THE ALGAL VEGETATION OF THE RIA DE AROSA (NW. SPAIN) *

M. DONZE **

1. INTRODUCTION

This study forms a part of biological, oceanographical, and sedimentological investigations carried out in the Ría de Arosa (NW. Spain) 1962—1964. Details of the aim and scope of these investigations have been set forth by Brongersma and Pannekoek (1966).

The present papet deals with the macroscopic algae of this region. Firstly, it was attempted to obtain a complete survey of the floristic composition. These data were utilized in a study of algal phytogeography (van den Hoek and Donze, 1967). Secondly, a rough description of the intertidal vegetation types and zonation patterns is given. Thirdly, the local distribution of species and vegetation types is outlined with respect to the main environmental factors. Fourthly, a rather detailed picture of the depth-distribution of many species is given.

This study is based on ± 6500 identifications from ± 600 samples. About 2500 specimens are preserved in the collections of the Rijksherbarium, Leiden (L).

2. MATERIALS AND METHODS

Observations on the algal vegetation were made in three ways:

(1) by dredging and sampling with a van Veen grab;

(2) by SCUBA diving;

(3) by direct inspectation of the littoral at low tide, often supplemented by observation of the higher part of the sublittoral by free diving.

From the deeper (> 2 m below low-water-mark) regions too little information is available to allow a detailed discussion of vegetation-types, although of the commoner species a reasonable impression of their depth-distribution has been obtained.

The investigation was executed in the following sequence:

(1) general description of the zonation;

(2) quantitative description of sample plots regarded as representative for the algal zone under consideration, using the phytosociological scale of Braun-Blanquet *** (cf. den Hartog 1959 for application of this method to algal vegetations);

*) An investigation sponsored by the Netherlands Organization for the Advancement of Pure Research (Z. W. O.). Participation of the author in the winter of 1964 was made possible by a grant from the Van Vollenhoven Fonds, Leiden.

**) Present address: Biophysical Laboratory of the State University, Schelpenkade 14a, Leiden, Netherlands.

***) The abundance is expressed by one of the figures of the following arbitrary scale:

× present, abundance difficult to estimate;

+ one or a few specimens only;

1 a good number of specimens;

2 many specimens or a covering of 5—25 % of the sample plot;

(3) sampling the vegetation from all sample plots (when covered by a turf of small algae, part of the total vegetation was taken);

(4) occasionally additional samples were taken, for instance, from tide pools and other local spots deviating from the normal pattern (see section 4), to complete as far as possible a floristic characterization and to obtain additional data for a study of distribution within the bay;

(5) critical analysis of the collected samples in the laboratory;

(6) preparation of herbarium specimens for later reference and deposit in the collections of the Rijksherbarium, Leiden.

The localities investigated are indicated on the map of the Ría de Arosa (fig. 1).

3. THE ENVIRONMENT

Cadée (1968) has given a description of the area and in order to avoid repetition I refer the reader to this work. More details will be published by other investigators of the team. For a detailed bathygraphic map of the Ría de Arosa is referred to the paper by Brongersma and Pannekoek (1966). Here I will restrict myself to record some data of special relevance to the algal vegetation. They are the following:

(1) Apart from loc. 8, 9, 10, 19, and 20, all localities investigated may be considered marine as to the composition of their floras.

(2) The main tidal range is about 2 m.

(3) The substrate is granite, with exception of loc. 1 and some small stretches at 11 and 20 where it consists of micaschists. No differences in zonation or species composition of the floras of these substrates could be detected.

(4) Tidal currents are weak, except near loc. 5.

4. THE VEGETATION

4.1. Littoral and shallow sublittoral vegetations

Described are vegetations that, for each locality, form a part of the local zonation pattern occurring on 'normal' sea-facing slopes. On these slopes survey-plots were chosen preferably forming a transect through the littoral. The size of the survey-plots was chosen as large as possible. The observations, expressed in the scale of Braun-Blanquet, have been processed according to the 'classical' phytosociological method (Ellenberg, 1956). In this way a number of biologically defined vegetation types was obtained. In fig. 2 these have been ranked according to their normal place in the zonation pattern and according to Lewis's (1964) 'Biological Exposure Scale'. Application of this Exposure Scale to this region did not make possible a clear-cut classification of all shores investigated. This is also true for the British Isles, for which it was designed. As a rough generalization, however, Lewis's criteria work quite well. Moreover, part of the discrepancies are due to local factors that can be satisfactory analysed (section 5).

3 covering 25—50 % of the sample plot;
4 covering 50—75 % of the sample plot;
5 covering 75—100 % of the sample plot.

The sample plot varied from 0.1 × 0.1 to 2.0 × 2.0 m². The data obtained from the sample plots are combined in tables giving the degree of presence by the following figures:

I species present in up to 20 % of the sample plots of the vegetation-type studied;
II species present in 20—40 % of the sample plots;
III species present in 40—60 % of the sample plots;
IV species present in 60—80 % of the sample plots;
V species present in 80—100 % of the sample plots.

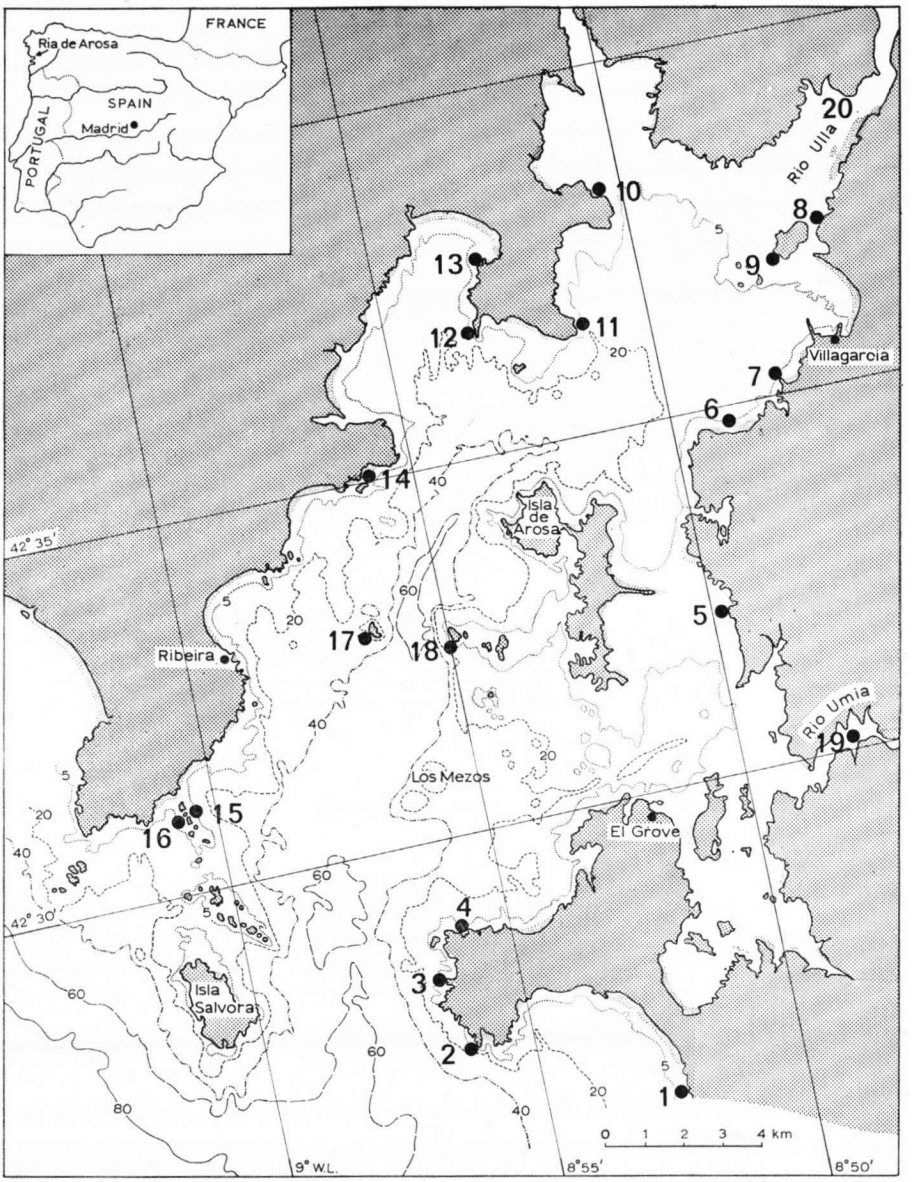


Fig. 1. The Ría de Arosa region. Indicated are the localities where the algal vegetations have been investigated, as follows: 1. Cape near Noalla; 2. Con Negro; 3. Punta Pédregal; 4. San Vicente; 5. Correal de Laneira; 6. Playa Sinas; 7. Punta Preguntoiro; 8. Carril; 9. Isla de Cortegada; 10. Punta Porto Mouro; 11. Punta de la Casilla — Punta del Chaso; 12. Pesqueira; 13. Esteiro; 14. Punta Rúa near Ratas; 15. Centolleiros, east side; 16. Centolleiros, west side; 17. Isla de Rua; 18. Isla Jidoiro Pedregoso; 19. estuary of the Río Umia; 20. estuary of the Río Ulla.

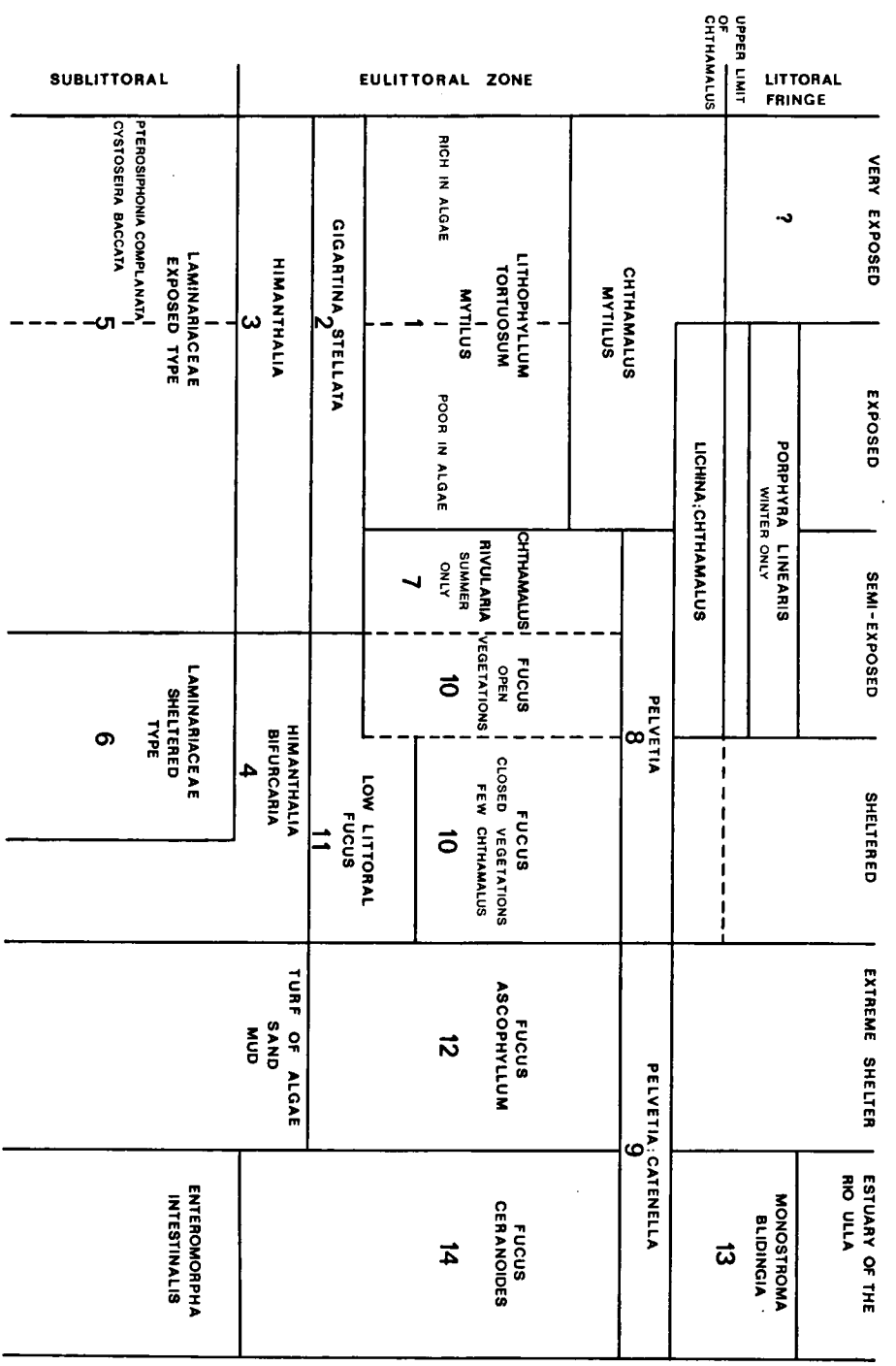


Fig. 2. Scheme of the patterns of zonation in the Ría de Arosa region. The numbers refer to the tables.

4.1.1. Very exposed shores. Loc. 1, 2, 3.

Littoral fringe.

1. Conspicuous 'black lichen' and *Cyanophyceae* zones are absent in the Ría de Arosa.

Eulittoral.

2. The higher part of the eulittoral is dominated by the barnacle *Chthamalus stellatus* and at a lower level also by *Mytilus edulis*. Small patches of *Ralfsia verrucosa* and *Hildenbrandia prototypus* occur.

3. *Lithophyllum tortuosum* vegetations. Tab. 1. On very exposed to exposed shores these vegetations form a well-defined zone in the eulittoral. Furthermore, this zone is characterized by dominance of *Chthamalus stellatus* and the occurrence of patches of *Mytilus edulis*. *Ceramium shuttleworthianum* and *Porphyra umbilicalis* are mostly found on the mussels. On the least exposed shores (loc. 14 and 17), where this vegetation occurs, most of the rarer species (almost all species indicated by I in tab. 1) do not occur in this zone. This is probably due to a decreased spray during low tide.

4. *Gigartina stellata* vegetations. Tab. 2. These turf-like vegetations form a zone in the eulittoral of very exposed to exposed shores, just above the *Himanthalia* belt. Apart from *Gigartina stellata*, *Caulacanthus ustulatus* and *Corallina officinalis* play also an important role. The upper limit of *Caulacanthus* is generally situated somewhat higher than that of *Gigartina stellata*.

5. *Himanthalia elongata* vegetations. Tab. 3. These vegetations form the lowest zone of the eulittoral in exposed and very exposed sites, the vertical extension of the zone being about 60 cm. For its development the slope of the substratum generally must be over 30°. On less steep rocks vegetations occur that can be regarded as a richer variant of the *Gigartina* vegetations.

Sublittoral.

6. *Laminariaceae* vegetations, exposed type. Tab. 5. On very exposed shores the first few metres of the sublittoral are dominated by *Saccorhiza polyschides* and *Laminaria ochroleuca*. Characteristic for very exposed sites are *Cystoseira baccata*, *Gelidium sesquipedale*, *Pterosiphonia complanata*, and large plants of *Laurencia pinnatifida*. *Callithamnion tetragonum* is very faithful to these vegetations.

4.1.2. Exposed shores. Loc. 4, 14, 15, 16, 17, 18, and relatively sheltered sites at loc. 1, 2, 3

Littoral fringe.

1. *Porphyra linearis* forms a distinct zone of about 1 m vertical extension in winter. In one case (loc. 18) *Prasiola stipitata* and *Entophysalis conferta* were observed in this belt.

Eulittoral.

2. *Lichina pygmaea* locally forms a zone in the higher part of the eulittoral belt; it is accompanied by *Chthamalus*, *Blidingia minima*, and sometimes *Hildenbrandia prototypus* or *Rivularia bullata*.

3. *Lithophyllum tortuosum* vegetations. Tab. 1. See section 4.1.1.3.

4. *Gigartina stellata* vegetations. Tab. 2. See section 4.1.1.4.

5. *Himanthalia elongata* vegetations. Tab. 3. See section 4.1.1.5. On slopes less steep than about 30° generally a turf vegetation or the 'sheltered' form of the *Himanthalia* vegetation was observed.

6. *Laminariaceae* vegetations, exposed type. Tab. 5. See section 4.1.1.6. On exposed shores, not subject to a continuous ocean surf, *Laminaria hyperborea* may dominate locally, while *Cystoseira baccata*, *Gelidium sesquipedale*, and *Pterosiphonia complanata* are absent or rare.

