

NOTES ON SOME CERAMIACEAE (RHODOPHYTA) FROM
CURAÇAO, ESPECIALLY THOSE FROM THE
EXPOSED NORTHEAST COAST

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SUMMARY

Twenty-five species of the red algal family Ceramiaceae are reported from the exposed northeast coast of the Caribbean island of Curaçao. Some of the more interesting finds are discussed in some detail, and one species, *Spermothamnion antillarum*, is described as new to science. Twelve species are recorded from the island for the first time. A survey of all Ceramiaceae ever recorded from Curaçao yields a total of 60 species, an uncommonly high number for any Caribbean region. Explanations for this high number may be found in the large variety of habitats and the relatively intense study the marine environment has undergone on this island.

INTRODUCTION

The northeastern coast of Curaçao (Netherlands Antilles – West Indies) is exposed to the NE. trade wind the whole year through; except for the inlets of Bartol Baai, Playa Grandi and Sint Jorisbaai the coast shows only small indentations ('Bocas'), and as a whole it is fully exposed to heavy wave action. As a result it is biologically entirely different from the SW. coast, which has more and larger lagoons, while the more sheltered position has allowed the development of coral reef formations in the sublittoral. Probably partly as a result of the adverse conditions to sampling, the NE. coast has not been studied as extensively as the SW. coast, at least algologically.

Marine algae of Curaçao received attention in the publications of Sluiter (1908), Taylor (1942), Diaz-Piferrer (1964), Van den Hoek (1969, 1978), and Van den Hoek et al. (1972, 1975, 1978).

As far as the Ceramiaceae is concerned, Sluiter (1908) reported 4 species from the SW. coast, Taylor (1942) mentioned 7 species, all from the SW. coast. Diaz-Piferrer (1964) gave data on 14 additional species, seven of which occurred on the NE. coast. Van den Hoek (1969) gave descriptions of algal vegetations of the open coasts of Curaçao, including some of the small Bocas on the NE. coast: a total number of 20 species belonging to the Ceramiaceae was mentioned, 12 of these being additions to the earlier reported species, while actually 16 species were reported from the NE. coast, thus bringing the total for this coast to 22 species.

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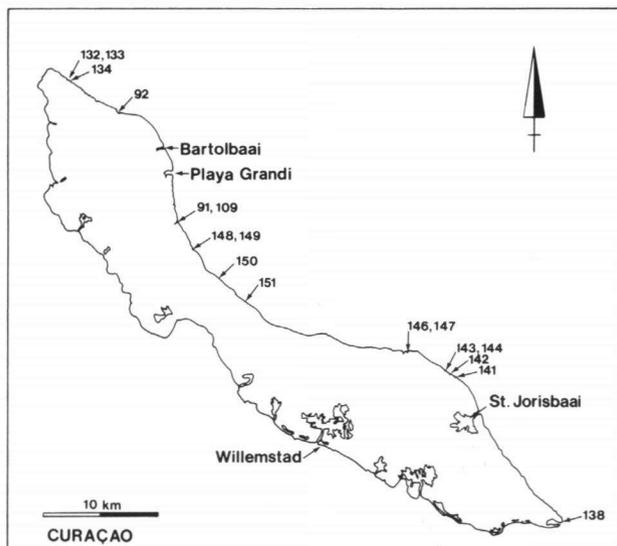


Fig. 1. Curaçao, position of collecting sites on the NE. shore.

In later publications Van den Hoek et al. (1972) added 3 species from inner bays and lagoons, and Van den Hoek et al. (1975) added 4 species from the coral reef. Van den Hoek (1978) described 3 more species from deep levels on the SW. coast (one being a reidentification of an earlier mentioned species), while at the same time (Van den Hoek et al., 1978) 5 additional species were mentioned for the same region. No additions to the NE. coast flora were published in that period.

The present paper deals especially with the Ceramiaceae of the NE. coast, and gives a number of additions, based on the collections of M. Vroman made in 1957–1958. The number of ceramiaceous species recorded from the NE. coast is thus brought to 42, twelve species of which appear to be new to the Curaçao algal flora.

MATERIAL AND METHODS

Material from the NE. coast of Curaçao was collected by M. Vroman during the period 27-ii-1958 to 11-vii-1958, as part of a larger collecting scheme covering the Netherlands Antilles, 1957–1958. Exact localities and dates are shown in fig. 1 and listed below.

Material was collected in the littoral zone, down to the sublittoral fringe or a little below. In some samples drift material was included, possibly of sublittoral origin. Plants were preserved in 4% formalin in seawater. For microscopic study plants or sections were stained in FCF–Fast Green, and embedded in Karo–corn syrup. Voucher specimens, formerly stored in the herbarium of the Vrije Universiteit at Amsterdam (AVU), have now been transferred to the Rijksherbarium at Leiden (L).

List of localities (fig. 1):

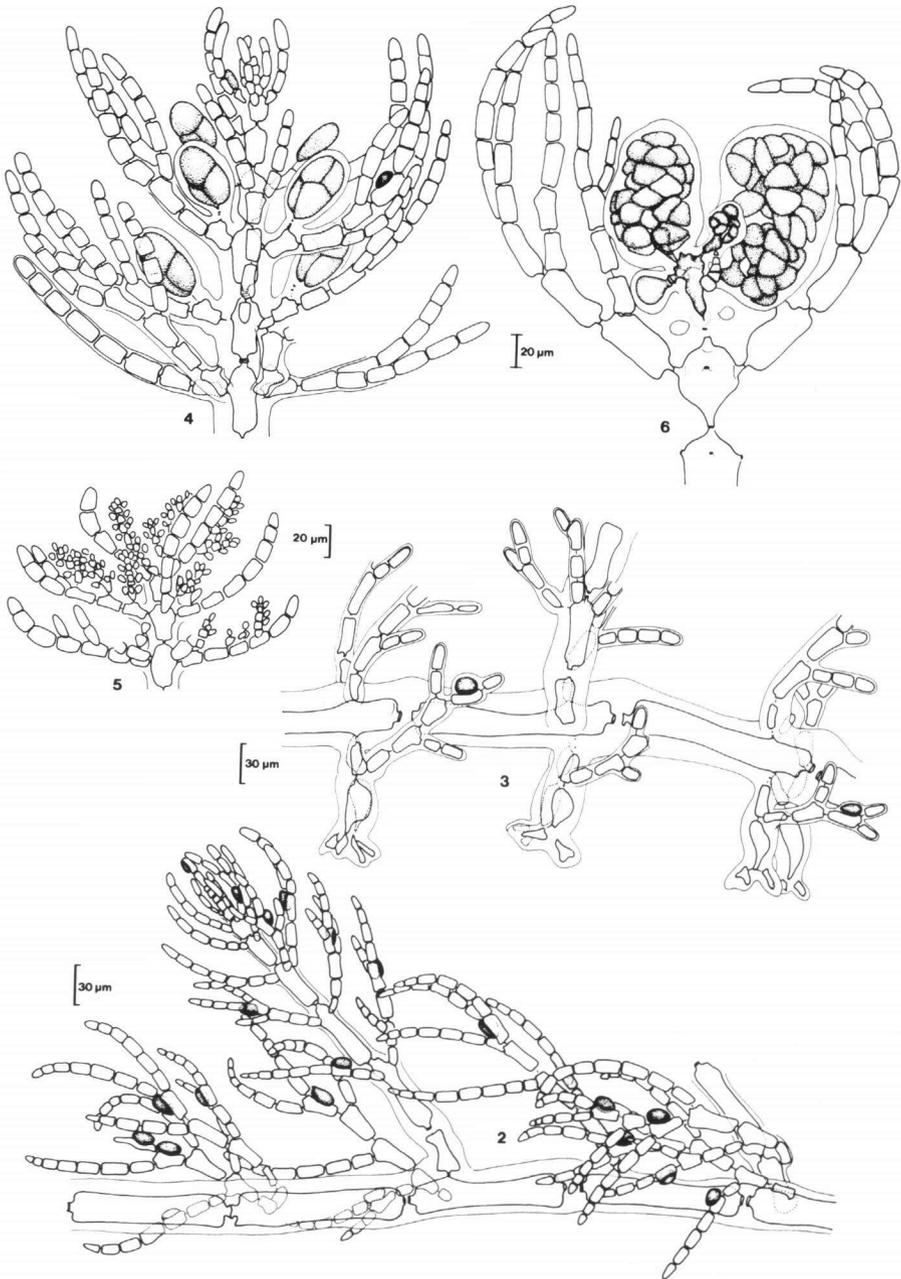
- 91 Boca Ascension, 27-ii-1958, eulittoral zone, including some pools.
- 92 Boca Grandi, on Savonet Estate*, 1-iii-1958, eulittoral and upper sublittoral zones.
- 109 Boca Ascension, 23-iv-1958, same locality as 91, but only collected in western part of Boca.
- 132 Boca Diego, 28-vi-1958, eulittoral zone, as well as some drift material.
- 132a Boca Diego, 1-vii-1958, locality as 132.
- 133 Boca Diego, 1-vii-1958, locality as 132, terrace in splash zone on E. side of Boca;
- 134 Boca Masalinja, 1-vii-1958, about sea level and upwards, including some drift material.
- 138 Punt Kanon (Oostpunt), 2-vii-1958, terraces in wash-zone; although not properly belonging to the NE. coast, this locality has been included because of its similar environment, i.e. exposure to heavy wave action.
- 141 Unnamed inlet between Boca Grandi and Boca Mangel, 4-vii-1958, pools in splash-zone c. 3 m above sea level.
- 142 Boca Grandi on Sint Catharina Estate, 4-vii-1958, eulittoral and upper sublittoral, as well as some drift material.
- 143 Boca Labadera, 8-vii-1958, drift material.
- 144 Boca Labadera, 8-vii-1958, attached material from eulittoral and upper sublittoral.
- 146 Boca Playa Canoa, 10-vii-1958, eulittoral and upper sublittoral, including some pools in the E. corner of Boca.
- 146a Boca Playa Canoa, 10-vii-1958, locality as 146, but in W. part of Boca; eulittoral and upper sublittoral, no pools.
- 147 Boca Playa Canoa, 10-vii-1958, locality as 146, but only sublittoral algae.
- 148 Boca San Pedro, 11-vii-1958, about sea level.
- 149 Boca San Pedro, 11-vii-1958, locality as 148, but about 1 m above sea level.
- 150 Kad. VH. 101, 11-vii-1958, pools in splash-zone (collected by M. Diaz-Piferrer).
- 151 Kad. VH. 95, 11-vii-1958, terrace c. 1.5–2 m above sea level, splash-zone (collected by M. Diaz-Piferrer and M. Vroman).

OBSERVATIONS AND DISCUSSION

***Antithamnionella breviramosa* (Dawson) Wollaston ex Womersley et Bailey**
(Figs 2–6)

Plants largely prostrate, the apices ascending. Prostrate axis 40–50 μm in diameter, the cells up to 100 μm long; in principle each cell provided with four whorl branchlets, but at irregular intervals a whorl branchlet replaced by an erect indetermi-

* More than one of the inlets on Curaçao have received the name Boca Grandi (see no 142).



