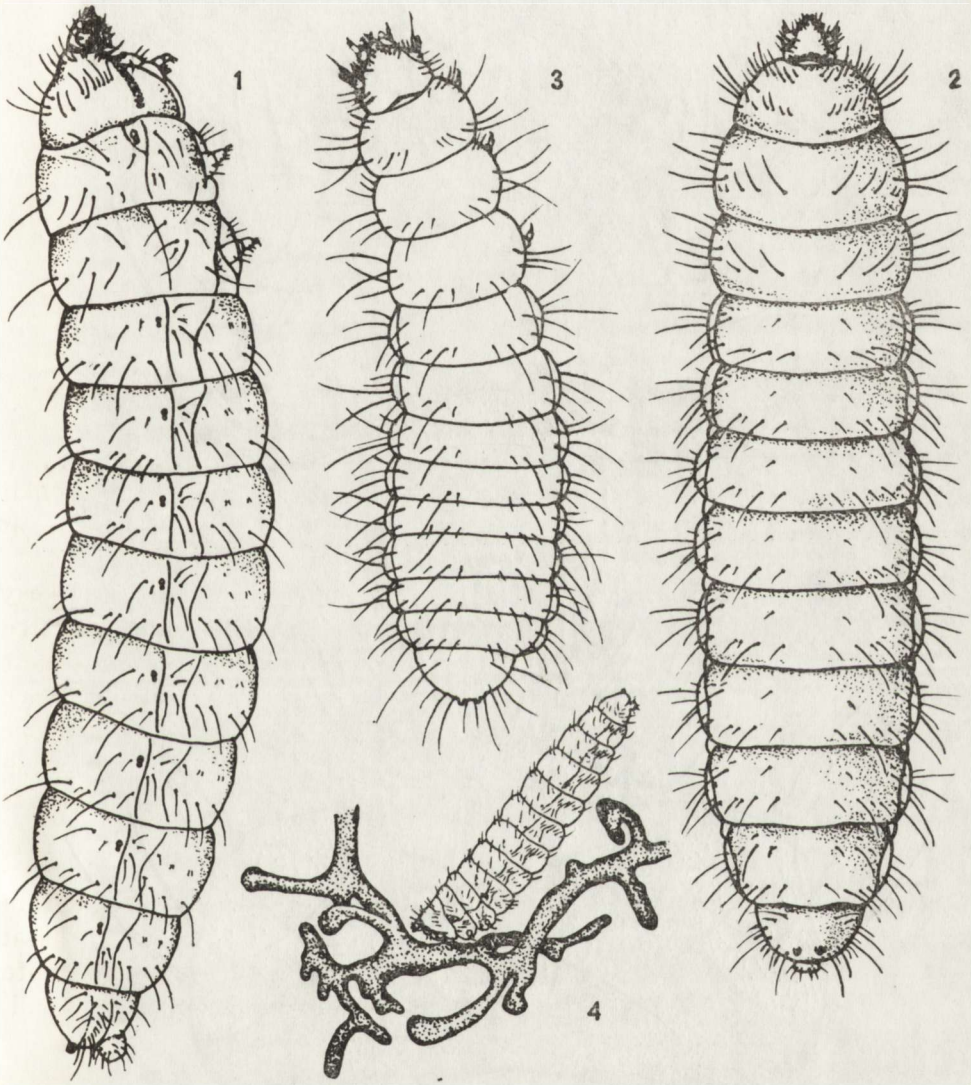
sclerotized lateral and basal margins, and one large seta near anterior angle. Very characteristic on ventral surface of prothorax is a pair of separate, rod-shaped, longitudinal scleromes of a form suggesting an inverted letter V. Each inner arm of sclerome provided with stout, sclerotized and pigmented process. Eusternum membraneous, with four pairs of setae. Episternum, epimeron, sternellum and posternella indefinite, membraneous and glabrous.

Mesothorax about twice as wide as long; posterior part of tergite with four pairs of conspicuous setae in transverse row, lateral part with two large and three



Figs. 1–4. *Trixagus dermestoides* (L.), larva: 1 – lateral view; 2 – dorsal view; 3 – young larva, dorsal view; 4 – older larva feeding on ectotrophic mycorrhizae of roots of birch.

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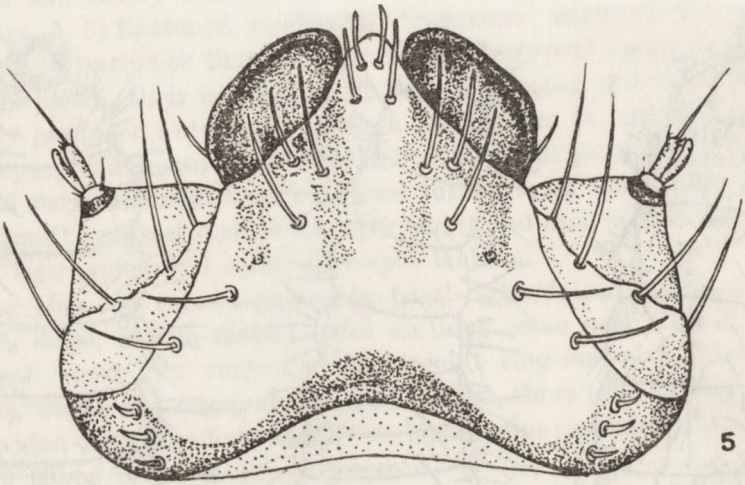
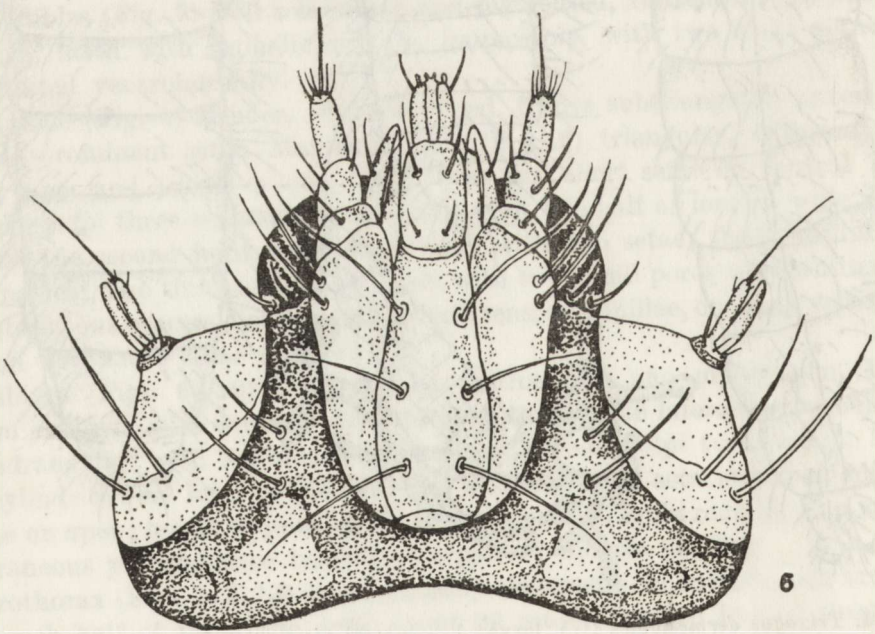
small setae. Laterotergite with two prominent setae and four small setae. Episternum bearing three pairs of setae.

Metathorax about one-third as long as wide; with six setae on each side of metanotum. Laterotergite with six or seven setae.

Legs (Fig. 12 and 13) rather short, similar in shape, the anterior one slightly longer than other. Coxa sessile, approximately oval with four setae on inner surface. Trochanter ring-shaped, outer face short, with one long seta on medial aspect. Femur subcylindrical, longer than trochanter, with four setae situated





Figs. 5, 6. *Trixagus dermestoides* (L.), larva, head: 5 – dorsal view; 6 – ventral view.

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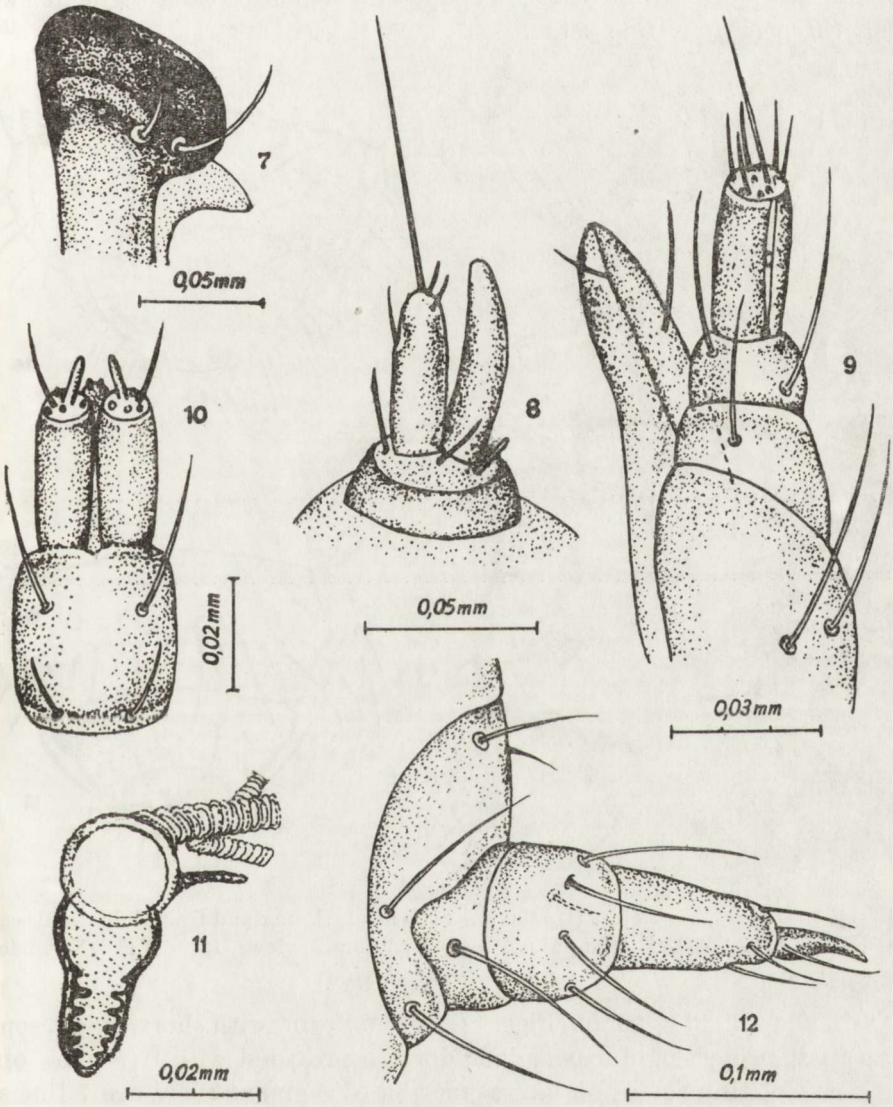
medially and one slender seta on dorsal surface. Tibio-tarsus subcylindrical, narrower than femur, provided with four setae around distal margin. Ungula about one-half length of tibio-tarsus, curved, base expanded mediad, bearing two fine setae.

Spiracles (Fig. 11) of annular-biforous type situated in the latero-anterior part of tergites, lightly sclerotized, broadest anteriorly, in number of nine pairs, first on mesothorax, slightly larger than abdominal spiracles.



Figs. 7–12. *Trixagus dermestoides* (L.), larva: 7 – left mandible, ventral view; 8 – right antenna, dorsal view; 9 – left maxilla, ventral view; 10 – first prementum, ventral view; 11 – spiraculum; 12 – left leg of metathorax, ventral view.

