Bryozoa from the Southern North Sea coast of

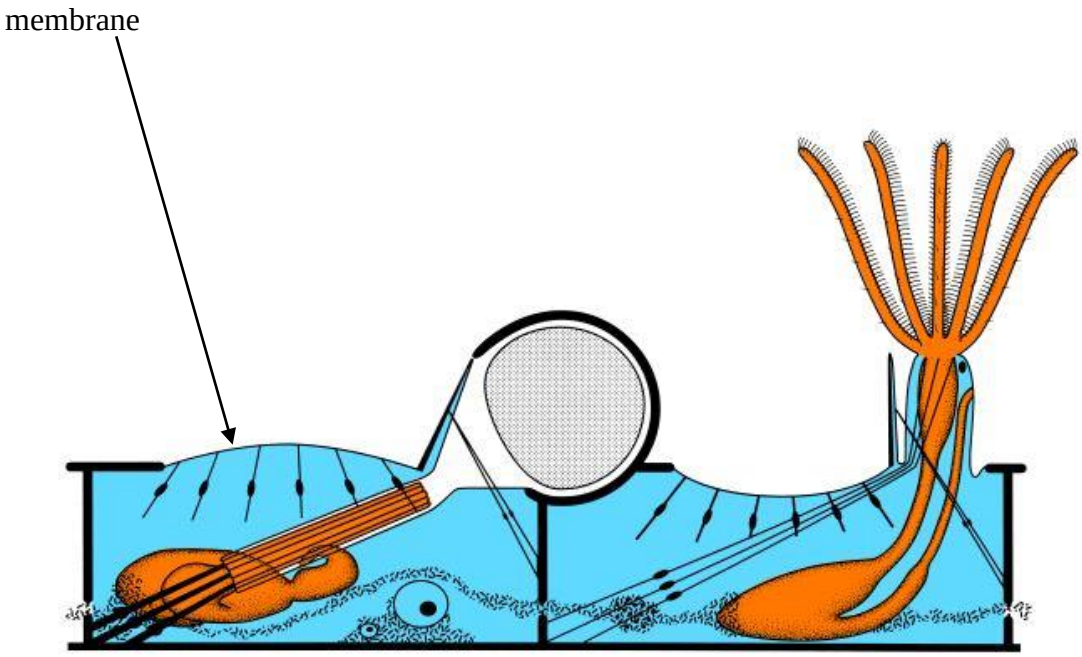
Belgium, the Netherlands and Germany.

Part III

Cheilostomatida “anasca”

= informal grouping of the Suborders
-Inovicellina
-Scupariina
-Malacostegina
and the Superfamilies
-Calloporoidea
-Buguloidea
-Flustroidea
-Cellarioidea in the Flustrina

Hans DE BLAUWE



Schematic image of the anatomy of two zooids of a **generalised anascan**, showing gut and lophophore (orange, extended and retracted), skeleton, muscles, funicular system, communication pores, ovary (left zooid), testis (right zooid) and an ovicell with developing larva.
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SUMMARY

Before you lies an updated English version of De Blauwe (2009). It is an idendification key for marine and brackish water moss animals (bryozoans) of the Southern Bight of the North Sea. It has become a virtually complete inventory of a group of animals that have been the object of few studies so far, but that encompasses a surprisingly large variety of species. About 200 species are discussed, all of which were found on beaches, in ports and in marine habitats betrween Cap Griz Nez (Northern France) and the Dutch-German border, expanded now to the German-Danish border.

The sandy substrate that is predominant in this area is usually poor in moss animal species. The fact that such a large number of species are described in this work is the result of an in-depth study of more than 20 years of observation (tidal mark material, specimens collected on the hard substrate of breakwaters, port structures, windmill piles, gas platforms, shells and stones) and of the review of the historical collections in Brussels (RBINS).

After the publication of De Blauwe (2009), a lot of data are added. Many beach combers reported their observations and have sent me material and photo's for confirmation or identification. Some resulted in new publications. Al reliable information is here included. The past 10 years, bryozoans are better studied in marine monitoring programs. This led to more species and more distributional data.

Thanks to different identification keys and a 20-30x magnifying glass it is possible to recognize most of the moss animals in the study area.

ACKNOWLEDGMENT

For more than 20 years I have been able to enjoy the understanding of my family for my long stay at the binocular and the computer and the encouragement of many members of the Strandwerkgroep, Strandwerkgemeenschap, Flanders Marine Institute, Royal Belgian Institute of Natural Sciences and International Bryozoology Association. Thanks to all who shared information, material and photo's and for giving permission to use it to contribute to a better understanding of this undervalued group of animals.

CLASSIFICATION OF THE BRYOZOA

For the classification of the species, the taxonomic criteria have been followed almost completely from https://www.marinespecies.org/ and http://bryozoa.net/.

Order CHEILOSTOMATIDA

"Anasca": The Suborder Anasca has been used widely previously, and is now considered to be an informal grouping of the suborders hereafter. It is clear that much further work is needed on the relationships between the families of cheilostomes.

Suborder Membraniporina

Superfamily Membraniporoidea

Family Membraniporidae

Biflustra tenuis (Desor, 1848)
Biflustra grandicella (Canu & Bassler, 1929)
Jellyella eburnea (Hincks, 1891)
Jellyella tuberculata (Bosc, 1802)
Membranipora membranacea (Linnaeus, 1767)

Family Electridae

Aspidelectra melolontha (Landsborough, 1852)
Conopeum reticulum (Linnaeus, 1767)
Conopeum seurati (Canu, 1928)
Einhornia crustulenta (Pallas, 1766)
Electra monostachys (Busk, 1854)
Electra pilosa (Linnaeus, 1767)
Pyripora catenularia (Fleming, 1828)

Suborder Aeteina

Superfamily Aeteoidea

Family Aeteidae

Aetea anguina (Linnaeus, 1758)
Aetea sica (Couch, 1844)
Aetea truncata (Landsborough, 1852)

Suborder Scrupariina

Superfamily Scruparioidea

Family Scrupariidae

Scruparia ambigua (d'Orbigny, 1841)
Scruparia chelata (Linnaeus, 1758)

Family Eucrateidae

Eucratea loricata (Linnaeus, 1758)

Suborder Flustrina

Superfamily Calloporoidea

Family Calloporidae

Ammatophora nodulosa (Hincks, 1877)
Amphiblestrum auritum (Hincks, 1877)
Amphiblestrum flemingii (Bu)sk, 1854)
Callopora craticula (Alder, 1856)
Callopora discreta (Hincks, 1862)
Callopora dumerilii (Audouin, 1826)
Callopora lineata (Linnaeus, 1767)
Callopora rylandi Bobin en Prenant, 1965
Cauloramphus spiniferum (Johnston, 1832)
Crassimarginatella solidula (Hincks, 1860)
Parellisina curvirostris (Hincks, 1862)
Tegella unicornis (Fleming, 1828)

Family Antroporidae

Rosseliana rosselii (Audouin, 1826)

Superfamily Flustroidea

Family Flustridae

Chartella papyracea (Ellis & Solander, 1786)
Flustra foliacea (Linnaeus, 1758)
Hincksina flustroides (Hincks, 1877)
Securiflustra securifrons (Pallas, 1766)

Superfamily Buguloidea

Family Bugulidae

Bicellariella ciliata (Linnaeus, 1758)
Bugulina avicularia (Linnaeus, 1758)

Bugulina flabellata (Thompson, in Gray, 1848)
Bugulina fulva Ryland, 1960
Bugula neritina (Linnaeus, 1758)
Bugulina simplex Hincks, 1886
Bugulina stolonifera Ryland, 1960
Bugulina turbinata Alder, 1857
Crisularia plumosa (Pallas, 1766)

Family Beaniidae
Beania mirabilis Johnston, 1840

Family Candidae
Caberea boryi (Audouin, 1826)
Cradoscrupocellaria ellisi (Vieira & Spencer Jones, 2012)
Cradoscrupocellaria reptans (Linnaeus, 1767)
Scrupocellaria scrupea Busk, 1852
Scrupocellaria scruposa (Linnaeus, 1758)
Tricellaria inopinata d'Hondt & O. Ambrogi, 1985
Tricellaria ternata (Ellis & Solander, 1786)

Superfamily Microporoidea

Family Setosellidae
Setosella vulnerata (Busk, 1860)

Superfamily Cellarioidea

Family Cellariidae
Cellaria fistulosa (Linnaeus, 1758)
Cellaria salicornioides Lamouroux, 1816
Cellaria sinuosa (Hassall, 1840)

BRYOZOA UNDER THE MICROSCOPE

The appearance of an individual (autozooid) or of a colony is extremely varied. The autozooid can be calcified or not, the colony encrusting or upright, firm or flexible, a few millimeters to 30 cm in size. The color varies from species to species and brightly colored embryos can give the colony a characteristic color during the reproductive period.

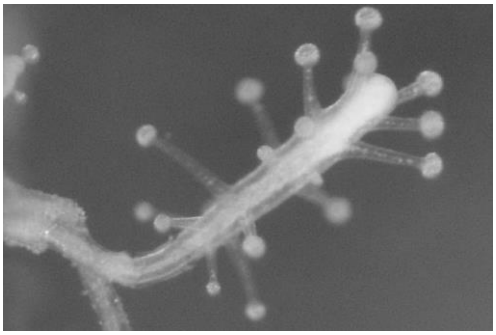
For beginners, the distinction between Hydrozoa and Bryozoa is not easy. The tentacles of hydroids capture and anesthetize the prey with nettle cells and bring them to the mouth opening. Moss animals have a ring of tentacles that carry cilia, not stinging cells. These cilia initiate a flow of water through which suspended particles flow to the mouth opening. The tentacles can move individually. When examining fresh substrates (mussels, pebbles, algae, etc.) in seawater, sometimes unexpected moss animls are discovered due to the characteristic tentacle crown that is bulged out.

1 a) Tentacles not retractable in an enclosure (fig. 1). ...……..... athecate hydroid
b) Tentacles in a whorl and retractable in an enclosure (arrow in fig. 2, 4). 2

2 a) Tentacles with nettle cells do not create a water flow (fig. 2). thecate hydroid
b) Tentacles with cilia create a flow of water (fig. 3, 4) ..... bryozoan

A colony consists of a group of individuals called autozooids that interact with each other. Each autozooid (Fig. 4) consists of a protective wall containing a polypid. Polypids can disappear and degenerate into "brown bodies". The protective wall or zoecium may persist after the death of the polypide, especially if it is calcified. The zoecium has an opening through which the polypid can partially come out for food intake. A polypide consists of a tentaculate lophophore, a U-shaped gut, muscular system, reproductive organs and a nervous system. In the center of the tentacle crown is the mouth, outside the tentacle crown is the anus.

The location on an individual is very important (fig. 5):
- basal: the surface of the zooid applied to the substratum;
- lateral: the sides;
- frontal: the top surface containing the opening;
- proximal: closest to the origin of the colony;
- distal: towards the growth end of the colony.



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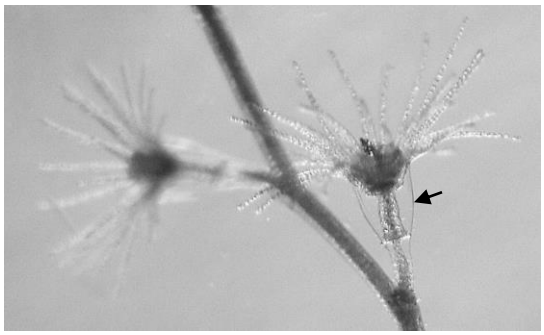

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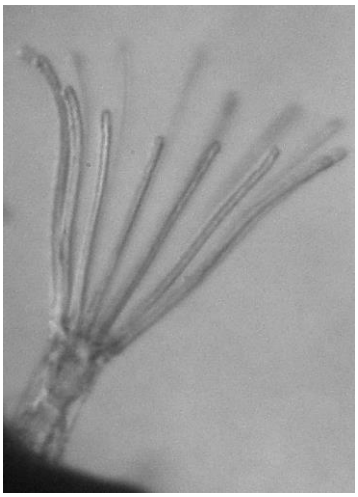

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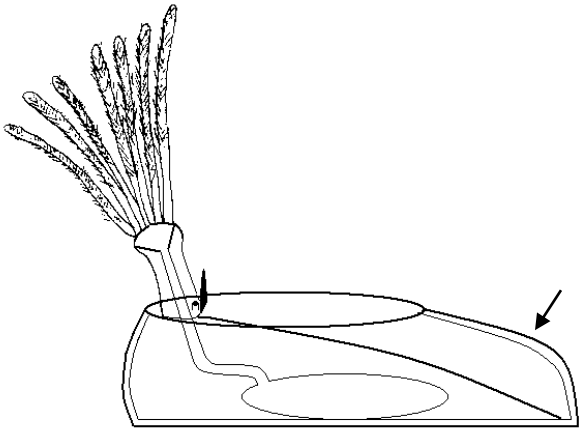

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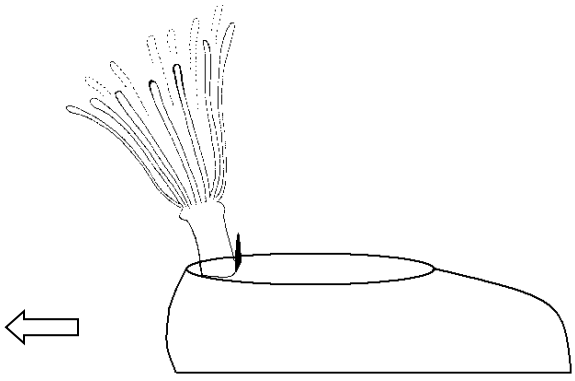


5 growth direction (distal) proximal

Depending on the function of the individual, a classification is made between autozooids and heterozooids. Autozooids have a nourishing function and therefore a tentacle crown. Heterozooids have no nourishing function and therefore no tentacle crown.

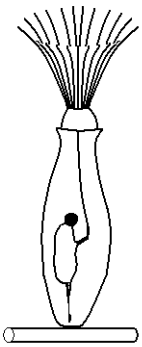
We distinguish three groups of moss animals in terms of structure: Ctenostomatida (fig. 1) have no calcified parts, Cyclostomatida (fig. 2) have a cylindrical calcification and Cheilostomatida (fig. 3) have a box-like calcification. Cyclostomatida and Cheilostomatida are mainly determined on the basis of the calcified shell.

Ctenostomatida are not calcified and do not have an operculum. In Ctenostomatida the term "peristome" is used for mouth cone, an elevation with the mouth opening at the end (fig. 4).

Cyclostomatida are also not closed by an operculum. Peristome here refers to the erect cylindrical part of the autozooid (fig. 5).

We can further divide the order of the Cheilostomatida into three large groups:
- species that have a large opening frontally (this group used to be called "Anasca"). This opening or opesia is covered by a membrane. The operculum is in the membrane. (fig. 7)
- the Family Cribrilinidae, characterized by a basket-shaped shield of fused flattened spines. (fig. 8)
- Species whose frontal surface is completely calcified, except for the opening closed by the operculum (formerly "Ascophora"). (fig. 9)

In Cheilostomatida, the opening of the autozooid is closed by a valve or operculum. This operculum can pivot in some species at condyles (Figs. 10, 11). The opening is sometimes surrounded by a high rim or peristome (fig. 6). Some species have a U-shaped bend (sinus (Fig. 10)) or an anvil-shaped plate (lyrula (Fig. 11)) on the proximal side of the opening.



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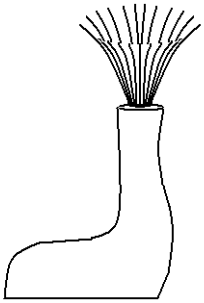

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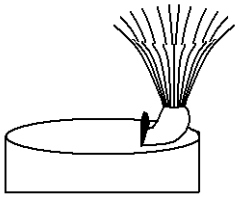

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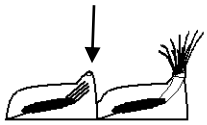

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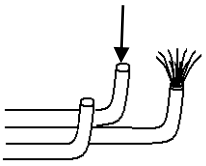

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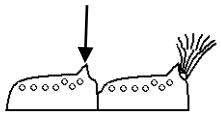

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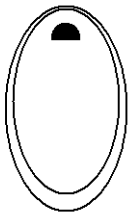

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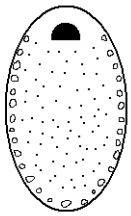

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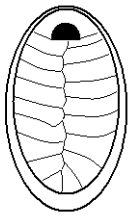

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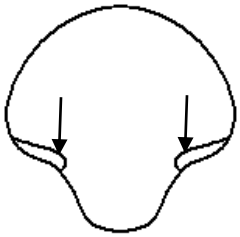

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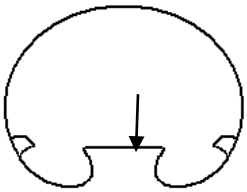

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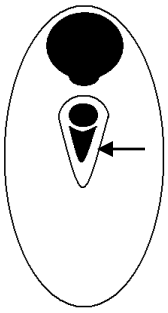
Heterozooids are individuals without a nutritional function. They do not have a protrusible tentacle crown and are unable to feed. Heterozooids include avicularia, kenozooids and cyclostome gonozooids. Special heterozooids occur in Cheilostomatida: avicularia (fig. 1-6) and vibracula (fig. 7-8). The function of avicularia and vibracula is thought to be defense, especially the removal of unwanted organisms or substances that are a nuisance to the colony. In avicularia, the tentacle crown is reduced to a vestige. In kenozooids the polypide is completely absent.

Avicularia are sessile (fig. 1) or pedunculated (fig. 2, 3). The mandible can be compared to the operculum of autozooids, it is a valve that closes an opening. The rostrum (⟵) is the distal part of the avicularium closed by the mandible (⇨)(fig. 4). In avicularia of the "bird's head" type, the rostrum and mandible resemble the upper and lower jaw of a bird's beak (Fig. 2).

Three types of avicularia are distinguished:
- on the autozooid, **adventitious** (fig. 1);
- between the autozooids (**interzooidal**) (fig. 5);
- **vicarious** avicularia take the place of a autozooid and are about the same size (fig. 6).

Vibracula are swollen bodies that bear a long brush, they are found in the family Candidae (fig. 7).

Other heterozooids are kenozooids. They form root-like structures or spines (fig. 8).
Root-like structures (rhizoids) are used for the attachment of the colony.



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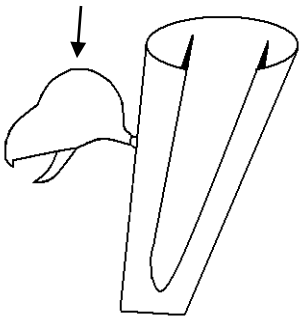

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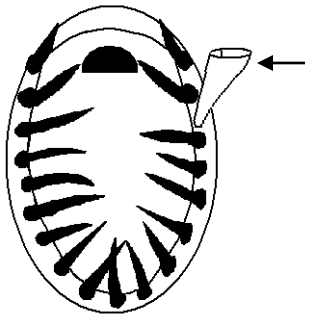

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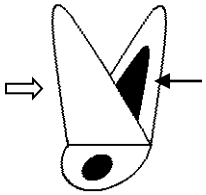

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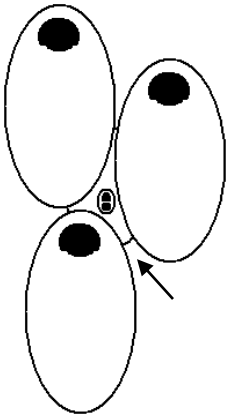

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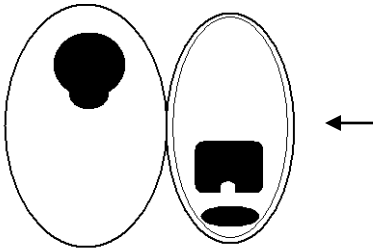

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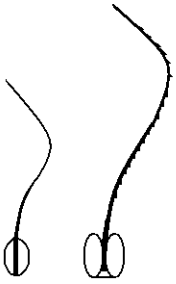

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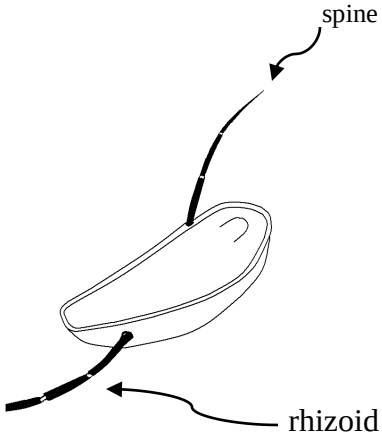

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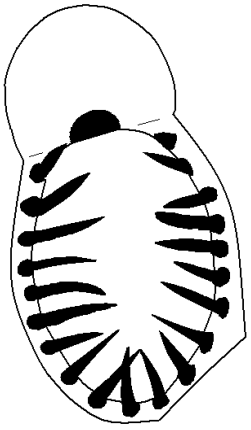
Many species bear spines:
- around the opesia (fig. 1);
- distal spines: around the distal half of the opesia (fig. 2);
- oral spines: around the opening (fig. 3);
- rarely on the frontal surface (fig. 4).

A scutum (fig. 5) is a broadened spine that curves over the frontal surface. A scutum occurs in the family Candidae.

Spines prevent predators such as slugs from moving across the colony. Spines break off easily. They are usually present on the colony-edge on young autozooids. Some spines consist of kenozooids that are connected to each other and to the autozooid by uncalcified joints. These spines are also mobile because of those uncalcified joints. Many broken spines are clearly hollow. On the basis of the remaining stumps (fig. 6) you can count the original number of spines per autozooid. Side lighting is particularly useful because the spines stand out with an exposed side and a shadow side.



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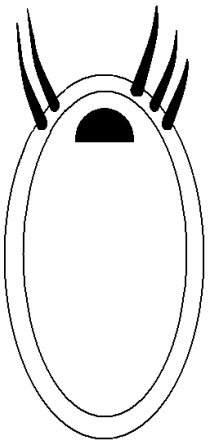

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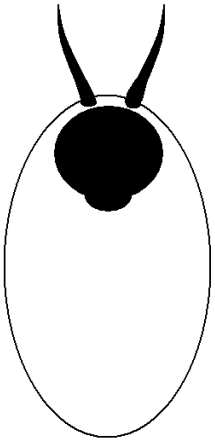

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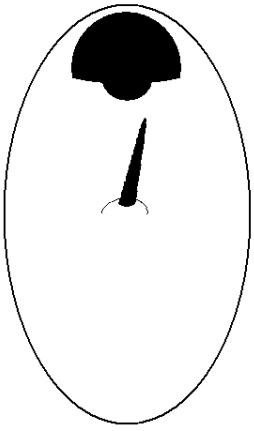

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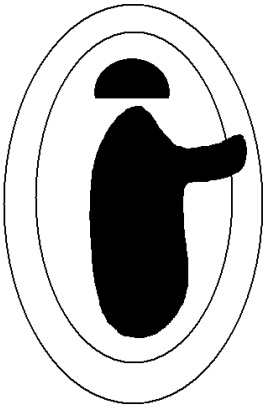

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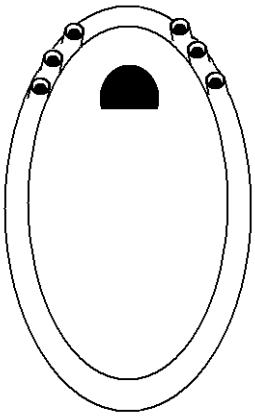

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REPRODUCTION, SETTLEMENT AND DISSEMINATION

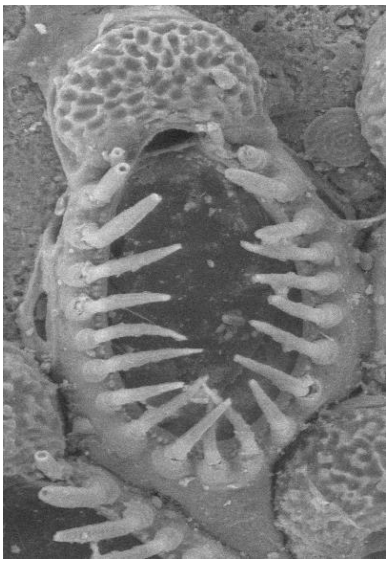
Moss animals are ambiguous. They make male and female sex cells, often at different times. Embryos are incubated in ovicells (photo 1) or in the zooecia itself (photo 2) or in Cyclostomatida in swollen gonozooids (photo 3).

Most cheilostome species have coronate larvae that are brooded until their release, do not feed, and live only a short time (hours or days) in the plankton before settling. Consequently, great distances cannot be bridged in this way.

An exception to this are the Membraniporoidea and some species from the genus Alcyonidium. They secrete eggs into the sea that grow into larvae that can survive free-floating for a few weeks or months and feed while in the plankton. For example, they can cover great distances and therefore species such as Electra pilosa and Conopeum reticulum are the first to colonize new substrates such as recent shipwrecks.

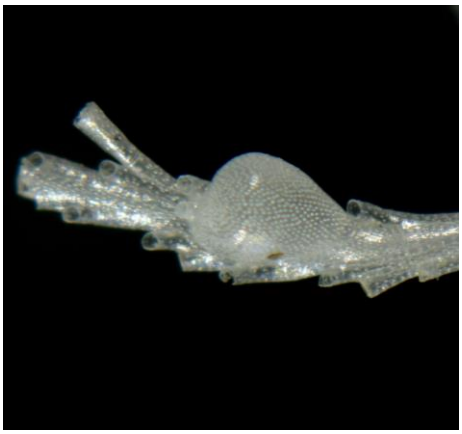
An attached colony that moves with its substrate can of course cover great distances. Fertile colonies, for example, move on floating algae, plastic objects or ship hulls. The large amount of plastic in the sea is undoubtedly contributing to the spread of moss animals today. Recreational boating transfers species from one marina to another.

The larva settles on a suitable substrate and forms a first zooid or ancestrula (photo 4). This ancestrula is usually different in shape from the later zooids and can be used for identification. The ancestrula buds 1, 2 or 3 first daughterzooids, which in turn expand the colony by budding. Colonies of tens to hundreds of genetically identical autozooids are formed.

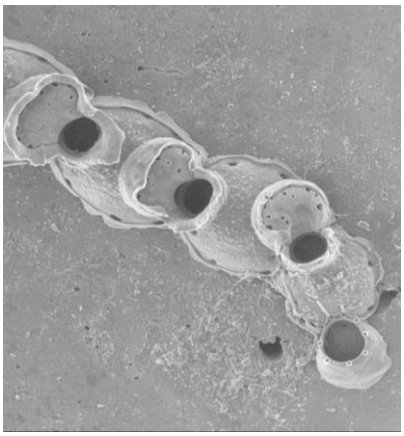


1 Cheilostomata part III

2 Ctenostomata part I



3 Cyclostomata part II



4 Cheilostomata part IV

COLLECT, IDENDIFY AND STORE

COLLECTION

Scientific samples are often transported in 70% alcohol, formalin or special liquids for DNA research. A beachcomber with interest in moss animals can transport beached substrates dry. Uncalcified species should be transported in seawater or alcohol. Pruning shears are useful for cutting the most interesting pieces out of plastic, so you don't have to carry large amounts. Bush-shaped colonies are best removed from the substrate with a knife. Handle them carefully so as not to make features such as spines disappear. The use of brushes to clean the colony is therefore not recommended for species with spines. Rinsing under running water is sometimes sufficient. In dry, calcified species, annoying grains of sand can be removed under magnification with a moist needle to which they adhere. Dirt can be removed from calcified colonies by soaking them in a bleach solution for a while. Rinse well afterwards.

EXAMINATION AND IDENTIFICATION

A magnification of 30x is very helpfull. In some species photography with a scanning electron microscope is even necessary.
Uncalcified colonies are examined in sea water, as are all living colonies. In fresh, living colonies, one can easely observe the number of tentacles and color of the tentacles, eggs, embryo's, tissue… .
Calcified colonies are viewed or dry, or completely completely submerged. Damp colonies that have just been removed from the water are difficult to identify due to the glittering effect of the remaining water.
Keep in mind that many features may have disappeared from washed up or deceased colonies. Spines are usually found in young zooids on the colony edge, in older colony parts they are often broken. The frontal surface may be worn off from sanding. Species that have a membrane over the frontal surface, over the opesia or over a frontal surface may have lost that membrane.
Lighting is very important in the investigation. Lighting from above does not give good results. Side lighting casts shadows to enhance features.

An impression can be made of the few species that drill into shells. Brush the shell with liquid polyester on the inside with a brush. Leave to dry, preferably on a vibrating surface such as the air pump of an aquarium. Then place the shell in hydrochloric acid (30% solution) in a Petri dish. When the shell has dissolved, you can carefully rinse off the remaining polyester fleece. The impression of the zooids and kenozooids can then be studied under binocular magnification. Store with care, the prints are very delicate.

CONSERVATION

Calcified species can be kept dry after rinsing with fresh water. With colonies on algae, it must be taken into account that the algae shrink when drying and the moss animals do not, so that they will break down. It is better to keep such colonies in 70% alcohol. Colonies without calcification are best stored in 4% neutralized formalin made with seawater. Important finds belong in a Natural History Museum. The amateur can keep the colonies, properly labeled, temporarily in rubbing alcohol from the supermarket or pharmacist and donate them later to a museum.

IDENTIFICATION KEYS

CLASSIFICATION AND KEY TO ORDERS

Class Stenolaemata: Body wall calcified and tubular.

Order Cyclostomatida: Opening circular, at the end of a small tube.

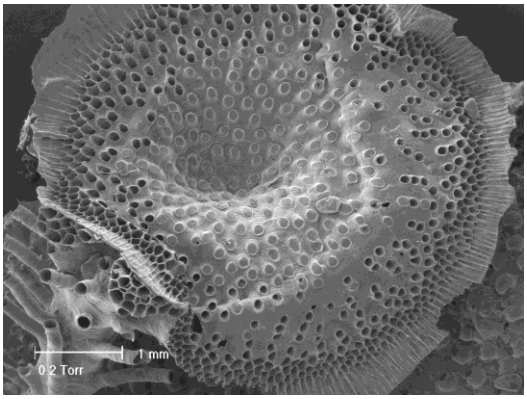
Class Gymnolaemata: Body wall calcified or not calcified. Zooids tubular, bottle-shaped or flattened.

Order Ctenostomatida: Body wall not calcified. Zooids cylindrical, bottle-shaped or flattened. Opening terminal, or frontal in encrusting species, not closed by an operculum.

Order Cheilostomatida: Body wall calcified, box-shaped. Frontal or subterminal opening, closed by a hinged flap (operculum).

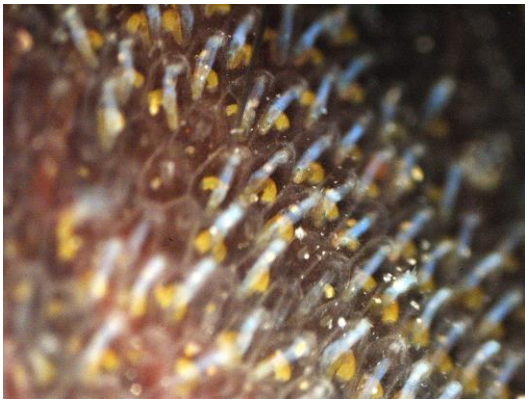
1 a) Body wall not calcified (photos 7 and 8). ..... Ctenostomatida (part I)
b) Calcification is always present, at least in the side walls. 2

2 a) Opening at the end and round, wall completely calcified, tubular (photo 5 and 6). ……. …… Cyclostomatida (part II)
b) Frontal or subterminal opening, usually closed by an operculum, the autozooid is box-shaped, frontally calcified (photo 9) or membranous (photo 10). ..... Cheilostomatida (p. 22)

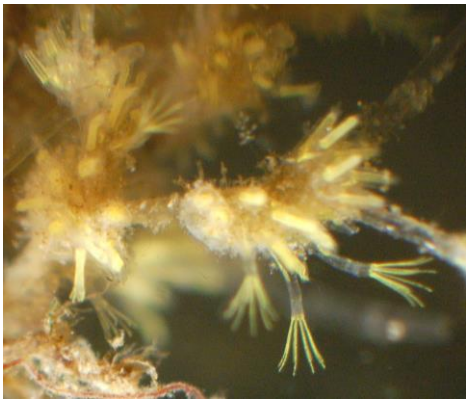


5: encrusting Cyclostomatida part II

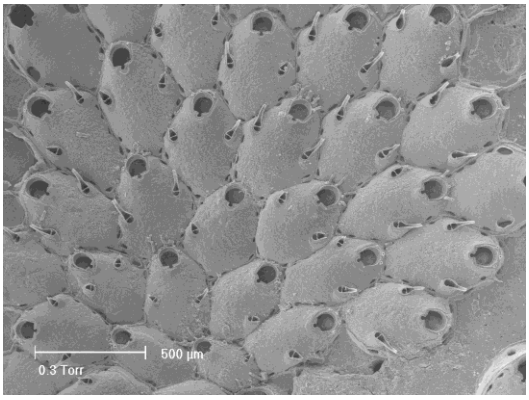
6: erect Cyclostomatida part II



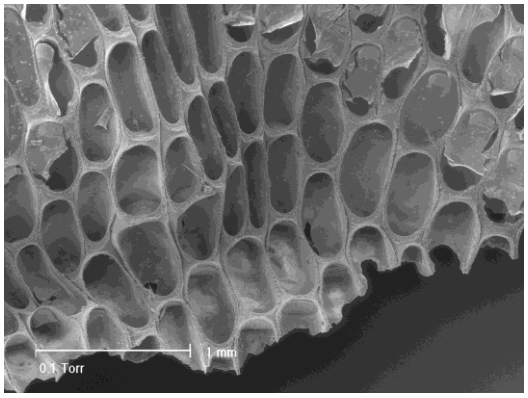
7: encrusting Ctenostomatida part I



8: erect Ctenostomatida part I



9: Cheilostomatida, frontally calcified Part IV



10: Cheilostomatida, opesia and frontal membrane in this part III

CHEILOSTOMATIDA

Key to the genera of Cheilostomatida

1 a) The colony consists of uniserial chains of autozooids (fig. 1). 2
b) Colony biserial of multiserial (fig. 2). 7

2 (1) a) Branched chains of fusiform zooids lying on the substrate, each with an upright distal portion resembling a tube lamp (fig.3). ……... *Aetea* (p. 44)
b) Not as described. 3

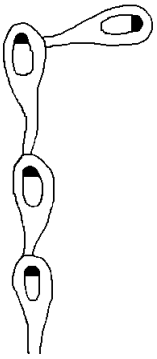
3 (2) a) Frontal surface with an uncalcified oval zone (opesia) (fig. 4). 4
b) Frontal surface completely calcified except for the orifice (fig. 5). ……. 6

4 (3) a) Colony consists of erect, branched chains of horn-shaped autozooids, on an adnate zooid chain (fig. 6) or a slender adnate stolon (fig. 7) …. *Scruparia* (p. 50)
b) Colony attached to the substratum with rhizoids. Autozooids with a tubular slender proximal portion and an upright coal scoop-shaped distal portion surrounded by spines (fig. 8). ……..... *Beania mirabilis* (p. 148)
c) Colony completely adnate (fig. 9). 5

5 (4) a) Branched chains of thickly calcified, teardrop-shaped autozooids. The oval frontal membrane occupies almost half of the total zooid length (fig. 10). …… ……..…..... *Pyripora catenularia* (p. 86)
b) Similar but thinner calcified autozooids, mostly with spines unless damaged. The autozooids make an oval scar in the substrate (fig. 11). …….. ……..…….. *Electra monostachys* (p. 76)

6 (3) a) Autozooids elongate oval, in irregularly branched chains, adjacent autozooids sometimes connected by short tubes (fig. 12). …..... *Plesiothoa gigerum* (part IV)
b) Autozooids fusiform with a long threadlike proximal part. The chains branch in a cross-shaped pattern (fig. 13). ……. *Hippothoa* (part IV)

7 (1) a) Colony erect. 8
b) Colony encrusting, as lying sheets or as clumps, or a honeycomb-like structure of erect connected plates. ……..... 18



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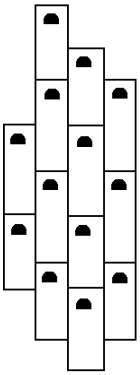

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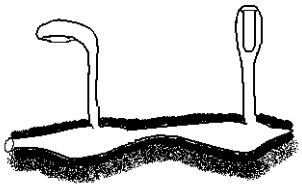

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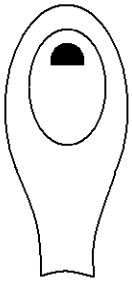

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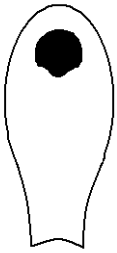

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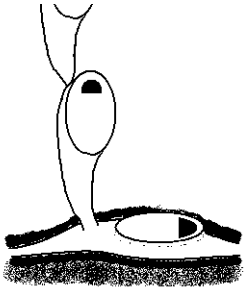

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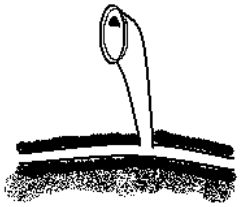

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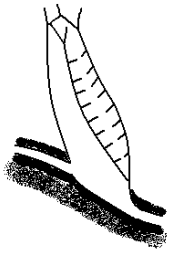

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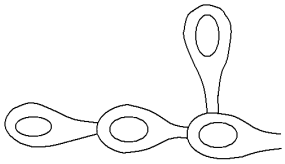

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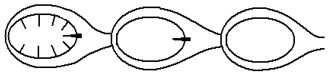

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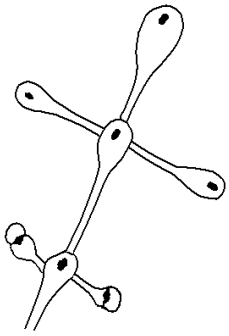

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8 (7) a) Colony flexible and branched. Bush-shaped, fan-shaped or like a twig. (fig. 1 and 2). ……..... 9
b) Colony rigid, branched like deer antlers. *Omalosecosa ramulosa* (part IV)
c) Colony rigid, branched flattened fronds. *Palmiskenea skenei* (part IV)

9 (8) a) Colony stiff, the white branches consist of slender cylinders, connected by yellow-brown chitinous joints. Autozooids calcified, covered by a glistening frontal membrane, orifices around the cylinder (fig. 4). ..... *Cellaria* (p. 168)
b) Colony consists of 1 or 2 layers of autozooids with orifices on 1 or 2 sides. 10

10 (9) a) Colony consists of 1 layer of autozooids, with orifices on 1 side (fig. 5). 11
b) Colony 2-layers of autozooids, with orifices on both sides (fig. 6). 16

11 (10) a) Avicularia present (fig. 8 en 9). …..……...……..... 12
b) Avicularia absent (fig. 7). ……..……..... *Bugula neritina* (p. 128)

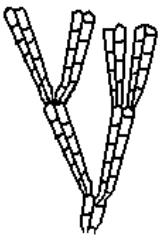
12 (11) a) Avicularia with a broad base connected to the autozooid (fig. 8). ...…….... 13
b) Avicularia like a stalked bird's head (fig. 9). 15

13 (12) a) Avicularia and vibracula present (fig. 10 en 11). 14
b) Vibracula absent. Large, lateral avicularia, as wide as an autozooid (fig. 8). ..... *Tricellaria* (p. 162)

14 (13) a) Basal surface with vibracula with toothed setae (fig. 10). ….. *Caberea* (p. 150)
b) Small vibracula with toothless setae, lateral and in ramifications (fig. 11). ..... *Cradoscrupocellaria* and *Scrupocellaria* (p. 152)

15 (12) a) Colony branches biserial. Autozooids with 4 to 9 long, curved spines, at the distal end of an oval opesia. (fig. 12). ..... *Bicellariella ciliata* (p. 146)
b) Colony branches biserial or multiserial, opesia elongated. Proximal ends of autozooids, in basal view, clearly bifurcated. Spines only in distal corners of the autozooids (fig. 13). ..... *Bugula*, *Bugulina and Crisularia* (p. 122)

16 (10) a) Colony branches slender, consisting of elongated autozooids in back-to-back pairs, with an oval opesia occupying about half the zooid length. The colony resembles a miniature poplar (fig. 14). ..... *Eucratea loricata* (p. 54)
b) Colony consist of erect bilaminar, branching fronds (fig. 15). 17



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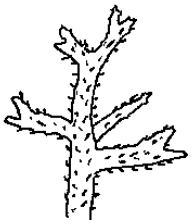

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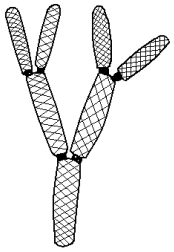

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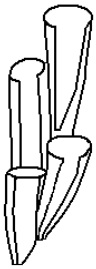

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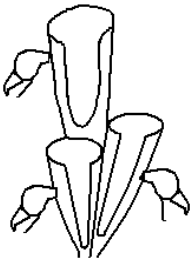

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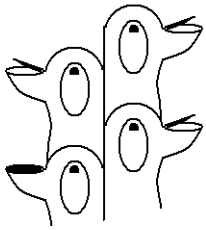

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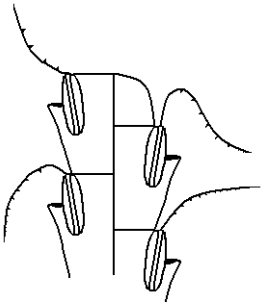

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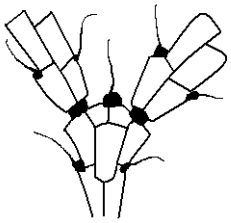

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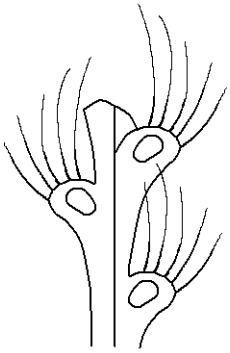

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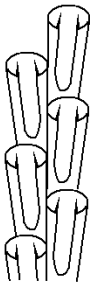

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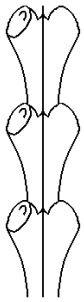

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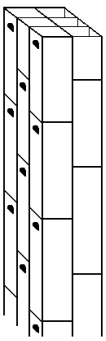

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17 (16)a) Autozooids urn-shaped, proximal gymnocyste with pores, opesia surrounded by spines, proximal spine constant (fig. 1). ….. *Electra pilosa* (p. 78)
b) Autozooids tongue-shaped, with distal spines (fig. 2). *Flustra foliacea* (p. 90)
c) Autozooids rectangular, with a pair of short distal spines (Fig. 3). Colony papery with rounded fronds. ..... *Chartella papyracea* (p. 92)
d) Autozooids elongated rectangular, without spines (fig. 4). Colony papery with wedge-shaped fronds. ……..…..... *Securiflustra securifrons* (p. 94)

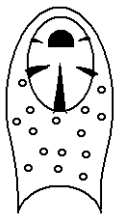
18 (7) a) Frontal surface with an opesia (uncalcified zone larger than the operculum) (fig. 5). ……..... 19
b) Opesia covered by a shield of fused flat spines (fig. 6). ……. 72
c) Frontal surface completely calcified, except for the orifice and possibly large pores (fig. 7). A membrane may lie over the calcified frontal surface. ……... 38

19 (18)a) Colony attached to the cephalopod shell of *Spirula*. Crudely constructed gymnocystal spines originate through folding of the proximal gymnocyst. …….. *Jellyella eburnea* (p. 68)
b) Not on *Spirula*. Gymnocyste not folded to crude spines. ……..…… 20

20 (19)a) Avicularia absent. (Note: the common *Conopeum reticulum* has kenozooids that can be hold for avicularia by beginners). 21
b) Avicularia present, sometimes only a few per colony. 31

21 (20)a) Autozooids elongated rectangular, the frontal surface is completely membranous except possibly a few rounded proximal tubercles (fig. 8). Forms lacy colonies on brown algae. Also on green algae on plastic or pebbles. ……..……..... *Membranipora membranacea* (p. 56)
b) Not like that, or if very similar, then not brown algae. 22

22 (21)a) Below the level of the autozooid margin, especially proximally, there is a calcareous layer that reduces the opesia (fig. 9, 10 en 11). ……...…..... 23
b) Opesia not reduced by a calcareous layer (fig. 5 en 8). ……....….... 27



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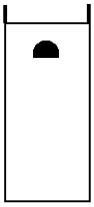

