

A guide to the identification of the terrestrial Isopoda of Maryland, U.S.A. (Crustacea)

Jeffrey W. Shultz¹

¹ *Department of Entomology, University of Maryland, College Park, Maryland, USA*

Corresponding author: *Jeffrey W. Shultz* (jshultz@umd.edu)

Academic editor: *K. Szlavetz* | Received 1 February 2018 | Accepted 11 June 2018 | Published 3 December 2018

<http://zoobank.org/D40B458A-3B6E-48D0-A8E9-4BA994D8EC79>

Citation: Shultz JW (2018) A guide to the identification of the terrestrial Isopoda of Maryland, U.S.A. (Crustacea). In: Hornung E, Taiti S, Szlavetz K (Eds) *Isopods in a Changing World*. ZooKeys 801: 207–228. <https://doi.org/10.3897/zookeys.801.24146>

Abstract

The terrestrial isopod fauna of Maryland is inferred using the taxonomic literature, internet-based citizen science projects, and original collecting. Twenty-two species are either known or are likely to occur in the state. This includes 17 mostly-European adventive species that comprise the vast majority of records. Of the five expected native species, three occur in or near marine or estuarine littoral habitats and each has yet to be recorded or recorded from only a single locality. This situation likely reflects the long history of systematic work on the European fauna and the availability of keys for the identification of these taxa, which contrasts with the limited taxonomic work on native species. A taxonomic key, illustrations, and brief descriptions of species known or expected to occur in Maryland are provided.

Keywords

Oniscidea, taxonomy, taxonomic key

Introduction

There are no up-to-date, comprehensive taxonomic keys to the terrestrial isopod species of the eastern United States, the most recent being that of Muchmore (1990). A standard solution to the identification problem has been to send specimens to taxonomic experts, but such expertise is increasingly rare (Sfenthourakis and Taiti 2015). Alternatively, the internet offers several citizen-science projects: BugGuide

(<https://bugguide.net/>), iNaturalist (<https://www.inaturalist.org/>), and Maryland Biodiversity Project (<https://www.marylandbiodiversity.com/>) where photos of specimens can be posted for identification by the internet community. Unfortunately, the photos often do not show key diagnostic features and the specimens thus remain unidentified or even misidentified. Given such problems, it has become common in ecological studies to circumvent the issue by grouping unidentified specimens into look-alike morphospecies, a practice known as “taxonomic minimalism” (Beattle and Oliver 1994), which limits comparisons across studies and may inadvertently inflate or reduce the actual number of species in a study (Krell 2004). This “solution” hampers the ability to associate taxonomic species with particular localities or habitats, to understand the dynamics of communities, and to recognize new native, adventive, or invasive species. The goal of this contribution is to provide a taxonomic key to the 22 species of terrestrial isopods that are known or expected to occur in Maryland as a step toward reducing the need for taxonomic minimalism in ecological studies in the state and adjacent areas.

Most terrestrial isopod species in Maryland are widely distributed and common European adventives (e.g., Hornung and Szilávecz 2003, Hornung et al. 2015, Norden 2008). Consequently, identification tools designed for use in Europe (e.g., Hopkin 2014) may be useful in the eastern United States and can potentially identify native forms to genus (e.g., *Ligidium*, *Miktoniscus*). Still, because such keys deal with a more diverse fauna than exists in Maryland and may omit some European species, such as *Chaetophiloscia sicula* (Hornung and Szilávecz 2003), the potential for misidentification is increased.

Maryland’s native terrestrial isopod fauna is small and probably consists of five species. Three marine or estuarine littoral species are either known from the state, *Miktoniscus spinosus* (Say, 1818) (Trichoniscidae) and *Scyphacella arenicola* Smith, 1873 (Scyphacidae), or are expected to occur based on established distributions, *Littorophiloscia vittata* (Say, 1818) (Halophilosciidae). Two inland terrestrial species are also expected, *Miktoniscus medcofi* (Van Name, 1940) (Trichoniscidae) and *Ligidium elrodii* (Packard, 1873) (Ligiidae), with the first state record of *L. elrodii* reported here. In addition, *M. spinosus* has been found in moist inland habitats in North Carolina (Schultz 1976) and this could be the case in Maryland. In fact, a recent photo taken at a suburban park in the District of Columbia, which is essentially encompassed geographically by Maryland, appears to show a specimen of *Miktoniscus* sp. (BugGuide: <https://bugguide.net/node/view/1469429>). The paucity of state records for native terrestrial isopods likely reflects several factors, including the lack of taxonomic work on the group, substantial reduction in native habitat, and the limited accessibility of taxonomic keys and other methods of identification.

Basic external anatomy of terrestrial isopods

The isopod body has three main regions or tagmata: head (cephalothorax), pereon (thorax), and pleon (abdomen) (Figure 1C). The anterior part of the head is typically

divided transversely by a raised frontal margin (fm, Figure 1A) that begins on the lateral surface, passes anteriorly ventral to the eye region and dorsal to the base of the antennae, and traverses the anterior surface of the head. It separates the cephalic dorsum (or vertex) (cd, Figure 1A) from the frontal lamina (frl, Figure 1A), a sclerotized region bordered laterally by the bases of the two large antennae. In some cases the frontal margin is interrupted medially or is absent, with the latter obscuring the distinction between the cephalic dorsum and frontal lamina. The frontal margin is often produced into a pair of anterolateral lobes (al, Figure 1A) between the eye region and base of the antenna. The frontal margin may also be produced medially in various ways (e.g., Figs 1A, 4A, C–F).

Each eye consists of either a compound eye (ce, Figure 1A) or one to three ocelli and is absent in some species (e.g., Figure 1C). Antennules (= antennae I) are very small and positioned medial to the base of the large antennae (antenna II). The five proximal articles (antennomeres) of the antennae constitute the peduncle (pe, Figure 1D), with the distal-most article bearing a terminal flagellum (fl, Figure 1D). Most species have only two or three distinct flagellar articles (Figs 3E, 4A, B, 5A, B) but some have 10 or more (Figure 5F, G). Species in the family Trichoniscidae have what can appear to be a thin, tapering undivided flagellum (Figure 2A–C), but inspection with high magnification will reveal multiple articles, the number of which can be useful for species identification.

The pereon consists of seven broad segments (Figure 1C), each bearing a pair of legs (pereopods) ventrally. The dorsal surface of each segment, the tergite (tg, Figure 1D), may be smooth or armed with tubercles or other sculpture (e.g., Figure 2B, C). The tergites bear ventrolateral extensions (epimera) (ep, Figure 1D) that collectively form the protected ventral space within which the legs operate.

The pleon has five free segments. The lateral margins of the first two lack epimera. The remaining three may be abruptly narrower than the last pereonal tergite (b, Figure 1E), often due to the absence or reduction of epimera. However, when large epimera are present, the pleonal margin may appear as a smooth continuation of the pereonal margin (a, Figure 1D).

Each free pleonal segment has a pair of ventral appendages, the pleopods, with a large plate-like part, the exopodite, and a medial part, the endopodite (Figure 1B). The endopodites of the first two pairs are enlarged and elongated in males (en, Figure 1B) and bear species-specific modifications (e.g., Figure 2D–G). The exopodites may have air-filled respiratory tubules called pseudotracheae that function as a lung. The lungs are visible in live specimens as thickened white patches on the lateral part of the exopodites. The white color typically disappears through loss of air when the animal is preserved. In species found in Maryland, the lungs may be absent, present in the first two pairs of pleopods (lg, Figure 1B) or present in all pleopods.

The last apparent segment of the pleon is the pleotelson, a combination of a terminal segment and the telson (pt, Figs 1B, D, 3B, D, 5C–E). The pleotelson has a pair of uropods, each comprising a basal protopodite that articulates distally with a

medial endopodite and lateral exopodite (Figure 1B–D). The relative sizes, lengths, and shapes of these elements and their position with respect to the pleotelson are often useful in identification.

