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ON THE FAUNA OF *CORALLINA OFFICINALIS* L. IN WESTERN NORWAY

By

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ABSTRACT

Three localities south of Bergen, one sheltered, one semi-exposed, and one very exposed, were chosen. Samples of *Corallina* were obtained at various times of the year from the intertidal and subtidal zones at the two more exposed localities. At the sheltered locality samples were taken from just below the intertidal zone only. Some 70 species and several higher groups were recorded and in most cases counted. The size of the animals found living on the plants is considered in relation to the form of growth of *Corallina* and the faunal composition in relation to the degree of exposure.

INTRODUCTION

Earlier studies of the fauna of *Corallina* have mostly been parts of general surveys of the algal fauna in particular regions. SLOANE et al. (1961) investigated the fauna of different algae, among them *C. officinalis*, in an area of rapids. They were able to show that some species have a preference for rapid currents and others for quiet water. RUFFO & WIESER (1952) sampled several algal species, among them *C. mediterranea*. WIESER (1959) also mentioned that he had sampled *C. mediterranea*. CHAPMAN (1955) sampled *C. granifera* (one sample only) from an exposed shore on the Azores.

My samples were taken at three localities south of Bergen. The localities can be classified as "very sheltered", "semi-exposed", and "very exposed", respectively.

The innermost locality, No. 1 (Fig. 1), is N. Steinskjær in Raunefjorden, just outside the Biological Station. There is almost no wave action. No open stretch of water leads in to the locality, but some waves come from passing small boats. Because of the lack of exposure considerable quantities of sediment have accumulated. All samples were taken at a depth of 0.6 m below mean tide level (MTL).

Locality 2, at the south-west end of Svartholmane in Fanafjorden, is considerably more exposed. Waves can travel in through Korsfjorden from the ocean and, although they lose much of their force on the way in, the surf can be heavy on stormy days. Wind from the south can also set up large waves through the fjord system. As a result, there is almost always some surf, but most of the time not very heavy. Samples were taken at MTL (locality 2A) and at a depth of 2.5 m (locality 2B).

Contribution from the Biological Station of the University of Bergen, Espegrend, N-5065 Blomsterdalen, Norway.

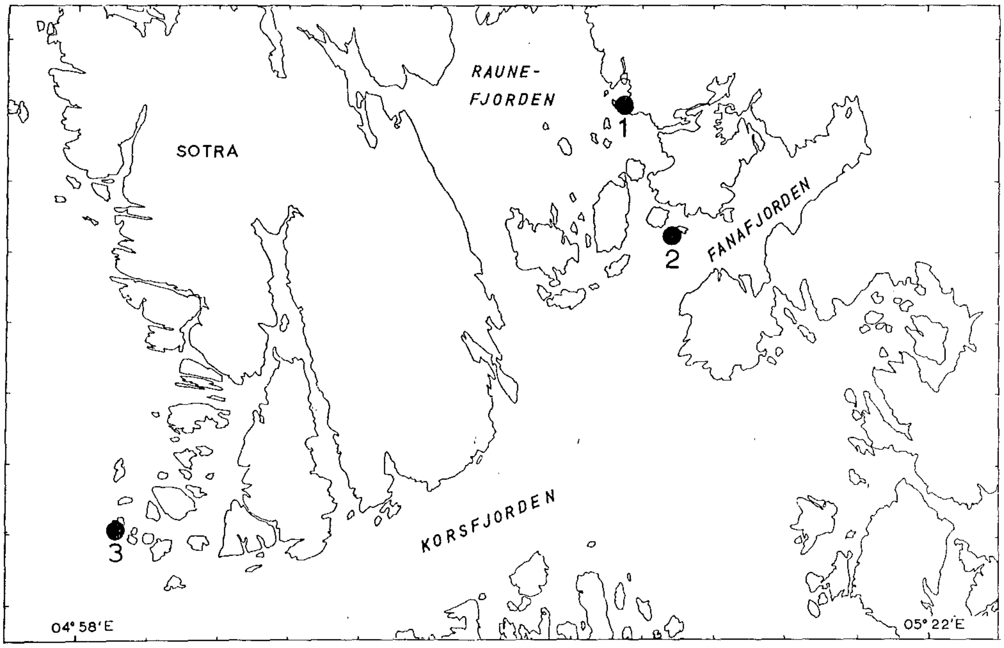

Fig. 1. Map of the area near the Biological Station, Espegrend, showing the three sampling localities.

The outermost locality, No. 3, is on the western side of N. Oddane, a small island on the open shore, exposed to the full force of the waves. Sampling *Corallina* from the shore there is possible on only a few days in the year. Sampling at 5 m is easier, but that also could be done only on calm days. Samples were taken at MTL (locality 3A), and at a depth of 5 m (locality 3B).

