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CALCAREOUS SPONGES OF THE NETHERLANDS

(PORIFERA, CALCAREA)

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ABSTRACT

The taxonomy of calcareous sponges occurring in the Netherlands is reviewed, using field observations of live individuals, microscopical examination of individual skeletons and study of the breeding cycle. This led to the conclusion that a new species had to be erected and other species reidentified. The common calcareous sponges in the Netherlands are found to be: *Leucosolenia variabilis* (Haeckel, 1872), *Scypha ciliata* (Fabricius, 1780) and *Scypha scaldiensis* n.sp.

INTRODUCTION

A recent publication on sponges of the Netherlands (Van Soest, 1977) provides data on calcareous sponges based on the taxonomy of Burton's monograph (1963). Unfortunately, it has been shown that Burton has gone too far by lumping large numbers of species (e.g. Hartmann, 1964; Jones, 1964; Tuzet, 1965; Borojevic, 1967). These authors do not share Burton's belief, that spicules provide the only valid characters and that a wide intraspecific variability exists in shape and size and in the presence or absence of spicule categories. One cannot describe species only by looking at spicule variation; also morphological, histological, cytological, ecological and life history characters have to be used.

Van Soest (1977) mentioned the following calcareous sponges: *Leucosolenia botryoides* (Ellis & Solander, 1786); *Clathrina coriacea* (Montagu, 1818); *Scypha ciliata* (Fabricius, 1780);

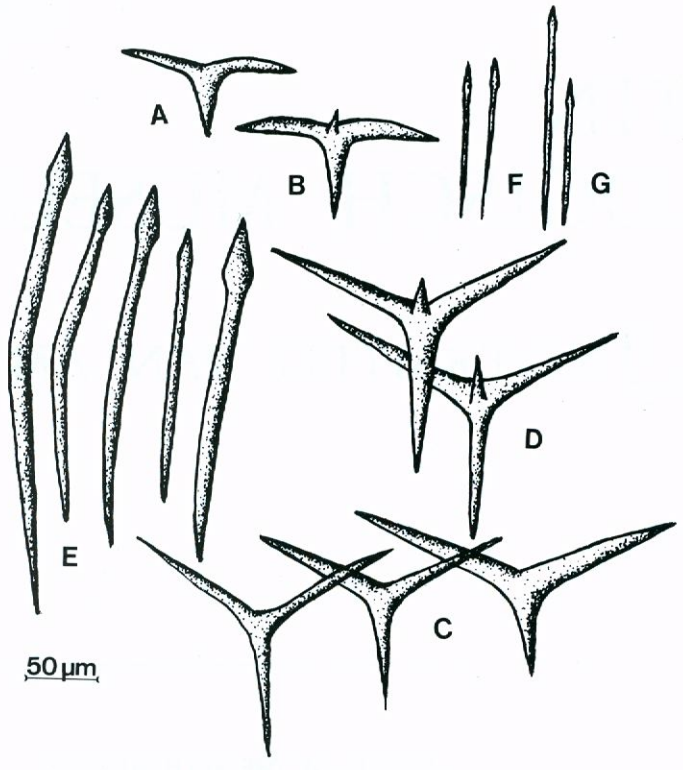

Fig. 1. Spicules of *Leucosolenia variabilis;* a, T-shaped triradiate; b, T-shaped quadriradiate; c, Triradiates; d, Quadriradiates; e, Large oxea; f, Small refringent oxea; g, Small non refringent oxea.

Grantia compressa (Fabricius, 1780). In view of the above, it was necessary to reexamine his data and to study these sponges in the field.

MATERIAL AND METHODS

Calcareous sponges were studied in the field and in the laboratory on variation in morphology and spiculation, breeding periods (in the genus *Scypha*), growth, population density and ecology.

