

THE LIFE-CYCLE OF TWO ASTIGMATIC MITES, *GLYCYPHAGUS (ZAPODACARUS) NEWYORKENSIS* (FAIN, 1969) COMB. NOV. AND *GLYCYPHAGUS (ZAPODACARUS) ZAPUS* SP. N. (GLYCYPHAGIDAE)

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TAXONOMY	SUMMARY : The life-cycle of two species of the genus <i>Glycyphagus</i> (Acari, Astigmata) is described. <i>Dermacarus newyorkensis</i> Fain, 1969, known previously only from the hypopus stage, becomes the type species of a new subgenus <i>Zapodacarus</i> , in <i>Glycyphagus</i> . A new species is described in this new subgenus, <i>Glycyphagus (Zapodacarus) zapus</i> sp. n. The species are closely related biologically and morphologically and were found in the same rodent nest. Their hypopi are not separable.
CHAETOTAXY	
LIFE CYCLE	
RODENT	
NESTS	
GLYCYPHAGUS	
TAXONOMIE	RÉSUMÉ : Le cycle évolutif de deux espèces du genre <i>Glycyphagus</i> (Acari, Astigmata) est décrit. <i>Dermacarus newyorkensis</i> Fain, 1969, connu jusqu'ici seulement par sa forme hypope devient le type d'un nouveau sous-genre <i>Zapodacarus</i> dans le genre <i>Glycyphagus</i> . Une nouvelle espèce est décrite dans ce nouveau sous-genre, <i>Glycyphagus (Zapodacarus) zapus</i> sp. n. Ces deux espèces sont étroitement apparentées sur les plans biologique et morphologique. On les rencontre ensemble dans les nids du même rongeur et leurs stades hypopes sont identiques.
CHÉTOTAXIE	
CYCLE DE	
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DE	
RONGEURS	
GLYCYPHAGUS	

INTRODUCTION

Dermacarus newyorkensis Fain, 1969 was described from hypopi (heteromorphic deutonymphs) from the Meadow Vole, *Microtus pennsylvanicus*, from New York, U.S.A. (FAIN, 1969a, b). The primary hosts of this species are the zapodids on which the hypopi are very abundant ; few individuals have been taken from other mammals. It has been reported from the Meadow Jumping Mouse, *Zapus hudsonius*, from Indiana, Minnesota, New York, Ontario and Rhode Island (FAIN, 1969b ; FAIN *et al.*, 1971 ;

FAIN and WHITAKER, 1973 ; RUPES and WHITAKER, 1968 ; WHITAKER, 1963b ; WHITAKER and MUMFORD, 1971 ; WHITAKER and WILSON, 1968), from the Pacific Jumping Mouse, *Z. trinitatus*, from Washington (FAIN and WHITAKER, 1973), and from the Woodland Jumping Mouse, *Napaeozapus insignis*, from New York and North Carolina (FAIN and WHITAKER, 1973 ; WHITAKER, 1963a). In addition we have records of this species from *Z. hudsonius* from Alaska, British Columbia and Colorado (WHITAKER, 1979), from the Western Jumping Mouse, *Z. princeps*, from Alberta, British Columbia, Montana, North Dakota, Utah and Wyoming, and from *Z. trinitatus*

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from British Columbia, Washington and Oregon (WHITAKER, 1979).

During investigations on nest material of a hibernating Meadow Jumping Mouse from Vigo Co., Indiana, U.S.A., two of us (G. S. J. and J. O. W.) discovered hypopi of *Dermacarus newyorkensis* mixed with adult glycyphagid mites which appeared to belong to the same species. E. J. S. designed a mite rearing chamber and succeeded in rearing hypopi of *D. newyorkensis* from eggs laid by mites removed from the nests of hibernating captive Meadow Jumping Mice. We here report the results of this work.

TAXONOMIC HISTORY OF THE SPECIES OF THE GROUP *DERMACARUS*

The taxonomy of the hypopial nymphs phoretic on mammals is complicated and has given rise to numerous errors on the part of the acarologists who have worked with them now for more than a century. We summarize here the most important features of this long history.

KOCH (1839) created the genus *Dermaleichus* for a group of mites living on birds. In 1841 he described *Dermaleichus sciurinus* from hypopial nymphs found on a squirrel. He supposed that these forms were adult mites. In 1842, he created a new genus *Homopus* for a new species *Homopus hypudaei* found on a rat. He also included *Dermaleichus sciurinus* in this genus. The name *Homopus*, however, was not valid as it was a homonym of *Homopus* Duméril and Bibron, Rept. 1835. *Dermaleichus* has become a synonym of *Analges* Nitzsch, 1818.

KRAMER (1877) described the large hypopus attached to the hairs of the European mole (*Talpa europaea*) as *Labidophorus talpae* n. g. and n. sp. He thought that these mites were adults.

HALLER (1880) found hypopi and adults of *Dermaleichus sciurinus* Koch in association with the squirrel *Sciurus vulgaris* and he erected for this species the new genus *Dermacarus*.

MICHAËL (1886b) succeeded in rearing labidophorid mites from nests of moles in England. He rejected KRAMER's names, *Labidophorus* and

talpae, as not valid since they had been given to immature forms. He consequently renamed them *Glycyphagus krameri* species nova. In fact the specimens described and figured by MICHAËL differed clearly from *L. talpae* Kramer and they belonged really to a new species that MICHAËL did not recognize. In another paper MICHAËL (1886a) described two other new species from adult specimens found in mole nests in England: *Glycyphagus platygaster* and *Glycyphagus dispar*.

ZACHVATKIN (1941) considered *Dermacarus* to be a synonym of *Labidophorus* and he created a new genus *Talpacarus* for *Glycyphagus platygaster* Michaël. Moreover he proposed a new name *Myacarus* for the taxon *Homopus* Koch, 1942, praeoc. (type species *Homopus hypudaei* Koch, 1842) and described a new genus *Xenoryctes* for *Glycyphagus krameri* Michaël.

TURK and TURK (1957) published figures of adults, tritonymphs and hypopi which they attributed to *Labidophorus hypudaei* (Koch, 1842). In fact, their figures of adults correspond closely to *Xenoryctes krameri* (Michaël) and not to *hypudaei*.

FAIN (1969c), in a study of commensal glycyphagids of the mole, succeeded in rearing hypopi of *Labidophorus talpae* Kramer and he demonstrated that the adult stages of this species did not correspond to *Glycyphagus krameri* as thought by MICHAËL but to *G. platygaster*. The genus *Talpacarus* and the species *platygaster* therefore became synonyms of *Labidophorus* and of *talpae* respectively. The error of MICHAËL occurred because he believed that the mole carried only one species of hypopus whereas it actually bears five different species of these nymphs.

FAIN (1969b) published a monograph on the hypopi phoretic on mammals. The hypopi of *Dermacarus hypudaei* and *D. sciurinus* were re-described and 17 new species described.

RUPES *et al.* (1971) described the life cycle of *Dermacarus ondatrae* Rupes and Whitaker, 1968 and created a new genus *Zibethacarus* to accommodate this species.

