



A new species of *Lepidozona* (Mollusca: Polyplacophora: Ischnochitonidae), found on whale bones off the coast of Chile

Una nueva especie de *Lepidozona* (Mollusca: Polyplacophora: Ischnochitonidae) encontrada sobre huesos de ballena frente a la costa de Chile

Enrico SCHWABE* and Javier SELLANES**

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ABSTRACT

Lepidozona balaenophila spec. nov. is described from Chile. It was found at a single location situated at the upper bathyal zone (240 m) off Concepción (~36°S). It lives, and probably feeds, on bones of dead whales. This is the first time that this type of habitat is described for a chiton. Furthermore, this is also the first report of a member of the genus *Lepidozona* from Chilean waters, and represents a considerable southward extension of the distribution range of the genus in the eastern Pacific Ocean.

RESUMEN

Se describe *Lepidozona balaenophila* spec. nov. de Chile. Esta especie fue encontrada en una única localidad en la zona batial superior (240 m) frente a la costa de Concepción (aproximadamente a 36°S). Vive sobre (y probablemente se alimenta de) huesos de ballenas muertas. Esta es la primera vez que se menciona este tipo de habitat para un chiton. También es la primera cita de una especie del género *Lepidozona* para aguas de Chile, lo que representa una ampliación considerable hacia el sur del área de distribución del género en el Pacífico oriental.

PALABRAS CLAVE: Mollusca, Polyplacophora, *Lepidozona*, sistemática, Océano Pacífico, Chile, huesos de ballena.

KEY WORDS: Mollusca, Polyplacophora, *Lepidozona*, systematics, Pacific Ocean, Chile, whale bones

INTRODUCTION

During recent ecological research in Chilean and Peruvian waters some samples of chitons were obtained. These were sent to the first author for identification. Careful examination of the material

showed that, besides *Leptochiton americanus* Kaas and Van Belle, 1985, a new species of *Lepidozona* was collected. This genus, unknown as yet from Chilean waters, reaches its highest density in the

* Zoologische Staatssammlung Muenchen, Muenchhausenstrasse 21, D-81247 Muenchen, Germany. Enrico.Schwabe@zsm.mwn.de

** Centre for Oceanographic Research in the Eastern South Pacific (COPAS), Cabina 3, Universidad de Concepción, Casilla 160-C, Concepción, Chile. jsellane@udec.cl

Table I. Material examined, the measurements and number of ctenidia.

Tabla I. Material examinado, medidas y número de ctenidios.

number	status	measurements (length/width in mm)	number of ctenidia		Institute	comments
			left	right		
1	holotype	10.4 x 6.3	18	19	ZSM (Moll 20034225)	
2	paratype	c. 7 x 5.5	17	16	ZSM (Moll 20034224)	disarticulated, specimen used for SEM
3	paratype	3.5 x 2.5	15	15	ZSM (Moll 20034226)	
4	paratype	c. 5.9 x 4.3	16	16	ZMB	tail valve absent
5	paratype	? x 6.1			UDEC	only valves iv-viii, but these in situ
6	paratype	c. 7.6 x 4.4			UDEC	tail valve isolated, ctenidia incomplete
7	paratype	8.3 x 5	16	16	ZSM (Moll 20034227)	
8	paratype	6.5 x 4	14	15	UDEC	girdle bent
9	paratype	5.6 x 3.5	15	15	MNHNC 2772 (200733)	
10	paratype	5.3 x 3.5			ZISP	
11	paratype	5.3 x 3.3		16	NSMT	

upper and middle East Pacific (FERREIRA 1978). This record represents an interesting southward extension of the genus. Another aspect that makes the species remarkable is its habitat. The species apparently lives on bones of dead whales. Although other molluscs, mainly gastropods and bivalves bearing chemosynthetic symbionts, have been described thriving on nekton falls (SMITH, MAYBAUM, BACO, POPE, CARPENTER, YAGER, MACKO AND DEMING, 1998 and references therein), this habitat was not reported so far for polyplacophorans. We suggest that the chiton not only lives on these bones, but also feeds on them. Besides, the area where the specimens were collected is affected by a severe bottom water oxygen deficiency ($<0.5 \text{ ml l}^{-1}$). This is due to the permanent presence of the southeastern Pacific oxygen minimum zone (OMZ), which at this latitude extends to depths up to 400 m (KAMYKOWSKI AND ZENTARA 1990).

