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Regional and temporal changes in epizoobiontic bryozoan-communities of *Flustra foliacea* (Linnaeus, 1758) and implications for North Sea ecology

F. Bitschofsky [a,*], S. Forster [b], J. Scholz [c]

[a] LOEWE, Biodiversity and Climate Research Centre (BiK-F) Senckenberganlage 25, D-60325 Frankfurt am Main, Germany
[b] University of Rostock, Institute of Biological Sciences, Marine Biology, Albert-Einstein-Straße 3, 18059 Rostock, Germany
[c] Senckenberg Research Institute and Natural History Museum, Section Marine Evertebrates III, Senckenberganlage 25, 60325 Frankfurt, Germany

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ABSTRACT

Until recently, bryozoans have not been used as indicators for changes in bottom communities or climate control in the North Sea Basin, despite a 200-year history of bryozoan collecting. The epizoobiontic bryozoan fauna of *Flustra foliacea* (Linnaeus, 1758) was analysed on 51 sample stations kept in four German museums. The samples cover the entire North Sea and different time periods (1776–2008, mainly the period of 1904/1905 compared to 1980–87). Cluster analysis shows a differentiation into a northern and a southern North Sea assemblage. The northern assemblage is characterized by *Amphiblestrum flemingii* (Busk, 1854), *Callopora dumerilii* (Audouin, 1826) and *Tricellaria ternata* (Ellis & Solander, 1786), while the southern North Sea is characterized by *Electra pilosa* (Linnaeus, 1767), *Crisia eburnea* (Linnaeus, 1758) and *Plagioecia patina* (Lamarck, 1816). Spatial separation approximately follows the 50 m depth contour. The temporal distribution patterns of bryozoans are discussed in terms of NAO (North Atlantic Oscillation) and temperature variations.

1. Introduction

Bryozoans are an important part of sessile epifauna in marine habitats (Hayward and Ryland, 1985) and they have been established as an excellent group for the study of ecology or coastal pollution (Soule and Soule, 1981). Their colonies show many distinct shapes, various colony forms and growth strategies. Furthermore, large numbers of encrusting species are able to coexist, even though they are often in direct competition for settling space and food (Jackson, 1979; Ward and Thorpe, 1991). Most marine bryozoans have precipitated calcium carbonate skeletons since the Lower Ordovician (Taylor and Ernst, 2004). As a calcifying biomat, erect or laminar bryozoans are able to cover large areas with relatively small investments of biomass. Thereby they form substrata attractive to both micro- and macro-organisms such as hydroids, barnacles, and other bryozoans. As with coral reefs, bryozoans can increase substratum complexity and diversity for sessile epizoic communities (Cuffey, 1973, 1977; Sterflinger et al., 2001). While producing skeletal material, bryozoans are rarely alone as often they are found associated with some organisms but not with others. Certain marine bryozoan species preferably grow on certain species of seaweed, on other bryozoans or are attached to certain types of gastropod shells (Cuffey, 1970). Living bryozoans are commonly observed as “epizoans” (growing on animal hosts) (Hageman et al., 2000, with review of literature). Schopf (1969) reported that 25–50% of bryozoans, whose substrata could be determined, are commonly observed as epizoans. “Epizoan” or the synonymous epizoite is generally used for organisms attached to a living host animal, a habitat referred to as “epizooism” (Taylor and Wilson, 2003, with review of literature). Paleontologists have usually designated epizoans as organisms that are attached to dead animal substrata, or even plant substrata. Therefore, Taylor and Wilson (2003) suggested the term epizoobiont to replace epizoan. In the present study on *Flustra foliacea* from various North Sea stations, the new term is applied.

This work analyses the epizoobiontic assemblage present on the North Sea bryozoan *Flustra foliacea* (Linnaeus 1758) which has been found over decades in abundance at various depths throughout the North Sea Basin. The very conspicuous colonies have long been attractive to amateur and professional collectors and are thus abundantly present in many museum collections. More than any other bryozoan species from the North Sea Basin, museum specimens of *F. foliacea* now form a valuable research resource for any study on temporal changes in their given habitats. Individual colonies may grow for more than 12 years and form bushy clumps up to 20 cm in diameter. Thereby they provide a reasonable stable

* Corresponding author.
E-mail address: bryozoa@bitschofsky.de (F. Bitschofsky).