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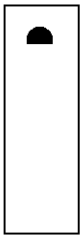

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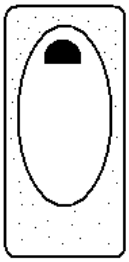

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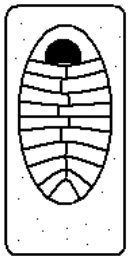

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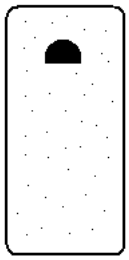

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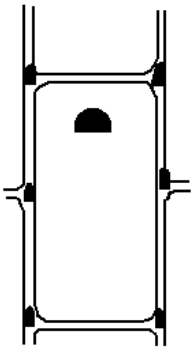

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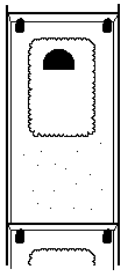

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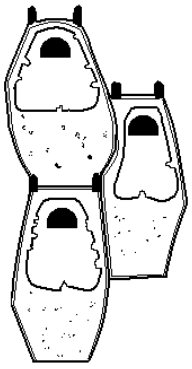

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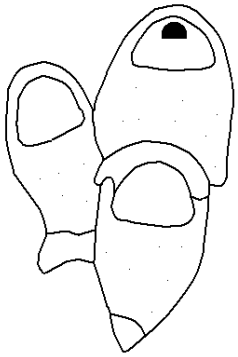

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23 (22)a) Ovicells do occur. Opesia trilobed or trifoliate. …… 24
b) Ovicells never occur. Opesia oval or rounded rectangular, never trifoliate, Ancestrula is a twin. …….. 25

24 (23)a) Opesia semielliptical or trilobed. Inconspicuous brood chambers may occur. Large rounded nodular kenozooids occur between the autozooids (fig. 1). ……..…….. *Ammatophora nodulosa* (p. 120)
c) Opesia trifoliate, with straight or convex proximal edge. Ovicells prominent, globular. …… *Rosseliana rosselii* (p. 115)

25 (23)a) On oceanic floatsam: for example plastic or goose barnacles. Resembling *Membranipora membranacea*, with longer proximal tubercles. ..... …… *Jellyella tuberculata* (p. 66)
b) One or more layers of zooids on shells or pebbles; or foming a honeycomb structure of plates of zooids, existing of two layers growing back to back. Cryptocyste underlaying frontal membrane mainly present proximally. At the edge of the oval opesia, minuscule spines may point towards the center of the opesia. (fig. 2). …….. 26

26 (25)a) Forming a layer or thick crust of several layers on shells or pebbles. Cryptocystal plate surrounding the opesia is mainly well developed proximally and laterally, its edge with the opesia is finely serrated. ... *Biflustra tenuis* (p. 58)
b) Forming large honeycomb structures resembling Pentapora fascialis. Spines on the edge of the cryptocystal plate pointing to the centre of the opesia are rare. ……...……. *Biflustra grandicella* (p. 60)

27 (22)a) Ovicells may be present. …… 28
b) Ovicells never present. …….. 29

28 (27)a) Opesia elliptical, with narrow calcareous margin and one or more low, rounded tubercles. Up to 4 spines in young zooids. Ovicell smooth, with a membranous area (fig. 3). ……..... *Crassimarginatella solidula* (p. 108)
b) Opesia surrounded by 17 to 22 spines with thickened bases. Ovicells uniformly granular (fig. 4). ..……...…….…....*Callopora discreta* (p. 100)

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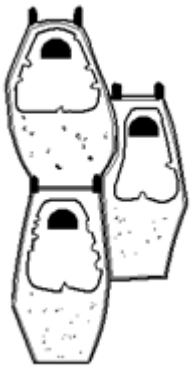

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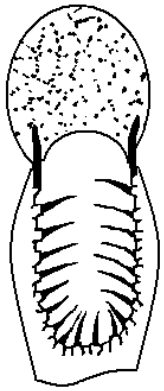


29 (27)c) Ancestrula with 8 spines, zooids with 2 thick distal spines (fig. 1). Ovicells absent. .....……. young colony of *Flustra foliacea* (p. 90)
d) Ovicells absent. If spines are present, then not thick. 30

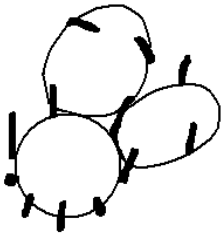
30 (29)a) Frontal view as in fig. 2. Sometimes small kenozooids (arrows) between the autozooids, often absent. Short slender lateral spines present under sheltered conditions. ……..... *Conopeum* (p. 70)
b) Frontal view as in fig. 3. The proximal calcareous layer occupies one sixth to one half of the frontal surface and may have pores. If spines are present, the one at the proximal end of the opesia is the most prominent. …… ……. *Electra/Einhornia* (p. 74)
c) Frontal view as in fig. 4. Autozooids in one or more series, sometimes as a non-contiguous crust in dense colonies. Looks like thickly calcified *Electra monostachys* (p. 76). ……..….. *Pyripora catenularia* (p. 86)

31 (20)a) Avicularia small, interzooidal, with long threadlike mandible. Proximal to the D-shaped opening are 2 small opesiules in the calcium layer below the frontal membrane (fig. 5). .....*Setosella vulnerata* (p. 166)
b) Not as described. 32

32 (31)a) Opesia bordered by numerous thin, pointed spines. Avicularia pedunculate, club-shaped, with terminal mandibles, resembles a thicker spine between the other spines (fig. 6). Not present on all autozooids. Ovicells cap-like, inconspicious. ..... *Cauloramphus spiniferum* (p. 110)
b) Avicularia not pedunculate. 33

33 (32)a) Avicularia on the zooids, their base is not on the substrate (fig. 7). …..... 34
b) Avicularia in between the zooids, their base is on the substrate (fig. 8). 35

34 (33)a) Ovicell without frontal ridge (fig. 9) or with a transverse membranous area bounded by a sinous ridge. 1-4 spines at the distal end, or up to 20 around the oval opesia. Basal pore chambers present. ……..... *Callopora* (p. 98)
b) Ovicell with a frontal ridge (fig. 10). Up to 4 spines at the distal end. Opesia three-lobed or oval. Basal pore chambers present. …….. *Amphiblestrum* (p. 116)
c) Ovicell with a frontal ridge. Pore chambers absent. Lateral walls with multiparous septula. ……. *Tegella unicornis* (p. 114)



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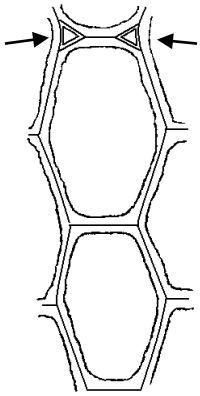

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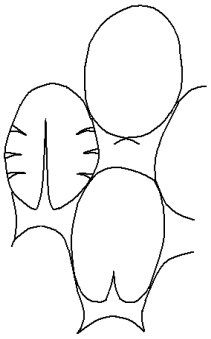

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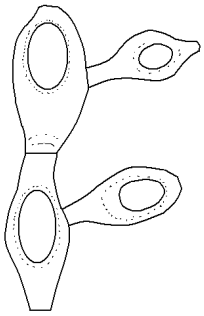

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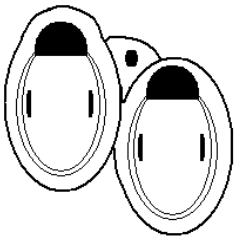

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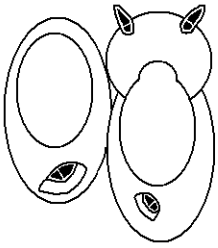

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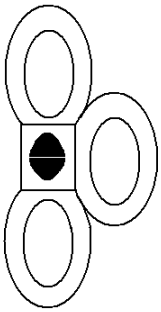

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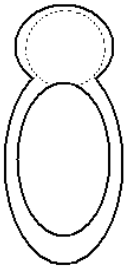

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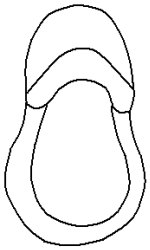

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35 (33)a) Avicularium with semi-elliptic mandible (fig. 1). 36
b) Avicularium with curved, pointed mandible (fig. 2)..……..
…….. *Parellisina curvirostris* (p. 112)

36 (35)a) Avicularium as large as an autozooid, rare. Autozooids spineless except in young zooids. Autozooids with 1 or 2 rounded knobs on the proximal frontal calcification. ……..... *Crassimarginatella solidula* (p. 108)
b) Avicularia much smaller than zooid, frequent. Zooid bears spines. 37

37 (36)a) Frontal membrane bordered by usually 10 to 14 short stout spines. Ovicells immersed. ……..…….. *Hincksina* (p. 96)
b) Frontal membrane bordered by only 2 distal spines. ... *Flustra foliacea* (p. 90)

all species from here on are covered in part IV (except *Aspidelectra melolontha* and *Callopora rylandi*)

38 (18)a) Zooids with an ascopore (opening without rostrum or mandible) proximal to the opening (fig. 3, 4, 5). If necessary, tilt the colony to inspect the perpendicular side of the peristome. (no central pore as in *Reptadeonella violacea* fig. 6). 39
b) No ascopore proximal to the orifice. ……..… 42

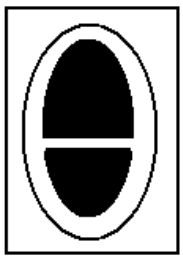
39 (38)a) Autozooids with an avicularium with a slender rostrum and mandible, proximo-lateral to the ascopore. ……. *Microporella ciliata*
b) Autozooids without avicularia. ……..…….. 40

40 (39)a) Ascopore crescentic (fig. 3). ……...….. *Fenestrulina*
b) Ascopore round or oval (fig. 4 en 5). ……. 41

41 (40)a) Ascopore in the peristome around the orifice(fig. 5). *Pacificincolidae*
b) Ascopore on the distal side of a small bump proximal to the orifice (fig. 4).
……..…….. *Haplopoma*

42 (38) a) Frontal shield evenly perforated (fig. 7). 43
b) Only marginal pores (fig. 8), sometimes inconspicuous, or not perforated. .. 53

43 (42) a) Avicularia absent. …..……. 44
b) Avicularia present, but sometimes not on all zooids. 48



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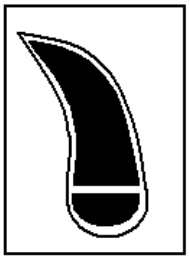

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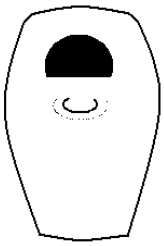

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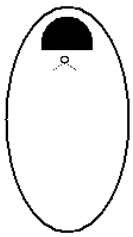

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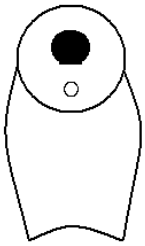

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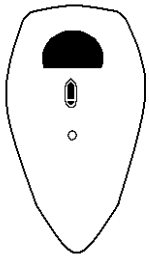

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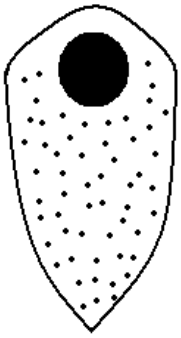

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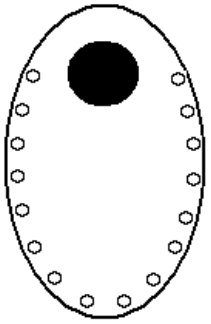

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44 (43) a) Orifice with a lyrula (fig. 1 en 2). …..... 45
b) Orifice without lyrula (fig. 3 en 4). 46

45 (44) a) Orifice with a broad, rectangular lyrula and a low, thickened peristome with a deep medio-proximal notch (fig. 5). ..... *Smittina*
b) Orifice with narrow, pointed lyrula and a broad, deep, flared peristome, especially prominent proximally (fig. 6). ..... *Phylactella labrosa*

46 (44) a) Orifice appears keyhole-shaped. Dwarf zooids with small round openings scattered between the autozooids (fig. 7). …..... *Trypostega venusta*
b) Orifice surrounded by thick spines (fig. 8). ... *Phaeostachys spinifera*
c) Orifice not so. ……..……..... 47

47 (46) Choose from the shape of the orifice and the location of the condyles from the drawings below:
(9) *Watersipora complanata*, wider than long
(10) *Hagiosynodes latus*, longer than wide
(11) *Hippoporina*, almost round
(12) *Pentapora fascialis*, proximal edge convex
(13) *Cryptosula pallasiana*, proximal edge concave

48 (43) a) Orifice with prominent lyrula and a medial suboral avicularium (fig. 5). ..... *Smittina*
b) Orifice with sinus (fig. 4) or bell-shaped (fig. 12 en 13). 49

49 (48) a) Orifice bell-shaped (fig. 12 en 13). 50
b) Orifice with sinus (fig. 4). 51

50 (49) a) Opening with convex proximal border (fig. 12). Ovicells large, not always present. Develops an erect colony that resembles a honeycomb. ..... *Pentapora fascialis*
b) Ovicells with concave proximal border (13). Ovicells absent. Forms flat adherent or irregular erected crusts. ..... *Cryptosula pallasiana*

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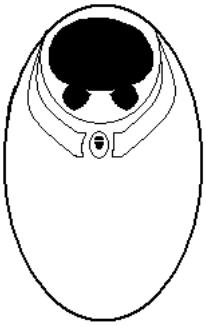

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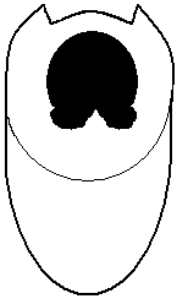

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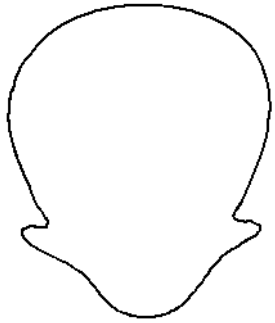

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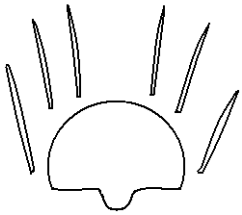

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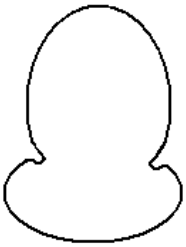

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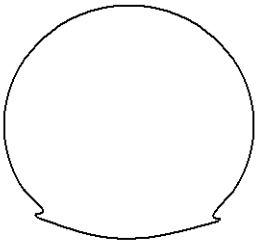

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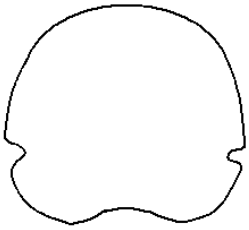

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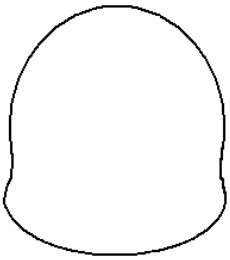

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51 (49) a) Orifice bordered by thick spines. Avicularia distant from the opening, obliquely directed proximally. Often a frontal umbo that bears a stout chitinous spine. Ovicell not perforated (fig. 1). …….. *Phaeostachys spinifera*
b) Few or no oral spines. Avicularia associated with the orifice. Ovicells with frontal or marginal perforations. ……..... 52

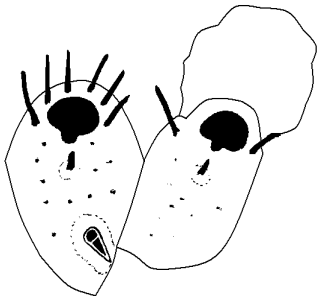
52 (51) a) Avicularia proximal to the orifice. Ovicell with frontal pores (fig. 2). …… *Schizomavella*
b) Avicularia lateral to the orifice, often on both sides. Ovicell with marginal pores or with radial ridges (fig. 3). ..... *Schizoporella*

53 (42) a) Orifice large. Lateral pores large, rectangular and separated by ribs. Avicularia, if present, perpendicular to the frontal plane, median suboral (fig. 4). ..... *Oshurkovia/Umbonula*
b) Not as described. ……....……... 54

54 (53) a) Ovicells with a frontal fissure (fig. 5 en 6). ……..... *Schizotheca*
b) Ovicells without a slit. ……..……... 55

49 (48) a) Colony porcelain white. Orifice with a knobbed or notched peristome (fig. 7), with conical umbo or a suboral avicularium. Frontal adventitious avicularia sporadic. ……..…… *Rhynchozoon bispinosum*
b) Not as described. ……... 50

55 (54) a) Avicularia lateral suboral, not present on all autozooids, the rostrum directed to the peristome. Ovicells with scattered pores (fig. 8). .... *Parasmittina trispinosa*
b) Not as described. 56



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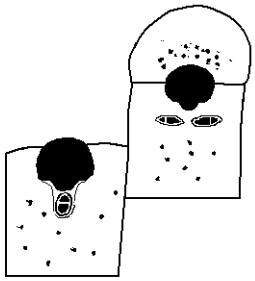

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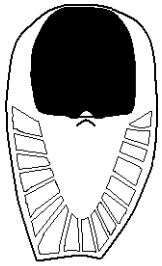

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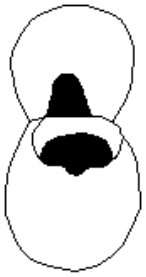

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57 (56) a) Avicularia absent. 58
b) Avicularia on all or on few zooids, sometimes hidden in the peristome. 61

58 (57) a) Orifice with well developed lyrula and bordered with 4 to 8 spines (fig. 1). ……..... *Escharella*
b) Orifice with inside on the proximal side a slender, forked tooth, resembling a lyrula (fig. 2). Very small colonies on shells off the coast.……..... ..... *Escharoides bishopi*
c) Orifice without lyrula. ……..... 59

59 (58) a) Zooids slightly calcified, sausage-shaped, close together, but with small open spaces between them. Ovicells originate on short, tapering female zooids (fig. 3). ..... *Celleporella hyalina*
b) Zooids thickly calcified, no spaces between the zooids. Ovicells developing from normal autozooids. with peristome. ……..... 60

60 (59) a) Orifice with high raised rim. Ovicells and frontal surface with one or more conical umbones (fig. 4). …….. *Escharina johnstoni*
b) Orifice bordered by a deep, protruding peristome. Ovicells with scattered pores (fig. 5). …… *Neolagenipora collaris*
c) Orifice with tubular peristome. Ovicells with a non-perforated frontal area (fig. 6). ..…..……..... *Lagenipora lepralioides*

61 (57) a) Orifice D-shaped. Zooids connected by short tubes with small spaces between them; each autozooid with a small avicularium immediately distal to the orifice or to the ovicell (fig. 7). ..... *Chorizopora brongniartii*
b) Not as described. 62

62 (61) a) Avicularia uniform, on the zooid, at the orifice or along the zooid margin. ... 63
b) Small and large avicularia present at the same time (fig. 8 to 10). 69

63 (62) a) Zooids with a distally directed avicularium in front of the orifice and a large single (fig. 11) or twinned (fig. 12) pore in the center. …. *Reptadeonella*
b) No large central pore(s). 64

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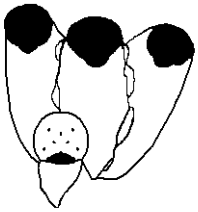

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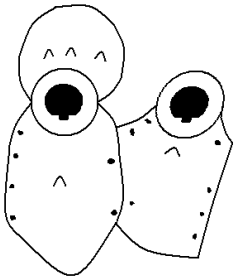

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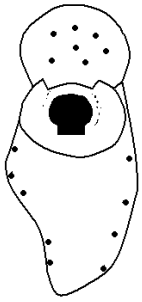

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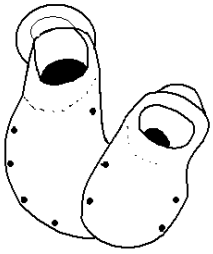

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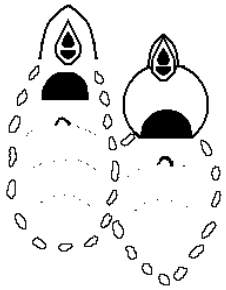

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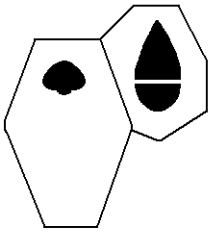

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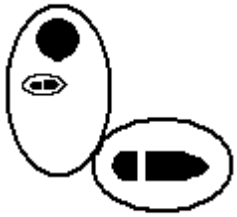

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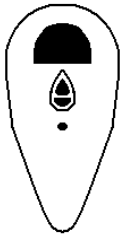

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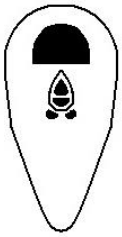

12

64 (63)a) Colony pumice-like. Orifice oval, often deeply immersed in a peristome. A spiny nodule on the edge of the peristome with a lateral avicularium (fig. 1). ……..……..... *Cellepora*
b) Not as described. …….....……... 65

65 (64)a) Orifice with (in)conspicuous lyrula (fig. 2) or with suboral tooth (fig. 3). 66
b) Orifice without lyrula or suboral tooth, but with sinus. 68

66 (65) a) Orifice large, with a small tooth proximally on the inside. Avicularia usually on either side of the orifice (fig. 3). ..... *Escharoides*
b) Orifice of normal size with lyrula.……..…….... 67

67 (66)a) Ovicells with frontal pores. ..... *Smittoidea*
b) Ovicells without pores or with up to 4 pores. …..…….. *Porella*

68 (65)a) Orifice with prominent sinus; peristome thin and protruding or absent. Avicularia single or paired, distal to the orifice, or proximal, close to the zooid border. Ovicells not perforated (fig. 4). Colony a flat sheet.
..... *Escharina* and *Herentia*
b) Colony encrusting lenticular, mound-like, nodular or cylindrical. Orifice with sinus. Peristome usually bears 2 conspicuous, cylindrical avicularia with small rounded mandibles. Additional interzooidal avicularia may occur (fig. 5). Ovicells with a perforated frontal area. ..... *Celleporina*

69 (62)a) Forms knotty colonies on snail shells. Orifice keyhole-shaped (fig. 6). Avicularia present. ..... *Hippoporidra lusitanica*
b) Orifice with sinus, not keyhole-shaped. 70

70 (69)a) Orifice without peristome and with sinus. Avicularia with swollen cystid on either side of the orifice (fig. 7). Colony a flat sheet. …….. *Buffonellaria*
b) Orifice with peristome and sinus. Colony encrusting lenticular, mound-like, nodular or cylindrical. ……..……..……..…….. 71

71(70) a) Single avicularium at the orifice, extra large avicularia are common. Ovicells with many scattered pores (fig. 8). ..... *Turbicellepora*
b) A small avicularium on top of a cylindrical tube on either side of the opening. Extra avicularia may occur. Ovicells with a perforated frontal area (fig. 5). ……
…….. *Celleporina*

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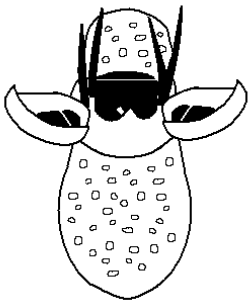

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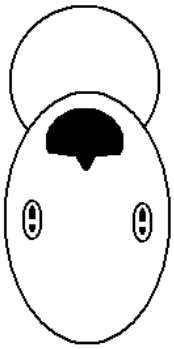

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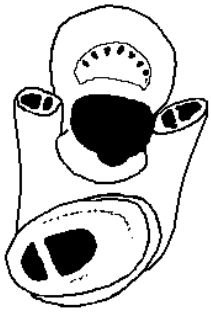

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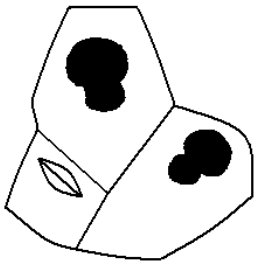

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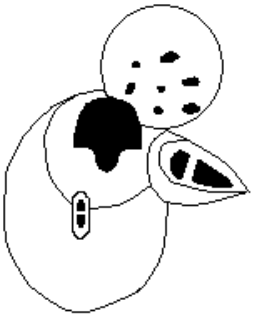


8

72 (18) a) Spines of the shield with slit-shaped interstices (fig. 1, 2, 3). ……..... 73
b) Only small pores between the spines of the shield (fig. 4-8). ……..……..... 75

73 (72) a) A short, thick, cylindrical spine on either side of the orifice (fig. 1), ovicells and avicularia are never present. ……..…..…... *Aspidelectra melolontha* (p. 88)
b) 2 to 6 thinner oral spines (or absent), ovicells and avicularia may occur. ……..
..... 74

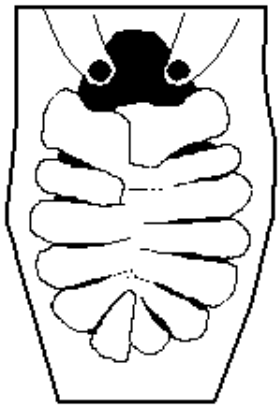
74 (73) a) 6-12 spines form the frontal shield (fig. 2). …..... *Callopora rylandi* (p. 106)
b) 16-20 spines form the shield (fig. 3). …..….. *Membraniporella nitida*

75(72) a) Zooids large (0.7 to 1.0 mm long), all costae with a pore. Ovicell with 2 teardrop fenestrae (fig. 4). ..... *Figularia figularis*
b) Not as described. 76

76 (75) a) Autozooids do not grow against each other, they are connected to each other by means of tubes (fig. 5), interzooidal kenozooids and avicularia. ……..
..... *Distansescharella seguenzai*
b) Not as described. 77

77 (76) a) Orifice bordered proximally by an arc formed by the first pair of costae (fig. 7, 8). ……..……..……..……...…… 78
b) Orifice distinctly D-shaped, proximally with a straight edge (fig. 6).
……..……. *Puellina*

78 (77) a) Ancestrula with opesia. Orifice with a thick border proximally, often with an umbo (fig. 7). Ovicell without avicularium. …..…..... *Cribrilina*
b) Ancestrula as a zooid, ovicells with pseudopores at the tip of conical processes, often an avicularium distal on the ovicell (fig. 8). .. *Collarina*



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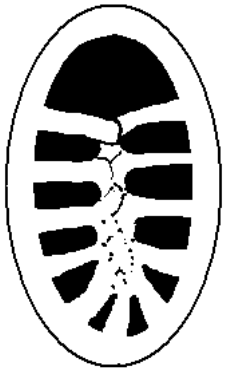

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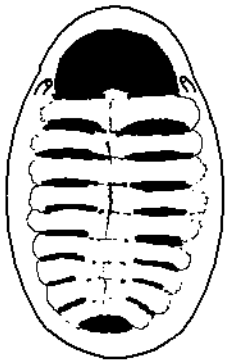

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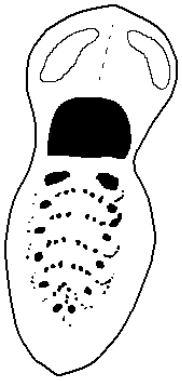

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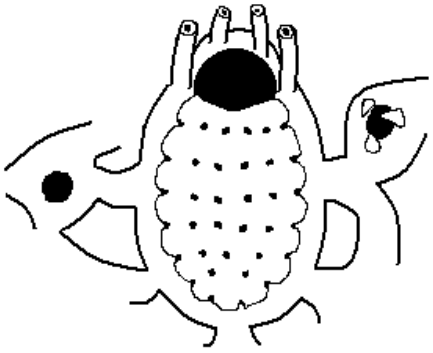

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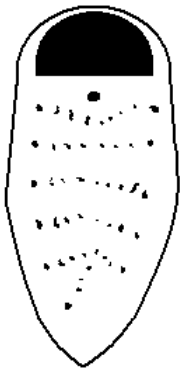

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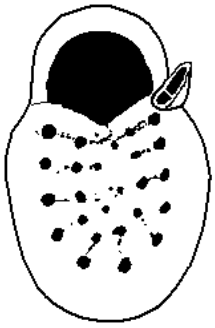

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8

Systematisch deel

Family Aeteidae

Genus Aetea

1 a) The stem of the autozooid is not ringed (in backlight). *Aetea truncata* (p. 48)
b) The stem of the autozooid is closely ringed (in backlight). 2

2 a) Distal portion of the autozooid wider than the stem, spatulate and usually curved so that the opening faces downward. Erect zooid part 0.6 to 0.8 mm long. …..... *Aetea anguina* (p. 44)
b) Erect zooidal portion straight, the distal part not wider than the stipe. The erect zooid part 0.8 to 1.8 mm long. ……..….. *Aetea sica* (p. 46)

Aetea anguina (Linnaeus, 1758)

Description: Colony white, the attached parts branching, a zooid stem erected from any widening. The zooid stem is weak but clearly ringed on transmitted light. The distal part of the zooid bears a frontal membrane occupying 1/4 to 1/3 of the free length, wider than the stem, spatulate, not ringed. Stem usually curved with the frontal membrane facing down. Embryos are incubated in delicate, membranous, disappearing brooding sacs, but they are rarely seen.

Occurence:
Belgium: on washed-up objects and *Himanthalia* buttons (De Blauwe, 2000a, 2000b, 2005, Vanhaelen *et al*., 2006). The oldest observation from Belgium was recorded in Westendorp (1843), on washed-up seaweed in Blankenberge.
The Netherlands: Lacourt (1949) mentions washing up on cork in Scheveningen. Bloklander found this species on material washed up in the Netherlands in the autumn of 1947 (Bloklander & Leenhouts, 1948). On washed up plastic and *Himanthalia* buttons (de Ruijter, 2012a, 2017b, 2020b). Found in 2015 for the first time autochthonous in the Netherlands on DDNZS nets on wreck 2801 and 2803 on the Doggersbank (Faasse et al., 2016). Again in 2016, numerous on worm tubes on nets at the Niponia wreck no 2305 (52°44.520'N – 3°58.702'E) (van Leeuwen *et al*., 2017).

Aetea anguina:

washed up on seeweed in Arcachon (France), August 2001 (RV)

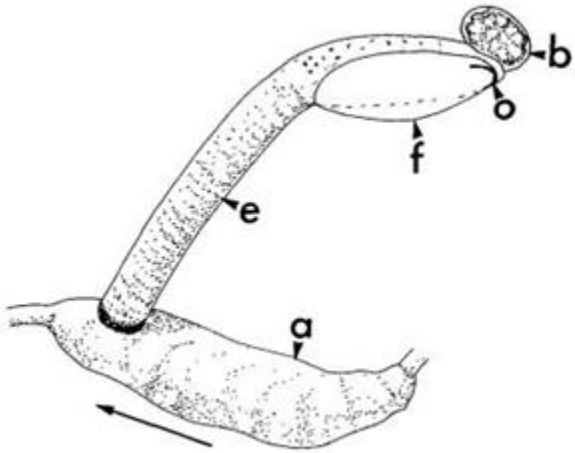


Fig. from Cook (1977), text from Ostrovsky (2013):
a: attached proximal part of autozooid
b: brood sac
e: erect distal part of autozooid
f: frontal membranous wall
o: operculum

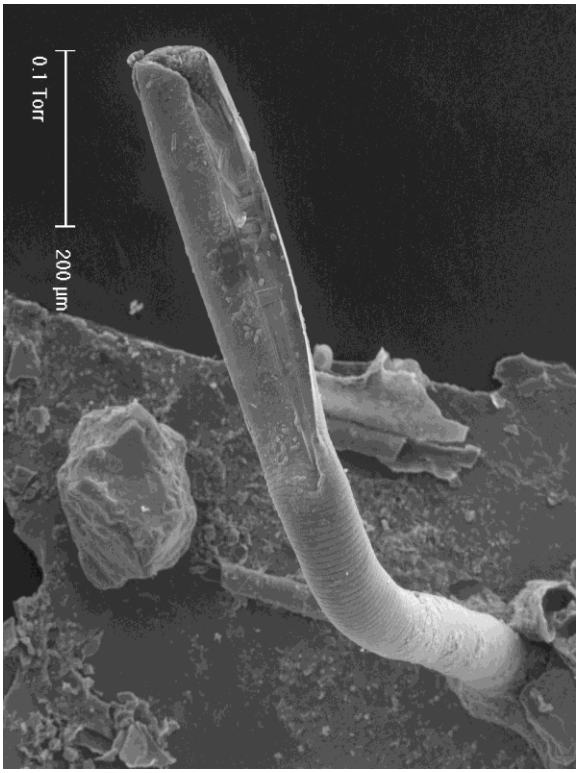
transmitted light (RV)

***Aetea sica* (Couch, 1844)**

Description: Colony as *Aetea anguina*. Stems of the zooids, annulate when viewed by transmitted light. The distal part carrying the frontal membrane is slightly wider than the stem and is about 1/3 of the total length. The erect zooid part is straight and longer than in *A. anguina*. Dried zooids may still be curved (as in the photo with transmitted light) where the membranous zone faces upwards. In contrast, in *Aetea anguina*, the membranous zone faces the substrate. Embryos are incubated in delicate, membranous, disappearing brooding sacs, but they are rarely seen.

Occurence:
Belgium: On washed up plastic, but less common than *Aetea anguina*.
The Netherlands: Lacourt (1949) mentions washing up on cork in Scheveningen. On washed up plastic (de Ruijter, 2014b, 2018b, 2019a, 2020b).

Aetea sica:



on washed up plastic in St-Idesbald, January 2005 (JC)

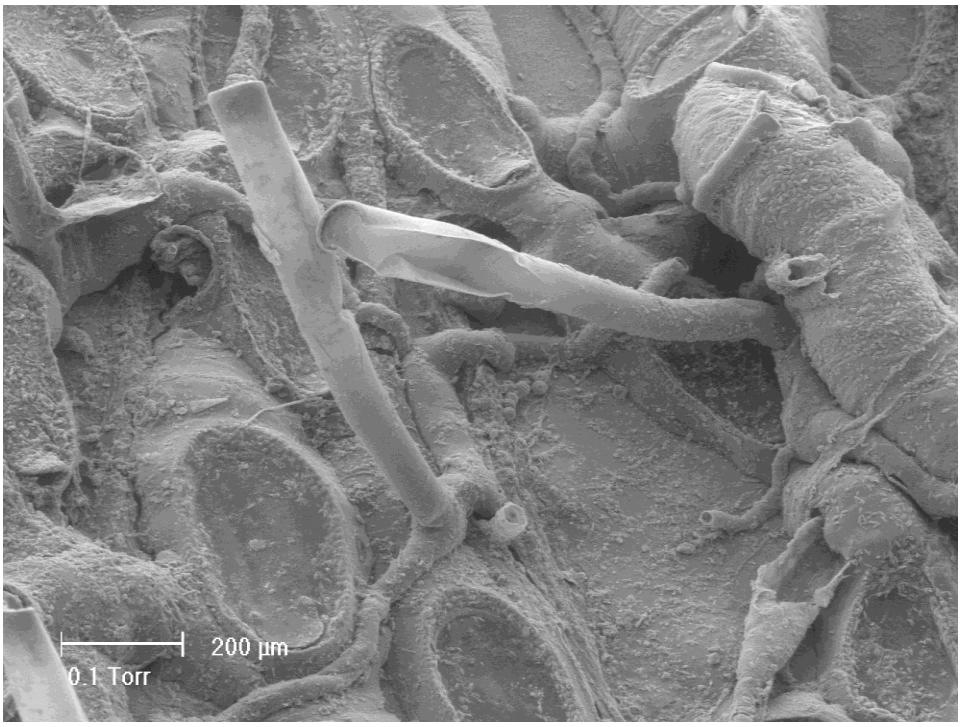
transmitted light (RV)

Aetea truncata **(Landsborough, 1852)**

Description:
Colony as *Aetea anguina*. Erect parts of the autozooids straight. Zooid stem punctate, not striated or annulate when viewed by transmitted light. Distal part occupies 1/3 to 1/2 of the free length.

Occurence:
Belgium: found on a beached *Himanthalia* button in September 2001 (De Blauwe, 2003) and on plastic washed up in St-Idesbald and Ostend in January 2005.
The Netherlands: de Ruijter (2013c, 2014b, 2014d, 2018d) reports a colony on washed up plastic.
Germany: reported from the German North Sea in Zettler *et al*. (2018).

Aetea truncata:



with *Pyripora catenularia* on beached plastic in St-Idesbald (JC)

erect part of an autozooid (HD)

Family Scrupariidae

Embryos are brooded in large terminal ovicells.

Genus Scruparia

1 a) Adnate part of the colony is a chain of zooids. Frontal membrane almost parallel to the zooidal axis. ..... *Scruparia ambigua* (p. 50)
b) Colony attached to the substrate by a stolon. Frontal membrane at an angle to the zooidal axis. ..... *Scruparia chelata* (p. 52)

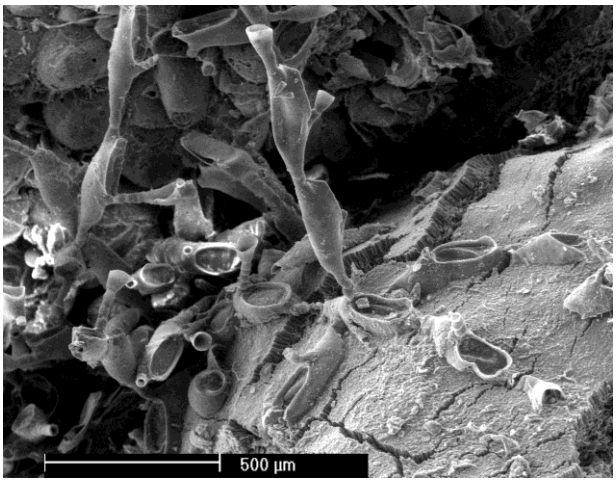
***Scruparia ambigua* (d'Orbigny, 1841)**

Description: Colony attached to the substrate by uniserial chains of autozooids. Autozooids long and slender, with the oval frontal membrane almost parallel to the basal wall of the zooid. Erect chains of autozooids originate by frontal budding of adnate or erect autozooids. Fertile autozooids bud from adnate or erect autozooids, with a high, terminaly pointed, bilobate ovicell on the maternal zooid. Ancestrula not attached directly to the substrate, but attached by the first two daughter zooids, which arise as distal and frontal buds.

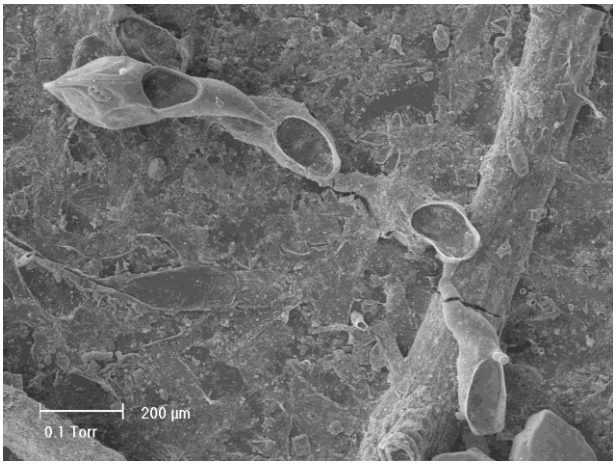
Occurence: In Belgium (De Blauwe, 2000b; Vanhaelen et al., 2006) and the Netherlands (de Ruijter 2013a, 2013c, 2014b, 2018b, 2018d, 2020c) on washed up objects or algae.
France: On hydroids off Cap Gris-Nez in July 1992 (Davoult *et al*. 1999).
Belgium: Lacourt (1978) mentions the washing up of *Scruparia chelata* along the entire Dutch coast, but his image 2 shows *Scuparia ambigua*. In his table he writes 'zooids in linear series, adherent at first, ...' which in turn relates to *S. ambigua*. The RBINS owns two colonies from 1900 and one from 1905, which are collected on the Flemish Banks.
The Netherlands: Observed in Zeeland near Katsehoek on Noord-Beveland on 1 February 1968 (Heerebout, 1970) and Wissenkerke (Faasse & De Blauwe, 2004).
Scruparia ambigua was collected at 10 m depth at platform L10-G. Collected at the PAWF (Vanagt et al. 2013) and the Borkum Reef Grounds (Coolen et al. 2015). Several samples from platform L10-A taken between 5 and 15 m depth also contained a number of *S. ambigua* colonies. (Beukhof et al 2016).
Germany: Collected German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

Scruparia ambigua:

Autozooids on hydroid stem (RV)



On plastic fishing gear, St-Malo, April 2005 (JC)



Autozooid with ovicell (left), on beached plastic at Blankenberge, December 1999 (JC)

Scruparia chelata **(Linnaeus, 1758)**

Description: Erect uniserial chains of zooids originate from an adnate stolon. Autozooids horn-shaped, with oval frontal membrane descending to the distal end of the basal wall. Reproductive zooids arise from frontal budding on the zooids. Ovicells nearly spherical, wider than the bearing zooid and about the same length.

Occurence: Beached specimens are common in Belgium and the Netherlands on washed-up plastic, *Himanthalia* buttons (De Blauwe, 2005; Vanhaelen et al., 2006, Verkuil 1998a, 1998b de Ruijter 2012a, 2014a, 2015d, 2018d, 2020a), *Bugulina flabellata* (de Ruijter, 2006), *Crisularia plumosa* (de Ruijter, unpubl.) and *Sargassum muticum* (de Ruijter, 2019b), most likely originating from the English Channel. At Katwijk on *Tubularia* (Maitland, 1851)

Belgium: Loppens (1906) listed this species as rare on algae, rocks, shells and Crustacea. Two colonies were collected at the Flemish Banks in 1900 and 1905 (RBINS collection). There is a recent find on a stone near the Westhinderpaal. A colony was found in 2002 on the wreck of the Birkenfels and in 2004 on the Kilmore (Zintzen, 2007).

The Netherlands:

The first autochtonous colony of *Scruparia chelata* was discovered on the shipwreck of the SS Nautilus (24 km off the coast of Texel) by Lengkeek *et al*. (2013) who investigated 10 shipwrecks on the Dutch continental shelf.

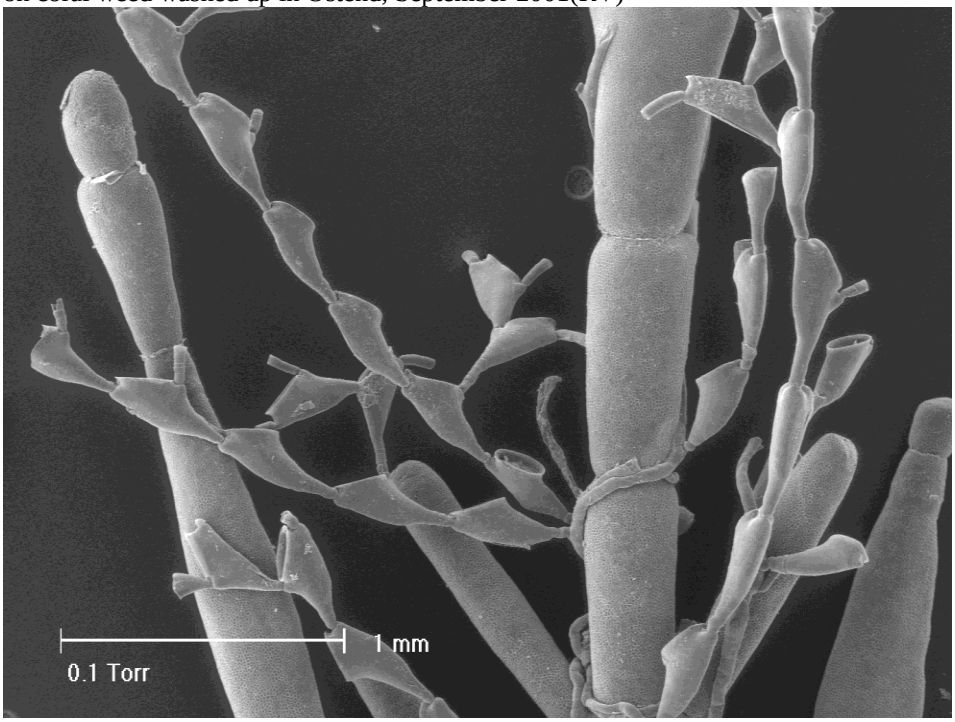
Collected on wormtubes and *Mytilus edulis* on nets taken from the wreck of Niponia nr 2305 (52°44.520'N – 3°58.702'E) (DDNZS 2016 - van Leeuwen *et al*. 2017).

