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New species of *Poecilochaetus* Claparède, 1875 (Polychaeta, Spionida, Poecilochaetidae) from Paranaguá Bay, southeastern Brazil

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Abstract

Two new species, *Poecilochaetus polycirratus* and *Poecilochaetus perequensis*, are described from Paranaguá Bay, southeastern Brazil. This contribution triples the number of *Poecilochaetus* species known from Brazil and adds to our knowledge of the genus worldwide. A comparative table for all species is provided and characters within the genus discussed.

Key words: *Poecilochaetus*, new species, Brazil

Introduction

Poecilochaetus is a widely recorded taxon and has around 30 nominal species (Table 1). Species have been recorded in sediments at depths ranging from the intertidal to more than 10000 m, though most have been found in shallow waters (Mackie 1990). Members live in poorly strengthened branching or U-shaped tubes. Collected specimens are fragile and fragment easily. The taxon is morphologically very distinctive. Key features include an anteriorly projecting chaetal cage surrounding the head, prominent distally free trilobed nuchal organs (sometimes reduced or vestigial), ampullaceous postchaetal lobes on a number of anterior segments, and a posterior region with specialized notochaetae (Rouse & Pleijel 2001).

As for the systematic status, Rouse & Pleijel (2001) considered the name Poecilochaetidae essentially redundant since it contains only *Poecilochaetus*. Blake & Arnofsky (1999) found that *Poecilochaetus* fell within Spionidae in their cladistic analysis of spioniform taxa. However, despite its monogeneric condition, Mackie (1990) assigned the known species to six groups, based on presence or absence of papillae on body surface, degree of development of nuchal organ, distribution of ampullaceous postchaetal lobes, and types of chaetae in the posterior parapodia. In a cladistic analysis of *Poecilochaetus*, Eibye-Jacobsen (2006) identified 2 major clades. One included Mackie's group 1; comprising forms with papillate or tuberculate body surfaces, vestigial nuchal organs, and lacking dorsal postchaetal lobes on chaetiger 1. The other accounted for species with smooth anterior dorsal surfaces and comprised two minor clades. The first of these consisted of species with barbed posterior notochaetae and included the 3 species of Mackie's group 4, but his remaining groups were not supported within the second. Therefore at this stage we prefer to retain the family status.

The Poecilochaetidae from Brazilian waters is poorly known with only one species recorded to date, *Poecilochaetus australis* Nonato, 1963. A further 2 species from Paranaguá Bay are described herein as new taxa.

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Material and methods

Paranaguá Bay is on the coast of Paraná State in southeastern Brazil (25°30'S, 48°25'W). An extensive coastal plain surrounds the Bay and the interior of the system is mainly fringed by mangrove swamps and marshes. The specimens were collected from intertidal areas using a core or by careful digging, and from the sublittoral using a Van Veen grab (0.05 m^2). Specimens were either extracted by hand or sediment samples were passed through a 0.5 mm mesh sieve. Some specimens were relaxed in $MgCl_2$, fixed in 8% formalin and preserved in 80% alcohol. Drawings were prepared with the aid of a camera lucida. The material is deposited in the following institutions: Museu do Centro de Estudos do Mar, Universidade Federal do Paraná, Brazil (MCEM); National Museum Wales, Cardiff, Wales, UK (NMW); The Natural History Museum, London, UK (BMNH); Zoological Museum, University of Copenhagen, Denmark (ZMUC); Los Angeles County Museum of Natural History: Allan Hancock Foundation Polychaete Collection, USA (LACM-AHF); Vasily I. Radashevsky personal collection (VIR).

Poecilochaetus polycirratus Santos & Mackie sp. nov.

Figures 1–25

Material examined. Encantadas Beach, Ilha do Mel, Paranaguá Bay (25°34.26'S, 48°18.98'W), low intertidal region. Holotype complete (MCEM 1290) and 3 paratypes, all incomplete (MCEM 1291).

Description. Only the holotype posteriorly complete, but in four fragments, mostly poorly preserved: anterior fragment with 108 chaetigers, 83 mm long and 3.5 mm wide including parapodia; median fragment with 69 chaetigers, 39 mm long; second median fragment with 132 chaetigers, 70 mm long; posterior fragment with 39 chaetigers, 11 mm long. Total length 159 mm for 348 chaetigers. Paratypes are 3 anterior fragments: 1. with 70 chaetigers, 52 mm long and 2.75 mm wide including parapodia; 2. with 57 chaetigers, 47 mm long and 2.75 mm wide; 3. not measured.

Prostomium small, subrectangular, longer than wide, anterior margin concave; positioned between notopodia of chaetiger 1. Two pairs of small subdermal black eyes; anterior pair reniform, other pair smaller and more rounded, set closer together near posterior margin of prostomium (Figures 1, 2).

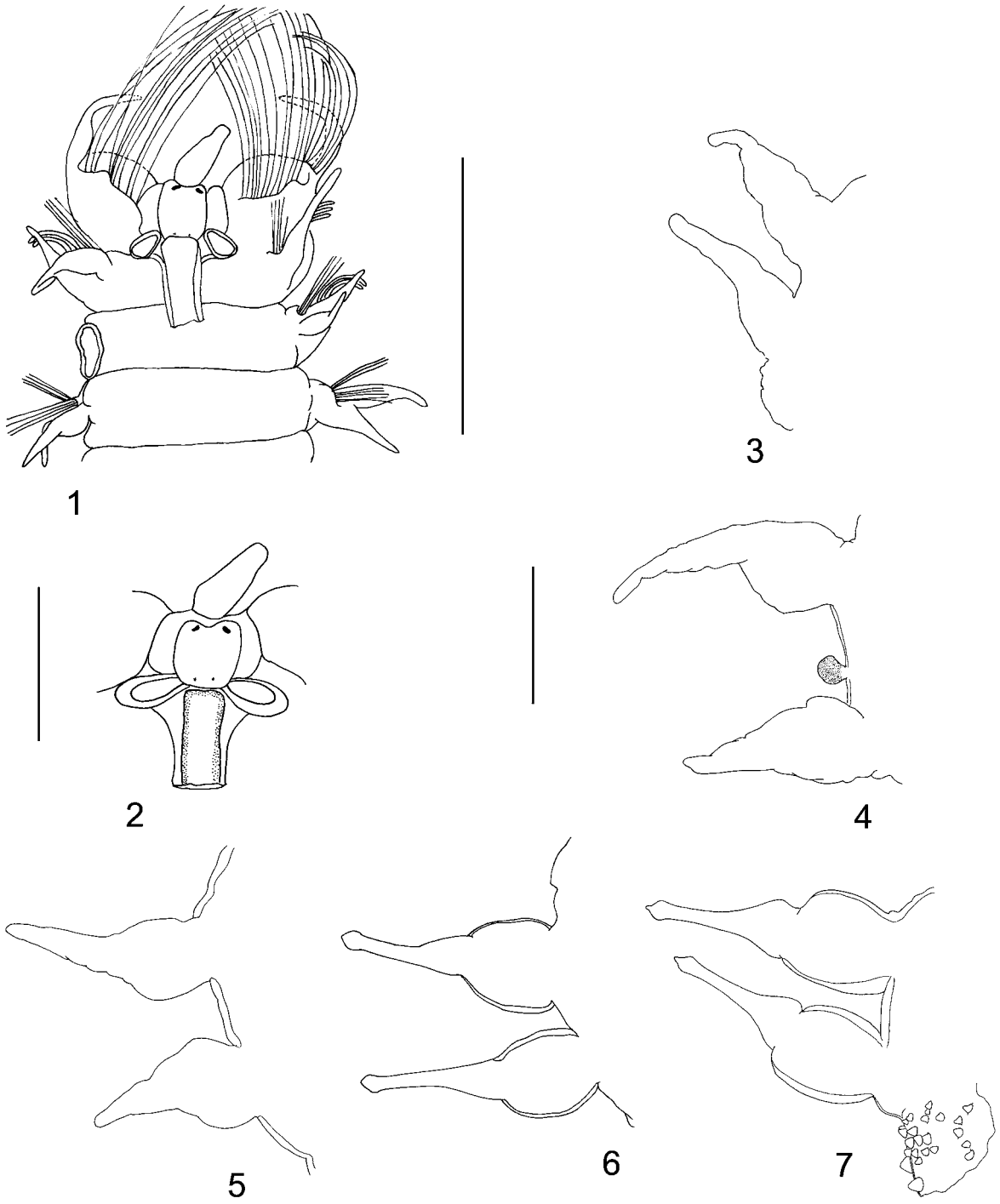
Peristomium small, collar-like surrounding prostomium laterally and giving rise to 3 nuchal lobes posteriorly. Medium lobe conspicuously longer, reaching further than chaetiger 3 (all distally incomplete). Lateral nuchal lobes short, discoid, and divergent, completely connected to basal region of median by well-developed membranes (Figure 2). Palps missing from all specimens. Long, blunt, cylindrical facial tubercle from upper margin of mouth, just below prostomium.

