The ecology of macrozoobenthos in Århus Bay, Denmark

Thesis submitted for the Degree of Doctor of Philosophy

University of Stirling

by

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To my parents

Bente and Christian Fallesen

Declaration

The work reported in this thesis is the result of my own investigations carried out at Natur og Miljøkontoret, Århus Amt, Denmark. It has not been nor will be submitted concurrently in candidature for any degree, in this or any other university.

Grethe Fallesen

Grethe Fallesen

Abstract

The aim of this thesis has been to:

1) assess the state of pollution in the two study areas and relate them to recent changes found in the Kattegat - Belt Sea area;
2) examine the observed spatial and temporal variability in species composition, abundance and biomass in Århus Bay and the Fornæs area and relate the variability to antropogenic and natural causes;
3) discuss and assess methods, particularly for the estimation of secondary production and the use of multivariate analyses as methods for examining changes in macrozoobenthic communities.

Macrozoobenthos were sampled at 15 stations in Århus Bay, Denmark from 1985 to 1991 while data from Fornæs (reference area) included 55 sampling stations from 1986 to 1990. Monthly sampling took place at one station in Århus Bay in 1990 and 1991. The two study areas are both situated on the eastcoast of Jutland in the Kattegat - Belt Sea area at 13-17 m depth and both receive waste water from long sea outfalls. Although both areas are subjected to salinity stratification for most of the year, the exposed position of the Fornæs area on the open Kattegat coast prevents it from suffering from severe oxygen deficiencies, unlike the Århus Bay which is a sheltered, semi-enclosed sedimentation area where oxygen concentrations in the bottom water can be very low. At Fornæs the sediment is sandy while it is silty in Århus Bay.

The spatial and temporal variability in the benthos in Århus Bay could to a great extent be explained by the variation in 7 important species: *Abra alba*, *Corbula gibba, Mysella bidentata, Nepthys hombergii, N. ciliata*, *Ophiura albida* and *Echinocardium cordatum*.

The fluctuations in the number and biomass of *A. alba* had a pronounced effect on the total abundance and biomass in Århus Bay. The severe winter of 1986/87 with low temperatures and oxygen depletion under the ice cover practically eliminated *A. alba* from the bay. *A. alba* quickly recolonized the area and was found in high numbers in 1988. Studies of growth of *A. alba* in 1990 and 1991 showed that by the end of 1990 the population had reached an average length of 10 mm while the average shell length was only 5 mm by the end of 1991. The difference between the two years could be attributed to the difference in sedimentation of phytoplankton from the water column.

As in other parts of the Kattegat - Belt Sea area, Århus Bay has experienced low oxygen concentrations in the bottom water in late summer early autumn throughout the 1980s. Only the oxygen depletion under the ice cover in early spring 1987 and the local oxygen deficiencies south of the outlet in 1989 and 1990 actually killed parts of the benthic fauna. Apart from 1981, the oxygen deficiencies have thus been less severe in Århus Bay than in other parts of the southern Kattegat in the 1980s.

The number of species, abundance and biomass decreased at Fornæs from 1980 to 1985 while the discharge of BOD was fairly constant during the same period. From 1986 there was a slight decrease in the discharge of BOD but a considerable increase in the number of species, abundance and biomass. At least for the second half of the 1980s there was no straightforward relation between the organic enrichment from the outlet and species composition, abundance and biomass and suggests that other factors are also important influencing the fluctuations in the benthic fauna.

Estimates of total secondary community production were found to be very dependent on the method used. The method described by Brey (1990) was found acceptable for estimating secondary production in Århus Bay but care should be exercised when comparisons are made with other areas where different methods have been used to estimate production. Secondary production was estimated more accurately for some of the abundant species in Århus Bay on the basis of monthly samplings by the method described by Crisp (1984).

Among the multivariate analyses the Detrended Correspondence Analysis (DCA) and non-metric Multidimensional Scaling (MDS) proved to be the most successful with the Århus Bay and Fornæs data sets.Two Way INdicator SPecies ANalysis (TWINSPAN) did not work well with the Fornæs data because it imposed discontinuities on data sets with continous variation in distribution of species among samples. As community types existed to a certain degree in Århus Bay TWINSPAN worked well with these data.

DCA and MDS were found to be useful techniques for analysing large data sets because they can summarize the data matrices to a manageable form and find possible patterns in the data sets. The results of the analyses can then be used as starting point for more detailed investigations of single species/samples or groups of species/samples. By using different transformations of the raw data the role of dominant or rare species can be assessed. A major problem in the assessment of multivariate techniques is the lack of external standards to compare with. The results of multivariate analyses must therefore be assessed critically on the basis of a careful examination of the species list combined with the knowledge and experience of the investigator.

The methods used all had their advantages and limitations but each of the different methods added some important information to the picture of the benthic community in Århus Bay and Fornæs. It was thus an considerable advantage to use several different methods to analyse the spatial and temporal variability in the benthic fauna in relation to antropogenic and natural causes.

Acknowledgement

I wish to thank Jytte Heslop, Director of Natur og Miljøkontoret, Århus Amt, for giving me the opportunity to undertake this work and for financial support. Jytte Heslop's pioneer work in monitoring investigations in Denmark has been a great source of inspiration throughout the sampling and study period. I am also grateful to Kurt Nielsen, Head of Hav og Kyst Afdelingen, Århus Amt, for his support and understanding during the study period.

I am most grateful to my supervisors Dr Donald McLusky, Stirling University, and Dr Tom Pearson, SEAS, for their interest in my work, for inspiring and stimulating discussions and for valuable comments on the manuscript. I also wish to thank Dr David Newberry, Stirling University, for introducing me to multivariate analysis. To Dr Richard Warwick, Plymouth Marine Laboratory, my most sincere thank for teaching me the programme PRIMER. I also like to thank Steven Hull and the Forth River Purification Board for use of their computer system and sediment laboratory.

I am also indebted to laboratory technician Jytte Hørning and students from Århus University who have carefully and with great enthusiasm helped collecting, sorting and identifying macrozoobenthos over the years. I also wish to thank the crews on "Tyrfing", "Genetica" and "Irene" for their collaboration and help. Thanks to Hanne Schmidt, Juana Jacobsen and Poul Henning Jensen for invaluable help with graphs and drawings. I am also grateful to Stig Mikkelsen for assistance and support concerning the database RAMBI. Thanks to Jonna Mosgaard for taking good care of "my" job while I was in Scotland.

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Table of content

Appendices *224*

1. Introduction

The present study is based on data collected from monitoring surveys carried out in Århus Bay and at Fornæs (figure 1.1) by the Environmental Office, County of Århus, Denmark. The Environmental Office is responsible for the monitoring of the coastal areas of the county. Both study areas are popular tourist and recreational areas where people enjoy bathing, fishing and all kinds of water sport. Commercial fishing also takes place in the areas. The establishment of long sea outfalls in the 1970s therefore caused great public concern about the impact of pollution on the environment in Århus Bay and Fornæs. This led to numerous investigations in the two areas and eventually to improved treatment of the waste water.

A very important consequence of the many investigations has been the establishment of long-term data series. The monitoring surveys have included investigations of hydrography, water chemistry, phytoplankton, sediment, macrobenthic vegetation and macrozoobenthos. The sampling intensity of these different factors has varied but macrozoobenthos has always been a substantial part of the monitoring programmes.

The author has been responsible for the monitoring of macrozoobenthos and sediments since 1985 but has also taken part in sampling and data treatment of hydrographic and water chemical data. The present study is mainly based on data from Århus Bay 1985 to 1991 but data from Fornæs 1986-1990 have also been used.

Monitoring of benthos in the Kattegat - Belt Sea area

There is a long tradition for studies of macrozoobenthos[1] in Kattegat - Belt Sea area. The quantitative study of macrobenthos was initiated by C.G.J. Petersen in 1910. His aim was to assess the amount of potential food for the fish stocks, and he and his colleagues therefore carried out numerous quantitative samplings of benthos in the Kattegat, the Belt Sea, the Sound and many fjords from 1910 to the 1930s (Petersen & Boysen Jensen, 1911, Petersen 1913, 1918, Blegvad 1930). From c 1970 onwards macrobenthic investigation in the Kattegat - Belt sea area has mainly focused on the impact of enhanced nutrient emission and discharge of waste water.

The reasons why benthic macrofauna has become a popular target for studies of eutrophication and routine monitoring of biological effects of discharge of waste water are the following:

- most species are long-lived (> 1 year) and sedentary which can provide a measure of pollution effects integrated over time;
- they are amenable to quantitative sampling;
- most species are relatively easy to identify, compared with meio- and microfauna;
- they are fairly well studied scientifically and their response to organic enrichment is to some extent predictable;
- they are important as fish food.

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[1]The exact definition of macrobenthos have been subject of continuing debate. Some researchers suggest that macrofauna should be separated from meiofauna by means of a 0.5 mm sieve (Eleftheriou & Holme 1984). In the present study macrofauna is defined as > 1 mm according to the standard recommended by The Baltic Marine Biologists.

The monitoring investigations in the Kattegat - Belt Sea area have shown that important changes have taken place in the macrobenthic communities in the area during the last 20 years (Baden *et al.* 1990, Ærtebjerg *et al.* 1990). The changes can roughly be divided into two trends: 1) a reduction in the benthic fauna caused by adverse oxygen conditions 2) an increase in the benthic biomass caused by enhanced food supply. The two trends will be described in more detail below together with a brief description of other recent changes in the Kattegat - Belt Sea.

The two study areas, Århus Bay and Fornæs (figure 1.1) are parts of the Kattegat - Belt Sea area and similar changes in the macrobenthic communities would therefore be expected. Both areas are subjected to discharge of organic matter from waste water and to

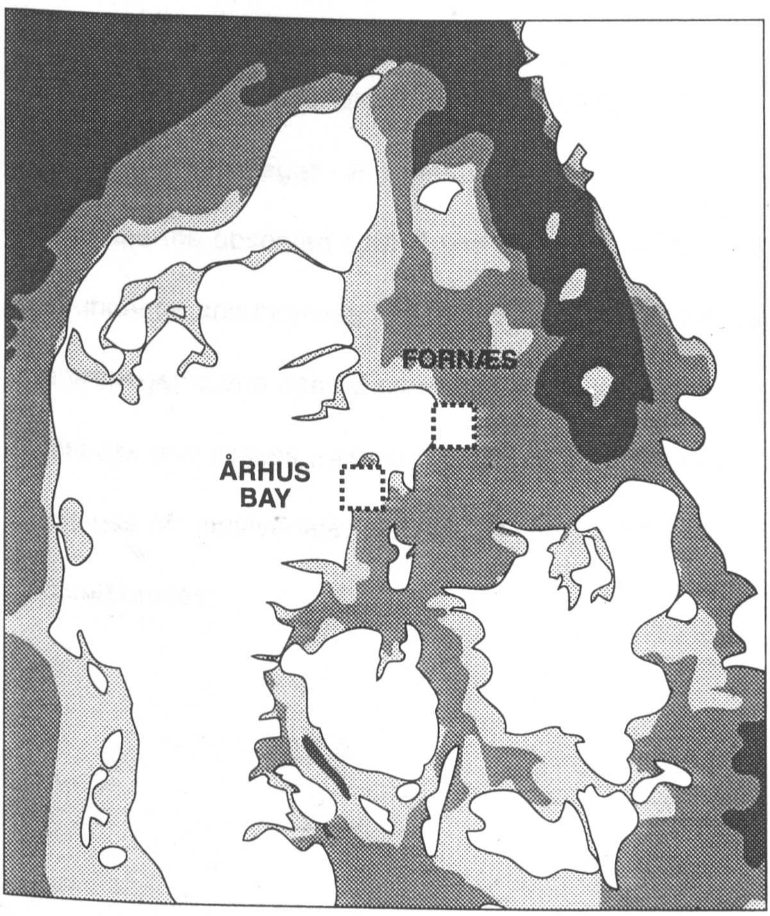


Figure 1.1
Map of the internal Danish waters with depths - 10 m and 30 m depths limits and the two study sites - Århus Bay and Fornæs.

the general eutrophication of the Kattegat - Belt Sea area. The two sampling areas are situated at the same depth but differ in their exposure to current and wave action, Århus Bay being a semi-enclosed sedimentation area with a silty bottom while Fornæs is open towards Kattegat and has a sandy bottom. Because of the differences between the two areas possible responses to organic enrichment, originating either from organic matter discharged through long-sea outfalls or from enhanced primary production, might be expected to differ.

Aims

The aim of this thesis is to:

1) assess the state of pollution in the two study areas and relate them to recent changes found in the Kattegat - Belt Sea area;
2) examine the observed spatial and temporal variability in species composition, abundance and biomass in Århus Bay and the Fornæs area and relate the variability to antropogenic and natural causes;
3) discuss and assess methods, particularly for the estimation of secondary production and the use of multivariate analyses as methods for examining changes in macrozoobenthic communities.

Recent changes in the Kattegat - Belt Sea area

Oxygen deficiencies

The first reported wide ranging oxygen depletion in the Kattegat-Belt Sea area took place in September 1981. The oxygen depletion killed demersal fish and benthic fauna in many Danish fjords and bays (Miljøstyrelsen 1984) and in Kiel Bay, Western Baltic (Weigelt & Rumohr 1986). During the 1980s oxygen deficiencies became the rule rather than the exception in many bays and fjords and in the southern part of the Kattegat (figure 1.2) (Rosenberg & Loo 1988, Ærtebjerg *et al.* 1990, Baden *et al.* 1990, Josefson & Jensen 1992a).

The catastrophic oxygen deficiency in 1981 could partly be explained by very unusual weather conditions. The winter of 1980/81 was one of the wettest in this century and consequently the terrestrial run-off of nitrogen was very high. This probably gave rise to enhanced primary production. The stratification was, moreover, very stable due to calm weather during the summer of 1981 and therefore the input of oxygen to the bottom water was very limited. However, no simple connection between weather and oxygen deficiency was found later in the 1980s when oxygen deficiencies became annual events in many parts of the Kattegat - Belt Sea area (Ærtebjerg *et al.* 1990). No statistically significant trends in meteorology and hydrography, causing reduced oxygen supply to the bottom water layer, could be established in either Kiel Bay (Babenerd 1991) or in the German Bight (Frey 1990) for the 1980s.

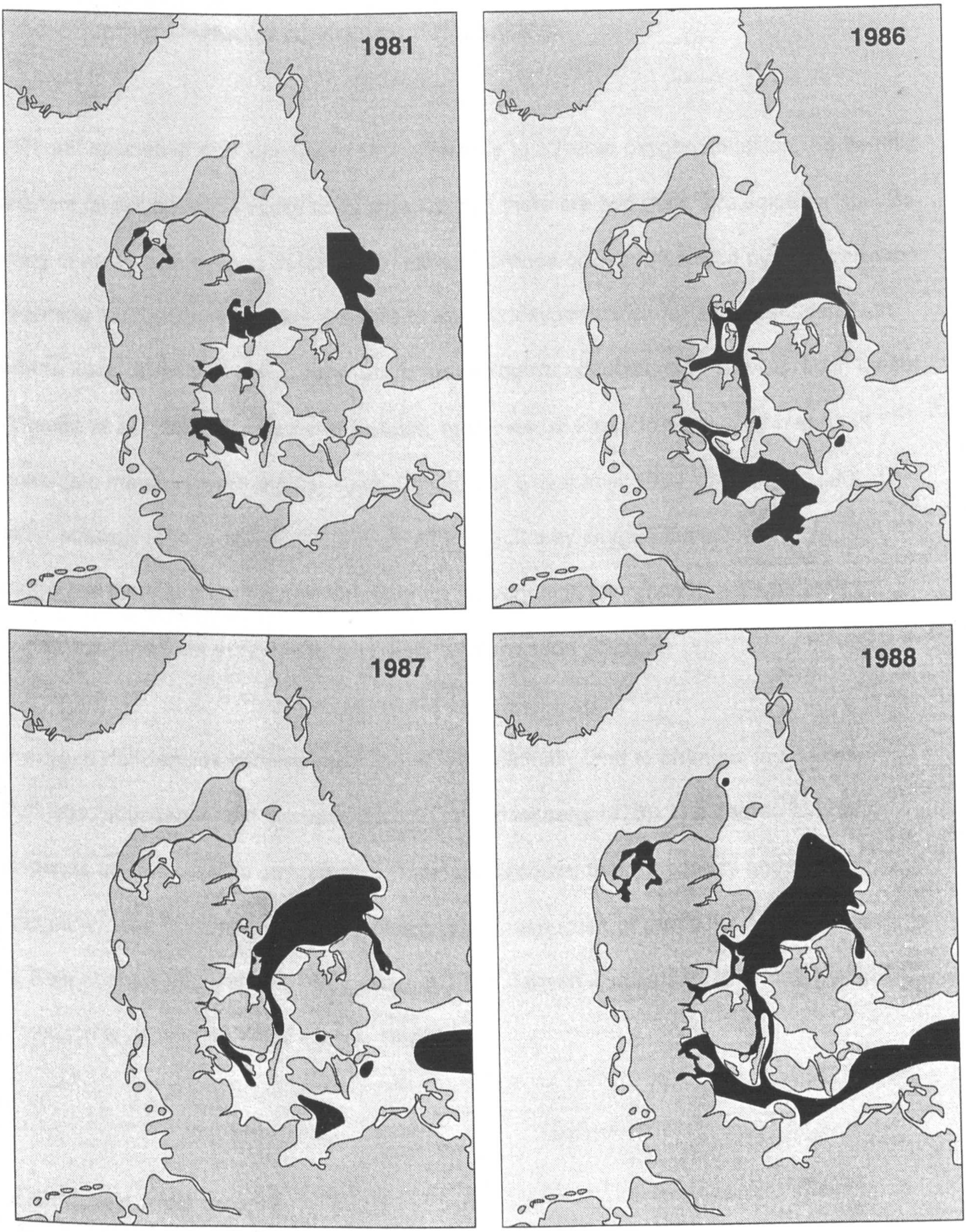


Figure 1.2
Spatial extent of oxygen deficiencies (< 2 mg O_2/l) in the 1980s (Ærtebjerg *et al.* 1990).

Macrobenthic response to oxygen deficiencies

Different species of macrobenthos react differently to adverse oxygen condition. As benthic animals do not have the ability to escape like fish there are two main strategies for species living in areas with oxygen deficiencies, either tolerance or death followed by recolonization (Varming 1988). Some species are able to tolerate oxygen deficit for short periods whilst others have developed behavioural and/or physiological adaptations to survive much longer (Theede *et al.* 1969). A number of species, moreover, are able to survive by means of anaerobic metabolism (Schöttler 1982, Schöttler & Grieshaber 1988, Oeschger 1990). The other strategy is to rapidly recolonize an area affected by oxygen depletion. Within both strategies there is a continuum from very low to very high tolerance to adverse oxygen conditions, and from very fast to very slow recolonization ability.

If oxygen deficiencies become recurring, it will eventually lead to changes in species richness, abundance and biomass (Pearson & Rosenberg 1978). The degree of change depends on how low the oxygen concentrations become, their frequency and duration, and can either lead to disappearence, displacement or reduction of particular species (Josefson & Rosenberg 1988, Varming 1988, Rachor 1990, Jensen & Josefson 1990, Weigelt 1991, Josefson & Jensen 1992a, Fallesen 1992).

Enhanced food supply

Large parts of the Kattegat area, especially the western and northern part including the Skagerak, have not suffered from oxygen deficiencies but instead experienced an increase of benthic biomass which is believed to be due to enhanced sedimentation of organic matter (Pearson *et al.* 1985, Josefson 1987, Jensen & Josefson 1990, Josefson 1990).

The observed increases in biomass are in accordance with the hypotheses that soft-sediment infauna in the area is food limited (Josefson, 1982), and that benthic biomass often increases in response to organic enrichment (Pearson & Rosenberg, 1978). The growth patterns of the dominant species, *Amphiura filiformis*, at three widely spaced sites at 55 to 100 m depth in the Skagerrak-Kattegat area during the period 1970 to 1989 support the hypothesis that the increased benthic biomass is caused by organic enrichment in this area (Josefson & Jensen 1992b). A number of studies from other areas, e.g. the Baltic near Gotland (Cederwall & Elmgren 1980), the German Bight (Rachor 1990) and the Dutch Wadden Sea (Beukema & Cadée 1986), have also related an increase in benthic biomass to enhanced primary production.

An increase in primary production and sedimentation of organic material during the last 2-3 decades is thus deduced from many benthic studies, while reliable direct data on primary production and sedimentation are scarce and, moreover, probably underestimate the primary production by at least 30% (Richardson & Christoffersen 1991). The increase in phytoplankton follows an increased input of nutrients to the Kattegat - Belts Sea area (Ærtebjerg *et al.* 1990).

The investigations in the Kattegat - Belt Sea area during the last 20 years have also revealed a drastic decrease in the catch of plaice, cod and lobster (ICES 1989, Baden *et al.* 1990) and increased frequency of mass occurrences of planktonic algae (Rosenberg 1990, Rosenberg *et al.* 1990, National Agency of Environmental Protection 1991).

The Danish Action Plan for the Aquatic Environment

The recurrent oxygen deficiencies and fish kills in the Kattegat - Belt Sea area during the

1980s gave rise to great public concern in Denmark. The concern culminated on the 8th of October 1986 when Danish television showed some stirring pictures of dead lobsters caught in the southern part of the Kattegat. The lobsters had died of oxygen deficiency. This event marked a turning point in the debate about the aquatic environment in Denmark. This was in many ways surprising because the death of the lobsters gave no new knowledge to the scientific debate about the aquatic environment (Varming *et al.* 1992).

The debate that followed the T.V. pictures lead to the "Action Plan for the Aquatic Environment" which was approved by the Danish Parlament in April 1987. The Action Plan was by no means the first initiative to reduce the environmental impact of emissions of nutrients and organic matter, but was the most strict, especially as far as agricultural emissions were concerned. The goals of the Plan were a reduction in the discharge of nitrogen and phosphorus to the aquatic environment of 50% and 80%, respectively, by 1993. The discharges of organic matter from waste water should also undergo considerable reductions. The Action Plan also caused reductions in the input of nutrients and organic matter to the two study areas as described in chapter 2.

The content of the thesis

Chapter 2 comprises a presentation of the two study areas. The pelagic environment is described by means of hydrography, oxygen concentrations, fluorescence, primary production and the amount of zooplankton while the benthic environment is characterized by analyses of organic content in the sediment and particle size. The chapter also describes the input of nutrients and organic matter to Århus Bay and the Fornæs area.

Chapter 3 describes the spatial and temporal variability in the benthic fauna in Århus Bay and at Fornæs by means of species richness, abundance, biomass and distribution of abundance/biomass on taxonomic groups and trophic groups.

Chapter 4 focuses on population dynamics of some of the important species in Århus Bay: *Abra alba, Corbula gibba, Mysella bidentata, Nephtys hombergii, Nephtys ciliata, Ophiura albida* and *Echinocardium cordatum*. Fluctuations in the number and distribution of these important species are related to variations in environmental factors, especially oxygen conditions, severe winters and input of organic matter (waste water + phytoplankton).

In chapter 5 the total macrobenthic production is estimated for Århus Bay and compared with other areas. Different methods for the estimation of secondary production are assessed on the basis of production estimates of *Abra alba*. The usefulness of production estimates in monitoring programmes is discussed.

In chapter 6 the following multivariate analyses are presented: Principal Component Analysis (PCA), Detrended Correspondence Analysis (DCA), Canonical Correspondence Analysis (CCA), non-metric Multidimensional Scaling (MDS) and Two Way INdicator SPecies ANalysis (TWINSPAN) and applied to species and environmental data from Århus Bay and Fornæs. The spatial and temporal patterns and trends found in the data sets by the analyses are discussed, together with an assessment of the different multivariate techniques.

Chapter 7 summarizes the discussions and conclusions from the preceding chapters. The summary is then the basis for an assessment of the state of pollution in the two study areas, Århus Bay and Fornæs. Similarly the summary is the basis for a comparison and discussion of different data treatment methods.

2. Description of Århus Bay and Fornæs

Introduction

The aim of this chapter is to describe factors affecting macrobenthos in Århus Bay and Fornæs. The description comprises the following factors:

- hydrography
- temperature and salinity
- input of nutrients and organic matter
- phytoplankton
- oxygen conditions
- sediment

The chapter focuses on the period 1985-1991, although important events before this period will be refered to when necessary.

The hydrography of Århus Bay and Fornæs

The hydrographic conditions of the Kattegat-Belt Sea area, including Århus Bay and Fornæs (figure 2.1) are mainly determined by the outflow of low salinity Baltic water in the surface and a compensatory inflow of high salinity Skagerak water in the bottom. As a consequence of the differences in salt content the two water bodies are separated from each other by a halocline. A gradual mixing of the two water bodies takes place in the Kattegat-Belt Sea and gives rise to a water body with medium salinity - Kattegat water (figure 2.2). The salinity stratification in the southern Kattegat usually consists of two layers

- either Baltic water and Kattegat water or Kattegat water and Skagerak water. However, a three-layer stratification is not uncommon at Fornæs (Århus Amt 1993a).

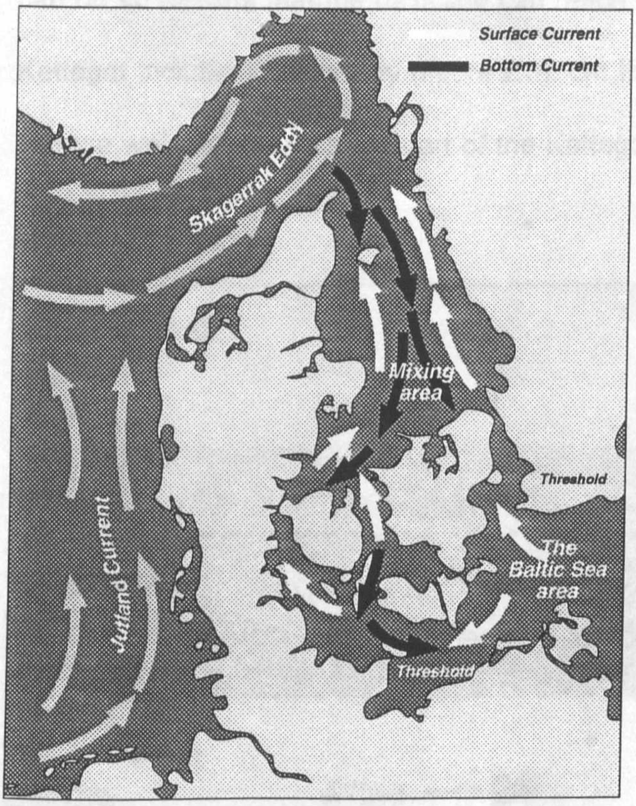


Figure 2.1
Map showing the main current patterns in Danish marine waters.

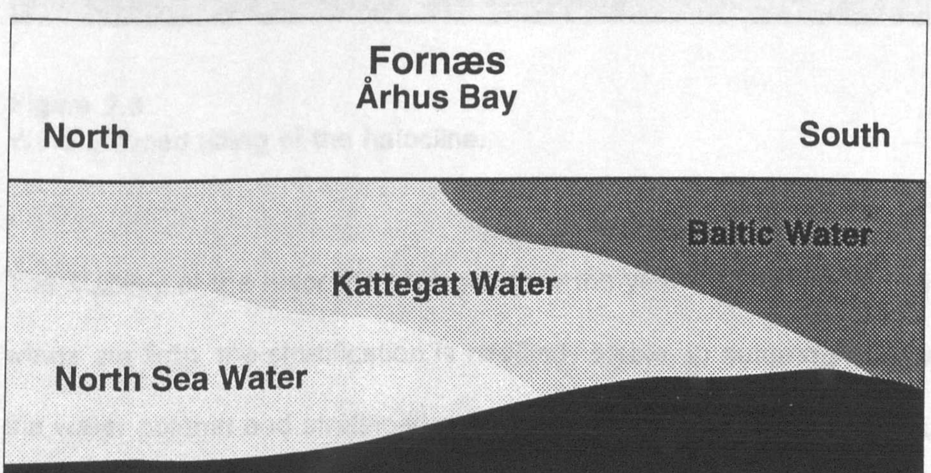


Figure 2.2
Stratification of the water column in southern Kattegat.

The vertical position of the halocline is strongly influenced by meteorological conditions like wind and atmospheric pressure. If the wind comes from the west the surface water will be pushed southward and eastward in the Kattegat which makes the halocline tilt. This tilting can be so forceful that the halocline can reach the surface in the western part of the Kattegat including Århus Bay (figure 2.3). On the other hand an easterly wind will push the surface water to the western part of the Kattegat and depress the halocline (Århus Amt, 1990a).

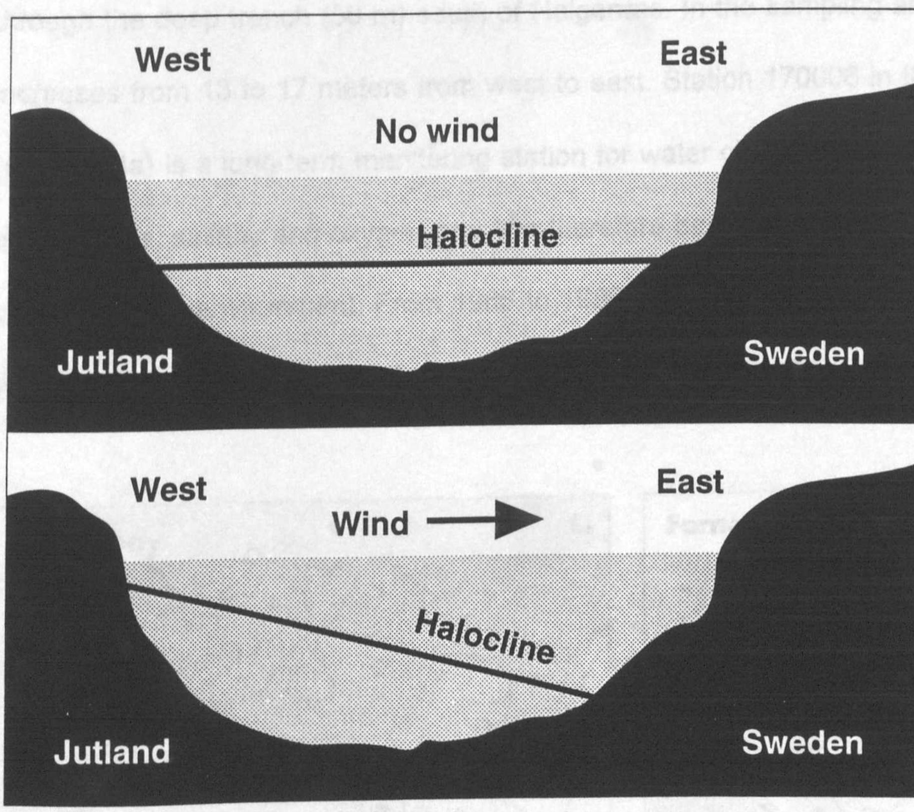


Figure 2.3
Wind induced tilting of the halocline.

The stability of the halocline changes over the year. During late spring and summer where winds are light, the stratification is relatively stable. In autumn strong winds cause mixing of the water column and stratification only occurs occasionaly during autumn and winter.

The tidal amplitude is only about 20 cm in the south west Kattegat and is of far less importance for the water level than the wind. Strong westerly winds lead to a high water level in Århus Bay and Fornæs because water from the Skagerak is pushed into the Kattegat, while, conversely, strong easterly winds cause low water levels.

The position and semi-enclosed shape of Århus Bay shelter it from a direct exposure from the Kattegat and from the strong current through the Belt Sea (figure 1.1). The current patterns in Århus Bay are very complicated and depend primarily on the hydrographic conditions in the southern Kattegat. Water exchange with the Kattegat takes place mainly through the deep trench (50 m) south of Helgenæs. In the sampling area depth gently increases from 13 to 17 meters from west to east. Station 170006 in the centre of the bay (figure 2.4a) is a long-term monitoring station for water chemistry and measurements of temperature, salinity and oxygen and has therefore been used to illustrate the fluctuations in the physical environment. From 1986 to 1989 data were collected monthly at stn. 170006 while weekly samplings took place in 1990 and 1991.

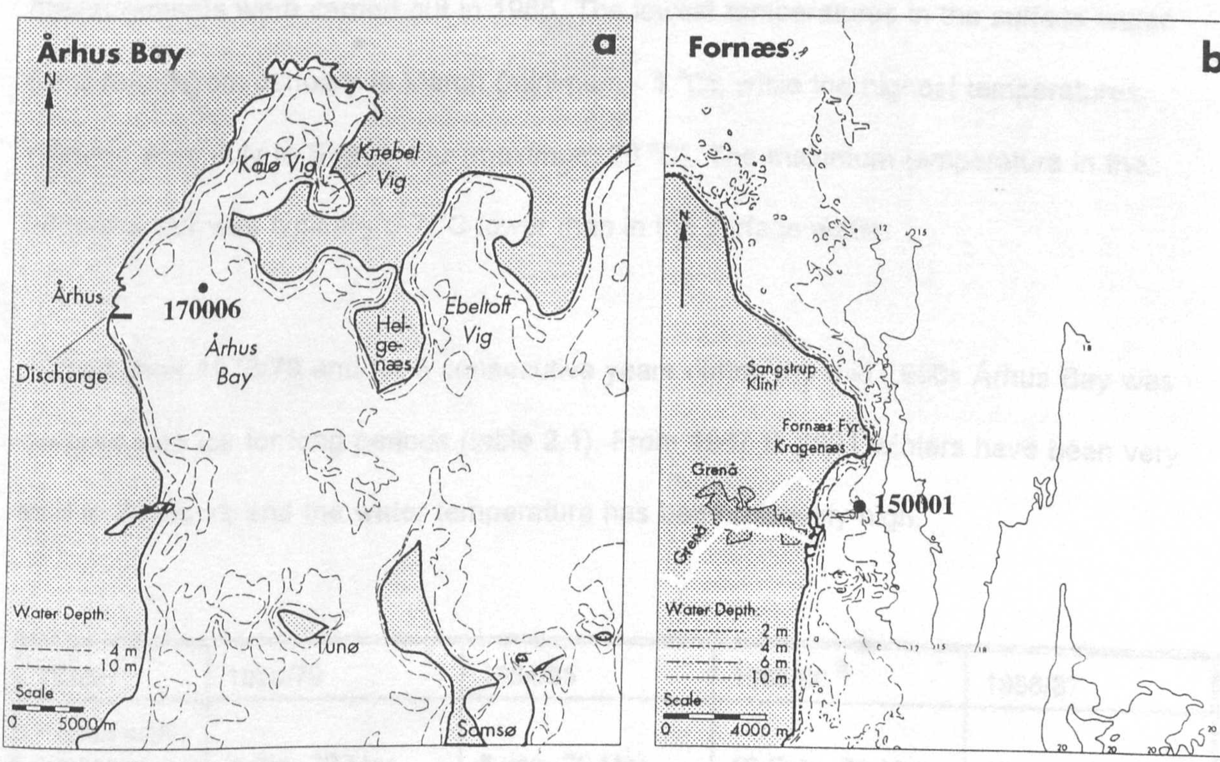


Figure 2.4
a) Århus Bay with water sampling stn. 170006.
b) The Fornæs area with water sampling stn. 150001.

Contrary to Århus Bay, the Fornæs area is situated completely exposed to wind and wave action from the Kattegat (figure 1.1). The strong current in the area is mainly northerly. Depth gradually increases from 13 to 17 meters in the sampling area apart from the south eastern corner where depth reaches 20 meters. Hydrographic measurements have taken place monthly at station 150001 (figure 2.4b) during the period 1989-1991.