The algal zonation varied from place to place, with *Corallina* occupying different levels at the different localities (Fig. 2). At locality 1 *Corallina* was found in a distinct zone from 0.6 m to about 1.1 m below MTL. At locality 2 it was found in two zones. Higher up it occurred as an undergrowth in a zone of *Fucus vesiculosus* L. and *Fucus serratus* L. from MTL and down to about 0.5 m. Immediately below, in the zone of *Alaria esculenta* (L.) GREV. and *Laminaria digitata* (HUDS.) LAMOUR only a few *Corallina* plants occurred. Further down there was a broad zone of *Corallina* going down to at least 3 m. At locality 3, the zonation looked much simpler. Uppermost was a broad zone of *Verrucaria*, below which were a number of other algae, the species depending on the topography or on the exposure at just that spot. Then came the zones shown in Fig. 2. The upward extension of *Corallina* was also dependent on the local topography. Downwards, the *Corallina* zone stopped where the *Alaria esculenta* zone began, at about MTL. In the *Alaria* zone there was no *Corallina*; probably the *Alaria* plants, sweeping over the rock with the waves,

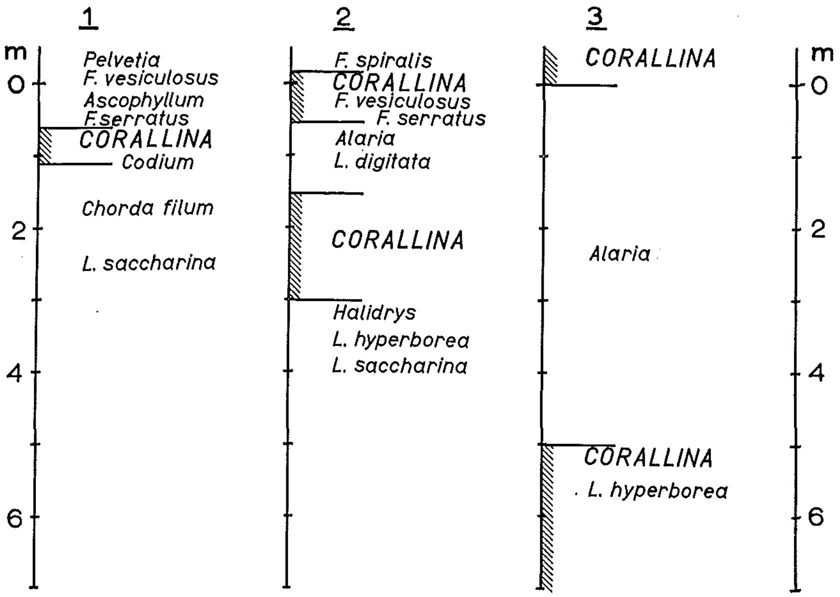

Fig. 2. The vertical distribution of *Corallina officinalis* (shaded) and of other large algae occurring in the same area. Mean tide level is at 0 m.

prevent settling of other plants. In the zone of *Laminaria hyperborea* (Gunn.) Fosl., *Corallina* was found as an undergrowth, down to at least 20—30 m, but the growth was very scattered at that depth.

Corallina plants seem to be very sensitive to desiccation, and the higher level of the upper *Corallina* zone at localities 2 and 3 is probably only possible because the waves keep the plants wet even at low tide. The *Corallina* plants in the upper zones at localities 2 and 3 grow very compactly, thus gaining extra protection against desiccation. The structure is reinforced by small *Modiolus modiolus* L. and *Musculus discors* L. with shells ranging from about 2 to 12 mm.

The different wave action at the three localities can be observed during sampling and deduced from a map of the area. But it is very difficult to say anything about the water movements to which animals living inside the *Corallina* growths are exposed. One knows that, due to friction, water movements are slower near the bottom than higher up in the water (Riedl & Forstner 1968). Probably there is also a gradient inside the *Corallina* growth, with swifter currents near the tops of the plants than at the holdfasts. This gradient must to a large extent be determined by the compactness with which the plants are growing. Obviously, in a compact growth the water movements are slowed down much more than in a looser growth.

One can get some indication of the rapidity of currents inside the *Corallina* growth from the type of sediment found there—soft, flocculent sediment indicating weak exposure and coarse sand, shell gravel or the absence of sediment indicating strong exposure.

Such a difference can be found between my localities. In the samples from location 1 and 2B there were variable amounts of flocculent sediment. At 2A and 3A there were shell fragments trapped within the *Corallina* plants, but no flocculent sediment. At 3B there was no sediment at all.

Although this gives no absolute values for exposure, it does indicate relative differences between the localities. Clearly, water movements are slower inside the *Corallina* growths at 1 and 2B than elsewhere. The lack of sediment between the *Corallina* plants at 3B indicates stronger currents than among the *Corallina* plants at 2A and 3A. extent. The relative degrees of exposure of the localities may be summarized as:

Least exposed	Intermediate	Most exposed
1 and 2B	2A and 3A	3B

Of the two localities intermediate in exposure, I find it probable that 3A is the more exposed, due to the much stronger wave action there.

Besides the "current effect" of exposure there is probably another effect which may be called the "crash effect", i.e. the shock waves from large breakers crashing against the shore. SCHLIEPER (1968) gives data showing that the metabolism of many animals is disturbed by high pressures lasting for one hour. On an exposed shore the situation will vary, each breaker giving periods of high and low pressure, but such wave action may often last for days or weeks.

TEMPERATURE AND SALINITY

The temperature was measured and water samples were taken at the same time as the *Corallina* samples, but only near the surface, as the largest variations were likely to occur there. Salinity was determined with a gold-thread aerometer.