Ventral surfaces of chaetigers 1–3 densely covered with small, red, rounded tubercles; those immediately surrounding mouth smallest. Ventrolateral surfaces of chaetigers 6 to 8 (or 9) and anterior faces of next 2 or 3 parapodia with similar conspicuous tuberculation (Figure 7); other anterior body surfaces smooth. No chitinous plate on dorsum of chaetiger 9.

Chaetiger 1 large, directed forwards; neuropodial postchaetal lobes long, cirriform; notopodial lobes rudimentary, triangular. Neuropodial postchaetal lobes of chaetigers 2–6 short, lanceolate, basally swollen (Figure 3–5); most notopodial lobes of similar size and shape, those of chaetigers 2 and 5 longer (Figures 1, 4).

Ampullaceous postchaetal lobes on chaetigers 7–13. Swollen basal parts of ampullaceous lobes glandular, distal parts smooth and somewhat iridescent (Figure 7).

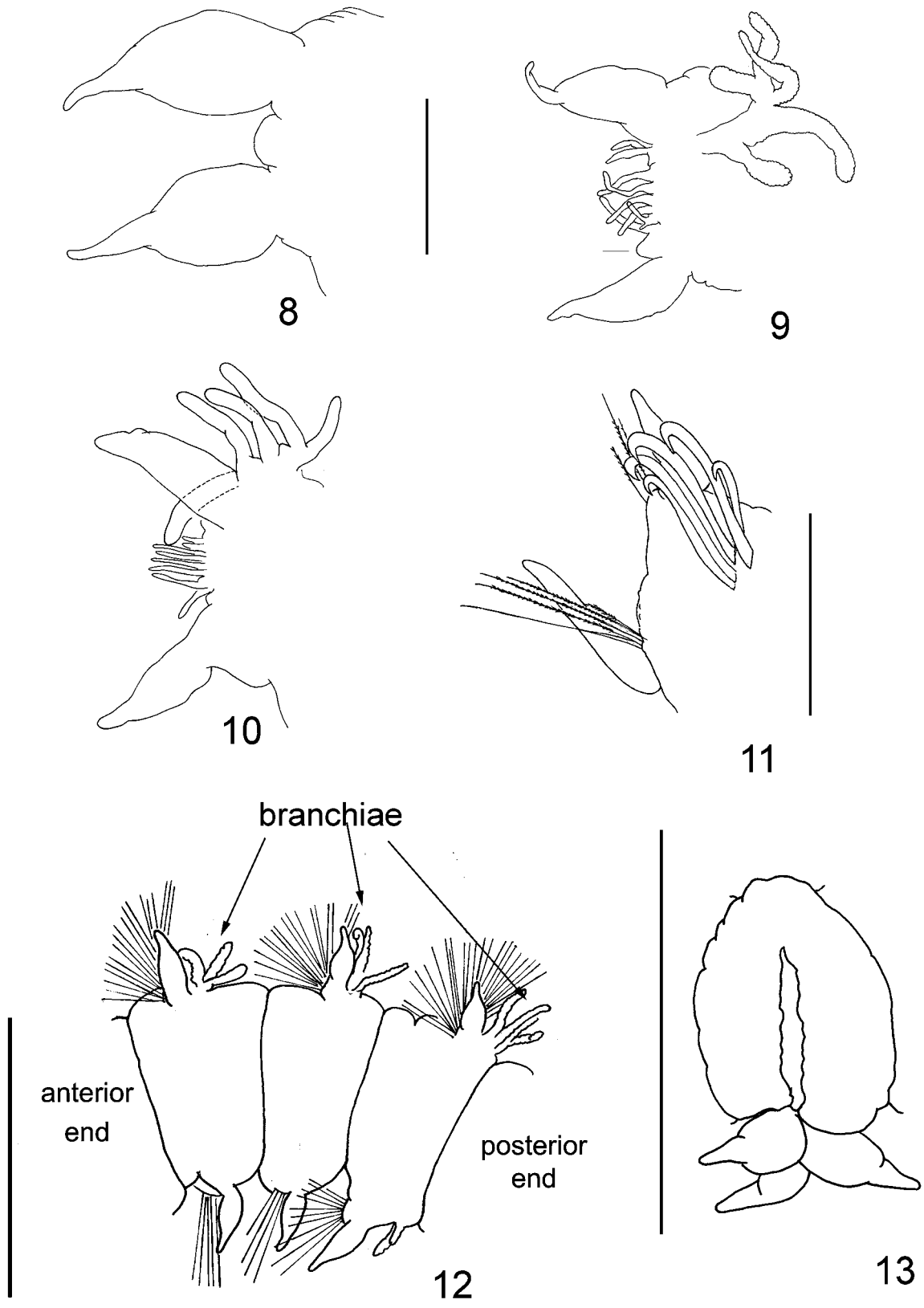
Postchaetal lobes on chaetiger 14 similar to those on chaetiger 6 (Figure 5). Over following 6–8 chaetigers distal parts of postchaetal lobes become narrower and more distinct from large swollen basal parts (Figure 8). In mid-body region, postchaetal lobes become narrower, more lanceolate (Figures 9, 10). Posteriorly, notopodial lobes become shorter than neuropodial ones (Figure 11).



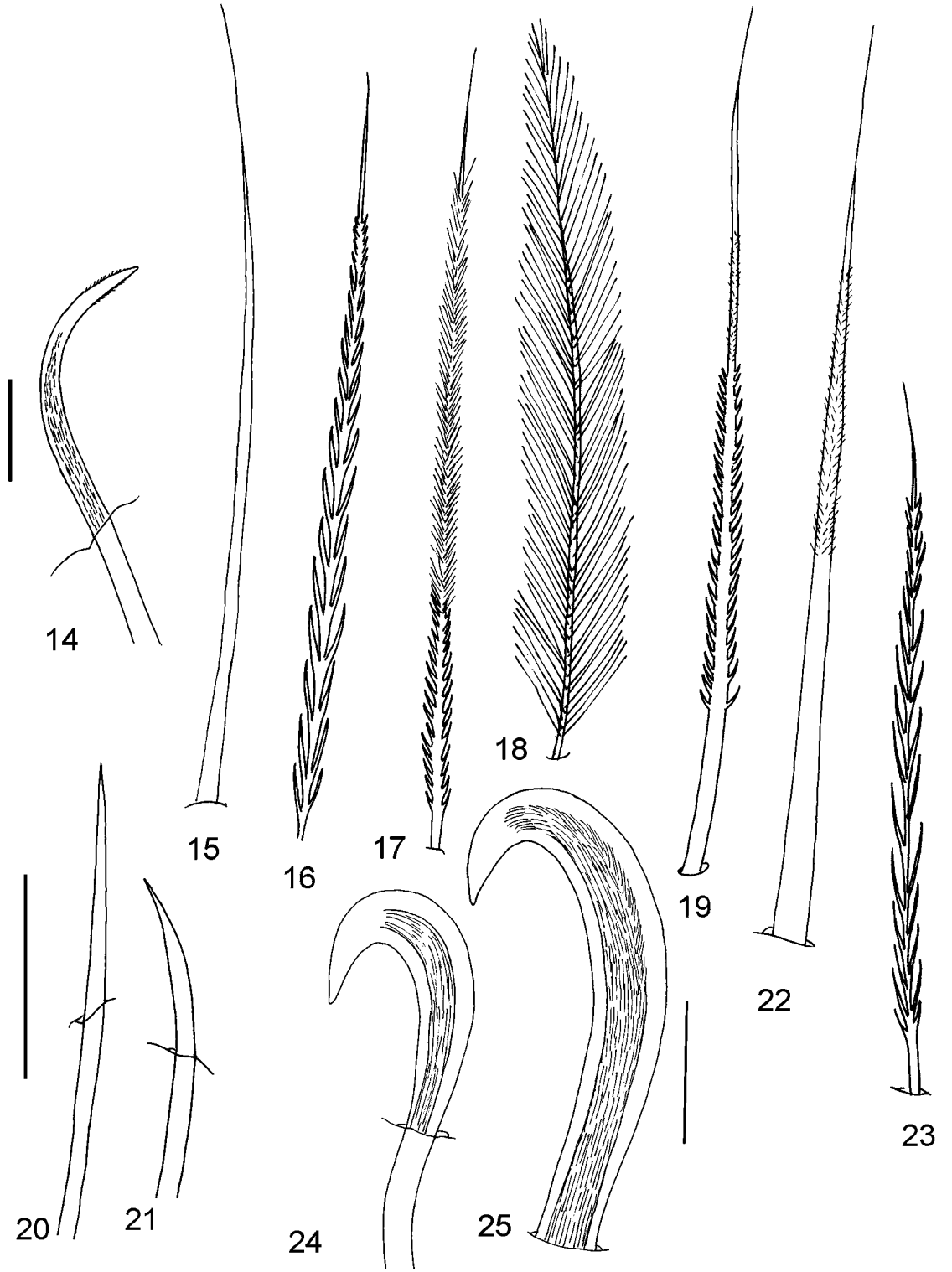
FIGURES 1–7. *Poecilochaetus polycirratus* sp. nov. 1. Holotype, dorsal view of anterior end, palps lacking; 2. detail of prostomium, dorsal view; 3. parapodium 3; 4. parapodium 5; 5. parapodium 6; 6. parapodium 7; 7. parapodium 10, sensory organ omitted. Chaetae omitted from all parapodia. All parapodia in anterior view. Scales. 1. 1.5 mm; 2. 1.0 mm, 4–7. 0.4 mm.