Figs 2–6. *Antithamnionella breviramosa*. – 2: Prostrate filament with determinate and indeterminate laterals. – 3: Attachment structures. – 4: Thallus apex with tetrasporangia. – 5: Spermatangia. – 6: Mature carposporophyte. – All material from sample 91.

nate axis. Thallus in older parts attached by two multicellular haptera per segment, haptera originating from the basal cell of the whorl branchlets. Determinate whorl branchlets up to 12 cells and (100–)200(–250) μm long, c. 18 μm in diam., tapering toward the apex, usually with three to five alternately arranged ramuli; rachis and ramuli of the branchlets often provided with ovate gland cells c. 20 μm in largest diameter. Indeterminate erect axes up to 1 mm tall, rarely rebranched, but the cells provided with whorls of four determinate branchlets of about the same structure as those on the prostrate axes, sometimes however simple and only 8 cells (100 μm) long.

Tetrasporangia on the basal cells of the determinate branchlets of the erect axes, ovate, 45–50 \times 27–33 μm , tetrahedrally divided.

Spermatangia in small cylindrical stands, with a four-celled axis, on a number of proximal cells of determinate branchlets in the apical parts of the erect axes.

Carposporophyte seemingly terminal on the erect axes, showing the structure typical of the genus, consisting of up to six gonimolobes of various ages. Carposporangia rounded angular, c. 18 μm in diameter.

MATERIAL EXAMINED: Boca Ascension (91), 27-ii-1958, epiphytic on *Laurencia scoparia* J. Ag., growing at sea level (tetrasporangial, male, carposporophytic); Boca Grandi (92), 1-iii-1958, epiphytic on *Gelidiella acerosa* (Forssk.) Feldmann et Hamel.

The Curaçao material differs from known Caribbean species of *Antithamnionella* by the consistent number of four whorl branchlets: *A. latiaxis* Abbott and *A. flagellata* (Boergesen) Abbott possess three and 2–3 whorl branchlets respectively (Abbott, 1979); *Antithamnion tristicum* Joly et Yamaguishi and *Antithamnion ternatum* Joly et Cordiero, both apparently belonging to *Antithamnionella*, have three whorl branchlets likewise. The latter two species were synonymized by Oliveira Filho (1969), and Schneider (1984) included them in *Antithamnionella breviramosa*, again a species usually with three whorl branchlets. Our material is similar to Boergesen's (1930) description of *Antithamnion elegans* Berthold, which mentioned tetramerous whorls; in this respect the Canarian material was said to differ from the Mediterranean *Antithamnion elegans*, the latter having trimerous whorls again. Boergesen (l.c.) considered this 'a character of no value', and Wollaston (1968) mentioned inconsistency in number of whorl branchlets as one of the generic characters in *Antithamnionella*. Feldmann-Mazoyer (1940) gives the number of whorl branchlets in Mediterranean material of *Antithamnion elegans* as 3–4(–5).

We have retained here the name *Antithamnionella breviramosa* as it seems likely that the Curaçao material is only a local variant of this species; it cannot be ruled out, however, that further study will show *Antithamnionella breviramosa* to be a junior synonym of *Antithamnion elegans*. *Antithamnionella breviramosa* is by now known to be widespread throughout the Caribbean, and worldwide in tropical to warm temperate seas.

Callithamnion cordatum Boergesen

MATERIAL EXAMINED: Boca Ascension (91), 27-ii-1958, epiphytic on *Laurencia scoparia* (male carposporophytic); Boca Labadera (143), 8-vii-1958, epiphytic on *Sargassum* sp., washed ashore (male).

A typical feature of this species is the short-celled main axis, at least the basal part of it: in our material main axes are up to 175 μm in diameter, the cells about half as long as broad; in more distal portions of the thallus the cells are longer than broad.

Callithamnion cordatum has been reported from Curaçao once before, apparently from a sheltered location, growing on *Rhizophora* (Diaz-Piferrer, 1964). Boergesen (1917) described it from deeper levels.

Centroceras clavulatum (C. Ag.) Montagne

A very common species, found in virtually every sample, with the exception of a few supralittoral localities (samples 150 and 151), the sublittoral locality 147, and the drift material of sample 143.

Plants usually grow in low algal turfs, mixed with other caespitose algae, e.g. *Cladophoropsis membranacea* (C. Ag.) Boergesen and *Jania* spp.

The majority of the material is sterile or tetrasporangial; male plants were observed in sample 142, cystocarpic plants in samples 91, 138, 141 and 144.

On several occasions plants were found infested with *Centrocerocolax ubatubensis* (see below).

Centrocerocolax ubatubensis Joly (Figs 7–11)

Plants forming mucilaginous lobed pustules on the substrate (usually *Centroceras clavulatum* – see however remarks below), up to 1 mm in diameter, anchored in the host with a few penetrating cells, but endophytic part usually rather limited. In the centre of the plant cell organization seemingly chaotic, but near the periphery the structure clearly monoaxial, each cell of the axes provided with a whorl of 4 or 5 short branchlets, embedded in mucilage.

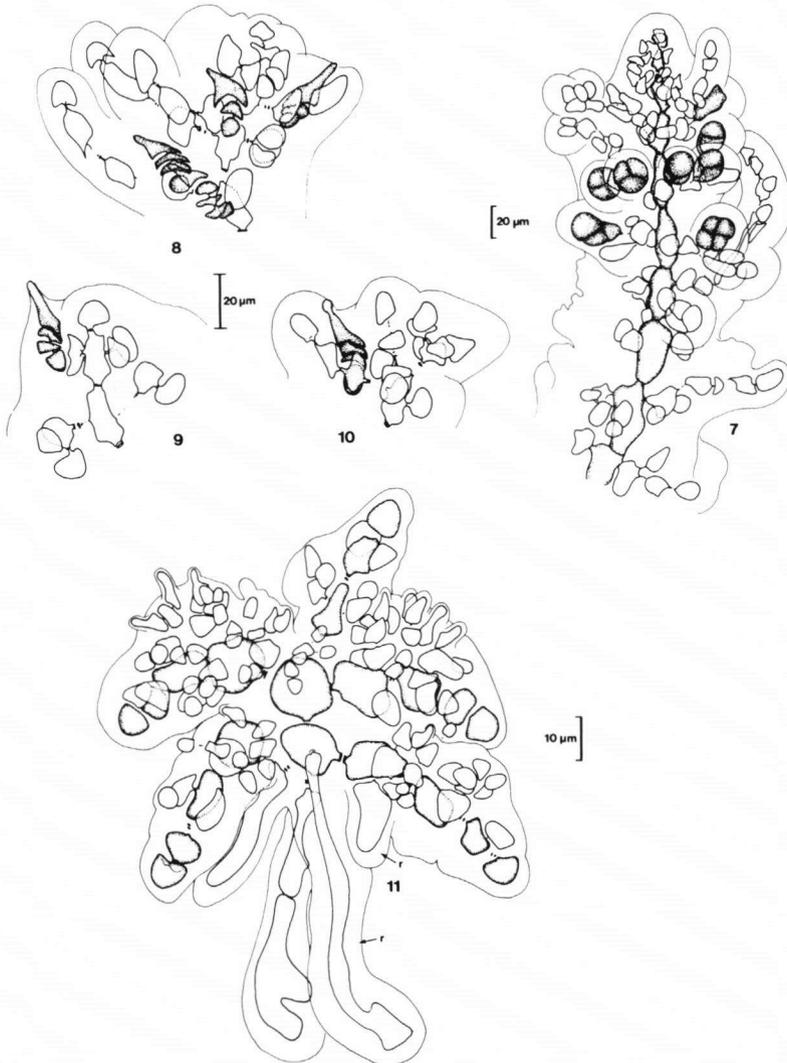
Tetrasporangia in numbers of one or two on the periaxial cells, more or less immersed and covered by the branchlets, at maturity c. $25 \times 20 \mu\text{m}$, tetrahedrally or irregularly divided.

Spermatangia covering the whole surface of the male plants, borne by virtually every cell that reaches the periphery of the pustules.

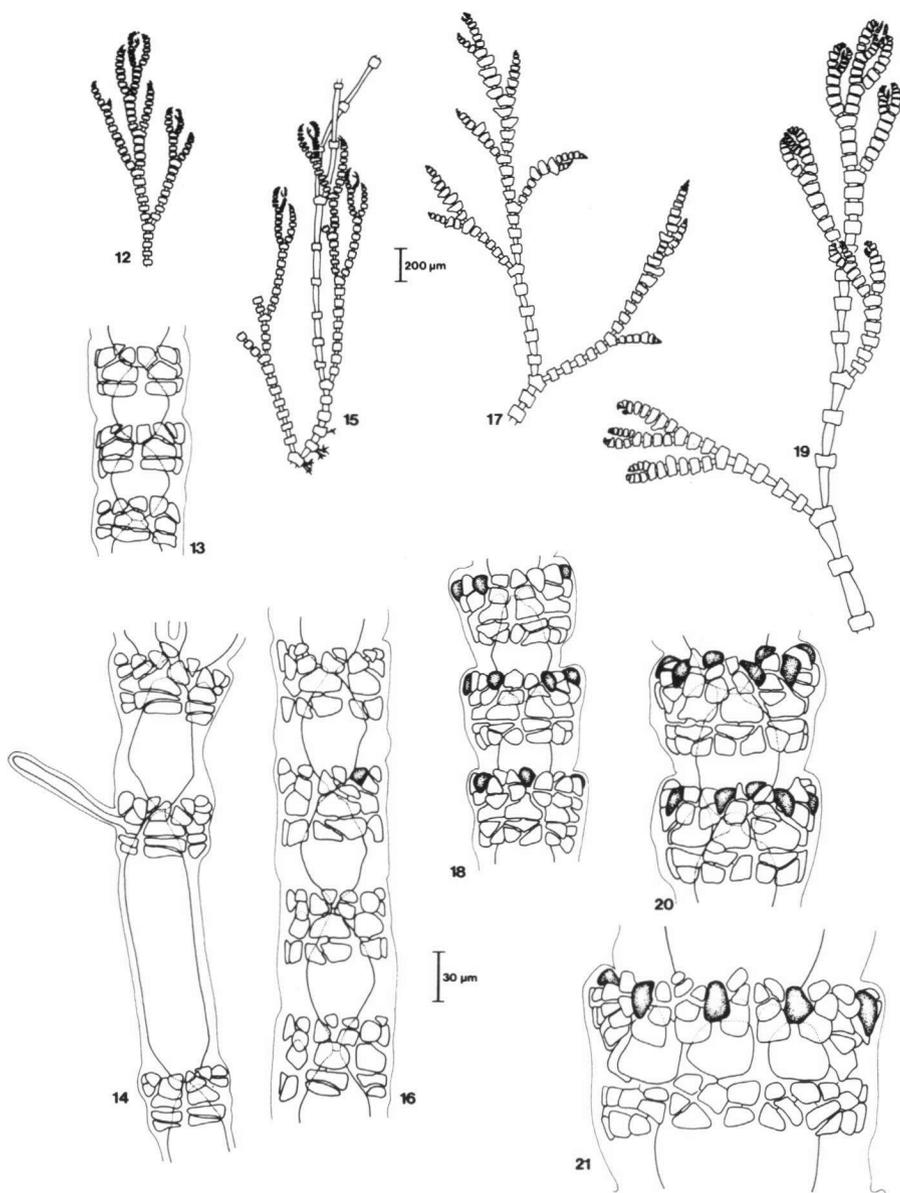
Carpogonial filaments borne on the periaxial cells, usually not more than one or two per axial segment. Carpoogonial filaments usually four-celled, the carpoogonia with either a short or a very long trichogyne. Carposporophytes hemispherical, up to 125 μm in diameter.