These observations were made in different localities along the coast of the Netherlands, during a period of 30 months, from July 1978 to December 1980. Five of these localities, all along the coast of the Eastern Scheldt (SW part of the Netherlands), were chosen as permanent stations, to be visited every two weeks: Flauwersbocht (artificial rocky shore); Wemeldinge (pontoon); Schelphoek (industrial harbour); Kats (marina); Sas van Goes (sluice).

Sampling was done directly from the shore at low tide, sometimes using a scraping net, or by snorkling; occasionally scuba dive techniques were used for sublittoral sampling. Spicules were studied, using light microscope (including interference contrast and polarized light) and scanning electron microscope. Three different preparation techniques were used. Thin hand made sections, mounted in artificial canada balsam, to study skeletal features. Mere spicule slides were gained after solution of the soft tissue of the sponge in sodium hypochlorate. The residu was washed in water and mounted in artifificial canada balsam. In order to be able to study the microstructure of spicules, dried pieces of the sponge were covered with a thin layer of gold, to study the material with SEM. Every two weeks a number of specimens were stained in Hemalun-eosin, after decalcifying with 10% acetic acid. After staining, oocytes and embryos, if présent, were visible.

TAXONOMY

Genus *Leucosolenia* Bowerbank, 1861
(Order Homocoelida, Family Leucosoleniidae)

Leucosolenia variabilis Haeckel, 1870 (fig. 1)

Synonyms.-

Ascandra complicata; Maitland, 1897: 55.
Ascartes fabricii; Maitland, 1897: 55.
Leucosolenia botryoides; Rousseau, 1902: 11; Van Soest, 1977: 264, pl. 1 A-B.
Leucosolenia fabricii; Rousseau, 1902: 12.
Leucosolenia complicata; Rousseau, 1902: 12.

Description.-

Sponge asconoid, appearing in two transitional forms, either forming a rather compact bushy mass (bushy form) or spreading out over the substratum (spreading form). Sponge connected basally with the substratum, by little, anastomosing, basal tubes, often bearing diverticula. Oscular tubes are long, smooth and slightly curved, they show no tendency to anastomose or form diverticula. Surface minutely hispid, vents terminal; colour alive and in spirit: white, yellow or grey. Skeleton consists of triradiates, quadriradiates and oxea.

Triradiates, slender, sagittal, unpaired angle distinctly larger than 120°, unpaired ray 50-100 µm by 7 µm, paired rays 80-120 µm by 7 µm. T-shaped triradiates are relatively scarce, unpaired ray 30-60 µm by 5-10 µm, paired rays 50-70 µm by 5-10 µm.

Quadriradiates, similar to triradiates, apical ray 10-40 µm by 7 µm, projecting into the cloacal cavity.

Oxea, curved at the proximal end, lance-headed, 80-320 µm by 2-9 µm; short, slender, refringent, straight 70-110 µm by 2-4 µm; do. non-refringent.

Distribution.-

The potential distribution of sponges in the Netherlands is restricted to only few areas with suitable substratum. *L. variabilis* is very common in the Oosterschelde (Eastern Scheldt). The species is more difficult to find in the Westerschelde and appears to be relatively scarce on the islands Texel and Terschelling in the northern part of the Netherlands. Occasionally the species has been found attached to cork and seaweed on the beaches along the west coast. The species was found recently in the sublittoral of the closed sea arm the Grevelingen (also in the SW part of the Netherlands) (pers.comm. Van Soest). Elsewhere the species is common along the coasts of Western Europe.

Distribution outside Europe (Burton, 1963): Arctic, Mediterranean, South Africa, Straits of Magellan, Chile.

Ecology.-

L. variabilis occurs in a variety of environments and shows no specific preference for substratum, although it is commonly found attached to algae, hydroids, etc.

Discussion.-

The taxonomy of the Homocoelidae has been a problem for a long time, mainly because of the mistakes made by Bowerbank (1864, 1866, 1874) and Haeckel (1872). Minchin (1904) revised the genus *Leucosolenia (Ascandra)* thoroughly and Sará (1953, 1956b) completed the taxonomy and ecology of the genus.