Key to adult terrestrial isopods of Maryland

- 1 Cuticle translucent to white. Eyes absent. Antenna with antennomere V much wider than the other antennomeres (Figure 1C). Associated with ants. (Platyarthridae)..... ***Platyarthrus hoffmannseggii* Brandt, 1833**
- Cuticle color variable. Eyes present, each usually compound or with one or three ocelli. Antenna variable, but antennomere V not significantly wider than the others. Not associated with ants or associated with ants only incidentally **2**
- 2 Antennal flagellum comprising two to many distinct articles (Figs 1D, 3E, 4A, B, 5A, B, F, G) **3**
- Antennal flagellum superficially appearing to be one article, either robust (fl, Figure 1E) or thin, tapering and elongate (Figure 2A–C), but comprising up to six articles visible with high magnification **4**
- 3 Antenna with two distinct flagellar articles (Figs 3E, 4A, B). Uropods may extend beyond elliptical perimeter of the body in dorsal view (Figure 4A, B) or may not (Figure 3B, D) **9**
- Antenna with three distinct flagellar articles (Figure 5A, B). Uropods extending beyond elliptical perimeter of body in dorsal view; protopodite usually not extending beyond pleotelson; exopodite large, conical or spear-head shaped; endopodite thin (Figure 5A, B, D) **16**
- Antenna with four distinct flagellar articles (Figure 1D). Uropods completing posterior elliptical perimeter of body in dorsal view, protopodite large, dorsoventrally flattened; exopodite small, endopodite elongate (Figure 1D). (Detonidae) ***Armadilloniscus ellipticus* (Harger, 1878)**
- Antenna with flagellum long, comprising 10 or more flagellar articles (Figure 5F, G). Uropods extending beyond elliptical perimeter of body in dorsal view; with protopodite robust, projecting posteriorly beyond pleotelson; endopodite and exopodite thin, elongate (Figure 5F, G). (Ligiidae) **19**
- 4 Compound eye present. Antennal flagellum approx. the same width basally as antennomere V and comprising four articles that decrease in size distally (fl, Figure 1E). Sandy marine beaches. (Scyphacidae) ***Scyphacella arenicola* Smith, 1873**
- Compound eye absent, but with one or three ocelli. Antennal flagellum abruptly narrower than preceding article, a narrow tapering cone (Figure 2A–C) comprising up to six articles visible with high magnification. Not usually associated with sandy marine beaches. (Trichoniscidae) **5**

- 5 Surface of pereon smooth; without tubercles, denticles or other sculpture (Figure 2A) **6**
- Surface of pereon sculptured, with tubercles and/or denticles (Figure 2B, C).... **7**
- 6 Each eye with three ocelli. Antenna with four or five flagellar articles visible with high magnification. Body length up to 5 mm (Figure 2A)
 ***Trichoniscus pusillus* Brandt, 1833**
- Each eye with one ocellus. Antenna with six flagellar articles visible with high magnification. Body similar to Figure 2A, length up to 7 mm
 ***Hyloniscus riparius* (C. L. Koch, 1838)**
- 7 Pereon with tubercles or denticles on longitudinal ridges (Figure 2B). Pleon not abruptly narrower than pereon; pleonal tergites with prominent epimera. Cuticle translucent or white, without dark pigments. Antenna with three flagellar articles visible with high magnification
 ***Haplophthalmus danicus* Budde-Lund, 1880**
- Pereon with tubercles in transverse or roughly transverse rows (Figure 2C). Pleon abruptly narrower than pereon. Cuticle pigmented. Antenna with four flagellar articles visible with high magnification. (*Miktoniscus*) **8**
- 8 Male pleopod I (Figure 2D) with exopodite long, almost as long as endopodite, ending in point; tip of endopodite long, round in cross section. Near marine or estuarine grasses, debris, etc. but may also occur in moist inland habitats ***Miktoniscus spinosus* (Say, 1818)**
- Male pleopod I (Figure 2F) with exopodite shorter, approx. half the length of endopodite, tapering distally but terminus broadly rounded; endopodite long, flattened in cross section. Moist terrestrial habitats
 ***Miktoniscus medcofi* (Van Name, 1940)**
- 9 Exopodite of uropod not extending beyond elliptical perimeter of body in dorsal view; broad, dorsoventrally flattened; protopodite and endopodite largely hidden in dorsal view (Figure 3B, D, E, cf. 1B). In life, able to roll into a ball with antennae hidden. (Armadillidiidae: *Armadillidium*) **10**
- Exopodite of uropod extending beyond elliptical perimeter of body in dorsal view; protopodite visible in dorsal view; exopodite prominent, attaching at terminus of protopodite, broad basally, tapering distally; endopodite thin, attaching at medial base of protopodite (Figure 4A, B). In life, unable to roll into a ball or, if able to enroll, antennae remain exposed **11**
- 10 Head with median frontal projection extending dorsally, with dorsal margin overlapping anterior edge of cephalic dorsum (fp, Figure 3A). Pleotelson subtrapezoidal, with posterior margin nearly straight (pt, Figure 3B)
 ***Armadillidium vulgare* (Latreille, 1804)**
- Head with prominent, median frontal projection extending dorsoanteriorly and not overlapping anterior edge of cephalic dorsum (fp, Figure 3C). Pleotelson subtriangular with posterior apex variably produced, but typically with rounded terminus (pt, Figure 3D) ***Armadillidium nasatum* Budde-Lund, 1885**

- 11 Pleon abruptly narrower than pereon (Figure 4B). Anterolateral lobes very small. Cuticle often with frosted-gray or dusty appearance, but this may be absent. Antennomeres IV and V usually with white terminal band. Frontal margin without evident median projection. (Porcellionidae, in part).....
 ***Porcellionides pruinus* (Brandt, 1833)**
- Pleon not abruptly narrower than pereon (Figure 4A). Anterolateral lobes prominent (Figure 4A, C–F). Cuticle without frosted-gray appearance. Antenna color variable but antennomeres IV and V usually without terminal white bands. Frontal margin with some form of median projection (Figure 4A, C–F) **12**
- 12 Dorsal surface of pereon essentially smooth **13**
- Dorsal surface of pereon with numerous bumps or tubercles..... **14**
- 13 Posterolateral margin of first pereonal tergite produced posteriorly into pointed angle (arrow, Figure 4F). Five pairs of lungs present. Frontal margin of head with small median triangular projection (Figure 4F) corresponding to vertical median carina of frontal lamina (ca, Figure 1A). In life, capable of rolling into a ball with antennae exposed. (Cylisticidae).....
 ***Cylisticus convexus* (De Geer, 1778)**
- Posterolateral angle of first pereonal tergite bluntly rounded, not produced posteriorly into a pointed angle (arrow, Figure 4E). Lungs restricted to pleopods I and II. Frontal margin with broad, convex median projection (Figure 4E). In life, not capable of rolling into a ball. (Porcellionidae, in part).....
 ***Porcellio laevis* Latreille, 1804**
- 14 Anterolateral lobes very prominent and broad, width of each approx. one-third width of head; in dorsal view, junction between median projection and anterolateral lobes V-shaped or nearly so (Figure 4C). Head dark brown to black, contrasting with base color of pereon. Pereon with dark mid-dorsal stripe (sometimes broken), usually bordered laterally by bright yellow markings that may be lost in preservative. (Porcellionidae, in part)
 ***Porcellio spinicornis* Say, 1818**
- Anterolateral lobes not so wide, joining convex median projection via curved margin, not V-shaped notches (Figure 4A, D). Head color not usually contrasting with base color of pereon. Pereon with dorsal color variable; if dark median line present, then not bordered by bright yellow markings **15**
- 15 Five pairs of lungs. Dorsum of pereon with low, irregular bumps and tubercles; surface usually with pattern of dark brown, reddish brown and tan; lateral surface at base of epimera with tan to nearly-white patches creating a pair of broken lines. Frontal margin with broad convex median projection (Figure 4D). (Trachelipodidae) ***Trachelipus rathkii* (Brandt, 1833)**
- Lungs restricted to pleopods I and II (as in Figure 1B). Dorsum of pereon tuberculate; color variable, ranging from solid brown or gray to various patterns, sometimes similar to *Trachelipus* but usually without a pair of broken light lines at base of epimera. Frontal margin with prominent triangular to subtriangular median projection with rounded apex (Figure 4A). (Porcellionidae, in part) ***Porcellio scaber* Latreille, 1804**

