

Observations on the acarofauna of fish aquariums. II. A new oribatid and two new halacarid mites

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In three previous notes we dealt with mites found in fish aquariums and associated or not with diseases of fish (FAIN & LAMBRECHTS, 1985 and 1986 and FAIN & BELPAIRE, 1985).

In this paper we describe a new oribatid mite, *Trimalaconothrus maniculatus* sp. n. (Malaconothridae), a new subgenus (*Amlimnohalacarus* subg. n.) and two new species in the genus *Limnohalacarus* WALTER, 1917 (Halacaridae): *L. (L.) mamillatus* sp. n. and *L. (A.) inopinatus* sp.n.

These mites were found in four aquariums containing two different species of fish (Discus and *Scalaria*). No pathological action has been observed in the fishes in relation with the presence of these mites in the aquariums.

All our measurements are given in microns (μm).

Material examined

The species that we describe herein were found in four aquariums in Antwerp, Belgium. Table 1 gives the variations in the number of mites in the various aquariums. Aquarium M2 is the same as M1 but the sample was taken one month later. All these aquariums belong to the same owner.

N° of aquarium	pH and mineral content					tempera- ture	Mite fauna	
	pH	mS	KH	Nitrites	Nitrates		Oribatid	Halacarids
M1	6,5	700	0,5	0,0106	200	25° C	++++	++++
M2	6,5	700	0,5	0,0106	200	25° C	++++	++++
M3	7,8	600	7	0,0146	10	25° C	+	+
M4	7,5	850	3,5	0,0058	60	25° C	+	+
M5	6,4	850	0,5	0,0255	300	25° C	++	++

TABLE 1 : Variations of the mite population in the various aquariums

It appears from these observations that mites were the most abundant in slightly acid waters (pH 6,4 to 6,5) with a low level of KH.

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Study of the species

Family Malaconothridae

Genus *Trimalaconothrus* BERLESE, 1916

The mites of the genus *Trimalaconothrus* are generally found in very damp or even in subaquatic habitats. They are frequently encountered in moist moss or *Sphagnum*.

An unidentified species attributed to this genus has been recorded from aquariums in Germany by GESCH (1982) and UNTERGASSER (1984).

The new species that we describe herein was found in several aquariums belonging to the same owner in Antwerp.

Trimalaconothrus maniculatus spec. nov.

Adult (figs 1-4): Colour yellowish. Holotype 560 long and 300 wide (maximum). Length and width of 4 paratypes: 570 x 285, 555 x 290, 552 x 270, 540 x 290. The tegument comprizes a thin granular cerotegument and a finely punctate cuticle devoid of pits or reticulate pattern. *Prodorsum*: Lateral angulation between legs I and II conspicuous. Each side with a S-shaped poorly sclerotized ridge. Rostral setae about 45 long, they are pilose in their basal half. Lamellar setae with a thick basal half and with a few barbules, they are 60 to 70 long and are 55 to 60 apart, they are situated close to the lateral margins of the body at about 30 from the rostral setae and 108 from the interlamellar setae. Interlamellar setae 105 long, 90 apart and situated at 135 from the anterior margin of body. Exobothridial setae very thin and short. *Notogaster*: Posterior region slightly scaly. A pair of pigmented eyes are present in front of setae *c1*. All the setae are smooth. Length of setae: *c2* 15; *c1*, *d1*, *d2* 20-25; *c3*, *e1* and *f2* 30-35; *e2* 70; *h1* 60; *h2* 105; *ps1* 25-30. Most of the long setae are curled. Orifices of the oil glands very small situated inside setae *f2*. *Venter*: Absence of thick transverse sclerite in the anterior region of the anal groove. Epimeral setae: 3-1-2-3, all, these setae are very short. Anal and genital slits of about the same length. There are 6 pairs of thin genital setae (25 to 30 long). One pair of anal and 3 pairs of longer adanal setae. Length of setae *h3* 25-30, *ps2* 60 and *ps3* 20-25. *Legs*: Tarsi tridactyle, the median claw thicker but shorter than the laterals. Tarsi I and II with long and very unequal setae *ft*, one is smooth and thin, the other is thick, flattened and its lateral margins bear numerous long and thin barbules. Tarsi III with both setae *ft* thick and barbulate. Tarsi IV with only one pilose seta *ft*. Setae *tc* of tarsi I and II long, bare with hooked apex. Setae *u*, *p* and *pv* are unequal flattened spines bearing finger-like projections (hence the name of the species: *maniculatus*). On tarsi III and IV these setae, as well as the setae *s* are dentate rather than finger-like; the setae *tc* are very unequal, the longest bearing barbules only in its basal third, the shorter is barbulate in its basal two thirds. *Solenidiotaxy*: Tarsus I with a long thick $\omega 1$ directed basally, 2 thin and parallel $\omega 2$ and $\omega 3$. The famulus is a conical spine.

Remarks:

This species is easily recognizable by the combination of the following characters:

