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Journal of Natural History

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/tnah20>

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Published online: 21 Feb 2007.

To cite this article: O. Reverter-Gil & E. Fernández-Pulpeiro (2005) A new genus of cyclostome bryozoan from the European Atlantic coast, *Journal of Natural History*, 39:25, 2379-2387, DOI: [10.1080/00222930400023743](https://doi.org/10.1080/00222930400023743)

To link to this article: <http://dx.doi.org/10.1080/00222930400023743>

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A new genus of cyclostome bryozoan from the European Atlantic coast

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(Accepted 17 December 2003)

Abstract

We have studied the type and other specimens of *Stomatopora calypsoides* (Jullien, 1882) collected in the NE Atlantic off the coast of the NW Iberian Peninsula and held in the Muséum national d'Histoire naturelle (Paris). We consider that this species should be placed in a new genus, *Jullienipora* gen. nov., because of its budding and branching patterns, and the presence and peculiar positioning of heterozoids. Assignment of this genus to a specific family must wait for the re-organization of the family Stomatoporidae.

Keywords: Bryozoa, Cyclostomata, Iberian Peninsula, NE Atlantic, new genus

Introduction

Museum collections of animals built up over the past 200 years, and chiefly acquired from large-scale oceanographic surveys, comprise an indispensable source not only of reference material but also of specimens from diverse parts of the world, which are often the subject of new studies. The number of new taxa described using the material conserved in various institutions is proof of the interest of such studies.

We have had the opportunity to study the type specimen of *Stomatopora calypsoides*, a cyclostome bryozoan described by Jullien (1882), and collected from off the coast of Portugal at a depth of more than 1000 m. We have also identified, and ascribed to the same species, another series of colonies present in other samples collected from the same site and also examined by Jullien, who nevertheless overlooked their presence. We consider that *S. calypsoides* displays a series of highly peculiar characteristics, not present in any other species of Cyclostomata, Recent or fossil, and that it should therefore be placed in a new genus.

All specimens studied are held in the Muséum national d'Histoire naturelle, Paris (MNHN). Photographs were made from uncoated material using a LEO 435 VP scanning microscope.

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Published 29 June 2005.

ISSN 0022-2933 print/ISSN 1464-5262 online © 2005 Taylor & Francis Group Ltd

DOI: 10.1080/00222930400023743

Systematic account

Genus *Jullienipora* gen. nov.

Diagnosis

Colonies encrusting, strictly uniserial (budding pattern II of Illies 1973); dichotomies absent; lateral branching present; heterozoids ovoid, transverse striated, produced by lateral budding.

Type species. *Stomatopora calypsoides* Jullien, 1882.

Etymology. This genus is dedicated to the French bryozoologist Jules Jullien.

Jullienipora calypsoides (Jullien, 1882)

(Figures 1–4)

Stomatopora calypsoides Jullien 1882, p 498, Plate XIII, Figure 3; Calvet 1906, p 463.

Material examined

Holotype (by original designation): MNHN-BRY-2799: “*Stomatopora calypsoides* Jullien, 1882. Travailleux, 14/6/1881, 1068 m. Coll. Jullien, 5t.10—n° 184. Type”. Corresponds to Travailleux 1881, D.2, 1st ser.: 41°43'N, 11°39'40"W. One colony (figured).

Other material. MNHN-BRY-3749, part: “*Lagenipora edwardsi* Jullien. *Mucronella longicollis* Jullien. Travailleux, 14/6/1881. 1068 m. Coll. Jullien, 16t.14. Types”. Corresponds to Travailleux 1881, D.2, 1st ser.: 41°43'N, 11°39'40"W. Four colonies, one of them marked in red and figured.

MNHN-BRY-3752, part: “*Lagenipora edwardsi* Jullien 1882. *Mucronella longicollis* Jullien 1882. Travailleux 1881. Coll. Jullien. Types”. Corresponds to Travailleux 1881, D.2, 1st ser.: 41°43'N, 11°39'40"W. One colony.