Temperature and salinity

Århus Bay

The distribution of temperature throughout the water column at stn. 170006 is shown in figure 2.5 for Århus Bay from 1986 to 1991 (Århus Amt, 1990a, 1991b, 1992a). No measurements were carried out in 1985. The lowest temperatures in the surface water were found from January to March (minimum - 1 °C), while the highest temperatures occured from July to September (maximum 20 °C). The maximum temperature in the bottom water was typically 5-7 °C lower than in the surface water.

In the winter 1978/79 and for 3 consecutive years during the mid 1980s Århus Bay was covered with ice for long periods (table 2.1). From 1987 to 1991 winters have been very mild in Denmark and the water temperature has been relatively high.

Winter	1978/79	1984/85	1985/86	1986/87
Period with ice cover	2 Jan.-20 Mar.	8 Jan.-20 Mar.	10 Febr.-21 Mar.	12 Jan.-27 Mar.

Table 2.1
Periods with ice cover in Århus Bay.

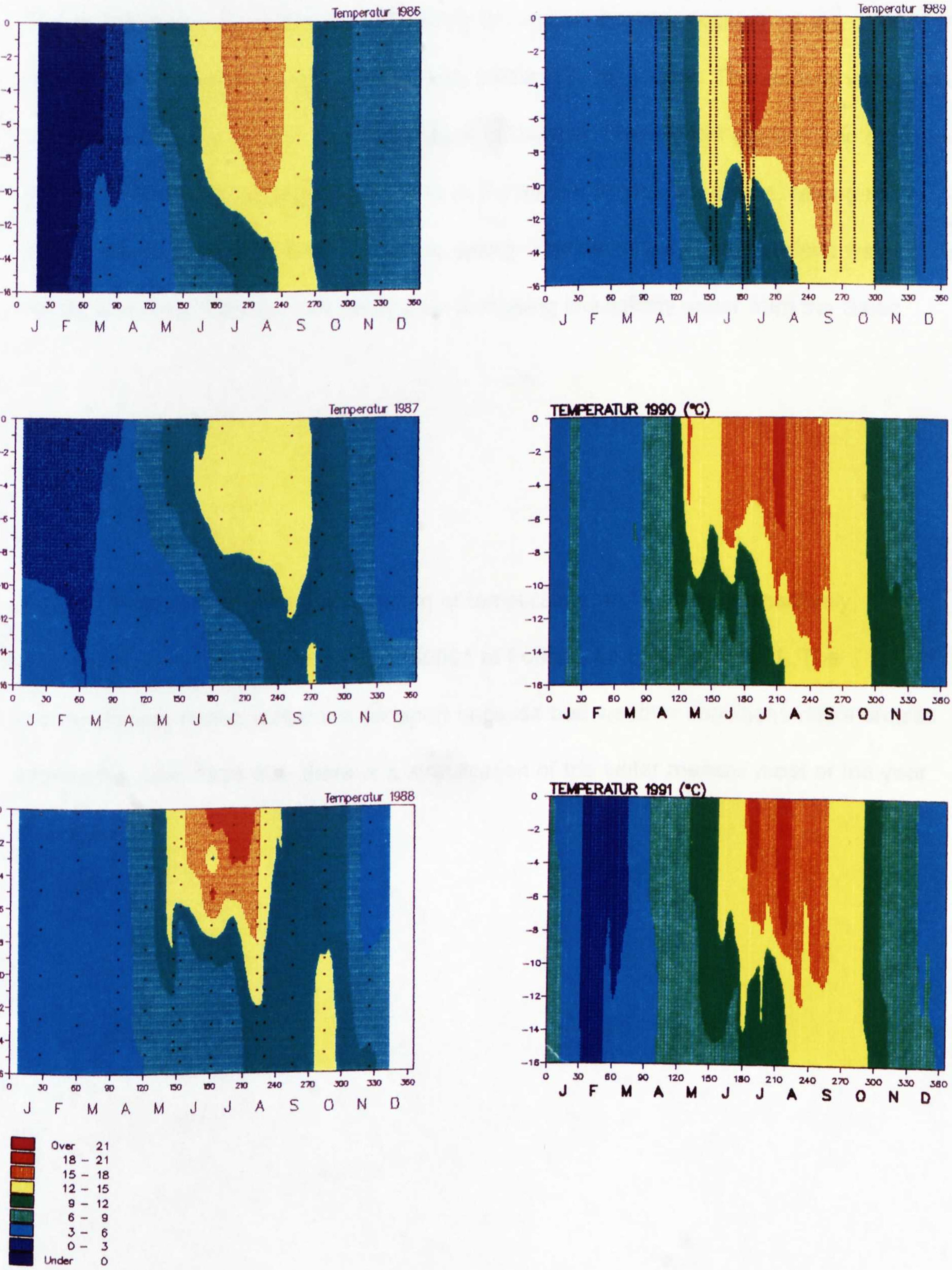


Figure 2.5
Distribution of temperature in °C throughout the water column at stn. 170006 in Århus Bay 1986-1991. Dots present measuring points. No dots are shown for 1990 and 1991 due to frequent sampling.

Figure 2.6 shows the distribution of salinity throughout the water column at stn. 170006 in Århus Bay from 1986 to 1991 (Århus Amt, 1990a, 1991b, 1992a). The surface water was seperated from the bottom water from April to October. The vertical position and thickness (depth) of the halocline varied according to the meteorological conditions. Mixing of the water column took place from autumn to spring. The low salinity in the surface water during spring and early summer was caused by outflowing low salinity water from the Baltic.

Fornæs

Figure 2.7 and 2.8 show the distribution of temperature and salinity, respectively, throughout the water column at stn. 150001 at Fornæs from 1989 to 1991. The measurements during winter are far apart because bad weather conditions make cruises impossible. Like Åhus Bay there is a stratification of the water masses most of the year (figure 2.8).

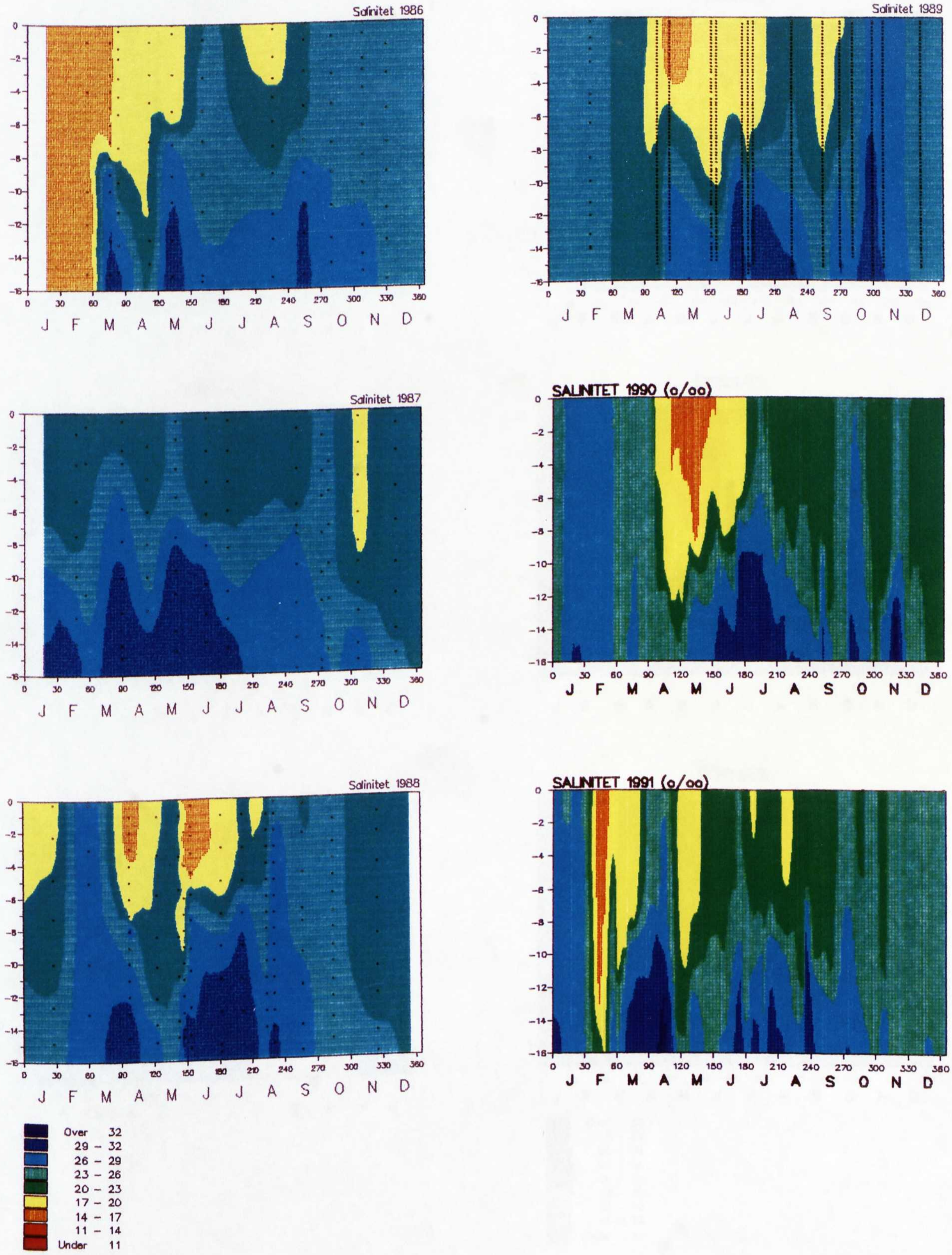


Figure 2.6
Distribution of salinity in ‰ throughout the water column at stn. 170006 in Århus bay 1986-1991. Dots present measuring points. No dots are shown for 1990 and 1991 due to frequent sampling.

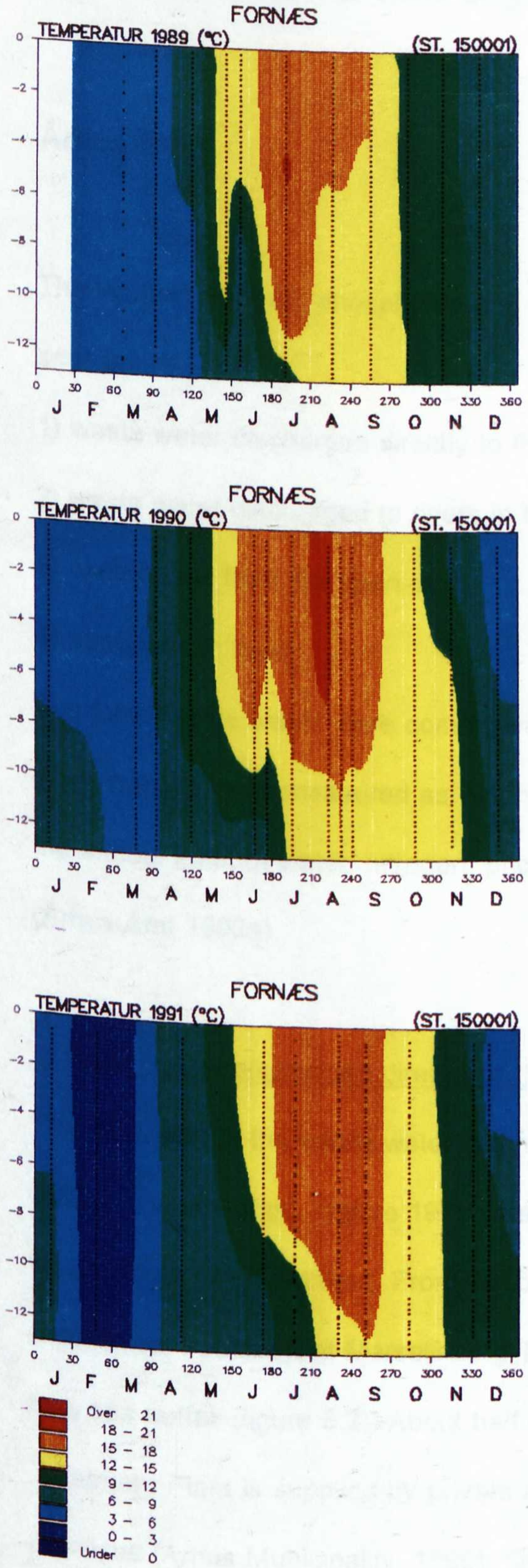


Figure 2.7
Distribution of temperature in °C throughout the water column at stn. 150001 at Fornæs 1989-91. Dots represent measuring points.

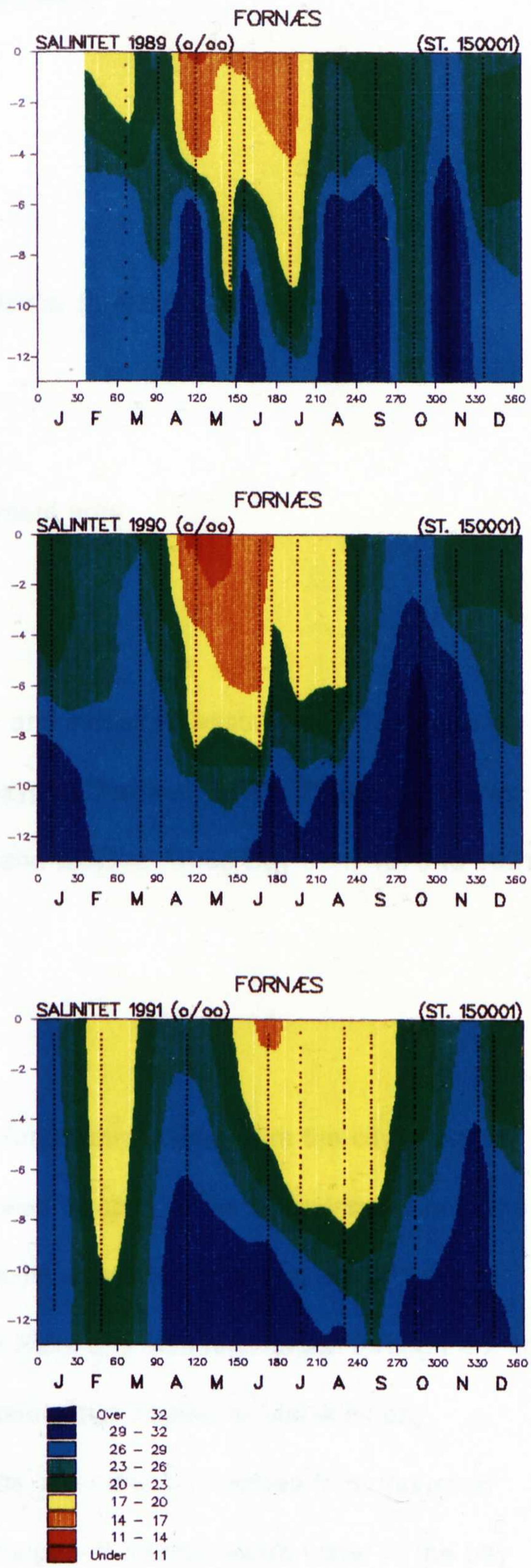


Figure 2.8
Distribution of salinity in ‰ throughout the water column at stn. 150001 at Fornæs 1989-91. Dots represent measuring points.

Input of nutrients and organic matter

Århus Bay

The input of nitrogen, phosphorus and organic matter to Århus Bay comes from four sources:

1) waste water discharged directly to the bay

2) waste water discharged to rivers in the catchment area

3) contribution from the open land

4) atmospheric input

The term "waste water" here comprises sanitary and industrial waste water. The input of organic matter was measured as Biochemical Oxygen Demand (BOD). Figure 2.9 shows the annual input of water, nitrogen, phosphorus and BOD to Århus Bay from 1978 to 1991 (Århus Amt 1992a).

<u>1) Waste water discharged directly to the bay</u>

The main part of the waste water discharged to Århus Bay comes from the city of Århus (250.000 inhabitants). Before 1975 waste water was discharged nearly untreated onto the beach south of the harbour. From 1975 onwards the waste water underwent primary mechanical treatment at Marselisborg Treatment Plant and was discharged through a 2 km long sea outfall (figure 3.2). About half of the waste water treated at Marselisborg Treatment Plant is supplied by private households, the other half comes from industrial premises (Århus Municipality, 1990). Other discharges of treated waste water to the bay are relatively small and the outlets are situated in Kalø Vig and Knebel Vig outside the sampling area (figure 2.4a).

In the late 1980s Marselisborg Treatment Plant underwent comprehensive improvements

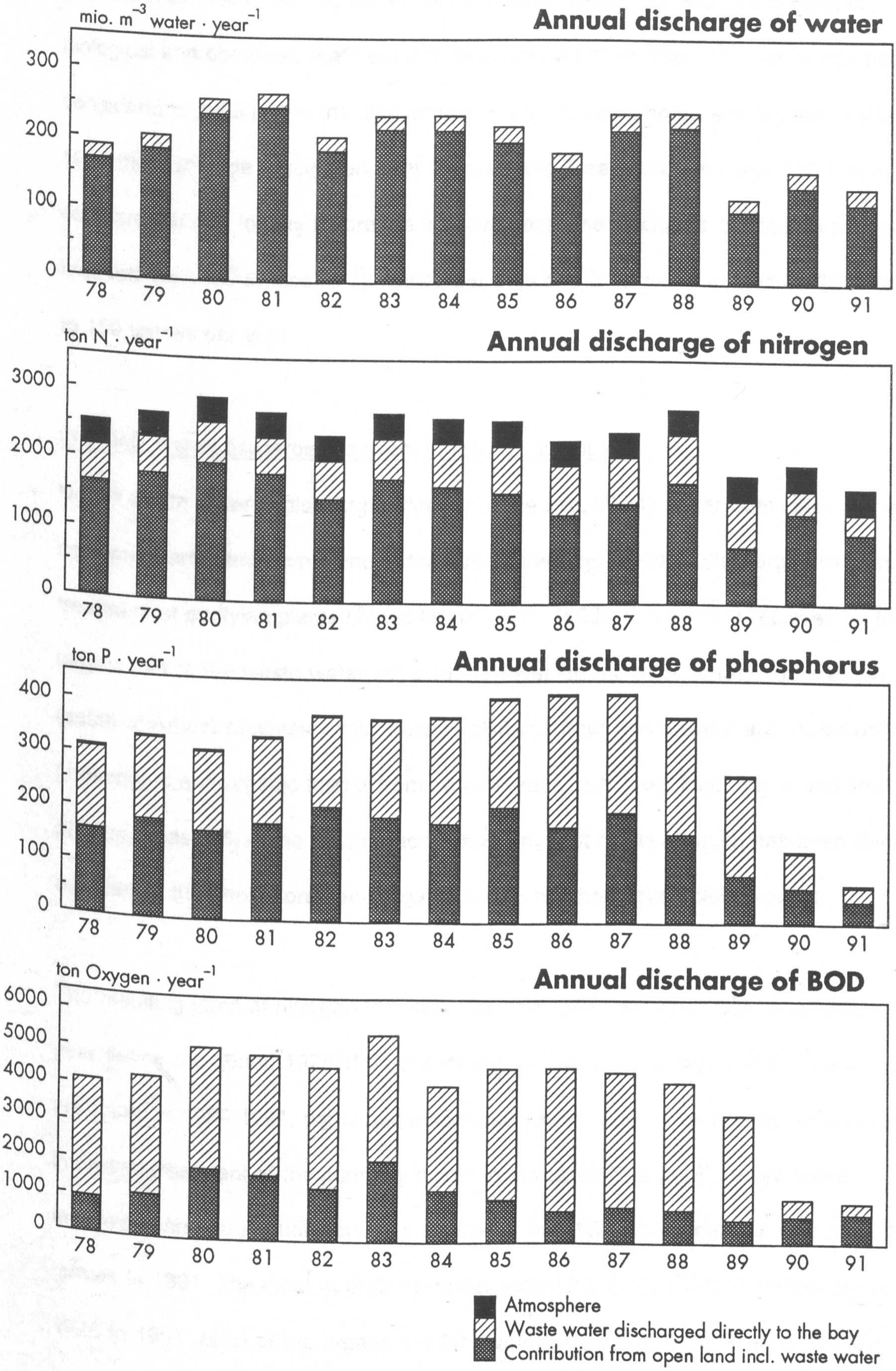


Figure 2.9
Annual input of water, nitrogen, phosphorus and BOD to Århus Bay 1978-1991.

and extensions and from January 1990 the waste water has received mechanical, biological and chemical treatment including removal of nitrogen. The result has been a considerable reduction in the discharge of nitrogen, phosphorus and organic matter. In 1991 the discharge of nitrogen from Marselisborg Treatment Plant was 129 tonnes per year compared to 500 tonnes before the improvement. The discharge of phosphorus was reduced from 160 tonnes to 13 tonnes per year and BOD was reduced by 95% from 3500 to 150 tonnes per year.

2) Waste water discharged to rivers in the catchment area

Not all waste water is discharged directly to the sea. Waste water from cities in the catchment area and from some of the suburbs around Århus is discharged to rivers after treatment at purifying plants (Århus Municipality, 1990). River Århus receives by far the largest part of the waste water but also the River Eg (north of Århus) and the River Giber (south of Århus) receives waste water. Pollutants from waste water are mixed with nitrogen, phosphorus and organic matter from natural areas, cultivated land, farms and sparsely built-up areas. When the rivers reach Århus Bay part of the nitrogen has been denitrified and part of the phosphorus and organic matter has been deposited in lakes.

The resulting input of nitrogen to Århus Bay has varied between 1200 and 2300 tonnes per year during the period 1978-1991 depending on precipitation (figure 2.9). The lowest inputs are found in 1989-1991, partly because these years were dry and partly because of the improved treatment at the purifying plants in the catchment area. Before these improvements the annual input of phosphorus was 150-200 tonnes but was reduced to 50 tonnes in 1991. The input of organic matter varied from 800 to 2000 tonnes per year from 1978 to 1991. Most of the organic matter from rivers comes from River Århus largely because of the outflow of planktonic algae from Lake Brabrand (western part of Århus). BOD from the Rivers Eg and Giber has never exceeded 100 tonnes and the amount has been reduced continuously through the 1980s to the present level of about 20 tonnes BOD per year for each of the rivers.

3) Contribution from the open land

As mentioned above the contribution from the open land is included in the figures for river input to Århus Bay (figure 2.9). There has been no decline in the leaching of nitrogen from fields during the sampling period after the figures have been corrected for differences in precipitation. According to the National Action Plan (1987) leaching of nitrogen from agricultural areas should be reduced by 50%. There is, however, no signs of a fulfilment of this objective by the deadline of 1993 (Århus Amt, 1991a).

4) The atmospheric input

The atmospheric input to Århus Bay was estimated as 12 kg/ha per year of nitrogen and 0.1 kg/ha per year of phosphorus (Hovmand, 1990) (figure 2.9). During the summer up to half of the nitrogen input to the bay comes from atmospheric input. At this time of year nitrogen limits primary production in the surface water and the input of nitrogen from the atmosphere may therefore be very important for the growth of phytoplankton.

Fornæs

In constrast to Århus Bay, most of the waste water discharged at Fornæs is industrial waste water. The discharge began in 1973 when two private long sea outfalls were established by a chemical and a food producing industry. In 1977 a municipal pipeline was brought into use discharging sanitary waste water from Grenå city and from industries in Grenå. Figures from 1978 to 1991 (Århus Amt, 1990c) are given in figure 2.10. The amount of organic matter measured as BOD and was slightly higher during the first half of the

1980s (1980-85) than during the second half (1986-90). Due to improved treatment at the municipal treatment plant from the summer 1991 the amount of BOD, nitrogen and phosphorus in 1991 was lower than in the preceding years.

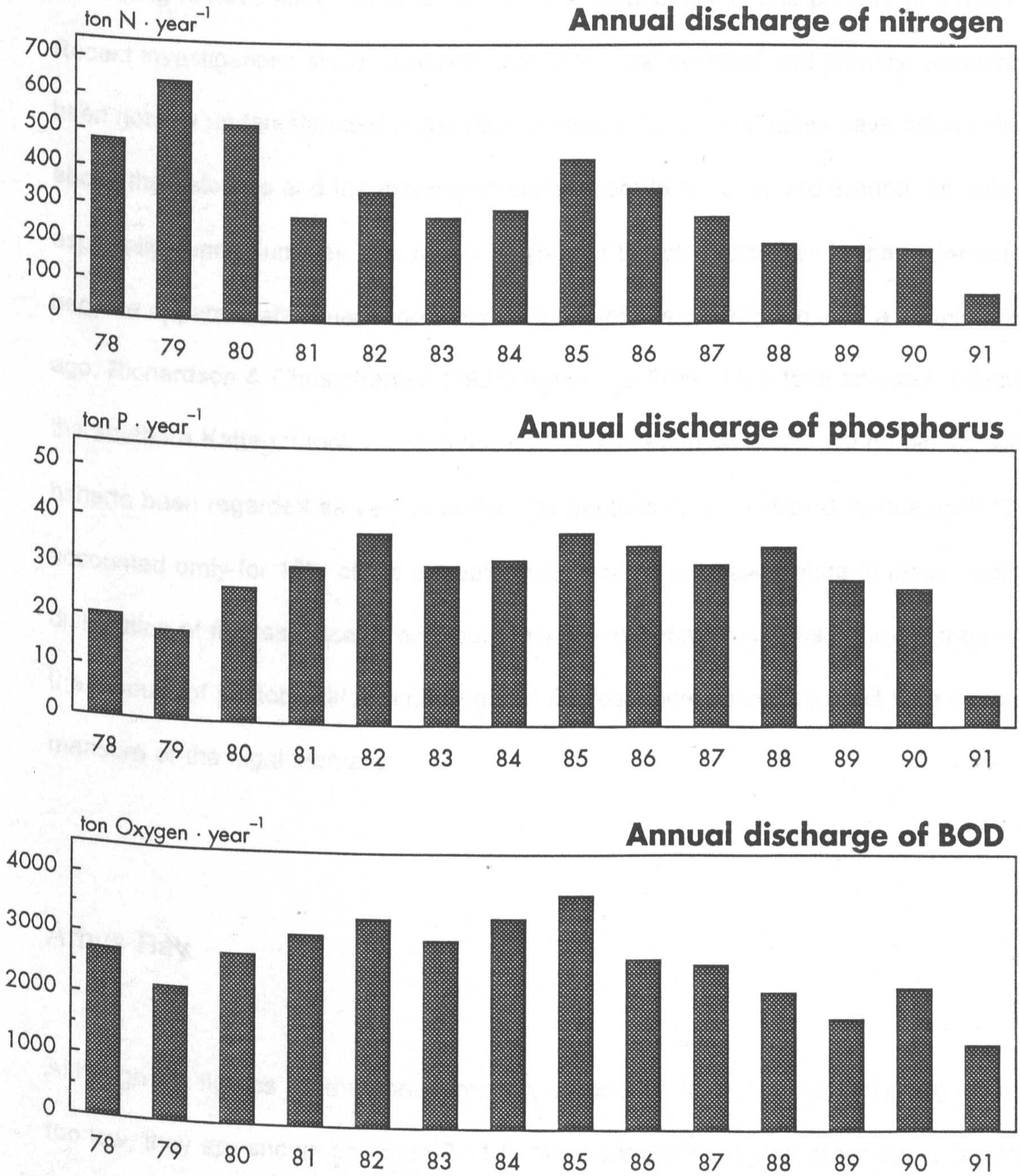


Figure 2.10
Annual input of nitrogen, phosphorus and BOD to the Fornæs area 1975-1991.

Phytoplankton

Phytoplankton is an important food source for macrobenthos and it would therefore be interesting to have fairly accurate estimates of algal biomass and primary production. Recent investigations show, however, that both algal biomass and primary production have been notably underestimated in the past because plankton samples have been collected above the halocline and the majority of algae seem to occur in and around the halocline, especially during summer. The actual position of the phytoplankton in the water column has become apparent after measurements of fluorescence were introduced a couple of years ago. Richardson & Christoffersen (1991) found that 30% of the total annual production in the southern Kattegat took place in the subsurface water while the spring bloom, which had hitherto been regarded as very important for benthos (Christensen & Kanneworff 1986), accounted omly for 19% of the annual production. As a consequence of these findings distribution of fluorescence throughout the water column is used as a simple measure of the amount of phytoplankton, knowing that fluorescence cannot be used as a exact measure of the algal biomass.

Århus Bay

Although the figures for the annual primary production from 1986 to 1991 are known to be too low, they are shown on figure 2.11 to allow comparisons with other areas (where the production probably is underestimated too). The lowest primary production was found in 1986 while the highest production was found in 1987 and 1988. The differences in production are probably partly caused by the variation in input and availability of nutrients (Århus Amt 1990a) and partly by the sampling frequency. Monthly samplings may coincide with periods with either high or low productivity which has an impact on the estimate of the annual production.

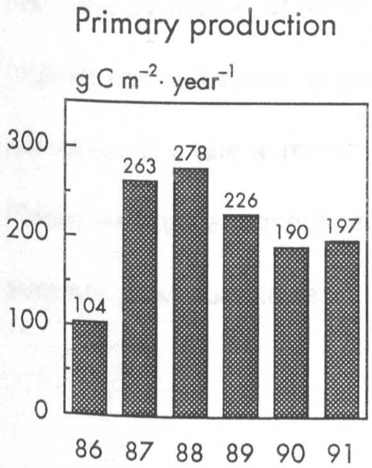


Figure 2.11
Primary production at stn. 6 in Århus Bay 1986-1991

The availability of nutrients changes during the year. Measurements of inorganic nitrogen and phosphorus show that both nutrients can limit the production in Århus Bay. Phosphorus was typically limiting in spring and nitrogen in autumn, while both nutrients occured in concentrations low enough to limit production during the summer (Århus Amt 1992b).

The seasonal variation in primary production in 1990 and 1991 is shown in table 2.2. Production in summer and autumn was equal to or bigger than the production in spring. Traditionally the spring production has been regarded as the major part of the annual production, but this does not seem to be the case in Århus Bay (Århus Amt 1992b).

	$g\ C\ m^{-2}$		% of annual production	
Period	1990	1991	1990	1991
February- April	43	56	23	28
Maj-July	65	78	34	40
August-October	70	49	37	25
Jan. + Nov.-Dec.	12	14	6	7

Table 2.2
Primary production in different periods of 1990 and 1991.

In 1990 and 1991 the distribution of phytoplankton throughout the water column was recorded by means of fluorescence. The results are shown in figure 2.12. In 1990 the highest concentrations of phytoplankton were found in July and August in and below the halocline. The late summer bloom consisted mainly of Dinoflagellates. In 1991 the spring bloom was more pronounced than in 1990 while the concentration of phytoplankton in late summer was much lower.

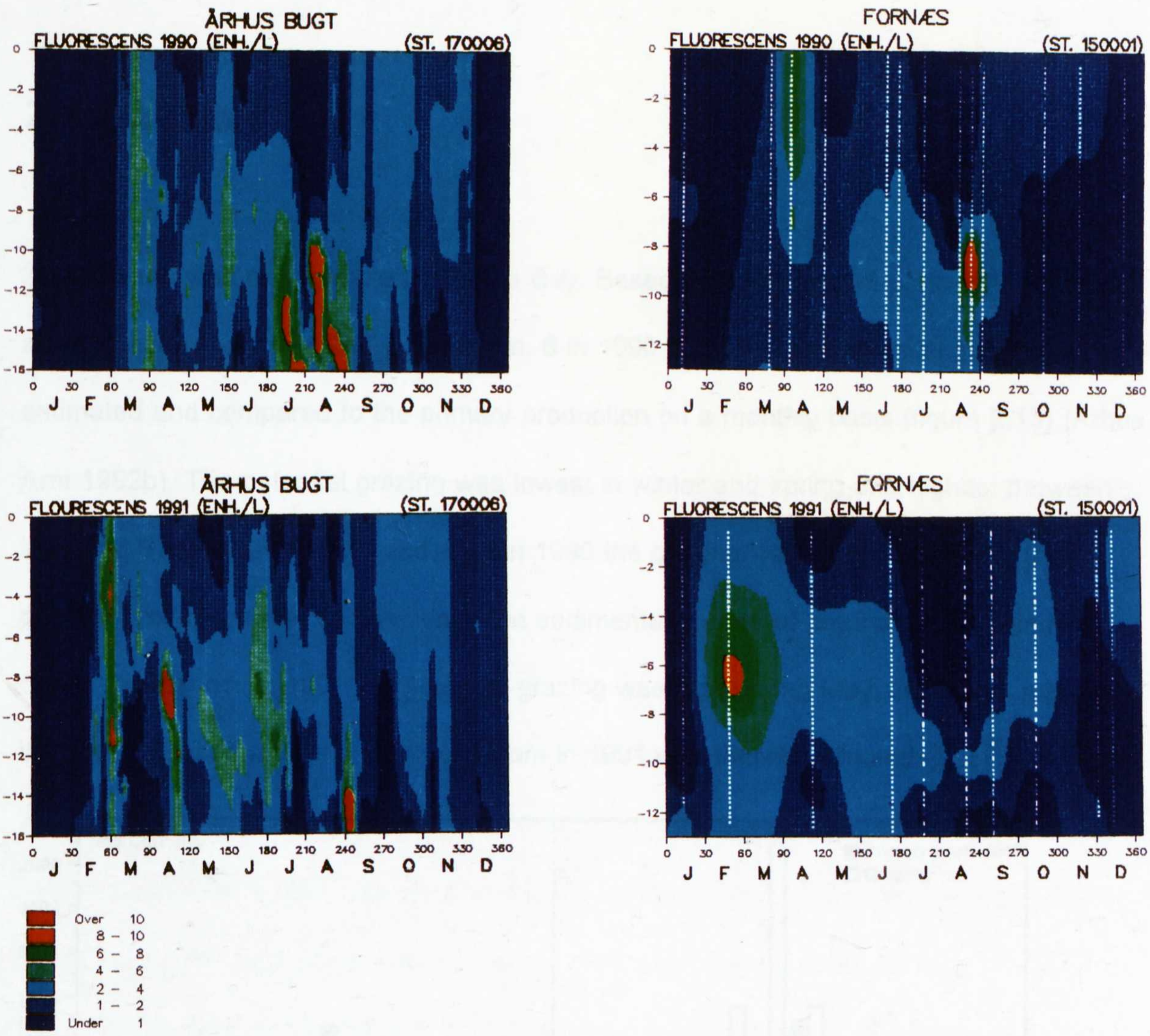


Figure 2.12
Distribution of fluorescence in units/l throughout the water column at stn. 170006 in Århus Bay and at stn. 150001 at Fornæs 1990 and 1991.

Fornæs

Primary production has not been measured at Fornæs but the distribution of phytoplankton throughout the water column was recorded as fluorescence in 1990 and 1991 (figure 2.12). As in Århus Bay there was a high concentration of algae around the halocline in August 1990. In February 1991 fluorescence was high due to the spring bloom. No high concentrations were measured in late summer 1991.

Zooplankton

Zooplankton was only sampled in Århus Bay. Based on samplings of proto- and mesozooplankton every 2nd week at stn. 6 in 1990 and 1991 the potentiel grazing was estimated and compared to the primary production on a monthly basis (figure 2.13) (Århus Amt 1992b). The potentiel grazing was lowest in winter and spring and highest between May and September. In July and August 1990 the grazing was low compared to the primary production and consequently the sedimentation rate of phytoplankton was high during this period. In 1991 the potential grazing was high during May, June and July and the sedimentation after the summer bloom in 1991 was therefore limited.