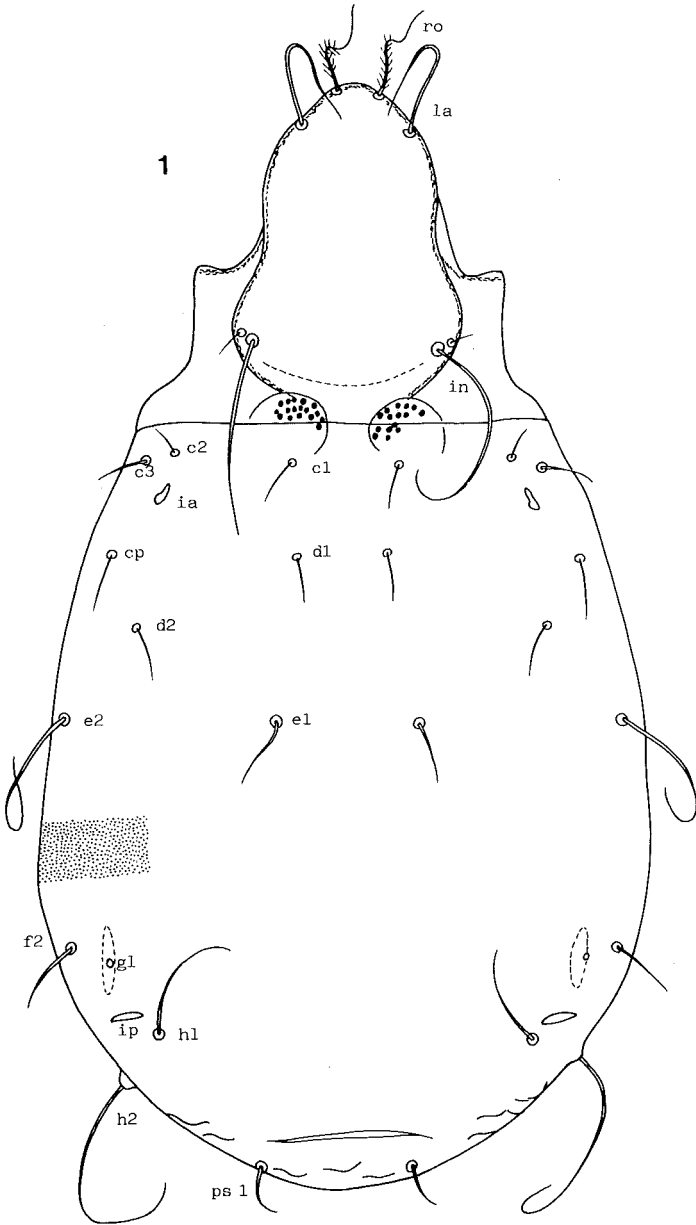


Fig 1. *Trimalaconothrus maniculatus* sp. n. Adult in dorsal view.

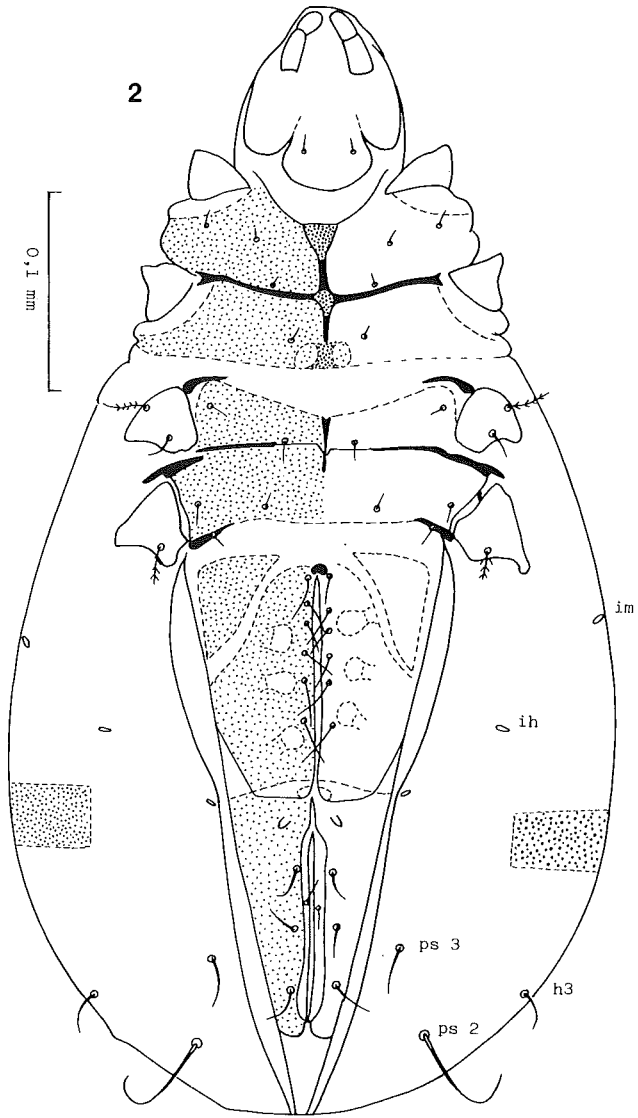
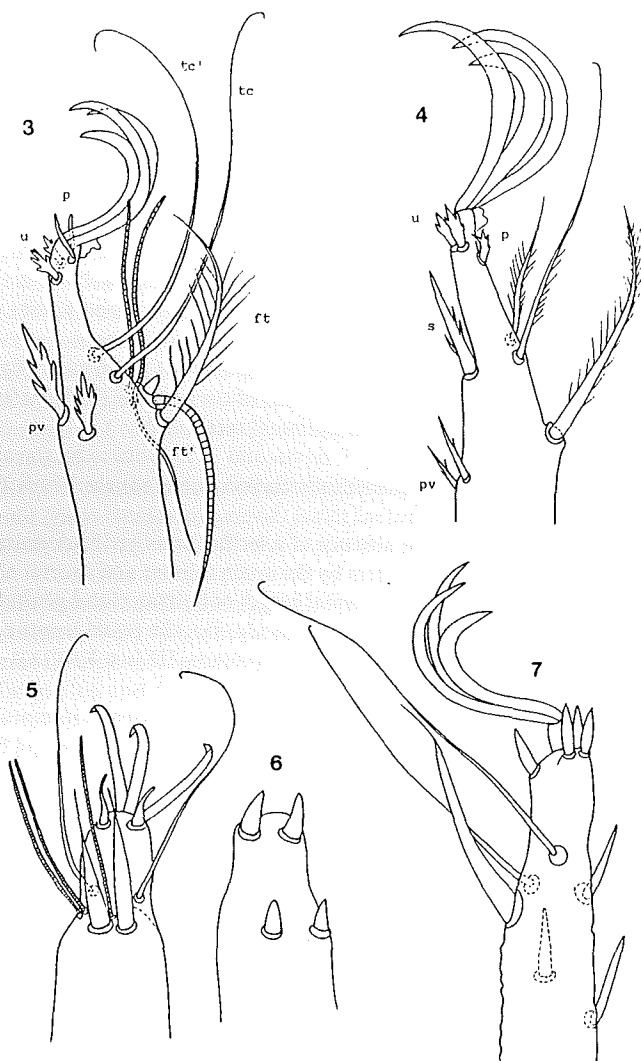


Fig 2. *Trimalaconothrus maniculatus* sp. n. Adult in ventral view.