MNHN-BRY-3900, part: “Travailleux, 1881, D.2 du 14/6. 1068 m. Coll. Jullien, 8t.18”. Corresponds to Travailleux 1881, D.2, 1st ser.: 41°43'N, 11°39'40"W. Two colonies, one of them marked in red and figured.

Voigttopora calypso: (MNHN-LP-R.61800) “Coll. d'Orbigny. *Stomatopora Calypso* d'Orbigny. Type. Sénonien. Saintes (Charente-Maritime). D'Orbigny 1852. Pal. Fr. Crétacé, T. 5: Bryozoaires, p. 841, pl. 630, fig. 5–8”.

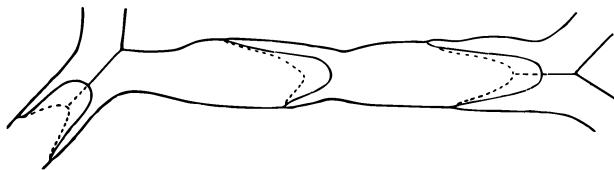


Figure 1. Budding pattern II after Illies (1973, p 310, Figure 3). Except for dichotomies, *Jullienipora calypsoides* shows the same distal budding pattern.

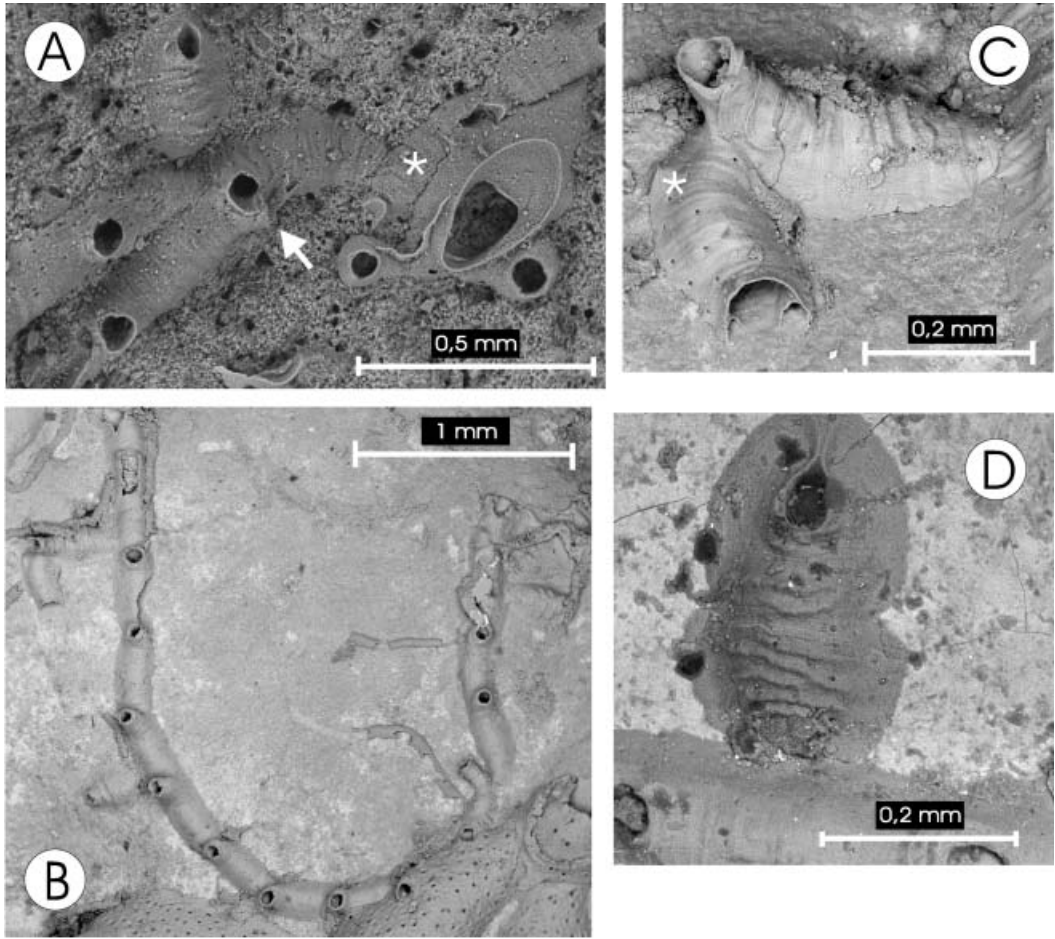


Figure 2. *Jullienipora calypsoides*. (A) MNHN-BRY-2799, holotype. Part of the colony showing a heterozoid (top left), branch overgrowth (arrow) and a presumed regeneration (asterisk; compare with Figures 3C, 4). (B) MNHN-BRY-3900. General view of the colony with three heterozoids. (C) MNHN-BRY-3900. Heterozoid and the second budding zooid in a branch. Note the lateral budding of the third zooid (asterisk), and the outline of the proximal extensions of succeeding zooid. (D) MNHN-BRY-3749. Heterozoid showing the existence of a distal suture formed by the union of two lateral folds.

Description

Colony encrusting, small, forming fine branches showing strictly uniserial growth, rectilinear or more or less curved.

Autozooids tubular, the central portion sometimes slightly dilated, smooth or slightly striated transversally, arranged in linear series, perfectly distinguishable from each other. Proximal portion adnate, distally raised up to form a peristome, often broken in the specimens examined, facing slightly forwards; zoecial aperture opens perpendicularly to the axis of the peristome.

Heterozoids very common, more or less ovoid, with frontal surface marked by conspicuous transverse striae; peristome narrower than in autozooids, angled at 30° to the substratum, with aperture facing forwards. Distally, under the peristome, a suture formed by the joining of two lateral folds can be observed. Heterozoids formed at right angles by lateral budding from the central or proximal portion of an autozooid; heterozoids always occur at the same side of the

