

THE FAUNA ASSOCIATED WITH OUTER SHELF AND UPPER SLOPE SPONGES (PORIFERA, DEMOSPONGIAE) AT THE FAROE ISLANDS, NORTHEASTERN ATLANTIC

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Eleven sublittoral sponges, *Geodia barretti*, *G. macandrewii*, *Geodia* sp., *Isops phlegraei*, *Stryphnus ponderosus*, *Thenea levis*, *T. valdiviae*, *Phakellia robusta*, *P. rugosa*, *P. ventilabrum* and *Tragosia infundibuliformis*, all of which are widely distributed in the North Atlantic, were examined for associated fauna. At least 242 epi- and infauna species were found, of which 115 are reported as sponge associates for the first time in the North Atlantic. Sixty species, 19 genera and 1 family are recorded for the first time from the Faroes. Two hundred and twenty-five taxa were found as epifauna on the sponges, three taxa occurred as infauna and 14 taxa both as epi- and infauna.

The morphology of the sponges influences the occurrence and composition of the represented fauna. Thus, the largest number of taxa were present on sponges having a spicule 'fur'. A number of species showed preference for the oscular cavities of *S. ponderosus* and the incurved furrow of *T. levis* and *T. valdiviae*. Only one sponge predator, *Hanleya nagelfar*, was found. The majority of the associated fauna uses the sponges as a substratum. Three categories of direct effect of interactions between the sponges and the associated fauna are proposed. The results of the present investigation show that demosponges constitute a substratum for a large number of benthic taxa on the outer shelf and upper slope in the northeastern Atlantic, and that the scarcity of earlier reports is a result of insufficient investigation. It is suggested that the fauna associated with sponges in temperate to cold waters is facultative, representing the fauna of the local geographical area. This is in contrast to the large number of apparently obligate associates of Porifera in warm tropical waters.

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INTRODUCTION

Demosponges have been shown to be inhabited by a wide diversity of invertebrates. The relevant literature has been reviewed for a number of faunal groups by ARNDT (1933), ARNDT & PAX (1936), ARNDT & VIETS (1939) and LAUCKNER (1980). PEARSE (1932) referred to demosponges as 'veritable living hotels', and according to BACESCU (1971) sponges constitute, next to tropical coral reefs, one of the richest and most interesting biotopes.

When reviewing the literature concerning fauna associated with demosponges in the North Atlantic (approximately north of 20° N) some general characteristics appear. The majority of the investigations originate from shallow water in warmer areas such as the Mediterranean (SANTUCCI 1922; TUZET & PARIS 1964; VIDAL 1967; PANSINI 1970; RÜTZLER 1976; KOUKOURAS & al. 1985, 1992; VOULTSIADOU-KOUKOURA & al. 1987), the Caribbean (WESTINGA & HOETJES 1981; VILLAMIZAR & LAUGHLIN 1991) and the Gulf of Mexico (PEARSE 1932).

The investigations have often focused on the association between a single faunal group or species and sponges (ALLMAN 1874; FAGE 1928; REES 1939; BOUILLON 1965, 1971; STOCK 1967a, b, c; BACESCU 1968, 1980; RÜTZLER 1968; CALDER 1970; DAUER 1973; HEARD & PERLMUTTER 1977; BRATTEGARD 1980; BIERNBAUM 1981; RISER 1982; UEBELACKER 1982; PAWLK 1983; ZULLO & STANDING 1983; OSHEL & STEELE 1985; DOUNAS & KOUKOURAS 1986; ERDMAN & BLAKE 1987; WILLIAMS 1987; SCOTT & al. 1988; LUGLI & PALAZZI 1991; DUFFY 1992; URIZ & al. 1992). Only a small number of reports exist from the eastern Atlantic boreal region (FRITH 1976, 1977; FORESTER 1979; PEATTIE & HOARE 1981; BONGERS 1983; COSTELLO & MYERS 1987), and even fewer on associations at greater depths (> 100 m) (VADER 1984a, b; CEDHAGEN 1994). In addition, some scattered information exists in the form of comments in connection with descriptions of species in expedition reports (LUNDBECK 1902, 1905, 1910). This scarcity of literature suggests either that associations involving sublittoral demosponges are rare in the North Atlantic, or insufficient investigations.

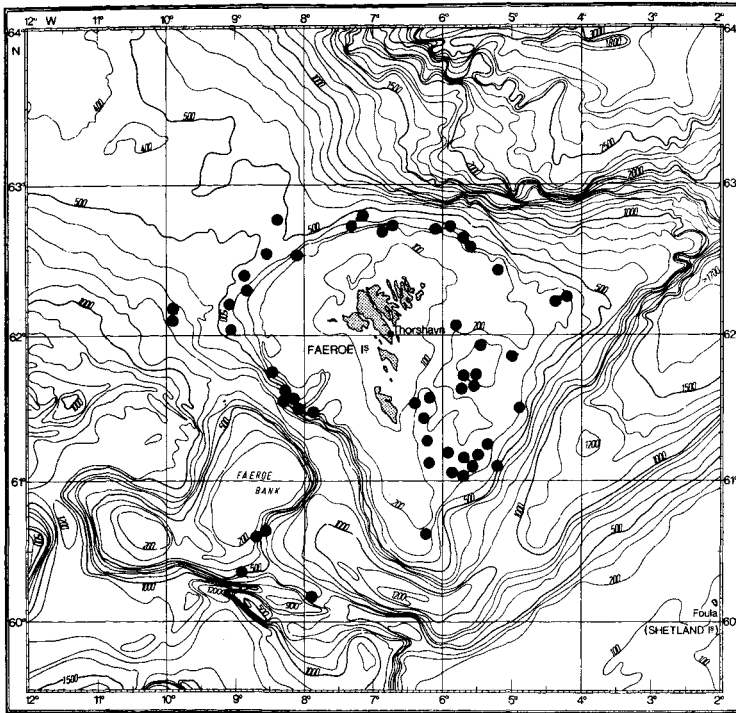


Fig. 1. BIOFAR stations (filled circles) at which sponges examined for associated fauna were collected. Stations placed very close to each other are only indicated with one mark.

The aims of the present investigation are to examine the existence of associations with demosponges on the outer shelf and upper slope in the northeastern Atlantic, and to examine the importance of sponge morphology for the composition of a possible associated fauna.

However, because of the uncertainties that inevitably are connected with qualitative sampling methods, as well as the limited knowledge of the biology of the single species, the existence of a closer association between

the represented fauna and the sponges can only rarely be demonstrated.

Thus, if not otherwise specified the term 'associate' as used in this paper exclusively refers to any species which was found on or in the sponges. Two species, *Gnathia abyssorum* (Isopoda) and *Hanleya nagelfar* (Polyplacophora), have previously been reported associated with sponges at the Faroe Islands (KLITGAARD 1991; WARÉN & KLITGAARD 1991).

Table 1. Systematic position of the 11 examined sponge species, and the number of specimens of each species examined for in- and epifauna in the laboratory and for associated macrofauna in the field. For list of BIOFAR stations at which specimens of each species were collected, see Appendix 2.

Order	Family	Species	Number of specimens	
			Laboratory	Field
Choristida	Geodiidae	<i>Geodia barretti</i> BOWERBANK, 1858	28	123-133
-	-	<i>G. macandrewii</i> BOWERBANK, 1858	27	15
-	-	<i>Geodia</i> sp.	32	68
-	-	<i>Isops phlegraei</i> SOLLAS, 1880	31	73
-	Stellettidae	<i>Stryphnus ponderosus</i> (BOWERBANK, 1866)	50	> 483
-	Theneidae	<i>Thenea levis</i> LENDENFELD, 1906	36	-
-	-	<i>T. valdiviae</i> LENDENFELD, 1906	44	-
Axinellida	Axinellidae	<i>Phakellia robusta</i> BOWERBANK, 1866	59	-
-	-	<i>P. rugosa</i> (BOWERBANK, 1866)	25	-
-	-	<i>P. ventilabrum</i> (JOHNSTON, 1842)	37	-
-	-	<i>Tragosia infundibuliformis</i> (FLEMING, 1866)	42	-

MATERIAL AND METHODS

The sponges

Eleven species, all widely distributed in the North Atlantic, were examined. They belong to the Demospongiae and represent two orders and four families (Table 1). The species were selected according to the following main criteria:

1. Common at the Faroe Islands. 2. Achieve a large size. 3. Of different morphologies.

The choristid species are characterized by a dominant mineral skeleton of silica spicules giving these sponges a very solid texture, while the axinellid species have a compound spicule and fibre skeleton resulting in a more elastic texture.

Following the family classification (BERGQUIST 1978) the eleven species can be divided into four morphological groups:

Geodiidae. Large, massive sponges (up to 72 cm in maximum dimension), characterized by a cortex of globular microscleres (sterrasters). A 'fur' of vertically oriented spicules can be found on the surface of *Geodia macandrewii* and *Isophs phlegraei*. *G. barretti* has the osculae assembled in depressions covered with a sieve, the number and depth of which vary.

Stellettidae. Large, massive sponges (maximum dimension of *Stryphnus ponderosus* 45 cm), always covered by a 3-5 mm thick 'fur' of spicules. The osculae are assembled in one or more of up to 20 cm deep cavities.

Theneidae. Smaller sponges (maximum dimension 16 cm), always covered by a thick 'fur' of spicules. *Thenea levis* is elongate with the in- and excurrent furrows on the opposite long sides. *T. valdiviae* is sphere-shaped or lump-formed with an equatorial incurrent furrow, and one or more osculae on top of the body.

Axinellidae. Foliateous or funnel-shaped (*Phakellia robusta*, *P. ventilabrum* and *Tragosia infundibuliformis*) or ramified sponges (*P. rugosa*), (maximum height 23 cm). A specimen of *P. robusta* and *P. ventilabrum* consists of one or more 'fans', and the occurrence of folds or other irregularities on the fan vary. The number of branches of *P. rugosa* also vary.