4.1.3. Semi-exposed shores. Loc. 17, 18, 6, 7, 12.

This is not a clearly defined category in the Ría de Arosa for two reasons. It appears to be the situation where the vegetation types that are characteristic for exposed and sheltered shores may occur together in several combinations (fig. 2). The dominants and a considerable number of species that characterize these vegetation types occur here at the limit of their range within the bay. In view of this it is not surprising to find that the zonation patterns observed in these localities show a high sensitivity to variations in the 'micro climate'. A second reason for deviations from a simple distribution in this exposure-range is the peculiar morphology of the Ría de Arosa (section 5.2.).

1. *Rivularia bullata* (tab. 7) reaches its most profuse development on these shores (summer only).

2. *Fucus* vegetations. Tab. 10. Open *Fucus* vegetations that occur here are per square metre poorer in species than the ones encountered on sheltered shores. A number of these vegetations together, however, do not markedly differ in species composition from the 'closed' *Fucus* vegetations of sheltered shores.

4.1.4. Sheltered shores. Loc. 5, 6, 7, 10, 11, 12, 13.

Littoral fringe.

1. Occasionally, small patches of black lichens ('*Verrucaria maura*') and/or *Blidingia minima* occur, but they do not form distinct zones.

Eulittoral.

2. *Pelvetia canaliculata* vegetations. Tab. 8.

3. *Fucus* vegetations. Tab. 10. See section 4.1.3.2. On sheltered shores the eulittoral is, below the *Pelvetia* band, occupied by a dense vegetation of *Fucus vesiculosis* and *F. spiralis*. See also section 7.

4. Low littoral *Fucus* vegetations. Tab. 11. These two cannot be defined strictly, as no obvious discontinuity occurs, but the low littoral part of the *Fucus* zone is generally much richer in species.

5. *Himanthalia-Bifurcaria* vegetations. Tab. 4. These vegetations dominate the low littoral of sheltered and semi-exposed shores. Their undergrowth consists of a sandy turf. In sheltered places they may descend to a depth of about 2 m below the low water line.

Sublittoral.

6. *Laminariaceae* vegetations, sheltered type. Tab. 6. In contrast to the *Laminariaceae* vegetations from exposed stations they are characterized by *Cystoseira concatenata*, *C. tamariscifolia*, *Bifurcaria bifurcata*, and an undergrowth consisting of a turf-like vegetation of small sand-fixing algae.

4.1.5. Extreme sheltered shores. Loc. 5, 6, 7, 8, 9, 13.

The influence of extreme shelter and decrease of salinity cannot be sufficiently separated in the available observations; compare section 6.1.

Littoral fringe.

1. In summer this region is almost bare (4.1.4.1.); in winter a distinct zone of *Enteromorpha compressa* and *Porphyra*, interpreted as a broad form of *P. linearis*, occurred at very sheltered sites near loc. 7.

Eulittoral.

2. *Pelvetia-Catenella* vegetations. Tab. 9. These vegetations form a distinct zone in the highest part of the eulittoral. The undergrowth consists of the *Catenella* vegetation which also occurs in high littoral cavities and grottos (section 4.2.1.).

3. *Fucus-Ascophyllum* vegetations. Tab. 12. Vegetations of this kind occupy the rest of the eulittoral.

Sublittoral.

Most of the sublittoral has a sand or mud bottom without much algal growth. Where a solid substratum is present very variable turf vegetations occur. These are too complicated to permit a reasonable subdivision with the available data.

4.1.6. Estuaries. Loc. 19 and 20.

Mainly vegetations occurring on solid substrata are considered. Some collections on mud and in marshes were made as well. These are included in table 18. For a review of algal ecology of brackish waters see den Hartog (1964, 1967). The available hydrographical data are insufficient for a useful detailed discussion of the vegetations of the Río Ulla and Río Umia. The following vegetation types can be distinguished:

Littoral fringe.

1. *Monostroma oxyspermum-Blidingia* vegetations. Tab. 13. These vegetations consist of small, foliaceous and thread-like green algae and *Cyanophyceae* on a thin layer of mud. They often form a distinct zone above the *Pelvetia* belt, or, in its absence, above the *Fucus* belt. At higher levels these vegetations occur in cavities. The species composition is very variable, gradually impoverishing with decreasing salinity. *Ulothrix subflaccida* was observed only in a small trickle with overrunning freshwater.

Eulittoral.

2. *Pelvetia-Catenella* vegetations. Tab. 9. Apart from the presence of a few typical brackish-water species (*Bostrychia scorpioides, Monostroma oxyspermum*) these vegetations do not differ markedly from the *Pelvetia* belt of very sheltered marine localities.

3. *Fucus ceranoides* vegetations. Tab. 14. These vegetations dominate the available solid substratum in the eulittoral of brackish water. With decreasing salinity the *Fucus-Ascophyllum* vegetation gradually changes into this type.

Sublittoral.

4. Where a solid substratum is present, the sublittoral is completely covered by a dense vegetation of *Enteromorpha intestinalis*. No observations on these vegetations were made in winter.

4.2. Vegetation types of shady localities

4.2.1. High eulittoral shade vegetations of very exposed shores. The rocks are covered mainly by encrusting algae: *Phymatolithon 'polymorphum', Hildenbrandia prototypus, Ralfsia verrucosa,* and *Peyssonelia atropurpurea.*

4.2.2. High eulittoral shade vegetations of exposed to semi-exposed shores. Tab. 15. Shady places in the higher eulittoral are often covered by a low (maximum height about 3 cm) and rather compact turf. These vegetations consist of numerous species of small, tightly entangled algae. At exposed sites *Gelidium pulchellum* dominates in these places. *Catenella* and *Bostrychia* are absent.

4.2.3. High eulittoral shade vegetations of sheltered shores. Tab. 15. Here *Catenella repens* dominates the turf vegetations.

4.2.4. High eulittoral shade vegetations of brackish water. Tab. 16. These are an impoverished variant of the former, with a few species added. Here *Bostrychia scorpioides* forms an important part of the turf.

4.2.5. Miscellaneous turf vegetations from the lower eulittoral. Tab. 18, column C 6. In shady localities in the lower eulittoral a number of very different vegetations occurs, which are often very rich in species. These vegetations appear to be too variable in composition to allow a sound differentiation based on the available data (± 60 records).

4.3. Vegetations from the deeper sublittoral

4.3.1. Large parts of the sandy bottom of the Ría are covered by a *'maerl' vegetation*, the presence of larger species of algae depending on the availability of solid substrata such as stones and shells. Its composition can be judged from the table of depth distribution in table 18.

4.3.2. Floating bottom vegetations. Shallow sandy and muddy bottoms often are covered by a dense layer of floating algae, especially enormous specimens of *Ulva 'lactuca'* (up to ± 1 m). The following species were also found in floating condition: *Asperococcus turneri, Striaria attenuata* f. *ramosissima, Cutleria multifida, Dictyota dichotoma, Laminaria saccharina**, *Saccorhiza polyschides**, *Enteromorpha ramulosa* (in very shallow water), *Gracilaria verrucosa*, and *Chylocladia kaliformis.*

4.3.3. From *solid substrata deeper than about 3 m* very few observations are available. At loc. 4, 7, 12, and 18 dense vegetations of *Saccorhiza polyschides* and *Laminaria ochroleuca* were observed to at least 10 m below low-water-mark. At loc. 17 the lower limit of both species is at about 15 m below low-water-mark.

5. LOCAL DISTRIBUTION

5.1. Local distribution of littoral and shallow sublittoral species

The distribution within the Ría de Arosa of all species encountered in the littoral and shallow sublittoral is given in table 18. In this section it is attempted to discuss the local distribution of the epilithic algae by comparison of the species lists of the various localities. For this discussion I used only the common and abundant species (indicated by = and ≡ in table 18) in order to eliminate differences in the intensity of sampling in these localities. The data from the estuary of the Río Umia have not been considered (loc. 19) because too few observations from solid substrata are available from this estuary. As only a few localities have been studied in winter I have omitted in the discussion also some species which are only abundant in that season.

To compare the floras of different localities a coefficient of similarity P of two floras is defined as $P = \frac{c}{a + b - c} \times 100$ where a and b are the number of species occurring in each station and c is the number of species common to both (Starmach, 1966). More sophisticated mathematical methods for handling this type of data are available (Sokal, 1963, 1966), but in this case their application did not seem to be necessary. It appeared already that exposure is the main factor in determining the local distribution of the algae. Therefore, as starting-point for the comparison of the different floras the most exposed station, loc. 2, was chosen. In fig. 3 the floras investigated by me have been arranged as to decreasing P, calculated with respect to loc. 2. The order established in this way is used in table 18 A.

Most striking is the low position of loc. 15 and 16 obtained in this way, as compared

*) As can be concluded from the characteristically developed haptera that have grown into the 'empty'.

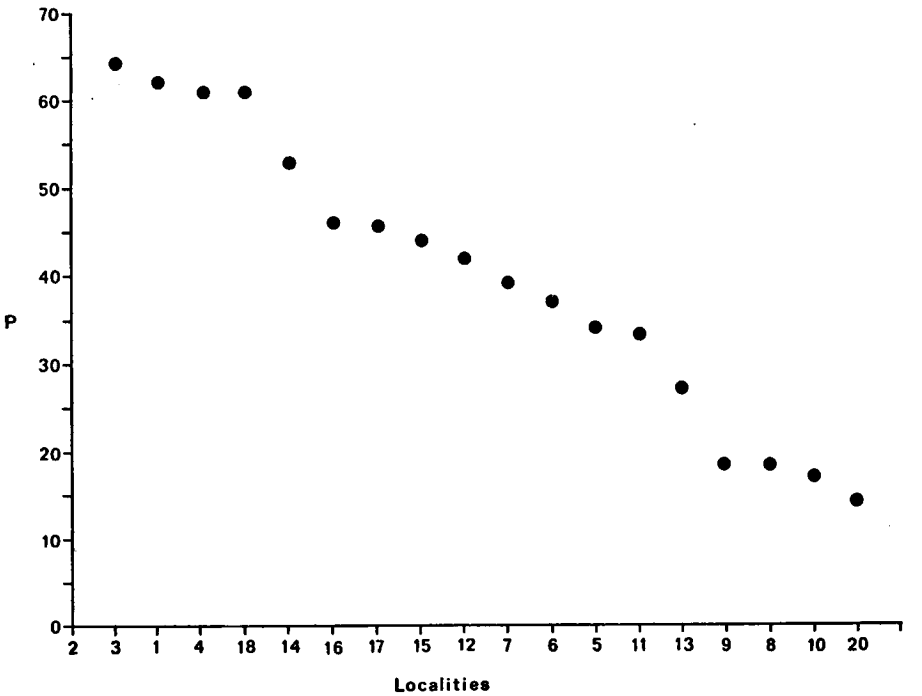


Fig. 3. For explanation see text, section 5.1.

with their position in the mouth of the Ría. This is sufficiently explained by the very gentle slope of the coast and the presence of reefs. In contrast, loc. 14, 17, and 18 have a very steep shore.

It appears that the flora of loc. 13 is very similar to the floras of localities with estuarine conditions. This also appears if calculation is started from loc. 9 or 13. Hydrographically, loc. 13 must be considered purely marine (L. Otto, pers. comm.). This effect gives a warning that in the discussion of the algal distribution in estuaries one cannot simply switch from exposure as 'major factor' to salinity. In nature, decrease in salinity is almost always accompanied by decrease in exposure. In many cases it will be very difficult to separate the ecological influence of these two factors. With my own, very detailed observations from the Río Ulla separation appeared impossible. Freshwater from the Río Ulla is mainly discharged along the north coast of the bay (L. Otto, pers. comm.). Its influence is reflected in the vegetation up to loc. 11. The absence of *Cystoseira* spp. on most of the northern coastline can perhaps be attributed to this effect.

5.2. Distribution of vegetation types

The distribution of vegetation types as described in section 4 is tabulated in table 17. A deviation is shown at loc. 12, where the eulittoral clearly shows an exposed character, while the sublittoral is occupied by vegetations characteristic for sheltered coasts. This can be explained by considering that in the Ría de Arosa 2 types of waves occur. In the first place there are waves which are generated by wind in the Ría; these are relatively

small and their influence does not extend very deeply into the sublittoral. Secondly the ocean surf, consisting of very large waves, penetrates into the Ría and is gradually damped. Probably the largest of these waves have decreased to the order of magnitude of the 'normal' waves in the Ría behind the chain of islands Isla de Arosa, loc. 18 and loc. 17. Now the extremes of the large waves, which occur perhaps only a few times a year, will exert the main influence in determining the exposed character of the sublittoral vegetation at loc. 17.

A profound influence of ocean surf in the higher part of the littoral only occurs if the surf is virtually always present. Its main influence in this part of the shore is to prevent the flora from desiccation. Quiet seas regularly occur in loc. 17, in contrast to loc. 1 and 2.

6. AUTECOLOGICAL OBSERVATIONS

Chlorophyceae

Chaetomorpha auricoma was dredged from about 1 m depth in the mouth of the Río Ulla. It made part of a free-floating vegetation of *Ulva lactuca*, *Enteromorpha intestinalis*, and *Gracilaria verrucosa*.

Cladophora rupestris. Apart from a few small specimens in a *Catenella* vegetation at loc. 10 it was observed only as a common component of the maerl vegetation at greater depth. These specimens were less than 2 cm long. *C. rupestris* seems to occupy here its 'Mediterranean' habitat, as contrasted by the situation in Brittany and the Netherlands where it abounds in the eulittoral (van den Hoek, 1963).

Codium adhaerens. It forms large patches in the eulittoral on shaded rocks in the *Lithophyllum tortuosum* zone of exposed sites.

Enteromorpha stipitata. This species was found only below the water-line on rafts in use for the mussel culture; it was very common in July 1963.

Ulva rhacodes. See van den Hoek and Donze (1966).

Phaeophyceae

Cystoseira concatenata. Common at loc. 5, 6, and 7 where it forms a distinct zone in the sublittoral. Its upper limit is generally somewhat lower than that of *C. tamariscifolia*.

Cystoseira myriophylloides This species is common in large tide pools at half-tide level in exposed and very exposed sites.

Fucus vesiculosus. The specimens growing low in the eulittoral generally form vesicles and reach a length of about 40 cm; the higher growing plants remain smaller (up to ± 20 cm) and are evesiculate. It should be noted that *Fucus* and *Ascophyllum* are harvested regularly for manure. The effect of this treatment has not been studied; where traces of harvesting were recognized no observations were made.

Halidrys siliquosa is confined to low-littoral rock pools.

Himanthalia elongata. On very exposed shores it forms a distinct zone of about 60 cm vertical extension in the lowest part of the eulittoral. In quiet water it may descend to several metres below low-water-mark. Sterile specimens are common in the *Fucus vesiculosus* belt and in low-littoral turf vegetations. They are found up to 1 metre higher than the mature specimens. Its occurrence is dependent on some degree of water movement as was clearly observable at loc. 5 where wave action is very limited but tidal currents are relatively strong. Here the shore exists of a number of small capes perpendicular to the coast line, and *Himanthalia* dominates the sublittoral at the heads of the capes, but is absent between them. To suggest a dependence of this species on the vicinity of the isobathe of 50 m as done by Fischer-Piette (1936) is a rather cryptic way to express

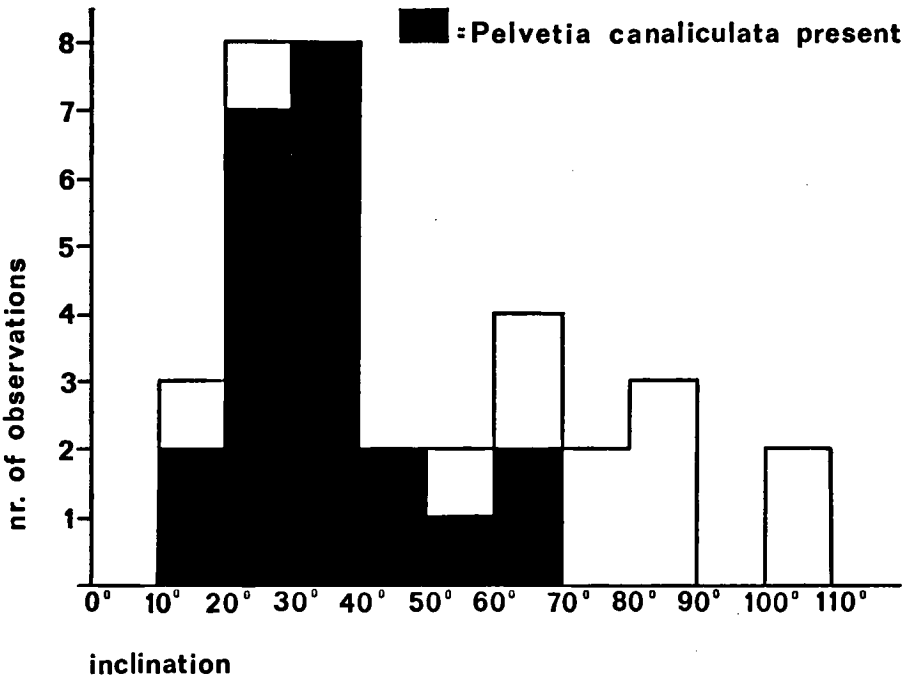


Fig. 4. Distribution of *Pelvetia canaliculata* as a function of the inclination of the substratum. Observation from loc. 17.

the ecological needs of this species. A narrowing of the fronds in very exposed stations, as observed by Sundene (1964) for several species of *Laminariaceae*, was also observed for the receptacula of this species.