The variations in temperature and salinity at the three localities are shown in Fig. 3. The temperature range was about the same at all localities, but the salinity range was slightly smaller at locality 3 than at the other localities, probably due to less drain-off from land after heavy rain.

The most extreme variation in salinity, found at locality 2, was from $26^0/_{00}$ to $35^0/_{00}$. Most of the time the salinity was over $30^0/_{00}$. Even $26^0/_{00}$ is probably tolerable for most littoral and sublittoral animals if it does not last for a long time.

It is possible that the variation in temperature makes some of the animals inhabiting *Corallina* migrate downwards during the coldest part of the year. This I have seen at least in the case of larger animals that are easier to observe, like some labrid fishes and the crab, *Cancer pagurus* LEACH.

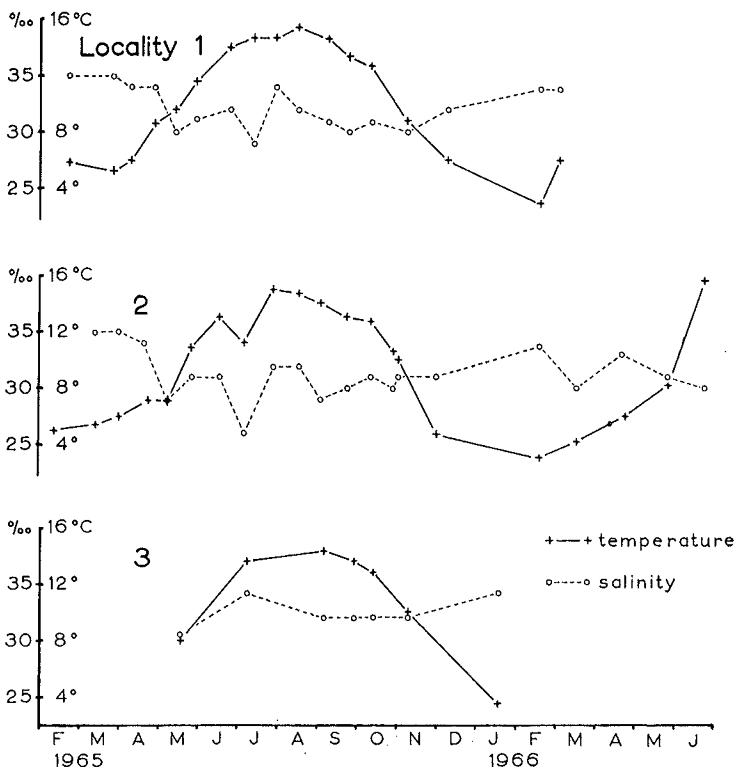

Fig. 3. Variations in salinity and temperature at the sampling localities.

COLLECTION AND EXAMINATION OF THE SAMPLES

The 2.5 and 5 m samples were obtained by skin-diving; the others could be taken by wading out from the shore. The samples were taken by enclosing small tufts of *Corallina* in a plastic bag and then detaching them from the rock by means of a knife or by tearing them off. At station 3B where the growth was more sparse, I had to pick the plants by hand and put them into the bag a few at a time. I could see that I lost some animals in this way, but most of them probably clung to the *Corallina* every time there was any danger, and thus would stay with the samples.

Immediately after the samples had been brought to the laboratory, they were fixed in $4^0/_{00}$ formaldehyde, and then stored for examination.

The samples were examined under a microscope with 12x magnification. Each branch was examined separately and the deposits in the jars were examined under higher magnification.

To have a means of quantitative reference between the samples the volume of each sample was measured (after the animals had been sorted out): a graded cylinder was filled with water to a known level, the *Corallina* sample, which had been lying on filter paper for about an hour to drain off excess water, was put into the cylinder and the rise of the water surface noted. The samples usually had to be measured in two or three portions to allow the use of a small cylinder graded for every 0.1 ml. The volumes of the samples ranged from 4 to about 20 ml. The numbers of each species found was multiplied by a factor to bring them up to the equivalent of 20 ml samples.

Species belonging to the groups, Foraminifera, Hydrozoa, Cnidaria, Nematoda, Polychaeta, Ostracoda, Harpacticoida, Halacarida, Chironomida, and Bryozoa, were not counted.

Because of large waves it was impossible to collect intertidal samples at the chosen locality in Fanafjorden on 1 November 1965. The sample that day was taken at a slightly less exposed site, 2A1, some 8 or 10 metres from the site, 2A2, which was chosen originally and was sampled later. The fauna at these two places was quite different in many respects, the most striking difference being the very large numbers of *Skeneopsis planorbis* (FABRICIUS), *Mytilus edulis* L., and *Turtonia minuta* (FABRICIUS) found at 2A2. This emphasises the caution which must be taken in drawing conclusions from an investigation like this.

THE FAUNA

Foraminifera

Foraminifera were found at all stations. They seemed usually to be adhering to the *Corallina* plants and their epiphytes, although some fell off during fixation.

Cnidaria

Hydrozoa were sparse. They were found in small numbers in some samples from 2B and 3B. At the locality near 2A large numbers of hydrozoan stalks were found in the sample from 1 November 1965, but there were no living animals.

