Systematic status of *Hydrozetes octosetosus* Willmann, 1932 (Acari: Oribatida: Hydrozetidae) in the light of ontogenetic and ecological studies

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Abstract

The systematic status of *Hydrozetes octosetosus* was investigated by comparing this species to *H. lacustris*, which is the type species for the genus *Hydrozetes* Berlese, 1902. These species are similar, but probably not synonyms as recently proposed. They differ mainly by the position of notogastral seta *lm* in the adult and position and length of this seta and total number of long setae in the posterior part of nymphs. In the adult of *H. octosetosus*, this seta inserts behind the opisthosomal gland opening (*gla*), but in front of it in *H. lacustris*. In the nymphs of *H. octosetosus* seta *lm* inserts behind *gla* opening, but medially to it in *H. lacustris*. In *H. octosetosus* this seta is very long and the total number of long setae in nymphs is four pairs, while in *H. lacustris* seta *lm* is short and the total number of long setae in nymphs is three pairs.

Keywords: Acari, aquatic mites, *Hydrozetes octosetosus*, juvenile stages, ontogeny, oribatid mites, setation

Introduction

Most oribatid mites live in terrestrial ecosystems, where they transform organic matter and release mineral elements for plant growth. But overall, this group of mites inhabits various ecosystems, from extremely dry to wet and flooded. Some species, like those of the genus *Hydrozetes*, live in freshwater habitats, such as lakes, ponds, and rivers (Krantz and Baker 1982). They occur mainly on plants, but also burrow inside stalks and in damaged and decaying leaves (Kranz 1978; Norton 1994).

Species of *Hydrozetes* are well adapted to fresh water, both by their physiology and morphology, and can live submersed in water indefinitely. The adults have microtubercles near the respiratory stigmata, which hold a thin layer of air (Krantz and Baker 1982); this plastron allows the mites to exchange respiratory gases with water. Some morphological adaptations, such as the boat shape of nymphs, long setae on the posterior part of the body, and thick and stiff setae on distal parts of the legs also seem important.
Adults of *Hydrozetes* can disperse through water in a special way. They form a gas bubble in the midgut, which decreases the density of their body and allows them to rise in the water rather quickly. This phenomenon, named levitation, was investigated in detail by Newell (1945). He found that the gas bubble is formed from smaller bubbles, which are pumped successively to the midgut by the pharynx. The mites can resorb the gas bubble to sink in the water column.

The genus *Hydrozetes* is common in lakes and rivers, but is not rich in species. Subias (2004) listed 25 species, of which six occur in Europe: *H. confervae* (Schrank, 1781), *H. lacustris* (Michael, 1882), *H. lemmæ* (Coggi, 1897), *H. octosetosus* Willmann, 1932, *H. parisiensis* Grandjean, 1948, and *H. thienemanni* Strenzke, 1943. They have been described and illustrated as adults, and in some species the nymphs have also been illustrated and partly described. *Hydrozetes confervae* and *H. thienemanni* are dioecious, while the other species are parthenogenetic and reproduce by thelytoky (Grandjean 1948), including *H. octosetosus*.

The adults of European species of *Hydrozetes* are about 500 μm long, oval in shape, with rather long legs and a well-sclerotized cuticle of brown coloration. At first glance these species look similar to each other and this creates problems with their determination, especially for species such *H. confervae*, *H. lacustris*, and *H. lemmæ*, which were described in the 18th and 19th centuries. The original descriptions are short and drawings are generalized, which makes the determination of species very confusing. This problem was well summarized by Newell (1945), who prepared a more detailed description of the genus *Hydrozetes* and a key to five taxa, including *H. confervae*, *H. lacustris*, and *H. lacustris octosetosus*.