Field sampling

Material was collected during BIOFAR cruises in May/June (1988, '89), July (1987, '88, '89), September/October (1989, '90) and November (1988, '89). Sponges were selected from 73 stations at depths between 157 and 780 m, located around the Faroes (Fig. 1). Samples were collected with triangular dredge (43 stns), shell-dredge (8 stns), detritus sledge (9 stns), Alfredo trawl (11 stns) and Rothlisberg & Percy epibenthic sledge (2 stns).

All sponges were sorted as soon as the sample came onboard. Selected specimens were, depending on their size, either packed separately or together with other specimens of the same species, and fixed in 4% borax-buffered formaldehyde. At stations where the number of specimens of *Stryphnus ponderosus* and representatives of the Geodiidae was very large (more than c. 20 specimens), the major part of the sponges was examined onboard and a representative selection of the associated macrofauna was kept.

Laboratory procedure

The sponges were rinsed in freshwater in an overflow vessel with the outflow water sieved through a 0.5 mm mesh, and transferred to 80% ethanol.

The examination of the sponges for epifauna included cutting open the oscular cavities of *Stryphnus ponderosus* and examining the in- and excurrent furrows and osculae of *Thenea levis* and *T. valdiviae*. Depending on the morphology of the sponges, they were subsequently either cut into 1 cm³ pieces or examined directly under a stereomicroscope for in- and smaller epifauna. Specimens of *T. levis* and *T. valdiviae* were always examined whole. Depending on the size of the other species, either the whole specimen or half of it (if very large, only 1/3 or 1/4), was examined. To make sure that all faunal elements were removed from the thick 'fur' of spicules on *S. ponderosus*, *T. levis* and *T. valdiviae* and some *Geodia macandrewii*, the dissected pieces of these species were sieved in, respectively, a 4 mm and a 0.5 mm sieve, and the 0.5 mm fraction was examined under a stereomicroscope. Additional fauna was searched for in the alcohol that the sponges had been stored in after sieving through a 0.5 mm sieve.

The associated fauna was classified as epi- or infauna, depending on whether the fauna was found on the surface of the sponges, including in the spicule 'fur', or inside the canals or the tissues. The term epifauna comprises here both errant and sessile species.

The fauna found was as far as possible identified to species level. Sometimes this was not possible owing to the lack of specialists or because the material was too damaged. Thus, the term taxon as used in this paper may refer to different levels of identification (species, genus, family etc.).

Underwater photographs

Eleven hundred underwater photographs were taken during a BIOFAR cruise in May 1990 at depths between 60 and 1050 m (J. Gutt, Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven). A number of these photographs have been used in this investigation to supply extra information about the presence of motile fauna on the sponges.

RESULTS

The sponges

A total of 411 sponge specimens were examined in the laboratory for in- and epifauna and, additionally, more than 760 specimens were examined for associated macrofauna in the field (Table 1).

Six of the 11 species (*G. barretti*, *Geodia* sp., *I. phlegraei*, *S. ponderosus*, *P. robusta* and *T. infundibuliformis*) are new to the Faroese area.

The associated fauna

At least 242 species were found associated with the 11 sponge species (Table 2). One hundred and fifteen species are for the first time reported associated with sponges in the North Atlantic. No less than 60 species, 19 genera and 1 family (Polycitoridae) are new records for the Faroe Islands area (Appendix 1).

Table 2. Numbers of taxa of each major group associated with each of the 11 examined sponge species. The total number of associated taxa of each group found in all 11 sponge species is shown (Total) as well as the percentage of this number of the total number of associated taxa (242) found (%). The bottom row gives the total number of taxa associated with each of the sponge species. The indicated numbers include all taxa found associated with the sponges examined in the laboratory as well as in the field. *G.b.* = *Geodia barretti*, *G.m.* = *G. macandrewii*, *G.sp.* = *Geodia* sp., *I.p.* = *Isops phlegraei*, *S.p.* = *Stryphnus ponderosus*, *T.l.* = *Thenea levis*, *T.v.* = *T. valdiviae*, *P.ro.* = *Phakellia robusta*, *P.ru.* = *P. rugosa*, *P.v.* = *P. ventilabrum*, *T.i.* = *Tragosia infundibuliformis*.

	<i>G.b.</i>	<i>G.m.</i>	<i>G.sp.</i>	<i>I.p.</i>	<i>S.p.</i>	<i>T.l.</i>	<i>T.v.</i>	<i>P.ro.</i>	<i>P.ru.</i>	<i>P.v.</i>	<i>T.i.</i>	Total	%
Protozoa	2	5	2	10	-	-	-	-	-	-	-	12	5.0
Porifera	-	1	1	1	2	1	1	1	1	1	1	2	0.8
Hydrozoa	1	2	6	8	3	1	1	3	3	3	3	14	5.8
Anthozoa	2	-	-	1	2	-	-	-	-	-	-	3	1.2
Nemertea	-	1	-	-	1	1	-	-	-	-	-	1	0.4
Nematoda	-	9	-	2	15	15	12	1	3	3	-	27	11.2
Polychaeta	3	21	6	9	35	38	41	9	4	1	5	63	26.0
Oligochaeta	-	1	-	-	1	3	1	-	1	-	-	3	1.2
Polyplacophora	-	1	1	1	1	1	-	-	-	-	-	1	0.4
Gastropoda	-	-	-	-	1	-	-	-	-	-	-	1	0.4
Bivalvia	-	6	3	3	3	6	3	3	1	-	-	10	4.1
Arachnida	-	-	-	-	1	-	-	-	-	-	-	1	0.4
Pycnogonida	-	-	-	-	2	2	3	1	1	-	-	7	2.9
Cirripedia	-	-	1	1	1	-	-	-	-	1	-	2	0.8
Tanaidacea	-	1	-	-	-	1	1	1	-	-	-	1	0.4
Isopoda	-	2	-	-	4	2	1	3	-	-	2	7	2.9
Amphipoda	-	3	-	-	6	4	2	-	3	1	-	16	6.6
Decapoda	-	-	-	-	2	-	-	2	-	-	-	4	1.7
Sipuncula	-	1	-	2	3	4	3	-	-	-	-	5	2.1
Bryozoa	-	3	3	11	19	15	13	13	5	7	2	31	12.8
Brachiopoda	-	1	-	1	1	1	1	1	-	-	-	2	0.8
Ophiuroidea	2	2	2	2	13	5	3	4	6	4	2	17	7.0
Pterobranchia	-	-	-	-	-	1	1	-	-	-	-	1	0.4
Ascidiacea	-	2	-	2	6	7	3	-	-	1	-	11	4.5
Total number	10	62	25	54	122	108	90	42	28	22	15	242	

The 242 species represent 14 phyla. The dominating groups are Polychaeta, Bryozoa and Nematoda with respectively 26, 12.8 and 11.2 % of the total number of taxa (Table 2).

The distribution of the associated fauna on the sponges
Ophiopholis aculeata (Ophiuroidea) was present on 10 of the sponge species, 115 taxa were associated with only one sponge species, and the remaining taxa with 2-9 sponge species (Appendix 1). The total number of associated taxa vary between the sponge species (Table 2). Comparison of Tables 2 and 3 shows that the dominating faunal groups of each sponge species, in number of taxa, are also the most frequently found on a wider range of sponge species. It is also evident that groups that are represented only by few taxa in Table 2, either because the groups have not been further identified, or because only few taxa were found, can be very frequently represented on the sponge species. As an example Porifera were frequently present on *I. phlegraei*, *S. ponderosus*, *T. levis* and *T. valdiviae*, and Hydrozoa were frequently found on the three last mentioned sponge species.

Table 4 shows that associated fauna was found on almost all specimens of *I. phlegraei*, *S. ponderosus*, *T. levis*, *T. valdiviae* and *P. robusta* and on 50-75 % of the specimens of the remaining sponge species, except for *G. barretti*. The number of taxa per sponge specimen was fairly even, except for *G. macandrewii*, *P. robusta* and *P. rugosa*, where a large number of associated taxa were present on a few specimens. Most specimens had none or only few associated taxa (Table 4).

The average number of associated taxa per sponge specimen was largest for *T. levis*, *T. valdiviae* and *S. ponderosus* in that order. The remaining sponge species all had low average numbers, about four or fewer taxa per specimen (Table 4). The discrepancy between the percentage occurrence of associated fauna and the average number of taxa present per sponge specimen is most pronounced in *P. robusta* and *T. infundibuliformis*. Only about 2-3 taxa and 1 taxon respectively were on average associated with a single sponge specimen, while associated fauna was found on more than three quarters of the examined specimens of both sponge species (Table 4).

Table 3. Percentage occurrence of the fauna groups of each of the 11 sponge species. As only a representative selection of the associated macrofauna was preserved in the field on stations where the number of sponges was very large, the percentages are calculated on basis of the fauna present on sponges examined in detail in the laboratory. *G.b.* = *Geodia barretti*, *G.m.* = *G. macandrewii*, *G.sp.* = *Geodia* sp., *l.p.* = *Isops phlegraei*, *S.p.* = *Stryphnus ponderosus*, *T.l.* = *Thenea levis*, *T.v.* = *T. valdiviae*, *P.ro.* = *Phakellia robusta*, *P.ru.* = *P. rugosa*, *P.v.* = *P. ventilabrum*, *T.i.* = *Tragosia infundibuliformis*.