L. complicata appears in a bushy and in an arborescent form (the latter form is never found in *L. variabilis*). Its habitats are rock-pools of the sublittoral and it is very rarely found in situations in which it is liable to be left dry at low tide. The sponge is very fragile. The very long oscular tubes are always provided with diverticula. The oscular rim is long. The unpaired angle of the triradiates is only slightly thicker than the paired angles, but always longer than the paired rays. Small non-refringent oxea are not present (Minchin, 1904; Sará, 1953, 1956b).

L. fabricii is considered a synonym of *L. complicata*.

L. botroides is a very characteristic species (Ellis & Solander, 1786), it appears only in one form and in one situation. The species is always found growing over algae, forming a dense cluster of smooth oscular tubes, rising from a basal reticulum of fine tubes. The sponge resembles a bunch of bananas. The oscular rim is short. The spiculation of *L. botryoides* resembles the spiculation of *L. variabilis*, however all spicules in *L. botryoides* are much more robust, T-shaped triradiates are abundant and large proximally thickened oxea are present (Michin, 1904; Sará, 1953, 1956a, 1956b).

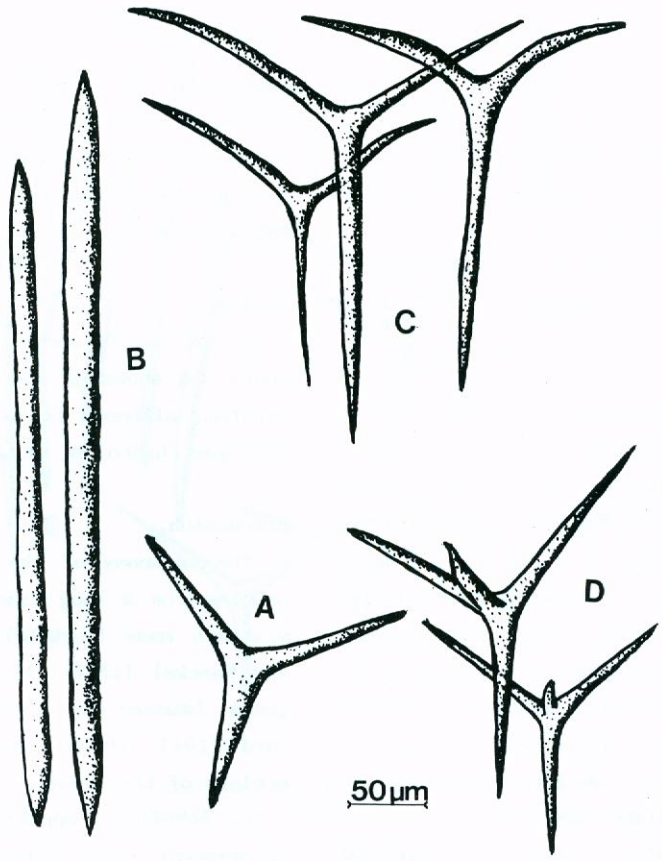

Fig. 2. Spicules of *Scypha ciliata;* a, Tubar triradiate; b, Oxea; c, Subendosomal triradiates; d, Endosomal quadriradiates.

Genus *Clathrina* Gray, 1867
(Order Homocoelida, Family Clathrinidae)

Clathrina coriacea (Montagu, 1818)

This species has been found only once in the coastal waters of the Netherlands (Van Soest, 1977: 264, pl. 1 C). It is apparently an autochthonous species. The material conforms to the description of this species in Burton (1963).

The family Clathrinidae is distinghuished from the family Leucosoleniidae by the following characters: Always a clathrate mass of anastomosing tubes, vents never markedly tubular; only regular triradiate systems are present; the larva is parenchymula larva, instead of the Amphiblastula larva found in the Leucosoleniidae.

