

Family Aturidae THOR, 1900

1900 Aturidae THOR, Arch. Math. Naturv. 23: 4.

Diagnosis: Idiosoma flattened dorso-ventrally, in genera recorded from Europe with complete ventral and dorsal shields separated by a dorsal furrow (in some extra-European genera dorsal sclerotization formed by various numbers of separate plates and platelets). Lateral eyes not in capsules, lying beneath the integument. Gnathosoma with anchoral process and separated from coxae in European genera (but without such process and fused to ventral shield in some extra-European genera); palp five-segmented, P-4 typically without a medial peg-like seta (*9-3 i* - rarely a slightly thickened or peg-like seta in this position: *9-14 g*, *9-19 n*). Legs with or without swimming setae, often exhibiting sexual dimorphism. Leg claws simple or with a clawlet, sickle-shaped. Genital field with 3 to numerous pairs of acetabula (exceptionally two, in *Haloaxonopsis* reduced to so-called wheel-like acetabula) lying on plates flanking the gonopore, these plates free or fused to the ventral shield.

Discussion: When he described and discussed in detail the taxonomic state of Aturidae as a “dumping ground [...] for those higher water mite genera with heavy sclerotized bodies which do not show the characteristics used to define the remaining families”, COOK (1974) expressed the hope that the family placement of the included subfamilies and genera could be ascertained on the basis of larval morphology. Since then, steps were made when Lethaxonidae and Frontipodopsidae were defined as separate families (COOK et al. 2000). Furthermore, OLOMSKI (2012) demonstrated striking similarities in reproductive behaviour and spermatophore morphology between *Brachypoda* (Axonopsinae) and representatives of Pionidae on the one hand, and *Aturus* (Aturinae) and Arrenuridae on the other, and proposed a rearrangement, more appropriately reflecting evolutionary pathways, of taxa at present assembled in Aturidae.

However, as research during the past decades has not yet produced a convincing alternative, we follow COOK’s (1974) system applying only the modifications of COOK et al. (2000). In this scenario, the family Aturidae is probably a polyphyletic taxon including a high number of genera and distributed over all continents except Antarctica. In addition to the three subfamilies present in Europe (see below), it includes Notoaturinae BESCH, 1964 with a Gondwanan distribution (southern Chile, eastern Africa, Australia and New Zealand).

Key to subfamilies

- 1 Genital field with 3-4 pairs of acetabula (e. g., *9-3 f*, *9-14 a-b* - some extra-European genera with higher acetabula numbers characterized by strongly-developed expansions near IV-L insertions and anterior margin of Cx-I not exceeding anterior idiosoma margin); dorsum with entire shield or several plates. Axonopsinae (page 48)
- Genital field with 5 or more pairs of acetabula (*9-3 g-h* - not easily recognized in dorsal or ventral view when arranged at posterior margin: *9-1 i*); dorsal shield entire. 2
- 2 (1) Acetabular plates rounded, heart-shaped or triangular, located ventrally, in males fused to ventral shield, in females surrounded by soft integument; medial suture line of Cx-IV well visible; anterior margin of Cx-I not reaching idiosoma margin (*9-3 h, k*). Albiinae (page 7)
- Acetabular plates longish, located posteroventrally; Cx-IV completely fused medially, at most traces of a suture line defined; anterior margin of Cx-I extending beyond idiosoma margin (e. g., *9-1 i*). Aturinae (page 9)

Subfamily Albiinae K. VIETS, 1925

1925h Albiinae K. VIETS, Arch. Hydrobiol. 16: 221.

Diagnosis: Dorsal shield entire. Tips of Cx-I not extending beyond frontal idiosoma margin. Cx-IV with more or less distinct medial, posterior and lateral suture lines; no projections associated

with IV-L insertions. Legs with or without swimming setae, without sexual dimorphism. Acetabular plates with numerous (eight or more) pairs of acetabula, lying separate from ventral shield in females, fused to ventral shield (but with well visible suture lines) in males. Palp without ventral projections.

Discussion: In the first half of the past century, Albiinae appeared to be a distinct taxonomic unit, but characters of taxa discovered since then have widely filled the gap between this subfamily and the Axonopsinae. COOK (1974) maintained the two subfamilies “mostly out of nostalgia”: otherwise, following the rules of zoological nomenclature, the widely used name of Axonopsinae would have disappeared as a synonym of Albiinae. However, taxa with intermediate character states are mostly found in the southern hemisphere, while in the European fauna members of the two subfamilies are easily distinguished from each other. In addition to *Albia*, recorded from all continents except for Antarctica, only one other genus is known, *Parasitalbia* K. VIETS, 1935, described from a single species at the adult stage and found parasitic on Ephemeroptera larvae in Sumatra.

Genus *Albia* THON, 1899

1899 *Albia* THON, Zool. Anz. 22: 100.