	<i>G.b.</i>	<i>G.m.</i>	<i>G.sp.</i>	<i>l.p.</i>	<i>S.p.</i>	<i>T.l.</i>	<i>T.v.</i>	<i>P.ro.</i>	<i>P.ru.</i>	<i>P.v.</i>	<i>T.i.</i>
Protozoa	14.3	14.8	18.8	54.8	-	-	-	-	-	-	-
Porifera	-	11.1	6.3	58.1	50.0	44.4	31.8	6.8	4.0	2.7	9.5
Hydrozoa	-	11.1	25.0	41.9	84.0	72.2	50.0	33.9	36.0	27.0	38.1
Anthozoa	-	-	-	3.2	8.0	-	-	-	-	-	-
Nemertea	-	3.7	-	-	2.0	2.8	-	-	-	-	-
Nematoda	-	33.3	-	25.8	66.0	91.7	88.6	1.7	4.0	5.4	-
Polychaeta	10.7	37.0	12.5	38.7	74.0	88.9	90.9	91.5	16.0	2.7	11.9
Oligochaeta	-	3.7	-	-	2.0	19.4	6.8	-	4.0	-	-
Polyplacophora	-	11.1	12.5	6.5	10.0	2.8	-	-	-	-	-
Gastropoda	-	-	-	-	4.0	-	-	-	-	-	-
Bivalvia	-	22.2	6.3	12.9	10.0	47.2	40.9	1.7	4.0	-	-
Arachnida	-	-	-	-	2.0	-	-	-	-	-	-
Pycnogonida	-	-	-	-	4.0	8.3	9.1	3.4	4.0	-	-
Cirripedia	-	-	-	3.2	-	-	-	-	-	2.7	-
Tanaidacea	-	3.7	-	-	-	5.6	4.5	1.7	-	-	-
Isopoda	-	3.7	-	-	62.0	11.1	6.8	10.2	-	-	52.4
Amphipoda	-	7.4	-	-	10.0	8.3	4.5	-	16.0	2.7	-
Decapoda	-	-	-	-	-	-	-	3.4	-	-	-
Sipuncula	-	18.5	-	12.9	12.0	58.3	50.0	-	-	-	-
Bryozoa	-	18.5	9.4	38.7	56.0	83.3	56.8	30.5	16.0	21.6	7.1
Brachiopoda	-	3.7	-	6.5	-	2.8	4.5	3.4	-	-	-
Ophiuroidea	3.6	11.1	6.3	6.5	24.0	47.2	59.1	11.9	36.0	18.9	4.8
Pterobranchia	-	-	-	-	-	22.2	6.8	-	-	-	-
Ascidiacea	-	3.7	-	6.5	12.0	22.2	6.8	-	-	2.7	-

Comments on single groups, including earlier records

Protozoa. Foraminiferans, especially species with calcareous shell attached to the cortex of the sponge, constitute a characteristic epifaunal group of the Geodiidae. *Cibicides refulgens* and *Hyrrokin sarcophaga* were the most frequently found protozoans on all four geodiids.

Hyrrokin sarcophaga is a parasite of *Isops phlegraei* and *Dragmastra normani* (SOLLAS, 1880) (Stellettidae) along Scandinavian coasts (CEDHAGEN 1994). Brown deposits as described by CEDHAGEN (1994) were also observed in this investigation surrounding *Hyrrokin sarcophaga* on all the Geodiidae. *H. sarcophaga* has recently been found living on the scleractinian coral *Lophelia pertusa* at the Faroe Islands (JENSEN & FREDRIKSEN 1992).

Porifera. Sponges of different growth forms were often found on the surface of the examined sponge species, especially on the Choristida, with encrusting forms dominating. Very characteristic is *Aplysilla sulphurea* which has a conspicuous sulphur yellow pigmentation and often was found covering most of the surface of *S. ponderosus*. *A. sulphurea* has previously been recorded

growing on three species of Demospongiae in the Adriatic Sea (RÜTZLER 1970).

Hydrozoa. The hydrozoans associated with Geodiidae and the athecate hydrozoans associated with Axinellidae were identified as far as possible. *Sertularella gayi* and *Lafoea gracillima* were the most commonly found hydrozoans on the geodiids (Appendix 1). *S. gayi* is, on account of its size of up to 25 cm (KRAMP 1935) and its frequent presence, a characteristic and conspicuous element of the epifauna of the geodiids as well as of *Stryphnus ponderosus*.

The athecate hydrozoans associated with the axinellids all belong to the Tubulariidae. They all had the hydrorhiza embedded in the tissues of the sponges and the hydrocaulus extending in the surrounding water. They were so numerous on some axinellids that the sponge looked like a 'hedgehog'. The number of endodermal ridges in the hydrocaulus (c. 14 distally), indicates that some specimens might be *Hybocodon prolifer*, previously recorded growing in sponges at Reykjavik, Iceland and at Plymouth, England (RUSSELL 1953; PETERSEN 1990).

Table 4. Number of taxa per sponge specimen of the 11 sponge species examined of in- and epifauna in the laboratory. The three bottom rows indicate respectively: The number of sponge specimens examined in the laboratory with associated fauna (Number with fauna), the percentage occurrence of sponge specimens with associated fauna of the total number of specimens of each sponge species examined in the laboratory (%), and the average number of associated taxa per sponge specimen (x*). *G.b.* = *Geodia barretti*, *G.m.* = *G. macandrewii*, *G.sp.* = *Geodia sp.*, *I.p.* = *Isophs phlegraei*, *S.p.* = *Stryphnus ponderosus*, *T.l.* = *Thenea levis*, *T.v.* = *T. valdiviae*, *P.ro.* = *Phakellia robusta*, *P.ru.* = *P. rugosa*, *P.v.* = *P. ventilabrum*, *T.i.* = *Tragosia infundibuliformis*.

Number of taxa	Number of sponge specimens										
	<i>G.b.</i>	<i>G.m.</i>	<i>G.sp.</i>	<i>I.p.</i>	<i>S.p.</i>	<i>T.l.</i>	<i>T.v.</i>	<i>P.ro.</i>	<i>P.ru.</i>	<i>P.v.</i>	<i>T.i.</i>
0	20	12	14	4	-	1	1	3	7	16	9
1	8	3	7	3	4	-	1	29	11	12	17
2	-	3	8	5	2	1	-	8	2	4	10
3	-	1	-	1	2	3	7	4	2	3	5
4	-	-	1	2	7	1	3	7	-	1	1
5	-	3	1	6	5	4	1	2	2	-	-
6	-	1	-	3	4	2	2	3	-	-	-
7	-	-	1	3	6	1	1	1	-	1	-
8	-	-	-	1	3	-	2	1	-	-	-
9	-	-	-	1	3	2	2	-	-	-	-
10	-	1	-	-	2	-	4	-	1	-	-
11	-	-	-	1	-	-	4	-	-	-	-
12	-	-	-	-	1	3	1	-	-	-	-
13	-	-	-	-	1	2	3	-	-	-	-
14	-	-	-	-	3	1	5	-	-	-	-
15	-	-	-	-	1	1	1	-	-	-	-
16	-	-	-	1	1	3	1	-	-	-	-
17	-	1	-	-	2	3	1	-	-	-	-
18	-	-	-	-	1	2	1	-	-	-	-
19	-	-	-	-	1	1	1	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	2	-	-	-	-	-
22	-	-	-	-	-	-	-	1	-	-	-
23	-	-	-	-	1	1	2	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	1	-	-	-	-	-
26	-	1	-	-	-	1	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-
30	-	1	-	-	-	-	-	-	-	-	-
Number with fauna	8	15	18	27	50	35	43	56	18	21	33
%	28.6	55.6	56.3	87.1	100	97.2	97.7	94.9	72.0	56.8	78.6
x*	0.3	4.3	1.2	4.4	7.9	12.0	9.7	2.5	1.6	1.1	1.3

Anthozoa. Two species of *Capnella* were found on three sponge species (Appendix 1). Associations between sponges and octocorals have only rarely been reported from the North Atlantic (RÜTZLER 1976), while members of the subclass Zoantharia are commonly found as sponge associates (ARNDT & PAX 1936; PEARSE 1947, 1950; WEST 1976, 1979; LEWIS 1982; WENDT & al. 1985).

Nemertea. A few fragments were found in spicule 'fur' on three sponge species, but no attempt was made to reach a further identification (Appendix 1).

Nematoda. All nematodes were found in the 'fur' of the two *Thenea* species and *S. ponderosus*. An exception is one specimen of *S. ponderosus*, where nematodes were present in an internal cavity containing sediment and spicule accumulations. Nematodes were only found on geodiid specimens with a 'fur' of spicules. A few nematodes were found in the tissues of specimens of *Phakellia* and one on the surface of a *P. robusta*.

Nematodes were not included in 'The Zoology of the Faroes'. Seven of the genera found here have also been recorded with *Lophelia pertusa* at the Faroe Islands

(JENSEN & FREDERIKSEN 1992), giving a total of 14 genera and one species newly reported from this area. *Enoplus communis* has previously been found associated with littoral sponges at North Hayling, Hampshire, UK (FRITH 1976), and at the island of Texel, Netherlands (BONGERS 1983).

Polychaeta. Polychaetes were found either into spicule 'fur' or lying on the cortex of geodiid sponges. The tube-dwelling species were attached to the cortex. The largest number of polychaetes were found in the spicule 'fur' of *S. ponderosus*, *T. levis* and *T. valdiviae*. Exceptions are a few specimens of Eunicidae, Polynoidae and *Nereis pelagica*, which were found in the oscular cavities of *S. ponderosus*. In *P. robusta* all specimens of Syllidae and Lumbrineridae and two specimens of Polynoidae were found in the canals, the remaining polychaetes on the surface. One specimen of *Exogone* cf. *naidina* was present in the tissues of *P. rugosa*, while the remaining polychaetes were found on the surface. In *P. ventilabrum* polychaetes were only found on the surface, while in *T. infundibuliformis* all polychaetes were found inside the canals.

It is notable that the large percentage occurrence of polychaetes of *P. robusta* (Table 3) is mainly a result of occurrence of one species, *Haplosyllis spongicola*, present in 91.5 % of the specimens. No other polychaete taxon is so frequently represented on the sponges. Ten of the listed polychaetes have previously been reported associated with sponges in the North Atlantic (Appendix 1) (FAUVEL 1923; VIDAL 1967; BACESCU 1971; DAUER 1973; RULLIER 1974; FRITH 1976; UEBELACKER 1978; FAUCHALD & JUMARS 1979; PEATTIE & HOARE 1981; ALÓS & al. 1982; KOUKOURAS & al. 1985; WENDT & al. 1985; HELGASON & al. 1990).