- 16 Head with prominent anterolateral lobes. Pleon not abruptly narrower than pereon, body broad and distinctly elliptical in dorsal view (Figure 5A). (Oniscidae)..... ***Oniscus asellus* Linnaeus, 1758**
- Head without anterolateral lobes. Pleon abruptly narrower than pereon, body more elongate, oblong in dorsal view (Figure 5B). **17**
- 17 Found in vegetation or under objects near marine or brackish water. Pleotelson with lateral margins weakly concave, posterior apex bluntly rounded to truncate (pt, Figure 5E). Head with color similar to that of pereon; pereon often with dark mid-dorsal line bordered laterally by bright yellow splotches. (Halophilosciidae) ***Littorophiloscia vittata* (Say, 1818)**
- Found in terrestrial environments. Pleotelson with lateral margins essentially straight (pt, Figure 5D) or distinctly concave (pt, Figure 5C). Coloration differing from above. (Philosciidae)..... **18**
- 18 Pleotelson triangular, with lateral margins straight or nearly so in dorsal view, posterior apex blunt (pt, Figure 5D). Pleon rather elongate, sides straight in dorsal view, epimera not forming lateral serration. Dorsal coloration of pereon purple-brown with small, light longitudinal markings (lineoles), typically without distinct mid-dorsal stripe; head color similar to pereon. Thus far known in Maryland only from forests in Baltimore..... ***Chaetophiloscia sicula* Verhoeff, 1908**
- Pleotelson with lateral margins distinctly concave, posterior apex pointed (pt, Figure 5B,C). Pleon more compact, epimera giving sides a serrate appearance in dorsal view. Dorsal coloration of pereon highly variable, but often brown with pattern of lighter markings, usually with very dark mid-dorsal line; head dark brown to black, often contrasting with lighter pereon. Widespread. (Philosciidae) ***Philoscia muscorum* (Scopoli, 1763)**
- 19 Uropod with protopodite very long, surpassing posterior terminus of pleotelson by more than the length of pleotelson; endopodite and exopodite long and thin, about equal in length, both arising from tip of protopodite (Figure 5F). Marine or brackish shorelines, splash zone, and directly adjacent areas. Larger, up to 4.8 cm ***Ligia exotica* Roux, 1828**
- Uropod with protopodite exceeding posterior tip of pleotelson by about one length of the pleotelson or less; endopodite about 1.5 times the length of exopodite, endopodite arising from protopodite proximal to exopodite (Figure 5G). Wet litter in woodlands, wetlands, near streams, etc. in mountains. Smaller, up to 1 cm ***Ligidium elrodii* (Packard, 1873)**

Family and species summaries

Family Armadillidiidae (*Armadillidium*) (Figs 1B, 3A–E)

Length up to 15 mm. Compound eyes present. Frontal lamina with broad projection [scutellum] (fp, Figure 3A, C). Frontal margin interrupted medially (Figure 3C) but this is hidden by scutellum in *A. vulgare* (Figure 3A). Anterolateral lobes prominent. An-

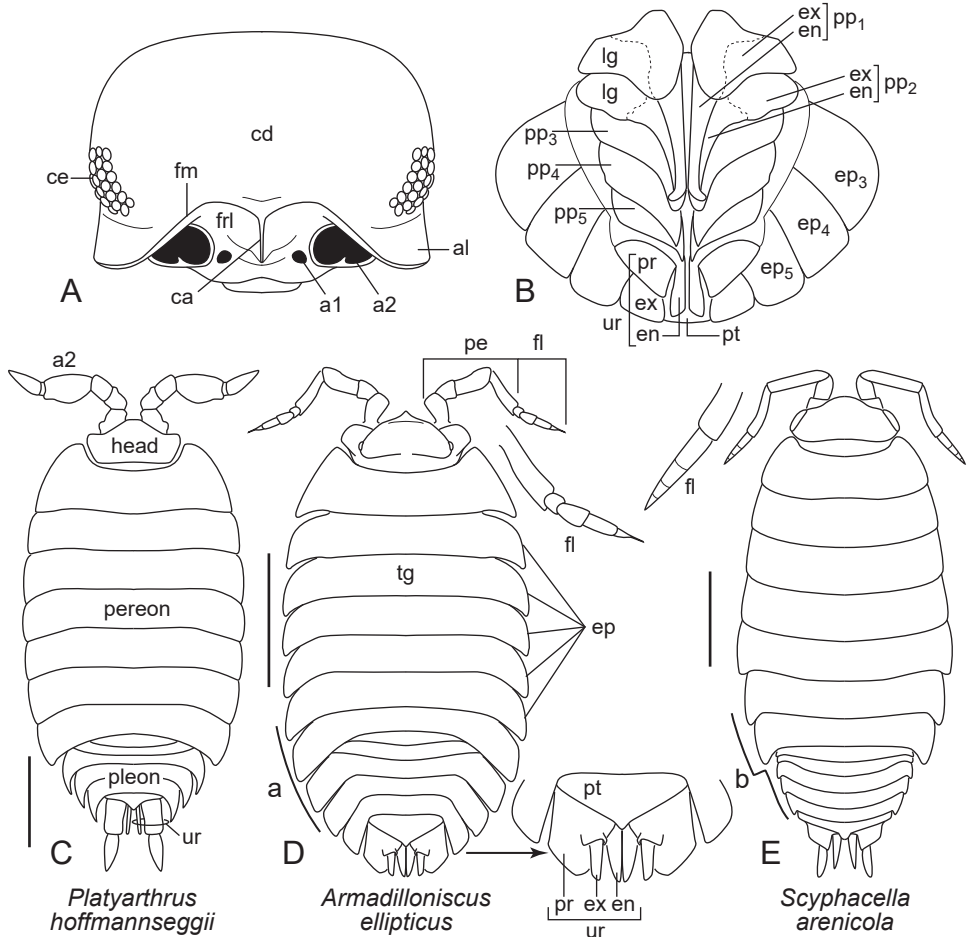


Figure 1. **A** *Cylisticus convexus*, head, dorsoanterior view, antennae removed (based on Schmidt 2008: figure 32) **B** *Armadillidium vulgare*, male pleon, ventral view **C** *Platyarthrus hoffmannseggii* (after Hopkin 2014: figure 17) **D** *Armadilloniscus ellipticus*, insets highlight uropods and antennal flagellum **E** *Scyphacella arenicola*, inset highlights antennal flagellum. Abbreviations: **a** lateral perimeter narrows gradually from pereon to pleon; **a1** socket of antenna I; **a2** antenna II or socket of antenna II; **al** anterolateral lobe; **b** lateral perimeter narrows abruptly from pereon to pleon; **ca** carina; **cd** cephalic dorsum; **ce** compound eye; **en** endopodite; **ex** exopodite; **fl** flagellum; **fm** frontal margin; **frl** frontal lamina; **lg** lung; **tg** tergite; **pe** peduncle of antenna II; **pp** pleopod; **pr** protopodite; **pt** pleotelson; **ur** uropod. Scale bars: 1 mm.

tenna with two distinct flagellar articles (Figure 3E). Pleon not abruptly narrower than pereon (Figure 3E). Lungs limited to first two pairs of pleopods (lg, Figure 1B). Uropod with exopodite broad, dorsoventrally flattened, completing rounded posterior outline of body in dorsal view (ex, Figure 3B, D, E); protopodite and endopodite, largely hidden in dorsal view (Figs 1B, 3B, D). In life, capable of rolling into a ball with antennae hidden.

