

# A revision of enigmatic species within European members of the genus *Arrenurus* Dugès (Acari, Hydrachnellae)

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Keywords : Hydrachnellae, *Arrenurus*, Europe, taxonomic, revision.

A number of European species of the genus *Arrenurus* (Acari, Hydrachnellae) are revised. The following synonyms are established: *A. hofsteni* Walter and *A. sinuator commutatus* Viets as junior synonyms of *A. latus* Barrois & Moniez; *A. ornatulus* Viets of *A. compactus* Piersig; *A. walteri* Koenike of *A. neumani* Piersig; *A. cyanipes* (Lucas) *sensu* Walter and *A. bucharicus* Sokolow of *A. papillator* (Müller); *A. stjoerdalensis naias* Lundblad of *A. coronator* Thor; *A. eugeminus* Piersig and *A. imitator* Koenike of *A. geminus* George; *A. insperatus* George of *A. stjoerdalensis* Thor; *Arrenurus brachyurus* Viets of *A. bifidicodulus* Piersig and *Arrenurus truncatellus georgei* Piersig of *A. truncatellus* (Müller). *A. spatiosus* Viets has been raised to species rank, while *A. papillator bicolor* Viets should stand as a subspecies. *A. distans* Walter, *A. scourfieldi* Soar and *A. tubulator* (Müller) are considered good species. *A. bueranus* Münchberg, *A. curtus* George, *A. incertus* Biesiadka, *A. soari* George and *A. paluster* Thor are considered *species incertae*. A lectotype has been designated for *A. scourfieldi*. Finally, a small number of old identifications have been re-examined.

## Révision des espèces énigmatiques des représentants européens du genre *Arrenurus* Dugès (Acari, Hydrachnellae)

Mots clés : Hydracariens, *Arrenurus*, Europe, révision taxonomique.

Plusieurs espèces européennes du genre *Arrenurus* sont révisées. Les synonymies suivantes ont été établies: *A. hofsteni* Walter et *A. sinuator commutatus* Viets deviennent nouveaux synonymes de *A. latus* Barrois & Moniez; *A. ornatulus* Viets de *A. compactus* Piersig; *A. walteri* Koenike de *A. neumani* Piersig; *A. cyanipes* (Lucas) *sensu* Walter et *A. bucharicus* Sokolow de *A. papillator* (Müller); *A. stjoerdalensis naias* Lundblad de *A. coronator* Thor; *A. eugeminus* Piersig et *A. imitator* Koenike de *A. geminus* George; *A. insperatus* George de *A. stjoerdalensis* Thor; *Arrenurus brachyurus* Viets de *A. bifidicodulus* Piersig et *Arrenurus truncatellus georgei* Piersig de *A. truncatellus* (Müller). *A. spatiosus* Viets a été élevée au rang d'espèces, tandis que *A. papillator bicolor* Viets reste une sous-espèce. *A. distans* Walter, *A. scourfieldi* Soar et *A. tubulator* (Müller) sont considérées comme espèces valides. *A. bueranus* Münchberg, *A. curtus* George, *A. incertus* Biesiadka, *A. soari* George et *A. paluster* Thor sont considérées comme *species incertae*. Un lectotype a été désigné pour *A. scourfieldi*. Enfin, un petit nombre de déterminations anciennes a été réexaminé.

## 1. Introduction

The aim of this study is a revision of problematical European species of the genus *Arrenurus* Dugès. In a few cases species outside this area are included. The locations of some important collections of eastern Eu-

ropean authors are unknown, thus some species described from that area are not included in this study. Additionally, some species have been re-identified.

The genus *Arrenurus* is the most species-rich genus of the water mites. They are heavily sclerotized, with a marked sexual dimorphism. Species of the genus are especially common in lentic waters. The genus is divided in 8 subgenera (Viets 1987). Recently, Cramer & Cook (1992) established a ninth subgenus by reducing *Dadayella*, formerly considered as a distinct genus, to a subgenus of *Arrenurus*. The subgeneric classifica-

1. Emmastraat 43-a, 1814 DM Alkmaar, The Netherlands.

tion, based on characteristics of the males, is somewhat problematic, as the subgenera *Megaluracarus*, *Micruracarus* and *Truncaturus* grade into one another. Females exhibit no subgeneric characters.

The genus has a world wide distribution. Viets (1987) listed in his catalogue more than 760 species (synonyms excluded, but *species incerta* included), and with the number of *Arrenurus*-species described since, the world total comes to nearly 800 species. From Europe, 148 species are known (Viets 1978).

