FIRST RECORDS OF *SLAVINA* (OLIGOCHAETA : NAIDIDAE) IN AUSTRALIA AND DESCRIPTION OF A NEW SPECIES

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Specimens of *Slavina appendiculata* d'Udekem, 1855 and *Slavina proceriseta* sp. nov., both from the state of Victoria, represent the first Australian records of this genus of freshwater oligochaetes. *S. proceriseta* sp. nov. from the La Trobe and Murray Rivers is the first naidid apparently restricted to Australia.

THE new *Slavina* material was identified from collections of previously unsorted oligochaete material held by the Museum of Victoria (MV), Melbourne, Victoria and the Murray Darling Freshwater Research Centre (MDFRC) in Albury, NSW. These are the first records of the genus in Australia and the new species is the first member of the cosmopolitan family Naididae known only from Australia.

Family NAIDIDAE

Genus **Slavina** Vejdovsky, 1883

Slavina Vejdovsky, 1883: 219.

Type species. Nais appendiculata d'Udekem, 1855.

The following diagnosis is derived from Sperber (1948) and Brinkhurst (1971b), roman numerals denote segmental position. Numerous sensory papillae arising from body wall. Body covered in foreign matter adhering to secretions produced by epidermal gland cells. Dorsal setae absent in II to III, IV or V. Hairs present, with non-serrate shafts, accompanied by needles without noduli, with tips finely or bluntly simple-pointed or bifid, often narrowest subapically and often slightly curved distally. Ventral setae fairly straight, with proximal to medial nodulus and usually with proximal bend. Stomach present. Clitellum absent between male pores. Vasa deferentia without prostate, joining atria above atrial duct. Atria with or without prostate. Penial setae present.

Slavina is a small genus of freshwater oligochaetes belonging to the Subfamily Stylarinae. Four species have been described. The type species, *Slavina appendiculata* (d'Udekem, 1855), is very widespread, occurring in Africa, North and South America, New Zealand, Asia and Europe (Brinkhurst 1971b) and now Australia. The remaining three species, *Slavina isochaeta* Cernosvitov, 1939, *Slavina sawayai* Marcus, 1944 and *Slavina evelinae* (Marcus, 1942) have only been found in South and/or Central America. Accounts of the genus and species include Harman (1965), Marchese (1986), Harman et al. (1988) and Grimm (1990).

Nemec & Brinkhurst (1987) divided the four species of *Slavina* into two groups for their analysis of naidid subfamilial relationships. Primarily, *S. evelinae* was separated from *S. appendiculata* because they differ in some aspects of their genital anatomies. Thus, *S. evelinae* has no atrial prostate and male ducts which empty into a common median pore, whereas *S. appendiculata* has atrial prostate and separate male pores. The other two species, whose genital anatomies have not been described, were allied with one or other of these two species according to similarities in setal morphology. Thus *S. isochaeta* was assumed to have the same genital anatomy as *S. evelinae* because it lacks elongate hairs anteriorly, while *S. sawayai*, which has long hairs in VI, was assumed to have the same genital anatomy as *S. appendiculata*.

The resulting trees suggested that *S. evelinae* and *S. appendiculata*, at least, might not be closely related. *S. evelinae* grouped with another subfamily, the Naidinae, because of its lack of atrial prostate and (in some analyses) slight difference in the form and size of the ventral setae between the anterior and posterior segments. The median male pore of *S. evelinae* emerged as an autapomorphy. However, the character 'anterior and posterior ventral setae different' is not one that any taxonomist would use

to separate genera. This character appears to have been subject to homoplasy and reversion within the family, according to the same analyses, and even varies within other genera. In any case, the ventral setae of *S. appendiculata/S. sawayai* were scored as 'anterior setae not slightly different to posterior setae' whereas in fact they are slightly different in *S. appendiculata*. Furthermore, if the occurrence of papillae on the body wall had been included as a character in the Nemec & Brinkhurst analyses then all papillate species (*Vejdovskyella* and *Slavina*) might have grouped closer together, with the absence of prostate on *S. evelinae* then being considered a reversion in parallel to the Naidinae. The reason for excluding papillae from the analyses was that it was not considered an appropriate character for analyses of relationships at the subfamilial level.