Oligochaeta. *Bathyrilus rarisetis* was the most common species. The oligochaetes were found in spicule 'fur' on the choristids, and on the surface of *P. rugosa*.

Polyplacophora. *Hanleya nagelfar* with a body length up to 70 mm is a very conspicuous epifaunal element of the choristids. Sometimes the chitons were found in excavated pits that could be so deep that the animals were almost hidden. Some specimens were found in the oscular cavity of *S. ponderosus*. The Faroese material has been included in a previous investigation on the biology of *H. nagelfar* (WARÉN & KLITGAARD 1991).

Gastropoda. Only three specimens of *Margarites* sp. were found in the 'fur' on two *S. ponderosus* (Appendix 1). The specimens were in a very poor condition and could not be identified further than genus level.

Bivalvia. *Modiolus phaseolinus* and *Hiatella arctica* were the most common bivalves (Appendix 1). They were found in spicule 'fur' of *G. macandrewii*, attached to the cortex of *Geodia* sp., and partly attached to the cortex (all *Heteranomia squamula* and one specimen of *Hiatella arctica*) and partly sitting in the spicule 'fur' (one specimen of *H. arctica* and one *M. phaseolinus*) of *I. phlegraei*. On *S. ponderosus* all bivalves were found in the spicule 'fur'. One specimen of *M. phaseolinus* was attached to the sieve of the incurrent furrow of *T. levis*. Three specimens were sitting in the fringe of spicules on the upper rim of the incurrent furrow. Similarly, 13 specimens of *M. phaseolinus* and one specimen of *H. arctica* were attached to the upper rim of the incurrent furrow of *T. valdiviae*. The remaining bivalves of *T. levis* and *T. valdiviae* were all found in the spicule 'fur'. The bivalves associated with *P. robusta* were all found between small folds on a single specimen. One specimen of *Dacrydium ockelmanni* was sitting in the rim of a *P. rugosa* and was overgrown by the sponge. Only *H. arctica* has previously been reported associated with sponges, respectively in the Adriatic Sea (SANTUCCI 1922) and in the North Aegean Sea (KOUKOURAS & al. 1985).

Acariformes. One specimen of the Halacaridae was found in the 'fur' of a *S. ponderosus* (Appendix 1).

Pycnogonida. A juvenile *Nymphon* sp. was deeply buried in the 'fur' of a *T. valdiviae*. An adult male of *N. grossipes* was found in an oscular cavity of a *S. ponderosus*. One adult male of *N. leptocheles* was sitting on the surface of a *P. robusta*, and one adult female was found between small folds on another specimen of this sponge species. One specimen of *N. cf. micronyx* was found in the 'fur' of a *T. valdiviae*. One ovigerous male of *N. spinosissimum* was attached by its claws to the surface of a *P. rugosa*. Two males (one larvigerous and one ovigerous), three adult females (one oviferous) and one juvenile of *Callipallene producta* were found in the 'fur' of *S. ponderosus*, *T. levis* and *T. valdiviae*. One adult female of *Pseudopallene malleolata* was attached by its claws to the surface of a *T. levis*.

Crustacea. The specimens of *Apseudes spinosus* were found in spicule 'fur' on *G. macandrewii*, *T. levis* and *T. valdiviae* and on the surface of a *P. robusta*.

Gnathia abyssorum was the most abundant isopod. It was most frequently found in the 'fur' of *S. ponderosus* and in the canals of *Tragosia infundibuliformis*. Adult males, females and juveniles were all found. A proposal to a life cycle of *Gnathia abyssorum* has been published (KLITGAARD 1991). *Aega ventrosa* was exclusively present in the oscular cavities of *S. ponderosus*. Both

adult males, adult females, some with eggs or juveniles in the marsupium, and immatures were found. Most of the remaining isopods were found in the spicule 'fur' on *Geodia macandrewii*, *S. ponderosus*, *Thenea levis*, and *T. valdiviae* or on the surface or between folds in *Phakellia robusta*. The seven specimens of *Nannoniscus oblongus* were found in the spicule 'fur' of a *G. macandrewii*, forming a kind of 'harem' as they comprised 6 females (5 with eggs in the marsupium, and 1 with an empty marsupium) and 1 adult male.

Most amphipods were found in spicule 'fur' or on the surface of the sponges, and the majority were juveniles (R. Palerud pers.commn).

Two specimens of *Caridion gordonii* and one *Munida sarsi* were found in oscular cavities in *S. ponderosus*. The remaining decapods were found on the surface of the sponges.

A number of the listed crustaceans have previously been reported associated with sponges in the North Atlantic (Appendix 1) (HANSEN 1916; MONOD 1926; ARNDT 1933; PEATTIE & HOARE 1981; VADER 1984a, b; KOUKOURAS & al. 1985).

Sipuncula. Sipunculans were found in spicule 'fur' on the sponges. *Nephasoma* cf. *minutum* constitutes a species complex. At present it is not possible to identify specimens belonging to this complex any further (A. Nørrevang pers.commn). *Nephasoma abyssorum* was more common on *T. levis* than on *T. valdiviae*, while the opposite is true of *Nephasoma diaphanes* which might indicate a habitat division of these two species.

Bryozoa. Bryozoans were not found on *G. barretti*, although about 150 specimens of this species were examined. Bryozoans were generally found attached to the surface of sponges. Exceptions are *Sertella beaniana* and *Idmidronea atlantica* found detached in the spicule 'fur' of *G. macandrewii*, *I. atlantica*, *Notoplites harmeri*, *Porelloides laevis*, and *Tessaradoma boreale* found detached between folds of *Phakellia robusta*, and *Bicellarina abyssicola*, *Caberea ellisii* and *S. beaniana* found detached on top of a *P. ventilabrum*. Only *Bicellarina alderi* was attached directly to *P. rugosa*. Other species were attached to a small piece of shell embedded in the tissues.

Following HAYWARD & RYLAND (1979, 1985), RYLAND & HAYWARD (1977) and RYLAND (1963) the bryozoans may be divided into two categories, encrusting and upright species. Of the 31 represented taxa, 20 (64.5 %) are upright and 11 (35.5 %) are encrusting. The most common species, *Bicellarina alderi*, present on nine of the sponge species (Appendix 1), is upright.

Brachiopoda. Brachiopods were only rarely found; the few specimens present were all attached with the pedicle to the sponge surface. This type of association, brachiopods attached to sponges, seems to be rare in the North Atlantic, while the opposite association, sponges growing on brachiopods, is often seen (pers. obs. and O. Tendal pers.commn). *Terebratulina retusa* has previously been reported from sponges in the North Atlantic (BRUNTON & CURRY 1979).

Ophiuroidea. Most specimens of *Gorgonocephalus* were found in oscular- or other cavities in *Stryphnus ponderosus*. One specimen was on top of an irregular *Geodia barretti*, and two specimens were sitting on fan-shaped *P. robusta* and *P. ventilabrum* with a number of arm tips wrapped around the rim of the fan.

Ophiopholis aculeata is the most numerous ophiuroid followed by *Ophiacantha abyssicola*, *Amphipholis squamata*, and *Ophiactis abyssicola* (Appendix 1). A distinct distribution pattern was observed regarding the location of the ophiuroids on *S. ponderosus*, *Thenea levis* and *T. valdiviae* (Table 5). Apart from one *Ophiura* cf. *sarsi* present in an incurrent furrow in *T. levis*, the ophiuroids were all found in spicule 'fur' of the *Thenea* species.

The remaining ophiuroids were found in oscular cavities in *G. barretti*, in spicule 'fur' on *G. macandrewii*, and lying on the cortex of *Geodia* sp.. *Ophiopholis aculeata* was likewise lying on the cortex of *Isops phlegraei*, while *A. squamata* was found in spicule 'fur'. A relatively large number of species, but only few individuals of each species, were found associated with *P. rugosa* (Appendix 1). They were all sitting on top of the sponges, some of them inside meshes in lattice-formed specimens, or with the arms wrapped around the 'stalk' of the sponges. The ophiuroids on *P. robusta*, *P. ventilabrum* and *Tragosia infundibuliformis* were

Table 5. The location of the four most dominant ophiuroid species associated with *Stryphnus ponderosus*, *Thenea levis* and *T. valdiviae*.

The ophiuroid species	<i>Stryphnus ponderosus</i>		<i>Thenea levis</i>		<i>Thenea valdiviae</i>	
	Osculae	Spicule 'fur'	Incurrent furrow	Spicule 'fur'	Incurrent furrow	Spicule 'fur'
<i>Ophiactis abyssicola</i>	15 (79 %)	4 (21 %)	-	-	-	-
<i>Ophiopholis aculeata</i>	12 (32 %)	25 (68 %)	18 (90 %)	2 (10 %)	16 (53 %)	14 (47 %)
<i>Amphipholis squamata</i>	-	-	6 (55 %)	5 (45 %)	5 (33 %)	10 (67 %)
<i>Ophiacantha abyssicola</i>	0	19 (100 %)	0	7 (100 %)	3 (50 %)	3 (50 %)

either lying on the surface of the sponges or between small folds.

A marked distribution pattern of the age classes of the ophiuroids associated with *S. ponderosus*, *Thenea levis* and *T. valdiviae* was found. This applies especially to *Ophiopholis aculeata*:

	<i>Ophiopholis aculeata</i>	All species of ophiuroids
<i>S. ponderosus</i>	1 juvenile (3 %)	3 juveniles (3 %)
<i>T. levis</i>	15 juveniles (75 %)	17 juveniles (43 %)
<i>T. valdiviae</i>	24 juveniles (80 %)	27 juveniles (53 %)

Two of the ophiuroids, *Amphipholis squamata* and *Ophiactis abyssicola*, have previously been reported in association with sponges in the North Atlantic (ZAVODNIK 1976; TYLER 1980; PEATTIE & HOARE 1981; KOUKOURAS & al. 1985).

