

Brachiopod-substrate relationships on the continental shelf of the Faroe Islands (NE Atlantic)

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Abstract

Six brachiopod species have been recorded in the BIOFAR-material. The Faroese brachiopods are epibenthic suspension feeders living attached or cemented to different kinds of firm substrates, including both other brachiopod species and conspecific individuals. The brachiopod-substrate relationships are elucidated by comparing geographical distributions with the nature of the seabed and by recording the substrate of individuals in recovered samples. It is concluded that the dominant substrate is stones, i.e. gravel and pebbles. Different brachiopod species can be recovered from the same location. Juvenile individuals and small species are often found attached to older individuals and/or larger species.

Introduction

In connection with the investigation of the BIOFAR brachiopod material by Thomsen (2001), the earlier records of the group around the Faroe Islands were critically surveyed. The BIOFAR brachiopod fauna was found to comprise six species: *Crania anomala* (Müller, 1776), *Hemithiris psittacea* (Gmelin, 1790) – one empty shell, *Terebratulina retusa* (Linné, 1758), *Platidia anomioides* (Scacchi and Philippi, 1844), *Dallina septigera* (Lovén, 1846),

and *Macandrevia cranium* (Müller, 1776). Two species, *Terebratulina septentrionalis* (Couthouy, 1838) and *Glaciarcula spitzbergensis* (Davidson, 1852), previously recorded by Wesenberg-Lund (1940; 1941) were not present in the BIOFAR material.

Thomsen (2001) analysed the biogeography of the Faroese brachiopods by comparing their geographic distributions with bathymetric records, temperature conditions, current regimes and water mass. It was found that only one species (*P. anomioides*) seems to be geographically restricted, occurring primarily on the banks. The other species have a general preference for depths between 200 and 500 m. The BIOFAR brachiopod species are mostly confined to Atlantic Water (temperature above 7 °C), but a mixture of Atlantic Water and Arctic Intermediate Water with a temperature above 6 °C is also important.

This paper investigates the substrate relationships on the basis of the BIOFAR material.