At this stage, there seems to be little justification for acting on the suggestion from the Nemec and Brinkhurst (1987) study, as also discussed by Sperber (1948), that *S. evelinae* be classified separate from *S. appendiculata*, particularly when we lack information on the genital anatomy of some species.

Slavina appendiculata (d'Udekem, 1855)

Fig. 1A–D

Nais appendiculata d'Udekem 1855: 552, pl. 1, fig. 3.—d'Udekem 1859: 21.—Vaillant 1890: 371.—Bretscher 1896: 508.

Slavina appendiculata (d'Udekem) Vejdovsky 1883: 219.—Sperber 1948: 133, fig. 15.—Yamaguchi 1953: 293, fig. 11.—Harman 1965: 565.—Brinkhurst and Jamieson 1971: 344, figs 7.8R–S, 7.9A–C.—Naidu & Naidu 1981: 115, figs 8–9.—Brinkhurst 1986: 87.—Marchese 1986: 236, fig. 3.—Grimm 1990: 141, fig. 12.—Pinder & Brinkhurst 1994: 126.

Nais lurida Timm 1883: 153, pl. 11, fig. 25.

Slavina lurida (Timm) Bousfield 1886: 268.

Slavina punjabensis Stephenson 1909: 272, pl. 19, figs 41–45, pl. 20, figs 50–52.

Slavina montana Stephenson 1923: 84, fig. 30.

Slavina truncata Harman 1965: 566, figs 1–2.

Original authors of all synonyms are listed above, with the more significant citations of these names. A comprehensive list of pre-1971 citations is available in Brinkhurst (1971b).

Material. MV F78054–F78059, one immature specimen (with regenerating head) plus fragments in alcohol and five immature specimens mounted whole on slides, from fine sandy sediment in main channel of La Trobe River at Moe-Willow Grove Road Bridge (38°11′18″S,146°15′12″E), July 1980, coll. R. Marchant (MV); MV F78060 and F78061, two immature specimens mounted whole on slides from La Trobe River, 100 m below drain carrying treated sewage (38°13′28″S, 146°16′04″E), 5 Nov. 1979, coll. R. Marchant (MV); Returned to MDFRC, one immature specimen mounted whole on slide, from Murray River at Dora Dora (35°57′S,147°29′E), 24 Mar. 1994, coll. J. Hawking (MDFRC).

Description (primarily based on Australian specimens—see Remarks below). Length of preserved body 1.9–2.3 mm, width 170–242 µm when slide mounted, number of segments 25 to 35 plus regenerating tails.