Type species: *Albia stationis* THON, 1899, by monotypy.

Diagnosis: Gnathosomal bay slender, much longer than wide. Palp slender, P-4 much longer than P-3.

Remarks: Distributed worldwide except Antarctica. In addition to the subgenera represented in Europe (see below), the three subgenera *Anchistalbia* COOK, 1974 (The Americas, Asia, Africa), *Dentalbia* COOK, 1974 (Oriental region) and *Spinalbia* COOK, 1974 (Africa and Asia) are known. Larvae of *Albia* have been described for species only from outside the study area (PRASAD & COOK 1972, SMITH 1984).

Key to subgenera and species

- 1 Suture line Cx-III/IV not reaching the median line. A pair of glandularia lying near the medial end of the suture line Cx-II/III (9-3*h*). Subgenus *Albia* (*s. str.*), only species in the area: *Albia* (*Albia*) *stationis* (page 8)
- Suture line Cx-III/IV continuous, reaching the median line. A pair of glandularia lying posterior to this line, in the European representative of the subgenus on the level of IV-L insertions (9-3*k*). Subgenus *Albiella*, only species in the area: *Albia* (*Albiella*) *davidsi* (page 9)

Subgenus *Albia* THON, 1899

Diagnosis: Glandularia on Cx-IV shifted far forward. Suture line Cx-III/IV developed only laterally, ending medial to IV-L insertions and not reaching the medial line. Male genital field extending to posterior end of ventral shield. Without greatly enlarged setae on coxal field or medial surface of P-2.

Remarks: Probably a monophyletic taxon; distribution Holarctic.

1. *Albia stationis* THON, 1899 (9-3*g-i*)

1899 *Albia stationis* THON, Zool. Anz. 22: 101.

Description: Colour yellowish, on the dorsal surface with a whitish excretory organ in a brownish-red central area. Idiosoma elliptical in shape, tips of Cx-I far posterior to frontal margin. Gnathosoma with a long anchoral process. Palps stocky, P-4 shorter than P-2, with a pair of long setae in the centre of the ventral surface. Males: Idiosoma length/width 710/530 µm. Acetabular plates fused to an unpaired genital plate which posteriorly also includes excretory pore and a pair of glands. Females: Idiosoma length/width 840-940/620-650 µm. Acetabular plates separate, subtriangular in shape, excretory pore platelet and flanking glandularia lying free in the integument.

Habitat and Biology: In summer-warm lowland streams with dead wood and sandy substratum, e.g. outlets of lakes. Preadult stages and life cycle unknown.

Distribution: Central, eastern and southeastern Europe, England, Turkey; rare. A subspecies described from eastern Siberia.

Subgenus *Albiella* LUNDBLAD, 1971

1971 *Albiella* Lundblad, Ark. Zool. (ser. 2) 23: 343.

Diagnosis: In setation of coxae and position of glandularia, shape of palps and formation of male genital field agreeing with *Albia* s. str., but suture line Cx-III/IV reaching the medial line, completely developed or reduced only in its lateral part.

Remark: Probably a sister taxon of *Albia* s. str., with the position of the coxal glandularia as a synapomorphy of both subgenera; species known from Indonesia (including New Guinea), India, Australia and Europe.

2. *Albia davidsi* SMIT & VAN DER HAMMEN, 1992 (9-3k)

1992 *Albia (Albiella) davidsi* SMIT & VAN DER HAMMEN, Ent. Ber., Amst. 52: 114.

Description: Male unknown. Female: Colour unknown, idiosoma length/width 1085/815 µm. In posterolateral part of dorsal shield, two glandularia lying close together. Tips of coxae pointed. Glandularia at anterior margin of Cx-IV large, located halfway between medial line and IV-L insertions. Leg swimming setae numbers: II-L-5, 5; III-L-4, 4; III-L-5, 9; IV-L-4, 3; IV-L-5, 8. Acetabular plate length/width 136/126 µm. Palp slender, length: P-1, 50; P-2, 120; P-3, 91; P-4, 156; P-5, 48 µm; P-4 with 2 setae in the distal half of ventral margin and 2 dorsodistal setae. II-IV-L with swimming setae.

Habitat and Biology: A single specimen reported from a pond. Life cycle and preadult stages unknown.

Distribution: Only known from the type locality near Amsterdam, The Netherlands. As the site was intensely investigated over five years without producing further records, SMIT & VAN DER HAMMEN (1992a) interpret the finding as accidental and suppose its main distribution area to be outside Europe.

Subfamily Aturinae THOR, 1900

Diagnosis: Dorsal shield entire, not divided into several platelets. Tips of Cx-I projecting well beyond idiosoma frontal margin. Genital plates with numerous (eight or more) acetabula in European taxa arranged along the posterolateral idiosoma margin.