In general, the genus gives no large taxonomic problems. Males, especially of the subgenus *Arrenurus*, are easy to identify. The identification of females is often difficult and enlarged by the considerable variation of important characters shown by some species, like the shape of the genital plates, e.g. in *A. terebratus* Viets (Smit, 1995). Separation of females of a number of species is in some cases impossible, e.g. *A. inexploratus* and *A. pugionifer* (Smit & Van der Hammen 1990). In the past, many descriptions were based on (single) females only, thus it is often difficult to determine whether these are good species, or must be assigned to a known species. It is clear that descriptions based on females only must be ignored. Moreover, mistakes were made by describing males and females of the same species as different species, e.g. *A. medio-rotundatus* Thor ♂ with *A. curvisetus* Viets ♀; *A. knauthi* Koenike ♂ with *A. schreuderi* Besseling ♀ and probably also *A. affinis* Koenike ♂ with *A. compactus* Piersig ♀ (Lundblad, 1962; Smit & Van der Hammen, 1990; Smit & Duursema, 1993). Similarly, males and females were assigned to one species, but actually belong to different species (see Smit & Van der Hammen, 1990). Finally, new species were described in the past which were based on not fully sclerotized males, i.e. immature males. The posterior part of the cauda is the last part to be sclerotized, and in not fully sclerotized males this has a different shape than in fully sclerotized males.

The following abbreviations are used: BMNH - Natural History Museum London, NHMB - Natural History Museum Basel, NMI - National Museum of Ireland, SMF - Forschungsinstitut und Naturmuseum Senckenberg, SMNH - Swedish Museum of Natural History, ZMA - Zoological Museum University of Amsterdam, ZMB - Museum für Naturkunde der Humboldt - Universität zu Berlin, coll. HS - Smit collection, Alkmaar, coll. WABD - collection of Water Authority Board of Drenthe, Assen; PI-PV segments 1-5 of palp. All measurements are in µm.

## 2. Systematic part

### *Arrenurus (Arrenurus) cuspidifer* Piersig, 1896

Material examined - Algeria: Lac Fetzara, 1 ♀, 29.vi.1924, leg. Gauthier (slide XIII /35, NHMB; non *A. affinis*, = *A. cuspidifer*).

Smit & Duursema (1993) showed that Koenike (1887) did not illustrate the correct female of *A. affinis* Koenike. Therefore, many identifications in the literature based on females only must be mistrusted. Walter (1928) reported females of the species from Algeria. He already pointed out that his females were not typical, because the genital plates were short. I examined one of his female specimens, and concluded that his identification is incorrect. The species reported by Walter (1928) as *A. affinis* must be assigned to *A. cuspidifer* Piersig.

### *Arrenurus (Arrenurus) distans* Walter, 1927

Material examined - Algeria: Agoulmine Temjout, 1 ♂, 30.vi.1925, leg. Gauthier (Slide XIV/02, NHMB); Agoulmine Temjout, 1 ♀, 28.vi.1925, leg. Gauthier (slide XII/94, NHMB); The Netherlands: 1 ♂ 2 ♀♀, province of Overijssel, pond Ootmarsum, sample 422, viii.1937 (coll. Besseling, ZMA, non *A. distans* WALTER, = *A. ornatus* George).

Walter originally described the species from southern France (in : Walter & Motas 1927); only the male was known to him. Later, he reported the species from Algeria (Walter 1928), on which occasion he described the female. A distinct feature of the male is the ligulate process, which is rounded with a pointed posterior extension (see fig. 1). Further, the hyaline membrane has a concave posterior margin with acute angled lateral corners. These characters separate the species from the closely related *A. maculator* (Müller). More difficult is the identity of the female. Walter (1928) described the female for the first time. The female he described is close to the female of *A. maculator* or *A. cuspidator* (Müller). The female of *A. distans* is a little larger compared to *A. cuspidator* and *A. maculator*, while posterolateral corners of the body are absent. Later, Viets (1930) also described the female of *A. distans* from material from Spain, erroneously considered by him as the first description. This female is very different from the female of Walter (*op. cit.*). It has short, broad genital plates, an extensive pigmentation of the gonopore, rounded posteromedial corners of the fourth coxal plates and distinct posterolateral corners of the body. The body length is equal to that of the female described by Walter (1928). It remains uncertain which of the two authors described the real female of *A. distans*.

Cassagne-Méjean (1966) synonymized *A. distans* with *A. maculator*. According to her, the description of *A. distans* falls within the variation of *A. maculator*. As stated above, males are easily separable. *A. maculator* may vary in size, the shape of the ligulate process and hyaline membrane is unlike *A. distans*. Therefore, the synonymization of the two species must be rejected. Thus, part of her description of *A. maculator* may refer to *A. distans*.

A male and two females from Ootmarsum, The Netherlands, were erroneously identified by Besseling (1964) as *A. distans*, but belong to *A. ornatulus* George.

***Arrenurus (Arrenurus) latus* Barrois & Moniez, 1887**

*Arrenurus hofsteni* Walter, 1910 new syn.

*A. sinuator commutatus* Viets, 1930 new syn.

Material examined. - *A. sinuator commutatus*. Spain: province of Valencia, Albufera, 1 ♀ holotype, 22.i.1919 (slide 3861, coll. Viets, SMF).