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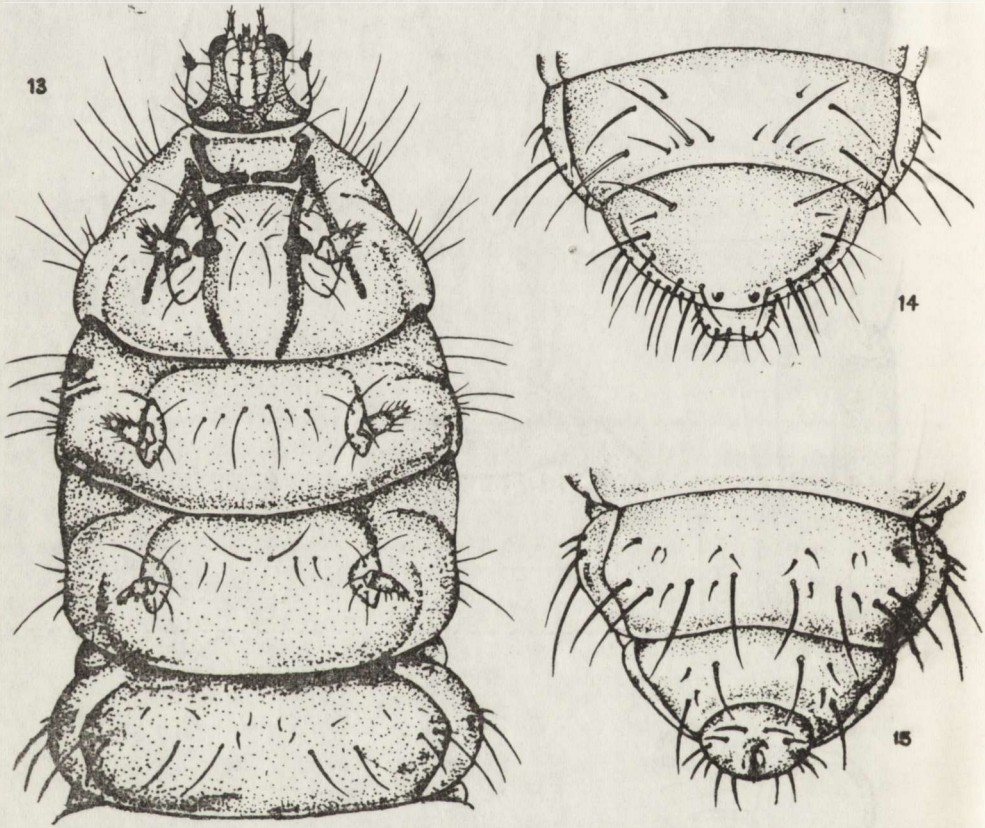
First to eight abdominal segments (Figs. 1, 2) similar in shape, third to sixth segments widest, all segments wider than thick. Anterior part of each tergum (Fig. 14) with two long and four fine setae. On posterior part of each tergum there is a transverse row of about 12 setae: 4 most conspicuous, 6 small and 2 or 4 fine ones. Abdominal sterna (Fig. 15) feebly sclerotized; on the anterior part of each sternum there are 10 tiny, barely visible setae, arranged in irregular transverse row; posterior part of each sternum with four pairs of conspicuous setae and two pairs of fine setae. Hypopleural region of each segment swollen, bearing three or four fine setae.



Figs. 13–15. *Trixagus dermestoides* (L.), larva: 13 – head, thorax and first abdominal segment, ventral view; 14 – VIII–X abdominal segment, dorsal view; 15 – VIII–X abdominal segment, ventral view.

Ninth abdominal segment (Figs. 14, 15) coniform, with short, small, separate cerci at apex, projecting dorsocaudad; dorsum provided with five pairs of long and one pair of tiny setae; on lateral margin of segment there are 7 fine setae; sternum with two pairs long setae and one pair of fine setae.

The prepupa is much shorter and thicker, but of same colour as preceding stage.

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The early instar larvae

First-instar larva (Fig. 3). Body length of distended larvae varying from 1.2 to 1.8 mm, head width from 0.12 to 0.15 mm. Its general form differs from that of later instars in that the body is less elongate, slightly sclerotized and pigmented, more flattened, the abdomen is less tapering posteriorly; in relation to body size the setae seem to be longer than in the subsequent larval stages. Coefficient of cephalic capsule growth in relation to length of body is 8–10 (in matura larva twice as large).

Second-instar larva similar to mature larva in shape. Body length varying from 2.0 to 2.7 mm, head-width from 0.20 to 0.27 mm. Chaetotaxy much less cospicuous than in the first stage.

Description of the pupa (Figs. 16-23)

The pupa has not as yet been described. Generally similar to the pupa of species of the family *Eucnemidae*. The sexes can be separated by the form of the IXth abdominal sterna and that of the gonothecae. Body (Fig. 16, 17) longitudinally oval, with abdomen tapering posteriorly; body epidermis only very feebly sclerotized.

Body length in both sexes greater than in imagines, varying from 4.0 to 4.5 mm (length of imago 2.5–3.2 mm); maximum breadth 1.3–1.7 mm. Body of a freshly emerged pupa milky white and provided with transparent both longer and shorter setae. With further development the body becomes yellowish, the apices of mandibles and the ocellar area brownish.

Head (Fig. 18, 19) spherical, with cephalic, lateral prominences feedly developed. Eyes area reniform, visible well through a transparent epidermis. Number and arrangement of particular setae of both sides of head are constant: there are 3 temporal, 2 preocular, 1 preantennal, 1 postoccipital and 3 preclypeal setae on each side of head. Antennae claviform, fitting prothorax sides and reaching up to the anterior pair of legs, terminal segments scattered with small spines. Labrum liguliform, each half with 3 fine setae at anterior edge. Outer mandibular face with two setae about the middle. Maxillary palpi cylindrical and rounded apically, with one seta situated anterolaterally. Labial palpi with one seta at base on its lower surface.

Pronotum almost trapezoid in shape, with obtuse posterior angles projecting posteriorly along the outer margin of elytra, its length 1.7 times as broad as long, equalling combined length of meso- and metanotum; each half with 5 setae along anterior edge, 5 setae on disc, about 14 setae along lateral margin, and 3–5 setae at posterior angle.

Mesonotum almost trapezoidal, about one third as long as pronotum, with slightly concave lateral sides, carrying in the middle part 10 minute setae around scutellum.

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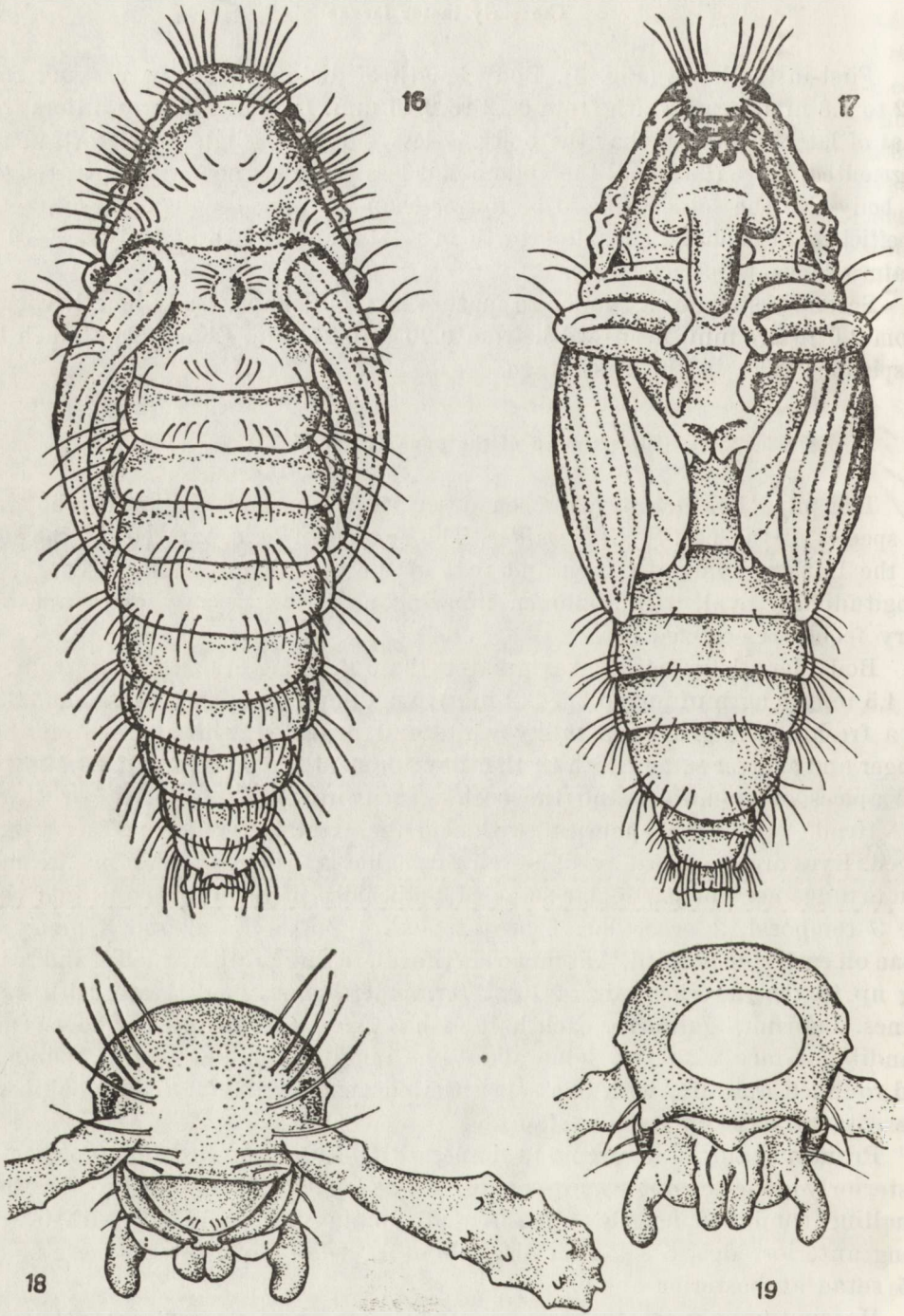

Figs. 16–19. *Trixagus dermestoides* (L.), pupa: 16 – dorsal view; 17 – ventral view; 18 – head, anterior aspect; 19 – head, posterior aspect.

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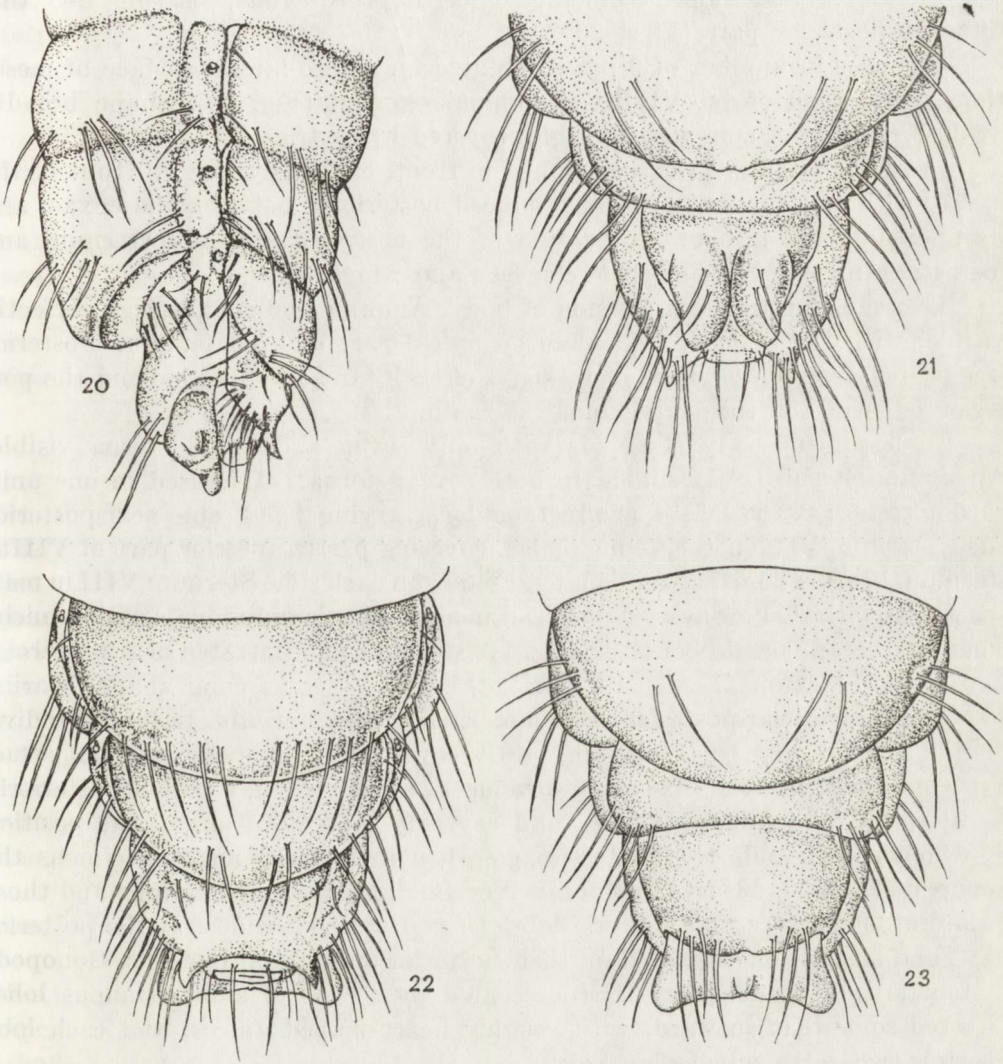
Metanotum almost rectangular in shape, a little longer than mesonotum, bearing 5 setae on each half.

