

Pseudopolydora species associated with mollusc shells on the south coast of South Africa, with the description of *Ps. dayii*, sp. nov.

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Two species of the genus Pseudopolydora, Ps. dayii, sp. nov. and Ps. antennata, were associated with gastropods on the south and south-east coasts of South Africa. Pseudopolydora dayii is characterized by prominent post-chaetal notopodial lobes on chaetiger 1 with very long chaetae, a prominent occipital tentacle, having hooded hooks that start on chaetiger 9, branchiae that start on chaetiger 6, stout hooks and lobes placed latero-posteriorly to the hooded hooks in posterior chaetigers. It is a surface-fouler and was found on several species of wild gastropods at four of the five sites sampled and from additional material from the south-west coast and on cultured abalone (Haliotis midae) at a farm on the south-west coast. Three individuals of Ps. antennata were found only with oysters at the easternmost site. This was the first record of this species outside of the Western Cape Province and it is possible that their association with the oysters was fortuitous.

Keywords: surface-foulers, molluscs, *Pseudopolydora*, South Africa

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INTRODUCTION

The infestation of commercially important shellfish by several genera of the *Polydora* group (Polychaeta: Spionidae) has been well documented worldwide (see reviews by Martin & Britayev, 1998; Lleonart, 2001). This field of research has, however, received scant attention in South Africa, but recent escalation in the mariculture of the abalone, *Haliotis midae* Linnaeus, 1758, and the oyster, *Crassostrea gigas* Thunberg, 1793 has led to renewed interest in this group of spionids. *Polydora hoplura* Claparède, 1870 has been recorded on both cultured oysters and abalone, while the latter are also infested by *Boccardia proboscidea* Hartman, 1940 and *Dipolydora capensis* (Day, 1955) (Nel *et al.*, 1996; Simon *et al.*, 2006; Simon & Booth, 2007), with the last species being the least problematic. To date, one and three species of the genera *Dipolydora* and *Polydora*, respectively, have been recorded on wild molluscs in southern Africa (Day, 1967; Schleyer, 1991) suggesting that the number of genera and species of the *Polydora* group infesting wild molluscs in South Africa may have been underestimated.

A preliminary survey was conducted to gain a better understanding of the diversity of species of the *Polydora* group infesting wild molluscs on the south and south-east coasts of South Africa in order to identify any species that might pose future problems in aquaculture facilities. Here an account of the *Pseudopolydora* Czerniavsky, 1881 species is presented.

MATERIALS AND METHODS

Molluscs were collected from the intertidal or shallow subtidal from five sites along the south and south-east coasts of South Africa in February and March 2005 and April 2006 (Figure 1). Worms were removed from the shells using a vermifuge, 0.05% phenol in seawater, for 3 hours to overnight. Once the worms abandoned their burrows, they were transferred to fresh seawater, relaxed with clove oil, preserved in 4% seawater–formalin and stored in 70% ethanol. Additional material from Sandbaai in Walker Bay was removed by dissolving the shells in which the worms were fixed (in 4% seawater–formalin and stored in 70% ethanol), in 5% HNO₃ diluted in 70% ethanol.

For scanning electron microscopy, the specimens were dehydrated in a series of ethanol of increasing concentration (80% to 100%), critical point dried and sputter coated. Specimens were viewed on Vega Tescan and Leo 1430 VP scanning electron microscopes. Specimens are lodged at the Iziko South African Museum, Cape Town, South Africa.

RESULTS AND DISCUSSION

SYSTEMATICS

Family SPIONIDAE Grube, 1850

Genus *Pseudopolydora* Czerniavsky, 1881;

Pseudopolydora antennata (Claparède, 1870)