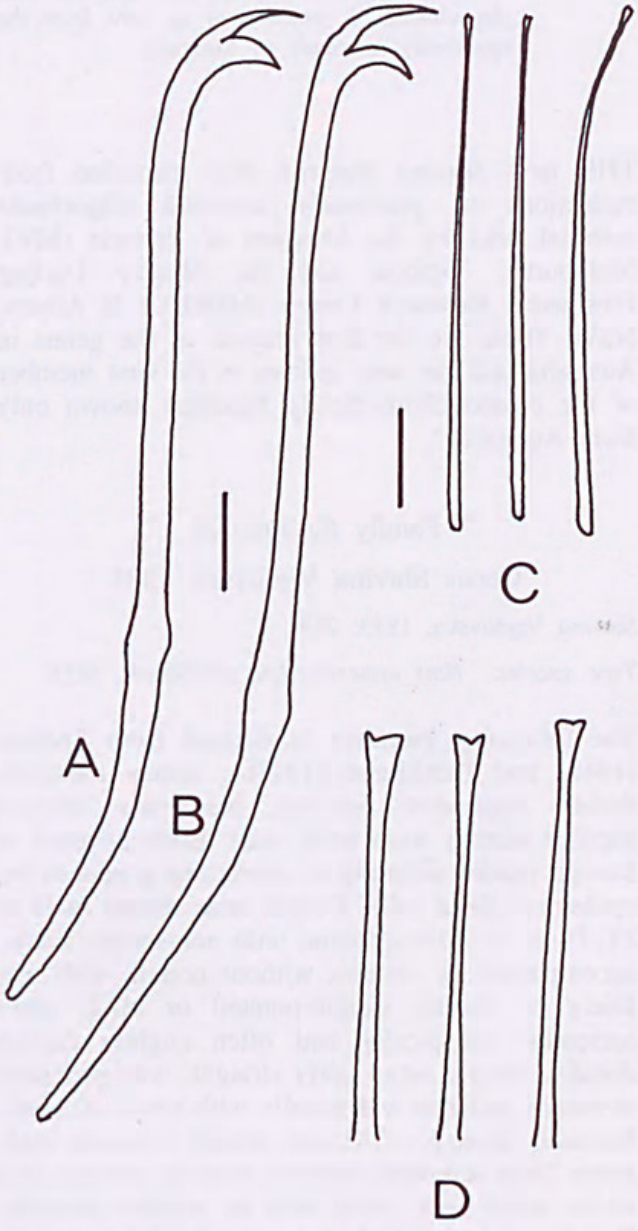

Fig. 1. A–D, *Slavina appendiculata*. A, ventral seta of II. B, ventral seta of posterior segment. C, needle setae. D, tips of needle setae. Bar scales: A–C, 9 µm; D, not drawn to scale. Illustrations drawn from Australian material.

Prostomium broad and flattened, up to three times wider at base than long in preserved specimens. Eyes present or absent (absent on all Australian specimens). Mouth ventral.

Ventral setae from II, (2)3–4(5) per bundle, moderately curved with nodulus located approximately $^1/_3$ of setal length from the proximal end, 2–3 µm wide, slightly longer in II (108–135 µm) than in rest (89–115 µm). Upper teeth thinner and 1.2 to 1.3 times longer than lower in all segments.

Dorsal setae from VI, each bundle with one (rarely two, except in VI and then up to three) long (195–290 µm, except in VI), stout (3.5–4 µm wide) hair setae and one or two thin (1 µm), short (40–56 µm) needles. Hairs of VI usually much longer (up to 630 µm) than those of other segments. Hairs with distended and flattened or minutely notched tips (visible at 400× magnification). Needles with narrow hair-like distal ends, usually terminating in slightly distended and flattened tips which may be notched in some instances (visible only when viewed at 1000× magnification).

Body wall with adhered layer of fine particulate organic material. Papillae projecting up to 30 µm (in preserved specimens) from the body wall and through foreign matter. Some specimens with regenerating tails.

Remarks. These Australian specimens closely fit previous descriptions of *S. appendiculata* such as Sperber 1948 and Brinkhurst (1971b). *S. appendiculata* is the only species with the combination of dorsal setae commencing in VI, elongate hair setae in VI, non-bifid needles and ventral setae with upper teeth slightly longer than lower. Since the new specimens are immature they do not have reproductive organs developed and so their genital anatomy cannot be compared to that described for *S. appendiculata*. Asexual reproduction predominates in the Naididae and it is rare to encounter specimens with the reproductive structures developed. Identifications of this species and other naidids, including first regional records, are usually made using sexually immature specimens for this reason. However, such specimens are fully developed in a somatic sense, apart from segments that are regenerating after asexual reproduction by budding.

While accepting this identification, some anatomical aspects of the Australian specimens should be discussed in relation to known variation within the species. First, there are no pigmented eye spots in any of the Australian specimens. However, other specimens without eyes, described as *Slavina montana* by Stephenson (1923) were attributed to *S. appendiculata* by Sperber (1948), who pointed out that the occurrence of eye spots is variable in some other naidid species (e.g. *Nais variabilis* and *Stylaria fossularis*). Similarly, Brinkhurst (1971b) concluded that eyeless specimens described as *Slavina truncata* by Harman (1965) were actually *S. appendiculata.*

Secondly, the needle setae of *S. appendiculata* are usually described and illustrated as being distended apically with bluntly rounded tips. By contrast, the needles of Australian specimens are similarly distended apically, but are usually flattened at the tip and, at high magnification, there occasionally appears to be a central notch. This is more noticeable on specimens temporarily mounted in alcohol. Yamaguchi (1953) described and illustrated similar tips to the needles of Japanese of *S. appendiculata.*

Thirdly, the hairs of Australian specimens are also slightly distended apically and often have roughly flattened tips (visible even at 400× magnification), which may also be notched as in the needles. This latter feature has not previously been noted for *S. appendiculata*, but similarly flattened hair tips have only recently been described for *S. isochaeta* by Harman et al. (1988), whereas this feature was not noted in the original description by Cernosvitov (1939).