Walter (1910) described *A. hofsteni* based on one male collected in Gotland. As already pointed out by Lundblad (1962), the specimen could be *A. latus* with a malformed petiole. I support this conclusion. The shape of the body and the patch of setae on PII of *A. hofsteni* are similar to *A. latus*. Also Walter (*op. cit.*) mentioned the similarity with *A. latus*. The male of *hofsteni* has been collected together with a female of *A. latus*. In all aspects, *A. sinuator commutatus* is similar to *A. latus*, e.g. medial margin of third and fourth coxal plates of equal length, PII with a moderate large patch of setae, narrow genital plates and a relatively large dorsal shield, covering almost the entire dorsum. *A. sinuator* (Müller) has a much smaller dorsal shield. Therefore, *A. sinuator commutatus* must be synonymized with *A. latus*. Viets (1930) compared the species only with *A. sinuator* (Müller), which also occurred on the type-locality. However, both species can be found very frequently together.

***Arrenurus (Arrenurus) compactus* Piersig, 1894**

*A. (Arrenurus) ornatulus* Viets, 1950 new syn.

Material examined - *A. ornatulus*. Germany: Deepenmoor, Lübeck, 1 ♂ holotype, viii.1908 (slide 6283, coll. Viets, SMF). *A. compactus*. The Netherlands: Gerritsflesch, province of Gelderland, 70 ♀ 38 ♀♀, 3.ix.1993, leg. H. Smit & H. van der Hammen (coll. HS).

In the original description of *A. ornatulus*, Viets (1950) compared the male with *A. ornatulus* George, from which it clearly differs in the rhomboid ligulate process. Unfortunately, Viets made no comparison with

the most closely related species, i.e. *A. compactus*, which also has a rhomboid ligulate process. Differences between the two species are the shape of the petiole, which has a straight posterior margin in *ornatulus* and a concave posterior margin in *compactus*, and the hyaline membrane, which has a straight posterior margin in *ornatulus* and a concave posterior margin in *compactus*. In all other characters the two species are similar. However, when examining a large collection of *A. compactus* from The Netherlands, both types of petioles can be observed. Further, the hyaline membrane of the type of *A. ornatulus* is slightly concave. Therefore, I conclude that *A. ornatulus* is a junior synonym of *A. compactus*.

***Arrenurus (Arrenurus) neumani* Piersig, 1895**

*A. walteri* Koenike, 1911 new syn.

Material examined - *A. neumani*. The Netherlands: Gerritsflesch, province of Gelderland, 118 ♂♂ 29 ♀♀, 3.ix.1993, leg. H. Smit & H. van der Hammen (coll. HS).

Walter (1907) illustrated and described an *Arrenurus*-female, which was later named *A. walteri* by Koenike (1911). Characteristic for *A. walteri* are the very large, rounded genital plates. Other characteristics are the body colour, which is deep red, the genital valves with chitinous patches and PII, which has four setae on the medial side. In a large collection of *A. neumani* from The Netherlands, females with more or less similar genital plates can be observed (see fig. 2). These genital plates differ from the typical genital plates of *A. neumani*, which are more rectangular. The number of setae on the medial side of PII of *A. walteri* is four, *A. neumani* usually has 5-6 setae. The body colour of *A. neumani* is also red. The anterior and posterior chitinous patches of *A. neumani* are not fused medially as in *A. walteri*, but it must be noticed that the illustration of Walter (1907) is very sketchy. I conclude that *A. walteri* is a junior synonym of *A. neumani*.

***Arrenurus (Arrenurus) papillator* (Müller, 1776)**

*A. cyanipes* (Lucas, 1846), sensu Walter (1925) new syn.

*A. bucharicus* Sokolow, 1928 new syn.

Material examined - *A. cyanipes*. Algeria: Guerrah el M'Krada between Bône and La Calle, 1 ♂, 10.iv.1925 (slide XIV / 12, NHMB), leg. Gauthier; Forêt de la Réghaïa, 1 ♀, 3.v.1925, leg. Gauthier (slide XIII / 81, NHMB); Mare Le Kral sup., 1 nymph, 11.xii.1924, leg. Gauthier (slide XIII / 45, NHMB) (all incorrectly labeled as «typus»); Bulgaria, Sofia, 1 ♂ 1 nymph, (slide 4727, 1937, coll. Viets, SMF). *A. papillator*. The

Netherlands: Voorne, dune slack, 1 ♂ 2 ♀♀, 16.v.1987, leg. H. Smit & H. van der Hammen (Coll. HS).

Lucas (1846) described a nymph from Algeria as *Hydrachna cyanipes*. Later, Walter (1925) assigned the species to the genus *Arrenurus*. The description and illustrations of Lucas (1846) are so inaccurate, that although the nymph can be assigned to the genus *Arrenurus*, at the species level it must be considered as a *species incerta*. It cannot be determined if the species reported by Walter (1925, 1928) is the same species described by Lucas (1846). The most distinct characteristic of the species of Walter is the very long antagonistic bristle on PIV, in the nymph as well as in the adult male and female. It must be noted that in the description of Lucas (1846) this character is not mentioned or illustrated. Viets (1930) described a nymph with a similar long antagonistic bristle from Spain as *A. praeacutus*, but synonymized it later with *A. cyanipes* (Viets, 1933). Before deciding whether the *Arrenurus*-species of Walter (*op. cit*) deserves a new name or not, I will discuss its identity. For the time being, I refer to it as *A. cyanipes*.