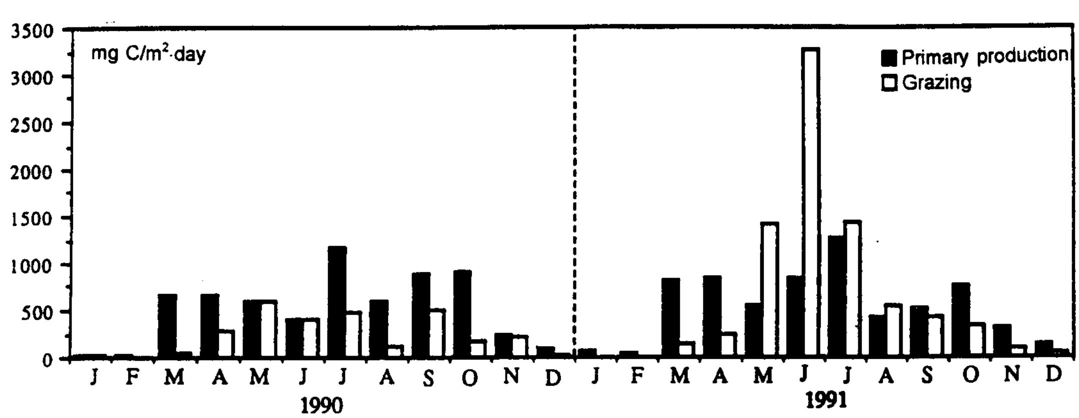


Figure 2.13
Monthly means of the total proto- and mesozooplanktons grazing (mg C/m^2·day) in relation to the primary production (mg C/m^2·day) at stn. 6 in Århus Bay 1990 and 1991.

Oxygen conditions

Århus Bay

Seasonal and annual differences in oxygen concentrations in Århus Bay

Oxygen concentrations were measured from 1986 to 1991 throughout the water column from the surface down to ½-1 m above the sea bottom. The results are shown in figure 2.14 (Århus Amt, 1990a, 1991b, 1992a). The oxygen concentrations experienced by the macrobenthos are much lower than shown on figure 2.14 because the oxygen concentration declines rapidly when approaching the sediment surface (Jørgensen, 1980). In winter, ice cover can prevent mixing of the water column and a stable stratification may develop under the ice leading to oxygen depletion of the bottom water. This seems to have been the case in late winter/early spring 1987. In other years the first decline in the oxygen content of the bottom water took place in spring/early summer after sedimentation of the phytoplankton spring bloom and establishment of a stable stratification (Århus Amt, 1990a). The decline in oxygen concentration at this time of year has not been observed to be critical for the fauna.

The lowest oxygen concentrations in Århus Bay were found in the bottom water from August to October (figure 2.14). At this time of year the temperature is highest and the stratification most stable. The most severe oxygen deficiency in Århus Bay occurred in September 1981 and killed most of the benthic fauna below the halocline (> 10m) (Århus Amt 1990d). Despite the occurrence of adverse oxygen conditions of long duration every year in September/October during the 1980s there is only one record of benthic inverterbrates killed by oxygen deficiency after 1981. In September 1990 dead *Abra alba* were found on the sediment surface at a number of stations in the western part of Århus Bay. Fish, killed by oxygen depletion have been observed more frequently, namely in

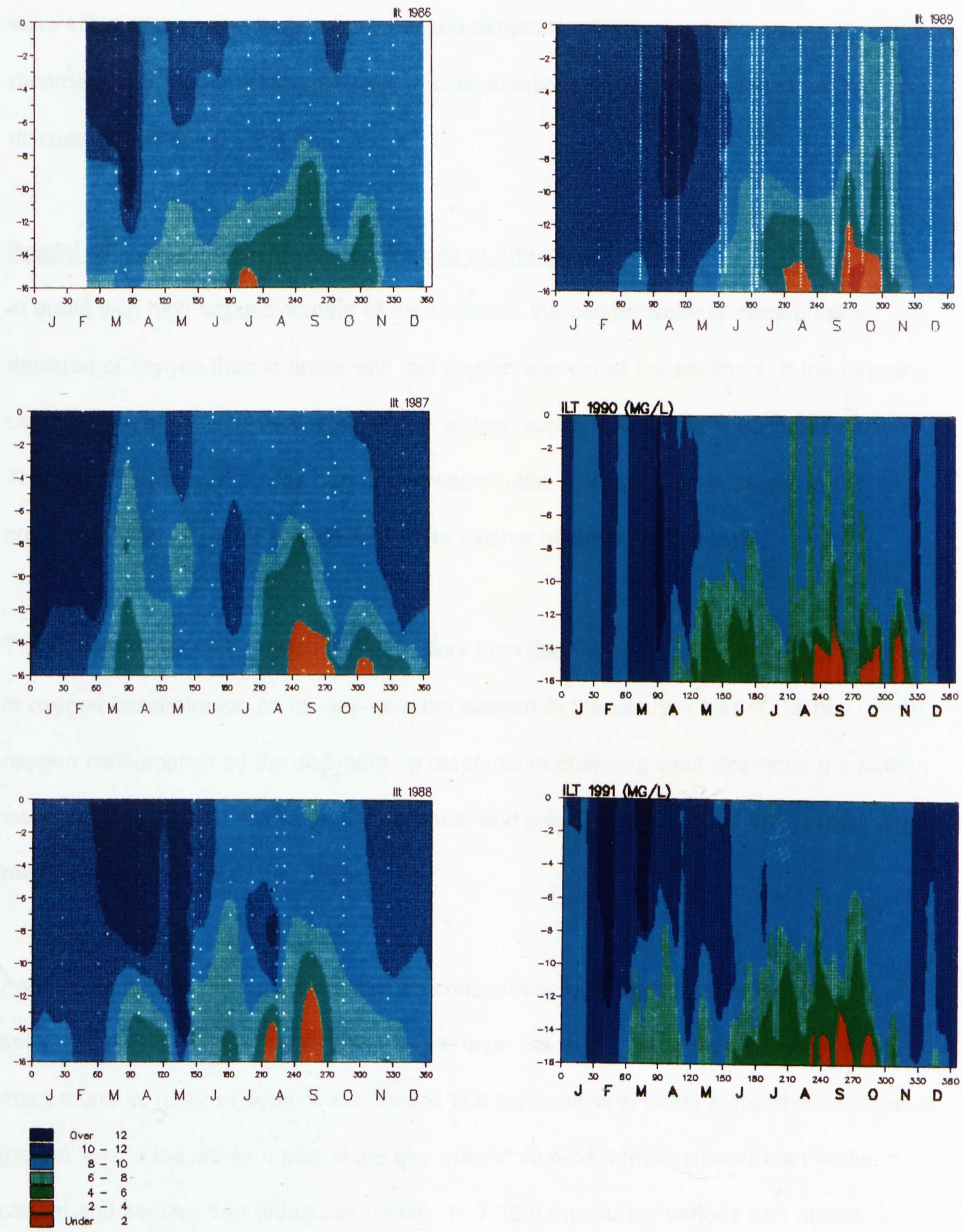


Figure 2.14
Distribution of oxygen in mg/l throughout the water column at stn. 170006 in Århus Bay 1986-1991.

1981, 1982, 1984, 1986, 1987, 1989, and 1990. It is likely that at least some inverbrates were killed at the same time but not washed ashore like the fish and therefore not recorded. The impact of adverse oxygen concentrations on the bottom fauna will be discussed in chapter 3 and 4.

Spatial differences in oxygen concentrations in Århus Bay

In areas with high organic content of the sediment the bottom water is more quickly depleted of oxygen than in areas with low organic content of the sediment. If the oxygen consumption of the sediment exceeds the oxygen supply the sediment becomes anoxic. This has often been the case near the sewage outlet. A visible sign of anoxia is the covering of the sediment surface with white sulphur bacteria (*Beggiatoa*).

The bottom water that comes into Århus Bay from the Kattegat will experience a reduction in oxygen concentration on its way from the eastern to the western part of the bay due to oxygen consumption by the sediment. In response to changing wind directions the bottom water will be pushed backwards and forwards and a further reduction of the oxygen content may take place (Århus Amt, 1990a).

Another factor that influences the oxygen concentrations in the bottom water is the thickness or the volume of the bottom water layer below the halocline. The halocline is often found in 10-12 m depth which means that the volume of water below the halocline at the stations in the western part of the bay (depth: 13.4-14.6 m) is smaller than in the central and eastern part of the bay (depth: 14.7-16.0 m). During periods with stable stratification the bottom water in the western part of the bay is thus more quickly depleted of oxygen than the central/eastern part of the bay where the volume of bottom water is larger.

Not all oxygen deficiencies are generated within Århus Bay, sometimes water with a low oxygen content penetrates into the bay from the deeper areas of the Kattegat or Skagerak (Århus Amt, 1990a).

Fornæs

The oxygen conditions at Fornæs are generally good (figure 2.15). Oxygen concentrations below 4 mg/l have only been registred on single days in late summer. Because of the distance between the measurements periods with low oxygen concentrations may look longer than they actually are.

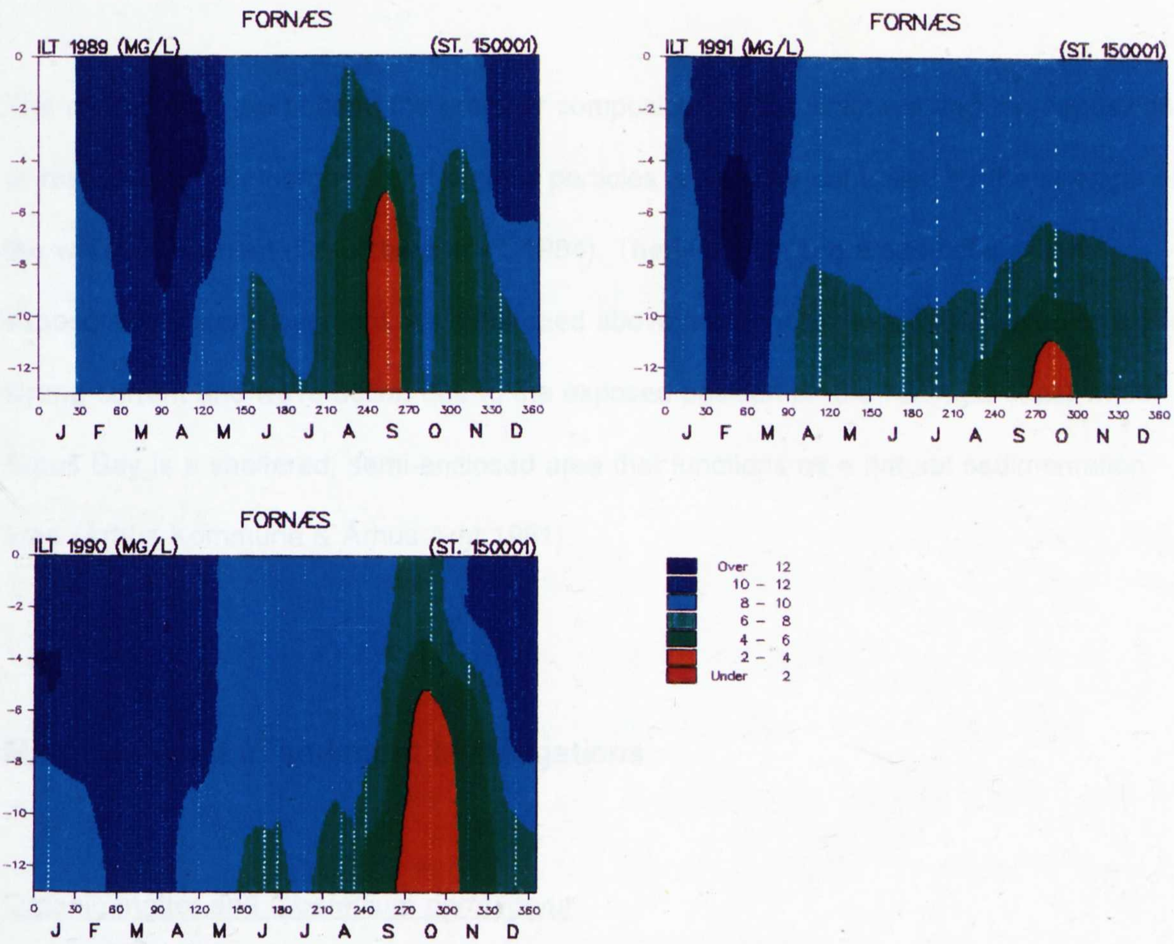


Figure 2.15
Distribution of oxygen in mg/l throughout the water column at stn. 150001 at Fornæs 1986-1991.

Sediment investigations

Although benthic communities are influenced by many different physical factors, the main characteristic of a benthic habitat is the type of substratum (McLusky & McIntyre 1988). The aim of the sediment investigations carried out in Århus Bay and at Fornæs has been to create a basis for discussion of the impact of the sedimentary environment on the structure and function of the two benthic communities. The distribution of benthic macrofauna species can often be related to the sedimentary characteristics of an area (Creutzberg *et al.* 1984, Basford *et al.* 1990, Künitzer *et al.* 1992), and in some cases closely related species show complementary distributions related to sediment conditions (Buchanan 1964, Fallesen & Jørgensen 1984, 1991).

The character of the bottom, the granular composition of the sediment and the deposition or resuspension of inorganic and organic particles are mainly controlled by the strength of the water movement (Creutzberg *et al.* 1984). The two sampling areas differ in their exposure to water movement. As mentioned above the Fornæs area is subjected to a fairly strong current and wave action due to the exposed position on the Kattegat coast while Århus Bay is a sheltered, semi-enclosed area that functions as a natural sedimentation area (Århus Kommune & Århus Amt 1981).

Methods used in sediment investigations

<u>Organic matter and *Clostridium perfringens*</u>

In addition to sampling of benthos, samples of the uppermost 1 cm of the sediment were collected for analysis of organic matter and the number of endospores of the human intestinal bacteria *Clostridium perfringens*. The endospores produced by *C. perfringens* survive for long periods of time in aquatic environments (Bisson and Cabelli 1980), and can therefore be used as a tracer for sanitary waste water. The number of endospores was determined using the Danish Standard Method DS 2256 (Dansk Standardiseringsråd 1983).

In Århus Bay samples were taken with a Van Veen grab sampler from 1985 to 1988 and with a Haps core sampler from 1989 to 1991. No sediment analyses were carried out in Århus Bay in 1986. At Fornæs samples were collected with a Van Veen grab throughout the sampling period (1986-90).

The organic content was measured as ignition loss at 550 °C. Sediment characteristics such as colour, texture, smell and the thickness of the oxic layer were noted on board the ship.

In order to evaluate the impact of the improved waste water treatment a baseline mapping of the organic content of the sediment and the distribution of *C. perfringens* was carried out at 94 stations in Århus Bay in October 1990 (Århus Amt 1993a).

<u>Particle size analysis</u>

Particle size analysis was performed on sediment from the 15 sampling stations in Århus Bay (figure 3.2). The analysis was carried out at the laboratories of the Forth River Purification Board. About 100 g of sediment was washed on a 125 μm sieve. The fraction > than 125 μm was dried at 100 °C to constant weight and then sieved through a stack of sieves ranging from 4 mm down to 3.85 μm following the Wentworth √2 scale (Buchanan 1984). The weight of the content of each sieve was measured. The fraction < than 125 μm was poured into a 1 liter measuring glass and extra water was added to reach 1 liter. A plastic tube attached to a string was lowered into the glass and after a top had been applied the glass was shaken vigorously so that the tube was filled with a representative sample of the content. The tube sample was used in the Laser Particle Sizer, Malvern 3601. The output from this analysis only gave proportions. After another shaking of the measuring glass 100 ml of the suspended mud was poured into a tube and dried at 100 °C and then weighted. The output from the particle sizer could thereafter be converted to weight and the results combined with the results from the dry sieving. No particle size analysis was carried out for the Fornæs area.

C/N analysis

Analyses of carbon, hydrogen and nitrogen in the sediment was performed for all 15 stations in Århus Bay by means of a Carlo-Erba, Elemental Analyser. Two determinations were undertaken for each sample. The sample from stn. 71 was not analysed at the same time as the other samples and this might have influenced the result.

Heavy metals

The levels of heavy metals in the sediments of Århus Bay and Fornæs have been measured recently and revealed that the levels are low (Århus Amt 1993b). The impact of heavy metals on the benthos is therefore not taken into account.

Scuba diver inspection

The condition of the sea bed south of the waste water outlet in Århus Bay has been of particular concern and has therefore been inspected by Scuba divers several times (Århus Amt, 1990d).

Results of sediment investigations

Århus Bay

<u>Organic content and *Clostridium perfringens*</u>

The result of mapping the organic content in Århus Bay and Kalø Vig in 1990 is shown in figure 2.16. The highest content of organic matter was found around and south/south east of the sewage outlet and in Kalø Vig. The high organic content in Kalø Vig is believed to be natural phenomenon. Apart from the organic enrichment south of the outlet there was a general increase in organic matter from west to east following the increase in depth.

The highest number of *C. perfringens* was found around and south east of the sewage outlet (figure 2.17). High numbers were also found off the Rivers Eg, Århus and Giber because sanitary waste water is discharged to the rivers. Although the number of *C. perfringens* was low in the central and eastern part of the bay and in Kalø Vig, their presence indicates that organic matter from sewage ends up all over the bay.

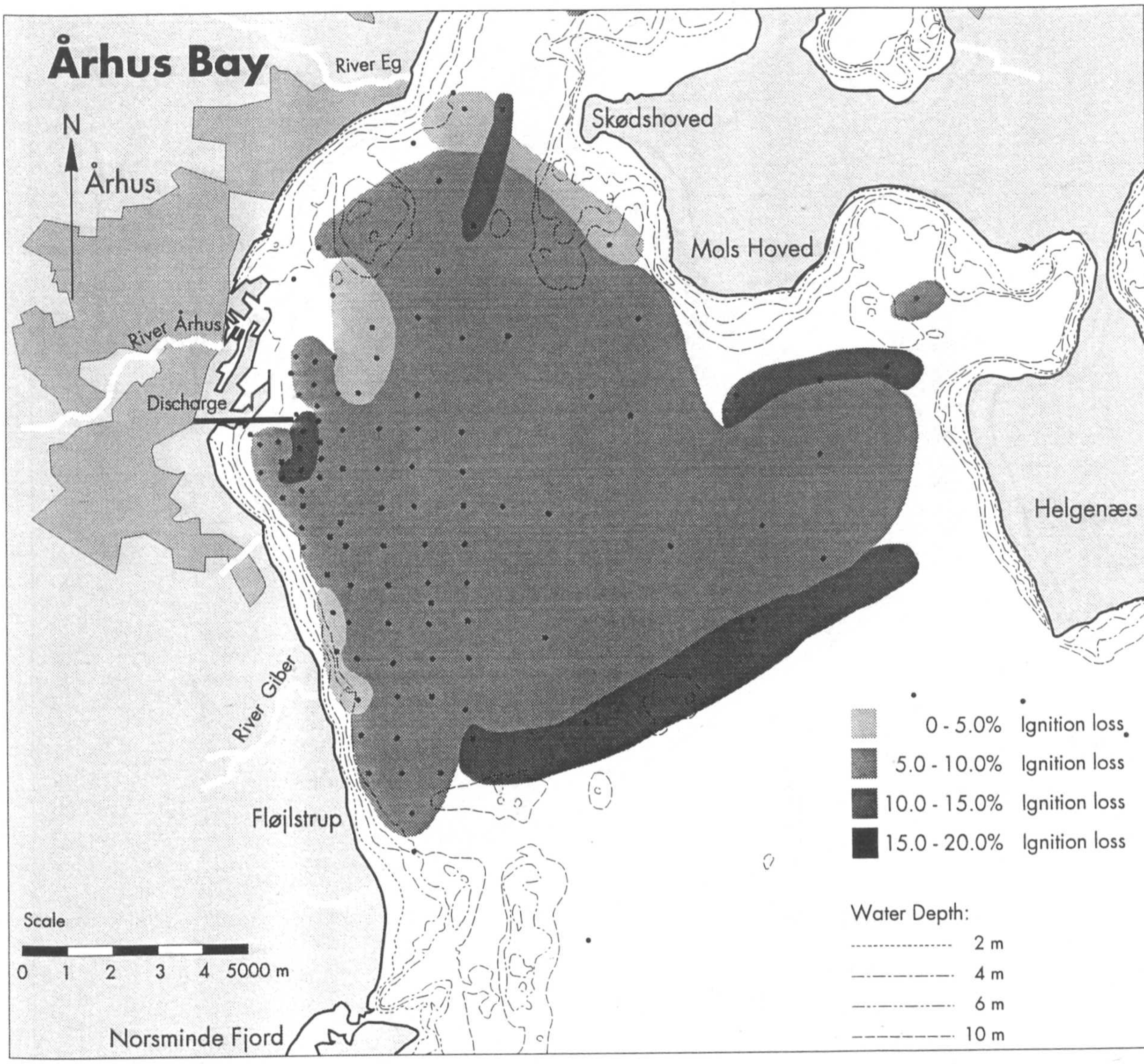


Figure 2.16
The organic content in Århus Bay and Kalø Vig 1990 measured as ignition loss (Århus Amt 1993a)

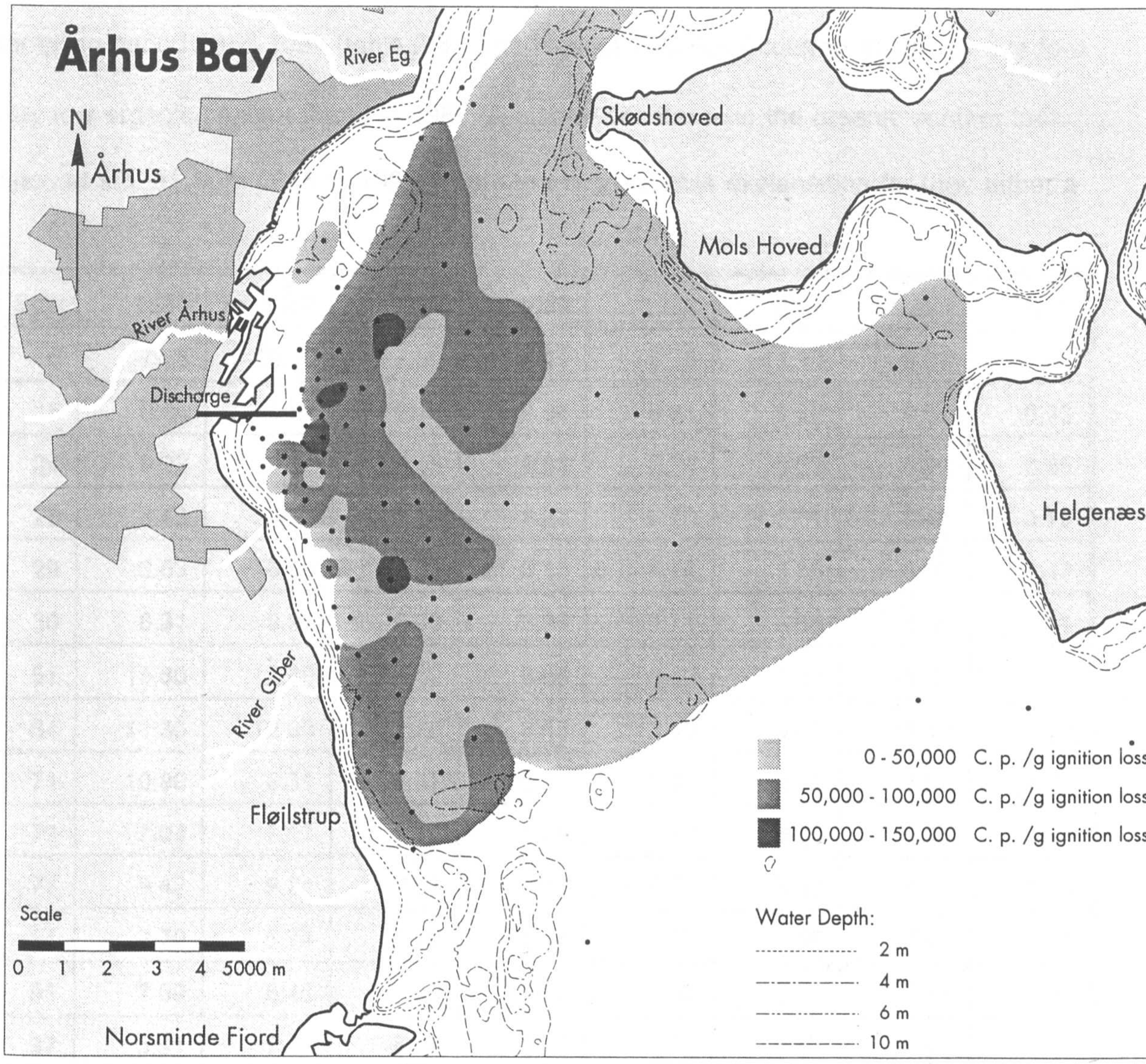


Figure 2.17
The number of *Clostridium perfringens* in Århus Bay and Kalø Vig 1990 (Århus Amt 1993a).

The organic content varied relatively little within the 15 sampling stations during the sampling period 1985-1991 (table 2.3). The highest variation occurred at stn. 64 due to a very low organic content found in 1989. A steady decrease in the organic content took place at stn. 51 from 1985 to 1991. There are two possible explanaition for that: either a

Stn.	1985	1987	1988	1989	1990	1991	Mean	S.D.
6	7.28	10.60	7.52	8.11	9.75	11.10	9.06	1.64
15	9.04	9.81	8.73	8.94	8.91	9.00	9.07	0.38
24	9.22	8.87	9.43	8.01	8.34	9.86	8.96	0.69
25	8.43	8.41	8.24	8.22	8.70	8.61	8.44	0.19
29	6.63	8.65	5.69	5.15	4.74	5.36	6.04	1.43
30	8.31	9.97	6.33	8.04	9.71	8.66	8.50	1.31
51	14.80	12.40	11.40	9.96	9.40	9.34	11.22	2.13
64	11.30	12.80	12.70	6.43	13.40	9.97	11.10	2.60
71	10.90	8.31	8.37	8.57	8.45	9.19	8.97	1.00
73	7.04	7.53	6.96	6.99	6.37	6.82	6.95	0.37
77	9.42	9.84	7.53	7.18	7.69	8.88	8.42	1.10
84	9.70	6.74	6.80	6.94	7.59	9.25	7.84	1.31
91	7.09	8.46	5.99	7.64	7.87	7.39	7.41	0.84
97	5.91	7.41	5.67	5.58	5.74	5.63	5.99	0.71
103	6.28	7.82	7.15	5.99	7.35	6.70	6.88	0.69

Table 2.3
Organic content in % of sediment dry weight, Århus Bay 1985-1991.

change in the current conditions due to expansion of the harbour west of stn. 51 or the slight annual reduction in the BOD load from 1986 to 1989 before the large reduction in 1990 (figure 2.9). A combination of the two factors is likely.

Particle size analysis

A cumulative frequency curve of the particle size distribution at stn. 6 is shown on figure 2.18 as an example. The frequency curves for the other station were hardly distinguishable from that of stn. 6.

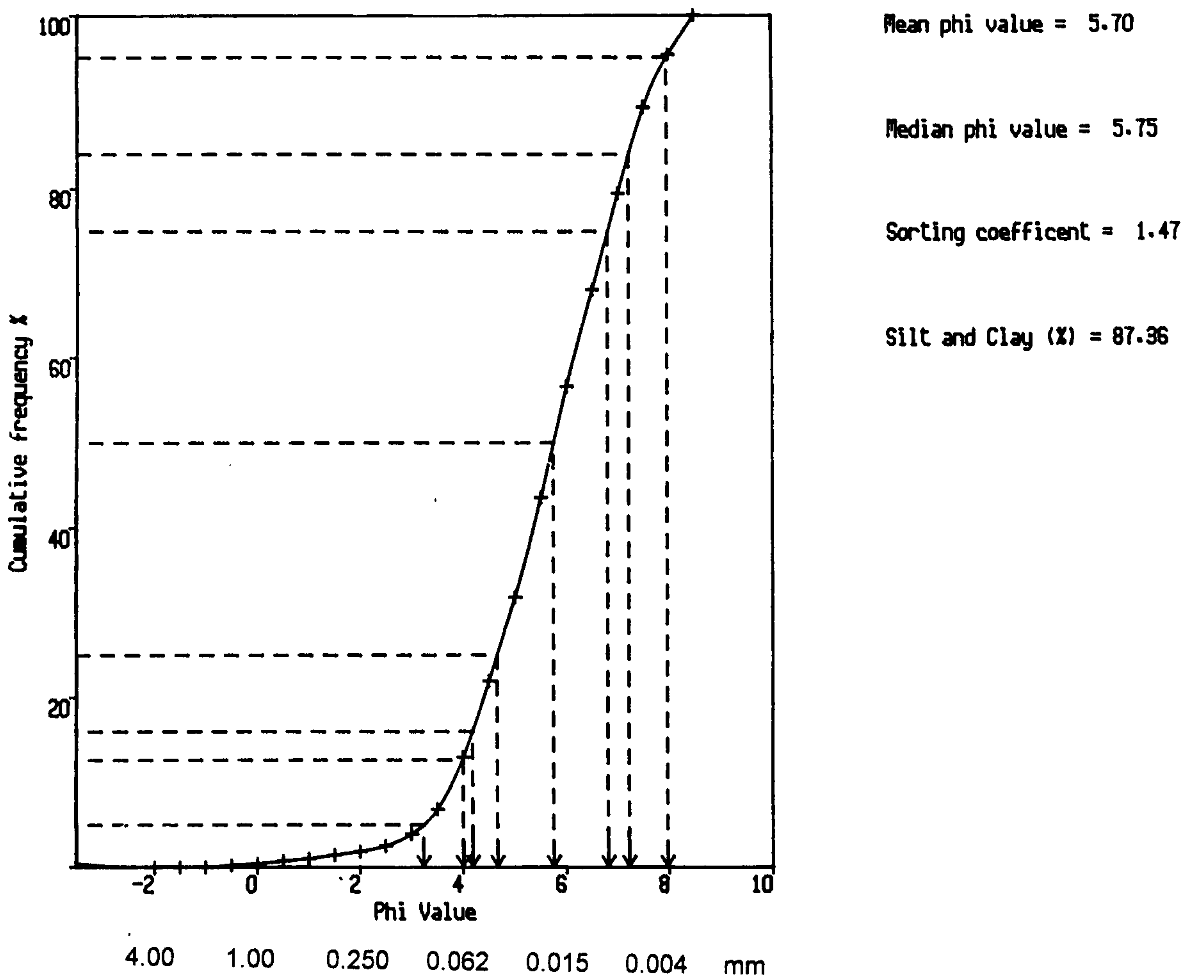


Figure 2.18
Cumulative frequency curve of the particle size distribution at stn. 6 in Århus Bay.

The percentage of silt-clay and the mean particle diameter is shown in table 2.4 which demonstrates that the granular composition was very similar everywhere in the bay. As the sediment comprises about 15% sand, 80% silt and 5% clay it is classified as silty according to Buchanan (1984). The mean sorting coefficent around 1.5 means that the sediment is poorly sorted (Buchanan 1984).

Stn.	Silt-clay %	Mean diameter
6	87.36	0.0192
15	84.51	0.0211
24	83.79	0.0215
25	84.85	0.0206
29	81.79	0.0212
30	85.47	0.0208
51	86.84	0.0190
64	84.92	0.0215
71	83.23	0.0216
73	83.76	0.0211
77	88.20	0.0187
84	86.58	0.0190
91	81.89	0.0213
97	83.07	0.0206
103	84.21	0.0208
Mean	84.70	0.0205
S.D.	1.91	0.0010

Table 2.4
Percentage of silt-clay and particle size diameter, Århus Bay.

C/N analysis

According to Grebmeier *et al.* (1988) C/N ratios between 6 and 8 in surface sediment often indicate a deposition of high quality, recent marine phytodetritus, while areas characterized by high C/N values (> 10) indicate either low quality, older, more refractory detrital material or terrestrial deposits or both.

Stn.	mean C/N-ratio
6	8.42
15	8.47
24	9.36
25	8.28
29	8.36
30	8.00
51	10.68
64	9.61
71	8.45
73	8.35
77	9.10
84	9.30
91	9.69
97	8.61
103	8.57

Table 2.5
Mean C/N-ratio, Århus Bay.

It is characteristic that the stations near and south of the outlet (stns. 51, 64, 77, 84, 91) had the highest C/N-ratios. The C/N-ration for stn. 71 was lower than expected but this might be an artefact (see above). The C/N-ratio at stn. 24 was also quite high, probably due to dead eelgrass in the samples.

Scuba diver inspection

The first Scuba diver inspection took place in November 1984 and showed that the sediment was azoic 400 m south of the outlet. In October 1986 the azoic zone extended 1500 m south of the outlet. In October 1989 the sediment was azoic to 500 m south of the discharge point. The sediment was covered with white sulphur bacteria, *Beggiatoa*, on all three occasions.

Fornæs

Organic content and *Clostridium perfringens*

The organic content varied little within stations from year to year (appendix 2.1). A map of the organic content of the sediment has therefore been drawn on basis of the mean organic content 1986-1991 (figure 2.19). The highest organic content was found east of the waste water outlet and in the south eastern part of the sampling area. The enhanced organic content in the south eastern part followed the increase in depth while the organic enrichment at stn. 42 and 43 probably was due to the discharge of waste water. A number of stations east and north east of the outlet had a slightly higher organic content compared to the remaining sampling stations.

The number of *Clostridium perfringens* was low compared to Århus Bay and never exceeded 10,000 per g ignition loss apart from stn. 42 nearest the outlet (Århus Amt 1990c). The occurrence of *C. perfringens* demonstrates, however, that organic matter from the waste water is spread all over the sampling area.