Figure 2A–I

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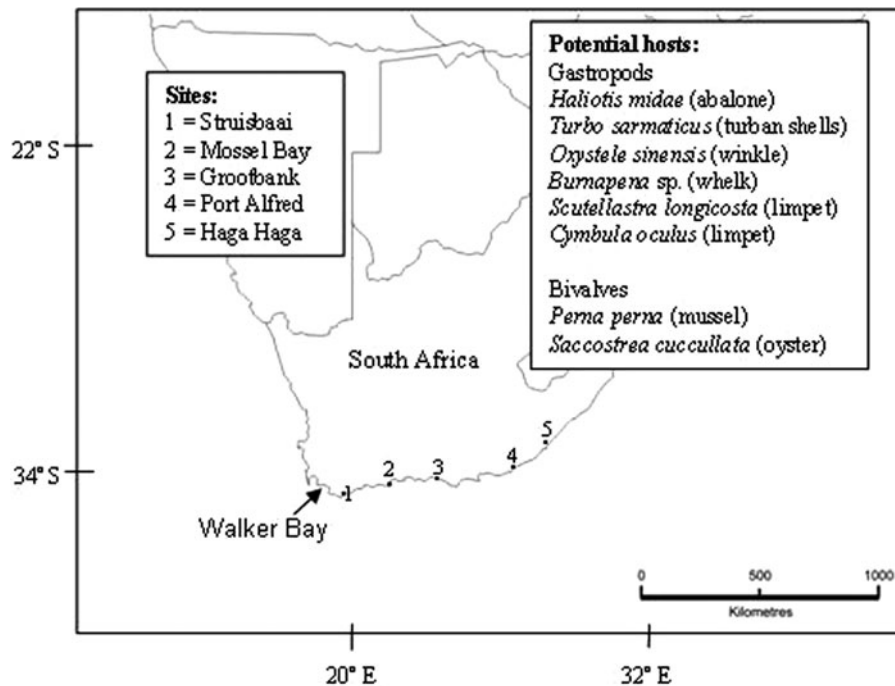


Fig. 1. Location of sampling sites and a list of potential molluscan hosts collected.

Polydora antennata: Carazzi, 1893: 25–26, Plate 2, figures 11 & 12;

Polydora (Carazzia) antennata: Fauvel, 1927: 56–57, figure 19 i–m;

Polydora (Carazzia) antennata: Okuda, 1937: 237, figure 15;

Pseudopolydora antennata: Woodwick, 1964: 149, figure 2.7 & 2.8;

Polydora antennata: Day, 1967: 473, figure 18.4 e–g;

Polydora (Pseudopolydora) antennata: Hartman-Schröder, 1981: 87, figures 115–118;

Pseudopolydora antennata: Hutchings & Turvey, 1984: 16, figure 6.

MATERIALS EXAMINED

South Africa: Eastern Cape Province, Haga Haga, (32°45'41"S 28°14'30"E). No complete specimens found; anterior fragments were 7.5 mm for 39 chaetigers and 1 mm wide at chaetiger 5, 10.8 mm for 46 chaetigers and 1.17 mm wide at chaetiger 5, and 7.17 mm for 38 chaetigers and 0.8 mm wide (SAMC: SAM A21473), collected by C.A. Simon, 25 February 2005. Two specimens were gravid, with eggs visible in chaetigers 15–24.

DESCRIPTION

Prostomium incised with lateral lobes giving it a T-shaped appearance; caruncle extends to about mid-chaetiger 5 (Figure 2A). 1 or 2 pairs of eyes present, anterior pair 3 times size of, and closer together than, posterior pair; short occipital tentacle (Figure 2A).

Chaetiger 1 with small notopodial lobes, chaetae absent (Figure 2A). On chaetigers 3–12 notochaetae spread out with a wide post-chaetal lobe (Figure 2B), chaetae on chaetigers 3–4, 6–12 arranged in 3 rows, first row with geniculate winged chaetae, second row with short spear-shaped chaetae and final row with long simple capillary chaetae; from

chaetiger 13 onwards chaetae extend from a bottle-shaped lobe (Figure 2C). Number of notochaetae decrease towards posterior, with spear-shaped and capillary chaetae, and finally only capillary chaetae. Neurochaetae from chaetigers 1–7 a single row of spear-shaped chaetae. Hooded hooks start on chaetiger 8, main tooth of the hooded hooks < 90° to the shaft with the secondary fang closely applied, shaft has a constriction (Figure 2D), 13 hooded hooks per anterior fascicle, increasing to 26 in posterior chaetigers of fragment. No accompanying neurochaetae (Figure 2B, C & E).

Chaetiger 5 with well developed post-chaetal lobes (Figure 2A, E, & F); in ventral view chaetiger 5 similar to preceding and succeeding chaetigers in terms of size and appearance (Figure 2E). Single row of winged notochaetae and spear-shaped neurochaetae present. Two types of spines arranged in a U-shape, inner spines longer with an angled distal end and rounded point, outer spines spoon-shaped with bristles within concavity and tapering point (Figure 2G) which may be worn or broken off.

Branchiae start on chaetiger 7, from chaetiger 8 branchiae overlap along midline of body. On two larger specimens they continue to end of fragment.

DISTRIBUTION

Day (1967) recorded *Ps. antennata* from Saldanha Bay and Strandfontein on the west coast of South Africa. In the present study it was found only at Haga Haga on the east coast.