All authors overlooked a species with a similar long antagonistic bristle, *i.e.* *A. papillator*. Males of both species are characterized by the absence of a cauda, a downturned petiole, which has a median cleft and an incomplete dorsal shield.

If we compare the illustration in the literature of the petiole, some differences can be observed. Walter (1928) illustrated a rounded petiole for *A. cyanipes*; the median cleft is not contracted posteriorly. However, examination of the holotype revealed that the illustration of the median cleft is inaccurate, as the median cleft is contracted posteriorly, making the petiole tongs-shaped. The petiole of *A. papillator* is always illustrated with straight lateral margins, narrowed anteriorly and with a contracted median cleft (see Neuman, 1880, fig. 1b; Piersig, 1897-1900, fig. 77a; Viets, 1936, fig. 448). Due to the fact that the petiole is strongly downturned in both species, it can only be illustrated accurately by putting the specimen on its posterior end. Otherwise, the illustration will give a distorted impression, which might explain the differences in the illustrated petioles. Lundblad (1936), who reported *A. cyanipes* from China, pointed out that there is much variation in the shape of the petiole and the size of the male (see below) of *A. cyanipes*. The petiole of his specimen from China has a concave lateral margin, and is more similar to *A. papillator* than to *A. cyanipes*. A male from Bulgaria (also examined by Lundblad) has a rather different petiole, not tongs-shaped but rectangu-

lar, the medial corners of the cleft rounded. Another feature is the lamellae on the ventral side of the petiole. Viets (1935) reported the presence of lamellae for his specimen from Bulgaria, Lundblad (1936) could not observe this feature on his specimen from China. According to Lundblad, Walter's specimen should have lamellae, but I failed to observe this character. The conclusion is, that there are no differences between the petioles of the two species, if we take into consideration the large variation in shape.

Males of *A. cyanipes* vary in length from 1620 (Algeria) to about 1170 (Bulgaria, China). A male from my own collection, collected in The Netherlands and assigned to *A. papillator*, measures 1320. In the literature, lengths for *A. papillator* are given of 1240-1350, intermediate between the minimum and maximum length of *A. cyanipes*.

Females of *A. cyanipes* and *A. papillator* are likewise similar. They are characterized by their large size. The genital plates are short, with enlarged acetabula near the anterior margin. Walter (1928) illustrated the female of *A. cyanipes* with a bowed, posterior margin of the genital plate. *A. papillator* is illustrated by most authors with straight anterior and posterior margins, but Neuman (1880) illustrated the female with a bowed genital plate. Specimens from The Netherlands have either a straight posterior margin, or a posterior margin which is slightly bowed.

I come to the conclusion that *A. cyanipes* sensu Walter is a junior synonym of *A. papillator*. The species shows considerable variation in shape of the petiole and size of the males. Females show some variation in the shape of the genital plate. In my opinion the species described by Lucas (1846) is a *species incerta*, and the specimens of Walter (1925, 1928) cannot be assigned to this species. However, now that Walter's species from Algeria has been synonymized with *A. papillator*, a new name is not necessary.

Sokolow (1928) described from Turkestan *A. bucharicus*; his description is based on one female only. I discussed above the variation in the shape of the genital plates, which have either a straight or a bowed posterior margin of the genital plate; *A. bucharicus* has a bowed posterior margin. Sokolow (1928) did not mention the enlarged acetabula, but from his illustration it can be concluded that these are present. Further, the size, the shape of the body and coxal plates, the setae along the margins of the genital plates and the long antagonistic bristle on PIV are similar to *A. papillator*. Therefore, *A. bucharicus* must be considered as a junior synonym of *A. papillator*.