Interramal sensory papillae on chaetigers 1–5 and 10–17 (Figure 4), lacking on chaetigers 6–9. On following segments, sensory organs sessile, evident as single small interramal pores. In posteriormost region, sensory organs slightly projecting as low papillae.

Multiple interramal cirri arise from anterior faces of parapodia from chaetigers 18 which persist for about one third of the body (Figures 9, 10); up to 8–10 cirri observed.



FIGURES 8–13. *Poecilochaetus polycirratus* sp. nov. 8. parapodium 20, anterior view; 9. parapodium 55, posterior view; 10. parapodium 69; 11. posterior parapodium; 12. dorsal view showing branchiae, chaetigers 63–65; 13. pygidium (holotype). Chaetae omitted from figures 8 to 10. All parapodia, except 55, in anterior view. Scales 8-11. 0.4 m; 12,13. 0.2 mm.



FIGURES 14–25. *Poecilochaetus polycirratus* sp. nov. 14. neuropodial hook from chaetiger 2; 15. notopodial capillary from chaetiger 2; 16. spinose chaeta from chaetiger 2; 17. spinose-plumose from chaetiger 22; 18. plumose chaeta from chaetiger 21; 19. spinose-plumose from posterior chaetiger; 20. notopodial spine from posterior chaetiger; 21. notopodial spine from posterior chaetiger; 22. hirsute chaeta from posterior chaetiger; 23. sympodial chaeta from posterior chaetiger; 24. superiormost notopodial hook from posterior chaetiger; 25. notopodial hook from posterior chaetiger. Scales 100 µm.

TABLE 1. Morphological characteristics of species currently assigned to *Poecilochaetus*. For convenience, species arranged primarily according to form of nuchal organs, ampullaceous lobes and, where possible, posterior notochaetae. Species in bold are those where the form of anterior and posterior chaetae are known.

Poecilochaetus	Nuchal lobe		Chaetigers bearing		Notopodial cirrus on chaetiger 1	Anterior dorsum	Chitinous plate on chaetiger 9	Branchiae (from chaetiger)	Interramal sensory organs	Interramal cirri	Modified chaetae				Posterior notopodial spines					Anal Cirri	Type locality	Depth
	Median	Lateral	Neuropodial falcate spines	Ampullaceous cirri							Plumose (from chaetiger)	Robust plumose	Spinose-plumose	Aristate	Slender smooth	Slender barbed	Robust smooth	Robust spinulose	Robust curved			
***fulgoris* Claparéde, 1875** [1]	V	–	2–4	7–11	–	P	–	–	all	–	22	–	+	–	–	–	–	+	–	3	NE Atlantic	1190–1325 m
***trachyderma* Read, 1986**	V	V	2–4	7–11	–	P	–	–	all	–	25 no 23 ne	–	+	–	–	–	–	+	–	?	New Zealand	477–515 m
granulatus Imajima, 1989	V	V	2&3	7–17	–	P	?	–	1–6, 13 on	–	?	?	?	?	?	?	?	?	?	?	Japan	15–120 m
bifurcatus Imajima, 1989	V	V	2&3	7–11	–	P	?	–	all	–	?	?	?	?	?	?	?	?	?	?	Japan	30–75 m
***clavatus* Imajima, 1989**	Sh	D	2&3	7–10	+	S	+	20	1–5, 10 on	1	17	+	+	–	+	–	+	–	–	2	Japan	70–80 m
***branchiatus* Miura, 1989** [2]	Sh	D	2&3	7–10	+ [3]	S	+	20	1–5, 10 on	1 3? [4]	17	–	+	–	–	–	+	–	–	2	Japan	77–144 m
vietnamita Gallardo, 1968	?	?	2-4	7–11	+	S	?	–	?	–	?	–	+	?	?	?	?	?	?	?	Vietnam	19 m
vitjazi Levenstein, 1962	?	D	2&3	7–11	?	S	?	?	?	?	?	?	?	Taper	?	?	?	?	?	?	Tonga Trench	10415–10687 m
multibranchiatus León-González, 1992	Sh	D	2&3	7–11	+	S	?	12	1–6, 11 on	–	?	?	+	?	?	?	?	?	?	?	Baja California Sur	160 m
bermudensis Hartman, 1965 [5]	?	?	2&3	7–12	+	S	–	?	1–5, 10 on	–	?	?	?	?	?	?	?	?	?	?	Bermuda	1000 m
japonicus Kitamori, 1965	Sh	D	2&3	7–13	+	S	?	?	?	3 [6]	16	+	?	?	?	?	?	?	?	?	Japan	5–20 m
***modestus* Rullier, 1965**	Sh	D	2&3	7–11	+	S	?	18	2–35	–	18	+	–	–	–	–	–	–	A	4	Togo	82 m
***tricirratus* Mackie, 1990**	M	D	2&3	7–11	+	S	+	13 no 17 ne	1–5, 10 on	3	17	+	–	Taper	–	–	+	–	A	4	Hong Kong	18–20 m
tropicus Okuda, 1935	L	V	2&3	7–13	+	S	?	19	1–5, 10 on	–	20	–	+	?	?	?	?	?	?	?	Palau	intertidal
***tropicus* (sensu Imajima 1989)**	L	V	2&3	7–13	+	S	+	21	1–5, 10 on	–	21	–	+	–	–	–	+	–	A	?	Ryuku Islands	intertidal
***polycirratus* sp. nov.**	M/ L?	D	2&3	7–13	+	S	–	17	1–5, 10 on	8–10	19	–	+	–	+	–	–	–	A	3	Brazil	intertidal
***ishikariensis* Imajima, 1989**	Sh	D	2&3	7–12	+	S	+	–	1–5, 9 on	–	17	–	–	Taper	–	+	–	–	–	?	Japan	84–88 m
***hystricosus* Mackie,1990**	M	D	2&3	7–13	+	S	+	–	1–5, 9 on	–	14	+	–	Cleft	–	+	–	–	–	3	Hong Kong	13–21 m
***johnsoni* Hartman, 1939** [7]	L	V	2&3	7–13	+	S	+	–	1–5, 9 on	–	15	–	–	Cleft?	–	+	–	–	–	4?	California	intertidal