According to descriptions and keys (Coggi 1897; Michael 1898; Willmann 1931, 1932; Strenzke 1943; Newell 1945; Grandjean 1948; Ghilarov and Krivulovčij 1975; Weigmann 2006), the adults of European species of *Hydrozetes* differ in the shape of the bothridium, the presence and shape of the sensillus, the number and shape of some notogastral setae, the shape of tectopedia I, the shape of some setae on tarsus I, the number of setae on femur IV, the number of claws on leg IV, and the dimension of the body. Because of the brown coloration, the adults need clearing at least in lactic acid, which makes ecological investigations very time consuming. In contrast, the juvenile stages of these species have a weakly sclerotized cuticle and flesh-coloration, and therefore their morphological characters are well visible without clearing. The most important morphological character of nymphs is the number of long setae in the posterior part of the body. For example, *H. octosetosus* has four pairs of long setae, while *H. lacustris* has three pairs. Deichsel (2004) recently studied the variation in number of these setae in *H. lacustris*, and considered *H. octosetosus* Willmann, 1932 and *H. parisiensis* Grandjean, 1948 as junior synonyms of *H. lacustris* (Michael, 1882).

*Hydrozetes octosetosus* was described by Willmann (1932) as a subspecies of *H. lacustris*. The description of the adult was rather short and generalized, and concerned mainly the anterior part of the body, which was also illustrated. The author did not investigate the pattern of notogastral setae in detail, so the description was, at several points, convergent with the diagnosis of *H. lacustris*. Fortunately, he also gave a short description and drawing of a nymph with four pairs of long setae in the posterior part of the body, which distinctly separated this taxon from *H. lacustris*. Nevertheless, many authors overlooked *H. octosetosus* in ecological investigations, and since Willmann (1932) no other author has recorded it in Europe. It was mentioned as a separate taxon by Newell (1945), Grandjean (1948), Fernández and Travè (1984), and Subias (2004), but only in the latter two papers was it
considered as a separate species. According to Subias (2004) *H. octosetosus* is recorded in central Europe, while *H. lacustris* is a boreal species.

The aim of this paper is to revise the systematic status of *H. octosetosus* Willmann, 1932, which, contrary to Deichsel (2004), we consider to be a separate species. We compare the morphological characters of juvenile and adult stages of *H. octosetosus* with those of *H. lacustris* (Michael, 1882), which is the type species for the genus *Hydrozetes* Berlese, 1902, and also the distribution of both species.

**Material and techniques**

For the morphological study on the ontogeny of *H. lacustris* and *H. octosetosus* we chose lakes where these species did not occur together. *Hydrozetes lacustris* was collected in lake U1 (Ulriken, Bergen, Norway), where it occurred alone and in high density (Table I). *Hydrozetes octosetosus* was collected in lake Martwe (Tuchola Forest, Poland), where it was distinctly more abundant than the co-occurring *Hydrozetes* sp. 1 and *H. lemnae*. The morphological description and illustrations of *H. lacustris* include the dorsal aspect of larva and tritonymph, anal region of larva and anogenital region of all nymphal stages, where new segments and setae appear during ontogeny. As the ontogeny of both species is similar, the drawings of *H. octosetosus* are limited to the dorsal aspect of larva and tritonymph, and the anal region of the larva and the anogenital region of the tritonymph. The adults of investigated species are also considered, to document the full development of setation during ontogeny. Terminology used follows that of Grandjean (see Travè and Vachon 1975 for many references).

The density of *H. octosetosus* and *H. lacustris* was investigated in *Sphagnum* mosses on the edges of some lakes in Bergen, Norway (lakes U1 and U2, Ulriken; lake Blåmansvannet and lakes F1 and F2, Fløyen; in each lake one sample of 20 cm × 20 cm × 5 cm was taken in June 2005) and in the Tuchola Forest, Poland (lakes Martwe and Wielkie Gacno; in each lake 10 samples of 10 cm × 10 cm × 5 cm were taken in September 2005).