FAIN and LUKOSCHUS (1974) were able to rear hypopi of *Dermacarus hypudaei* to the adult stage. While the hypopi of this species resembled

those of *Dermacarus sciurinus*, the adults on the contrary were clearly different and corresponded closely to the genus *Glycyphagus*. The only significant difference between *G. hypudaei* and *Glycyphagus* s. str. was the presence of strong spinous combs on tibiae I and II of the males of *G. hypudaei* which are lacking in *Glycyphagus* s. str. These authors have therefore proposed to conserve the taxon *Myacarus* Zachvatkin, but as a subgenus of *Glycyphagus*. *Dermacarus hypudaei* thus becomes *Glycyphagus (Myacarus) hypudaei* (Koch, 1842).

Since 1971, about 12 new species have been added to the genus *Dermacarus*, all but one from the hypopial form, and they cannot therefore be included with certainty in a correct genus or subgenus. The only exception is *Glycyphagus (Myacarus) microti* Spicka and O'Connor, 1980 for which all stages are known. The adults of this species belong to a group containing four other species (*G. bicaudatus* Hughes, 1961 ; *G. abnormis* Volgin, 1961 ; *G. zachvatkini* Volgin, 1961 ; *G. helveticus* Fain and Mumcuoglu, 1979) characterized in the female by the short length of the setae *d 5* (FAIN and MUMCUOGLU, 1979).

REMARKS ON THE DORSAL CHAETOTAXY IN THE GENUS *GLYCYPHAGUS*

1. Presence of the setae *ve* in the genus *Glycyphagus* :

HUGHES (1948, 1976) as well as FAIN and LUKOSCHUS (1974) and FAIN and MUMCUOGLU (1979) have mentioned the presence of setae *ve* in the genus *Glycyphagus*. They are situated behind the *vi* setae and distinctly in front of the two pairs *sci* and *se*. A similar situation is observed in the two species described herein. However, if we examine the larvae of these species we note that the situation of the propodonotal setae is quite different. Behind setae *vi* we find only two pairs of unequal setae situated on a transverse line, the inner pair being about half as long as the outer pair. Obviously these setae are the *sci* and the *se*, and there are no setae *ve*. In the protonymphs the inner pair (*sci*) is also half

as long as the outer (*se*) but it is distinctly more anterior, although still more median than the latter. This anterior migration of setae *sci* is more marked in the tritonymphs and adults and in these stages there is also a lateral migration of these setae so that they become situated exactly in front of the *se* setae. In the adults the *sci* are always shorter than the *se* but the difference in the lengths is less marked than in the larvae or the protonymphs.

We think thus that the setae that we have designated to be the *ve* are in fact the *sci* that have migrated forwards. Those we have designated to be the *sci* and the *se* are the *se* and the *d 1* respectively. Consequently the setae that we named previously to be *d 4* should become *d 5*.

In this paper we will use these new designations.

The absence of setae *ve* is not the rule in the Glycyphagidae. These setae are lacking in *Glycyphagus*, *Zibethacarus* and *Lepidoglyphus* but are present in *Blomia*, *Dermacarus* (in *D. sciurinus*), *Austroglycyphagus* and in several other genera of uncertain affinities included in the Glycyphagidae.

2. Situation of setae *d 1*, *d 2* and *d 3* :

We will follow here the sequence of the anterior dorsal setae proposed by FAIN and LUKOSCHUS (1974) and not the modification proposed by FAIN and MUMCUOGLU (1979) concerning the situation of *d 2* compared to *d 3* (the previous *d 1* and *d 2*).

MATERIALS AND METHODS

Wild Meadow Jumping Mice were live-trapped 3 kilometers southeast of Terre Haute, Vigo County, Indiana from 11 to 14 October 1974. The mice were placed in separate terraria with 10 centimeters of moistened sand and peat moss for substrate and with cotton and wood shavings for nest material. Water, rolled oats, potato and apple were provided. The terraria were covered with plywood and placed in an environmental chamber at 15°C with a photoperiod of 10 hours light, 14 hours dark on 14 October. Relative

humidity was about 37 percent. On 19 October the temperature was lowered to 10°C and the relative humidity was raised to 45 percent. The mice were left undisturbed except for checking the food supply until 8 January 1975 when the nest of one hibernating mouse was removed and examined. On 13 March the temperature in the environmental chamber was raised to 20°C and the relative humidity was lowered to 30 percent.

Clumps of nest material were teased apart over a white sheet of paper which was then examined with the aid of a stereoscopic microscope (17 to 30 ×). Glycyphagid mites were found and were placed in groups of two to 30 in rearing chambers constructed as follows: a slide ring (5 × 18 mm) was glued in the middle of a microscope slide (2.54 × 7.62 cm). A coverslip (18 mm diameter) was partially sealed to the top of the slide ring with a small amount of petroleum jelly applied with a hypodermic syringe. Dry granulated yeast and a moistened filter paper (5 × 5 mm) provided food and humidity. All chambers were placed under inverted, translucent, plastic buckets (2500 ml) at room temperature (23 to 24°C). An open petri dish (60 × 20 mm) of water provided additional humidity. Rearing chambers were examined at least once a day with the aid of the microscope.

RESULTS

On 7 January one rearing chamber contained about 30 mites from a laboratory nest. All stages except hypopi were included. Ten days later it contained three hypopi.

A male and a female placed in a rearing chamber on 7 January were observed copulating the next day. By the third day 11 eggs had been laid. Eggs began to hatch out the fourth day and the majority had hatched by the seventh day. The first protonymphs were observed on the 12th day, and on the 17th day the first hypopi appeared.

A tritonymph put in a rearing chamber on 7 January was inert the next day. By 9 January it had molted into a female and was observed copulating on 10 January.

During copulation the male assumed a dorso-posterior position with his penis, which is mid-ventral, inserted in the female's posterior *bursa copulatrix*. The male tightly clasped the mid-dorsum of the female with legs I and II. Legs III clasped her ventro-posterior. Legs IV hung limp or loosely clasped the female like legs III. The female was active, crawled about and fed, and the male was quiescent.

Eggs (0.2 mm long, 0.13 mm diameter) were translucent and oval. In the rearing chambers the female tucked eggs under the edge of the filter paper or in cracks in the yeast. In the nest of the hibernating Meadow Jumping Mouse eggs were attached to nest material.

Hypopi were kept alive in petri dishes containing moist yeast and on the hairs of a dead, refrigerated (8°C) Meadow Jumping Mouse for 25 and 17 days, respectively. No tritonymphs emerged and the hypopi died.

Raising the temperature on 13 March from 19 to 20°C in the environmental chamber caused the Meadow Jumping Mice to cease hibernating. Material taken from a nest 25 days after the temperature was raised contained an active colony of mites.

The study of this material (A. F.) has shown that it contained not only the entire life cycle (eggs, larvae, protonymphs, hypopi, tritonymphs, males and females) of *Dermacarus newyorkensis* but also a second and new species closely related to the former and also represented by all developmental stages. All stages were slightly different from those of *D. newyorkensis* except the hypopi which were identical. It appears therefore that *D. newyorkensis* is a complex of two closely related species separable in all their stages except the hypopial stage.

The present paper is devoted to the description of these species.

DESCRIPTION OF THE SPECIES

Genus *Glycyphagus* Hering, 1838

Subgenus *Zapodacarus* subg. nov.