Scruparia chelata was observed at different depths (5–25 m) on platforms L10-G and L10-A, both as detached specimens and attached to *M. edulis* (Beukhof et al 2016).

Germany: Collected German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

Scruparia chelata:

on coral weed washed up in Ostend, September 2001(RV)



SEM same specimen (JC)

Family Eucrateidae

Genus Eucratea

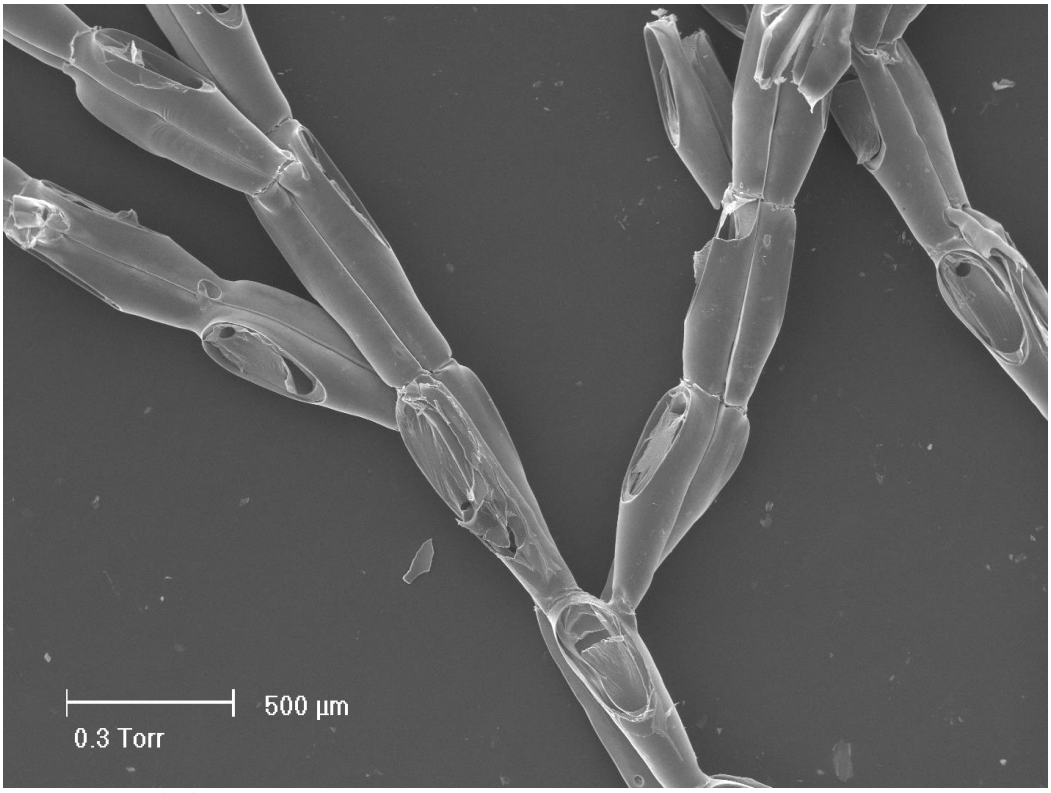
Eucratea loricata **(Linnaeus, 1758)**

Description:
The colony forms erect tufts, attached to the substrate with rhizoids. The colony resembles a miniature poplar, about 10 to 25 cm high, whitish brown. Branches composed of zooid pairs standing back-to-back, all pairs oriented in the same direction. Zooids elongated, widening distally. Polypide with 10–14 tentacles. Spines and avicularia absent. Embryos develop in external membranous sacs.

Occurence:
This species was regularly collected in 1905 and 1908 on the Flemish Banks in the area delineated by 51°22'North, 51°27'North, 2°25'East and 2°31'East (Gilson collection in the RBINS) (De Blauwe et al., 2006). Loppens (1906) considered this species as common sublittoraly. Maitland (1851) reports this species from the beach of Domburg, Lacourt (1949) adds Scheveningen, Den Helder and on a trawler in IJmuiden.
A washed ashore colony was found in Wissant (Northern France) on August 5, 1987 (De Grave & d'Udekem d'Acoz, 1988). No recent sightings.
Germany: reported by Zettler *et al*., 2018

Eucratea loricata:

Norway, 2004 (RV)



Norway,2004 (JC)

Superfamily Membraniporoidea

Membranipora/Biflustra/Jellyella and *Conopeum/Einhornia* are easily confused. They can be distinguished by the ancestrula, which is single or double. However, the ancestrular region is often absent. Comparison of the ecological data of each species gives a good indication for identification. *Membranipora membranacea* grows on brown algae. *Biflustra tenuis* and *Conopeum reticulum* occur on rocks and shells, not on brown algae. *Conopeum seurati* is limited to water with low salinity. *Conopeum reticulum* occurs in brackish water and in the sea. *C. reticulum* can be recognized by the presence of characteristic kenozooids, but these kenozooids are often absent in our region. Care should be taken not to confuse *Conopeum* with *Electra monostachys* or *Einhornia crustulenta*.

Family Membraniporidae

The Membraniporidae have a twinned ancestrula.

Genus Membranipora

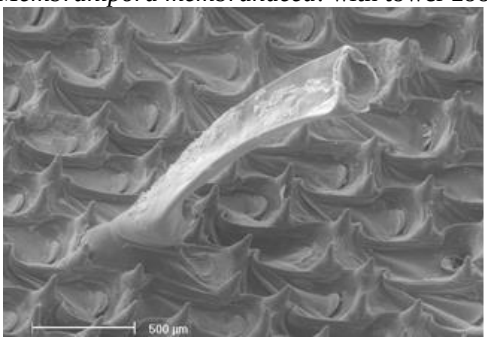
***Membranipora membranacea* (Linnaeus, 1767)**

Description:
The colony forms an extensive, leathery cover on brown algae. Zooids rectangular, with tubercles or short spines (the apex of which is not calcified) at the corners. The membrane covers the entire frontal plane. Colony flexible, so it can cling to seaweeds such as *Laminaria* without breaking when the leaves move in the waves. 'Tower zooids' where the frontal membrane faces upward like a tube may be present. Polypide with about 17 tentacles.

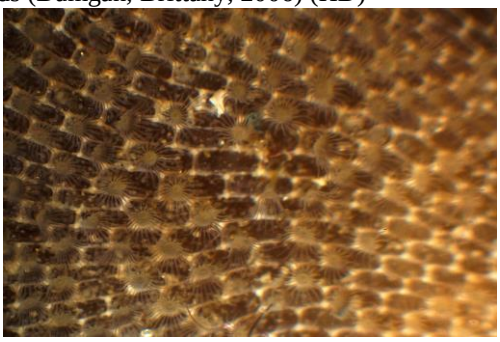
Occurence: Lives on brown algae along rocky coasts. On *Laminaria digitata* and *L. hyperborea* the colonies reach large sizes, small colonies can be found on *Fucus serratus*, *Ascophyllum nodosum* and *Himanthalia elongata* buttons. Occasionally washes up on these seaweeds along the Belgian and Dutch coast. Rarely found on plastic and pebbles covered with green algae.
France: Common along the rocky coast of Brittany and Normandy. Detached seaweeds drift to the north and get beached there with their epifyts as far as Helgoland.
Belgium: Not native.
The Netherlands: Two records from the Oosterschelde: Canal van Goes on sea grass (Heerebout, 1970) and Wemeldinge on sea lettuce (Mulder, 1983) are probably misidentifications. Conclusion: not native.

Germany: Collected German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

Membranipora membranacea: with tower zooids (Damgan, Brittany, 2006) (HD)



zooids and a tower zooid, due to the drying of the seaweed, the zooids are no longer perfectly rectangular (Brittany, 2004) (JC)



Damgan, Brittany, 2006 (HD)

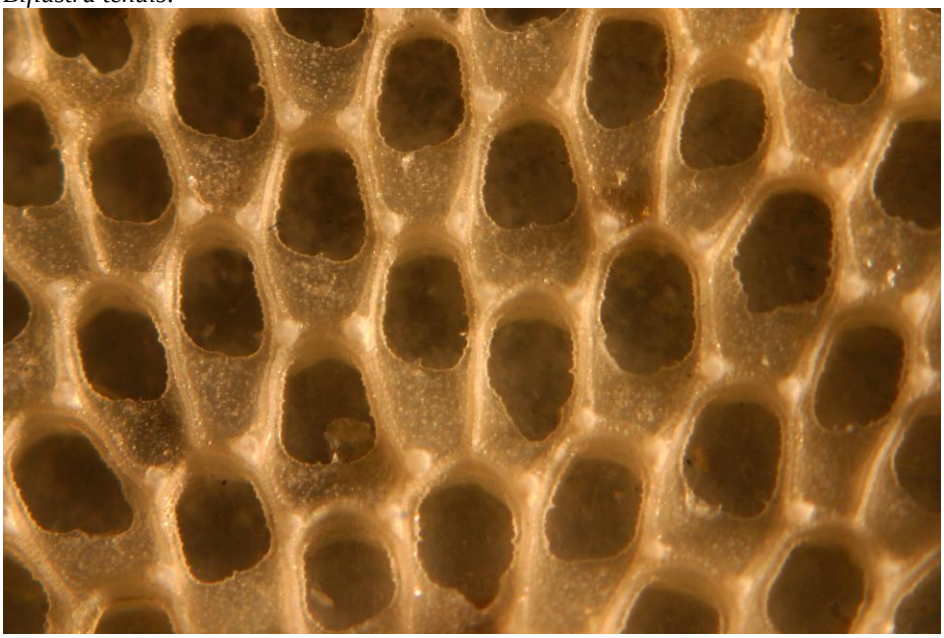
On *Fucus vesiculosus*, beached in Belgium (HD)

***Biflustra tenuis* Desor, 1848**

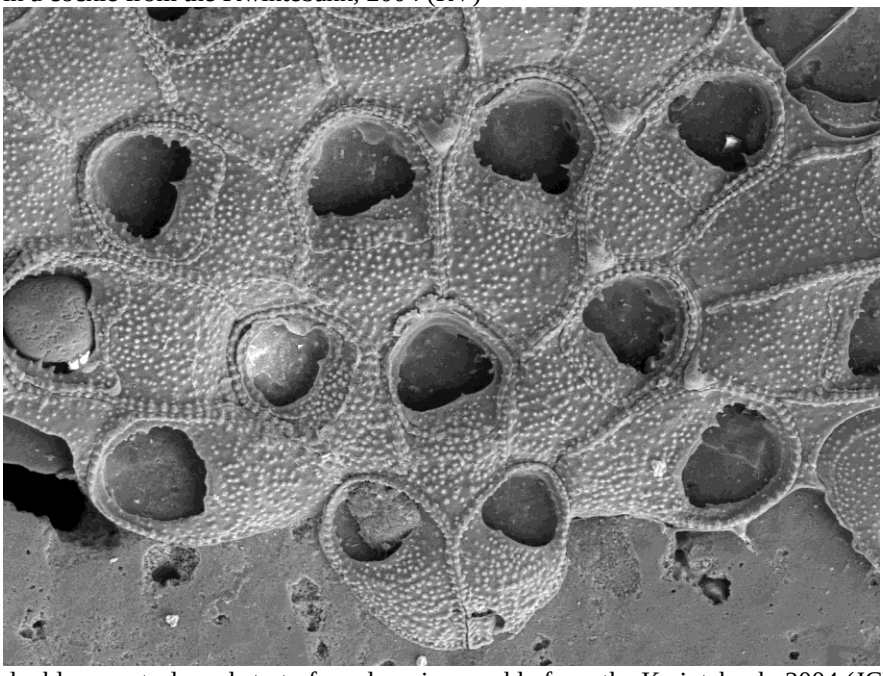
Description:
The colony forms a crust on pebbels or shells offshore. Often several layers grow on top of each other and thus form a thick crust on the substrate. Zooids rectangular to octagonal. Beneath the frontal membrane lies a calcareous cryptocystal plate that is mainly well developed proximally, but also laterally. This plate is granulated and its edge with the opesia is finely serrated. The size of the opesia is variable. Small spiny nodules may appear at the zooid angles.

Occurence: Prenant & Bobin (1966) report the species from the Pacific, warm and temperate Atlantic coasts of America, the West African coasts, Mediterranean and Denmark (Levinsen, 1894); everywhere in shallow water (0 to 60 m) and they find it curious that it has not yet been encountered on the western coast of Europe. Hayward & Ryland (1998) consider this species to be tropical and are not aware of its occurrence in the North Sea. Colonies can be found on the beach, mainly on discolored cockles in Ostend, Wenduine, Knokke, Nieuwvliet, Domburg and Westkapelle, washed up or after sand replenishment.
Belgium: In the period 1899-1914 Gustave Gilson collected several colonies on the Flemish Banks. Unfortunately, they remained unrecognized until 2005 (De Blauwe *et al*., 2006). Lives on stones and shells between the Goote and Thornton Banks (Kerckhof & De Blauwe, 2006), the Kwinte Bank, the Hinder Banks and on the erosion stones of the Belwind wind farm after 2012.
The Netherlands: Lacourt (1949) reports that this species forms thick layers on shells, sites were Scheveningen, Katwijk, Noordwijk. The entry in the identification table of Lacourt (1978) is incomprehensible: numerous along the entire coast, much on seaweed! The species still lives off the coast near Zeeland.
France: The species was NOT found on the Atlantic coast of France, nor in the English Channel, despite the many searches of the author.

Biflustra tenuis:



in a cockle from the Kwintebank, 2004 (RV)

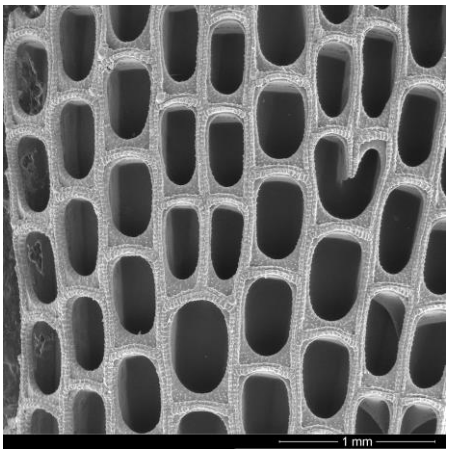


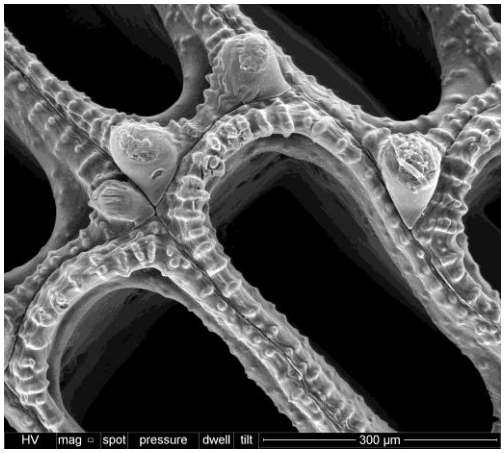
double ancestrula and start of a colony in a cockle from the Kwintebank, 2004 (JC)

***Biflustra grandicella* (Canu & Bassler, 1929)**

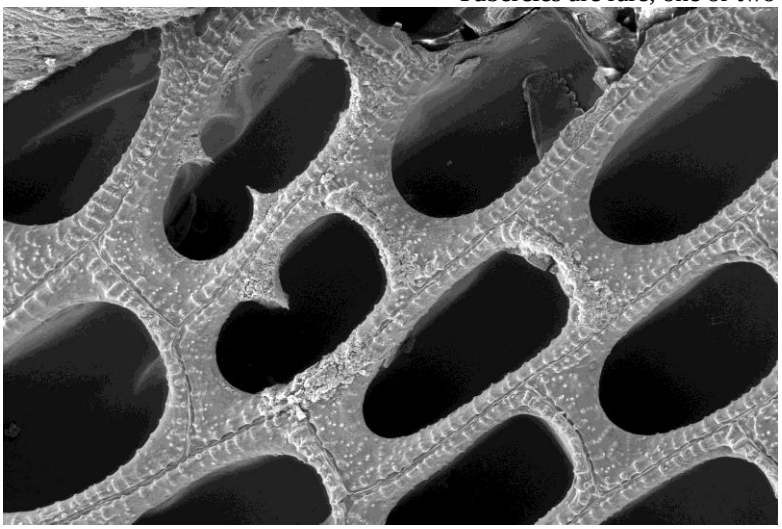
Description: Colony pale to yellowish brown unilaminar, encrusting cobbles, later forming erect, folded and anastomosed bilaminar plates, ca 0.6 mm thick. Forming a coral like mass as big as a basketball, rigid and brittle (similar colonies as *Pentapora foliacea*). Zooids rectangular, sometimes wider distally than proximally, 0.64-0.80 mm long and 0.29-0.52 mm wide, distal end rounded and proximal margins concave, with beaded rims along thick and salient lateral walls. Frontal membrane without spinules, covering entire zooid. Operculum with a thin marginal sclerite. Opesia oval, mostly narrower proximally, 0.46-0.52 mm long, occupying about 70 procent of the zooid length. Cryptocyst granulose and slightly beaded; proximal cryptocyst without proximomedial plate but sometimes with minute denticles projecting into the opesia, frequently placed proximally rather than distally. Tubercles are rare, one or two in proximal corners, often occurring in small clusters in a colony. Lateral transverse walls with 4 multiporous mural septula, each one with 3 to 12 perforations in the septulum. Distal transverse walls with 1 to 3 series of uniporous mural septula at the middle of the vertical wall; sometimes a few multiporous septula. Tentacle number without exceptions 14.

Distribution: *Biflustra grandicella* is described from the vicinity of Hongkong (Canu & Bassler, 1929). Liu (1992) regards this species as endemic to Chinese coastal waters. The species is reported outside China from New Zealand (Grange & Gordon, 2005), Brazil (Almeida et al. (2017)), Australia (Tilbrook, 2012), Singapore (Tilbrook & Gordon, 2016) and The Netherlands. (De Blauwe, 2017).
During three events the species was reported in the Netherlands. This will be discussed more in detail on the following pages.

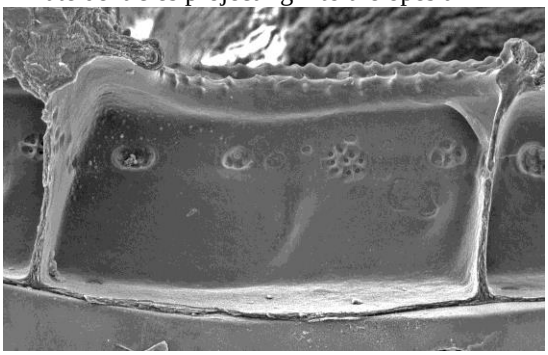




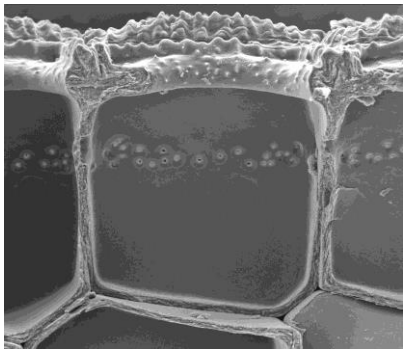
Tubercles are rare, one or two in proximal corners



minute denticles projecting into the opesia



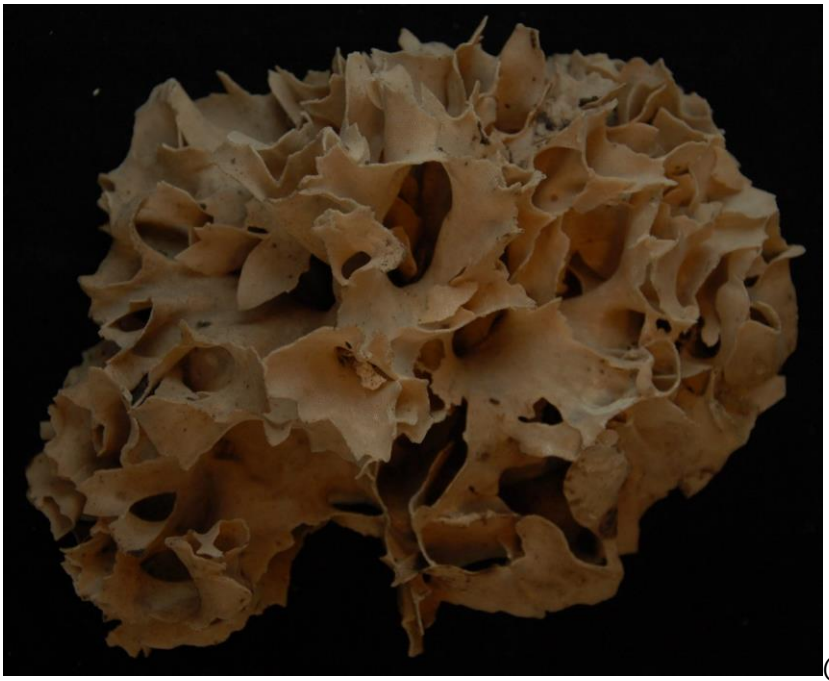
Lateral wall with multiporous mural septula



Distal wall with uniporous mural septula

The Netherlands:

1st event (not published before): Herman Nijhuis worked at the Verolme shipyard in Rozenburg (Rotterdam) in 1968. He collected a sample (20 x 15 cm) scraped off the wall of a mammoth tanker. A piece of the material was sent to the author in 2020 and identified as *Biflustra grandicella*. According to Herman, there was a heap of bryozoans at the warf, measuring 20 by 20 meters and 3 meters high before it was crumbled ! And the tanker was only cleaned for 10% then!

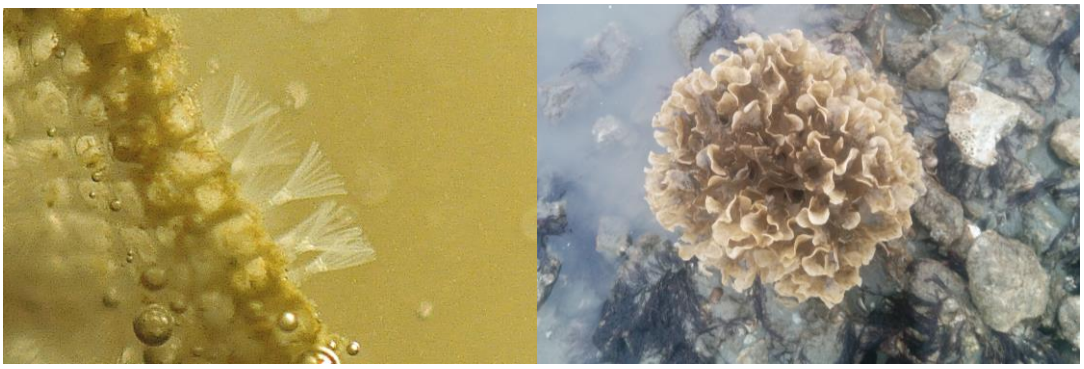

@ Herman Nijhuis

2nd event: A colony fragment was found on the beach nearby the nuclear power plant in Vlissingen in December 2016. The beach is very well known for its fossils and it would be strange that earlier beached material stayed unnoticed. Several colonies in situ were found at extreme low tide in Februari 2017 next to the warm water outlet of the power plant (De Blauwe, 2017). The population remains stable in the following years and seems not to expand to other regions. The temperature on this spot is higher than the surrounding area and the colonies are growing on the small area with pebbles surrounded by sand. A colonie was collected at freezing temperatures of -7°C, the sample was kept in seawater and an hour later, the bucket was frozen. The bucket thawed during the trip home and the colony was brought into seawater at room temperature. A week later, the colony was investigated under light microscope and still

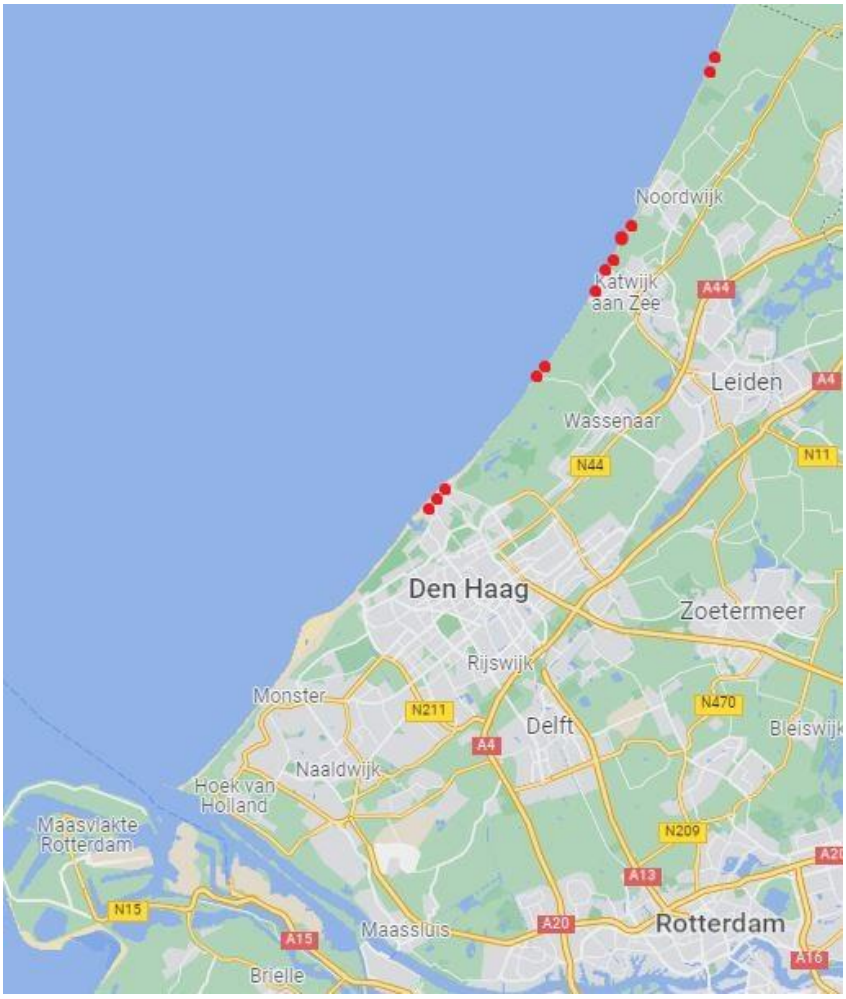
alive. This species formerly only known from (sub)tropical areas can thus survive a short period of freezing.

In situ population at the warm water outlet of the power plant


@ Ann De Love



3d event: Between the end of August and the beginning of December 2021, 12 colony fragments washed upon the shores of The Netherlands between Den Haag and Langervelderslag (see map), another fragment beached more to the south at Goeree in Februari 2021. Where those colony fragments come from remains a mystery. It is not evident that a new population has settled off the coast. It is rather plausible that fragments of a ship's hull have been broken off by, for example, sanding over a sandbank. Another possibility is that the fragments were scraped off in a harbor and then dumped into the sea. However, there is no evidence for such practices.



Red dots: locations of beached colony fragments in 2020

Observations of beached colony fragments of *Biflustra grandicella*

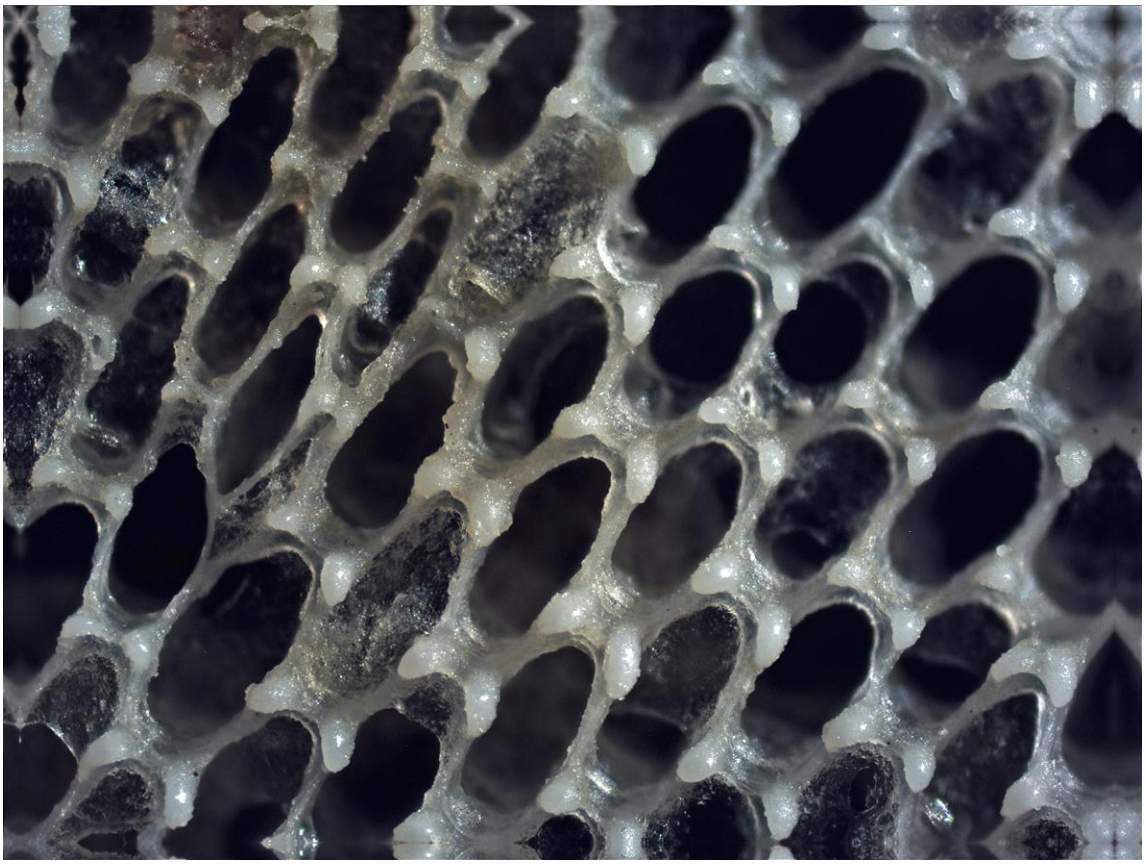
August 29th 2020	Langevelderslag, Sieneke Langelaan (de Ruijter 2020c)
September 18th 2020	Wassenaar (Jacoline van Duijn)
September 28th 2020	Scheveningen (Bep Koolma), stukje in mijn bezit
September 29th 2020	Katwijk-Noordwijk (Egmond, M. Cadée, W. Schipper – in de Ruijter 2020c)
September 30, 2020	Katwijk (Jacoline van Duijn)
October 1st 2020	Katwijk (Jacoline van Duijn)
October 2 2020	Wassenaar (Jacoline van Duijn)
October 2 2020	Langevelderslag (Sieneke Langelaan)
October 17 2020	2 fragments Scheveningen (Joyce Tentij)
October 19 2020	Katwijk (Joop Verkuil and Arie Twigt) (de Ruijter, 2020c)
December 8 2020	Noordwijk – Katwijk, small fragment (Arie Twigt)
February 5 2021	Goeree (Katie van der Wende)

There was an identical invasion of *Bugula neritina* in roughly the same area a few years earlier (p. 126)

***Jellyella tuberculata* (Bosc, 1802)**

Description: Colony encrusting, unilaminar, white. Zooids rectangular, frontal surface of autozooids mostly membranous, with a small amount of calcified cryptocyst proximally. Lateral wall slightly calcified. Cryptocyst developed, irregular, occupying less than one-fifth of zooidal length, with minute tubercles on surface; paired calcified wings (supposedly for muscle attachment) occur inside the cryptocyst.
Gymnocyst developed proximally, sometimes fused, often forming two rounded tubercles. Operculum with heavily sclerotized outer rim, wider than long.
Polypides with 15 translucent white tentacles. Avicularia absent. Ooecium absent. Colonies develop from a twinned ancestrula.
Resembles *Biflustra tenuis* but the proximal calcareous plate is smaller, the tubercles can be quite long and obliquely directed proximally.

Occurence: Widespread in all tropical and warm temperate ocean waters on brown algae. It is the most abundant encruster of drift *Sargassum* in tropical Western Atlantic, and it is found more occasionally on hard substrata, especially floating plastic debris (Winston et al. 1996).
Belgium: This species washed ashore:
2008 November 25th , on plastic between Zeebrugge and Blankenberge
2017 October 29th , Oostende on a washed up buoy with also Columbus crab
2019 March 26th , Bredene on plastic bottle with *Lepas anatifera*
2019 September 13th, Lombardsijde, on *Lepas anatifera*, not verified
The Netherlands: On September 2nd, 2014 on barnacles near Egmond (de Ruijter 2015b).



2019 March 26th , Bredene on plastic bottle with Lepas anatifera

***Jellyella eburnea* (Hincks 1891)**

Description:
Colonies encrusting shells of *Spirula*. Twinned ancestrular zooids with gymnocyst occupying at least two-thirds of frontal length. Autozooids indistinctly rhombic in frontal outline, longer than wide. Basal walls uncalcified apart from a marginal rim surrounding a basal window; substrate may be etched beneath basal window. Gymnocyst well developed, proximal gymnocyst generally occupying about one-half to one-third of the frontal area, tapering distally and absent at distal end of zooids; smoothly calcified surface fluted or folded into rucks, tubercles, or spines variable in prominence and number; spines short, hollow, sometimes open-ended but more often rounded and terminally closed, hook-like, those adjacent to the opesium bending over frontal membrane but not reaching the mid-line, occasionally with transverse furrows; one or sometimes more distally directed tubercles present in proximal part of gymnocyst, often originating along border with proximal neighboring zooid, very occasionally longer and spine-like. Cryptocyst lacking. Opesium ovoidal, longer than wide. Operculum crescent-shaped, with a marginal sclerite. Vertical walls forming a narrow shelf at distal end of zooid, and often with minor buttresses in corners of zooids and at junctions with basal walls. Pore chambers lacking. Simple pores present in lateral vertical walls separating zooidal series, located close to basal walls. Multiporous septulae developed in transverse vertical walls adjacent to basal walls; individual pores about 1 µm in diameter, centered within depressions separated by slight buttresses, sometimes two or more pores sharing the same depression. No ovicells or avicularia. Kenozooids present in areas of crowding, particularly where growing edges coalesce.

Gymnocystal spines. The crudely constructed gymnocystal spines of *J. eburnea* originate through folding of the proximal gymnocyst.

Occurrence: This is the sole bryozoan found on the *Spirula* shells. Colonies are known from Florida, South Africa, East Africa, Madagascar, Mauritius, Fiji, Australia, and New Caledonia (Taylor & Monks, 1997). Frank Husslage found a Spirula on the beach of Oost-Kapelle (The Netherlands) in the spring of 2014. Arie Twigt, who has the shell in his collection brought a colony of *J. eburnea* attached to the *Spirula* to my attention.

The species described by Winston (1982, p. 120) as Membranipora sp. is probably closely related to *J. eburnea*. This un-named species from the east coast of Florida was found only on wood and plastic objects in beach drift. The proximal gymnocyst is not as well developed as that in typical *J. eburnea*, and Winston mentions that, unlike those in *J. eburnea*, the ends of the gymnocystal spines may be bifid, but other aspects of skeletal morphology are strikingly similar.

source: https://waarneming.nl/photos/31815202/

Photo Arie Twigt

Family Electridae

Genus Conopeum

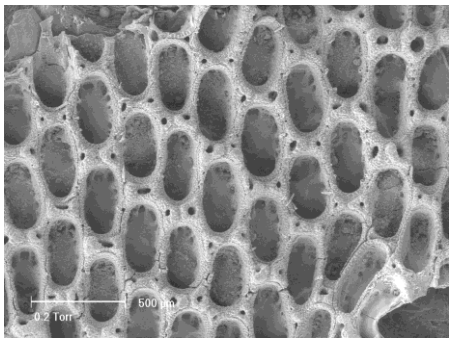
1 a) Marine or estuarine. Frontal calcification present, but reduced. Spines, if any, placed around the opesia; often a pair of triangular chambers (kenozooids) at the distal end of each zoid; on hard substrates. ..... *Conopeum reticulum* (p. 70)
b) Only in brackish water. Frontal calcification practically absent. Spines limited to a small pair at the distal end of the zooid; kenozooids rare and not in pairs; often on plants in estuaries. ……..……..... *Conopeum seurati* (p. 72)

***Conopeum reticulum* (Linnaeus, 1767)**

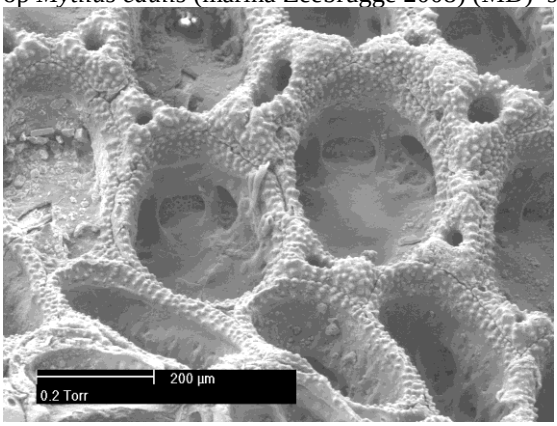
Description: The colony forms a mesh-like crust. Zooids flat. Lateral walls strongly calcified. Frontal surface largely membranous, opesia elliptic to ovate. There may be a varying number of small spines around the opesia, typically thin and pointed and sometimes sloping over the frontal membrane.
Characteristic is the presence of a pair of triangular kenozooids at the distal end of each zooid. Unfortunately, the kenozooids are not always present, which leads to confusion with other species. Occasionally the two kenozooids have fused into a bar along the distal end of the zooid. Avicularia do not occur, although beginners may mistake the kenozooids as avicularia. Polypide with 10 or 11 tentacles. Ovicells do not occur. Ancestrula single.
The best character (if spines and kenozooids are lacking) is a large septula (porous zone where zooids are connected to each other), in the terminal wall typically supported by thickened vertical calcified struts. These vertical struts do not occur in similar species as *C. seurati*, *Electra monostachys* or *Einhornia crustulenta*. The struts are best seen holding a cleaned colony at an angle and examin the terminal wall.

Occurence: Native and also often present on washed up plastic.
Belgium: Very common along the coast mainly on mussels, also on crab shells, off the coast mainly on the inside of cockles and on stones. Subtidal on rocks of the erosion protection in Belwind, Aug 2018 (pers. comm. F. Kerckhof).
The Netherlands: Very common along and off the coast and in the estuaries. It was found on only one of the 10 shipwrecks examined in Dutch waters, namely on the 'Victoria City' (Lengkeek *et al*., 2013). Collected at the Dutch Borkum Reef Grounds (Coolen *et al*., 2015).
Germany: Collected in the German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

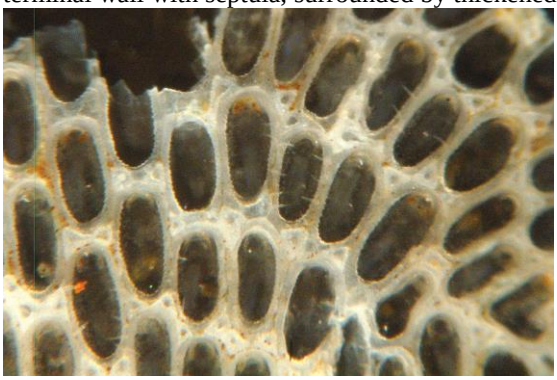
Conopeum reticulum



op *Mytilus edulis* (marina Zeebrugge 2008) (MD) some kenozooids have fused into a bar (JC)



terminal wall with septula, surrounded by thickened calcified struts (JC)



Zooids with spines surrounding the opesia (RV)

***Conopeum seurati* (Canu, 1928)**

Description: Encrusting colony, the shape is determined by the nature of the substrate; on flat surfaces it forms leathery crusts, on irregular surfaces (as on plant stems) it often rises in two-layered lobes. Zooids are typically elongated rectangular, shape and size vary according to the substrate.
Calcification thinner than in *C. reticulum*. Frontal calcification much more reduced, present as small triangular plates in the corners of the zooid and a narrow, granular margin within the erect lateral walls.
Spines very variable, usually a single small pair at the distal end of the zooid, often absent, rarely long and curved. Kenozooids can occur in disturbed places; they are usually elongated, triangular, irregularly placed and never in pairs at the distal end of the zooid. Polypide with 12 to 14 tentacles. Often very similar to *Einhornia crustulenta*. The operculum is translucent except for the brown margin, while in *E. crustulenta* the operculum is completely opaque.

Occurence:
Belgium: Not common, probably strongly deteriorated due to pollution and loss of biotope. Recently some colonies on mussels in the marina of Zeebrugge and in at Nieuwpoort.
The Netherlands: On reed stems and other substrates. Tolerates very low salinity and very large fluctuations in concentration. There are numerous sites in the Delta area (Faasse & De Blauwe, 2004). Reported from Texel in 1966 (Jebram, 1968), Oostvoornse Meer (de Kluijver, 1997), the marina and the inner sluice canal in IJmuiden (Faasse & De Blauwe, 2004).
Germany: Collected in the German esturaies/Wadden Sea (Zettler *et al*., 2018).


On reed, Nieuwpoort (2006) (HD)

Conopeum seurati:

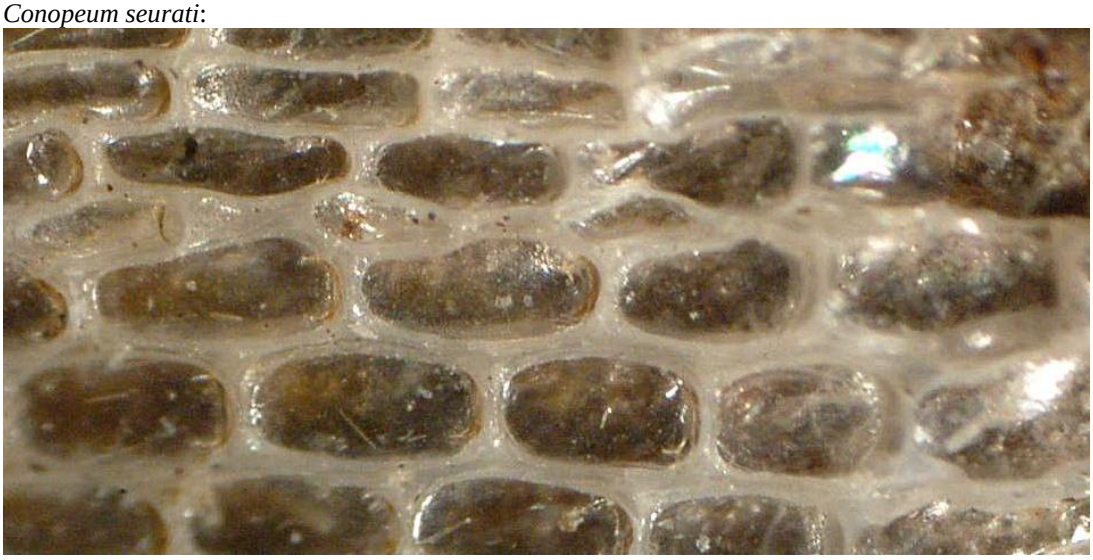
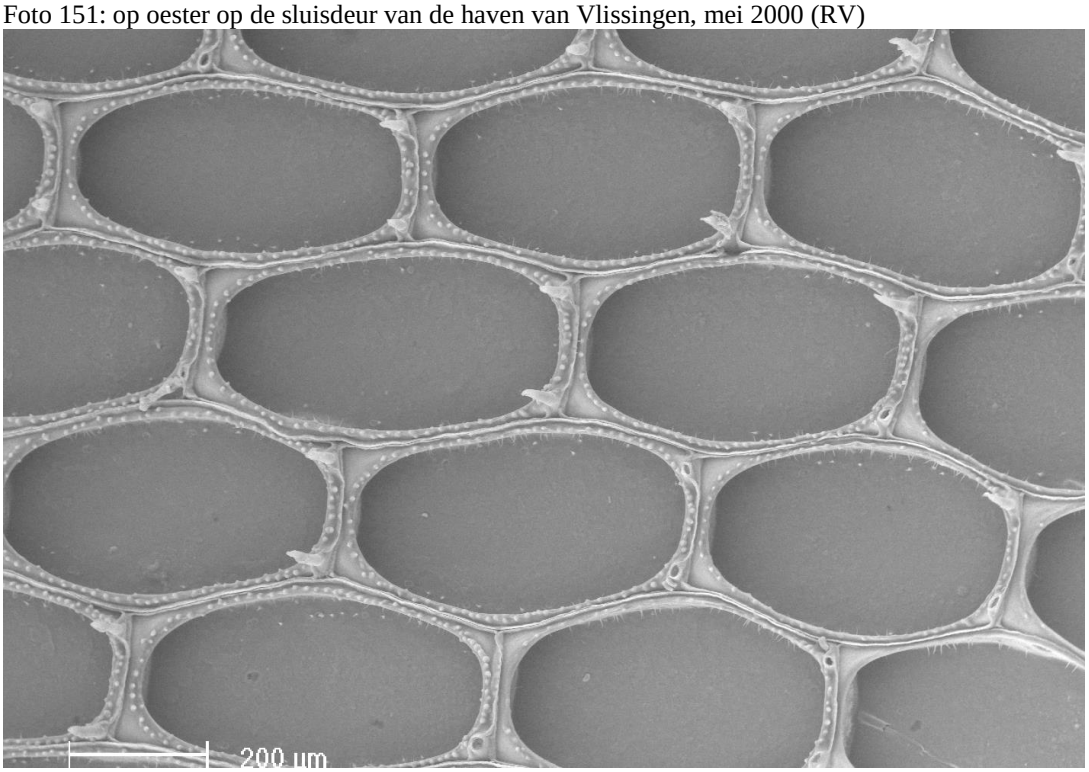


Foto 151: op oester op de sluisdeur van de haven van Vlissingen, mei 2000 (RV)



SEM same colony (JC)

Genus Electra/Einhornia

The new genus *Einhornia* is characterized by a single proximedial spine and a calcified operculum. Molecular research confirms that the species in this genus stand out from other *Electra* species (Nikulina, 2007).