| Morphological characters | *H. lacustris* | *H. octosetosus* |
|--------------------------|---------------|-----------------|
|                          | L  | PN | DN | TN  | L  | PN | DN | TN  |
| Body length              | 231| 303| 378| 498 | 242| 314| 375| 480 |
| Body width               | 141| 171| 235| 290 | 143| 178| 231| 280 |
| Length of                |    |    |    |     |    |    |    |     |
| Seta le                  | 25 | 16 | 16 | 16  | 30 | 30 | 31 | 33  |
| Seta in                  | 17 | 12 | 15 | 16  | 32 | 15 | 16 | 16  |
| Seta c₃                  | 16 | 12 | 15 | 17  | 14 | 12 | 12 | 12  |
| Seta la                  | 14 | 13 | 15 | 17  | 14 | 14 | 16 | 17  |
| Seta lm                  | 19 | 13 | 15 | 17  | 42 |     |     |     |
| Seta h₁                  | 21 | 23 | 33 | 42  | 22 | 24 | 33 | 42  |
| Genital opening          | nd | 28 | 37 | 53  | nd | 26 | 36 | 51  |
| Anal opening             | 55 | 72 | 98 | 130 | 58 | 74 | 96 | 124 |

L, larva; PN, protonymph; DN, deutonymph; TN, tritonymph; nd, not developed.
Results

*Morphology of juvenile stages of* Hydrozetes lacustris (*Michael, 1882*)

**Larva.** Larva with three pairs of legs, shape oval, body flesh-coloured (Figure 1). Prodorsum triangular, porose, lateral part slightly wrinkled. Setae ro, in, and ex smooth, seta le barbed; seta le longest, seta ex shortest. Bothridium (bo) weakly developed, sensillus (ss) long, setiform.

Gastronotal region with 12 pairs of setae, including seta h₃ positioned near anal opening (Figure 2A). Setae of c-series, da, dm, and la shorter than other setae and smooth. Seta lm

![Figure 1. Hydrozetes lacustris, larva, dorsal aspect.](image)
also smooth and situated medially to opisthosomal gland opening (gla), setae dp, lp, h₁, and h₂ on small apophyses and barbed; seta h₁ thicker and shorter than h₂, stiff and pointed. Length of setae of d- and l-series increases from anterior to posterior part of gastronotal region. Seta h₂ longest, seta h₃ shortest. Cupule pair ih positioned lateral to anterior part of anal valves. Cuticle with small pits.

**Nymphal stages.** All nymphs with four pairs of legs, slimmer than larva, boat-shaped and flesh-coloured. Number and shape of setae on the prodorsum as in larva, but more setae (15 pairs) present in the gastronotal region.

The successive juvenile stages differ distinctly in the body size (Table I) and the number of setae in the anogenital region. Genital valves of protonymph with two pairs of setae
(Figure 2B); three pairs of pseudanal setae ($p_1 - p_3$) on paraproct valves; setae $p_2$ and $p_3$ thin, seta $p_1$ thick and stiff; all setae smooth. Pairs of cupules $ips$ positioned lateral to anterior part of anal valves. Genital valves of deutonymph with four pairs of setae (Figure 3A). A pair of aggenital setae ($ag$) between genital and anal valves; three pairs of pseudanal setae present; three pairs of adanal setae ($ad_1 - ad_3$) on paraproctal valves; all setae short, thin, and smooth. Anogenital region rarely with pits. Genital valves of tritonymph usually with six pairs of setae (Figure 3B), seta $ag$ present. Setae $p_2$ and $p_3$ and

Figure 3. *Hydrozetes lacustris*, anogenital region of: (A) deutonymph; (B) tritonymph.
three pairs of adanal setae small. Anal valves with two pairs of small setae. Pairs of cupules iad positioned lateral to anterior part of anal valves of deuto- and tritonymph. Anogenital region of nymphs rarely with pits.