Elytra and wings in a live specimens fitting obliquely at both sides of body and passing to the underside. Pupae preserved in alcohol have elytra and wings more or less spread aside. Apex of elytra reaching the fifth abdominal sternum. Setae on anterior part of elytron 4 in number, and arranged in longitudinal row. Wings partly visible, their apex reaching the fourth abdominal sternum.



Figs. 20–23. *Trixagus dermestoides* (L.), pupa: 20 – male, VI–X segment, lateral view; 21 – female, VII–X segment, ventral view; 22 – male, VII–X segment, dorsal view; 23 – male, VII–X segment, ventral view.

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Abdomen convex dorsally, composed of 9 segments; width of first four abdominal segments almost equal to that of mesonotum; subsequent abdominal segments gradually tapering toward apex. Each half of abdominal terga except the last one, with normal number 5–6 (usually 6) setae near posterior margin, and 2–3 setae at lateral edge. Last abdominal tergum provided posteriorly with two short cerci, and with 20–24 setae, which are arranged as in Figs. 20–22. Cerci corniform, projecting caudally and acuminate, curving slightly upward. Caudal notch arched, broad and shallow.

Pleura of abdominal segments strongly protuberant, bearing 2–3 fine setae at posterior part (Figs. 20–23).

Spiracles in number of 9 pairs, situated on antero-lateral surface of mesothorax and each of Ist–VIIIth abdominal segment (Fig. 20). Shape broadly oval. First pair of spiracles invisible, covered by elytra.

Prosternum (Fig. 17) broad, lobed in front, extremely long in front of the coxae, with a prominent process produced posteriorly between the coxae, and its apex inserted into an excavation of the mesosternum. Mesosternum and metasternum partly visible between legs and wings.

Legs clinging to the underside of body. Anterior and middle legs perfectly visible, with three short, fine setae on apical part of each femora. Posterior legs partly covered by wings, distal parts of each tarsi reaching beyond the posterior edge of the third abdominal sternum.

Underside of body (Fig. 17) with only seven abdominal sterna visible. Abdominal sterna I–VII similar in both sexes; sterna I–III fused in one unit, without setae; sterna IV–VI semirectangular, carrying 2 or 4 setae near posterior edge; sternum VII longest, semicircular, covering partly anterior part of VIIIth sternum, bearing 2 median and 3 lateral setae, on each side. Sternum VIII in male specimens with shallow excised posterior margin, female individuals with semicircular one; setae 5 in number on each half of sternum, concentrated near posterolateral edge. Sternum IX of male (Fig. 23) large, of semicircular shape, bearing 4 setae situated near posterior margin on each half of sternum. In female individuals IXth sternum partly visible, partly covered by gonopods, without setae.

Gonotheca in both sexes well developed, symmetrical, situated posteriorly to the ninth abdominal sternum, and covering the genital organ the position of which corresponds to that of imago when in rest. In male specimens the gonopods (Fig. 22, 23) tri-lobed, only very small apex of median lobe and those of lateral lobes are visible. Lateral lobes large, flattened, widest at the posterior part, and slightly emarginated on their posterior and lateral margins. Gonopods in female individuals (Fig. 21) represented by a pair of subcontinuous lobes directed somewhat outward, with roughly heart-shaped apices, and each lobe bearing two setae on median part.

Anal cone (Figs. 20–22) situated between posterior part of IXth tergum and gonotheca; apex of cone with one pair of median setae on dorsal surface and two pairs of lateral setae.

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Imago

Trixagus dermestoides (L.) is a very distinct, characteristic and easily identifiable species by its emarginate eyes and a strongly carinate frons (Fig. 25).

The adult which emerged from the pupa in the laboratory measured 2.5–3.2mm in length and 1.14–1.28 mm in its greatest width. Measurements of body are also similar to those of specimens captured in field.

Body fairly strongly convex (Fig. 24) anteriorly broadest, fairly regular oblong-oval in outline; unicolorous, dorsal side red-brownish or brown, moderately shining; underside, legs and appendages of head paler. Vestiture of whole body grayish or yellowish, hairs fine, suberect and moderately dense.

Head (Fig. 25) subspherical, sparsely punctate, inserted up to the eyes into the prothorax and covered below by the prosternal lobe. Front obtusely bicarinate; carinae distinct parallel and remote distant; between carinae there is a delicate elevation. Eyes dorsal-lateral, obovate, slightly convex, with oblique, rather broad triangular impressions, extended across from the edge nearest to the insertion of the antennae, to almost the middle of the eye. Antennae 11-segmented, with a loose, three-segmented club, inserted on the front between the eyes, beneath a supra-antennal ridge, received in grooves on the prosternum.

Pronotum trapezoidal, with a fairly sinuate base, prominent acute posterior angles, and feebly arcuate sides gradually narrowed to the front; disc moderately convex, basal region elevated in middle and at each side slightly depressed, hind angles with long and distinct carinae; surface coarsely but not closely punctate. Prosternum (Fig. 27) broad and slightly lobed in front, produced posteriorly between the coxae into a prominent narrow process which fits into the mesosternal fossa. Prosternal inter-coxal process rather broad and flat, markedly deflexed towards the apex. Metasternum with tarsal grooves very short, only feebly diverging from femoral sulcus.

Elytra (Figs. 24, 29) entire, fitting closely posterior pronotal edge not wider than thorax, gradually narrowing posteriorly, with rounded apex; their surface striate; striae sparsely and distinctly punctured, intervals almost flat, rather coarsely punctate, the punctures finer than those of the striae; surface between the punctures very minutely punctulate.

Abdomen almost boat-shaped, with five visible sternites, the sutures complete; surface microrugose.

Male: distinguished from the female by much longer antennae with a longer and wider club, and by much longer hairs on outer margin of elytra at apex (Fig. 29); furthermore by abdominal segment VIII and IX, differing in shape. Sternum VIII short, subtrapezoidal, with a fairly long median process at about a third of sternum length; anterior part with a pair of arcuate struts, posterior part pilose on their ventral surface, each hind angles bearing a pair of long setae. Tergum VIII semicircular, pilose on its posterior edge. Sternum

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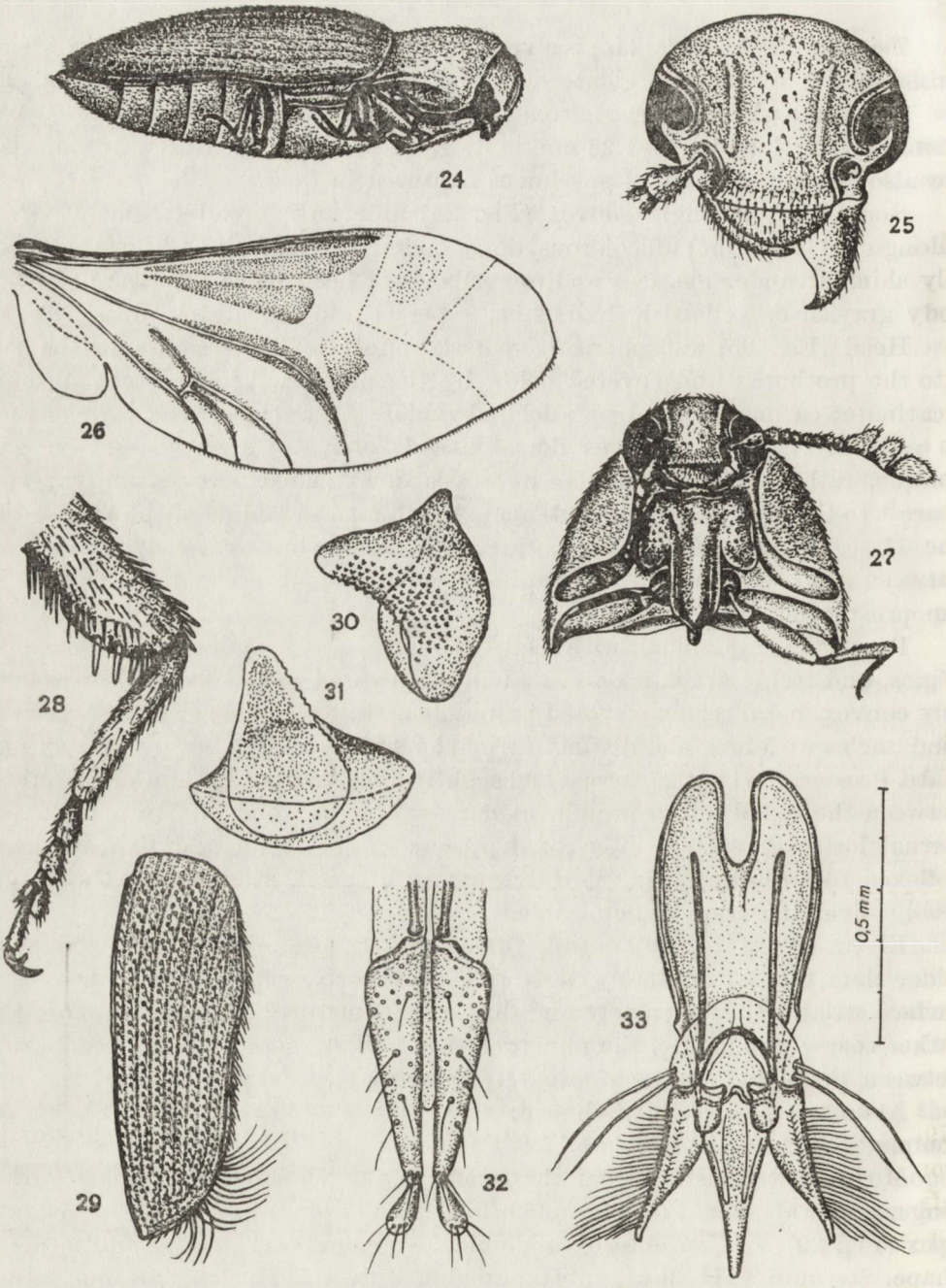

Figs. 24–33. *Trixagus dermestoides* (L.), imago: 24 – lateral view; 25 – head, anterior view; 26 – wing; 27 – head and prothorax, ventral view; 28 – tarsus and apex of tibia; 29 – elytron; 30, 31 – processes in bursa copulatrix; 32 – ovipositor; 33 – aedeagus.

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IX distinctly elongate, subtrapezoidal in posterior, and triangular in anterior part, sclerotized on lateral edge, membraneous on median surface, densely pilose at apex. Tergum IX with posterior and anterior edges rather strongly excised, their postero-lateral margin bearing numerous (10–12) long setae. Tergum X is linguliform in shape, pilose at apex.

The aedeagus (Fig. 33) is of a trilobed type similar to that of *Elateridae*. Penis slender, strong, stout at base, with gradually regularly tapering apical part, and with a short median process anteriorly; the base produced into two long lateral struts; median orifice situated ventrally near to the base. Parameres a little shorter than penis, stout at base, flattened horizontally, with bases meeting dorsally; profusely pilose – with a row of minute setae on dorsal surface and a fringe of long setae along lateral margin. Basal piece large and well developed, much longer than parameres, membraneous in the centre and sclerotized anteriorly on sides, with a deep median notch anteriorly, and with a pair of long setae at posterior angles.

Female: Sternum VIII subtriangular, with a median process prolongated in a well sclerotized slender rod of about twice of sternum length; each lateral margin with one long seta, and posterior one with a row of dense setae. Tergum VIII slightly excised anteriorly, and with pilose, rounded posterior edge. Female genitalia undescribed so far. Ovipositor (Fig. 32) slender, composed of slightly sclerotized parts. IXth tergite consisting of two elongated, membraneous scleri-tes, which bear ventrally two long baculi, and laterally a row of scarce pores. Hemisternites (sternum IX) composed of two triangular sclerites, its base articulating with long baculi about four times longer than lenght of hemisternite, and its surface scarcely covered with short setae and pores. Apex of heavily sclerotized hemisternite bearing a small stylus with sensorial bristles. Vulva located between hemisternites. Bursa copulatrix with a pair of annular processes (Figs. 30, 31) well pigmented and sclerotized, their outer face densely covered by small, short spines. One pair of accessory glands, hemispherical in form, with two lateral duct of glands, joining a common duct, which opens into the median portion of the vagina.