Pterobranchia. The colonies of *Rhabdopleura normani* were on both *Thenea* species found in the spicule 'fur'. The species has previously been reported associated with sponges in Norway (BURDON-JONES 1954).

Ascidiacea. All ascidians, except three specimens present in the 'fur' of a *G. macandrewii*, were attached to the sponge surface. Colonies of *Didemnum* sp. covered large parts of the surface of some specimens of *S. ponderosus*, one *Styela atlantica* was attached to the 'stalk' of a fan-shaped *P. ventilabrum*. A single *Polycarpa pomaria* was sitting in the bottom of a 9 cm deep oscular cavity in *Stryphnus ponderosus*, and another specimen was attached to the upper rim of the incurrent furrow of a *T. levis*.

One specimen of *Molgula mira* (MONNIOT & KLITGAARD 1994) was found as an epibiont of *Styela atlantica*, which again was sitting in the spicule 'fur' of *Stryphnus ponderosus*. The specimen showed an anatomic adaptation for incubation of the larvae hitherto unknown in ascidians.

The occurrence of ascidians differs between the two *Thenea* species (Tables 2 and 3). In this way the largest number of species and the largest percentage occurrence of ascidians were found on *T. levis*.

A large number of the solitary ascidians are juveniles (C. Monniot pers.commn). This includes one *Ascidia* sp. (on *T. levis*), all specimens identified as Styelidae, one *Polycarpa* sp. (on *T. valdiviae*) and three specimens of *Polycarpa pomaria* (two on *S. ponderosus* and one on *T. levis*). The specimens of *Ascidia tritonis* (on *S. ponderosus*) and *Styela atlantica* (on *I. phlegraei*, *Stryphnus ponderosus*, *T. levis*, and *Phakellia ventilabrum*) are adults but small (C. Monniot pers.commn). The size of *A. tritonis* and *Styela atlantica* may reach 17 and 4 cm respectively, while the maxi-

mum size of the sponge-associated specimens is 3.5 and 1.6 cm respectively.

Thus the most common ascidian taxa, *Ascidia tritonis*, *Polycarpa pomaria*, *Styela atlantica* and Styelidae, are predominantly represented by juveniles or small adults. Four of the species, *Ascidia tritonis*, *Styela atlantica*, *Polycarpa pomaria*, and *Pyura tessellata*, have previously been found associated with sponges in the North Atlantic (Appendix 1) (LÜTZEN 1967).

The occurrence of epi- and infauna

Epifauna was represented by 225 taxa, and infauna by 17 taxa. All specimens of *Haplosyllis spongicola* were present as infauna in *Phakellia robusta* and *Tragosia infundibuliformis*, a few specimens being found as epifauna on *Stryphnus ponderosus* and the two *Thenea* species. *Gnathia abyssorum* was as frequently present as infauna in *Tragosia infundibuliformis* and *P. robusta* as as epifauna on *S. ponderosus*. Although most frequently present as epifauna, the following twelve taxa might occur also as infauna in the axinellids: *Enoplus* sp., *Synonchus* sp., *Phanoderma* sp. B, *Enoplolaimus* sp., *Pionosyllis* sp., *Syllis armillaris*, Polynoidae indet., Lumbrineridae indet., *Exogone* cf. *naidina*, *Glycera lapidum*, *Munna boeckii*, and *Metopa* cf. *robusta*.

Infauna was exclusively found in the axinellids. The infauna was most frequent and most abundant in *Phakellia robusta* and *T. infundibuliformis*. An explanation may be that these two species have larger, more distinct canals and softer structure than *P. rugosa* and *P. ventilabrum*.

The total absence of infauna in choristids is remarkable because a number of endobiotic species, especially polychaetes but also bivalves and echinoderms, have been recorded for *Geodia cydonium* (JAMESON, 1811) in the Mediterranean (SANTUCCI 1922; VIDAL 1967; CONNES & al. 1971; ZAVODNIK 1976; KOUKOURAS & al. 1985). As the structure of the Faroese species is similar to that of *G. cydonium* (a dominating spicule skeleton and a cortex of sterrasters), the explanation might be the existence in the Faroese species of a chemical defence. Compounds of a kind that could serve this function have, however, not been found in *G. barretti*, *G. macandrewii*, *Geodia* sp., *I. phlegraei* and *Stryphnus ponderosus* (HOUGAARD 1991).

DISCUSSION

The collection methods

Although towing time was kept short, varying degrees of abrasion and fragmentation of the samples were inevitable because of the gravelly bottoms around the Faroes. This explains the, often poor, condition of speci-

mens of *Phakellia rugosa* and *P. ventilabrum*, and the varying amounts of spicule 'fur' left on the cortex of *Geodia macandrewii*.

Wearing is evidently also the explanation for the often poor condition of the non-encrusting Porifera, Hydrozoa and upright Bryozoa on the sponges, and probably leads to underrepresentation of Protozoa and Bivalvia. More robust groups like Anthozoa, Cirripedia, Brachiopoda and Ascidiacea seem rather unaffected by the sampling methods.

Except for *Hanleya nagelfar*, the errant fauna may be influenced in two different ways during sampling. The errant fauna may be underrepresented (Appendix 1) owing to losses during towing, washing out of the sample during recovery and to escape reactions of groups such as Amphipoda and Decapoda. Thus, only one specimen of *Munida sarsi* was found in an oscular cavity of *S. ponderosus*, whereas galatheids repeatedly have been seen sitting on or in the vicinity of specimens of this sponge on underwater photographs. On the other hand, contamination with foreign fauna may also be expected during the sampling, either from one sponge to another or by covering of the sponges with sediment. This applies especially to sponges with a spicule 'fur'.

The sponges as food

Only one proven sponge predator, *Hanleya nagelfar*, was found in this investigation. The apparent scarcity of sponge predators may be a result of the sponge texture and/or the applied sampling methods. To graze the very solid choristids special adaptations are needed, such as a powerful radula and the ability of manipulating the spicules and transporting them safely through the alimentary canal as demonstrated by *Hanleya nagelfar* (WARÉN & KLITGAARD 1991).

Haplosyllis spongicola has previously been reported as a predator of *Mycale* sp. (FAUCHALD & JUMARS 1979), but whether it predaes on *P. robusta* has yet to be determined. Even though the axinellids have a softer texture, a predator like *Haplosyllis spongicola* must be expected to show adaptations to ensure a safe transport of the spicules through the alimentary canal. Another strategy is to be small enough to avoid the spicules when consuming the sponge tissue, as in *Branchiosyllis oculata* (EHLERS, 1887) (Polychaeta) (PAWLIK 1983), or perhaps to sort out the spicules.

Within the Crustacea, *Paramphithoe hystrix* (ROSS, 1835) (Amphipoda) is reported as a micropredator of sponges at Bonne Bay, Newfoundland (OSHEL & STEELE 1985). In addition, VADER (1984a) found the species on sponges in northern Norway. RÜTZLER (1976) identified five species of sponge-feeding crustaceans at the coast of Tunisia. Parasitic copepods on sponges have been

reported many times from different parts of the North Atlantic (ARNDT 1933; SILÉN 1963; STOCK 1970; LAUCKNER 1980).

Nudibranchs have often been found to feed on sponges in the North Atlantic area (M'INTOSH 1863; ABELOOS & ABELOOS 1932; FORREST 1953; MILLER 1961; SWENNEN 1961; THOMPSON 1964; CAREFOOT 1967; BLOOM 1976; BARBOUR 1979; EYSTER & STANCYK 1981; JUST & TENDAL 1983; CATTANEO-VIETTI 1986), while there are few reports of other gastropod orders (QUINN 1981; HARASEWYCH & al. 1988; WARÉN & KLITGAARD 1991).

In this investigation prosobranchs were represented by only three specimens of *Magarites* sp., and no nudibranchs and only few crustaceans were found. These groups are probably underrepresented owing to the sampling method. Parasitic copepods are probably uninfluenced by the sampling methods, but they are not easily found owing to their small size and often peculiar, vermiform shape. A closer examination of the canals of the sponges might demonstrate the presence of this group in the area.†

The sponges as a habitat

BARTHEL (1992) suggests that hexactinellids play an important role in the eastern Weddell Sea, Antarctica, by colonizing areas of open sediment and modifying the sediment by deposition of spicules, thereby providing a suitable substratum for a variety of demosponge species as well as other benthic animals. That hexactinellids in the Weddell Sea are inhabited by a large number of organisms has been demonstrated by KUNZMANN (1992). Likewise, BETT & RICE (1992) discuss the possible relationships in the Porcupine Seabight, (NE Atlantic), between hexactinellids (*Phoronema carpenteri* (THOMSON, 1869)), their spicule mats, and the macrobenthos. Three categories of so-called direct effect of interactions are emphasized:

1. Provision of hard substratum in an open sediment situation.
2. Provision of refugia from predation or physical hazard.
3. Provision of an enhanced food supply.

These three categories of direct effect of interactions may also apply to demosponges in the Faroese area.

Concerning the first category, sponges may on soft bottoms provide a hard substratum of sedentary groups, as exemplified by the two *Thenea* species. Taxa such as Hydrozoa, Bryozoa, Brachiopoda, Pterobranchia and Ascidiacea and bivalves (e.g. *Modiolus phaseolinus* and *Hiatella arctica*) may, on a soft bottom with scarcity of suitable substratum, colonize the two *Thenea* species (Table 3 and Appendix 1). In contrast to BETT & RICE (1992), who found large, solitary, gelatinous ascidians

in areas with large quantities of spicules, the majority of the ascidians found on the two *Thenea* species are juveniles or small adults. In addition, sponges may increase the dispersal of errant hard bottom fauna into otherwise inaccessible areas. In this way the majority of the nematodes present on the two *Thenea* species belong to the order Enoplida, of which most species are known to live on hard bottoms (P. Jensen pers.commn). They may on soft bottoms use sponges as a hard substratum. The same is probably true for *Bathydrylus rarisetis* (Oligochaeta), a species commonly found in coarse sediments (C. Erséus pers.commn). Also ophiuroids may use sponges as a substitute on soft bottoms (ZAVODNIK 1976). In the present investigation ophiuroids were found on 47-59 % of the specimens of the two *Thenea* species (Table 3).