MATERIAL AND METHODS

The material presented herein was collected in July 2003 during a cruise on

board the R/V Kay Kay of the University of Concepción. The samples were gathered using a 1 m wide Agassiz trawl (AGT) by a 20 min. trawl at a site located just beneath the shelf break off Concepción ($36^{\circ} 29.9' \text{ S} - 73^{\circ} 40.8' \text{ W}$) at 240 m depth. The specimens were attached to osseous remains (mainly pieces of whale ribs) and rocks. The chitons were fixed and conserved in 75 % ethanol. For the description one specimen was disarticulated and prepared as described in SCHWABE AND RUTHENSTEINER (2001).

Abbreviations

MNHNC: National Museum of Natural History, Chile
 NSMT: National Science Museum, Tokyo, Japan
 UDEC: Universidad de Concepción, Chile
 ZISP: Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia
 ZMB: Natural History Museum Berlin (formerly Zoologisches Museum Berlin), Germany
 ZSM: Zoologische Staatssammlung Muenchen, Germany

SYSTEMATICS

Class POLYPLACOPHORA Gray, 1821
Subclass NEOLORICATA Bergenhayn, 1955
Order CHITONIDA Thiele, 1910
Family ISCHNOCHITONIDAE Dall, 1889
Order *Lepidozона* Pilsbry, 1892

Type species: *Chiton mertensii* von Middendorff, 1847, by original designation, Indo-Pacific distribution with the highest diversity in the Northeastern Pacific, Pleistocene - Holocene

Lepidozона balaenophila spec. nov. (Figs. 1-10)

Material examined: Shown in Table I.

Type locality: Just beneath the shelf break off Concepción, Chile (36° 29.9' S - 73° 40.8' W).

Etymology: From Latin: *balaena* = whale; N.L. fem. substantive from Gr. fem. adj. *philê*, loving; *balaenophila* = friend of whales or lover of whales, since the majority of specimens were found living on whale bone remains.

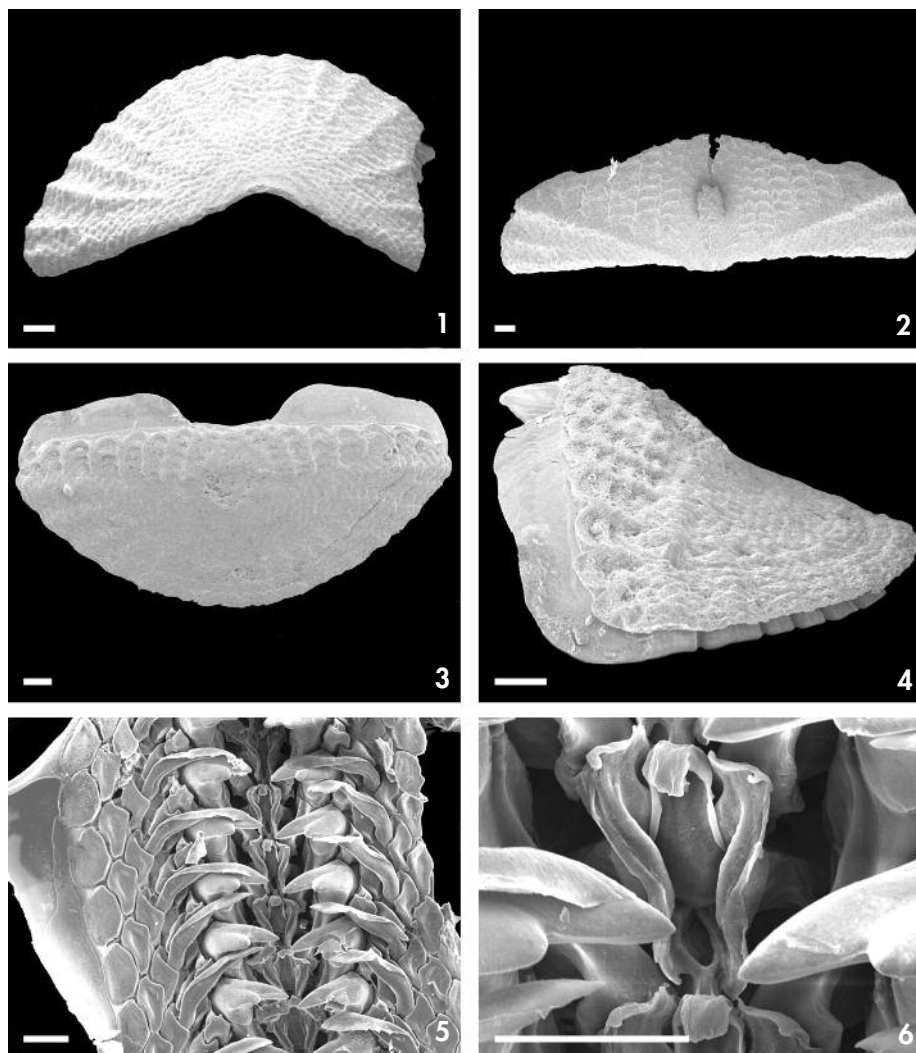
Diagnosis: Small sized animal (largest specimen 10.4 mm in length) with an oval outline. Colour yellowish beige with a few darker freckles, girdle of the same ground colour but banded. Tegmentum strongly sculptured. Radula has the central tooth with a simple blade and the major lateral tooth with a bicuspid head. Ctenidia arranged holo-branchially and abanally.