Definition : This new subgenus is closest to *Glycyphagus* s. str., *Myacarus* and *Zibethacarus*. It differs from *Glycyphagus* s. str., in both sexes by the strong modification of setae *w* and *r* of tarsi IV into thick spines. In the male it differs by tarsi I to III being thick and produced apico-ventrally, by claws I-III and by the more posterior situation of the penis (between coxae IV). *Zapodacarus* differs from *Myacarus* in both sexes by the spinous modification of setae *w* and *r* of tarsi IV ; in the male by the more posterior situation of the penis, the modification of legs and claws I to III and by the absence of combs on tibiae I and II, these combs being replaced by normal barbed setae. *Zapodacarus* is distin-

guished from *Zibethacarus* in both sexes by the presence of a dorsal shield or crista, the longer dorsal setae and the different structure of the cuticle ; the male differs by the absence of combs on tibiae I-II and the modified aspect of legs and claws I to III (Table 1). Type species : *Dermacarus newyorkensis* Fain, 1969.

1. *Glycyphagus* (*Zapodacarus*) *newyorkensis* (Fain, 1969) comb. nov.

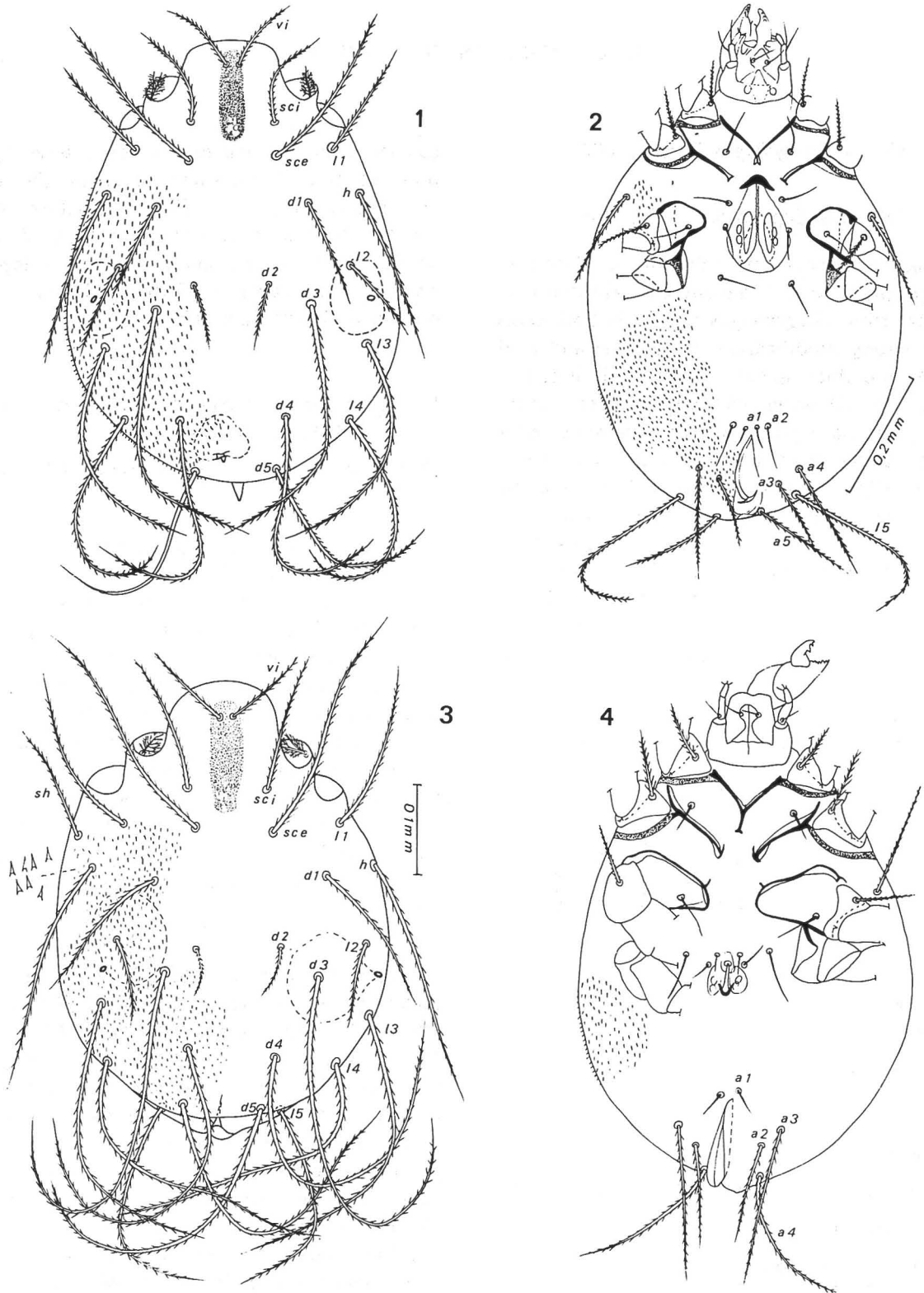
Dermacarus newyorkensis FAIN, 1969a : 410 ; 1969b : 111.

As *Glycyphagus* (*Zapodacarus*) *newyorkensis* has been described from the hypopus stage we have to select, among our material, which adult type will represent the most accurately this species. We designate for this purpose the adults with the following characters : Propodotal shield relatively wide (ratio width : length = 1 : 3 to 1 : 4.2), cuticular elevations larger, fewer and lacking in several parts of the idiosoma, ventrally and dorsally, spines *w* and *r* of legs IV much thicker, some dorsal setae (e.g. *d* 2) shorter. The adults showing these characters are more abundant in our material than those of the second species.