The shape of setae on dorsal and lateral part of gastronotal region is similar to those in the tritonymph (Figure 4). Setae of c-series, d-series, la, and lm short and smooth, seta lm

Figure 4. *Hydrozetes lacustris*, tritonymph, dorsal aspect.
situated medially to gla. Other setae longer and thicker and positioned on small apophyses in posterior part of body. Setae lp, h2, and h1 as long as body, thick at basal part, pointed and smooth; setae h3 and p1 distinctly shorter, but thicker, stiff, pointed, and smooth. Central part of gastronotal region with small pits, frontal and lateral parts slightly wrinkled.

*Morphology of juvenile stages of Hydrozetes octosetosus Willmann, 1932*

The juvenile stages of *H. octosetosus* are similar to those of *H. lacustris* in the body shape and the number of setae (Figures 5–7), but differ from them in several important morphological characters, as follows:

1. The position of seta lm in relation to opening gla: in *H. octosetosus* this seta inserts posteriorly to gla, but medially to it in *H. lacustris*; consequently in the former species the distance between seta lm and lp is distinctly shorter than between seta lm and la, while in the latter species the distance between setae of l-series is similar.
2. The length of seta lm: in *H. octosetosus* this seta is rather long in the larva and very long in the nymphal stages, while in *H. lacustris* it is short.

Figure 5. *Hydrozetes octosetosus*, larva, dorsal aspect.
Figure 6. *Hydrozetes octosetosus*. (A) Anal region of larva; (B) anogenital region of tritonymph.
3. The length of setae *le* and *ex* in all juvenile stages: in *H. octosetosus* seta *le* is longer but seta *ex* is shorter than in *H. lacustris*.
4. The length of seta *in* in the larva: in *H. octosetosus* this seta is longer than in *H. lacustris*.
5. The number of genital setae: the nymphs of *H. octosetosus* usually have more of these setae than those of *H. lacustris*.

Figure 7. *Hydrozetes octosetosus*, tritonymph, dorsal aspect.
6. The shape of some setae on tarsus I, which is considered an important morphological character of the genus *Hydrozetes* (Willmann 1931; Grandjean 1948; Ghilarov and Krivoluckij 1975; Weigmann 2006): in the tritonymph of *H. octosetosus* seta $pv''$ is thinner, while seta $s$ is thicker than in *H. lacustris* (Figure 8); *H. octosetosus* has also thinner seta $pv''$ on tarsus II than *H. lacustris*.

**Development and variability of setation**

The number of setae on the prodorsum remains similar during the ontogeny of *H. lacustris* and *H. octosetosus*, but these species differ in the length of some setae (Table I). Compared to those of *H. lacustris*, all juvenile stages of *H. octosetosus* have seta $le$ nearly twice as long and seta $ex$ distinctly shorter, while seta $in$ is longer only in the larva. The bothridium is

![Figure 8. Tritonymph, paraxial aspect of: (A) tarsus I of *Hydrozetes lacustris*; (B) tarsus I of *H. octosetosus*; (C) tarsus II of *H. lacustris*; (D) tarsus II of *H. octosetosus*.](image-url)
weakly developed in all juvenile stages, with long, setiform sensillus. In the adults of these species the sensillus is short, setiform or absent, rarely clavate. From among 535 adults of *H. lacustris* from lake U1 (Ulriken, Norway) only seven specimens had a clavate sensillus on one or both sides.

The number of gastronotal setae changes similarly during the ontogeny of these species, because new segments and setae appear in the anal region. There are 12 pairs of gastronotal setae in the larva, while in the protonymph three pairs of pseudanal setae (*p*₁⁻*p*₃) first appear on segment PS, and the number of gastronotal setae is 15 pairs; *p*-series setae are present in the deutonymph, tritonymph, and adults (Figures 9, 10). In the protonymph some setae (*lp*, *h*₁, and *h*₂ in *H. lacustris* and *lm*, *lp*, *h*₁, and *h*₂ in *H. octosetosus*) grow very long in the posterior part of the body, and remain similar in the deutonymph and