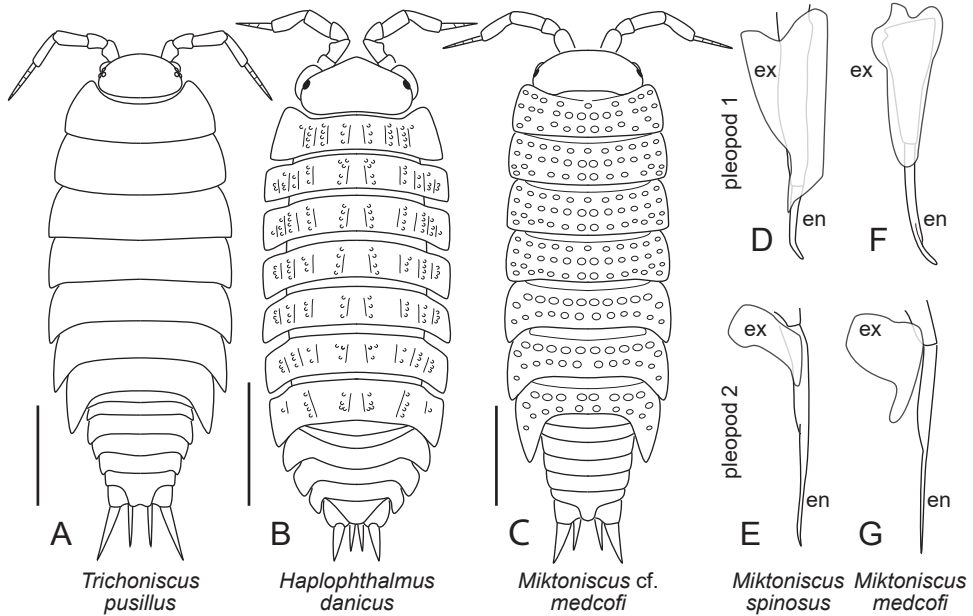


Figure 2. Trichoniscidae. **A** *Trichoniscus pusillus* **B** *Haplophthalmus danicus*, highlighting cuticular sculpture of pereon **C** *Miktoniscus* cf. *medcofi*, highlighting cuticular sculpture of pereon **D–E** *Miktoniscus spinosus*, male **D** right pleopod I, ventral view **E** right pleopod II, ventral view (based on Schultz 1976: figs 8, 9, as *M. halophilus*) **F–G** *Miktoniscus medcofi*, male: **F** right pleopod I, ventral view **G** right pleopod II, ventral view (based on Schultz 1976: figs 40, 41). Abbreviations: **en** endopodite; **ex** exopodite. Scale bars: 1 mm.

Armadillidium vulgare (Latreille, 1804) (Figs 1B, 3A, B)

With features of the family and genus, also the following: Projection of frontal lamina triangular, with broad, transverse dorsal margin overlapping frontal margin (fp, Figure 3A). Pleotelson subtrapezoidal, broadly truncated posteriorly (pt, Figure 3B). Sources: Richardson (1905), Schultz (1982) and Hopkin (2014). U.S. Distribution: Introduced. Throughout contiguous 48 states (Jass and Klausmeier 2000, 2001). Recorded in Maryland by Richardson (1905), Hornung and Szlávecz (2003), Norden (2008), BugGuide, iNaturalist, and Maryland Biodiversity Project. Habitat: Synanthropic. Litter and under stones or other objects, occurs in somewhat drier conditions than most terrestrial isopods.

Armadillidium nasatum Budde-Lund, 1885 (Figure 3C)

With features of the family and genus, also the following: Projection of frontal lamina extending dorsoanteriorly, not overlapping anterior margin of cephalic dorsum (Figure 3C). Pleotelson subtriangular, with rounded to somewhat pointed posterior apex (pt, Figure 3D). Sources: Richardson (1905), Schultz (1982), and Hopkin (2014).

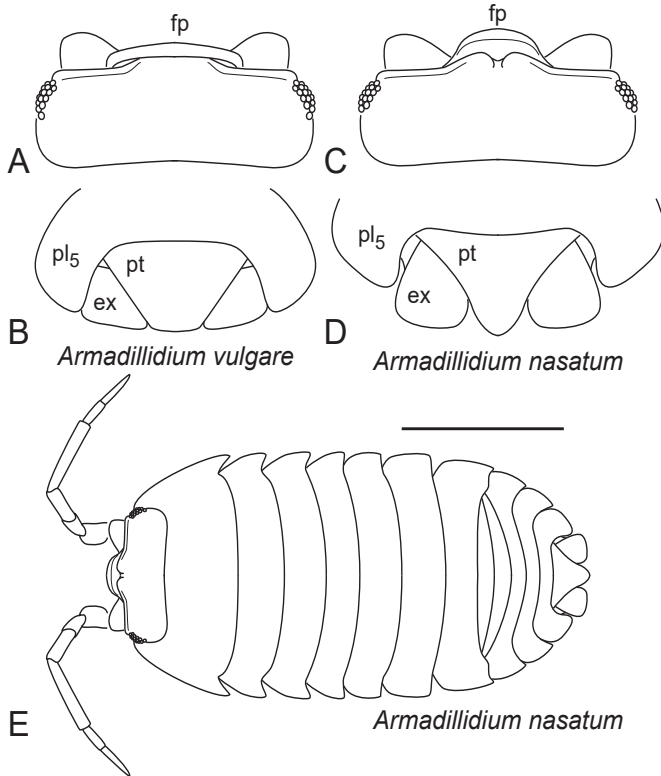


Figure 3. Armadillidiidae. **A–B** *Armadillidium vulgare* **A** head, dorsal view **B** posterior end of pleon, dorsal view **C–E** *Armadillidium nasatum* **C** head, dorsal view **D** posterior end of pleon, dorsal view **E** Dorsal view. Abbreviations: **ex** exopodite of uropod; **fp** frontal projection; **pl₅** pleonal tergite V; **pt** pleotelson. Scale bar: 5 mm.

U.S. Distribution: Introduced. Eastern and central states, also Idaho and California (Jass and Klausmeier 2000, 2001). Recorded in Maryland by Smith and Goodhue (1945), Hornung and Szlávecz (2003), Norden (2008), Hornung et al. (2015), BugGuide, iNaturalist, and Maryland Biodiversity Project. Habitat: Synanthropic. Litter and under stones or other objects, often in drier habitats than most terrestrial isopods.

Family Cylisticidae (*Cylisticus*)

Cylisticus convexus (De Geer, 1778) (Figs 1A, 4F)

Body length up to 15 mm. Compound eyes present. Antenna with two distinct flagellar articles. Frontal lamina divided by median vertical ridge (carina) that terminates dorsally as a small, triangular median projection at frontal margin (ca, Figure 1A). Anterolateral lobes prominent (al, Figs 1A, 4F). Posterolateral margin

of first pereonal tergite produced into broad, posteriorly pointed angle (arrow, Figure 4F), thus distinguishing it from *Porcellio laevis* (arrow, Figure 4E). Surface of pereon smooth. Pleon not abruptly narrower than pereon (as in Figure 4A). Five pairs of lungs. In life, capable of rolling into a ball, with antennae exposed. Sources: Richardson (1905), Schultz (1982) and Hopkin (2014). U.S. Distribution: Introduced. Throughout most of contiguous 48 states (Jass and Klausmeier 2000, 2001). Recorded in Maryland by Hornung and Szlávecz (2003), Norden (2008), Hornung et al. (2015), BugGuide, and Maryland Biodiversity Project. Habitat: A variety of moist litter and soil habitats.

Family Detonidae (*Armadilloniscus*)

Armadilloniscus ellipticus (Harger, 1878) (Figure 1D)

Body length up to 4 mm. Compound eye present, each with five to ten facets. Antenna with four distinct flagellar articles (fl, Figure 1D), an additional minute terminal article may be present. Pleon not abruptly narrower than pereon (a, Figure 1D). Lungs absent. Uropods with protopodite greatly enlarged, flattened, projecting posteriad far beyond pleotelson, resembling adjacent tergal extension; exopodite short, arising from dorsomedial margin of protopodite; endopodite long, arising from base of protopodite; protopodite, exopodite (ex) and endopodite (en) all ending posterior to pleotelson (pt) (Figure 1D). Sources: Harger (1880), Richardson (1905) and Schultz (1982). U.S. Distribution: Probably introduced. Massachusetts, New York, North Carolina, Florida (Jass and Klausmeier 2000, 2001), and Alabama (BugGuide). Not yet recorded from Maryland. Scattered, worldwide distribution (Schmalfuss 2003). Habitat: Drift line on marine shores, especially under planks, stones, vegetation, etc. Clings to under-surface of objects, usually does not run when disturbed (Schultz 1982).