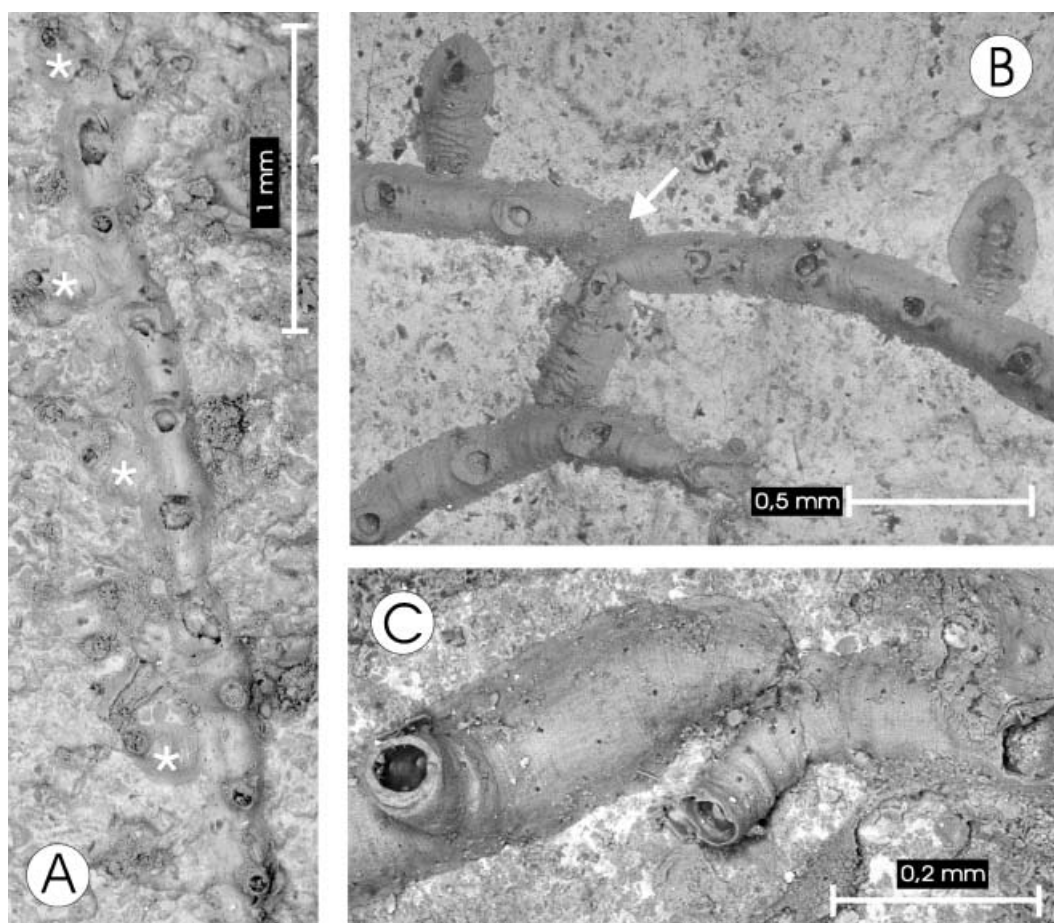


Figure 3. *Jullienipora calypsoides*. (A) MNHN-BRY-3900. A linear branch showing four heterozoids on the same side (asterisks). (B) MNHN-BRY-3749. Branching pattern. The second lateral branching is partially covered with external material (arrow). (C) MNHN-BRY-3900. A possible regeneration (compare with Figures 2A, 4).

colony, usually the convex side when the branches are curved. Heterozoids are short when isolated (0.28 mm), or longer when branching occurs (0.34 mm).

Autozooids usually produced by distal budding from a proximal autozooid. Dichotomies not observed in any of the specimens studied. The only means of generating new branches is by lateral branching, which follows a very characteristic pattern observed three times: a heterozoid is generated from the lateral side of an autozooid; from the