



Schizoretepora hassi sp. nov. (Bryozoa: Phidoloporidae) from Lebanon (Eastern Mediterranean) and reappraisal of *Schizotheca serratimargo* (Hincks, 1886)

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Abstract: *Schizoretepora hassi* sp. nov., one of the most frequent bryozoans in shaded rocky habitats sampled along the coasts of Lebanon between 3 and 36 m depth, is described here. Its status as steno-endemic in the Levantine basin versus successful Erythraean immigrant is unresolved. Colonies erect and typically with a distinct abfrontal surface occupied by kenozooids, are variable in shape, from ramose with dichotomic branching to reteporiform. The great similarity of its autozooids and avicularia with those of the bilaminar *Schizotheca serratimargo* argues for classing the latter in the genus *Schizoretepora*.

Résumé : *Schizoretepora hassi* sp. nov. (Bryozoa : Phidoloporidae) des côtes du Liban (Méditerranée orientale) et réévaluation de *Schizotheca serratimargo* (Hincks, 1886). Description de *Schizoretepora hassi* sp. nov., un des bryozoaires les plus fréquents dans les habitats rocheux ombragés échantillonnés sur les côtes du Liban entre 3 m et 36 m. Son statut de sténo-endémique du bassin levantin ou bien de migrant lessepsien n'est pas établi. Les colonies sont érigées et possèdent typiquement une face abfrontale pourvue de kénozoïdes, avec une forme variable, surtout en branches à ramifications dichotomiques mais aussi rétéporiformes. Sa grande ressemblance au niveau des autozoïdes et des aviculaires avec *Schizotheca serratimargo*, une espèce dressée bilaminée, indique que ce dernier devrait être classé en *Schizoretepora*.

Keywords: Bryozoans • New species • Levantine basin • Lessepsian species

Introduction

The Levantine basin in the Eastern Mediterranean is characterized by a particularly warm climate (Abboud-Abi Saab et al., 2004) associated with high salinity and biotic

instability caused by the increasing influx of alien species from the Red Sea (e.g. Por, 1989; Galil, 2000). The bryozoan fauna of the Eastern Mediterranean is less studied than that of the Western Mediterranean (Rosso, 2003) and the deficit in knowledge is particularly acute in the Levantine area where the bryozoan fauna is known only from few papers (e.g. Powell, 1969; Ünsal & d'Hondt, 1979; d'Hondt, 1988; Nicoletti et al., 1995; Chimenz et al., 1997; Koçak et al., 2002).

Several surveys of the littoral benthos along the coast of Lebanon were undertaken by means of diving between 1999 and 2003 within the frame of the French-Lebanese programme of scientific cooperation CEDRE. Extensive sampling by the authors from 0 to 40 m depth produced a large collection of bryozoans from various habitats. This collection comprises about 95 species including a notable number of alien species never recorded in the Mediterranean (Harmelin et al., in prep.). One of the most common and conspicuous species in shaded rocky habitats was an erect phidoloporid. When compared with other Atlanto-Mediterranean phidoloporids it turned out to be a previously undescribed species of *Schizoretepora* (here named *S. hassi* sp. nov.). This comparison also led to re-examine the generic position of the well-known *Schizotheca serratumargo* (Hincks, 1886), which should be assigned to *Schizoretepora* because of its many morphological similarities with the new species.

Material and methods

The studied specimens were collected during four diving surveys of benthos along nearly the entire coastline of Lebanon between 1999 and 2003. SEM observations were made at the Station Marine d'Endoume with a Hitachi S-570 on specimens cleaned with commercial bleach (sodium hypochlorite) and gold coated. Measurements were made with a Wild stereomicroscope. The type material was deposited at the Muséum national d'Histoire naturelle, Paris (*MNHN*), Natural History Museum, London (*NHM*) and the Senckenberg Museum, Frankfurt (*SMF*). Remaining material is kept, in part, at the Lebanese University, Faculty of Science, Department of Natural Sciences, Hadath and provisionally at the Centre d'Océanologie de Marseille, Station Marine d'Endoume, 13007 Marseille.