Description (of the holotype and for internal features of specimen # 2)

General outline. The species is oval with an average length/width ratio of 1.54 (10 specimens) (Figs. 9, 10), moderately high in elevation, slightly keeled with straight sided slopes. Dorsal elevation of valve iv 0.33 (high 1.4 mm/length 4.2 mm). Head valve is somewhat wider than semicircular, with a shallow notch in the wide V-shaped posterior margin (Fig. 1). Intermediate valves rather short compared to their width (Fig. 2). Valve ii is the longest and valve v the widest. Posterior margin slightly concave on both sides of the indistinct to absent apex. The semicircular tail valve has the mucro in the anterior third. It is slightly elevated and somewhat anteriorly directed. Postmucronal slope rather flat (about 30°) and straight, except for a little depression directly behind the mucro (Figs. 3, 4).

Tegmentum. The general valve sculpture consists of very fine granules, which are arranged in quinquex, easily visible on the head valve, the lateral areas, and in the postmucronal area. In addition there are 13-17 rather indistinctly elevated, radially arranged ribs on head valve, 2-4 on intermediate valves (more prominent in the diagonal ridge and the posterior margin), and about 13-16 on postmucronal area (Figs. 1-4, 9). On these ribs more or less round tubercles may be found in random arrangement. The central area and the antemucronal area are sculptured with about 7 (in the disarticulated paratype) longitudinal ribs, latticed by 4-8 transversally arranged riblets. The latter are less distinct and the spaces between them are smaller than those of the longitudinal ribs (Figs. 2-4). The jugal area is indistinct, but appears smooth at the posteriormost region.

Articulamentum. The translucent white layer is rather thin, which results in the brownish colour of the tegmentum showing in the central part. Intermediate valves with short trapezoid to rectangular apophyses, which are widely spaced but connected by a very shallow sutural lamina that is inconspicuously notched (Figs. 3, 4). The insertion plates are short, with broad, sharp, somewhat rugose teeth. Slit formula: 10/1-2/12, slit rays present.