A few small Actinia were found in some samples from 1, 2A, 3A, and 3B.

Turbellaria

When watching fresh samples I could see some turbellarians creeping around on the algae. They occurred in samples from all sites.

Nemertini

In fresh samples from locality 1 there were some nemertines, among them *Lineus longissimus* GUNNERUS.

Nematoda

Nematoda were found at all stations. There were somewhat larger quantities at 2A, 3A, and 3B, which were most exposed. This is unexpected, but is difficult to comment on without knowledge of the species involved. Also unexpected was a scarcity of Nematoda at locality 1, because WIESER (1959) showed that Nematoda usually make up a much larger part of the fauna in localities with much sediment than in those with small amounts.

Polychaeta

Serpulids were found at every locality except 3B.

Spirorbis corallinae De Silva & Knight-Jones was by far the most common polychaete in my samples. This species, described in 1962, has not previously been reported from the Norwegian coast, but no work on Spirorbinae from Norway has been published since then. At locality 1 *S. corallinae* was relatively scarce; at 2A it was missing. At 2A2, 2B, and 3A it was more common, in some samples very common. At 3B I found no serpulid in any of the samples. This may have been because it was observed that the much more slender *Corallina* plants at this site were repeatedly laid flat against the rock by wave action and thus would have brought serpulids living on them in contact with the bottom. *Spirorbis* retreats into its tube immediately if anything larger than food particles comes in contact with its tentacles. As 3B is subject to almost constant wave action any hypothetical *Spirorbis* living on *Corallina* there would have had to stay inside its tube all the time, and would have been unable to feed. The time taken by the wave currents at station 3B to shift and lay the *Corallina* plants flat the other way was very short, much shorter than the time *Spirorbis* take to emerge from their tubes after they have been disturbed, as observed with animals in a petri-dish. The very compact structure of *Corallina* at 0 m (2A2 and 3A) prevents the plants from being laid flat, and probably also prevents any movement of the plants and rubbing between them. Furthermore, *S. corallinae* sits mostly on the middle part of the plants, well protected against rubbing which would mostly affect the smaller branches near the top.

S. pagenstecheri Quatrefages was found in all samples from locality 1, but it was always second in number to *S. corallinae*. It was not found elsewhere. According to De Silva & Knight-Jones (1962) *S. pagenstecheri* can be found "very abundantly on *Corallina officinalis* in rock pools in the upper half cf the shore" (loc. cit., p. 607). They also wrote that "of the various species *Spirorbis pagenstecheri* seems most tolerant of turbid estuarine conditions" (loc. cit., p. 605). Although the salinity at locality 1 is never low enough to justify use of the term "estuarine" it can probably be quite low for short periods after heavy rain. Rain also brings turbidity from suspended sediment brought out by streams.

S. granulatus (L.) was found in two samples from 2B. This species is difficult to distinguish from *S. corallinae* without crushing the tube. It is therefore possible that it has escaped my attention in other samples. At 2B one specimen of *S. tridentatus* (Levinsen) was also found. Small numbers of *Pomatoceros triqueter* (L.) and *Hydroides norvegica* (Gunnerus) were found in some samples from 2B.

The group, "Polychaeta non Serpulida", consists of errant polychaetes and some species that probably live in tubes but leave them when formalin is added to the samples. The species included in this group are either very small or represented by very small individuals.

Harpacticoida

Harpacticoida were found in all samples. In the sample from 2B, 16 June 1965, the following 11 species were found: *Zaus aurelii* POPPE, *Tisbe furcata* (BAIRD), *Scutellidium hippolytes* (KRÖYER), *Parathalestris* sp., *Parathalestris harpactoides* (CLAUS), *Dactylopodia vulgaris* (var. *dessimilis* BRIAN), *Parastenhelia spinosa* (FISCHER), *Amphiascus minutus* (CLAUS), *Ameira longipes* BOECK, *Mesochra pygmaea* (CLAUS), and *Laophonte inopinata* T. SCOTT.

Ostracoda

Ostracoda were found at all stations and in almost all samples. The ostracod fauna present in samples from 2A has been reviewed by HAGERMANN (1968).

Isopoda

In an earlier publication (DOMMASNES 1968) I have discussed briefly the occurrence of some of the isopods from these localities in relation to exposure. Here I shall give a list of species and a few comments only.

Three species of *Idotea* were found. They are *I. pelagica* LEACH, *I. baltica* (PALLAS), and *I. granulosa* RATHKE. Their distribution is shown in Table 1. Although no *Idotea* were found in the *Corallina* at locality 1, *I. granulosa* was common among *Ascophyllum* at that locality. The complete absence of *I. granulosa* and *I. pelagica* from the samples from 2B is puzzling. Their presence at 3B shows that they are able to thrive at that depth and the occurrence of *I. pelagica* in the 3A samples shows that this species is also able to live in *Corallina* growing more compactly than that found at 2B. On the other hand, *I. baltica* seems to thrive at 2B. The occurrence of *I. pelagica* and *I. granulosa* at 3B shows that both species tolerate a high degree of exposure.

Ianiropsis breviremis G. O. SARS has been found at all the localities.