Schizoretepora hassi sp. nov.

Type material

Holotype: Ras El Chakaa (N Batroun), 10-13 m, overhang, 19/10/1999; *MNHN BRY-20060* (Fig. 1D pars).

Paratypes: Six sets of specimens. 1: same locality as holotype, 10 colonies or fragments; *SMF 3026* (Fig. 1D pars). 2: Ras El Chakaa, 3-5 m, cave, 19/10/1999, 10 colonies or fragments; *NHM 2007.3.15.1-10* (Fig. 1A). 3: Tripoli, Ramkine Island, 5-7 m, cave, 14/07/2003, 10 colonies or fragments; *SMF 3027*. 4: Selaata (N Batroun), 6 m, cave, 23/10/1999, 6 colonies or fragments; *MNHN BRY-20061* (Fig. 1B). 5: Selaata, 32 m, overhang, 2/05/2001, 2 colonies; *NHM 2007.3.11-12* (Fig. 1C). 6: Beirut, Harf El Kalb, 34 m, overhang, 21/10/1999, 1 reticulate colony; *MNHN BRY-20059* (Fig. 1E).

Other material examined: Chak El Hatab, cave, 12-14 m, 5/07/2003, 13/07/2003. Selaata (N Batroun): 6-8 m, small semi-dark caves, 18/10/1999; 20-21 m, semi-dark cave, 14/09/2002 and 6/07/2003; 35 m, overhang, 24/09/2002 and 9/07/2003. Kafar Abida (S Batroun), small cave, 7-8 m, 30/05/2000. Barbara (S Batroun), 26 m, 8/06/2000. Off Jbail (Byblos), shoal Tablieh, small cave, 16 m, 17/10/1999. Off El Zahrani, shoal Harf El Hawieh, overhang, 14 m, 6/06/2000. In addition, non-type material (colonies and fragments) of same origin as type series 1-6.

Etymology

Dedicated to Dr. Hans Hass, famous Austrian pioneer in scientific diving and underwater photography and cinematography, author of a thesis on reteporids collected by diving in the Mediterranean Sea during the 1940's.

Description

Colonies yellow to pale pink, small (< 1 cm) to medium-sized (2.5-3 cm), erect, fan-shaped or forming a corolla; branches relatively narrow (Table 1), strongly calcified, ramifying more or less regularly directly from the base, occasionally with anastomoses resulting in elongate, irregular or more evenly reticulate fenestrae (Fig. 1). Frontal surface of branches moderately or notably convex, comprising 3 to 8 longitudinal rows of autozooids arranged quincuncially (Fig. 2A). Abfrontal surface occupied by kenozooids, very convex, often with vertical sides bordering the frontal face (Fig. 2B). Autozooids slightly longer than wide, separated by distinct sutures; frontal shield with irregularly shaped nodules and 2-4 large, marginal pores (Fig. 2A-C). Primary orifice semi-elliptical, longer than wide; distal rim with 15-18 acute to blunt, triangular denticles, proximal border with a u-shaped sinus flanked by irregularly mamillated condyles (Fig. 3A). Secondary orifice with a pseudosinus similar in size and shape to the sinus, forming a gutter as secondary calcification proceeds; peristome relatively low in young zooids, thicker in older zooids, but generally without distinct lateral flanges; four to six latero-distal oral spines, thin, moderately long (180-200 µm), easily detached from their base; bases particularly thick, fused by calcification into two arched, bilateral units, rapidly covered by secondary calcification (Fig. 3A). Adventitious avicularia single, irregularly present, typically proximo-lateral to orifice and directed latero-distally, occasionally laterally, relatively large (length: 0.4 to 0.5 times the autozooid width; table 1), crossbar proximal and oblique to pseudosinus, tip of rostrum generally reaching the level of the distal half of orifice; mandible acute, triangular, oblique to frontal plane, on distally swollen cystid (Fig. 2A-B). Giant, vicarious avicularia present on lateral sides of branches; directed distally or laterally; rostrum

Table 1. Measurement of *Schizoretepora hassi* and '*Schizotheca*' *serratimargo*. Mean \pm standard deviation, range (number of localities, number of measurements). L: length, W: width, N: number. Measurements in μm except branch width in mm. Origin of material: *S. hassi*: Lebanon, Selaata, 6 m, 20 m, 32 m; Harf El Kelb, 34 m. *S. serratimargo*: Italy, Bari, 12 m. Balearic Is., Cabrera Foradada, 25 m; Mallorca, Formentor, 30 m; Minorca, Gamba Cave, 10 m. Crete, Kalilimenes, 35 m.