***australis* Nonato, 1963**	L	V	2&3	7–13	+	S	+	–	all	–	17	–	–	Cleft	–	+	–	–	–	?	Brazil	intertidal
***magnus* Imajima, 1989**	Sh	D	2&3	7–13	+	S	+	–	1–5, 9 on	–	16	–	+	Taper	–	+	–	–	–	?	Japan	10 m
***toyoshiomarae* Miura, 1989** [8]	Sh	D	2&3	7–13	+	S	+	–	1–5, 9 on	–	?	–	+	?	–	+	–	–	–	2	Japan	18–40 m
***fauchaldi* Pilato & Cantone, 1976**	M	D	2&3	7-13	+	S	+	–	1–5	–	16-19	–	–	–	–	–	+	–	Sig	3	Sicily	15–30 m
Elicodasia mirabilis Laubier & Ramos, 1973 [9]	?	?	?	?	?	?	?	?	?	?	?	?	?	?	+	?	?	?	Sig	3	Catalonia, Spain	50–150 m
***perequensis* sp. nov.**	M	Sh	2&3	7–13	+	S	+	–	1–5, 10 on	–	17	+	–	Knob	+	–	–	–	Sig	3	Brazil	intertidal to 15 m
***koshikiensis* Miura, 1988**	M	D	2&3	7–13	+	S	+	–	1–5, 10 on	–	?	–	+	Knob	–	+	–	–	C	4	Japan	200 m
elongatus Imajima, 1989	M	D	2&3	7–13	+	S	+	–	1–5, 10 on	–	17	+	+	?	?	?	?	?	?	?	Japan	8–270 m
tokyoensis Imajima, 1989	L	D	2&3	7–13	+	S	+	19	1–5, 10 on	–	17	+	+	?	?	?	?	?	?	?	Japan	13 m
paratropicus Gallardo, 1968	M	M	2&3	7–13	+	S	?	–	?	–	17	?	?	?	?	?	?	?	?	?	Vietnam	9–43 m
gallardoi Pillato & Cantone, 1976[10]	?	?	?	?	?	?	?	?	?	–	?	?	+	Knob	?	–	+	–	C	?	Vietnam	43 m
***serpens* Allen, 1904** [11]	L	M	2&3	7–13	+	S	+	19-21	1–5, 10 on	–	17	+	+	Knob	–	–	+	–	C, H	4	SW England	intertidal
serpens honiarae Gibbs, 1971 [12]	L	L	2&3	7–13	+	S	+	17-18	1–5, 10	–	17	+	–	Knob	?	?	?	?	?	?	Solomon Islands	intertidal
***trilobatus* Imajima, 1989**	L	L	2&3	7–13	+	S	+	18	1–5, 10 on	–	17	+	+	Knob	+	–	–	–	C, H	3	Japan	5–57 m
***spinulosus* Mackie,1990**	M	M	2&3	7–13	+	S	+	17	1–5, 10 on	–	18	–	+	–	+	–	-	–	C, H	?	Hong Kong	intertidal
exmouthensis Hartmann-Schröder, 1980[13]	M	M	2&3	7–13	+	S	+	18	1–5, 10 on	–	17	+	+	?	?	?	?	?	?	?	Australia	intertidal

Key: + present, – absent no –notopodia, nc –neuropodia
Nuchal organs: V –vestigial, D –discoid, Sh –short, M –medium, L –long
Anterior dorsum: P –papillate, S –smooth

Aristate chaeta: Taper –tapering to arista, Cleft –cleft at base of arista, Knob –with knob-like process at base of arista
Posterior notopodial hooks (form): Sig –sigmoidal, C –curved, H –hooked, A –ancistroid

Notes

[1] From redescription of Pilato & Cantone (1976)
[2] Possibly = *P. clavatus* (Miura, pers. comm.)
[3] Miura (1989: fig. 1d).
[4] Miura (1989: fig. 2j & l).
[5] Including redescription of Pilato & Cantone (1976)
[6] Kitamori (1965: fig. 1F)
[7] Including redescription of Pilato & Cantone (1976)
[8] Possibly = *P. magnus* (Miura, pers. comm.)
[9] Possibly = posterior region of *P. fauchauldi* (see Mackie 1990)
[10] Possibly = posterior region of *P. paratropicus* (see Mackie 1990)
[11] Including reassessment by Gibbs (1971) and pers. obs.
[12] Including re-examination by present authors (BMNH 1970.67)
[13] Including re-examination of Mackie (1990)

Branchiae arise on posterior faces of notopodia from chaetiger 17 as single cirriform filaments. Number of filaments progressively increasing to 5 or 6 over following chaetigers and branchiae assume palmate form (Figures 9, 10, 12). Branchiae absent from posterior third of body.

Pygidium with large oblique anus and three short ventral anal cirri (Figure 13). Cirri distally tapered; paired cirri basally broader, somewhat pyriform, arising laterally just above more subulate unpaired one. Length ratio of superior to inferior cirri 1:1.

Chaetiger 1 with long, slender capillaries, finely hirsute in distal regions (hairs visible at x400 magnification), notochaetae longer; arranged fan-like in both rami forming cephalic cage. Neuropodia of chaetigers 2 and 3 with 4–5 slightly hirsute falcate hooks (Figure 14); tips of 1 or 2 partially-formed replacement hooks evident superiorly. Several (4–6) short slender finely hirsute capillaries superior to fully formed emergent hooks in both chaetigers. Notopodia of same chaetigers with 2 types of chaetae, inferior finely hirsute and superior spinose capillaries. Following chaetigers also with finely hirsute capillaries, appearing smooth (Figure 15) or almost so at x400, and spinose capillaries (Figure 16) in notopodia. Hirsute capillaries increasingly accompany spinose ones in superior parts of rami; neuropodia with only finely hirsute capillaries. From chaetiger 9 spinose chaetae appear inferiorly in neuropodia, and hirsute nature of capillaries becomes more obvious in both rami.

Chaetae markedly different from chaetiger 19; both rami superiorly and inferiorly with long, plumose capillaries (Figure 18) in addition to spinose and hirsute capillaries. In the middle of each ramus occur 10–12 hirsute capillaries with conspicuous stiff hairs in their medial regions, replaced from chaetiger 20 by spinose-plumose chaetae (Figure 17). By chaetiger 52, chaetae less abundant, particularly outer plumose ones.

In posterior chaetigers, tips of spinose-plumose chaetae become progressively smoother (Figure 19). Four or five notopodial hooks on posteriormost 37 chaetigers, accompanied by several spines (Figures 20, 21). Hooks long, slender, strongly curved, ancistroid (Figures 24, 25); superiormost hook half size and thickness of others (Figure 11). Hooks and spines accompanied by smooth tipped spinose-plumose chaetae (Figure 19), sympodial chaetae (Figure 23), and plumose (Figure 18) and hirsute capillaries (Figure 22).

Etymology. The specific name “polycirratus” with multiple cirri, refers to the numerous slender interramal cirri.

Remarks. In *Poecilochaetus*, 11 other taxa are known to have branchiae (Table 1): *P. serpens* Allen, 1904, *P. serpens honiarae* Gibbs, 1971, *P. tropicus* Okuda, 1935, *P. modestus* Rullier, 1965, *P. exmouthensis* Hartmann-Schröder, 1980, *P. clavatus* Imajima, 1989, *P. tokyoensis* Imajima, 1989, *P. trilobatus* Imajima, 1989, *P. spinulosus* Mackie, 1990, *P. tricirratus* Mackie, 1990 and *P. multibranchiatus* León-González, 1992. These species differ from each other variously in the number of ampullaceous postchaetal lobes, commencement of branchiae, number of branchial filaments, length and shape of nuchal organs, and presence and number of interramal cirri (Table 1).

Poecilochaetus polycirratus sp. nov., closely resembles *P. modestus* from West Africa and *P. tricirratus* from Hong Kong (Table 1). All have nuchal organs with an elongate median lobe and discoid lateral lobes, and possess large ancistroid notopodial hooks in their posterior regions. The new species differs markedly from the others (categorized as group 2 by Mackie 1990) in possessing ampullaceous lobes on chaetigers 7–13, not 7–11. Furthermore, the branchiae have up to 6 filaments, rather than only 1 or 2.

Posterior ancistroid notopodial hooks are found also in *P. tropicus* from the Palau Islands as redescribed by Imajima (1989) from an entire Japanese specimen. This species, like *P. polycirratus*, has ampullaceous lobes on chaetigers 7–13 and an elongate median nuchal lobe, but the branchiae are present as 2 separate filaments.