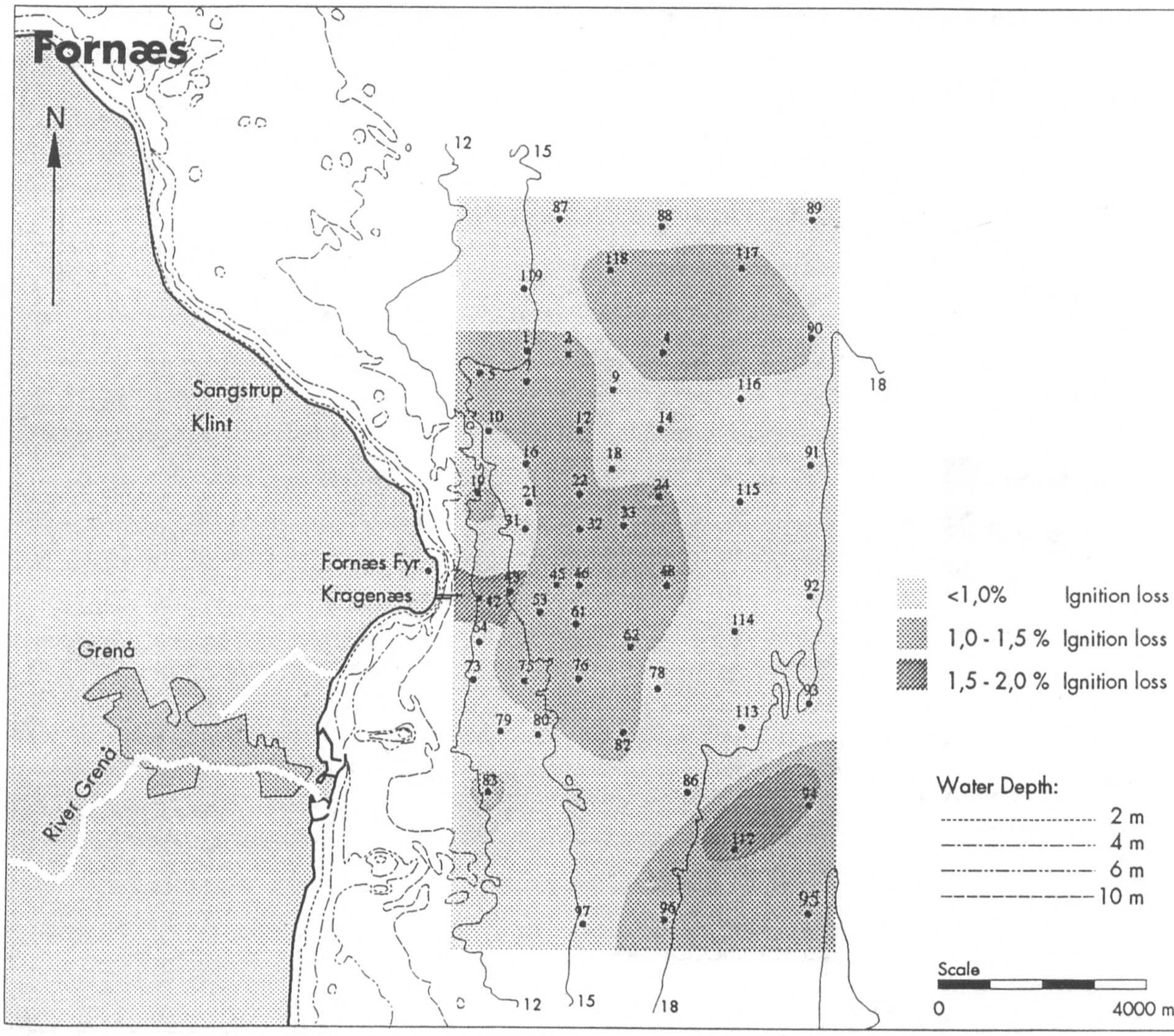


Figure 2.19
The mean organic content at Fornæs 1986-1991 measured as ignition loss.

Particle size

As mentioned above, no particle size analysis was carried out at Fornæs but the texture of the sediment was noted on board the ship. The map on figure 2.20 is drawn on basis of these descriptions. The area is sandy although in the deeper south eastern part, near the outlet and a few other stations there is some silt in the sediment. A couple of stations have a very coarse sediment - stns. 16, 21, 64, 80, 86 and 97. In the triangle formed by the latter three stations, sampling within this area was abandoned from 1985 onwards due to the presence of coarse sediment with stones and many *Modiolus modiolus*.

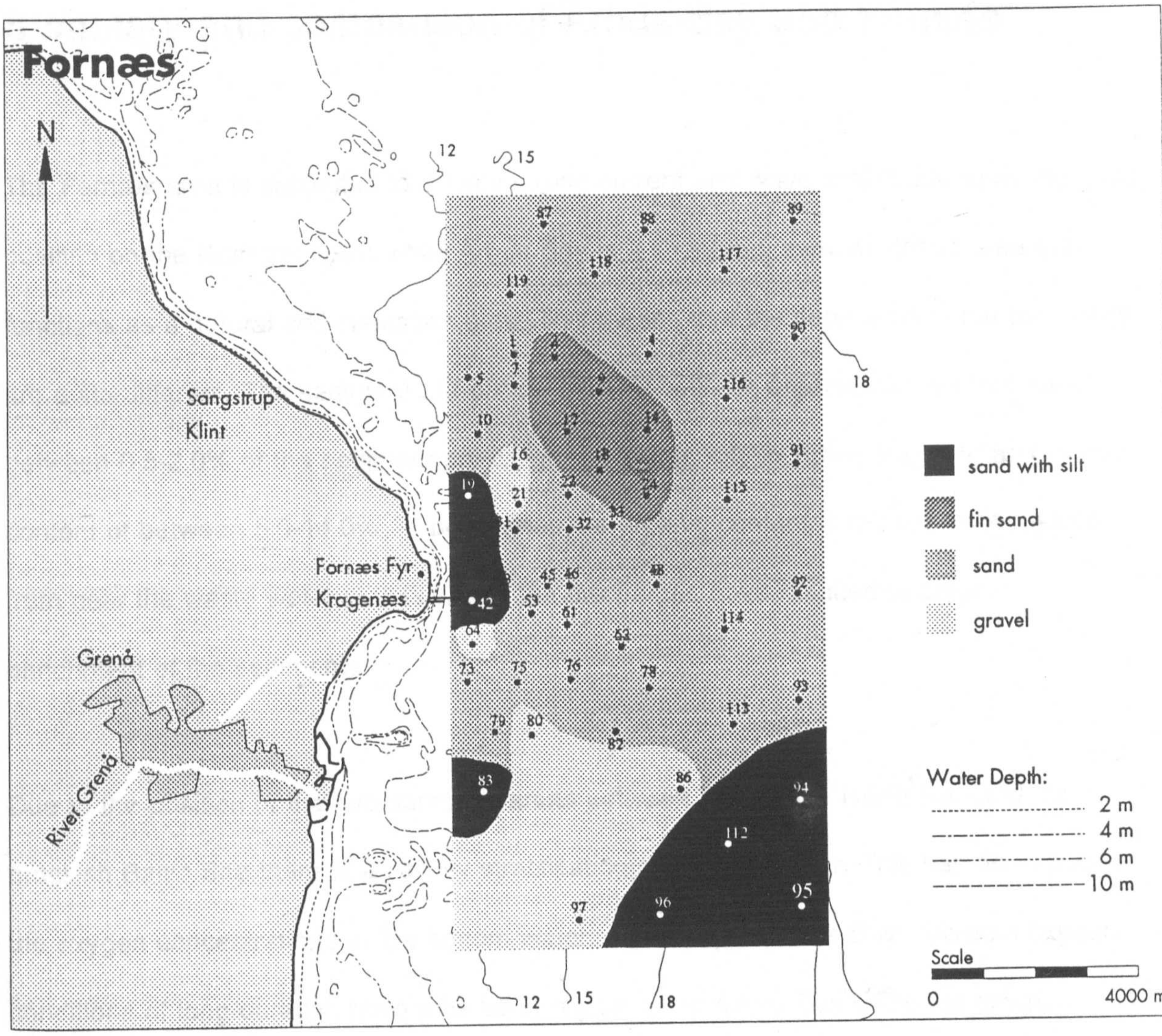


Figure 2.20
Sediment types at Fornæs

Summary and comparison of Århus Bay and Fornæs

The Fornæs area is subjected to a fairly strong current and wave action due to its exposed position on the Kattegat coast while Århus Bay is a sheltered, semi-enclosed area that functions as a natural sedimentation area. This means that the sediments in the two areas are quite different. The sediment at Fornæs is sandy with an organic content that varies between 0.5-2.0% of the sediment dry weight while it is silty in Århus Bay with an organic content of between 5.0-14.0%. In both areas the organic content is related to depth apart from near the waste water outlets where the discharges have resulted in organic enrichment of the sediments.

Due to the position of the two sampling areas between the marine North Sea and the brackish Baltic Sea there is a salinity stratification most of the year. This has an impact on the oxygen concentrations in the bottom water, especially in Århus Bay. Adverse oxygen conditions of long duration have thus been registered in Århus Bay while the oxygen conditions are generally good at Fornæs.

The discharge of organic matter from waste water to Århus Bay was greatly reduced from 3500 to 150 t BOD per year by the beginning of 1990 due to improved waste water treatment. The discharge of organic matter to the Fornæs area was reduced from c. 2500 to c. 1400 t BOD per year by the middle of 1991.

Distribution of fluorescence throughout the water column has shown that a considerable amount of the phytoplankton is situated at and around the halocline. Traditionally phytoplankton sampling has taken place above the halocline which means that the algal biomass and primary production probably have been underestimated by at least 30%. Fluorescence is therefore used as a simple measure for the amount of phytoplankton.

3. Spatial and temporal variability in the benthic fauna, Århus Bay and Fornæs

Introduction

Århus Bay is inhabited by an *Abra* community (*sensu* Petersen 1913) while Fornæs is inhabited by a *Venus* community (Petersen 1913). The *Abra* community in Århus Bay is dominated by bivalves, especially *Abra alba*, *Mysella bidentata* and *Corbula gibba*. Other prominent members of the *Abra* community are: *Nephtys hombergii*, *N. ciliata*, *Ophiura albida* and *Echinocardium cordatum*. In the *Venus*-community at Fornæs polychaetes are commonly the numerically dominant group although bivalves are well represented. In the south eastern part of the sampling area *Amphiura filiformis* can be very abundant. *Fabulina fabula* is the most abundant bivalve, but *Arctica islandica*, *Macoma calcarea* and *Abra alba* are also frequent. *Chamelià (Venus) striatula* is not very abundant but is found in nearly every sample. The polychaetes *Myriochele oculata*, *Polydora caeca* and *Prionospio fallax* have alternately occurred in very high numbers. *Scoloplos armiger*, *Pholoe inornata*, *Spiophanes bombyx*, *Chaetozone setosa* and *Nephtys spp.* are found in more moderate and stable numbers. *Ophiura albida*, *Echinocardium cordatum* and *Ampelisca brevicornis* are, moreover, widely distributed in the area.

The present chapter describes the spatial and temporal variability, in number of species, abundance and biomass, of taxonomic and trophic groups in the two study areas during the sampling period.

Inspired by Pearson and Rosenberg (1978) the variability in number of species (S), abundance (A) and biomass (B) is presented along transects. SAB-curves from Århus Bay and Fornæs are compared to the generalized diagram of changes in species richness, abundance and biomass along a gradient of organic enrichment shown in figure 3.1.

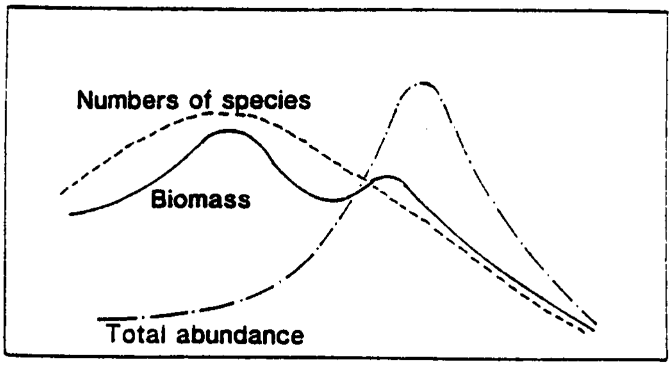


Figure 3.1
Generalised diagram of changes in number of species, total abundance and biomass along a gradient of organic enrichment from "normal" (left) to grossly polluted (right).

Pearson and Rosenberg found that sediments in the vicinity of a discharge point are often devoided of benthic macrofauna due to anaerobic conditions. Not far away from this area a few small opportunistic species appear. Further away from the most organically enriched area species richness (S) rises rapidly as enrichment declines, reaches a maximum in moderately enriched areas, and then declines to an intermediate level in unenriched normal communities. Some short distance from the first poor community abundance (A) rises dramatically due to one or two very abundant opportunistic species. As enrichment declines abundance declines progressively to a steady state level usually found under normal conditions. The biomass curve (B) exhibits two peaks, associated with the high abundances in the highly enriched areas and the high diversities in the moderately enriched areas respectively. The secondary biomass maximum occurs in that area of the gradient where organic enrichment of the sediments is sufficient to provide a rich food source but not yet high enough to cause serious oxygen depletion. The changing SAB relationship described above as taking place along a gradient in space of decreasing enrichment may also occur along a similar gradient in time (Pearson & Rosenberg 1978). Although the SAB curves provide a simplified picture of reality, they have been found to be widely applicable (Pearson *et al.*,1983, Bonsdorff & Österman 1986, Gray *et al.* 1988, Rees *et al.* 1990, Fallesen 1992).

Methods

Sampling methods - Århus Bay

A large number of bottom fauna investigations have been carried out in Århus Bay since 1971 (Århus Amt 1990d). In the 1970s the aim of the sampling surveys was to assess the impact on the bottom fauna caused by waste water discharge and most sampling stations were therefore concentrated in the vicinity and south of the long sea outfall (figure 3.2). The investigations in the 1980s have mainly focused on the impact of recurring oxygen deficiencies and have therefore included sampling stations in the central and eastern part of the bay. The main purpose of the investigations in 1990 and 1991 has been to evaluate the effect of the improved waste water treatment.

Until 1985, the number and position of sampling stations changed from one survey to the next because bottom fauna investigations were carried out by different institutions. Since 1985 the same 15 stations have been visited every year between late September and early November (figure 3.2). No samples were collected at stn. 73 in 1989. Positions and depth are given in appendix 3.1. In order to investigate seasonal variation and estimate growth and production, samples were taken monthly at stn. 6 in 1990 and 1991. Stn. 6 was chosen for monthly sampling because of the long time series of benthic and pelagic data at this station.

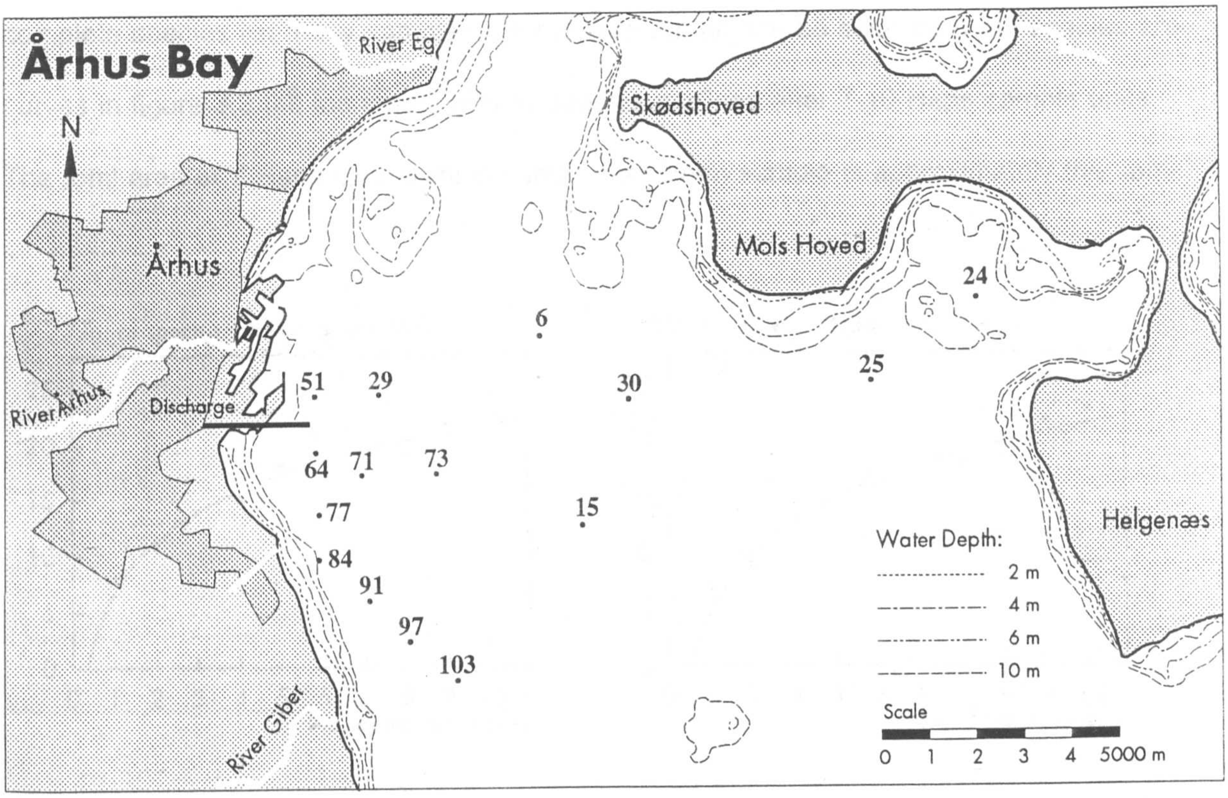


Figure 3.2
The 15 sampling stations in Århus Bay 1985-1991.

The number of sampling units and the choice of sampling gear have partly been determined by the current "trend" in monitoring investigations and partly by cost-benefit analyses. As a consequence of this, one Van Veen grab sample (0.1 m^2) per station has been taken during the period 1985-1988 while 7 Haps core samples (0.0123 m^2) (Kanneworff & Nicolaisen 1973) were collected at each station in the annual surveys from 1989 and onwards. The monthly sampling at stn. 6 in 1990 and 1991 included 10 such sampling units. Samples have always been washed on a 1-mm sieve.

<u>The impact of change in sampling method</u>

The *Abra* community in Århus Bay is dominated by a few abundant species which occur in nearly every sampling unit, while the majority of species occur less frequently (appendix 3.2). As most species, abundant as well as rare, have a patchy distribution on the sea bottom (Gray 1981) their number can be very variable among sampling units. To obtain a complete species list many samples are required but as can be seen from the species-area curves in figure 3.3 the increment of new species declines after 7-10 Haps sample units. The total area of 7 Haps core samples and 1 Van Veen sample is approximately the same.

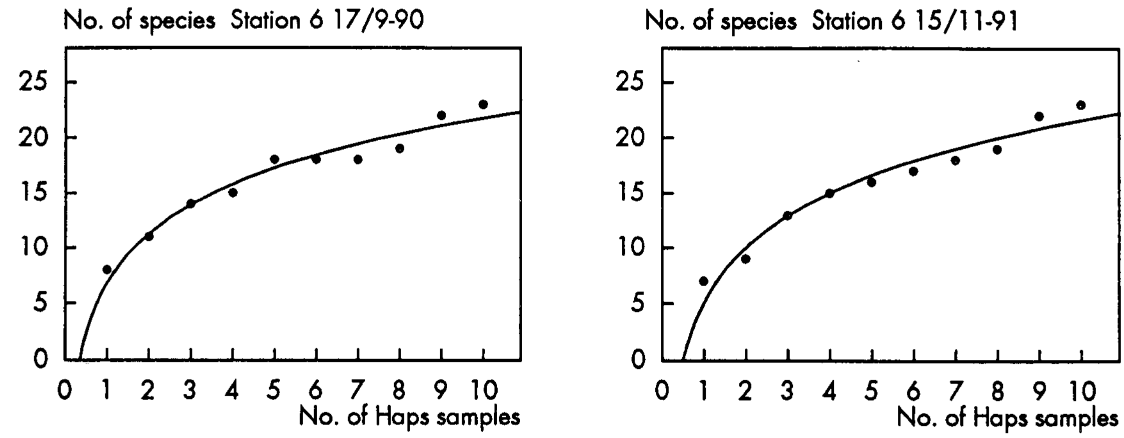


Figure 3.3
Species-area curves from stn. 6, 17 Sept. 1990 and 15 Nov. 1991, respectively.

The change in sampling gear from 1 Van Veen to 7 Haps from 1989 onwards is likely to affect the estimation of abundance per m^2. Jensen (1980) found that sampling with a Haps gives a higher abundance per m^2 than sampling with a Van Veen when the same area is sampled. Firstly, because the Haps takes a cylindrical bite of the sea bottom whereas the Van Veen grab does not bite to an equal depth over the whole area. Secondly, because the clumped distribution of species means number of individuals is better estimated by more small samples (Haps) than 1-2 big samples. Thirdly, sorting a small sample is probably more efficient than sorting a big sample and it is less time consuming to get the same accuracy for the mean number of individuals per m^2 with a Haps than with a Van Veen grab (Jensen, 1980).

It is difficult to evaluate the impact of the change in sampling method when no parallel samples with both instruments have been taken. Moreover, the natural variation and the variation caused by other factors may overrule possible differences caused by the difference in sampling procedure.

Sampling methods - Fornæs

The strategy for monitoring investigations at Fornæs has been to evaluate the spatial extent of the impact of waste water discharge. Therefore surveys have covered a very big area taking only one sample at each station rather than taking multiple samples at fewer stations. The station grid varied, especially at the beginning of the 1980s. From 1983 to 1985 the same stations were sampled every year and these stations are included in the surveys from 1986 to 1990. Figure 3.4 shows the sampling stations from 1986 to 1990. Postitions and depth are given in appendix 3.1.

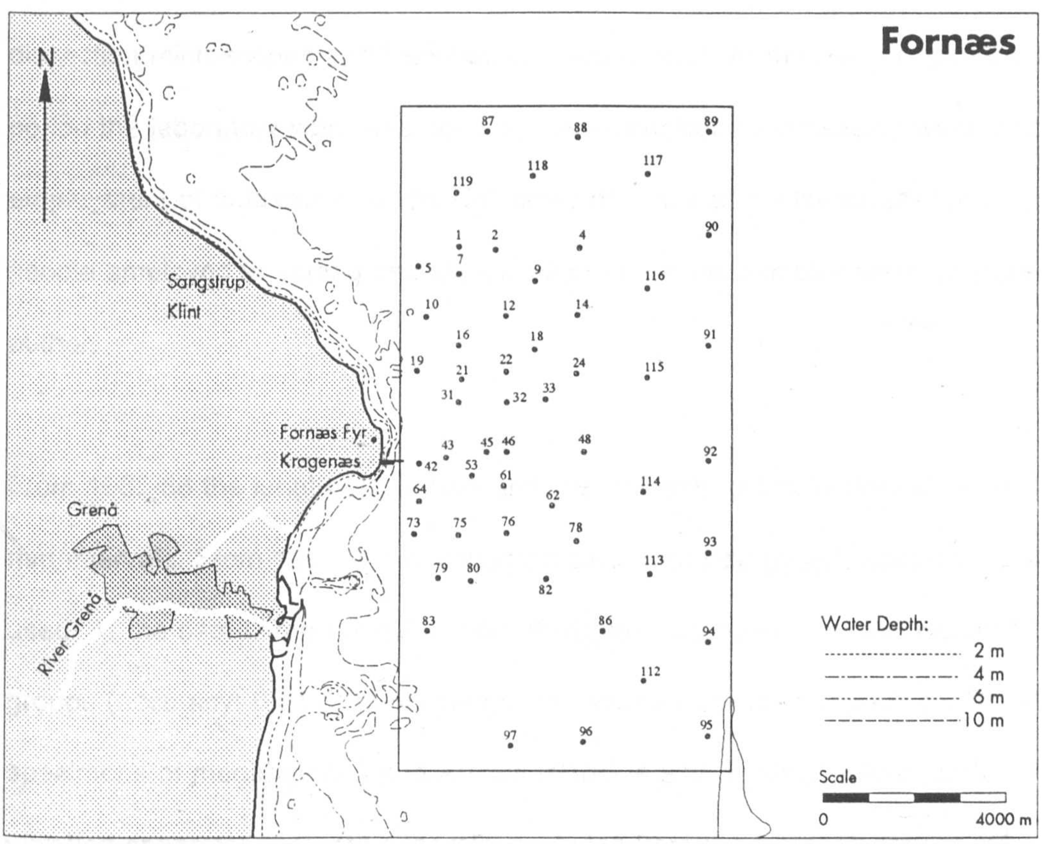


Figure 3.4
Sampling stations at Fornæs 1986-1990.

All monitoring investigations at Fornæs have taken place at the same time of year namely, May or June, and all samples have been collected with a 0.1 m^2 Van Veen grab and washed on a 1-mm mesh sieve. A Haps core sampler would be too small for sampling at Fornæs, because the benthic community includes many large species like *Echinocardium cordatum* and *Arctica islandica*. Even with a Van Veen grab it can be difficult to take a sample in a dense population of *Arctica islandica*.

Laboratory procedure

After being washed on a 1-mm sieve on board the ship the samples were preserved in alcohol. Formalin was avoided for health reasons. The samples were sorted using dissection microscopes and identified to species level. At the beginning of the sampling period the laboratory work was done by the author but an increasing work load soon led to employment of students from the University of Århus and a laboratory technician. The people employed in sorting and identification of benthic samples were all supervised by the author.

From 1985-88 the length of bivalves and the diameter of brittle stars were measured in ½ mm intervals. From 1989 and onwards an electronic size gauge (accuracy: 0.03 mm) was used. At the same time the estimation of biomass changed from wet weight of taxonomic groups (accuracy: 0.01 g) to dry weight of species (accuracy: 0.0001 g). Occasional specimens of megabenthos and *Arctica islandica* and *Echinocardium cordatum* were weighed separately and are generally excluded from the biomass graphs. Wet weight and dry weight have been converted to ash free dry weight using the conversion factors given by Rumohr *et al.* (1987). All data were stored in the database RAMBI (Registrering Af Marine Bentiske Invertebrater) (Mikkelsen & Fallesen 1990).

Presentation of data

The variablility in number of species, abundance and biomass for the 15 stations in Århus Bay from 1985 to 1991 have been arranged along 3 transects. The variability in the same parameters is shown for 7 selected stations (out of 55 stations) from the Fornæs area from 1980/81 to 1990. In order to characterize the two benthic communities in more detail the abundance and biomass figures have been subdivided into 5 taxonomic groups and 4 trophic groups. The complete species lists from the two study areas are found in appendix 3.2 and 3.3. Appendices 3.4 and 3.5 show the total number of species, abundance per m^2 and biomass (ash free dry weight) per m^2. Appendix 3.6 shows the species list from the RAMBI database with taxonomic and trophic groups.

SAB curves

SAB-curves (*sensu* Pearson & Rosenberg 1978) have been established along the 3 transects in Århus Bay for 1985 and 1991 and for stn. 6 from 1976 to 1991 and along one transect at Fornæs for 1986 and 1990.

Results

Århus Bay

Number of species

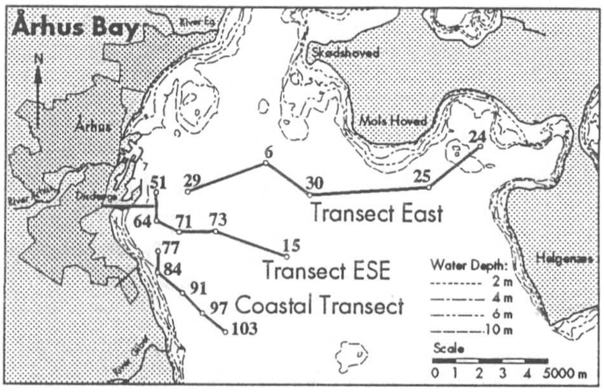
The variation in number of species along the 3 transects is shown in figure 3.5. The lowest number of species was found at stn. 64 south of the sewage outlet, although species richness increased after the reduction in sewage discharge. The number of species was also low at stn. 51 before the waste water treatment was improved in the beginning of

1990. For the remaining stations the number of species varied between 9 and 40 during the sampling period. At a number of stations in the central and eastern part of the bay (stn. 15, 24, 25 and 30) species richness was fairly low in 1988; the same was true for stn. 97. At many stations (stn. 6, 15, 25, 29, 30, 71, 77, 97 and 103) the highest number of species was found in 1990.

Abundance

The abundances of taxonomic groups per m^2 along the 3 transects are shown in figure 3.6. The lowest abundances were found at stn. 51 and 64 although the number of individuals increased remarkably at stn. 51 after the reduction in waste water discharge. The highest abundances were found along the coastal transect, especially at stn. 77, 84 and 91. The stations in the central and eastern part of the bay (stn. 6, 15, 24, 25 and 30) had relatively low abundances. A number of stations had a higher abundance in 1989, 1990 and 1991 compared to the period 1985-1988. A possible effect of the change in sampling method cannot be excluded, although a great deal of the increase at many stations could be attributed to the increase in abundance of *Mysella bidentata*. The majority of individuals belonged to Mollusca. This group is comprised almost exclusively of bivalves in Århus Bay.

The abundance of trophic groups is shown in figure 3.7. The dominant group was deposit feeders because the two most abundant bivalves, *Abra alba* and *Mysella bidentata*, were referred to this group. Suspension feeders were relatively abundant along the coastal transect and at stns. 24 and 71 in 1989 and 1990, mainly due to *Corbula gibba*.



Number of species 1985-1991

ind·m^{-2}

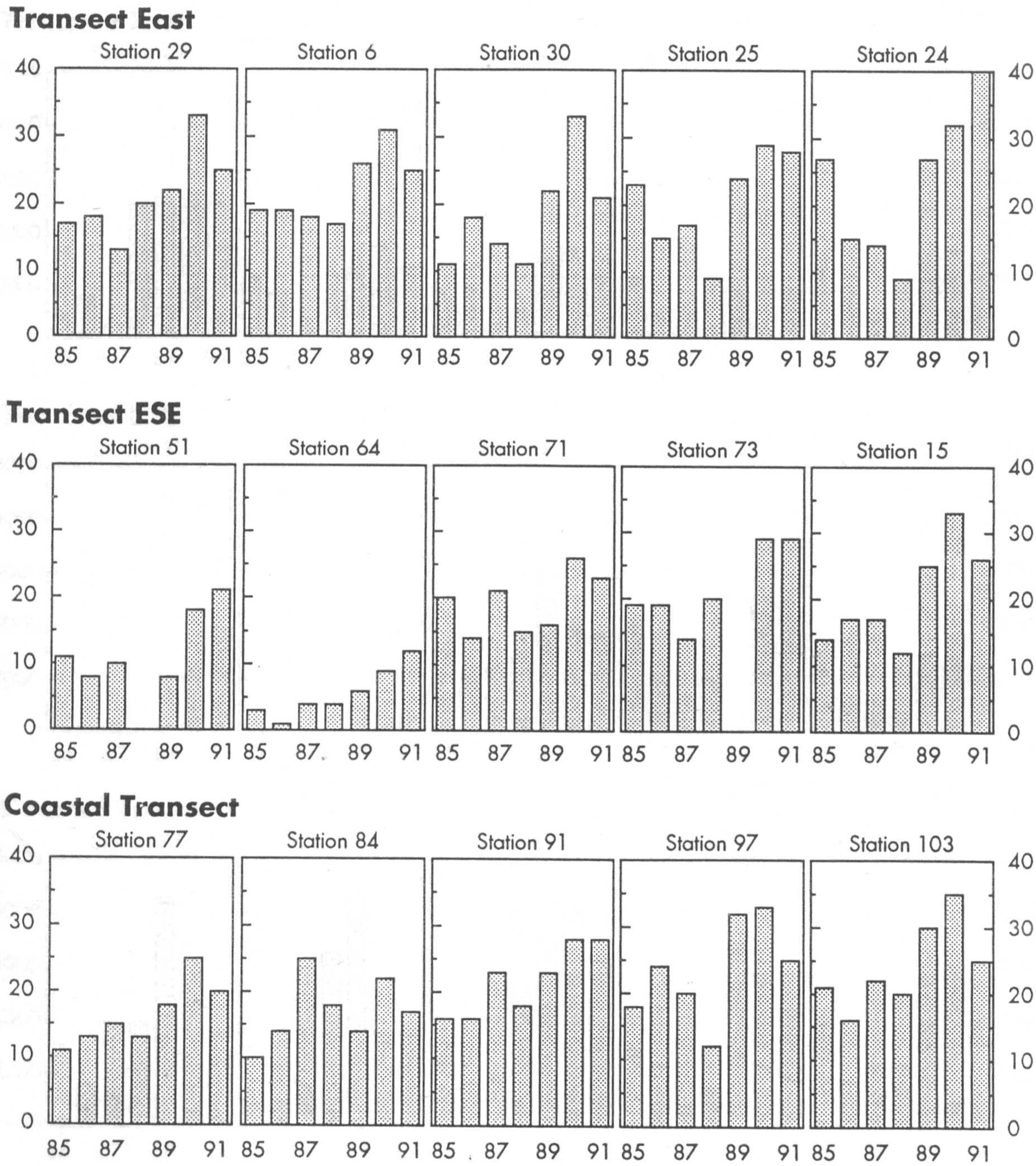


Figure 3.5
Variation in the number of species at the 15 stations in Århus Bay, 1985-1991.

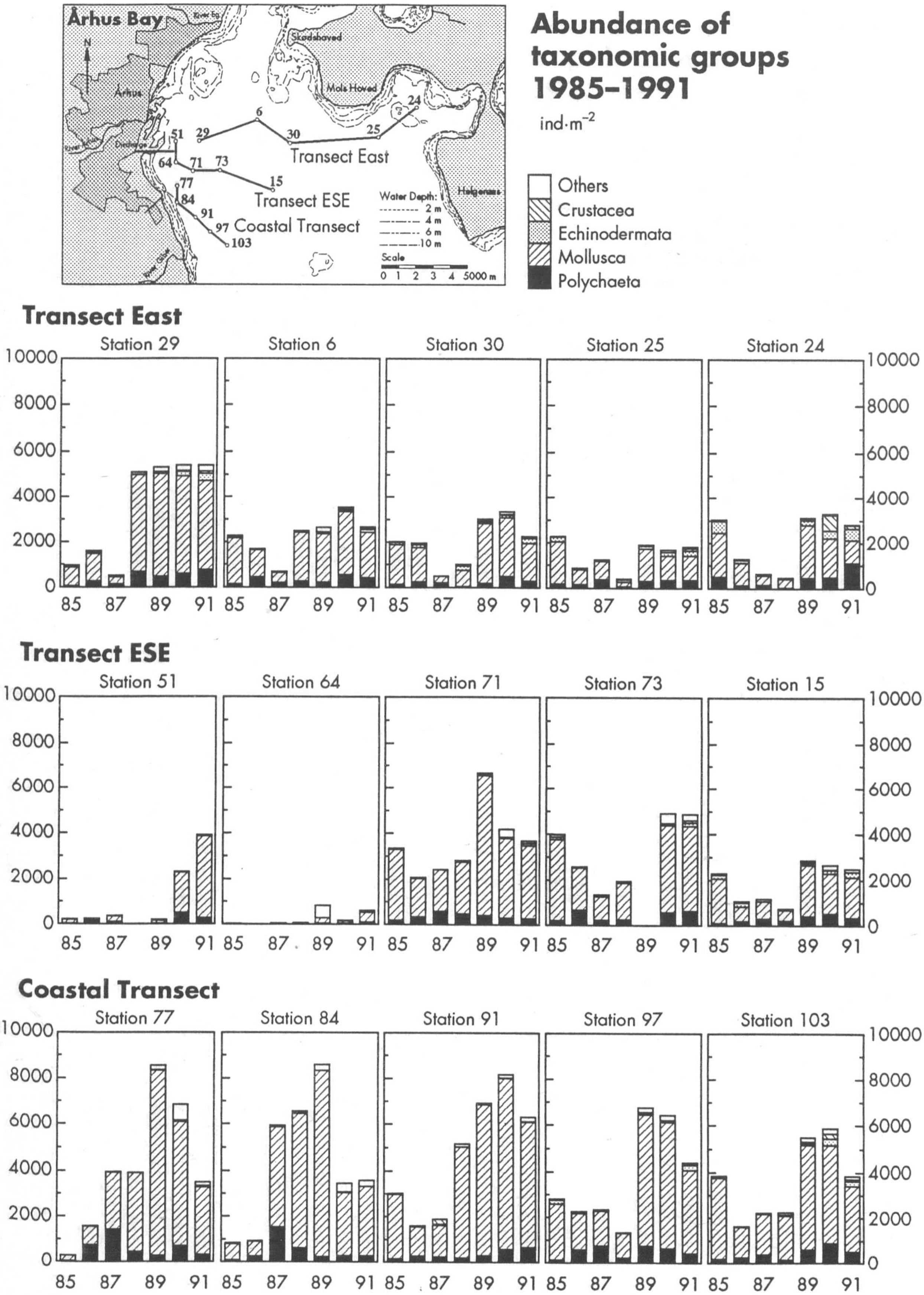


Figure 3.6
Variation in abundance of taxonomic groups at the 15 stations in Århus Bay, 1985-1991.