1 a) Frontal calcification with many pores. ……..…….. *Electra pilosa* (p. 78)
b) Frontal calcification not perforated. 2

2 a) Proximal spine short and thick, other spines absent. Operculum calcified, like an opaque semicircular valve. Estuarine habitats. .. *Einhornia crustulenta* (p. 74)
b) Spines present or absent. Operculum uncalcified. *Electra monostachys* (p. 76)

***Einhornia crustulenta* (Pallas, 1766)** EAL BREAD

Description: Colony encrusting, white. Zooids elongated, rectangular or oval, separated by narrow grooves. The frontal calcification comprises less than ¼ of the total length. A narrow fine-grained calcareous margin extends around the proximal half of the elliptical opesia. Operculum very conspicuous, slightly calcified and visible as an opaque structure. Operculum with transverse proximal border shallowly concave; operculum height distinctly shorter than width (Nikulina, 2007). Lateral spines absent; the medial proximal spine (small and rare) is a low chitinous cone on top of a calcified hump; later the top can calcify.

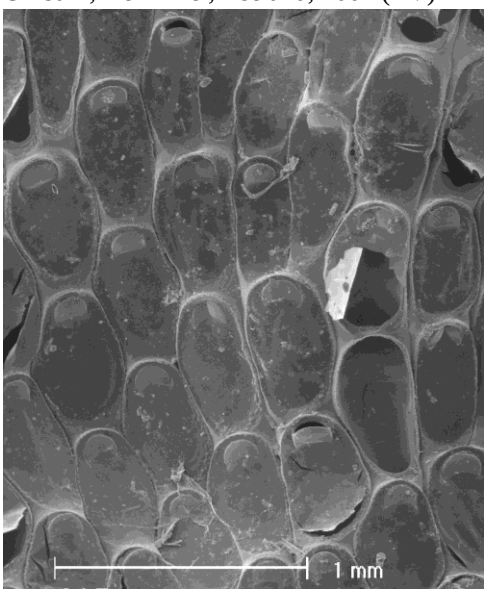
It forms 'growing stones' in brackish water in the Netherlands. Often in these stones *E. crustulenta* and *C. seurati* grow on top of each other. In the Netherlands, zooids occur with little frontal calcification and without a spine, making it difficult to distinguish between the two species. The calcified operculum is the most obvious feature.

Occurence: On many substrates, limited to estuarine habitats.
Belgium: In the brackish part of the Ostend harbour, in the marina of Zeebrugge, in the Nieuw Bedelf in Nieuwpoort and at the marina of Doel in the Western Scheldt.
The Netherlands: Sites are known throughout the coastal region (Faasse & De Blauwe, 2004). Bijma & Boekschoten (1985) provide a distribution map of the 'growing stones' in the southwest of the Netherlands. Very recent: Wadden Sea on a fragment of Ensis, together with *C. reticulum* (email with photo L. van Walraven, 2020). Recently found in

the Zoutsloot in Harlingen (de Boer, Bennema, Kuijper & van Leeuwen, 2020). Lauwersmeer? (Lawrentsmeer in Nikulina,2007).
Germany: Helgoland, Sylt, Jade Bight

Einhornia crustulenta:

On bark, Den Inkel, Zeeland, 2001 (RV)



SEM Zooids without proximal spine (JC)

Zooids with proximal spine and calcified operculum (RV)

***Electra monostachys* (Busk, 1854)**

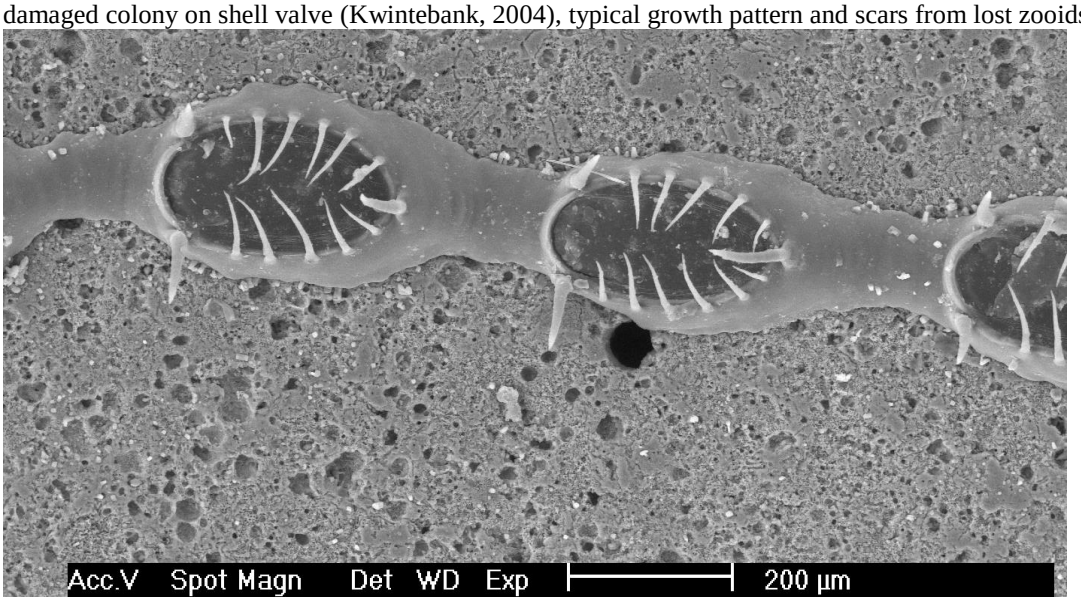
Description: Colony forms a star-shaped crust. Zooids elongated, proximally narrower. Frontal calcification 1/4 to 1/3 of the surface, smooth, without pores. Oval to elliptical opesia. Operculum with a thin marginal induration. The number of spines varies considerably; most constant is the medial proximal spine, which is thin, pointed and curved over the frontal membrane. A pair of equally slender but straight spines are at the distal end of the opesia. Up to 4 to 6 pairs of short, curved spines may surround the frontal membrane, but they are often absent.

The zooids often form an oval scar on the inside of shells. Young colonies of *Conopeum reticulum* resemble *Electra monostachys* in that the first zooids grow in a single row in the opposite direction of the ancestrula and have proximal frontal calcification. A good distinction is the fact that with *Electra monostachys* the zooids make a scar in the substrate, which does not happen with *Conopeum reticulum*.

Occurence: Usually on stones or the inner side of empty bivalve shells, often together with *Aspidelectra melolontha*. Occurs in the sea and in river mouths. Rarely washes up on plastic.
Belgium: Collected alive on shells on the Kwintebank and the Hinderbanks.
The Netherlands: Records from Texel (Mulder, 1983), shell banks near Terschelling and Vlieland (Dankers & Van Moorsel, 2001), south-west of Terschelling and west of Schouwen (Jebram, 1968) and from the Goesse Sas and from the Western Scheldt (Faasse & De Blauwe, 2004). Collected in March 2008 on a roof tile in the tidal pool in Kattendijke. In 2013 in an old cockle in Westkapelle (de Ruijter 2013b). Collected in 2021 in a valve of Acanthocardia echinata on Ameland (e-mail with photo Ellen van der Niet). From Ameland to Rottumeroog traces of this species present in old and fossile bivalves Staal (2020). A colony of *Electra monostachys* comprising several dozens of zooids was found on one of the scour protection rocks from platform L10-G (Beukhof et al 2016).
Germany: Collected in 2015 on the inner side of a bivalve on the seadside of Borkum by J.H.(Dimítrios) de Regt (on observado.org with photo). Collected in the German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

Electra monostachys:

damaged colony on shell valve (Kwintebank, 2004), typical growth pattern and scars from lost zooids



Few zooids with spines on shell valve (Kwintebank, 2004), zoïden met stekels (JC)

***Electra pilosa* (Linnaeus, 1767)**

Description: Colony at first encrusting. In the absence of enough substrate (on hydroid stems), the colony forms erect blades of zooids growing back-to-back. The thin translucent frontal calcification occupies up to half of the frontal surface, often much less. Striking and characteristic are the large round pores in the frontal calcification. 1 to 12 spines surround the oval opesia. The proximal spine is always present, usually longer than other spines and sometimes 2 to 3 times as long as the zooid. In this case, the colony will look hairy. Operculum transparent, with a thin chitinous induration.

Occurence: Grows on just about anything: rocks, shells, hydroids, plastic, algae, other bryozoans. Definitely the most common species in the area. Encrusting colonies are often present on washed up material such as plastic and *Himanthalia* buttons.
Belgium: Loppens (1906) and the collection in the RBINS testify that this species was also very common in the past. Very common on beach heads and in marinas, also off the coast on stones, shells and shipwrecks (Zintzen, 2007), also in inland waters such as the inner harbor of Zeebrugge. Subtidal on rocks of the erosion protection in Belwind, Aug 2018 (e-mail F. Kerckhof).
The Netherlands: Very common in Zeeland on beach heads and in marinas, also in inland waters such as the Sas van Goes. Lengkeek et al (2013) found it on all of the 10 examined shipwrecks in Dutch waters. Collected at the Dutch Borkum Reef Grounds (Coolen et al 2015).
Germany: Collected in the German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

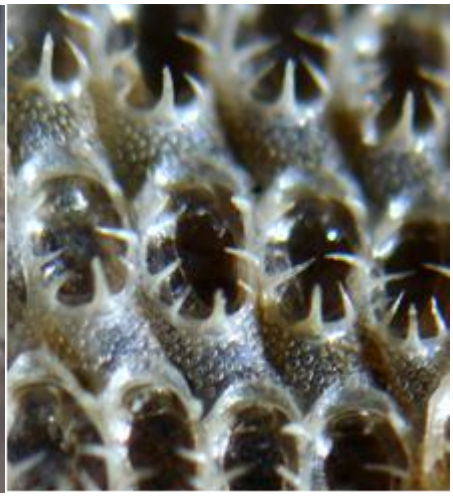
Mass occurrences of *Electra pilosa*: see p. 80

***Electra verticillata* (Ellis & Solander, 1786)**
Many bryozoologists considered *E. verticillata* as one variety of colony morphology of *Electra pilosa* (Linnaeus 1767). Nikulina *et al*. (2013) proved it is a separate species occurring in Brittany and southwards along the Atlantic coast of France and Spain, the western Mediterranean and the west coast of Africa. Absent from the North Sea.

On hydroid stem

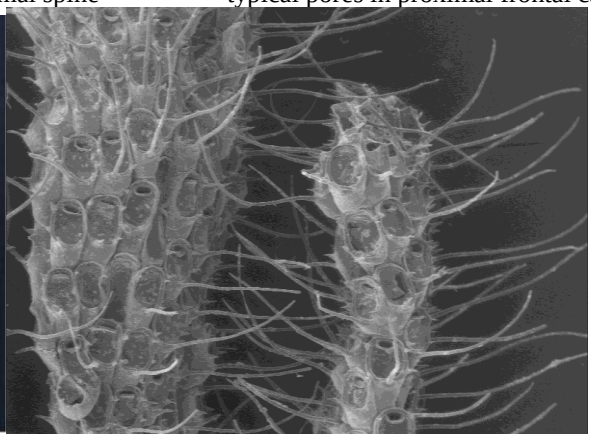
on *Fucus*

On hydroid stem, short proximal spine



typical pores in proximal frontal calcification

Erect colony part



erect colony parts with very long proximal spine

Massive stranding of *Electra pilosa* on the coast of the Netherlands in 2020/21.

In 1967, H. Prigge describes a remarkable growth form of *Electra pilosa*, in particular spherical colonies with a diameter of 3 to 7 cm that can be carried along by the current over the seabed and meanwhile growing in all directions. This growth form washed up the Dutch coast and on the German Wadden Islands.

@Jacoline van Duijn Katwijk, (3 December 2020)

After an inquiry it turned out that this phenomenon did not occur in Zeeland and not in the other countries surrounding the North Sea. Prigge was delighted with the massive wash-up he witnessed on the island of Norderney, all the more because the old island residents never saw anything like this. That means 1965 was probably the first event since 1900. A second, more limited wave came in 1966. The phenomenon was so drastic that there was odor nuisance (it happened in summer and early autumn) and caused problems for tourism and fishing.

After that, a massive wash-up was no longer reported, until de Ruijter (2019c) mentions lots of colonies washed up at the end of September 2019 at Terschelling. The NIOZ

(Royal Netherlands Institute for Sea Research) has seen the amount of *Electra pilosa* increasing in samples in recent years, even at great distances from the coast.

In 2020 many dozens of observations with photos were posted on waarneming.nl (almost 200 observations) and on facebook. It delivered beautiful images, the beach got knee-high mossy cliffs and golden yellow moss animal carpets (De Blauwe et al. 2021).

@Sytske Dijksen (18 December 2020 Texel)

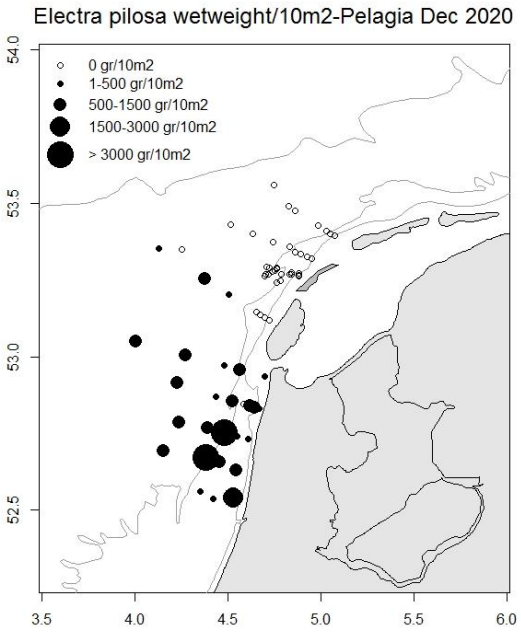
The real mass beaching in North Holland starts on 6 November. *Electra* is deposited in carpets of hundreds of meters long, tens of meters wide and from 15 cm to knee high. From mid-December to February 2021, entire beach strips on Texel are covered under moss animals. At the end of June and in summer, especially beaches of Ameland are covered with long carpets of *Electra pilosa*. Because it is summer, it has a severe impact to tourism and is mentioned in the newspapers and on the radio in Friesland.


@Tello Neckheim, 30 Nov 2020 @ Mathias Deen, Ijmuiden 27 Nov 2020 IJmuiden

A mass occurence of *Electra pilosa* on the **German North sea coast** started in September 2021. (Britta Kind, pers. comm.) On Helgoland anything like that was noticed during summer, so it started later.

Sampling at sea by NIOZ in December 2020

During the massive washing up of moss animals in 2020, NIOZ happened to conduct benthos research along a large part of the North Holland coast up to the west point of Terschelling. Between December7 and 14, a total of 70 stations were sampled with the Triple D plane. A strip of bottom 20 cm deep and 20 cm above the bottom was sampled over a strip of 50 meters long. So in total 10 square meters. The total area in which was sampled was approximately 3800 km².
All live animals are counted and measured from the catches. In the case of Electra pilosa, the wet weight has been determined. Amounts per station varied between 55 and 5800 grams per 10 square meters. North of the Texel stones (halfway Texel) no *Electra pilosa* was found in the catches. This suggests that the massive presence of material on the Texel beach was fed by transport from the south.
The sampled area where *Electra pilosa* was found in all catches spans 2300 km², the amount of animals caught is on average 37.7 grams per 1 m². This means roughly 86 thousand tons of *Electra pilosa* on the seabed. We probably only see a small part of it washing up on our beaches.



Electra pilosa, wet weight per 10 m² during sampling in December 2020 (NIOZ)

August 8th, 2021 Beam trawl Survey (pers. comm Joel Cuperus)
https://beamtrawlsurvey.blogspot.com/2021/08/blauwe-wijting-en-harig-mosdiertje-blue.html?fbclid=IwAR2sdzVcfvoWFQIorjQ9qFweALK0O90JedeR1NHTBNUd5SG6n5_lfLRsIlM)

On Wednesday the first haul contained one basket of plaice, a few sole and some small turbot. The haul that followed, looked full with bryozoan Electra pilosa. The species has been washed ashore since November 2020 till now, so it is no real surprise we catch it as well. The starboard side contained at least 2000 kg Electra pilosa. The haul after, we decided with the crew to half the time of the haul to 15 minutes. Unfortunately, this didn't work out as planned. Both sides were again full with bryozoans. We decided to once again empty the nets overboard.

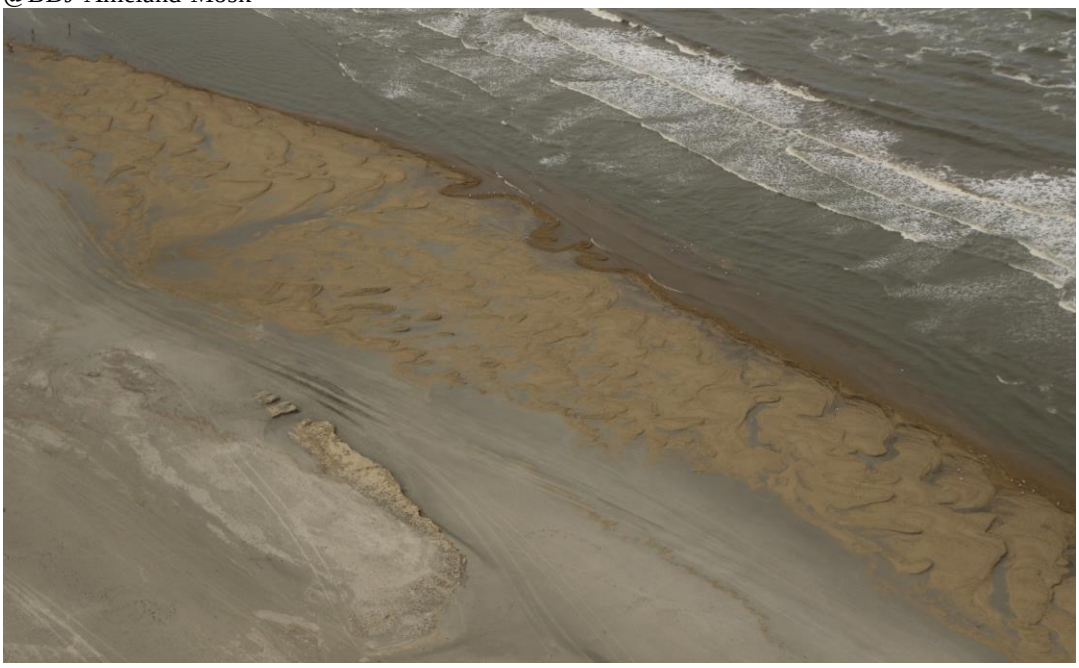
German North Sea area

Electra pilosa was found en masse in dredges in the German North Sea area in late summer 2021 and it could also be seen on underwater photos of the Steingrund, an area northeast of Helgoland.. During summer, there was also on the 'Steingrund' no *Electra*-bloom as the divers told, who had been doing the monitoring there in July. So, it must have appeared afterwards.

How can this increase in *Electra pilosa* be explained?

In recent years, many windmills have been built on the Dutch border in Belgium and in Dutch waters. On the basis of those windmills there is a lot of space for all kinds of organisms, including hydroids and moss animals. Another theory is the changed fishing pressure and fishing methods, so that the soil is less disturbed, so that shell tube worm fields of the polychaete *Lanice conchilega* and hydroid fields can develop better. The breaking off of established colony parts can be an additional spreading mechanism.

@BDJ-Ameland-Mosk



August 3de, 2021 aerial photo Pim Wolf, Ameland, *Electra pilosa* invasion

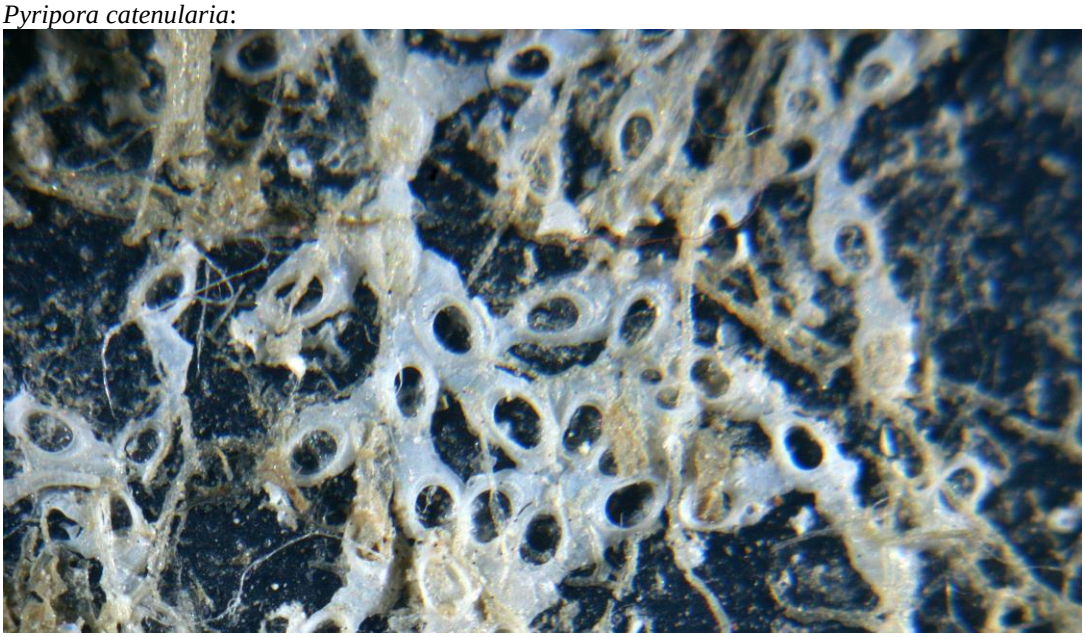
Genus Pyripora

***Pyripora catenularia* (Fleming, 1828)**

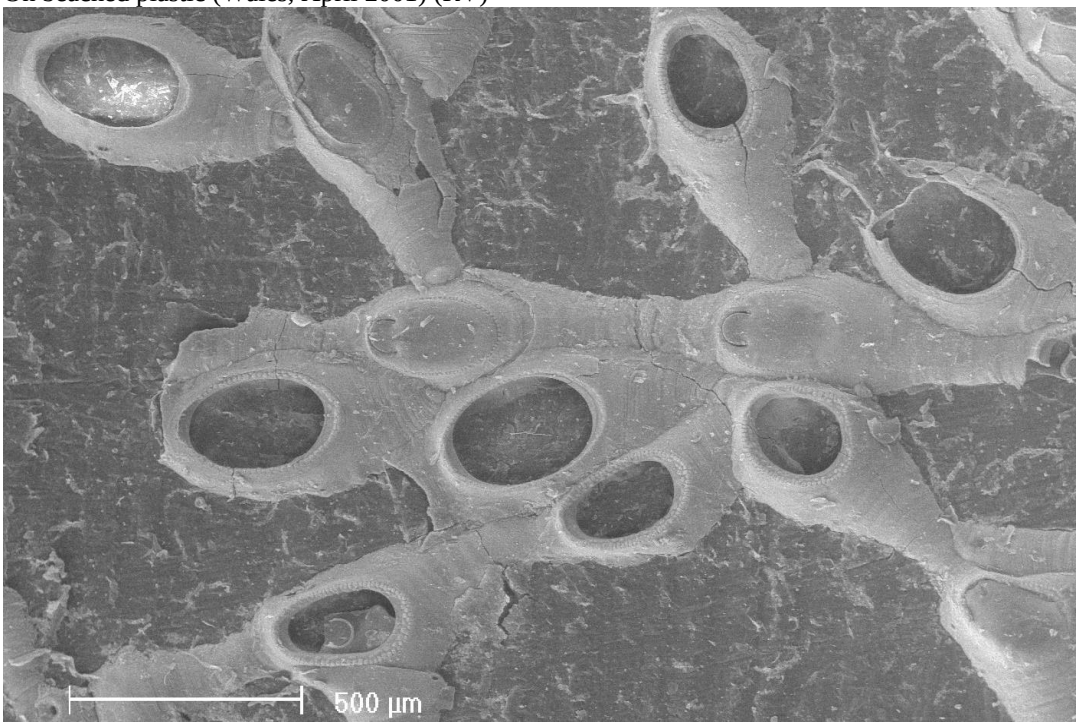
Description:
The colony forms long chains of zooids, branching across the substrate. Zooids elongated. Frontal calcification about half the zooid length, tapering proximally; smooth, fine-grained and without pores, some shallow transverse grooves or ridges may occur. Operculum with a distal marginal induration, placed at the distal end of the frontal membrane. Zooids grow over obstacles but not over each other, in that case a kenozooid is formed. Looks quite similar to spineless *Electra monostachys* but the calcification is thicker.

Occurence:
Belgium: beached in December 2000 on a shoe sole and on plastic in September 2001 (De Blauwe, 2003), autumn 2004 (De Blauwe, 2005) and January 2005.
The Netherlands: a colony washed up on rope or plastic (de Ruijter 2013a , 2014b, 2014c and 2014d, 2015d, 2018c).

Pyripora catenularia:



On beached plastic (Wales, April 2001) (RV)



Same colony (JC)

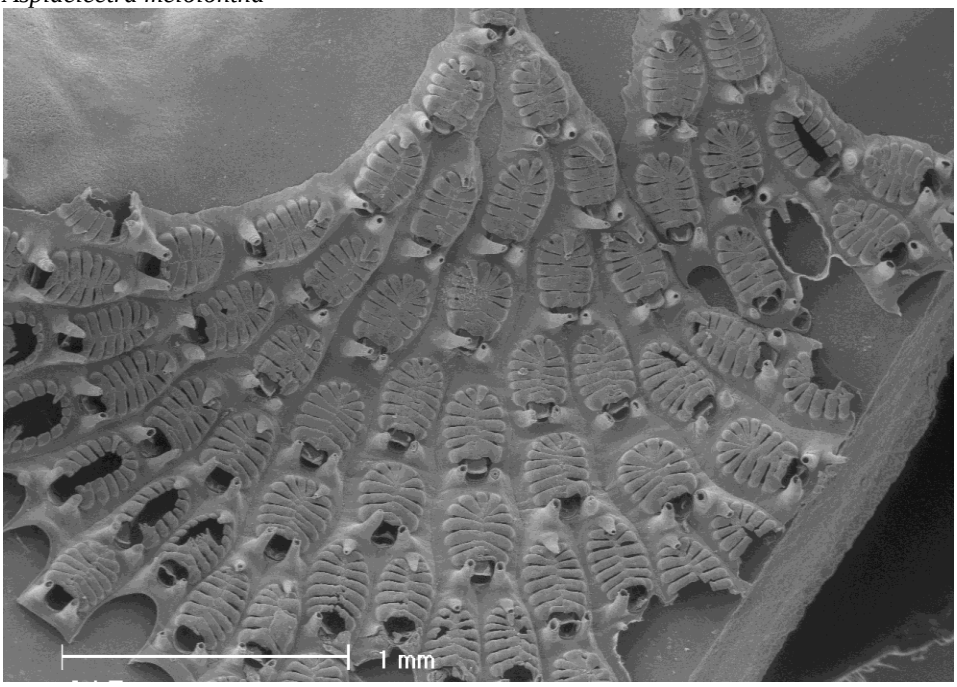
Genus Aspidelectra

***Aspidelectra melolontha* (Landsborough, 1852)**

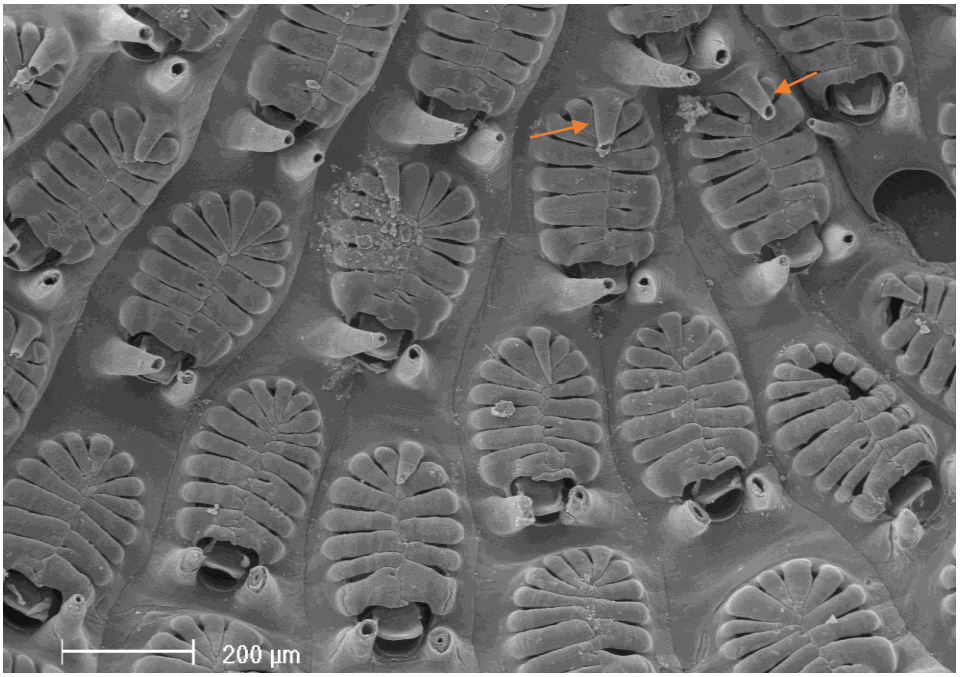
Description: The colony forms a lobed, fan-shaped or bushy branched crust, characteristically on the inside of shells. Zooids in regular linear series that branch frequently, separated by deep grooves. Lateral walls and frontal calcifications slightly calcified and smooth. Frontal membrane, except for the operculum, hidden behind a convex, basket-shaped shield of broad flattened spines that converge along the midline of the zooid. Two short, thick cylindrical spines present, each on one side of the opening. A third may coincidentally be present at the proximal end of the frontal shield. Polypide with 9-10 tentacles.

Occurence: Often together with *Electra monostachys* on stones and in shells and can occur frequently on the inside of empty oysters, mussels and cockles.
Belgium: Found on the Flemish Banks. Can be found on the beach after sand nourishments (Knokke, Ostend).
The Netherlands: Along the entire Dutch coast, in the Western Scheldt and the Oosterschelde (Lacourt, 1978). Can be found on the beach after sand nourishments in Nieuwvliet and from Westkapelle to Domburg, mostly in old valves of *Cerastoderma edule*. Sometimes on washed up plastic (de Ruijter, 2011b, 2012b, 2014b, 2014c, 2015a, 2019b, 2020c).
Germany: Collected in the German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

Aspidelectra melolontha



On inner side of shell of *Cerastoderma edule*, Kwintebank, 2004, typical growth pattern (JC)



same colony, zooids with (arrows) and without proximal spine

Superfamily Flustroidea

Family Flustridae

Genus Flustra

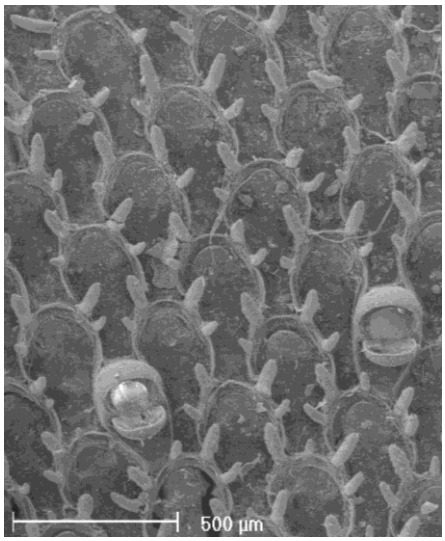
Flustra foliacea **(Linnaeus, 1758)**

Description:
The colony begins as a flat crust on the substrate. Erect bilaminar lobes are formed in the second year. Growth from March to September. The winter rest causes growth lines on the leaves. Twelve-year-old colonies were reported. The colony forms a flexible seaweed-like tuft up to 20 cm high, typically leaf-like and terminating in rounded lobes. Light gray brown, when fresh with a lemon scent. Zooids of the bilayered fronds are tongue-shaped. 4 to 5 short thick distal spines, narrowed at the base and club-shaped.
Avicularia half the size of a zooid; proximal part triangular, with frontal membrane, distal part semicircular and erect with hood-like rostrum and a strongly chitinized mandible. Ovicells in dead colonies as an ovoid chamber immersed into the distal zooid, in living colonies as a crescent-shaped cap distal to the parent zooid, its opening is separated from the zooid opening, distal to the operculum. Zooids of the first year incrustation are quite similar to *Conopeum reticulum*, without kenozooids and with two large distal spines that are longer than in *M. membranacea*. Polypide with 13-14 tentacles.

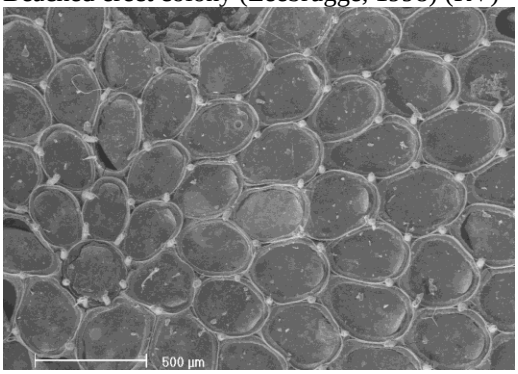
Occurence: Sublittoral and mostly on rough bottoms with strong currents. They formed a rich microhabitat with *Bugulina flabellata*, *Cradoscrupocellaria* and *Crisia eburnea* as dominant epizoites (Stebbing, 1971a). Stebbing (1971b) lists 25 bryozoans found on *Flustra foliacea*. Significantly decreased, presumably due to bottom disturbance from beam trawling.
Belgium: The numerous material preserved in the RBINS shows that this species was very common on the Flemish Banks at the beginning of the 20th century. During a campaign in June 2005, not a single colony was found on the Hinderbanken (De Blauwe *et al*., 2006). A young colony on a rock was found off Zeebrugge in July 2001.
The Netherlands: washes ashore less and less often, a strong decline was already reported in Lacourt (1978): 'was numerous along the entire Dutch coast, seems to be rare anymore'.
Germany: Collected in the German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

Flustra foliacea

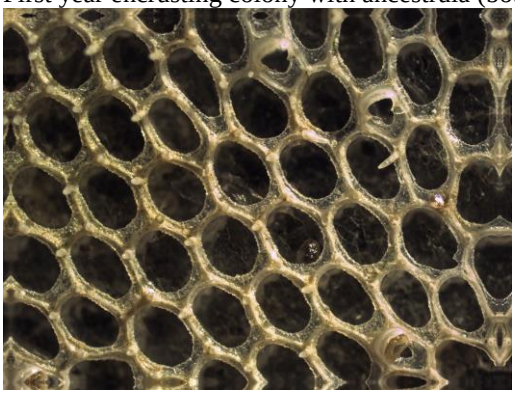
Beached erect colony (Zeebrugge, 1998) (RV)



zooids and 2 avicularia in erect colony (JC)



First year encrusting colony with ancestrula (bottom left side), on beached plastic Northumberland (JC)



Encrusting colony with avicularia and few kenozooids @ Rien de Ruijter.

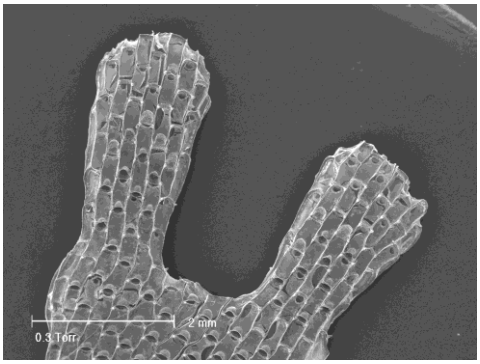
Genus Chartella

***Chartella papyracea* (Ellis & Solander, 1786)**

Description:
The colony forms a whitish, delicate tuft up to 3 cm high. Resembles miniature of *Flustra foliacea*. The narrow fronds are bilaminar. Zooids rectangular 0.5 x 0.2 mm. Walls thin, slightly calcified; a short thick spine on the distal corners of the zooid. Operculum slightly sclerotised, with a thin marginal induration. Avicularia do not occur. Ovicells immersed, visible as a small domed hood, its opening distal to the operculum. Embryos pale orange.

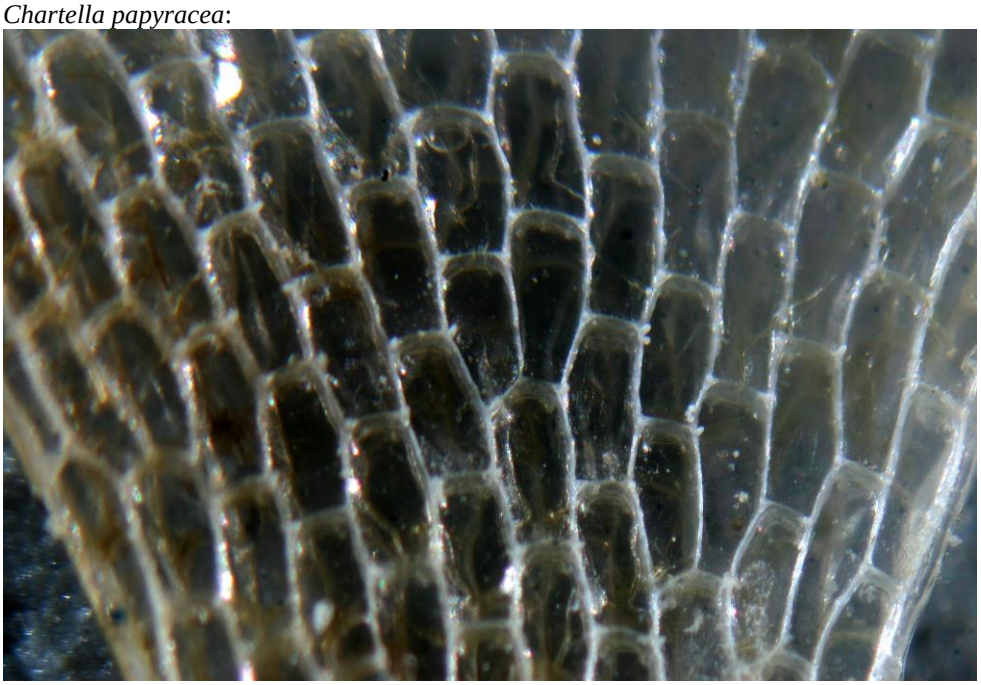
Occurence:
A colony was collected off the Belgian coast in 1899, 1900 and 1905 (RBINS collection). In that period, many colonies were also collected from the English Channel. In recent years a colony washed up on a fishing net in Ostend.


on a stone in St-Jacut, Brittany, April 2005 (RV)

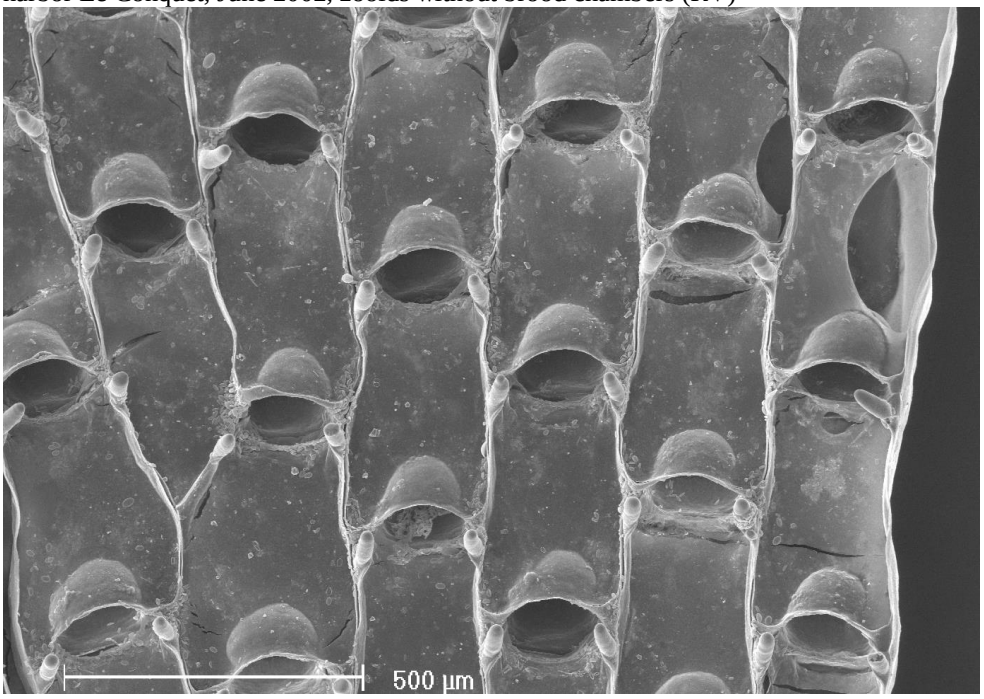


typical leaf tip (JC)

Chartella papyracea:



harbor Le Conquet, June 2002, zooids without brood chambers (RV)



zooids with brood chambers (JC)

Genus Securiflustra

***Securiflustra securifrons* (Pallas, 1766)**

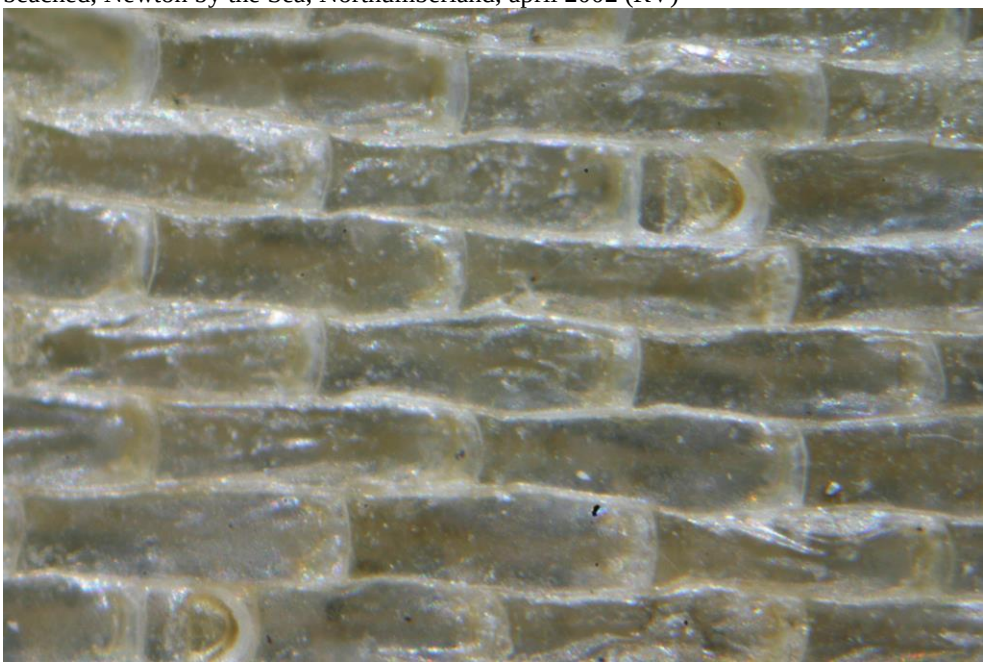
Description: The colony forms a whitish tuft up to 10 cm high. Fronds often wedge-shaped with angular apex. Lateral fronds originate on lateral kenozooids. Zooids rectangular, long and narrow, 0.7 to 1.1 mm long and 0.14 to 0.2 mm wide. The distal angle of the zooid is spineless. The frond margin is bordered by a row of kenozooids. Avicularia sit between the zooids in the zooid series, they are quadrangular, with a raised and thickened rostrum and semicircular, brown mandible. Ovicells globular, immersed.