The new species possesses interramal cirri, a feature previously described only in *P. tricirratus*, *P. japonicus* Kitamori, 1965 and *P. clavatus* (including *P. branchiatus*; Miura pers. comm.). However, the cirri are much more numerous (up to 10 against 1–3) in the new species (Table 1). The posterior notopodial chaetae of Kitamori’s species are not known. *Poecilochaetus clavatus* differs markedly in having ampullaceous lobes on chaetigers 7–10, straight notopodial spines, and 2 (rather than 3) anal cirri.

Poecilochaetus polycirratus sp. nov., is unusual in apparently lacking a chitinous plate on the dorsum of chaetiger 9. The plate was not observed on any of the 4 specimens available. It is considered to be consistently absent in *Poecilochaetus* species with heavily papillated body surfaces (Mackie 1990: group 1; Eibye-Jacobsen 2006: papillate clade). In smooth-bodied forms, only *P. bermudensis* Hartman, 1965 has been recorded as lacking such a plate (see Pilato & Cantone 1976). No mention of the structure was made in the original descriptions of *P. tropicus*, *P. vietnamita* Gallardo, 1968, *P. modestus*, *P. japonicus*, *P. vitjazi* Levenstein, 1962, and *P. multibranchiatus*. Confirmation of the presence or absence of the chitinous plate on chaetiger 9 would require re-examination of the type specimens in the first instance. It may be necessary also to examine additional material (including *P. polycirratus*), preferably covering a range of specimen sizes, as it is possible that the plate may be lost or worn away on larger examples of some species.

Occurrence. Intertidal flat, muddy-sand, Paranaguá Bay, southeast coast of Brazil.

***Poecilochaetus perequensis* Santos & Mackie sp. nov.**
Figures 26–50

Material examined. Just northwest of where Perequê Creek enters Paranaguá Bay, Paraná (25°33.83'S, 48°21.33'W); muddy sand and standing water at mid-tide level. Holotype (MCEM 1292) 1 dissected paratype (MCEM 1293), 1 paratype (MCEM 1294), 1 dissected paratype (NMW.Z.1998.082.0009), 19 paratypes (NMW.Z.1998.082.0010–0014), 2 paratypes (BMNH 2008.157–2008.158), 1 paratype (ZMUC-POL-1953), 1 paratype (LACM-AHF POLY 2195).

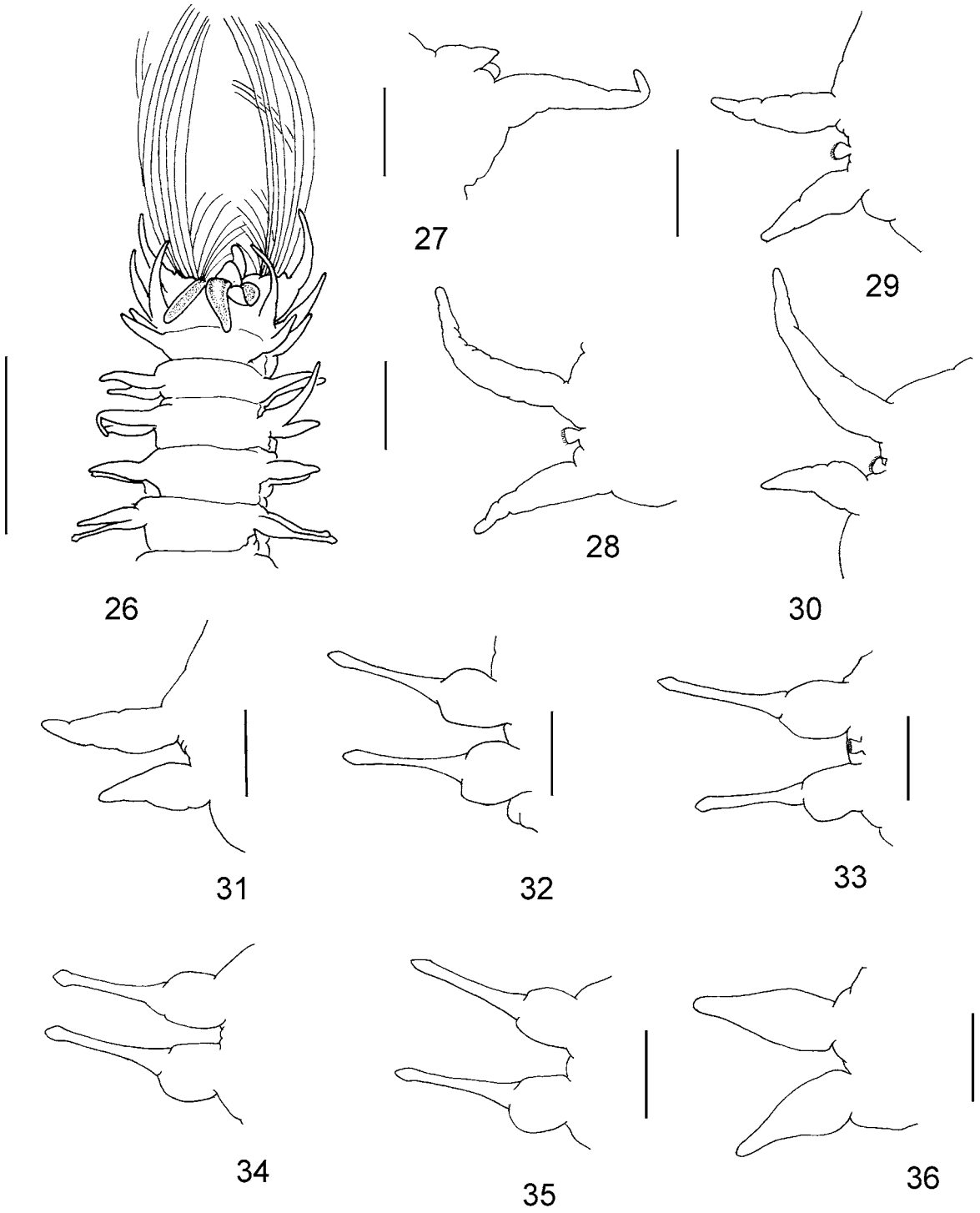
Other material examined. Mouth of Maciel River, Paranaguá Bay, silty sand, 15 m, (VIR 9802), 3 specimens; Gamboa do Maciel, 1 specimen (C. Santos); Ilha das Cobras (25°28.9' S, 48°26.0' W), silty sand, 4 m, 4 specimens (VIR 9796).

Description. Holotype entire with 106 chaetigers, 36 mm long and 1.40 mm wide from tip to tip of ampullaceous parapodia. Dissected paratype (MCEM 1293) entire with 90 chaetigers, 23 mm long and 1.25 mm wide. Second dissected paratype (NMW.Z.1998.032.0009) entire (now in 2 pieces) with 95 chaetigers, 25 mm long and 1.20 mm wide. Other paratypes (1.0-1.7 mm wide), mostly fragmented; largest complete paratype (NMW.Z.1998.032.0014) 106 chaetigers, 41 mm long and 1.65 mm wide.