distal extremity of this heterozoid an autozooid is budded, which turns sharply at 90°; a second autozooid is formed from the proximal part of the autozooid by lateral budding, orientated in the opposite direction to the first autozooid (Figures 2C, 3B).

Ancestrula unknown. In two samples (MNHN-BRY-2799, MNHN-BRY-3900) apparent regeneration from a fractured branch was observed (Figures 2A, 3C, 4).

Measurements (in mm)

The following abbreviations are used: Az, autozooid; Hz, heterozoid; P, peristome; PHz, heterozoid peristome; L, length; l, width.

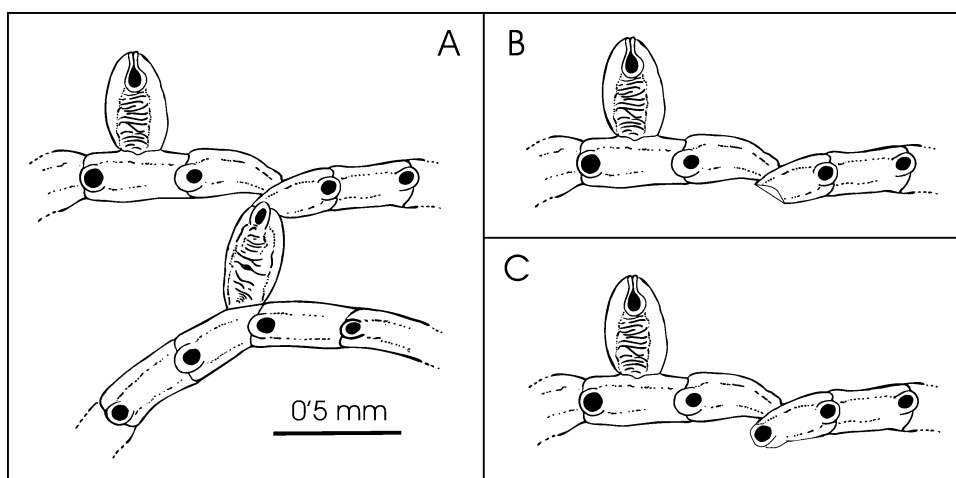


Figure 4. Hypothetical process of regeneration in *Jullienipora calypsoides*. (A) Intact colony. (B) Loss of the basal heterozooid of a branch. (C) Regeneration of a second peristome orientated oppositely to the original zooid (compare with Figures 2A, 3C).