Jaera praehirsuta FORSMAN was found at 1, 2A2, and 3A. It therefore seems that this is primarily a littoral species. BOCQUET (1953) showed that the different colour patterns of the *Jaera* species are genetically determined. The colour patterns found in my material agree exactly with the forms BOCQUET named *uniforme* and *bifasciatum*. *Uniforme* was most abundant, and at station 3A *bifasciatum* was not found at all.

Specimens of *J. praehirsuta* from two samples have been measured and their sex determined. The results are shown in histograms in Fig. 4. In March there were few very small specimens, but in July there were many, and four of the large females had eggs. This indicates that breeding had not yet started in March, but was nearly finished in July. It should, however, be noted that the two samples are from different localities, probably with different populations and maybe slightly different breeding times.

A few specimens of *Munna boecki* KRÖYER were found in a sample from locality 1. Larger numbers were found at 2B with a maximum of 52 per 20 ml of algae in the sample from 16 June 1965.

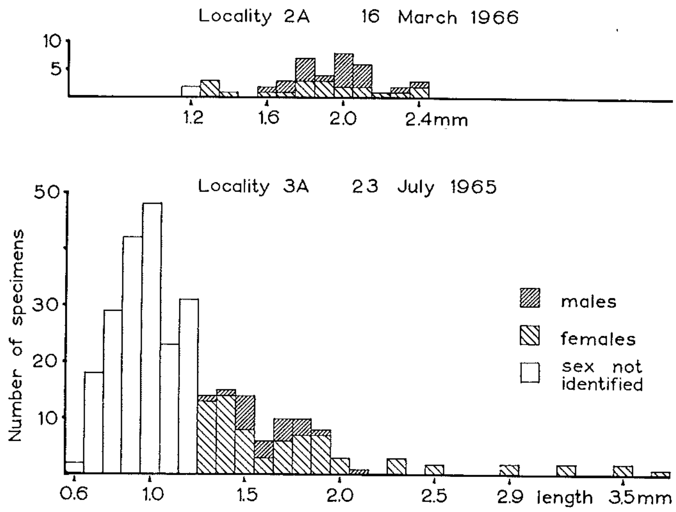

Fig. 4. Size distribution of *Jaera praehirsuta* from two samples. The sex of animals smaller than 1.3 mm could not be identified.

Tanaidacea

The only tanaid found was *Tanais cavolinii* H. MILNE-EDWARDS, which was found in one sample from 2A1 and one from 3A, only a few specimens in the latter sample. A total of 42 specimens was found; only two of these were males.

Amphipoda

The distribution of most of the amphipods in relation to wave exposure has been discussed in a previous paper (DOMMASNES 1968). A list of the species and their occurrence is given in Table 1.

Decapoda

Three species of Anomura were found, but never more than one or two specimens in each sample. *Pagurus bernhardus* (L.) was found at locality 1 on 25 March 1965. *Galathea intermedia* LILLJEBORG was found at 2B on 17 Jan. 1966. *Porcellana longicornis* (L.) was found in three of the samples from 2B.

One specimen of the brachyuran, *Pirimela denticulata* (MONTAGU), was found at 2B on 23 May 1966.

Insecta

A few chironomid larvae were found at 1 and 2A.

Halacarida

Halacarida were found at all stations. The quantities varied much from sample to sample, even at the same locality and in some samples none were found at all. At least two species, very different in size and morphology, were found.

Table 1. List of species (and higher systematic groups, when the species have not been identified). The numbers refer to "20 ml samples".