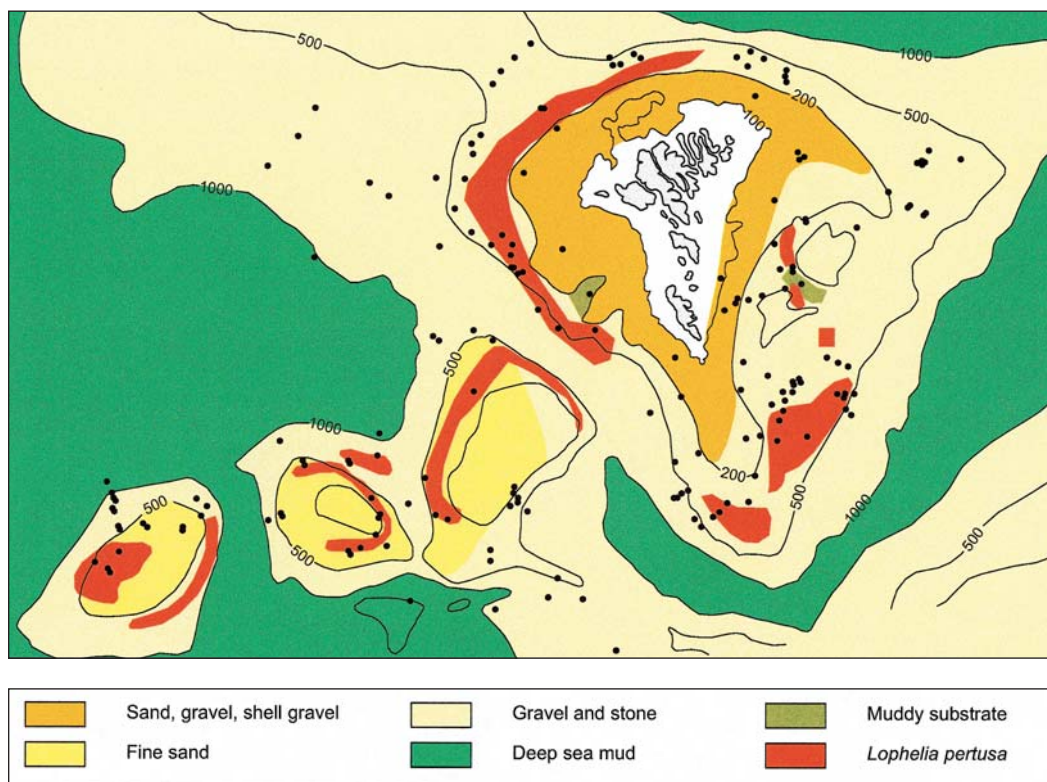


Fig. 1. Modified map of bottom types with location of all BIOFAR stations from which brachiopods were recovered.

Material and methods

The main part of the BIOFAR material was recovered by the Faroese R/V "Magnus Heinason" and the Norwegian R/V "Håkon Mosby" using benthic sampling gear (Tendal *et al.*, 2005). It was sorted first by the staff of the Kaldbak Marine Laboratory near Tórshavn, and then identified by the author (Thomsen, 2001). The list of the BIOFAR stations gives position, depth, gear, estimated bottom temperature, water mass, estimated current and seabed sediment (Nørrevang *et al.*, 1994). The substrate characterisations in the latter refer-

ence should be viewed in relation to the gear used, as finer grain sizes may have been winnowed away during recovering of the samples. The samples are stored at the Museum of Natural History in Tórshavn.

For clarifying the distribution in relation to sediment- and bottom types in the wider sense, a map recently compiled from many sources by Bruntse and Tendal (2001) was used. The map, which has been somewhat modified by the author, is crude and schematic, but represents the best base at present.

The substrate of each individual can vary

| SPECIES | NUMBER OF STATIONS | NUMBER OF INDIVIDUALS | | |
|-----------------------------|--------------------------|-----------------------|-------------------|-------|
| | | LOOSE DEAD | WITH SUBSTRATE | TOTAL |
| <i>Crania anomala</i> | 41 | 27 / 0 | 195 | 222 |
| <i>Hemithiris psittacea</i> | 1 | 1 / 0 | - | 1 |
| <i>Terebratulina retusa</i> | 125 | 328 / 45 | 693 | 1066 |
| <i>Platidia anomioides</i> | 6 | 5 / 0 | 3 | 8 |
| <i>Dallina septigera</i> | 75 | 115 / 17 | 520 | 652 |
| <i>Macandrevia cranium</i> | 157 | 672 / 99 | 2008 | 2779 |
| TOTAL | 187 | 1148 / 161 | 3419 | 4728 |

Fig. 2. Recovered BIOFAR brachiopod species, number of BIOFAR stations and number of individuals. Loose brachiopods are brachiopods recovered without substrate or remnants of such. Dead brachiopods are empty brachiopod shells.

often be accurately determined as brachiopods are regularly preserved either cemented or attached to the substrate by a pedicle.

Results and discussion

Distribution of brachiopods in relation to sediment- and bottom types/seabed

All the Faroese brachiopod species are sessile epibenthic suspension feeders, living either cemented or attached to a firm substrate by a pedicle. Hence the nature of the seabed is important when interpreting their distribution. Recovering of specimens from soft-bottom environments are rare. These finds may be related to ice-rafted pebbles serving as substrates or to winnowed shells

of dead brachiopods providing substrates for younger generations of living brachiopods. Such clusters or "nests" of brachiopods have e.g. been described from an entirely soft bottom off North Norway (Thomsen, 1989; 1990). Off the Faroe Islands they were observed on underwater photographs on a seabed of gravel (Tendal, pers. com.; 2005).

Figure 1 shows the location of all the stations from which brachiopods were recovered on a map of bottom types compiled recently by Bruntse and Tendal (2001). Most stations yielding brachiopods are found in areas of gravel and stones. According to Bruntse and Tendal (2001) gravel and stones mixed with sand, and fine

sand are the most common sediment types around the Faroes from ca. 300 m depth to ca. 1,000 m.