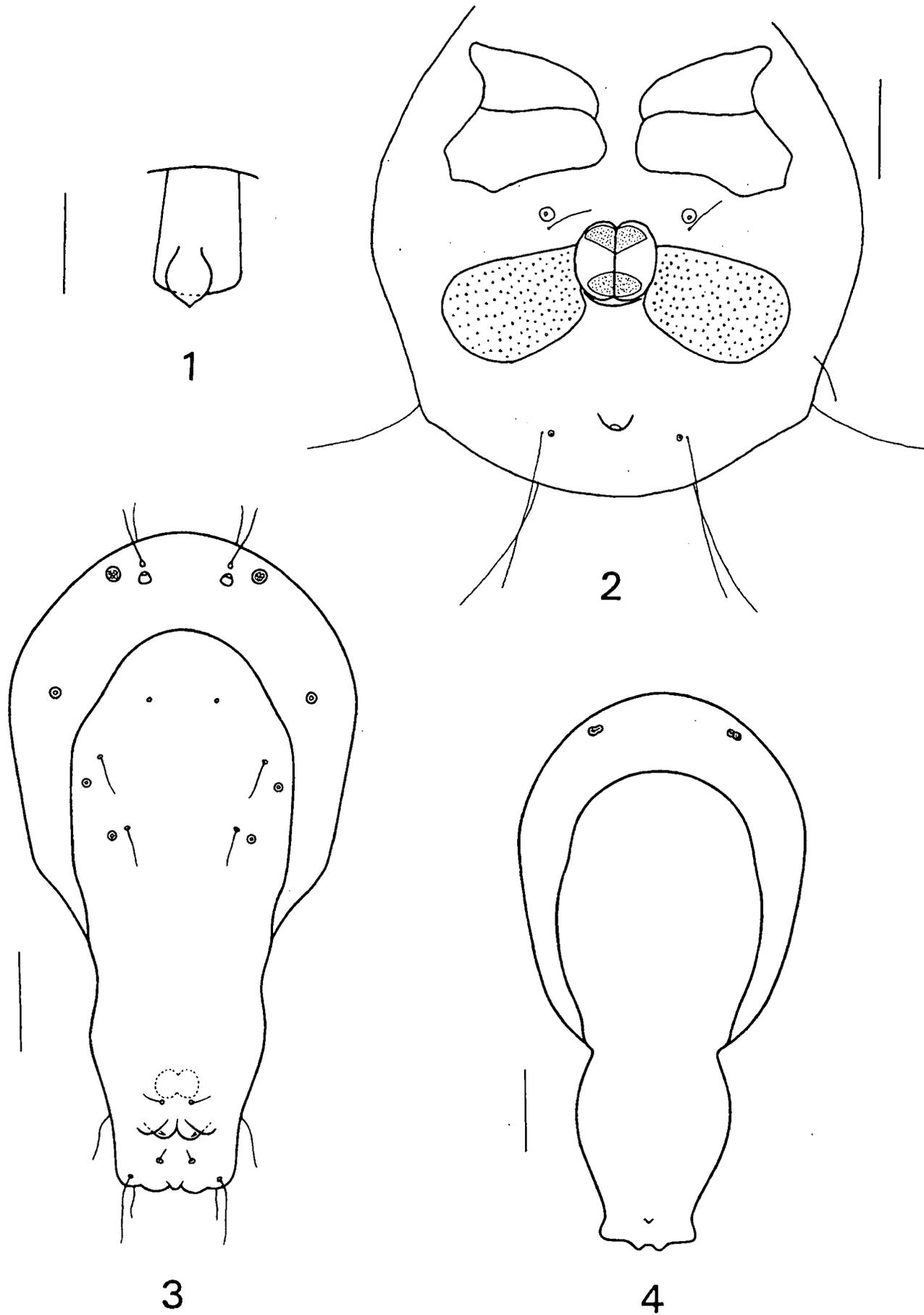


Fig. 1. Detail of petiole of *A. distans* ♂ (from Agoulmine Temjout, Algeria).

Fig. 1. Détail du pétiole de *A. distans* ♂ (d' Agoulmine Temjout, Algérie).

Fig. 2. *A. neumani*, ventral view ♀ (from Gerritschfles, The Netherlands).

Fig. 2. *A. neumani*, face ventrale ♀ (de Gerritschfles, Pays-Bas).

Fig. 3. *A. spatiosus*, ventral view ♂ (from Nijlandsloopje, The Netherlands).

Fig. 3. *A. spatiosus*, face ventrale ♂ (de Nijlandsloopje, Pays-Bas).

Fig. 4. *A. freemani* (= *A. stjoerdalensis*), holotype ♂.

Fig. 4. *A. freemani* (= *A. stjoerdalensis*), holotype ♂.

Scale lines: fig. 1 100 μm; figs. 2, 3 200 μm.

*Arrenurus (Arrenurus) papillator bicolor* Viets, 1935  
nov. comb.

*Arrenurus cyanipes bicolor* Viets, 1935

Material examined. - Bulgaria: Sofia, Sümpfe, 1 ♂ holotype 1 nymph, iii.1934 (slide 4909, coll. Viets, SMF).

The male from Bulgaria described as a subspecies of *A. cyanipes*, is quite different. Size, shape of the petiole and fourth coxal plates differ from *A. papillator*. Lundblad (1936) synonymized the subspecies with the nominate form, but I agree with Viets (1935) that it deserves ranking as a subspecies.

*Arrenurus (Megaluracarus) curtus* George, 1906  
[*sp. inc*]

Gledhill & Viets (1976) considered *A. curtus* a good species. However, Soar & Williamson (1929) considered the male on which the description of George (1906) was based to be an immature specimen. Unfortunately, the holotype has been lost. The description of the species by George (1906) is very poor, and in my opinion the species must be considered a *species incerta*.

*Arrenurus (Megaluracarus) coronator* Thor, 1900

*A. stjoerdalensis naias* Lundblad, 1962 new syn.

Material examined. - *A. stjoerdalensis naias*. Sweden: Lake Jukkasjärvi, 1 ♀ holotype, 10.viii.1917, leg. O. Lundblad (slide 5707, SMNH).