Geographic distribution

The genus *Trixagus* KUGELANN, 1792 (synonym: *Throscus* LATREILLE, 1796) comprises 71 species[1], the majority of which (37) have been described from Palearctic Region; 10 species are known from Ethiopian, 8 from Oriental, 6 from Nearctic, 6 from Neotropical and 4 from Australian Region. Only four species occur in Poland, of which *T. dermestoides* (LINNAEUS, 1767) is the com-

[1] From Europe two species, *Throscus laticollis* RYBIŃSKI, 1896 and *T. brevicollis* BOVOULOIR, 1865 are known both having a rather oblique, deep and sharply defined groove in the metasternum for reception of middle tarsi. Both therefore belong to the genus *Aulonothroscus* HORN, 1890.

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monest member of the genus. The distribution area of the latter species is wide, covering almost the whole Europe, reaching north to 64°, and extending east into Siberia and Caucasus.

In Poland it was recorded as *T. adstrictor* (Herbst, 1792) or *T. vastator* (Kugelann, 1792) as well as under its proper name – *Trixagus dermestoides* (L.) from the following locations:

Pobrzeże Bałtyku: Lüllwitz, 1916 (Koszalin). Pojezierze Mazurskie: Kugelann, 1792 („Preussen", locus typicus of *Dermestes vastator* Kugelann); Kugelann, 1794, Illiger, 1798, Siebold, 1847, Lentz, 1857 („Preussen"). Pojezierze Pomorskie: Skwarra, 1929 (distr. Chełmno: Linie). Nizina Wielkopolsko-Kujawska: Letzner, 1871, 1889 (prov. Zielona Góra: Głogów, Rudno), Szulczewski, 1922 (Poznań), Arnold, 1938 (prov. Zielona Góra: Skwierzyna, Międzyrzecz). Śląsk: Weigel, 1806, Schilling, 1829, Reitter, 1870, Schwarz, 1873, Gerhardt, 1910, Kuhnt, 1912. Śląsk Dolny: Letzner, 1871, 1889 (prov. Wrocław: Węgliniec, Zgorzelec, Legnica, Ścinawa, Środa Śląska, Wrocław; prov. Opole: Brzeg). Wzgórza Trzebnickie: Letzner, 1871, 1889. Śląsk Górny: Kelch, 1846 (prov. Opole: Obra, Kup), Roger, 1856 (prov. Katowice: Rudno). Roztocze: Tenenbaum, 1913 (distr. Tomaszów Lubelski: Kunki). Nizina Sandomierska: Viertl, 1872 (vicinity of Tarnów), Kotula, 1873 (distr. Bochnia: Niepołomice). Wyżyna Krakowsko-Wieluńska: Kotula, 1873 (Kraków and vicinity), Łomnicki, 1886 (Kraków), Lgocki, 1908 (distr. Częstochowa: Ostatni Grosz, Potok Złoty). Wyżyna Małopolska: Lgocki, 1908 (distr. Radomsko: Kłomnice, Zdrowa, Nieznanice). Sudety Zachodnie: Letzner, 1871, 1889 (Jelenia Góra Basin). Sudety Wschodnie: Letzner, 1871, 1889 (Kłodzko Basin). Beskidy: Reitter, 1878. Beskid Zachodni: Wachtl, 1870 (distr. Żywiec: Żywiec), Letzner, 1889 (distr. Cieszyn: Ustroń), Pawłowski, 1967, 1968 (distr. Sucha Beskidzka: Barańcowa, 690 m above sea level). Beskid Wschodni: Trella, 1925 (vicinity of Przemyśl).

Apart from the localities mentioned above, I have the following data on the distribution of the species in this country, which are based on the collection of mature specimens deposited chiefly in the Institute of Zoology, Polish Academy of Sciences, Warszawa, and in the Institute of Systematic and Experimental Zoology of the Polish Academy of Sciences, Kraków:

Pobrzeże Bałtyku: Wieliszewo, distr. Słupsk; Koszalin. Pojezierze Pomorskie: Smolniki, distr. Iława. Pojezierze Mazurskie: Augustów. Nizina Wielkopolsko-Kujawska: Łęczyca. Nizina Mazowiecka: Szczytno distr. Sochaczew; Grodzisk Mazowiecki; distr. Pruszków: Łubiec, Sieraków, Żbików; distr. Nowy Dwór Mazowiecki: Nowe Budy, Zamość, Dziekanów Leśny, Sadówka, Zegrze; periphery of Warszawa: Natolin, Łazienki, Bielany, Wawer, Radość; distr. Wołomin: Drewnica, Zielonka, Pustelnik, Czarna Struga, Klembów, Urle; Dębe Wielkie, distr. Mińsk Mazowiecki; distr. Piaseczno: Skolimów, Chojnów, Stefanów. Puszcza Białowieska: National Park. Śląsk Dolny: distr. Środa Śląska: Szymanów, Ujazd Dolny, Wrocisławice. Śląsk Górny: Chełmek, distr. Chrzanów – May 15, 1898, 60 specimens on the ground coll. by S. Stobiecki. Wyżyna Krakowsko-Wieluńska: periphery of Kraków: Bielany, Sikornik, Wolski Las, Panieńskie Skały, Mogilany, Przegorzały, Zwierzyniec. Góry Świętokrzyskie: Święty Krzyż Mt. about 550 m above sea level. Wyżyna Lubelska: Agatówka, distr. Kraśnik. Roztocze: Zwierzyniec, distr. Zamość, Smoryń, distr. Biłgoraj. Nizina Sandomierska: Niepołomice Primeval Forest; Kłaj, Grodkowice, distr. Bochnia. Sudety Zachodnie: Biały Kamień, distr. Wałbrzych, Góry Kaczawskie, Wielka Sowa Mt; Jelenia Góra Basin; Karkonosze Mts. (zone of forests). Beskid Zachodni: Cieszyn; Łapanów, distr. Bochnia; distr. Kraków: Swoszowice, Soboniowice, Libertów, Zakrzów; Głogoczów, distr. Myślenice;

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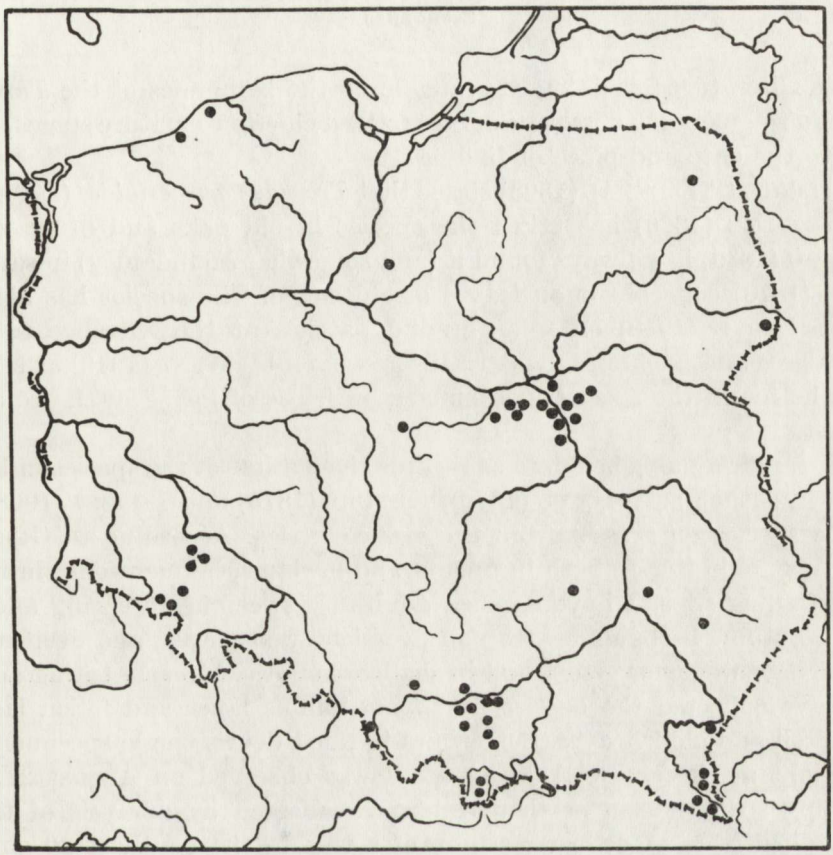
distr. Limanowa: Pogorzany, Szczyrzyc. Kotlina Nowotarska: Zakopane; Poronin, distr. Nowy Targ. Beskid Wschodni: Przemyśl. Bieszczady: Habkowce, distr. Lesko; Ustrzyki Górne, Zatwarnica, distr. Ustrzyki Dolne; Żuków range, about 700 m above sea level; Otryt range, about 800 m above sea level. Pieniny: Kras; Valley of the River Potok Pieniński; Trzy Korony, about 850 m above sea level.



Map 1. *Trixagus dermestoides* (L.), verified places of collection in Poland.

The distribution of the localities, mentioned above, shows Map 1. From the given map it is clear that the species occurs everywhere in Poland in lowland area and in lower situation of mountains (up to 800 m above sea level).

Outside Poland, the following data are available from our collections:

Russian S.F.S.R.: Lisij Nos near Leningrad, May 11, 1958, 1 specimen, coll. by R. Bielawski; vicinity of Moskva, August 6, 1968, one larva and several pupae, coll. by B. Burakowski.

Ukrainian S.S.R.: near Borščev, May 17, 1939, 3 specimens, coll. by Sz. Tenenbaum; near Zaleščiki, June 26, 1921, 1 specimen, coll. by S. Stobiecki.

Hungary: Sátor hegység, Istvánkút, May 30, 1957, 13 specimens, coll. by B. Burakowski.

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Rumania: Sinaia, 800 m above sea level, July 2–6, 1957, 3 specimens, coll. by B. Pisarski; July 2, 1959, 5 specimens, coll. by R. Bańkowska.

Bulgaria: Makedonija, Petrič, June 12, 1959, 1 specimen, coll. by R. Bielawski; Sofia-Knjaževo, September 5, 1959, several larvae, coll. by B. Burakowski.

Bionomics

In the literature few data are available on the bionomics of the *Throscidae*. Sparse and fragmentary observations are related chiefly to mature stages, and are limited to the date and place of finding.

The adult. Gyllenhal (1808) states that *Trixagus dermestoides* (L.) inhabits oaks. Stephens (1830) has taken the species in old oaks and in gravel-pits. Westwood (1839) has always found it (and somewhat abundantly) in sand-pits. Reitter (1878) collected it on leaves of alder-tree. The species has also been taken by Lloyd (1940) on some ground patches at the entrance to rabbit burrows. Tree and bush on moulder soils are given by West (1940) as a typical habitat; he found the species in Denmark on herbs of low growth from June to August.

There are few published data as regards the habitat of the species in Poland. Some authors such as Wachtl (1870), Kotula (1873) and Lgocki (1908) have taken the species on grasses from the low countries. According to Gerhardt (1910) it occurs in Silesia both in upland and lowland; he mentions shrubs and herbs as finding sites. I have catched adults by sweeping in spring and early summer from low herbs under trees in overshadowed places, and even more so on outskirts of woods or glades and in shallow hollows. In early spring and autumn I have collected the beetles by sifting humus layer and fallen last-year rotting birch and alder leaves. Sometimes in flood debris single specimens were found; flight at the artificial illumination was observed on August 21, 1965. Hibernating specimens in earthen cell were collected by analysis of the soil samples taken from places near stump of a tree to the depth of 20 cm. Also I have reared numerous adults from larvae and pupae found in samples, and I have collected simple adults even in winter under bark of tree.