Brachiopod – substrate relationships

Brachiopods were recovered from 187 BIOFAR stations (Fig. 1): *Crania anomala* was found at 41 stations, *Terebratulina retusa* at 125 stations, *Platidia anomioides* at 6 stations, *Dallina septigera* at 75 stations and *Macandrevia cranium* at 157 stations (Fig. 2). The material comprises 4,728 individuals including loose (1,148) or dead (161) specimens (Fig. 2). Five different kinds of gear were applied in recovering the material, but most was collected with a triangular sledge (ca. 52 %) or a detritus sledge (ca. 32 %) see Thomsen (2001).

A detailed study of the relationships between the brachiopods and their substrates has been carried out based on those individuals that were sampled attached to their substrate (including those where only fragments of recognizable substrates were adhering to the pedicles). Altogether this amounts to about 73 % of the material.

Crania anomala lives cemented to a sub-

strate. Fig. 3A shows that by far the most frequent substrate is stones, i.e. gravel and pebbles in a geological context. Shells of whole or fragmented bivalves, mostly *Astarte*, have also been recorded as substrate, but much less frequently.

The other brachiopod species all have a pedicle that attaches them to the substrate, e.g. stones, corals, shell debris, other brachiopods, e.g. conspecific individuals, serpulids and bivalves. With regard to *Terebratulina retusa*, the analysis shows (Fig. 3B) that stones, fragments of corals (*Lophelia*), other brachiopod species (*Macandrevia cranium* and *Dallina septigera*) and shell debris are common substrates. Juvenile individuals are very often attached to larger/older individuals of other brachiopod species in a somewhat cryptic manner, located towards the posterior part of the brachial valve. This position of attachment seems favourable for the survival of the adult, at least in the first period of attachment when the newly settled individuals are small and light. Doherty (1979) found that as the recruited brachiopods grow they become a burden for the larg-

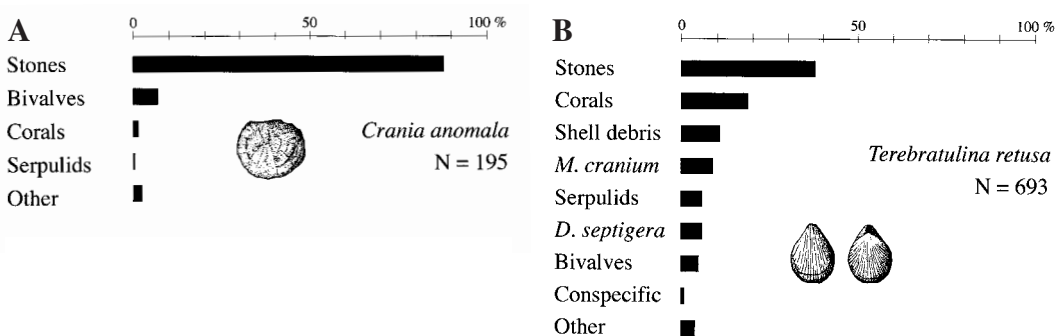


Fig. 3. Relationships between two brachiopod species and their substrates based on the BIOFAR material. A. *Crania anomala*, B. *Terebratulina retusa*.

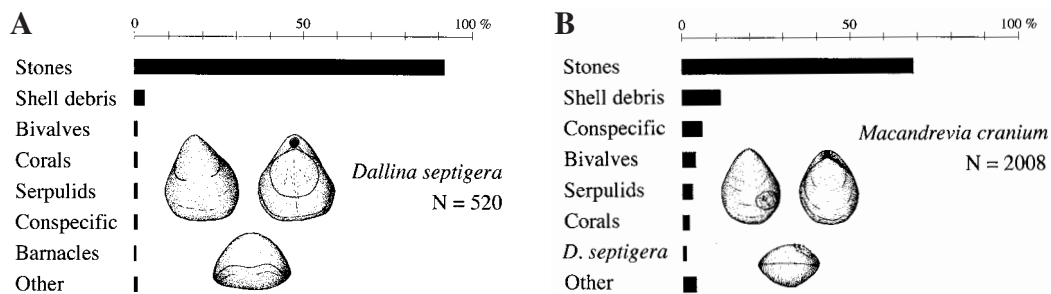


Fig. 4. Relationships between two brachiopod species and their substrates based on the BIOFAR material. A. *Dallina septigera*, B. *Macandrevia cranium*.

er/older conspecific and reduce its survival and consequently their own. Adult conspecifics attached to rocks appeared to have a higher survivorship.