Remarks: While the two genera known from Europe are rather distinctive in comparison with representatives of other subfamilies, several genera from other continents exhibit character combinations grading to Axonopsinae (Cook 1974), with the result that the subfamily is probably para- or polyphyletic. In addition to the genera treated here, six further genera have been described: *Subalbia* K. VIETS, 1914 and *Subaturus* K. VIETS, 1916 (West Africa), *Aturides* LUNDBLAD, 1937 and *Neaturus* LUNDBLAD, 1941 (Neotropics), *Phreatobrachypoda* COOK, 1963 (North America) and *Bharatalbia* COOK, 1967 (India, Japan, Northern America).

Key to genera and subgenera

- 1 No projections associated with IV-L insertions (9-1 i; 9-9 b); male IV-L-5 lacking strongly thickened setae (but IV-L and often also posterior idiosoma variously modified in shape and setation - e. g., 9-4 b, 9-6 a-e, g-h); ventral margin of P-2 with (one or several) projections only in the distal part (9-4 c). Genus *Aturus* (page 10)
- Posteriorly-directed projections covering IV-L insertions (9-12 d, l); male IV-L-5 generally with strongly thickened setae (9-4 f); ventral margin of P-2 in most European species with projections and tubercles preferably in the proximal part (e. g., 9-4 g). Genus *Kongsbergia* 2
- 2 (1) Males (females unknown): I-L modified, I-L-4 with a very long distoventral seta, I-L-5 expanded, with a heavy ventral seta (9-4 m). Subgenus *Parakongsbergia* K. VIETS, 1949
Not recorded from the area covered, only known from the type locality of *K. (Parakongsbergia) hans-vietsi* K. VIETS, 1949, in Macedonia.
- Male I-L not modified in the described manner (9-4 h). Subgenus *Kongsbergia* (page 34)

Genus *Aturus* KRAMER, 1875

1875 *Aturus* KRAMER, Arch. Naturg. 41: 309.

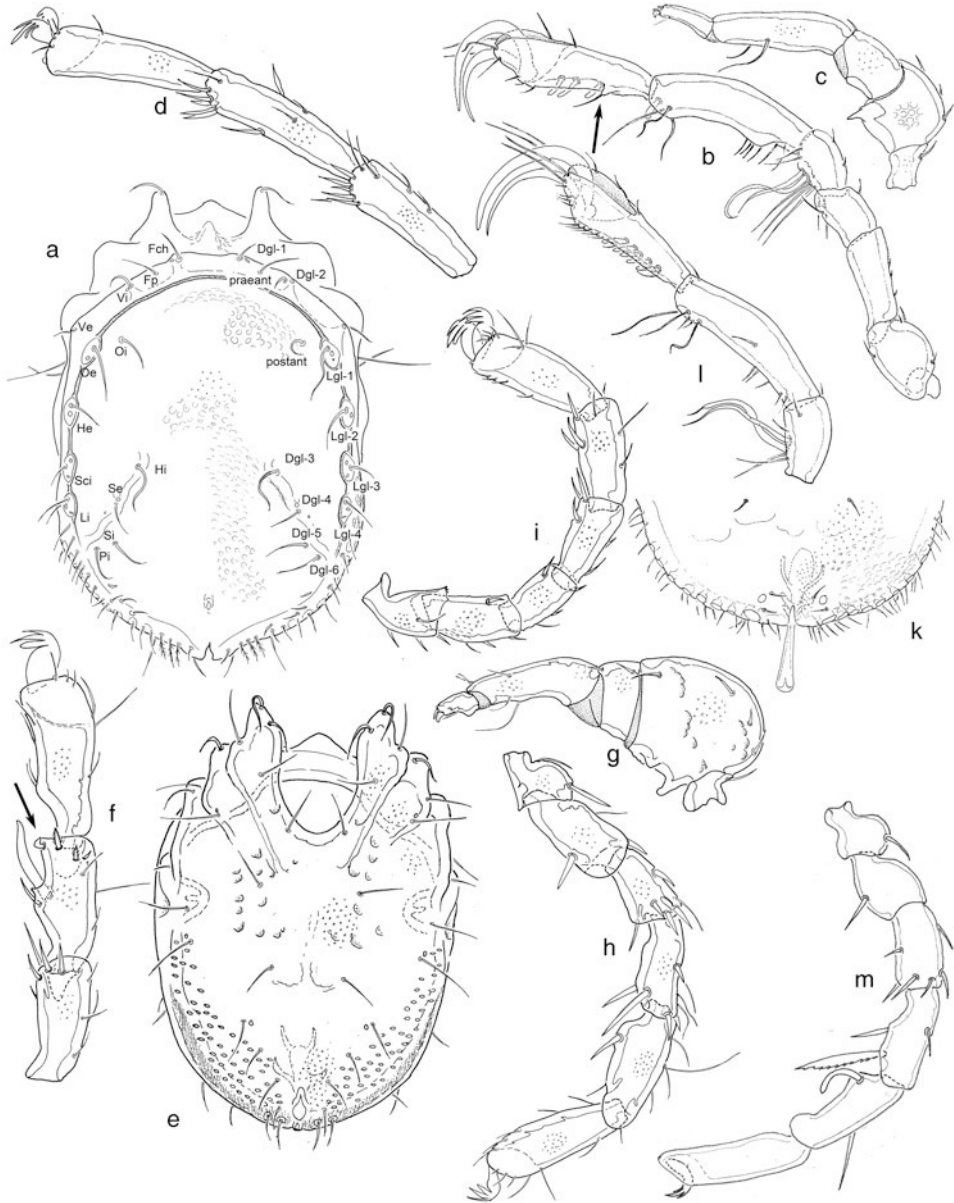
Type species: *Aturus scaber* KRAMER, 1875, by original designation.