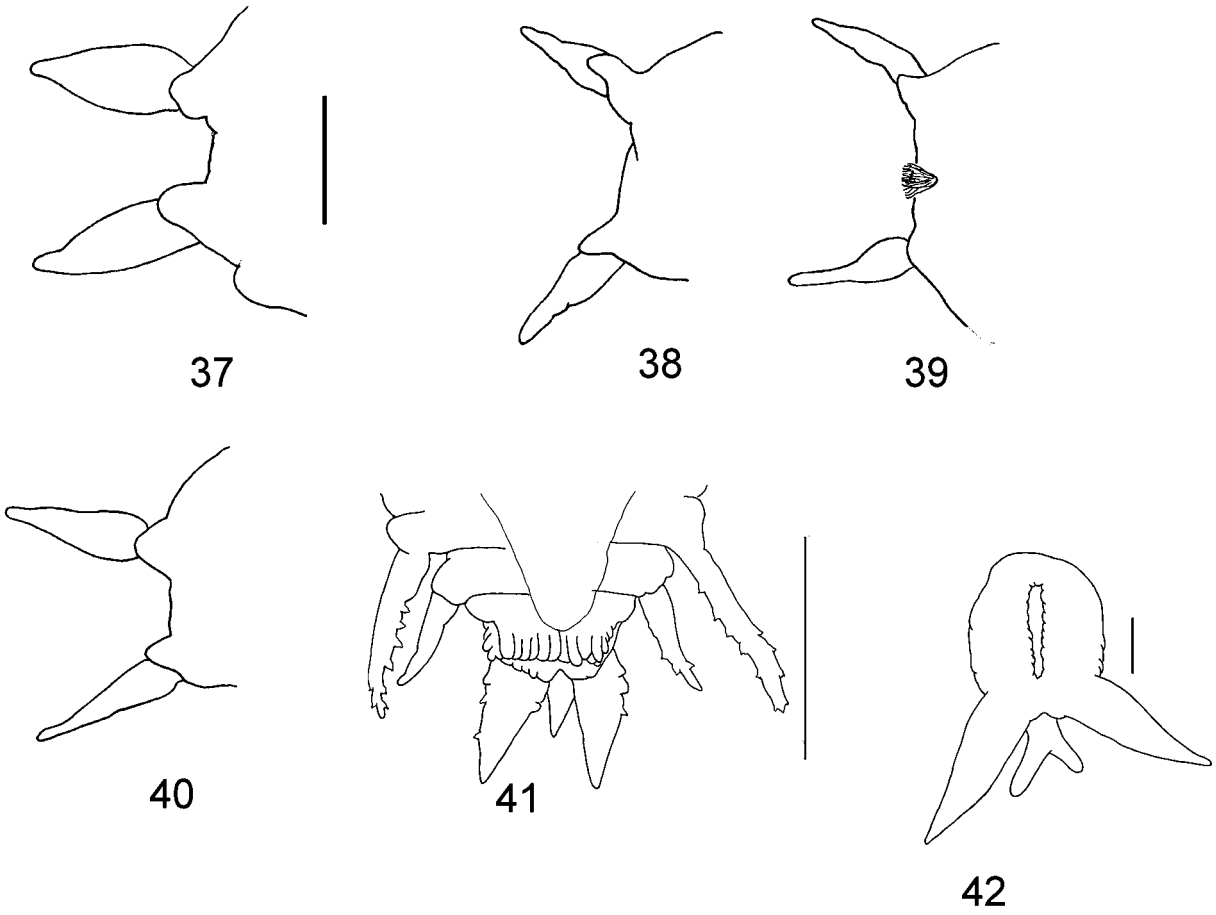
Prostomium small, rounded pyramidal, longer than wide, anterior margin concave or straight; positioned between notopodia of chaetiger 1 (Figure 26). Two pairs of small subdermal dark brown to black eyes; anterior pair round to reniform on short flat frontal part of prostomium, other pair smaller and round to bar-shaped, set closer together on posterior base of domed part.

Peristomium small, collar-like, surrounding prostomium laterally and giving rise to 3 nuchal lobes posteriorly (Figure 26). Median lobe longer, of moderate length, reaching up to chaetiger 4 or 5. Lateral lobes short, divergent, basally fused to median, reaching chaetiger 2 or 3. Anteriorly grooved palps, long, tapering, reaching chaetiger 30–35; short basal part expanded, overlapping posterior dome of prostomium. Margins of palp groove adorned with dense papillae of two types, long slender cirriform (25–75 µm long) and shorter (7–15 µm), cirriform to clavate, forms. Cirriform papillae often distally narrowed, with short digitiform tips. Lateral surfaces of palps longitudinally with 3 sparse rows of long cirriform papillae; rows irregular and, in distal regions, increasingly positioned toward abfrontal surfaces. Long, blunt cylindrical facial tubercle from upper margin of mouth, just below prostomium (Figure 26).

Ventral surfaces of chaetigers 1 and 2, and margins of mouth, covered with tiny pale yellow, rounded tubercles. Parapodial faces of anterior chaetigers with some sparsely distributed and barely visible tubercles appearing, as for other body surfaces, smooth (under zoom microscopy, x40). Ventrolateral surfaces of chaetigers 6 and 7 slightly tuberculate. Obtuse triangular chitinous plate on posterior dorsum of chaetiger 9; pale straw to light reddish brown in colour.



FIGURES 26–36. *Poecilochaetus perequensis* sp. nov. Paratype. 26. anterior end, dorsal view, palps omitted; 27. parapodium 1; 28. parapodium 2; 29. parapodium 3; 30. parapodium 5; 31. parapodium 6; 32. parapodium 8; 33. parapodium 11; 34. parapodium 12; 35. parapodium 13; 36. parapodium 14. All chaetae omitted. All parapodia in anterior view. Scales. 26. 1 mm; 27–36. 0.2 mm.



FIGURES 37–42. *Poecilochaetus perequensis* sp. nov. Paratype. 37. parapodium 19, anterior view; 38. parapodium 30; 39. parapodium 49; 40. parapodium 63; 41. pygidium, dorsal view; 42. holotype pygidium. All chaetae omitted. All parapodia in anterior view. Scales 37–41. 0.2 mm; 42. 0.1mm.

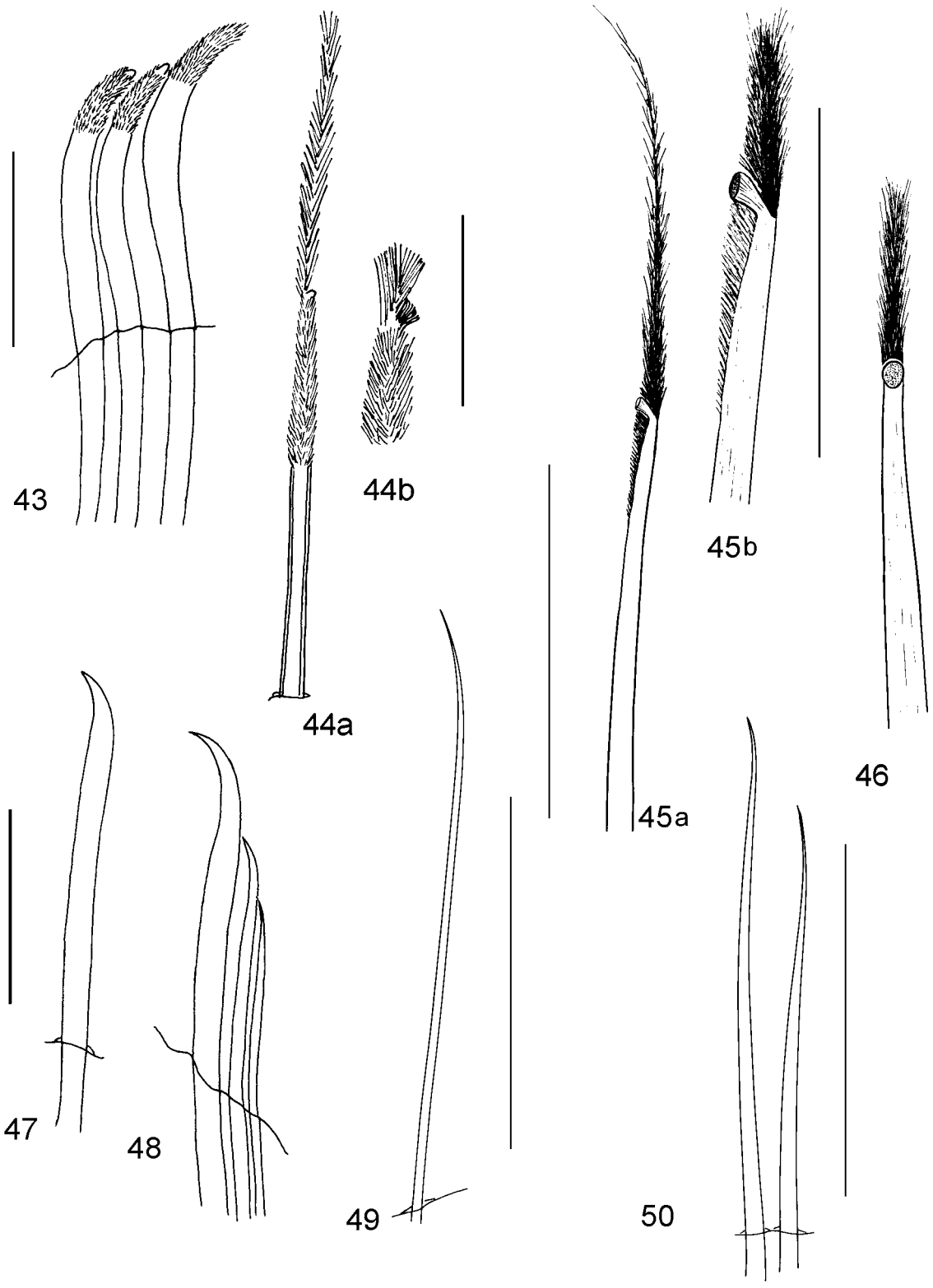
Chaetiger 1 large, directed forwards; neuropodial postchaetal lobes long, cirriform, notopodial lobes short, triangular (Figure 27). Neuropodial postchaetal lobes of chaetigers 2–6 short (Figures 28–31), lanceolate; longest on chaetiger 2 (Figure 28), shortest on chaetigers 4–6 (Figures 30-31). Notopodial postchaetal lobes on chaetigers 3, 4 and 6 of similar size and shape to respective neuropodial lobes, those of chaetigers 2 and 5 much longer.