Locality	1			2A 2A1	2A 2A2	2B							3A		3B		
Date	25 Mar. 65	23 June 65	9 Sept. 65	1 Nov. 65	16 Mar. 66	7 May 65	16 June 65	3 Sept. 65	3 Sept. 65	17 Jan. 66	17 Jan. 66	23 May 66	23 July 65	17 Jan. 66	23 July 65	6 Sept. 65	29 Sept. 65
Foraminifera	×	×	×	×	×	×	×	×	×	×	×	×	×	×	—	×	×
Hydrozoa	—	—	—	×	—	—	—	×	×	—	—	×	—	—	—	—	×
Actinia	—	×	×	×	×	—	—	—	—	—	—	—	×	—	—	×	×
Nematoda	×	×	—	×	×	×	—	×	×	×	×	×	×	×	×	×	×
Spirorbis corallinae	×	×	×	—	×	×	×	×	×	×	×	×	×	×	—	—	—
S. pagenstecheri	×	×	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. granulatus	—	—	—	—	—	×	—	—	×	—	—	—	—	—	—	—	—
S. tridentatus	—	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—
Pomatoceros triqueter	—	—	—	—	—	—	—	×	×	×	×	×	—	—	—	—	—
Hydroides norvegica	—	—	—	—	—	—	—	×	—	—	×	—	—	—	—	—	—
Polychaeta non Serpulida	×	×	×	×	×	×	×	×	×	×	×	—	×	—	—	×	×
Harpacticoida	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Ostracoda	×	×	×	×	×	×	×	×	×	×	×	×	×	—	×	×	×
Idotea pelagica	—	—	—	98	4	—	—	—	—	—	—	—	308	30	82	57	—
I. baltica	—	—	—	—	—	3	—	—	66	—	2	—	—	—	—	—	—
I. granulosa	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	33	60
Janiropsis breviremis	5	67	42	—	19	29	16	—	—	1	—	—	10	5	11	49	—
Jaera praehirsuta	25	—	3	—	39	—	—	—	—	—	—	—	572	67	—	—	—
Munna boecki	—	7	7	—	—	6	52	—	11	1	—	4	—	—	—	—	—
Tanais cavolinii	—	—	—	159	—	—	—	—	—	—	—	—	—	6	—	—	—
Stenothoe monoculoides	95	—	10	229	16	17	—	6	7	—	—	3	18	35	—	53	47
Apherusa bispinosa	15	—	15	—	—	23	—	—	2	4	95	3	—	—	—	—	—
A. jurinei	185	13	147	—	18	9	—	6	—	1	—	3	2	10	36	20	44
Dexamine spinosa	—	—	1	—	—	—	—	—	—	—	5	—	—	—	—	—	—
D. thea	5	—	40	—	—	—	4	3	3	6	—	—	—	—	—	—	—
Gammarellus homari	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
G. angulosus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	2	—
Hyale nilssoni	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—
H. pontica	—	—	—	—	—	—	—	—	—	—	—	—	8	3	14	—	—
Sympleustes glaber	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—
Tryphosa sarsii	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Ampithoe rubricata	—	—	12	—	—	3	36	9	16	—	—	—	—	—	—	—	—
Parajassa pelagica	—	—	—	—	—	—	—	—	—	—	—	—	2	5	—	708	504
Jassa falcata	—	—	1	—	1	39	36	24	7	1	7	7	—	8	11	—	35
Corophium bonelli	—	15	70	—	—	3	20	—	6	3	—	2	—	—	—	—	—
Caprella linearis	—	—	—	—	—	6	36	—	7	—	—	—	—	—	—	—	—

6.

Pagurus bernhardus	2	—	—	—	—	—	—	—									
Galathea intermedia	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Porcellana longicornis	—	—	—	—	—	1	—	—	—	2	2	—	—	—	—	—	—
Pirimela denticulata	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Chironomidae	×	×	×	×	—	—	—	—	—	—	—	—	—	—	—	—	—
Halacarida	—	×	×	×	—	×	×	×	×	×	×	×	×	×	×	×	—
Phoxichilidium femoratum	10	—	—	105	—	—	—	—	—	—	—	1	—	—	—	—	—
Margarites helicinus	—	—	—	—	—	—	—	—	—	—	—	8	8	—	11	—	20
Gibbula sp.	—	—	—	—	—	—	12	3	5	—	—	—	—	—	—	—	—
Lacuna vincta	—	—	—	—	—	—	—	3	2	—	—	—	6	—	18	27	16
Littorina saxatilis	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—
L. obtusata	—	—	—	4	2	—	—	—	—	—	—	—	—	—	—	—	—
Cingula semicostata	—	—	—	—	1	—	—	—	2	—	—	—	—	—	—	—	—
Alvania punctura	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—
Rissoa inconspicua	—	—	—	12	1	—	—	—	—	—	91	4	—	—	—	—	—
R. parva	—	—	1	4	3	—	—	15	25	1	27	13	4	—	—	—	—
Skeneopsis planorbis	20	—	—	3600	7	—	—	—	—	—	2	—	4	224	—	—	—
Omalogyra atomus	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—
Ammonicera rota	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Risoella opalina	—	—	—	—	—	—	—	—	9	—	—	—	—	—	—	—	—
Nucella lapillus	—	—	—	8	1	—	—	—	—	—	—	—	1	—	—	2	—
Chrysallida spiralis	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—
Odostomia eulimoides	—	—	—	—	—	—	4	—	—	1	—	2	—	—	—	—	—
O. scalaris	—	—	—	8	—	—	4	—	—	—	7	—	—	—	—	—	—
O. turrita	—	—	—	—	—	11	—	—	—	—	18	3	—	—	—	—	—
Limapontia capitata	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—
Doto coronata	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
Anomia sp.	—	—	—	—	—	—	—	—	—	7	—	2	—	—	—	—	—
Mytilus edulis	—	—	—	416	—	—	—	—	—	—	—	—	—	—	—	—	—
Modiolus modiolus	10	7	20	—	11	—	—	9	5	—	2	3	6	35	4	83	55
Musculus discors	10	22	4	8	52	6	—	—	11	1	114	37	22	43	—	—	—
Hiatella sp.	—	7	2	12	5	3	—	3	20	10	4	2	2	8	—	—	—
Lasaea rubra	—	—	—	—	—	—	—	—	—	—	—	—	—	40	—	—	—
Turtonia minuta	5	—	—	1470	3	—	—	—	—	2	2	—	14	61	—	—	—
Crisiidae	—	—	—	—	—	—	×	×	×	—	×	×	—	—	—	—	—
Hornera violacea	—	—	—	—	—	×	—	×	×	×	×	×	—	—	—	—	—
Electra pilosa	—	—	—	—	—	—	×	×	×	—	×	×	—	—	×	—	×
Scrupocellaria reptans	—	—	—	—	—	×	×	—	×	—	×	—	×	×	—	—	—
Hippothoa hyalina	—	—	—	—	×	×	×	×	×	×	×	×	×	×	×	×	×
Pedicellaster typicus	—	—	1	—	—	—	—	—	—	4	—	—	—	—	—	—	—
Asterias rubens	—	—	—	—	—	3	4	—	—	2	—	—	—	—	—	—	—
Leptasterias mülleri	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Amphipholis squamata	—	—	—	—	—	6	—	3	—	8	7	—	—	—	—	—	—
Ascidia sp.	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Pycnogonida