ECOLOGY

Associated with the oyster, *Saccostrea cucullata* Born, 1778. The burrows were visible as indentations on the external surface of the valve of the oyster that was attached to the rock and it is therefore doubtful that they had specifically

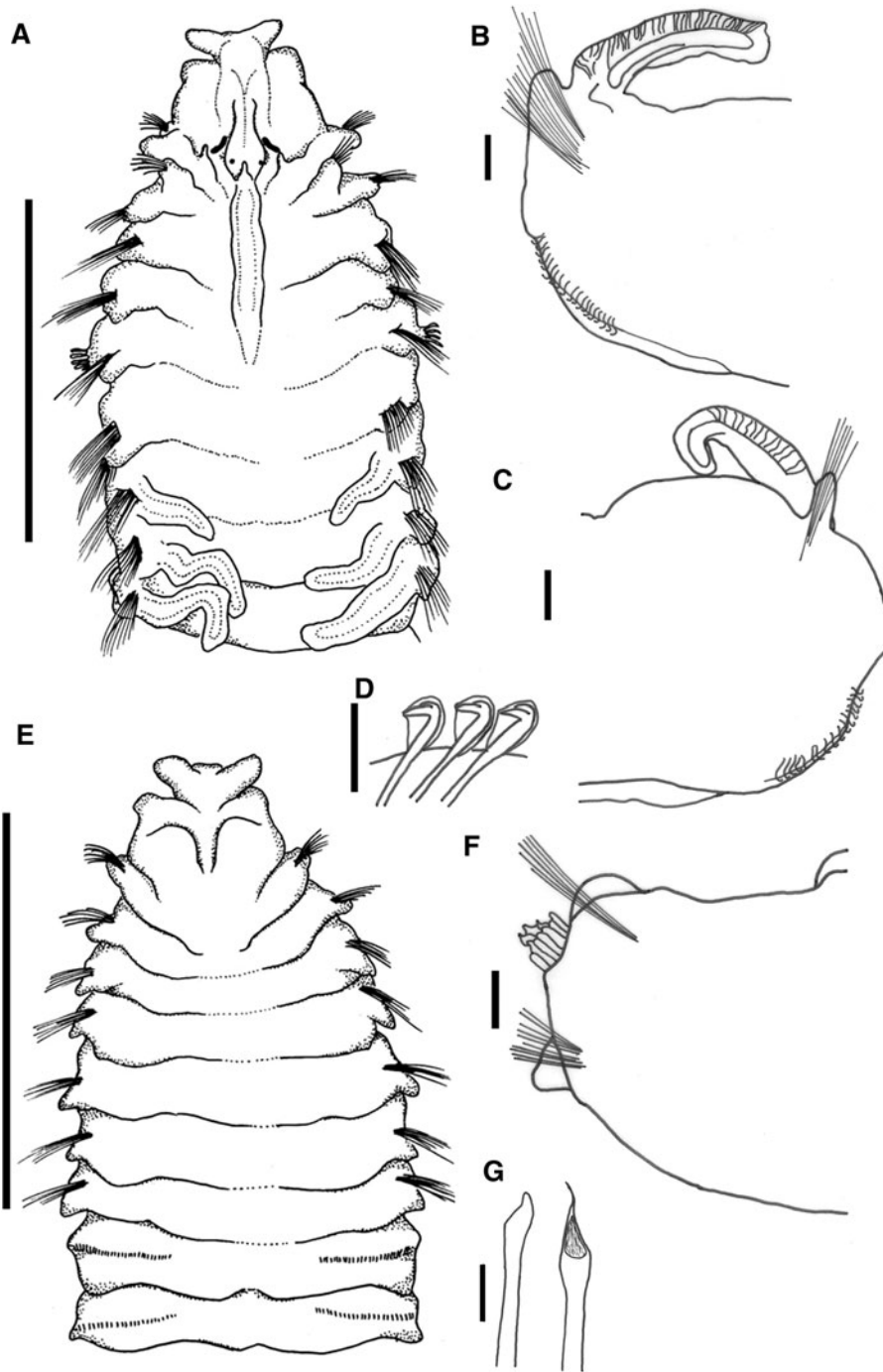


Fig. 2. *Pseudopolydora antennata*. (A) Anterior region, dorsal view; (B) chaetiger 7, anterior view; (C) chaetiger posterior to 12, anterior view; (D) hooded hooks; (E) anterior region, ventral view; (F) chaetiger 5, anterior view; (G) modified spines of chaetiger 5. Scale bars: A & E = 1 mm; B, C, F & I = 100 μ m; D, G = 35 μ m.

bored into the shells. This supposition is supported by the fact that although Day (1955) had found a specimen in algal mats, they were more numerous in dredgings off the Saldanha Bay coast (Day, 1961).