Family Halophilosciidae (*Littorophiloscia*)

Littorophiloscia vittata (Say, 1818) (Figure 5E)

Body length up to 5 mm. Compound eyes present. Head without anterolateral lobes. Antenna with three distinct flagellar articles (as in Figure 5B). Pleon abruptly narrower than pereon (as in Figure 5B). Lungs absent. Unable to roll into a ball. Head color usually similar to that of pereon. Pereon and pleon usually with dark median stripe bordered by bright yellow patches, also a series of lateral submarginal yellow markings. Pleotelson with lateral margins weakly concave, posterior end rounded to almost truncate (pt, Figure 5E). Sources: Schultz (1963, 1974). U.S. Distribution: Native. Coasts of Atlantic Ocean and Gulf of Mexico, New York to Texas (Jass and Klausmeier 2000, 2001), not yet recorded from Maryland. Habitat: Marine and brackish shores

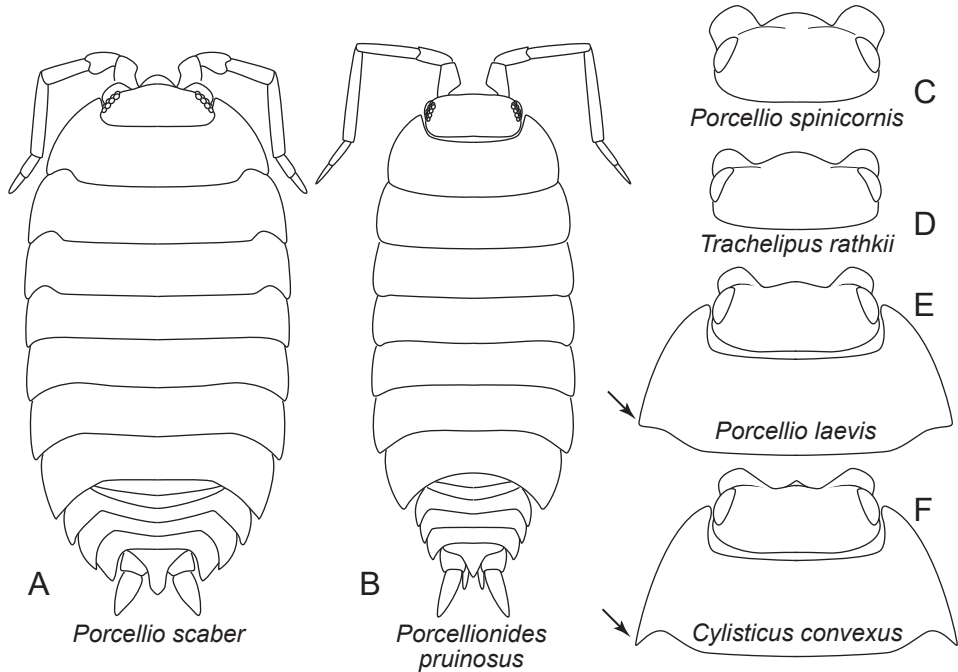


Figure 4. Porcellionidae, Trachelipodidae, Cylisticidae. **A** *Porcellio scaber* **B** *Porcellionides pruinosus* **C** *Porcellio spinicornis*, head, dorsal view **D** *Trachelipus rathkii*, head, dorsal view **E** *Porcellio laevis*, head and first pereopod, dorsal view **F** *Cylisticus convexus*, head and first pereopod, dorsal view.

between water and drift line, but also somewhat farther away from shore under objects, in marsh grass, debris, etc. (Schultz 1974).

Family Ligiidae (*Ligia*, *Ligidium*) (Figure 5F, G)

Compound eyes present, very large with many facets. Antenna with many (> 10) flagellar articles. Uropod with protopodite projecting posteriorly beyond tip of pleotelson; endopodite and exopodite long and thin. Lungs absent. Rapid runners.

Ligia exotica Roux, 1828 (Figure 5F)

Only marine littoral species known in Maryland with features of the family, also the following: Body length (excluding uropods) up to 30 mm. Antenna, especially flagellum, very long with more than 20 flagellar articles. Pleon not abruptly narrower than pereon, outline of body fusiform, tapering posteriorly. Uropod with protopodite very long, cylindrical; endopodite and exopodite nearly equal in length, attaching to protopodite at its terminus, total length of uropod up to 18 mm. Sources: Richardson (1905) and Schultz

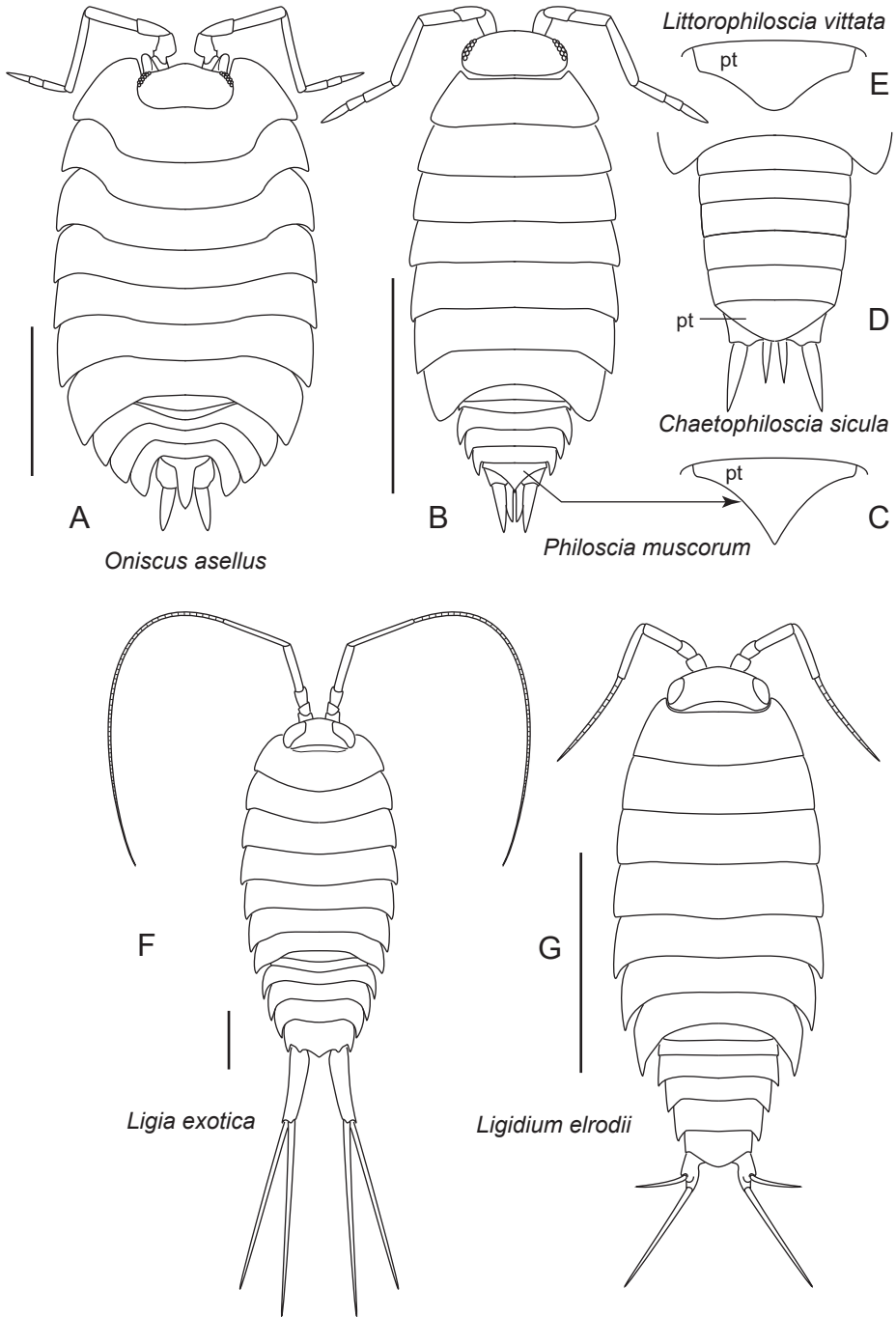


Figure 5. Oniscidae, Philosciidae, Halophilosciidae, Ligiidae. **A** Oniscidae: *Oniscus asellus* **B–E** Philosciidae **B–C** *Philoscia muscorum* **B** dorsal view **C** pleotelson **D** *Chaetophiloscia sicula*: dorsal view of pleon (after Vandel 1962: figure 247) **E** *Littorophiloscia vittata*: pleotelson, dorsal view **F–G** Ligiidae **F** *Ligia exotica* **G** *Ligidium elrodii*. Scale bars: 5 mm.