Shape of the tarsal chaetotaxy (very unequal setae *ft*, modified aspect of spines *u*, *p* and *pv*), epimeral formula 3-1-2-3, absence of pits or reticulation on the cuticle, six pairs of relatively short genital setae.

The genus *Trimalaconothrus* comprizes until now more than 40 species, most of them



Figs 3-7. Figs 3-4: *Trimalaconothrus maniculatus* sp. n. Adult: apical part of tarsi I (3) and IV (4).
 Figs 5-7: *Trimalaconothrus glaber* (MICHAEL, 1888). Adult (type specimen): apical part of
 tarsus I dorsally (5) and ventrally (6) and of tarsus IV (7).

being described from countries outside Europe. KNÜLLE (1957) listed 16 species from Europe and more recently two new species have been added to this list. Most of these species have been inadequately described and KNÜLLE in his key retained only seven species as valid: *T. glaber* (MICHAEL, 1888), *T. tardus* (MICHAEL, 1888), *T. novus* SELLNICK, 1921, *T. vietsi* (WILLMANN, 1925), *T. foveolatus* WILLMANN, 1931, *T. sculptus* KNÜLLE, 1957 and *T. saxosus* KNÜLLE, 1957. To this list should be added *T. buresi* KUNST, 1959. Another species *T. scutatus* MIHELIC, 1959, described from Austria, probably does not belong to the genus *Trimalaconothrus* owing to the fact that it possesses a sensillus.

At first aspect our new species resembles *T. glaber*, however examination of typical material (slides n°s 1930.8.25 1106 and 1108) shows that both species differ from each other by the following characters: 1) Chaetotaxy of tarsi very different. In *T. glaber* the two setae *ft* of tarsi I to III are very thick, conical, bare and subequal, and the setae *u*, *p* and *pv* are devoid of finger-like projections; on tarsi III and IV the setae *tc* are equal in length and bare (figs 5-7); 2) Absence of sclerotized transverse cushion in the anterior region of the adanal plate. This sclerite is present in *T. glaber* (see KNÜLLE, 1957); 3) Interlamellar setae shorter (in *T. glaber* they are incomplete and measure at least 140) and closer to each other (in *T. glaber* these setae are 120 apart); 4) Only 6 pairs of genital setae (7 pairs in *T. glaber*). Owing to the dorsal mounting of the types of *T. glaber* (in balsam) it was not possible to study the anal and the epimeral setae.

T. maniculatus differs from *T. tardus*, *T. novus* and *T. foveolatus* by the aspect of the tarsal chaetotaxy and the absence of pits or reticulation on the cuticle. From *T. sculptus* it differs by the smooth aspect of the dorsal setae, the smaller adanal setae, the presence of only 2 pairs of epimeral setae III, the absence of sclerifications on the dorsum, the larger size of the body. From *T. saxosus* it differs by the much thinner and shorter adanal setae, the smooth aspect of the dorsal setae, the equal length of both anal and genital plates. It is distinguished from *T. vietsi* by the much larger body size, the equal lengths of anal and genital plates, the presence of 2 pairs of setae on epimeres III (see KNÜLLE, 1957).

Habitat

Holotype and 40 mounted paratypes, all adults, and numerous immatures, from 2 aquariums M1 (=M2) and M5, containing two different fishes (*Discus* and *Scalaria*), in Antwerp, on 3 January and 6 February 1986. Holotype in the Institut royal des Sciences naturelles de Belgique. Paratypes in the British Museum (Nat. Hist.) London, in the Museum National d'Histoire naturelle, Paris and in the U.S. National Museum, Washington.

Family Halacaridae

Genus *Limnohalacarus* WALTER, 1917

With the new subgenus and the two new species that we describe herein, the genus *Limnohalacarus* comprizes now three subgenera, 12 species and one subspecies.

1. *Limnohalacarus* s. str. WALTER, 1917. Palps with trochanter much narrower than

genu-femur and articulating at about a right angle with the latter; tibiae of legs I and II without barbed spines, on tibiae III spines are either present or absent. All claws with long combs. Tarsi I-IV with 9-8-6-5 setae (character observed only in *L. mamillatus*). *Type species: Halacarus wackeri* WALTER, 1914. This subgenus includes eight other species. All the group is confined to the Old World (Europe, Asia and Tropical Africa), it includes the following species: *L. mauritzi* ROMIJN & VIETS, 1924; *L. africanus* WALTER, 1935; *L. fontinalis* WALTER & BADER, 1952, *L. portmanni* BADER, 1967; *L. major* BADER, 1968; *L. capernaumi* PETROVA, 1967; *L. lanae* GREEN, 1976; *L. mamillatus* sp. n.

2. *Stygohalacarus* VIETS, 1934. Palps with trochanter as wide as genu-femur (in lateral view) and normally articulated with the latter without forming an angle. All the tibiae of legs with 2 apical barbed spines; genera I and II with 2 apical and genera III and IV with one apical barbed spines.

Type species: Limnohalacarus (Stygohalacarus) scupiensis VIETS, 1934. This subgenus is monotypic. Described from Europe.

3. *Amlimnohalacarus* subg. n.: Palp-trochanter as in *Limnohalacarus*. *Legs:* Genua I-IV without barbed spines; tibiae I-III with 1-1-2-1 barbed spines, tibia IV with a thick rather long, subapical barbed seta. Claws I with only a few apical short and narrow spines, the rest of the concavity of the claw without such spines. Claws II-IV with short combs formed of 4 to 5 narrow spines. *Leg chaetotaxy:* Tarsi I-IV with 7-6-6-5 setae, in the type species.