The second category of BETT & RICE (1992) is the protection from large predators for organisms inhabiting the prosthelia of living hexactinellids, spicule mats or sediment rich in spicules. This may also apply to the taxa found in spicule 'fur' on sponges in the present investigation. About half of the ophiuroids present on the two *Thenea* species are juveniles, probably because they get more and more exposed to predation when they grow. Another possible explanation, however, is that the ophiuroids change habitat when getting larger.

Likewise, cavities in the sponges may afford protection to other organisms. Ophiuroids in the incurrent furrows of *T. levis* and *T. valdiviae* and the oscular cavities of *S. ponderosus* may be protected from predation, a relationship suggested also for *Ophiothrix lineata* LYMAN, 1860 (HENDLER 1984) and *Ophiactis savignyi* (MÜLLER & TROSCHEL, 1842) (MLADENOV & EMSON 1988). This may also apply to crustaceans. In this way one *Munida sarsi* was found in an oscular cavity in *S. ponderosus*, and on underwater photographs galatheids are often seen sitting close to or on specimens of *S. ponderosus*. Similar associations between species of *Munida* and sponges have been reported by HARTNOLL & al. (1992) and VILLAMIZAR & LAUGHLIN (1991). Flabelliferan isopods have often been found in cavities and canals in sponges in the North Atlantic (ARNDT 1933; PEARSE 1932; DOUNAS & KOUKOURAS 1986; STONE & HEARD 1989). At the Faroe Islands both adults and juveniles of *A. ventrosa* were found in oscular cavities in *S. ponderosus*. In addition, *Gnathia abyssorum* was frequently present in the canals of *Tragosia infundibuliformis* as well as in the spicule 'fur' of *S. ponderosus*, and sponges have often been reported as a habitat of the Gnathiidae (KLITGAARD 1991).

Concerning the third category sponges might supply an associated fauna with an enhanced food supply. The food might consist of sediment and organic detritus accumulated on the sponges. This has been pointed out as

an explanation several times when a more abundant occurrence of associates is observed on sponges with a complex gross morphological structure than on sponges with a simple surface contour (DAUER 1973; FRITH 1976; WENDT & al. 1985). From underwater photographs from the Faroe Islands it appears that specimens of *S. ponderosus* can be partly covered by sediment. The presence of detritus on top of specimens of *Geodia* has likewise been observed on underwater photographs from the Swedish west coast (O. Tendal pers.commn). These observations, as well as the presumed accumulation of organic detritus on specimens of *Thenea levis* and *T. valdiviae*, could explain the occurrence of the largest number of associated taxa as well as the largest frequency of groups like Nematoda, Polychaeta and Sipuncula on these sponge species. An observation that may support this assumption is that the majority of the associated nematodes of *G. macandrewii*, as well as about half the number of those associated with *S. ponderosus* and the two *Thenea* species, are microbial feeders (P. Jensen pers.commn).

It has often been suggested that sponge associates utilize plankton and organic particles concentrated in the water flowing through the incurrent and excurrent canals of the sponges (ANGER 1972; WEST 1976; ZAVODNIK 1976; WESTINGA & HOETJES 1981; BONGERS 1983; COSTELLO & MYERS 1987). However, as the excurrent water has no planktonic particles owing to the filtration of the sponge, and a reduced oxygen level caused by the respiration as well as an addition of egested material, associated suspension feeders might be expected only on the incurrent surface of the sponge or inside the incurrent canals. Thus in the present investigation all specimens of *Heteranomia squamula*, *Verruca stroemia* and *Terebratulina retusa* were attached to the incurrent area of *I. phlegraei*; specimens of *Modiolus phaseolinus* were frequently attached to the upper rim of the incurrent furrow of *Thenea levis* and *T. valdiviae*; colonies of *Didemnum* sp. and incrusting sponges often covered large parts of the incurrent surface of *S. ponderosus* (similar associations are reported by RÜTZLER (1970)); *Cibicides refulgens*, a suspension feeder (T. Cedhagen pers.commn), was frequently attached to the incurrent surface of the geodiids.

Concerning the associated ophiuroids, *Amphipholis squamata* is known as an omnivore (BOFFI 1972; EMSON & WHITFIELD 1989) and *Ophiopholis aculeata* as a suspension feeder (LABARBERA 1978). *O. aculeata* however, is also capable of eating detritus (R. Emson pers.commn). It is conceivable that the individuals of these two species have advantage of the position in the incurrent furrow of *T. levis* and *T. valdiviae* by either filtering the current flow into the sponge or by collecting the particles accumulated on the poral sieves.

The present Faroese investigation demonstrated the representation of a large number of associated species mainly present as epifauna. I suggest, that most species present as epi- or infauna in sponges in temperate/cold waters are facultative inhabitants representing the fauna present in the local geographical area. This is in contrast to warm tropical waters where a large number of apparently obligate sponge associates have been recorded (see A.J. BRUCE 1976, 1977, 1981, 1983a, b). The same has been postulated for the fauna associated with the scleractinian coral *Lophelia pertusa* (JENSEN & FREDERIKSEN 1992). However, to demonstrate the degree of association between the represented species and the sponges investigations of the composition of the fauna in the ambient habitat is necessary.

The results of the present investigation show that the presence of a 'fur' of spicules or of cavities like the oscular cavities of *S. ponderosus* and the incurved furrows of *T. levis* and *T. valdiviae* are of importance for the presence of associated fauna. The importance of sponge morphology on the composition of the associated fauna is a conclusion too in FRITH (1976), KOUKOURAS & al. (1985) and WENDT & al. (1985). Thus the morphology of the sponges as well as the possible influence of secondary metabolites from sponges can be expected to be determining factors in the composition of an associated fauna in temperate to cold waters as well as in warm tropical waters.

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Appendix 1. The fauna associated with the eleven examined sponge species. The taxa are listed in phylogenetical order according to the following authors: Protozoa: (LOEBLICH & TAPPAN 1988), Hydrozoa: (KRAMP 1935), Anthozoa: (CARLIGREN 1945), Nematoda: (PLATT & WARWICK 1988), Polychaeta: (GEORGE & HARTMANN-SCHRÖDER 1985), Oligochaeta: (BRINKHURST 1982), Mollusca: (HØISÆTER 1986), Pycnogonida: (KING 1974), Crustacea: (ENCKELL 1980), Sipuncula: (GIBBS & CUTLER 1987), Bryozoa: (RYLAND & HAYWARD 1977; HAYWARD & RYLAND 1979, 1985), Brachiopoda: (BRUNTON & CURRY 1979), Echinodermata: (HØISÆTER 1990), Ascidiacea: (MILLAR 1970). + = present but not counted, * = the species has previously been reported associated with sponges in the North Atlantic, = new record for the Faroe Islands area, ** = the species was found as an epibiont of *Styela atlantica* (Ascidiacea). *G.b.* = *Geodia barretti*, *G.m.* = *G. macandrewii*, *G.sp.* = *Geodia* sp., *S.p.* = *Stryphnus ponderosus*, *T.l.* = *Thenea levis*, *T.v.* = *T. valdiviae*, *P.ro.* = *Phakellia robusta*, *P.ru.* = *P. rugosa*, *P.v.* = *P. ventilabrum*, *T.i.* = *Tragosia infundibuliformis*.

	<i>G.b.</i>	<i>G.m.</i>	<i>G.sp.</i>	<i>l.p.</i>	<i>S.p.</i>	<i>T.l.</i>	<i>T.v.</i>	<i>P.ro.</i>	<i>P.ru.</i>	<i>P.v.</i>	<i>T.i.</i>
PROTOZOA											
☐ cf. <i>Dendrophrya erecta</i> WRIGHT, 1861				+							
☐ <i>Tholosina confusa</i> (CUSHMAN, 1920)					+						
☐ <i>T. vesicularis</i> BRADY, 1879											+
<i>Ammodiscus</i> cf. <i>intermedius</i> HÖGLUND, 1947			+								
☐ <i>Trochammina</i> sp.					+						
<i>Quinqueloculina seminulum</i> (L., 1758)			+								
* <i>Hyrokkin sarcophaga</i> CEDHAGEN, 1994	+	+	+	+							
☐ <i>Planulina ariminensis</i> D'ORBIGNY, 1826					+						
<i>Cibicides lobatulus</i> (WALKER & JACOB, 1798)						+					
<i>C. refulgens</i> MONTFORD, 1808	+	+	+	+							
☐ <i>Nonion umbilicatum</i> (MONTAGU, 1803)						+					
<i>Paromalina coronata</i> (PARKER & JONES, 1857)			+		+						
PORIFERA											
☐ * <i>Aplysilla sulphurea</i> SCHULZE, 1878						+					
Unidentified morphological types.		+	+	+	+	+	+	+	+	+	+
HYDROZOA											
Tubulariidae indet.									+	+	+
☐ * <i>Hybocodon prolifer</i> L. AGASSIZ, 1862									+	+	+
<i>Eudendrium rameum</i> (PALLAS, 1766)				+							
Lafocidae indet.					+						
<i>Lafocia</i> sp.					+						
<i>L. gracillima</i> (ALDER, 1856)		+	+	+							
<i>Halecium</i> sp.					+						
<i>H. beani</i> JOHNSTON, 1847					+						
<i>Kirchenpaueria pinnata</i> (L., 1758)					+						
<i>Halopteris catharina</i> (JOHNSTON, 1833)						+					
<i>Nemertesia antennina</i> (L., 1758)							+				
Sertulariidae indet.									+		
<i>Sertularella gayi</i> (LAMOUROUX, 1821)	+		+	+	+						
Unidentified morphological types.		+	+	+	+	+	+	+	+	+	+
ANTHOZOA											
<i>Capnella</i> sp.	+										
☐ <i>C. glomerata</i> (VERRILL, 1869)				1	38						
<i>C. florida</i> (RATHKE, 1806)	8				17						
NEMERTEA											
Nemertea indet.		1			2	1					
NEMATODA											
<i>Enoplus</i> sp.		46		6	116	42	47			1	
☐ * <i>E. cf. communis</i> BASTIAN, 1865						3	2				
☐ <i>Enoplodes</i> sp.					1						
☐ <i>Enoplolaimus</i> sp.		1				2	1		1		
<i>Crenopharynx</i> sp. A					20	1					
<i>C. sp. B</i>					1						
☐ <i>Micoletzkyia</i> sp.					1		2				
<i>Phanoderma</i> sp. A					4	9	5				
<i>P. sp. B</i>						2	7			1	

Appendix I. Cont.