REMARKS

Recorded descriptions demonstrate a degree of intraspecific variation with regards to caruncle length and shape of the modified spines of chaetiger 5. In the specimens examined here, the caruncle extends to mid-chaetiger 5, but has been described as extending to the posterior of chaetiger 2 (Day,

1967, original material misplaced; Hartman-Schröder, 1981), from the anterior of chaetiger 5 to the posterior margin of chaetiger 6 (Woodwick, 1964), middle of chaetiger 6 (Hutchings & Turvey, 1984) and to the posterior margin of chaetiger 6 (Okuda, 1937). The modified spines of chaetiger 5 of the specimens in the present study most closely resemble those of *Ps. antennata* as described by Okuda (1937) and Hartman-Schröder (1981). Day (1955, 1967) describes only the spoon-shaped spine on chaetiger 5. The spines in the outer row lack the second tooth described by Woodwick (1964). The South African specimens differ from those

described by Hutchings & Turvey (1984) in several ways; in the former the modified spines of chaetiger 5 are arranged in a tight U-shape (not a J-shape), the inner spines are not hirsute, and the worms are shorter, for similar numbers of chaetigers. Day (1955) suggested that the local specimens may represent a separate variety of *Ps. antennata*, and the current study supports this. However, a final decision can only be made once more, and better, material have been examined.

Pseudopolydora dayii sp. nov.

Figures 3A–F, 4A–E;

MATERIAL EXAMINED

Holotype: South Africa, Eastern Cape Province, Haga Haga ($32^{\circ}45'41''\text{S}$ $28^{\circ}14'30''\text{E}$), collected by C.A. Simon, 25 February 2005, associated with the abalone *Haliotis midae* (SAMC, accession number SAM A21468).

Paratypes: 1, same data as holotype, (SAMC, accession number SAM A21469); 3, Western Cape Province.

Struisbaai, $34^{\circ}45'19''\text{S}$ $20^{\circ}03'02''\text{E}$, collected by C.A. Simon, 7 March, 2005, associated with *H. midae*, *Perna perna* (mussel) and *Scutellastra longicosta* (limpet) (SAMC, accession numbers SAM A21470–A21472); 2, Sandbaai, $34^{\circ}25'60''\text{S}$ $19^{\circ}11'60''\text{E}$, collected by C.A. Simon, September 2003, SAM A21474 SEM preparations. SAM A21472 includes light microscope slides and remaining fragments.

Additional material examined: Eastern Cape Province: Grootbank, $33^{\circ}59'14''\text{S}$ $23^{\circ}32'36''\text{E}$, collected by C.A. Simon, 9 March 2005; Western Cape Province: Mossel Bay, $34^{\circ}10'56''\text{S}$ $22^{\circ}07'20''\text{E}$, collected by C.A. Simon, 8 March 2005, Gansbaai ($34^{\circ}36'13''\text{S}$ $19^{\circ}21'5''\text{E}$) abalone farm, April 2007.

ETYMOLOGY

This species is named in honour of John Day, South Africa's most prominent polychaete taxonomist.

DESCRIPTION

Holotype 13.25 mm for 74 chaetigers and 0.8 mm wide at chaetiger 5. Longest paratype measures 14 mm for 79