Laminaria saccharina. Sundene (1964) gave evidence that in *Alaria esculenta* the beneficial effects of exposure may be a requirement for survival at temperatures close to its upper tolerance; the same seems to be true for *Laminaria hyperborea*. The reverse effect appears to occur in *L. saccharina*; in Brittany it is a ubiquist (Feldman, 1954, Dizerbo, 1964) while in the Ría de Arosa it is confined to sheltered habitats.

Pelvetia canaliculata. On the Island of Rúa (loc. 17) the inclinations of all accessible rock faces in the littoral were measured and the presence or absence of *Pelvetia* noted. The result is given in fig. 4. It appears that there is a rather distinct maximum slope below which *Pelvetia* can occur. *Pelvetia* disappears as soon as wave action becomes too severe, a fact that is generally recognized (Lewis, 1964). This has been experimentally verified by Hatton (cited by Fischer-Piette, 1941) who showed that breakage of desiccated fronds is at least one reason for the absence of *Pelvetia* in exposed sites. Thus my observations can be interpreted by the difference in action of the waves on different slopes, that on the steepest substratum being the most severe. The relative sharpness of the maximum suggests its use as a biological indicator of the intensity of wave action. Contrary to expectation in view of Hattons experiments, no correlation could be found between the occurrence of *Pelvetia* and shading or exposition of the substratum.

Measurements of the vertical extension of the *Pelvetia* zone show significant correlations with both the slope and the exposition of the substratum (42 measurements).

These observations cannot be interpreted further, since it must be expected that different ecological mechanisms determine the upper and lower limits of a species. Absolute measurements of the level of the borders are necessary. These data show, however, that further investigations along this line will be useful. In extreme shelter *Pelvetia* becomes much larger than in localities with some wave action.

RHODOPHYCEAE

Amphiroa rigida. This species occurs together with *Cystoseira myriophylloides* in large pools in the eulittoral. It seems to be confined to this habitat.

Asparagopsis armata. The conclusion of Dizerbo (1964) on the difference in habitat between this species and its '*Falkenbergia*' stage also applies to this region. '*Falkenbergia*' has a much wider ecological amplitude, being not so dependent on wave action; it occurs in the eulittoral and at greater depth.

Lithophyllum tortuosum. On very exposed shores this species forms a well-defined zone in the eulittoral. It is most abundant on shaded vertical substrata, where it may reach a surface-covering of 70 %. On insolated substrata it gets sparser. Here it only occurs in small fissures: one centimetre depth suffices for the presence of a *Lithophyllum* hemisphere of 10 cm diameter. It also occurs just in contact with the water level of rock pools, but never continually submerged.

Lithothamnion calcareum and *Lithothamnion corallioides.* See Cabioch (1966). A combined distribution map of these two species is given by Cadée (1968). In most of the samples both species occur together, *L. calcareum* being generally more abundant on sand and gravel, while *L. corallioides* dominates on clayey sediments.

Porphyra purpurea. In shallow pools, constructed for the culture of molluscs near loc. 7 specimens up to 2 m were found floating in summer.

Rhodymenia palmata. This species was found only on the stalks of *Laminaria hyperborea* or in its immediate vicinity.

7. TAXONOMIC NOTES

With few exceptions the nomenclature of Parke and Dixon (1964) was followed. See also van den Hoek and Donze (1966). Compare table 18.

CYANOPHYCEAE

A critical identification of *Calothrix*, *Lyngbya*, *Oscillatoria*, and *Spirulina* species with the usual handbooks is hardly possible.

CHLOROPHYCEAE

Blidingia, *Enteromorpha.* The revision of Bliding (1963) was used for identification of species belonging to these genera.

Chaetomorpha auricoma (Suhr) Kjellmann. See Sjöstedt (1920).

Cladophora. Most of the identifications were checked by Prof. Dr C. van den Hoek.

Cladophora hutchinsiae (Dillw.) Kütz. The '*rectangularis*' form of this species was observed a few times together with 'normal' plants in material dived from 5—10 m near loc. 4 (van den Hoek, 1963).

Cladophora parriaudii van den Hoek. As culture experiments are necessary (van den Hoek, 1963) this identification of formol-conserved material must remain uncertain.

Spongomorpha arcta (Dillw.) Kütz. See Kornmann (1962).

Ulothrix subflaccida Wille cannot be distinguished from *U. acrorhiza* Kornmann without culture experiments (Kornmann, 1964).

Ulva 'lactuca' L. Under this name a number of species are comprised in the present paper, among which *U. rigida* (C. Ag.) Thw. and *U. olivascens* Dangeard. Since accurate descriptions and delineation of these species are still lacking, it is impossible to assign specimens to any one of them with sufficient degree of accuracy (for a review, cf. van den Hoek, 1964).

PHAEOPHYCEAE

Cystoseira baccata (Gmel.) Silva. Specimens with very small air-vesicles regularly occur; these resemble very much *C. foeniculacea* (L.) Grev.

Fucus L. For a review, cf. Powell (1963).

Fucus ceranoides L. Certain specimens are intermediate between *F. vesiculosus* and *F. ceranoides*. All collected specimens were dioecious.

Fucus serratus L. was observed only on the S. and W. coasts of the isle of Cortegada; it was reported from the same place in 1933 (Miranda, 1934). Here *F. serratus* vegetations occur in the sublittoral fringe. On higher levels, up to about halfway the eulittoral zone, plants interpreted as hybrids with *F. vesiculosus* occur. It is imaginable that introduction of *F. vesiculosus* genes into *F. serratus* may give rise to plants that are better adapted to life higher in the littoral than 'pure' *F. serratus* plants are. In the *F. serratus* plants growing lowest, no *F. vesiculosus* influence (air bladders, thickened conceptaculae) could be found. In the Ría de Barquera Fischer-Piette (pers. comm.) observed a *Fucus* population consisting only of intermediate forms. The specimens pictured by Ardré (1957, fig. 2 and 3) seem to represent such hybrids. The occurrence of hybrids is also probable because it concerns open vegetations where competition is limited (Knight and Parke, 1950). As *F. serratus* almost reaches the southern limit of its geographic distribution in the Ría de Arosa, its absence in all other places investigated seems reasonably explained by assuming that in this area it cannot stand competition by other large brown algae. These are absent at Cortegada, most likely because of still somewhat estuarine conditions.

Fucus spiralis L. The gross-morphological difference between this species and evesiculate specimens of *F. vesiculosus* is, in many cases, insufficient for identification. Monoecious specimens have been called *F. spiralis*. From a taxonomic point of view this is certainly unsatisfactory, although some support may come from the fact that all material thus identified originates from the higher part of the eulittoral. Distinctly separated *F. spiralis* and *F. vesiculosus* zones, as occur in mid- and northern Europe, have not been observed in the Ría de Arosa.

Giffordia 'recurvata' (Kuckuck *ex* Kornmann) Cardinal. This combination is not valid according to the International Code of Botanical Nomenclature as a Latin diagnosis is lacking.

Sphacelaria cirrhosa (Roth) C.Ag. De Haas-Niekerk (1965) showed that this species is distinct from *S. furcigera* Kütz. (see also van den Hoek, 1968). This is also my experience. I found these species often growing together and separation on the criteria given by the above-mentioned author was always clear.

Sphacelaria britannica Sauv. Recently, van den Hoek (1968) showed by culture experiments that this 'species' is a stage in the life-cycle of *S. furcigera*.

Striaria attenuata (Grev.) Grev. forma *ramosissima* (Kütz.) Hauck. My material agrees very well with the type specimens of *Encocelium ramosissimum* Kütz. 1843 in the collection

of the Rijksherbarium, collected near Venice. Unilocular sporangia are never arranged in rows, but always irregularly distributed on the tallus (Kützing, 1849, Hauck, 1885).

RHODOPHYCEAE

Acrosorium uncinatum (Turn.) Kylin. Most of the material being sterile, I did not succeed to distinguish critically between this species and *A. reptans* (Crouan *frat.*) Kylin and *Cryptopleura ramosum* (Huds.) Kylin *ex* Newton (cf. van den Hoek and Donze, 1966). All material has been joined under this arbitrarily chosen name.

Calliblepharis ciliata (Huds.) Kütz. All morphologically intermediate forms between this species and *C. jubata* (Good. et Woodw.) Kütz. occur; plants growing on very exposed coasts mostly resemble *C. jubata*. Without microscopic examination these plants often can hardly be distinguished from *Gigartina teedii*.

Corallina officinalis L. I think it is impossible to distinguish more than one species in my material (cf. van den Hoek and Donze, 1966).

Gelidium pulchellum (Turn.) Kütz. Under this name I have included also *G. pusillum*, *G. pulvinatum*, and *G. crinale* (cf. van den Hoek and Donze, 1966, Dixon 1958).

Gigartina pistillata (Gmel.) Stackh. Intermediate plants with *G. teedii* are common (cf. Gayral, 1958).

Griffithsia. The collected material was sterile and could not be identified.

Gymnogongrus norvegicus (Gunn.) J. Ag. and *Gymnogongrus patens* (Good. et Woodw.) J. Ag. The difference between these species is not always clear.

Phymatolithon polymorphum (L.) Foslie. See also Adey (1964). This name is used here in a collective sense comprising also *P. lenormandii* (Aresch.) Adey and possibly other species.

Polysiphonia urceolata (Lightf. *ex* Dillw.) Grev. All ecorticate specimens with 4 pericentral siphons have been joined under this arbitrarily chosen name.

ACKNOWLEDGEMENTS

It is a pleasure to thank Prof. Dr C. van den Hoek who took part in the field work in summer 1964. He identified a considerable part of the material (especially *Cladophora* and small *Phaeophyceae*) and checked many other identifications. Without his constant guidance and stimulating discussions this study would have been impossible.

I wish to express my sincere thanks to all participants in the Ría de Arosa investigations, especially to Mrs Dr M. Brongersma-Sanders, Dr W. Vervoort, Ir L. Otto, and Dr W. J. Sluiter. Thanks also go to Miss J. Coenen who in July 1962 made a preliminary floristic exploration of the Ría; to Miss C. W. van der Voet who collected most of the bottom samples and assisted in field work on the shore in July 1963; and also to Miss U. W. Oosterhoff and Mr H. H. Brongersma who assisted in diving.

Don Luis Losada Lago from Villagarcía generously placed his factory-building on Punta Preguntoiro at our disposal for setting up a temporary laboratory.

My thanks are also extended to Miss Dr J. Th. Koster, Mrs F. Ginsburg-Ardré, and Mr G. R. Heerebout for help with some of the identifications, to Miss A. Flinterman for making microscopic preparations of *Corallinaceae*, to Prof. Dr C. G. G. J. van Steenis and Dr C. den Hartog for critically reading the manuscript, and to Dr J. Barber for correcting the English text.

BIBLIOGRAPHY

ADEY, W. H. 1964. The genus Phymatolithon in the Gulf of Maine. Hydrobiologia 24: 377—420.
ARDRÉ, F. 1957. Florule hivernale de la Ria de Vigo. Rev. Alg. n.s. 3: 135—196.
—— 1959. Un intéressant Hildenbrandtia du Portugal. Rev. Alg. n.s. 4: 227—237.
—— 1961. Algues du Portugal: Liste préliminaire. Rev. Gén. Bot. 68: 443—457.
BLIDING, C. 1963. A critical survey of European taxa in Ulvales. Part I. Op. Bot. Univ. Lund. 8: 3.
BODDEKE, R. 1958. The genus Callithamnion Lyngb. in the Netherlands. Acta Bot. Neerl. 7: 589—604.

BRONGERSMA, L. C., & A. J. PANNEKOEK. 1966. Investigations in and around the Ria de Arosa, N.W. Spain 1962—1964. Leidse Geol. Meded. 37: 1—5.
CABAÑAS RUESGAS, F., E. FISCHER-PIETTE & J. SEOANE. 1958. Petite contribution à une monographie bionomique de la Ria de Vigo. Bull. Inst. Océanogr. Mon. 55 (1127): 56 pp.
CABIOCH, I. 1966. Contribution à l'étude morphologique, anatomique et systématique de deux Mélobésiées: Lithothamnion calcareum (Pallas) Aresch. et Lithothamnion corallioides Crouan. Bot. Mar. 9: 33—54.
CADÉE, G. C. 1968. Molluscan biocoenoses and thanatocoenoses in the Ria de Arosa, Galicia, Spain. Zool. Verh. Leiden no 95.
CARDINAL, A. 1964. Etude sur les Ectocarpacées de la Manche. Beihefte Nova Hedwigia Heft 15.
CONWAY, E. 1964. Autecological studies of the genus Porphyra: I. The species found in Britain. Brit. Phyc. Bull. 2: 342—348. — II. Porphyra umbilicalis (L.) J. Ag. Ibid. 2: 349—363.
DE TONI, J. B. 1895. Sylloge Algarum.
DIXON, P. S. 1958. The morphology, ecology and taxonomy of certain Florideae. Brit. Phyc. Bull. 1: 32—33.
—— 1959. Taxonomical and nomenclatural notes on the Floridaea I. Bot. Notiser 112: 339—352.
—— 1960. Ditto, II. Ibid. 113: 295—319.
—— 1962. Ditto, III. Ibid. 115: 245—260.
—— 1964. Ditto, IV. Ibid. 117: 56—78.
DIZERBO, A. H. 1964. L'écologie d'Asparagopsis armata Harv. et de Falkenbergia rufolanosa (Harv.) Schmitz dans le massif Armoricain. C. R. IV. Congr. Int. Algues Marines 1961: 177—186.
DROUET, F. 1963. Ecophenes of Schizothrix calcicola (Oscillatoriaceae). Proc. Ac. Nat. Sc. Philadelphia 115: 261—281.
ELLENBERG, H. 1956. Grundlagen der Vegetationsgliederung I. Stuttgart.
FELDMANN, G. 1940. Recherches sur les Céramiacées de la Méditerranée occidentale. Alger, 510 pp.
—— 1964. Sur une nouvelle espèce iridescente de Chondria (Rhodophyceae, Rhodomelaceae). Rev. Gén. Bot. 71: 45—55.
FELDMANN, J. 1937—1943. Les algues marines de la côte des Albères. Rev. Alg. 9: 141—335; 11: 247—330; 12: 77—100; Trav. Alg. 1: 29—113.
—— 1938. Recherches sur la végétation de la Méditerranée. La côte des Albères. Rev. Alg. 10: 1—339.
—— 1954. Inventaire de la Flore Marine de Roscoff. Trav. Stat. Biol. suppl. 6: 1—152.
FELDMANN, J. & G. 1963. Une nouvelle espèce de floridée parasite du genre Gelidiocolax Gardner. Rev Gén. Bot. 70: 557—571.
FISCHER-PIETTE, E. 1936. Etudes sur la biogéographie intercotidale des deux rives de la Manche. J. Linn. Soc. Zool. 40: 181—272.
—— 1940. Contribution à l'étude de la répartition actuelle et passée des organismes dans la zone néritique. Mém. Soc. Biogéogr. 7: 393—434.
—— 1955. Répartition, le long des côtes septentrionales de l'Espagne, des principales espèces peuplant les rochers intercotidaux. Ann. Inst. Océan. 31.
—— 1959. Contribution à l'écologie intercotidale du Détroit de Gibraltar. Bull. Inst. Ocean. Mon. 1145: 32 pp.
—— & J. SEOANE CAMBA. 1962. Ecologie de la ria-type. La Ria del Barquero. Bull. Inst. Océan. Mon. 1244: 37 pp.
FUNK, G. 1955. Beiträge zur Kenntnis der Meeresalgen von Neapel. Pubbl. Staz. Zool. Napoli 25, suppl. 174 pp.
GAYRAL, P. 1958. Algues de la côte Atlantique Marocaine. Rabat.
GINSBURG-ARDRÉ, F. 1963. Algues du Portugal: Liste préliminaire II. Rev. Gén. Bot. 70: 371—382.
HAAS-NIEKERK, T. DE. 1965. The genus Sphacelaria Lyngbye (Phaeophyceae) in the Netherlands. Blumea 13: 145—161.
HALOS, M. TH. 1964. Etude morphologique et systématique de quelques Céramiacées de la Manche. Paris (thèse de 3me cycle).
—— 1964. Sur l'Aglaothamnion decompositum (Grateloup ex J. Ag.) comb. nov. et sa position systématique. Bull. Soc. Phyc. France no 10.
—— 1965. Sur trois Callithamniées des environs de Roscoff. Cah. Biol. Mar. 6: 117—134.
HAMEL, G. 1924—1930. Floridées de France I—VI. Rev. Alg. 1: 278—292, 427—457; 2: 39—67, 280—309; 3: 99—158; 5: 61—109.
—— 1930—1931. Chlorophycées des côtes françaises. Rev. Alg. 5: 1—54, 383—430; 6: 9—73.
—— 1931—1939. Phéophycées de France. Paris.
HARTOG, C. DEN. 1955. A classification system for the epilithic algal communities of the Netherlands coast. Acta Bot. Neerl. 4: 126—135.
—— 1959. The epilithic algal communities occurring along the coast of the Netherlands. Wentia 1: 1—241.
—— 1964. Typologie des Brackwassers. Helgol. Wiss. Meeresunters. 10: 377—390.

