

A new species of scale-worm (Polychaeta: Polynoidae), *Lepidonotopodium atalantae* sp. nov., from the East Pacific Rise at 13°N and 9°50'N

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Abstract: A new species of scale-worm, *Lepidonotopodium atalantae*, belonging to the sub-family Lepidonotopodinae (Polychaeta: Polynoidae) has been found in samples collected on the deep-sea hydrothermal vent sites of 9°N and 13°N on the East Pacific Rise. It is mainly characterized by elytra, regularly ornamented on their posterior border, and very long anal cirri. This is the fifth species of *Lepidonotopodium*, all belonging to the deep-sea hydrothermal vent fauna.

Résumé : Une nouvelle espèce de Polynoidae (Polychaeta), *Lepidonotopodium atalantae* sp. nov., de la ride du Pacifique oriental à 13°N et 9°50'N. *Lepidonotopodium atalantae* sp. nov., appartenant à la sous-famille des Lepidonotopodinae, a été trouvée dans des échantillons récoltés sur les sites hydrothermaux profonds de 9°N et 13°N sur la dorsale du Pacifique oriental. Elle se distingue principalement par ses élytres portant des ornements réguliers sur leur bord postérieur et par de très longs cirres anaux. C'est la cinquième espèce de *Lepidonotopodium*, toutes appartenant à la faune des sources hydrothermales profondes.

Keywords : Annelida, Polychaeta, Polynoidae, deep-sea, hydrothermal vent, East Pacific Rise.

Introduction

Pettibone described the first hydrothermal vent species of Polynoidae in 1983, *Lepidonotopodium ifimbriatum*, from the hydrothermal area off Western Mexico at 21°N. She erected a new subfamily, the Lepidonotopodinae, for this unusual species. Scale-worms are well represented in the hydrothermal vent fauna and, since this first species, about 40 other species have been described from the known

hydrothermal vent areas. All the species are characterized by a small number of segments as compared to the littoral species. Among these species, five other Lepidonotopodinae, belonging to two genera, have been described: *L. williamsae* Pettibone, 1984 and *L. riftense* Pettibone, 1984 from the Galapagos Rift, *L. piscisae* Pettibone, 1988 from the Explorer Ridge, *L. minutum* Pettibone, 1989 from the Mariana Back Arc Basin and the branchiate *Thermopolynoe branchiata* Miura, 1994 from the Lau Back Arc and North Fiji Basins.

In this paper we describe *Lepidonotopodium atalantae*, a new species of Lepidonotopodinae from the 9°N and 13°N areas, on the East Pacific Ridge, which has been found

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among *Riftia pachyptila* Jones, 1981 washings, during the HOPE'99 cruise (April-May 1999).

Material and methods

Type locality: East Pacific Rise, 12°48.66'N, 103°56.43'W, 2630 meters depth ("Genesis" vent site). Animals found in *Riftia pachyptila* washings.

Type material: Holotype (MNHN n° poly 43, Paris) from 12°48.66' N, 103°56.43' W, 2630 m depth (Nautile dive 1383). Paratypes (MNHN n° poly 43, Paris) USNM n° 186545, Washington D.C.) from the same vent field [Nautile dives 1360 (2 specimens), 1361 (2 specimens), 1369 (1 specimen), 1383 (11 specimens) and 1384 (4 specimens)] and from 9°46'N, 104°21'W, 2515 m depth [Nautile dives 1372 (2 specimens) and 1374 (1 specimen)].

Material: Four specimens, fixed with 10% formalin in sea-water and preserved in ethanol, were prepared for SEM. The specimens were critical point dried with carbon dioxide, sputtered with gold and examined with a Philips scanning electron microscope (XL30).

Other species studied: specimens belonging to four other species of *Lepidonotopodium* were examined for comparison. Specimens of *L. williamsae* and *L. fimbriatum* were from our samples at 13°N-vent field (East Pacific Rise). The specimen of *L. riftense* was collected at hydrothermal vents in the Guaymas Basin. Specimens of *L. piscesae*, a gift from C.R. Fisher, were collected on the Main Field vent area on the Juan de Fuca Ridge. No specimen of *L. minutum* (Mariana Back-Arc Basin) was available for our study.