Figure 9. *Hydrozetes lacustris*, adult, dorsal aspect. (A) Region of bothridium.
tritonymph. In the deutonymph three pairs of adanal setae \((ad_1 - ad_3)\) first appear on segment AD, and are present in the tritonymph and adult. In the tritonymph two pairs of setae appear on the anal valves and are present in the adult. In both species the coxisternal setal formula is \(3 - 1 - 2\) (larva), \(3 - 1 - 2 - 1\) (protonymph), \(3 - 1 - 2 - 2\) (deutonymph), and \(3 - 1 - 2 - 3\) (tritonymph and adult). In the larva seta \(1c\) is difficult to observe, because it is scaliform and covers Claparède’s organ, which is well presented by Grandjean (1963). In the investigated populations the formula of the genital setae was \(2 - 4 - (6 - 7) - (6 - 7)\) (protonymph to adult) in \(H. lacustris\) and \((2 - 3) - (5 - 6) - (7 - 8) - (7 - 8)\) in \(H. octosetosus\). Some nymphs and adults have one genital seta more on one side than on the other.

In the juvenile stages of \(H. octosetosus\) the migration of seta \(lm\) is observed from medial to posterior position in relation to opening \(gla\), compared to \(H. lacustris\). In all juvenile stages of \(H. lacustris\) this seta is small, thin, and smooth and placed medially to \(gla\), rarely behind it, while in the adult it is usually in front of \(gla\). In \(H. octosetosus\) this seta is rather long and barbed in the larva, and is placed slightly behind \(gla\) opening, while in the protonymph,
deutonymph, and tritonymph it is placed behind gla and is very long. In the adult seta lm is similar in shape to the other notogastral setae, and is positioned behind gla, near seta lp.

In the juvenile stages of both species some variability in the gastronotal setae also occurred. In H. octosetosus one seta lm was sometimes thin and, when it was broken near the basal part, it looked like a short seta. In some individuals one seta lm grew closer to gla than the other, and some other gastronotal setae were positioned at different distances from the anterior border.

In the adults of H. octosetosus and H. lacustris the loss of some setae of the c-series was observed, compared to the tritonymph. Based on the position of these setae in the tritonymph, the first seta or pair of setae c1 was lost, and also the next seta or pair of setae c3, and only setae c2 remained. Among 165 adults of H. octosetosus from lake Martwe (Tuchola Forest, Poland) one had all setae of the c-series, five adults had five setae, 61 adults had four setae, 35 adults had three setae and 63 adults had a pair of setae c2. Among 57 adults of H. lacustris from this lake eight had five setae, 33 adults had four setae, three adults had three setae, and 13 adults had a pair of setae c2. Interestingly, the Norwegian adults of H. lacustris had more c-series setae than the Polish adults. Among 535 adults of this species from lake U1 (Ulriken) nine had all setae of the c-series, 11 adults had five setae, and the others had four setae (pairs c2 and c1).

The adult of H. octosetosus differs from that of H. lacustris in several important morphological characters, as follows:

1. The position of seta lm relative to opening gla: in H. octosetosus this seta inserts behind this opening, while in H. lacustris it is in front of it; consequently in the former species seta lm inserts far from seta la and near seta lp, while in the latter species the distance between setae of l-series is similar.
2. The length of dorsal setae, mainly the d-series: in H. octosetosus these setae are longer than in H. lacustris.
3. The length of prodorsal setae le and in: in H. octosetosus these setae are longer than in H. lacustris.
4. The number of genital setae: H. octosetosus usually has more of these setae than H. lacustris.
5. The length of seta ft and shape of seta s on tarsus I: in H. octosetosus seta ft is shorter than in H. lacustris and seta s is barbed, while in the latter species is smooth (Figure 11).