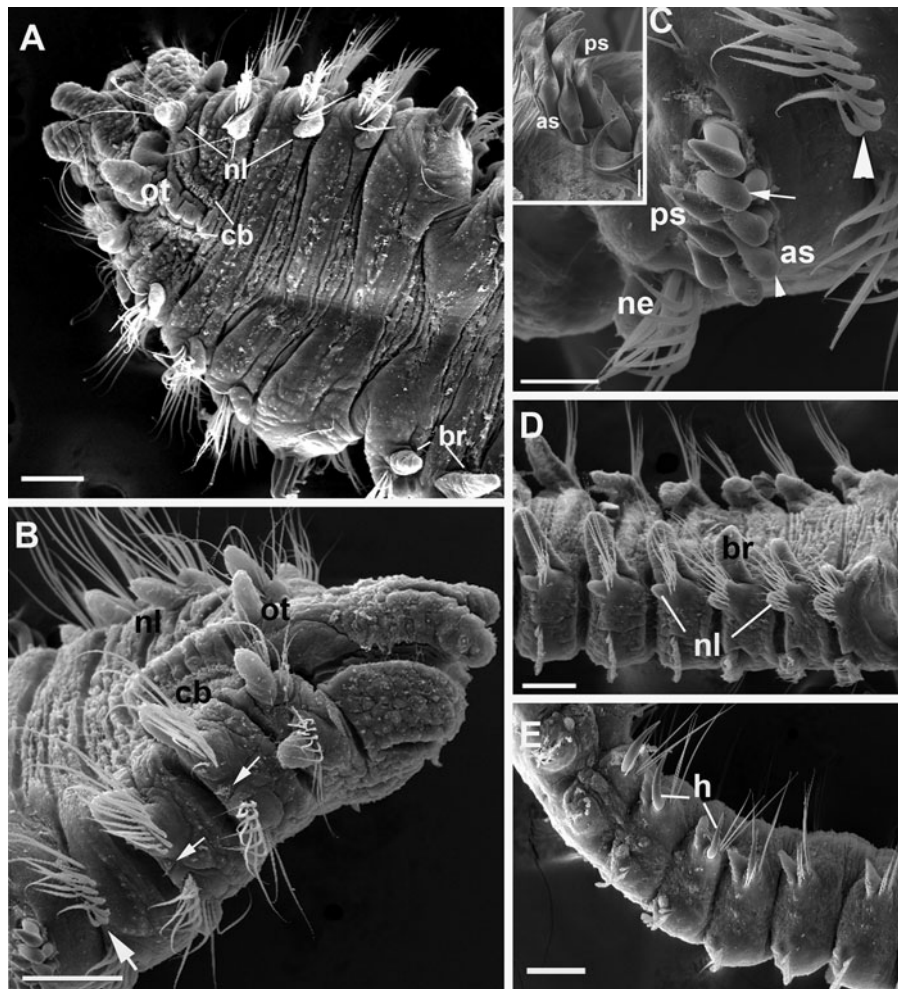


Fig. 3. *Pseudopolydora dayii* sp. nov. Dorsal (A) and dorso-lateral (B) view of the anterior end showing the occipital tentacle (ot), well-developed notopodial lobes (nl), ciliary bands (cb) along the sides of the caruncle, lateral organs (small arrows) and J-shaped arrangement of the anterior row of chaetae on chaetiger 4 (large arrow); (C) spines of chaetiger 5 showing J-shaped arrangement of the anterior row of pennoned spines (as) and falcate posterior spines (ps), with broken (arrow) and complete spines (small arrowhead) in anterior row. Note the J-shapped arrangement of the geniculate notochaetae in the anterior row of chaetiger 4 and the placement of the neuropodial lobe (ne) on chaetiger 5. Insert shows a close-up of the modified spines of chaetiger 5; (D) chaetigers 6–11, showing the change in structure of the post-chaetal notopodial lobes and branchiae (br); (E) lateral view of posterior chaetigers showing the hooks (h). Scale bars: A, B, D–E = 100 µm; C = 40 µm; insert = 20 µm.