As for *Dallina septigera* (Fig. 4A) more than 90 % of the individuals are attached to stones. Other kinds of substrates seem to be rare. *Macandrevia cranium* (Fig. 4B) also shows a "preference" (larval settlements of articulated brachiopods are random) for stones, but not as pronounced as for *Dalli-*

na septigera. Shell debris and other individuals of *Macandrevia cranium* (i.e. conspecific occurrences) are also important. Juvenile individuals are often attached to larger/older individuals which again may be attached to other, older individuals, thus constituting the clusters of brachiopods previously mentioned. *Platidia anomioides* was not included in this analysis due to insufficient material.

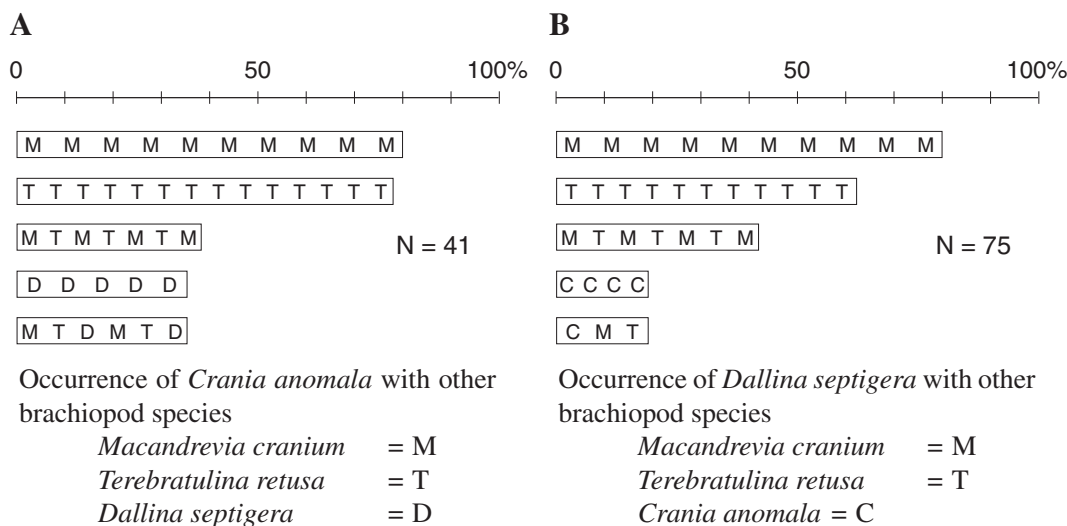


Fig. 5. Co-occurrence of brachiopod species. A. *Crania anomala*, B. *Dallina septigera*.

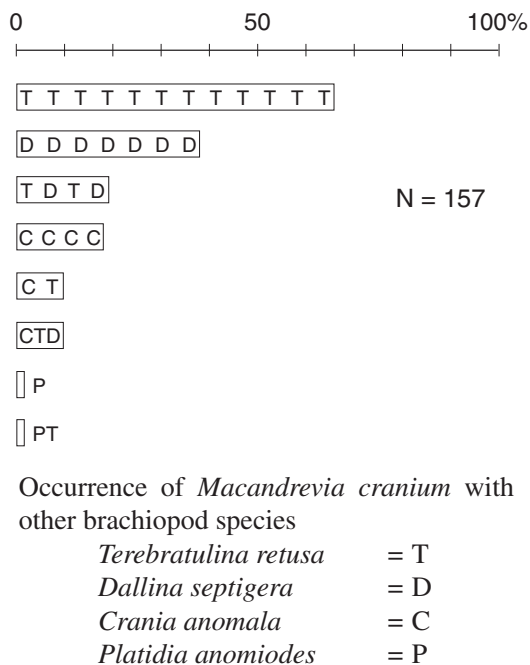


Fig. 6. Co-occurrence of brachiopod species *Macandrevia cranium*.