Description of *Lepidonotopodium atalantae* sp. nov.

Holotype: length 9 mm for 23 segments, width 4.5 mm including chaetae. The largest paratype has a length of 7.9 mm for 22 segments, the smallest has a length of 2.5 mm for 17 segments. The body is short, suboval in outline, flattened dorsoventrally, slightly tapered and rounded anteriorly and posteriorly. Living specimens are red to pinkish, they become light brown after preservation. Notopodial chaetae are straw coloured. Neuropodial chaetae are light brown.

The 11 pairs of elytra are located on segment 2, 4, 5, 7, 9, 11, 13, 15, 17, 19 and 21. They cover the dorsum and are attached eccentrically on prominent elytriphores, with dorsal cirri on the posterior segments. Some specimens exhibit 10 pairs of elytra. The elytra are opaque, oval to subreniform, overlapping, with 6 to 12 macrotubercles (up to 500 µm long) raised on the posterior border and sharply set off from the surface. The macrotubercles have smooth tips and the longest ones have a median position on the border (Figs. 1a-c). These latter project up to one fourth of

their length from the border of the elytra. Their elytral surface appears smooth but is covered, in the non-overlapping area, with numerous globular (12 µm in diameter) or clavate (up to 27 µm long) micropapillae. On some specimens, posterior or anterior elytra lack macrotubercles, probably due to a loss and incomplete regeneration. The dorsal cirri on segments lacking elytra have cylindrical cirrophores, attached dorsoposteriorly on the notopodia; they are slightly bulbous with tapering tips. They extend well beyond the tip of the neurochaetae. The dorsal tubercles on the cirrigerous segments are large and inflated (Fig. 1d). The surfaces of both the elytriphores and dorsal tubercles have bands or tufts of cilia (Fig. 1d). There is one transversal ciliated ridge per segment, uninterrupted on the anterior part of the body and interrupted in the middorsum more posteriorly.

The prostomium is bilobed, the anterior lobes subtriangular, each with a small frontal filament; lateral antennae are absent (Fig. 1e). The median antenna is inserted in the anterior notch, having a short cylindrical ceratophore and a short subulate style. A ciliated band is located at the base on the ceratophore. The palps are slightly subulate, longitudinally lined, about one and a half times the length of the prostomium. Eyes are lacking. The first or tentacular segment is not visible dorsally. The tentaculophores of the tentacular segment are lateral to the prostomium and lack chaetae; the styles of the two pairs of the dorsal and ventral tentacular cirri are similar in length, smooth, tapered. The dorsal tentacular cirri are subequal in length to the palps, the ventral one slightly shorter. The facial tubercle is lacking.

The second or buccal segment bears the first pair of large elytriphores, and biramous parapodia. The ventral or buccal cirri are attached basally on prominent cirrophores lateral to the ventral mouth; they are similar in shape to the tentacular

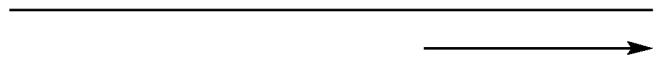


Figure 1. *Lepidonotopodium atalantae* sp. nov. **a.** light and **b.** to **h.** Scanning Electron Microscopy views. **a.** Living specimen in dorsal view. **b.** Dorsal view of an elytron from segment 11. **c.** Detail of the posterior macrotubercle of the same elytron. **d.** Antero-dorsal view of a median left parapodium. **e.** Prostomium and three anterior chaetigers in dorsal view. **f.** Frontolateral right view of the extremity of the everted proboscis. **g.** Tip of a superior notochoeta. **h.** Medium neurochaeta.