Tableau 1. Dimensions de *Schizoretepora hassi* et '*Schizotheca*' *serratimargo*. Moyenne \pm écart-type, valeurs extrêmes (nombre de localités, nombre de mesures). L : longueur, W : largeur, N : nombre. Mesures en μm excepté la largeur des branches en mm. Origine du matériel : *S. hassi* : Liban, Selaata, 6 m, 20 m, 32 m ; Harf El Kelb, 34 m. *S. serratimargo* : Italie, Bari, 12m. Iles Baléares, Cabrera Foradada, 25 m ; Mallorca, Formentor, 30 m; Minorca, Gamba Cave, 10 m. Crète, Kalilimenes, 35 m.

	<i>S. hassi</i>	<i>S. serratimargo</i>
Branch W	0.95 \pm 0.26, 0.5-3.3 (5, 70)	4.2 \pm 2.3, 13-2 (5, 47)
Autozooid L	399.8 \pm 37.7, 320-465 (4, 24)	530.2 \pm 39.4, 460-600 (3, 24)
Autozooid W	332.1 \pm 41.8, 240-390 (4, 24)	367.1 \pm 28.8, 315-435 (3, 24)
Primary orifice L	114.0 \pm 6.0, 100-125 (4, 25)	128.4 \pm 6.4, 120-140 (4, 28)
Primary orifice W	100.7 \pm 4.9, 95-110 (4, 25)	116.0 \pm 5.1, 110-125 (4, 28)
Adventitious Avicularium L	133.3 \pm 11.1, 125-160 (3, 12)	222.7 \pm 32.9, 180-255 (2, 13)
Adventitious Avicularium W	65.0 \pm 11.2, 60-85 (3, 12)	100.5 \pm 19.3, 75-130 (2, 13)
Vicarious Avicularium L	273.5 \pm 44.0, 180-340 (4, 17)	447.7 \pm 38.7, 390-520 (4, 22)
Vicarious Avicularium W	126.1 \pm 18.2, 85-160 (4, 17)	198.9 \pm 23.7, 150-230 (4, 22)
Abfrontal Avicularium L	154.3 \pm 33.4, 115-210 (3, 15)	-
Oral spines N	4-6	2-4

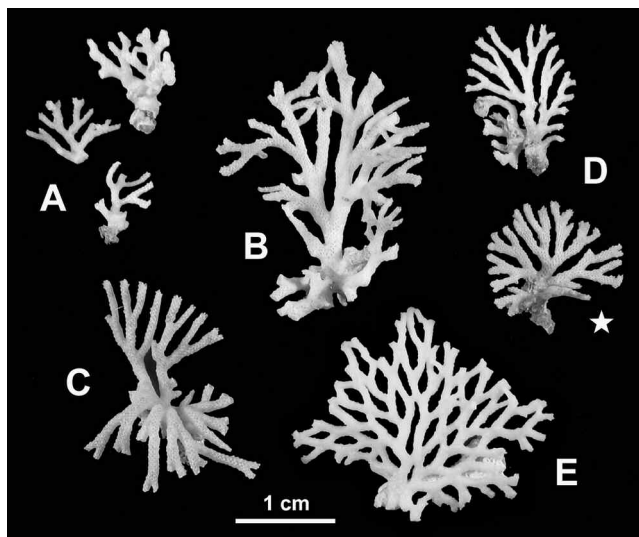


Figure 1. *Schizoretepora hassi* sp. nov. Colonies of various size and shape from the type series. **A.** Three small colonies, Ras El Chakaa, cave, 3-5 m, 19/10/1999, paratypes. **B.** Large colony with anastomoses, Selaata, cave, 6 m, 22/10/1999, paratype. **C.** Large, dichotomously branching colony, Selaata, overhang, 32 m, 2/05/2000, paratype. **D.** Two medium-sized, typically shaped colonies, Ras El Chakaa, overhang, 11-13 m, 19/10/1999, holotype (star) and paratype. **E.** Reticulate colony, Harf El Kalb, overhang, 34 m, 21/10/1999, paratype.