—— 1967. Brackish water as an environment for Algae. Blumea 15: 31—43.
HARVEY, W. H. H. 1846—1851. Phycologia brittanica 1—4.
—— 1853. Nereis Boreali — Americana II. Rhodospermeae. New York.
HAUCK, F. 1885. Die Meeresalgen Deutschlands und Österreichs. Leipzig.
HOEK, C. VAN DEN. 1963. Revision of the European species of Cladophora. Diss. Leiden.
—— 1964. Criteria and procedures in present-day algal taxonomy. In D. F. Jackson, Algae and Man, New York, 1966.
—— & M. DONZE. 1966. A contribution to the knowledge of Ulva rhacodes. Nova Hedwigia 10: 495—498.
—— & —— 1966. The algal vegetation of the rocky Côte Basque (SW. France). Bull. Centre Etud. Rech. Scient. Biarritz 6: 289—319.
—— & —— 1967. Algal phytogeography of the European Atlantic coasts. Blumea 15: 63—89.
—— & A. FLINTERMAN. 1968. The life-history of Sphacelaria furcigera Kütz. (Phaeophyceae). Blumea 16: 193—238.
KNIGHT, M., & M. PARKE. 1950. A biological study of Fucus vesiculosus L. and F. serratus L. Journ. Mar. Biol. Ass. 29: 439—514.
KORNMANN, P. 1962. Eine Revision der Gattung Acrosiphonia. Helgol. Wiss. Meeresunters. 8: 219—242.
—— 1964. Die Ulothrix-Arten von Helgoland I. Helgol. Wiss. Meeresunters. 11: 27—38.
KOSTER, J. TH. 1955. The genus Rhizoclonium in the Netherlands. Pubbl. Staz. Zool. Napoli 27: 335—357.
KUCKUCK, P. 1899. Beiträge zur Kenntnis der Meeresalgen 6. Die Gattung Myriotrichia Harvey. Wiss. Meeresunt. Helgol. N.F. 3: 55—82.
—— & P. KORNMANN. 1961. Ectocarpaceen Studien VII, Giffordia. Helgol. Wiss. Meeresunters. 8: 119—152.
KÜTZING, F. T. 1843. Phycologia generalis.
—— 1845—1869. Tabulae phycologicae 1—19.
—— 1849. Species algarum.
KYLIN, H. 1947. Die Phaeophyceen der schwedischen Westküste. Lunds Univ. Årsskr. 43: 1—99.
—— 1956. Die Gattungen der Rhodophyceen. Lund, 15 + 673 pp.
LEWIS, J. R. 1964. The ecology of rocky shores. London.
LINDSTEDT, A. 1943. Die Flora der marinen Cyanophyceen der schwedischen Westküste. Akad. Abh. Univ. Lund (thesis Lund, 121 pp.).
MAGNE, F. 1957. Sur le "Myriogramme minuta" Kylin. Rev. Alg. n.s. 3: 16—26.
MAZOYER, G. 1938. Sur une nouvelle espèce de Ceramium des côtes marocaines, Ceramium callipterum nov. sp. Bull. Soc. Hist. Nat. de l'Afrique du Nord 29: 14—18.
MIRANDA, F. 1934. Materiales para une flora de las Rías Bajas Gallegas. Bol. Soc. Esp. Hist. Nat. 34: 165—180.
NEWTON, L. 1931. A Handbook of the British Seaweeds. London.
POWELL, H. T. 1963. Speciation in the genus Fucus L., and related genera. Syst. Ass. Publ. no 5: 63—77.
PREDA, A. 1908. Flora Italica Cryptogama pars II. Algae Florideae.
ROSENVINGE, L. K. 1909—1931. The marine algae of Denmark. 1. Rhodophyceae. Kgl. Danske Vidensk. Selsk. Skr. 7 Raekke, 1: 1—152; 2: 153—284; 3: 285—488; 4: 489—630.
RUSSELL, G. 1963. A study in populations of Pylaiella littoralis. J. Mar. Biol. Ass. U. K. 43: 469—483.
SEOANE CAMBA, J. 1965. Estudios sobre las algas bentónicas en la costa sur de la Península Ibérica (littoral de Cadiz). Inv. Pesq. 29: 3—216.
SJÖSTEDT, L. G. 1920. Algologiska studier vid Skånes södra och östra kust. Lunds Univ. Årsskr. N.F. Ard. 2: 16.
SOKAL, R. R. 1966. Numerical taxonomy. Scientific American 215 (6): 106—117.
—— & P. H. A. SNEATH. 1963. Principles of numerical taxonomy. Freeman & Cie.
STARMACH, K. 1966. The winter flora of algae in a spring trickle on gravel banks near the stream Mszanka. Acta Hydrobiol. 8: 293—300.
SUNDENE, O. 1965. Experimental ecology of large brown algae. Abstr. 10th Int. Bot. Congr.: 280.
TAYLOR, W. R. 1957. Marine algae of the northeastern coast of North America. Michigan.
—— 1960. Marine algae of the eastern tropical and subtropical coasts of the Americas. Michigan.
TURNER, D. 1819. Fuci sive plantarum fucorum generi. London. 4: 1—153.

Table 1. Lithophyllum-Ceramium shuttleworthianum vegetations. 13 survey plots from localities 1 (6x), 2 (2x), 4, 12, 14, 16, 17.

For species with degree of presence I and abundance not over 1 see table 18.

Chthamalus stellatus	V	2-5
Lithophyllum tortuosum	IV	1-3
Ceramium shuttleworthianum	IV	+-3
Mytilus edulis	III	3-4
Polysiphonia urceolata	III	+-2
Phymatolithon polymorphum	III	+-2
Porphyra umbilicalis	II	1-2
Corallina officinalis	II	+-2
Ceramium flabelligerum	II	+-2
Gelidium pulchellum	II	+-1
Laurencia pinnatifida	II	+-1
Ralfsia verrucosa	II	+-1
Ceramium tennuissimum	I	+-2
Balanus perforatus	I	3

Table 2. Gigartina stellata vegetations. 14 survey plots from localities 1, 2 (3x), 3 (2x), 4, 14 (2x), 15, 16 (4x).

For species with I and abundance not over 1 see table 1.

Gigartina stellata	V	2-5
Corallina officinalis	V	+-5
Caulacanthus ustulatus	IV	1-3
Gelidium pulchellum	IV	+-2
Ulva lactuca	IV	+-1
Ceramium rubrum	IV	+-2
Enteromorpha ramulosa	IV	+-2
Dictyota dichotoma	III	+-4
Lomentaria articulata	III	+-3
Himanthalia elongata	III	+-2
Laurencia pinnatifida	III	+-2
Chondrus crispus	II	+-2
Enteromorpha compressa	II	+-3
Ceramium echionotum	II	+-3
Gigartina teedii	II	+-3
Ralfsia verrucosa	II	+-3
Balanus perforatus	II	2-5
Petrocelis cruentus	II	1-3
Mytilus edulis	II	2-4
Ceramium flabelligerum	II	+-2
Cladophora laetevirens	II	+-2
Laurencia obtusa	II	+-2
Leathesia difformis	II	+-2
Fucus vesiculosus	II	+-2
Hildenbrandia prototypus	II	1-2
Ceramium ciliatum	II	+-1
Callithamnion tetricum	II	+-3
Cladophora sericea	II	+-1
Sphacelaria furcigera	II	+
Chthamalus stellatus	I	3-4
Ceramium shuttleworthianum	I	+-2
Cladophora albida	I	+-2
Rhizoclonium riparium f. validum	I	+-2
Cladostephus spongiosus	I	1-2
Porphyra umbilicalis	I	+-2
Codium tomentosum	I	2
Ceramium tenuissimum	I	+-1

Table 3. Himanthalia elongata vegetations, "exposed" type.
11 survey plots from localities 1 (3x), 2 (4x), 17.

Table 4. Himanthalia-Bifurcaria vegetations, "sheltered" type.
19 survey plots from localities 1 (3x), 4 (2x), 7, 6, 11 (3x), 12, 14, 15, 16, 17, 18 (2x).

For species with a degree of presence I and an abundance never over 1 see table 18.

	Table 3		Table 4	
Himanthalia elongata	V	2-4	V	1-5
Ulva lactuca	V	+-4	V	+-3
Corallina officinalis	IV	+-5	IV	1-5
Chondrus crispus	III	+-4	III	+-3
Ectocarpus fasciculatus	II	+-1	II	+-1
Mesophyllum lichenoides	II	+-2	II	+-5
Caulacanthus ustulatus	II	+-3	II	1-4
Callithamnion tetragonum	II	+	II	+
Acrosorium uncinatum	II	+-1	I	1-3
Ceramium tenuissimum	II	+-2	I	1-3
Ceramium rubrum	V	1-3	IV	+-3
Laurencia pinnatifida	V	+-5	IV	+-3
Polysiphonia brodiaei	IV	+-2	III	+-2
Lomentaria articulata	IV	+-2	II	+-1
Codium tomentosum	III	+-3	II	+-3
Gastroclonium ovatum	II	+	I	+-1
Pterosiphonia thuyoides	II	+-1	I	+-2
Epilithon membranaceum	II	+-2		
Callithamnion tetricum	II	+-2	I	+-1
Ceramium shuttleworthianum	II	+-1	I	+-1
Ralfsia verrucosa	II	1-2	I	1
Callithamnion hookeri	II	+		
Gymnogongrus patens	II	+-1		
Gelidium attenuatum	II	+-3		
Pterosiphonia complanata	II	+-1		
Dictyota dichotoma	III	+-1	IV	+-3
Gelidium pulchellum	III	+-2	III	+-5
Gigartina teedii	II	+-3	IV	+-3
Bifurcaria bifurcata	I	+	IV	+-4
Ceramium echionotum	II	+-1	III	+-2
Cladophora laetevirens	I	+-1	III	+-2
Enteromorpha compressa	II	+	III	+-2
Sphacelaria cirrhosa			IV	+-2
Laurencia obtusa	I	+	III	+-4
Fucus vesiculosus	I	+	II	+-2
Leathesia difformis	I	1	III	+-3
Enteromorpha ramulosa	I	+	III	+-4
Rhizoclonium riparium f. validum	II	+	II	+-2
Cladostephus spongiosus			III	+-2
Sphacelaria furcigera	I	+	II	+-2
Polysiphonia fruticulosa	I	1	II	+-1
Ceramium ciliatum			II	+-1
Cladophora albida	I	+	II	+-2
Colpomenia peregrina			II	+-1
Jania rubens	I	+	II	+-1
Halopteris scoparia			II	+-2
Enteromorpha clathrata			II	+-1
Rhizoclonium implexum			II	+-1
Chaetomorpha capillaris			II	+-1
Cystoseira tamariscifolia			I	1-2
Saccorhiza polyschides	I	+	I	2
Laminaria saccharina			I	1-2

Table 5. Sublittoral vegetation of Laminariaceae of exposed shores. 19 survey plots from localities 1 (7x), 2 (3x), 3 (3x), 4, 16, 17 (4x).

Table 6. Sublittoral vegetations of Laminariaceae of sheltered shores. 21 survey plots from localities 1, 4 (2x), 5 (3x), 6, 7 (6x), 12 (2x), 14, 15 (2x), 16 (2x), 17.

For species with a degree of presence I and an abundance never over 1 is referred to table 18.

	Table 5		Table 6	
Ceramium rubrum	V	+-3	V	+-4
Chondrus crispus	V	+-4	IV	1-2
Ulva lactuca	IV	+-3	V	+-4
Corallina officinalis	IV	+-5	V	+-5
Saccorhiza polyschides	IV	1-5	IV	+-4
Acrosorium uncinatum	III	1-2	IV	+-3
Himanthalia elongata	IV	+-3	III	+-4
Laurencia pinnatifida	IV	+-3	III	+-3
Ectocarpus fasciculatus	III	+-1	II	+-2
Laminaria ochroleuca	III	1-3	II	1-4
Rhodophyllis bifida	II	+-2	II	+-2
Codium tomentosum	III	+-3	I	1-2
Polysiphonia fruticulosa	II	+-2	II	+-2
Gelidium pulchellum	II	+-2	II	+-2
Callithamnion tetragonum	V	+-1	I	+-1
Gelidium sesquipedale	III	1-3	I	+
Lomentaria articulata	III	+-2	I	+-1
Pterosiphonia complanata	III	+-3		
Calliblepharis ciliata	III	+-2		
Gelidium attenuatum	III	+-3	I	+-2
Haematocelis rubens	II	+-2		
Cystoseira baccata	II	+-5		
Plocamium coccineum	II	+-2		
Giffordia recurvata	II	+-1		
Callithamnion hookeri	II	+		
Gigartina teedii	II	+-2	IV	+-3
Ceramium echionotum	I	+	IV	+-2
Enteromorpha compressa	II	+-1	IV	+-3
Sphacelaria cirrhosa	I	+	II	1-4
Dictyota dichotoma	I	+	III	+-3
Cystoseira tamariscifolia	I	+-2	III	+-4
Apoglossum ruscifolium	I	+-1	III	+-1
Enteromorpha ramulosa	I	+-2	III	+-2
Colpomenia peregrina	I	1	IV	+-1
Ceramium tenuissimum	I	+-1	III	+-1
Jania rubens	I	+-1	III	+-2
Asparagopsis armata, "Falkenbergia" stage	I	1-2	III	+-3
Nitophyllum punctatum	I	+	III	+-1
Cladophora hutchinsiae			IV	+-2
Bifurcaria bifurcata			III	+-3
Halopteris filicina			II	+-1
Halopteris scoparia			II	+-1
Enteromorpha clathrata			II	+-5
Cladostephus spongiosus			II	+-1
Ectocarpus arctus			II	+-2
Ceramium ciliatum			II	+-2
Laminaria saccharina			II	1-4
Cladophora vagabunda			II	+-3
Dasya corymbifera			II	+
Cystoseira concatenata			II	1-4
Laurencia obtusa			II	+-3
Cladophora albida			II	+-1
Cladophora sericea			II	+-2
Leathesia difformis			I	2
Pterocladia capillacea	III	+-2	II	+-2
Polysiphonia brodiaei	II	+-3	I	+-3
Gymnogongrus patens	II	+-2	I	1-2
Gigartina stellata	II	+-2	I	1-2
Gelidium pulchellum	II	+-2	II	+-2
Mesophyllum lichenoides	II	+-3	I	+-4
Giffordia hincksiae	II	+-1	I	+-1
Halurus equisetifolius	II	+-1	I	+
Rhodymenia palmata	I	1-2	I	2
Polysiphonia "urceolata"	I	+-2	I	+
Asparagopsis armata	I	3		
Dictyopteris membranacea	I	2		
Laminaria hyperborea	I	2-5	I	5
Schizymenia dubyi	I	+-2	I	+-1
Gelidium latifolium	I	1-2	II	+-2
Cladophora laetevirens	I	+	II	+-2
Gastroclonium ovatum	I	+	II	+-2
Hypoglossum woodwardii	I	+	II	+-2
Acrochaetium virgatulum	I	+-1	II	+-2
Champia parvula	I	+	II	+
Gracilaria foliifera	I	+	II	+-2
Lithophyllum incrustans			I	5
Callophyllis laciniata			I	2
Asperococcus bullosus			I	3
Symploca hydnoides			I	2
Chondria coerulescens			I	2
Hildenbrandia occidentalis var. lusitanica			I	2

Table 7. Rivularia bullata vegetation.
5 surveys from localities 5, 6, 11, 12 and 15.