Occurrence of investigated species in lakes

In Norwegian lakes H. lacustris and H. octosetosus occurred together, but in different proportions (Table II). The exception was lake U1, where H. lacustris lived alone and in high density. In Polish lake Martwe in the Tuchola Forest H. octosetosus occurred together with Hydrozetes sp. 1 and H. lemnae, while in lake Male Gacno it occurred together with H. lacustris and Hydrozetes sp. 1.

Discussion and remarks

Juvenile stages of oribatid mites are generally poorly known, and keys to species concern mainly the adults. In the higher Oribatida (Brachypylina or Circumdehiscentiae), to which the genus Hydrozetes belongs, the juvenile stages differ distinctly from the adults, mainly in
the body shape, cuticular sclerotization, and the shape and numbers of setae on the dorsal part of the hysterosoma. In the case of *H. lacustris* and *H. octosetosus*, the nymphs have some long setae on the posterior part of the body and their determination seems to be easier than for the adults. Besides, the morphological characters of juveniles are very helpful in a more precise determination of species.

Our conclusions regarding *H. octosetosus* and *H. lacustris* are inconsistent with the results of Deichsel (2004), who considered *H. octosetosus* a junior synonym of *H. lacustris*, with a position intermediate between the latter and mites that would usually be identified as *H.

Table II. Density (individuals per dm$^3$) of *Hydrozetes lacustris*, *H. octosetosus*, and *Hydrozetes* sp. 1 in some lakes in Norway and Poland.

| Lake and locality                      | Species       | No. of adults | No. of nymphs | Total | Density (ind. dm$^{-3}$) |
|----------------------------------------|---------------|---------------|---------------|-------|-------------------------|
| Lake U1, Ulriken, Norway, 611 m a.s.l. | *H. lacustris*| 535           | 67            | 602   | 301                     |
| Lake U2, Ulriken, Norway, 584 m a.s.l. | *H. octosetosus* | 118          | 6             | 124   | 62                      |
| Lake Blåmansvannet, Floyen, Norway, 402 m a.s.l. | *H. lacustris* | 64           | 5             | 69    | 35                      |
| Lake F1, Floyen, Norway, 551 m a.s.l. | *H. octosetosus* | 225          | 198           | 423   | 212                     |
| Lake F2, Floyen, Norway, 560 m a.s.l. | *H. lacustris* | 26           | 17            | 43    | 22                      |
| Lake Martwe, Tuchola Forest, Poland, 112 m a.s.l. | *H. octosetosus* | 6        | 4             | 10    | 5                       |
| Lake Male Gacno, Tuchola Forest, Poland, 125 m a.s.l. | *Hydrozetes* sp. 1 | 226 | 45           | 271   | 136                     |
|                                        | *H. octosetosus* | 45           | 31            | 76    | 38                      |
|                                        | *H. octosetosus* | 185          | 92            | 277   | 55                      |
|                                        | *Hydrozetes* sp. 1 | 26 | 5             | 31    | 5                       |
|                                        | *H. lemmæ*     | 1           | 1             | 1     | <1                      |
|                                        | *H. octosetosus* | 62           | 9             | 71    | 14                      |
|                                        | *H. lacustris*  | 57           | 1             | 58    | 12                      |
|                                        | *Hydrozetes* sp. 1 | 2  | –             | 2     | <1                      |
parisiensis. In the adults he considered such morphological characters as the body length, distance between insertions of setal pairs \( la, da \), and bothridia, and the number of notogastral setae in \( l \)- and \( h \)-series. In the juvenile stages he observed no morphological differences except the number of long setae on the posterior part of nymphs. Among 186 studied adults from six sites, Deichsel (2004) observed a gradual transition of the total number of \( l \)- and \( h \)-series setae between five and ten pairs. Similarly, among 56 studied nymphs the number of long setae varied between two and eight pairs. The author quantified the systematic value of these characters, using the Wards method with Euclidean distances in Statistica 6.0 (StatSoft, Tulsa, OK, USA).