Genus *Grantia* Fleming, 1828
(Order Heterocoelida, Family Grantiidae)

Grantia compressa (Fabricius, 1780)

This species has been found washed ashore on the beach of Camperduin (Van Soest, 1977); it is apparently an allochthonous species. The material conforms to the description of this species in Burton (1963).

The family Grantiidae is distinguished from the family Sycettidae by the following characters: Transition between the syconoid and the leuconoid form, appearing sacciform, compressed; vents apical or dispersed; dermal cortex present, consisting of tangential radiates and oxea.

Genus *Scypha* Gray, 1821
(Order Helerocoelida, Family Sycettidae)

Scypha ciliata (Fabricius, 1780) (fig. 2)

Synonyms.-

Sycandra ciliata; Vosmaer, 1882: 51.

Sycandra ciliata, trans.var. *coronata;* Vosmaer, 1882: 51.

Sycon ciliatum; Maitland, 1897: 55; Van

Soest, 1977; 265 (in part), pl. 2 A .

Description.-

Sponge syconoid, tubular, erect, cylindrical. Surface papillate and hispid. Distal chambers grouped around central atrial cavity. Vent apical usually without fringe, sometimes with fringe. Texture soft to firm; colour alive and in spirit: white, yellow, grey or brown. Tubar skeleton of basal rays of subendosomal sagittal triradiates and several rows of tubar triradiates, distal cones ornamented with oxea; endosomal skeleton of paired rays of subendosomal sagittal triradiates and endosomal triradiates and quadriradiates.

Tubar triradiates, sagittal or subregular, paired rays 100-180 µm by 5-10 µm, basal ray 100-200 µm by 5-10 µm.

Ectosomal oxea 300-3000 µm by 6-18 µm.

Subendosomal triradiates, sagittal, paired rays 100-200 µm by 5-10 µm, basal ray 220-260 µm by 5-10 µm.

Endosomal triradiates, sagittal or subregular, paired rays 100-150 µm by 5-10 µm, basal ray 100-200 µm by 5-10 µm.

Endosomal quadriradiates, similar to triradiates, with apical ray 20-80 µm by 7-10 µm.

Distribution.-

The species is very common in all coastal waters of the Netherlands, provided suitable substratum is present. At present it is not found in the closed sea arm Grevelingen (salinity 20-23°/$_{oo}$ S). Elsewhere the species appears to be very common in all Western European coastal waters.

Distribution outside Europe (Burton, 1963): Arctic, Atlantic and Pacific coasts of North America, Chili, Atalantic, Mediterranean and Indian coast of Africa, Australia.

Ecology.-

The sponge is able to grow on all suitable substrata such as seaweeds, wood, rock, etc. In the littoral, *S. ciliata* is mostly found underneath rocks, except on Terschelling, where it was commonly found attached on the upper side of rocks. At Terschelling, too, the species reaches a considerable length of up 18 cm, whereas in other parts of the Netherlands the length apparently does not exceed 5 cm.

Discussion.-

Dubosq & Tuzet (1937, 1941) considered *S. ciliata* and *S. coronata* as being two separate species, based largely on ovogenetical and embryological criteria. However, both species are morphologically identical. The original description by Ellis & Solander (1786) does not provide distinctive features (they were probably unaware of Fabricius' earlier description), and Haeckel's criteria (1872) are merely based on the thickness of the oxea and the length of the apical ray of the quadriradiates. Above all, its is not clear on which skeletal citeria Dubosq and Tuzet identified their material. If we follow Haeckel's description, both "species" occur in the Netherlands, as part of a series of continuous transitions.

Furthermore they are not geographically distinct and they occupy the same ecological niches. Breeding of *"coronata"* individuals occurs in the same period of the year as that of *"ciliata"* individuals. Therefore in agreement with Burton, *S. ciliata* and *S. coronata* are regarded as being one species.

Scypha scaldiensis n.sp. (figs. 3-4)

Synonym.-

Scypha ciliata (in part: fo. *villosus*); Van Soest, 1977: 265, pl. 2 B.