Lundblad (1962) described a female *Arrenurus* from northern Sweden as a new forma of *A. stjoerdalensis* Thor. As he already pointed out, the genital plates are quite different from this species. He based his assignment to *A. stjoerdalensis* on the palp, which has PII with 6 setae on the inner medial side, and PIV with forked tactile setae and 4-5 setae on dorsal margin. Examination of the type revealed that PII has 5 setae on the inner medial side. The difference between the genital plates of *A. stjoerdalensis* and *A. s. naias* is so large, that they cannot be assigned to the same species. Further, the shape of the palp of *A. s. naias* is not unique for *A. stjoerdalensis*. *A. coronator* has a similar palp. Lundblad (1962) described the genital plates as wing-shaped. Closer examination of the holotype revealed, that the left plate is slightly wing-shaped (lateral margin pointed anteriorly), the right plate however has a different shape (directed straight to lateral margin, narrowed laterally). The shape of the genital plate is similar (right plate) or almost similar (left plate) to *A. coronator*, a species also occurring in large lakes. Other similarities between the two taxa are the small coxal field, the size of the body and the shape of the third and fourth coxal plates. Only the shape of the body of *A. s.*

*naias*, which is broad egg-shaped, differs from *A. coronator*, which has a more oval-shaped body. However, the body-shape of *A. s. naias* might be distorted due to mounting of the specimen. *A. stjoerdalensis naias* is here considered as a junior synonym of *A. coronator*.

*Arrenurus (Megaluracarus) geminus* George, 1901

*A. (Megaluracarus) eugeminus* Piersig, 1901 new syn.

*A. (Megaluracarus) imitator* Koenike, 1908 new syn.

Material examined - *A. geminus*. England: Lincolnshire, 1 ♂, 1901 (slide 1929-11-20-63, coll. Soar, BMNH); Lincolnshire, 1 ♂, 1901 (slide 1929-11-20-64, coll. Soar, BMNH). *A. imitator*. The Netherlands: province of Gelderland, Wapenveld, Nieuwe Wetering, 1 ♂, 2.v.1988, leg. M. Koopmans (male in Koenikefluid, palp + legs slide HOL 38, coll. HS).

Although the two slides from the collection of Soar are in poor condition, it is still possible to examine the shape of the cauda and the genital plates. I assume that these slides are the type material, although George (1901) did not mention the type-locality. The two males differ in the shape of the distal part of the cauda. The male of slide 1929-11-20-64 has a cauda with more pronounced posterolateral corners, while the distal margin has two rounded extensions in the middle, which are almost absent in the male of slide 1929-11-20-63. These differences are in my opinion the result of the slide making and the position of the specimen in the slide. Piersig (1901a) concluded incorrectly that two species were involved, and named the male of fig. 5 of George (1901) *Arrenurus eugeminus*. Unfortunately, it is impossible to conclude on which slides the illustrations of George were based. It must be noted that the conclusions of Piersig (1901a) were only based on the illustrations of George (1901), which are very inaccurate. The posterolateral corners and the distal extensions of the cauda are illustrated too large by George. Both males of the collection of Soar have a concavity in the posterodorsal part of the cauda, and the configuration of the glandularia and setae is similar. The cauda is long, well set off from the body and widened in the middle. The genital plates are short and broad. *A. eugeminus* is here synonymized with *A. geminus*.

All above mentioned characteristics, including shape of the palp and spur of fourth leg, are similar for *A. imitator* Koenike. According to George (1901) the length of *A. geminus* is 1270. The specimen from my own collection, assigned to *A. imitator*, is 1183 long. However, nothing is known about the variation in length of *A. geminus* or *A. imitator*. *A. imitator* is considered here as a junior synonym of *A. geminus*

***Arrenurus* (? *Megaluracarus*) *incertus* Biesiadka, 1978 [sp. inc.]**

As already pointed out by Viets (1987), the name *A. incertus* is preoccupied. The description of Biesiadka (1978) is based on one female only. The shape of the body and fourth leg of this female are quite aberrant from normal *Arrenurus*-females, and probably the female is a monstrosity. Therefore, it should be considered a *species incerta*, and I will not give the species a new name. Based on the shape and chaetotaxy of the palp, it is close to *A. cylindratus* Piersig.

***Arrenurus* (*Megaluracarus*) *scourfieldi* Soar, 1913**

Material examined. - England: Cornwall, Near the Lizard, 1 ♂ lectotype (new designation), 1912 (slide 1929-11-20-107, coll. Soar, BMNH).

A species considered as *species incerta* by Gledhill & Viets (1976). The male I examined from the collection of Soar is in good condition, only the palps and legs are lacking. The shape of the body is unlike any other species, and I consider *A. scourfieldi* therefore as a good species. For a description of the species see Soar (1913) and Soar & Williamson (1929).

***Arrenurus* (*Megaluracarus*) *soari* George, 1901 [sp. inc.]**

Material examined - England: Lincolnshire, 1 ♂, 1901 (slide 1929-11-20-115, coll. Soar, BMNH); Lincolnshire, 1 ♀, 1901 (slide 1929-11-20-116, coll. Soar, BMNH, non *A. soari*, = *A. securiformis* Piersig).