MNHN-BRY-2799 (holotype): LAz: 0.37 ± 0.04 ($n=9$); lAz: 0.14 ± 0.014 ($n=9$); LH_z: 0.28 ($0.27-0.29$) ($n=3$); lH_z: 0.20 ($0.17-0.21$) ($n=3$). MNHN-BRY-3749: LAz: 0.37 ± 0.03 ($n=11$); lAz: 0.15 ± 0.016 ($n=11$); LH_z: 0.34 ($0.31-0.40$) ($n=4$); lH_z: 0.20 ($0.18-0.22$) ($n=4$). MNHN-BRY-3900: LAz: 0.39 ± 0.04 ($n=10$); lAz: 0.17 ± 0.016 ($n=10$); LH_z: 0.33 ($0.29-0.38$) ($n=3$); lH_z: 0.20 ($0.18-0.22$) ($n=3$); LP: 0.12 ($0.09-0.16$) ($n=6$); lP: 0.10 ($0.09-0.12$) ($n=6$); LPH_z: 0.12 ($n=1$); lPH_z: 0.08 ($n=1$).

Discussion

Stomatopora calypsoides, the type species of the new genus proposed, is characterized by colonies composed of strictly uniserial chains of zooids, by very frequent ovoid, striated heterozooids formed by lateral budding from one side of the colony, and by having a unique branching pattern; dichotomous branching, common in other comparable species, has not been observed, branch proliferation being due exclusively to two consecutive processes of lateral branching.

This species is difficult to locate or even recognize as belonging to the Bryozoa because of its small size and the fact that it usually appears damaged and covered by other organisms. In fact, *Stomatopora calypsoides* was described by Jullien (1882) from a single colony dredged by the *Travailleur* from the western Iberian Peninsula, whereas on studying the material from the same dredge survey that is held in the Muséum national d'Histoire naturelle (Paris) we were able to locate another seven colonies, nearly all damaged to a greater or lesser extent. Some of these samples were studied by Jullien himself, we assume in detail because they contain the type material of *Lagenipora edwardsi* Jullien and of *Mucronella longicollis* Jullien. However, the author overlooked the presence of *S. calypsoides* in these samples and even placed a label over one of the colonies that we studied.

Except for the type specimen, which was found on the inner side of a small shell, the other specimens were found on ferromanganese nodules, an abundant substratum at this sampling site. It is therefore possible that the species is more common than may appear at first, but that it has been overlooked.

Jullien (1882) placed the species in the genus *Stomatopora*. Forms showing uniserial growth have frequently been included in this genus in the past; however, they may correspond to more complex species, and therefore the validity of this genus has been questioned (Smitt 1867; Canu 1918). At present *Stomatopora* is a perfectly valid genus and is defined by the Jurassic type species, *S. dichotoma* (Lamouroux), for which a neotype was chosen by Walter (1969), and revised by Illies (1976). Nevertheless, there are some problems concerning Recent species assigned to this genus, as briefly mentioned by Taylor and Weedon (2000, p 374).

In his brief, original description of *Stomatopora calypsoides*, Jullien (1882, p 498) stated that “Cette espèce ayant quelques rapports avec l’*Alecto Calypso* de d’Orbigny...”. This species, described by d’Orbigny (1850) as *Alecto calypso*, was later transferred by the author (d’Orbigny 1852) to the genus *Stomatopora*, a denomination used in the author’s catalogue (no. 8298) as well as on the label associated with the type specimen preserved in the type specimen room in the Laboratoire de Paléontologie of the Muséum national d’Histoire naturelle (R. 61800). At present this species is the type species of the genus *Voigtopora*, which was described by Bassler (1952) as similar to *Stomatopora* “but with zooecia broad, elliptical, slightly constricted at base and marked by transverse lines”. Later, Brood (1972) called into question the validity of *Voigtopora*, because, in his opinion, the defining characters are also present in many species belonging to the genus *Stomatopora*. However, in her re-description of *Voigtopora calypso*, Illies (1974, 1976) considered the genus to be valid, with particular budding and branching patterns, i.e. lateral branches, and long proximal parts of zooids flanking their parental zooids. A good description and photographs of this species have been also provided by Pitt and Taylor (1990). No Recent species have been included in this genus, although Dr P. D. Taylor (personal communication) believes that the *Stomatopora antarctica* described by Waters (1904) may be a *Voigtopora*.