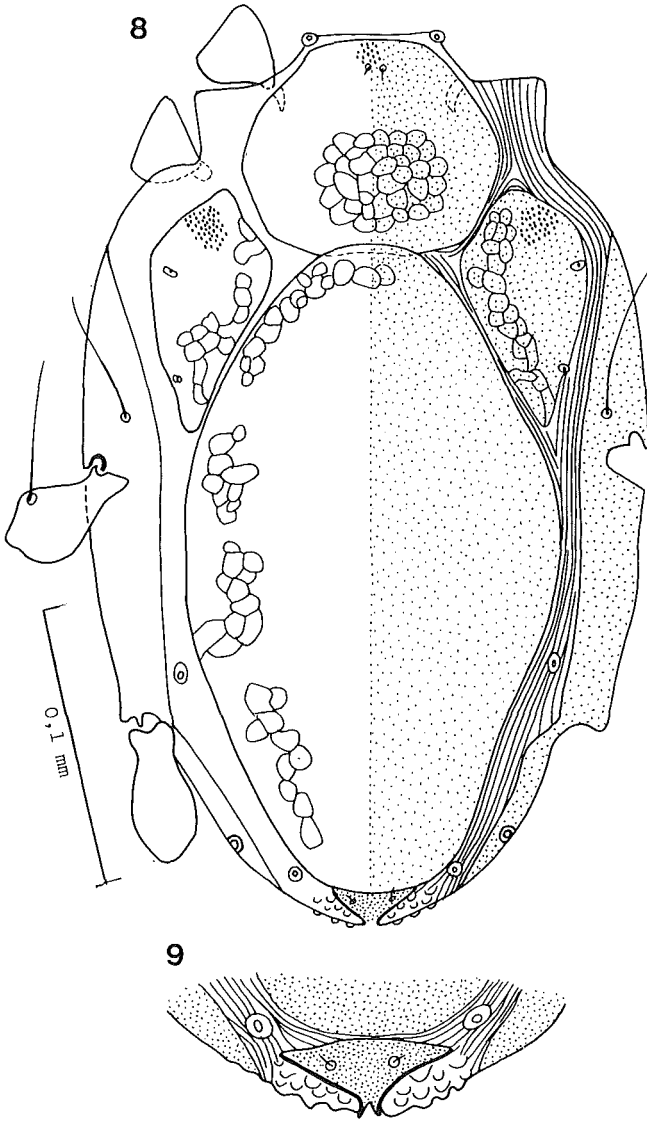
Type species: Limnohalacarus (Amlimnohalacarus) inopinatus sp. n. Found in aquariums in Belgium. A second species, *L. (A.) cultellatus* VIETS, 1940 has been described from South America.

Most of the species of *Limnohalacarus* live in freshwater, especially in subterranean waters (PETROVA, 1967). They have been recorded from deep wells, lakes, marshes and springs. Three species were found in brackish water (e.g. *L. portmanni* and *L. major* from the Lake Tanganika and *L. fontinalis* from a well with slightly brackish water.)

The two species recorded herein were found in fish aquariums in Antwerp. The presence of halacarid mites in aquariums had already been reported by Gensch (1982) in Germany but the mites were not identified at the generic or specific level. We believe that these species found in aquariums are not local species. Probably they have been introduced in Europe with the tropical fishes or plants. One can surmise that the ecological conditions existing in these aquariums and which are suitable for the tropical fishes (high temperature, good aeration and abundant food supply) are also very convenient for these mites.

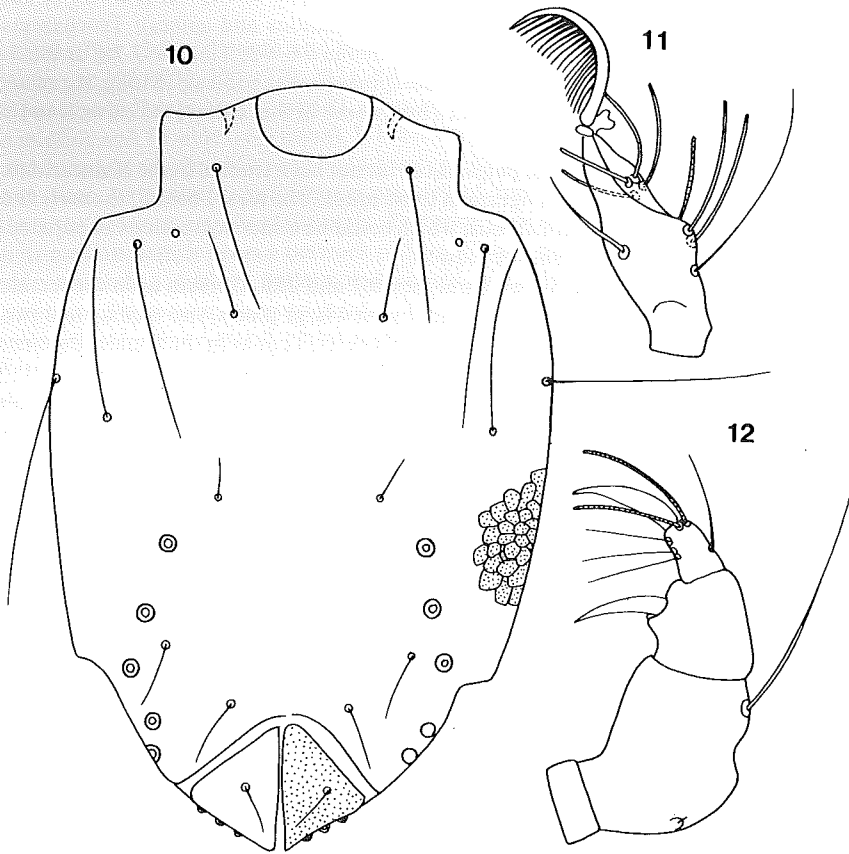
1. *Limnohalacarus (Limnohalacarus) mamillatus* spec. nov.