Figure 1. *Schizoretepora hassi* sp. nov. Colonies de taille et de forme diverses provenant des séries types. **A.** Trois petites colonies, Ras El Chakaa, cave, 3-5 m, 19/10/1999, paratypes. **B.** Grande colonie avec des anastomoses, Selaata, grotte, 6 m, 22/10/1999, paratype. **C.** Grande colonie avec ramifications dichotomiques, Selaata, surplomb, 32 m, 2/05/2000, paratype. **D.** Deux colonies de taille moyenne et de forme typique, Ras El Chakaa, surplomb, 11-13 m, 19/10/1999, holotype (étoile) et paratype. **E.** Colonie réticulée, Harf El Kalb, surplomb, 34 m, 21/10/1999, paratype.

acute, triangular, with hooked tip; crossbar robust, without a columella; uncalcified area of rostrum triangular; opesia small; cystid large, nodulous, with 2-5 large pores, extending on the abfrontal face (Fig. 2A, B & D). Ovicell recumbent on distally adjacent autozooid, with frontal wall smooth, imperforate, with broad, elliptical frontal fissure; prominent and visible on young colony parts, afterwards immersed in secondary calcification (Fig. 2C). Abfrontal kenozooids large, nodular, polygonal, generally arranged in two rows along the branches, with one to 5 pores, apparent or immersed sutures, bearing small, acute, triangular avicularia sporadically present, generally more frequent at the colony base (Fig. 2D).

Habitat

Schizoretepora hassi has been collected in 9 localities along the coast of Lebanon, from Ramkine Island (off Tripoli) in the north to El Zahrani in the south, ranging from 3 to 34 m depth. However, it probably occurs in even deeper water. All samples are from shaded hard-substrate habitats such as overhangs, caves, and undersides of boulders. Colonies were found particularly abundant on vertical walls of small caves with significant water circulation. The associated sessile fauna comprised many other bryozoans, including several lessepsian species (Harmelin et al., in prep.), scleractinians (*Polycyathus mullerae*,