Diagnosis: Dorsal shield in males generally fused posteriorly to ventral shield, in females free, surrounded by a complete dorsal furrow; this furrow in both sexes directed dorsally, with 4-5 pairs of glandularia (Lgl-1-4, occasionally also Dgl-2). Dgl-1, often also Dgl-2, fused to frontal part of ventral shield. Postocularia, 4 pairs of glandularia and excretory pore on dorsal shield. Tips of Cx-I slightly extending beyond frontal margin; Cx-IV without glandularia, no projections or condyles associated with IV-L insertions. Legs without swimming setae. Male IV-L-4/5, occasionally also III-L, showing sexual dimorphism in shape and setation, species-specifically developed to various degrees. Acetabular plates slender, often extending beyond posterolateral idiosoma margin and bearing numerous acetabula in one or (rarely) two rows. In males, genital area often with a deep median cleft and genital field bearing variously modified setae. Palp segments shortened, P-2 with or without a short distoventral projection.

Remarks: In view of the enormous variety of character combinations in *Aturus*, MITCHELL (1954c) proposed to organize species groups, no subgenera are presently accepted. For a survey on numbering and terminology of idiosoma glandularia and setae see 9-4 a. The numbers given to dorsoglandularia follow SMITH et al. (2010) and differ from the scheme of BADER (e. g., 1994) who named Dgl-1 and -2 as “Prae- and Postantenniformia” and designated as “Dgl-1” what here is named “Dgl-3” (for more details see Vol. I, pp. 244-250).

As male legs showing sexual dimorphism are of particular importance for taxonomy in the genus, we introduce a series of terms. In normal position when crawling, the anterior side of legs is generally turned to the observer in ventral view, the posterior side in dorsal view; however, the position of IV-L is rather flexible, and single segments may also be rotated against each other. The following types of setae may be found: “sword setae” – much enlarged and flattened; “blade setae” – enlarged, denticulate at least on one side; “bi-” or “trifurcated setae” – apically with 2, or 3 tips; “denticulate setae” – with numerous tips, long; “elk-horn setae” – with numerous tips, short; “whip setae” – long, distally hair-like, narrowed and spiralling.

Sex-specific modifications in the male III-IV-L are observed as follows: III-L-4/5 generally little modified; III-L-4 may bear a long, thickened posterodistal seta; III-L-5 with a group of 1-3 setae in the centre on posterior and ventral surface (“central setae”) and several setae at distal margin (“distal setae”, occasionally including 1-2 whip setae); between these two groups a row of “ventral setae” may be present. IV-L-4 again with a group of “central setae” and a group of “distal setae”, but both groups in many cases making part of one dense field of variously modified “distoventral” setae. Among them, in most species, a pair of sword setae at anterior distal margin. IV-L-5 ventrally with a group of variously modified “proximal setae” – these setae strongly overlapping with IV-L-5



9-4: a-d, *Aturus scaber*, a-c, male; a, dorsum, with explanation of the numbering system for glandularia; b, IV-L (arrow: proximoventral extension); c, palp; d, female IV-L-4-6; e-h, *Kongsbergia materna*, male; e, venter; f, IV-L-4-6 (arrow: distoventral seta); g, palp; h, I-L-4-6; i, *Kongsbergia pectinigera* female IV-L-4-6; k-l, *Aturus rotundus*, male; k, posterior idiosoma margin; l, IV-L-4-6; m, *Kongsbergia (Parakongsbergia) hansvietsi*, male, I-L-4-6. (a-l, GERECKE 2014b, m after K.VIETS, 1949c).

distoventral setae, together obviously forming a functional unit; furthermore, the proximoventral margin in most cases with a row of simple, long setae ("ventral line setae"), distal margin with a group of "distal setae" rather various in length, often including a whip seta.

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