A species considered as *species incerta* by Gledhill & Viets (1976). I examined a male from the collection of Soar, identified by George as *A. soari*. It is very likely that the description is based on a not fully sclerotized male, as pores are lacking in the posterior part of the cauda. The posterolateral corners of the cauda are the last part of the body to be formed, and are therefore absent in not fully sclerotized males. In *A. soari* these corners are absent. Already George (1901) mentioned that Soar suspected the male not to be fully developed. Later, Piersig (1901a) and Soar & Williamson (1929) were the same opinion. Therefore, I agree with Gledhill & Viets (1976) that the species should be considered as a *species incerta*. The female in the collection of Soar, identified by George as *A. soari*, is in my opinion a female of *A. securiformis* Piersig. Although not fully sclerotized, it has the characteristic club-shaped genital plates of *A. securiformis*.

***Arrenurus* (*Megaluracarus*) *spatiosus* Viets, 1919 nov. stat.**

*A. muelleri spatiosus* Viets, 1919

Material examined. - Germany: Oelkassen b. Eschershausen, 1 ♂ holotype, 28.vi.1911, leg. Kühne (slide 1115, coll. Viets, SMF); The Netherlands: province of Drente, Nijlandsloopje, 1 ♂, 19.ix.1994, leg. G. Duursema (coll. HS); province of Drente, De Beek, 1 ♂ (not fully sclerotized), 14.ix.1993, leg. G. Duursema (coll. WABD).

Viets (1919) originally described *A. spatiosus* as a variety of *A. muelleri* Koenike. *A. spatiosus* is much larger than *A. muelleri* (1350 for *spatiosus* and 1160 for *muelleri*), the configuration of the setae of the cauda of both species differs, as well as the shape of the tubercle on the cauda. Furthermore, the distance between two setae located between the tubercle on the cauda and the excretory pore is much larger in *A. muelleri* compared to *A. muelleri spatiosus*. The differences are large enough to warrant ranking as a full species. I disagree with Lundblad (1962), who synonymized *A. muelleri spatiosus* with *A. muelleri*. The shape of the cauda of both species is somewhat variable. One of the two males of *A. spatiosus* from The Netherlands has a slightly different posterior part of the cauda compared to the holotype, but is otherwise similar (see fig. 3). This male is 1334 long and 698 wide. Viets (1919) found the species in a pond (also the habitat of *A. muelleri*), the new records from The Netherlands, the second and third ever recorded, come from streams, one of these being very polluted.

***Arrenurus* (*Megaluracarus*) *stjoerdalensis* Thor, 1899**

*A. adnatus* Koenike, 1902

*A. freemani* Halbert, 1903

*A. insperatus* George, 1905 new syn.

Material examined - *Arrenurus adnatus*. Germany: Hamburg, Bille, 1 ♂ holotype, leg. Bohten (slide 625, ZMB, only palp present!); Austria: Lunz Untersee, 1 ♂, 1911 (slide II / 07, NHMB); Lunz Untersee, 2 ♂♂ (only palps present), 1911 and 1913, (slides II / 08 and IV / 34, NHMB); Lunz Untersee, 2 ♀♀, (IV / 31 and IV / 32, NHMB, both incorrectly labelled «typus»); Achensee, 2 ♀♀, (slides II / 24, II / 25, NHMB). *A. freemani*. Ireland: Co. Dublin, Gullierstown, Charapool, 1 ♂ holotype, 12.x.1902 (NMI). *A. stjoerdalensis*. Sweden: a large number of ♂♂ and ♀♀, different locations (coll. Lundblad, SMNH). *A. insperatus*: England: Lincolnshire, 1 ♂ holotype, 1895 (slide 1929-11-20-40, coll. Soar, BMNH).

Lundblad (1962) synonymized *A. adnatus* and *A. freemani* with *A. stjoerdalensis*. I support his conclusion. I examined the holotype of *A. freemani* (see fig. 4), which is similar to *A. stjoerdalensis*, only a little smaller than the specimens of *A. stjoerdalensis* in Lundblad's collection. The length of Halbert's specimen is 1392, the width 720. The measurements of Halbert (1903) are inaccurate, as he mentioned the length being 1440 and the width 780. The ligulate hyaline extensions as well as the glandularia cannot be seen anymore in the holotype of *A. freemani*. Later, Halbert (1944) reduced *A. freemani* to a subspecies of *A. adnatus*.

Viets (1956) synonymized *A. stjoerdalensis* with *A. buccinator* (Müller). However, the two species are easily separable. The cauda of *A. buccinator* has a small tubercle, while a rudimentary petiole and a hyaline process are absent. Further, the cauda of *A. buccinator* is more slender. Females of *A. stjoerdalensis* have much larger genital plates.