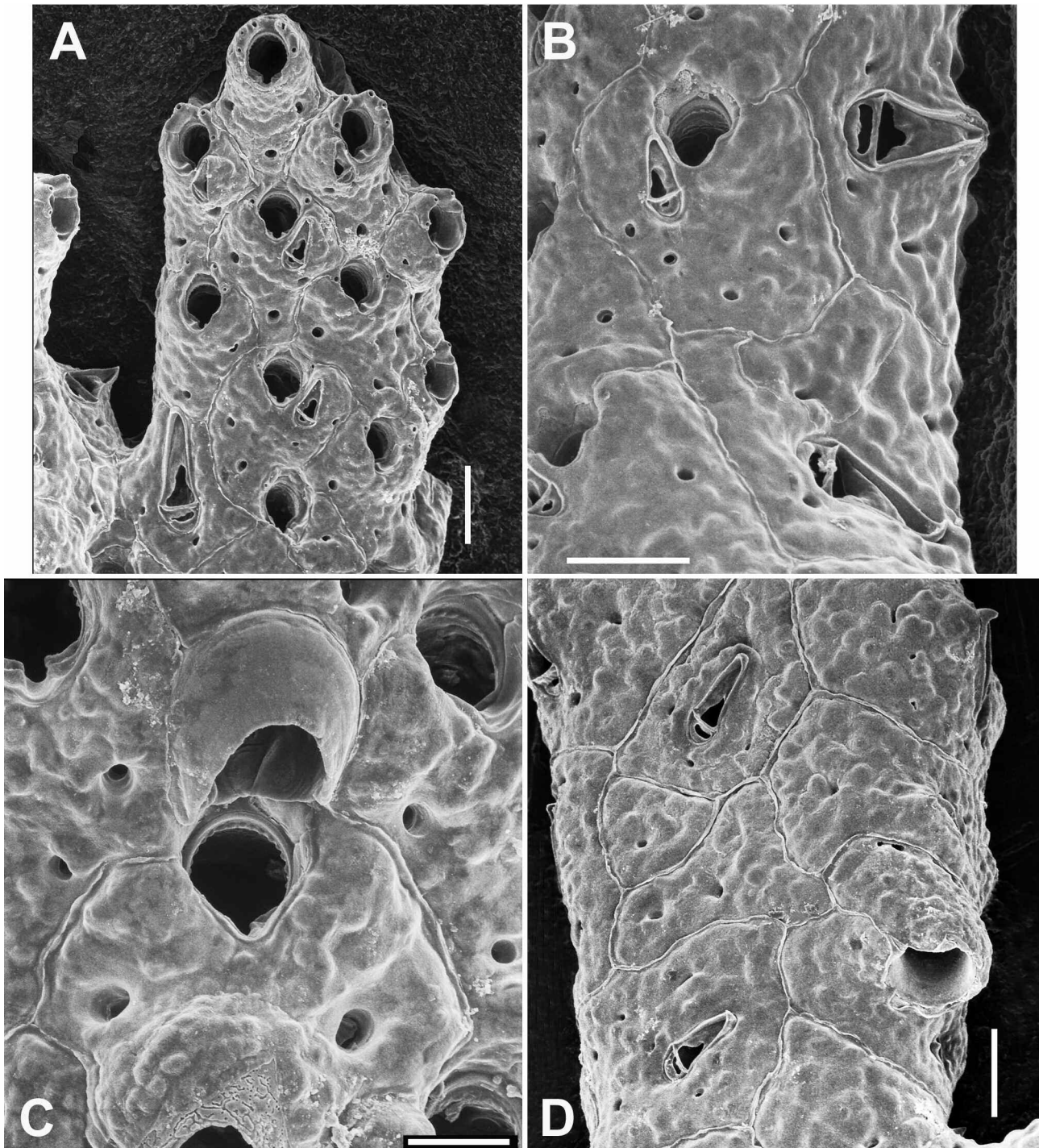


Figure 2. *Schizoretopenora hassi* sp. nov. Selaata, overhang, 20 m (A, B, D); El Zahrani, 14 m (C). **A.** Branch tip with 11 autozooids and two giant vicarious avicularia. **B.** Two giant vicarious avicularia and an autozooid. **C.** Ovicellate autozooid from a young branch part, a second ovicell with secondary calcification is visible at the bottom of the picture. **D.** Abfrontal face with two kenozooids bearing an avicularium and a spirorbid embedded in the kenozooidal calcification. Scale bars: 200 μm (A, B, D), 100 μm (C).

Figure 2. *Schizoretopenora hassi* sp. nov. Selaata, surplomb, 20 m (A, B, D) ; El Zahrani, 14 m (C). **A.** Extrémité d'une branche avec 11 autozoïdes et deux aviculaires vicariants géants. **B.** Deux aviculaires vicariants géants et un autozoïde. **C.** Autozoïde ovicellé d'une partie jeune d'une branche, une seconde ovicelle avec de la calcification secondaire est visible dans le bas de la figure. **D.** Face dorsale avec deux kénozoïdes portant un aviculaire et un spirorbe enfoui dans la calcification secondaire. Echelle : 200 μm (A, B, D), 100 μm (C).

Phyllangia mouchezi, Abel, 1959; *Madracis pharensis* Lacaze-Duthiers, 1897), sponges, tunicates (in particular the conspicuous lessepsian species *Herdmania momus*, Savigny, 1816).