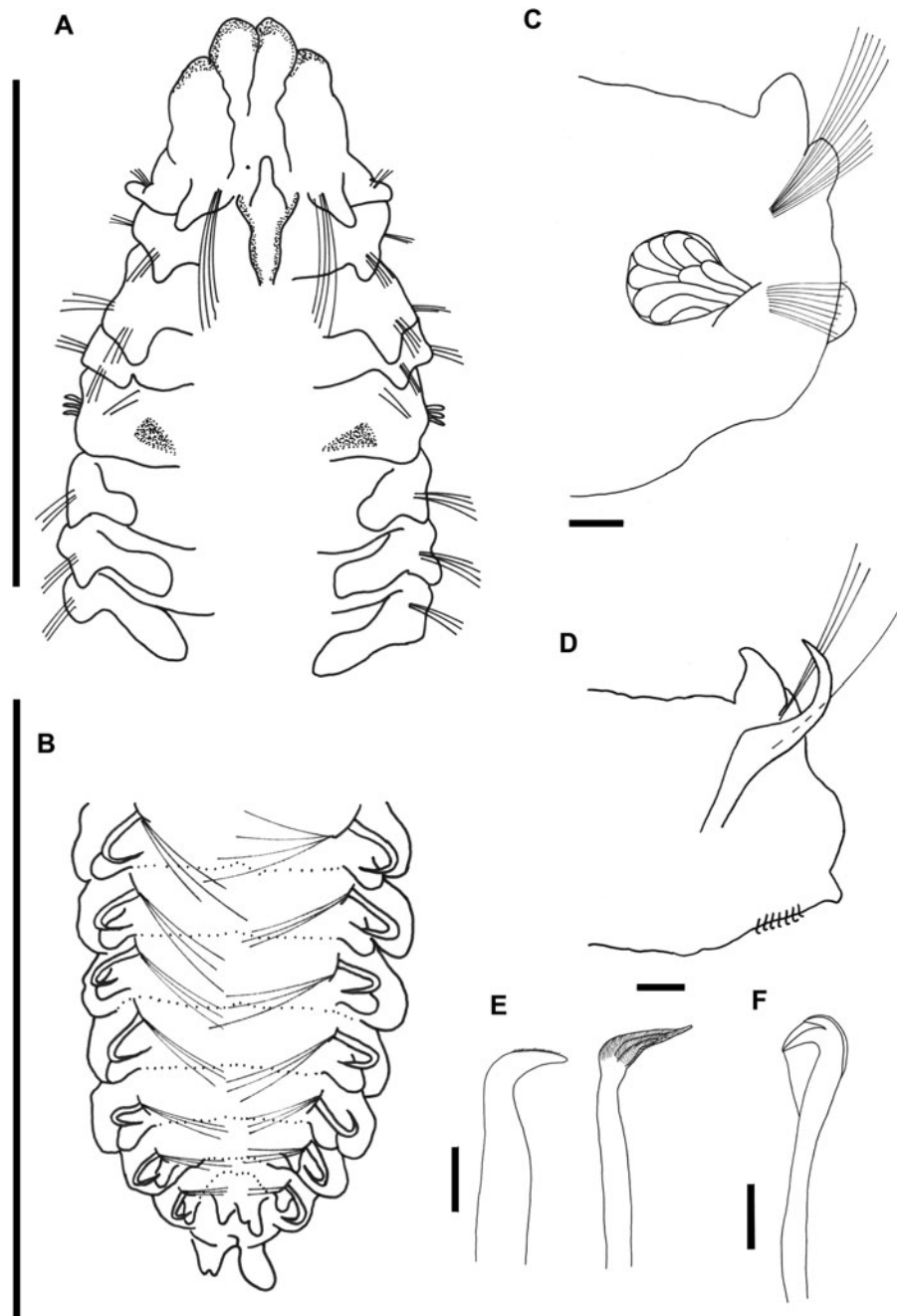


Fig. 4. *Pseudopolydora dayii* sp. nov. (A) Dorsal anterior and (B) dorsal posterior chaetigers (holotype: SAM A21468); (C) chaetiger 6 showing glandular sacs; (D) transverse section of a posterior chaetiger showing the positions of the hook, dorsal cirrus, neuropodial lobe and hooded hooks; (E) modified falcate (left) and pennoned (right) spines of chaetiger 5; (F) hooded hooks. Scale bars: A & B = 1 mm; C = 70 μ m; D = 50 μ m; E = 35 μ m; F = 14 μ m.

chaetigers, and 0.8 mm wide at chaetiger 5. Prostomium strongly incised, caruncle extending to posterior margin of chaetiger 2, nuchal organ ciliary band along lateral margins of caruncle (Figures 3A & B, 4A); finger-like occipital tentacle present between notopodial lobes of chaetiger 1, occipital tentacle and notopodial lobes of similar size and twice as long as they are wide (Figures 3A & B, 4A). Holotype with 1 eye, paratypes with 1 or 2 pairs, anterior pair up to 3 times larger than second. Only one specimen with intact palps; extend to approximately the ninth chaetiger with pigment at base of palp. Live specimens cream-coloured, 1 or 2 pairs of black spots on dorsal surface of chaetiger 5 (Figure 4A).

Chaetiger 1 separated from the peristomium, with prominent post-chaetal notopodial lobes approximately 1.5 times the length of those on succeeding chaetigers; post-chaetal notopodial lobes of chaetigers 2 to 8 broad, from chaetiger 9 the lobes become more cirriform (Figure 3A, B & D); notopodial post-chaetal lobes of chaetigers 2–4 similar in length to branchiae on chaetiger 6 (Figure 3A & B). Chaetiger 1 with approximately seven capillary notochaetae up to ~ 213 μ m long inserted anteriorly to notopodial lobes; winged neurochaetae present (Figures 3A & B, 4A). Notochaetae of chaetigers 2–4, 6 and subsequent chaetigers arranged in 2 rows, but posterior chaetigers have 1 row. On chaetigers 2–4, capillary