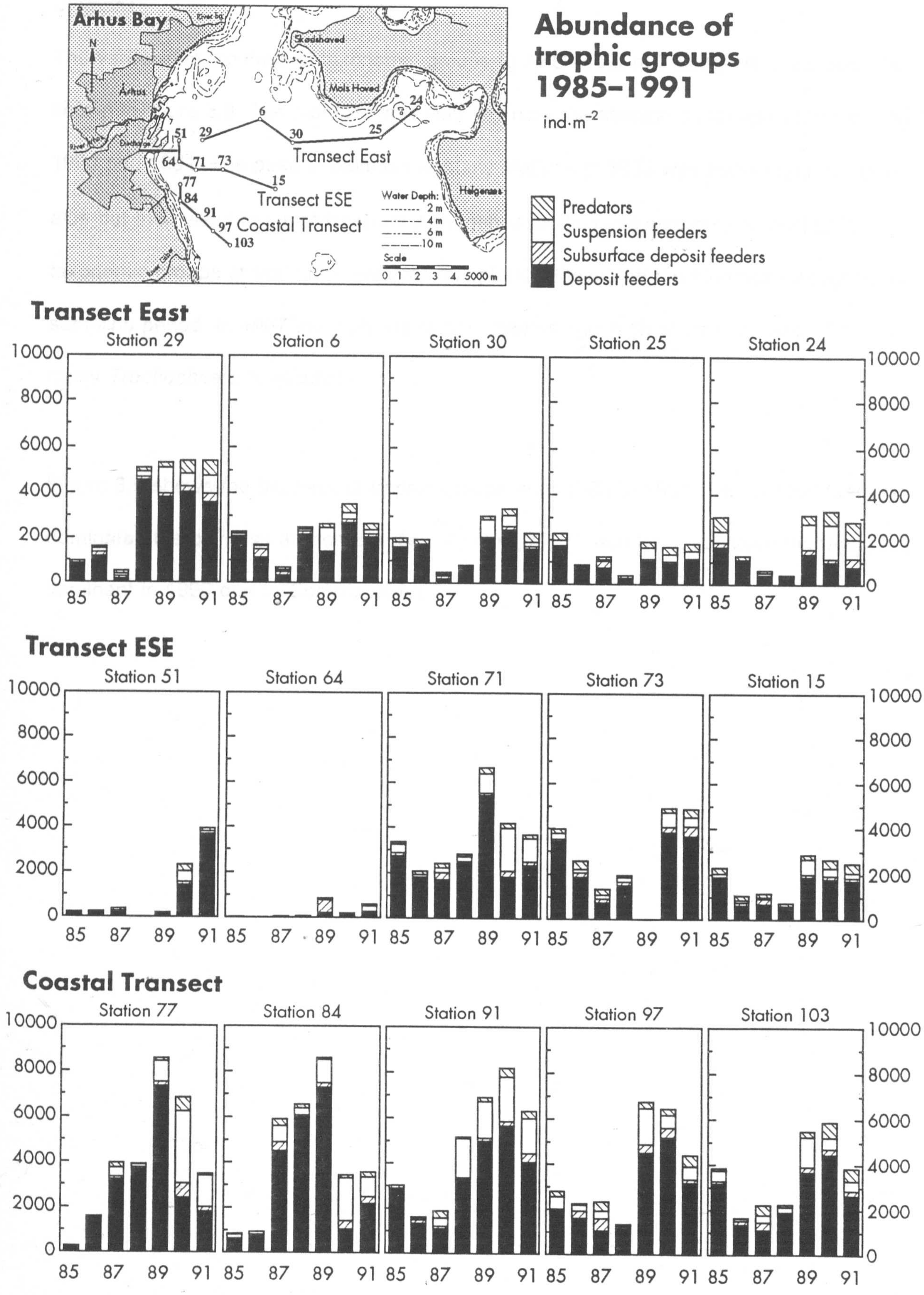


Figure 3.7
Variation in abundance of trophic groups at the 15 stations in Århus Bay, 1985-1991.

Biomass

The variation in biomass of taxonomic groups (g AFDW per m^2) along the 3 transects is shown in figure 3.8. The biomass was very low near the sewage outlet apart from stn. 51 in 1990 and 1991. The peak in biomass at many stations in 1988 was mainly due to *Abra alba* but their weight cannot be exactly quantified as biomass was only estimated for taxonomic groups at that time. Bivalves completely dominated the biomass throughout the sampling period. In 1987 the biomass of polychaetes was high at stns. 77 and 84 due to many *Trochochaeta multisetosa*.

Figure 3.9 shows the biomass of trophic groups from 1989 to 1991. The deposit feeders dominated the biomass at most stations. At stns. 71, 77 and 84 suspension feeders were dominant in 1990 due to *Corbula gibba*.

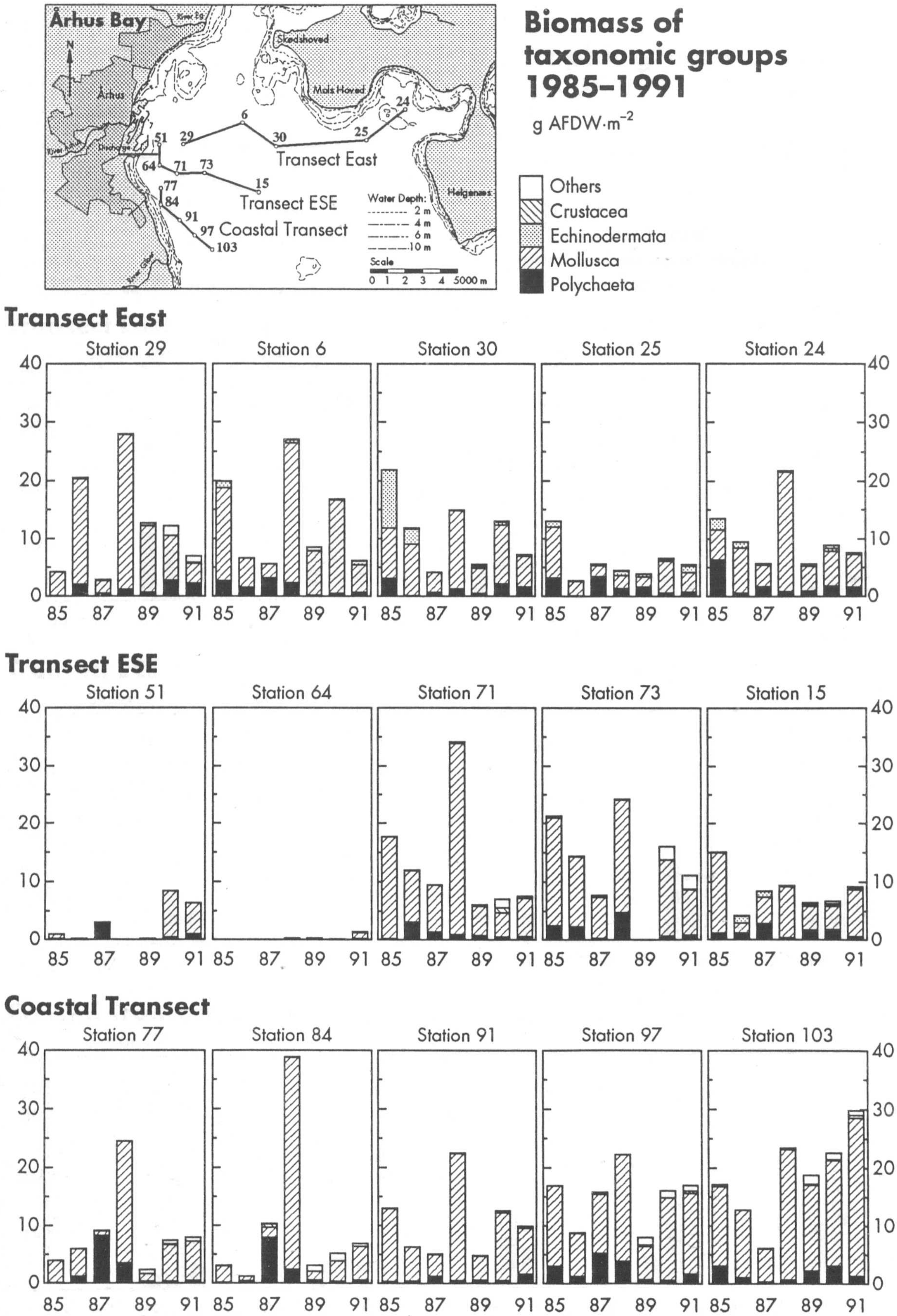


Figure 3.8
Variation of biomass of taxonomic groups at the 15 stations in Århus Bay, 1985-1991.

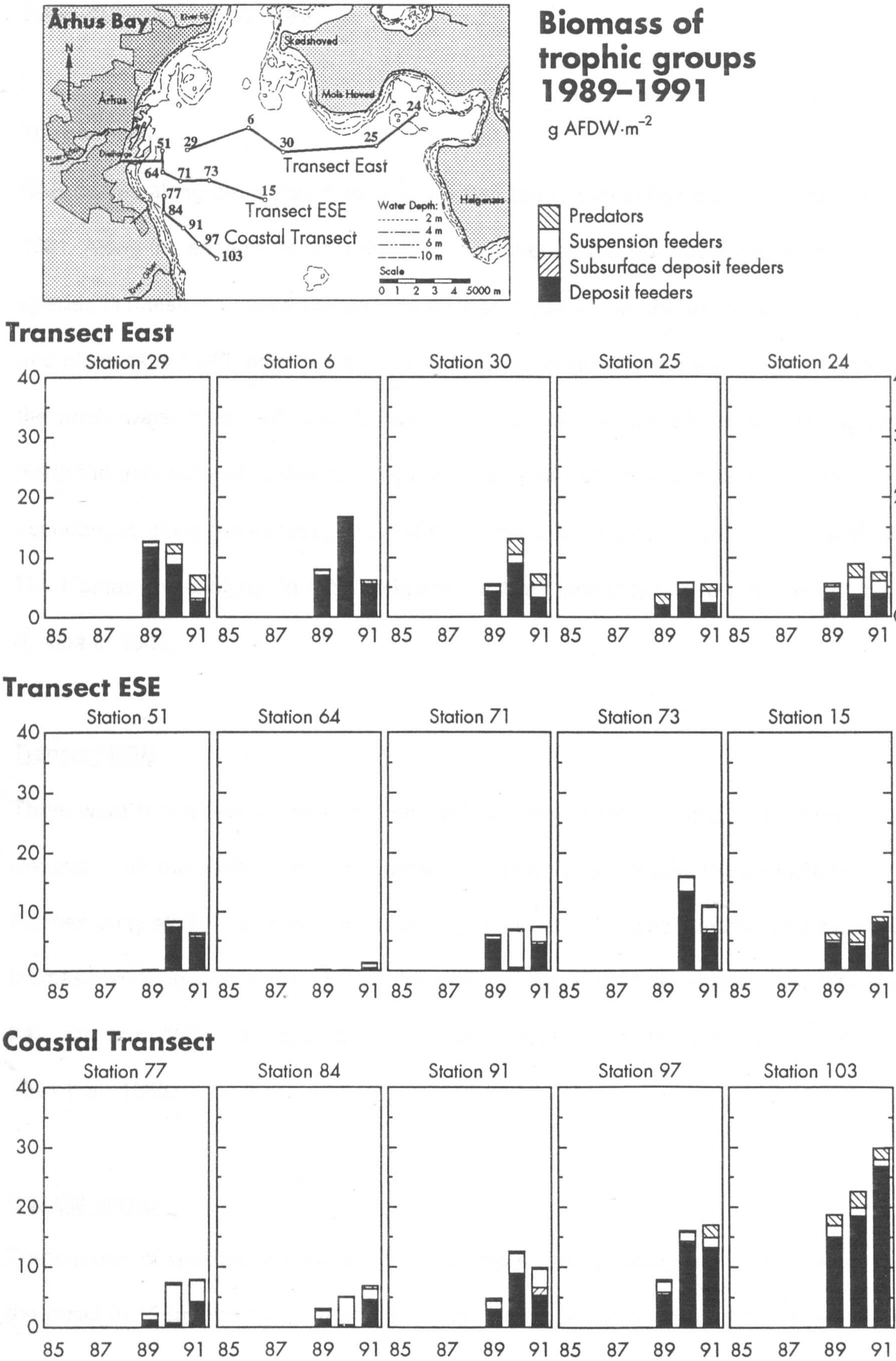


Figure 3.9
Variation in biomass of trophic groups at the 15 stations in Århus Bay 1989-1991.

SAB-curves, Århus Bay

Transect east

SAB curves along the 3 transects in Århus Bay are shown in figure 3.10 for 1985 and 1991. Along the eastern transect the lowest number of species was found at stn. 30 but species richness increased towards the east both years. Stn. 29 had a very low abundance and biomass in 1985, probably caused by its position close to the waste water outlet. After the waste water treatment was improved the abundance at stn. 29 became the highest along the transect mainly due to a high number of *M. bidentata* and *A. abra*. The abundances along the remaining part of the transect were very similar in 1985 and 1990. The biomass was higher in 1985 compared to 1991, primarily due to a higher number of *A. alba* in 1985.

Transect ESE

There were only a few species and very little biomass at stns. 51 and 64 in 1985. At some distance from the outlet species richness, abundance and biomass rapidly increased. Further away all 3 parameters decreased again. In 1991 species number, abundance and biomass were equally high on both sides of the outlet. A decline toward the middle of the bay, similar to 1985 was observed. As on the eastern transect the biomass was lower in 1991 than 1985.

Coastal transect

The number of species, abundance and biomass increased along the transect away from the outlet in 1985. The same trend was found for species richness and biomass in 1991 while the highest abundance was observed at stn. 91 due to *M. bidentata*.

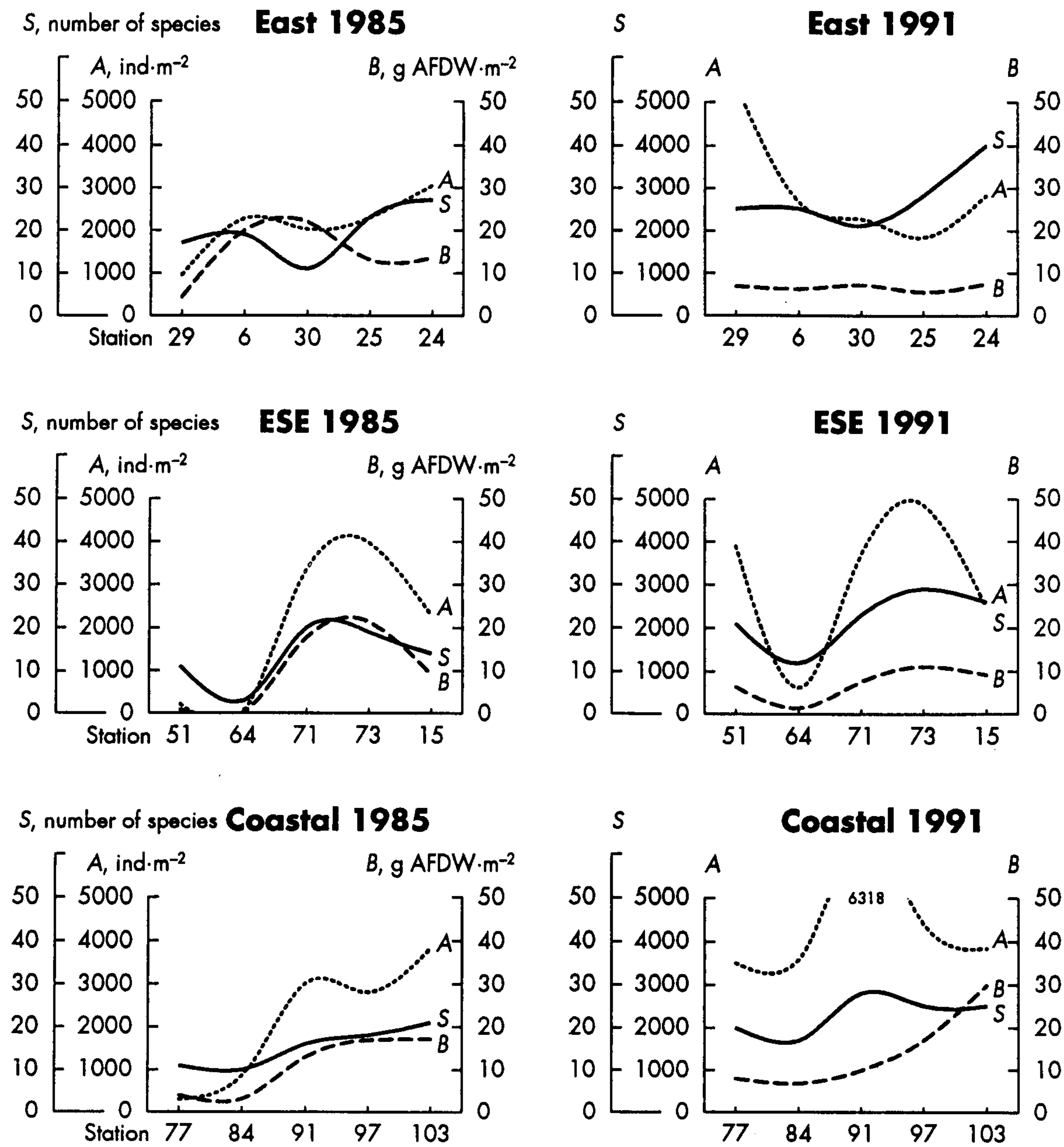


Figure 3.10
SAB-curves along the 3 transects in Århus Bay 1985 and 1991.

Stn. 6, gradient in time

A SAB curve for stn. 6 along a time gradient from 1976 to 1991 is shown in figure 3.11. The high number of species found in the late 1970s is a result of relatively large sample areas (4 Van Veen grabs per station). The high abundance and biomass in 1978 was mainly due to a successful cohort of *A. alba*. The cohort disappeared during the severe winter 1978/79 (Århus Amt 1990d). After the disastrous oxygen deficiency in September 1981 only a few species and very little biomass were found. In 1982 a high number of juvenile (especially bivalves) had recolonized the empty bottom, and the number of species and the abundance was high. From 1983 to 1988 species richness was very stable but increased slightly around 1990. The fluctuations in biomass from 1983 onwards was primarily determined by *A. alba* which also greatly influenced the variation in abundance. *C. gibba* contributed considerably to the high abundance in 1989 while *M. bidentata* was very abundant at stn. 6 in 1990 and 1991. The contribution to the biomass from these two species was, however, limited.

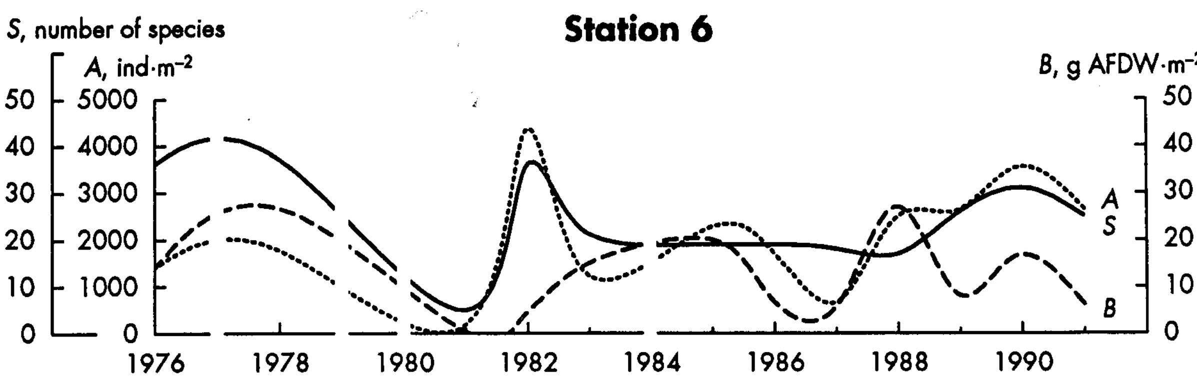


Figure 3.11
SAB-curves from stn. 6, Århus Bay from 1976 to 1991.

Fornæs

Number of species

The number of species at the 7 stations at Fornæs are shown in figure 3.12. The highest number of species was found at the beginning of the 1980s and in 1990. The lowest number was recorded in the mid 1980s.

Abundance

Figure 3.13 shows the abundance of taxonomic groups from 1980 to 1990. Abundance was high at stns. 2, 42, 48 and 73 in the beginning of the 1980s and high again in the late 1980s and 1990 (apart from stns. 42 and 73 in 1989). Contrary to Århus Bay molluscs were not the dominant group. Polychaetes were generally much more abundant and often made up half of the individuals at a station. The high number of polychaetes at stn. 42 in the beginning of the 1980s was caused by *Myriochele oculata*. *M. oculata* was also abundant at stns. 2, 48 and 73. The polychaete *Prionospio fallax* was very abundant in 1990, while *Polydora caeca* was abundant in 1981-1982 and in 1987-1988. The echinoderms were numerous at stn. 95 in 1986 and 1989 due to many juvenile *Amphiura filiformis*.

The abundance of trophic groups is shown in figure 3.14. The deposit feeders were generally dominant as was found in Århus Bay but contrary to Århus Bay the majority of deposit feeders were polychaetes. Suspension feeders were numerous at stns. 42, 73 and 95 due to *C. gibba* and/or *A. filiformis*.

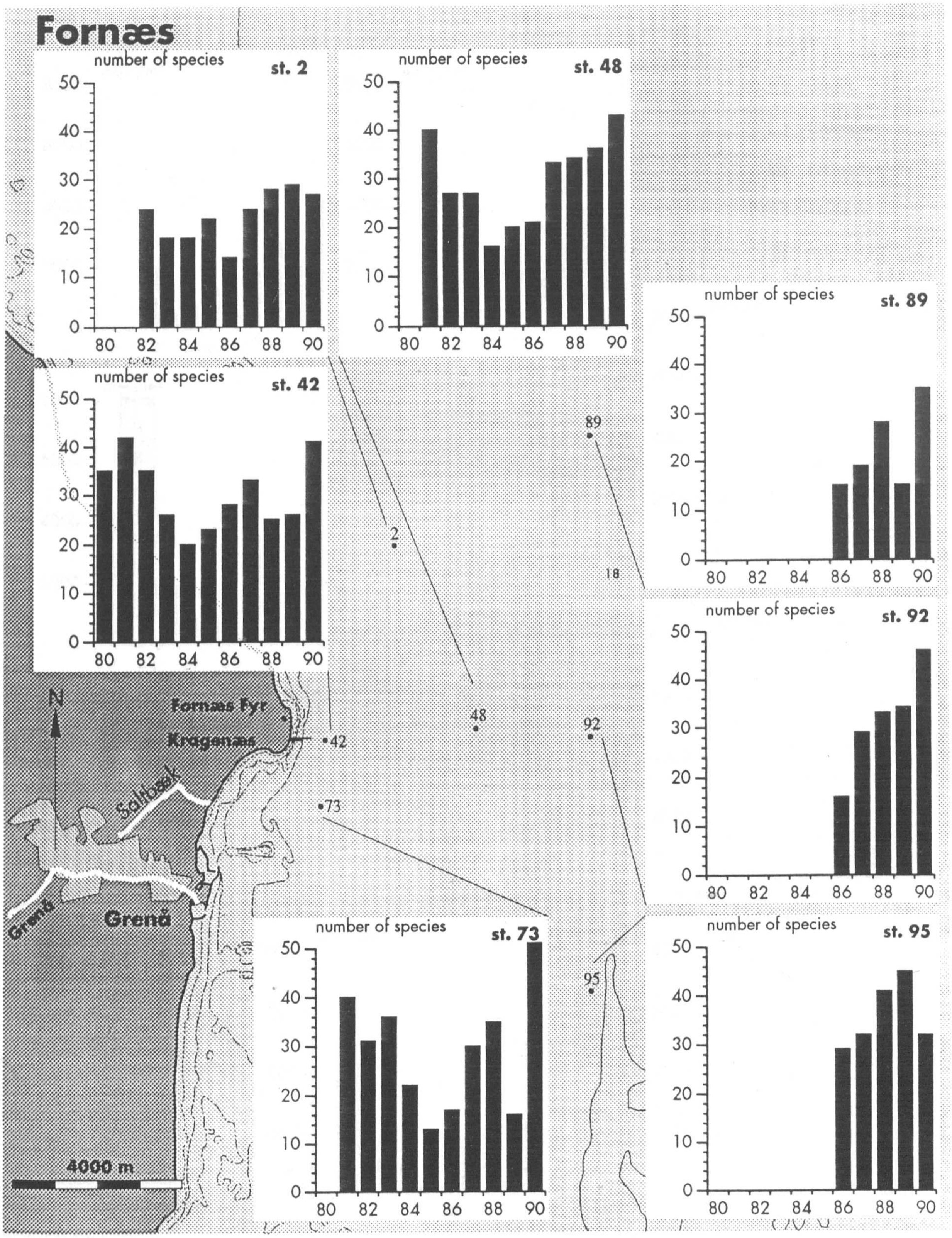


Figure 3.12
The variation in number of species at 7 stations at Fornæs, 1980-1990.

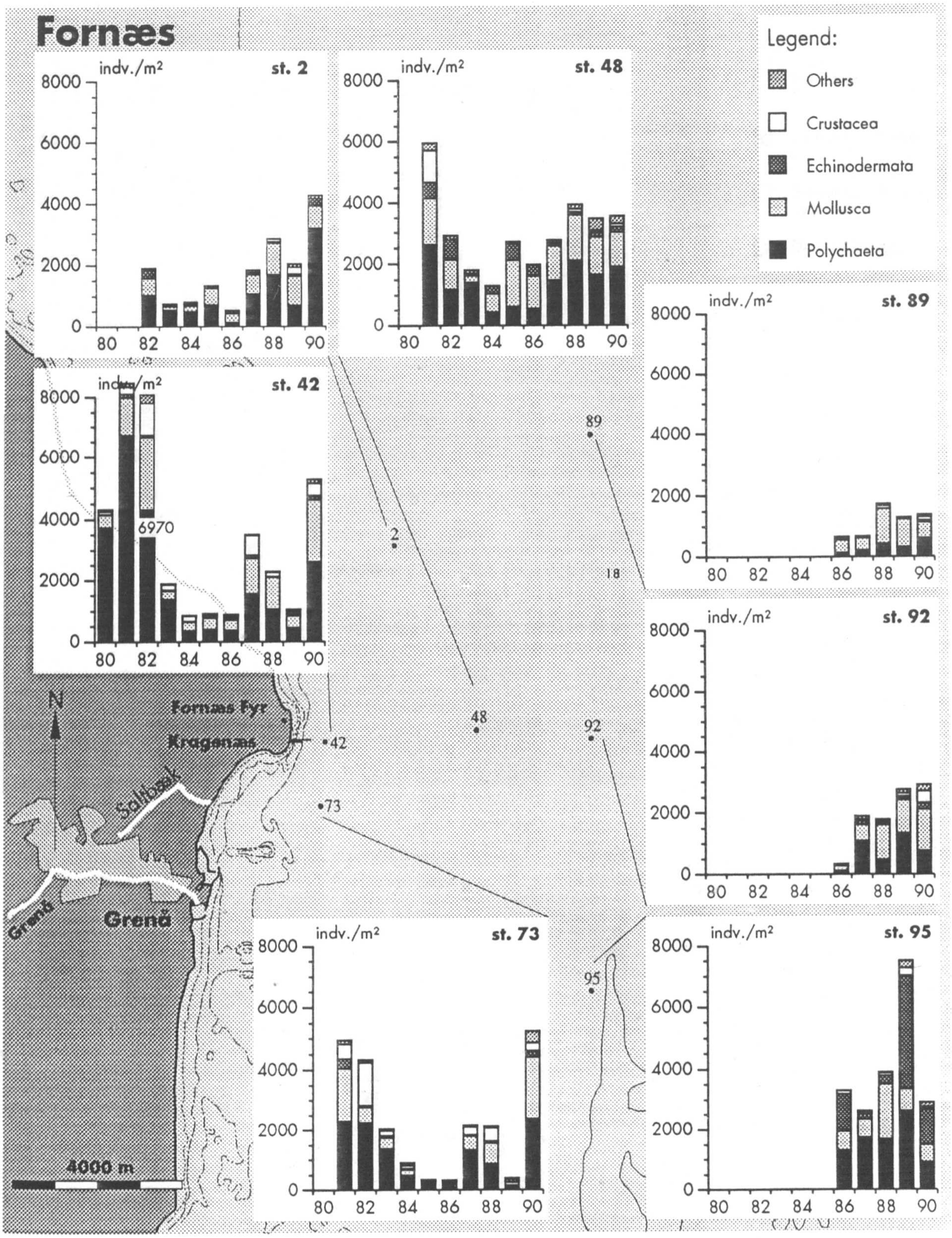


Figure 3.13
The variation in abundance of taxonomic groups at 7 stations at Fornæs, 1980-1990.

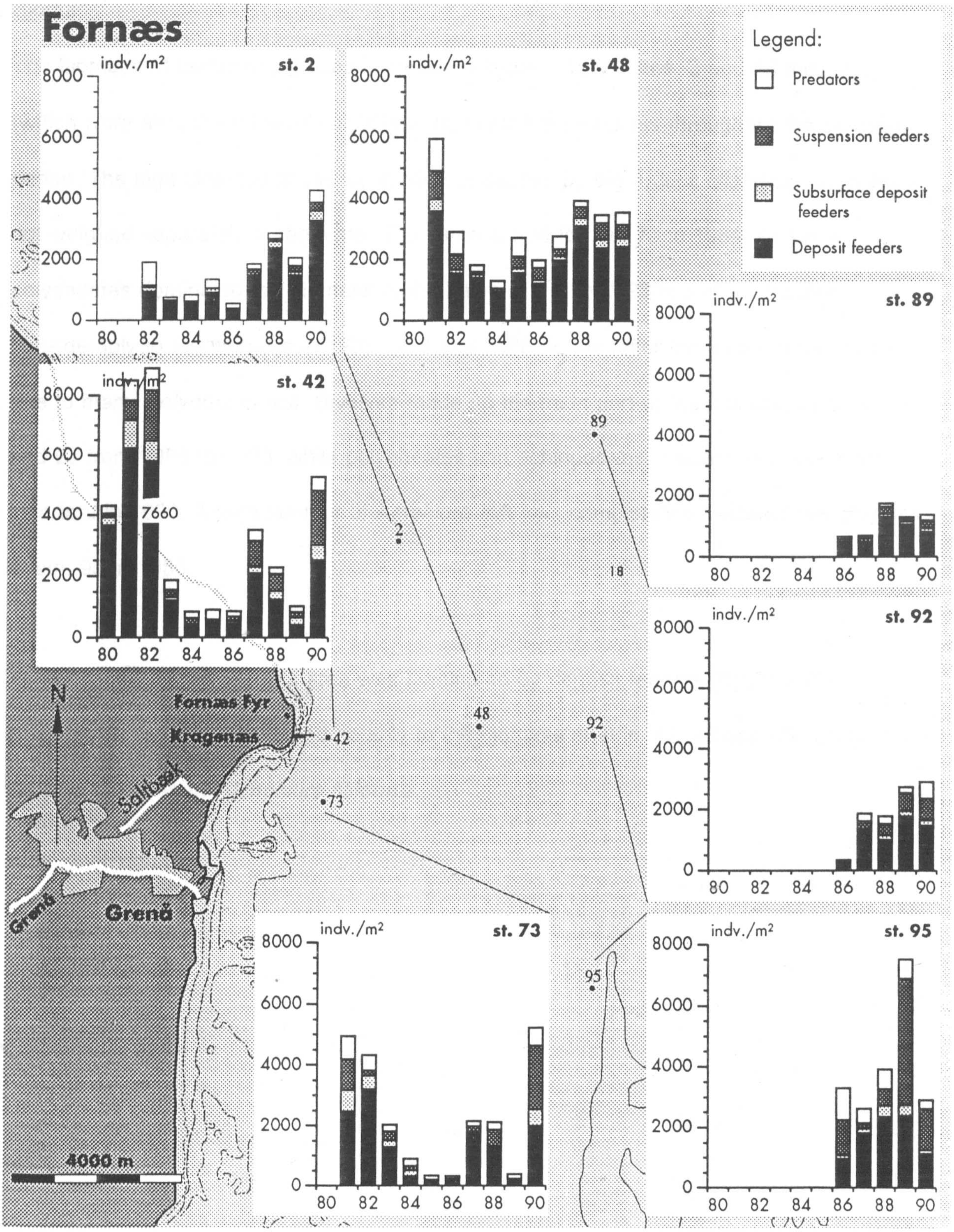


Figure 3.14
The variation in abundance of trophic groups at 7 stations at Fornæs, 1980-1990.

Biomass

The biomass of taxonomic groups is shown in figure 3.15. At stns. 2 and 48 molluscs (which were almost exclusively bivalves) dominated the biomass throughout the sampling period. The high biomass at stn. 48 in 1983 is caused by big *Arctica islandica* which were not weighed separately at that time. The same is true for stn. 73 in 1984. At stn. 42 polychaetes dominated the biomass at the beginning of the 1980s and contributed considerably to the biomass in 1986,1987 and 1988. In the latter period this was mainly due to many *Polydora caeca*. Bivalves made up the main part of the biomass at stns. 89 and 92 from 1986 to 1989, while polycheates and echinoderms, respectively, were very inportant in 1990. A high number of *Amphiura filiformis* completely dominated the biomass at stn. 95 in 1986.

As in Århus Bay the Fornæs area was dominated by deposit feeders (figure 3.16). Suspension feeders contributed notably to the biomass at stns. 42, 73 and 95 due to many *Corbula gibba* and/or *Amphiura filiformis*.