(1982). U.S. Distribution: Introduced. Known from New Jersey, North and South Carolina, Texas, Florida and California (Jass and Klausmeier 2000, 2001). Recorded from Maryland (Chesapeake Bay) by BugGuide, iNaturalist, and Maryland Biodiversity Project. Habitat: Marine to brackish shoreline, especially adjacent surfaces (pilings, rocks, etc.)

Ligidium elrodii (Packard, 1873) (Figure 5G)

Only terrestrial species to occur in Maryland with features of the family, also the following: Body length up to 10 mm. Antenna with approx. 11 flagellar articles. Uropod with protopodite extending distad to pleotelson; endopodite articulating with protopodite at a point distad to articulation with exopodite, endopodite almost 1.5 times longer than exopodite. Sources: Richardson (1905) and Schultz (1970, 1982). U.S. Distribution: Native. Known from localities throughout the eastern states, also California [?] (Jass and Klausmeier 2000, 2001). Recently recorded from forests in Garrett County (J. Shultz, original observation). Habitat: Moist to wet litter and moss especially near swamps, marshes, springs, ponds, streams, also caves.

Family Oniscidae (*Oniscus*)

Oniscus asellus Linnaeus, 1758 (Figure 5A)

Body length up to 16 mm. Perimeter a wide ellipse in dorsal view. Compound eyes present. Antenna with three distinct flagellar articles. Head with prominent anterolateral lobes. Pleon not abruptly narrower than pereon. Lungs absent. Pleotelson elongate, pointed. Dorsoventrally flattened, not capable of rolling into a ball. Sources: Richardson (1905), Schultz (1982), and Hopkin (2014). U.S. Distribution: Introduced. Scattered eastern and central states, also Washington and Oregon (Jass and Klausmeier 2000, 2001). Recorded from Maryland by Norden (2008), BugGuide, iNaturalist, and Maryland Biodiversity Project. Habitat: Leaf litter, under bark and similar situations.

Family Philosciidae (*Chaetophiloscia*, *Philoscia*) (Figure 5B–D)

Compound eyes present. Antenna with three distinct flagellar articles (Figure 5B). Head without anterolateral lobes. Pleon abruptly narrower than pereon (Figure 5B, D). Lungs absent. Unable to roll into a ball.

Chaetophiloscia sicula Verhoeff, 1908 (Figure 5D)

With features of the family, also the following: Body length up to 7.5 mm. Body outline similar to Figure 5B, but pleon more elongate and lateral margins smooth, not

serrated (Figure 5D). Pleotelson broad, triangular (width about double the length) with lateral margins straight or nearly so, posterior apex bluntly rounded (pt, Figure 5D). Dorsum with purplish-brown pigment interrupted by median series of small light markings and over much of surface by light longitudinal markings (lineoles); epimera pigmented except for distal light marginal line and proximal light mark that widens anteriorly; head with markings similar to pereon. Source: Vandel (1962). U.S. Distribution: Introduced. Known thus far only from Baltimore, Maryland (Hornung and Szlávecz 2003). Habitat: In Baltimore, litter in mature temperate deciduous forest.

Philoscia muscorum (Scopoli, 1763) (Figure 5B, C)

With features of the family, also the following: Body length up to 12 mm. Pleon compact with epimera forming serrated lateral margin (Figure 5B). Pleotelson with lateral margins concave, posterior apex pointed (pt, Figure 5C). Head typically dark, often contrasting with lighter pereon. Pereon usually with dark mid-dorsal stripe. Sources: Schultz (1974) and Hopkin (2014). U.S. Distribution: Introduced. New England, New York, New Jersey; also Washington State (Jass and Klausmeier 2000, 2001). Recorded from Maryland by Schultz (1974), Hornung and Szlávecz (2003), Norden (2008), Hornung et al. (2015), BugGuide, iNaturalist, and Maryland Biodiversity Project. Habitat: A variety of mesic terrestrial habitats.

Family Platyarthridae (*Platyarthrus*)

Platyarthrus hoffmannseggii Brandt, 1833 (Figure 1C)

Body length up to 5 mm. Cuticle white to translucent. Eyes absent. Antenna with pre-flagellar antennomere very robust, wider than other peduncular antennomeres; flagellum superficially appearing to be undivided but actually with two articles, basal article very short. Anterolateral lobes prominent. Pleon not abruptly narrower than pereon. Lungs absent. Source: Hopkin (2014). U.S. Distribution: Introduced. Recorded from New York, Connecticut (Jass and Klausmeier 2000, 2001) and Philadelphia, Pennsylvania (BugGuide). Not yet reported from Maryland, but the record from Philadelphia indicates that it may occur in the state. Habitat: Soil, associated with ants.

Family Porcellionidae (*Porcellio*, *Porcellionides*) (Figure 4A–C, E)

Compound eyes present. Antennae with two distinct flagellar articles (Figure 4A, B). Lungs restricted to pleopods I and II. Uropods extending posteriad beyond end of pleotelson (Figure 4A, B).

Porcellio laevis Latreille, 1804 (Figure 4E)

With features of the family, also the following: Body length up to 18 mm. Large, broad species, body outline similar to Figure 4A. Medial frontal margin projecting anteriorly as a broad weakly convex edge. Anterolateral lobes prominent, each less than third the width of head. Pereon smooth, without tubercles or other significant sculpture. Pleon not abruptly narrower than pereon (as in Figure 4A). Posterolateral angle of first tergite bluntly rounded, not produced posteriorly (arrow, Figure 4E). Source: Hopkin (2014). U.S. Distribution: Introduced. Widely distributed in the contiguous 48 states (Jass and Klausmeier 2000, 2001). First records from Maryland are vacant lots in Baltimore City (K. Szlávecz, unpublished observation) as well as agricultural fields in Anne Arundel and Prince Georges Counties and forests in Garrett County (J. Shultz, original observation). Habitat: Diverse environments, especially synanthropic habitats.

Porcellio scaber Latreille, 1804 (Figure 4A)

With features of the family, also the following: Body length up to 17 mm. Head with frontal margin produced medially to form a prominent triangular to subtriangular projection. Dorsal surface of head and pereon with numerous tubercles. Pleon not abruptly narrower than pereon. U.S. Distribution: Introduced. Widely distributed in the northeastern, north-central, and western states, also Florida (Jass and Klausmeier 2000, 2001). Recorded from Maryland by Richardson (1905), Hornung and Szlávecz (2003), Norden (2008) and Maryland Biodiversity Project. Habitat: Diverse mesic terrestrial habitats.

Porcellio spinicornis Say, 1818 (Figure 4C)

With features of the family, also the following: Body length up to 12 mm. Body outline similar to Figure 4A. Head with frontal margin produced medially into broad convex to rectangular projection that extends laterally almost to the medial edge of large anterolateral lobes; each anterolateral lobe about a third the width of head; in dorsal view, the median and anterolateral lobes join at V-shaped notch. Head dark, pereon generally lighter than head but with dark median stripe; in life, dark stripe bordered laterally by bright yellow markings. Source: Hopkin (2014). U.S. Distribution: Introduced. Northeastern and northern Great Lake states, Nebraska, Tennessee, Arkansas (Jass and Klausmeier 2000, 2001); also North Dakota, Iowa (BugGuide), and Ohio (iNaturalist). Not yet recorded from Maryland. Habitat: Moist substrates and associated vertical surfaces.

Porcellionides pruinosus (Brandt, 1833) (Figure 4B)

With features of the family, also the following: Body length up to 12 mm. Body often with frosted gray-white appearance due to layer of microscopic beads, structural color that varies with lighting and timing of molt cycle (Hadley and Hendricks 1985). When coating absent, color varying but often red-brown, sometimes with light wavy

markings. Head with frontal margin lacking median projection. Anterolateral lobes weakly developed. Antennae with articles IV and V with terminal white bands; first flagellar article about twice as long as second. Pleon abruptly narrower than pereon. Sources: Richardson (1905), Schultz (1982) and Hopkin (2014). U.S. Distribution: Introduced. Recorded throughout the contiguous 48 US states. Recorded in Maryland by Richardson (1905) (as *Metoponorthus pruinosus*); *Porcellionides* sp. recorded by Maryland Biodiversity Project. Habitat: Rotting logs, dung, etc.