chaetae up to 125 μm , approximately twice as long as winged chaetae in anterior row. Notochaetae in anterior row of chaetigers 3, 4 and 6 geniculate and arranged in weak J-shape, but most marked in chaetiger 4 (Figure 3B & C), with winged and capillary chaetae in the posterior row. Notopodia on posteriormost 14 to 22 chaetigers with stout hooks (usually 1, but sometimes 2 hooks per notopodium) accompanied by up to 4 capillaries (Figures 3E, 4B & D). Chaetigers 1–8 with 2 rows of neurochaetae; anterior row of chaetigers 1–5 with winged chaetae, which are shorter than capillary chaetae in posterior row; chaetigers 6–8 have mainly short winged chaetae with approximately 3 inferior capillary chaetae. Hooded hooks start on chaetiger 9 (Figure 3D); about 17, 12 and 8 hooks per series on anterior, median and posterior chaetigers of holotype, in paratypes about 16 hooks per series in anterior and mid body, about 10 on posterior chaetigers. Hooks bidentate on all chaetigers, with slightly constricted shaft, main fang about 45° to shaft with small angle (Figure 4F) between teeth. No other chaetae associated with hooded hooks (Figure 3D & E, 4D). On posterior chaetigers (~last 25% of the body) lobe placed lateroposteriorly to hooded hooks (Figure 4D).

Chaetiger 5 moderately modified and about 1.5 times the length of preceding chaetigers, 2 types of modified spines arranged in 2 vertical rows. Anterior row spines pennoned with subdistal constriction, forms weak J-shape with 1 pennoned spine present in posterior row; posterior row with falcate, weakly bristled spines (Figures 3C, 4E); numbers of spines variable: holotype has 4 spines in anterior row and 5 in posterior row; paratypes may have 5:5, 4:6, or 5:4 anterior:posterior arrangement; 2 to 3 dorsal capillaries present and about 5 winged neurochaetae and approximately 7 straight lanceolate chaetae inserted anteriorly to postchaetal lobe; postchaetal neuropodial lobe the same size as those of preceding and subsequent chaetigers.

Branchiae start on chaetiger 6 (Figures 3A & D, 4A) and extend for $\frac{1}{2}$ to $\frac{2}{3}$ of body; longest branchiae on chaetigers 12–16, but never overlap in mid-dorsum, reduce in size posteriorly. Pygidium reduced, with 4 lobes; the 2 ventral lobes largest, dorsal pair small and difficult to see (Figure 4B).

Paired glandular pouches composed of few large sacks visible in chaetigers 6–8 (Figure 4C). Lateral organs visible on chaetigers 2, 3 (Figure 3B), 6 and subsequent chaetigers.

Two specimens, collected in September 2003 and April 2007, were brooding planktic, 4-chaetiger larvae with long swimming chaetae. No nurse eggs present.

DISTRIBUTION

South and south-east coasts of South Africa.

ECOLOGY

This worm is a surface fouler of live gastropods including the abalone *Haliotis midae*, the limpet, *Scutellastra longicosta* (Lamarck, 1819) and the mussel, *Perna perna* Linnaeus, 1758, in the intertidal and shallow subtidal regions. When present, there were a maximum of four per shell. These worms have been found mainly on wild molluscs, but a few individuals have been found on badly infested cultured abalone from a farm in Gansbaai in the Western Cape Province.

REMARKS

Pseudopolydora dayii bears a close resemblance to the genus *Carazziella* Blake & Kudenov, 1978—the falcate spines on chaetiger 5 are weakly bristled, the modified spines on chaetiger 5 are arranged in a line and not in a U- or J-shape, and the pygidium is reduced with 4 lobes (see Blake & Kudenov, 1978; Blake, 1979, 1996). However, owing to the presence of the neuropodial lobe and a modified short pennoned spine on chaetiger 5, the weak J-arrangement of the anterior spines on chaetigers 4 and 5 and the high number of hooded hooks per ramus compared to most *Carazziella* species, the new species was placed within *Pseudopolydora*.