Occurence: Well know species from Northumberland (UK), frequently beached at Seahouses, collected at the wreck of the Somali, 5 miles from the Farne Islands during the DDNZS campaign in June 2018.
Belgium: *Securiflustra securifrons* is a northern species not expected here. All samples in the RBINS labeled as *S. securifrons* were in fact *Chartella papyracea*.
France: There is one colony in the RBINS, fished up in the Channel on 7 February 1906 at a depth of 28 to 34 m on the range 50°45'N-1°3'E to 50°46'N-1°9'E.
The Netherlands: On March 12, 2003, a plastic chair washed ashore on Vlieland, on which about 20 colonies were found that were identified as *S. securifrons* (de Ruijter, 2003a). This material, which could have been *Chartella papyracea*, has not been collected.
In 2021 two colonies were found on the beach of Texel, after sand nourishment with sand collected at 13.4 km off the coast of Texel. (May 10th by Sytske Dijksen; May 11th by Rob Dekker (de Ruijter, 2021)).
Germany: Collected in the German North Sea (Zettler *et al*., 2018).


@Rob Dekker, Texel

Securiflustra securifrons

beached, Newton by the Sea, Northumberland, april 2002 (RV)



idem, zooids and few interzooidal avicularia (RV)

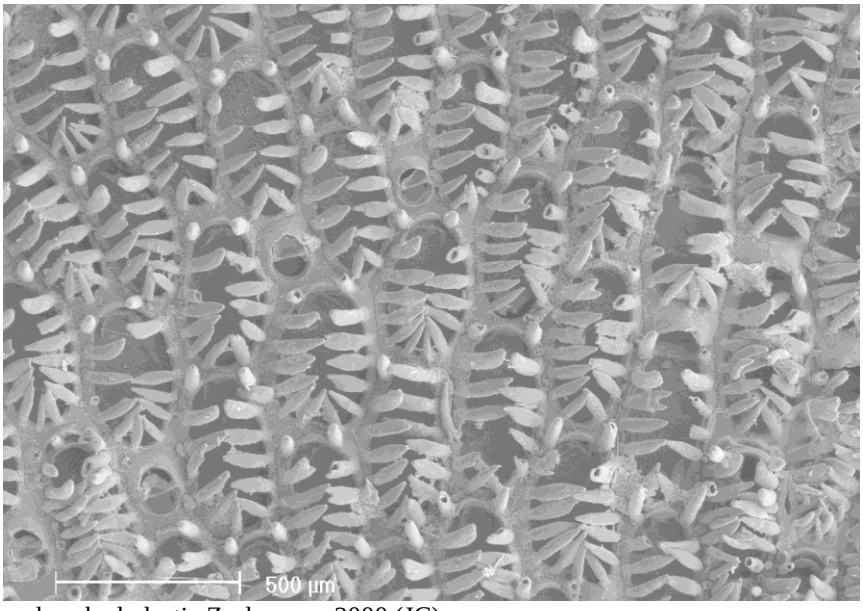
Genus Hincksina

Revised diagnosis (**Berning et al 2021):** Colony encrusting. Zooecia well calcified, communication via uniporous septula. Narrow gymnocyst present but variably developed, cryptocyst reduced to practically absent. Cylindrical or flattened oral as well as mural spines of variable shape encircling the opesia, spines in late astogenetic zooids may be branched and/or dimorphic to polymorphic in some species, spine bases jointed or fully calcified. Brooding in endozooidal ovicells positioned in the proximal part of a distal autozooid or an avicularium, not closed by the operculum but by an ooecial vesicle, ooecium a short hood formed by the proximal cystid of the distal zooid or avicularium, ectooecium and endooecium calcified. Avicularia interzooidal, occasionally vicarious; rostrum round or pointed, palatal opesia framed by an immersed calcified shelf, mandible hinged on a pair of lateral teeth. Kenozooids, which replace an autozooid or avicularium, may occasionally be present. Ancestrula tatiform (with membranous frontal wall.

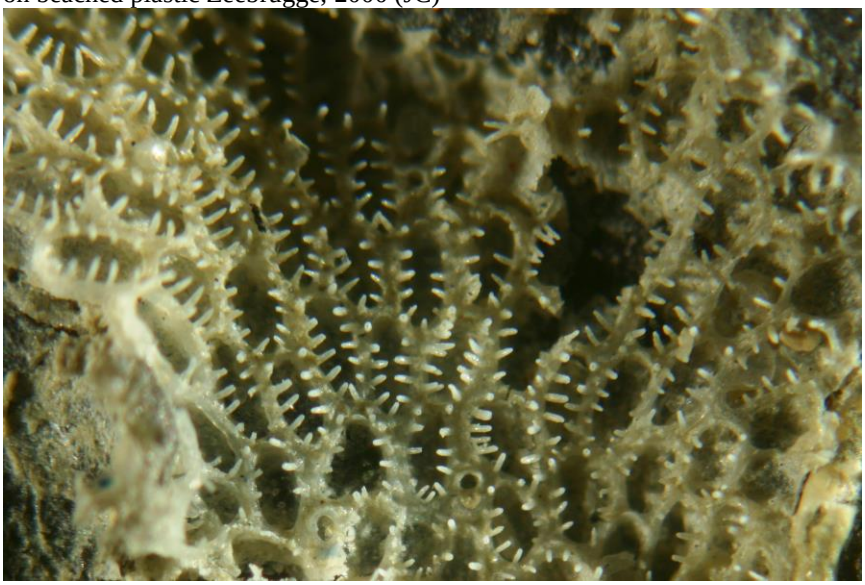
***Hincksina flustroides* (Hincks, 1877)**

Description. Colony encrusting, unilaminar, multiserial, forming light brown circular or lobed patches. Autozooids oval to rectangular 369–523 x 210–293 µm, arranged in irregular series, separated by shallow grooves, skeleton whitish translucent when dried. Vertical walls with two or more uniporous septula per neighbouring zooid. Gymnocyst reduced to practically absent, sometimes exposed in proximal, lateral and distal corners, and/or as a very narrow band along the distolateral zooecial margin, cryptocyst not developed, opesia therefore extensive. Opercular region laterally framed by a pair of vertically directed, cylindrical or slightly flattened oral spines in both auto- and ovicellate zooids; frontal membrane in mature zooids overarched by 8–12 (most often 9–10) cylindrical to flattened subclavate mural spines of variable width, the distal ones may be bifid while the proximal spines are generally smaller and shorter as well as more cylindrical, lateral spines of variable length and either leaving a central gap in some zooids or exceeding beyond the zooidal midline in others; all spines jointed at their base. Ovicell endozooidal in proximal part of distal autozooid, ooecium continuous with the proximal gymnocyst, forming a short but broad hemispherical cap, proximal margin raised centrally, often producing a central peak.

Occurence:
Belgium: on beached plastic in 1999 and twice in 2000. In June 2005 a dead colonie was sampled on a shell on the Hinderbanken.
The Netherlands: colonies on beached plastic (de Ruijter 2103c, 2014b, 2017b).



on beached plastic Zeebrugge, 2000 (JC)


On beached plastic Zeebrugge, 2000 (RV)

Superfamily Calloporoidea

Family Calloporidae

Genus Callopora

1 a) 4 spines at distal end of young zooids, only 1 or 2 remaining later; 2 spines in fertile zooids, 1 or both may be greatly enlarged. ..... *Callopora dumerilii* (p. 102)
b) More than 4 spines, usually at least 8 around the opesia. 2

2 a) 8-12 spines, broad and flattened, spanning the frontal membrane and meeting in the middle; 2 pairs of erect distal spines. ..... *Callopora rylandi* (p. 106)
b) Spines around the opesia sometimes over the membrane, but not flattened and not meeting in the middle. 3

3 a) Ovicell with a transverse membranous area bounded by a sinous ridge. 12 to 15 spines around the oval opesia. …… *Callopora craticula* (p. 98)
b) Ovicell not so. …… 4

4 a) Opesia surrounded by 17–22 thin spines, curved over the frontal surface. Avicularia absent. ..... *Callopora discreta* (p. 100)
b) 8-11 spines; straight, thick and cylindrical. Avicularia on the proximal part of the zooid. ..... *Callopora lineata* (p. 104)

***Callopora craticula* (Alder, 1856)**

Description: Colony forms small patches. Autozooids oval, vitreous. Gymnocyst about one-quarter of the frontal surface. 12 to 15 thin, pointed spines, inclined inwards over the oval opesia and almost meeting in the midline of the autozooid. A small avicularium present on the gymnocyst: rostrum narrow, pointed, directed distally or proximally. Ovicell spherical, with a transverse membranous area that is bounded by a thickened sinuous ridge. Embryo colour red to orange. Ancestrula identical to autozooids but with about 9 spines.

Occurrence: on stones, shells and algal holdfasts at ELWS and subtidal. Reported from German North Sea (Zettler *et al*. 2018) and from Helgoland (pers. comm. Britta Kind).

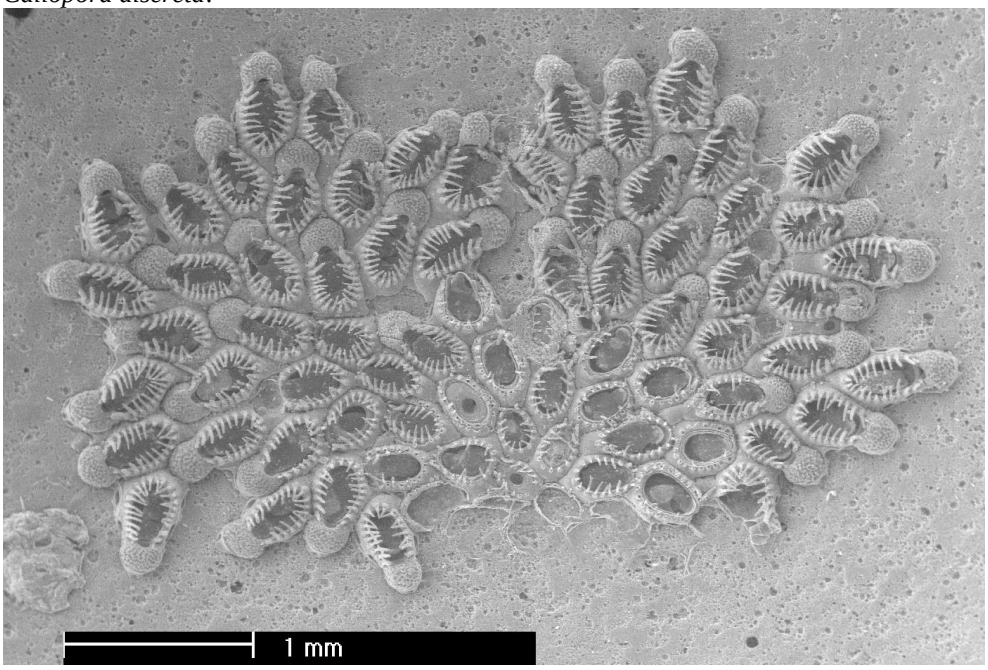
No photo's available

***Callopora discreta* (Hincks, 1862)**

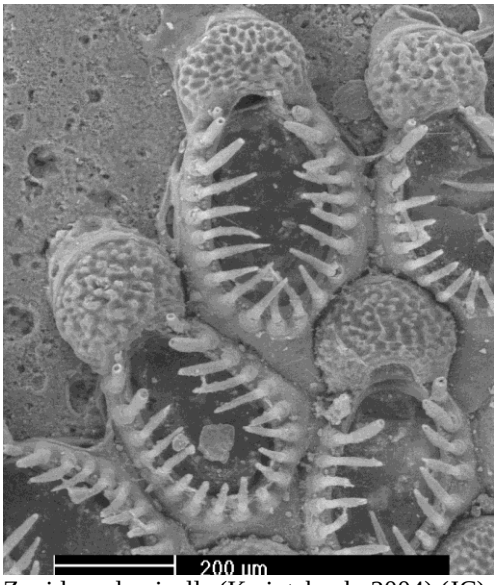
Description: Colony encrusting, unilaminar, multiserial, usually less than 50 zooids. Zooids ovate, small, separated by deep grooves. Lateral wall thickened and slightly projecting as a border around the opesia, with 17-22 short, thin, pointed spines; 2 most distal usually erect or curved slightly outward, the rest strongly curved over the frontal membrane. Spine base strongly thickened. Avicularia absent. Ovicells approximately spherical, thickly calcified, with a rough surface.

Occurence: In 2004 and 2005 living colonies were discovered in Belgium on the Kwintebank and deceased colonies on the Hinderbanken, there were no previous reports from the North Sea. A colony was found in the RBINS collection on a shell that Gilson fished up in 1905 on the Hinderbanken.

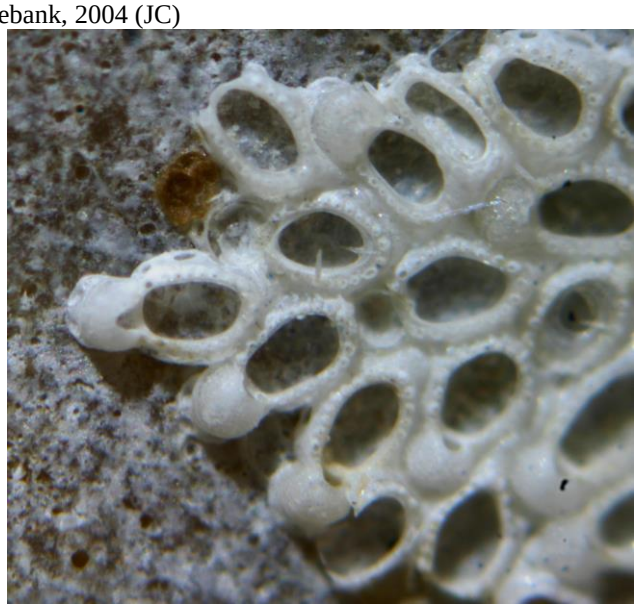
Callopora discreta:



Colony in *Cerastoderma edule* from the Kwintebank, 2004 (JC)



Zooids and ovicells (Kwintebank, 2004) (JC)



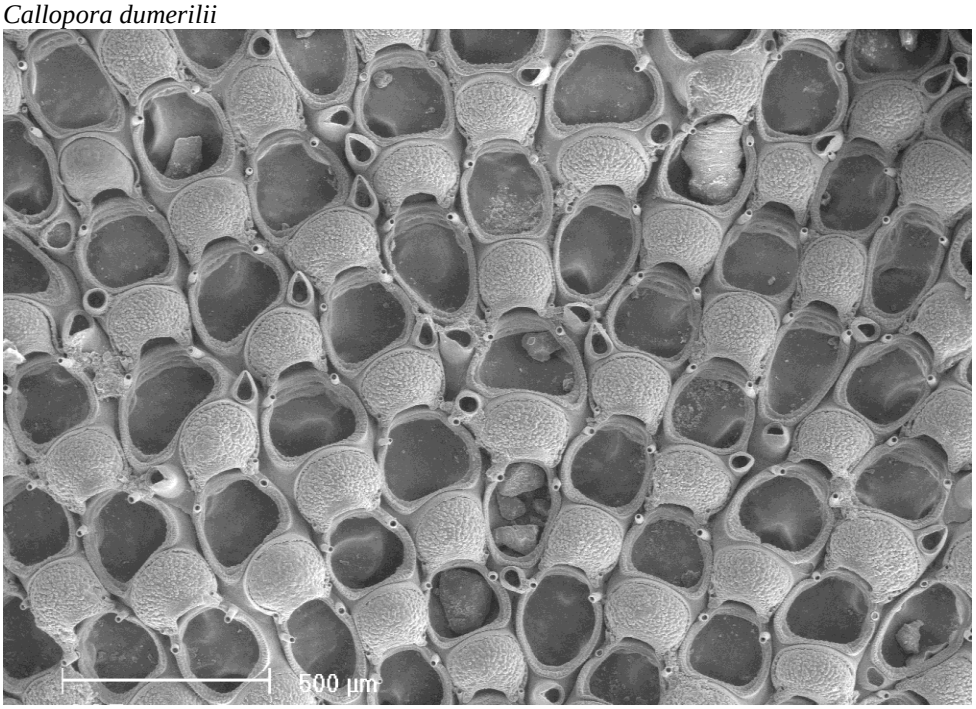
zooids with broken spines (Kwintebank, 2004) (RV)

***Callopora dumerilii* (Audouin, 1826)**

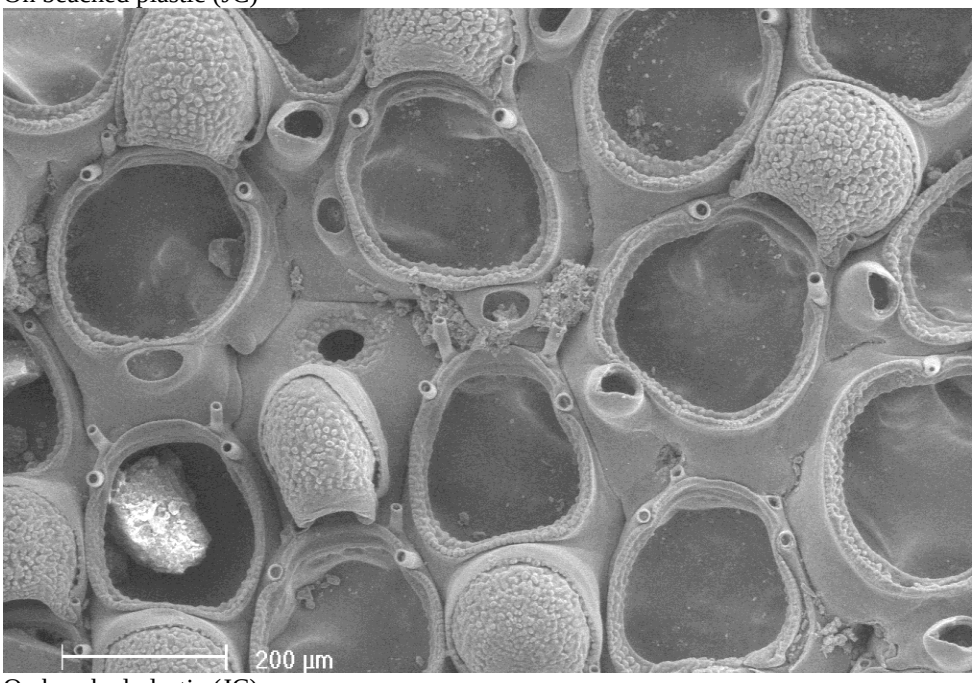
Description: Colony encrusting, unilaminar, multiserial. Autozooids ovate, sometimes broadened proximally. Separated by deep grooves. Frontal calcification small, triangular, smooth and vitreous. 4 (rarely 6) spines at the distal end of the zooid; distal pair small, pointed and erect, usually absent, especially near ovicells, proximal pair always present, 1 or both may be strongly elongated and thickened, straight or curved, erect or draped over the frontal surface. Avicularia small, placed on the frontal calcification, with pointed rostrum, often absent. Ovicells spherical with finely grained surface. Eggs and embryos orange. Colonies without ovicells can be confused with *Amphiblestrum auritum*.

Occurence: In Belgium (De Blauwe, 2005) and the Netherlands (de Ruijter, 2011a, 2012a, 2015a) on washed up objects and *Himanthalia buttons* originating from the Channel coast and Brittany in France.
Belgium: Live colonies were found in 2005 on pebbles between the Hinderbanks. Also on calcareous tube worms on buoys at sea (pers. comm. F. Kerckhof). Subtidal on rocks of the erosion protection in Belwind, August 2018 (pers. comm. F. Kerckhof).
The Netherlands: In Zeeland, this species lives near the Goesse Sas and on the north side of the Zeeland Bridge (Faasse & De Blauwe, 2004) and on the Klaver Bank (pers. comm. G. van Moorsel).
Germany: Collected in the German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

Callopora dumerilii



On beached plastic (JC)



On beached plastic (JC)

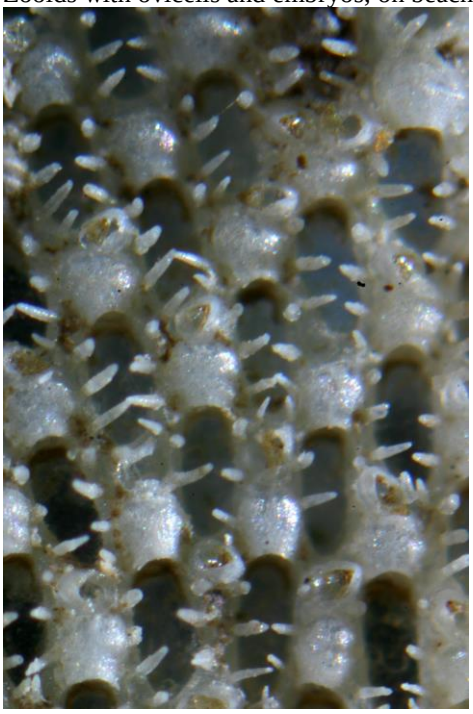
***Callopora lineata* (Linnaeus, 1767)**

Description: Colony encrusting, unilaminar, multiserial. Autozooids rectangular to irregular polygonal, separated by shallow grooves. Lateral walls erected as a rim around the elongated oval opesia, 8 to 11 (rarely 6-14) straight, thick cylindrical spines. Avicularia oriented differently, on the proximal part of the zooid. Ovicells very conspicuous, spherical, fine-grained; frontal with a large uncalcified surface. Embryos pink or orange.

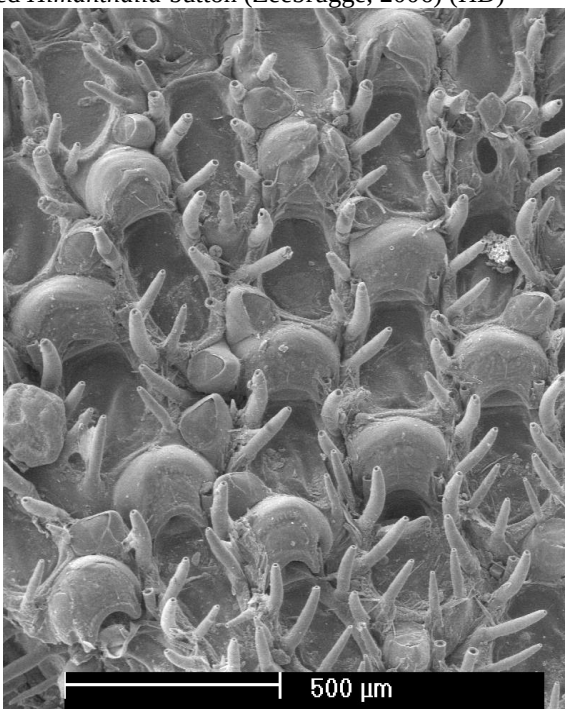
Occurence:
France: In 1908 a specimen was dredged just north of Cap Gris-Nez, France (RBINS collection).
In Belgium and the Netherlands (de Ruijter, 2007, 2012a, 2020c) on washed up objects and especially on *Himanthalia* buttons.
Germany: Collected in the German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

Callopora lineata:

Zooids with ovicells and embryos, on beached *Himanthalia* button (Zeebrugge, 2006) (HD)



On beached plastic (De Haan, 2001) (RV)



on beached *Himanthalia* button (Oostduinkerke, 2005) (JC)

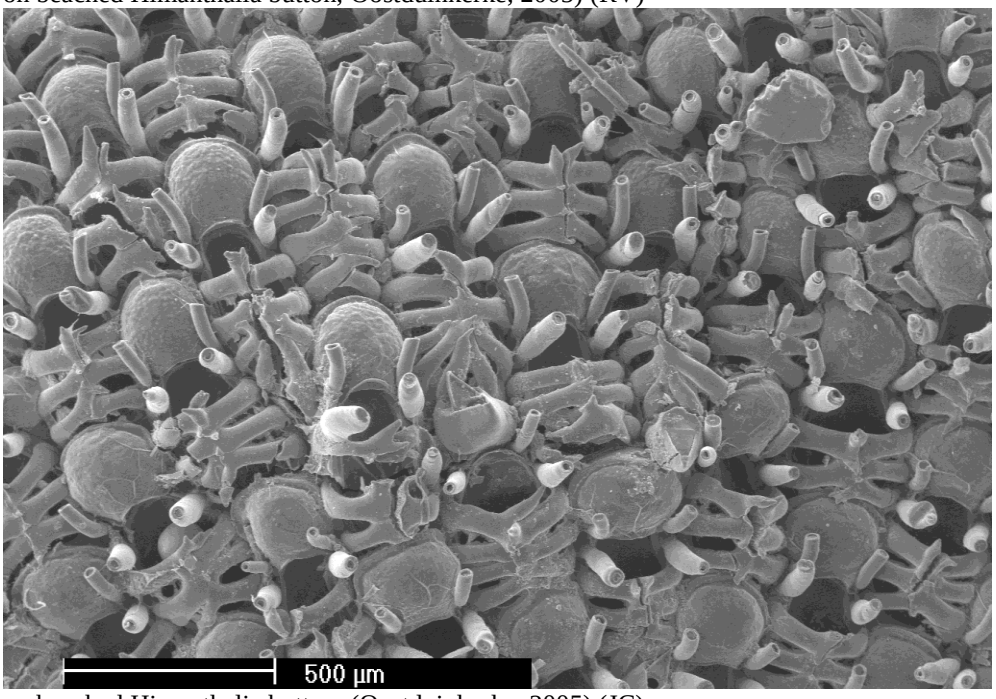
***Callopora rylandi* Bobin en Prenant, 1965**

Description: Colony encrusting, unilaminar, multiserial. Autozooids oval, separated by shallow grooves. Usually 3-6 lateral pairs of spines and a single proximal spine, broad and flattened, hollow, hanging over the frontal membrane and meeting in the middle, where they widen or split and then fuse. There are 4 to 6 erect cylindrical spines around the distal end of the zooids (4 in the presence of an ovicell). A small avicularium is sometimes present on the proximal part of the zooid, directed proximally or distally.
Ovicells spherical, flattened frontally, with an inconspicuous rim distally. Embryos orange.
Ancestrula half as long as later zooids, oval; 10 erect cylindrical spines surrounding the frontal membrane. In the ancestrula and the first formed zooids, all spines are erect. Young colonies can therefore be confused with other species, for example with *Callopora lineata*. May be confused with *Membraniporella nitida* (part IV) but the frontal shield consists of less flattened spines with a larger spacing.

Occurence: Recently found in Belgium and the Netherlands on *Himanthalia* buttons washed ashore (De Blauwe, 2000b and 2005; Vanhaelen et al., 2006; de Ruijter, 2011b, 2012a, 2014a, 2017b, 2020c).
Germany: Collected at Helgoland (pers. comm. Britta Kind) (on beached *Himanthalia*?)

Callopora rylandi:

on beached Himanthalia button, Oostduinkerke, 2005) (RV)



on beached Himanthalia button, (Oostduinkerke, 2005) (JC)

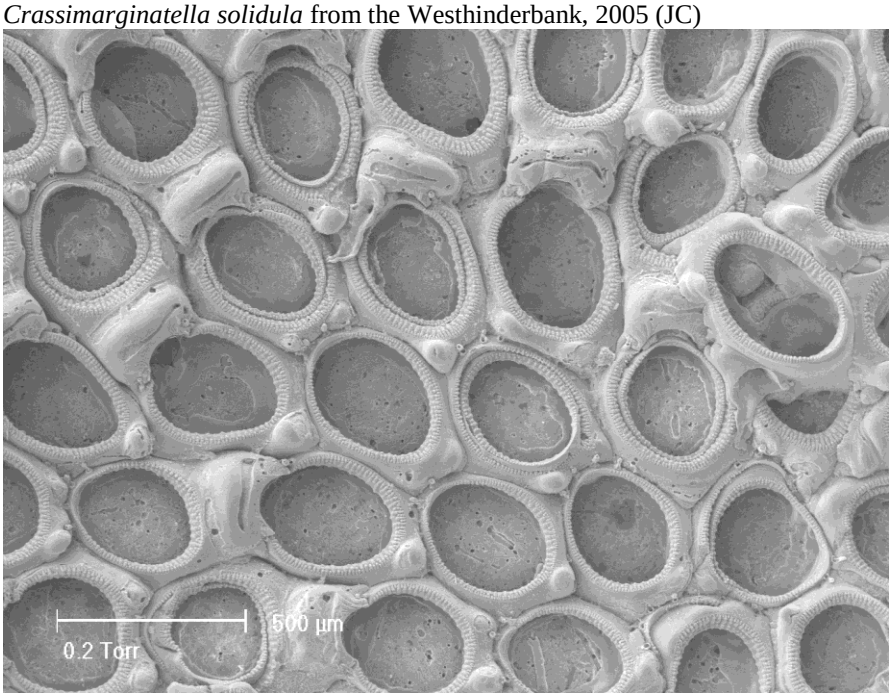
Genus Crassimarginatella

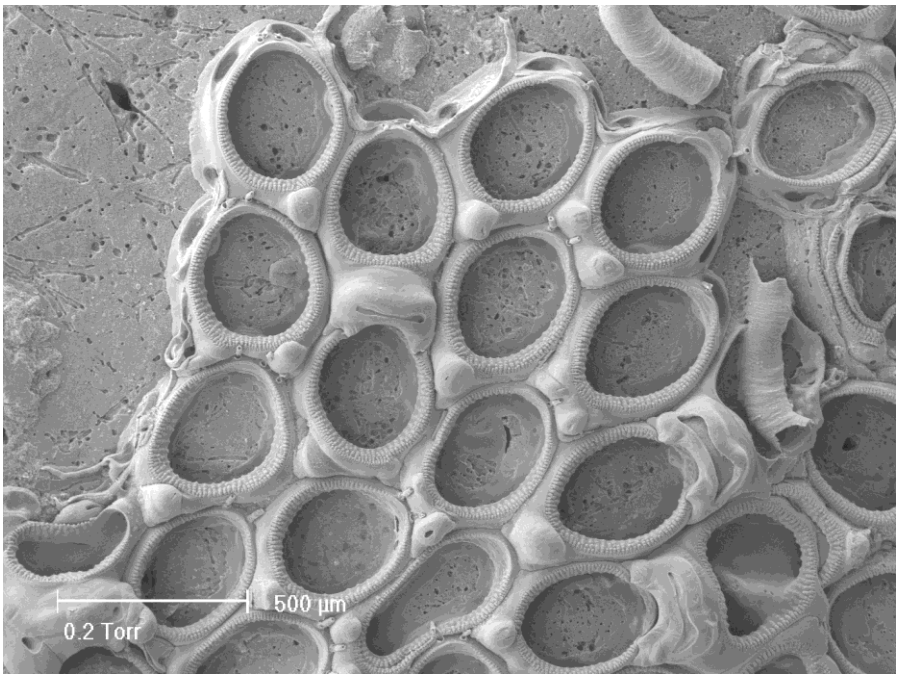
***Crassimarginatella solidula* (Hincks, 1860)**

Description: Colony encrusting, unilaminar, multiserial. Zooids ovate, closely adjacent, separated by shallow grooves. Frontal calcification minor, usually hidden by 1 or 2 smooth, calcified nodules; opesia oval. 4 distal short spines in young zooids. Only 2 spines were found in young zooids in Belgian material.
Irregularly formed kenozooids; with extensive calcification and reduced opesia may occur. Ovicells depressed, wider than long and in front rather flat, smooth and finely grained, with an area of uncalified ectooecium frontally. Avicularia rare, as large as an autozooid, interzooidal, with two sharp spines medially that grow towards each other from the lateral margin over the avicularium.
Ancestrula as an autozooid, but half the size with 11 to 13 short spines around the opesia.

Occurence: In 2004-2005 5 colonies were discovered on the Hinderbanken, of which one on a peblle, the others on the inside of loose shell valves.

Crassimarginatella solidula from the Westhinderbank, 2005 (JC)





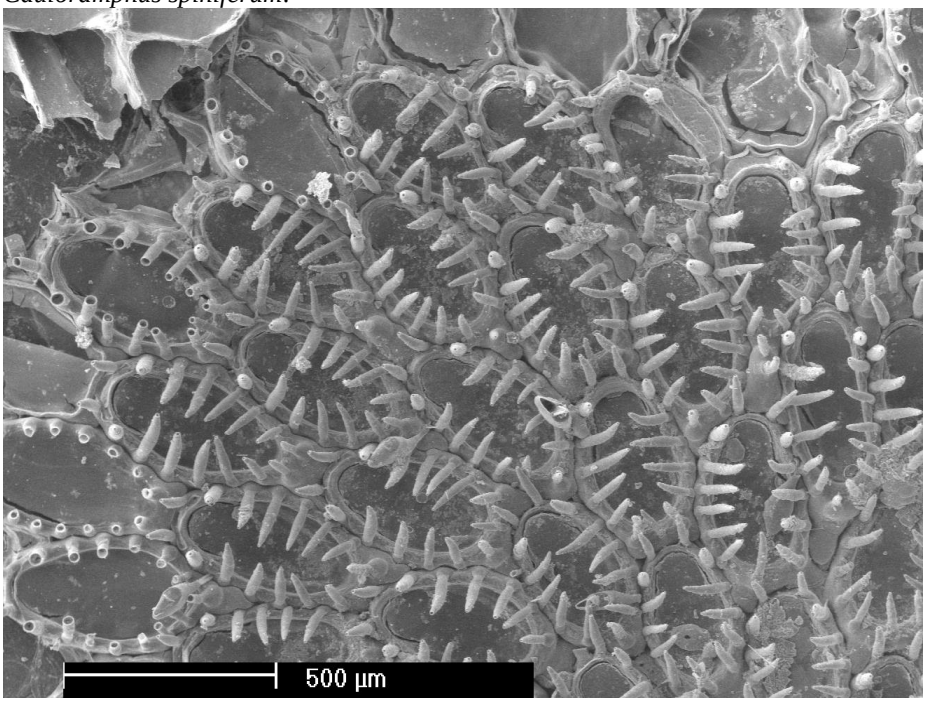
Genus Cauloramphus

Cauloramphus spiniferum **(Johnston, 1832)**

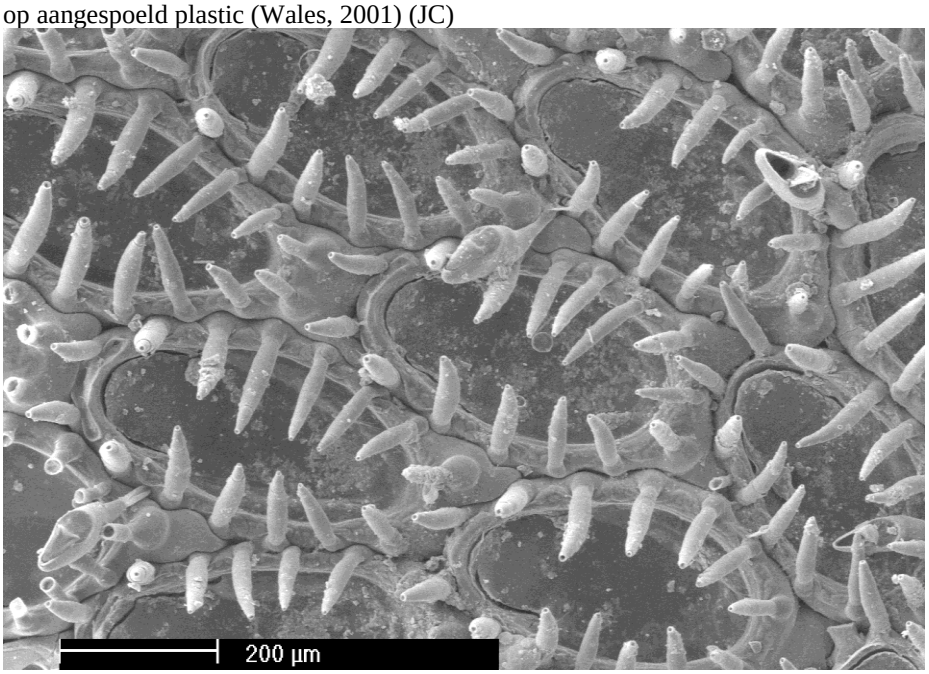
Description: Colony encrusting, unilaminar, multiserial. Autozooids ovate, closely spaced and indistinctly separated by deep grooves. Opesia oval and occupying most of the surface. Lateral wall thick, with 11 to 16 spines, 4 at distal end, erect, the rest regularly rounded and drooping over the opesia. Spines thick and blunt, hollow, basal with a joint, often short, about half the width of the opesia, but up to twice as long.
Avicularia petiolate, resembling a spine. There are sometimes 1 or 2 avicularia between the spines, but often absent. Narrowed at the base and swollen to a characteristic club-shaped apex.
Ovicells closed by autozooidal operculum, very small, not well visible, like a shallow crescent-shaped cap at the distal end of the zooid. Ancestrula ovate, half the size of an autozooid with about 12 spines around the frontal membrane.

Occurence: In Belgium and the Netherlands on washed-up plastic and *Himanthalia* buttons, originating from the English Channel (De Blauwe, 2000b; de Ruijter 2011c, 2015c, 2018a).

Cauloramphus spiniferum:



op aangespoeld plastic (Wales, 2001) (JC)



idem, zoïden met gesteelde avicularia (JC)

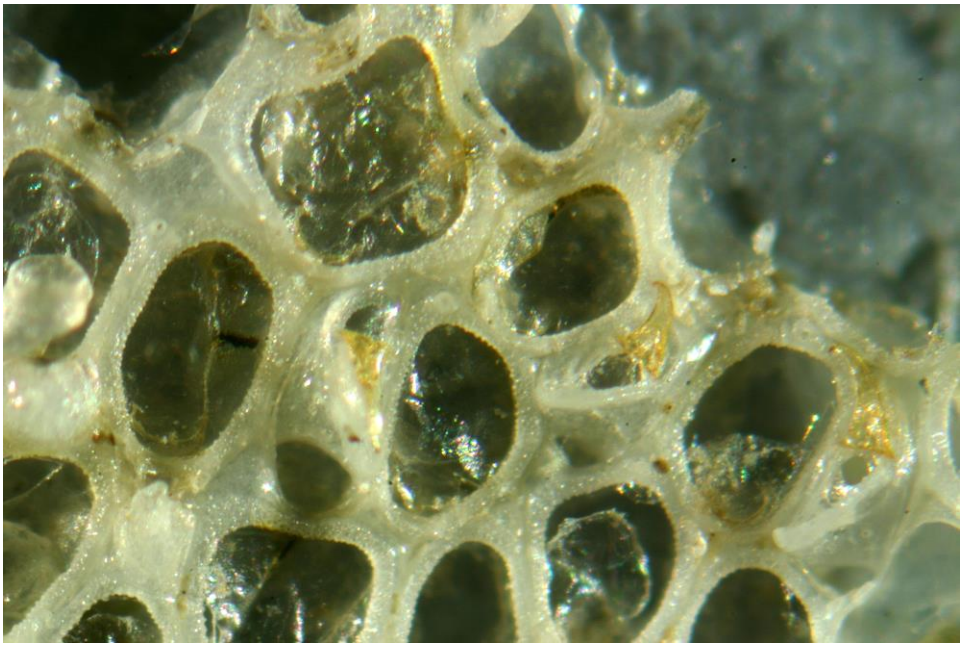
Genus Parellisina

***Parellisina curvirostris* (Hincks, 1862)**

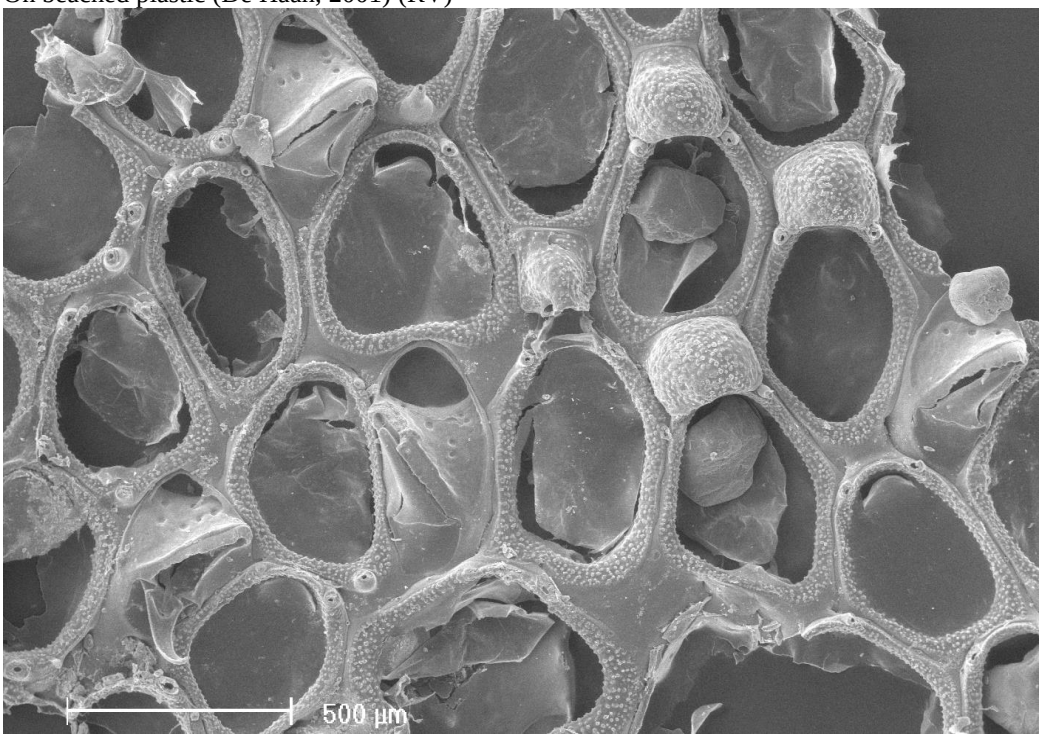
Description: Colony encrusting, unilaminar, multiserial. Autozooids ovate or with an irregular outline, separated by shallow grooves. Lateral walls erected to a rim around the opesia. Short spines may surround the opesia, typically 1 medial and proximal and 1 on each side of the orifice, frequently absent. Rostrum of avicularia erect, directed distally and curved to one side, proximal end with a small rounded or triangular opesia. Each avicularium with a small distal kenozooid.
Ovicells spherical, wider than long, with a rough grained surface. Ancestrula elliptical, half the size of the autozooids, encircled by marginal spines. The first two daughterzooids have very short spines.

Occurence: In Belgium once on a washed-up plastic object, on September 15, 2001 in De Haan (De Blauwe, 2003).

Parellisina curvirostris:



On beached plastic (De Haan, 2001) (RV)



SEM-foto of the same colony (JC)

Genus Tegella

***Tegella unicornis* (Fleming, 1828)**

Description: Colony encrusting. Autozooids elongate quadrangular. Calcification thin and delicate. Frontal surface almost completely occupied by an oval frontal membrane. A hollow tubular spine on each side of the orifice. A second pair of spines might be present in young zooids but is soon obscured by the developing ovicell. An avicularium on the gymnocyst and more might be present on the lateral walls. Rostrum acute to the frontal plane and directed distally of proximally. If an ovicell develops, the avicularium above becomes intimately associated with it and appears to surmount it. Ovicell hyperstomial, flattened in front with a broad transverse area of membranous ectooecium, bounded by a ridge. Embryos orange.

Occurrence: Boreal and Arctic species, widespread in the northern North Sea.
Germany: on German coasts (Hayward & Ryland, 1998 and Zettler *et al.*, 2018) and in Helogland (pers. comm. Britta Kind).

Photos not yet available

Family Antroporidae

Genus Rosseliana

Autozooids with cryptocyst occupying half of the frontal area. Spines and avicularia absent. Ovicells small, immersed, closed by autozooidal operculum.