Figure 1. *Lepidonotopodium atalantae* sp. nov. **a.** Vues en microscopie optique et **b.** à **h.** en microscopie électronique à balayage. **a.** Habitus d'un spécimen vivant, en vue dorsale. **b.** Elytre du segment 11. **c.** Microphotographie d'un macrotubercule de la même élytre montrant l'aspect lisse de son extrémité. **d.** Vue antérieure d'un parapode médian gauche. **e.** Vue dorsale du prostomium et des trois premiers segments sétigères. **f.** Vue fronto-latérale (côté droit) de l'extrémité du proboscis évainé. **g.** Extrémité d'une soie notopodiale supérieure. **h.** Soie neuropodiale médiane.

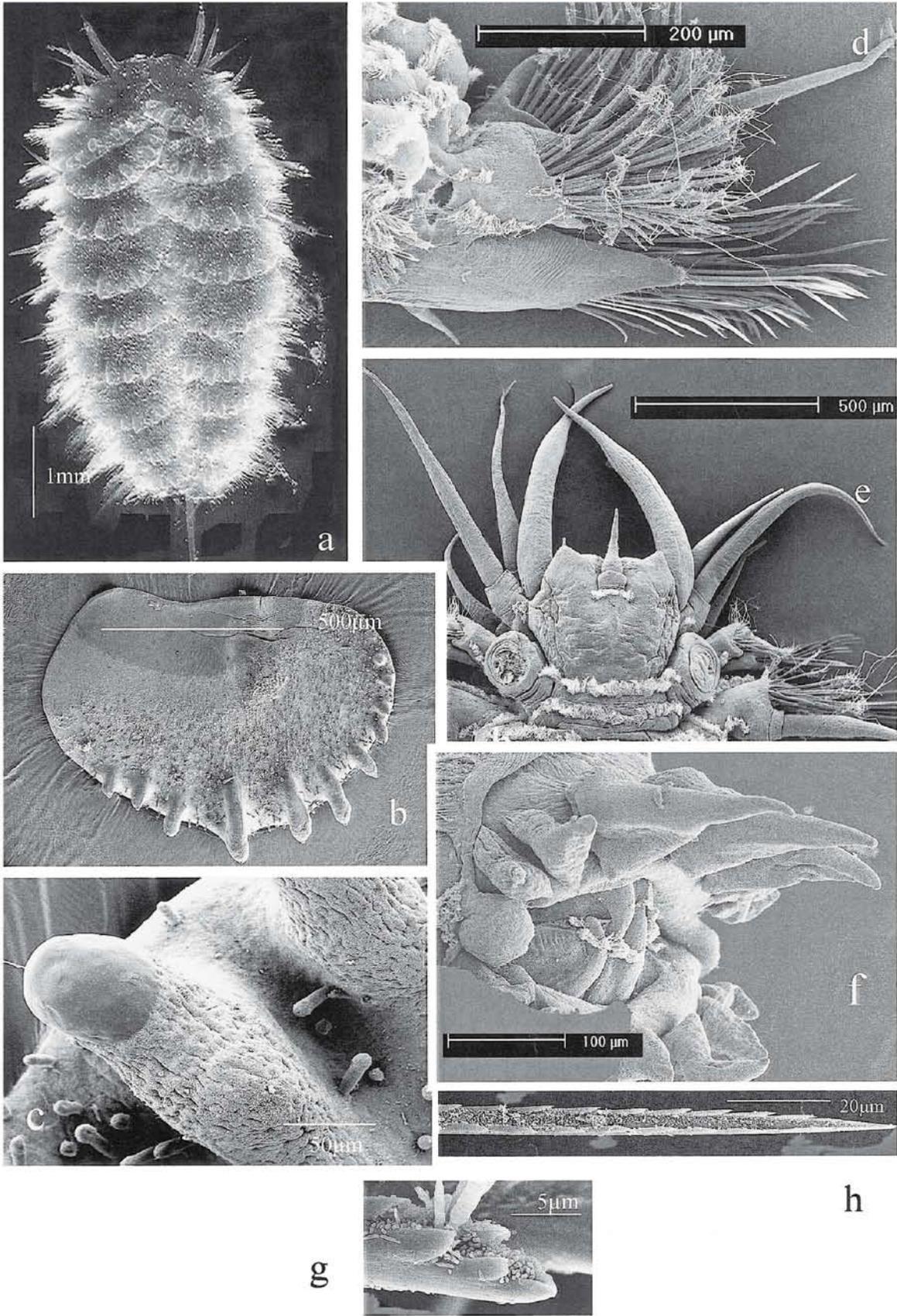


Table 1. Key to the species of *Lepidonotopodium*, EPR = East Pacific Rise, BAB = Back-Arc Basin.
 Tableau 1. Clé des espèces de *Lepidonotopodium*, EPR = Dorsale du Pacifique Est, BAB = Bassin Arrière-Arc.