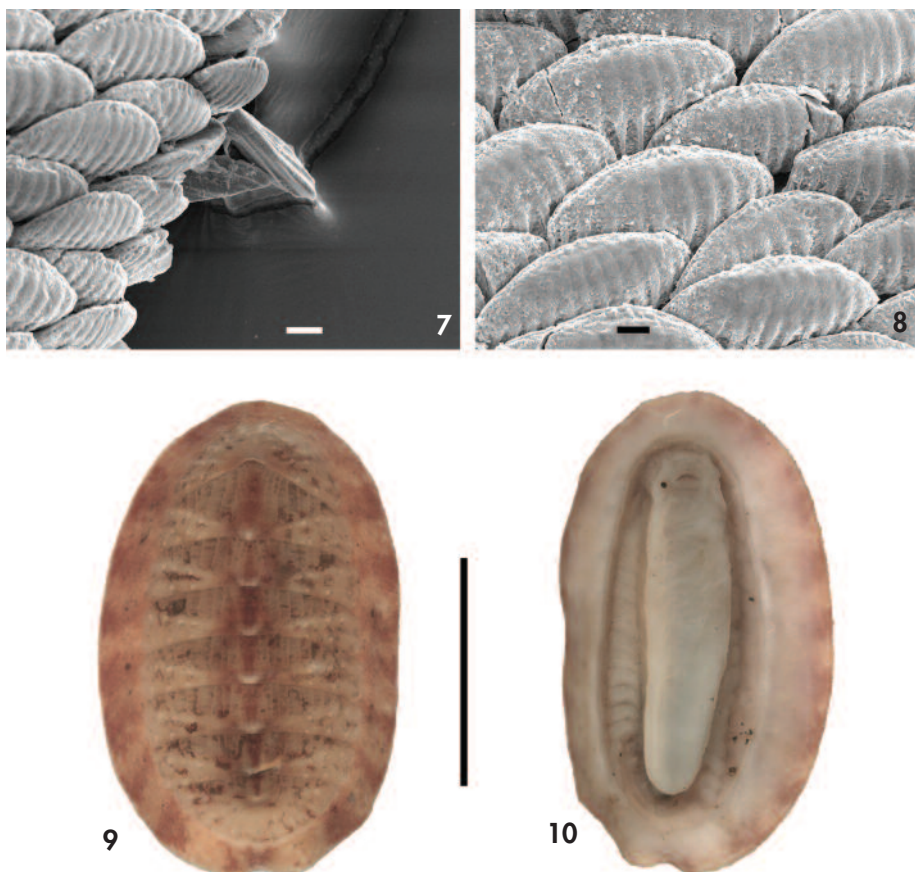


Figures 1-6: *Lepidozona balaenophila* spec. nov., disarticulated paratype (ZSM Moll 20034224), c. 7 x 5.5 mm. 1: dorsal view of the first valve; 2: dorsal view of valve ii; 3: dorsal view of the tail valve; 4: left lateral view of the tail valve; 5: working part of the radula; 6: enlargement of the central tooth and the first lateral teeth. Scale bars, 1-4: 200 μ m, 5, 6: 50 μ m.

Figuras 1-6: Lepidozona balaenophila spec. nov., paratipo desarticulado (ZSM Moll 20034224), c. 7 x 5,5 mm. 1: vista dorsal de la primera valva; 2: vista dorsal de la segunda valva; 3: vista dorsal de la última valva; 4: vista lateral izquierda de la última valva; 5: zona de uso de la rádula; 6: ampliación del diente central y del primer diente lateral. Escalas, 1-4: 200 μ m, 5, 6: 50 μ m.

Perinotum. The rather small girdle is dorsally densely covered with elongated, rectangular scales (94-98 x 67-70 μ m), which are sculptured with 10-12 strong radial ribs (Figs. 7, 8). Ventrally

there are rectangular slender scales that measure 48-75 x 20-23 μ m. The perinotum is surrounded by a hemline of short, straight spicules (84 x 32 μ m), which are sculptured by about 6 dis-



Figures 7, 8. *Lepidozona balaenophila* spec. nov., disarticulated paratype (ZSM Moll 20034224), c. 7 x 5.5 mm. 7: dorsal view of the perinotum margin, close to valve ii, to show the marginal spicules and the dorsal scales; 8: close-up of the dorsal girdle scales, close to valve ii. Figures 9, 10. *Lepidozona balaenophila* spec. nov., holotype (ZSM Moll 20034225), 10.4 x 6.3 mm. 9: dorsal view, head region on top; 10: ventral view, head region on top. Scale bars, 7, 8: 50 μ m, 9, 10: 5 mm.

Figuras 7, 8. *Lepidozona balaenophila* spec. nov., paratipo desarticulado (ZSM Moll 20034224), c. 7 x 5,5 mm. 7: vista dorsal del borde del perinotum, próximo a la segunda valva, mostrando las espículas marginales y las escamas dorsales; 8: visión cercana al cinturón de las escamas dorsales, próximas a la valva segunda. Figuras 9, 10. *Lepidozona balaenophila* spec. nov., holotipo (ZSM Moll 20034225), 10,4 x 6,3 mm. 9: vista dorsal, la cabeza hacia la parte superior; 10: vista ventral, la cabeza hacia la parte superior. Escalas, 7, 8: 50 μ m, 9, 10: 5 mm.

torted, longitudinal ribs (Fig. 7). In addition, very short, smooth, elongated spicules (20 x 5 μ m) and long, smooth, slender spines, 92-130 x 10 μ m in size, may be found along the margin. These spines are situated on long and slender ring-shafts, which measure about 55 x 7.5 μ m.