Discussion

The finding of a conspicuous, new phidoloporidae widely distributed along the coast of Lebanon raised the problem of its generic identity, but also of that of a well known species, *Schizotheca serratimargo*, which shows many similar morphological traits. The morphological plasticity of colonies of this new species is remarkable and zooids are also variable to a lesser extent. As the Levantine basin is a hot spot for species introduction in the Mediterranean, the question of the biogeographic origin of *S. hassi* sp. nov. is addressed.

All morphological features of *S. hassi* are in accordance with the definition of genus *Schizoretepora* Gregory, 1893. This genus gathers phidoloporidae with erect colonies either fenestrate or ramose, autozooids with sinuate primary orifice and devoid of proximal oral avicularium, and ovicell with a broad frontal fissure and without labellum (e.g. Gautier, 1962; Zabala & Maluquer, 1988). None of the *Schizoretepora* species listed by Phil Bock (2006) in his web site on bryozoans corresponds with the present species. *Schizoretepora solanderia* (Risso, 1826), a 'vinculariform' species rather common in the Mediterranean, differs from *S. hassi* mostly in having a well-developed peristome forming a high collar with a spiramen and an upper slit. Other differences relate to the shape and orientation of the adventitious avicularium, the lateral arrangement of the giant vicarious avicularia, the presence of abfrontal, vicarious avicularia only near the base of the colony and the constant number of 4 oral spines (Calvet, 1902; Gautier, 1962). However, the orificial area of young autozooids with a still poorly developed peristome is very similar to that of *S. hassi*, particularly in having oral spines with basal parts thickly fused (Fig. 3B). Two other *Schizoretepora* species listed from the Mediterranean (Gautier, 1962; Zabala & Maluquer, 1988; Rosso, 2003), *S. imperati* (Busk, 1884) and *S. longisetae* (Canu & Bassler, 1928), have large, reteporiform colonies.

The species which presents the closest similarities with *S. hassi* in the shape of zooids is *Schizotheca serratimargo* (Hincks, 1886). This typically Mediterranean species (Reverter-Gil & Fernández-Pulpeiro, in press) was not recorded in Lebanon but is relatively common in other warm regions of the Mediterranean, such as the Balearic Islands (Zabala, 1986), the Adriatic Sea (e.g. Hayward & McKinney, 2002; Novosel, 2005), the Ionian Sea (Di Geronimo et al., 1988) and also the Aegean Sea and Crete (Harmelin, 1969 and unpublished data), mainly in shaded

habitats. Conversely to the other species of *Schizotheca* Hincks, 1877, which are encrusting, including the type species *S. fissa* (Busk, 1856), *S. serratimargo* is erect (Reverter-Gil & Fernández-Pulpeiro, in press). Colonies are large, with broad, bilaminar, adeoniform, or more occasionally eschariform branches (McKinney, 1989). SEM examination of both *S. serratimargo* and *S. hassi* (Fig. 3) reveals striking morphological similarities, particularly the structure of the frontal shield, the shape, proportions and position of the adventitious avicularia and of the giant vicarious avicularia, the shape of the primary and secondary orifices including the beaded anter and the thick and fused bases of the orificial spines. However, *S. hassi* clearly differs from *S. serratimargo* in the greater number of oral spines (4-6 instead of 2-4), the smaller size of zooids and colonies (Tab. 1), and obviously in having branches with frontal and abfrontal surfaces, the latter bearing kenozooids. The great similarity between *S. serratimargo*, *S. hassi* and *S. solanderia* in zooidal characters (Fig. 3) argues for ascribing *S. serratimargo* to the same genus, i.e. *Schizoretepora*. The bilaminar structure of branches of *S. serratimargo* does not preclude this attribution. The capacity of *Schizoretepora* to produce a bilaminar colony was already described in the case of the type species, *S. tessellata* (Hincks, 1878), which is normally fenestrate but can develop secondary, folded, bilaminar lobes (Harmer, 1934; Hayward & Cook, 1983). The particularity of *S. serratimargo* is that this capacity is permanently expressed. Therefore, we consider that *S. serratimargo* should be classed in *Schizoretepora* and that *Schizotheca* should be restricted to encrusting species.