The mobility of the adults is surprising. They are swift runners and strong flyers. Interesting, however sometimes, are contrary data given by some authors as regards the leaping power of adults. Hoffman and al. (1803) give an accurate description of leaping of *Trixagus dermestoides* (L.). Illiger (1807) and Gyllenhal (1808) also maintain that the species possesses the capacity of leaping. Latreille (1804), Lacordaire (1857) and Leconte (1861), however, maintained opposed views. Of the same opinion is Westwood (1839), who studied this problem; he says "I have never, however, observed it to possess such a saltorial power". Kiesenwetter (1858), according to his own observation, mentions a low leap of the species. Similarly Blanchard (1917) reports a feeble leaping capacity in species of *Trixagus* Kug. and *Aulonothroscus* Horn. Accord-

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ing to CROWSON (1955) the species of the *Throscidae* are not able to "clink". I have been able to verify the above represented opinions, and I have also myself observed often the leaping of *Trixagus dermestoides* (L.). These beetles become extremely compact when disturbed (Fig. 24), being able to retract their antennae and legs and they may remain motionless for some time. The imagines possess a remarkable capacity for leaping when lying on their back after the manner of the *Elateridae*, however, the jump is not so high. It is a self-evident truth, that the mechanism of leaping occurs in the *Throscidae*, and is connected with the considerable mobility of the articulation between the prothorax and the posterior part of the body. It appears as a straightupward hop accompanied by a clicking sound in consequence of sudden stroke of prosternal inter-coxal process into the mesosternal fossa. Adults of *Trixagus dermestoides* (L.) lying on the back leap unwillingly at first, then try to turn at normal position by the seizure of substratum by its legs, but failling to do this, the beetle retracted its appendages, bends upward its body between prothorax and mesothorax, and rapidly strikes its prosternal process into the mesosternal fossa, at that time the beetle executes the sudden jump in a straightupward motion, and in the end the specimen falls normally on its legs. Sometimes, however, falling again on their back, the beetles may repeat leaping several times up to assumption of normal position.

The food. It is unknown, whether the adults subsist on the same food as larvae, but STAMMER (1933) states that imagines have two pairs of mycetomes, which contain three forms of symbiotic microorganisms. Mycetomes are placed in fat-body. Anterior pair of mycetomes contains globose and oblong-oval bacteria, while in the posterior one long, thread-shaped bacteria are found. Unknown is the way of transport of symbionts during metamorphosis.

The mating. During a study of the bionomics of *Trixagus dermestiodes* (L.), it was noticed that the way of courtship and of mating is a specific phenomenon. The copulation only in this species, however, appears to be known. VERHOEFF (1895) gives a detailed account of the mating of this species; he observed this sex act near Bonn (F.R.G.) in the evening at 6.30 h. on May 28, and I have lately also been able to observe the courtship ritual, and the mating of adults emerging in early spring. All field and laboratory observations were made between 8th and 20th April.

The males of the species may be separated from females by the presence of long setae on the posterior part of elytra; these setae are usually concealed below the elytra in inactive condition, and may have been considered as aids to assist the male during courtship and mating. The mating of *Trixagus dermestoides* (L.) much differs from the sex act of other beetles, at which usually the typical copulation occurs with the male firmly mounted with his venter on the dorsum of the female. In contrast to this type of copulation, the male of *T. dermestoides* (L.) is not placed on back of the female, and not clasps the female with its legs, but always stands with its legs on the substratum, drawing its body obliquely and a little behind to female. Before the mating the male may walk around the

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female briskly. Since males are larger than females, their abdomen is much convex, and in order to intromit, the posterior end of the male must been nearly lateral and somewhat behind to the apex of the abdomen of the female. I observed the male many times during mating placed on the left side of female, much rarer in the right situation, whereas VERHOEFF (1895) has only once recorded the male mating in the left-side position. During mating the female is usually quiescent, its antennae are commonly slant and legs are held close to the body. The male then mounts the female tapping its elytra and prothorax with its vibrating elytra and wings. The amplitude of the vibration of the wings is smaller than of the elytra. The function of tapping is to stimulate the female at close range or in actual contact during mating. The posterior abdominal segments of the male would be curled dorsally to a great extent, and further curved ventrally to reach the apex of the abdomen of the female, these were extruded about one-quarter of the body length. If the female has been sexually stimulated, genital plates are opened and successful mating does occur. Field and laboratory observation shows that this ritual does always occur.

I observed a single mating in a mixed forest near Warszawa after sunset on April 20, 1958. Mating occurred on a stump of alder-tree. In mid-May of 1960, I saw specimens running and mating on dry twigs on the ground. In my laboratory male beetles mated readily and would even repeat copulation several times. One male placed with female in a narrow glas-tube was seen to mate three times during ten minutes, and ten times over a six-hours period. The copulation lasted from 50 seconds to 5 minutes, and was observed to occur commonly at different time of the day. Mating takes place more readily at warm temperatures. The lowest temperature at which mating was observed was 12°C.

Oviposition was not observed although it probably begins in the spring and often continues through the summer period, because the younger larvae (length of body 1.2 to 3.5 mm) were found in the field from the end of August to November. The narrow and elongated ovipositor suggests an adaptation to lay down eggs in soil close to litter between thick roots near stump of tree.

The early stages. The descriptions of immature stages are lacking. According to HELLWIG (GYLLENHAL 1808) the metamorphosis of the species takes place in oak trees. STEPHENS (1830) likewise regards the larvae of the species of the genus *Trixagus* as lignivorous, and the mature specimens are generally found beneath bark of tree. HENRIKSEN (1913) reports that the larvae of *Trixagus* sp. live in earth, and in Denmark pupation takes place in May, the adults emerging in June. WEST (1940) reports the larvae of *T. dermestoides* (L.) found in great quantities from mole-hill, they were taken on April 5, but in laboratory one pupa only was obtained from larva on May 12, and the imago emerged on June 9.

I succeeded to observe all stages in the field, and in my laboratory to rear imagines from a certain number of collected larvae and pupae. The larvae have been taken chiefly at depths between 5 and 20 cm. The larvae are soil inhabitants,

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apparently preferring relatively moist situations. The sort of soil may not have a greater significance: specimens were found in sandy, loamy, mouldery, and peaty soils, but always near stump of tree, and usually just under the litter. Sometimes the larvae have been collected in greater abundance. I found one time about 200 larvae between two thick roots of elm-tree, much numerous specimens were near stump. Older larvae were reared in the laboratory in glass tubes 12×60 mm filled in 2/3 with sterilized sand moistened with 10% of water by weight, and plugged by scroll of cotton-wool. Besides larvae were reared in glass jars of one-litre capacity, containing sand, clay or moulder soil with mycorrhizal roots samples. For observation artificial cells were made on jars periphery in one-half its height.

The larvae were inactive, usually resting among soil and bits of roots. They fed on the external stratum of ectotrophic mycorrhizal roots of birch (Fig. 4), beech, elm, and even pine. Appendages of mouth, particularly the mandibles indicate, that the larva feeds rather upon juices of mycorrhizal roots, than upon the more solid tissues of roots. Considering on indigency of dietary, it seems that both larva and imago remain in endosymbiontic relations with bacteria, agglomerations of which may be observed as a white fat-body on the sides of the alimentary canal.

Life-cycle is usually completed in two years. It is probable, under exceptional atmospherical conditions, that the larval period would be prolonged by an additional year. The larvae are usually sluggish and may make only short horizontal and vertical migrations. Several larvae taken on September 4, 1960, and reared in laboratory in artificial cells, have not left out their sites until May 1961, when were obtained some pupae, and in June 1961 emerged images, which remained yet in pupal chambers until Dezember 1961. Other larvae journeyed over up to 30 mm in period from September 18 to September 29. In moulting period the larvae moved in space by snakely way. Pupation takes place in oval chamber that has been prepared earlier by the larva. The earthern cell measuring about 7 mm by 3 mm, and is formed from 3 to 20 cm below the soil surface, usually in the compact soil just below the humus layer. In pupal cell the larva is arcuate, before pupation its straightened. The pupa in chamber turns round longitudinal axis of the body. The pupal period lasts seven to about twenty days. The duration of pupal stage in field is 7 to 10 days in the first part of August, and from 12 to 18 days in October. The pupae have been found most aboundantly in the second half of September. However, in my laboratory I reared pupae from larvae already in March, and subsequently from April to October.

Overwintering. The newly developed adults spend the winter commonly in their pupal cell and emerge the following spring, but occasionally emerge during the autumn months if the weather is mild, and then specimens sometimes may disperse and overwinter under the bark of tree, in litter, and under leaves or mosses. I found the hibernating larvae on November 4 and 19,

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December 2, and Februar 4; these were in the soil at a depth of 5–20 cm.

Predators. Wireworms: *Athous subfuscus* (MÜLL.), *Dalopius marginatus* (L.) and *Ectinus aterrimus* (L.) were observed in Kampinos Forest as principal predators of larvae and pupae of discussed species. These predators lived chiefly in humus layer, and they usually had not penetrated the deeper layer of barren soil, just for that reason in the depth of 15–20 cm larvae of *Trixagus dermestoides* (L.) were less damaged. According to STAMMER (1934, 1955) a parasitic Nematode, *Bradynema trixagi* WACHEK inhabits the body of some imagines; in female the parasite fills completely the egg-calyx. In breeding the lower fungi were often mortality factor.

Collecting and rearing data

Poland. Kampinos Forest, Dziekanów Leśny, distr. Nowy Dwór Mazowiecki, April 5, 1959; in birch forest with an alder-tree admixture, several imagines in litter, copulate in laboratory on April 8–11. Same locality and habitat as above, May 15, 1960; just under the litter in humus soil and between mycorrhizal roots near stump of birch a depths between 5 and 20 cm — 30 larvae, part of which were reared in laboratory in humus; 2 pupae taken out June 13, 10 pupae July 16, 1960. Same place, June 1960; several larvae, from which 3 pupae taken out July 3–10, 17 pupae July 27, 3 images emerged August 13, 1960. Same place, July 17, 1960 — 8 larvae and 2 pupae; August 15, 1960 — 1 larva and 5 pupae; September 4, 1960 — in earth sample of four-litre capacity, one mature larva of length 5.0 mm from which pupa taken out May 22, 1961, imago emerged June 23, reared until December 2, 1961; several larvae, 1.2–3.5 mm long, two larvae moulting on 7 and 27, September 1960; September 18, 1960 — 11 mature larvae, 9 jounger larvae, length of body 2.5–4.0 mm. Same locality and place, April 9, 1961, several imagines, reared in laboratory copulating on following day; several hibernating larvae and imagines in their pupal cells have been found on November 19, 1961, December 2, 1962 and Februar 4, 1966.

Distr. Nowy Dwór Mazowiecki: Sieraków, September 18, 1960, in soil near birch, 26 larvae. Same locality, October 1, 1960, 12 larvae, 6 of which reared in laboratory, prepupae and pupae observed May 25, 1961, and immature imagines June 23, these were in pupal cells until October 17, 1961. Sadówka, October, 22, 1961, 23 mature, arcuate larvae in earthen chambers. Nowe Budy, April 23, 1962, 28 larvae, in laboratory part of which pupated June 1, 1962. Wywrotnia Góra, October 1, 1966, a few larvae and one pupa, from which imago taken out October 15, 1966. Zamość, distr. Nowy Dwór Mazowiecki, October 15, 1967, several larvae and one pupa, imago emerged October 28, 1967.

Warszawa-Bielany, September 11, 1960, in leafy forest adjoining alders stands, between two large roots of big stump of alder-tree, in loamy soil at depths from 2 to 20 cm below the soil surface — over 180 larvae accompanied by one pupa and 3 soft, immature imagines. Same locality and habitat, April 13, 1961, several imagines in litter, in laboratory observed the mating on April 15 and 17, 1961.

Klembów, distr. Wołomin, March 27, 1966, in pine forest witch a birch admixture, between mycorrhizal roots of pine, in dark brown soil, 1 larva. Same locality and place, May 2, 1966, 14 larvae. Same place, August 23, 1968, in sandy soil, several larvae, one immature imago, sex pupae, from which four imagines emerged September 4, 1968.

Mountains Góry Świętokrzyskie, Święty Krzyż Mt., October 27, 1968, in mixed forest, between mycorrhizal roots of beech, in mould soil, 5 last stadium larvae, from which 2 larvae reared, imagines emerged June 4, 1969.

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Bulgaria: Sofia-Knjaževo, September 5, 1959, in a birch grove clearing, 11 larvae have been found in clayey soil at a depth about 3–5 cm near stump of birch; 8 larvae brougth to Warsaw on September 12, 1959, and reared in laboratory in the clay, one pupa observed from April 30 to May 22, 1960, the imago emerged on May 23, 1960.

Russian S.F.S.R.: vicinity of Moskva, August 6, 1968, in mixed forest, between two large roots of birch in loamy soil with sand admixture; one larva and several pupae with exuviae of larvae, in laboratory 10 adults emerged September 15–24, 1968.

All material above mentioned leg. et cult. B. Burakowski.