Cluster analysis did not confirm the diagnostic value of the total number of \( l \)- and \( h \)-series setae in the adult. Consequently, Deichsel (2004) assumed that the morphological variability he observed was intraspecific, and considered \( H. \ parisiensis \) Grandjean, 1948 and \( H. \ octosetosus \) Willmann, 1932 to be junior synonyms of \( H. \ lacustris \) (Michael, 1882). He also proposed two morphotypes of \( H. \ lacustris \): \( H. \ lacustris \ lacustris \) (forma typica), with a total number of 13 pairs of notogastral setae in the adult, and at most four pairs of long setae in the posterior part of nymphs, and \( H. \ lacustris \ parisiensis \), with more than 13 pairs of notogastral setae in the adult and more than four pairs of long setae in the nymphs. These morphotypes are also considered in Weigmann’s (2006) key to the adults of German species of \( H ydrozetes \). In Weigmann and Deichsel (2006), the description of \( H. \ lacustris \) included an illustration of \( H. \ lacustris \ f. \ parisiensis \), but in the key to the nymphs only four species are included: \( H. \ confervae \), \( H. \ lacustris \), \( H. \ lemmnae \), and \( H. \ thienemanni \).

In the light of our results Deichsel’s (2004) synonymies can be questioned. \( H ydrozetes \ octosetosus \) differs from \( H. \ lacustris \) in several morphological characters that he did not study: namely the position of seta \( \text{lm} \) relative to the opening \( \text{gla} \); the length of seta \( \text{in} \) in the larva and setae \( \text{le} \) and \( \text{ex} \) in all juvenile stages; the number of genital setae; and the shape of some setae on tarsus I and II. While he counted the total number of setae of \( l \)- and \( h \)-series in the adults, he did not separate the series, which is made necessary by the presence of \( H. \ parisiensis \) in the population. In the latter species, neotrichy occurs in the \( h \)-series (Grandjean 1948), where usually more than three pairs of setae are present. As \( H. \ lacustris \) has only three pairs of \( h \)-series setae and the same number of \( l \)-series setae, which variability did Deichsel (2004) really observe: \( l \)-series, \( h \)-series, or both series? We believe he was observing variability of \( h \)-series setae in \( H. \ parisiensis \). Since he did not take note of the relative positions of seta \( \text{lm} \) to opening \( \text{gla} \), he could not recognize the adults of \( H. \ octosetosus \); if they were present, they were included in \( H. \ lacustris \).

Deichsel (2004) did not name the \( c \) setae in his drawing, so we can only conclude that German populations of \( H. \ lacustris \) had one pair of setae \( c_2 \), if the total number of notogastral setae was 13 pairs. However, adults of \( H. \ lacustris \) from Norway have two to three pairs of setae of \( c \)-series, and those from Poland have one to three pairs, so the total number of notogastral setae is higher than that reported by Deichsel. This problem applies also to adults of \( H. \ octosetosus \) from lake Martwe in the Tuchola Forest, which have one to three pairs of \( c \)-series setae. Taking this into consideration, it is useless to compare total numbers of notogastral setae when adults of \( H. \ lacustris \) or \( H. \ octosetosus \) are mixed with those of \( H. \ parisiensis \), because two series of setae (\( c \)- and \( h \)-series) vary. For example, adults of \( H. \ lacustris \) and \( H. \ octosetosus \) with two pairs in the \( c \)-series have the same total number of notogastral setae as adults of \( H. \ parisiensis \), which have one pair in the \( c \)-series and four pairs in the \( h \)-series.