Female (figs 8-12): Length and width of the holotype (idiosoma) 306 x 201. It contains a round egg of 72 diameter. Total length including gnathosoma 345. Length and width in 3 paratypes: 310 x 200; 309 x 190; 295 x 210. Posterior margin of idiosoma with small rounded projections (mamillate). *Dorsum:* Anterior plate 75 long and 90 wide (maximum) bearing a network pattern in its posterior half; a few dark granules (eye) and a pair



Figs 8-9. *Limnohalacarus mamillatus* sp. n. Female in dorsal view (8); posterior region of dorsum, enlarged (9).

of microsetae are present in the anteromedian part; a crest is lacking; the anterior margin bears two lateral pores. Posterior plate ellipsoidal, with broadly rounded extremities, it bears a network more developed anteriorly and is 219 long and 128 wide (ratio length: width = 1,7 to 1,71 in 3 paratypes). Ocular plates triangular, longer (84) than wide (45); bearing anteriorly a number of dark granules, larger than those of the anterior plate (eyes); they also bear a poorly developed network, one small pore and a lyrifissure. Postocular plates absent. Lateral plates devoid of network but bearing a long seta. All these plates are separated from each other by soft striated skin. Excretory pore terminal surrounded by a small punctate plate bearing two microsetae. *Venter*: Most of the venter is covered by a large punctate plate bearing 6 to 8 suckers. Behind this plate are the two



Figs 10-12. *Limnohalacarus mamillatus* sp. n. Female in ventral view (10); tarsus I (11) and palp (12) in lateral view.

paramedian genital plates separated by the vulva and carrying each a thin seta. *Gnathosoma*: Length, including rostrum 60, width of the base 51. It bears 2 pairs of thin setae. Chelicerae 68 long. Palps: Trochanter 6 long and 14 wide in lateral view; genu-femur 30 long and 23 wide in lateral view. The axis of both segments form an angle of about 60°. The genu-femur bears 2 unequal dorsal setae, one subapical, thin and 45 long, the other very short and situated in the basal third of the segment. Tibia 20 long and 18 wide in lateral view, bearing a strong ventral subapical spine. Tarsus 12 long and 10 wide in lateral view, it bears a strong apical spine (18 long), one long and thin dorsal seta, three long and thin ventral setae and two long dorsal solenidions. *Legs*: Legs I to IV inserted laterally, but legs I-II are slightly ventral whilst legs III-IV are distinctly dorsal. Coxae rudimentary. Lengths of segments (legs I to IV): Trochanters 22-22-45-45; Basifemora 33-33-27-25; Telo-femora 57-57-45-45; Genua 42-40-42-42; Tibiae 60-60-75-84; Tarsi 57-57-66-65. Chaetotaxy of legs (number of setae, including solenidions and spines): Trochanters 1-1-1-0; Basifemora 4-4-2-1; Telo-femora 4-4-3-3; Genua 6-6-4-3; Tibiae 9-7-7-6 or 9-6-7-6; Tarsi 9-8-6-5. Only the tibiae bear bipectinate spines (one subapical, 18 long, the other prebasal 26 long). Claws: All the claws with a long comb of thin spines, the claws II to IV are bifid at their apex.

The nature of the setae of legs and palps has so far not been studied in the Halacaridae. The solenidions are difficult to recognize in these mites. The tarsi I bear 7, the tarsi II 6 and the tarsi III and IV 2 cylindrical setae which could be either solenidions or eupathidias. The palp-tarsus bear 2 dorsal solenidions.

Nymph II: Length of idiosoma of two paratypes 261 and 255. Dorsum as in the female except that there is a postscapular plate. Venter with 4 large plates, two median and two lateral. The posteromedian plate bears 7 pairs of suckers. Legs as in the female. Pigmented eyes not observed.

Nymph I: Idiosoma 150 long in a paratype. Same aspect of the idiosoma as in the nymph II but there are 5 pairs of suckers. Legs I to III with 6 free segments as in nymph II; legs IV with only 5 free segments, the basi and telo-femur being fused. Chaetotaxy of legs; Femora IV with 2 setae; Tibiae 6-5-5-5; Tarsi 7-6-6-5.

Larva: Length and width of idiosoma in one paratype 165 x 108. Dorsum as in the nymphs. Venter: there is no posteromedian plate, the idiosoma being striated. Legs: In all the legs the basifemur is fused with the telofemur, this fusion is not complete in tarsus I. Leg chaetotaxy: Trochanters 1-1-1; Femora 4-4-3; Genua 4-4-3; Tibiae 5-5-5; Tarsi 7-6-6. Male: unknown.

Habitat

Holotype and 20 paratypes female, 18 paratypes nymphs (7 nymphs I, 11 nymphs II) and 6 paratypes larvae, all from aquarium n° M1, Antwerp, 3.I.1986. Other paratypes from the same aquarium but on February 1986 (25 females, 20 nymphs II, 7 nymphs I and 5 larvae) and from aquariums M3 and M4 (5 females and 6 nymphs) and M5 (16 females, 10 nymphs) from the same locality. Types deposited as for *T. maniculatus*.

Remarks

This species is very close to *L. lanae* GREEN, 1976, described from a crater lake in Java. We have examined the holotype of *L. lanae*. This specimen is deeply stained in red and rather opaque. *L. mamillatus* differs from that species by the following characters:

1. Posterior extremity, especially along the ventral surface, with sclerotized rounded elevations. These structure have not been observed in *L. lanae*
2. Presence of three pigmented eyes (not observed in *L. lanae*)
3. Absence of seta on trochanter IV (this seta is present in *L. lanae*)
4. Tibia II with 6-7 setae (8 in *L. lanae*)
5. Posterodorsal plate relatively wider, the ratio length: width = 1,7 to 1,71 (in *L. lanae* this ratio is 1,4)
6. Tarsi III and IV subequal and shorter (66 and 65 long); in *L. lanae* these tarsi are more unequal and longer (69 and 75)
7. Gnathosomal base narrower (width 51, for 60 in *L. lanae*).

2. *Linohalacarus (Amlimnohalacarus) inopinatus* spec. nov.