MATERIAL EXAMINED: Boca Ascension (91), 27-ii-1958, on *Centroceras clavulatum* (male, female, tetrasporangial); Boca Grandi (92), 1-iii-1958, on *Ceramium* sp. (male, female, tetrasporangial); Boca Diego (132), 28-vi-1958, on *Centroceras clavulatum* (male, female, tetrasporangial); Boca Masalinja (134), 1-vii-1958, on *Centroceras clavulatum* (male, female, tetrasporangial); Boca Grandi (142), 4-vii-1958, on *Centroceras clavulatum* and *Ceramium tenerrimum* (Martens) Okamura (male, female, tetrasporangial); Boca Labadera (144), 8-vii-1958, on *Centroceras clavulatum* (male, female, tetrasporangial).

The Curaçao material growing on *Centroceras* is generally in good agreement with Joly's (1965) description, but we have seen the 'typical' long trichogynes in only one sample (144); usually they only just emerge from the mucilaginous matrix of the plant (figs 8–10).



Figs 7–11. *Centrocerocolax ubatubensis*. – 7: Thallus apex with tetrasporangia. – 8–10: Carpogonial filaments. – 11: Juvenile plant from *Ceramium*, showing differentiation of several main axes and development of spermatangia (r=rhizoid).—Figs 7–10 from sample 132, fig. 11 from sample 92.



Figs 12–14. *Ceramium byssoideum*. – 12: Thallus apex. – 13 & 14: Cortication pattern. – Figs 12 & 13 from sample 134, fig. 14 from sample 144. — Figs 15–18. *C. dawsonii*. – 15 & 17: Thallus apices. – 16 & 18: Cortication patterns. – Figs 15 & 16 from sample 132, figs 17 & 18 from sample 142. — Figs 19–21. *C. taylorii*. – 19: Thallus apex. – 20 & 21: Cortication patterns in young and mature segments respectively. – Material from sample 109.

On two occasions the species was found growing on *Ceramium* spp., and in those cases the general appearance of the plants was aberrant, although not their detailed structure or cell dimensions (fig. 11): Immediately from the initial stages the plants differentiate into a number of well defined axes, each axis with a central filament and a limited development of whorl branchlets, almost in the form of a cortication; the thallus never develops into the rather amorphous pustules as known from *Centroceras*.

Our records suggest that *C. ubatubensis* is generally present, but often overlooked because of its small size; thus it is reported here from Curaçao for the first time.

Ceramium

The genus *Ceramium* in the Caribbean (as in many other places worldwide) is particularly rich in species and notoriously difficult taxonomically. This may in part explain why there is little consistency in the records of this genus: for instance Diaz-Piferrer (1964) reported four species from Curaçao; subsequently Van den Hoek (1969) and Van den Hoek et al. (1972, 1975, 1978) reported additional finds only of *C. nitens* (C.Ag.) J.Ag., while six other species (and one of *Ceramiella*) were mentioned (see also table 2).

Since a solution of the taxonomic problems must await a thorough revision of the genus, and in order to document our own identifications, we present basic characteristics of the vegetative morphology of all our finds (table 1), and drawings of apical sections and cortication patterns. Important additional characters may be mentioned under each of the species separately.

All material from the NE. coast was very small, often not exceeding 10 mm in height. Therefore, a strict discrimination between 'erect/bushy' and 'prostrate' habit cannot be made for most of the species: usually filaments are partly creeping, with the apices and laterals ascending. All the species discussed here have incomplete cortication.

***Ceramium byssoideum* Harvey (Figs 12–14)**

***Ceramium dawsonii* Joly (Figs 15–18)**

***Ceramium taylorii* Dawson (Figs 19–21)**

Material attributable to these species is characterized by a clear horizontal separation between acropetal and basipetal sections of the cortical bands. Womersley (1978) has synonymized several species of this type under *C. flaccidum* (Kütz.) Ardissonne, among them the here reported *C. byssoideum* and *C. taylorii*, and also *C. gracillimum* Griff. ex Harvey, reported by Van den Hoek (1969). It is uncertain whether true boundaries exist between the species: in the series *C. byssoideum*, *C. dawsonii* and *C. taylorii* we observe an increasing maximum filament diameter, increasing number of periaxial cells, and increasing complexity of especially the basipetal corticating groups. *Ceramium byssoideum* is characterized by its transversally elongated basipetal cortical cells, but intermediates between this form and *C. daw-*

sonii, where those cortical cells divide longitudinally, were found in the Curaçao material. In *C. dawsonii* we could distinguish two forms, differing in number of periaxial cells and filament diameter (compare figs 15, 16 and 17, 18). The number of gland cells varies largely within most of the forms here discussed.

MATERIAL EXAMINED: *Ceramium byssoideum*: Boca Masalinja (134), 1-vii-1958, on *Galaxaura* sp. (tetrasporangial); Boca Labadera (144), 8-vii-1958, on *Gelidiella acerosa* (male); Boca Playa Canoa (146), 10-vii-1958, on *Laurencia obtusa* (Huds.) Lamour. — *Ceramium dawsonii* (narrow filaments): Boca Diego (132), 28-vi-1958, on *Sargassum* sp.; idem (132a), 1-vii-1958, on *Dictyota mertensii* (Martius) Kütz.; Boca Playa Canoa (146 & 146a), 10-vii-1958, on *Turbinaria turbinata* (L.) Kuntze and *Ochtodes secundiramea* (Montagne) Howe. — *Ceramium dawsonii* (broad filaments): Boca Grandi (92), 1-iii-1958, on *Laurencia* sp. (tetrasporangial); Boca Grandi (142), 4-vii-1958, on *Laurencia* sp. (tetrasporangial, male, carposporophytic); Boca Labadera (144), 8-vii-1958, on *Laurencia* sp. (tetrasporangial, carposporophytic). — *Ceramium taylorii*: Boca Ascension (109), 23-iv-1958, on *Chamaedoris peniculum* (Ellis et Solander) Kuntze and *Hypnea spinella* (C. Ag.) Kütz.; Boca San Pedro (148), 11-vii-1958, on *Sargassum* sp. and *Bryothamnion triquetrum* (Gmelin) Howe.

Table 1. Major vegetative characteristics of eight species of *Ceramium* on the NE. coast of Curaçao.

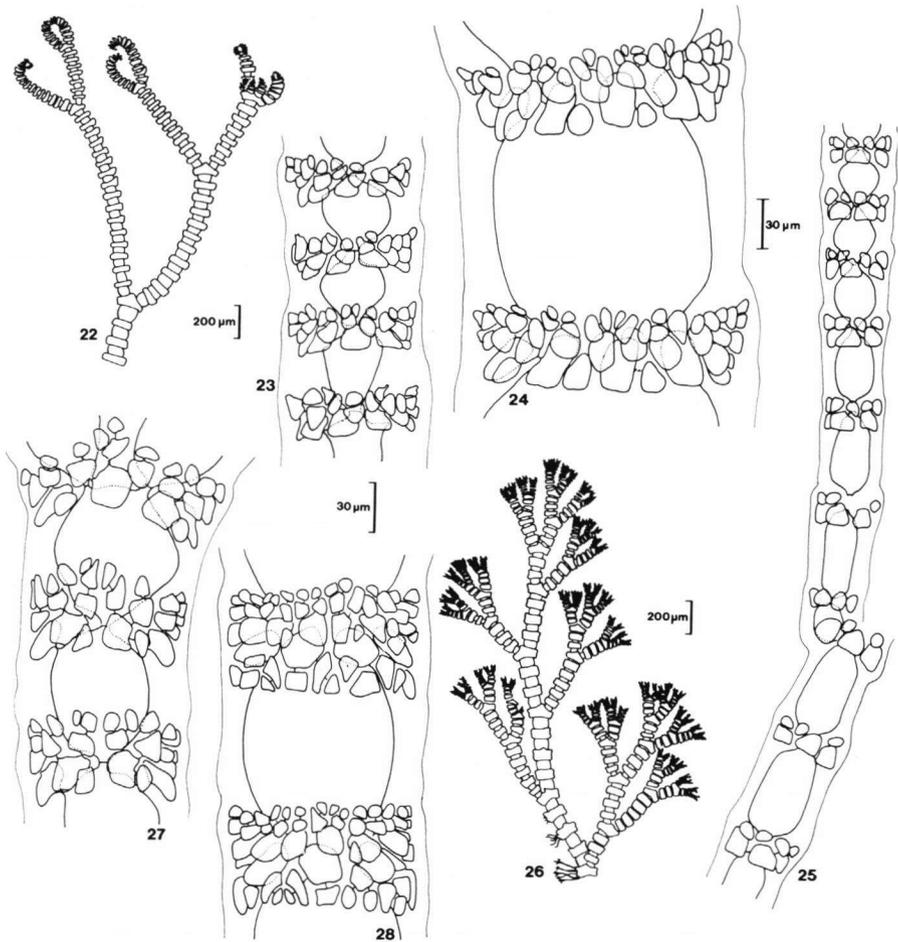
	<i>C. byssoideum</i>	<i>C. dawsonii</i>	<i>C. taylorii</i>	<i>C. fastigiatum</i> f. <i>flaccidum</i>	<i>C. floridanum</i>	<i>C. brevizonatum</i> var. <i>carabicum</i>	<i>C. tenerimum</i>	<i>C. sp.</i>
number of periaxial cells	4-5	(4-)5 5-6	7(-8)	4-5	6	8-10	9-10	(6-)8
apices incurved	±	±	±	? ¹	-	++	++	-
branching type ²	m. a	m. a	m. a	? ¹	m.a	d	d	d
cortical groups ³								
up	2	2	2	2	2	2	2	2
down	1	1	1	-	1-2	(1) ⁴	2	2
sideward	-	-	-	-	-	-	1	-
max. filament diameter (µm)	50-70	60-100	170	45	120	200	300	200
gland cells	+,-	+,-	+	-	-	-	+	-

¹ material too fragmentary for observation.

² m. a = sympodial branching with development of well recognizable main axis; d = (sub)dichotomous.

³ number of initials given off by primary periaxial cells.

⁴ only in older nodes.