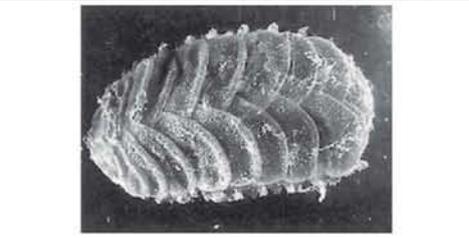
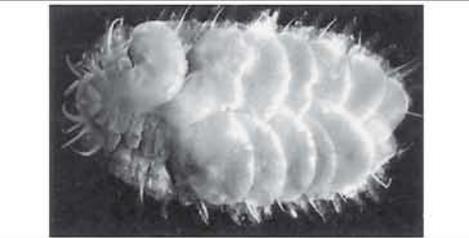
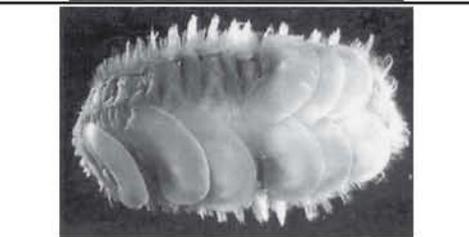
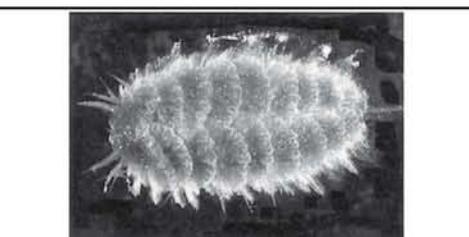
	<i>L. fimbriatum</i>	<i>L. williamsae</i>	<i>L. riftense</i>	<i>L. minutum</i>	<i>L. piscesae</i>	<i>L. atalantae</i> sp. nov.
Reference	Pettibone, 1983	Pettibone, 1984	Pettibone, 1984	Pettibone, 1989	Pettibone, 1988	Present study
Type locality	21°N/EPR	Galapagos Rift	Galapagos Rift	Mariana BAB	Explorer Ridge	13°N/EPR
Other locality	13°N/EPR	21°-13°N/EPR?	13°N/EPR?		Gorda Ridge	9°50'N
Ecology	On active edifices associated with alvinellids	Among <i>Calyptogenia Alvinella</i> and <i>Riftia</i>	Among <i>Calyptogenia Alvinella</i> and <i>Riftia</i>	Unknown	Among <i>Ridgeia</i> (<i>Vestimentifera</i>)	Among <i>Riftia</i> thickets and in baited traps
Synonyms					<i>L. pettibonae</i> Detinova	
Length range	up to 37 mm	up to 36 mm	up to 13 mm	up to 7.5 mm	up to 29 mm	up to 9 mm
Number of segments	30	26	24	23	28	23
Prostomium shape						
Habitus						
Palps (length compared with the prostomium):	Cylindrical, smooth, filamentous tips 2 x	Cylindrical, smooth, tapered tips 1.5 x	Cylindrical, tapered tips 1.5 x	Cylindrical, stout, tapered tips 2 x	Cylindrical, smooth, tapered tips 1.5 x	Cylindrical, slightly subulate tapered tips 2 x

Table 2. Key to the species of *Lepidonotopodium*.
Tableau 2. Clé des espèces de *Lepidonotopodium*.