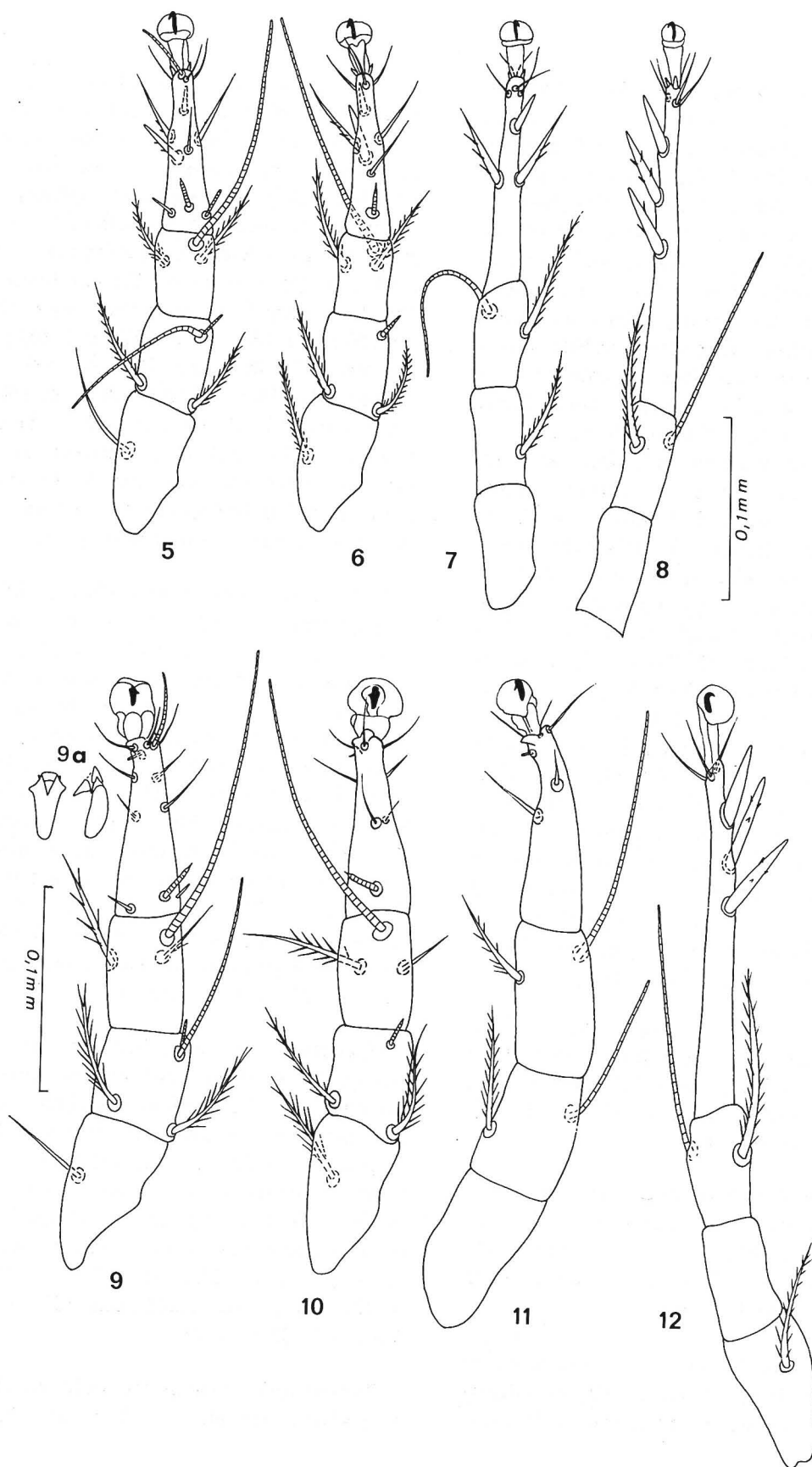
TABLE 1 : Important characters separating some closely related genera and subgenera of Glycyphagidae. (+ = character present ; — = character absent).

	Glycyphagus					
	<i>Glycyphagus</i> s. str.	<i>Myacarus</i>	<i>Zapodacarus</i>	<i>Zibethacarus</i>	<i>Lepidoglyphus</i>	<i>Dermacarus</i>
IN BOTH SEXES						
Dorsal shield						
Absent	—	—	—	+	+	—
Very narrow	+	+	+	—	—	—
Narrow to wide	—	—	—	—	—	+
Setae <i>v</i> e	—	—	—	—	—	+
IN MALES						
Situation of penis						
Between coxae :	III	III	IV	III	III	IV
Combs on tibiae I-II	—	+	—	+	—	—
Modification of tarsi and claws I, II and III	—	—	+	—	—	+

Female (Figs. 1, 2, 5-8) : Idiosoma on 7 females (length × width in μm) : 750 × 510 ; 705 × 495 ; 665 × 440 ; 660 × 450 ; 640 × 480 ; 630 × 450 ; 560 × 390. Some of the large females contain 5 to 9 non-embryonated eggs. Cuticle covered with small and thin elevations except in the following areas where these elevations are absent : anterior part of dorsum, lateral parts of venter, posterior part of dorsum and in some specimens, of venter. **Dorsum** : Propodotal shield relatively wide ; in 6 females it measures (length × maximum width, in μm) : 160 × 42 ; 149 ×



FIGS. 1-4 : *Glycyphagus (Zapodacarus) newyorkensis* (Fain, 1969).
 Female in dorsal (1) and ventral (2) view ; male in dorsal (3) and ventral (4) view.



FIGS. 5-12 : *Glycyphagus (Zapodacarus) newyorkensis* (Fain, 1969).

Female : legs I (5), II (6), III (7) and IV (8) ; male : legs I (9), II (10), III (11) and IV (12) ; claw of leg I (9a).

36 ; 147 × 39 ; 145 × 39 ; 143 × 34. The ratio width : length varies from 1 : 3.71 to 1 : 4.2. The setae *vi* are situated on the shield approximately at the junction of the anterior fifth and the posterior four fifths. The anterior fifth of the shield is less sclerotized than the rest of the shield. Grandjean's organ short, with several short and irregular branches. Setae *sx* divided in two main branches bearing numerous secondary thinner branches. Copulatory papilla sclerotized, conical and situated close to posterior margin of the body ; it is 23 to 30 μm long. Bursa short. Spermatheca with the base bearing a thin sclerotized ring and two short chitinized canaliculi with inflated apex. *Venter* : Sternum short. Epimeres II to IV, vulva and anus as in *Glycyphagus hypudaei*. Epigynium relatively thick. Gnathosoma 125 μm wide at its base (female of 720 μm long) ; chelicerae well developed, 130 μm long. *Legs* : Lengths of tarsi I to IV (in μm) in a female of 720 μm long : 93-93-120-192. Chaetotaxy of idiosoma (female 720 μm long) (lengths in μm) : *vi* 150 ; *sci* 178 ; *sce* 280 ; *d1* 225 ; *d2* 100 ; *d3* 480 ; *d4* 440 ; *d5* 405 ; *h* 300 ; *sh* 165 ; *l1* 210 ; *l2* 130 ; *l3* 340 ; *l4* 420 ; *l5* 370 ; *a3* 150 ; *a4* 240 ; *a5* 255. Chaetotaxy of the legs : Number of setae : Tarsi I to IV 13-12-10-10. Tarsi I and II with *wa* and *ra* forming thick barbed setae. Tarsi III and IV with *w* and *r* forming barbed spines, those of tarsi IV are 6 to 7 μm thick. Solenidia : The $\omega 1$ on tarsi I-II is short and ends in a very thin prolongation.

Male (Figs. 3, 4, 9-12) : Length and width of idiosoma in 6 specimens (in μm) : 545 × 385 ; 540 × 390 ; 515 × 345 ; 510 × 330 ; 490 × 310 ; 480 × 360. Cuticle as in the female but the elevations are less developed.

Dorsum : Shield as in female ; measurements in 7 specimens (length × width, in μm) : 145 × 43 ; 130 × 36 ; 129 × 39 ; 126 × 42 ; 126 × 39 ; 123 × 41 ; 108 × 33. The ratio width : length varies from 1 : 3 to 1 : 3.6.