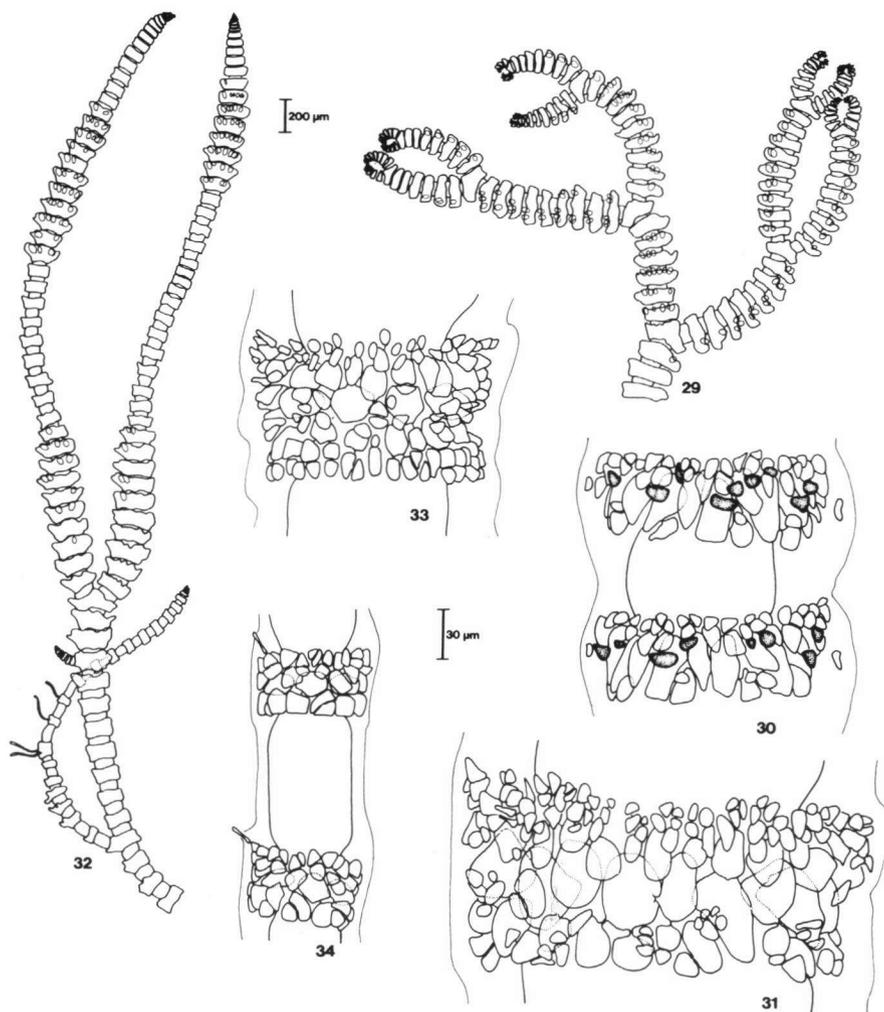


Figs 22–24. *Ceramium brevizonatum* var. *caraibicum*. – 22: Thallus apex. – 23 & 24: Cortication patterns in young and old segments respectively. – All material from sample 148. — Fig. 25. *C. fastigiatum* f. *flaccidum*, detail of filament. Sample 132a. — Figs 26–28. *C. floridanum*. – 26: Thallus apex. – 27 & 28: Cortication patterns. – Figs 26 & 28 from sample 134, fig. 27 from sample 146.

***Ceramium brevizonatum* Petersen var. *caraibicum* Petersen et Boergesen**
(Figs 22–24)

Characteristics, in addition to the ones mentioned in table 1, are the very limited development of basipetal cortication (sometimes absent), and the cortical cells gradually diminishing in size in acropetal direction.

MATERIAL EXAMINED: Boca Grandi (92), 1-iii-1958 (carposporophytic); Boca San Pedro (148), 11-vii-1958, in low algal turf (carposporophytic).



Figs 29–31. *Ceramium tenerrimum*. – 29: Thallus apex. – 30 & 31: Cortication patterns. – All material from sample 134. — Figs 32–34. *Ceramium* sp. – 32: Thallus apex (tetrasporangial). – 33 & 34: Cortication patterns in main axis and proliferation respectively. – All material from sample 134.

***Ceramium fastigiatum* (Roth) Harvey f. *flaccidum* H.E.Petersen (Fig. 25)**

Characterized by the very limited development of cortical tissue from the periaxial cells: only one secondary row of cells is formed in acropetal direction.

MATERIAL EXAMINED: Boca Diego (132a), 1-vii-1958, on *Dictyopteris justii* Lamour., material washed ashore.

Ceramium floridanum J. Ag. (Figs 26–28)

A prominent feature is the strictly complanate arrangement of all laterals (cf. Taylor, 1960).

MATERIAL EXAMINED: Boca Masalinja (134), 1-vii-1958, on *Eucheuma* sp.; Boca Playa Canoa (146), 10-vii-1958, on *Hypnea* sp. in algal turf (tetrasporangial, male, carposporophytic); idem (146a), 10-vii-1958, on *Ochtodes secundiramea* (tetrasporangial).

Ceramium tenerrimum (Martens) Okamura (Figs 29–31)

A characteristic feature is the initial cell of the sideways corticating group, which reaches about the same size as the primary periaxial cell; thus the impression is given of about 20 periaxial cells being present per node.

MATERIAL EXAMINED: Boca Ascension (91), 27-ii-1958; Boca Grandi (92), 1-iii-1958 (tetrasporangial); Boca Masalinja (134), 1-vii-1958, in algal turf with *Jania* spp. and epiphytic on *Eucheuma* sp. (tetrasporangial, carposporophytic); Boca Grandi (142), 4-vii-1958, in algal turf and on *Peyssonnelia* sp. (male, tetrasporangial); Boca Labadera (144), 8-vii-1958, in algal turf and on *Amphiroa* sp. (male, tetrasporangial); Boca Playa Canoa (146), 10-vii-1958, in algal turf (tetrasporangial).

Ceramium sp. (Figs 32–34)

The number of periaxial cells, normally eight in main axes, is reduced to six in proliferations.

MATERIAL EXAMINED: Boca Masalinja (134), 1-vii-1958, in algal turf with *Jania* spp. (tetrasporangial).

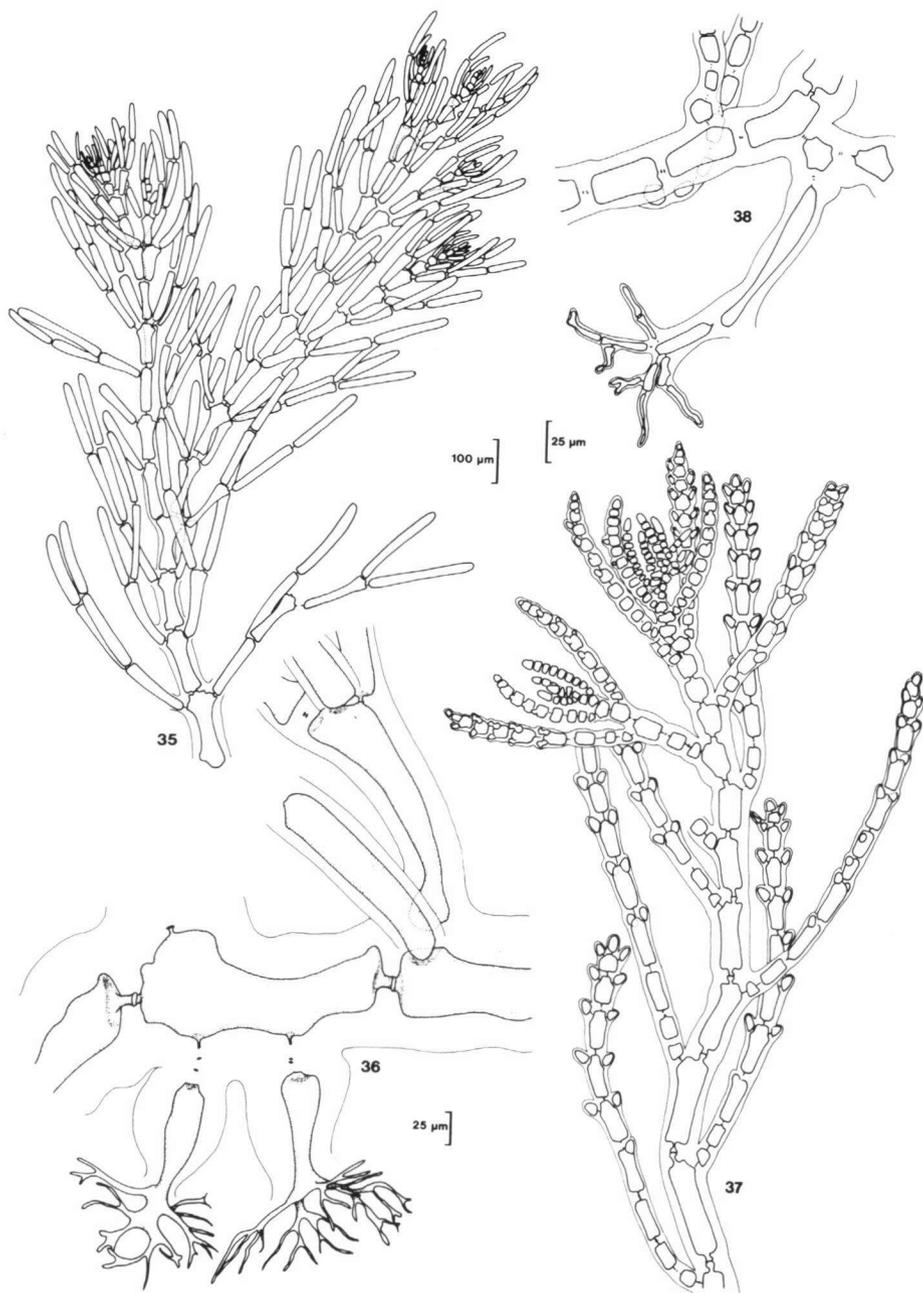
The scarce material could not satisfactorily be identified with one of the Caribbean species of the genus. Judging from the figures it might be identical with *C. equisetoides* Nakamura (= *C. nakamurai* Dawson), described from Formosa (Taiwan). From the type description no exact data are available on number of periaxial cells and further cortication (Nakamura, 1950), but Itono (1977) states that five periaxial cells are present, significantly fewer than in our material.

Crouania attenuata (Bonnemaison) J. Ag.

MATERIAL EXAMINED: Boca Grandi (92), 1-iii-1958, on *Jania* spp.; Boca Playa Canoa (146), 10-vii-1958, on *Jania capillacea* Harvey growing in an algal turf in the upper sublittoral.

Our material was sterile on both occasions. This species was earlier reported from several localities on the SW. coast of Curaçao (Diaz-Piferrer, 1964; Van den Hoek, 1969; Van den Hoek et al., 1978).

Boergesen (1917) stated that per axial cell four whorl branchlets were present, in our material the number is invariably three, such in accordance with the definition of the genus as given by Wollaston (1968).