Holotype : ZMA POR.4650, Kats, marina, on weeds attached to pontoons, 23-XI-1979, coll. Th. van Koolwijk & J. Vermeulen.

Paratypes: ZMA POR.4652, 20 specimens, Wemeldinge, on harbour poles, 20-VIII-1975, coll. R.W.M. van Soest & J. Vermeulen.

ZMA POR.4651, 8 specimens, Schelphoek, on pontoon, 23-XI-1979, coll. Th. van Koolwijk & J. Vermeulen.

BMNH reg. No. 1981.8.7.1-2, 2 specimens, Schelphoek, same data.

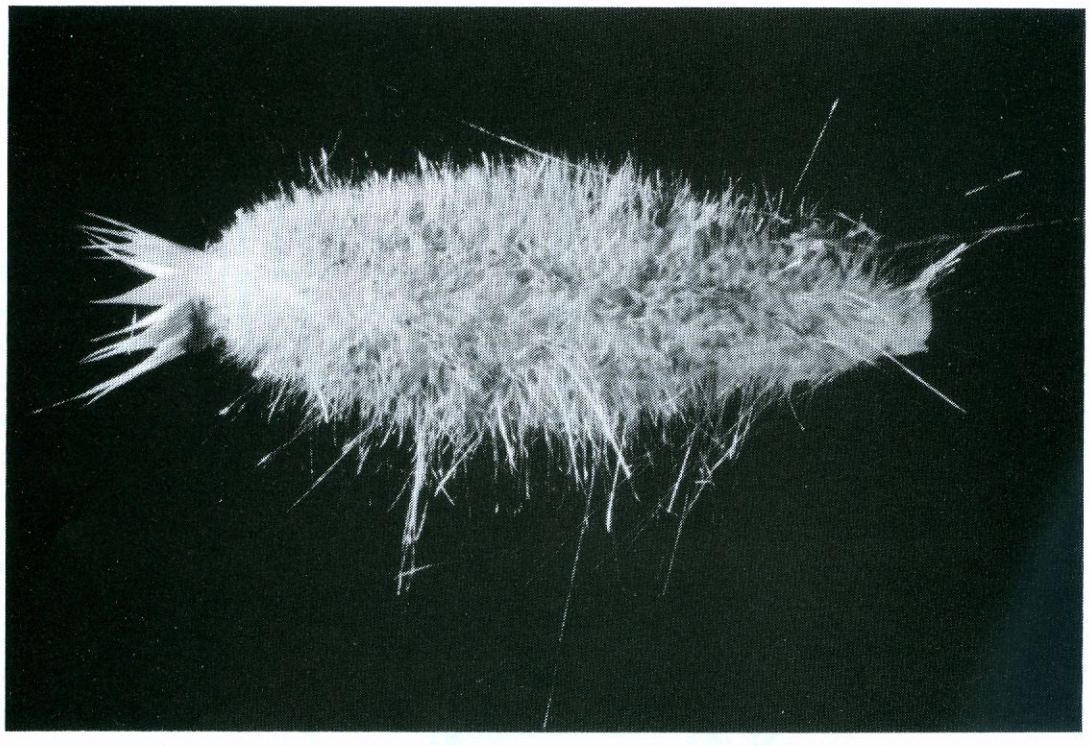

Fig. 3. *Scypha scaldiensis* n.sp., holotype ZMA POR.4650.

Description.-

Sponge tubular, erect, cylindrical, syconoid. Surface hispid, scarcely papillate. Distal chambers grouped around central atrial cavity. Vent apical, always with large fringe. Colour alive and in spirit: Grey or brown. Sponge length up to 5 cm. Tubar skeleton of basal rays of subendosomal sagittal triradiates and several rows of regular tubar triradiates. Distal cones ornamented with large oxea, giving the sponge a very "hairy" look. Endosomal skeleton of paired rays of subendosomal sagittal triradiates and endosomal triradiates and quadriradiates.