Rivularia bullata	V	1-3
Chthamalus stellatus	V	2-5
Hildenbrandia prototypus	III	+-2
Ralfsia verrucosa	II	+-2
Elminius modestus	I	1
Mytilus edulis	I	3

Table 8. Pelvetia vegetations of sheltered and semi-exposed sites.
9 survey-plots from localities 2, 4 (2x), 7 (2x), 12, 15, 17, 18.

Table 9. Pelvetia vegetations of very sheltered shores.
12 survey-plots from localities 7 (2x), 8, 9, 20 (8x).

1) only in brackish water (loc. 20).

2) in winter only

	Table 8		Table 9	
Pelvetia canaliculata	V	2-5	V	2-5
Hildenbrandia prototypus	III	2-3	IV	2-5
Catenella repens			IV	1-5
Bostrychia scorpioides			II	2-4
Fucus sp. juv.	I	+	II	+-2
Rhizoclonium riparium f. riparium			II	+-3
Enteromorpha compressa	I	4	II	+-5
barnacles	V	3-5	IV	+-2
Fucus spiralis	I	1	II	+-3
Blidingia marginata 1)			I	2
Blidingia minima ramifera 1)			I	3
Monostroma oxyspermum 1)			I	+-2
Rivularia atra			I	2
Calothrix scopulorum			I	2
Calothrix confervicola			I	1
Chaetomorpha linum			I	+
Enteromorpha ramulosa			I	+
Blidingia minima	I 2)	4	I	+
Porphyra linearis 2)	I	1	I(cf.)	1
Entophysalis deusta	I	1	I	1
Ralfsia verrucosa	I	2	I	2
Porphyra umbilicalis	I	2-3		
Lichina pygmaea	II	1-5		
Ulothrix subflaccida 2)	I	+		
Plectonema battersii	I	+		

Table 10. Fucus vegetations from semi exposed shores. 22 survey plots from localities 1 (2x), 3, 4 (2x), 7 (8x), 14, 16, 17 (3x) and 18 (4x).
Table 11. Fucus vegetations from the lower eulittoral of sheltered to semi-exposed shores. 20 survey plots from localities 1 (2x), 4 (2x), 5 (4x), 6 (3x), 7 (4x), 10, 11, 12 (2x) and 18.
Table 12. Fucus-Ascophyllum vegetations from extreme shelter. 34 survey plots from localities 5, 7 (11x), 8 (11x), 9 (4x), 10 (3x) and 20 (4x).

For species with a degree of presence I and an abundance not over 1 see table 18.

	Table 10		Table 11		Table 12	
Fucus vesiculosus	IV	+-5	V	2-5	IV	1-5
Enteromorpha compressa	IV	+-4	III	+-5	IV	+-4
Ulva lactuca	III	+-2	III	+-4	II	+-3
Caulacanthus ustulatus	I	+-1	I	+-3	I	3
Gelidium pulchellum	II	+-4	IV	+-3	IV	+-4
Ceramium flabelligerum	I	+	II	+-2	II	+-3
Rhizoclonium riparium f. riparium	I	+	II	+-3	II	+-2
Rhizoclonium implexum			II	+-1	II	+-2
Chaetomorpha linum	I	1	II	+-1	II	+-1
Cladostephus spongiosus			II	+-3	II	+-3
Rhodochorton floridulum			I	+-1	I	+-5
Gymnogongrus griffithsiae			I	+-3	I	+-3
Calothrix confervicola			I	2	I	1-3
Enteromorpha ramulosa	I	+-1	II	+-5	III	+-4
Sphacelaria furcigera	I	+	II	+-3	III	+-4
Callithamnion polyspermum	I	+-3	I	+-2	II	+-5
Pilayella littoralis			I	+-2	II	+-2
Chondrus crispus	I	1	I	+-2	II	1-4
Ascophyllum nodosum					III	+-4
Polysiphonia lanosa					III	+-2
Catenella repens					III	1-4
Blidingia marginata					I	+-2
Lyngbya aestuarii					I	1-5
Fucus serratus					I	3
Gigartina stellata	II	+-1	IV	+-3	I	+-2
Fucus spiralis	II	2-5	I	4	III	2-5
Elachista fucicola	II	+-2	III	+-2	I	+-2
Laurencia pinnatifida	I	5	III	+-3	I	1-3
Gigartina teedii			III	+-3	I	2-3
Ceramium rubrum	I	+	II	+-3	I	+
Himanthalia elongata	II	+-3	II	+-3		
Cladophora albida	I	+	II	+	I	2
Cladophora laetevirens			II	+-3	I	+
Dictyota dichotoma			II	+-2	I	2
Enteromorpha clathrata			II	+-5	I	1
Corallina officinalis	II	+-1	II	1-5	I	+
Lophosiphonia reptabunda			III	+-5		
Symploca hydnoides			I	+-5		
Laurencia obtusa			II	+-2		
Ceramium shuttleworthianum	II	+-2	I	+		
Petrocelis cruentus	I	+	I	1-4		
barnacles	V	1-5	II	3-5	II	3-5
Hildenbrandia prototypus	III	+-4	I	1-2	IV	+-4
Ralfsia verrucosa	III	+-3	I	+-1	I	+-1
Mytilus edulis	II	2-4	I	2	I	2
Blidingia minima	II	+-2	I	+	I	+-4
Pelvetia canaliculata	I	1-2			I	+-1
Porphyra umbilicalis	III	+-4				

Table 13. Monostroma-Blidingia vegetation.
33 survey plots from locality 20.

Monostroma oxyspermum	IV	1-5
Rhizoclonium riparium f. riparium	III	+-5
Blidingia marginata	II	1-5
Blidingia subsp. minima	II	1-5
Enteromorpha compressa	II	3-5
Enteromorpha intestinalis	I	+-5
Elminius modestus	I	5
Ulothrix subflaccida	I	5
Oscillatoria margaritifera	I	1-4
Entophysalis deusta	I	2-4
Porphyra cf. linearis	I	+-3
Cladophora globulina	I	1-3
Rivularia atra	I	+-3
Spirulina tenerrima	I	3
Cladophora glomerata	I	2
Rhizoclonium implexum	I	+-1
Hildenbrandia prototypus	I	1
Lyngbya lutea	I	+
Schizothrix calcicola	I	+
Cladophora sericea	I	+
Callithamnion polyspermum	I	+
Fucus sp. juv.	I	+
Urospora sp.	I	+

Table 14. Fucus vegetations from brackish water.
16 survey-plots from localities 19 (3x) and 20 (13x).

Fucus ceranoides	IV	2-5
Blidingia marginata	III	+-5
Hildenbrandia prototypus	III	+-5
Bostrychia scorpioides	I	+-3
Fucus vesiculosus	II	2-5
Enteromorpha compressa	II	+-4
Rhizoclonium riparium f. riparium	II	+-3
Elachista fucicola	II	+-2
Ascophyllum nodosum	I	3-5
Fucus spiralis	I	+-2
Rhizoclonium implexum	I	3
Cladophora globulina	I	2
Blidingia minima	I	1
Pelvetia canaliculata	I	1
Catenella repens	I	+
Polysiphonia lanosa	I	+
Pilayella littoralis	I	+

Table 15. High littoral grotto vegetations.
23 survey plots from localities 1 (2x), 3, 6 (2x), 7 (6x), 9, 10 (3x), 14, 17 (4x), 18 (2x), 8.

Table 16. High littoral grotto vegetations from brackish water.
7 survey-plots from locality 20.

For species with I and abundance not over 1 see table 18.

	Table 15		Table 16	
Catenella repens	III	+-5	V	1-5
Gelidium pulchellum	V	1-5		
Callithamnion polyspermum	IV	+-5	III	3-4
Hildenbrandia prototypus	III	+-3	II	1-2
Ulva lactuca	II	+-1	III	+-1
Fucus sp. juv.	II	+-1	III	+-1
Bostrychia scorpioides	I	1	III	2-4
Rhodochorton purpureum	II	2-5	II	+-3
Blidingia marginata			III	3
Sphacelaria furcigera	I	+-1	II	+
Rhizoclonium implexum	I	+	II	+
Enteromorpha clathrata			II	1
Monostroma oxyspermum			II	2-3
Rhizoclonium riparium f. riparium	II	+-2	I	4
Enteromorpha compressa	II	+-4		
Enteromorpha ramulosa	II	1-3		
Ceramium flabelligerum	II	+-3		
Cladophora albida	II	+-1		
Gigartina stellata	II	+-1		
Lophosiphonia reptabunda	I	3-5		
Blidingia minima	I	+-2	I	1
Ralfsia verrucosa	I	+-2		
Chaetamorpha linum	I	+-1		
Laurencia pinnatifida	I	+-1		
Entophysalis deusta	I	1-3		
Balanus perforatus	I	4-5		
Oscillatoria bonnemaisonii	I	2		
Oscillatoria nigroviridis	I	2		
Calothrix confervicola			I	3
Blidingia minima subsp. ramifera			I	3
Cladophora globulina			I	1

VEGETATION TYPES	LOCALITIES																		
	1	2	3	4	18	14	16	17	15	12	7	6	5	11	13	9	8	10	20
Laminariaceae, exposed type	x	x	x	x			x	x											
Himanthalia elongata	x	x		x				x											
Lichina pygmaea				x			x												
Porphyra linearis					x			x											
Lithophyllum tortuosum	x	x		x	x		x	x		x									
Gigartina stellata	x	x	x	x		x	x		x										
Pelvetia canaliculata		+		x	x			x	x	x	x								
Rivularia bullata				x					x	x		x	x	x					
Laminariaceae, sheltered type	+			+		x	x	x	x	x	x	x	x	?					
Himanthalia-Bifurcaria	+			+	x	x	x	x	x	x	x	x	x	x					
Fucus	+		+	+	x	x	x	x			x								
Low littoral Fucus	+			+	+					x	x	x	x	x	x			x	
Fucus-Ascophyllum											x		x		x	x	x	x	x
Pelvetia-Catenella											x				x	x	x		x

Table 17. Distribution of vegetation types.
+: only in relatively sheltered sites.
See map fig. 1.

Table 18. List of species observed during this investigation.

18 A. Local distribution.

In the first part of the table the occurrence of species in the littoral and shallow sublittoral of the investigated localities (see map fig. 1) is indicated by the following degrees of shading: — present; = common; ≡ forming a conspicuous part in at least one vegetation-type (having over 25 % surface covering).

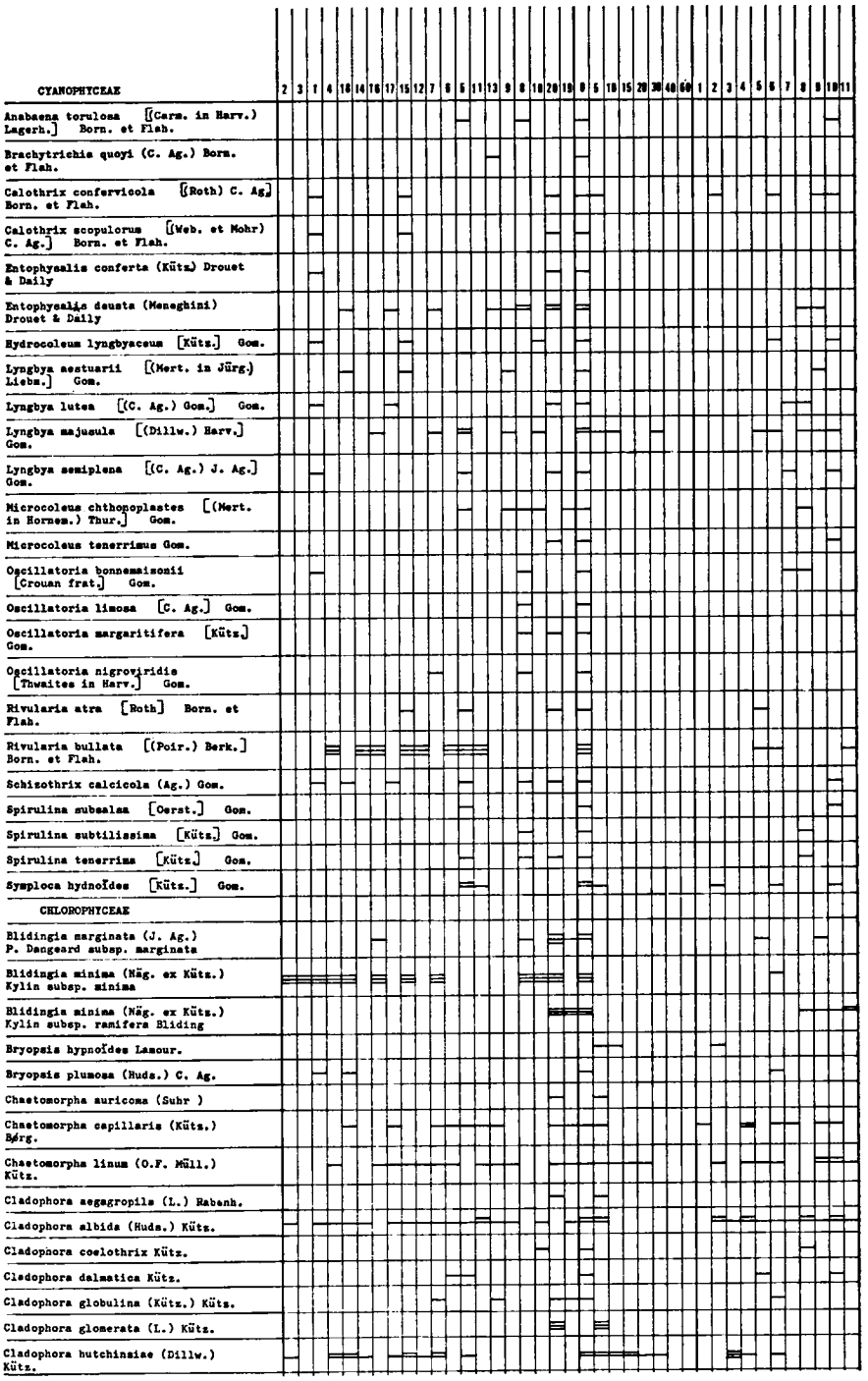
18 B. Depth distribution.