Figs 35 & 36. *Diplothamnion jolyi*. — 35: Erect filament. — 36: Attachment structures. — Material from sample 132. — Figs 37 & 38. *Dohrniella antillarum*. — 37: Erect filament. — 38: Attachment structure. — Fig. 37 from sample 132a, fig. 38 from sample 134.

Diplothamnion jolyi Van den Hoek (Figs 35, 36)

Plants partly prostrate, the apices ascending. Prostrate filaments 60–75(–90) μm in diameter, the cells up to 600 μm long, provided with up to three unicellular digitate haptera. Erect filaments up to 3 mm tall, c. 60 μm in diameter below, tapering to c. 12 μm apically. Cells much longer than broad basally (up to 400 μm), becoming progressively shorter toward the apex. Each cell of the erect axes provided with a pair of opposite laterals, these decussate in successive segments. Determinate laterals sometimes simple, usually, however, with one forking from the basal cell, each of the two ramuli one- or two-celled. Determinate laterals up to 400 μm long, 20–25 μm in diameter, the apices blunt. Indeterminate laterals at intervals of 2 to 5 segments, replacing determinate branchlets.

No reproductive structures found.

MATERIAL EXAMINED: Boca Ascension (91), 27-ii-1958, on *Laurencia microcladia* Kütz.; Boca Diego (132), 28-vi-1958, on *Sargassum* sp., washed ashore; idem (132a), 1-vii-1958, on *Dictyopteris justii*, washed ashore; Boca Labadera (143), 8-vii-1958, on *Sargassum* sp., washed ashore; Boca San Pedro (149), 11-vii-1958, on *Sargassum* sp., washed ashore.

Diplothamnion jolyi was described from rather deep levels on the SW. coast of Curaçao (Van den Hoek, 1978), and mentioned as a probable 'depth' of 'shade' species (Van den Hoek et al., 1978). Our material was mainly found on drift specimens of *Sargassum* and *Dictyopteris*, and is apparently of sublittoral origin, although its original level remains a matter of speculation.

The NE. coast material differs from the original description by its thicker filaments (prostrate filaments 30–50 μm in the type, erect filaments 20–45 μm), and the not notably swollen determinate branchlets (in the type 18–30 μm proximally, 25–40 μm distally).

Ballantine & Wynne (1986) reported *D. jolyi* from offshore Puerto Rico, and they stated that it is a common species throughout the Caribbean.

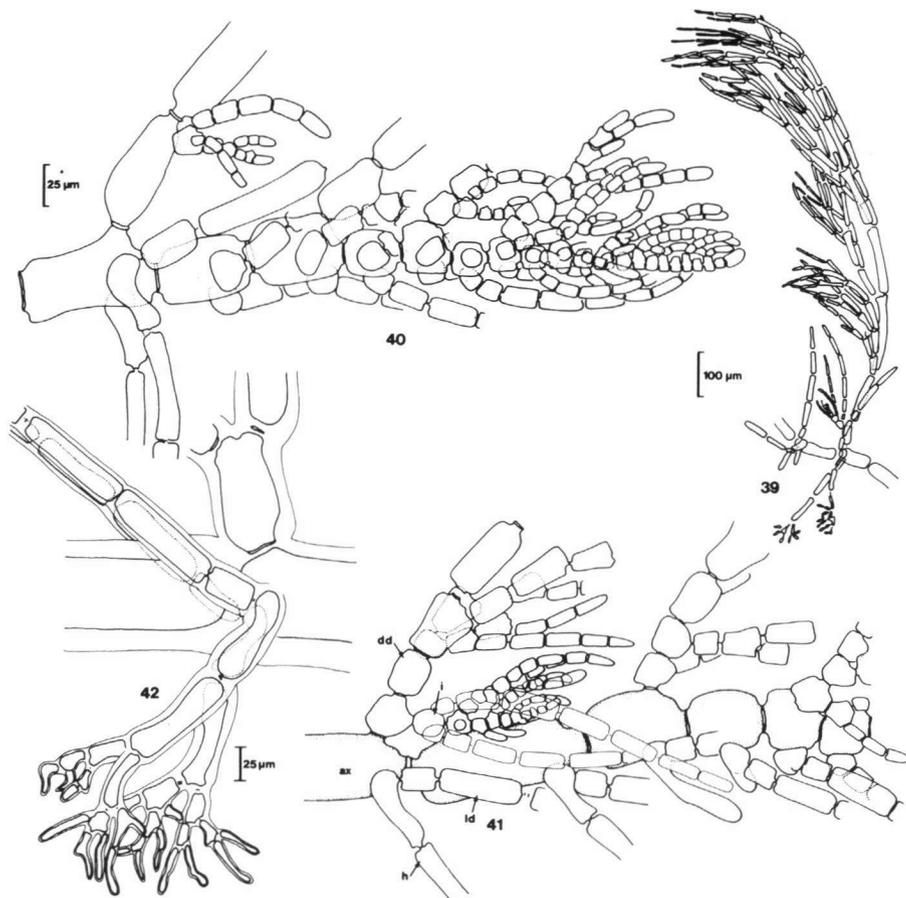
Dohrniella antillarum (Taylor) Feldmann-Mazoyer (Figs 37, 38)

Plants partly prostrate, the apices ascending, up to 1.5 m tall. Prostrate filaments 25–50 μm in diameter, the cells 50–100 μm long; axes gradually tapering to 6 μm diameter apically, the subapical segments shorter than broad. Plants attached by means of multicellular haptera originating from the basal cells of the laterals. Each cell, of both prostrate and erect parts, provided with one lateral, determinate or indeterminate, laterals spirally arranged. Determinate laterals consisting of up to 12(–15) cells, these distally provided with 1–3 papilliform cells.

No reproductive structures seen.

MATERIAL EXAMINED: Boca Ascension (91), 27-ii-1958, on *Hypnea spinella* (C. Ag.) Kütz.; Boca Diego (132a), 1-vii-1958, on *Dictyopteris justii*, washed ashore; Boca Masalinja (134), 1-vii-1958, on *Dictyopteris justii*, washed ashore; Boca Labadera (143), 8-vii-1958, on *Sargassum* sp., washed ashore.

The Curaçao material is considerably smaller than indicated by Taylor (1960) for this species. Plant size and cell length are in better agreement with some descriptions



Figs 39–42. *Grallatoria reptans*. – 39: Thallus detail with mature determinate laterals and haptera. – 40 & 41: Apical sections of prostrate filaments, showing development of laterals of different kinds. – 42: Mature haptera. – All material from sample 146 (ax = main prostrate axis, dd = dorsal determinate branchlet, h = hapteron, i = indeterminate branch, ld = lateral determinate branchlet).

of the variety *brasiliensis* Joly et Ugadim (e.g. Oliveira Filho, 1969, and Cordeiro-Marino, 1978). However, another characteristic of this variety, i.e. the lower number of papilliform cells, appeared to vary a great deal in the Curaçao material: the illustrated plant (from sample 132a) agrees with the typical variety, but other plants had only up to five papilliform cells per lateral, often secundly arranged.

The variety *brasiliensis* has earlier been recorded by Van den Hoek (1969).

Grallatoria reptans Howe (Figs 39–42)

MATERIAL EXAMINED: Boca Playa Canoa (146), 10-vii-1958, on *Caulerpa vickersiae* Boergesen.

This species, infrequently found in the Caribbean, is reported here for the first time from Curaçao.

There appears to have been a good deal of confusion on the exact structure and development of the thallus of *Grallatoria*. Abbott (1976) stated that 'although haptera, indeterminate and determinate branches usually arise from the repent axial cells, the order of occurrence and the arrangement is not necessarily fixed, ...' Probably on basis of such observations, Schneider (1984) has been led to remark that 'In *Grallatoria reptans* indeterminate erect axes never arise on determinate axes, ...', this presumably being one of the characters that offset *Grallatoria* against *Callithamniella*.

Our own observations and those of Wynne & Ballantine (1985) show that there is a quite strict sequence of development and arrangement of laterals of all kinds (including haptera), in agreement with the descriptions of Howe (1920) and Taylor (1960):

1) Immediately behind the apical cell of the prostrate axis, every other axial cell develops a dorsal branch. Although in a mature state this branch is many times subdichotomously branched, it is definitely determinate in nature. Very soon, however, it issues an indeterminate shoot from the adaxial side of its basal cell. This indeterminate branch may show a somewhat stunted growth, but it repeats the branching pattern of the main prostrate axis nevertheless, and it may develop into a new prostrate filament. Truly erect indeterminate axes are absent.

2) All segments of the prostrate axis develop a pair of opposite unbranched determinate laterals in lateral positions. Hence, the segments of the prostrate filaments alternately bear whorls of two and three determinate branches.

3) Multicellular haptera develop from the basal cells of the unbranched determinate laterals; through a deformation of the basal cell it may appear as though haptera were formed first, and unbranched laterals subsequently.

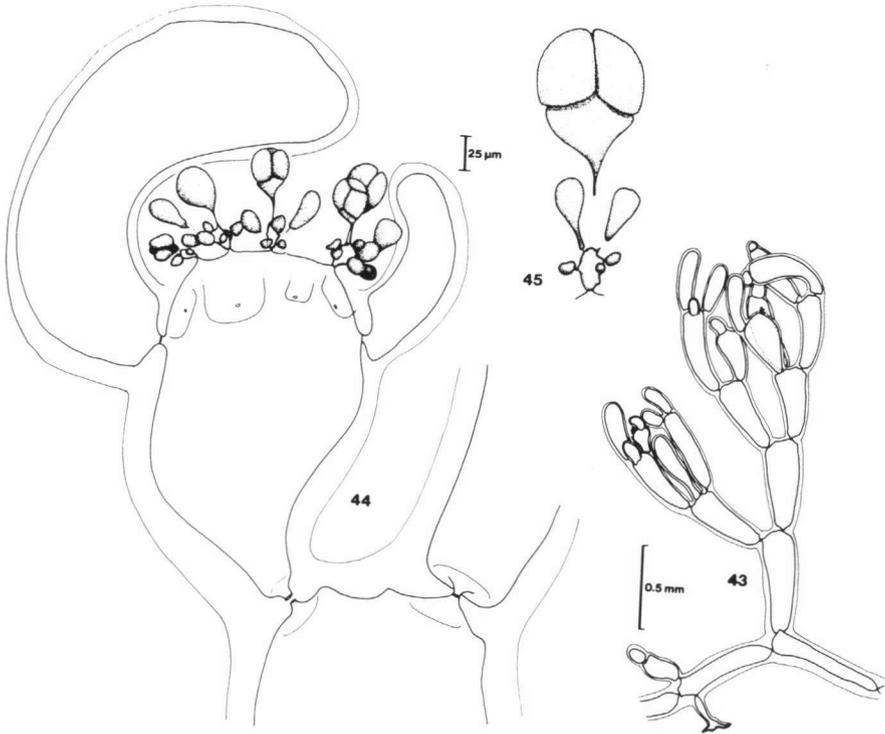
As for the relationship between *Grallatoria* and *Callithamniella*, a decision must await more conclusive information on the post-fertilization developments especially in the latter genus (see also Schneider, 1984).