Pseudopolydora dayii is unique for this genus in that the hooded hooks first appear on chaetiger 9, the angle between the shaft and the main fang of the hooded hooks is closer to 45° than 90° and it possesses neuropodial lobes ventral to the hooded hooks on posterior chaetigers. It resembles *Ps. gibbsi* Light, 1974 and *Ps. pigmentata* Woodward, 1964 most closely with respect to the distribution of the branchiae (starting on chaetiger 6), the absence of notopodial lobes on chaetiger 5 (only 6 of the 17 species of this genus lack a notopodial lobe on chaetiger 5), the arrangement of the modified spines on chaetiger 5 in a straight, vertical or gently curved line (instead of the J- or U-shaped arrangement common in this genus) and a strongly curved falcate spine and habitat (associated with calcium substrates: gastropod shells, sponge and coral rock, respectively). In addition, *Ps. dayii* and *Ps. gibbsi* both have stout hooks on the posterior chaetigers and a reduced pygidium (only anterior fragments of *Ps. pigmentata* were described). The only other species of *Pseudopolydora* with modified notochaetae on the posterior chaetigers is *Ps. corallicola* Woodward, 1964, which has spines. The new species differs from *Ps. gibbsi* and *Ps. pigmentata* in having an occipital tentacle, a strongly bilobed prostomium and more hooded hooks per series (8–16 compared to 6–8 in *Ps. dayii* and *Ps. gibbsi*, respectively).

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REFERENCES

- Blake J.A. (1979) Four new species of *Carazziella* (Polychaeta: Spionidae) from North and South America, with a redescription of two previously described forms. *Proceedings of the Biological Society of Washington* 92, 466–481.

- Blake J.A.** (1996) Family Spionidae Grube, 1850. In Blake J.A., Hilbig B. and Scott P.H. (eds) *Taxonomic atlas of the benthic fauna of the Santa Barbara Basin and Western Santa Barbara Channel*. Volume 6. *The Annelida*. California: Santa Barbara Museum of Natural History, pp. 81–224.
- Blake J.A. and Kudenov J.D.** (1978) The Spionidae (Polychaeta) from southeastern Australia and adjacent areas with a revision of the genera. *Memoirs of the Natural Museum of Victoria* 39, 171–280.
- Carazzi D.** (1893) Revisione del genera *Polydora* Bosc, e cenni su duo specie che vivono sulle ostriche. *Mitteilungen aus der Zoologischen Station zu Neapel* 11, 4–45, pl. 2.
- Day J.H.** (1955) The Polychaeta of South Africa. Part 3: Sedentary species from Cape shores and estuaries. *Journal of the Linnaean Society, Zoology*, 4, 407–452.
- Day J.H.** (1961) The polychaete fauna of South Africa. Part 6: Sedentary species dredged off Cape coasts with a few new records from the shore. *Journal of the Linnaean Society, Zoology*, 44, 463–560.
- Day J.H.** (1967) *Polychaeta of Southern Africa. Part 2 Sedentaria*. London: Trustees of the British Museum (Natural History), London.
- Fauvel P.** (1927) Polychètes sédentaires. Addenda aux errantes, Archiannélides, Myzostomaires. *Faune de France* 16, 1–494.
- Hartman-Schröder G.** (1981) Die Polychaeten der tropisch-subtropischen Westküste Australiens (zwischen Exmouth im Norden und Cervantes im Süden). *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institute* 78, 19–96.
- Hutchings P.A. and Turvey S.P.** (1984) The Spionidae of South Australia (Annelida: Polychaeta). *Transactions of the Royal Society of South Australia* 108, 1–20.
- Leonart M.** (2001) *Australian abalone mudworms: avoidance and identification. A farm manual*. www.frdc.com.au/subprograms/aas/download/mudworm.a.farm.manual.pdf. Accessed 10 September 2003.
- Martin D. and Britayev T.A.** (1998) Symbiotic polychaetes: review of known species. *Oceanography and Marine Biology: an Annual Review* 36, 217–340.
- Nel R., Coetze P.S. and Van Niekerk G.** (1996) The evaluation of two treatments to reduce mud worm (*Polydora hoplura* Claparede) infestation in commercially reared oysters (*Crassostrea gigas* Thunberg). *Aquaculture* 141, 31–39.
- Okuda S.** (1937) Spioniform polychaetes of Japan. *Journal of the Faculty of Science, Hokkaido Imperial University, Series 6, Zoology* 5, 217–258.
- Schleyer M.H.** (1991) Shell-borers in the oyster, *Striostrea margaritacea*: pests or symbionts? *Symbiosis* 10, 135–144.
- Simon C.A. and Booth A.J.** (2007) Population structure and growth of polydorid polychaetes that infest the cultured abalone, *Haliotis midae*. *African Journal of Marine Science* 29, 499–509.
- Simon C.A., Ludford A. and Wynne S.** (2006) Spionid polychaetes infesting cultured abalone, *Haliotis midae*, in South Africa. *African Journal of Marine Science* 28, 167–171.
- and
- Woodwick K.H.** (1964) *Polydora* and related genera (Annelida, Polychaeta) from Eniwetok, Majuro and Bikini Atolls, Marshall Islands. *Pacific Science* 18, 146–159.

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