Tubar triradiates, regular to sagittal, rays 80-150 µm by 9-11 µm.

Ectosomal oxea 500-7000 µm by 5-10 µm.

Subendosomal triradiates, sagittal, paired rays 80-200 µm by 5-10 µm, basal ray 180-350 by 5-10 µm.

Endosomal triradiates, sagittal or subregular, paired rays 100-280 µm by 5-10 µm, basal ray 200-300 µm by 5-10 µm.

Endosomal quadriradiates, similar to endosomal triradiates with apical ray 80-350 µm by 5-10 µm.

Triradiates of distal cones 30-60 µm by 5-10 µm.

Distribution.-

The species is common in the Oosterschelde, but not found elsewhere.

Discussion.-

The first record of *S. scaldiensis* is Wemeldinge, 28-VIII-1951, leg. J.H. Stock. Although the sponge is common at the present time, it is very rare in preserved collections before 1975. The Oosterschelde, where *S. scaldiensis* appears to be present, is a unique environment. It contains very clear water, with rather high and constant salinity (28-30°/$_{oo}$ S). Each tide 4% of the total watervolume is renewed. It has a rather rich flora and fauna, with specific sponge endemes, such as *Mycale micracanthoxea* Buizer & Van Soest, 1977, and rarities as *Haliclona loosanoffi* Hartmann, 1958 (cf. Van Soest, 1976).

Van Soest (1977) found among "normal" papillate *S. ciliata* specimens, occasionally samples of greyish, very hairy specimens. He suggested that this form might be identical with *S. villosum* (Haeckel, 1872). From a microscopical slide of one of Haeckel's specimens of *Sycandra villosum* (from Ireland, incorporated in the Muséum national d'Histoire naturelle, Paris, kindly sent on loan by Prof. C. Lévi),