A few specimens initially appeared to have dorsal setae from IV or V but upon closer examination these specimens were found to have single small ventral setae in the most anterior bundles and gaps between these bundles and the larger ventral setae of the first hair-bearing segment. This indicates that the anterior setae of these specimens have not fully regenerated after asexual reproduction, leading to incorrect counting of segments.

Lengths of the dorsal and ventral setae of the Australian specimens (Table 1) are similar to lengths reported previously for *S. appendiculata* from other regions (Sperber 1948; Harman et al. 1979; Naidu & Naidu 1981; Marchese 1986; Grimm 1990).

Thus, in almost all respects, the Australian specimens fall within the range of variation reported for specimens identified as *S. appendiculata* on other continents. The flattened hair tips have not been reported before but is of such a minor nature that it does not preclude us from identifying the Australian specimens as *S. appendiculata.*

Distribution. Cosmopolitan, but within Australia this species is known only from the La Trobe and Murray Rivers, Victoria.

	Ventral II–V (µm)	Ventral >V (µm)	Hairs >VI (µm)	Hairs VI[1] (µm)	Needles (µm)
S. appendiculata					
Lengths from literature[2]	111–147	90–135	228–450	600–800	30–70
Australian specimens	108–135	89–115	195–290	630	43–56
S. proceriseta	110–115	140–150	142–215	—	62–70

Table 1. Ranges of setal lengths for Australian and non-Australian specimens of *S. appendiculata* and for *S. proceriseta* sp. nov. [1]Maximum lengths recorded. [2]Sperber (1948), Harman et al. (1979), Marchese (1986), Naidu and Naidu (1981) and Grimm (1990).

Slavina proceriseta sp. nov.

Fig. 2A–G

Etymology. From the Latin *procerus* (long and thin) and seta, referring to the slender ventral setae.

Type material. Holotype MV F78063 mounted whole in Permount, from La Trobe River, 100 m below drain discharging treated sewage (38°13′28″S,146°16′04″E), 3 July 1979.

Other material. MV F78066, five fragments or specimens with only partially regenerated anterior ends in alcohol, from La Trobe River at Moe-Willow Grove Road Bridge (38°11′18″S,146°15′12″E), July 1980, coll. R. Marchant (MV); MV F78064–F78065, two fragments mounted whole in Permount with intact anal ends, from Acheron River at Glendale Lane (37°21′S,145°42′E), 1 Nov. 1993, coll. A. Pinder and P. Lillywhite (MV); MV F78067, one fragment in alcohol, with anal end intact from Murray River at Dora Dora (35°57′S, 147°29′E), 24 Mar. 1994, coll. J. Hawking (MDFRC).

Description. Length of complete holotype 1.95 mm and width 182 µm (at segment III) to 272 µm (in mid-body) when preserved, number of segments 23 (excluding regenerating tail). A specimen with an incompletely regenerated anterior end was 2.5 mm long, but is now in five pieces, and has 35 segments.

Prostomium short and bluntly rounded, half as long (19 µm) as wide at base (37 µm). Eyes absent. Brain semi-ovoid between pharynx and prostomium. Mouth of preserved holotype appearing to be directed anteriorly rather than ventrally. Pharynx slightly thickened in II and III, oesophagus narrower and gut widening abruptly in VII. Coelomocytes not observed.

Ventral setae from II, each bundle with 2 to 5 long, thin (2-2.5 µm) slightly curved bifid setae. Those of II–IV shorter (110–115 µm long) than the rest (which are 140–150 µm) and slightly thinner (1.5 µm instead of 2 µm). Upper teeth 2.5 to 3 times as long (12–15 µm) as the lower and slightly thicker and more curved. The lower teeth are fairly straight and diverge from the main shaft at an angle of about 10–15°. Nodulus poorly developed and located about $^1/_3$ of the length of the seta from the proximal end.

Dorsal setae from V, each bundle with 1 to 3 (2 or 3 anteriorly, reducing to 1 per bundle posteriorly) moderately long (142–215 µm) hairs per bundle with shafts 2–2.5 µm, gradually narrowing to a fine point. Hairs accompanied by an equal number of short (62–70 µm), fine (1–1.5 µm) needles which are broadest basally, narrowest subapically and terminate in a minutely bifid tip. The teeth of the needles are very short and equal, diverging at an angle of 15–30° and often appearing palmate or even simple pointed if viewed at a less than optimum angle.