Ampullaceous postchaetal lobes on chaetigers 7–13 (Figures 32–35). Wide basal parts of ampullaceous lobes glandular, distal parts smooth and slightly iridescent.

Postchaetal lobes on chaetiger 14 (Figure 36) similar to those on chaetiger 6. Thereafter, postchaetal lobes of both rami become narrower and shorter (Figures 37–40). In posterior region, postchaetal lobes cirriform; notopodial lobes slightly longer than neuropodial ones.

Interramal cup-like sensory papillae, with distal tufts of cilia, on chaetigers 1–5 (Figures 27–30) and 10–15 (degree of protrusion variable after chaetiger 10), lacking on chaetigers 6–9. On following segments, sensory organs sessile, evident only as single projecting tufts of cilia (Figure 39). In posterior region (from about chaetiger 70–80), sensory organs again projecting as low cilia-bearing papillae. Interramal cirri absent. Branchiae absent.

Pygidium with small terminal anus and three ventral anal cirri; longer paired cirri arising just above short unpaired one, latter sometimes bifurcate (Figures 41, 42). Length ratio of superior to inferior cirri 2:1.



FIGURES 43–50. *Poecilochaetus perequensis* sp. nov. Paratypes. 43. neuropodial hooks from chaetiger 2; 44a. transitionary aristate chaeta from chaetiger 20, 44b. detail; 45a. fully formed aristate chaeta from chaetiger 63, lateral view, 45b. detail; 46. aristate chaeta from chaetiger 35, frontal view; 47. notopodial hook from chaetiger 63; 48. notopodial hooks from chaetiger 71; 49. slender notopodial spine from posterior chaetiger; 50. neuropodial spines from chaetiger 80. Scales 43, 44a, 45a, 47–50.100 µm; 44b,45b,46.50 µm.

Chaetiger 1 with long, slender capillaries, arranged fan-like in both rami, forming cephalic cage; notochaetae longer. Notopodial capillaries smooth (viewed at x400 magnification), slightly hirsute (at x1000). Most neuropodial capillaries of chaetiger 1 appear distinctly annulated where concentric rings of fine hairs occur; transverse annulations on other neurochaetae and notochaetae indistinct. Neuropodia of chaetigers 2 and 3 with 4-5 hirsute falcate hooks (Figure 43). Several short slender capillaries (3–4) superior to emergent hooks in both chaetigers; single, partially formed, hooks seen embedded below bases of capillaries. Notopodia of same chaetigers with, slender capillaries; these and neuropodial ones smooth or with barely visible hairs (x1000). Following 2 chaetigers with capillaries only, some obviously hirsute (x400). Spinose chaetae appear in superior part of notopodia from chaetiger 6 (occasionally 5) and in inferior part of neuropodia from chaetiger 7 (occasionally 8).

Chaetae markedly different from chaetiger 17 (one from 18); long, plumose capillaries appear superiorly and inferiorly in both rami, and larger, sympodial spinose chaetae replace earlier spinose chaetae. In addition, 6–8 robust, heavily hirsute, capillaries with plumose tips project from small conical parapodia. These robust capillaries completely replaced by aristate chaetae over following 2–3 chaetigers and intermediate forms can occur (Figure 44a, b); aristate chaetae generally numerous from chaetiger 19. Fully formed aristate chaeta (Figure 45a, b) with truncate hook-like tufted knob at base of plumose arista (arista easily detached). A ‘beard’ of long hairs occurs below knob, where chaetal shaft narrows. In frontal view, knob appears as rounded button above a narrowing shaft and below long plumose arista (Figure 46). Initially 7–8 aristate chaetae in each ramus, decreasing to 6–7 in median chaetigers.

In posterior third of body (around chaetigers 60–70 on larger specimens), dorsalmost two aristate chaetae in notopodia gradually transition into slightly sigmoidal spines with gently curved tips, some almost straight; uppermost spine thinnest (Figures 47, 48). Notopodial spines accompanied by 5 aristate, 3 sympodial and small number of plumose chaetae. Corresponding neuropodia with 6–7 aristate, 4–5 sympodial, and more abundant plumose chaetae. In following segments (around chaetigers 75–80) notopodial spines increase to 4–5 per notopodium, and other chaetae become less numerous—comprising 2–3 aristate and 2 sympodial chaetae accompanied inferiorly by sparse bundle of smooth capillaries. Any remaining plumose chaetae increasingly denuded of long hairs. Neuropodia with 5–7 aristate and 3–4 sympodial chaetae; plumose chaetae becoming progressively smoother with only 4–5 inferior chaetae retaining some sparse long hairs.

In posterior sixth of body (from about chaetiger 80-85), aristate chaetae and sympodial chaetae decrease to only 1 per notopodium, accompanied by 5–6 smooth capillaries. Neuropodia with 2–3 aristate, 1–2 sympodial and 4–5 smooth capillary chaetae. Sparsely haired plumose chaetae rare in both rami. Robust sigmoidal notopodial spines accompanied by small posterior row of slender, smooth needle-like, spines with slightly curved tips (Figure 49) from about chaetiger 75–80; initially 4–5 slender spines, later increasing to about 12 in bundle. Number of sigmoidal spines increases to 6 or 7 on posteriormost chaetigers; aristate and sympodial chaetae absent. Neuropodia from about chaetiger 80–85 also with spines; initially 2 ventral spines, increasing to 4 in number, accompanying 4–5 smooth capillaries and 2 (decreasing to 0) aristate chaetae. Neuropodial spines very similar to robust sigmoidal notopodial spines (Figure 50), but maximally only a little thicker than superiormost of these.

Colour. In life, anterior orange-red and yellow, median and posterior regions brown. Preserved specimens in alcohol, white.

Etymology. The specific name "perequensis" refers to the name of the creek near the type locality in Paranaguá Bay. "Perequê" comes from the indigenous language Tupy-guarany, and means the entrance of a place for feeding and breeding of fishes.

Occurrence. Muddy sand, intertidal flat and shallow sublittoral (to 15 m) Paranaguá Bay, southeast coast of Brazil.

Remarks. *Poecilochaetus perequensis* sp. nov. resembles *P. australis* Nonato, 1963, the only species previously reported to Brazilian coast, in the presence of aristate chaetae and ampullaceous postchaetal lobe on

chaetigers 7–13. However, *P. perequensis* differs markedly in having both large and slender, smooth, curved spines in posterior notopodia, rather than only slender barbed ones. In addition, the lobes of the nuchal organ are more similar in length in *P. perequensis.* In *P. australis* they are more disparate, the median nuchal organ reaching to chaetiger 10, while the lateral ones are vestigial. The aristate chaetae are quite different in the 2 species. Aristate chaetae in *P. perequensis* have a lateral tufted hook-like projecting knob, surmounted by a plumose arista, as found in *P. serpens honiarae, P. trilobatus,* and *P. koshikiensis*. Should *P. gallardoi* Pilato & Cantone, 1976 prove to be the posterior end of *P. paratropicus* Gallardo, 1968 from Vietnam (see Mackie 1990), then *P. paratropicus* would possess this form of aristate chaeta too (see Table 1). Eibye-Jacobsen (2006) identified *P. paratropicus* from Thailand and coded the species as having a dorsal chitinous plate on chaetiger 9, and posterior notopodia with both curved hooks and straight (or weakly curved) spines. The first feature is a new observation, the second consistent with the synonymy of *P. gallardoi*, however Eibye-Jacobsen (2006) did not consider the presence or absence of aristate chaetae in his cladistic analyses.