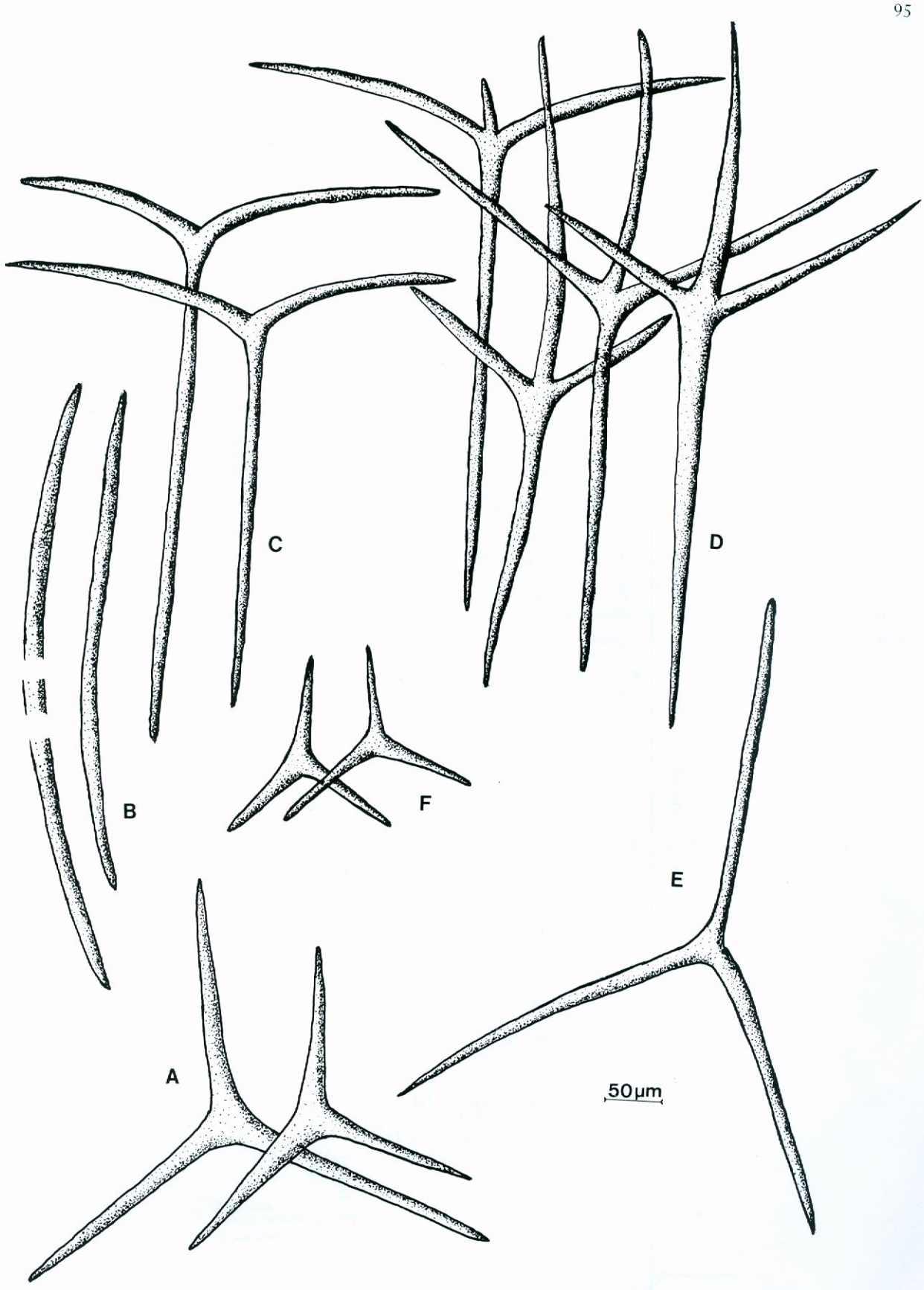

Fig. 4. Spicules of *Scypha scaldiensis* n.sp.; a, Tubar triradiates; b, Oxea; c, Subendosomal triradiates; d, Endosomal quadriradiates; e, Endosomal triradiate; f, Triradiates of the distal cones.

	May		June		July		August		September		October		November		December		January		February		March		April	
	S.c.	*S.s.*	*S.c.*	*S.s.*	*S.c.*	*S.s.*	*S.c.*	*S.s.*	*S.c.*	*S.s.*	*S.c.*	*S.s.*	*S.c.*	*S.s.*	*S.c.*	*S.s.*	*S.c.*	*S.s.*	*S.c.*	*S.s.*	*S.c.*	*S.s*	*S.c.*	*S.s.*
Total No. of specimens	6	4	8	6	12	8	12	21	6	9	6	13	8	17	4	10	6	19	6	27	5	4	4	3
No. of specimens with embryos	1	0	4	1	5	4	7	1	0	1	1	4	0	2	0	1	0	4	0	6	0	0	0	0
% Active [1]	17	0	62	17	60	50	80	52	80	11	50	31	50	70	0	60	0	32	0	22	0	0	0	0
% Embryos	0	0	12	0	17	0	25	48	80	0	33	8	50	60	0	50	0	10	0	19	0	0	0	0

[1] (Oocytes, embryos or both)

Table I: Breeding cycle of *Scypha ciliata (S.c.)* and *Scypha scaldiensis (S.s.)*.

it was clear that it is not identical with *S. scaldiensis*. The conspicuous robustness of the oxea and the tubar triradiates in *S. villosum* (10-30 µm), differ from the rather slender oxea and tubar triradiates in *S. scaldiensis* (7-11 µm). In *S. villosum* we see spicules of two clearly different sizes, spicules as mentioned above are two to four times as robust as endosomal and subendosomal spicules, whereas in *S. scaldiensis* they are of about the same thickness.