By wetting the specimens of *S. calypsoides* it becomes apparent that the growth is strictly uniserial, a pattern described by Illies (1973, p 310, Figure 3) as budding pattern II (see Figure 1). Therefore, the long proximal parts of zooids flanking their parental zooids, which characterize the genus *Voigtopora*, are not present in this species.

In the different species traditionally considered as belonging to the genus *Stomatopora*, the usual mode of branching consists of dichotomous division of a branch, by means of emission of a central septum which comes in contact with the terminal membrane, thereby dividing the bud in two (Borg 1926; Harmelin 1976; Illies 1976). However, in some cyclostome species a different branching pattern, lateral branching, in which the zooid is formed from the flank of another branch, has been described. Harmelin (1976) believed that this branching is produced a posteriori by partial dissolution of the calcareous material of the lateral wall of a zooid, centred on some pseudopores. According to Harmelin (1976) this particular kind of branching should appear in primitive uniserial forms. Jablonski et al. (1997) state that “lateral branching has the advantage of allowing colonies to infill patches of unoccupied substratum space between older branches in the interior of the colony”, thereby diversifying the direction of growth of the colony, and minimizing the problems generated by biotic cover. Lateral branching has been cited by various authors in different species (Busk 1859; Hincks 1880; Gregory 1896, 1899; Lang 1904; Waters 1904; Canu and Bassler 1920, 1929; Harmelin 1974, 1976; Illies 1974, 1976; Pitt and Taylor 1990). This particular kind of branching had not been paid particular attention by the authors citing it, until the studies of Harmelin (1974, 1976), in which it was studied in detail, and of Illies (1974, 1976) who first made lateral branching the fundamental character separating the genus *Voigtopora* from the genus *Stomatopora*.

However, it must be pointed out that dichotomous branching is always present in species that show lateral branching; in fact, in *V. calypso* dichotomous branching is so common that each internode is formed by only three or four zooids, whereas lateral branching is so sporadic that the type specimen of the species only has one branch formed in this way. In the eight colonies of *S. calypsoides* available to study, dichotomous branching has not been observed, whereas lateral budding is extremely common. The zooids produced by this kind of budding differ from the autozooids, being shorter, clearly ovoidal, marked by conspicuous transverse striae that are not as apparent in the autozooids, and possessing a peristome inclined to the substratum with the aperture orientated distally and not upwards. This peculiar morphology is in clear contrast with the similarity between the autozooids and the first zooid of a lateral branch in other species that show this kind of branching, e.g. *V. calypso*, although the first budded zooid in lateral branches of runner-like cyclostomes and cheilostomes are often relatively short (Dr P. D. Taylor, personal communication). The different morphology of heterozooids and autozooids is difficult to explain, although their mere existence is particularly characteristic, as polymorphism in Cyclostomata is generally very limited. The isolated lateral heterozooids may correspond to abortive zooids, because they are short and show a distal suture (Figure 2D), which may indicate that linear growth in this branch has been interrupted. However, they are abundant and always situated on the same side of the colony (Figure 3A), and there is no obstacle to their growth on the substratum; therefore we can assume that these zooids have a particular function. Although we are aware that the gonozooids of cyclostomes usually show a higher density of pseudopores than in this case, and that they are not usually abundant, we believe that a possible reproductive function of the heterozooids of *S. calypsoides* should not be discounted. Notwithstanding this, the unusual morphology of the first lateral zooid may be related to the specific branching pattern of this species; branching in *S. calypsoides* is produced exclusively by two consecutive lateral branchings (Figure 3B). Whereas in other species, such as *V. calypso* or *Voigtopena dixonii* (Vine), the lateral branches show a pattern of growth similar to any other branch (see Illies 1976, p 107, Figure 8a, b; Taylor 2002, p 58, Plate 7, Figure 1), in *S. calypsoides* the first lateral zooid (heterozooid) gives rise, by distal budding, to an autozooid which turns sharply at an angle of 90° in its proximal section so that it is orientated perpendicularly to the heterozooid (and therefore parallel to the parent branch of the heterozooid). From the proximal part of the second zooid, a third zooid arises, by lateral budding, in the opposite direction to the second zooid, so that opposing branches are produced.