Female (figs 13-23): Length and width (idiosoma) 298 x 210. Length and width of 4 paratypes: 308 x 230; 300 x 220; 292 x 208; 285 x 205. All our specimens contain and ovoid opaque body (? excretory materiel). *Dorsum*: Anterior plate roughly hexagonal, 75 long in midline and 76 wide (maximun). It bears a transverse median and rounded crest in its anterior part, which is followed by two very small setae. In front of this crest the plate is mamillate. Its posterior half bears a network of lines. There is a pair of pores laterally along the anterior margin of the plate. Posterior plate ellipsoidal, 190 long and 120 wide in its median part, it bears a network of lines. Ocular plates subcircular, 42 long and 45 wide, without a distinct pattern and devoid of ocular pigment; laterally it bears a lyrifissure. Postocular plates triangular, 30 long, bearing a network of lines and a pair of anterolateral pores. Lateral plates with a poorly developed pattern of lines. *Venter*: Anterior half covered by a large punctate plate bearing 3 pairs of long setae (45 to 65 long) and a pair of lyrifissures. Posterior plate roughly trapezoidal, the posterior margin widely incised, it bears 7 pairs of suckers. This plate is 90 long in midline, 93 wide along anterior margin and 127 wide in its posterior quart. The two genital plates bear each 2 setae. Excretory orifice terminal, surrounded by a plate bearing a pair of very small setae. The lateral plates bear a pair of very thin and long (80) setae. *Gnathosoma*: Total length 100, rostrum alone 38, its base bearing ventrally a network of lines and anteriorly 2 pairs of setae. Chelicerae 105 long. *Palps*: Trochanter 6 long and 21 wide (in lateral view), genu-femur much longer (45) and wider (30 in lateral view); tibia 17 long, 18 wide; tarsus 11 long, ending in a large apical spine 26 long. The genu-femur bears 2 dorsal setae, a long and thin subapical (30) and a very short basal. The tibia bears a strong ventro-apical spine and very short dorsal solenidion. The tarsus bears, in addition to the apical spine, 2 thin and long ventral setae (18-20 long), one thin dorsal seta (20 long) and 2 longer dorso-apical solenidions. *Legs*: All the legs are inserted laterally, however the legs I and II are slightly ventral whilst the legs III and IV are distinctly dorsal. Coxae very short partly fused with the body. The females and the nymphs II have the femora divided in a short basi-femur and a longer telo-femur. In the nymph I the basi and telofemur IV are fused. Chaetotaxy of legs I to IV: Trochanters 1-1-1-1, Basifemora 4-3-2-1, Telofemora 4-4-3-3, Genua 6-6-4-3, Tibiae 6(or 7)-6-7-6, tarsi 7-6-6-5. The tibiae I and II bear a subapical bipectinate spine, tibiae III with 2 bipectinate spines, one subapical, the other in the basal third. Tibia IV with a subapical thick, rather long and barbed seta. Claw I with an apical

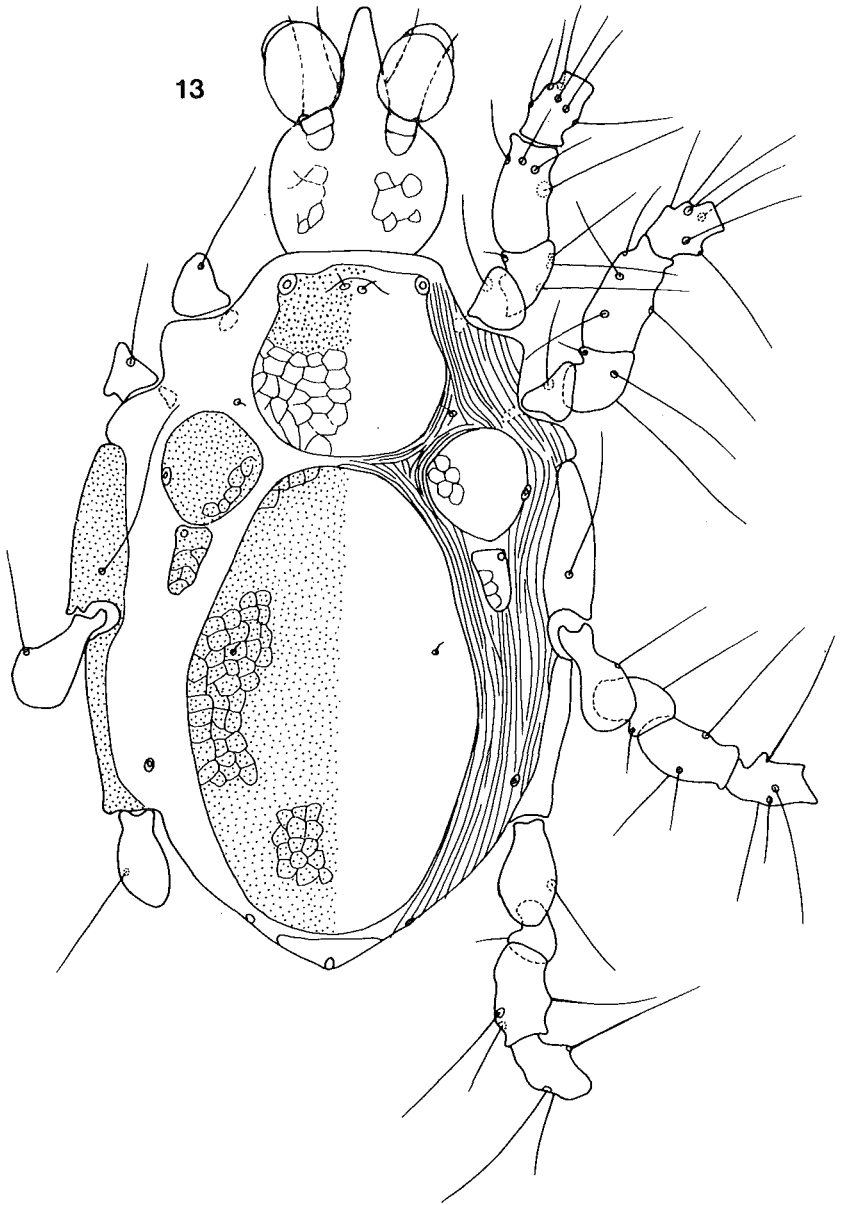
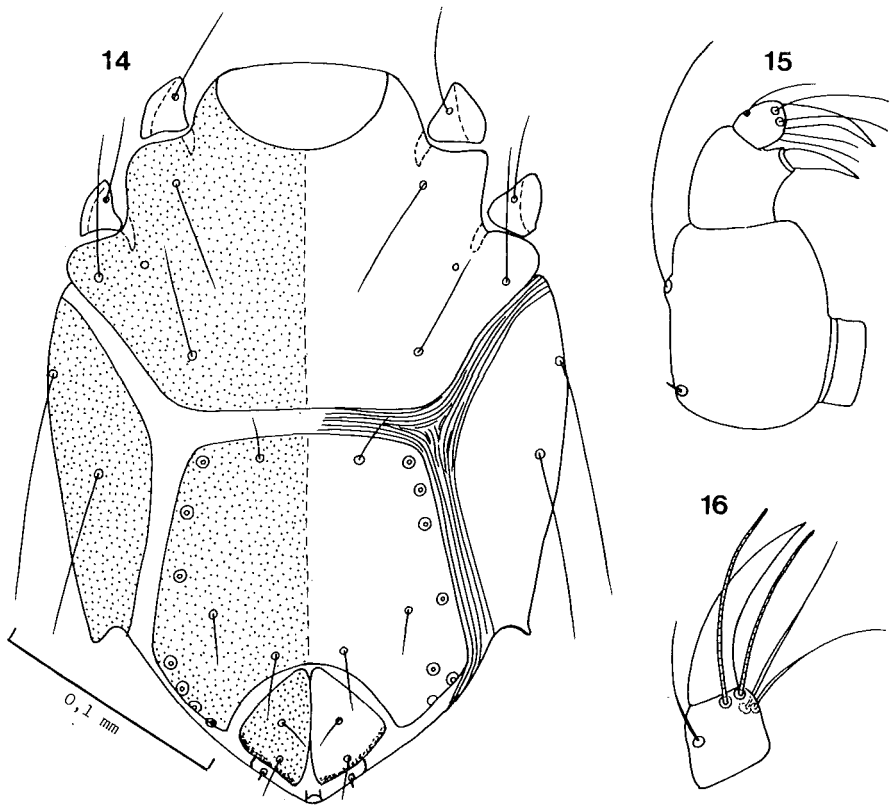