Phoxichilidium femoratum (RATHKE) occurred in large numbers only in the sample from 2A1. The *Corallina* in this sample was bound up by a net of hydroid stalks, but I found no living hydroids. They had probably been eaten by the pycnogonids.

Gastropoda

18 species of prosobranchs were found, most of them in small numbers only.

Margarites helicinus (FABRICIUS) was found at 2B once only and at 3A and 3B. A few juvenile specimens of *Gibbula* sp. were found at 2B in the samples from June and September.

Some specimens of *Lacuna vincta* (MONTAGU) were found at 2B, 3A, and 3B. It was found in all samples from 3B, the numbers ranging from 16 to 27 per 20 ml, indicating that *L. vincta* occurs regularly among *Corallina* at this site. *Littorina saxatilis* (OLIVI) and *L. obtusata* (L.) were found in small numbers at 2A.

Cingula semicostata (MONTAGU) was found at 2A2 and 2B. Two specimens of *Alvania punctura* (MONTAGU) were found at 2B. Two species of *Rissoa* were found. *R. inconspicua* ALDER was found at 2A and 2B. In a sample taken on 17 Jan. 1966 at 2B there were more than 90 specimens per 20 ml of algae. *R. parva* (DA COSTA) was found at all localities except 3B. At locality 1 only one specimen was found. At 2A there were a few specimens in each of the two samples, but at 2B *R. parva* was found in five of the seven samples with a maximum of 27 per 20 ml of algae in on sample.

Skeneopsis planorbis (FABRICIUS) was found at all localities except 3B. The species seems to be able to survive in very exposed habitats, at least with the protection afforded by *Corallina*. It may be absent from 3B because the *Corallina* there does not form such a compact growth and thus gives less protection against water movement. Two specimens of *Omalogyra atomus* (PHILIPPI) were found at 2B, and one specimen of *Ammonicera rota* (FORBES & HANLEY) at locality 1. Some specimens, probably of *Rissoella opalina* (JEFFREYS), were found in one sample from 2B.

Juvenile specimens of *Nucella lapillus* (L.) were found in small numbers at 2A, 3A, and 3B.

A few species of opisthobranchs were found. Most belonged to the family Pyramidellidae, known to be "ectoparasites" on molluscs and polychaetes with calcareous shells or tubes. No species occurred in all of the samples from one site, and no opisthobranch was found in large numbers. The pyramidellids found were: *Chrysallida spiralis* (MONTAGU), *Odostomia eulimoides* HANLEY, and *Odostomia turrita* HANLEY at 2B, and *Odostomia scalaris* MACGILLIVRAY at 2A1 and 2B. *O. turrita* occurred in relatively large numbers, 18 per 20 ml of algae in one sample taken on 17 Jan. 1966.

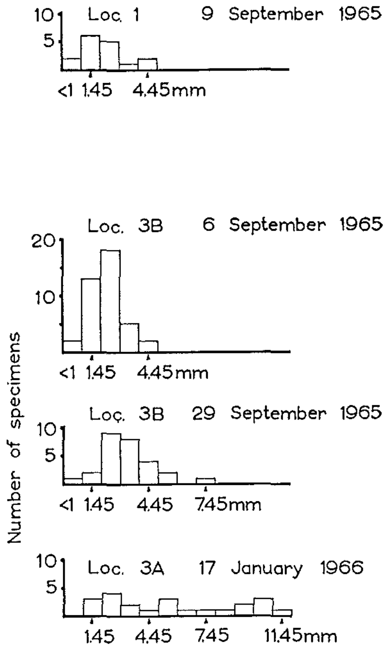

Fig. 5. Size distribution of *Modiolus modiolus* from four samples. The mean value for each column is given, for example, in the column marked 4.45 mm all sizes from 4.0 mm to 4.9 mm (mean value 4.45 mm) are included.

A few specimens of the saccoglossan, *Limapontia capitata* (Müller), were found at 2A1.

A nudibranch, probably *Doto coronata* (Gmelin), was found in one sample from 3B. This species is almost unrecognizable after fixation, and it may well have escaped my notice in other samples.

Bivalvia

The bivalves, because of the size of some of them, made up a considerable part of the biomass, even in samples where they did not occur in large numbers.

A few very small specimens of *Anomia* sp. were found on *Corallina* from 2B.

Small *Mytilus edulis* L. were found in large numbers at 2A1. They ranged in size from less than 1 to 17 mm. Most of them were 1—3 mm.