Family Scyphacidae

Scyphacella arenicola Smith, 1873 (Figure 1E)

Body length up to 5 mm. Compound eyes present. Antennae with four flagellar articles that decrease in length distad, base of flagellum only slightly narrower than preceding article. Head without frontal margin, no clear border between cephalic dorsum and frontal lamina. Pereon with numerous scales; cuticle tuberculate, each tubercle tipped with small spine. Source: Richardson (1905), Schultz (1972). U.S. Distribution: Native. Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, and Florida (Jass and Klausmeier 2000, 2001). Reported from Maryland (Dorchester Co.) by Richardson (1905) and Schultz (1972) at Choptank River (not “Cleoptauk River”). Habitat: Littoral; marine sand beaches above high water mark.

Family Trachelipodidae

Trachelipus rathkii (Brandt, 1833) (Figure 4D)

Body length up to 15 mm. Body outline similar to Figure 4A in dorsal perspective. Compound eyes present. Antennae with two distinct flagellar articles. Pereon with low bumps or tubercles; surface usually mottled dark brown, red brown and tan, with distinct lateral tan patches at base of epimera creating a pair of broken lateral light lines. Five pairs of lungs. Uropods projecting beyond pleotelson and general body outline. Sources: Richardson (1905) and Hopkin (2014). U.S. Distribution: Introduced. Maine south to North Carolina and west to Wisconsin and Arkansas; also Washington State (Jass and Klausmeier 2001). Recorded in Maryland by Norden (2008), Hornung et al. (2015), BugGuide, iNaturalist, and Maryland Biodiversity Project. Habitat: Moist soil, leaf litter, etc.

Family Trichoniscidae (*Haplophthalmus*, *Hyloniscus*, *Miktoniscus*, *Trichoniscus*) (Figure 2)

Body length < 8 mm. Each eye with one ocellus (*Haplophthalmus*, *Hyloniscus*, *Miktoniscus*) or three ocelli (*Trichoniscus*). Antenna ending in a narrow, tapering, pointed

flagellum (Figure 2A–C) comprising up to six articles when observed using high magnification. Lungs absent. Pleotelson with terminus truncate or with median notch or concavity (emarginate), not pointed (Figure 2A–C).

Haplophthalmus danicus Budde-Lund, 1880 (Figure 2B)

With features of the family, also the following: Body length up to 4 mm. Each eye with one ocellus. Antennae with three flagellar articles observable with high magnification. Cuticle lacking dark pigments; translucent, white or cream. Head densely tuberculate dorsally, tubercles conical. Tergites of pereon armed with low longitudinal crests with roughened and/or tuberculate dorsal surfaces. Pleon segments III–V with prominent epimera; outline of pleon not abruptly narrower than pereon. Sources: Richardson (1905), Schultz (1982) and Hopkin (2014). U.S. Distribution: Introduced. Known from the eastern and southwestern states (Jass and Klausmeier 2000, 2001). Recorded in Maryland by Lohmander (1927), Hornung and Szlávecz (2003), Norden (2008) and Hornung et al. (2015). Habitat: Moist litter and debris.

Hyloniscus riparius (C. L. Koch, 1838)

With features of the family, also the following: Body length up to 7 mm. Body outline similar to Figure 2A. Each eye with one ocellus. Antennae with six flagellar articles observable with high magnification. Dorsum smooth, without tubercles or other sculpture. Pleon abruptly narrower than pereon. Male with hook on third segment (merus) of pereopod 7. U.S. Source: Richardson (1905) and Schultz (1965). U.S. Distribution: Introduced. Recorded from Maryland by Hornung and Szlávecz (2003), Norden (2008) and Hornung et al. (2015). Habitat: Moist to wet soil or litter, flood plains.

Miktoniscus spinosus (Say, 1818) (= *M. halophilus* Blake, 1931) (Figure 2C–E)

With features of the family, also the following: Body length up to 5 mm. Each eye with one ocellus. Antennae with four flagellar articles observable with high magnification. Dorsum of pereon with transverse to roughly transverse rows of tubercles. Pleon abruptly narrower than pereon. In male: Pleopod I with exopodite an elongate plate narrowing distally to a terminal point, exopodite only slightly shorter than endopodite; endopodite cylindrical, terminating with a distinct medial bend (Figure 2D). Pleopod II with plate-like endopodite short, with small distomedial lobe; terminus of endopodite spatulate with square apical border (Figure 2E). Source: Schultz (1976). U.S. Distribution: Native. Coastal reed marshes from Massachusetts south to Georgia (Schultz 1976, 2001); unidentified *Miktoniscus* in DC (BugGuide). Recorded from “edge of an estuary” in Calvert County, Maryland by Schultz (1976) as *M. halophilus*. Habitat: Brackish and estuarine marshes along the Atlantic Coast,

also moist leaf litter of inland forests in river bottoms and near streams in piedmont of North Carolina (Schultz 1976).

Miktoniscus medcofi (Van Name, 1940) (Figure 2C, F, G)

With features of the family, also the following: Body length up to 5 mm. Each eye with one ocellus. Antennae with four flagellar articles visible with high magnification. Dorsum of pereon with transverse to roughly transverse rows of tubercles. Pleon abruptly narrower than pereon. In male: Pleopod I with plate-like exopodite tapering distally to broadly rounded apex; endopodite tapering and flattened distally but resulting lamella with central longitudinal “mid-rib”, terminus with file-like striations under high magnification (Figure 2F). Pleopod II with plate-like exopodite comparatively long with long distomedial lobe; terminus of endopodite not spatulate (Figure 2G). Sources: Van Name (1940) and Schultz (1976). U.S. Distribution: Native. New York south to Florida west to central states (Jass and Klausmeier 2000, 2001), including Texas (Hutchins and Drukker 2016); unidentified *Miktoniscus* in DC (BugGuide). Not yet recorded from Maryland, but its presence in adjacent areas suggests that it occurs in the state. Habitat: Moist soil, under logs, caves.

Trichoniscus pusillus Brandt, 1833 (Figure 2A)

With features of the family, also the following: Body length up to 5 mm. Each eye with three ocelli. Antenna with four or five flagellar articles visible using high magnification. Dorsal cuticle smooth, with reddish to purplish pigments. Pleon abruptly narrower than pereon. Posterior margin of pleotelson with median concavity (emarginate). Sources: Richardson (1905), Schultz (1982) and Hopkin (2014). U.S. Distribution: Introduced. Northeastern states from Maine south to North Carolina and west to Wisconsin and Arkansas; also Washington State (Jass and Klausmeier 2001). Recorded in Maryland by Hornung and Szlávecz (2003) and Norden (2008). Habitat: Moist soil and litter.

Acknowledgements

An earlier version of this key was developed at the University of Maryland for use in a graduate course on terrestrial arthropods. I thank Katalin Szlávecz for suggesting that I develop the key further for inclusion in this symposium. Reviewers Sandor Farkas and Stefano Taiti provided many helpful and constructive comments. Specimens of *Ligidium elrodii* were found by the author in pitfall samples provided by the Maryland Department of Natural Resources. I thank Jennifer Selfridge and Gwen Brewer for access to these samples. The author was supported by the Maryland Agricultural Experiment Station.