Fig. 13. *Limnohalacarus* (*Amlimnohalacarus*) *inopinatus* sp. n. Holotype female in dorsal view.

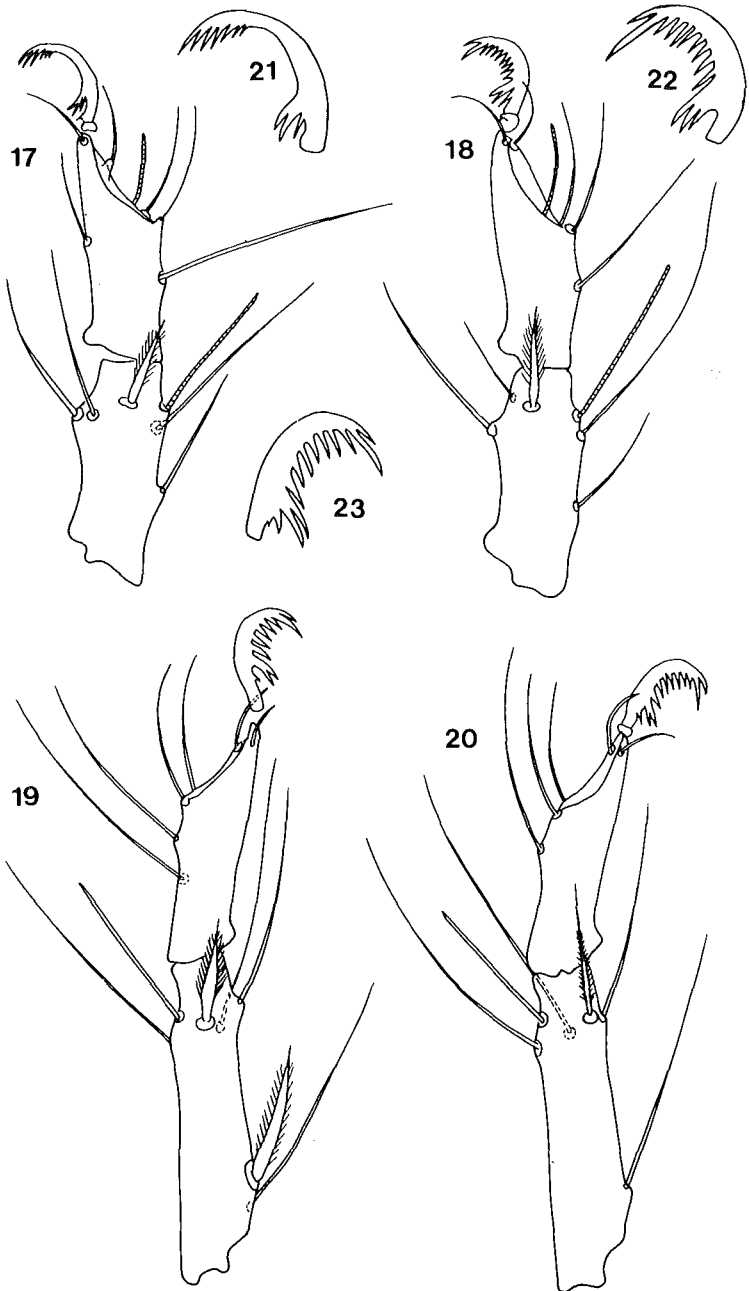
comb of 4 to 5 very short spines and near the base one larger toothed process. Claws II to IV with a bifid apex and a complete comb formed of narrow spines and a basal toothed process. Length of leg segments: Trochanters 24-24-42-39, Basifemora 30-30-26-26; Telofemora 45-45-40-40; Genua 30-30-34-36; Tibiae 48-48-69-72; Tarsi 48-48-60-57.