	<i>G.b.</i>	<i>G.m.</i>	<i>G.sp.</i>	<i>Lp.</i>	<i>S.p.</i>	<i>T.l.</i>	<i>T.v.</i>	<i>Pro.</i>	<i>P.ru.</i>	<i>P.v.</i>	<i>T.i.</i>
☒ <i>Anticoma</i> sp.					4	3	1				
Leptosomatidae sp. A					1						
Leptosomatidae sp. B						5	1				
Leptosomatidae sp. C										1	
☒ <i>Cylicolaimus</i> sp.						8					
<i>Leptosomatum</i> sp.		2			18	9	6				
☒ <i>Platycomopsis</i> sp.					1						
<i>Synonchus</i> sp.		172		9	33	170	187	2	3	1	
☒ <i>Thoracostoma</i> sp.		12			8		1				
☒ <i>Oxystomina</i> sp.		1									
☒ <i>Viscosia</i> sp.		3			1						
<i>Eurystomina</i> sp.						1	1				
☒ <i>Rhabdodemia</i> sp.						1					
☒ <i>Sabatieria</i> sp.						1					
☒ <i>Paracanthonchus</i> sp.		1			19						
<i>Halichoanolaimus</i> sp.						1					
☒ <i>Desmodora</i> sp.		2									
☒ <i>Theristus</i> sp.					3						
POLYCHAETA											
Polynoidae indet.		+	+		+	+	+	3			1
☒ <i>Pholoe pallida</i> CHAMBERS, 1985										1	
Sigalionidae indet.						+					
☒ <i>Eulalia hanssoni</i> PLEIJEL, 1987					1	1					
☒ <i>E. mustela</i> PLEIJEL, 1987		1									
☒ <i>E. tjalfiensis</i> DITLEVSEN, 1917						1	2				
<i>Eumida</i> sp.								1			
☒ * <i>Glycera lapidum</i> QUATREFAGES, 1865		2		2	1	9	10				1
<i>Goniada maculata</i> ØRSTED, 1843					1	1					
<i>G. norvegica</i> ØRSTED, 1844						1					
<i>Sphaerodorum</i> sp.							1				
<i>Nereimyra punctata</i> (O.F. MÜLLER, 1788)					1		1				
Syllidae indet.					2		1				
Autolytinae indet.											1
<i>Autolytus</i> sp.		1									
☒ <i>Exogone longicirris</i> WEBSTER & BENEDICT, 1887					1		1				
☒ * <i>E. naidina</i> ØRSTED, 1845					14	5	3			1	
* <i>E. verugera</i> (CLAPARÉDE, 1868)					1		2				
☒ * <i>Haplosyllis spongicola</i> (GRUBE, 1855)					1	1	3	587			1
☒ <i>Odontosyllis</i> sp.					1						
☒ <i>Pionosyllis</i> sp.		3			3		1	6	1		2
<i>Sphaerosyllis</i> sp.					1		2				
<i>S. erinaceus</i> CLAPARÉDE, 1863		6			12	1					
☒ * <i>S. hystrix</i> CLAPARÉDE, 1863		8			7	4	1				
* <i>Syllis armillaris</i> (O.F. MÜLLER, 1776)	1	8	4	10	60	1	2	1			
☒ <i>S. cornuta</i> RATHKE, 1843					2	7	5				
☒ * <i>Trypanosyllis coeliaca</i> CLAPARÉDE, 1868		2	1	1	3	1	7				
cf. Nereidae					1						
<i>Nereis</i> sp.					1						
* <i>N. pelagica</i> L., 1761	1	6	1	1	27	2	1	1		1	
* <i>N. zonata</i> MALMGREN, 1867					2		1				
Eunicidae indet.		+	+	+	+	+	+				
Lumbrineridae indet.		+			+	+	+	1			
Dorvilleidae indet.					+	+	+				
Paraonidae indet.					+	+	+				
Spionidae indet.		+			+	+	+				
<i>Aphelochaeta</i> sp.					1	1	5				
<i>Chaetozone</i> sp. indet.						2	1				

Appendix 1. Cont.

	G.b.	G.m.	G.sp.	I.p.	S.p.	T.l.	T.v.	Pro.	Pru.	P.v.	T.i.
C. sp. A						5	19				
C. sp. B					3	13	18				
cf. <i>Cirratulus</i> sp.			1								
<i>C. incertus</i> McINTOSH, 1916					3		1				
☐ <i>Tharyx</i> sp.							1		1		
☐ cf. <i>Pherusa falcata</i> STØP-BOWITZ, 1948				1			1				
* <i>Notomastus</i> cf. <i>latericeus</i> M. SARS, 1851				1		2					
Maldanidae indet.		+			+	+	+				
cf. <i>Asclerocheilus intermedius</i> (SAINT-JOSEPH, 1894)						4					
☐ <i>Sclerocheilus</i> cf. <i>minutus</i> GRUBE, 1863						7					
☐ <i>Oligobregma</i> cf. <i>aciculata</i> HARTMAN, 1965				1			1				
Oweniidae indet.		+			+	+	+				
Sabellidae indet.	+				+	7	+				
<i>Brachiomma</i> sp.		1				4	3				
<i>Euchone</i> sp.		1				2	1				
☐ <i>E. southerni</i> BANSE, 1970						1					
<i>Jasmineira</i> sp.		1					2				
☐ <i>J. caudata</i> LANGERHANS, 1880		5				2	5				
☐ cf. <i>J. elegans</i> SAINT-JOSEPH, 1894						1					
☐ <i>Myxicola</i> cf. <i>aesthetica</i> (CLAPARÉDE, 1870)		1									
Ampharetidae indet.					+	+	+				
Trichobranchidae indet.							+				
Terebellidae indet.		+		+	+	+	+				
<i>Polycirrus</i> sp.									3		
<i>Placostegus tridentatus</i> (FABRICIUS, 1779)						1			1		
OLIGOCHAETA											
Tubificidae indet.						1					
☐ <i>Bathyrilus rarisetis</i> (ERSÉUS, 1975)		2				5	10		1		
☐ <i>Grania pusilla</i> ERSÉUS, 1974					2	1					
MOLLUSCA, Polyplacophora											
☐ * <i>Hanleya nagelfar</i> (LOVÉN, 1846)		4	9	2	24	1					
MOLLUSCA, Gastropoda											
<i>Margarites</i> sp.					3						
MOLLUSCA, Bivalvia											
<i>Yoldiella nana</i> (M. SARS, 1865)									1		
☐ <i>Dacrydium ockelmanni</i> MATTSON & WARÉN, 1977		2				3	2	1	1		
<i>Modiolus phaseolinus</i> (PHILIPPI, 1844)		15		1	13	29	32	4			
<i>Acar nodulosa</i> (O.F. MÜLLER, 1776)			1			1					
<i>Bathyarca pectunculoides</i> (SCACCHI, 1834)		1									
☐ <i>Chlamys vitrea</i> (GMELIN, 1791)		1			2						
<i>Heteranomia squamula</i> (L., 1758)		2	1	14							
<i>Astarte</i> sp.						1					
<i>A. sulcata</i> (DA COSTA, 1778)			1			1					
* <i>Hiatella arctica</i> (L., 1767)		5		2	9	1	3				
ARACHNIDA, Acariformes											
Halacaridae indet.					1						
PYCNOGONIDA											
<i>Nymphon</i> sp.							2				
<i>N. grossipes</i> FABRICIUS, 1780					1						
☐ <i>N. leptochelēs</i> G.O. SARS, 1888								2			
☐ <i>N. cf. micronyx</i> G.O. SARS, 1888							1				
<i>N. spinosissimum</i> (NORMAN, 1894)									1		
☐ <i>Callipallene producta</i> G.O. SARS, 1888					2	2	2				
☐ <i>Pseudopallene malleolata</i> (G.O. SARS, 1881)						1					

Appendix I. Cont.