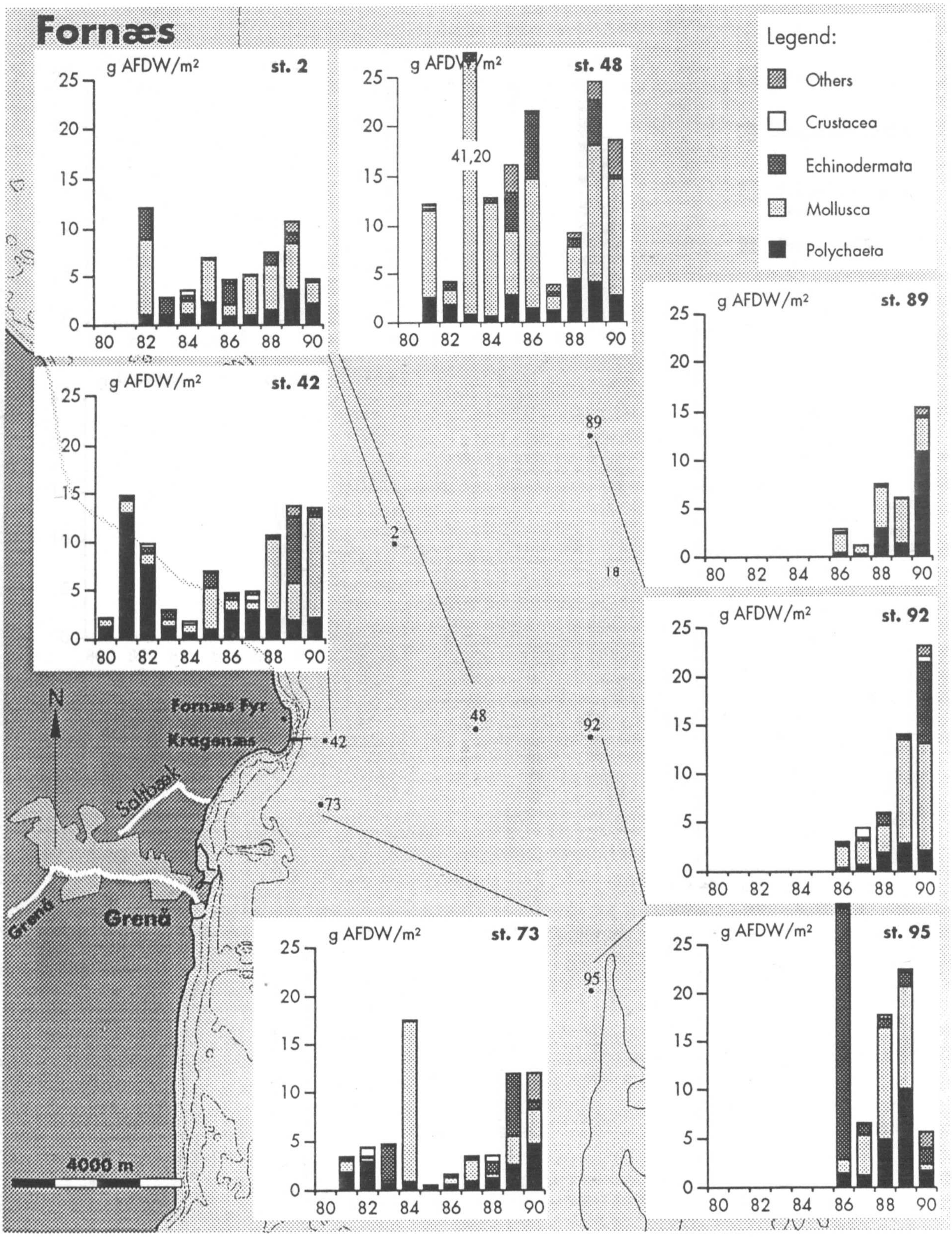


Figure 3.15
The variation in biomass of taxonomic groups at 7 stations at Fornæs, 1980-1990.

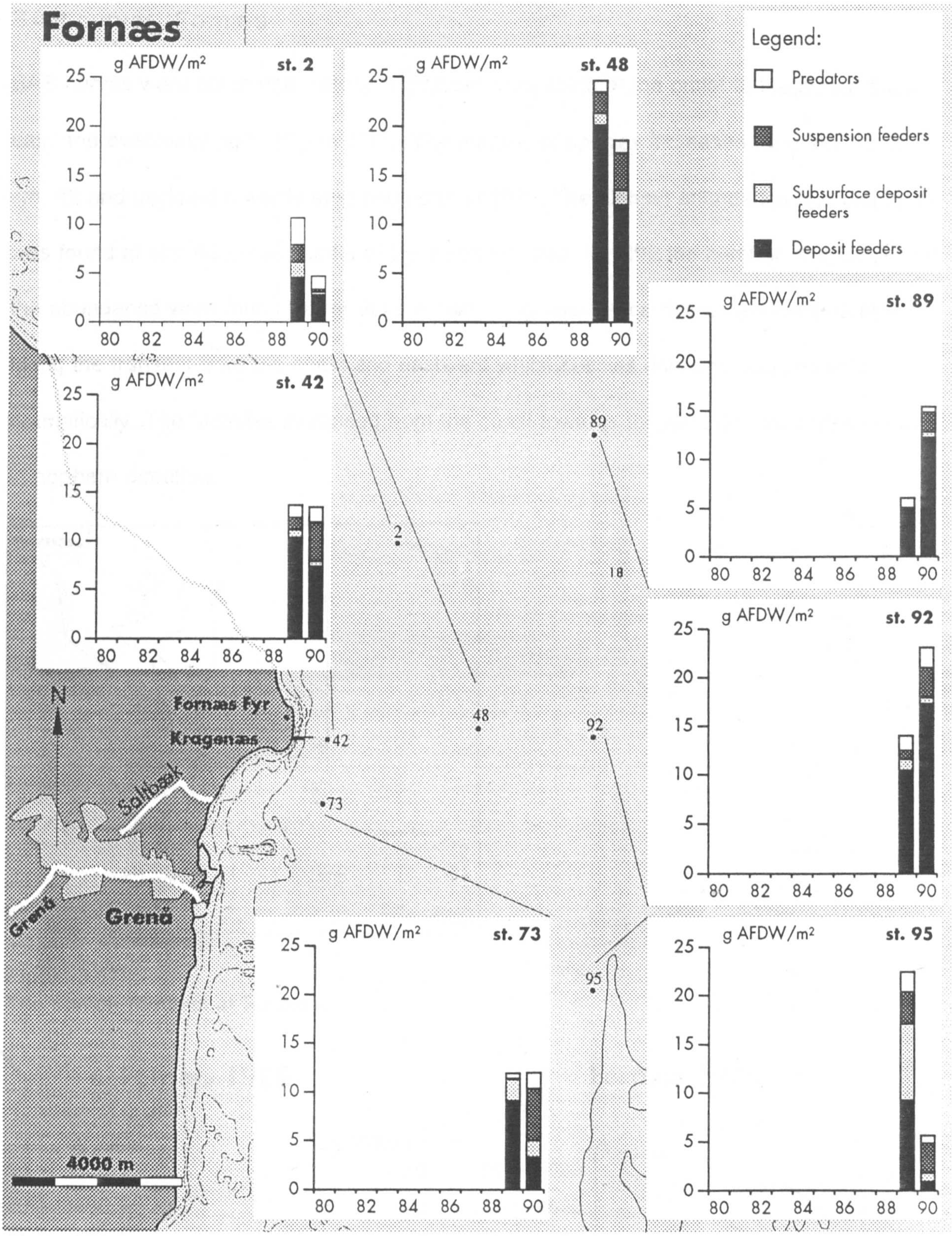


Figure 3.16
The variation in biomass of trophic groups at 7 stations at Fornæs, 1989-1990.

SAB-curves, Fornæs

SAB curves were constructed along a gradient from south of the outlet to the outlet, then east and eventually north (figure 3.17). The number of species increased from stn. 73 to stn. 42 and declined towards east and north in 1986. The highest abundance and biomass was found at stn. 48 in the middle of the sampling area. In 1990 the number of species and the abundance were much higher than in 1986. The abundance decreased considerably along the transect from the coast and eastward whilst species richness declined less dramatically. The biomass increased from the coast towards the east and decreased again in northern direction.

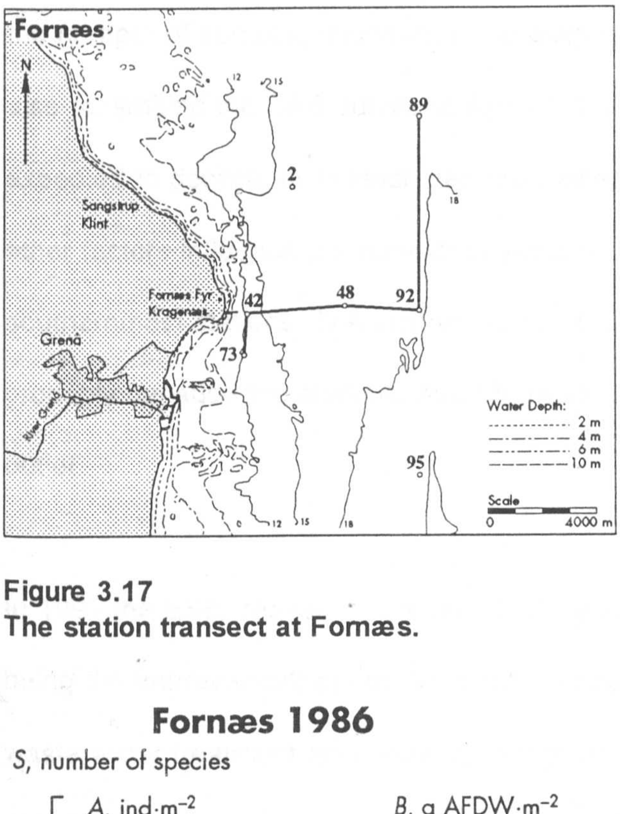


Figure 3.17
The station transect at Fornæs.

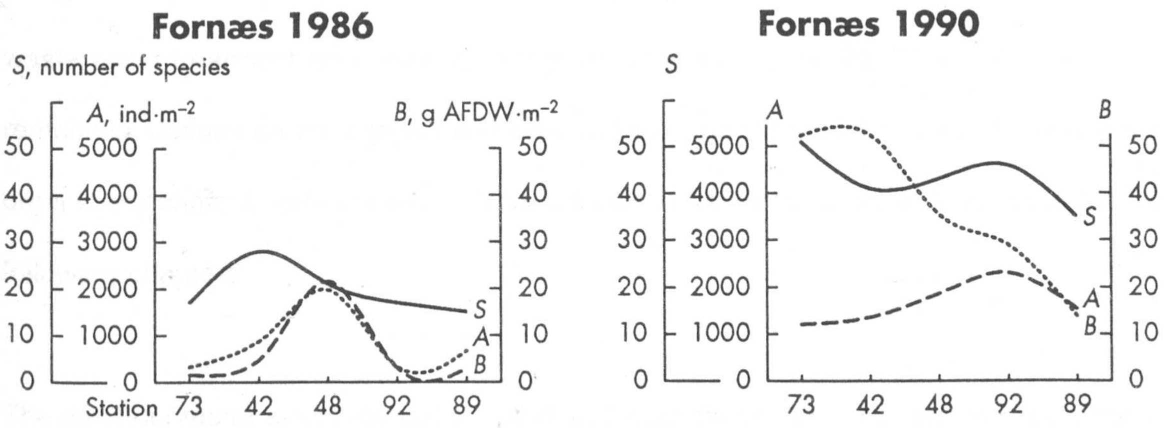


Figure 3.18
SAB-curves along the transect at Fornæs in 1986 and 1990.

Discussion

SAB-curves

The SAB curves along the ESE transect in Århus Bay in 1985 resembled in a number of ways the generalized SAB curves in figure 3.1. The peak in abundance along this transect, however, did not occur close to the outlet, but was found at some distance from it in the area where species richness had already increased. The high abundance at stns. 71 and 73 was primarily caused by two species which may be regarded as opportunists (see chapter 4), namely *Abra alba* and *Mysella bidentata*. Further along the enrichment gradient the number of species, abundance and biomass declined. The coastal transect in 1985 also resembled the SAB curves in figure 3.1 although abundance would have been expected to decline, or at least stabilize furthest away from the outlet; this indicates that other factors influence the number of species, abundance and biomass on the southernmost stations. The eastern transect did not resemble the idealised model very well, probably because the stations, apart from stn. 29, were too far away from the waste water outlet.

In 1991 the ESE transect still looked like the idealised SAB curves, the only difference being the improvement at stn. 51 which had become an enriched area. The improved waste water treatment also resulted in high abundance at stns. 29, 77 and 84. At the remaining stations on the coastal and eastern transects other factors than the gradient of organic enrichment were important. This will be further investigated and discussed in the following chapters.

The SAB curves at stn. 6 revealed a peak of "opportunists" in 1982 after the disastrous oxygen deficiency in 1981. The number of species stabilised within the next couple of years whereas the abundance and biomass exhibited relatively large fluctuation due to variations in abundance and biomass of a few dominant species.

At Fornæs the shape of the SAB curves could not be related to any organic enrichment gradient from the outlet.

In general, the applicability of the SAB model depends on the hydrography in the study area and other factors that will modify the benthic response to organic enrichment. Even though it can be difficult to relate SAB curves to an enrichment gradient, SAB curves do provide a simple graphic presentation of species richness, abundance and biomass along a gradient.

Trophic groups

Both the semi-enclosed Århus Bay with silty sediment and the open coast at Fornæs with sandy sediment were dominated by deposit feeders throughout the sampling period. Pearson & Rosenberg (1987) found that strong or moderate water movements in shallow waters and high food availability favours suspension feeders. A higher abundance of suspension feeders would therefore have been expected in both areas. Many species are, however, capable of switching feeding modes to suit changing circumstances (Pearson & Rosenberg 1987). Most notably those feeding in the benthic boundary layer are often able to exploit both suspended and deposited particles (Pearson 1970). The number of suspension feeding animals may therfore be much higher than indicated on the graphs above. In parts of the Fornæs area suspension feeding is probably the dominant feeding mode due to many large *Arctica islandica*. This cannot be seen from figure 3.14 and 3.16 because of the relatively low abundance of *A. islandica* and the exclusion of the species from the biomass. The problems of assigning species to particular trophic groups and the sparse or non-existent information about the feeding modes of many species weaken the utility of trophic groups in the interpretation of environmental changes.

Impact of pollution

Based on the figures of species richness, abundance and biomass and the SAB curves for Århus Bay there is no doubt that the waste water outlet has an impact on the benthic community. It is also evident from the figures that changes took place after the improvement of the waste water treatment. The following chapters (4 and 5) will investigate the observed changes in more details by examining population dynamics, growth and secondary production in Århus Bay.

At Fornæs the fluctuations in species richness, abundance and biomass were very difficult to relate to changes in the discharge of waste water. The high number of polychaetes in the early 1980s at stn. 42 may be a consequence of discharge of organic matter. The possible impact of the waste water outlet on the benthic fauna at Fornæs and the spatial and temporal changes in Århus Bay will be further investigated by means of multivariate analysis (chapter 6).

4. Population dynamics, Århus Bay

Introduction

This chapter describes the spatial and temporal variability of 7 important species in Århus Bay and discusses causes of variability in growth, density and distribution patterns. The species are: Numerical dominants: *Abra alba, Corbula gibba* and *Mysella bidentata*;
Species with complementary distributions: *Nepthys hombergii* and *N. ciliata*;
Species known to be sensitive to pollution: *Ophiura albida* and *Echinocardium cordatum*.

For all 7 species the changes in abundance are described for the period 1985 to 1991. For the bivalves changes in the size-frequency distribution can also be followed because the length of all bivalves have been measured. Length measurements are particularly interesting from the monthly samples at stn. 6 in 1990 and 1991 because they allow an estimation of growth which, apart from being interesting in itself, also produces a basis for estimation of secondary production (see chapter 5).

Abra alba

Abra alba (Wood) is the key species in the so called *Abra*-community (Petersen 1913) which is characteristic for the Danish Belt Sea area, Øresund and many fjords. *A. alba* occurs in muddy to silty sand down to 30 m depth (Danmarks Natur, bind 3). *A. alba* has been classified as a surface deposit feeder (Rasmussen 1973) but Rosenberg (1993) showed that *A. alba* could also act as a suspension feeder.

Distribution

A. alba is widely distributed in Århus Bay and has been found at all 15 stations (figure 4.1). The abundance varies considerably from year to year but the temporal variation in density is rather consistent among stations. *A. alba* was quite abundant in 1985 at most stations. Few *A. alba* were found in 1987; only stn. 15, 24 and 25 had a notable population of *A. alba* in 1987. Apart from the eastern (stn. 24 and 25) and some central stations (stn. 15 and 30) and the two stations near the sewage outlet (stn. 51 and 64) *A. alba* occurred in high numbers all over the bay in 1988. No *Abra alba* were found at st. 64, 71, 77 and 84 in 1989 and 1990. A month before the annual sampling survey in 1990 dead *A. alba*, apparently killed by oxygen deficiency, were found on the sediment surface in the same area (Århus Amt 1991b). In 1991 *A. alba* reappeared in the samples at all four stations. The biomass of *A. alba* is shown in appendix 4.1.

Growth

The exact time of spawning for *Abra alba* is not known for Århus Bay, but investigations from other Danish waters show that it has a fairly long spawning period from June to November (Rasmussen, 1973; Muus, 1973; Blanner, 1982). According to Muus (1973) spawning may also take place in spring. Nearly all *A. alba* less than 2 mm length pass through a 1-mm mesh sieve (Bachelet and Cornet, 1981) and recruitment therefore refers to "sieve recruitment". The time between the settlement and retention in a 1-mm mesh sieve may be up to eight months in the Øresund (Muus, 1973), but is not known for Århus

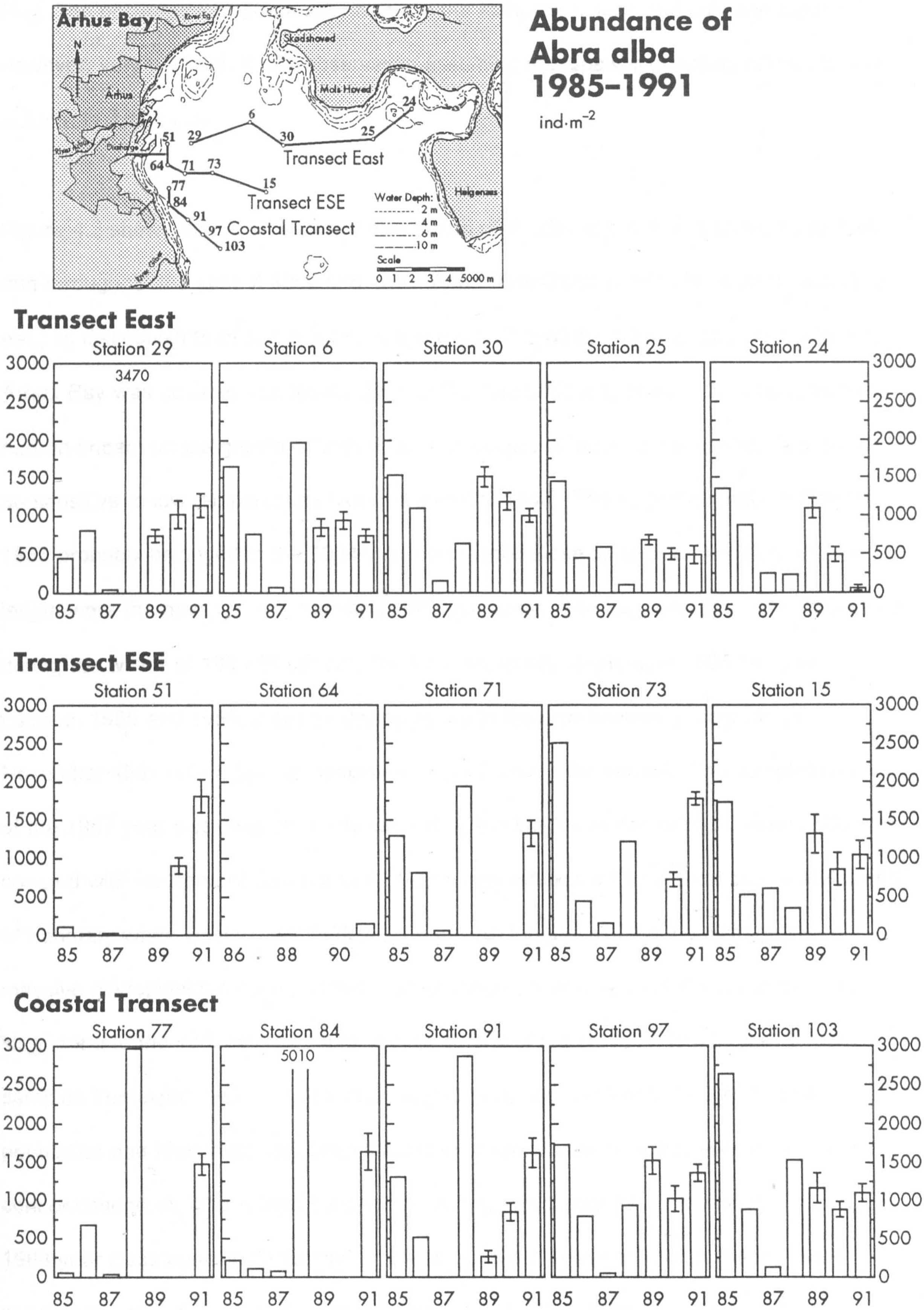


Figure 4.1
Variation in abundance of *Abra alba* at the 15 stations in Århus Bay 1985-1991.
Error bars are sampling error, S.E.

Bay. The occurrence of 2-mm specimens in the samples in June and July correspond, however, very well with Muus' observation assuming that spawning/settling takes place in autumn in Århus Bay.

Figure 4.2 shows the size-frequency distribution of *A. alba* at stn. 6 in autumn 1985-1989 and throughout the year in 1990 and 1991. Apart from October 1985 the cohorts are fairly easy to distinguish from one another in figure 4.2. The winter 1984/85 was very cold and Århus Bay was covered with ice for 2½ months (see table 2.1, chapter 2). This may have had an impact on the growth of both adult and juvenile *A. alba* as the species is known to be sensitive to low temperatures (Arntz & Rumohr 1986). The largest animals in October 1985 probably belonged to the 1984 year class while those up to approximately 10 mm length were the newly (sieve) recruited 1985 year class. The bay was also covered with ice during the winter of 1985/86 but only for 5 weeks. In late September 1986 two year classes, 1985 and 1986, could be distinguished in the size-frequency diagram. In November 1987 only a few old specimens were found in the sample. The complete failure of the 1987 year class was probably caused by the severe winter 1986/87. Århus Bay was covered with ice from 12 January to 27 March only interrupted by a short period at the end of February when westerly winds drove the ice out the bay. As the ice disappeared a massive phytoplankton spring bloom started. When the ice returned the water became stagnant and the sedimentation and decomposition of the spring bloom began. Sediment samples from April 1987 revealed that the sediment had been anoxic. The *A. alba* population had hence not only been subjected to low temperature but also to low oxygen concentrations. *A. alba* is also sensitive to oxygen deficiency (Dries & Theede, 1974). The 1988 year class completely dominated the sample in November 1988 but a few large specimens were also present, probably survivors from the 1986 year class. In October 1989 two cohorts, namely year class 1988 and 1989, could be distinguised in the samples.

Abra alba stn. 6, Århus Bay

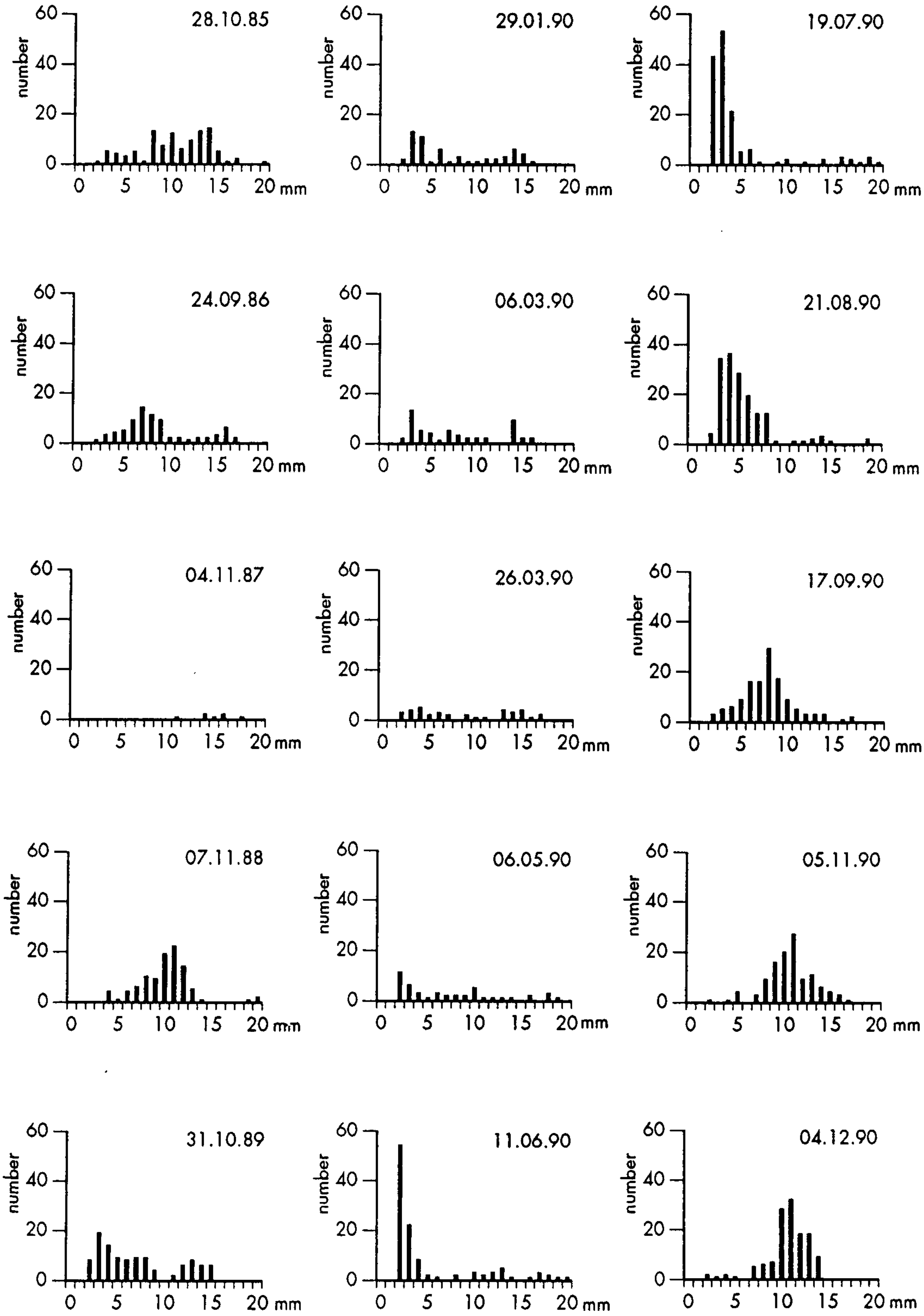


Figure 4.2
Size-frequency distribution of *Abra alba* at stn. 6 in Århus Bay in autumn 1985-1989 and throughout the year in 1990.

continues

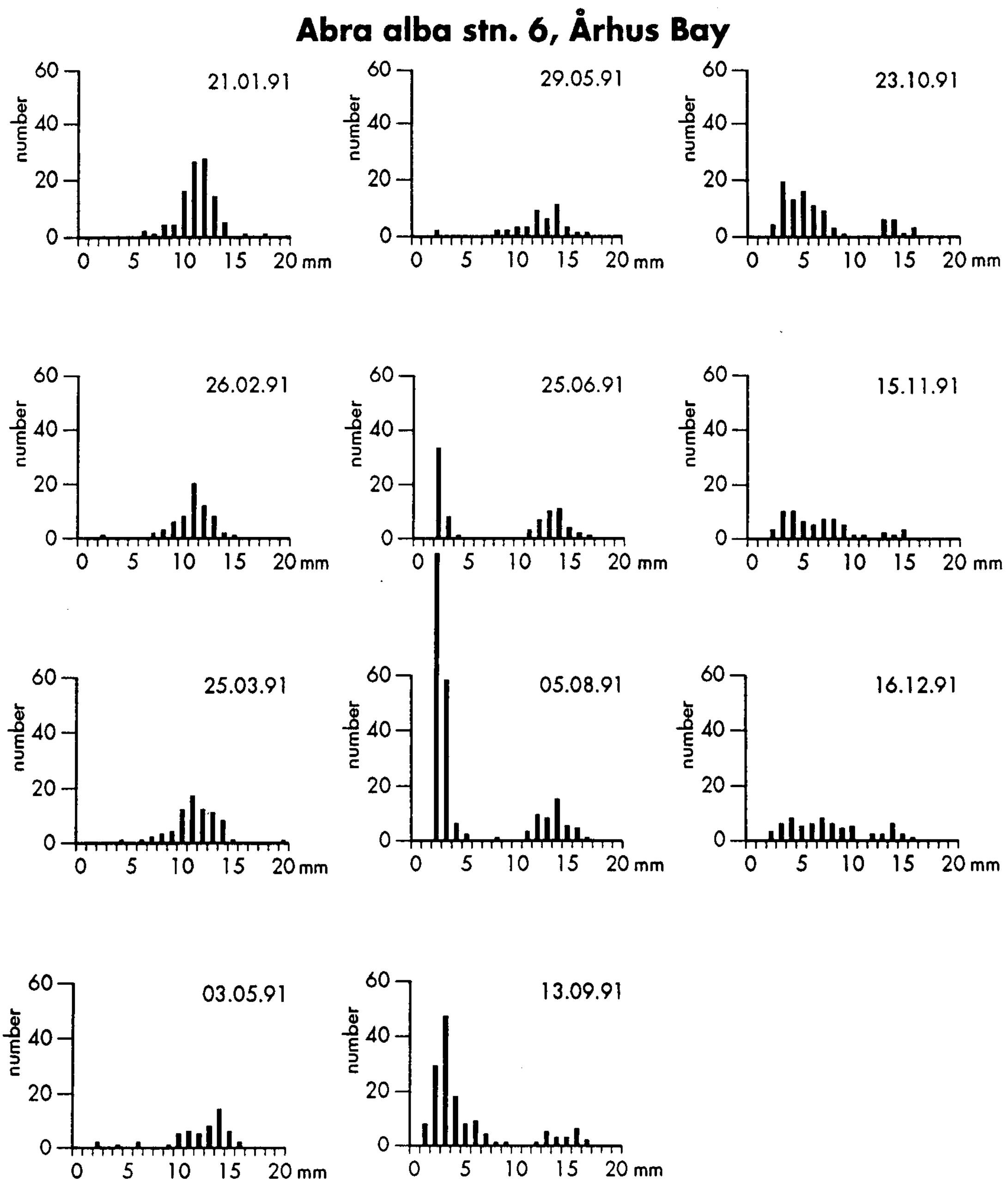


Figure 4.2 (continued)
Size-frequency distribution of *Abra alba* at stn. 6 in Århus Bay throughout the year in 1991.

During winter and spring 1990 the abundance of the 1988 and 1989 year classes decreased. The 1990 year class appeared in the samples in May but the main recruitment took place in June and July 1990. The growth of the 1990 year class was very fast between 21 August and 17 September where the average length increase of *A. alba* was 2.80 mm (4.26 mm to 7.06 mm). The fast growth continued between 17 September and 5 November where the increase in length was 3.00 mm (7.06 to 10.06 mm). By this time the cohorts from 1988 and 1989 had both died out. After November the 1990 year class hardly showed any growth until spring 1991. The abundance of the 1990 year class gradually declined during 1991 but could still be found in the samples in December 1991.

The 1991 year class appeared in May, but as in 1990 the bulk of the recruitment was found in June and July 1991. The growth of the juveniles was much slower in 1991 than in 1990, e.g. the average length increase of juvenile *A. alba* was less than one mm between 5 August and 13 September. Due to the poorer growth rate of the 1991 year class the average shell length in November 1991 was only about half of the average shell length the year before, i.e. 5.05 mm in 1991 compared to 10.06 mm in 1990.

Factors affecting distribution and growth

Hily & Le Bris (1984) considered *A. alba* as an "r" strategy species (Pianka 1970) because of its high fecundity, short life cycle, rapidly varying demographic strategy and occurrence in disturbed areas. These characters enable *A. alba* to rapidly recolonize an area after it has been wiped out by some sort of disturbance caused by e.g. sediment instability (Rees 1983), low winter temperature (Arntz & Rumohr 1986) or oxygen deficiency (Rachor 1980, Arntz & Rumohr 1986, Fallesen 1992). Another factor influencing growth and abundance is the availability of food. In the Bay of Morlaix *A. alba* rapidly adapted its demographic strategy to the eutrophic conditions following the "Amoco Cadiz" oil spill by increasing its reproductive protential, growth and abundance (Dauvin & Gentil 1989). In a mature *Abra* community in the Bay of Brest, away from sources of organic pollution, there were lower population densities, a lower growth rate and more stable recruitment than close to a sewage outlet and in an area where dredging took place (Hily & Le Bris 1984). It was, however, impossible to establish a rule to describe the pattern of change in successive cohorts of *A. alba* during the 3 years and Hily & Le Bris (1984) concluded that local environmental conditions seemed the most evident factor responsible for reproduction success. Likewise in Kiel Bay local and annual differences in recruitment during a three year study period could not be explained by differences in the severity of the preceding winter or in deoxygenation of the near-bottom water in summer (Rainer 1985). The observed local differences in growth rate were thus thought to be geographic variations in the availability of food or in hydrological conditions (Rainer 1985).

The variation in growth, size-distribution and abundance of *A. alba* in Århus Bay seems to be very consistent with observations from other areas. Severe oxygen deficiencies like the disastrous anoxia in September 1981, the depletion under the ice in the winter of 1987 and at the coastal stations in 1990, killed *A. alba*, but the ability for rapid recolonization enabled *A. alba* to reappear the following year often in high numbers. As the bottom was completely defaunated after the anoxia in 1981 (Fallesen 1992) there was no competion for food or space which resulted in very high densities of *A. abra* in 1982 (up to 3661 indviduals per m^2). Abundance was also high at most stations in 1988 and at the coastal stations in 1991 (figure 4.1). Although winters with ice cover have occurred several times during the sampling period and the 1980s have been characterized by recurring oxygen deficiencies, only extremely low temperatures or oxygen concentrations seem to have had a severe impact on *A. alba*. This fits well with the observations by Rainer (1985) from Kiel Bay that differences in recruitment may be attributable to environmental factors other than low

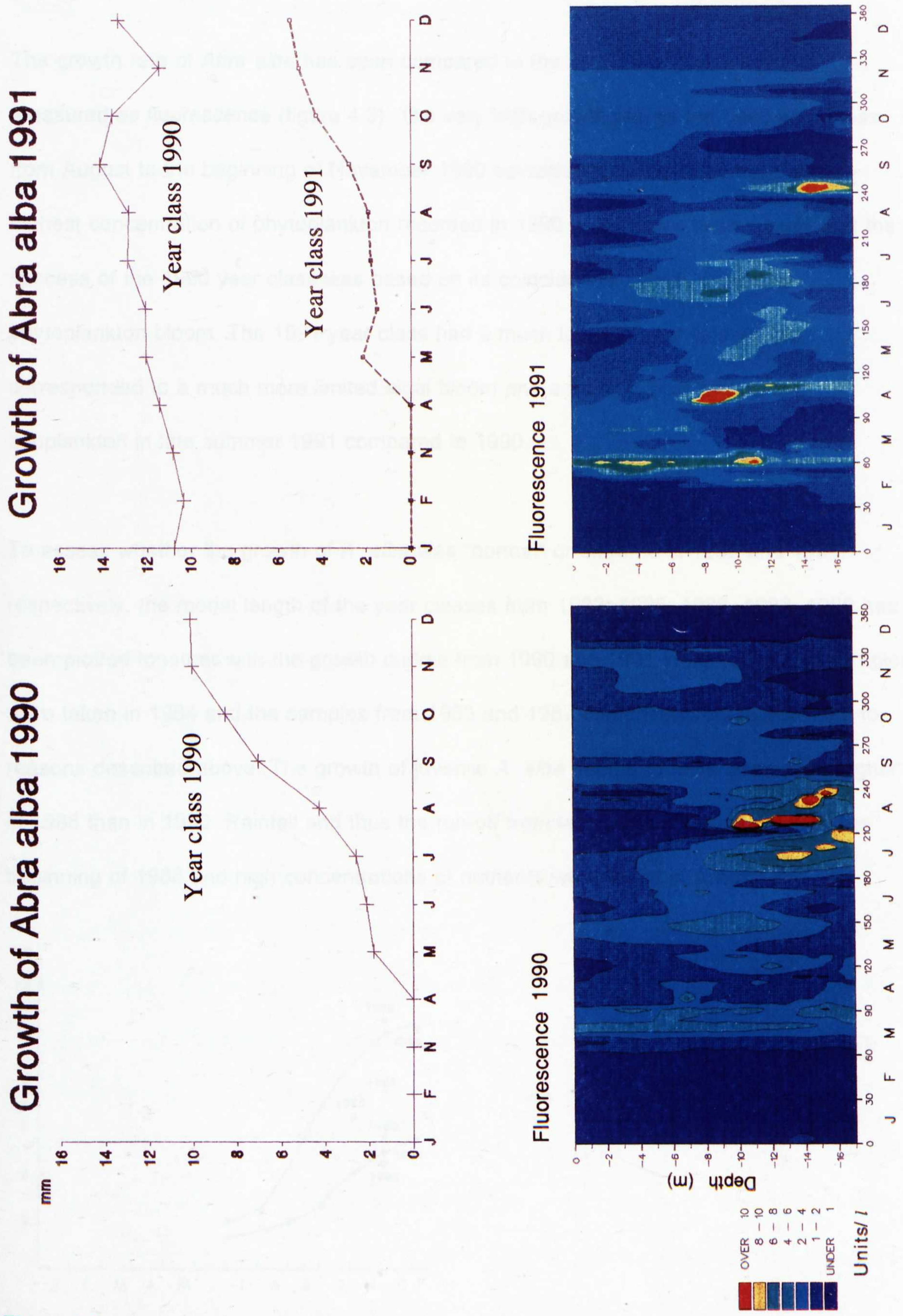


Figure 4.3
The growth of *Abra alba* compared to the amount of phytoplankton measured as fluorescence at stn. 6 in Århus Bay in 1990 and 1991.

temperature and oxygen depletion, such as availability of food and hydrological conditions.