Notes on the taxonomic rank of the *Throscidae*

The affinities of the *Throscidae* formerly have been doubtful. Some taxonomists were placing them near to, or with the *Elateridae*, some with the *Dermestidae* or *Byrrhidae*, others amongst the *Eucnemidae*. As a separate family the *Throscidae* was established by Wollaston (1854). Many entomologists, basing exclusively on adult characters, divided the family into two subfamilies: *Throscinae* and *Lissominae*. These are, however, well marked groups and so different from each other that should be given a family rank. This conclusion is strengthened by both adult and early instar characters.

The two families may be characterised as follows:

1. Adult: Body feebly rugose-punctate, matt, covered with moderately long, suberect dense hairs. Antennae not serrate, except last three segments if they form a club, and not turned in repose, but received in long grooves on prosternum (Fig. 27). Mandibles (Fig. 25) internally weekly sclerotized, witn a simple apex, and without penicillus. Prosternum in front with a short, truncate chin-piece (Fig. 27). Grooves of propleuron for reception of antennae shallow and long, extending almost to posterior angles of prothorax. Trochanters of front legs short. Tarsal segment 1–3 without pulvilli below, fourth segment with short membraneous lobes beneath (Fig. 28). Wings (Fig. 26) with dark long spots; closed radial cell and radio-medial crossvein lacking. Basal-piece of the aedeagus (Fig. 33) well developed, its length greater or equalling that of parameres. Basal part of the median lobe produced into two long median struts. Hemisternites of ovipositor (Fig. 32) with conspicuous styli on the apex. Bursa copulatrix with processes (Figs. 30, 31) in shape of annular ring.
   Larva: Body spindle-shaped, plump and fleshy, feebly sclerotised. Head much reduced, its width of full-grown larva is only about half that of prothorax. Anterior margin of frontoclypeal region without nasale (Fig. 5). Mandibles blunt, bitting outwardly, without retinaculum and penicillus (Fig. 7). Prothorax on ventral surface with trapezoidal prosternal area, and a pair of separate rod-shaped scleromes (Fig. 13). Legs very short, weak, finely setose (Fig. 12). Spiracles of annular-biforous type (Fig. 11). Abdominal mediotergites without subovate patch and prickles (Fig. 2). Ninth abdominal segment coniform, with short, blunt, very small upward-directed horns (Fig. 14).
   Pupa: Body weekly setose. Antennae claviform (Fig. 18). Prothorax and abdominal segments without styli (Fig. 16). Ninth abdominal segment provided posteriorly with two short acuminate cerci (Figs. 20–22) . . . . . *Throscidae.*

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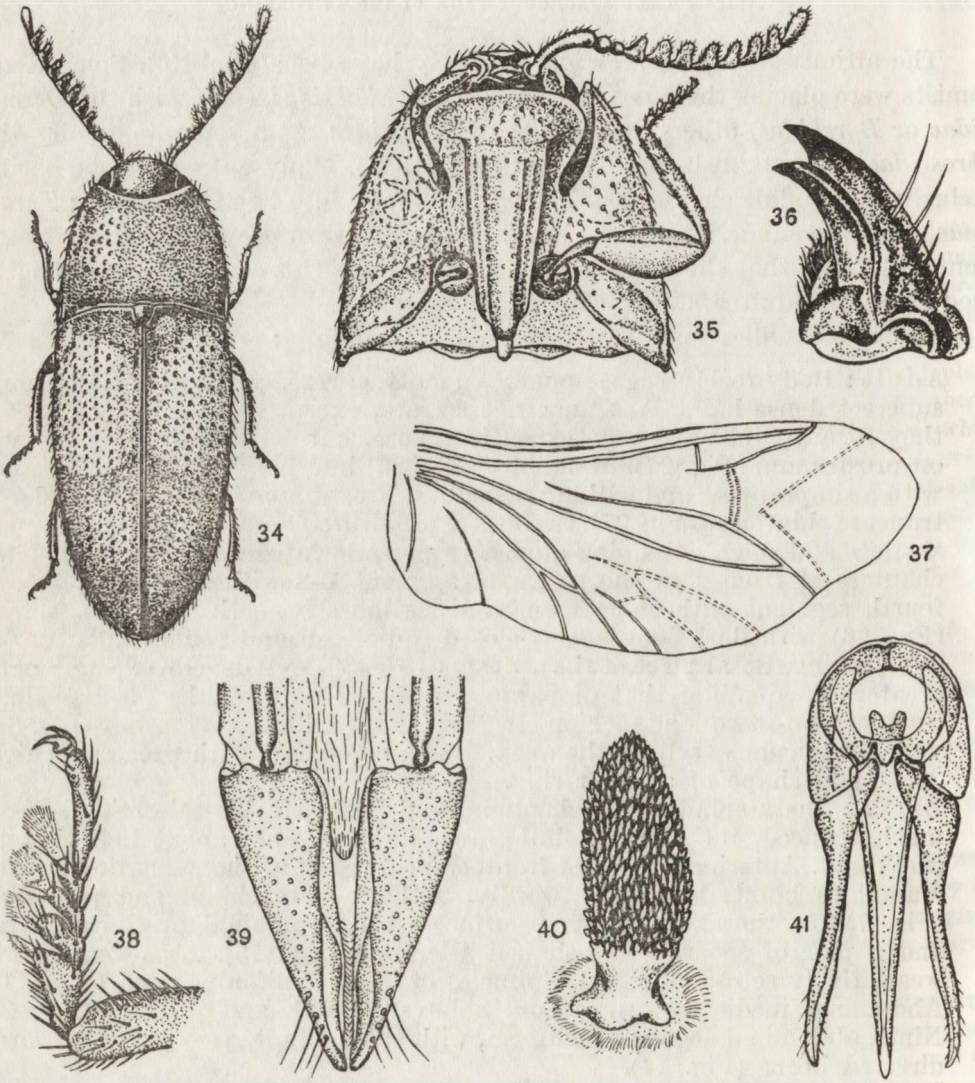
—. Adult: Body polished and brillant, sparsely hairy (Fig. 34). Antennae serrate, turned in repose (Fig. 35). Mandibles (Fig. 36) well sclerotised, with two teeth on apex and scarce penicillus ventrally. Prosternum in front with a distinct, convexed chin-piece (Fig. 35). The prothoracic pouches for reception of antennae very deep. Trochanters of front legs very long. Tarsal segments 1–4 with long pulvilli below (Fig. 38). Wings (Fig. 37) with radial cell and radio-medial cross-vein, dark long spots lacking. Basal-piece of the aedeagus (Fig. 41) weakly developed, its lenght smaller than one of parameres. The basal part of the median lobe with short, semi-



Figs. 34–41. *Drapetes biguttatus* (Pill.), imago: 34 — dorsal view: 35 — head and prothorax, ventral view; 36 — right mandible; 37 — wing; 38 — tarsus and apex of tibia; 39 — ovipositor; 40 — process in bursa copulatrix; 41 — aedeagus.

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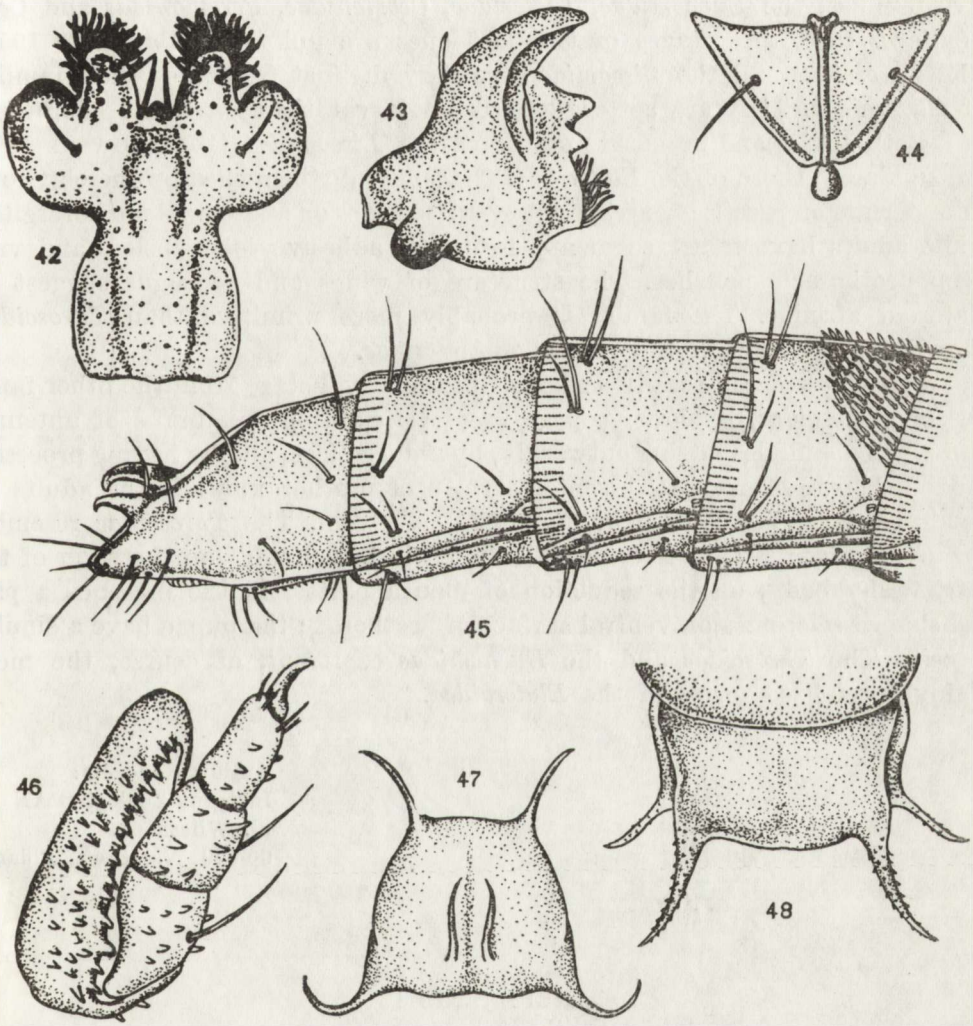
circle plate. In ovipositor the hemisternites (Fig. 39) with reduced styli on the apex. Bursa copulatrix with trident processes or teethed strobite (Fig. 40).

Larva: Body hard-skinned, elongate cylindrical, slightly flattened, well sclerotised. Head great, its width about equal one of prothorax. Anterior margin of frontoclypeal region with well developed, unidentate nasale (Fig. 42). Mandibles acuminate, biting inwardly, with ax-shaped retinaculum and scarce penicillus on inner face (Fig. 43). Prothorax on ventral surface with a triangular prosternal area and a long claviform intersternite sclerite (Fig. 44). Legs long, well developed, covered with spine-like setae



Figs. 42–48. *Drapetes biguttatus* (Pill.). 42–46 – mature larva: 42 – frontoclypeal region, dorsal view; 43 – right mandible, ventral view; 44 – prosternal area; 45 – VI–IX abdominal segment, lateral view; 46 – left leg of mesothorax, anterior aspect. 47, 48 – pupa: 47 – prothorax; 48 – last abdominal segments, dorsal view.

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(Fig. 46). Spiracles of biforous type. Second to sixth abdominal mediotergites with a subovate patch covered with prickles (Fig. 45). Ninth abdominal segment with subcircular caudal notch and bifide, short urogomphi; inner prongs projecting either toward each other, outer prongs corniform, projecting caudally and curving slightly inward (Fig. 45).
Pupa: Body without vestiture. Antennae long, moniliform. Prothorax with six styli (Fig. 47). Third to sixth abdominal segments with a short stylus on each side. Ninth abdominal segment provided posteriorly with four long cerci (Fig. 48) . . . . . *Lissomidae.*

Both these families belong to the superfamily *Elateroidea*, which comprises five families, the *Eucnemidae*, *Elateridae*, *Cebrionidae*, *Perothopidae* and *Cerophytidae*. Immature stages of two last ones are unknown (Crowson 1955). The *Throscidae* and the *Lissomidae* are very distinct from the others families of *Elateroidea*. They are better defined on larval than on adult characters.

Both adults and immature stages of the *Lissomidae* (Burakowski 1973) are similar to those of the *Elateridae*. The larvae distinguished by the claviform intersternite on prosternal area, and several prickles on abdominal mediotergites; while adults have tarsal segments 1–4 with adhesive lobes below and very deep prothoracic pouches. The structure of wings and aedeagus suggest an elateroid affinity. The family is probably more primitive than *Throscidae*, showing affinities with the primitive *Elateridae*.