Nymph II: Length of idiosoma in 2 paratype 260 and 230. Dorsal surface as in the female. Venter as in the female but the posterior plate bears 7 to 8 pairs of suckers and the posterior margin of this plate is distinctly incised. Genital plates absent. Excretory orifice and plate as in female. Legs as in the female.

Nymph I: Length 200. Same aspect as the nymph II but the postero-ventral plate bears 3 or 4 pairs of suckers, this plate is also incised posteriorly as in nymph II. Legs as in nymph II except that the femur IV is not divided. Chaetotaxy of legs: Trochanters and genua as in nymph II. Basifemora I to III 3-3-2; Telofemora 3-3-2; Femora IV with 2 setae; Tibiae 6-6-7-5; Tarsi 7-6-6-5.



Figs 14-16. *Limnohalacarus* (*Amlimnohalacarus*) *inopinatus* sp. n. Female in ventral view (14); palp in lateral view (15); palp-tarsus (16).



Figs 17-20. *Limnohalacarus (Amlimnohalacarus) inopinatus* sp. n. Female; lateral view of tarsi and tibiae of leg I (17), II (18), III (19) and IV (20). Claws of legs I (21), II (22) and IV (23).

Male and larva unknown.

Habitat:

Holotype and 10 paratypes females, 8 nymphs II and 2 nymphs I, from the same aquariums as for *Trimalaconothrus maniculatus*. Antwerp, January and February 1986. Holotype and paratypes as for *T. maniculatus*.

Remarks:

This species is close to *L. cultellatus*. It differs from it by the following characters:

1. Predorsal plate more hexagonal with a very distinct curved crest in its anterior part.
2. Postdorsal plate relatively wider, the ratio length: width is 1,58 (for 1,87 in *L. cultellatus*); its posterior extremity more broadly rounded.
3. Postventral shield (pregenital) more widened in its posterior part and distinctly trapezoidal.
4. Róstrum shorter and thicker.
5. Palptarsus with 3 thin setae and 2 solenidions (only 3 setae in *L. cultellatus*) and the basal seta of genu-femur is a microseta.
6. Certain segments of legs with more setae. Tibial barbed spines longer and stronger.
7. In nymphs I and II the posterior margin of posteroventral plate is incised.

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References

- BADER, C., 1967. - *Limnohalacarus portmanni*, eine neue Süßwasserhalacaride aus dem Tanganika-See. Rev. Zool. Bot. afr. 75: 275-281.
- BADER, C., 1968. - Wassermilben aus Zentralafrika. Ann. Mus. r. Afr. Centr. Tervuren. Sér. in-8°. Sci. Zool. n° 163: 1-9.
- FAIN, A. & BELPAIRE, C., 1985.- A new mite (Acari, Anoetidae) parasiting the gills of young eels *Anguilla anguilla* (L.). Bull. Anns Soc. r. belge nt. 121: 285-292.
- FAIN, A. & LAMBRECHTS, L., 1985. - A new anoetid mite parasitic in the swimbladder of the aquarium fish *Pangasius sutchi*. Bull. Anns Soc. r. belge Ent. 121: 119-126.
- FAIN, A. & LAMBRECHTS, L., 1986. - Observations on the acarofauna of fish aquariums. I. Mites found in association with Discus fish. Bull. Anns Soc. r. belge Ent. (in press).
- GESCH, W., 1982. - Gliederfüßser als Fischparasiten. Das Aquarium n° 153: 133-136.
- GREEN, J., 1976. - A new species of *Limnohalacarus* (Acari: Halacaridae) from a crater lake in Java. J. Zool. London, 178: 279-283.
- HUGHES, R.D. & JACKSON, C.G., 1958. - A review of the Family Anoetidae (Acari). The Virginia Journ. Sci. 9: 1-198.
- KNÜLLE, W., 1957. - Morphologische und Entwicklungsgeschichtliche Unterzuchungen

- zum Phylogenetischen System der Acari, Acariformes Zachv. I. Oribatei: Malaconothridae. Mitteil. Zool. Mus. Berlin, 33, 97-213.
- ROMIJN, G. & VIETS, K., 1924. - Neue Milben. Arch. f. Naturgesch.: 215-225.
- PETROVA, A., 1967. - Deux nouveaux Halacariens d'Israël - *Limnohalacarus capernaumi* n. sp. et *Lohmannella heptapegoni* n. sp. Int. J. Speleol. 2: 355-362.
- UNTERGASSER, D., 1984. - Milben im Aquarium. Das Aquarium, n°193: 354-359.
- VIETS, K., 1934a. - Fünfte Mitteilung über Wassermilben aus unterirdischen Gewässern (Hydrachnellae und Halacaridae) Zool. Anz., 105: 133-141.
- VIETS, K., 1934b. - Siebente Mitteilung über Wassermilben aus unterirdischen Gewässern (Hydrachnellae und Halacaridae). Zool. Anz. 106: 118-124.
- VIETS, K., 1940. - Zwei neue Porohalacaridae (Acari) aus Südamerika. Zool. Anz. 130: 191-201.
- WALTER, C., 1914. - Notizen über die Süßwasserformen der Halacariden nebst Beschreibung einer neuen Art. Arch. f. Hydrobiol. u. Plankt. 9: 277-285.
- WALTER, C., 1917. - Schweizerische Süßwasserformen der Halacariden. Rev. Suisse Zool. 25: 441-423.
- WALTER, C., 1935. - Voyage de Ch. ALLUAUD et P.A. CHAPPUIS en Afrique Occidentale française IX. Hydracarina. Arch. f. Hydrobiol. 28: 69-136.
- WALTER, C. & BADER, C., 1952. - Mission Scientifique de l'OMO. Tome VII (62): Hydracarina. Mém. Mus. nat. Hist. nat. Sér. A. Zool. IV.: 87-236.

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