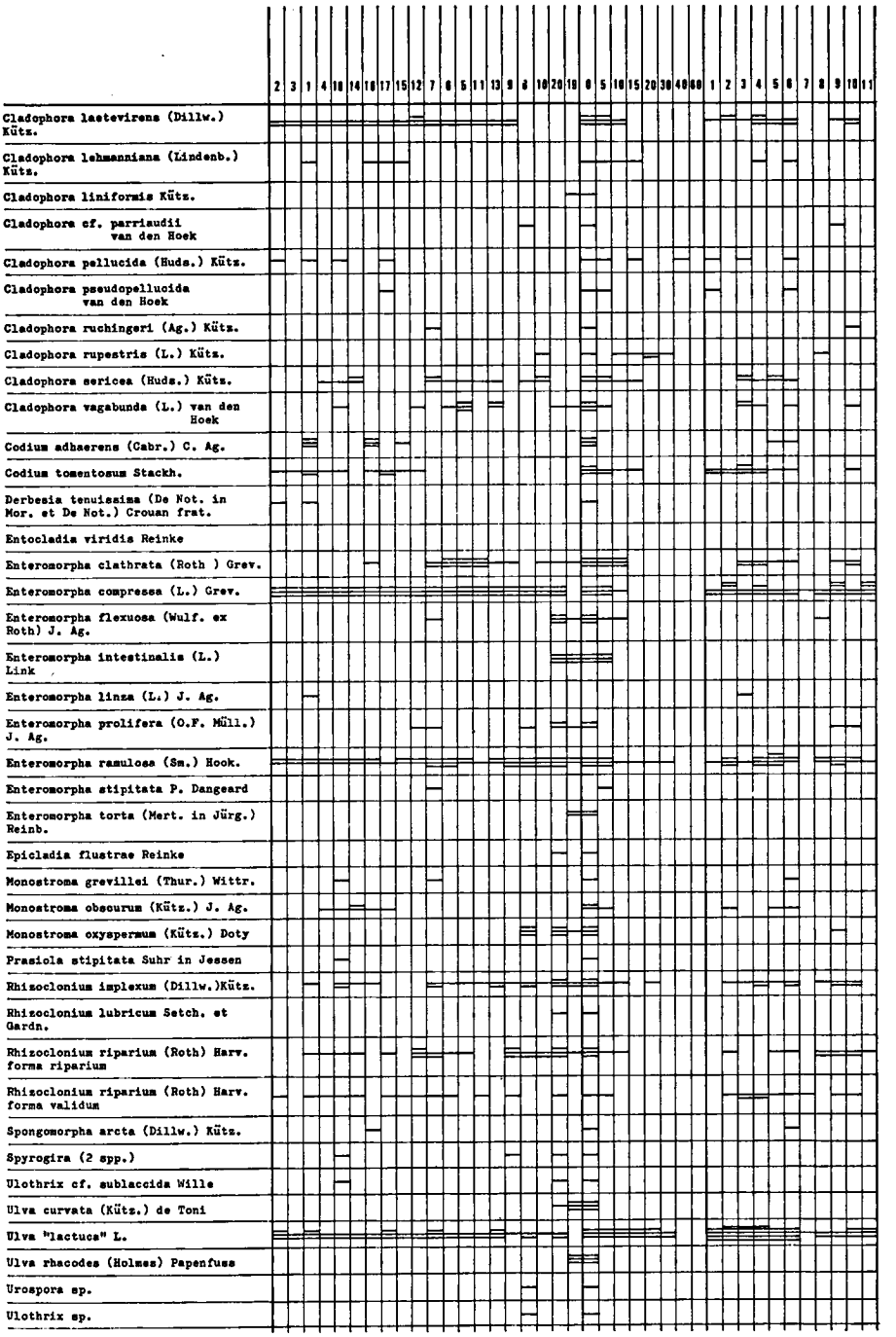
In the middle part the depth distribution as observed by diving and dredging is indicated in the same scale. The first column represents the littoral, the second from low-water-mark to 5 m depth, the third from 5.10 below lowwater-mark, and so on.

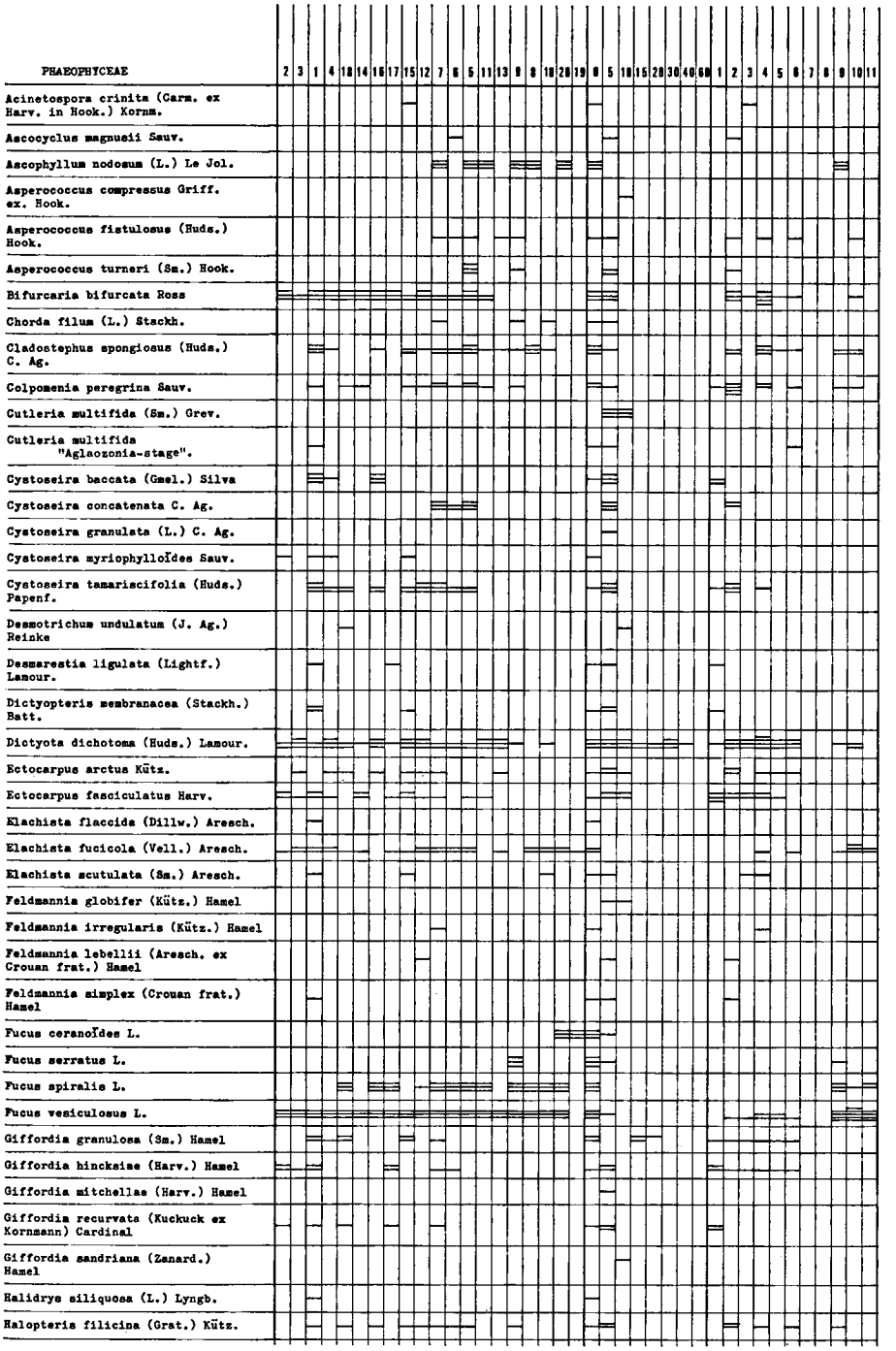
18 C. Distribution over the vegetation-types.

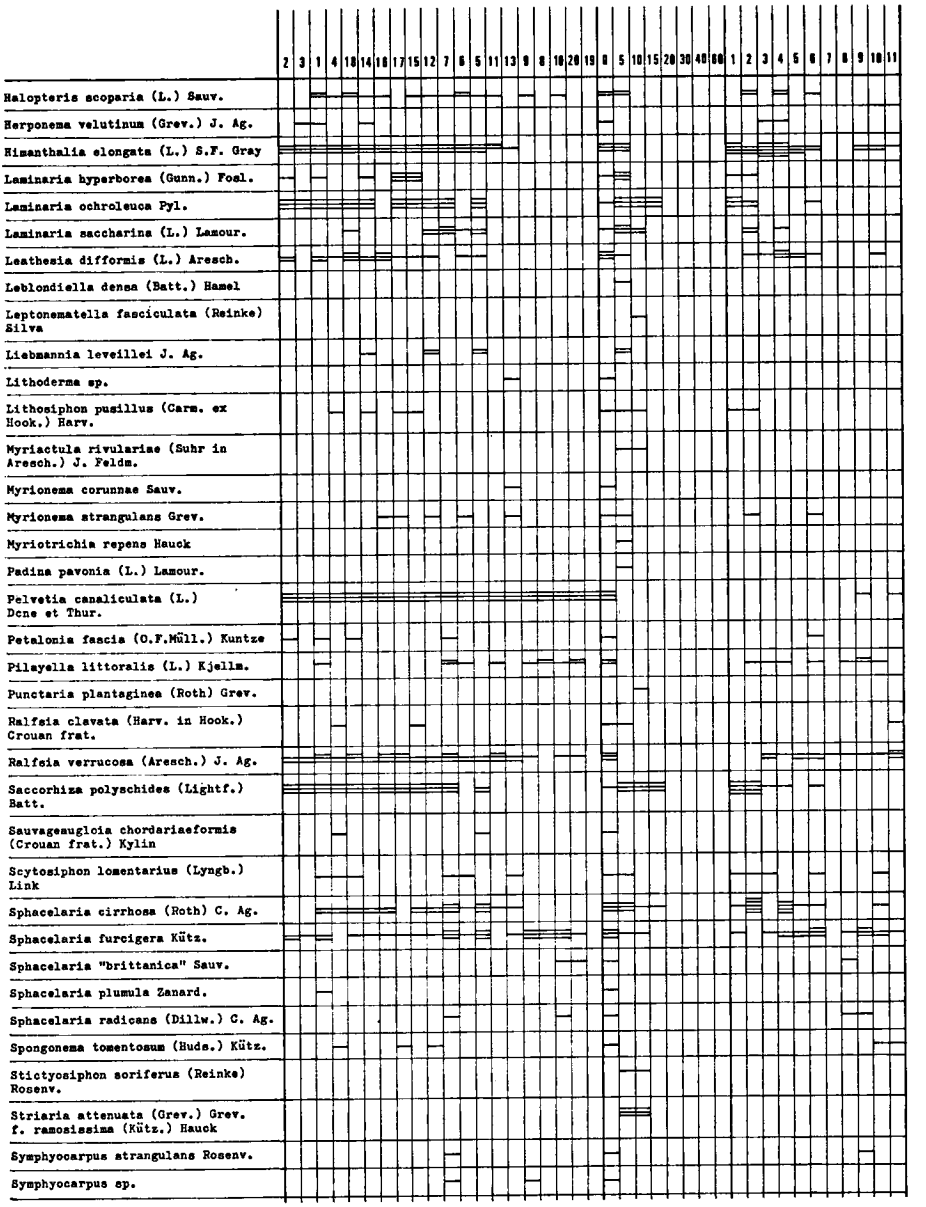
In the last part of this table the degree of presence by which the species participate in these described vegetation-types that are richest in species is represented by the following scale: — = I; = = II; ≡ = III; ≣ = IV; ≣ = V.
The following vegetation-types are included:

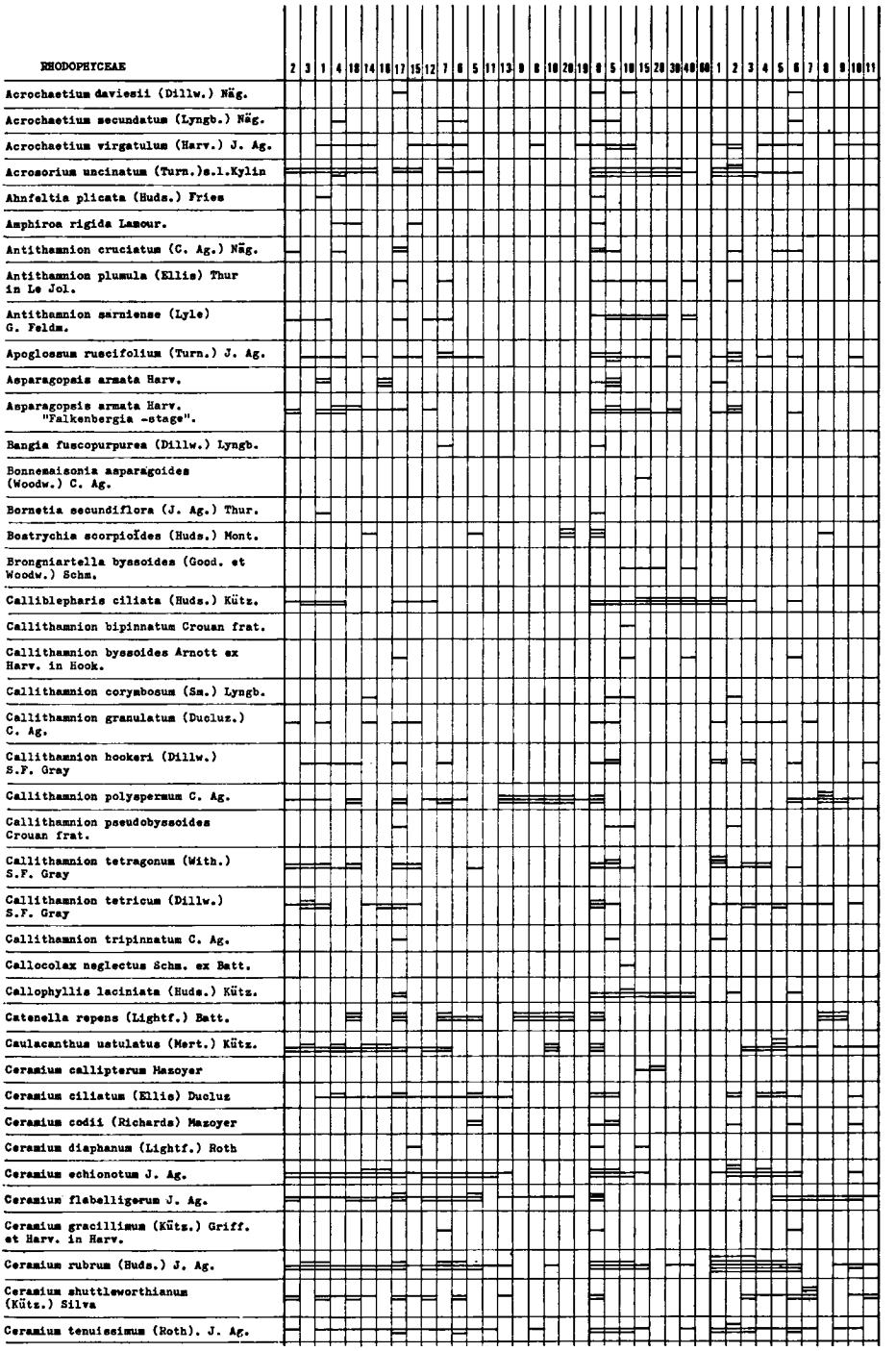
Column 1. *Laminariaceae* vegetations, exposed type.
2. *Laminariaceae* vegetations, sheltered type.
3. *Himanthalia elongata* vegetations.
4. *Himanthalia-Bifurcaria* vegetations.
5. *Gigartina stellata* vegetations.
6. Miscellaneous turf vegetations.
7. *Lithophyllum tortuosum* vegetations.
8. High littoral shade vegetations.
9. *Fucus-Ascophyllum* vegetations.
10. Low littoral *Fucus* vegetations.
11. *Fucus* vegetations.