Schizoretepora hassi presents a great plasticity in colony shape. Most collected colonies are ramose, with branches bifurcating irregularly in several contorted planes or more regularly in a concave fan or corolla (Fig. 1). Adjacent branches may join and fuse into an irregular mesh (Fig. 1B) or a typical fenestrate structure (Fig. 1E). The few available fenestrate colonies were collected on a deep-water (34 m), overhanging wall together with ramose colonies. However, the scarcity of those reteporiform colonies should exclude any environmental inference from their location. Young, terminal parts of branches are generally slightly compressed (Fig. 2A), but older parts are subcylindrical with the frontal and abfrontal faces separated by vertical sides bearing giant vicarious avicularia. Although smaller, colonies of *S. hassi* are very similar in shape to those of the Indo-Pacific species *Reteporella graeffei* (Kirchenpauer, 1869) (see Harmer, 1934, pl. 35, fig. 12-15), and of *Reteporella elegans* Harmelin, 1976. The latter, considered to be a Mediterranean endemic, occurs in coralligenous bottoms from SE Sicily (Di Geronimo et al., 2002) and in caves at Malta (J.G. Harmelin, unpublished data) but is apparently absent from Lebanon.

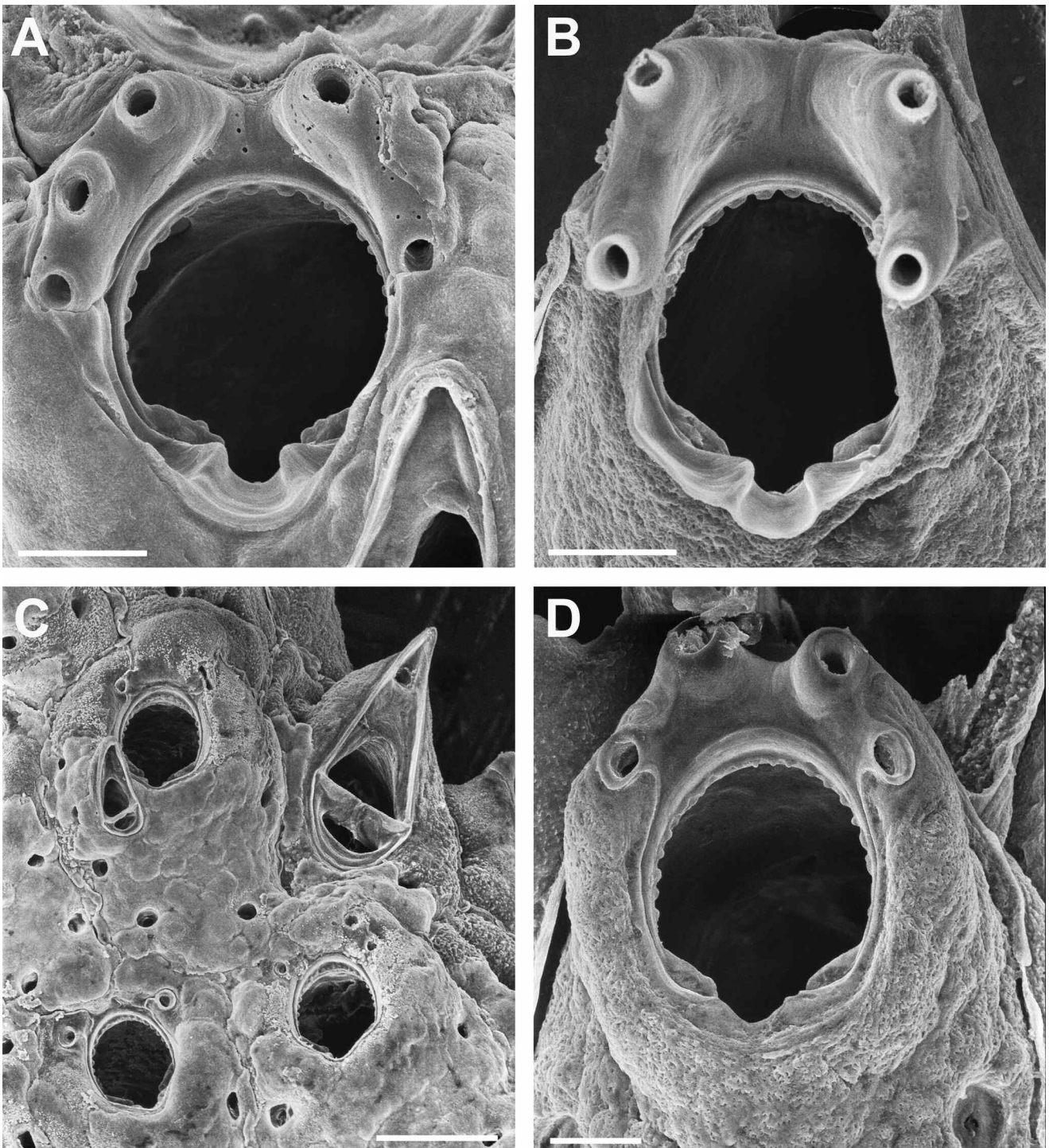


Figure 3. *Schizoretepora hassi* sp. nov. **A, B, D.** Primary and secondary orifice of young autozooids with fused bases of distal oral spines of *S. hassi* sp. nov. (A: Selaata, 20 m), *Shizoretepora solanderia* (B: France, Marseille, Riou, 14 m) and '*Schizotheca*' *serratimargo* (D: Italy, Bari, 12 m). **C.** *S. serratimargo*, Bari, 12 m, three older autozooids with a lateral, giant, vicarious avicularium. Scale bars: 50 μ m (A, B, D), 200 μ m (C).

Figure 3. *Schizoretepora hassi* sp. nov. **A, B, D.** Orifice primaire et secondaire de jeunes autozoïdes avec les bases fusionnées des épines orales de *S. hassi* sp. nov. (A : Selaata, 20 m), *Shizoretepora solanderia* (B : France, Marseille, Riou, 14 m) et '*Schizotheca*' *serratimargo* (D : Italie, Bari, 12 m). **C.** *S. serratimargo*, Bari, 12 m, trois autozoïdes plus âgés avec un aviculaire vicariant géant latéral. Echelle : 50 μ m (A, B, D), 200 μ m (C).