Griffithsia

So far, one species of *Griffithsia* was reported from Curaçao, *G. cf. globulifera* (Van den Hoek, 1969; Van den Hoek et al., 1972); another species, *G. tenuis* C. Ag., reported by the same authors, is nowadays assigned to the genus *Anotrichium*. In our NE. coast material two species of *Griffithsia* were found.

Griffithsia caribaea Feldmann-Mazoyer (Figs 43–45)

Plant consisting of creeping filaments attached by unicellular digitate haptera, and bearing erect systems of subdichotomously/trichotomously branched filaments up to 4 mm tall. Cells of the prostrate filaments cylindrical, c. 160 μm in diameter, up to 600 μm long. Cells of the erect systems somewhat clavate, 200–250 μm in diameter at the distal end, up to 600 μm long. Apical cells 60–80 μm in diameter.



Figs 43–45. *Griffithsia caribaea*. – 43: Habit of female plant. – 44: Pedicel with tetrasporangial clusters and involucre cells. – 45: Tetrasporangial cluster. – All material from sample 132.

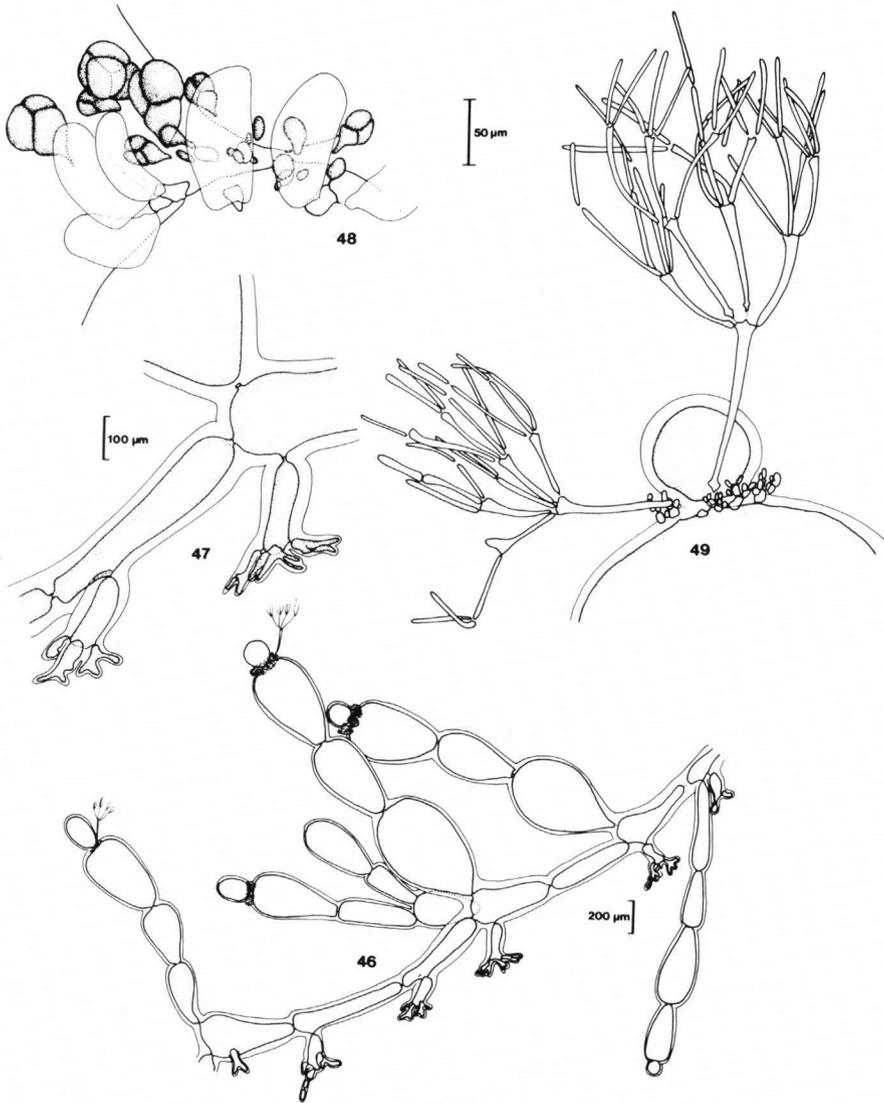
Tetrasporangia in a number of small clusters on top of a single inflated pedicel (up to 300 μm in diameter), surrounded by 8–10 incurved involucre cells. Involucre cells borne directly by the pedicel. Tetrasporangial clusters with a stalk cell and up to c. 10 tetrasporangia; mature tetrasporangia c. 125 \times 80 μm , tetrahedrally divided.

Procarys and carposporophytes seemingly terminal on pedicel, surrounded by involucre cells.

Male reproductive structures not seen.

MATERIAL EXAMINED: Boca Diego (132), 28-vi-1958, on *Sargassum* sp., washed ashore (tetrasporangial, female); Boca Labadera (143), 8-vii-1958, on *Sargassum* sp., washed ashore (female); Boca Playa Canoa (146a), 10-vii-1958, entangled with *Hypnea spinella* (tetrasporangial).

Except for the height of the plant, general morphology and cell sizes of our material are in good agreement with *G. caribaea*. In sample 146a a somewhat bigger plant was found: erect system up to 10 mm tall, cells up to 300 μm in diameter and up to 1200 μm long; reproductive morphology as described above.



Figs 46–49. *Griffithsia cf. schousboei*. – 46: Habit of male plant. – 47: Haptera. – 48: Tetrasporangial clusters. – 49: Thallus apex with trichoblasts and juvenile spermatangial stands. – All material from sample 132.

Griffithsia cf. schousboei Montagne (Figs 46–49)

Plants consisting of prostrate filaments attached by multicellular digitate haptera, and bearing erect filaments up to 4 mm tall. Cells of the prostrate filaments cylindrical, 100–200 μm in diameter, up to 700 μm long. Erect filaments little branched, moniliform, the elliptical or almost globular cells up to 900 μm in diameter and up to 1000 μm long. Some subapical cells with a number of polychotomously branched trichoblasts.

Tetrasporangial clusters in two whorls on subapical cells. Clusters of the inner whorls consisting of a stalk cell and a few tetrasporangia in various stages of development; in clusters of the outer whorl the stalk cell bearing one or two curved involucrel cells in addition to the tetrasporangia. Mature tetrasporangia c. $62 \times 50 \mu\text{m}$.

Spermatangial stands in identical positions as tetrasporangial clusters, but without involucrel cells.

Female structures not seen.

MATERIAL EXAMINED: Boca Diego (132), 28-vi-1958, on *Sargassum* sp., washed ashore (tetrasporangial, male).

This species grew mixed with *G. caribaea*, from which it can be distinguished by its cell shape and arrangement of tetrasporangia and their involucrel cells. However, the identity of the material is not quite certain yet: there are two Caribbean species with moniliform filaments, i.e. *G. schousboei* Montagne and *G. globifera* (Harvey) J. Ag. From the latter species our material differs in the position of the spermatangial stands and in the origin of involucrel cells in connection with the tetrasporangia (see e.g. Boergesen, 1917), and actually *G. globifera* belongs to a different subgeneric group (Baldock, 1976: 546). *Griffithsia schousboei* as described from the Mediterranean (e.g. Feldmann-Mazoyer, 1940; Coppejans, 1983) differs from our material by having tetrasporangial and spermatangial stands on a number of consecutive subapical cells; in the Curaçao material these structures are found strictly on the first subapical cell, much the same as in *G. subbiconica* Stegenga (Stegenga, 1986).

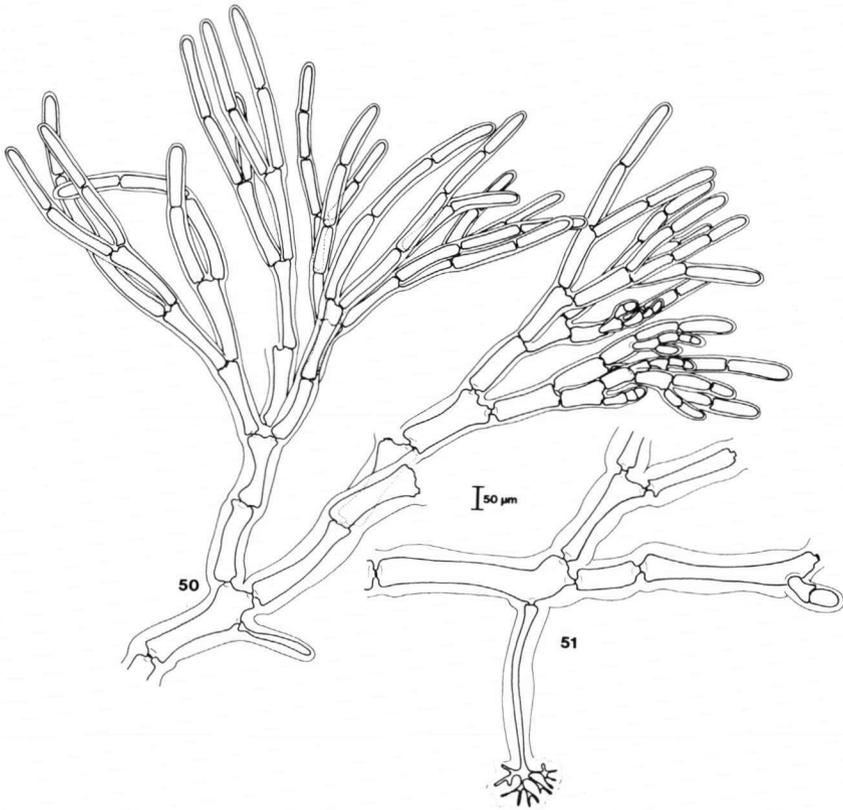
Monosporus herpesticus Vickers (Figs 50, 51)

Plants consisting of prostrate filaments, attached by unicellular digitate haptera, and bearing erect subdichotomously branched filaments c. 3 mm tall. Cells of the prostrate filaments 80–100 μm in diameter, up to 400 μm long. Erect filaments gradually tapering to 35 μm diameter, the cells cylindrical, up to 500 μm long (or up to 12 times longer than broad). Filaments branched with an imperfect dichotomy every segment.

No reproductive structures found.

MATERIAL EXAMINED: Boca Labadera (143), 8-vii-1958, on *Sargassum* sp., material washed ashore.

Although sterile, the material is assigned to the genus *Monosporus* on basis of similarity with plants from Costa Rica, for which reproductive structures in the form of monosporangia are known (Kemperman & Stegenga, in press). With respect to



Figs 50 & 51. *Monosporus herpesticus*. – 50: Thallus apex. – 51: Hapteron. – Material from sample 143.

cell dimensions and monosporangial sizes (in Costa Rican material) our plants resemble apical sections of *M. australis* (Harvey) J. Ag. (see Baldock, 1976), but it remains much smaller; *M. australis* is up to 50–90 mm tall. Taylor (1960) mentioned two species from the Caribbean under 'uncertain records': (*Corynospora*) *Monosporus herpestica* Vickers and (*Corynospora*) *Monosporus? belangeri* (Montagne) De Toni. Comparison with (probably original) material of *M. herpestica* in L has led us to assign our material to that species. In size our species is also close to *Neomonospora sericata* Segawa (Segawa, 1941), but in that species the sporangia are situated on the basal cell of small branchlets, whereas in the Costa Rican plants sporangia were terminal on a single stalk cell.