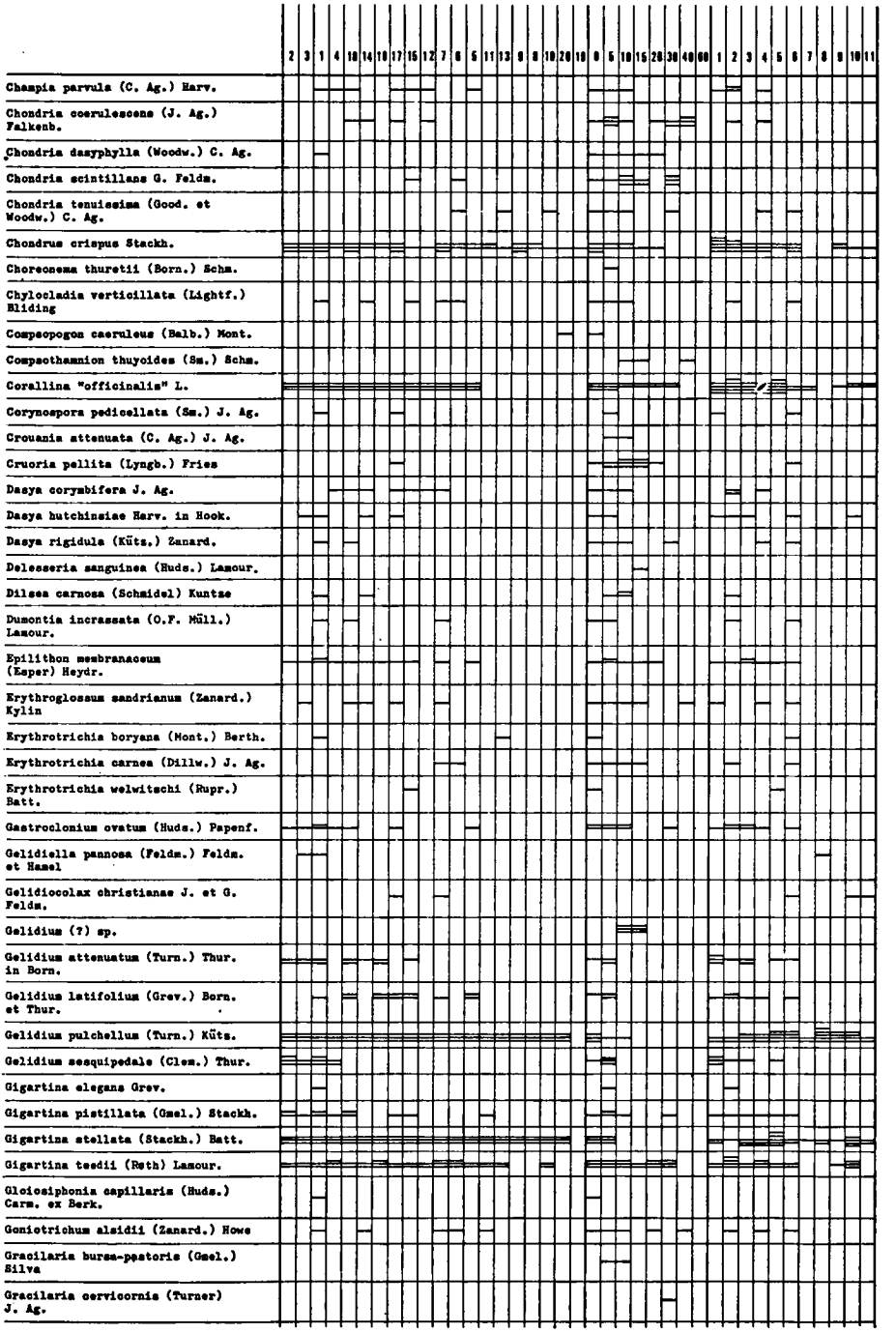

2 3 1 4 18 14 16 17 15 12 7 8 6 11 13 9 8 18 20 19 9 5 15 15 20 30 40 60 1 2 3 4 5 6 7 8 9 10 11
CYANOPHYCEAE
Anabaena torulosa [(Carm. in Harv.) Lagerh.] Born. et Flah.
Brachytrichia quoyi (C. Ag.) Born. et Flah.
Calothrix confervicola [(Roth) C. Ag.] Born. et Flah.
Calothrix scopulorum [(Web. et Mohr) C. Ag.] Born. et Flah.
Entophysalis conferta (Kütz.) Drouet & Daily
Entophysalis deusta (Meneghini) Drouet & Daily
Hydrocoleum lyngbyaceum [Kütz.] Gom.
Lyngbya aestuarii [(Mert. in Jürg.) Liebm.] Gom.
Lyngbya lutea [(C. Ag.) Gom.] Gom.
Lyngbya majusula [(Dillw.) Harv.] Gom.
Lyngbya semiplena [(C. Ag.) J. Ag.] Gom.
Microcoleus chthonoplastes [(Mert. in Hornem.) Thur.] Gom.
Microcoleus tenerrimus Gom.
Oscillatoria bonnemaisonii [Crouan frat.] Gom.
Oscillatoria limosa [C. Ag.] Gom.
Oscillatoria margaritifera [Kütz.] Gom.
Oscillatoria nigroviridis [Thwaites in Harv.] Gom.
Rivularia atra [Roth] Born. et Flah.
Rivularia bullata [(Poir.) Berk.] Born. et Flah.
Schizothrix calcicola (Ag.) Gom.
Spirulina subsalsa [Oerst.] Gom.
Spirulina subtilissima [Kütz.] Gom.
Spirulina tenerrima [Kütz.] Gom.
Symploca hydnoides [Kütz.] Gom.
CHLOROPHYCEAE
Blidingia marginata (J. Ag.) P. Dangeard subsp. marginata
Blidingia minima (Näg. ex Kütz.) Kylin subsp. minima
Blidingia minima (Näg. ex Kütz.) Kylin subsp. ramifera Bliding
Bryopsis hypnoides Lamour.
Bryopsis plumosa (Huds.) C. Ag.
Chaetomorpha aurioma (Suhr)
Chaetomorpha capillaris (Kütz.) Børg.
Chaetomorpha linum (O.F. Müll.) Kütz.
Cladophora aegagropila (L.) Rabenh.
Cladophora albida (Huds.) Kütz.
Cladophora coelothrix Kütz.
Cladophora dalmatica Kütz.
Cladophora globulina (Kütz.) Kütz.
Cladophora glomerata (L.) Kütz.
Cladophora hutchinsiae (Dillw.) Kütz.

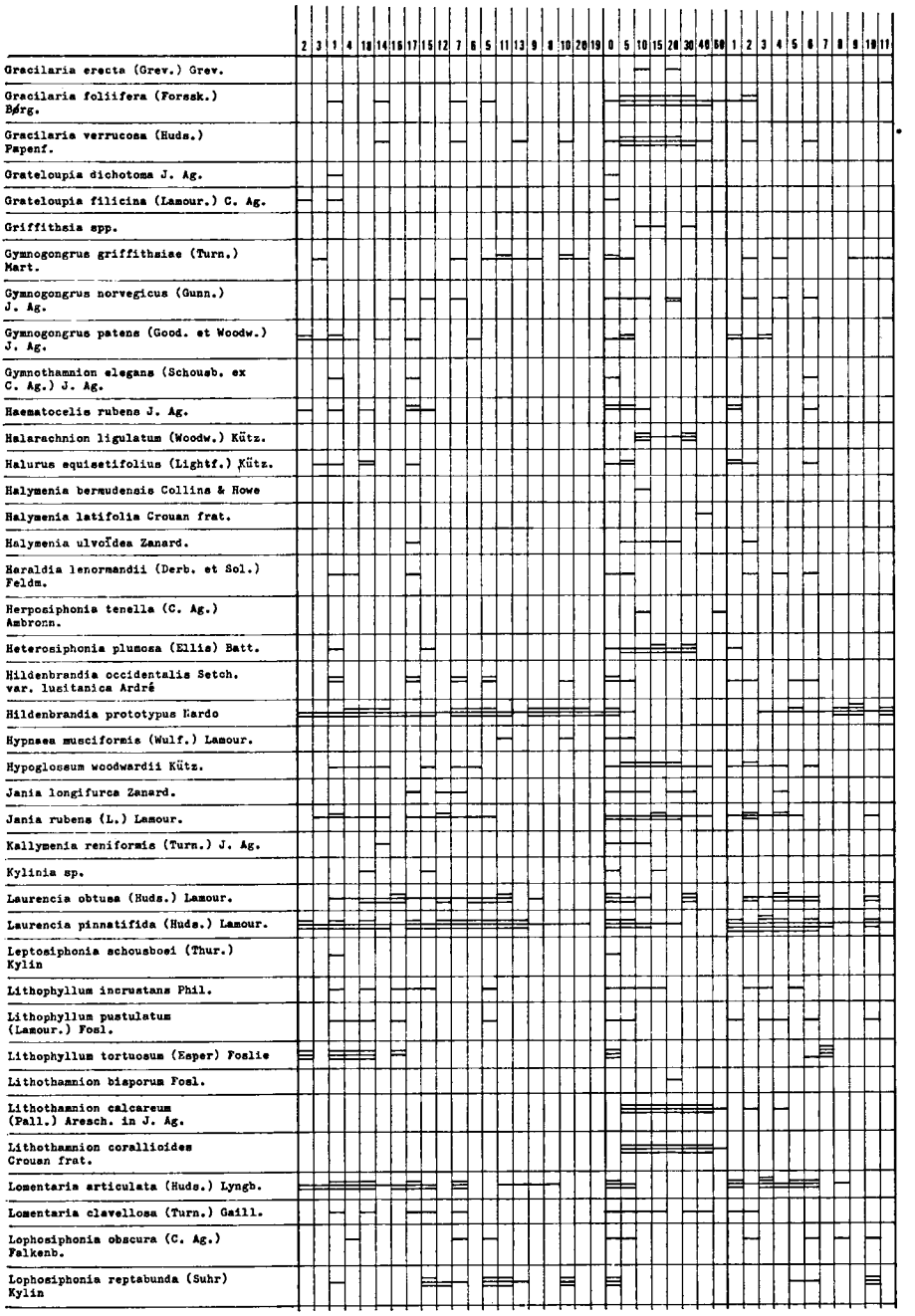

2 3 1 4 10 14 18 17 15 12 7 6 5 11 13 9 8 10 20 19 0 5 10 15 20 30 40 80 1 2 3 4 5 6 7 8 9 10 11
Cladophora lastevirens (Dillw.) Kütz.
Cladophora lehmanniana (Lindenb.) Kütz.
Cladophora liniformis Kütz.
Cladophora cf. parriaudii van den Hoek
Cladophora pellucida (Huds.) Kütz.
Cladophora pseudopellucida van den Hoek
Cladophora ruchingeri (Ag.) Kütz.
Cladophora rupestris (L.) Kütz.
Cladophora sericea (Huds.) Kütz.
Cladophora vagabunda (L.) van den Hoek
Codium adhaerens (Cabr.) C. Ag.
Codium tomentosum Stackh.
Derbesia tenuissima (De Not. in Mor. et De Not.) Crouan frat.
Entocladia viridis Reinke
Enteromorpha clathrata (Roth) Grev.
Enteromorpha compressa (L.) Grev.
Enteromorpha flexuosa (Wulf. ex Roth) J. Ag.
Enteromorpha intestinalis (L.) Link
Enteromorpha linza (L.) J. Ag.
Enteromorpha prolifera (O.F. Müll.) J. Ag.
Enteromorpha ramulosa (Sm.) Hook.
Enteromorpha stipitata P. Dangeard
Enteromorpha torta (Mert. in Jürg.) Reinb.
Epicladia flustrae Reinke
Monostroma grevillei (Thur.) Wittr.
Monostroma obscurum (Kütz.) J. Ag.
Monostroma oxyspermum (Kütz.) Doty
Prasiola stipitata Suhr in Jessen
Rhizoclonium implexum (Dillw.)Kütz.
Rhizoclonium lubricum Setch. et Gardn.
Rhizoclonium riparium (Roth) Harv. forma riparium
Rhizoclonium riparium (Roth) Harv. forma validum
Spongomorpha arcta (Dillw.) Kütz.
Spyrogira (2 spp.)
Ulothrix cf. sublaccida Wille
Ulva curvata (Kütz.) de Toni
Ulva "lactuca" L.
Ulva rhacodes (Holmes) Papenfuss
Urospora sp.
Ulothrix sp.

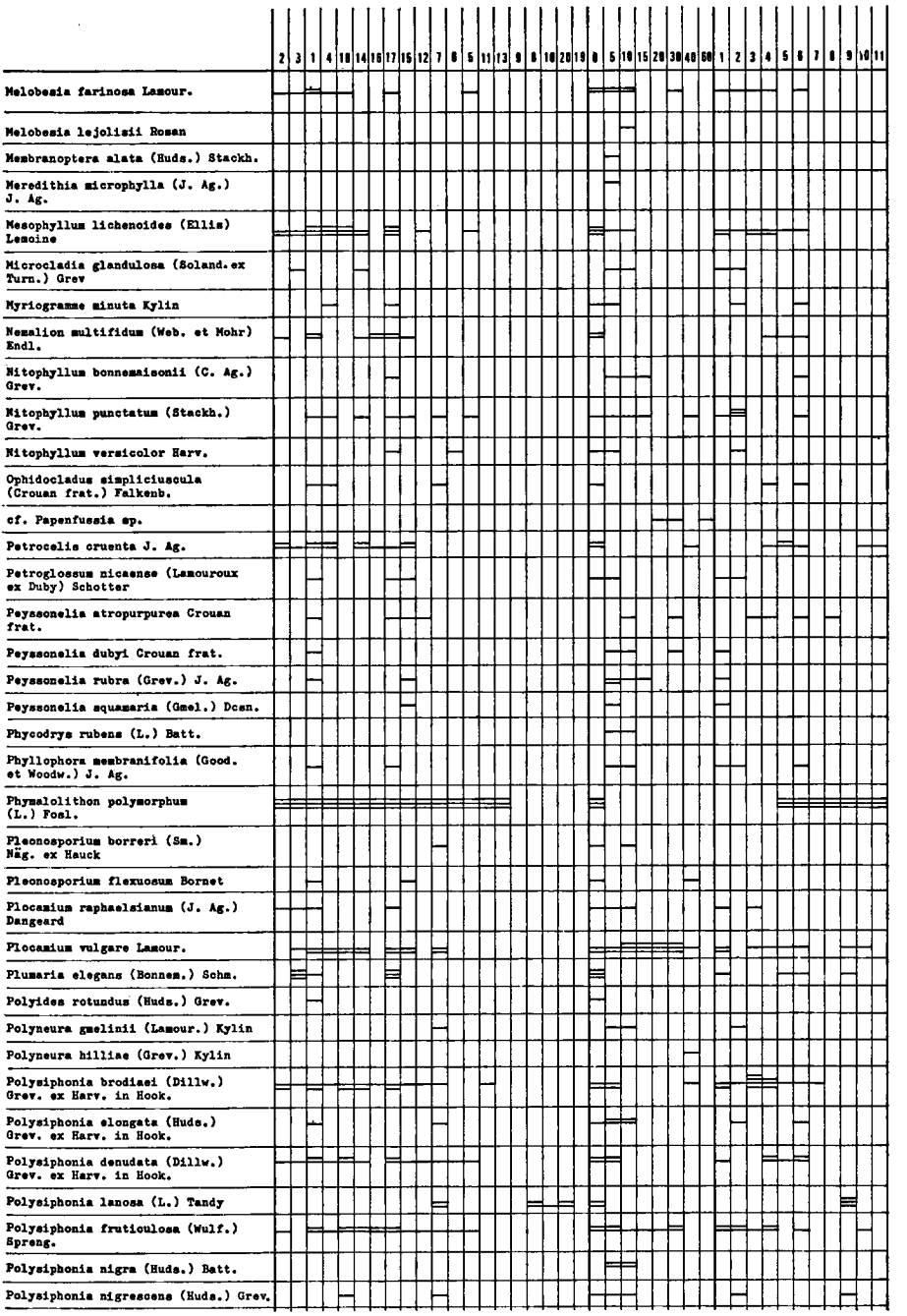

PHAEOPHYCEAE
2 3 1 4 18 14 16 17 15 12 7 6 5 11 13 9 8 18 28 19 0 5 18 15 28 30 40 60 1 2 3 4 5 6 7 8 9 10 11
Acinetospora crinita (Carm. ex Harv. in Hook.) Kornm.
Ascocyclus magnusii Sauv.
Ascophyllum nodosum (L.) Le Jol.
Asperococcus compressus Griff. ex. Hook.
Asperococcus fistulosus (Huds.) Hook.
Asperococcus turneri (Sm.) Hook.
Bifurcaria bifurcata Ross
Chorda filum (L.) Stackh.
Cladostephus spongiosus (Huds.) C. Ag.
Colpomenia peregrina Sauv.
Cutleria multifida (Sm.) Grev.
Cutleria multifida "Aglaozonia-stage".
Cystoseira baccata (Gmel.) Silva
Cystoseira concatenata C. Ag.
Cystoseira granulata (L.) C. Ag.
Cystoseira myriophylloïdes Sauv.
Cystoseira tamariscifolia (Huds.) Papenf.
Desmotrichum undulatum (J. Ag.) Reinke
Desmarestia ligulata (Lightf.) Lamour.
Dictyopteris membranacea (Stackh.) Batt.
Dictyota dichotoma (Huds.) Lamour.
Ectocarpus arctus Kütz.
Ectocarpus fasciculatus Harv.
Elachista flaccida (Dillw.) Aresch.
Elachista fucicola (Vell.) Aresch.
Elachista scutulata (Sm.) Aresch.
Feldmannia globifer (Kütz.) Hamel
Feldmannia irregularis (Kütz.) Hamel
Feldmannia lebellii (Aresch. ex Crouan frat.) Hamel
Feldmannia simplex (Crouan frat.) Hamel
Fucus ceranoïdes L.
Fucus serratus L.
Fucus spiralis L.
Fucus vesiculosus L.
Giffordia granulosa (Sm.) Hamel
Giffordia hincksiae (Harv.) Hamel
Giffordia mitchellae (Harv.) Hamel
Giffordia recurvata (Kuckuck ex Kornmann) Cardinal
Giffordia sandriana (Zanard.) Hamel
Halidrys siliquosa (L.) Lyngb.
Halopteris filicina (Grat.) Kütz.