The growth rate of *Abra alba* has been compared to the amount of phytoplankton measured as fluorescence (figure 4.3). The very high growth rate of the 1990 year class from August to the beginning of November 1990 coincided with the settlement of the highest concentration of phytoplankton recorded in 1990. It therefore seems likely that the success of the 1990 year class was based on its coincidence with an extended phytoplankton bloom. The 1991 year class had a much lower growth rate which corresponded to a much more limited algal bloom and a much higher grazing by zooplankton in late summer 1991 compared to 1990.

To assess whether the growth of *A. alba* was "normal" or extreme in 1990 and 1991, respectively, the modal length of the year classes from 1982, 1985, 1986, 1988, 1989 has been plotted together with the growth curves from 1990 and 1991 in figure 4.4. No samples were taken in 1984 and the samples from 1983 and 1987 comprised very few *A. alba* for reasons described above. The growth of juvenile *A. alba* seems to have been even higher in 1988 than in 1990. Rainfall and thus the run-off from land were extremely high at the beginning of 1988 and high concentrations of nutrients were found in Århus Bay

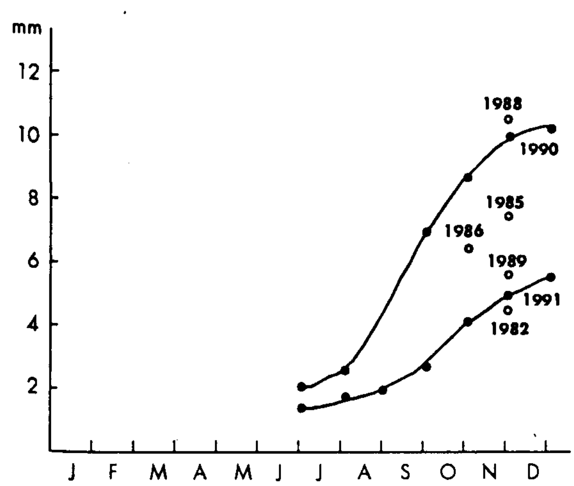


Figure 4.4
Growth curves for *Abra alba* at stn. 6 in Århus Bay in 1990 and 1991 and the modal length of the year classes from 1982, 1985, 1986 and 1989.

(Århus Amt 1990b). The basis for algal blooms was therefore present but due to the sampling methods used for phytoplankton (see chapter 2) it is unknown if any blooms occurred around and below the halocline that could have facilitated the growth of *A. alba* as in 1990. The size of *A. alba* by the end of the growing season in the remaining years was between the size in 1990 and 1991 apart from 1982 when it was a little smaller than 1991.

Other factors may, however, also influence growth and abundance of *A. alba*. Biological interactions like intra- and interspecific competition and predation are also possible causes for the differences between years. Josefson (1982) found that growth rates of *Abra nitida* were negatively correlated with adult density/biomass at two deep water stations (100 and 300 m) off the Swedich west coast. There seems to be no relation between adult density and growth of juvenile *A. alba* in Århus Bay as adult density was generally low (figure 4.2). Hily & Le Bris (1984) observed increased populations of *Melinna palmata, Ampharete grubei, Polydora antennata, Owenia fusiformis* and *Lanice conchilega* when the growth of *Abra alba* decreased and refered to this as trophic competition. No such relations were obvious in Århus Bay.

Predation is another stock controlling factor and *A. alba* is known to be eaten by a variety of fish and invertebrates (Boysen-Jensen 1919, Arntz 1980, Scheibel 1981, Allen 1983, Hily & Le Bris 1984). Rainer (1985) has calculated that predation on *A. alba* by dab, flounder and plaice of commercial size is about 1% of the estimated production of *A. alba* in Kiel Bay. According to the fishermen, dab is the only demersal fish of commercial importance in Århus Bay nowadays. If the fish predation is of the same order of magnitude in Århus Bay as in Kiel Bay predation on juvenile *A. alba* by invertebrates may be of greater importance than the predation by fish. Hily & Le Bris (1984) mention that an increase in the number of *Ophiura albida* coincided with the disappearence of two cohorts of *A. alba* in the Bay of Brest.

All in all *Abra alba* is an interesting biological indicator for fluctuations in the benthic environment in Århus Bay and the relation between the pelagic and the benthic environment. The majority of the variation in growth and abundance of *A. alba* can be explained by food availability, oxygen deficiency and low water temperature. Biological interactions seem to be less important but have to be considered.

Corbula gibba

Corbula gibba (Olivi) is also a prominent member of the *Abra*-community. *C. gibba* occurs in sediments from mud to silty sand (Tebble 1976). *C. gibba* is a very efficient suspension feeder (Kiørboe & Møhlenberg 1981).

Distribution

Corbula gibba was found at all 15 stations in Århus Bay but the spatial and temporal distribution of the species varied considerably (figure 4.5). The biomass of *C. gibba* is given in appendix 4.2. At the majority of stations *C. gibba* only occurred in notable numbers in 1989 following a successful recruitment. *C. gibba* remained relatively abundant at stns. 71, 77, 84 and 91 south of the sewage outlet after 1989 whilst it died out at the other stations. A similarly successful recruitment took place in 1982 (Fallesen 1992) when *C. gibba* was found in high numbers all over the bay but quickly disappeared from the middle of the bay (Århus Amt 1990).

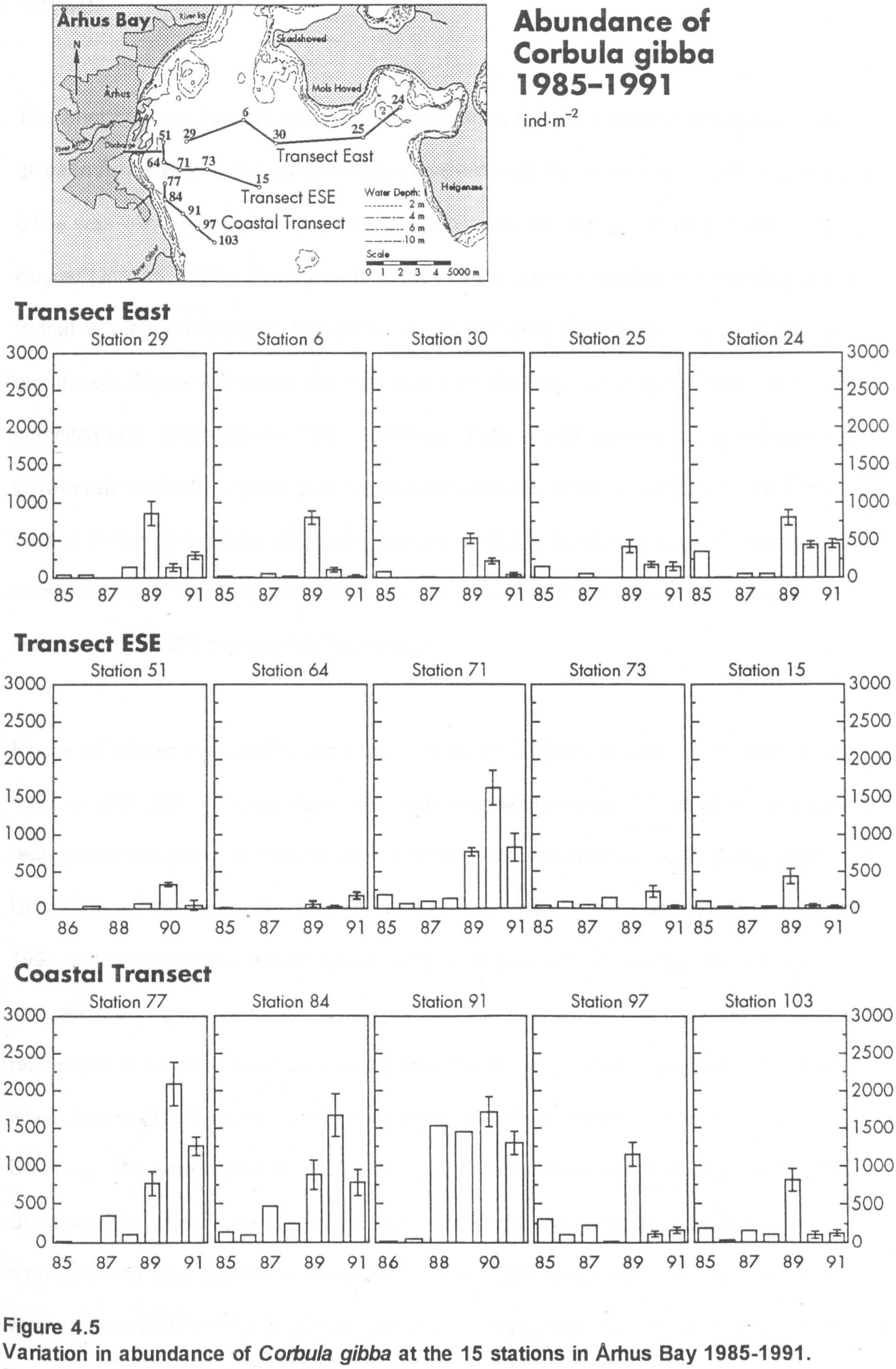


Figure 4.5
Variation in abundance of *Corbula gibba* at the 15 stations in Århus Bay 1985-1991. Error bars are sampling error, S.E.

Growth

The length of time between settling and retention in a 1-mm sieve is not known for *Corbula gibba* in Århus Bay. In the Limfjord (Nissum Bredning), Denmark, the growth of juvenile *C. gibba* was very rapid, reaching a size of 3 mm within the first 1 to 2 months after settling in August (Jensen, 1990). If the growth rate for newly settled juveniles in Århus Bay is similar to that found in the Limfjord, the specimens found in the samples in October 1989 were 2-3 months old. Figure 4.6 shows the size-frequency diagrams for *C. gibba* from the monthly sampling at st. 6 in 1990 and 1991. Unlike *Abra alba* it was very difficult to estimate the growth rate of *Corbula gibba* from the monthly samples at stn. 6 because of the continuous decline in numbers during spring and summer 1990. By the end of August 1990 the samples only contained a few specimens. No recruitment took place in 1990 and the recruitment in 1991 appeared to be minimal.

Figure 4.7 shows the size-frequency histograms for *C. gibba* at stns. 71, 84 and 91 from 1987 to 1991. Stn. 77 is not shown as it was very similar to stn. 71. As at stn. 6 a distinct recruitment took place in 1989 whilst the recruitment was minimal the following years. Unlike the populations at stn. 6 *C. gibba* did not die out at the 4 stations during 1990 and 1991 although they were diminished in 1991. One year after their appearance in the samples the *C. gibba* populations had reached a modal length of 4-5 mm. Jones (1956) recorded that *C. gibba* reached a mean size of c. 4 mm after one year in the Irish Sea while Jensen (1990) found that *C. gibba* reached 6-7 mm after one year in Nissum Bredning. The growth rate during the first year is thus slower in Århus Bay than in Nissum Bredning. The growth rate during the second year also seems to be slow but growth may be masked by size-dependent mortality. Jensen (1990) suggested that spawning may weaken the condition of the animals and cause sudden increased mortality in summer. This may also be the case in Århus Bay.

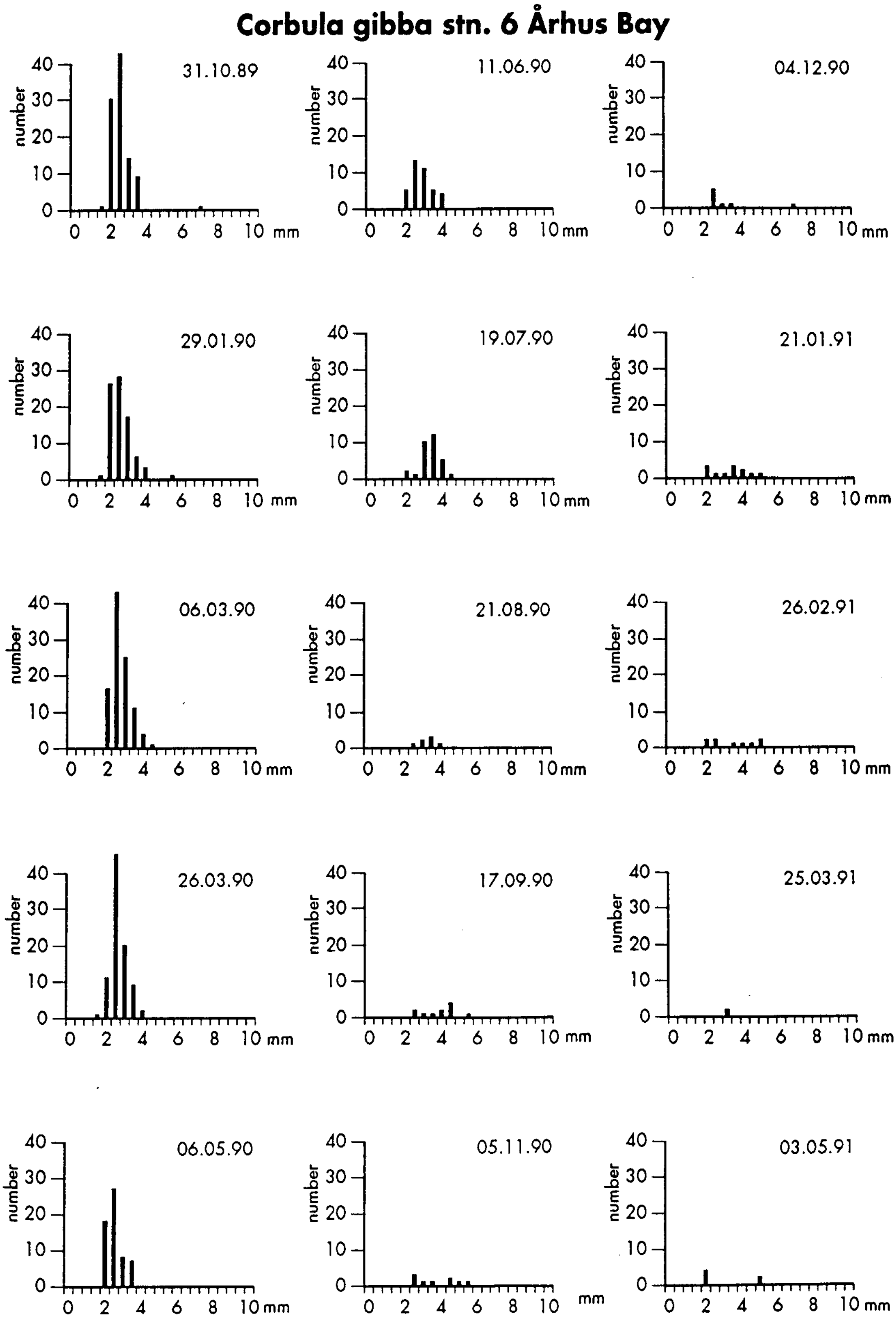


Figure 4.6
Size-frequency distribution of *Corbula gibba* at stn. 6 in Århus Bay in October 1989 and throughout 1990 and 1991.

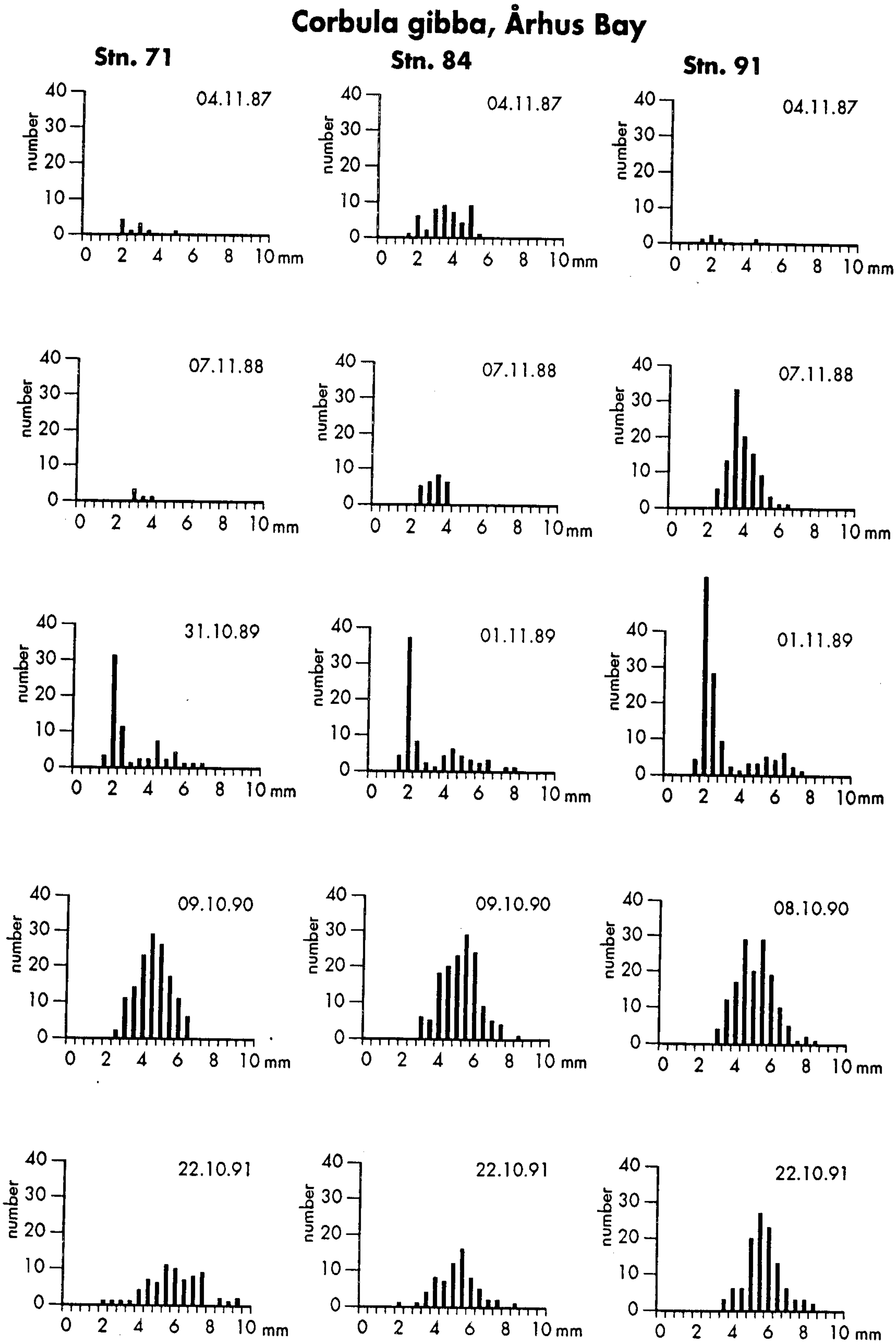


Figure 4.7
Size-frequency distribution of *Corbula gibba* at stns. 71, 84 and 91in Århus Bay 1987-1991.

Factors affecting distribution and growth

The very variable density of *C. gibba* in Århus Bay is best explained by an combination of irregular recruitment pattern and spatial differences in mortality rates. The irregular recruitment pattern is difficult to explain. Recruitment failure follows severe winters (1984/85, 1985/86 and 1986/87) as well as very mild winters (1987/88, 1989/90 and 1990/91). As *C. gibba* is known to be one of the last species to be eliminated by adverse oxygen conditions (Pearson & Eleftheriou 1981, Weigelt & Rumohr 1986, Baden *et al.* 1990) it is not surprising that no connection between recruitment success or survival and low oxygen concentration in late summer can be found. High densities of *C. gibba* have been reported from polluted areas where the species often has been found in organically enriched areas at the edge of anoxic and azoic zones (Pearson & Rosenberg 1978, Crema *et al*, 1991). In accordance with these observations the enhanced growth and survival of *C. gibba* at stns. 71, 77, 84 and 91 south of the outlet compared to the stations in the central part of the bay may be caused by an increased food supply. The differences in environmental conditions between the coastal stations and the central/eastern stations and their impact on the distribution, density and growth of macrobenthos will be further discussed in the final discussion of this chapter.

Mysella bidentata

Mysella bidentata (Montagu) occurs in sediments from mud to fine sand (Tebble 1976). *M. bidentata* has been described as an indirect deposit feeder by O'Foighil *et al.* (1984) and Ockelmann & Muus (1978) but has also been referred to as a suspension feeder (Rachor 1990, Josefson & Rosenberg 1988). I have regarded *M. bidentata* as surface deposit feeder.

Distribution

Mysella bidentata has also been found at all 15 stations in Århus Bay, but as with *Corbula gibba*, the fluctuations are considerable in space and time (figure 4.8). The biomass figures are given in appendix 4.3. *M. bidentata* was found in relatively low numbers at the central and eastern stations throughout the sampling period. Even though the density of *M. bidentata* was comparably low at these stations, the species was the second most abundant at stn. 6 in 1990 and 1991. The highest densities were found at stns. 71, 77 and 84. A medium high but fairly stable density was observed at stns. 29, 73, 91, 97 and 103 from 1989 to 1991. The number of *M. bidentata* in the central/eastern part of the bay was relatively low.

Growth

The size-frequency distribution of *M. bidentata* (not shown) revealed that the majority of individuals were a little less than 2 mm long and very few were longer than 2.5 mm. The abundance of *M. bidentata* increased in August 1990 and 1991 which can only be explained by a new year class reaching the size of sieve recruitment. No distinction could be made between the new year class and older animals, neither could any growth be seen. Investigations of *M. bidentata* in Galway Bay, Ireland, concluded that only the second year class and older animals was caught on a 1-mm sieve (O'Foighil *et al.,* 1984). The same seems to be true for Århus Bay. As the use of a 1-mm sieve thus excludes most of the population from being sampled, calculation of growth and production was not attempted.

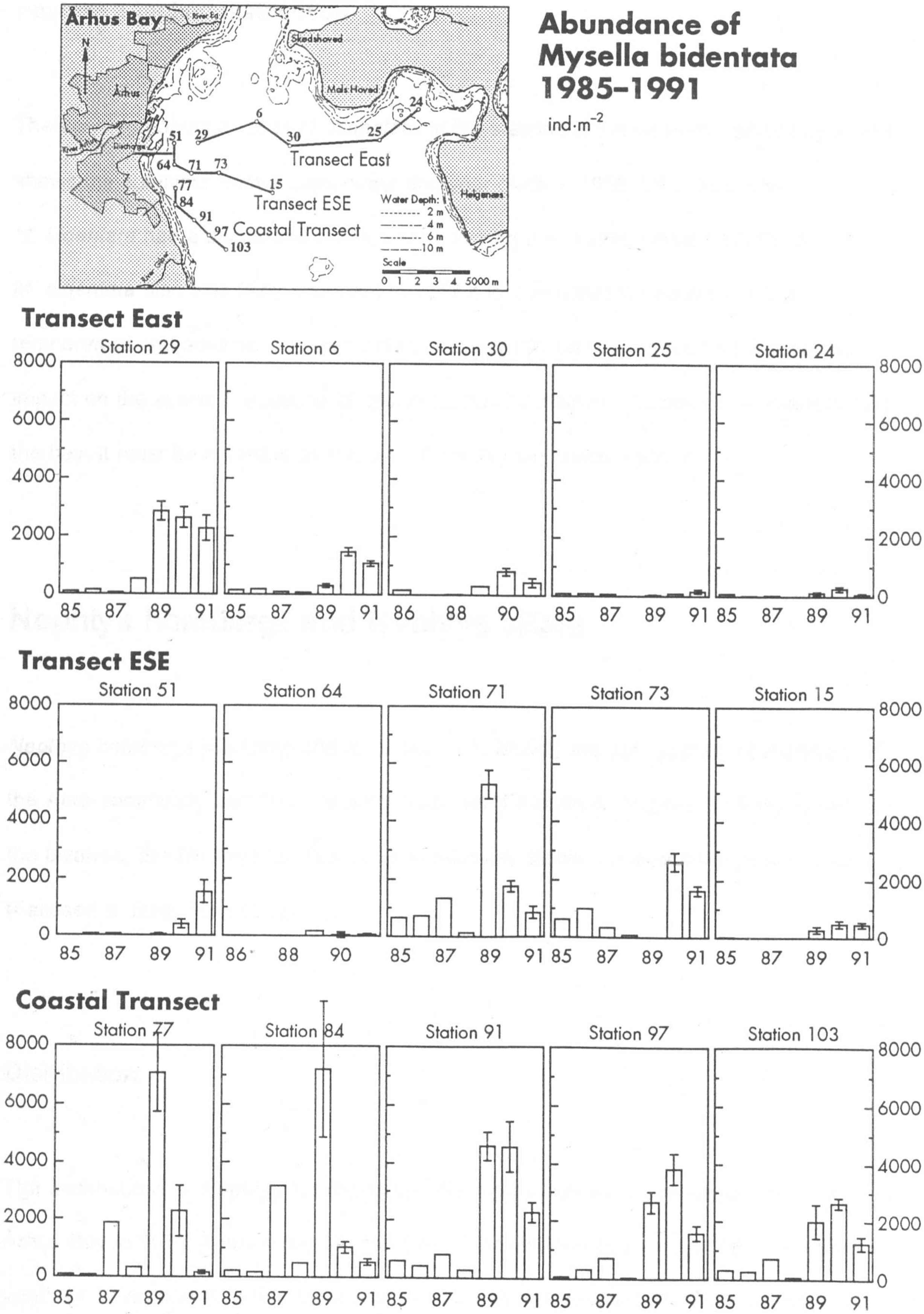


Figure 4.8
Variation in the abundance of *Mysella bidentata* at the 15 stations in Århus Bay 1985-1991. Error bars are sampling error, S.E.

Factors affecting distribution

The very high abundance of *M. bidentata* at the stations in the western part of bay in 1989 shows the survivors from a even larger first year class in 1988. Like *Abra alba, M. bidentata* had a successful recruitment following the severe winter 1986/87. As *M. bidentata* also was fairly abundant in 1987 it is questionable whether the low temperature and adverse oxygen conditions under the ice cover have had any notable impact on the species. Because *M. bidentata* has its main distribution in the western part of the bay, it must be regarded as tolerant of low oxygen concentrations.

Nephtys hombergii and Nephtys ciliata

Nepthys hombergii (Savigny) and *N. ciliata* (O.F. Müller) are both prominent members of the *Abra*-community and they are both predators (Fallesen & Jørgensen 1984). Contrary to the bivalves, the *Nephtys* species occur in relatively stable numbers from year to year (Fallesen & Jørgensen 1984).

Distribution

The distributions of *Nephtys hombergii* and *Nephtys ciliata* were almost complementary in Århus Bay in 1976 (figure 4.9a): *N. hombergii* inhabited the coarser sediments at shallow depth (< 12 m) and *N. ciliata* the deeper areas with fine deposits (8-17 m) (Fallesen & Jørgensen 1991). Nevertheless, *N. hombergii* had become overall dominant in the western part of the bay south of the sewage outlet in 1978 and 1979 (figure 4.9b). After the

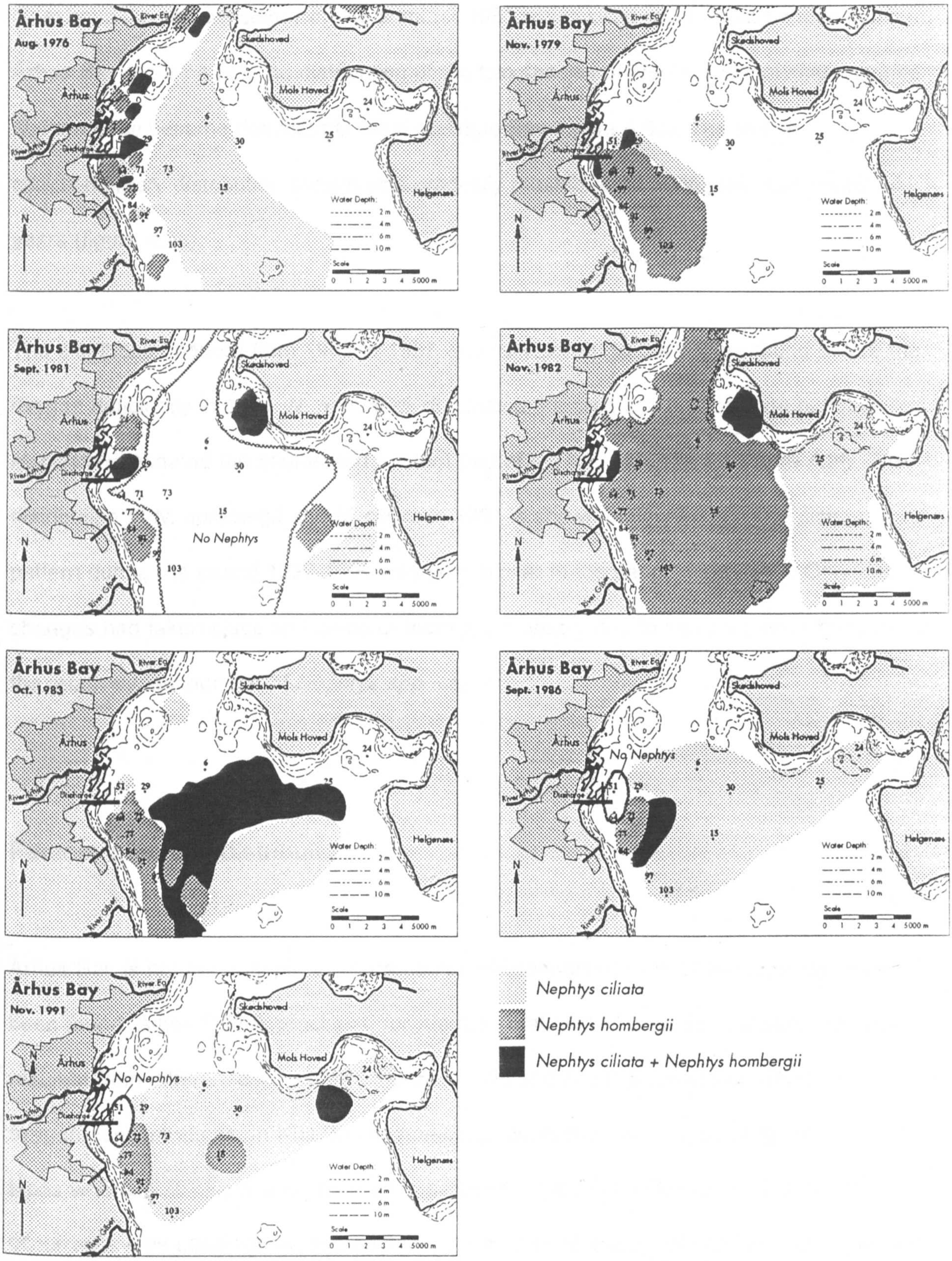


Figure 4.9
The distribution of *Nephtys hombergii* and *N. ciliata* in Århus Bay from 1976 to 1991.

disastrous oxygen deficiency in late summer 1981 which killed most of the benthic fauna in Århus Bay (figure 4.9c), the distribution of the two species of *Nephtys* completely changed, *N. hombergii* became dominant in most of Århus Bay (figure 4.9d). The former complementary distribution pattern was gradually reestablished during the next couple of years (figure 4.9e).

The distribution pattern from 1985 to 1987 was very similar to the pattern found before the oxygen deficiency in 1981: *N. hombergii* dominated the area south of sewage outlet while *N. ciliata* dominated the central and eastern part of the bay plus stn. 97 (figure 4.9f). The distribution of *N. hombergii* and *N. ciliata* in 1991 is shown in figure 4.9g. The distribution pattern during the period 1989-1991 was very similar to the period 1985-1987. Only minor changes had taken place and some of them are probably due to sampling error because of the relatively low number of *Nephtys spp.* per m^2.

Factors affecting distribution

Århus Bay is not the only place where complementary distribution of *Nephtys spp.* has been found. Alheit (1978) concluded for Kiel Bay that niche separation between species resulted from differences in sediment preferences and in tolerance of low salinity and oxygen concentrations. In Kiel Bay *N. hombergii* appeared over a wide range of sediment types whereas *N. ciliata* was confined to sediment types with small grain size. No co-occurrence was observed on fine sediments, because *N. ciliata* only occurred in areas with high salinity and oxygen concentrations, while *N. hombergii* showed greater tolerance to reduced concentrations of salinity and oxygen (probably combined with higher resistance to hydrogen sulphide)(Alheit 1978). In Århus Bay the sediment is very similar among stations and salinity differences would have no influence at the depths considered (see chapter 2).

This points to oxygen conditions as a major factor responsible for the distribution of the two species. Throughout the sampling period (1985-1991) *N. hombergii* was dominant in the western part of the bay south of the sewage outlet which fits well with its higher tolerance to low oxygen concentrations. Experiments support the observations that *N. hombergii* is more tolerante to low oxygen concentrations than *N. ciliata* (Fallesen & Jørgensen 1991, Pedersen 1991).