Modiolus modiolus L. was found in most of the samples and at all stations except 2A1, but it was less common at 2B than elsewhere. It was the only bivalve in *Corallina* at 3B. It ranged in size from less than 1 to 11 mm. In the samples where *M. modiolus* was most common, all the specimens were measured; the results are shown in Fig. 5. The histograms from locality 3 show an increase in size from September to January, but most interesting is the absence of larger individuals in the September sample. This indicates that the largest animals must have migrated to other habitats between January and September. That is also natural, because *M. modiolus* usually grows to about 100 mm. At locality 1, where *Corallina* was growing on stones, they only had to go down between the stones where many large *M. modiolus* already lived. At the other localities they had to migrate much farther, and perhaps few were successful.

Musculus discors L. was common everywhere except at 3B. This is a much smaller species than *M. modiolus*. According to TEBBLE (1966) its maximum size is 12.7 mm. Many of the animals I found were almost that size and thus were probably mature. *M. discors* seems therefore to be able to stay among *Corallina* for the entire life-span after the pelagic larval stages.

Hiatella sp. was also found at all sites except 3B, but never in large numbers. The specimens found were always small, never more than 10 mm, and were attached by their byssus in between the lower parts of the *Corallina* plants.

Lasaea rubra (MONTAGU) was found at 3A on 17 Jan. 1966, but in no other sample. In the British Isles it is found on rocky shores (TEBBLE 1966).

Turtonia minuta (FABRICIUS) was found everywhere except 3B. At 1, 2A2 and 2B only a few specimens were found, but at 2A1 there were 1,470 specimens per 20 ml of algae. At 3A the species was also common.

All the bivalves found were attached to the substrate with byssus threads and, except for *Anomia*, were well able to move around if conditions became unsuitable. When kept in an aquarium, *Modiolus* and *Musculus* tended to congregate on the branches of *Corallina* projecting farthest upward from the bottom.

Bryozoa

At 2B at least one species of the family Crisiidae was found, but it was not common in any of the samples. No Crisiidae were found at other stations.

Hornera violacea M. SARS was also found at 2B only. It was slightly more common than the Crisiidae, although it never occurred in large quantities.

A few colonies of *Electra pilosa* (L.) were found at 2B and 3B. *Scrupocellaria reptans* (L.) was found, very sparsely, at 2B and 3A.

Hippothoa hyalina (L.) was found regularly at all sites except locality 1. It was found at 2A2 in relatively large quantities and in all samples from 2B in more variable quantities. *H. hyalina* was also quite numerous at 3A and was abundant in two of the three samples from 3B. The colonies of *H. hyalina* had exactly the same red colour as the *Corallina* plants they were growing on, although they are usually considered to be white (MARCUS 1940; MATURO 1959).

The reason for the complete absence of bryozoans from the samples taken at locality 1 may be the relatively large amount of sediment on the bottom. This probably prevents settling of the larvae or kills them by clogging soon after. MATURO (1959) considers silting a major factor in preventing the establishment of bryozoans.

Echinodermata

One or two starfish were found in a few samples. *Pedicellaster typicus* M. SARS was found once at localities 1 and 2B. The specimens were very small. *Asterias* *rubens* (L.) (R approximately 5 mm) was found in three samples from 2B. *Leptasterias mülleri* M. SARS (R = 1 mm) was found once at 2B.

The brittle-star, *Amphipholis squamata* (DELLE CHIAJE), was found in several samples. All specimens were small (R$\leq$6 mm). Some of them were found inside tubes of dead *Hydroides norvegica.*

Ascidiacea

An *Ascidia* sp. was obtained once from locality 1 only.

THE SIZE OF THE ANIMALS

The most significant factor in determining the *Corallina* fauna is probably the space available between the branches. The compact way in which *Corallina* usually grows means there is little interstitial space where animals can move, and thus limits the maximum size of the animals that can live there. One therefore should expect that the fauna of *Corallina* is characterized, inter alia, by smaller forms than the fauna of the surrounding algae and rocks. Thus no large or medium-sized Anomura or Brachyura were found. Among the surrounding algae and stones one could find larger specimens of both groups and quite large pagurids were sometimes seen walking on top of the *Corallina* growths. No large nudibranchs were found, although they were not uncommon on the larger algae growing nearby.

Though some of the recorded species can grow quite large, only small specimens occurred among the *Corallina.* One such example is *Modiolus modiolus*, large specimens of which occurred between the stones at locality 1, while only small specimens were found in the *Corallina* growing on these stones. Small specimens of *M. modiolus* were all that were found elsewhere as well (see discussion on *M. modiolus* p. 13). Another example is *Nucella lapillus* which was represented by juvenile specimens only, although large specimens were common at a distance of only half a metre. The starfish, too, were all very small.

SUMMARY

This work gives an account of the fauna of *Corallina officinalis* at three localities south of Bergen, one very sheltered, one semi-exposed, and one very exposed. A list of species is given.

The fauna of *C. officinalis* is characterized by the smallness of the animals as compared with the fauna of the surrounding larger algae and rocks.

Modiolus modiolus, which settle on *C. officinalis* as larvae, migrate to other habitats before they are one year old.

In the most sheltered locality lack of wave exposure results in an accumulation of sediment which prevents the settling of bryozoans.

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