	<i>G.b.</i>	<i>G.m.</i>	<i>G.sp.</i>	<i>I.p.</i>	<i>S.p.</i>	<i>T.l.</i>	<i>T.v.</i>	<i>P.ro.</i>	<i>P.ru.</i>	<i>P.v.</i>	<i>T.i.</i>
CRUSTACEA, Cirripedia											
* <i>Verruca stroemia</i> (O.F. MÜLLER, 1776)				25	1						1
<i>Balanus hammeri</i> (ASCANIUS, 1767)			1								
CRUSTACEA, Tanaidacea											
<i>Apseudes spinosus</i> (M. SARS, 1858)		1				2	2	1			
CRUSTACEA, Isopoda											
<i>Gnathia abyssorum</i> juvenile					112			1			110
<i>G. abyssorum</i> (G.O. SARS, 1872) females					10			1			
* <i>G. abyssorum</i> (G.O. SARS, 1872) males					34						4
<i>Astacilla longicornis</i> (SOWERBY, 1806)						1					
<i>Aega ventrosa</i> M. SARS, 1848					11						
☒ <i>Disconectes</i> cf. <i>furcatus</i> G.O. SARS, 1870											1
* <i>Munna boeckii</i> KRØYER, 1839		1			3			2			
<i>Nannoniscus oblongus</i> G.O. SARS, 1869		7									
* <i>Janira maculosa</i> LEACH, 1814					2	3	4	4			
CRUSTACEA, Amphipoda											
<i>Aeginella spinosa</i> BOECK, 1860					3	1					
Gammaridea indet.					1					1	
Lysianassidae indet.		3									
<i>Orchomene</i> sp.							1				
<i>O.</i> cf. <i>serratus</i> (BOECK, 1861)		1									
<i>Metopa</i> sp.					2						
<i>M.</i> cf. <i>robusta</i> G.O. SARS, 1892											1
<i>Harpinia</i> cf. <i>pectinata</i> G.O. SARS, 1891						1					
<i>Byblis crassicornis</i> METZGER, 1875						1					
<i>Leucothoe</i> sp.					1						
<i>Cressa</i> sp.					2						
Ischyroceridae indet.										3	
cf. <i>Gammaropsis</i> sp.						1					
<i>Pardalisca</i> cf. <i>tenuipes</i> G.O. SARS, 1893		1									
Aoridae indet.					1					1	
* <i>Laothoes meinerti</i> BOECK, 1870							1				
CRUSTACEA, Decapoda											
☒ <i>Caridion gordonii</i> (BATE, 1858)					2						
* <i>Pagurus bernhardus</i> (L., 1758)								1			
☒ <i>Munida sarsi</i> BRINKMAN, 1936					1						
<i>Hyas coarctatus</i> LEACH, 1815								1			
SIPUNCULA											
☒ <i>Nephasoma abyssorum</i> KOREN & DANIELSSEN, 1875				1		16	8				
☒ <i>N. diaphanes</i> (GEROULD, 1913)					1	1	8				
☒ <i>N. flagriferum</i> (SELENKA, 1885)						1					
<i>N.</i> cf. <i>minutum</i> (KEFERSTEIN, 1862)		5		4	5	58	82				
☒ <i>Onchnesoma steenstrupi</i> KOREN & DANIELSSEN, 1875					1						
BRYOZOA											
<i>Bicrista abyssicola</i> KLUGE, 1962		+	+	+	+	+	+	+		+	+
<i>Crisia</i> sp.			+	+	+	+	+	+			
<i>C. eburnea</i> (L., 1758)				+		+					
<i>Tubulipora</i> sp.				+		+					
☒ cf. <i>T. penicillata</i> (FABRICIUS, 1780)						+	+				
<i>Idmidronea</i> sp.				+	+	+	+				
<i>I. atlantica</i> (FORBES, in JOHNSTON, 1847)		+	+	+		+	+				
<i>Plagioecia patina</i> (LAMARCK, 1816)				+						+	
<i>Diplosolen obelia</i> (JOHNSTON, 1838)			+	+	+	+	+	+			+
☒ <i>Tervia</i> sp.						+					
<i>Annectocyma major</i> (JOHNSTON, 1847)										+	

Appendix 1. Cont.

	G.b.	G.m.	G.sp.	I.p.	S.p.	T.l.	T.v.	P.ro.	P.ru.	P.v.	T.i.
<i>Entalophoroecia cf. deflexa</i> (COUCH, 1842)						+					
<i>Hornea lichenoides</i> (L., 1758)				+			+				
<i>Disporella hispida</i> (FLEMING, 1828)					+						
<i>Chartella barleei</i> (BUSK, 1860)										+	
<i>Amphiblestrum</i> sp.						+					
<i>A. flemingii</i> (BUSK, 1854)				+	+						
<i>A. minax</i> (BUSK, 1860)									+		
☐ <i>Cellaria fistulosa</i> L., 1758					+	+					
<i>Caberea ellisii</i> (FLEMING, 1814)					+	+		+		+	
☐ <i>Notoplites jeffreysii</i> NORMAN, 1868				+	+	+	+	+			
<i>N. harmeri</i> RYLAND, 1963				+	+	+		+			
<i>Bicellarina alderi</i> (BUSK, 1859)		+	+		+	+	+	+	+	+	+
<i>Smittoidea reticulata</i> (J. MACGILLIVRAY, 1842)					+					+	
<i>Porella compressa</i> (SOWERBY, 1805)				+							
<i>Porelloides laevis</i> (FLEMING, 1828)								+			
<i>P. struma</i> (NORMAN, 1868B)								+			
<i>Palmicellaria</i> sp.				+							
☐ <i>Tessaradoma boreale</i> (BUSK, 1860)			+		+	+	+	+			
<i>Sertella beaniana</i> (KING, 1846)		+		+	+	+	+	+	+	+	
☐ <i>S. rara</i> (JULLIEN, 1903)					+						
BRACHIOPODA											
* <i>Terebratulina retusa</i> (L., 1758)		1		15	9		2	3			
<i>Glaciarcularia spitzbergensis</i> (DAVIDSON, 1852)						1					
ECHINODERMATA, Ophiuroidea											
☐ <i>Ophioscolex purpureus</i> DÜBEN & KOREN, 1846					1						
☐ <i>Gorgonocephalus caputmedusae</i> (L., 1758)					1			1			
☐ <i>G. lamarckii</i> (MÜLLER & TROSCHER, 1842)	1				3					1	
<i>Ophiactis</i> sp.					1						
* <i>O. abyssicola</i> (M. SARS, 1861)					19				3		
<i>O. balli</i> (THOMPSON, 1840)					2						
<i>Ophiopholis aculeata</i> (L., 1767)	2	3		1	37	20	30	13	3	4	1
* <i>Ophiopholis squamata</i> (DELLE CHIAJE, 1829)		2	2	1		11	15		1		
<i>Ophiacantha</i> sp.										1	
<i>O. abyssicola</i> G.O. SARS, 1871			1		19	7	6	1	2	2	3
☐ <i>O. anomala</i> G.O. SARS, 1871					2						
☐ <i>O. bidentata</i> (RETZIUS, 1805)					2						
☐ <i>O. spectabilis</i> G.O. SARS, 1871					1						
☐ <i>O. granulifera</i> VERRILL, 1885a					1						
☐ <i>Ophiocten gracilis</i> (G.O. SARS, 1871)									1		
<i>Ophiura</i> sp.					1	1		1			
<i>O. sarsii</i> LÜTKEN, 1858						1			1		
PTEROBRANCHIA											
* <i>Rhabdopleura normani</i> ALLMAN, 1869						+	+				
ASCIDIACEA											
☐ Polycitoridae indet.						+					
<i>Didemnum</i> sp.					+						
<i>Ascidia</i> sp.						1					
* <i>A. tritonis</i> HERDMAN, 1883					4						
Styelidae indet.		2		1	1	4	1				
☐ <i>Styela atlantica</i> (VAN NAME, 1912)		1			6	1				1	
☐ <i>S. similis</i> MONNIOT, C., 1970				1							
<i>Polycarpa</i> sp.						1	1				
* <i>P. pomaria</i> (SAVIGNY, 1816)					9	1					
☐ <i>P. porculus</i> MONNIOT & MONNIOT, 1979						1	1				
* <i>Pyura tessellata</i> (FORBES, 1848)					1						
☐ ** <i>Molgula mira</i> (ÄRNBÄCK-CHRISTIE-LINDE, 1931)					1						

Appendix 2. For each of the eleven sponge species is given a list of the BIOFAR stations at which specimens examined for associated fauna were collected. Data of each station (position, depth, gear, temperature, sediment) in NØRREVANG & al. (1994).

Sponge species	BIOFAR Stns
<i>Geodia barretti</i>	043, 117, 156, 163, 234, 268, 279, 287, 352, 376, 469, 474, 476, 483, 486, 488, 504, 530, 531, 534, 535, 536, 540, 550, 551, 559, 756
<i>Geodia macandrewii</i>	117, 287, 328, 375, 376, 379, 451, 453, 469, 476, 486, 488, 504, 535, 540, 550, 559, 734, 756
<i>Geodia</i> sp.	043, 279, 328, 373, 374, 379, 474, 475, 476, 486, 498, 530, 531, 532, 535, 536, 551, 558, 559
<i>Isops phlegraei</i>	043, 279, 282, 287, 375, 451, 453, 469, 474, 476, 483, 486, 488, 530, 536, 550, 551, 558, 559, 734
<i>Stryphnus ponderosus</i>	043, 046, 148, 282, 374, 375, 389, 451, 453, 469, 470, 474, 475, 476, 486, 488, 503, 504, 535, 536, 540, 558, 559, 756
<i>Thenea levis</i>	047, 156, 158, 376, 377, 378, 451, 453, 483, 486, 487, 550, 559
<i>Thenea valdiviae</i>	156, 158, 282, 375, 376, 377, 378, 451, 453, 469, 483, 486, 550, 559
<i>Phakellia robusta</i>	019, 052, 149, 153, 156, 190, 234, 281, 282, 346, 356, 373, 374, 375, 379, 389, 451, 453, 468, 471, 475, 476, 530, 550, 552, 558, 559
<i>Phakellia rugosa</i>	027, 122, 156, 175, 264, 279, 281, 377
<i>Phakellia ventilabrum</i>	019, 043, 118, 153, 155, 279, 347, 374, 377, 451, 453, 468, 471, 474, 475, 476, 483, 488, 530, 536, 551, 552, 558, 559
<i>Tragosia infundibuliformis</i>	043, 052, 149, 150, 156, 191, 205, 279, 281, 346, 356, 375, 451, 452, 453, 468, 471, 474, 476, 483, 537