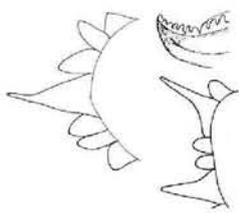
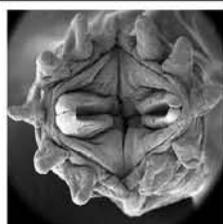
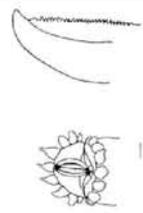
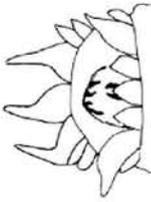
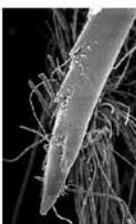
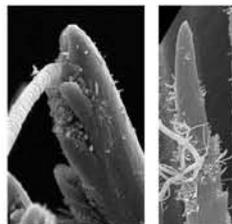
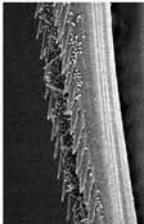
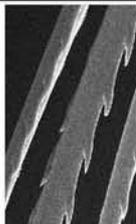
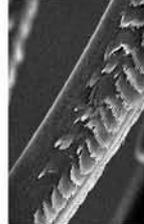
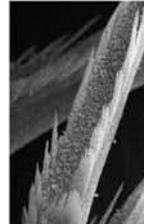
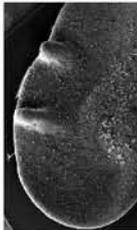
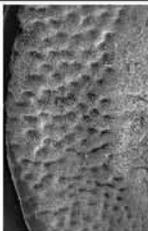
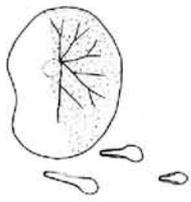
	<i>L. fimbriatum</i>	<i>L. williamsae</i>	<i>L. riftense</i>	<i>L. minutum</i>	<i>L. piscesae</i>	<i>L. atalantae</i> sp. nov.
Pharyngeal papillae	 7 dorsal: the dorsal one very large. 6 ventral papillae: the 2 middle ones very small	 7 pairs, bulbous, subequal in size	 9 pairs, bulbous, lateral ones small or only 7 pairs of subequal in size	 Seven pairs.	 Seven pairs; middle dorsal one slightly larger	 Seven pairs; 3 dorsal bigger as well as the two ventral-lateral ones
Jaws	Jaws with 5-7 teeth	Jaws with 5-7 teeth	Jaws with numerous teeth	Two pairs of hooked jaws without teeth or serration	Jaws with up to 12 teeth	Jaws with numerous small teeth
Notosetae			not seen	not seen		
Sabre-like neurosetae	0	0	0	0		0
Neurosetae			not seen	not seen		

Table 3. Key to the species of *Lepidonotopodium*.
Tableau 3. Clé des espèces de *Lepidonotopodium*.

	<i>L. fimbriatum</i>	<i>L. williamsae</i>	<i>L. rufense</i>	<i>L. minutum</i>	<i>L. piscesae</i>	<i>L. atalantae</i> sp. nov.
Median antenna	inserted in anterior notch cylindrical ceratophore short subulate style	inserted in anterior notch short cylindrical ceratophore subulate style extending to about the tip of the palps	inserted in anterior notch short cylindrical ceratophore short tapering style	ceratophore in anterior notch short bulbous short subulate style	large cylindrical ceratophore in anterior notch style short tapered about length of ceratophore	ceratophore in an anterior notch short cylindrical ceratophore short subulate tip ciliated band at the base of ceratophore
Eye spots	0	0	0	0	2	0
Tentacular cirri length compared with palps length	< palps, subequal in length, smooth tapered	= palp, the ventral cirrus slightly shorter than the dorsal one	= palp length 2 pairs subequal smooth, tapered	= palp length 2 pairs subequal smooth, tapered	< palp subequal in length	≤ palp inequal the inferior one smaller
Elytron						
Micropapillae						
Number of elongate papillae on segments	0/2 11-12	0/4 12-15	0/2 11-12	not seen	0/5 11-15	0/4 11-14
Anal cirri	long equal in length to dorsal cirrus	absent	long ventral	long	with or without ?	very long

cirri and are longer than the following ventral cirri. The mouth is enclosed in upper, lateral and posterior lips between segments 1 to 3. Seven pairs of unequal bulbous papillae encircle the opening of the extended pharynx. The three dorsal papillae are pear-shaped, longer than the other ones, as well as two lateroventral ones (Fig. 1f; Table 2). The two pairs of dorsal and ventral hooked jaws are minutely serrated with numerous teeth.