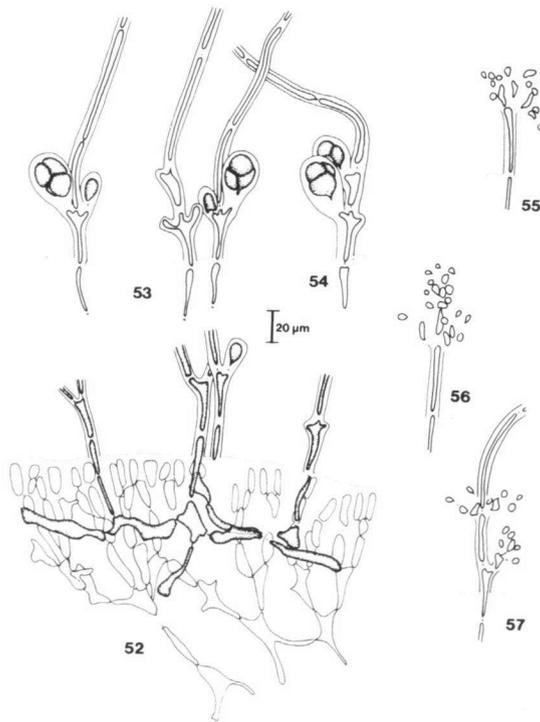
Van den Hoek et al. (1978) mentioned a *Corynospora* sp. from the coral reef of the Curaçao SW. coast; that species may or may not be identical to our material.

Pleonosporium caribaeum (Boergesen) R.E. Norris

MATERIAL EXAMINED: Boca Diego (132), 28-vi-1958, on *Sargassum* sp., washed ashore; Boca Labadera (143), 8-vii-1958, on *Sargassum* sp., washed ashore; Boca San Pedro (149), 11-vii-1958, on *Sargassum* sp., washed ashore.

Reported here from Curaçao for the first time. Although plants are small (up to 5 mm tall) and sterile, there can be little doubt on their identity. The material is possibly of sublittoral origin.

Originally described as *Mesothamnion caribaeum* (Boergesen, 1917), this species was transferred to *Pleonosporium* by Norris (1985).



Figs 52–57. *Spermiothamnion antillarum*. – 52: Endophytic and emergent filaments on *Euclima*. – 53 & 54: Tetrasporangia. – 55–57: Spermatangial stichidia. – All material from sample 148.

***Spermiothamnion antillarum* Stegenga & Vroman, nov. spec.** (Figs 52–57)

Plantae ex reticulo filamentorum endophyticorum et numerosis emergentibus inramosis filamentis c. 600 µm elatis constantes. Cellulae filamentorum endophyticorum formarum irregularium, usque ad 10–12 µm diametro et circa 2–5plo longiores quam latiores. Filamenta erecta tenuia fere capillacea, ca. 7,5 µm diametro, cellulae usque ad 100 µm longae (vel usque ad 14plo suae diametros), sed cellulae proximales multo breviores. Tetrasporangia sessilia in una vel duabus cellulis proxima-

libus filamentorum emergentium, unum vel duo per cellulam. Tetrasporangia 30–40 × 22–24 µm, tetraedrice divisa. Stichidia spermatangiorum aut terminalia in filamentis erectis, aut in positionibus similibus atque tetrasporangia. Stichidia globulosa ad elongata, usque ad 50 µm longa, ex paucissimis cellulis matricialibus spermatangiorum et spermatangiis constantia. – **T y p u s** (in L): lamina vitrea *Vroman 148-26*, loco dicto Boca San Pedro, 11-vii-1958, semi-endophyticus in *Eucheuma* cf. *schrammii* (Crouan) J. Ag., in saxo calcareo (corali) crescens, in loco littoris undis exposito.

Plants consisting of a network of endophytic filaments and numerous emergent unbranched filaments c. 600 µm tall. Cells of the endophytic filaments of irregular shape, up to 10–12 µm in diameter and about 2–5 times longer than broad. Erect filaments thin, almost hair-like, c. 7.5 µm in diameter, the cells up to 100 µm long (or up to 14 times their diameter), but the proximal cells much shorter.

Tetrasporangia sessile on one or two proximal cells of the emergent filaments, one or two per cell. Tetrasporangia 30–40 × 22–24 µm, tetrahedrally divided.

Spermatangial stichidia either terminal on reduced erect filaments, or in similar positions as tetrasporangia. Stichidia globular to elongate, up to 50 µm long, consisting of very few spermatangium mother cells and spermatangia.

Female reproductive structures not seen.

Type: *Vroman 148-26* (permanent slide), Boca San Pedro (148), 11-vii-1958, semi-endophytic in *Eucheuma* cf. *schrammii* (Crouan) J. Ag., growing on fossil coral limestone, in a wave-exposed locality at sea level (in L).

So far, this species is known from the type only. It is assigned to the genus *Spermothamnion* despite absence of female reproductive structures. Growth habit and morphology of the spermatangial stands at least suggest a position in the tribe Spermothamnieae, but generic assignment may alter after discovery of female plants, as has happened to many species formerly assigned to *Spermothamnion* (see e.g. Gordon, 1972).

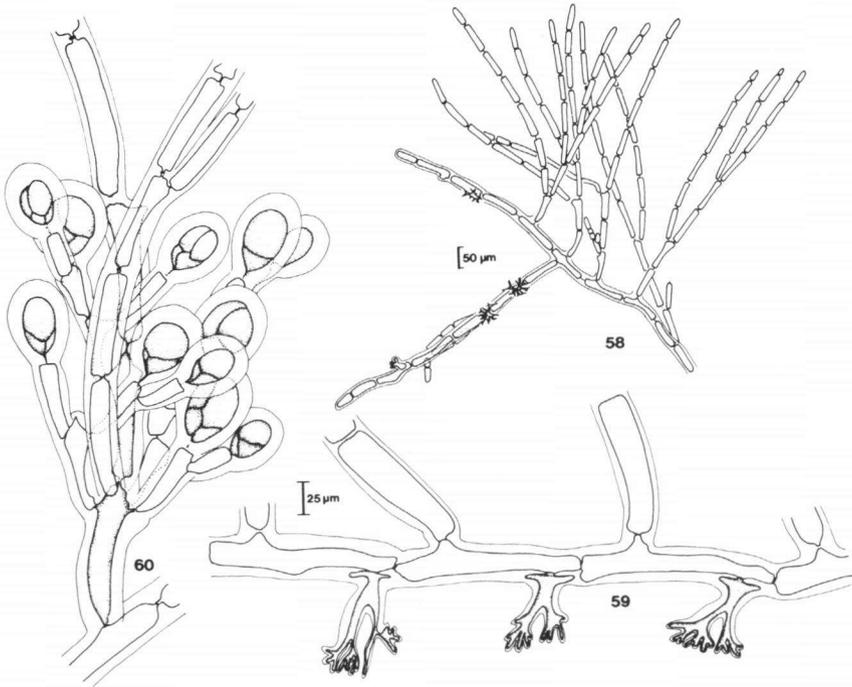
General plant and cell dimensions of this species are extremely small for a member of the Ceramiaceae. In this respect it can be compared with species like *Callithamnion endovagum* Setch. et Gardn. and *Callithamnion reductum* Baardseth, both also semi-endophytes. In our species, we think, the structure of the male stichidia speaks against a position in the Callithamnieae.

***Spermothamnion investiens* (Crouan) Vickers (Figs 58–60)**

Plants forming felty patches on the substrate, consisting of prostrate filaments attached by unicellular digitate haptera, bearing an erect filament on virtually every cell. Prostrate filaments (25–)30(–35) µm in diameter, the cells cylindrical, 100–175 µm long. Erect filaments up to 2 mm tall, simple or with few laterals, 22.5–25(–30) µm in diameter, apically tapering to c. 20 µm, the cells 75–175 µm long.

Tetrasporangia in cymose clusters, whorls of up to four such clusters borne by a few proximal cells of the erect filaments. Tetrasporangia (60–)62–70(–75) × 50–55 µm, tetrahedrally divided; apparently the two topmost spores in a sporangium larger than the two basal ones.

No sexual reproductive structures observed.



Figs 58–60. *Spermothamnion investiens*. – 58: Habit, prostrate filaments seen from below. – 59: Haptera. – 60: Tetrasporangia. – Fig. 58 from sample 147, figs 59 & 60 from sample 148.

MATERIAL EXAMINED: Boca Diego (132), 28-vi-1958 and 1-vii-1958, on *Dictyopteris justii* and *Sargassum* sp., washed ashore (tetrasporangial); Boca Masalinja (134), 1-vii-1958, on *Dictyopteris justii*, washed ashore; unnamed Boca between Boca Grandi and Boca Mangel (141), 4-vii-1958, on *Dictyopteris justii*, washed ashore (tetrasporangial); Boca Grandi (142), 4-vii-1958, sublittoral on *Dictyopteris justii* (tetrasporangial); Boca Labadera (143), 8-vii-1958, on *Dictyopteris justii*, washed ashore (tetrasporangial); Boca Playa Canoa (147), 10-vii-1958, sublittoral on *Dictyopteris justii* (tetrasporangial); Boca San Pedro (148), 11-vii-1958, sublittoral on *Dictyopteris justii* (tetrasporangial).

Spermothamnion investiens is a very common epiphyte on *Dictyopteris justii* along the whole NE. coast of Curaçao. From the same substrate it was earlier recorded by Diaz-Piferrer (1964), but from a number of other substrates elsewhere, e.g. *Codium* (Oliveira Filho, 1969), *Galaxaura* (Norris & Bucher, 1982) and the echinoderm *Euclidaris* (Boergesen, 1917).

The Curaçao material has larger cell dimensions than described elsewhere (e.g. Taylor, 1960: 10–20 µm diameter in erect filaments), and slightly larger than the variety *cidaricola* (Boergesen, 1917: erect filaments 16–25 µm in diameter). From *S. gorgoneum* (Mont.) Bornet, earlier mentioned from Curaçao (i.a. Van de Hoek, 1969), this species differs by the possession of tetrasporangia instead of polysporangia, and by having the sporangial clusters in whorls instead of singly on the axial cells, but the vegetative cell sizes are much the same.

Spyridia aculeata (Schimper) Kütz.

MATERIAL EXAMINED: Boca Ascension (91), 27-ii-1958, in algal vegetation in the most sheltered part of the Boca, associated with *Padina gymnospora* (Kütz.) Vickers.

Reported from the NE. coast once before (Van den Hoek, 1969), also known from the SW. coast (Taylor, 1942).