The type of *A. insperatus* is in poor condition, especially the outline of the cauda is rather distorted. However, a number of characters can still be seen. Distally the cauda has two rounded extensions, which are, as a result of the distortion, not as conspicuous as in specimens of *A. stjoerdalensis* from Lundblad's collection. The rudimentary petiole is clearly visible in *A. insperatus*. The genital plates are broad and extending to the lateral body margin. Gledhill & Viets (1976) considered it a *species incerta*, but I come to the conclusion that *A. insperatus* is a junior synonym of *A. stjoerdalensis*.

***Arrenurus (Megaluracarus) tubulator* (Müller, 1776)**

A number of authors, e.g. Lundblad (1962), Besseling (1968) and Gledhill & Viets (1976) considered *A. tubulator* a synonym of *A. globator* (Müller). Viets (1987) listed it in his catalogue as a subspecies of *A. globator*. Bader (1975) on the contrary is of the opinion that both species should be separated.

Males as well as females are easy separable. Differences between males of the two species are found in the cauda (longer than wide in *globator*, as long as wide in *tubulator* and also higher compared with *globator*) and the distal margin of the cauda (straight in *globator*, slightly concave in *tubulator*). Females differ in the shape of the genital plate (narrow in *globator*, broad in *tubulator*) and the shape of the pigmentation of the gonopore (anterior and posterior pigmentation separated in *globator*, fused in *tubulator*; posterior and anterior margin of pigmentation rounded in *globator*, straight and oblique in *tubulator*). Bader (1975) poin-

ted out that the colour of the two species is different (greenish in *globator*, yellowish in *tubulator*). However, in contrast with the opinion of Bader, the colour of *Arrenurus*-species is not always a stable character, e.g. some species are known to be coloured green or red. Nevertheless, both species should in my opinion be separated. An ecological argument can be found in the distribution in The Netherlands. *A. globator* is a very common and widespread species, occurring in many water-types. *A. tubulator* is rare and only found in ponds of the pleistocene region.

***Arrenurus (Micruracarus) bifidicodulus* Piersig, 1897**

*Arrenurus brachyurus* Viets, 1914 new syn.

Material examined. - *A. brachyurus*. Germany: Berlin, Grunewaldsee, 1 ♂ holotype, viii.1899, leg. Protz (slide 1636, coll. Viets, SMF).

*A. brachyurus* is very close to *A. bifidicodulus*, and differs only in the shape of posterior margin of the cauda. The palp, shape of coxal plates and genital plates, configuration of the setae and chitinous spines on the cauda of *A. brachyurus* are similar to *A. bifidicodulus*. PIV of both species is rather long, with a concave dorsal margin. Furthermore, both species have a small concavity on the posterior end of the cauda. Although it cannot be determined with certainty whether the type of *A. brachyurus* is mature or not, the two species are so close that it is very likely that the posterior margin of the cauda of *A. brachyurus* is incompletely sclerotized. Therefore, I synonymize both species, with *A. brachyurus* being a junior synonym of *A. bifidicodulus*.

***Arrenurus (Truncaturus) paluster* Thor, 1901 [sp. inc.]**

Thor (1901) described this very unusual species. The male has a cauda and a spur but a female gonopore. The description of the female is very poor, an illustration of the complete female is lacking. A description of the palp of both male and female is lacking as well. Therefore, it is better to consider it as a *species incerta*. Already Viets (1978) questioned the identity of the species.

***Arrenurus (Truncaturus) truncatellus* (Müller, 1776)**

*Arrenurus truncatellus georgei* Piersig, 1900 new syn.

Material examined. - *Arrenurus truncatellus georgei*. England: Lincolnshire, 1 ♂ holotype, 1884 (slide 1929-11-20-128, coll. Soar, BMNH).

George (1884) illustrated a male of *A. truncatellus*, which was later renamed by Piersig (1900; 1901b) as *A. georgei* and *A. truncatellus georgei* respectively. *A. truncatellus georgei* differs from *A. truncatellus truncatellus* in the presence of hyaline vesicles at the posterior end of the cauda. The holotype is in bad condition, but is probably an immature male, and therefore not completely sclerotized, as the posterior end of the body is shorter than in *A. truncatellus truncatellus*. The vesicles, still visible in the holotype, might be the glandularia, which are located in *A. truncatellus truncatellus* close to the posterior margin of the cauda. Otherwise, *A. truncatellus georgei* is similar to *A. truncatellus truncatellus*. Viets (1978) considered the subspecies a *species incerta*, but in my opinion it must be synonymized with *A. truncatellus truncatellus*.

#### *Arrenurus* (?) *bueranus* Münchberg, 1955 [sp. inc.]

The description of Münchberg (1955) was based on a single female, which had a peculiar dorsal body margin with a bud-shaped structure. He pointed out, that because of the regular shape of the structure, any abnormality should be rejected. Abnormality within *Arrenurus*-females occurs quite regularly. Although rare, even females with petiole-like structures can be found. Most of the abnormalities are of regular shape. Therefore, in my opinion, *A. bueranus* must be considered as an abnormality, despite the regularity of the bud-shaped structure. It should be regarded as a *species incerta*.

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