***Rosseliana rosselii* (Audouin, 1826)**

Description: The colony forms a small patch. Autozooids oval, arched distally but often narrowed proximally. Zooid boundaries marked by a raised lateral wall. Vertical walls thickened and crenellate. Cryptocyst slightly concave and crenellate. Opesia semi-elliptical with a slightly concave proximal edge. Ovicell a small, indistinct, shallow crescentic cap at the distal end of the autozooid.

Occurrence: South and west of the British Isles on shells and stones.
The Netherlands: De Ruijter 2014b reports that a colony on plastic washes ashore in 2013 at Egmond aan Zee.

Photos not yet available

Genus Amphiblestrum

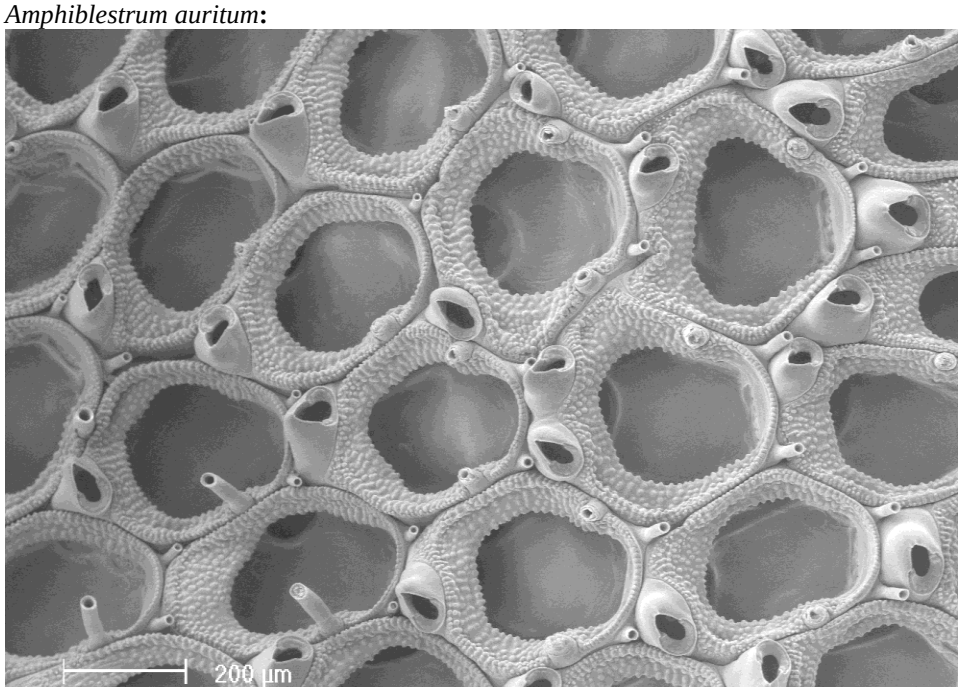
1 a) Up to 6 distal spines, 1 strongly elongated, curved and thickened, draped over the frontal surface. Opesia remarkably three-lobed, formed by the cryptocyste below the membrane. ..... *Amphiblestrum flemingii* (p. 118)
b) 3 or 4 early stage spines, generally 1 permanent. Cryptocyste minimal, opesia broadly oval; usually at least 2 avicularia per zooid. ….. *Amphiblestrum auritum*

***Amphiblestrum auritum* (Hincks, 1877)**

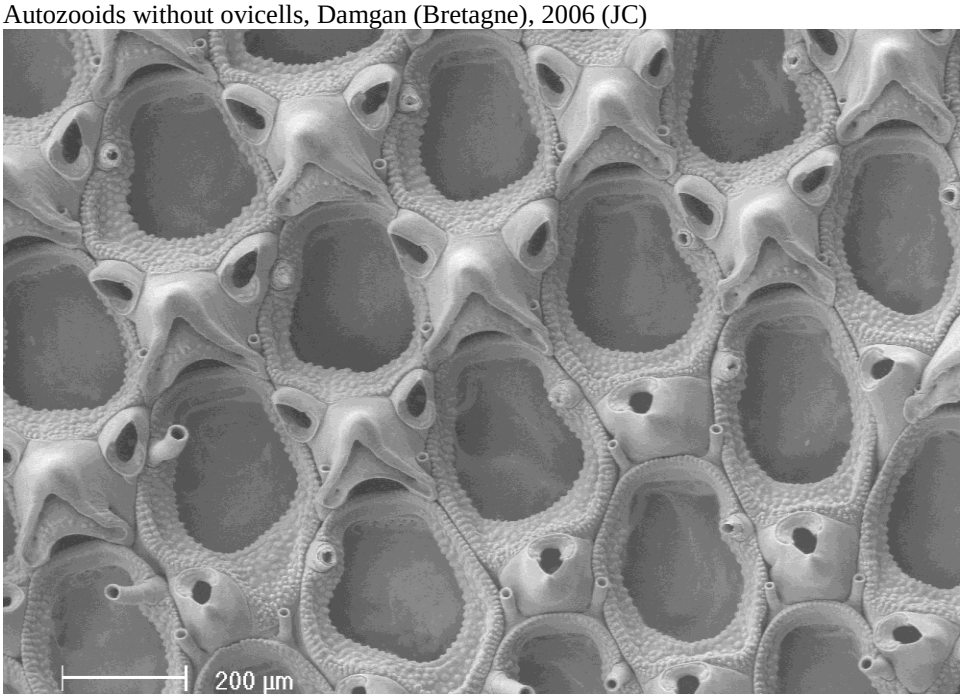
Description: Colony encrusting, unilaminar, multiserial. Autozooids hexagonal to oval. Frontal calcification minimal, hidden by one, sometimes two avicularia. Opesia ovate, ¾ from the frontal surface. 4 spines at the distal end of newly formed autozooids, one often enlarged. Later, only 1 spine remains. Usually two avicularia on the proximal margin of the zooid, if the previous zooid has an ovicell, they are just distal to it. Ovicells with characteristic ridge marking the edge of a triangular zone. Embryos white. Colonies without ovicells are difficult to distinguish from *Callopora dumerilii*.

Occurence: On the lower beach and shallow sublittoral. In Belgium and the Netherlands sometimes on washed up objects.
Belgium: In the Bay of Heist a colony was found on 11 March 2004 on a rock along the eastern harbor dam of Zeebrugge.
The Netherlands: Only recently discovered autochthonous in Zeeland (Faasse & De Blauwe, 2004). Collected on the Dogger Bank in 2016.
Germany: Collected in the German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

Amphiblestrum auritum:



Autozooids without ovicells, Damgan (Bretagne), 2006 (JC)



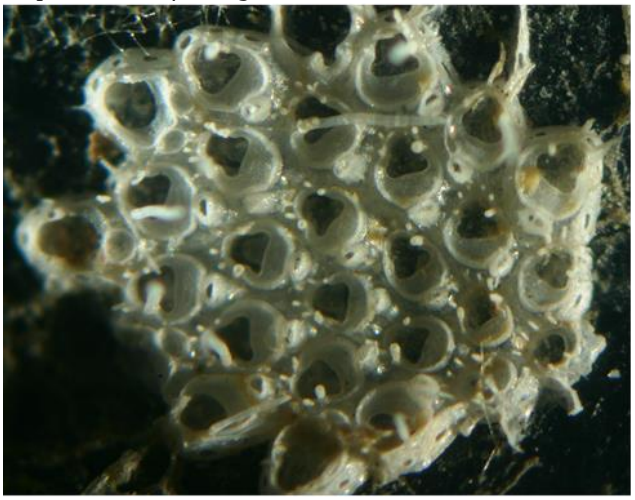
Autozooids and ovicells, idem (JC)

***Amphiblestrum flemingii* (Busk, 1854)**

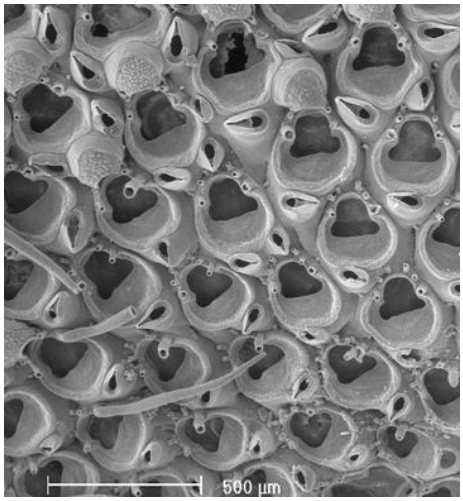
Description: Colony encrusting, unilaminar, multiserial. Autozooids oval, close together, 0.5 x 0.2 mm. Lateral walls erected to a prominent rim around the frontal membrane. Gymnocyst wall minimal, usually hidden by 1 or 2 avicularia. A cryptocystal calcareous wall lies below the frontal membrane and makes the opesia characteristically three-lobed. Up to 6 oral spines distally, only 4 in the presence of an ovicell. The distal pair of spines short and thin, 1 of the proximal pairs very long and thickened, often flattened and curved and draped over the frontal surface of the zooid. 1 or 2 avicularia associated with each zooid; the orientation of the pointed mandible is variable.
Ovicells spherical, smooth and glittering, with a rounded, granular frontal zone. Ancestrula smaller than autozooids, round, with 8 or 9 erect spines around the opesia.

Occurence:
France: On boulders near Cap Gris-Nez in June 1992 (Davoult *et al*. 1999).
Belgium: Known from washed up plastic objects (De Blauwe, 2009)
The Netherlands: washed up on the leg of an Augustine crab *Lithodes maja* (Lacourt, 1949) which was probably landed and thrown overboard by fishermen from the northern North Sea. According to Maitland (1897) rare in the Netherlands (washed up?). Washed up at Bergen aan Zee on nylon rope in 2009 (de Ruijter, 2011a) and on plastic (de Ruijter 2013a, 2014b, 2014d, 2015a, 2017a).
Germany: Collected at Helgoland (pers. comm. Britta Kind).

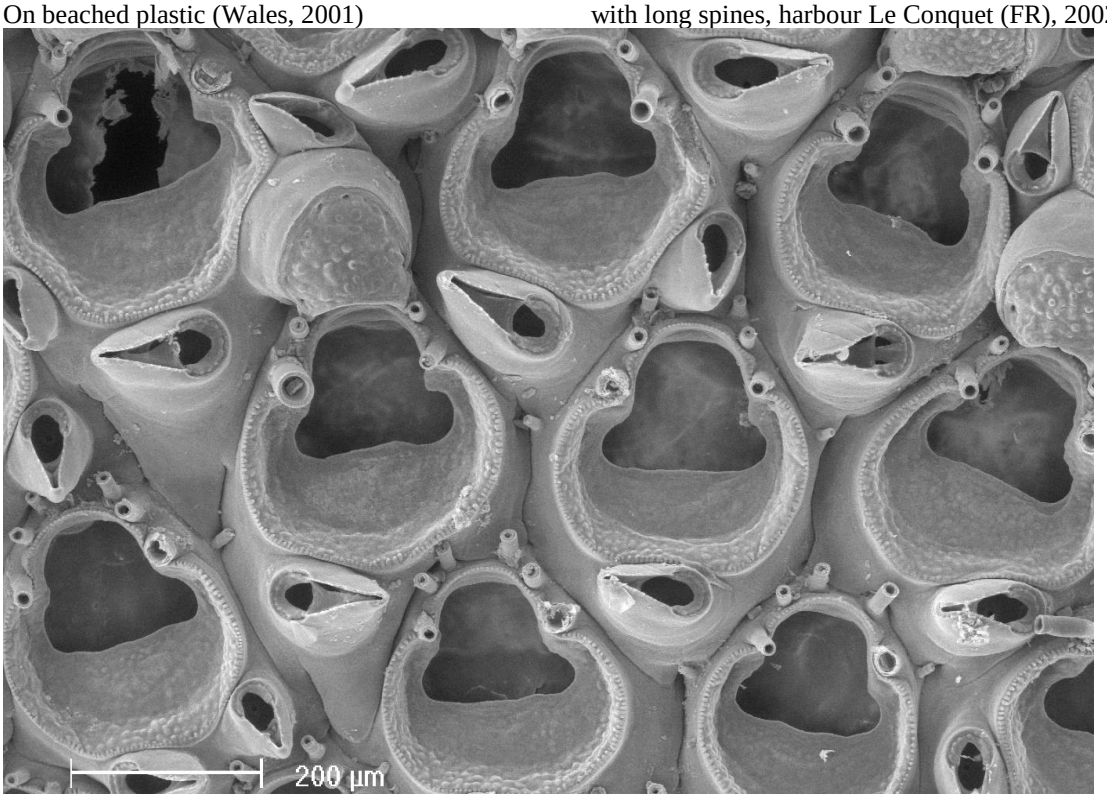
Amphiblestrum flemingii:



On beached plastic (Wales, 2001)



with long spines, harbour Le Conquet (FR), 2002



idem (JC)

Genus Ammatophora

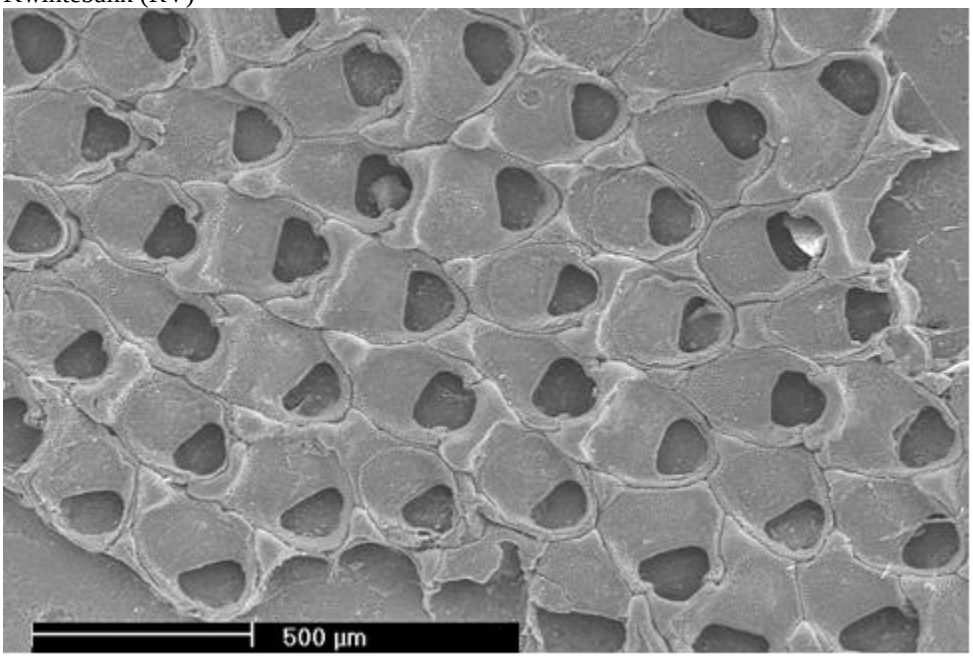
***Ammatophora nodulosa* (Hincks, 1877)**

Description: Colony encrusting, unilaminar, multiserial. Zooid border conspicuous by an erect lateral margin. Under the proximal half of the frontal membrane lies a granulated calcareous layer. The opesia is semi-elliptic to three-lobed. Ovicells small and inconspicuous. Typical are the large rounded interzooidal kenozooids.

Occurence:
Belgium: In 1906 a colony was fished up on the Flemish Banks 51° 29' 30'N - 2° 36'E (RBINS collection). Discovered in 2004 on the inside of shell valves of the Kwintebank and a large colony (diameter of 2 cm) on a flint boulder from between the Hinderbanks. In 2005, 8 shell valves were fished on the Hinderbanks with one or more colonies of this species on the inside.

Ammatophora nodulosa:

Kwintebank (RV)



Kwintebank (JC)

Superfamily Buguloidea

Family Bugulidae

Genus Bugula, Bugulina and Crisularia

Bugula senso lato was devided into 4 clades by Fehlauer-Ale *et al*. (2015).

Bugula Oken senso stricto comprises one species from our area, e.g. *Bugula neritina*. All species in this clade lack articulated spines and exclusively share the presence of long zooids, bifurcating biserial branches with bifurcation type 4 or a modified type 3 with uniserial appearance, and spherical ooecia attached to the inner distal angle of the autozooid.

Crisularia Gray was resurrected for some species, including the only one from our area, *Crisularia plumosa*. These species share the combined presence of bifurcation type 3 (Harmer, 1923) and an ooecium with proximally exposed entooecium and calcification restricted to the distal edge.

Bugulina Gray was resurrected for, in our area, *B. flabellata*, *B. fulva*, *B. simplex*, *B. stolonifera* and *B. turbinata*. They are characterized by dimorphic avicularia and globular ooecia centred in the zooid midline and attached to the distal region of the autozooid, with the proximal and lateral ectooecial area calcified, but the rest of the oeecium membranous, so that when the ooecium is preserved dried, the distal and frontal areas are often shrunken and depressed, showing the calcified entooecium characteristic of the *Crisularia* species. Except for *B. avicularia* and *B. stolonifera*, whose colonies have biserial branches (in *B. stolonifera* branching patterns types 3, 4 and 5 may occur in the same colony), species in this clade are characterized by colonies with multiserial branches.

The fourth clade, *Virididentula* does not occur in our area.

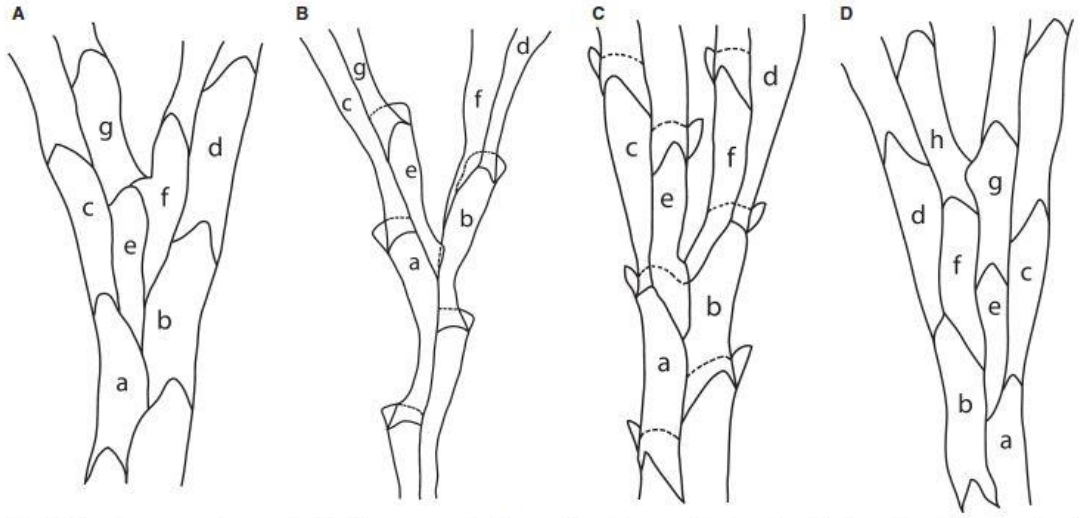


Fig. 1 Bifurcation pattern of species included in present study. A, type 4 found in some *Bugula* species (*Bugula neritina-minima* group) and *Virididentula* gen. n. B, modified type 3 found in some *Bugula* species (*Bugula uniserialis* group). C, type 3, found in *Crisularia*. D, type 5, found in some *Bugulina* species (A, C, and D redrawn from Ryland, 1960).

Bugulina avicularia, Le Conquet (FR), 2002

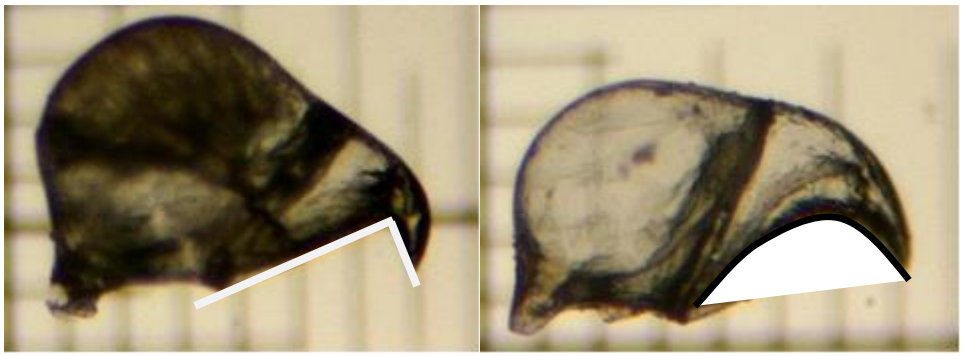
Bugulina flabellata on beached plastic, Oostende, 1999

1 a) Avicularia and spines absent. ..... *Bugula neritina* (p. 128)
b) Avicularia present, spines present. 2

2 a) Autozooids in two series. 3
b) Branches with autozooids in 4 or more series. 7

3 a) Inner distal angle spineless. Outer distal anlgle extended to a pointed protuberance. ..... *Crisularia plumosa* (p. 144)
b) Both distal angles bear at least one spine. 4

4 a) Outer distal angle bears 1 spine; avicularia short and plump, the beak rectangular hook-shaped..... *Bugulina turbinata* (p. 142)
b) Outer distal angle with 2-3 spines; avicularia not short and plump, beak bent down. 5



Hook-shaped bent down

Bugulina fulva, marina Trébeurden (FR), 2002

Bugula neritina, dried colony, marina Hendaye (FR), 2001

Crisularia plumosa, Goesse Sas, 2006

Bugulina simplex, marina Trébeurden (France), 2002

Bugulina stolonifera, marina Zeebrugge, 2006

Bugulina turbinata, Marloes (Wales), 2000

5 a) Outer distal angle bears 3 spines, inner angle with at least 2 spines. ..... *Bugulina fulva* (p. 136)
b) Outer distal angle bears 2 spines, inner angle with 1 spine. 6

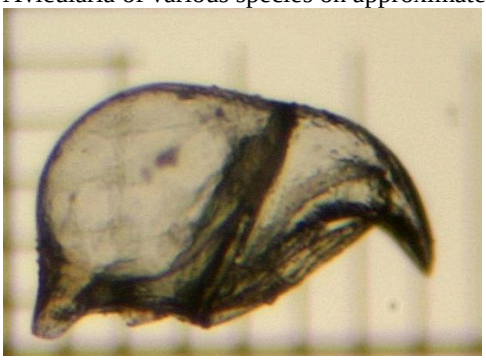
6 a) The frontal membrane takes up 2/3 to 3/4 of the length of the zooid; avicularia small (<200 µm), their length not exceeding the width of a zooid. …… ..... *Bugulina stolonifera* (p. 140)
b) The frontal membrane occupies almost the entire length of the zooid; avicularia longer (approx. 300 µm), their length exceeds the width of the zooid. ..... *Bugulina avicularia* (p. 132)

7 a) Outer distal angle of marginal zooids bears one spine (rarely 2), inner angle with one spine..... 8
b) Outer distal angle of marginal zooids bears three spines (rarely 2), inner angle with at least 2 spines..... 9

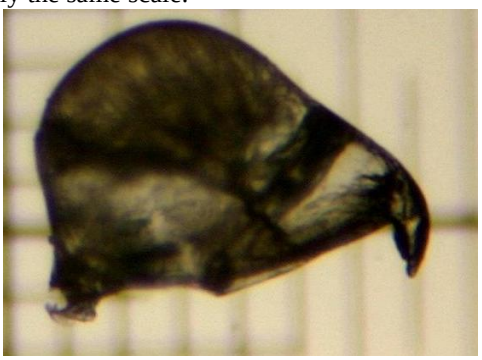
8 a) Avicularia confined to the marginal autozooids, beak bent down. ..... *Bugulina simplex* (p. 138)
b) Large avicularia present on marginal zooids, small ones on the inner zooids, the beak rectangular hooked..... *Bugulina turbinata* (p. 142)

9 a) Beak of avicularia rectangular hooked. ..... *Bugulina flabellata* (p. 134)
b) Beak of avicularia bent down. ..... *Bugulina fulva* (p. 136)

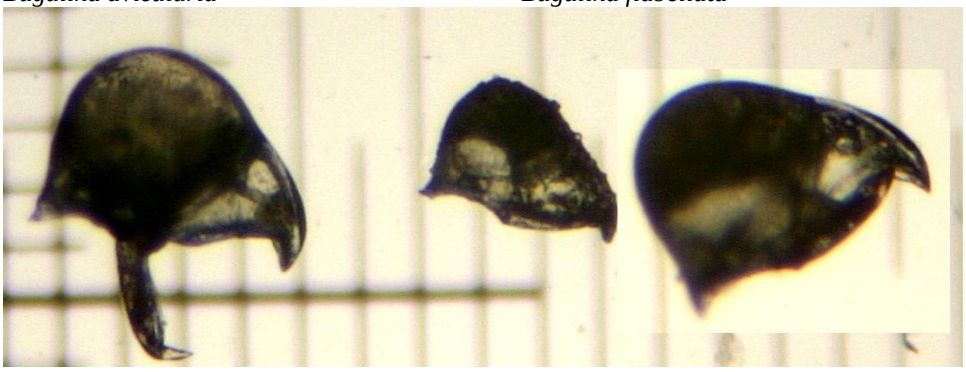
Avicularia of various species on approximately the same scale:



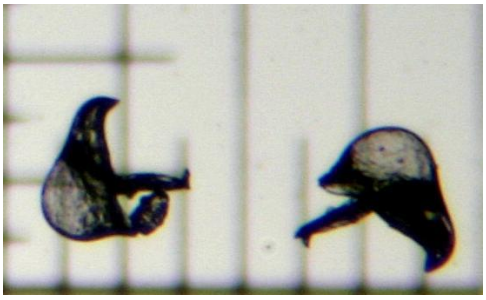
Bugulina avicularia



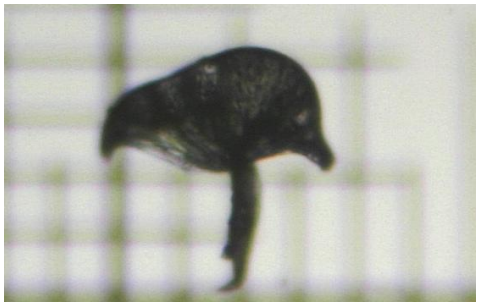
Bugulina flabellata



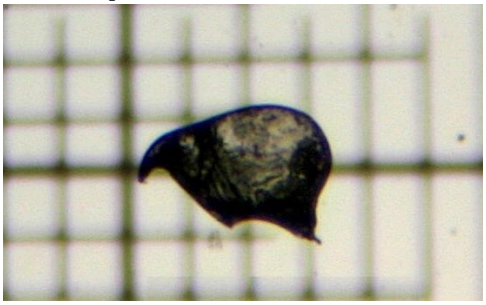
Bugulina fulva



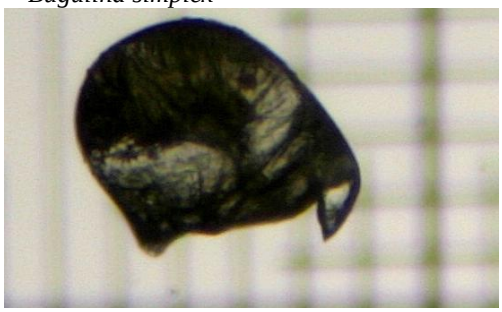
Crisulina plumosa



Bugulina simplex



Bugulina stolonifera



Bugulina turbinata

***Bugula neritina* (Linnaeus, 1758)**

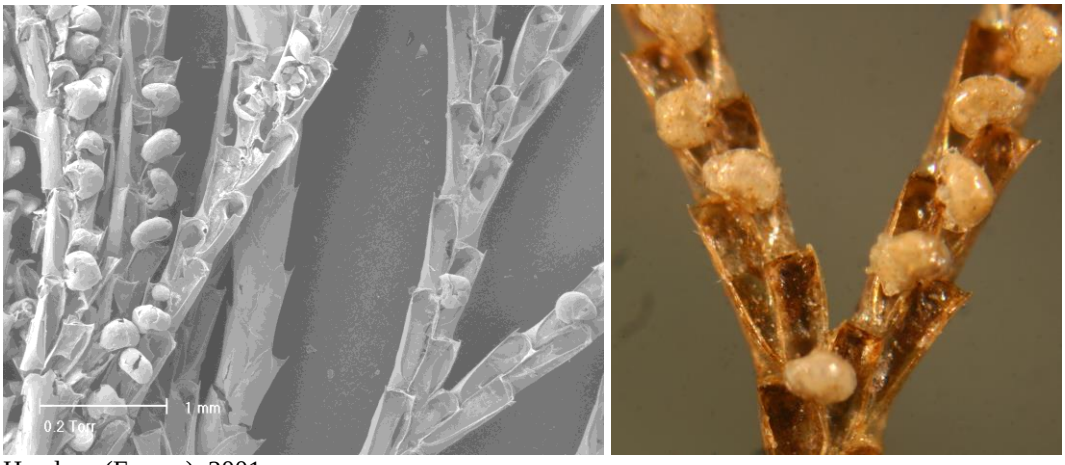
The *Bugula neritina* complex seems to consists of three sibling species (Fehlauer-Ale et al. 2014).

Description:
A beginning naturalist might be most likely to mistake *Bugula neritina* for a small red seaweed. Colonies upright, bushy, branching tufts, up to 15 cm or so in height. They are usually dark red-purple or purple-brown, though occasionally they are a dull, dark red. Branches with zooids in 2 series. Zooids large, narrowing proximally; the entire frontal surface membranous. Spines absent, but the free outer distal corner protrudes slightly. Polypide with 20-24 tentacles. Avicularia do not occur.
Spherical ooecia produce each a single, dark-brown embryo at a time. Ooecia white, attached to the inner distal angle of the autozooids and oriented obliquely to the axis of the branch. Ancestrula symmetrical, with a U-shaped membranous space; spineless.

Occurence: *Bugula neritina* has a broad global distribution in temperate, subtropical and tropical waters. First observation in our neighbourhood was in southern England, presumably introduced on ships and first discovered at Plymouth between 1904 and 1912 (Ryland & Hayward 1977).
A species of harbours, ship hulls, buoys and submerged objects. To be expected on yachts from Southern Europe and as a temporary or permanent introduction to ports.
Belgium: Found once on a yacht in the Mercator marina in Ostend in 1999 (Kerckhof, 2000) and the next time on that location was on test panels in August 2021. In 2010 as fouling species on the research vessel "Belgica" when it was visting the inner harbor of Brugge/Zeebrugge (https://waarnemingen.be/observation/49920706/). In November 2019 a specimen was found attached to a pontoon in the marina of Zeebrugge https://waarnemingen.be/observation/181991741/. Since then, a population has been established in this place every year.
The Netherlands: *Bugula neritina* was first found in April 2007, in the marina of Burghsluis (Faasse, 2007). This observation concerns fresh outgrowths on old stolons. Therefore, the species was probably already present in 2006. Since 2008, the species has been found in 'Roompot Marina' near Wissenkerke as well (Faasse *et al.*, 2013).
In November 2015, two colonies were found in material from the marina of St. Annaland, in the northeast of the Oosterschelde area. In the same month also found in the marina near the Goesse Sas (Faasse & Ligthart, 2016). In 2017 one colony in Sophiahaven (Kamperland, pers. obs.), the marina of Wemeldinge (Kuijper & Cadée, 2018) and common in Burghsluis (de Ruijter, 2019c and pers. obs.). In 2020 observed in

the marinas of Burghsluis and Scharendijke, in 2021 at Wemeldinge and in the Grevelingen.

Bugula neritina, Burghsluis @ Marco Faasse



Hendaye (France), 2001

Washed ashore op plastic in the Netherlands:

13 jan 2017 at Bergen aan Zee (de Ruijter, 2017a).
13 nov 2018 Sytske Dijksen on Texel (pers. comm. with photo)
7 sep 2020 on Texel (de Ruijter 2020c)

Since September 2017, loose colonies have been washing up on the beach:

3/9/2017	Langevelderslag	3 colonies
4/9	Katwijk – Noordwijk	hundreds
6/9	Noordwijk	1
9/9	Noordwijk	2
9/9	Katwijk	1
10/9	Ijmuiden	11
16/9	Katwijk/Noordwijk	2
23/9	Ijmuiden/Noordpier	1
4/11	Noordwijk	1
17/11	Katwijk	2
2/12	Katwijk	1
5/12	Noordwijk	1
11/12	katwijk	1
23/12	Katwijk/Noordwijk	several tens
7/1/2018	Bergen aan Zee	1 (de Ruijter 2018b)
14/1	Velzen	several
7/10	Ijmuiden	on *Tubularia larynx* (de Ruijter, 2018d)
6/12	Langerveldslag	1 (de Ruijter 2019a)
14/12	Bergen aan Zee	1

September 4th hundreds of colonies lay over 2 km, most of them attached to barnacles, between Katwijk and Noordwijk. There were 11 near Ijmuiden on September 10, 2017, also on barnacles (de Ruijter, 2017b). The barnacles were all *Amphibalanus amphitrite*, chipped with base included, there was no paint or anything else on the underside (Kuijper & Cadée, 2018).
This washing up is similar to that of *Biflustra grandicella*. It concerns more or less the same coastal area. Where those colonies come from remains a mystery. It is not evident that a new population has settled off the coast. It is rather plausible that fragments of a ship's hull have been broken off by, for example, sanding over a sandbank. Another possibility is that the fragments were scraped off in a harbor and then dumped into the sea. However, there is no evidence for such practices.

Grevelingen 2021 @ Ad Aleman

Grevelingen 2021 @ Ad Aleman

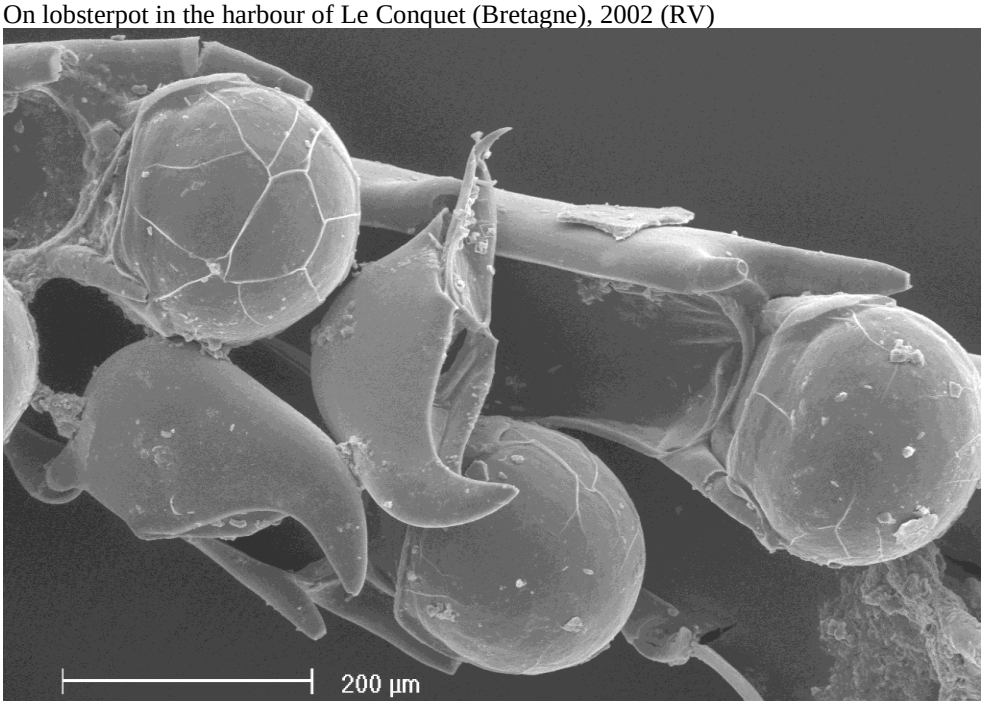
Bugulina avicularia **(Linnaeus, 1758)**

Beschrijving: Bushy, 2-3 cm high, branches spiral around the main axis. Orange-brown. Branches two-row. Zooids rectangular or narrowing at proximally, almost all of the frontal surface membranous. Outer distal angle with 2 spines, inner distal angle with 1 spine. Polypide with 13-15 tentacles. Avicularia large, their length exceeds the width of the bearing zoid, attached at 1/3 or halfway up the lateral wall. Ooecia spherical. Yellow embryos from June to November. Mainly confused with *B. stolonifera,* which is more of a port species.

Occurence: On hydroids and shells where, as with *B. flabellata*, the immediate carrier is usually another bryozoan colony such as *Flustra foliacea*.
Belgium: In the RBINS there are two colonies on *Flustra foliacea*, both dredged in 1905 (51°29'15'N-2°32'45'E and 51°31'30'N-2°34'30'E). No recent observations from the southern North Sea.
The Netherlands: Faasse (1998) rightly suggests that reports from the Netherlands of *B. avicularia* in Lacourt (1949), Heerebout (1970), Otten (1992), Platvoet et al. (1995), Faasse (1996) in harbor centers concern *Bugulina stolonifera*. fig. 29 of '*Bugulina avicularia'* in Lacourt (1978) clearly represents *Bugulina stolonifera*, because the avicularia are no longer than the width of a zooid.

Bugulina avicularia:

On lobsterpot in the harbour of Le Conquet (Bretagne), 2002 (RV)



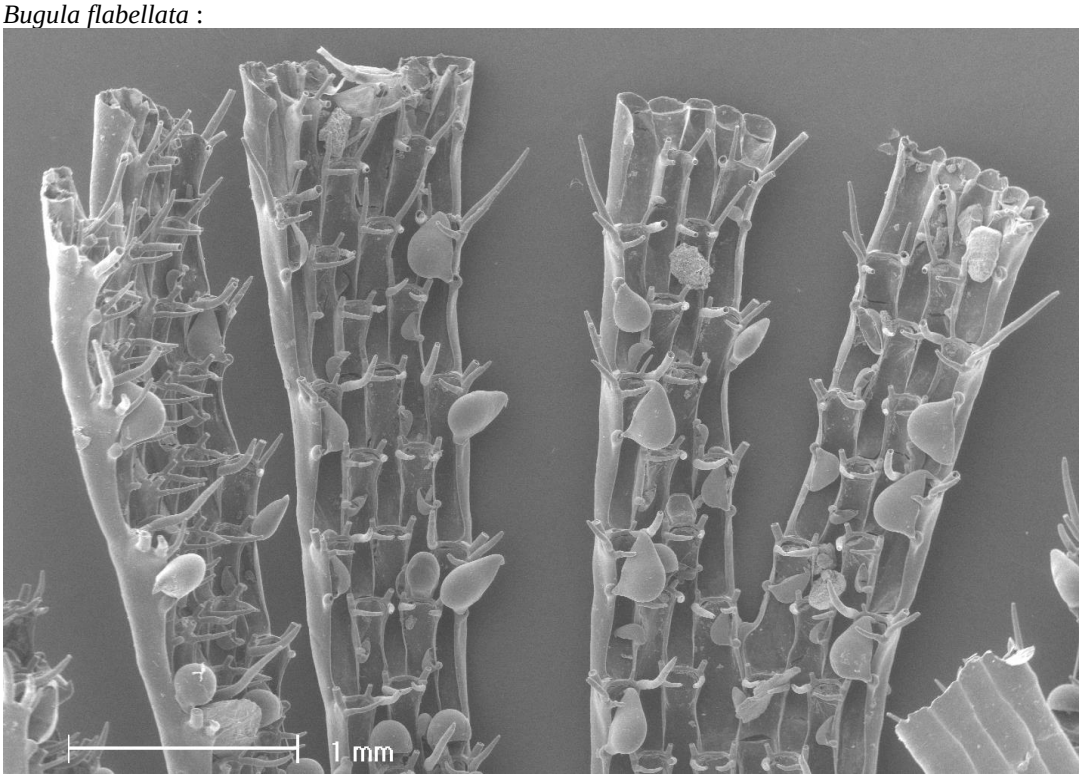
SEM-photo same colony (JC)

***Bugulina flabellata* (Thompson, in Gray, 1848)**

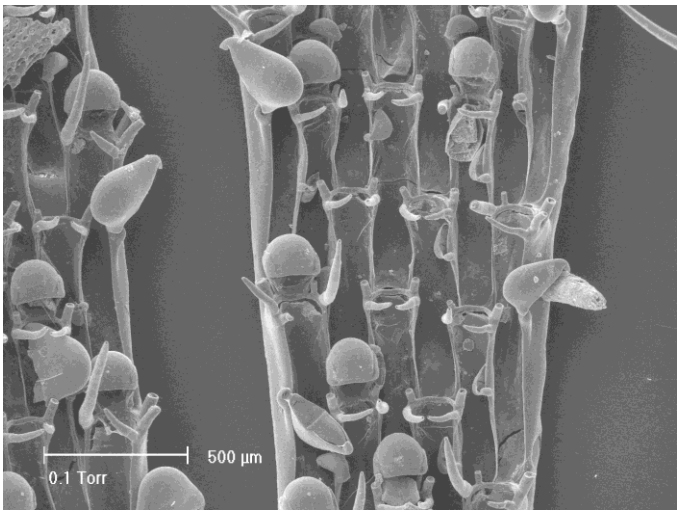
Description: Forms a tuft 2-3 cm high, of yellowish color when alive, but turning gray or brown when dried. Branches broad, widest distally, somewhat circularly arranged. Zooids in 3 to 8 series, elongated, remaining equal width, the membrane occupies all or most of the frontal surface. Spines 3 on distal outer angle, 2 on distal inner angle (2:2 on inner zooids), of variable size; these on the marginal zooids are sometimes very large. Polypide with 14 tentacles. Avicularia present on zooids of inner and marginal series, the latter considerably larger; attached 1/3 to half way down the side; beak rectangular hooked. Ooecia almost spherical; embryos yellow, from May to October. Ancestrula with 3 proximal spines and 3 at each distal corner.