References

- Beattle AJ, Oliver I (1994) Taxonomic minimalism. *Trends in Ecology & Evolution* 9: 488–490. [https://doi.org/10.1016/0169-5347\(94\)90320-4](https://doi.org/10.1016/0169-5347(94)90320-4)
- Blake CH (1931) New land isopods from New England. *Occasional Papers of the Boston Society of Natural History* 5: 341–348. <https://biodiversitylibrary.org/page/36241657>
- Brandt I (1833) *Conspectus Monographiae Crustaceorum Oniscodorum Latreillii*. *Byulleten moskovskogo Obshchestva Ispytatelei Prirody* 6: 171–193.
- Budde-Lund G (1880) Isopoda [Oniscidea]. In: Meinert F, *Crustacea Isopoda, Amphipoda et Decapoda Daniae*. *Naturhistorisk Tidsskrift* 12: 467–470.
- Budde-Lund G (1885) *Crustacea Isopoda Terrestrial per Familias et Genera et Species Descripta*. Copenhagen, 319 pp. <https://doi.org/10.5962/bhl.title.109769>
- De Geer A (1778) Des cloportes. *Mémoires pour Server a l'Histoire des Insectes* 7: 545–554.
- Hadley NF, Hendricks GM (1985) Cuticular microstructures and their relationship to structural color and transpiration in the terrestrial isopod *Porcellionides pruinosus*. *Canadian Journal of Zoology* 63: 649–656. <https://doi.org/10.1139/z85-093>
- Harger O (1878) Descriptions of new genera and species of Isopoda, from New England and adjacent regions. *American Journal of Science and Arts, Series 3*, 15: 373–379. <https://doi.org/10.2475/ajs.s3-15.89.373>
- Harger O (1880) Report on the marine Isopoda of New England and adjacent waters. Report of the U. S. Commissioner of Fish and Fisheries, 1878, Part 6: 297–462. <https://doi.org/10.5962/bhl.title.1391>
- Hopkin S (2014) A key to the woodlice of Britain and Ireland. FSC Publications, Telford, 52, 32.
- Hornung E, Szilávecz K (2003) Establishment of a Mediterranean isopod (*Chaetophiloscia sicula* Verhoeff, 1908) in a North American temperate forest. *Crustaceana Monographs* 2: 181–189.
- Hornung E, Szilávecz K, Dombos M (2015) Demography of some non-native isopods (Crustacea, Isopoda, Oniscidea) in a Mid-Atlantic forest, USA. *ZooKeys* 515: 127–143. <https://doi.org/10.3897/zookeys.515.9403>
- Hutchins B, Drukker N (2016) *Miktoniscus medcofi* (Isopoda, Trichoniscidae) in Texas: a range extension for the genus and species. *The Southwestern Naturalist* 61(1): 78–79. <https://doi.org/10.1894/0038-4909-61.1.78>
- Jass J, Klausmeier B (2000) Endemics and immigrants: North American terrestrial isopods (Isopoda, Oniscidea) north of Mexico. *Crustaceana* 73(7): 771–799. <https://doi.org/10.1163/156854000504804>
- Jass J, Klausmeier B (2001) Terrestrial isopod (Crustacea: Isopoda) atlas for Canada, Alaska, and the contiguous United States. Milwaukee Public Museum, *Contributions in Biology and Geology* 95: 1–105. <https://research.nhm.org/pdfs/4571/4571.pdf>
- Koch CL (1838) Deutschlands Crustaceen, Myriapoden und Arachniden, ein Beitrag zur deutschen Fauna, Heft 22, Regensburg (Pustet), 1–24.
- Krell J-T (2004) Parataxonomy vs. taxonomy in biodiversity studies – pitfalls and applicability of “morphospecies” sorting. *Biodiversity & Conservation* 13: 795–812. <https://doi.org/10.1023/B:BIOC.0000011727.53780.63>

- Latreille P (1804) Histoire naturelle, générale et particulière, des crustacés et des insectes. Cloportides 7: 25–49.
- Linnaeus C (1758) Systema Naturae. Regnum Animalium. Editio decimal, Vol. 1, Stockholm, 637 pp.
- Lohmander H (1927) On some terrestrial isopods in the United States National Museum. Proceedings of the United States National Museum 72: 1–18. <https://doi.org/10.5479/si.00963801.72-2713.1>
- Muchmore WB (1990) Terrestrial Isopoda. In: Dindal DL (Ed.) Soil Biology Guide. John Wiley & Sons, New York, 805–817.
- Norden AW (2008) The terrestrial isopods (Crustacea: Isopoda: Oniscidea) of Plummers Island, Maryland. Bulletin of the Biological Society of Washington 15(1): 41–43. [https://doi.org/10.2988/0097-0298\(2008\)15\[41:TTICIO\]2.0.CO;2](https://doi.org/10.2988/0097-0298(2008)15[41:TTICIO]2.0.CO;2)
- Richardson H (1905) Monograph on the isopods of North America. Bulletin of the United States National Museum 54: 1–727. <https://doi.org/10.5962/bhl.title.1031>
- Roux P (1828) Crustacés de la Méditerranée et de son Litoral. Ord. Isopodes, Isopoda; Fam. Cloportides, Oniscides [no page numbers]. Paris.
- Packard A (1873) On the cave fauna of Indiana. Annual Report of the Peabody Academy of Sciences 5: 93–97.
- Say T (1818) An account of the Crustacea of the United States. Journal of the Academy of Natural Sciences of Philadelphia 1: 57–80, 97–101, 155–169, 235–253, 313–319, 374–401, 423–441, 445–458.
- Schmalzfuss H (2003) World catalog of terrestrial isopods (Isopoda: Oniscidea). Stuttgarter Beiträge zur Naturkunde, Serie A, 654: 1–341. http://www.oniscidea-catalog.naturkundemuseum-bw.de/Cat_terr_isop.pdf [Accessed: 21 May 2018]
- Schmidt C (2008) Phylogeny of the terrestrial Isopoda (Oniscidea): a review. Arthropod Systematics & Phylogeny 66: 191–226. [http://www.senckenberg.de/root/index.php?page_id=8064#66%20\(2\)](http://www.senckenberg.de/root/index.php?page_id=8064#66%20(2))
- Schultz GA (1963) *Philoscia robusta*, a new species of terrestrial isopod crustacean from southeastern United States. Journal of the Elisha Mitchell Scientific Society 79: 26–29.
- Schultz GA (1965) The distribution and general biology of *Hyloniscus riparius* (Koch) (Isopoda, Oniscoidea) in North America. Crustaceana 8(2): 131–140. <https://doi.org/10.1163/156854065X00659>
- Schultz GA (1970) Descriptions of new subspecies of *Ligidium elrodii* (Packard) *comb. nov.* with notes on other isopod crustaceans from caves in North America (Oniscoidea). The American Midland Naturalist 84: 36–45. <https://doi.org/10.2307/2423724>
- Schultz GA (1972) A review of the family Scyphacidae in the New World (Crustacea, Isopoda, Oniscoidea). Proceedings of the Biological Society of Washington 84: 477–488. <http://direct.biostor.org/reference/74012>
- Schultz GA (1974) The status of the terrestrial isopod crustaceans *Philoscia muscorum*, *P. vittata*, *P. robusta* and *P. miamiensis* in the New World (Oniscoidea, Philosciidae). Crustaceana 27(2): 147–153. <https://doi.org/10.1163/156854074X00352>
- Schultz GA (1976) *Miktoniscus halophilus* Blake, *M. medcofi* (Van Name) and *M. morganensis* n. comb., reconsidered with notes on New World species of the genus (Crustacea,

- Isopoda, Trichoniscidae). *The American Midland Naturalist* 95(1): 28–41. <https://doi.org/10.2307/2424231>
- Schultz GA (1982) Terrestrial isopods (Crustacea: Isopoda: Oniscoidea) from North Carolina. *Brimleyana* 8: 1–26. <https://biodiversitylibrary.org/page/42326111>
- Schultz GA (2001) *Miktoniscus spinosus* (Say, 1818) *nov. comb.* for *Miktoniscus halophilus* Blake, 1931, and *Philoscia spinosa* Say, 1818, from eastern United States (Isopoda, Oniscoidea, Trichoniscidae). *Crustaceana* 74(11): 1397–1399. <https://doi.org/10.1163/15685400152885336>
- Scopoli I (1763) *Entomologia carniolica exhibens Insecta Carnioliae indigena*. Isopoda: 413–415.
- Sfenthourakis S, Taiti S (2015) Patterns of taxonomic diversity among terrestrial isopods. *ZooKeys* 515: 13–25. <https://doi.org/10.3897/zookeys.515.9332>
- Smith FF, Goodhue LD (1945) DDT aerosols to control onion thrips and other pests in greenhouses. *Journal of Economic Entomology* 38: 173–179. <https://doi.org/10.1093/jee/38.2.173>
- Smith SI (1873) Professor Cope's cave crustaceans. *American Naturalist* 7: 244–245.
- Van Name WG (1940) A supplement to the American land and fresh-water isopod Crustacea. *Bulletin of the American Museum of Natural History* 77: 109–142. <http://digitallibrary.amnh.org/handle/2246/1073>
- Vandel A (1962) *Faune de France*, 66. Isopodes terrestres (deuxième partie): 417–931.
- Verhoeff KW (1908) Über Isopoden. 15. Aufsatz. *Archiv für Biontologie* 2: 335–387. <https://biodiversitylibrary.org/page/26708616>