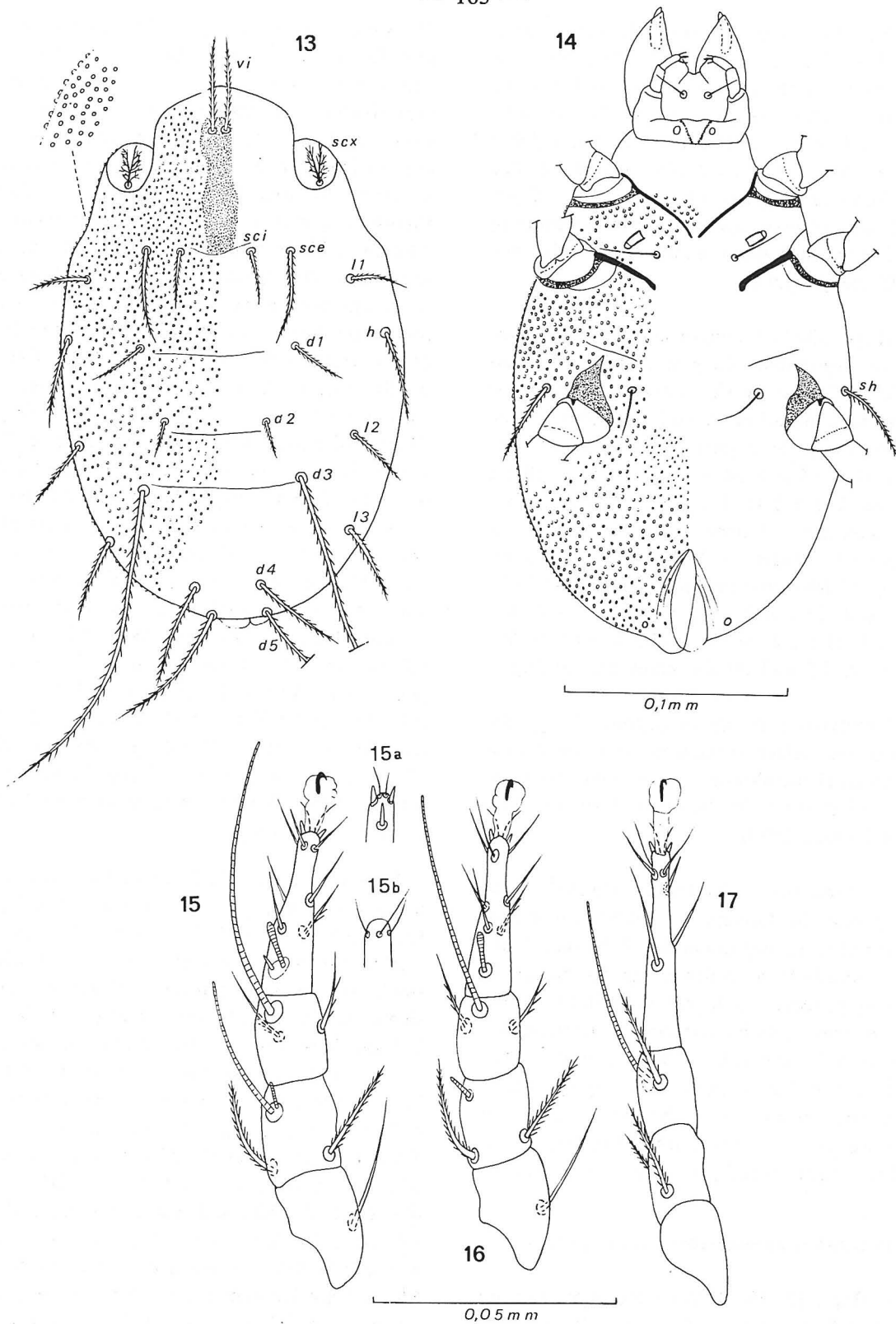
Venter : Sternum 30 μm long. Genital organ situated at the level of coxae IV or slightly behind. Penis narrow, curved at 180° at its base,

its straight apical part 30 μm long. *Legs* : Tarsi I to III modified, relatively thick and with the apex produced ventrally in a curved ventral and conical projection. The claws of these tarsi are also modified, they are expanded apically and are apparently formed of three sclerotized parts separated by non-sclerotized membranes. Length of tarsi I-IV (in a male of 525 μm long) : 98-93-105-195. *Length of idiosomal setae* (in μm) : *vi* 120 ; *sci* 165 ; *sce* 290 ; *d1* 200 ; *d2* 78 ; *d3* 490 ; *d4* 450 ; *d5* 410 ; *l1* 200 ; *l2* 120 ; *l3* 420 ; *l4* 430 ; *l5* 340 ; *h* 300 ; *sh* 150. There are 4 pairs of anal setae, the *a2* are lacking : *a3* 100 ; *a4* 180 ; *a5* 185. Number of setae on tarsi I-IV : 8-8-6-6. On tarsi IV the setae *w* and *r* are strong barbed spines 7 to 7.5 μm thick, the seta *s* is a smaller non-barbed spine.

Tritonymph : Length and width of idiosoma in 5 specimens (in μm) : 465 × 340 ; 450 × 335 ; 450 × 305 ; 425 × 298 ; 390 × 255. Cuticular elevations smaller than in the female and present in the area of the *vi* setae but in this area they have a more nodular, rounded aspect. *Dorsum* : Shield poorly sclerotized, it measures, in 4 specimens (in μm) : 100 × 28 ; 96 × 27 ; 94 × 24 ; 88 × 29. (Ratio width : length = from 1 : 3 to 1 : 3.9). Length of setae (in a specimen of 425 μm long) : *vi* 60 ; *sci* 60 ; *sce* 160 ; *d1* 57 ; *d2* 27 ; *d3* 270 ; *d4* 225 ; *d5* 210 ; *l1* 80 ; *l2* 54 ; *l3* 210 ; *l4* 195 ; *l5* 150 ; *h* 150 ; *sh* 80. There are 4 pairs of anal setae, the *a2* are lacking ; *a3* 25 ; *a4* 65 ; *a5* 60.

Hypopus : This stage has been described previously (FAIN, 1969). All our new specimens correspond with the original description except for the length of the bare seta of femur I. In the original figure this seta was too short. In fact its length varies from 70 to 90 μm long as mentioned in the typical description. In 4 specimens from nests of *Zapus hudsonius* studied during this work the lengths and widths are : 325 × 225 μm ; 335 × 221 μm ; 345 × 245 and 375 × 260 μm . Tarsi I-IV 36-34-24-26.

Protonymph : Length and width of idiosoma in 4 specimens (in μm) : 330 × 234 ; 321 × 215 ;



FIGS. 13-17 : *Glycyphagus (Zapodacarus) newyorkensis* (Fain, 1969).

Larva in dorsal (13) and ventral (14) view ; larval legs I (15), II (16) and III (17), apex of leg I in ventral (15a) and dorsal (15b) view.

318 × 198 ; 290 × 195. Dorsal shield in 4 specimens : 75 × 20 ; 75 × 18 ; 74 × 21 ; 69 × 18 (ratio width : length from 1 : 3.52 to 1 : 4.16. Chaetotaxy of idiosoma (in μm) : *vi* 50 ; *sci* 43 ; *sc e* 100 ; *d 1* 39 ; *d 2* 21 ; *d 3* 200 ; *d 4* 180 ; *d 5* 130 ; *l 1* 50 ; *l 2* 45 ; *l 3* 145 ; *l 4* 69 ; *h* 90 ; *sh* 45. There are 3 pairs of anals 18 to 22 μm long. Six of our protonymphs are in the molting stage and contain hypopi which agree with the type of *G. newyorkensis*.