Occurence: On other Bryozoa, even if they seem to grow on rocks or shells.
Belgium: Loppens (1906) mentions this species as common on *Flustra foliacea*, stones and shells and in the harbor of Nieuwpoort sublittorally on harbor structures. The large amount of material on *Flustra foliacea* in the RBINS suggests that this species was much more common in the early 20th century than it is today.
Recently washed up in Belgium on *Flustra foliacea* and plastic objects. During a campaign on the Hinderbanken in 2005 *Bugulina flabellata* was found at only one location. The decline of *Flustra* may be at the base of a decline of *Bugulina flabellata*.
The Netherlands: Very few observations from the Netherlands: washed up in Scheveningen on cork (Lacourt, 1949), in September 2003 at Callantsoog (de Ruijter, 2003b), in August 2005 at Egmond aan Zee (de Ruijter, 2006), on *Flustra* (de Ruijter 2013b, 2014a and e), on plastic (de Ruijter, 2014c and e) near Camperduin on washed-up plastic lobster trap entrance on 4 May 2020 (de Ruijter, 2020b).
Collected in 2015 on the Doggersbank (Faasse *et al*., 2016).
Germany: Collected in the German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

Bugula flabellata :



Harbour of Le Conquet (Bretagne), 2002 (JC)



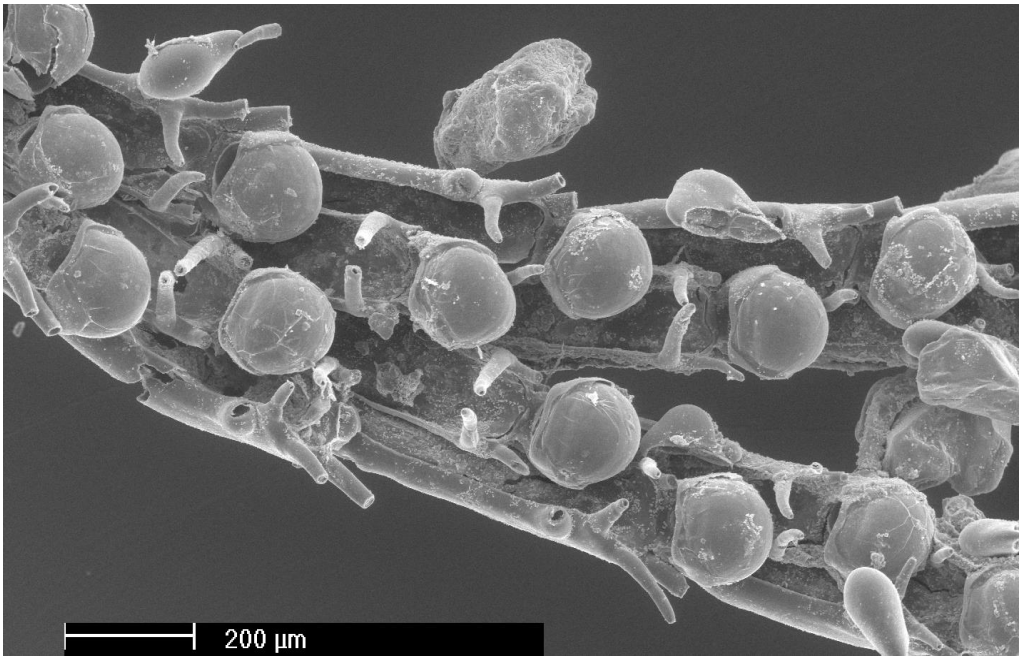
SEM-photo from the same colony (JC)

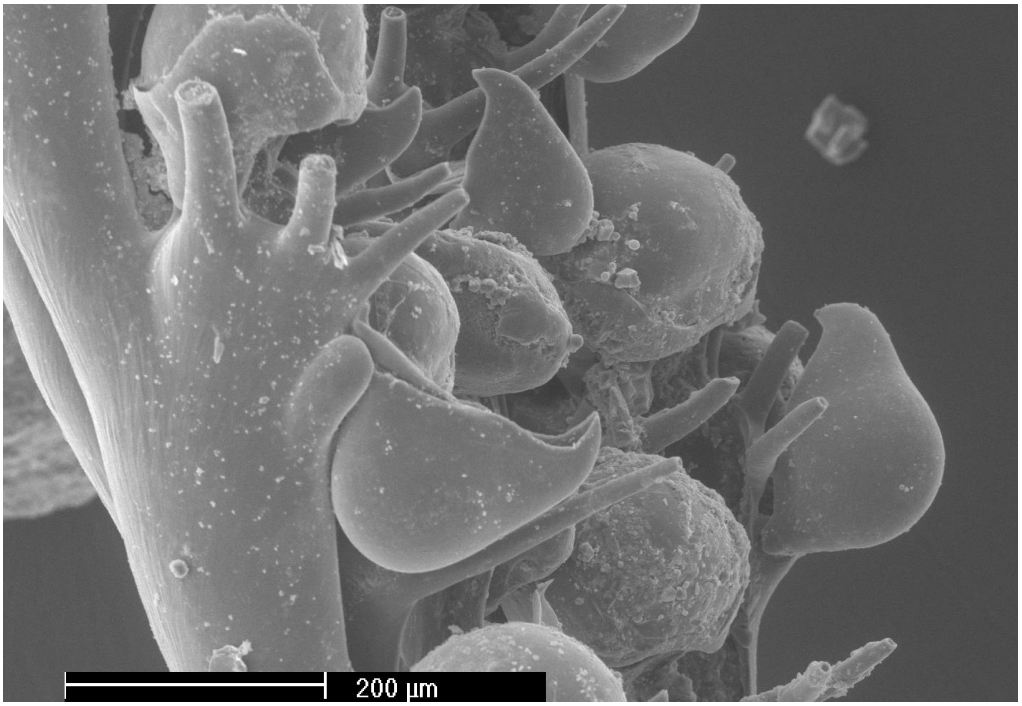
avicularium (RV)

***Bugula fulva* Ryland, 1960**

Description: The colony forms a dense yellow-brown tuft, 2-3 cm high. Branches with autozooids in 2 series, distal in a colony branches can consist of four series of autozooids and then split into two branches of two zooid series. Autozooids rectangular or slightly narrowed proximally. The opesia occupies the entire frontal surface.
Spine formula on marginal zooids 3:2 or 3:3; formula of inner zooids 3:3 (2:2 in the presence of oecia). Polypide with 13 tentacles. Avicularia attached just below the spines, their length somewhat more than the width of a zooid, or smaller on the inner zooids; beak bent down. Ooecia almost spherical. Embryos yellow, present during summer and autumn. Ancestrula with 3 proximal spines, 3 (rarely 2) on each distal corner, and often with one on each side.

Occurence: Rare on washed up plastic: Zeebrugge (De Blauwe, 2005), Bergen aan Zee (de Ruijter, 2017a).





Bugulina fulva on beached plastic Zeebrugge, 2004 (JC)

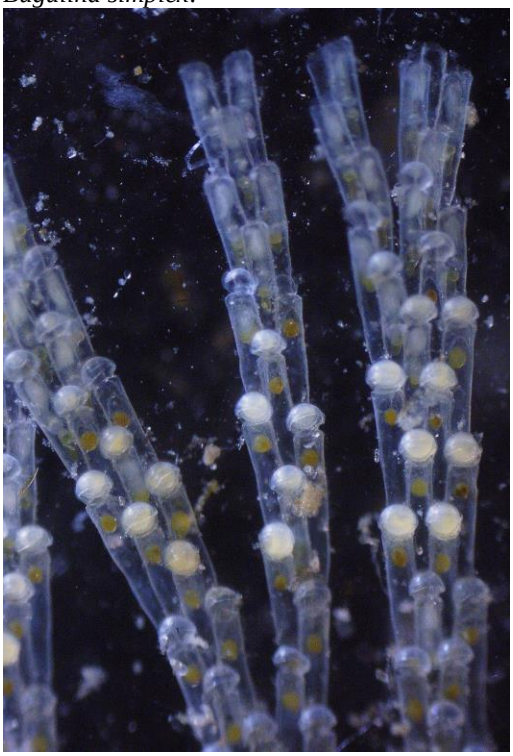
***Bugulina simplex* Hincks, 1886**

Description: Forms a funnel-shaped colony, which later becomes bushy. Height up to 3 cm. Straw-colored to orange-brown. Branches are narrow proximally and widen distally. They are usually made up of 3 to 6 series of zooids. Zooids frontally enterly membranous. Spine formula usually 1:1. Sometimes a second spine on the distal outer corner of marginal zooids. Polypide with 12 to 14 tentacles. Avicularia only present on the marginal zooids. Their length is equal to or slightly more than the zooid width. The beak is bent downwards. Ooecia as a distal hemisphere. Embryos yellow, from July to November. Ancestrula with 3 distal spines and 1 proximal spine. Settlement mainly in August and September.

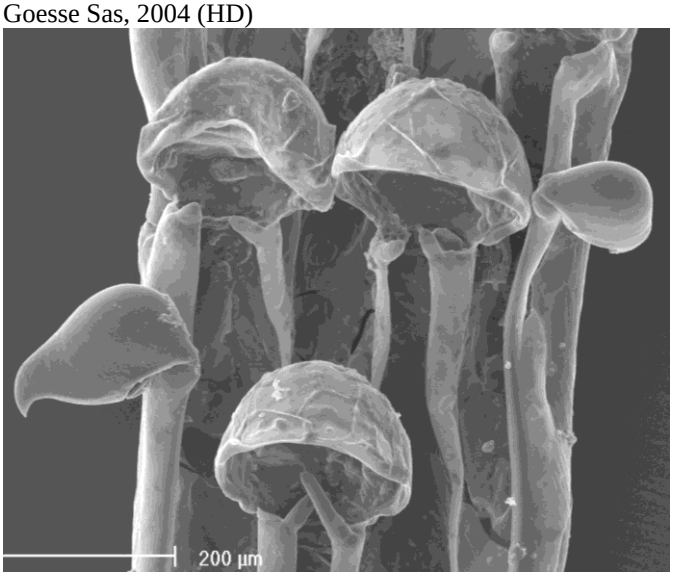
Occurence:
Belgium: discovered in the Mercator marina in Oostende in en in Nederland in het Sas van Goes, beide September 2000 (De Blauwe & Faasse, 2001). Recently washed ashore in Zeebrugge on a plastic bucket (De Blauwe, 2005) and found in the Zeebrugge marina since June 2007.
The Netherlands: discovered in Sas van Goes in September 2000 (De Blauwe & Faasse, 2001). In Zeeland expanding to other marinas: Burghsluis, Wemeldinge, Yerseke, Scharendijke and Ouddorp. Only present for a short time of the year and often in small concentrations or very locally.


colony, marina Yerseke, 2006 (HD)

Bugulina simplex:



Goesse Sas, 2004 (HD)



Trébeurden (Bretagne), 2002 (JC)

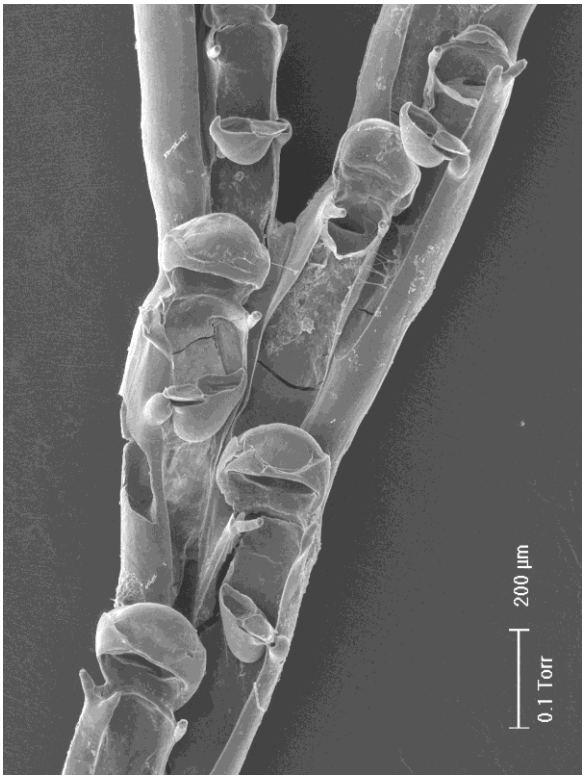
Bugulina stolonifera Ryland, 1960

Description: Forms compact tufts up to 4 cm high. A creeping stolon may develop on which secondary clumps sprout. Color light tan to gray. The branches consist of two series of zooids. Zooids tall and slender. The frontal surface is half to three quarters membranous. Spine Formula 2:1. In some colonies the spines are barely developed. Colonies with more spines were found in the fall, causing confusion with other species. Polypide with 13 or 14 tentacles. The length of the avicularium is less to equal to the zooid width, attached somewhat lower than the distal outer spine, the beak is curved downwards. Ooecia almost spherical. Embryos yellow. Ancestrula with two or three spines on either side distally, one spine proximally. Until 1998 incorrectly identified in our region as *Bugula avicularia* (Faasse, 1998 & Kerckhof, 2000), except by d'Hondt & Cadée (1994).

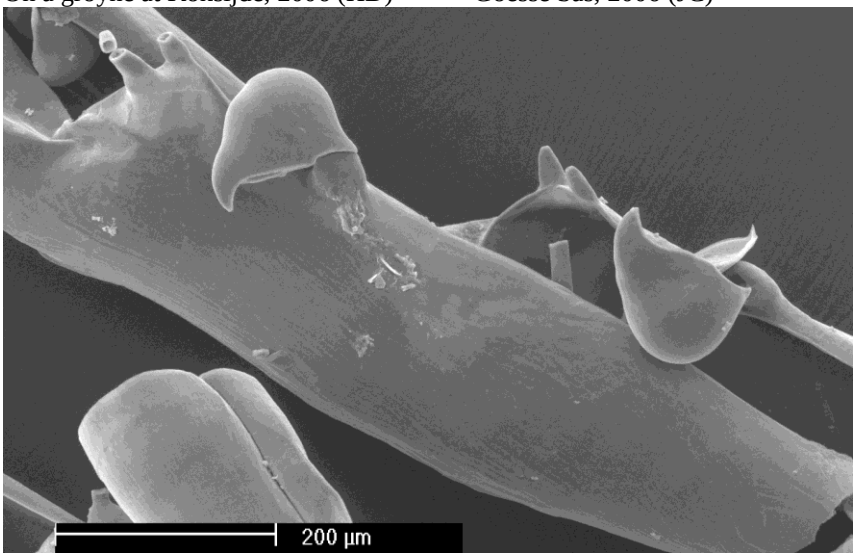
Occurence: Tolerates reduced salinity and pollution.
Belgium: Loppens (1906) does not yet mention this species from Nieuwpoort. Polk (1976) found them in the "Spuikom" of Ostend and mentions them under the name B. avicularia. Author found colonies in the marina of Zeebrugge, Blankenberge, Nieuwpoort, in the "Spuikom" of Ostend en on a groyne in Koksijde.
The Netherlands: This species is considered invasive and therefore the first possible report in the Netherlands is interesting: Horst (1885) in the former Zuiderzee (Faasse, 1998). Common in marinas, such as Burghsluis (de Ruijter, 2019c). Present on the North Sea side of the Brouwersdam (de Kluijver, 1989) and in canals and closed water bodies in Zeeland (Faasse & De Blauwe, 2004). Also reported from the NIOZ harbor on Texel in d'Hondt & Cadée (1994).
Germany: Collected in the German North Sea (Zettler *et al*., 2018).

Bugulina stolonifera:

On a groyne at Koksijde, 2006 (HD)



Goesse Sas, 2006 (JC)



Goesse Sas, 2006 (JC)

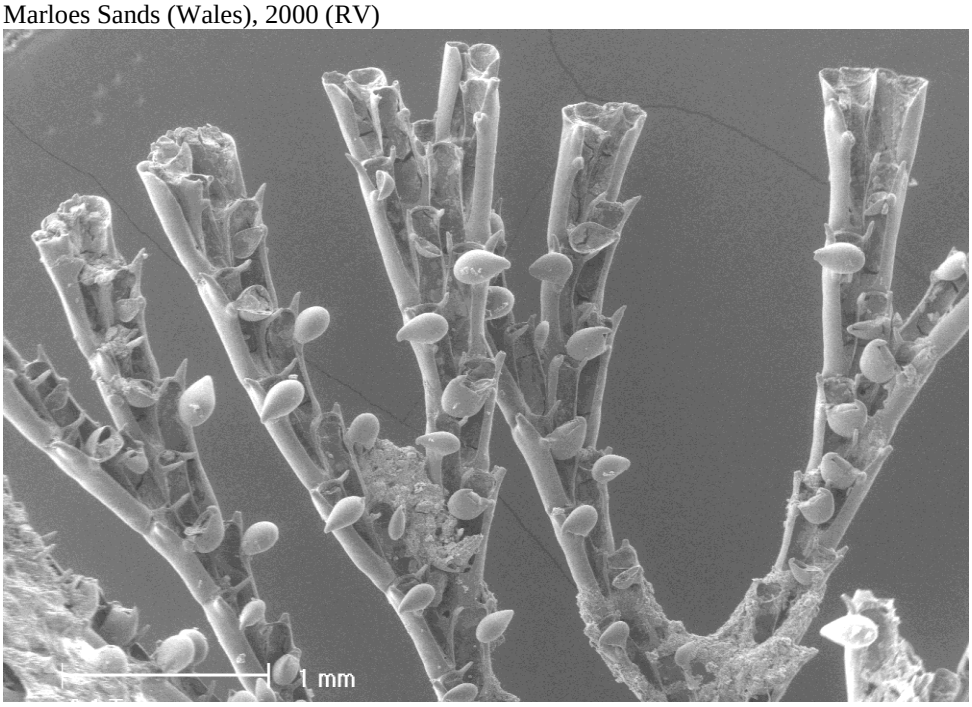
***Bugulina turbinata* Alder, 1857**

Description: Forms tufts up to 6 cm high. The branches are spirally implanted on the main axis. The branches are proximally narrow and consist of two series of zooids. Distally they become wider and multiserial. Most of the frontal zooid surface is membranous. Spine Formula 1:1. Polypide with 13 tentacles. Avicularia attached just below the spine. Those on the inner zooids are much smaller than those on the marginal zooids. The beak is short and curved downwards like a hook. Ooecia almost spherical. Embryos yellow, present from August to November.

Occurence:
Belgium: In 1904 a specimen was dredged off the Belgian coast at 51°21'N-2°32'E and in 1911 at the Schoonveld Drought (RBINS collection). There are no recent finds from Belgium.
The Netherlands: Found on washed up *Flustra foliacea* on Texel (de Ruijter, 2004) and on washed up plastic (de Ruijter, 2006, 2012b). Recorded by Van Moorsel & Waardenburg (1990) from wreck 'K' off the west coast of the Netherlands on 2 August 1991 at a depth of 25 m (52°26'15"N, 03°44'04"E) (Faasse et al., 2013).
Germany: Collected in the German North Sea (Zettler *et al*., 2018).

Bugulina turbinata:

Marloes Sands (Wales), 2000 (RV)



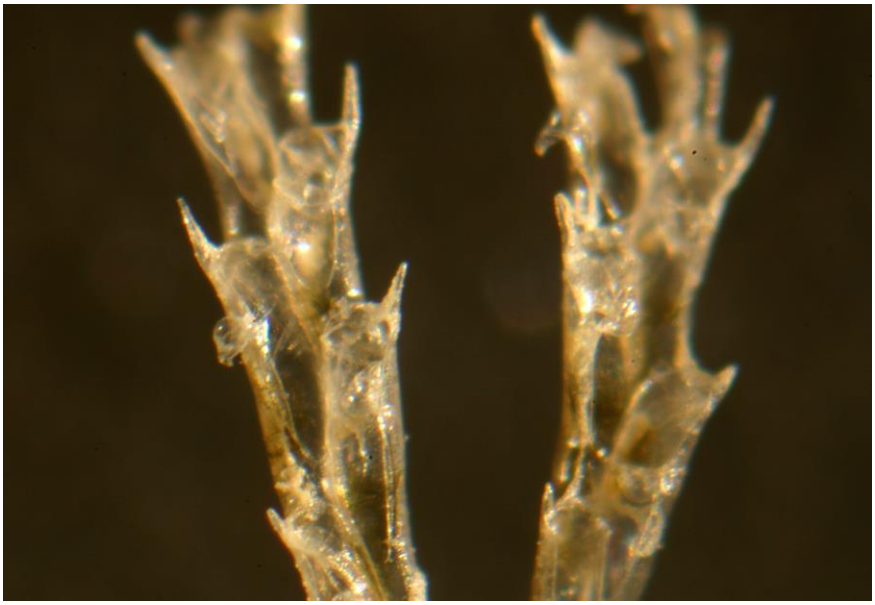
Trébeurden (Bretagne), 2003 (JC)

Crisularia plumosa **(Pallas, 1766)**

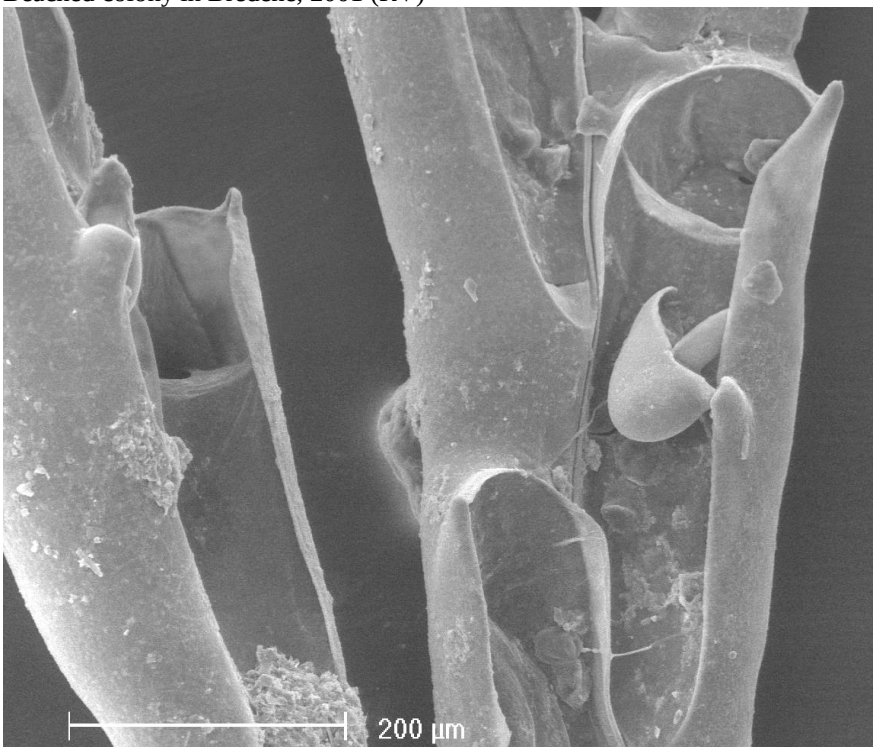
Description: Elongated, feathery tufts are spirally implanted on a main stem. Length up to 8 cm. Color light brown-yellow-orange. The twigs consist of two series of autozooids. Autozooids slender, proximally narrowest, three quarters to almost all of the frontal surface membranous. Inside angle without spine. Distal outer angle with one prominent spine.
Polypide with 14 tentacles. Avicularia very small, their length less than the width of a zooid. The beak is slightly bent downwards. A oecium with embryos looks spherical. Embryos yellow, from July to September. Ancestrula vase-shaped with a rounded terminal frontal membrane, without spines.

Occurence:
Belgium: Loppens (1906) lists this species as rather rare on shells. Three colonies were collected on the Flemish Banks in 1905 and one colony in 1911 (RBINS collection). Found in Belgium in 1999 in the Spuikom of Ostend (Polk, 1976 & Kerckhof, 2000) and on the boulders along the Eastern breakwater of the Zeebrugge harbor (Baai van Heist) just below the low water mark.
The Netherlands: Common in Zeeland on stones and in harbours. Reported more northerly in the Netherlands from Den Helder and the former Zuiderzee (Lacourt, 1949). On washed up plastic (de Ruijter 2008, 2015b, 2020b).
Germany: Collected in the German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).


colony (marina Breskens, 2006) (HD)



Beached colony in Bredene, 2001 (RV)



SEM-photo of the same colony (JC)

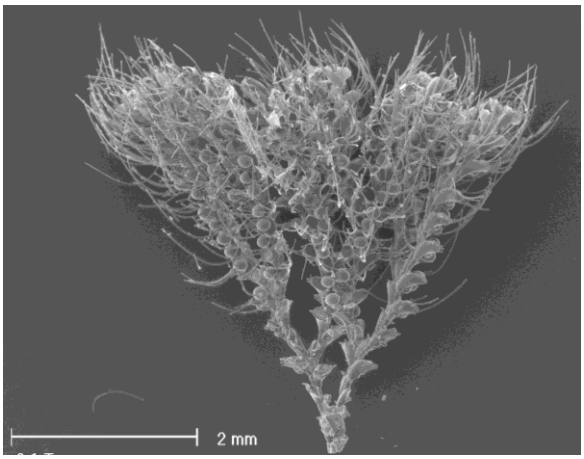
Genus Bicellariella

***Bicellariella ciliata* (Linnaeus, 1758)**

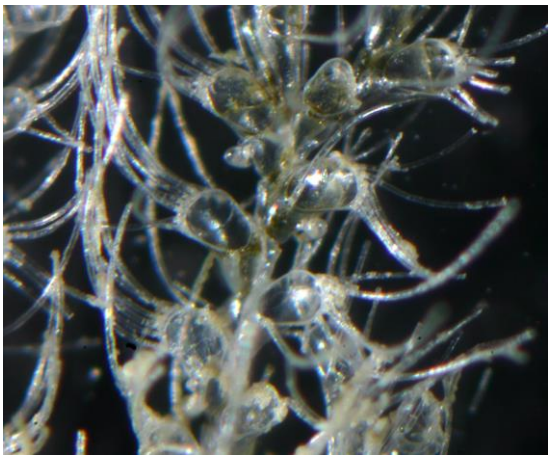
Description: Forms a white, feathery tuft, up to 25 mm high. The curved branches consist of 2 series of zooids, the zooids are alternating. The narrow proximal zooid parts grow against each other, the distal parts are bent outwards. The frontal membrane is oval and occupies about 1/3 of the zooid length.
One proximal spine and a row of 4 to 9 inwardly curved spines on the distal margin. The polypid has 12 to 16 tentacles. Avicularia attached to the outside of the zooid, proximal to the opesia. Inner margin of the beak serrated. Ovicells attached next to the membrane by means of a short stalk. Almost spherical, with the opening on the side of the frontal membrane. Embryos pure white. A first generation carries embryos in April-May and then dies. A second generation carries embryos in August. Colonies formed from second-generation larvae overwinter. Ancestrula funnel-shaped with a terminal round membrane, around which 10 to 12 spines. This ancestrula was previously mistaken for another species, namely *Brettia tubaeformis*.

Occurence: Grows on groynes, stones, shells, hydroids, bryozoans, etc. from the lower beach and in shallow sublittoral areas.
Belgium: Loppens (1906) called this species fairly common. Native in the Bay of Heist and on shipwrecks (Zintzen, 2007).
The Netherlands: In the eastern part of the Oosterschelde, in the Western Scheldt estuary and one record from the Veerse Meer. De Ruijter (2005, 2007 and 2008, 2014b, 2014c) reports colonies on washed up plastic at Egmond aan Zee. Previously washed ashore in the Netherlands between Zeeland and Den Helder (Lacourt, 1949).
Germany: Collected in the German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

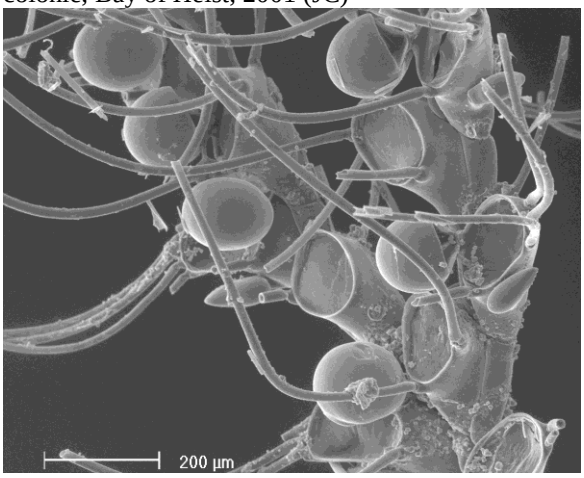
Bicellariella ciliata:

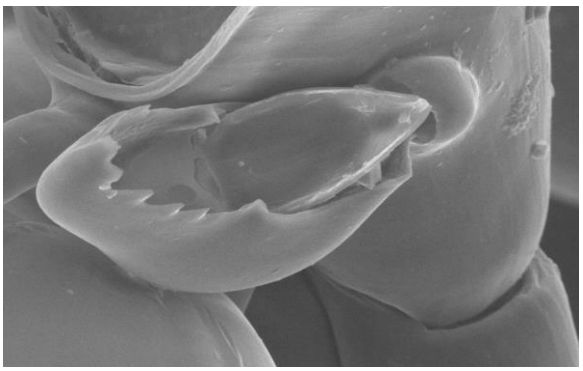


colonie, Bay of Heist, 2001 (JC)



idem (RV)





Inner margin of avicularium serrated (JC)

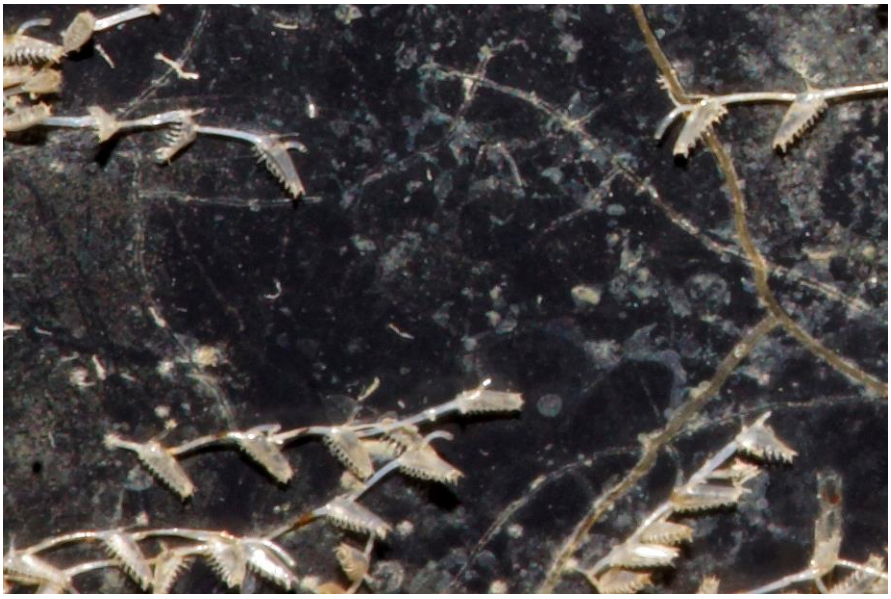
Family Beaniidae

Genus Beania

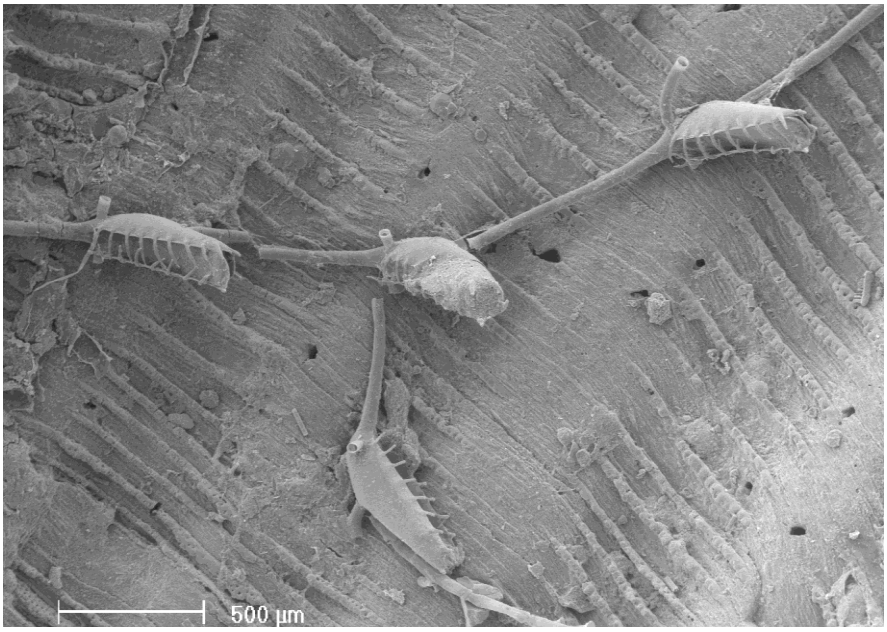
Beania mirabilis **Johnston, 1840**

Description: The colony is thin, branching and attached with rhizoids. The rhizoids originate basally and have an adhesive plate against the substrate. Zooids proximally tubular and abutting the substrate. Erected distally, in the shape of a coal shovel. Frontal membrane elongated, 5 to 11 spines on each side. One or two spines on the distal margin. Avicularia and ovicells are absent in this species.

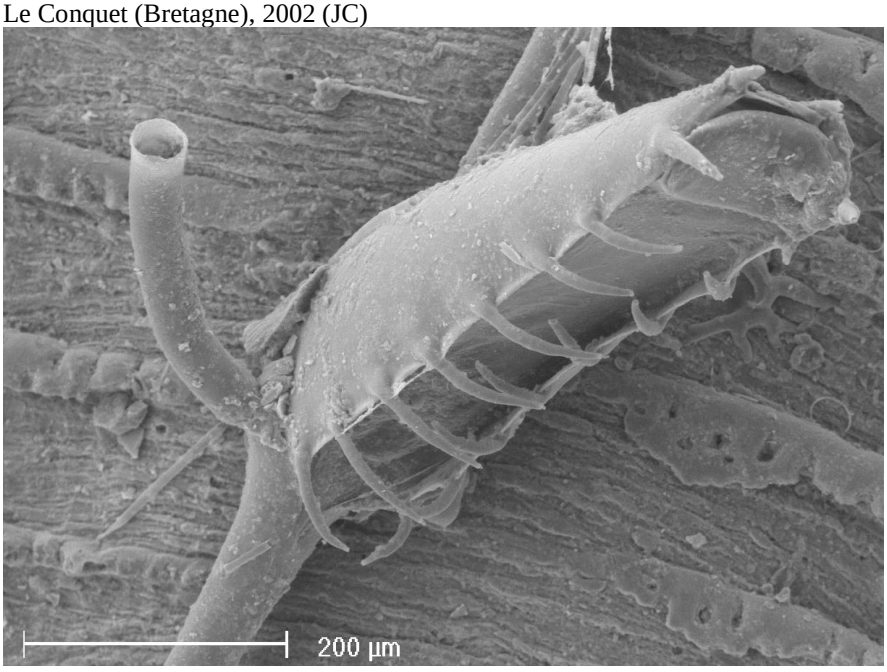
Occurence:
Belgium: A colony washed ashore in September 2001 on a *Himanthalia* button in Zeebrugge (De Blauwe, 2003) and in January 2005 in Ostend on a plastic object.
The Netherlands: Beached in the autumn of 1947 (Bloklander & Leenhouts, 1948). On washed up plastic (de Ruijter, 2011c, 2013a, 2014a, 2014d, 2018b, 2020b).


Colonies on beached plastic, Texel 2017 @ Sytske Dijksen

Beania mirabilis :



Le Conquet (Bretagne), 2002 (JC)



Family Candidae

Genus Caberea

***Caberea boryi* (Audouin, 1826)**

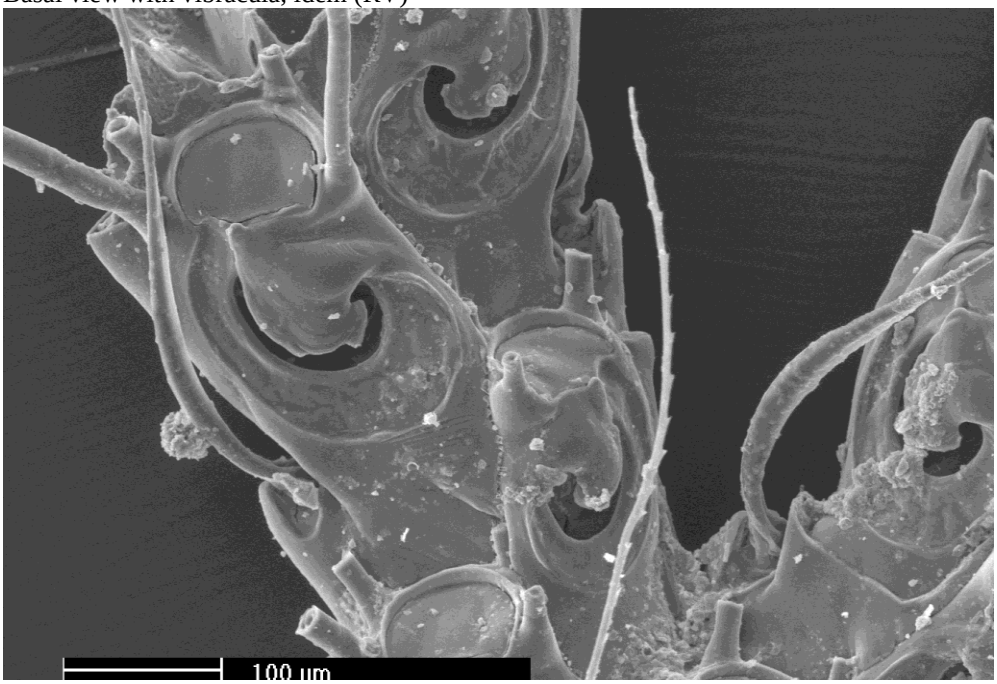
Description: The colony forms a small, fan-shaped tuft, up to 1 cm high, attached with rhizoids. The branches appear hairy. The zooids are in 2, rarely 3 series. The zooid is short, with an oval membrane occupying most of the frontal surface, around which is a broad calcified border. Distally, 1 spine is on the inner angle and 2 or 3 on the outer angel. The scutum covers almost all of the frontal membrane except for a crescent-shaped proximal portion. Polypide with 12 tentacles. Lateral avicularia are small with a rounded mandible. A frontal avicularium on the inner lateral side of the zooid. Its rounded mandible ends in a hook. A vibraculum covers the basal surface of the zooid. In the center is a groove, at an angle to the axis of the branch. The seta is finely sawn. Ovicells subglobular, slightly bent to the axis of the branch. A small membranous area lies just distal to its opening.

Occurence:
Belgium: This southern species washed up on plastic in Ostend in January 2005.
The Netherlands: Beached in the autumn of 1947 (Bloklander & Leenhouts, 1948) and washed up on plastic near Ouddorp in 2014 (de Ruijter, 2014c).


Colony from Le Conquet (Brittany, France), 2002 (RV)

Caberea boryi :

Basal view with vibracula, idem (RV)



Zooids from a colony on a lobster pot in St-Malo (France), 2005 (JC)

Genus *Cradoscrupocellaria* and *Scrupocellaria*

The genus ***Cradoscrupocellaria*** is characterized by the presence of

- articulate distal unbranched spines,
- a branched scutum arising from midline of the inner edge of the opesia,
- a trapezoidal vibracular chamber,
- single axial vibraculum,
- an ooecium with some ectooecial pores

The genus ***Scrupocellaria s. str.*** is redefined for a Clade characterized by presence of an avicularium at the outer wall of the ooecium; according to four morphological features:

- vibracular chamber with curved setal groove,
- ooecium with a single and small ectooecial fenestra,
- two axillary vibracula,
- a membranous operculum with a distinct distal rim.

1 a) 1 axial vibraculum. Scutum branched. 2
b) 2 axial vibracula, scutum spatulate or absent. ……..... 3

2 a) Rhizoids with several close-spaced reverse hooks for most of their length. ..... *Cradoscrupocellaria reptans* (p. 156)
b) Rhizoids smooth, attachment disc-like, with some projections at distal end. …… *Cradoscrupocellaria ellisi* (p. 154)

3 a) Scutum spatulate. ..... *Scrupocellaria scrupea* (p. 158)
b) Scutum absent. …..... *Scrupocellaria scruposa* (p. 160)

Cradoscrupocellaria ellisi: single axial vibraculum with setae

Cradoscrupocellaria ellisi: rhizoid smooth, attachment disc-like, with some projections at distal end.

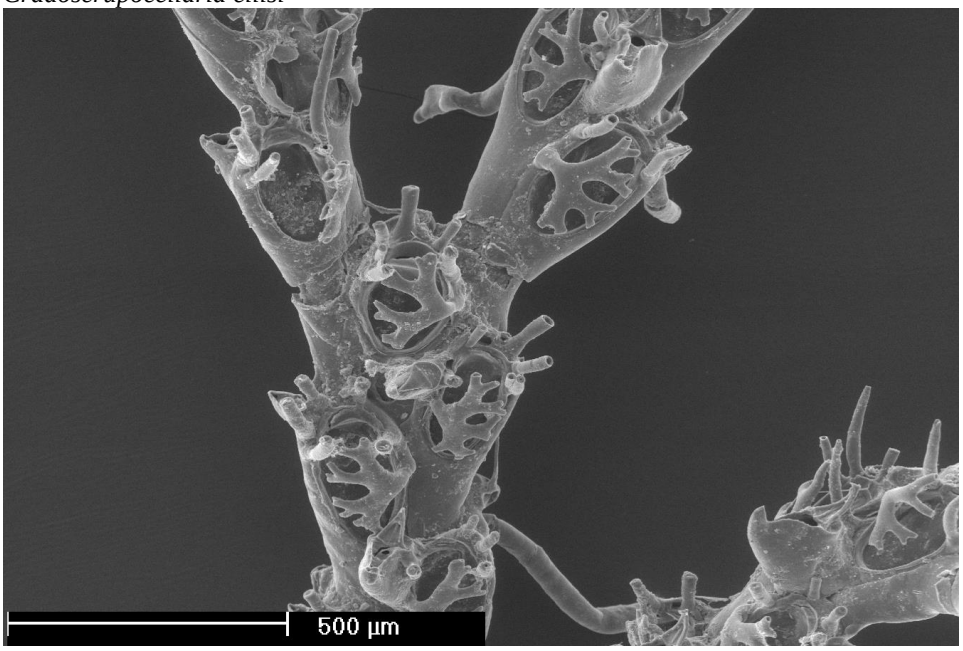
***Cradoscrupocellaria ellisi* (Vieira & Spencer Jones, 2012)**

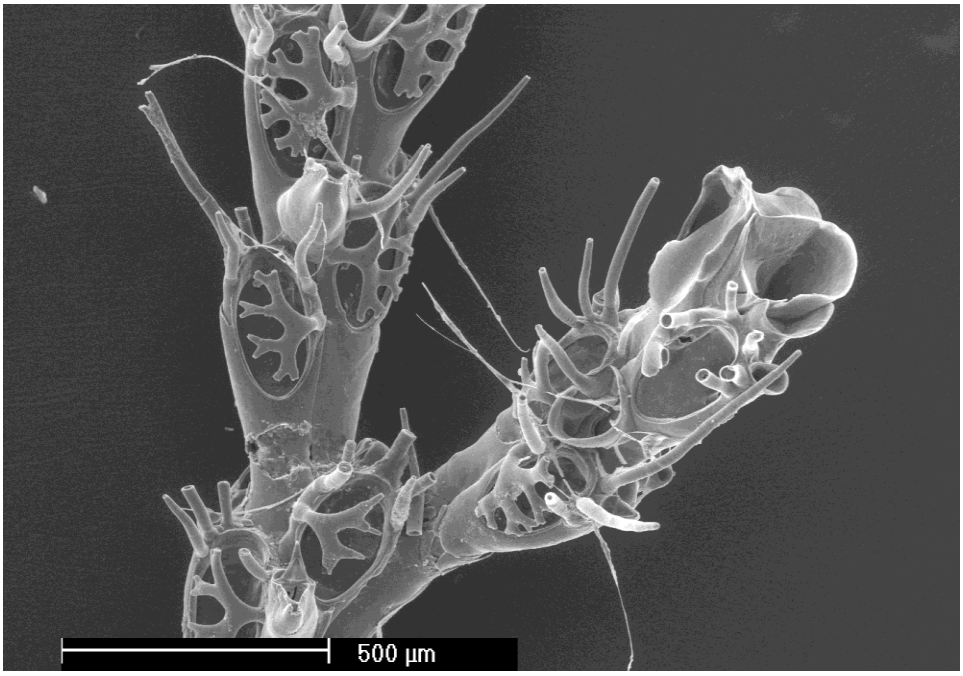
Description: Colony erect, branched, internodes comprising 5–12 zooids. Opesia oval, occupying distal half (approximately) of zooid. Scutum inserted at midline of inner edge of opesia, branched, occupying almost entire opesial area, slender, flattened, branched 2–3 times, with 8–13 stout projections at distal tips; scutum angled at 115–155°, with first branches about 0.045–0.060 mm wide, secondary branches about 0.035–0.045 mm. Zooid spines as follows: 1 long distal spine, 3 outer spines, 1–2 inner spines; most proximal outer and inner spines directed frontally; axial zooid with 5 distal spines. One distolateral avicularium sometimes present on each zooid, distolaterally directed and obscured by outer distal spines; rostrum triangular, with slightly serrated lateral edge, mandible triangular. A large avicularium present on gymnocyst of some zooids. A basal vibracular chamber often present proximally on basal surface of each zooid, rarely conspicuous in frontal view; setal groove directed transversely, straight, with smooth seta longer than one zooid length. A single axial vibraculum. Rhizoids smooth, attachment disc-like, with some projections at distal end. Ovicell hyperstomial, hemispherical, with 12–18 small rounded pores; 2 outer and 2 inner distal spines in ovicelled zooids.

Remarks: This species was previously recorded by numerous authors as *Scrupocellaria reptans*. Records from literature before 2012 and even later are unreliable and the material in collections should be re-examined. *Cradoscrupocellaria ellisi*, named after the British naturalist John Ellis (1714–1776), is distinguished by smooth (not hooked) rhizoids, robust more-branched scuta and ovicells with small rounded pores.

Distribution: Widespread in North Sea, British Channel, Irish Sea, Celtic Sea; Adriatic and Tasmania.
Occurence: Probably the most common *Cradoscrupocellaria* species beached in our area.
Belgium: 5 Colonies re-examined from own collection, beached on plastic or *Himanthalia* buttons.
The Netherlands: Probably also common on beached material but colonies have not been re-investigated. Reported from beached *Himanthalia* button (de Ruijter, 2012a, 2014a) and on 20 percent of the more than 100 colonies of *Flustra foliacea* washed ashore near Ouddorp (de Ruijter, 2015d).
Germany: *C. ellisi/reptans* collected at Helgoland (pers. comm. Britta Kind) (on *Himanthalia*?).