The biramous parapodia have shorter notopodia located on the anterodorsal sides of the longer neuropodia (Fig. 1d). The notopodium is subconical, with acicular lobes and is enclosed anterodorsally by flaring bracts. The neuropodium is deeply cleft in the upper and lower part, with conical prechaetal acicular lobe and rounded postchaetal lobe of equal length. Tufts of bacteria are located on the margin of neuropodia and notopodia, and on the chaetae (Figs 1h, 1g). The notochaetae are numerous, forming thick radiating bundles. They are stouter than the neurosetae (Fig. 1d). The superior short notochaetae have two rows of spines and bare tips. Notochaetae from the middle of the parapodium have two rows of three to four large blunt spines (Fig. 1g). The neurochaetae are numerous, forming fan-shaped bundles. They have two rows of numerous spines along one side, with bare slightly hooked tips (Fig. 1h; Table 2). The ventral cirri are very short, tapered, attached on the base of the neuropodia.

On about one third of the specimens, there are four pairs of large elongated papillae on segments 11 to 14. Segmental or nephridial papillae were not obvious on other segments. They are attached on the ventroposterior sides of the neuropodia and are similar in size, extending to the tip of the neurochaetae. The pygidium is not visible dorsally. There is a pair of very long ventral anal cirri, as long as one fourth of the body.

Etymology. *atalantae*: the species is named for the French research vessel "L'Atalante" and her crew to thank all the men and women who helped us during the cruises.

Discussion

Lepidonotopodium was erected by Pettibone (1983) for *L. fimbriatum* from hydrothermal rift-area off western Mexico at 21°N. It is the type species of the subfamily Lepidonotopodinae, polynoids without lateral antennae, with a bilobed prostomium and with well developed notopodial bracts. They have 11 pairs of elytra, located on segments 2, 4, 5, 7, 9, 11, 13, 15, 17, 19 and 21. Since this first description, *L. riftense* and *L. williamsae* were described from the same location (Pettibone 1984). *Lepidonotopodium minutum* was described from the hydrothermal rift area of the Mariana Back-arc Basin in the western central Pacific (Pettibone 1989) and *L. piscesae* was

described from Explorer Ridge (Pettibone, 1988) and the Axial Seamount Caldera on the Juan de Fuca Ridge in the Northeast Pacific (Pettibone 1990). Another genus in this subfamily, *Thermopolynoe*, was erected by Miura (1994) with the species *T. branchiata* from Lau and North Fidji Back-arc Basins. This genus differs from *Lepidonotopodium* in having arborescent branchiae.

Lepidonotopodium atalantae is a small species of *Lepidonotopodium* as are *L. riftense* and *L. minutum*. Although Pettibone (1984) mentioned some specimens of *Lepidonotopodium riftense* with a variable number of oval projections near the posterior border of the elytra, these specimens do not correspond to the species described here. *L. atalantae* differs from *L. riftense* by the ornamentation of the elytra (6-12 regularly spaced macrotubercles projecting from the border of the elytra in *L. atalantae* and a few irregularly spaced small macrotubercles in *L. riftense*), the number of ventral papillae when present (4 pairs in *L. atalantae* and 2 pairs in *L. riftense*) and the conspicuous very long anal cirri in *L. atalantae* and shorter in *L. riftense*. The prostomium has triangular cephalic peaks in *L. riftense*, *L. minutum* and *L. atalantae* whereas *L. fimbriatum*, *L. piscesae* and particularly *L. williamsae* have more prominent cylindrical lobes. All these characters are summarized in the tabular key to the species of *Lepidonotopodium* (Tables 1, 2 and 3).

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