Larva (Figs. 13-17) : Length and width of idiosoma in two specimens (in μm) : 255 × 165 and 205 × 135. Cuticle with small rounded or shortly pointed elevations covering almost all the dorsum and the greatest part of the venter. Dorsal shield 60 × 14 and 54 × 14 μm (ratio width : length from 1 : 4.2 to 1 : 3.8). *Venter* : Epimeres I separated. Coxae I with a Claparède organ distinctly longer (8 μm) than wide (5 μm). Chaetotaxy of idiosoma (in μm) : *vi* 33 ; *sci* 15 ; *sc e* 40 ; *d 1* 23 ; *d 2* 15 ; *d 3* 150 ; *d 4* 36 ; *d 5* 63 ; *l 1* 21 ; *l 2* 24 ; *l 3* 35 ; *h* 39 ; *sh* 27. The setae *l 4*, *l 5* and all the anals are lacking.

Egg and prelarva : In an embryonated egg the two conical sclerotized formations were developed on the prelarval membrane. They have the same situation and shape as in the other Astigmata (see FAIN and HERIN, 1979).

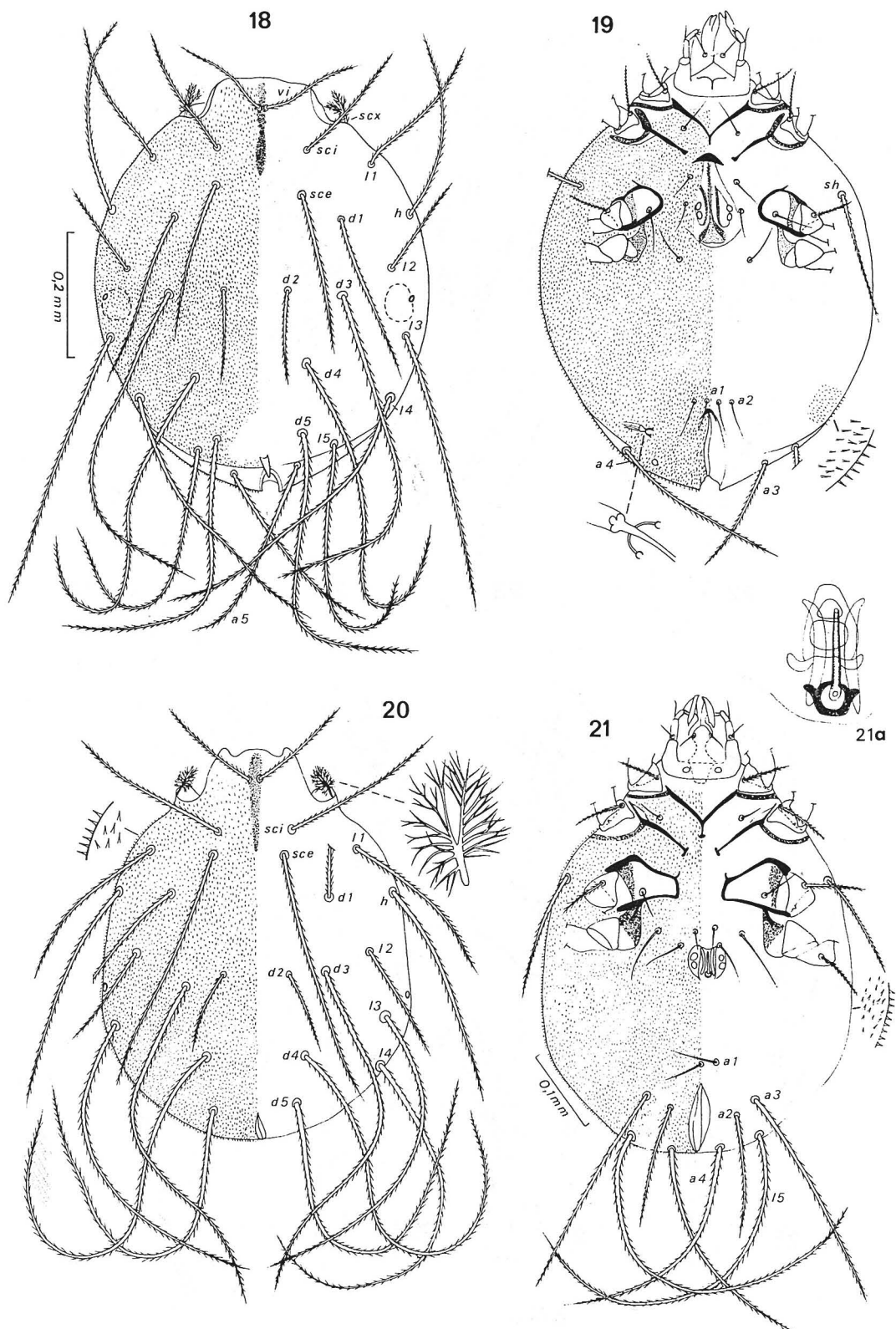
Material examined : Material collected from laboratory nests in January : 4 females, 4 males, 21 tritonymphs, 12 protonymphs, 9 larvae, 7 hypopi. In addition we collected 26 specimens in the molting process : 9 larvae containing protonymphs, 6 protonymphs containing tritonymphs, 7 protonymphs containing hypopi, and 4 tritonymphs containing females. Among the material collected from the laboratory nests in February we found : 19 females, 23 males, 10 tritonymphs, 1 protonymph, 1 larva and 6 hypopi.

2. *Glycyphagus* (*Zapodacarus*) *zapus* spec. nov.

Female (Figs. 18, 19, 22-25) : Holotype 675 μm long and 465 μm wide (idiosoma). It contains