All 6 taxa, including (*P. perequensis*) have ampullaceous lobes on chaetigers 7–13, but the presence of branchiae readily distinguishes *P. serpens, P. serpens honiarae* and *P. trilobatus* from the others. *Poecilochaetus koshikiensis* Miura, 1988 has reduced, discoid, lateral nuchal lobes—rather than the short (reaching chaetiger 2 or 3), medium (reaching chaetiger 4 or 5) or long (reaching chaetiger 6 or beyond) lobes of the other 5 taxa. *Poecilochaetus perequensis* appears closest to *P. paratropicus* (including *P. gallardoi*). Both have plumose chaetae from chaetiger 17, and posterior notopodial hooks and spines. Nevertheless, the two species are easily separated by the fact that the posterior notopodial hooks and spines are relatively slender in *P. perequensis* compared to the robust forms found in *P. paratropicus.* Furthermore, aristate chaetae are always present by chaetiger 19 (18-20) in *P. perequensis,* but are absent from at least the first 25 chaetigers in *P. paratropicus*.

The distinctive sigmoidal notopodial hooks of *Poecilochaetus perequensis* are very similar to those found posteriorly in *P. fauchaldi* Pilato & Cantone, 1976. The Mediterranean species differs in having discoid lateral nuchal organs and robust posterior notopodial spines, and also lacks aristate chaetae.

Discussion

Pilato & Cantone (1976) and Mackie (1990) tried to examine relationships within *Poecilochaetus* through tabulation of the morphological characteristics of the species. This led the latter to recognize 6 morphological groups. Additional species described by Imajima (1989) and León-González (1992) revealed greater variety within the genus and the recent cladistic analysis of Eibye-Jacobsen (2006) did not lend support for Mackie's groups *sensu stricto*. For example, the number of chaetigers with ampullaceous lobes was found to change independently within different clades.

High chaetal diversity is a feature of *Poecilochaetus* and Mackie (1990) identified 14 main chaetal forms, each of which have (or could have) specific distribution in the body. However, one continuing problem with assessments of the genus concerns the fragmentary nature of many type specimens. Of the 35 taxa listed in Table 1, only 20 are known from complete specimens or material long enough for the posterior chaetae to be determined. Excluding possible synonyms (*P. branchiatus, P. toyoshiomarae*), this is reduced to 18. Two of the remaining 17 taxa (*Elicodasia mirabilis* & *P. gallardoi*) may be posterior regions of other described species (*P. fauchaldi* & *P. paratropicus*). Hence, the posterior chaetae of almost half the described taxa are not known. This is unfortunate since these can be characteristic for related species (Mackie 1990; Eibye-Jacobsen 2006).

In *P. perequensis* sp. nov., at least 75% of the anterior and median chaetigers are required to determine the two major notochaetal forms (sigmoid hooks and slender curved spines) found in the posterior region. The robust notopodial hooks of *P. serpens* are restricted to the posterior 15% of adult *P. serpens* with around 110

chaetigers (Allen 1904). Conversely, the posterior notochaetae of *P. ishikariensis* could be determined from an incomplete specimen of 50 chaetigers (Imajima 1989). Other chaetal forms can also remain undetected in posteriorly incomplete specimens. The tufted hook-like aristate chaetae, present from around chaetiger 19 in *P. perequensis* sp. nov. are found posterior to chaetiger 30 in *P. trilobatus*, and posterior to chaetiger 80 in adult *P. serpens*.

Poecilochaetus is particularly prevalent in tropical and subtropical locations (Table 1) and it seems certain that many more species await discovery. Indeed, 7 new species are currently being described from Thailand (Eibye-Jacobsen, pers. comm.). The additional knowledge derived from these will expand our knowledge of the taxon and help improve analyses of the relationships within it.

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References

Allen, E.J. (1904) The anatomy of *Poecilochaetus*, Claparède. *Quarterly Journal of Microscopical Science*, 48, 79–151.

Blake J.A. and Arnofsky P.L. (1999) Reproduction and larval development of the spioniform Polychaeta with application to systematics and phylogeny. *Hydrobiologia*, 402, 57–106.

Claparède, E. (in Ehlers, E. 1875) Beiträge zur Kenntniss der Verticalverbreitung der Borstenwürmer in Meere. *Zeitschrift für Wissenschaftliche Zoologie*, 25, 1–102.

Day, J.H. (1973) New Polychaeta from Beaufort, with a key to alI species recorded from North Carolina. *NOAA Technical Reports*, 375, 1–140.

Eibye-Jacobsen, D. (2006) A preliminary phylogenetic analysis of Poecilochaetidae (Annelida: Polychaeta) at the species level. *Marine Ecology*, 26(2005), 171–180.

Gallardo,V.A. (1968) Polychaeta from the Bay of Nha Trang, South Vietnam. *Naga Report*, 4, 35–279.

Gibbs, P.E. (1971) The polychaete fauna of the Solomon Islands. *Bulletin of the British Museum (Natural History)*, 21, 101–211.

Hartman, O. (1939) New species of polychaetous annelids from Southern Califomia. *Allan Hancock Pacific Expeditions*, 7, 159–171.

Hartman, O. (1965) Deep-water benthic polychaetous annelids off New England to Bermuda and other North Atlantic areas. *Occasional Papers Allan Hancock Foundation*, 28, 1–378.

Hartmann-Schröder, G. (1980) Die Polychaeten der tropischen Nordwestküste Australiens (zwischen Port Samson im Norden und Exmouth im Süden) *In*: Hartmann-Schröder, G. & Hartmann, G. Zur Kenntnis des Eulitorals der australischen Küsten unterbesonder Berücksichtigung der Polychaeten und Ostracoden. *Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut*, 77, 41–110.

Imajima, M. (1989) Poecilochaetidae (Annelida, Polychaeta) from Japan. *Bulletin of the National Science Museum, Tokyo, Series A (Zoology)*, 15, 61–103.

Kitamori, R. (1965) Two new species of rare families, Disomidae and Paralacydonidae (Annelida: Polychaeta). *Bulletin Tokai Regional Fisheries Research Laboratory*, 44, 41–44.

Laubier, L. & Ramos, J. (1973) A new genus of Poecilochaetidae (Polychaetous annelids) in the Mediterranean: *Elicodasia mirabilis. Proceedings of the Biological Society of Washington*, 86, 69–78.

León-González, J.A. de (1992) Soft-bottom polychaetes from the western coast of Baja California Sur, Mexico. ll. Poecilochaetidae. *Cahiers Biologie Marine*, 33, 109–114.

Levenstein, R.Ya. (1962) The polychaetes from three abyssal trenches in the Pacific Ocean. *Zoologicheskii Zhurnal*, 41,

1142–1148.
Mackie A.S.Y. (1990) The Poecilochaetidae and Trochochaetidae (Annelida: Polychaeta) of Hong Kong. *In*: Morton, B. (Ed), *Proceedings of the Second International Marine Biological Workshop: The marine flora and fauna of Hong Kong and southern China*. Hong Kong University Press, Hong Kong, pp. 337–362.
Miura, T. (1988) *Poecilochaetus koshikiensis*, a new polychaete species from Shimo-Koshiki Island, Japan. *Proceedings of the Biological Society of Washington*, 101, 671–675.
Miura, T. (1989) Two new species of the genus *Poecilochaetus* (Polychaeta, Poecilochaetidae) from Japan. *Proceedings of the Japanese Society of Systematic Zoology*, 39, 8–19.
Nonato, E. (1963) *Poecilochaetus australis* sp. nov. (Annelida, Polychaeta). *Neotropica*, 9(28), 17–26.
Okuda, S. (1935) *Poecilochaetus tropicus* n.sp., a remarkable sedentary polychaete from the South Seas. *Zoological Institute, Faculty of Science, Hokkaido Imperial University*, 11, 289–291.
Pilato, G. & Cantone, G. (1976) Nuove specie di *Poecilochaetus* e considerazioni sulla famiglia dei Poecilochaetidae (Annelida: Polychaeta). *Animalia*, 3, 29–63.
Read, G.B. (1965) New deep-sea Poecilochaetidae (Polychaeta: Spionida) from New Zealand. *Journal of Natural History*, 20, 399–413.
Rouse, G. & Pleijel, F. (2001) *Polychaetes*. Oxford Press, Oxford, 354 pp.
Rullier, F. (1965) Contribution à la faune des annélides polychètes du Dahomey et du Togo. *Cahiers O.R.S.T.O.M. Série Oceanographie*, 3, 1–5.