Body wall with an adhered layer of fine particulate organic matter, which, in preserved specimens, may appear to be distributed in narrow (6–10 µm) bands around the body. Papillae, up to 5 µm wide and 12 µm long (in preserved specimens) project from the body wall and penetrate through the adhered organic material. Spacing of the papillae is variable but some occur as close together as 15 µm and 21 papillae project from one side of the body wall in profile along the length of the holotype. Papillae apparently occurring around the circumference of each segment, but the precise distribution not determined. Tips of papillae with numerous short fine hairs.

Remarks. The subfamily Stylarinae is defined (Nemec & Brinkhurst 1987) by the absence of noduli on the needle setae and (with the exception of some *Slavina*) an absence of prostate tissue on the atria, although the latter is considered to be a symplesiomorphy. The new specimens are immature but the needles definitely lack a nodulus. Of the seven genera assigned to the subfamily, only *Vejdovskyella* Michaelsen, 1903 and *Slavina* have a papillate body wall covered with adhering foreign matter, as in the new species. Other characteristics typical of *Slavina* displayed by the new species include dorsal bundles with few non-serrate fairly stout hairs starting between IV and

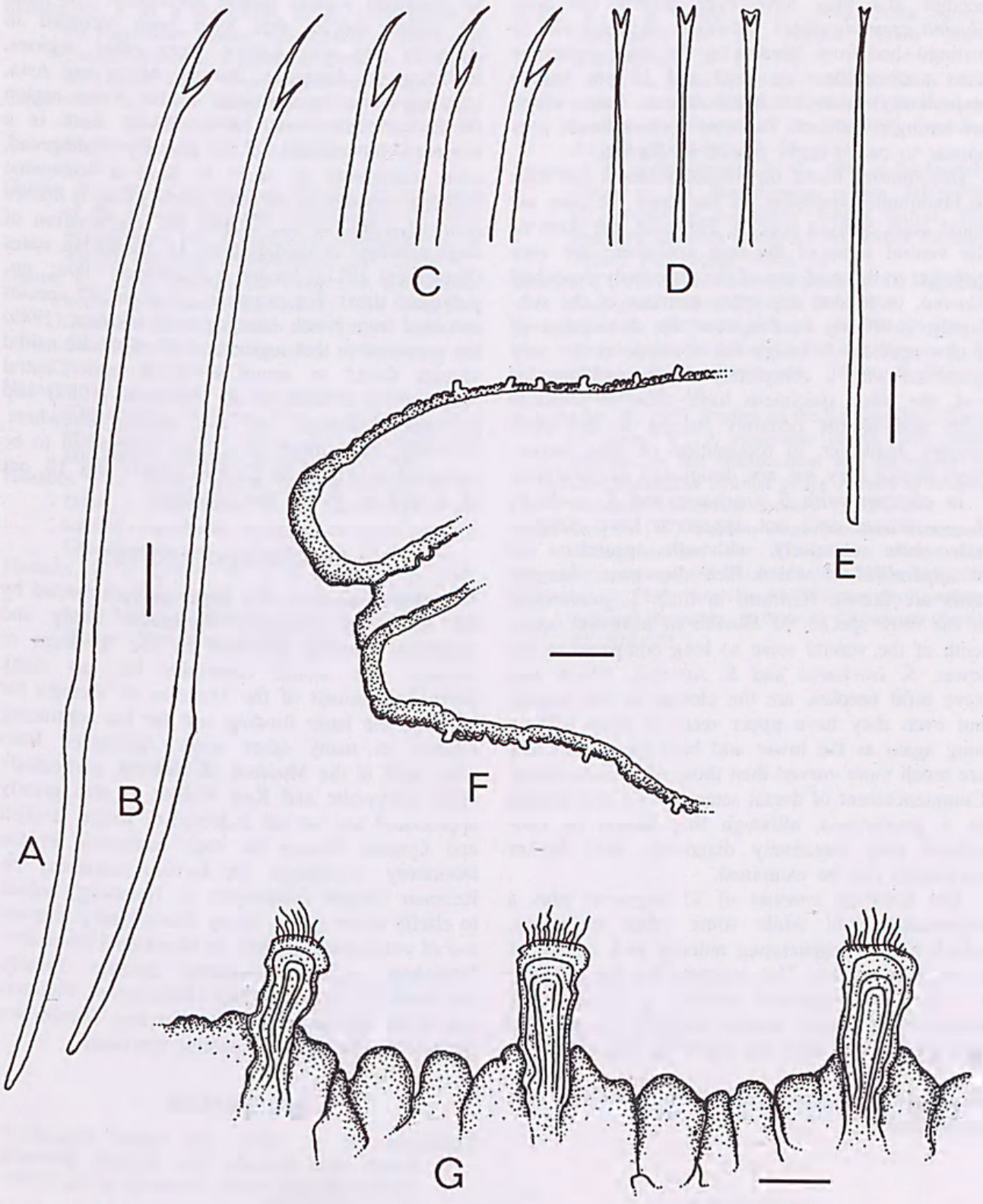

Fig. 2. A–G, *Slavina proceriseta* sp. nov. A, ventral seta of V. B, ventral seta of XI. C, examples of tips of ventral setae. D, tips of needle setae. E, needle seta. F, anterior of worm in profile showing short rounded prostomium and forward projecting mouth. G, section of body wall showing papillae. Bar scales: A, B, E, 9 µm; F, 28 µm; G, 5 µm; C, D, not drawn to scale. Illustrations drawn from holotype.

VI and a few fine needle setae which narrow sub-apically. *Vejdovskyella* also has stout dorsal setae from VI, possesses fine simple pointed needles and may have eyes present (as does *Slavina appendiculata*). However, *Vejdovskyella* is distinguished from *Slavina* by the more numerous hairs and needles (up to 9 and 12 per bundle respectively) and the much stouter hairs which are strongly serrated. The new species would thus appear to be correctly placed in *Slavina*.

Descriptions based on limited material can lead to taxonomic confusion, as has been the case for some other *Slavina* species. However, the form of the ventral setae of the new specimens are very different to those of any of the previously described *Slavina*, or indeed any other member of the subfamily, justifying in this case the description of a new species. Although the holotype is the only specimen with a completely regenerated anterior end, the other specimens have setae of identical form and almost certainly belong to the same species. However, in recognition of their incomplete nature they are not designated as paratypes.