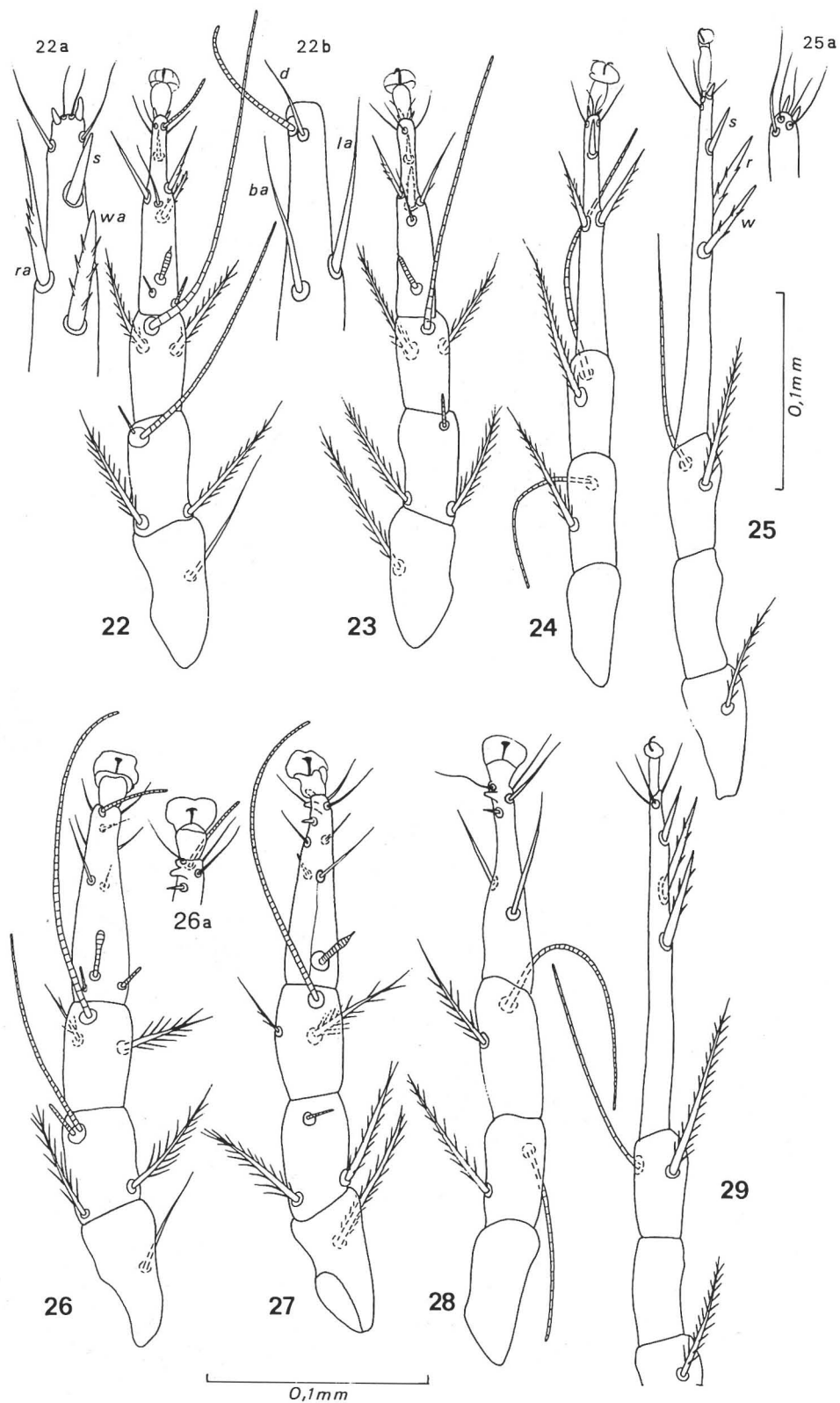
11 non-embryonated eggs. Length and width (in μm) in 4 paratypes : 690 × 550 ; 660 × 480 ; 640 × 500 ; 615 × 420. Cuticle uniformly and very densely covered with very small pointed elevations. These elevations are lacking in a small area in front of the copulation cone ; immediately in front of this bare area the elevations are slightly longer than in the other parts of the body. *Dorsum* : There is no true shield but only a narrow sclerotized crista 120 to 160 μm long and 18 to 23 μm maximum wide. The setae *vi* are situated on this crista slightly behind the junction of the anterior fifth and the posterior four fifths of the crista. The ratio width : length varies from 1 : 6.9 to 1 : 7.78. Setae *sc x* and general shape and situation of dorsal setae as in *G. newyorkensis*. Copulatory cone well sclerotized, subterminal, 39 μm long. *Venter* : *Sternum* short (18 μm). Other epimeres and epigynium as in *G. newyorkensis*. Gnathosoma 117 μm wide, chelicerae 120 μm long. Legs as in *G. newyorkensis* but the spines *w* and *r* are much thinner (3 to 3.5 μm thick). Length of tarsi I-IV (in μm) : 102-100-126-180. Chaetotaxy of idiosoma (in μm) : *vi* 150 ; *sci* 180 ; *sc e* 300 ; *d 1* 220 ; *d 2* 145 ; *d 3* 460 ; *d 4* 450 ; *d 5* 450 ; *l 1* 190 ; *l 2* 150 ; *l 3* 420 ; *l 4* 450 ; *l 5* 400 ; *h* 300 ; *sh* 180. There are 5 pairs of anal setae. Chaetotaxy of legs : Number and arrangement of setae as in *G. newyorkensis*.

Male (Figs. 20, 21, 26-29) : Length and width of idiosoma in 5 paratypes (in μm) : 485 × 350 ; 455 × 370 ; 450 × 348 ; 443 × 345 ; 380 × 300. Cuticle uniformly and densely covered with very small and short elevations. *Dorsum* : Anterior shield as in female but smaller, it is 100 to 111 μm long and 15 to 16 μm maximum wide (ratio width : length varying from 1 : 6.6 to 1 : 7). Gnathosoma 87 μm wide (in a paratype of 450 μm long). Legs as in *G. newyorkensis*. Tarsi I to IV 86-83-89-153 μm long. Chaetotaxy of idiosoma (in μm) : *vi* 120 ; *sci* 180 ; *sc e* 270 ; *d 1* 210 ; *d 2* 85 ; *d 3* 460 ; *d 4* 480 ; *d 5* 440 ; *l 1* 170 ; *l 2* 130 ; *l 3* 390 ; *l 4* 390 ; *l 5* 370 ; *h* 270 ; *sh* 135. There are 4 pairs of anal setae (the *a 2* are lacking) : *a 3* 150 ; *a 4* 240 ; *a 5* 280. Setae of tarsi I to IV as in *G. newyorkensis* but



FIGS. 18-21 : *Glycyphagus (Zapodacarus) zapus* sp. nov.

Female in dorsal (18) and ventral (19) view ; male in dorsal (20) and ventral (21) view ; penis (21a).



FIGS 22-29 : *Glycyphagus (Zapodacarus) zapus* sp. nov.

Female : legs I (22), II (23), III (24) and IV (25) ; apical half of tarsus I in ventral (22a) and dorsal (22b) view ; apical part of tarsus IV in ventral view (25a). Male : legs I (26), II (27), III (28) and IV (29) ; apex of tarsus I in ventral view (26a).

the setae *w* and *r* are much thinner (3 to 3.2 μm thick).

Tritonymph : There are no free tritonymphs in our collection but only one tritonymph in the molting stage and containing a female. This nymph is 510 μm long and 360 μm wide. Cuticle as in the female. Dorsal shield 86 μm long and 13 μm maximum wide (ratio width : length = 1 : 6.6). Length of setae (in μm) : *vi* 36 ; *sci* 33 ; *sce* 105 ; *d1* 33 ; *d2* 18 ; *d3* 180 ; *d4* 150 ; *d5* 125 ; *l1* 58 ; *l2* 33 ; *l3* 130 ; *l4* 110 ; *l5* 65 ; there are 3 pairs of anal setae 21 to 27 μm long.

Hypopus : We have 4 protonymphs in the molting stage and containing a hypopus. The hypopi are not separable from those of *G. newyorkensis*.

Protonymph : We have only protonymphs in the molting stage (containing hypopi). Three of those measure (idiosoma in μm) : 345 \times 240 ; 270 \times 180 ; 240 \times 170. Cuticle as in the female. Dorsal shield (in μm) : 66 \times 6 ; 63 \times 9 ; 62 \times 7. Ratio width : length from 1 : 8.8 to 1 : 11. Length of setae (specimen of 345 μm long) : *vi* 54 ; *sci* 42 ; *sce* 111 ; *d1* 33 ; *d2* 18 ; *d3* 225 ; *d4* 200 ; *d5* 178 ; *l1* 63 ; *l2* 48 ; *l3* 175 ; *l4* 135 ; *l5* 75. There are 3 pairs of anal setae 18 to 21 μm long.