Etymology.-

The name *scaldiensis* is derived from the latin name *Scaldia* = (Ooster) Schelde (ref. Julius Caesar, *de Bello Gallico*).

Breeding cycle in *S. ciliata* and *S. scaldiensis* (cf. table I, fig. 5).-

In order to find other distinctive characters between *S. ciliata* and *S. scaldiensis*, breeding periods of both species were studied. It has already been shown that they occur in the same ecological niche without signs of hybridization, so we may conclude that both species are not very closely related. Orton (1914, 1920) showed that breeding in *S. coronata* occurred twice a year - late spring and late summer and fall. In *S. ciliata* (table I) breeding occurred in a continuous period from May to November. The individuals disintegrate late fall, after breeding. During winter the young and small individuals grow. In early spring we see again a regression in population density. These remaining individuals breed during summer.

In *S. scaldiensis*, the breeding period is much longer, from June to early February. This period is divided into two by a sexually non-active period in the month of September. A large part of the population disintegrates during early fall but the remaining part of the population and the fast growing young individuals continue to live throughout the winter.

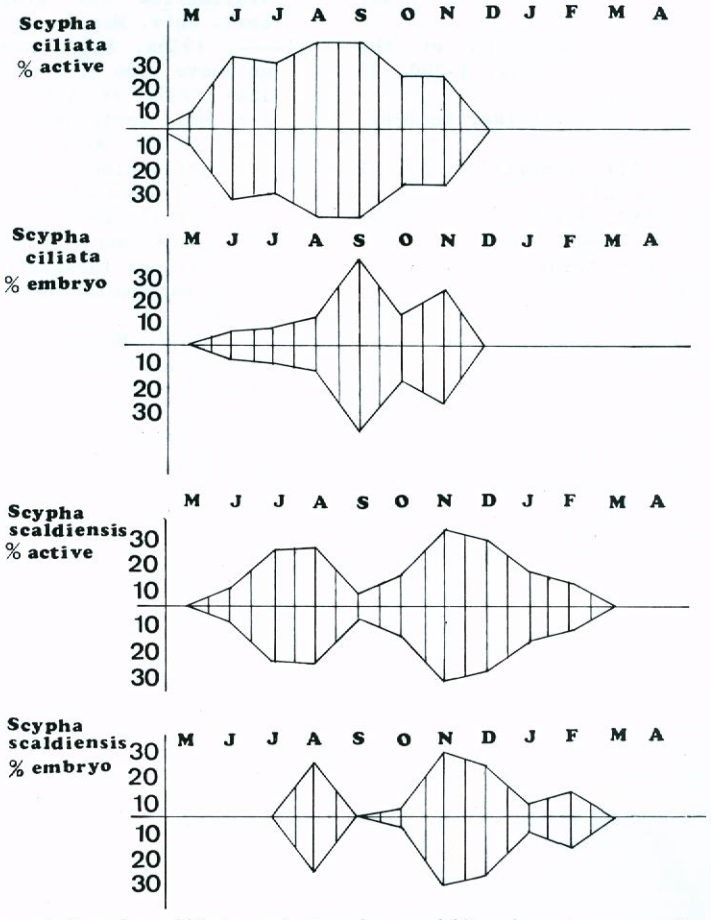

Fig. 5. Breeding cycle of *Scypha ciliata* and *Scypha scaldiensis* n.sp.; a, Percentage of sexually active specimens of *Scypha ciliata*; b, Percentage of embryobearing specimens of *Scypha ciliata*; c, Percentage of sexually active specimens of *Scypha scaldiensis* n.sp.; d, Percentage of embryobearing specimens of *Scypha scaldiensis* n.sp.

This group is forming oocytes in late spring. The severe winter of 1978/1979 reduced the population, but the winters of 1979/1980 and 1980/1981 apparently had no influence on the population. The winter breeding period of the species might indicate that *S. scaldiensis* originates from more southern regions and the recent common occurrence of the species might be due to introduction via imported oysters.

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