In common with *S. isochaeta* and *S. evelinae*, *S. proceriseta* does not appear to have elongate hair setae anteriorly, although specimens of *S. appendiculata* which lack the usual elongate hairs are known (Grimm, in litt.). *S. proceriseta* is the only species of *Slavina* to have the upper teeth of the ventral setae so long compared to the lower. *S. isochaeta* and *S. sawayai*, which also have bifid needles, are the closest in this respect but even they have upper teeth at most half as long again as the lower and both have teeth that are much more curved than those of *S. proceriseta*. Commencement of dorsal setae in V is also unique to *S. proceriseta*, although that should be considered only tentatively diagnostic until further specimens can be examined.

The holotype consists of 23 segments plus a regenerating tail while some other specimens, which have a regenerating anterior end, consist of up to 35 segments. This suggests that the holotype is a recently separated anterior zooid, that the fission zone occurs around segment 23 and that specimens of at least 58 segments may occur.

Distribution. Recorded only from the riverine sites listed above.

DISCUSSION

Slavina proceriseta is one of only two naidid species known only from Australia. The other is a new species of *Dero (Allodero)* which will be published separately. Other specimens of *Dero* collected from the Northern Territory possibly represent a further new species but this cannot be described without further specimens. The other 29 naidid species that have been recorded in Australia are also known from other regions, including the Americas, Europe, Africa and Asia, although none are restricted to the Asian region (Pinder & Brinkhurst 1994). While there is a tendency for naidids to be globally widespread, other continents do seem to have a somewhat higher proportion of endemic naidids than is known from Australia so far, despite the examination of large numbers of naidids from all Australian states (Brinkhurst 1971a; Pinder & Brinkhurst 1994; unpublished data). For example, 12 of the 67 species recorded from North America by Brinkhurst (1986) are restricted to that region and 27 of the 84 naidid species found to occur in South and Central America by Brinkhurst & Marchese (1989) and subsequent authors are not known elsewhere. Similarly, the number of species considered to be restricted to Africa by Grimm (1987) was 10, out of a total of 48 for that continent.

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