The proliferation of branches in different directions may produce branch overgrowths (samples MNHN-BRY-2799, MNHN-BRY-3752). When these overgrowths occur together with partial destruction of zooids this can give the false impression of a dichotomy, as in Figure 2A; however, close inspection reveals the remnants of the true parent zooid overgrowing the frontal wall of the proximal zooid (arrow).

Destruction of parts of the chains of zooids, frequent in runner-like bryozoans, and the posterior regeneration that follows a pattern reminiscent of that described by Taylor (1985) in Palaeozoic *Corynotrypa*, may explain the occurrence of the two lateral branches observed and not associated with heterozooids (Figures 2A, 3C). As explained in Figure 4, if the heterozooid is eliminated from a lateral branch, and perhaps even the proximal part of the second zooid of the branch, the latter may sometimes regenerate a second peristome in an opposing position to the first, and the two branches, one lateral, will therefore be in opposing positions, united by a zooid with two peristomes.

A number of authors have highlighted the difficulty of characterizing different species of cyclostome bryozoans, due to the scarcity and variability of the characters present. We believe that the strictly uniserial growth of the *S. calypsoides* colonies, whose zooids lack long proximal parts of zooids flanking their parental zooids, as well as the absence of dichotomies, the abundance of lateral branches and the presence of heterozooids allow the species to be placed in a new genus, *Jullienipora*. This genus is clearly differentiated from other forms that show runner-like growth, in particular from *Voigtopora*, a genus that also shows lateral branching.

Lateral branching appears as a new feature during the Lower Cretaceous (Illies 1976; Jablonski et al. 1997) with *V. calypso* representing a group having both dichotomous and lateral branching. *Jullienipora* may represent another, different line of evolution, in which lateral branching became predominant, displacing the usual dichotomous pattern of branching. The particular morphology of *J. calypsoides*, which we have found to be similar mainly to fossil forms from the Cretaceous, leads us to believe that we are dealing with a primitive species, with little relation to the present-day fauna. Assignment of this genus to a specific family must wait for the re-organization of the family Stomatoporidae.

There exist other uniserial species in which only lateral, and not dichotomous, branching appears to occur, such as in the Recent species *Stomatopora antarctica*, described by Waters (1904), and the fossil species *Stomatopora opposita*, described by Canu and Bassler (1920), and *V. dixonii*, recently cited by Taylor (2002). In these three species, the zooids are much larger than in *S. calypsoides*, and none of them appear to have either heterozooids or the characteristic pattern of branching by means of two consecutive lateral buddings. A more detailed study of the former species (*S. antarctica* and *S. opposita*) would be necessary for accurate characterization and to be able to consider their inclusion in the genus *Jullienipora*. The species *V. dixonii* has been placed in the genus *Voigtopora* (see Taylor 2002) because the zooids are flanked on either side by proximal parts of the next zooid.

Acknowledgements

We are most grateful to Dr J.-L. d'Hondt (Muséum national d'Histoire naturelle, Paris) for facilities given for the study of specimens. Special thanks are due to Dr S. Reguant (Universitat de Barcelona) and Dr P. D. Taylor (The Natural History Museum, London) for helpful discussion and sending of bibliography, and to Dr J.-G. Harmelin (Station marine d'Endoume, Marseille) for helpful discussion. Thanks are also due to Mr Ramiro Barreiro (Servicio de Microscopía da Universidade de Santiago de Compostela) for the scanning electron micrographs, and to Ms Teresa González for drawings.

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