Radula. The radula of the disarticulated paratype consists of 41 teeth rows, of which 34 are mineralized. Central tooth slender and rectangular (43 x 20.2 μ m) with a forward and downward bent single blade. First lateral tooth elongated-rectangular (50 x 18 μ m) with two keeled ribs on the inside. These two ribs

exactly cover the lower part of the central tooth. When seen from above, the blade-shaped first lateral tooth resembles a slender "S". On the blade's margin small hooks may be found (Figs. 5, 6). Second lateral tooth has a long, slender and slightly keeled shaft, which bears a bicuspid blade. Inner denticle is nearly twice as long as outer one. Inner denticle sharply pointed and slender, contrary to the stout and obtuse outer one. First uncinial tooth short and squarish, with a shallow notch on the base, where the second uncinial interlocks with a two-finger like projection. Third uncinial tooth very slender, elongated (like a palm-leaf) and supports the inner denticle of the major lateral tooth. The remaining teeth are more or less arrow-head like in shape and become larger and more regular towards the outer margin (Fig. 5).

Mantle cavity. The ctenidia are arranged holobranchially and abanally with interspaces (Fig. 10), and range between 14 and 19 per side (see Table I).

Habitat: Attached to osseous remains (mainly pieces of whale ribs) and rocks, at 240 m depth.

Distribution: So far known from the type locality only.

Discussion: FREMBLY (1827) was the first to write about the Polyplacophora from Chile. More information about the chiton fauna of Chile was added later by BRODERIP AND SOWERBY (1832-1833). PLATE (1897, 1899, 1901) has given an excellent account on some chitons from Chile, which were described in detail morphologically as well as anatomically. Unfortunately, he did not mention any *Lepidozona* species.

Another thorough work about chitons from Chile was published by LELOUP (1956). He gave a very detailed review on most Chilean taxa. None of the above works mention a single specimen of *Lepidozona*.

In a series of papers on Latin American *Lepidozonas* FERREIRA (1974, 1978, 1983, 1985) discussed the taxonomy of the taxa occurring in this region. His research was supported by the study of type material and additional museum

material. He gave a good impression of the distribution of chitons in the East Pacific ocean. According to FERREIRA's studies and the summary of KAAS AND VAN BELLE (1987), the genus *Lepidozona* was not known to exist in Chile. The finding of a representative of this group for the temperate waters of South America's West Coast is remarkable, and represents a considerable extension of the group's distribution.

For the bicuspid blade of the major lateral tooth in the new species the closest congeneric is *L. vietnamensis* STRACK, 1991. This species, however, differs in the different morphology of the central tooth and of the dorsal girdle scales. The radial ribs in *L. vietnamensis* are more prominent and distinct than in *L. balaenophila* spec. nov. (see STRACK 1991, p. 52-53). Besides this, the distribution of this species from warm and temperate regions down to Chile is unlikely.

Other species with a similar general appearance are *L. sinudentata* (Carpenter in Pilsbry, 1892), *L. pectinulata* (Carpenter in Pilsbry, 1893), and *L. guadalupensis* FERREIRA, 1978. All these species, illustrated in KAAS AND VAN BELLE (1987), have an unidentate cusp of the major lateral tooth, a different shaped central tooth, as well as different girdle scales.

Superficially, *L. balaenophila* spec. nov. may be misinterpreted as a member of *Callistoichiton*, especially *C. expressus* (Carpenter, 1865), but it may be distinguished by the higher number of radial ribs and the tubercles on them (for comments on distinguishing features for both genera see STRACK 1991, p. 53). In addition, *C. expressus* shows more radial ribs on the dorsal girdle scales and has a unidentate blade of the major lateral tooth. The sole member of this genus that occurs in Chilean waters – *Callistoichiton pulchellus* (Gray, 1828) – has a pitted appearance, a unidentate bladed major lateral tooth, different dorsal girdle scales, and a different sculpture of the radial ribs.