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and perennial substratum for various epizoobionts, many of them other bryozoan species (Stebbing, 1971a, 1971b; Menon, 1975; Hayward and Ryland, 1998). The colonies are built of palmate fronds, which are divided into broad terminally rounded lobes. In its first year of growth, *F. foliacea* form flat incrustations and then changes to erect growth in the second year. The colonies grow seasonally from March to September and stop growing from October to February. This cessation of growth is marked by annual growth check lines across the surface of the frond (Stebbing, 1971b). *Flustra foliacea* is a cold temperate and boreal species occurring from the Barents Sea, Greenland and the Kara Sea, south as far as the Bay of Biscay but probably not into the Mediterranean. *Flustra foliacea* occurs on coarse bottoms in the sublittoral zone and it is most frequent in areas with strong currents. It is generally abundant around the British Isles and throughout the North Sea (Hayward and Ryland, 1998). In general, the epizoobiontic

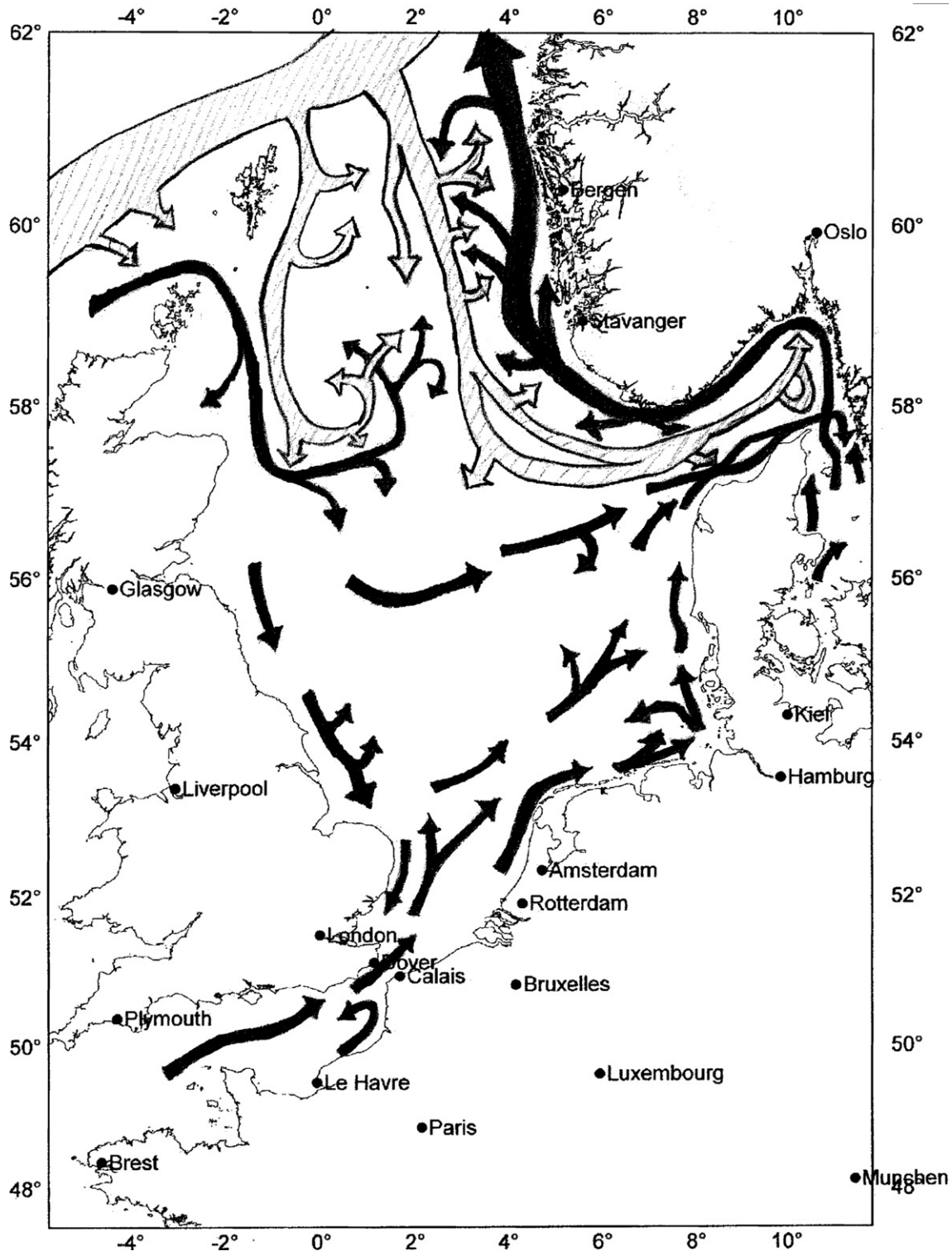

Fig. 1. Simplified current system of the North Sea. Width of arrows indicates magnitude of volume transport, shaded arrows – pure Atlantic water (redrawn after Turrell, 1992).