Spyridia filamentosa (Wulfen) Harvey

MATERIAL EXAMINED: Boca Diego (132), 28-vi-1958; Punt Kanon (138), 2-vii-1958 (tetrasporangial); Boca Playa Canoa (146), 11-vii-1958 (tetrasporangial); Boca San Pedro (148), 11-vii-1958 (tetrasporangial).

Apparently, a common plant on both sides of the island. Plants are usually well developed, reaching a height of c. 100 mm.

Wrangelia argus Montagne

MATERIAL EXAMINED: Boca Ascension (91), 27-ii-1958 (tetrasporangial, carposporophytic); Boca Grandi (92), 1-iii-1958; Boca Masalinja (134), 1-vii-1958, in algal turf, mixed with *Jania capillacea* (tetrasporangial); Punt Kanon (138), 2-vii-1958, epiphytic on *Laurencia papillosa* (Forssk.) Greville; Boca Grandi (142), 4-vii-1958, in part epiphytic on *Laurencia* sp. (tetrasporangial, male, carposporophytic); Boca Labadera (144), 8-vii-1958, on *Laurencia papillosa* (male); Boca Playa Canoa (146), 10-vii-1958, eulittoral in algal turf and epiphytic on *Penicillus capitatus* Lamarck (tetrasporangial, carposporophytic); idem (147), 10-vii-1958, upper sublittoral.

A common species on both sides of the island. On the NE. coast it often forms dense stands c. 10 mm high, either in algal turfs or epiphytically.

GENERAL DISCUSSION

The marine algal flora of Curaçao, at least with respect to the family Ceramiaceae, appears to be uncommonly rich in species. A compilation of literature data and our own observations gives a total of 60 species (table 2). We certainly must take into account some possible 'duplication' in this list, due to different systematic views or interpretations by various authors (see e.g. under *Ceramium*), and some of the species only identified as to genus may prove to belong to already registered species. But we can nevertheless assume that some 50 species of Ceramiaceae have reliably been recorded from the island; this compared with a number of 64 species listed by Taylor (1960) (uncertain records excluded) for the area stretching between Bermuda and the Carolinas in the north and southern Brazil and Uruguay in the south (of course, this number has risen considerably in later years).

The number of species becomes even more strikingly high if we compare it with surveys of limited areas within the Caribbean, some about the same geographical extent, some larger (table 3). Probably, the number of species primarily reflects the great variety of habitats to be encountered on the island of Curaçao, with all gradations between full exposure to waves and complete shelter, open coasts and lagoons,

Table 2. Species of Ceramiaceae recorded from Curaçao.

References: 1 = Sluiter, 1908; 2 = Taylor, 1942; 3 = Diaz-Piferrer, 1964; 4 = Van den Hoek, 1969; 5 = Van den Hoek et al., 1972; 6 = Van den Hoek et al., 1975; 7 = Van den Hoek et al., 1978; 8 = Van den Hoek, 1978; 9 = the present paper.

Records provided with an asterisk are known from bays and lagoons on the NE. coast.

	NE. coast	SW. coast
<i>Acrothamnion butleriae</i> (Collins) Kylin	—	7
<i>Aglaothamnion furcellariae</i> (J. Ag.) Feldmann-Mazoyer	5*	5, 7
<i>Aglaothamnion</i> sp.	—	4, 6
<i>Aglaothamnion</i> sp. 2	—	7
<i>Anotrichium tenue</i> (C. Ag.) Näg. ¹	4, 5*	5, 6, 7
<i>Antithamnion antillarum</i> Boergesen	5*	3, 4, 5, 6, 7
<i>Antithamnion cruciatum</i> (C. Ag.) Näg.	—	3
<i>Antithamnion tristicum</i> Joly et Yamaguishi ²	5*	5, 6, 7
<i>Antithamnion</i> sp. 1	—	6
<i>Antithamnionella breviramosa</i> (Dawson) Wollaston	9	—
<i>Balliella pseudocorticata</i> (Dawson) Young ³	—	7, 8
<i>Callithamniella</i> sp.	—	7
<i>Callithamnion byssoides</i> Arnott in Hook.	—	3
<i>Callithamnion cordatum</i> Boergesen	3, 9	3
<i>Callithamnion halliae</i> Collins	—	2
<i>Callithamnion</i> sp.	4	4, 7
<i>Centroceras clavulatum</i> (C. Ag.) Montagne	4, 5*, 9	1, 2, 4, 5, 6, 7
<i>Centrocerocolax ubatubensis</i> Joly	9	—
<i>Ceramiella</i> sp. ⁴	—	7
<i>Ceranium brevizonatum</i> Petersen		
var. <i>caraibicum</i> Petersen et Boergesen	9	6, 7
<i>Ceranium byssoideum</i> Harvey	3, 9	3
<i>Ceranium</i> cf. <i>calipterum</i> Mazoyer	4	—
<i>Ceranium codii</i> (Rich.) Feldmann-Mazoyer	5*	4, 5, 6, 7
<i>Ceranium dawsonii</i> Joly	9	—
<i>Ceranium fastigiatum</i> (Roth) Harvey ⁵	3, 9	3
<i>Ceranium floridanum</i> J. Ag.	9	—
<i>Ceranium gracillimum</i> Griff. ex Harvey	4, 5*	4, 5, 6, 7
<i>Ceranium leutzelburgii</i> Schm.	4, 5*	4, 5, 6, 7
<i>Ceranium nitens</i> (C. Ag.) J. Ag.	—	3, 5, 6
<i>Ceranium strictum</i> (Kütz.) Harvey	3	—
<i>Ceranium subtile</i> J. Ag.	—	2
<i>Ceranium taylorii</i> Dawson	9	—
<i>Ceranium tenerrimum</i> (Martens) Okamura	4, 5*, 9	4, 5, 6, 7
<i>Ceranium tenuissimum</i> Lyngb. f. <i>arachnoideum</i> C. Ag. ⁶	—	1
<i>Ceranium</i> sp.	9	—
<i>Corynospora</i> sp.	—	6, 7
<i>Crouania attenuata</i> (Bonnem.) J. Ag.	9	3, 4, 6, 7
<i>Diplothamnion jolyi</i> Van den Hoek	9	6 ⁷ , 7, 8
<i>Dohrniella antillarum</i> (Taylor) Feldmann-Mazoyer	4, 9	—
<i>Grallatoria reptans</i> Howe	9	—
<i>Griffithsia caribaea</i> Feldmann-Mazoyer	9	—
<i>Griffithsia</i> cf. <i>globifera</i> Harvey	4, 5*	4, 5, 6, 7
<i>Griffithsia</i> cf. <i>schousboei</i> Montagne	9	—

(Table 2 continued)	NE. coast	SW. coast
<i>Gymnothamnion elegans</i> (Schousb.) J. Ag.	—	3
<i>Haloplegma duperreyi</i> Montagne	—	7
<i>Monosporus herpesticus</i> Vickers	9	—
<i>Pleonosporium caribaeum</i> (Boergesen) R. E. Norris	9	—
<i>Rhododictyon bermudense</i> Taylor	—	8
<i>Spermothamnion antillarum</i> n. sp.	9	—
<i>Spermothamnion investiens</i> (Crouan) Vickers	3, 9	3, 6
<i>Spermothamnion macromeres</i> Collins et Hervey	—	2
<i>Spermothamnion speluncarum</i> (Collins et Hervey) Howe	5*	4, 5, 6, 7
<i>Spyridia aculeata</i> (Schimp.) Kütz.	4, 9	2, 4
<i>Spyridia clavata</i> Kütz.	4, 5*	—
<i>Spyridia complanata</i> J. Ag.	3	—
<i>Spyridia filamentosa</i> (Wulfen) Harvey	4, 5*, 9	1, 2, 4, 5, 6, 7
<i>Tiffaniella gorgonea</i> (Montagne) Doty et Menez ⁸	3, 4	6, 7
<i>Wrangelia argus</i> Montagne	4, 5*, 9	1 ⁹ , 2, 4, 6, 7
<i>Wrangelia bicuspidata</i> Boergesen	4, 5*	3, 4, 7
<i>Wrangelia penicillata</i> C. Ag.	4	—

¹ As *Griffithsia tenuis* C. Ag., see Baldock (1976).

² Probably belonging to *Antithamnionella*, see remarks under *A. breviramosa*.

³ As *Bakothamnion curassivicum* Van den Hoek, see Huisman & Kraft (1984).

⁴ Genus since reduced to synonymy, now *Ceramium*, see Kraft (1981).

⁵ In the present report specifically the forma *flaccida* H. E. Petersen.

⁶ Taylor (1960) lists this as a 'doubtful record'.

⁷ As *Diplothamnion tetrastichum* Joly et Yamaguishi, see Van den Hoek (1978).

⁸ As *Spermothamnion gorgoneum* (Montagne) Bornet, see e.g. Gordon (1972).

⁹ As *Wrangelia plebeia* C. Ag., see Taylor (1960).

Table 3. Comparison of various geographical regions within the Caribbean with respect to the number of recorded ceramiaceous species.

Area	Number of species	References
Virgin Islands	22 ¹	Boergesen, 1917, 1920
Puerto Rico	40	Almodovar & Ballantine, 1983 Ballantine & Wynne, 1986
Jamaica	23	Chapman, 1963
Florida (Dry Tortugas)	26 ¹	Taylor, 1928
Belize	15	Norris & Bücher, 1982
Costa Rica	31	Kemperman & Stegenga (in press)
Panama	4	Earle, 1972
Northern Lesser Antilles	16	Vroman, 1968
Trinidad	6	Richardson, 1975
Aruba and Bonaire	21	Vroman & Stegenga (in press)
Curaçao NE. coast	42	the present paper
SW. coast	42	the present paper
total	60	the present paper

¹ Numbers considerably risen since date of cited reference.

etc.; also the various habitats have undergone a relatively intense study; most likely, in many areas the less prominent representation of Ceramiaceae indicates that they have been undercollected or overlooked (several of the species reach dimensions of only a few mm). There seem to be hardly any logically explainable barriers for the dispersion of algal species within the Caribbean, and actually many of the relatively rare species are known from widely scattered locations within or outside the Caribbean, while in the case of Curaçao, even the nearby islands of Aruba and Bonaire have a much lower number of recorded Ceramiaceae (Vroman & Stegenga, in press; see table 3).

Table 2 shows that the number of species on the NE coast is hardly lower than that on the sheltered SW coast. Probably the same applies to the benthic algae as a whole: in our survey we found approximately 170 species on the NE coast, compared with c. 155 in the bays and lagoons (Van den Hoek et al., 1972) and little short of 180 on the open coasts on both sides of the island (Van den Hoek, 1969). However, as remarked elsewhere (Vroman & Stegenga, in press), one must be cautious when making comparisons of species numbers which apparently are based on incomplete knowledge: The present survey, giving several additions to the Curaçao algal flora, even in a single family, shows that further basic floristic research is far from superfluous, and even a prerequisite for meaningful conclusions on Caribbean marine phytogeography.

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