The habitat of the new species is noteworthy. To our knowledge the possibility of chitons feeding on whale bones has not been reported to date. On

the other hand, it is known that sunken whale bones give rise to chemosynthesis-based communities, where primary food for metazoans is generated locally by bacteria relying on reduced compounds for energy (SMITH AND KUKERT 1989). These reduced compounds (like

sulfide) are in turn generated by the decay of organic matter, or, in the case of whale-bones, by the oil they contain (SMITH ET AL. 1998). Further investigations are needed to elucidate if these chitons are part of such a chemosynthetically fuelled system.

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BIBLIOGRAPHY

- BRODERIP, W. J. AND SOWERBY, G. B., 1832-1833. Characters of new species of Mollusca and Conchifera, collected by Mr. Cuming. *Proceedings of the Zoological Society of London*: 25-33, 50-61, 104-108, 124-126 (1832), 173-179, 194-202 (1833).
- FERREIRA, A. J. 1974. The genus *Lepidozona* in the Panamic Province, with the description of two new species (Mollusca: Polyplacophora). *The Veliger*, 17(1): 162-180 (wrong pagination).
- FERREIRA, A. J., 1978. The genus *Lepidozona* (Mollusca: Polyplacophora) in the temperate eastern Pacific, Baja California to Alaska, with the description of a new species. *The Veliger*, 21(1): 19-44.
- FERREIRA, A. J., 1983. The chiton fauna of the Revillagigedo Archipelago, Mexico. *The Veliger*, 25 (4): 307-322.
- FERREIRA, A. J., 1985. Three new species of *Lepidozona* (Mollusca: Polyplacophora) from the Gulf of California. *The Veliger*, 27(4): 423-429.
- FREMBLY, J., 1827. A description of several new species of Chitones, found on the coast of Chili, in 1825; with a few remarks on the method of taking and preserving them. *Zoological Journal London*, 3 (10): 193-205; Suppl. Plates, 4th part, pls 16-17 (issued July 1830-Sept. 1831)
- KAAS, P. AND BELLE, R. A. VAN, 1987. *Monograph of living chitons*. (Mollusca: Polyplacophora) 3, Ischnochitonidae: Chaetopleurinae, Ischnochitoninae (pars), additions to vols 1 and 2. E. J. Brill/W. Backhuys, Leiden, 302 pp.
- KAMYKOWSKI, D. AND ZENTARA S., 1990. Hypoxia in the world ocean as recorded in the historical data set. *Deep-Sea Research* 37, (12): 1861-1874.
- LELOUP, E., 1956. Reports of the Lund University Chile Expedition 1948-49. 27. Polyplacophora. *Lunds Universitets Arsskrift* (n.s.), 52: 1-94.
- PLATE, L. H., 1897. *Die Anatomie und Phylogenie der Chitonen*. Fauna Chilensis 1 (1). *Zoologische Jahrbücher* (Syst.), 1, Suppl. 4: 1-243, pls 1-12.
- PLATE, L. H., 1899. *Die Anatomie und Phylogenie der Chitonen*. Fauna Chilensis 2 (1). *Zoologische Jahrbücher* (Syst.), 2, Suppl. 5: 15-216, pls 2-11.
- PLATE, L. H., 1901. *Die Anatomie und Phylogenie der Chitonen*. Fauna Chilensis 2 (2). *Zoologische Jahrbücher* (Syst.), 3, Suppl. 5: 281-600, pls 12-16.
- SCHWABE, E. AND RUTHENSTEINER, B., 2001. *Callochiton schilfi* (Mollusca: Polyplacophora: Ischnochitonidae) a new species from Indonesian waters. *Vita Marina*, 47 (4): 175-184.
- SMITH, C. R. AND KUKERT, H., 1989. Vent fauna on whale remains. *Nature*, 341: 27-28.
- SMITH, C. R., MAYBAUM, H., BACO, A. R., POPE, R. H., CARPENTER, S. D., YAGER, P. L., MACKO, S. A. AND DEMING, J. W., 1998. Sediment community structure around a whale skeleton in the deep Northeast Pacific: macrofaunal microbial and bioturbation effects. *Deep-Sea Research II*, 45: 335-364.
- STRACK, H. L., 1991. Description of a new *Lepidochiton* from the Azores and of a new *Lepidozona* from Vietnam (Mollusca, Polyplacophora). *Bulletin du Muséum national d'Histoire naturelle Paris*, 4e ser., 13 (A) 1-2: 49-59.