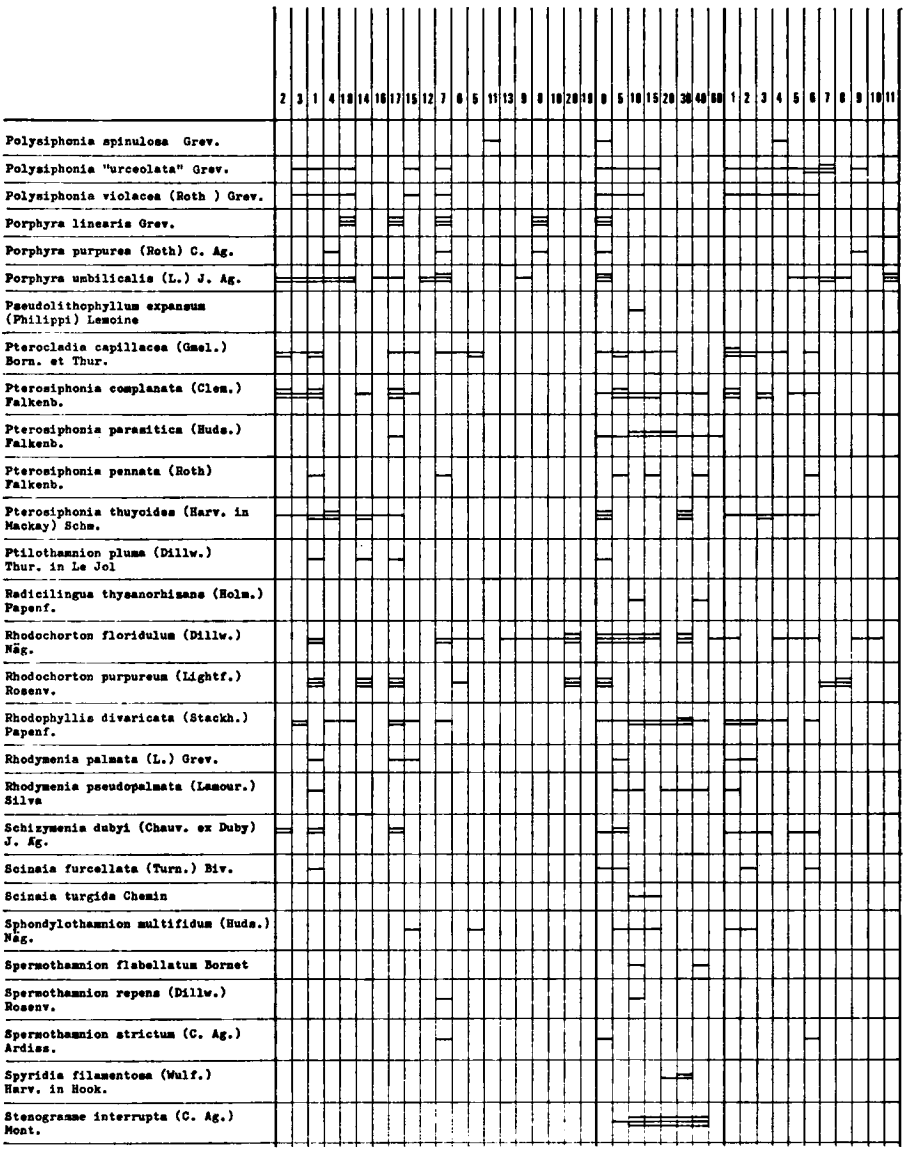

2 3 1 4 18 14 16 17 15 12 7 6 5 11 13 9 8 18 20 19 0 5 10 15 20 30 40 80 1 2 3 4 5 6 7 8 9 10 11
Halopteris scoparia (L.) Sauv.
Herponema velutinum (Grev.) J. Ag.
Rhizanthalia elongata (L.) S.F. Gray
Laminaria hyperborea (Gunn.) Fosl.
Laminaria ochroleuca Pyl.
Laminaria saccharina (L.) Lamour.
Leathesia difformis (L.) Aresch.
Leblondiella densa (Batt.) Hamel
Leptonematella fasciculata (Reinke) Silva
Liebmannia leveillei J. Ag.
Lithoderma sp.
Lithosiphon pusillus (Carm. ex Hook.) Harv.
Myriactula rivulariae (Suhr in Aresch.) J. Feldm.
Myrionema corunnae Sauv.
Myrionema strangulans Grev.
Myriotrichia repens Hauck
Padina pavonia (L.) Lamour.
Pelvetia canaliculata (L.) Dcne et Thur.
Petalonia fascia (O.F.Müll.) Kuntze
Pilayella littoralis (L.) Kjellm.
Punctaria plantaginea (Roth) Grev.
Ralfsia clavata (Harv. in Hook.) Crouan frat.
Ralfsia verrucosa (Aresch.) J. Ag.
Saccorhiza polyschides (Lightf.) Batt.
Sauvageaugloia chordariaeformis (Crouan frat.) Kylin
Scytosiphon lomentarius (Lyngb.) Link
Sphacelaria cirrhosa (Roth) C. Ag.
Sphacelaria furcigera Kütz.
Sphacelaria "brittanica" Sauv.
Sphacelaria plumula Zanard.
Sphacelaria radicans (Dillw.) C. Ag.
Spongonema tomentosum (Huds.) Kütz.
Stictyosiphon soriferus (Reinke) Rosenv.
Striaria attenuata (Grev.) Grev. f. ramosissima (Kütz.) Hauck
Symphyocarpus strangulans Rosenv.
Symphyocarpus sp.


RHODOPHYCEAE
2 3 1 4 18 14 16 17 15 12 7 8 5 11 13 9 8 10 20 19 8 5 10 15 28 38 48 68 1 2 3 4 5 6 7 8 9 10 11
Acrochaetium daviesii (Dillw.) Näg.
Acrochaetium secundatum (Lyngb.) Näg.
Acrochaetium virgatulum (Harv.) J. Ag.
Acrosorium uncinatum (Turn.)s.l.Kylin
Ahnfeltia plicata (Huds.) Fries
Amphiroa rigida Lamour.
Antithamnion cruciatum (C. Ag.) Näg.
Antithamnion plumula (Ellis) Thur in Le Jol.
Antithamnion sarniense (Lyle) G. Feldm.
Apoglossum ruscifolium (Turn.) J. Ag.
Asparagopsis armata Harv.
Asparagopsis armata Harv. "Falkenbergia -stage".
Bangia fuscopurpurea (Dillw.) Lyngb.
Bonnemaisonia asparagoides (Woodw.) C. Ag.
Bornetia secundiflora (J. Ag.) Thur.
Boetrychia scorpioides (Huds.) Mont.
Brongniartella byssoides (Good. et Woodw.) Schm.
Calliblepharis ciliata (Huds.) Kütz.
Callithamnion bipinnatum Crouan frat.
Callithamnion byssoides Arnott ex Harv. in Hook.
Callithamnion corymbosum (Sm.) Lyngb.
Callithamnion granulatum (Ducluz.) C. Ag.
Callithamnion hookeri (Dillw.) S.F. Gray
Callithamnion polyspermum C. Ag.
Callithamnion pseudobyssoides Crouan frat.
Callithamnion tetragonum (With.) S.F. Gray
Callithamnion tetricum (Dillw.) S.F. Gray
Callithamnion tripinnatum C. Ag.
Callocolax neglectus Schm. ex Batt.
Callophyllis laciniata (Huds.) Kütz.
Catenella repens (Lightf.) Batt.
Caulacanthus ustulatus (Mert.) Kütz.
Ceramium callipterum Mazoyer
Ceramium ciliatum (Ellis) Ducluz
Ceramium codii (Richards) Mazoyer
Ceramium diaphanum (Lightf.) Roth
Ceramium echionotum J. Ag.
Ceramium flabelligerum J. Ag.
Ceramium gracillimum (Kütz.) Griff. et Harv. in Harv.
Ceramium rubrum (Huds.) J. Ag.
Ceramium shuttleworthianum (Kütz.) Silva
Ceramium tenuissimum (Roth). J. Ag.


2 3 1 4 18 14 10 17 15 12 7 6 5 11 13 9 8 10 20 18 9 5 10 15 28 30 40 60 1 2 3 4 5 6 7 8 9 10 11
Champia parvula (C. Ag.) Harv.
Chondria coerulescens (J. Ag.) Falkenb.
Chondria dasyphylla (Woodw.) C. Ag.
Chondria scintillans G. Feldm.
Chondria tenuissima (Good. et Woodw.) C. Ag.
Chondrus crispus Stackh.
Choreocnema thuretii (Born.) Schm.
Chylocladia verticillata (Lightf.) Bliding
Compsopogon caeruleus (Balb.) Mont.
Compsothamnion thuyoides (Sm.) Schm.
Corallina "officinalis" L.
Corynospora pedicellata (Sm.) J. Ag.
Crouania attenuata (C. Ag.) J. Ag.
Cruoria pellita (Lyngb.) Fries
Dasya corymbifera J. Ag.
Dasya hutchinsiae Harv. in Hook.
Dasya rigidula (Kütz.) Zanard.
Delesseria sanguinea (Huds.) Lamour.
Dilsea carnosa (Schmidel) Kuntze
Dumontia incrassata (O.F. Müll.) Lamour.
Epilithon membranaceum (Esper) Heydr.
Erythroglossum sandrianum (Zanard.) Kylin
Erythrotrichia boryana (Mont.) Berth.
Erythrotrichia carnea (Dillw.) J. Ag.
Erythrotrichia welwitschi (Rupr.) Batt.
Gastroclonium ovatum (Huds.) Papenf.
Gelidiella pannosa (Feldm.) Feldm. et Hamel
Gelidiocolax christianae J. et G. Feldm.
Gelidium (?) sp.
Gelidium attenuatum (Turn.) Thur. in Born.
Gelidium latifolium (Grev.) Born. et Thur.
Gelidium pulchellum (Turn.) Kütz.
Gelidium sesquipedale (Clem.) Thur.
Gigartina elegans Grev.
Gigartina pistillata (Gmel.) Stackh.
Gigartina stellata (Stackh.) Batt.
Gigartina teedii (Roth) Lamour.
Gloiosiphonia capillaris (Huds.) Carm. ex Berk.
Goniotrichum alsidii (Zanard.) Howe
Gracilaria bursa-pastoris (Gmel.) Silva
Gracilaria cervicornis (Turner) J. Ag.


2 3 1 4 18 14 16 17 15 12 7 6 5 11 13 9 8 10 20 19 0 5 10 15 20 30 40 50 1 2 3 4 5 6 7 8 9 10 11
Gracilaria erecta (Grev.) Grev.
Gracilaria foliifera (Forssk.) Børg.
Gracilaria verrucosa (Huds.) Papenf.
Grateloupia dichotoma J. Ag.
Grateloupia filicina (Lamour.) C. Ag.
Griffithsia spp.
Gymnogongrus griffithsiae (Turn.) Mart.
Gymnogongrus norvegicus (Gunn.) J. Ag.
Gymnogongrus patens (Good. et Woodw.) J. Ag.
Gymnothamnion elegans (Schousb. ex C. Ag.) J. Ag.
Haematocelis rubens J. Ag.
Halarachnion ligulatum (Woodw.) Kütz.
Halurus equisetifolius (Lightf.) Kütz.
Halymenia bermudensis Collins & Howe
Halymenia latifolia Crouan frat.
Halymenia ulvoïdea Zanard.
Haraldia lenormandii (Derb. et Sol.) Feldm.
Herposiphonia tenella (C. Ag.) Ambronn.
Heterosiphonia plumosa (Ellis) Batt.
Hildenbrandia occidentalis Setch. var. lusitanica Ardré
Hildenbrandia prototypus Nardo
Hypnaea musciformis (Wulf.) Lamour.
Hypoglossum woodwardii Kütz.
Jania longifurca Zanard.
Jania rubens (L.) Lamour.
Kallymenia reniformis (Turn.) J. Ag.
Kylinia sp.
Laurencia obtusa (Huds.) Lamour.
Laurencia pinnatifida (Huds.) Lamour.
Leptosiphonia schousboei (Thur.) Kylin
Lithophyllum incrustans Phil.
Lithophyllum pustulatum (Lamour.) Fosl.
Lithophyllum tortuosum (Esper) Foslie
Lithothamnion bisporum Fosl.
Lithothamnion calcareum (Pall.) Aresch. in J. Ag.
Lithothamnion corallioides Crouan frat.
Lomentaria articulata (Huds.) Lyngb.
Lomentaria clavellosa (Turn.) Gaill.
Lophosiphonia obscura (C. Ag.) Falkenb.
Lophosiphonia reptabunda (Suhr) Kylin


2 3 1 4 18 14 16 17 15 12 7 8 5 11 13 9 8 18 20 19 0 5 10 15 29 30 48 60 1 2 3 4 5 6 7 8 9 10 11
Melobesia farinosa Lamour.
Melobesia lejolisii Rosan
Membranoptera alata (Huds.) Stackh.
Meredithia microphylla (J. Ag.) J. Ag.
Mesophyllum lichenoides (Ellis) Lemoine
Microcladia glandulosa (Soland. ex Turn.) Grev
Myriogramme minuta Kylin
Nemalion multifidum (Web. et Mohr) Endl.
Nitophyllum bonnemaisonii (C. Ag.) Grev.
Nitophyllum punctatum (Stackh.) Grev.
Nitophyllum versicolor Harv.
Ophidocladus simpliciusculus (Crouan frat.) Falkenb.
cf. Papenfussia sp.
Petrocelis cruenta J. Ag.
Petroglossum nicaense (Lamouroux ex Duby) Schotter
Peyssonelia atropurpurea Crouan frat.
Peyssonelia dubyi Crouan frat.
Peyssonelia rubra (Grev.) J. Ag.
Peyssonelia squamaria (Gmel.) Dcsn.
Phycodrys rubens (L.) Batt.
Phyllophora membranifolia (Good. et Woodw.) J. Ag.
Phymatolithon polymorphum (L.) Fosl.
Pleonosporium borreri (Sm.) Näg. ex Hauck
Pleonosporium flexuosum Bornet
Plocamium raphaelsianum (J. Ag.) Dangeard
Plocamium vulgare Lamour.
Plumaria elegans (Bonnem.) Schm.
Polyides rotundus (Huds.) Grev.
Polyneura gmelinii (Lamour.) Kylin
Polyneura hilliae (Grev.) Kylin
Polysiphonia brodiaei (Dillw.) Grev. ex Harv. in Hook.
Polysiphonia elongata (Huds.) Grev. ex Harv. in Hook.
Polysiphonia denudata (Dillw.) Grev. ex Harv. in Hook.
Polysiphonia lanosa (L.) Tandy
Polysiphonia fruticulosa (Wulf.) Spreng.
Polysiphonia nigra (Huds.) Batt.
Polysiphonia nigrescens (Huds.) Grev.


2 3 1 4 18 14 16 17 15 12 7 6 5 11 13 9 8 10 20 19 8 5 10 15 20 30 40 50 1 2 3 4 5 6 7 8 9 10 11
Polysiphonia spinulosa Grev.
Polysiphonia "urceolata" Grev.
Polysiphonia violacea (Roth) Grev.
Porphyra linearis Grev.
Porphyra purpurea (Roth) C. Ag.
Porphyra umbilicalis (L.) J. Ag.
Pseudolithophyllum expansum (Philippi) Lemoine
Pterocladia capillacea (Gmel.) Born. et Thur.
Pterosiphonia complanata (Clem.) Falkenb.
Pterosiphonia parasitica (Huds.) Falkenb.
Pterosiphonia pennata (Roth) Falkenb.
Pterosiphonia thuyoides (Harv. in Mackay) Schm.
Ptilothamnion pluma (Dillw.) Thur. in Le Jol
Radicilingua thysanorhizans (Holm.) Papenf.
Rhodochorton floridulum (Dillw.) Näg.
Rhodochorton purpureum (Lightf.) Rosenv.
Rhodophyllis divaricata (Stackh.) Papenf.
Rhodymenia palmata (L.) Grev.
Rhodymenia pseudopalmata (Lamour.) Silva
Schizymenia dubyi (Chauv. ex Duby) J. Ag.
Scinaia furcellata (Turn.) Biv.
Scinaia turgida Chemin
Sphondylothamnion multifidum (Huds.) Näg.
Spermothamnion flabellatum Bornet
Spermothamnion repens (Dillw.) Rosenv.
Spermothamnion strictum (C. Ag.) Ardiss.
Spyridia filamentosa (Wulf.) Harv. in Hook.
Stenogramme interrupta (C. Ag.) Mont.