Cradoscrupocellaria ellisi





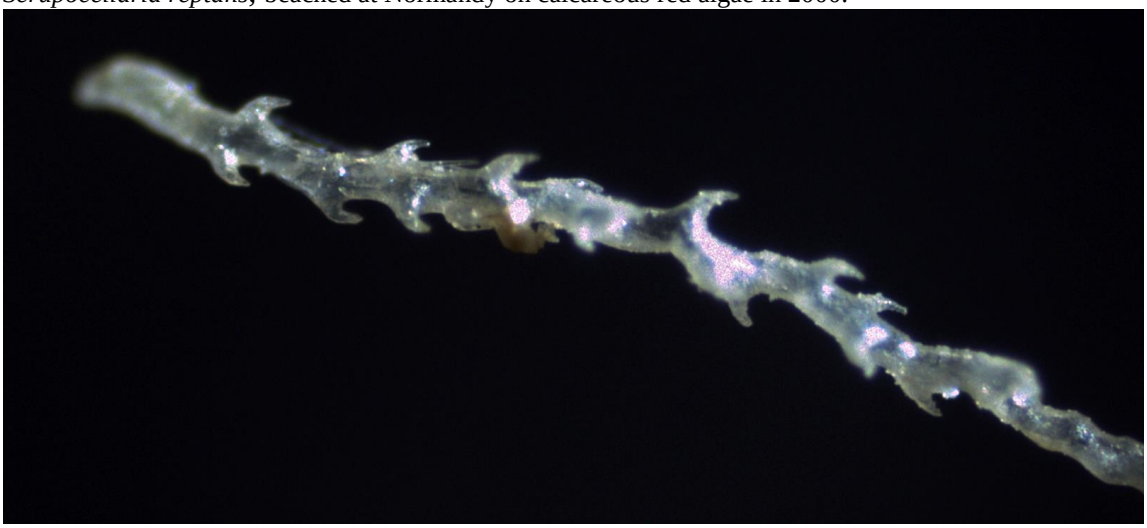
***Cradoscrupocellaria reptans* (Linnaeus, 1767)**

Redescription: Colony erect, branched, internodes comprising 4–10 zooids. Lateral edge of internode almost straight to slightly curved; chitinous joint passing across gymnocyst and below opesia in both outer zooids (C and D) of bifurcation, and across proximal gymnocyst of inner zooids (F and G). Autozooid subelongate, narrowed proximally, with smooth proximal gymnocyst. Opesia oval, occupying distal half (almost) of zooid, cryptocyst very narrow, inconspicuous. Scutum inserted at midline of inner edge of opesia, branched, occupying most of opesia; slender, flattened, branched 2–3 times, with 6–9 distal stout projections; angled at 100–120°, with first branches about 0.035–0.045 mm wide, and secondary branches about 0.025–0.035 mm. Zooid spines as follows: 1 long distal spine, 3 outer spines, 1–2 inner spines; most proximal outer and inner spines directed frontally; axial zooid with 5 distal spines. One distolateral avicularium sometimes present on each zooid, distolaterally directed and obscured by outer distal spines; rostrum triangular, with slightly serrated lateral edge, mandible triangular. A very large avicularium present on gymnocyst of some zooids, almost aquiline, with a raised tubular base, rostrum serrated laterally, slightly curved and directed forwards; mandible triangular with hooked tip. A basal vibracular chamber often present proximally on basal surface of each zooid, inconspicuous in frontal view; setal groove directed transversely, straight, with smooth seta longer than one zooid length. Single axial vibraculum. Rhizoids with several close-spaced reverse hooks for most of their length. Ovicell hyperstomial, hemispherical, with 8–13 medium-sized rounded pores; 2 outer and 1–2 inner distal spines in ovicelled zooid.

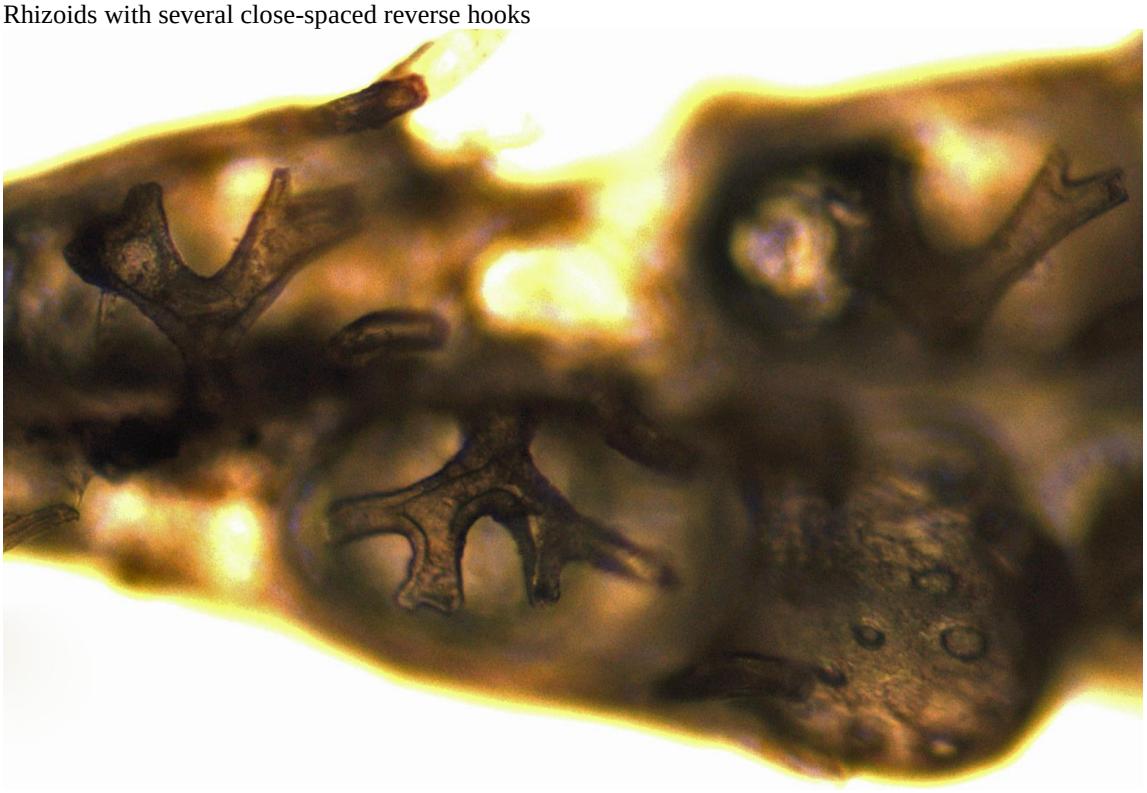
Distribution: Western Britain.

Occurence: Not in the North Sea. Possible on beached material but not yet confirmed.

Scrupocellaria reptans, beached at Normandy on calcareous red algae in 2000.



Rhizoids with several close-spaced reverse hooks



Genus *Scrupocellaria* van Beneden, 1845 s. str. (Vieira *et al*., 2014)

Diagnosis. Candidae with jointed branches, almost rectangular zooids, tapering proximally and with broadly oval opesia occupying most of the frontal surface. Joints crossing or slightly below the opesia of outer zooids and crossing the gymnocyst of the inner zooids at the bifurcation. Cryptocyst present or reduced. Oral spines often present, unbranched. Frontal scutum sometimes present, asymmetrical, arising from distal third of the inner margin of the opesia or slightly below it. Lateral avicularia present, aquiline, with a serrated rostrum and hooked tip. Frontal avicularia often present, small, monomorphic. Vibracular chamber almost triangular, with a rhizoidal foramen; setal groove curved and directed obliquely; 2 axillary vibracula. Ooecium with single ectooecial fenestra and a small avicularium at its outer border.

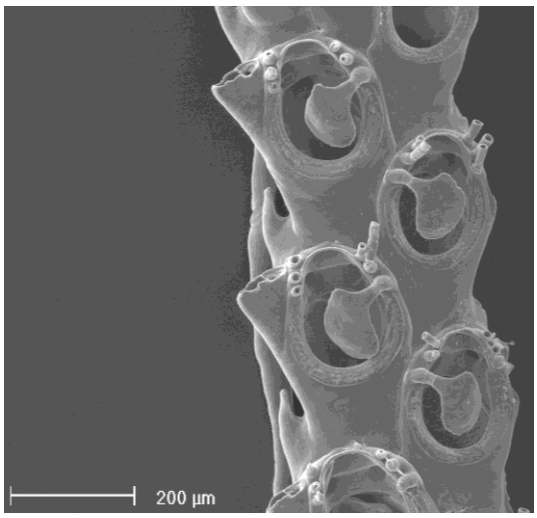
***Scrupocellaria scrupea* Busk, 1852**

Description: Colony erect, branched. The zooid bears 3-4 spines on the outer distal corner, 1 or 2 on the inner distal corner. The zooid in the axillary branch has 5 distal spines, 1 of which is medial. The scutum is round or oval with the proximal portion larger than the distal. Vibracula are present basally. 2 axial vibracula at a bifurcation. Lateral avicularia are large, small frontal avicularia are only present together with ovicells. Ovicells are nearly spherical, with small fenestra.

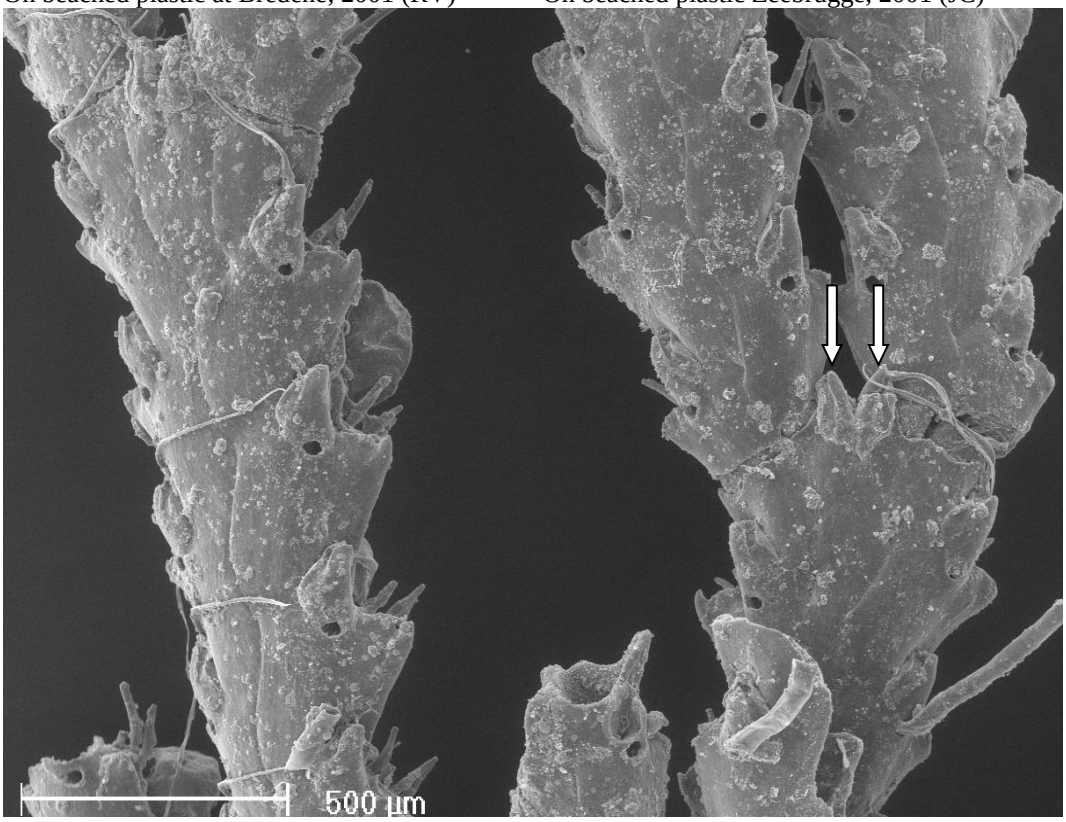
Occurence:
Belgium: Occasionally on beached plastic objects and nets and on an empty oyster doublet between Oostduinkerke and De Panne in October 2004 (De Blauwe, 2005).
The Netherlands: Bloklander and Leenhouts (1948) report washing ashore in the autumn of 1947. Five colonies beached on a piece of lobster trap near Ouddorp (de Ruijter 2015c).
Germany: not reported**.**

Scrupocellaria scrupea:

On beached plastic at Bredene, 2001 (RV)



On beached plastic Zeebrugge, 2001 (JC)



Basal view, with 2 axial vibracula, beached at Westende 2000 (JC)

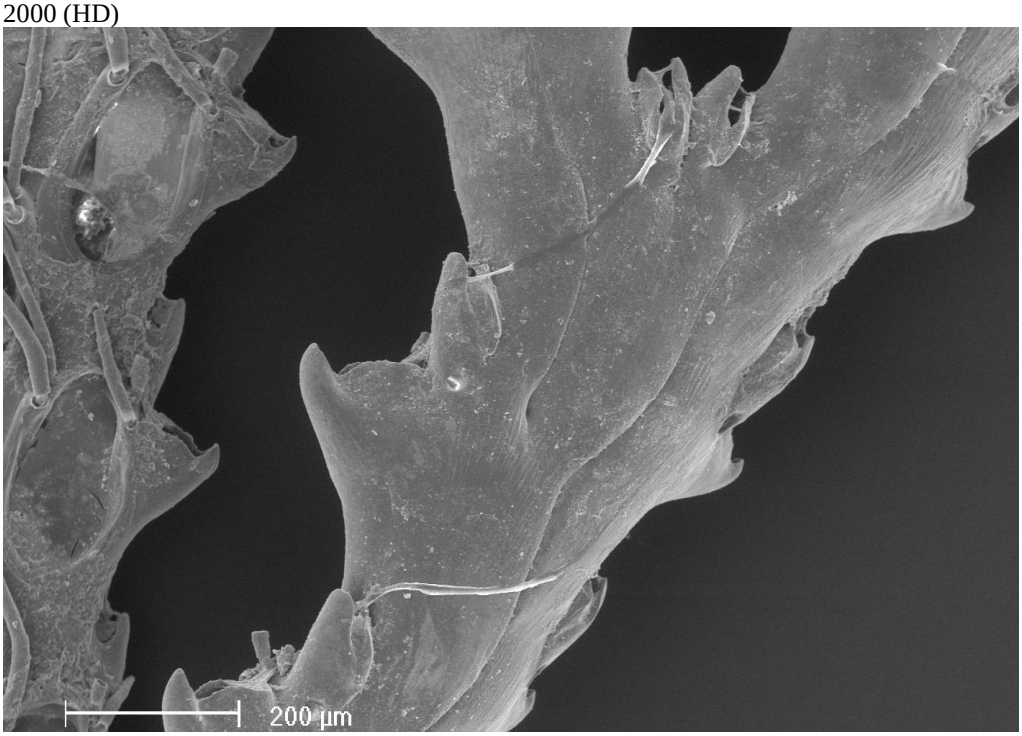
***Scrupocellaria scruposa* (Linnaeus, 1758)**

Description: Colony erect, branched. The zooid bears 2-3 spines on the outer distal corner, 1-2 on the inner distal corner. Spines are often broken off. No scutum.
Vibracula occur on the basal surface and there are 2 axial vibracula at the bifurcation of branches. Lateral avicularia are large, frontal avicularia small and only present with ovicells. Ovicells are nearly spherical, often with teardrop-shaped fenestra to the inside of the branch.

Occurence: On algae, rocks, shells, Bryozoa (Hayward & Ryland, 1998). In Belgium and the Netherlands, this species occasionally washes up on plastic objects.
Belgium: Loppens (1906) describes this species as fairly common on rocks, shells, hydroids and *Flustra foliacea*. On several shipwrecks (Zintzen, 2007). In June 2005, one colony was found on a rock between the Hinderbanks (De Blauwe *et al*., 2006).
The Netherlands: Native in Zeeland throughout the Oosterschelde, in the Goes Canal near the lock and in the Western Scheldt near Vlissingen (Faasse & De Blauwe, 2004) and on the Klaverbank (pers. comm.. G. van Moorsel). Also mentioned on stones on West-Terschelling (Slager, 1983), Den Helder (van der Sleen, 1920), Dreischor (van Moorsel & Waardenburg, 1999) and before the closure in the Grevelingen (Heerebout, 1970). Collected on the Dogger Bank in 2016. On several shipwrecks and nets clinging to them (Lengkeek et al., 2013; van Leeuwen et al., 2017).
Germany: Collected in the German North Sea (Zettler *et al*., 2018) and at Helgoland (pers. comm. Britta Kind).

Scrupocellaria scruposa:

basal side with uncalcified joints, rhizoids and 2 axial vibracula, on washed up plastic Westende, 2000 (HD)



frontal view (left), basal view of branch bifurcation with 2 vibracula (right) (JC)

Genus Tricellaria

1 a) Ovicell with multiple pores, scutum usually lobed. ……... *Tricellaria inopinata*
b) Ovicell with no or few pores or a fenestra, scutum not lobed. ……
……. *Tricellaria ternata* (p. 164)

Tricellaria inopinata **d'Hondt & Occhipinti Ambrogi, 1985**

Description: Colony erect, branched, attached by rhizoids. The branches consist of alternating zooids in 2 series. The first zooids after a branch have a chitinous joint. Zooids elongated, narrow proximally, distally an oval frontal membrane. 3 spines on the outer distal angle, the most proximal of which is usually forked at the end. 2 or 3 spines on the inner distal angle. The zooid in the axil of the branch bears 1 or more large spines. A scutum, often lobed, covers only the proximal half of the frontal membrane (entirely in *Cradoscrupocellaria*). However, the scutum is variable: it can be a smooth plate, or lobed in 2, 3 or 4 parts. Polypide with 13 tentacles. Avicularia large, as wide as a zooid, lateral, triangular, with a mandible on the distal side. No frontal avicularia. Ovicells spherical, as long as wide, with pores, which are interconnected by lines. Pink embryos. Released larva yellow with some pink-red dots. Ancestrula a small cup with 10 long spines surrounding a frontal membrane.

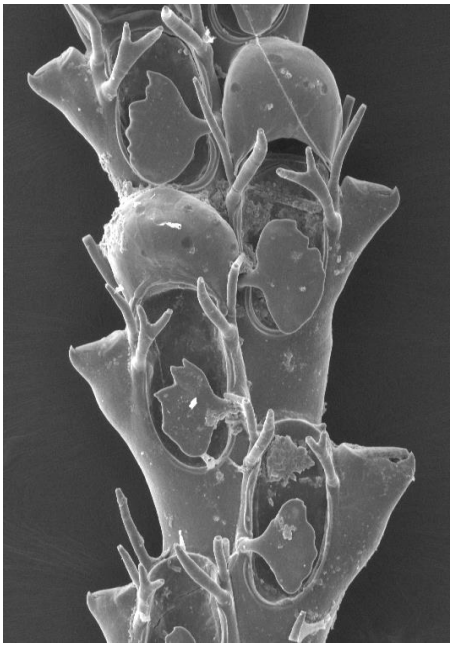
Occurence: *Tricellaria inopinata* is suspected to originate from the eastern Pacific Ocean. Indeed, the species matches the description of *Menipea (Tricellaria) occidentalis catalinensis* described from the west coast of the United States by Alice Robertson in 1905. The first European sighting comes from Venice where the species was described as new. Later, observations of the Atlantic Ocean (northern Spain), southern England and finally the Netherlands, Belgium and France follow. *Tricellaria inopinata* is rapidly colonizing the marinas of Europe (De Blauwe & Faasse, 2001).

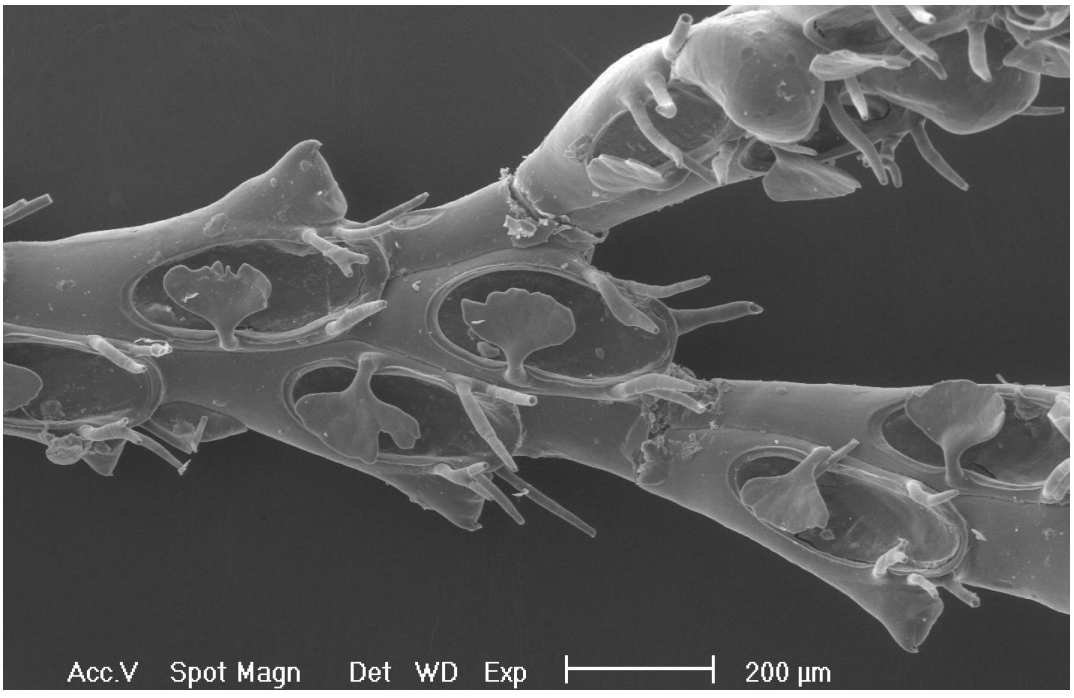
Belgium, the Netherlands and Germany:

This introduced species is very common in marinas, especially in August and September, where it grows on pontoons, ship hulls, *Sargassum*, *Codium*, rope, mussel shells, ... Highly spreading species that can be expected on all coasts, mainly in marinas, but also in the infrastructure. Washes up on plastic and algae (De Blauwe (2002, 2003), de Ruijter (2008, 2020b)).

This species was first noticed in the Netherlands in the Goesse Meer in August 2000. It was already the most common bryozoan species in the marina of Breskens.

Tricellaria inopinata: Goesse Meer, 2004 (RV)



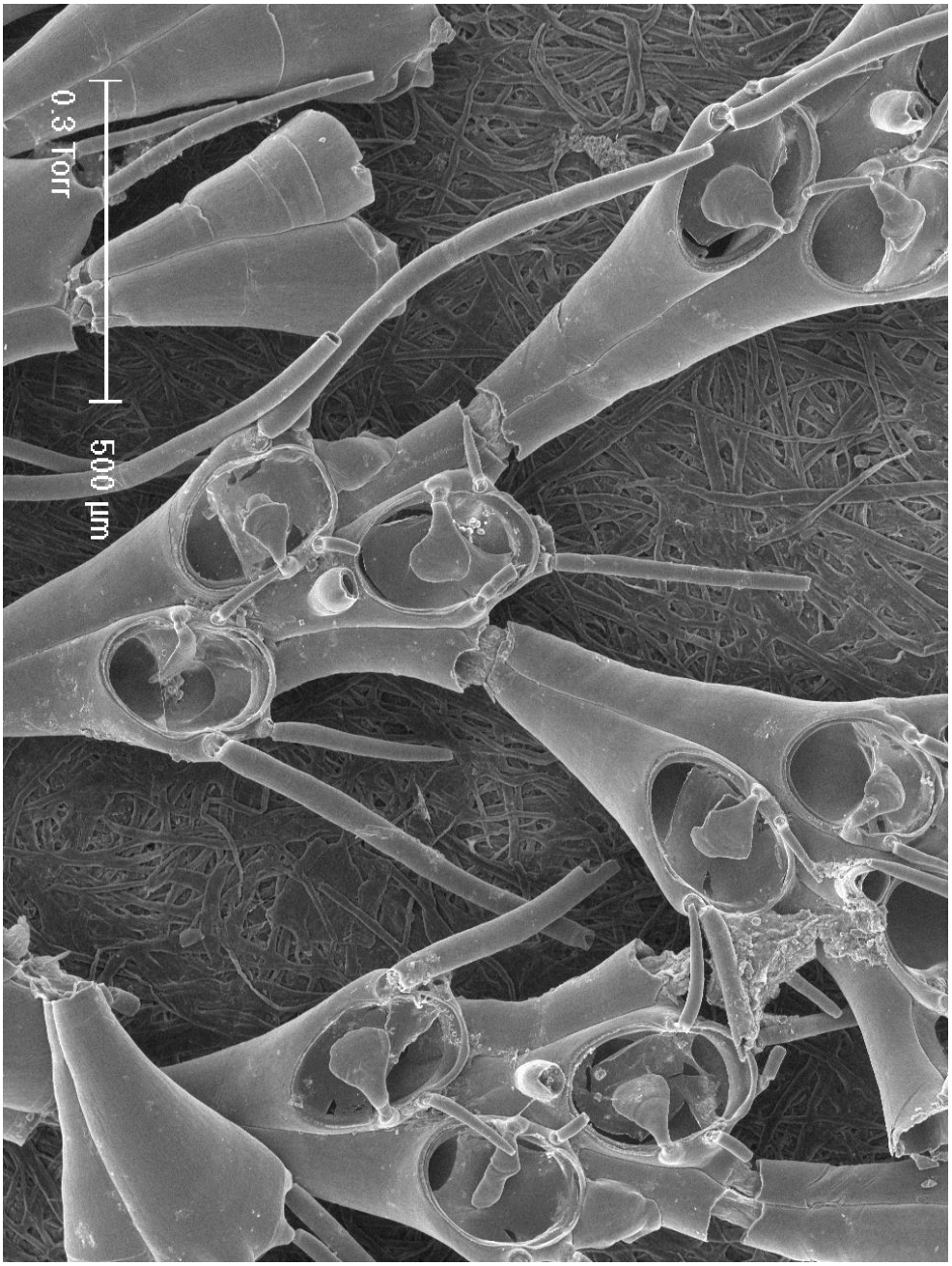


Tricellaria ternata **(Ellis & Solander, 1786)**

Description: A delicate white tuft, up to 3 cm high, attached by means of rhizoids. The zooid has 3 spines on the distal margin, 2 in case there is a,n ovicell. A small undivided scutum, partially covering the frontal membrane. Lateral avicularia are triangular and large. Frontal avicularia are small and pointed proximally, usually absent and in the proximal part of an internode. Ovicells are longer than wide and have single, few or no pores.

Occurence: A northern species. For Belgium this species is mentioned by Loppens (1906). He considered *T. ternata* to be rare on shells, algae and especially on hydroids. Indeed, his attached drawing bears more resemblance to *T. ternata* than to *Scrupocellaria scrupea*, a species with a similar scutum that he does not name. However, no material was found in the RBINS. Maitland (1851) mentions a washed up colony from Katwijk.

Tricellaria ternata: Norway, 2004 (JC)



Family Setosellidae

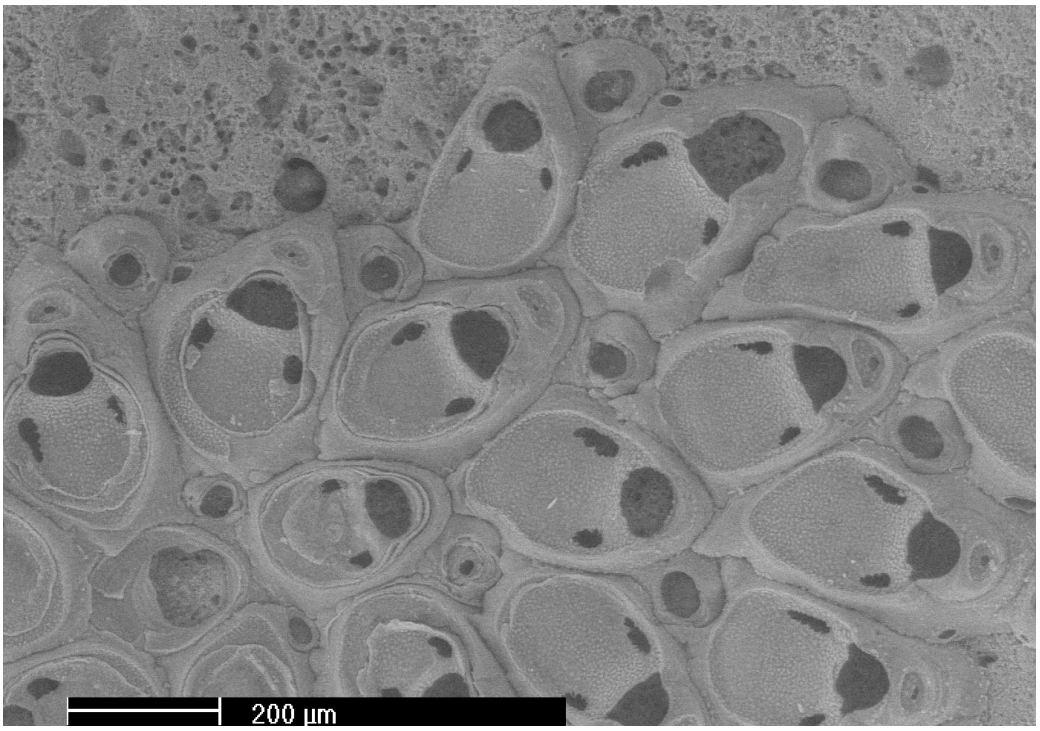
Genus Setosella

Setosella vulnerata **(Busk, 1860)**

Description: The colony forms a small crust. Zooids oval and small. Below the frontal membrane is a calcareous layer with an opening similar to the operculum and two small slit-shaped openings in the distal half at the edge of this calcareous layer. An interzooidal avicularium distal to the zooid with an oval body and rounded opening. This avicularium bears a chitinous slender mandible that is twice as long as a zooid. Ovicell subimmersed just distal to the orifice, closed by autozooidal operculum. Ancestrula smaller than the zooids with a larger opening in the calcareous layer below the membrane.

Occurence:
Belgium: In 2007 two colonies were found on the inside of shells that Gilson collected in 1905 on the Hinderbanken. In May 2004, six dead colonies were found on shells from the Kwinte Bank and in June 2005 another two on shells from the Hinder Banks.
The Netherlands: De Ruijter (2103c) reports a colony on washed up plastic.

Setosella vulnerata: Kwintebank 2004



Superfamily Cellarioidea

Family Cellariidae

Genus Cellaria

1 a) Zooids in strictly alternating series, not in contact with the distal and proximal zooids of the same serie. Avicularia as big as a zooid and replacing a zooid. ..... *Cellaria salicornioides* (p. 170)
b) Zooids in the same serie in contact with their proximal and distal neighbors. Avicularia smaller than the zooids. 2

2 a) Firm colony with internodes about 1 mm thick. Zooids hexagonal with broad ends. Avicularia but half the size of a zooid, square, with a semicircular or roughly triangular mandible oblique to the axis of the internode. ……. ..... *Cellaria sinuosa* (p. 172)
b) Internodes more slender, about 0.6 mm thick. Zooids diamond-shaped or hexagonal, with pointed ends. Avicularia only 1/3 of the zooid length, quadrangular, with a narrow crescent-shaped mandible, oriented transversely to the axis of the internode. ..... *Cellaria fistulosa* (p. 168)

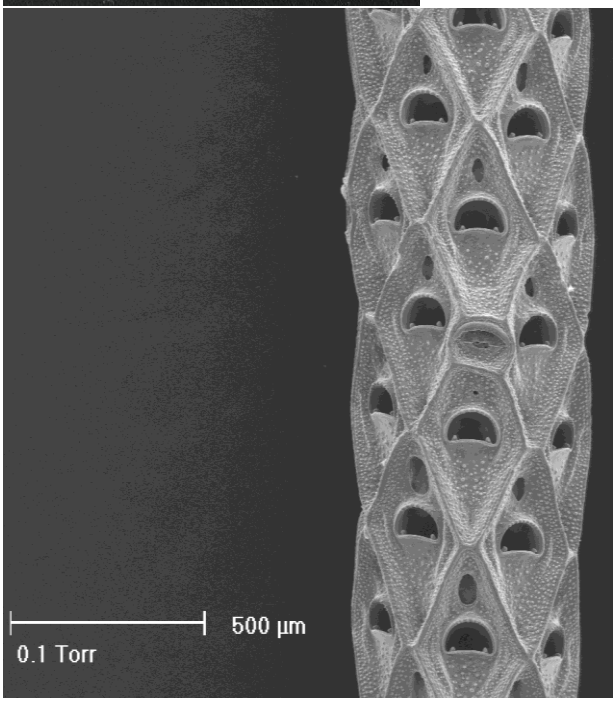
Cellaria fistulosa **(Linnaeus, 1758)**

Description: Frequently branched tuft up to 6 cm high. Internodes cylindrical, up to 8 mm long. The internodes are not club-shaped. Usually 5 or 6 longitudinal zooid series. Each zooid is in contact with its distal and proximal neighbor, this contact can be very small. The width of an internode is 0.4 to 0.8 mm. Zooids hexagonal, terminally pointed. The lateral walls are erected around the collapsed frontal surface. Opesia semicircular, with an erect margin. Two small teeth on the proximal edge of the opening. Avicularia between two consecutive zooids, 1/3 of the zooid length with a transverse elliptic opesia. Mandible less than a semicircle, only slightly angled to the axis of the internode. Opening of the ovicells small and rounded, just distal to the opesia.

Occurence: On various hard substrates in the deeper sublittoral.

Belgium: Occurs in the English Channel and two samples from the Flemish Banks from 1900 and 1911 are also preserved in the RBINS. Loppens (1906) considers this species to be quite rare.
The Netherlands: De Ruijter 2015a reports the washing up of *Cellaria* cf. *fistulosa* on a plastic net and 10 colonies on a piece of lobster trap (2015c).

Cellaria fistulosa : Fishing harbor of Le Conquet (Brittany, France), 2002



avicularium

***Cellaria salicornioides* Lamouroux, 1816**

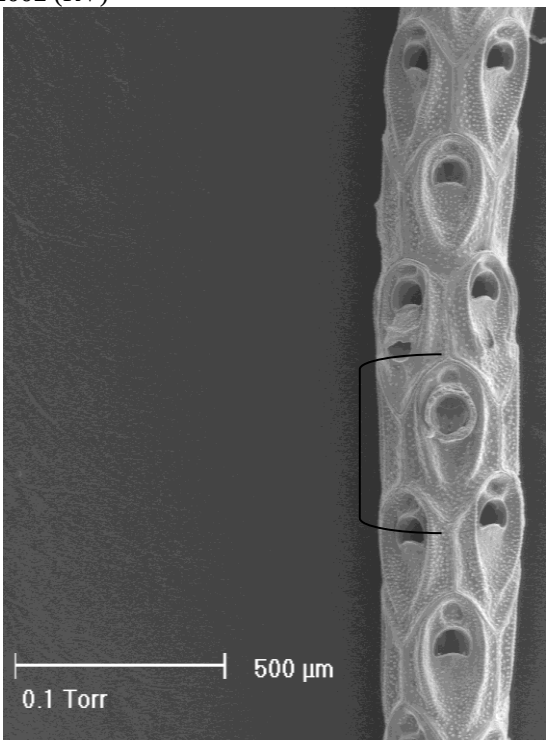
Beschrijving: De tengerste van de drie. Vormt een verspreid bosje tot 5 cm hoog. Internoden 5 tot 10 mm lang, cilindrisch, soms verdikt tot knotsvormig waar fertiele zoïden voorkomen. Internoden 0,2 tot 0,5 mm breed met 2 tot 5 longitudinale zoïdenrijen. Zoïden alternerend ingeplant. Opeenvolgende zoïden niet in contact met elkaar. Deze rangschikking wordt echter niet gevolgd waar de internode verdikt is. Zoïden zeshoekig tot ovaal, soms haast rechthoekig waar de internode op zijn wijdst is. Opesia in het distale derde deel van het frontale oppervlak. Halfcirkelvormig met een rechte of licht convexe proximale rand, met een kort tandje bij elke hoek. Operculum lichtbruin met een korrelig oppervlak en een opvallende marginale verdikking. Avicularia tussen twee zoïden en zo groot als een zoïde, niet algemeen. Een vergrote chitineuze mandibel staat op een half bolvormig verkalkt rostrum, onder schuine hoek met het frontale oppervlak. De ronde opening van de broedkamer ligt distaal van de opesia, bij oudere zoïden is ze dwars ovaal ten gevolge van verdere verkalking.

Occurence: In Belgium, only known from fragments adhering to recently washed up plastic (De Blauwe, 2003). These fragments were almost certainly brought in from outside the area. Such fragments have also been found in sub-fossil grit from Ostend.

Cellaria salicornioides :

Fishing harbor Le Conquet (Brittany, France), 2002 (RV)

fossiel, Oostende (RV)



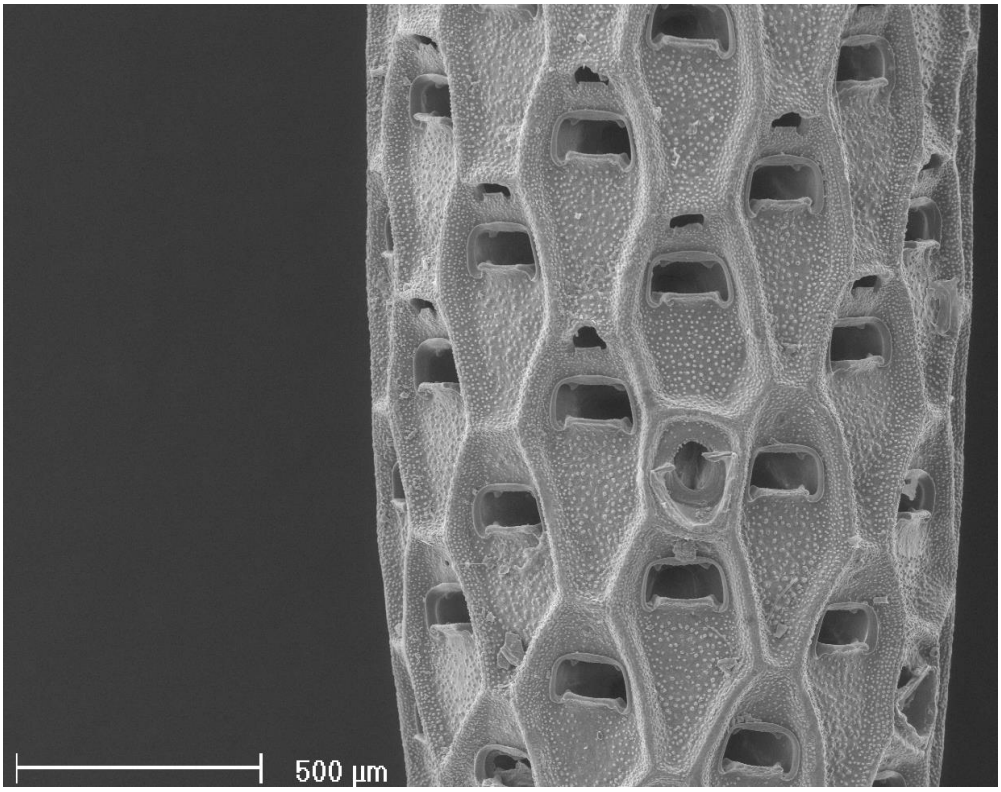
with avicularium , haven Le Conquet (Bretagne), 2002

Cellaria sinuosa **(Hassall, 1840)**

Beschrijving: Een dicht bosje, doorgaans 4 tot 5 cm hoog, soms tot 10 cm. Internoden cilindrisch, knotsvormig aan de uiteinden van de kolonie. Internoden meestal 4-10 mm lang, diameter 0,4 tot 1,6 mm. De stevigste soort met tot 10 longitudinale zoïdenrijen. Zoïden zeshoekig met opvallende dwarswanden. Elke zoïde is in breed contact met zijn proximale en distale buur. Opesia halfcirkelvormig, ongeveer zo groot als het operculum, zijn proximale boord met een opgerichte, vierkante lip en een scharnierpunt aan elke kant ervan. Een paar kleinere scharnierpunten kunnen dieper zichtbaar zijn, binnen de distale rand van de opesia. Avicularia tussen twee opeenvolgende zoïden, half zolang als een zoïde, afgerond vierhoekig, met elliptische opesia. Mandibel halfcirkelvormig of afgerond driehoekig, schuin gericht op de as van de internode. Broedkamers met langwerpige opening, de proximale rand met een opgerichte, hoekige lip.

Occurence: In the English Channel, deep sublittoral, even on sandy bottoms, attached to rough fragments. Washed up in De Haan in September 2001 on plastic.

Cellaria sinuosa: fishing harbor Le Conquet (Brittany, France), 2002



GLOSSARY OF SPECIAL TERMS

Ancestrula: first zooid of a colony formed by metamorphosis of a free-swimming larva.
Ascopore: a median frontal pore just proximal to the orifice in *Microporella*, *Haplopoma* and *Fenestrulina*.
Autozooid: nourishing zooid with tentacles.
Avicularium: specialized zooid in Cheilostomatida with reduced polypide but strong muscles which operate a mandible-like operculum
Basal: the side opposite to the frontal side (of the autozooid)
Condyle: One or pair of oppositely placed protuberances on which te operculum pivots in the orifice of ascophorine Cheilostomatida.
Costa: one of the modified spines overarching the frontal membrane in cribriomorph Cheilostomatida; usually united with neighbouring costae to form a frontal shield.
Cryptocyst: horizontal calcareous lamina on the basal side of the frontal membrane in some species.
Distal: toward the growth end of the colony, away from the ancestrula.
Ectooecium: outer, generally calcified layer of ooecial wall.
Endooecium: inner, often membranous layer of ooecial wall.
Fenestra: uncalcified area in the ectooecium, in which the endooecium is displayed.
Frontal: the top surface, which contains the opening.
Gonozooid: zooid modified as a brood chamber (Cyclostomatida).
Gymnocyst: a calcified frontal shield formed of exterior calcification, constituting part or all of the frontal shield.
Heterozooid: individual that is not a feeding zooid (stolonial kenozooid, spinous kenozooid (*Flustrellidra*), avicularium and vibraculum (Cheilostomatida)).
Intertentacular organ: tubular organ between the tentacles that plays a role in the secretion of eggs. It is only present during the reproductive season in species that secrete eggs.
Interzooidaal: wedged in between autozooids some avicularia are interzooidal.
Internode: segment of an articulated colony.
Joint: uncalcified connection between calcified colony segments (internodes).
Kenozooid: individual that is not a feeding zooid (stolonial kenozooid, spinous kenozooid (Flustrellidra), usually without either orifice or muscles.
Lateral: the side walls.
Lyrula: median tooth, often anvil-shaped, on the proximal side of the orifice in some Cheilostomatida.

Mandibel: articulated part of an avicularium, moved by muscles, and homologous with the operculum of an autozooid.
Marginal: around the opesia (marginal spines).
Mucro: see suboral mucro.
Operculum: flap that closes the opening in Cheilostomatida.
Opesia: the opening in the cryptocyst below the frontal membrane in Cheilostomatida.
Orifice: opening in the autozooid wall through which the tentacles are exserted.
Ovicell: globular brood chamber in Cheilostomatida.
Oral: surrounding the orifice (oral spines).
Peristome: in Cheilostomatida, an elevated rim in relation to the orifice.
Polypide: tissue and organs in the autozooid (tentacles, tentacle sheath, alimentary canal, muscles and nerve ganglion).
Proximal: toward the origin of the colony.
Rhizooids: root-like structures that attach established colonies to the substrate.
Rostrum: distal part of an avicularium occupied by mandible.
Scutum: a broad and sometimes lobed marginal spine bent over the opesia in some species of Cheilostomatida.
Sinus: slit at proximal edge of orifice in some Cheilostomatida.
Suborale mucro: elevation just proximal to the orifice.
Umbo: elevation on the frontal wall or ovicell.
Vibraculum: heterozooid in *Scrupocellaria* en *Caberea* with operculum in form of a long seta slung between condyles.
Vicareous avicularium: one that replaces an autozooid in a series (as large as an autozooid).
Zooid: single bryozoan individual.
Zoöeciule: filiform heterozooid with small opening that may occur in the genus *Hippothoa*.
Zoecium: protective wall of a zooid, membranous or calcified.

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