The *Throscidae* are easily separable in the larval stage from the other families of *Elateroidea*, by having large basal articulating membrane of antenna, and blunt mandibles bitting outwardly, by reduced legs, and by having processes on rod-shaped scleromes on venter surface of prothorax, while the adults do not have the radial cell and radio-medial cross-vein. The *Throscidae* resemble the *Eucnemidae*. Their relationship is based in larval stage on the form of the soft, fleshy body, on the reduction of mouth parts and the presence a pair rod-shaped scleromes on ventral surface of prothorax; the pupae have a similar setosity The *Throscidae* and the *Eucnemidae* represent, of course, the more highly specialized forms of the *Elateroidea*.

Author's address:
Instytut Zoologii PAN
ul. Wilcza 64.
00-679 Warszawa, Poland.

REFERENCES

Arnold W. 1938. 3. Beitrag zur Käferfauna der Grenzmark Posen-Westpreussen. Abh. Ber. grenzmärk. Ges. nat. wiss. Abt., Schneidemühl, **12**: 37–42.

Blanchard F. 1917. Revision of the *Throscidae* of North America (*Coleoptera*). Trans. Amer. ent. Soc., Philadelphia, **43**: 1–26.

http://rcin.org.pl

Böving A. G., Craighead F. S. 1930. An Illustrated Synopsis of the Principal Larval Forms of the Order *Coleoptera*. Ent. amer., Brooklyn, N. Y., **11** (N. S.): 1–256, pls. 1–84.

Burakowski B. 1973. Immature Stages and Biology of *Drapetes biguttatus* (Piller) (*Coleoptera, Lissomidae*). Ann. zool., Warszawa, **30**: 335–347, 30 figs.

Crowson R. A. 1955. The natural classification of the families of *Coleoptera*. London, 187 pp., 213 figs.

Gerhardt J. 1910. Verzeichnis der Käfer Schlesiens preussischen und österreichischen Anteils, geordnet nach dem Catalogus coleopterorum Europae vom Jahre 1906. Dritte, neubearbeitete Auflage, Berlin, XVI + 431 pp.

Giljarov M. S. 1964. *Throscidae*. In: „Opredelitel' obitajuščih v počve ličinok nasekomyh", Moskva, 919 pp., 567 figs.

Gyllenhal L. 1808. Insecta Svecica. Classis I. *Coleoptera* sive *Eleuterata*. Tomus I. Scaris, XII + 572 pp.

Henriksen K. 1913. Biller II. Pragtbiller og Smeldere (*Serricornia* I). Danmarks Fauna, **14**, København, 114 pp., 130 figs.

Herbst J. F. W. 1792. Natursystem aller bekannten in- und ausländischen Insekten, als eine Fortsetzung der Büffonschen Naturgeschichte. Der Käfer vierter Theil. Berlin, VIII + 197 pp., 12 pls.

Hoffman J. J., Koch J. D. W., Müller P. W. J., Linz J. M. 1803. Entomologische Hefte enthaltend Beiträge zur weitern Kenntniss und Aufklärung der Insektengeschichte. Frankfurt am Main, XVI + 119 + 130 + 4 pp., 3 pls.

Illiger K. 1798. Verzeichnis der Käfer Preussens. Entworfen von Johann Gottlieb Kugelann Apotheker in Osterode. Halle, XLII + 510 pp.

Illiger K. 1807. Portugiesische Käfer. Mag. Insk.k., Braunschweig, **6**: 1–80.

Kelch [A.] 1846. Grundlage zur Kenntniss der Käfer Oberschlesiens, insonders der Umgegend von Ratibor. In: Zu der öffentlichen Prüfung aller Classen der Königlichen Gymnasiums zu Ratibor den 4. und 7. April, und dem mit Entlassung der Abiturienten verbundenen Redeactus den 20. April laden ergebenst ein Director und Lehrer-Collegium. Ratibor, pp. I–II + 1–54.

Kiesenwetter H. 1858. *Coleoptera*. IV. 2. In: Naturgeschichte der Insecten Deutschlands, 1, IV, 2. Berlin, pp. 177–384.

Kotula B. 1873. Przyczynek do fauny chrząszczów Galicyi. Spraw. Kom. fiz., Kraków, **7**: (53)–(90).

Kugelann J. G. 1792. Verzeichnis der in einigen Gegenden Preussens bis jetzt entdeckten Käfer-Arten nebst kurzen Nachrichten von denselben. Neuestes Magazin für die Liebhaber der Entomologie, herausgegeben von David Hinrich Schneider. Stralsund, Band 1, Heft 2–4, pp. 252–306, 477–512.

Kugelann J. G. 1794. Verzeichnis der in einigen Gegenden Preussens bis jetzt entdeckten Käfer-Arten, nebst kurzen Nachrichten von denselben. Neuestes Magazin für die Liebhaber der Entomologie, herausgegeben von David Hinrich Schneider. Stralsund, Ersten Bandes Fünftes Heft, pp. 513–582.

Kuhnt P. 1912. Illustrierte Bestimmungs-Tabellen der Käfer Deutschlands. Ein Handbuch zum genauen und leichten Bestimmen aller in Deutschland vorkommenden Käfer. Lieferung 2–16. Stuttgart, pp. 65–1138, 10350 figs.

Lacordaire Th. 1857. Historie naturelle des Insectes. Genera des Coléoptères ou exposé méthodique et critique de tous les genres proposés jusqu'ici dans cet ordre d'insectes. IV. Paris, 579 pp.

Latreille [P. A.] [1796]. Précis des caractères génériques des insectes, disposés dans un ordre naturel. Paris, XIII + 1 + 201 + 7 pp.

Latreille P. A. 1804. Gattungen und Horden der Käfer, Coleopteren. Mag. Insk.k., Braunschweig, **3**: 1–138.

http://rcin.org.pl

Le Conte J. L. 1861. Classification of the *Coleoptera* of North America. Part I. Smithson. Misc. Coll., Washington, XXIV+214 pp., 6 figs.

Lentz F. L. 1857. Neues Verzeichnis der Preussischen Käfer. Königsberg, 170 pp.

Letzner K. 1871. Verzeichnis der Käfer Schlesiens. Z. Ent., Breslau, N. F., **2**, XXIV+328 pp.

Letzner K. 1889. Fortsetzung des Verzeichnisses der Käfer Schlesiens. Z. Ent., Breslau, N. F., **14**: 237–284.

Lgocki H. 1908. Chrząszcze (*Coleoptera*) zebrane w okolicy Częstochowy w Królestwie Polskiem w latach 1899–1903. Ent. pol., Łódź, **1**: 40–43, 81–84.

Linnaeus C. 1767. Systema Naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Editio duodecima reformata. I, 2. Vindobonae, pp. 533–1327+36 pp.

Lloyd R. W. 1940. *Coleoptera* at Skenfrith, Monmouthshire. Ent. monthly Mag., London, **76**: 177.

Lüllwitz A. 1916. Verzeichnis der im Regierungsbezirk Köslin aufgefundenen Käfer. Stett. ent. Ztg., Stettin, **76**: 205–264.

Łomnicki A. M. 1886. Muzeum Imienia Dzieduszyckich we Lwowie. Dział I. Zoologiczny Oddział zwierząt bezkręgowych. IV. Chrząszcze czyli Tęgoskrzydłe. (*Coleoptera*). Lwów, XXXI+308 pp.

Pawłowski J. 1967. Chrząszcze (*Coleoptera*) Babiej Góry. Acta zool. cracov., Kraków, **12**: 419–665, pls. XXXVII–XLV, 30 figs.

Pawłowski J. 1968. Nowe dla Babiej Góry gatunki chrząszczy (*Coleoptera*). III. Fragm. faun., Warszawa, **14**: 209–229.

Reitter E. 1870. Uebersicht der Käfer-Fauna von Mähren und Schlesien. Verh. naturf. Ver. Brünn, **8**, 2: III–VIII, 1–195.

Reitter E. 1878. Beitrag zur Coleopteren-Fauna der Carpathen. Dtsch. ent. Z., Berlin, **22**: 33–64.

Roger J. 1856. Verzeichnis der bisher in Oberschlesien aufgefundenen Käferarten. Z. Ent., Breslau, **10**, Coleoptera: 1–132.

Rybiński M. 1897. Wykaz chrząszczów nowych dla fauny galicyjskiej. Spraw. Kom. fiz., Kraków, **32**: 46–62.

Schilling [S.] 1829. [Verzeichniss von einigen in Schlesien gesammelten Coleoptern]. Beitr. Ent. Schles. [Gravenhorst], Breslau, **1**: [1–4].

Schwarz E. 1873. Die schlesischen *Throscus*-Arten. Jber. Ver. schles. Ges. vaterld. Kult., Breslau, **50**: 182–183.

Siebold C. Th. E. 1847. Beiträge zur Fauna der wirbellosen Thiere der Provinz Preussen. (Zehnter Beitrag). Die preussischen Käfer. N. Preuss. Prov.-Bl., Königsberg, **3**: 203–219, 350–367, 419–451.

Skwarra E. 1929. Die Käferfauna des Zehlaubruches. Schr. phys.-ökon. Ges. Königsberg, Königsberg, **66**, 2: 181–274.

Stammer H. J. 1933. Neue Symbiosen bei Coleopteren. Zool. Anz., Leipzig, **6**. Supplementband: 150–155.

Stammer H. J. 1934. Die Nematoden als Kommensalten und Parasiten der Insekten. Zool. Anz., Leipzig, **7**. Supplementband: 195–206, 3 figs.

Stammer H. J. 1955. Ökologische Wechselbeziehungen zwischen Insekten und anderen Tiergruppen. Ber. Wandersamml. dtsch. Ent., Berlin, **7**: 12–61, 41 figs.

Stephens J. F. Illustrations of British Entomology; or, a Synopsis of Indigenous Insects: containing their generic and specific distinction: with an account of their metamorphoses, times of appearance, localities, food, and economy, as far as practicable. Mandibulata. III. London, 380 pp., pls. XVI–XIX.

Szulczewski J. W. 1922. Chrząszcze Wielkopolski. Prac. Kom. mat.-przyr. PTPN, B, Poznań, **1**, 3–4: 183–243.

http://rcin.org.pl

Tenenbaum Sz. 1913. Chrząszcze (*Coleoptera*) zebrane w Ordynacyi Zamojskiej w gub. Lubelskiej. Pam. fiz., Warszawa, **21**, III: 1–72.

Trella T. 1925. Wykaz chrząszczów okolic Przemyśla. *Elateridae* — Sprężyki, *Eucnemidae* — Goleńczyki, *Cerambycidae* — Kózki. Pol. Pismo ent., Lwów, **4**: 92–96.

Verhoeff C. 1895. Zur Kenntnis der Copula bei *Trixagus* (Coleopteren, *Eucnemidae*). Ent.. Nachr., Berlin, **21**: 263–265.

Viertl A. 1872. Przyczynek do fauny Galicyi. b) Chrząszcze (*Coleoptera*) z okolicy tarnowskiéj. Spraw. Kom. fiz., Kraków, **6**: (65)–(69).

Wachtl F. 1870. Spis chrząszczów z dorzecza Soły i Koszarawy. Spraw. Kom. fiz., Kraków, **4**: (246)–(262).

Weigel J. A. V. 1806. Geographische, naturhistorische und technologische Beschreibung des souverainen Herzogthums Schlesien. Zehnter Theil. Verzeichnis der bisher entdeckten, in Schlesien lebenden Thiere. Berlin, XII+358 pp.

West A. 1940. Fortegnelse over Danmarks Biller. Ent. Medd., København, **21**: 1–412.

Westwood J. O. 1839. An Introduction to the Modern Classification of Insects; founded on the Natural Habits and Corresponding Organisation of the Different Families. Vol. I. London, XII+462 pp., 56 figs.

Wollaston T. V. 1854. Insecta Maderensia; being an account of the Insects of the Islands of the Madeiran group. London, XLIII+634 pp., 12 pls.

STRESZCZENIE

[Tytuł: Rozwój, rozmieszczenie i środowisko *Trixagus dermestoides* (L.) wraz z uwagami o *Throscidae* i *Lissomidae* (*Coleoptera*, *Elateroidea*)]

Praca jest oparta na materiałach wszystkich postaci rozwojowych *Trixagus dermestoides* (L.) zebranych przez autora głównie w Polsce; nieliczny materiał larw i poczwarek uzyskano w czasie badań terenowych w okolicy Sofii i Moskwy. Przeprowadzone hodowle laboratoryjne oraz obserwacje w terenie pozwoliły autorowi uzyskać szereg danych bionomicznych.