Co-occurrence of brachiopod species

The occurrence of brachiopods with other brachiopod species, i.e. recovered from the same station, has also been studied with regard to *Crania anomala*, *Dallina septigera* and *Macandrevia cranium*. Figure 5A demonstrates that *Crania anomala* occurs most frequently with *Macandrevia cranium* and *Terebratulina retusa* and less frequently with *Dallina septigera*. This probably reflects the fact that the latter mostly is living at greater depths than *Crania anomala*. As for *Dallina septigera* (Fig. 5B) it occurs most often with *Macandrevia cranium* and *Terebratulina retusa*. Juvenile/young *Macandrevia cranium* and *Terebratulina retusa* are often found attached to

larger *Dallina septigera*. *Macandrevia cranium* (Fig. 6) occurs most frequently with *Terebratulina retusa* the latter most often living attached to the former.

Conclusion – "like plums on their stems"

Thomson (1874) gave the first description of the relationship between brachiopods and substrate on the continental shelf off the Faroe Islands: "The bottom was chiefly small rounded pebbles of the dark aname-site of the Faroes, and sticking to them, singly or in little groups like plums on their stems, were many large specimens of the rare brachiopod *Terebratula cranium*, O.F. Müller, along with abundance of the commoner form *Terebratulina caput-serpentis*, L." (note: *T. cranium* = *M. cranium*; *T. caput-serpentis* = *T. retusa*). The present study has confirmed this description, the dominant substrate for the Faroese BIO-FAR brachiopods are stones (i.e. gravel and pebbles). Additional substrates are corals (*Lophelia*), shell debris, other brachiopods (including conspecific individuals), serpulids and bivalves.

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References

- Bruntse, G. and Tendal, O.S. 2001. *A bibliography of benthic marine invertebrates of the Faroese Economic Exclusive Zone*, In: Bruntse, G. and Tendal, O.S. (eds). *Marine biological investigations and assemblages of benthic invertebrates from the Faroe Islands*. Kaldbak Marine Biological Laboratory, the Faroe Islands, 80 pp.
- Doherty, P.J. 1979. A Demographic Study of a Subtidal Population of the New Zealand Articulate Brachiopod *Terebratella inconspicua*. *Marine Biology* 52: 331-342.
- Nørrevang, A., Brattegard, T., Josefson, A.B., Sneli, J-A. and Tendal, O.S. 1994. List of BIOFAR stations. *Sarsia* 79: 165-180.
- Tendal, O.S., Brattegard, T., Nørrevang, A. and Sneli, J-A. 2005: The BIOFAR 1 programme: background, accomplishment, and some outcome from inter-Nordic investigations around the Faroe Islands (NE Atlantic). *BIOFAR Proceedings 2005*: 9-32.
- Thomsen, E. 1989. *Aspects of macrofaunal preservation, stratigraphy and palaeoecology in Late Quaternary continental shelf sediments off northern Norway*. Dr. scient. Thesis. University of Tromsø. 170 pp.
- Thomsen, E. 1990. Application of brachiopods in palaeoceanographic reconstructions; *Macandrevia cranium* (Müller, 1776) from the Norwegian shelf. *Boreas* 19: 25-37.
- Thomsen, E. 2001. Brachiopoda in the Faroe Islands area. *Froðskaparrit* 49: 109-126.
- Thomson, C.W. 1874. *The Depths of the Sea*. London. 2nd. Edition, 527 pp.
- Wesenberg-Lund, E. 1940. Brachiopoda. *The Zoology of the Faroes* 3, 1: 1-8.
- Wesenberg-Lund, E. 1941. Brachiopoda. *The Danish Ingolf Expedition* 4, 12: 1-17.