Larva (Figs. 30-34) : The only larva in our collection is 195 μm long and 144 μm wide. Cuticle completely covered with very small elevations except in the narrow area occupied by the shield which is 58 μm long and 9 μm wide (ratio width : length = 1 : 6.4). Claparede's organ very short, as wide as long (3.6 μm). Length of setae (in μm) : *vi* 30 ; *sci* 12 ; *sce* 30 ; *d1* 18 ; *d2* 15 ; *d3* 170 ; *d4* 40 ; *d5* 68 ; *l1* 18 ; *l2* 21 ; *l3* 42 ; *h* 37 ; *sh* 29. The *l4* and *l5* setae and all the anals are lacking.

Material examined : All our material (holotype and paratypes) has been collected from the same laboratory nests of *Zapus hudsonius* and on the same dates as for the specimens of *Glycyphagus* (*Zapodacarus*) *newyorkensis* (in January and

February 1975). Holotype female and paratypes (5 females, 5 males, 1 tritonymph containing a female) collected on 23 January. Other paratypes : immatures in the molting stage (4 protonymphs containing hypopi) and 1 larva from other dates in January or February.

REMARKS : *Glycyphagus* (*Zapodacarus*) *zapus* is closely related to *G. (Z.) newyorkensis*. It is, however, separable from the latter by the following characters :

1. Differences in the ornamentation of the cuticle : In *G. zapus* it consists of very thin and numerous elevations covering almost all the dorsum and the venter. These elevations are present in all stages except in the hypopus. In *G. newyorkensis* these elevations are larger, often rounded, less numerous and lacking in some parts of the idiosoma.

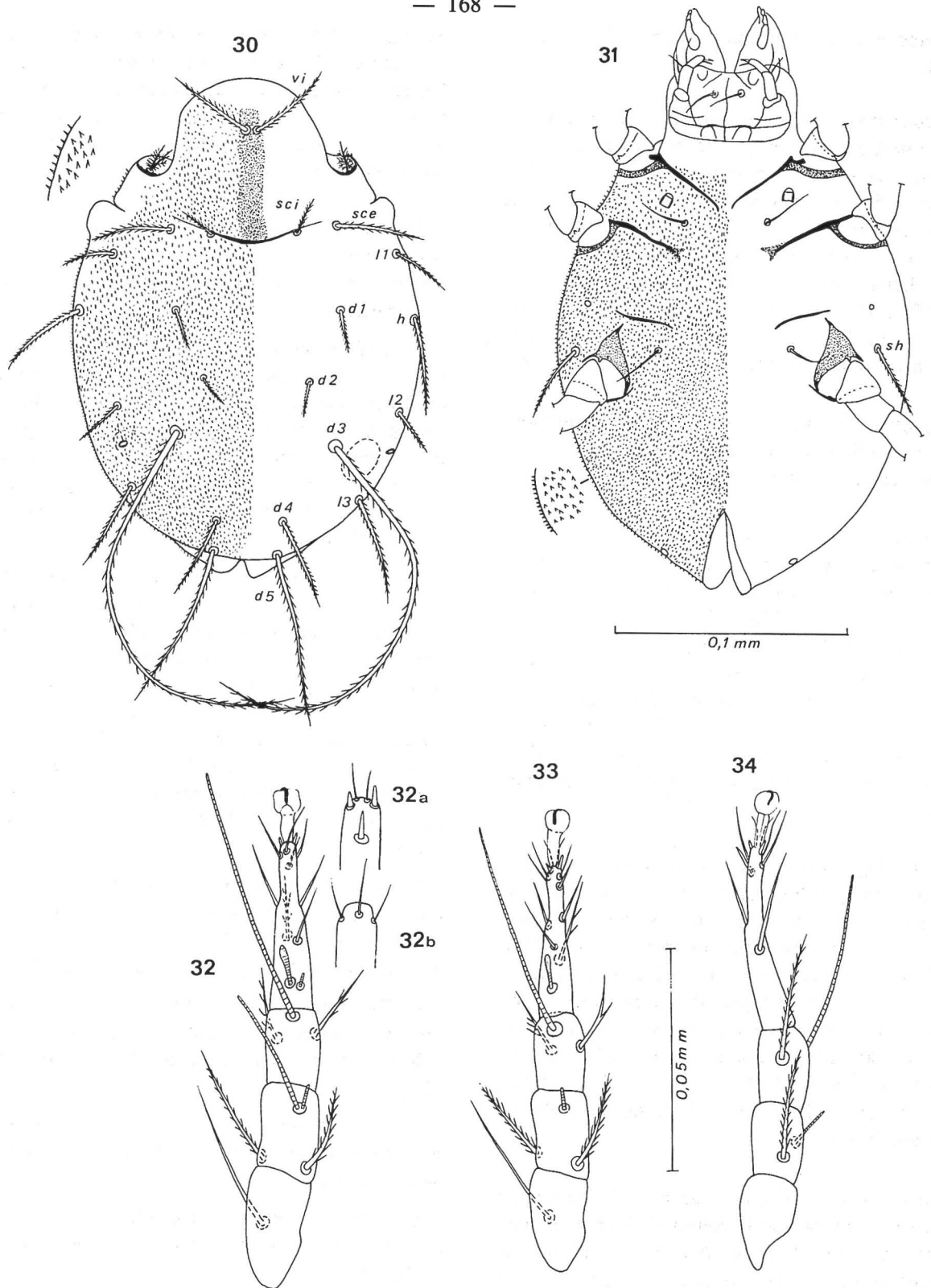
2. Differences in the width of the dorsal shield : In *G. zapus* this shield is very narrow resembling a crista ; its ratio width : length varies from 1 : 6.6 to 1 : 7.8 in the adults ; it is 1 : 6.6 in a tritonymph ; from 1 : 8.8 to 1 : 11 in the protonymph and is 1 : 6.4 in a larva. In *G. newyorkensis* these ratios are very different : in the females 1 : 3.71 to 1 : 4.2 ; in the males 1 : 3 to 1 : 3.6 ; in the tritonymphs 1 : 3 to 1 : 3.9 ; in the protonymphs 1 : 3.52 to 1 : 4.16 ; in the larvae 1 : 3.8 to 1 : 4.2.

3. Differences in the spines of tarsi IV : In both sexes the spines *w* and *r* of tarsi IV are about twice as thick (6 to 7.5 μm) in *G. newyorkensis* than in *G. zapus* (3 to 3.2 μm thick).

4. Differences in the length of tarsi IV : These tarsi are longer in the males of *G. newyorkensis* (180 to 195 μm) than in those of *G. zapus* (140 to 156 μm).

5. In both sexes some dorsal setae, especially *d2*, are distinctly longer in *G. zapus* than in *G. newyorkensis*.

6. In the larvae, the Claparede's organ is longer than wide in *G. newyorkensis* and as long as wide in *G. zapus*.



FIGS. 30-34 : *Glycyphagus (Zapodacarus) zapus* sp. nov.
Larva in dorsal (30) and ventral (31) view ; larval legs I (32), II (33) and III (34), apex of tarsus I in ventral (32a) and dorsal (32b) view.

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