In the nymphal stages Deichsel (2004) observed the number of long setae to vary between two and eight pairs, but as noted above the reader does not know the source of the
variability: it may be in the \(l\)-series, the \(h\)-series or both series. In the nympha stages this problem is more complicated than in the adults, because in a population of \(H.\) \textit{lacustris} mixed with \(H.\) \textit{parisiensis} the number of long setae varies in both \(l\)-series and \(h\)-series. \(Hydrozetes\) \textit{lacustris} has one long pair in the \(l\)-series \((lp)\), while \(H.\) \textit{parisiensis} (after Grandjean 1948) has two pairs \((lm\) and \(lp)\), just as in \(H.\) \textit{octosetosus}. Additionally, the number of long \(h\)-series setae varies in \(H.\) \textit{parisiensis} because of neotrichy, so the total number of long setae has no systematic value. If nympha of \(H.\) \textit{octosetosus} were present in Deichsel’s (2004) study, they would have been included in \(H.\) \textit{parisiensis}. It would be atypical of adults of \(H.\) \textit{lacustris} to have a total of five pairs of setae in the \(l\)- and \(h\)-series, and nympha with a total of two pairs of long setae in the posterior part of body, which Deichsel observed. The adults of both \(H.\) \textit{lacustris} and \(H.\) \textit{octosetosus} have six pairs of setae in the combined \(l\)- and \(h\)-series, while \(H.\) \textit{parisiensis} has more setae because of neotrichy. In the nympha of \(H.\) \textit{lacustris} three pairs of long setae \((lp, h_1, h_2)\) are present, while in \(H.\) \textit{octosetosus} there are four pairs \((lm, lp, h_1, h_2)\) and in \(H.\) \textit{parisiensis} more than four pairs because of neotrichy \((lm, lp, and all long setae of the \(h\)-series).

\textit{Hydrozetes\) \textit{lacustris} and \(H.\) \textit{octosetosus} are interesting in that some setae of the \(c\)-series have been lost, relative to the tritonymph, and such patterns are thought to reflect phylogeny. During this phylogeny two pairs of setae \((c_1, c_3)\) are subject to loss, after which only setae \(c_2\) remained. However, it is still not clear which pair is lost first, \(c_3\) or \(c_1\); Grandjean (1951, 1968) believed it was pair \(c_3\), while Shaldybina (1972) thought it was pair \(c_1\). The order of loss of setae of the \(c\)-series in this study is \(c_1\) then \(c_3\), consistent with Shaldybina (1972). However, Grandjean’s (1951, 1968) pattern of loss of setae of this series also appears in the higher oribatid mites, for example, in the family Ceratozetidae, where pair \(c_3\) is lost before pair \(c_1\) (Seniczak et al. 1990).

In studied adults of \(H.\) \textit{octosetosus} and \(H.\) \textit{lacustris} the sensillus was short, setiform, or was absent, rarely clavate. Willmann (1932) observed only a clavate sensillus in \(H.\) \textit{octosetosus}, while Michael (1898) mentioned both forms of sensillus in \(H.\) \textit{lacustris}.

In European species of \textit{Hydrozetes} the shape of some setae on tarsus I of adults may have a diagnostic value (Grandjean 1948), but is probably relevant to the juvenile stages too and varies geographically. For example, in the Norwegian adults of \(H.\) \textit{lacustris} seta \(s\) was smooth, while in those studied by Willmann (1931) it was barbed; the Norwegian adults also had thinner seta \(pv''\) and thicker seta \(u\) compared to those studied by Grandjean (1948). Therefore the leg setation of \textit{Hydrozetes} should be investigated on wider geographical material.

The distribution of \(H.\) \textit{octosetosus} differs from that of \(H.\) \textit{lacustris}. In some lakes these species occur together, but in different proportions. Moreover, \(H.\) \textit{lacustris} occurred alone in lake U1 (Ulriken, Norway), while \(H.\) \textit{octosetosus} occurred in lake Martwe (Tuchola Forest, Poland) without \(H.\) \textit{lacustris}. This kind of distribution would not be expected from a single highly variable species of the type proposed by Deichsel (2004). \textit{Hydrozetes octosetosus} is new to the fauna of Poland, based on the list published by Olszanowski et al. (1996), and to the Norwegian fauna (Mehl 1979).

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