The frontal aspect of the zooids of *S. hassi* is highly variable within each colony depending on their position and age, i.e. the amount of secondary calcification. The oral spines are easily detached and their fused bases are visible only on young zooids. The same range of variation in zooidal characters was observed in colonies from different localities. The frequency of the different types of avicularia was variable but no particular pattern could be evidenced either within individual colonies or between colonies, except for the abfrontal, vicarious avicularia whose frequency tends to increase towards the base of the colony. In several samples, spirorbids colonising proximal parts of the abfrontal surface were embedded by secondary calcification (Fig. 2D).

The discovery of an undescribed but common and particularly conspicuous bryozoan in the Mediterranean could be surprising considering that the bryozoan fauna of this sea and the Adriatic Sea is relatively well known. However, as stressed by Rosso (2003), knowledge of the biodiversity of the Eastern Mediterranean is still poor. This is especially obvious in the Levantine area, which contrasts considerably with other regions of the Mediterranean. This area has never been investigated in great detail, especially on the basis of collections taken by diving, which allows sampling in cryptic habitats, usually populated by many bryozoans. Another case of remarkable recent discovery in Lebanon is that of two conspicuous lithistid sponges in caves (Pérez et al., 2004). The finding of *S. hassi* suggests two alternative hypotheses: (i) it is a steno-endemic restricted to the Levantine area, or (ii) it is an alien species settled for long in this area, coming probably from the Red Sea via the Suez Canal. Further surveys in other areas of the Eastern Mediterranean and in the Red Sea will be needed to precisely map the actual distribution of this species, which presently is one of the most characteristic components of sciaphilic communities from rocky habitats along the Lebanese coast.

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