Podano dokładne opisy dotychczas nieznanej larwy i poczwarki, omówiono zewnętrzną morfologię postaci dojrzałej uwzględniając przy tym dymorfizm płciowy. Pracę zilustrowano licznymi oryginalnymi rysunkami. Przy charakterystyce rozmieszczenia prócz własnych materiałów posłużono się danymi z prac systematycznych i faunistycznych. W części bionomicznej pracy przedstawiono ekologię zbadanego gatunku. W odniesieniu do postaci dojrzałej omówiono przezimowanie, zdolność skakania w górę w przypadku ułożenia chrząszcza na grzbiecie, endosymbiozę z bakteriami, sposób i przebieg kopulacji. W odniesieniu do larw autor omawia ich środowiska glebowe, ruchliwość, odżywianie, przezimowanie, przeobrażenie oraz czynniki ograniczające ich rozwój. Ponadto podano metodę hodowli oraz jej przebieg w warunkach laboratoryjnych.

W końcowej części pracy autor zamieszcza uwagi o stanowisku i randze *Throscidae* w układzie systematycznym, nadto podaje charakterystykę dwu rodzin w nadrodzinie *Elateroidea*, to jest *Throscidae* i *Lissomidae*, dawniej łączo-

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nych jako podrodziny w *Throscidae*. Charakterystyka ta oparta jest na cechach morfologicznych wszystkich postaci rozwojowych dwu przedstawicieli wymienionych rodzin, a mianowicie *Trixagus dermestoides* (L.) oraz wcześniej (Burakowski 1973) opracowanego gatunku — *Drapetes biguttatus* (Piller).

РЕЗЮМЕ

[Заглавие: Развитие, распространение и среда *Trixagus dermestoides* (L.) и заметки о *Throscidae* и *Lissomidae* (*Coleoptera, Elateroidea*)]

В настоящей работе автор рассматривает результаты исследований над морфологией, распространением и биономией *Trixagus dermestoides* (L.) затем дает характеристику *Throscidae* и *Lissomidae*, раньше соединяемых как подсемейства в *Throscidae*. Работа опирается на материалах всех стадий развития собранных автором главным образом в Польше; небольшой материал личинок и куколок приобретено во время полевых исследований в окрестностях Софии и Москвы. По отношению к *Lissomidae* опирались на ранее (Burakowski 1973) обработанном виде *Drapetes biguttatus* (Piller). Проведены лабораторные выращивания и наблюдения в поле позволили автору получить ряд биономических данных.

Приведены точные описания неизвестной до сих пор личинки (рис. 1–15) и куколки (рис. 16–23). Обсуждено наружную морфологию зрелой особи (рис. 24–33) учитывая притом полевой диморфизм. При характеристике разпространения кроме собственных материалов использовано данные из систематических и фаунистических работ. Указано кратко метод выращивания и его развитие в лабораторных условиях.

Из анализа собранного и выращиванного материала и наблюдений *Trixagus dermestoides* (L.) получено следующие биономические данные:

1. Вид в Польше заселяет покрытые деревьями низинные районы и подгорья до приблизительно 800 м над ур. м.

2. Взрослые особи по зимовке появляются в апреле или в начале мая. Можно тогда их встретить в подстилке, среди опавших листьев, на травах и кустарниках, а также на сухих ветках лежащих на земле.

3. Жуки проявляют значительную подвижность. Они являются летучими и при уложение на спине способны пригать вверх, что было подвераемое многими авторами. Прыжки совершают способом похожим как у *Elateridae*. Жук неохотно пригает и сначала пытается перевернуться при помощи ног, цепляясь коготками субстрата, чтобы принять нормальное положение. Обычно на горизонтальной а особенно гладкой поверхности это ему не удается по поводу большой выпуклости тела и коротких ног, тогда он поджимает ноги, выгибает тело вверх в пункте соединения переднегруди со среднегрудью, затем внезапно ударяет отростком переднегруди в ямку на среднегруди, вследствие чего жук неожиданно подпрыгивает

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вверх и обернувшись падает на ноги. В случае падения снова на спину он возобновляет попытку прыжка.

4. Эндосимбиоз с тремя видами бактерии был констатирован у имаго (STAMMER 1933). Симбионты находятся в двух парах мицетомов помещенных в жировом теле. В цикле развития способ переношения симбионтов до сих пор неизвестный.

5. Копуляция происходит в апреле и в мае, она значительно отличается от копуляции у других жуков, у которых вообще самец усаживается на спине самки. Самец *Trixagus dermestoides* (L.) во время полого акта находится на одном уровне с самкой, чаще по ея левой стороне, наискось и немного позади. Процесс копуляции у этого вида очень характерный. Самка обычно сидит неподвижно, зато самец распрямляет крылья косо по бокам, широко отклоняет надкрылья, которыми вибрируя ударяет и гладит надкрылья самки. По всей вероятности ласкание длинными волосками на конце надкрылий умеет в половом акте стимулирующее влияние па самки. Копуляция может происходить несколько раз и каждый раз длится от нескольких десятков секунд до пяти минут.

6. Яйца были вероятно откладываны весной и летом, так как молодые личинки длины от 1,2 до 3,5 мм находилось от конца августа до ноября.

7. Личинки заселяют умеренно влажную почву песчаную, глинистую или перегнойную, обычно под подстилкой на глубине до 20 см.

8. Личинки кормятся на корнях поряженный эктотрофной микоризой. Наиболее найдено из в соседстве корневой шеи, особенно берёз, реже ольх, буков и сосен. Проявляют они очень малую подвижность.

9. Цикл развития в общем лвугодний. Личинки в возрасте около 15 месяцев в благоприятных условиях растут до 6 мм и являются готовыми к превращению в августе-сентябре, в неблагоприятных условиях или происходящие из яиц позже откладыванных могут жить год больше и могут поэтому зимовать дважды.

10. Личинка перед превращением строит в почве кукольную каморку, обычно под верхним слоем перегноя. В том периоде тело личинки дуговато согнуто. Самое многочисленное превращение в общем происходит в августе, реже в сентябре, а бывает даже в октябре. Стадия куколки длится от 7 дней в августе и начале сентября до около 20 дней в октябре.

11. Зрелые особи зимуют в кукольных каморках, только некоторые особи опускают каморки уже осенью и тогда можно находить жуки до весны под корой деревьев, под опавшими листьями и в подстилке.

12. Главными врагами личинок, а особенно куколок *Trixagus dermestoides* (L.) являются хищные личинки видов семейства *Elateridae*, среди которых в польских условиях констатировано: *Athous subfuscus* (MÜLL.), *Dalopius marginatus* (L.) и *Ectinus aterrimus* (L.). По исследованию Стаммера (STAMMER 1934, 1955) возрослые особи подвергаются атакам паразитических нематод *Bradynema trixagi* WACHEK, которые у некоторых самок *Trixagus dermestoides* (L.) заполняют целиком латеральные яйцеводы. В выращиванию большую смертность вызывают низшие грибы, особенно в условиях малой влажности и высшей температуры.

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BIBLIOTEKA

В концевой части работы помещены заметки о местообитании и ранге *Throscidae* и *Lissomidae* в систематическом укладе. Многие морфологические признаки четко выделяют эти семейства из числа других *Elateroidea*. Характеристика тех семейств учитывая стадия развития представляется слелующим образом:

1. Имаго. Тело матовое, снабжено деликатными морщинами и пунктами, а также густым волосяным покровом. Усики непиловодные с исключением трех последних члеников, когда они образуют булаву, не завертывающиеся во время отдыха, но уложены в плейральных бороздах (рис. 27). Мандибулы (рис. 25) слабо склеротизированы на внутренной стороне, с одиночной верхушкой, без бахромы волосков при основанию. Переднегрудка (рис. 27) в передней части с коротким обрезаным базальным склеритом. Проплейральные борозды неглубокие и длинные растягивающиеся почти до задних углов переднегруди. Вертлуги передних ног которкие. Членики лапок от первого до третьего на низу без тарзальных пульвилл, четвертый членик с короткой перепончатой лопастинкой (рис. 28). Крылья с продольными, темными пятнами, вез замкнутой радиальной ячейки и радио-медиальной жилки (рис. 26). Базальный склерит гениталий самца хорошо развинутый, его длина больше или равняется длине парамеров (рис. 33). База пениса с двумя длинными балочками. Гемистерниты яйцеклада с боковыми отростками на верхушках (рис. 32). Совокупительная сумка с отростками в виде колец (рис. 30, 31).

   Личинка. Тело веретеновидное, коренастое и мясистое слабо склеротизированное. Голова сильно редицирована, ея ширина у взрослой личинки равняется около половины ширины переднеспинки. Передний край лобной пластинки без назале (рис. 5). Мандибулы с тупой верхушкой, с наружным режущим крайем, без среднего зубца и кисточки волосков (рис. 7). Переднегрудь на нижней стороне с трапециевидным простернум и парой отделенных от себя склеромов в виде разветьленных прутиков (рис. 13). Ноги очень короткие, слабые, деликатно ощетиненные (рис. 12). Дыхальца кольцево-двудырчатые. Тергиты брюшка без пластинок с колючками (рис. 1–3). Девятый сегмент брюшка конусообразный, с короткими малыми отростками обернутыми к зади (рис. 14). Личинка живёт в почве на корнях деревьев пораженных микоризой.

   Куколка. Тело деликатно ощетиненное. Усики булавовидые. Переднегрудь и сегменты брюшка без отростков (рис. 16). Девятый сегмент брюшка в задией части с двумя короткими заостренными отростками (рис. 20–22). . . . . *Throscidae*.

— Имаго. Тело гладкое и блестящее с скупым волосяным покровом. Усики пиловидные, свёртывающиеся во время отдыха (рис. 35). Мандивулы (рис. 36) сильно склеротизированы, с двумя зубцами на верхушке и с бахромой волосков при базе. Переднегрудка (рис. 35) в передней части с выпуклым воротничком. Проплеиральная глубокая ямка для прятания усиков. Вертлуги передних ног длинные. Членики лапок от первого до четвертого внизу с длинными перепончатыми лопастинками тарзальными пульвиллами (рис. 38). Крылья с радиальной

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ячейкой и радио-медиальной жилкой, без рподольных темных пятен (рис. 37). Базальный склерит гениталий самца слабо развит, его длина меньше длины парамеров (рис. 41). База пениса с короткой полукруглой пластинкой. Гемистерниты яйцеклада без боковых отростков на верхушках (рис. 39). Совокупительная сумка с отростками в виде шишок (рис. 40) или трезубцев.

Личинка. Тело кожанное, цилиндричное, легко сплоснутое спино-брюшно, очень склеротизированное. Голова большая, ея ширина почти равняется ширине переднеспинки. Передний край лобной пластинки с хорошо развинутым однозубным назале (рис. 42). Мандибулы с заостренной верхушкой, внутренным режущим краем, с кисточкой волосков, средний зубец в виде топора (рис. 43). Переднегрудь на нижней стороне с треугольной переднегрудкой, разделенной средниной головчатой балочкой (рис. 44). Ноги длинные хорошо развинутые, покрытые колючими щетинками (рис. 46). Дыхальца двудырчатые. Тергиты брюшка от второго до шестого с полуовальными пластинками покрытыми колючками (рис. 45). Девятый сегмент брюшка с вырезом на верхушке и розветвленными короткими урогомфами; внутренние ветви повернутые к себе, наружные ветви в виде рогов направленные кверху и легко загнутые к внутри (рис. 45). Личинка живет в истлевшей древесине лиственных деревьев.

Куколка. Тело нагое. Усики длинные, чётковидные. Переднеспинка с шестью отростками (рис. 47). Сегменты брюшка от третьего до шестого с коротким отростком на каждым боку. Девятый сегмент брюшка в задней части с четырьмя длинными отростками (рис. 48). . . . . *Lissomidae*.

Семейство *Lissomidae* в пределах семейств *Elateroidea* составляет промежуточное звено между *Throscidae* и *Elateridae*. Похожее строение личинок и куколок а также крыльев и гениталий самцов *Lissomidae*, указывает на более близкое сродство с *Elateridae*, с которыми составляют более примитивную группу чем *Throscidae*. Самыми близкими родственниками *Throscidae* являются жуки семейства *Eucnemidae*: оба эти семейства составляют очень высоко специализированные группы среди *Elateroidea*.

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Redaktor pracy — prof. dr J. Nast

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