Although adverse oxygen concentrations can explain why *N. ciliata* avoids some areas it cannot explain the lack of co-occurrence on fine sediments with adequate oxygen conditions nor can it explain the distribution of the two species after the oxygen deficiency in 1981 (figure 4.9d). Interspecific differences in the time of spawning seem to be an important part of the explanation of the distribution pattern after the oxygen deficiency in 1981. The catastrophic oxygen conditions had effectively killed off the *N. ciliata* populations before their spawning period in November-December. It is significant that up to the recruitment of winter 1982/83, *N. ciliata* was not able to establish permanent populations in the central part of the bay. On the other hand, the *N. hombergii* populations or part of them had spawned just before the oxygen deficiency. As a result larvae of only *N. hombergii* were present in the defaunated area, ready to settle at the start of recolonization (Fallesen & Jørgensen 1991). As described above *N. ciliata* slowly regained dominance of the central and eastern part of the bay. Fallesen and Jørgensen suggest that because *N ciliata* grow to a larger size than *N. hombergii*, *N. hombergii* would more often be a prey item for *N. ciliata* than *N. ciliata* for *N. hombergii*. Cannibalism/predation is confirmed by findings of remnants of smaller specimens of *Nephtys* in the gut content of *Nephtys spp.* (Scheibel 1981, Fallesen & Jørgensen 1991). Once the *N. ciliata* populations have reached a certain size and age structure, interference from *N. hombergii* should therefore no longer be possible unless the oxygen condition deteriorate. The sudden dominance of *N. hombergii* at some stations could thus be interpreted as a deterioration of the oxygen conditions and ensuing disappearence of *N. ciliata,* but other explanations have to be considered. Olive *et al.* (1981) found that species of *Nephtys* sometimes completely or partly failed to spawn and instead resorbed the gametes. A successful spawning and recruitment is, however, influenced by many other factors, too. A couple of years failure in spawning success of *N. ciliata* could offer *N. hombergii* a chance to colonize areas normally inhabited by *N. ciliata*. The temporary dominance of *N. hombergii* at stn. 6 in 1990 and stn. 15 in 1991 is probably caused by spawning failure of *N. ciliata*. If deteriorating oxygen conditions were the cause of the disappearence of *N. ciliata*, the same development would be expected at neighbouring stations. Permanent coexistence between the two species will only occur in areas which are disturbed regularly by adverse oxygen conditions. Under such circumstances *N. ciliata* would never reap the benefit of its larger size, longer life span and superiority on fine sediments since the population would be killed off by oxygen deficiency at intervals.

Assuming that *N. hombergii* and *N. ciliata* are good indicators on fine sediments for oxygen conditions then it can be concluded that the western part of the bay suffers regularly from low oxygen concentrations. This conclusion fits well with the observation of dead *Abra alba* in the same area.

Notes on identification

Rainer (1984, 1989) has revised the genus *Nephtys* and described new *Nephtys* species and redescribed "old" ones. As very few *Nephtys assimilis*, *N. kersivalensis* and *N. pente* have been found in the marine areas of Århus County the revision of the genus does not affect the conclusions above.

Ophiura albida

Ophiura albida (Forbes) is also a member of the *Abra*-community. *O. albida* is primarily a predator but it has also been observed to scavenge and surface deposit feed (Danmarks Natur, bind 3)

Distribution

The number of *Ophiura albida* per m^2 at the 15 stations in Århus Bay from 1985 to 1991 is given in table 4.1. Throughout the sampling period hardly any *O. albida* were found in the vicinity and south of the sewage outlet at stns. 51, 64, 71, 77, 84 and 91 - the latter only until 1991. The abundance of *O. albida* in Århus Bay was generally very low in 1987 and 1988 and the species was even absent from some of the stations (stns. 29, 30, 97 both years and stns. 6 and 73 only 1987) where it normally occurred. From 1988 to 1991 *O. albida* increased considerably in abundance apart from near the outlet. Compared to the other stations in the middle of the bay the abundance of *O. albida* at stn. 6 was notably lower. The number of juvenile *O. albida* per m^2 is also given in table 4.1 from 1989 onward; densities of juveniles were not registred before 1989. As can be seen from table 4.1 the number of juvenile *O. albida* was quite high in 1990 and 1991.

Factors affecting distribution

Like *Abra alba, Ophiura albida* is sensitive to low oxygen concentrations and low temperature (Arntz & Rumohr 1986). The oxygen deficiency under the ice cover in early

Transect east		Stn. 29	Stn. 6	Stn. 30	Stn. 25	Stn. 24
1985		60	40	110	210	510
1986		50	10	100	10	130
1987		0	0	0	70	50
1988		0	30	0	100	30
1989	Total	23	35	58	116	209
	Juv.	12	0	35	58	105
1990	Total	174	70	104	71	337
	Juv.	174	70	35	58	174
1991	Total	339	81	217	232	476
	Juv.	339	81	217	174	476

Transect ESE		Stn. 51	Stn. 64	Stn. 71	Stn. 73	Stn. 15
1985		10	0	20	110	180
1986		0	0	0	10	180
1987		0	0	0	0	90
1988		0	0	0	50	10
1989	Total	0	0	0	-	70
	Juv.	0	0	0	-	54
1990	Total	0	0	0	0	105
	Juv.	0	0	0	0	46
1991	Total	0	0	0	151	244
	Juv.	0	0	0	139	186

Coastal transect		Stn. 77	Stn. 84	Stn. 91	Stn. 97	Stn. 103
1985		0	0	0	170	60
1986		0	0	0	0	0
1987		0	0	0	0	10
1988		0	10	0	0	30
1989	Total	0	0	0	35	81
	Juv.	0	0	0	0	46
1990	Total	0	0	0	46	232
	Juv.	0	0	0	46	221
1991	Total	0	0	441	209	209
	Juv.	0	0	441	209	174

Table 4.1
The number of *Ophiura albida* and juvenile *O. albida* along the 3 transects in Århus Bay.

spring 1987 is therefore the most likely explanation for the disappearance of *O. albida* from 1986 to 1987. Like *A. alba*, *O. albida* only survived at stns. 15, 24, 25. Adverse oxygen conditions are the most obvious explanation for the permanent absence of *O. albida* in the vicinity and south of the sewage outlet during the whole sampling period. The high number of juvenile *O. albida* at stns. 29, 73 and 91 in 1991 may indicate an improvement of the oxygen conditions at these stations.

After the disastrous oxygen deficiency in 1981 it took two years for *O. albida* to reestablish. Likewise *O. albida* did not appear in the samples until 1989 after the elimination in early spring 1987. Nierman *et al.* (1990) made similar observations in the German Bight.

Investigations of stomach samples of dab (*Limanda limanda*) in Århus Bay in 1991 showed that the main content of the stomachs was arms and discs of *O. albida* (C.A. Jensen pers. comm.). The predation may thus be relatively severe on *O. albida*. Whether predation can explain the low number of *O. albida* at stn. 6 remains unknown but it may have an impact on the density.

Echinocardium cordatum

Echinocardium cordatum (Pennant) lives in muddy to clean sand and is regarded as surface deposit feeder (Buchanan 1966).

Distribution

During the periods 1911-25 (Petersen 1913, Petersen unpubl. data) and 1975-79 *Echinocardium cordatum* was a prominent member of the benthic fauna in Århus Bay. The oxygen deficiency in 1981 eliminated *E. cordatum* temporarily, but the species reappeared in the samples in 1983 (Fallesen 1992). Apart from a few specimens found in 1985 (figure 4.10) *E. cordatum* was absent from Århus Bay during the second half of the 1980s. In 1990 *E. cordatum* was found at 6 stations in the central and eastern part of the bay and at the southernmost stations in the western part (figure 4.10). The distribution was very similar in 1991 but it is notable that *E. cordatum* occurred at stn. 51 just north of the outlet.

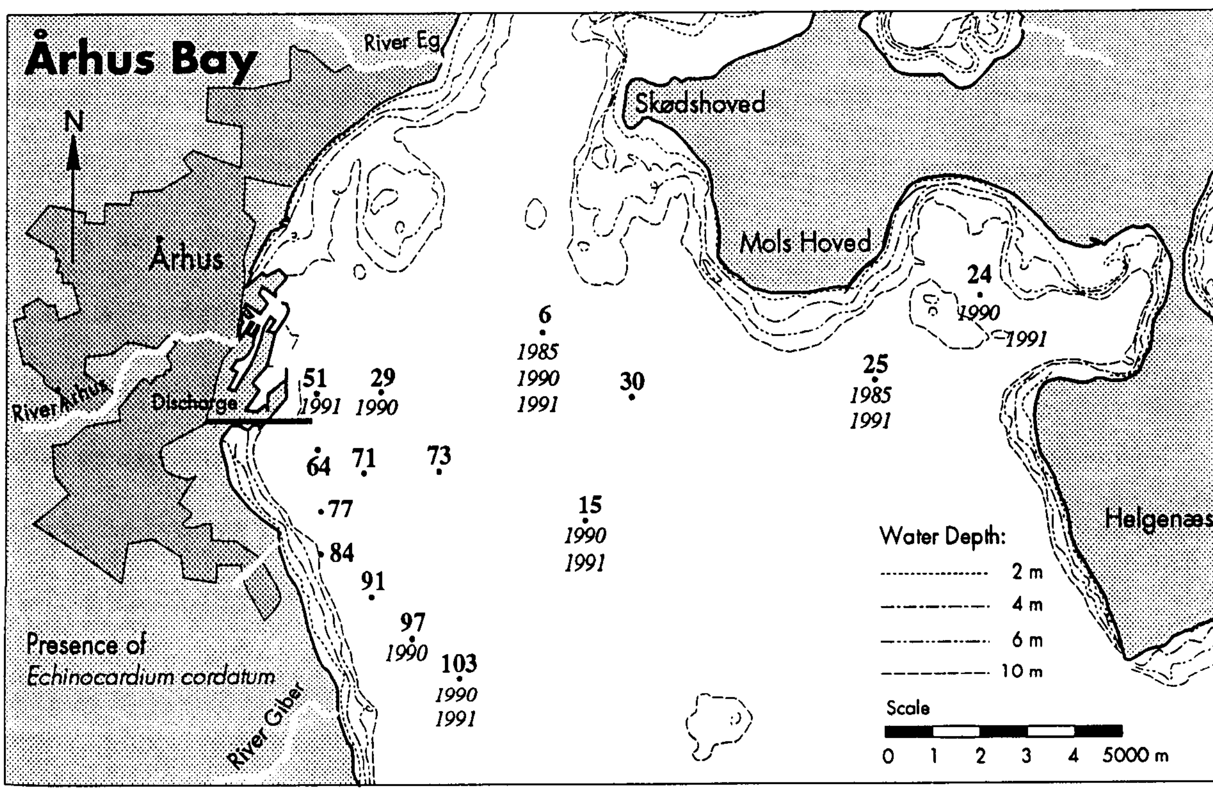


Figure 4.10
Years and stations where *Echinocardium cordatum* has been present in Århus Bay during the period 1985-1991.

Factors affecting distribution

The tolerance of *E. cordatum* to low oxygen concentrations has never been thoroughly investigated but like other echinoderms they seem to be fairly sensitive to adverse oxygen conditions (M. Jensen, pers. comm.). Like *Abra alba* and *Ophiura albida*, *E. cordatum* is also sensitive to low temperature (Beukema 1985). Pearson *et al.* (1985) found that *E. cordatum* was absent or smaller throughout the Kattegat area in 1984 compared to 1911-12. Pearson *et al.* concluded that the decrease of large species such as *E. cordatum* is in accordance with the hypothesis that intermittent low oxygen conditions have affected many of the shallower areas of the Kattegat and kept the system in an early successional stage (Pearson & Rosenberg 1978). Throughout the sampling period *E. cordatum* was never found in the vicinity or south of the sewage outlet apart from stn. 51 in 1991. These observations point at adverse oxygen conditions as a major cause for the absence of *E. cordatum* in Århus Bay in the second half of the 1980s. Recruitment failure could be another explanation. Beukema found that successful year classes only occurred 3 times during a 10 year period off the west-Frisian islands of Texel and Terschelling. On the other hand Nierman *et al.* (1990) observed a high number of *E. cordatum* for 4 consecutive years after an oxygen deficiency in the German Bight. Although *E. cordatum* lives for at least 4-5 years and in some areas up to 20 years (Buchanan 1966, Beukema 1985), survivers from the 1983 recruitment in Århus Bay may not have had sufficient adult potential for successful recruitments. If the environmental conditions were inadequate for *E. cordatum* in 1987, through intermittent oxygen deficiencies in addition to low winter temperature, then it may not have been able to reestablish until 1990. The cause of absence must therefore be regarded as a mixture of recruitment failure and adverse environmental conditions.

Discussion

The distributions of *Abra alba*, *Nephtys ciliata*, *Ophiura albida* and *Echinocardium cordatum* show that an area south of the sewage outlet, including stn. 64, 71, 77, 84 and to some extent stn. 91has been greatly affected by adverse oxygen conditions which made it impossible for these species to maintain permanent populations in the area. Stn. 51 was also notably affected by hypoxic conditions until the waste water treatment was improved in 1990.

During the severe winter 1986/87 low temperature and the oxygen depletion of the bottom water affected the whole bay and practically eliminated *A. alba* and *O. albida* from the area apart from stn. 15, 24 and 25. The severe winter also added to the difficulties for *E. cordatum* to reestablish in the bay. *A. alba* quickly recolonized the area and was found in large numbers in 1988 while it took *O. albida* two years to reestablish. *E. cordatum* did not reestablish permanently until 1990 due to a mixture of recruitment failure, adverse oxygen conditions and the severe winter of 1986/87. The erratic occurrence of *Corbula gibba* in the bay could neither be explained by oxygen deficiencies nor low winter temperature.

The occurrence of *Mysella bidentata* in high densities south of the outlet and the longer lasting appearance of *C. gibba* in the same area are probably related to the enhanced food availability in the area. Other species which are less tolerant to adverse oxygen conditions are not able to reap the benefit of the increased food supply whether this comes from organic enrichment from the outlet or is a kind of "coastal effect". It might seem strange that suspension feeders and surface deposit feeders would benefit from the discharge and not deposit feeders but this fits well with the sediment data. The sediment investigations (chapter 2) showed, that the stations in the vicinity and south of the outlet (stns. 51, 64, 71, 77, 84 and 91) had relatively high carbon/nitrogen (C/N) ratios which indicated that the nutritional quality of the surface sediment was fairly low. The organic content in the sediment (measured as ignition loss) at the stations in question was not particularly high apart from st. 64. It is doubtful whether the organic content of the sediment has had any impact on the fauna apart from consumption of oxygen. Both Hummel (1985) and Nakaoka (1992) found that there was no relationship between organic content in the sediment and the growth of bivalves but found instead that growth rates were related to the food supply from the water column. The observed differences in growth rate of *Abra alba*, being related to the sedimentation of phytoplankton, support this view.

5. Secondary production, Århus Bay

Introduction

Ecological investigations concerned with water pollution are traditionally based on evalution of changes in the number of species, abundance and biomass combined with diversity measurements and possibly classification and ordination techniques (Pearson & Rosenberg 1978, Arntz & Rumohr 1986, Warwick & Clarke 1991, Weigelt 1991). The impact of pollution on benthic secondary production has only been investigated in a limited number of community studies (Rees 1983, Elliott & McLusky 1985, Beukema & Cadée 1986, McLusky 1987, Elliott & Taylor 1989).

The total macrobenthic production has never been estimated for Århus Bay and one of the purposes of this chapter is to calculate the production of Århus Bay and compare the estimate with other areas. Another purpose is to assess the impact of pollution on the secondary production at the 15 stations in Århus Bay and to discuss the usefulness of production estimates in monitoring programmes. The chapter also focuses on the calculations of production of *Abra alba* and *Corbula gibba* and the value of growth and production estimates in the interpretation of population fluctuations.

Crisp (1984) has described a method to estimate production which requires frequent field sampling and the ability to identify cohorts whose history in terms of growth and changes in numbers can be followed. The method can only be applied succesfully to abundant species but, fortunately, a large proportion of total community production can often be attributed to rather few species (Warwick 1980). Measurements of production, using the method described by Crisp is, however, a very time-consuming and expensive procedure and attempts have therefore been made to find short cuts to the estimation of production (Robertson 1979, Banse & Mosher 1980, Schwinghamer *et al.* 1986, Brey 1990).

Robertson (1979) demonstrated that the $P/\bar{B}$-ratio decreases with the lifespan of the organisms and calculated an empirical regression equation from which production of macrobenthos could be estimated from an annual $P/\bar{B}$-ratio and lifespan. The $P/\bar{B}$-ratio has also been found to be inversely related to weight at sexual maturity (Banse & Mosher 1980) and to individual body mass per size class (Schwinghamer *et al.* 1986). All of these empirical findings depend on the negative exponential relation of metabolic rate to body weight in animals. Brey (1990) investigated the relations between annual somatic production (P), annual $P/\bar{B}$-ratio ($P/\bar{B}$), mean annual biomass ($\bar{B}$) and mean individual weight (W) in order to establish improved empirical relations, which may allow a more accurate estimate of productivity. In total 337 data set, representing 138 species were included. The comparison of original data with estimates based on the empirical relations showed that at the community level (i.e. sum of all species) annual production could be estimated from mean annual biomass ($\bar{B}$) and mean individual weight (W) of each population by means of the empirical regression functions of P on $\bar{B}$ and W. Brey also calculated distinct multiple linear regression of P on $\bar{B}$ and W for the main taxonomic groups (Mollusca, Polychaeta and Crustacea) and recommended the use of these wherever possible.

Methods

Total annual macrobenthic production at the 15 stations in Århus Bay

Total macrobenthic production has been estimated for the 15 sampling stations in Århus Bay only for the period 1989-1991. A production estimate for the period 1985-1988 would be less accurate due to the sampling and weighing method used at that time (see chapter 4). The secondary production was computed using the regression equations given by Brey (1990):

Mollusca:	$\log_{10}(P) = (-0.591) + (1.030)\log_{10}(\bar{B}) + (-0.283)\log_{10}(W)$
Polychaeta[1]:	$\log_{10}(P) = (-0.018) + (1.022)\log_{10}(\bar{B}) + (-0.116)\log_{10}(W)$
Crustaecea:	$\log_{10}(P) = (-0.614) + (1.022)\log_{10}(\bar{B}) + (-0.360)\log_{10}(W)$
Total:	$\log_{10}(P) = (-0.473) + (1.007)\log_{10}(\bar{B}) + (-0.274)\log_{10}(W)$

The calculations were not made for every single population separately, but for the taxonomic groups as a whole, with the excepthion of from *Abra alba* and *Macoma calcarea* which were treated separately due to their considerable contributions to the total biomass and production. Oligochaeta and Phoronidae were included in the regression for Polychaeta. The production of the *Nephtys spp.* was calculated separately, using $P/\bar{B}$-ratios obtained by Fallesen and Jørgensen (1984):

N. ciliata:	$P/\bar{B}$ value = 1.02
N. hombergii:	$P/\bar{B}$ value = 1.14

[1]There is a print mistake in Brey's paper. The coefficient for log(B) is negative wheras it should be positive.

Brey has given no regression equations for Coelenterata, Nemertinea, Ophiuroidea and Echinoidae (only the last two groups are of any quantitative importance in Århus Bay) so the regression for "total" production was used for these groups. Specimens of megabenthos, *Asterias rubens*, *Arctica islandica* and fragments of big *Neanthes virens*, only found occasionally in the samples, were left out of the calculations. Conversion factors for dry weight to ash free dry weight were obtained from Rumohr *et al.* (1987).

Total macrobenthic production at station 6, Århus Bay

The total macrobenthic production could be estimated more accurately at stn. 6 in 1990 and 1991 than at the other stations because samples were collected monthly. The frequent sampling made it possible to use the Crisp method to calculate production for the two most abundant bivalves *Abra alba* and *Corbula gibba*. The production estimates for the remaining species and taxonomic groups (apart from *Nephtys spp.*) were based on the Brey method but the results were computed on true annual means of biomass and individual weight contrary to the production estimate for the 15 stations where the total annual production was computed on basis of one single annual sampling in October/November.

The production of *Abra alba* was computed according to the method described by Crisp (1984) for stocks with separable recruitment and age classes. The cohorts were separated by eye. The average length (l) of a cohort was used in the calculations. A length - weight relationship was obtained from Brunswig (1973, in Rumohr *et al.* 1987):

$$\mathrm{Log}_{10}(\mathrm{AFDW}) = 2.94\log_{10}(l) - 2.09$$

Conversion factors between wet weight, dry weight and ash free dry weight were also obtained from Rumohr *et al.* (1987).

No recruitment was observed for *Corbula gibba* during 1990 and 1991 and the production was therefore estimated as stock with no recruitment (Crisp 1984). Length was converted into weight using the regression equation :

$$AFDW\ (mg) = 0.01273 * l^{3.038}$$

given by Jensen (1990)[2].

The production of *Nephtys spp.* were calculated using $P/\bar{B}$-ratios from Århus Bay obtained by Fallesen and Jørgensen (1984). For the rest of the species production was computed using the regression equations given by Brey (1990).

In order to compare the method described by Brey with the method described by Crisp the production of *Abra alba* at station 6 in 1990 and 1991 was also calculated using Brey's regression equations for Mollusca. In the following the two methods will be referred to as the Brey method and the Crisp method although the method described by Crisp was not developed by him.

[2]There is also a print mistake in Jensen's paper. The correct coefficient is 0.01273 not 0.1273 (Jensen, pers. comm.)

Results

Total macrobenthic production at the 15 stations in Århus Bay, 1989, 1990 and 1991

The results of the estimation of the total annual production for all 15 stations in Århus Bay in 1989, 1990 and 1991 are shown in figure 5.1 and table 5.1. The figure shows that the total annual production was fairly constant for each individual station from year to year. The most important contributors to production in Århus Bay were *Abra alba* and other Mollusca (nearly exclusively Bivalvia) (table 5.1). The production of Mollusca was higher than the production of Polychaeta at all stations. The highest productions of Polychaeta were found at stns. 6, 29, 73, 84, 97 and 103. The production of *Nephtys spp.* was equal to or higher than the production of the remaining polychaetes at stns. 15, 24 and 25.

Production was very low at stn. 51 in 1989 but after the 90% reduction of the sewage discharge in the beginning of 1990 production increased dramatically mainly due to *Abra alba*. At stn. 64, just south of the sewage outlet, few species and very little biomass were found in 1989 and 1990 resulting in a very low production. As the environmental conditions improved slightly at stn. 64 during 1991, the biomass and consequently the production increased to 2 g AFDW/m^2 in 1991.

The highest total annual productions were found at stns. 91, 97 and 103 in the southern part of the study area (table 5.1). *Macoma calcarea* contributed considerably to the total production at stns. 97 and 103. *Corbula gibba* was one of the main contributors to the total production at stns. 71, 77, 84 and 91, especially in 1990 but also in 1991.

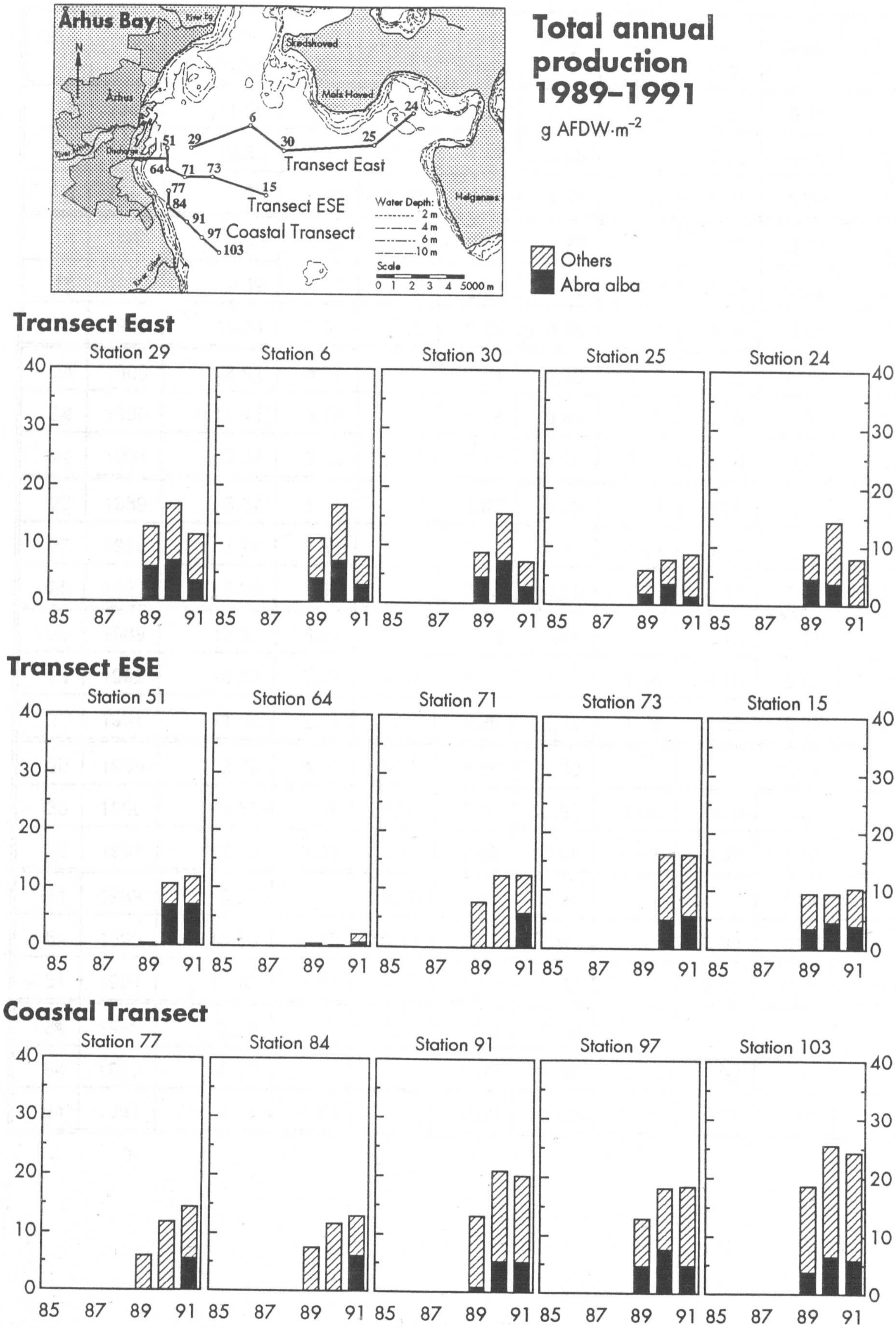


Figure 5.1
Total annual production (g AFDW per m^2) divided into *Abra alba* and "Others" for the 15 stations in Århus Bay in 1989, 1990 and 1991.

St.	Year	Total P g AFDW	Abra alba	Maco cal	Other Moll.	Poly etc.	Neph cil	Neph hom	Crus	Others
6	1989	11.01	4.11	2.31	0.85	3.44	0.09	0.02	0.13	0.07
6	1990	16.83	7.17	3.98	1.47	3.98		0.16	0.03	0.05
6	1991	7.87	3.03	0.87	0.80	1.03	0.47	0.67	0.08	0.93
15	1989	9.50	3.52	0.92	0.68	2.77	1.16	0.02	0.13	0.31
15	1990	9.49	4.53	0.02	1.01	1.42	0.37	1.46	0.08	0.61
15	1991	10.34	3.98	3.02	0.65	0.96	0.94	0.25	0.01	0.54
24	1989	8.91	4.57		1.94	1.49	0.28	0.02	0.14	0.46
24	1990	14.43	3.74		5.68	0.55	1.06	0.69	1.63	1.08
24	1991	8.01	0.04	1.13	3.85	1.18	0.56	0.18	0.73	0.34
25	1989	5.92	1.88		1.03	0.82	0.64	0.78		0.77
25	1990	7.75	3.65	0.45	2.03	0.42	0.44	0.09	0.07	0.59
25	1991	8.69	1.45		3.18	0.19	1.75	0.17	0.30	1.65
29	1989	12.87	6.03	2.49	2.02	2.04		0.14	0.14	0.02
29	1990	16.82	7.06	0.64	1.93	5.60	1.26	0.18	0.08	0.06
29	1991	11.53	3.63		2.26	3.21	1.64	0.00	0.72	0.06
30	1989	8.79	4.58	0.35	1.60	1.59			0.14	0.52
30	1990	15.50	7.39	1.33	3.04	0.82	2.09	0.02	0.04	0.77
30	1991	7.21	2.96	0.53	3.05	0.54		0.07	0.03	0.02
51	1989	0.27		0.10	0.11	0.01			0.04	0.00
51	1990	10.53	6.88	0.00	2.66	0.91		0.03	0.04	
51	1991	11.72	6.93		1.16	3.52		0.09	0.03	0.01
64	1989	0.38			0.19	0.19				
64	1990	0.17			0.07	0.05		0.02	0.03	
64	1991	2.04	0.64		0.90	0.28		0.17	0.05	

Figure 5.1
Production estimates for stn. 6-64 in Aarhus Bay 1989, 1990 and 1991.

continues

St.	Year	Total P g AFDW	Abra alba	Maco cal	Other Moll.	Poly etc.	Neph cil	Neph hom	Crus	Others
71	1989	7.69		2.28	3.43	1.81		0.13	0.05	
71	1990	12.35			8.68	3.39		0.19	0.09	0.01
71	1991	12.42	5.80		4.80	1.35		0.11	0.36	
73	1989	no data	-	-	-	-	-	-	-	-
73	1990	16.27	4.92	3.85	1.95	5.33		0.06	0.13	0.03
73	1991	16.21	5.58	1.15	3.32	5.81	0.03	0.11	0.13	0.08
77	1989	6.02			4.03	1.88		0.09	0.02	0.00
77	1990	11.89			9.60	1.73		0.11	0.43	0.02
77	1991	14.44	5.60	0.04	6.67	1.95		0.08	0.10	
84	1989	7.56			4.66	2.76		0.14		
84	1990	11.73		0.00	8.78	2.74		0.10	0.09	0.01
84	1991	12.96	6.18		4.79	1.61		0.35	0.03	0.00
91	1989	13.15	0.93	0.86	10.17	0.97		0.18	0.01	0.03
91	1990	20.93	5.37	1.27	12.39	1.85			0.04	0.00
91	1991	20.04	5.28	0.60	10.21	3.57		0.04	0.33	
97	1989	12.94	4.79	1.26	2.69	3.76		0.05	0.12	0.29
97	1990	18.16	7.66	3.51	3.55	3.23	0.16	0.02	0.03	0.02
97	1991	18.47	4.86	5.21	3.66	2.40	1.10	0.36	0.11	0.78
103	1989	18.62	3.82	6.32	2.44	3.87	1.72	0.07	0.23	0.14
103	1990	25.49	6.50	7.61	4.85	3.28	2.73		0.22	0.28
103	1991	24.28	5.92	10.97	2.39	2.00	1.14	0.02	0.31	1.52

Figure 5.1 (continued)
Production estimates for stn. 71-103 in Århus Bay 1989, 1990 and 1991.

The total biomass, total annual production and $P/\bar{B}$-ratio are given in table 5.2 for all 15 stations from 1989 to 1991. There is a great variation in biomass and production among stations whereas the variation in $P/\bar{B}$-ratio is very limited.

Stn.	Year	$\bar{B}$ g AFDW m^{-2}	P g AFDW m^{-2} y^{-1}	P/$\bar{B}$-ratio
6	1989	7.67	11.01	1.44
6	1990	15.98	16.83	1.05
6	1991	5.83	7.87	1.35
15	1989	6.15	9.50	1.54
15	1990	6.29	9.49	1.51
15	1991	10.37	10.34	1.00
24	1989	5.23	8.91	1.70
24	1990	10.16	14.43	1.42
24	1991	7.86	8.01	1.02
25	1989	3.75	5.92	1.58
25	1990	6.37	7.75	1.22
25	1991	5.63	8.69	1.54
29	1989	12.05	12.87	1.07
29	1990	11.38	16.82	1.48
29	1991	6.70	11.53	1.72
30	1989	5.18	8.79	1.70
30	1990	12.31	15.50	1.26
30	1991	6.98	7.21	1.03
51	1989	0.20	0.27	1.36
51	1990	7.61	10.53	1.38
51	1991	5.77	11.72	2.03
64	1989	0.23	0.38	1.66
64	1990	0.08	0.17	2.08
64	1991	1.39	2.04	1.46

Figure 5.2
Biomass, production and P/$\bar{B}$-ratio for st. 6-64 in Århus Bay, 1989-1991.

continues

St.	Year	$\bar{B}$ g AFDW m^{-2}	P g AFDW m^{-2} y^{-1}	P/$\bar{B}$-ratio
71	1989	6.25	7.69	1.23
71	1990	7.35	12.35	1.68
71	1991	7.56	12.42	1.64
73	1989	-	-	-
73	1990	15.50	16.27	1.05
73	1991	10.66	16.21	1.52
77	1989	2.39	6.02	2.52
77	1990	6.35	11.89	1.87
77	1991	9.48	14.44	1.52
84	1989	3.20	7.56	2.36
84	1990	7.18	11.73	1.63
84	1991	8.13	12.96	1.59
91	1989	7.57	13.15	1.74
91	1990	14.18	20.93	1.48
91	1991	12.44	20.04	1.61
97	1989	7.57	12.94	1.71
97	1990	15.58	18.16	1.17
97	1991	17.34	18.47	1.07
103	1989	18.48	18.62	1.01
103	1990	23.65	25.49	1.08
103	1991	30.00	24.28	0.81
Mean		8.91	11.78	1.48
S.D.		5.99	5.82	0.36
Maximum		30.00	25.49	2.52
Minimum		0.08	0.17	0.36

Figure 5.2 (continued)
Biomass, production and P/B-ratio for st. 71-103 in Århus Bay, 1989-1991.

Total macrobenthic production at stn. 6 in Århus Bay 1990 and 1991

In order to obtain the best possible estimate of production at stn. 6 for 1990 and 1991 different methods were taken into use as described above.

Production of *Abra alba*

The results and calculations of production for *Abra alba* in 1990 and 1991, using the Crisp method for stocks with recruitment and age classes separable, are given in appendix 5.1. The 1990 cohort was far the most productive and exhibited a very high productivity in September and October 1990, corresponding with a very high growth rate. The 1990 year class continued to be fairly productive during 1991 and had a much higher annual production in 1991 than the 1991 cohort. The relatively low growth rate of the 1991 year class combined with a decrease in number in late autumn resulted in a very limited production.

The annual production of the different year classes are shown in table 5.3. The total annual production in 1991 was half of the total annual production in 1990 due to the very low production of the 1991 year class. The production of the youngest year class in 1991 was only about 10% of that of the youngest year class in 1990. The very succesful 1990 year class was therefore the main contributor to production in both 1990 and 1991.

The $P/\bar{B}$ values reflect the differences between the two years (table 5.3). The high $P/\bar{B}$ value for 1990 is caused by a highly productive year class consisting of young individuals whilst most of the production in 1991 originates from older individuals, which results in a much lower $P/\bar{B}$ ratio.

Abra alba 1990	P g AFDW m^{-2}		*Abra alba 1991*	P g AFDW m^{-2}
Year class 1988	1.61			
Year class 1989	2.28			
Year class 1990	7.10		Year class 1990	4.61
			Year class 1991	0.79
Total 1990	10.99		Total 1991	5.40
P/$\bar{B}$ 1990	3.40		P/$\bar{B}$ 1991	1.41

Table 5.3
The production of *Abra alba* at stn. 6, Århus Bay in 1990 and 1991 estimated by the Crisp method.

The production of *A. alba* using the Brey method is shown in table 5.4. The estimated production of *A. alba* in 1991 is very near to the result obtained by the Crisp method whereas the estimate for 1990 is much lower.

Abra alba	B g AFDW	W g AFDW	P g AFDW	P/$\bar{B}$
1990	3.23838	0.00457	3.95	1.22
1991	4.03650	0.00558	4.69	1.16

Table 5.4
The production of *Abra alba* at stn. 6, Århus Bay in 1990 and 1991 estimated by the Brey method.

<u>Production of *Corbula gibba*</u>

The results of the production estimates of *C. gibba* in 1990 and 1991, using the method described be Crisp (1984) for stock with no recruitment, are shown in appendix 5.2 and summarized in table 5.5. Contrary to *Abra alba* there was only one cohort, namely the 1989 year class. The highest production increment was found during summer 1990. The P/$\bar{B}$

values for *C. gibba* were low both in 1990 and 1991 as would be exepted for a population in decline. Due to the very limited recruitment (8 specimens) found in the samples in autumn 1991 no attempt was made to estimate the production for the 1991 year class.

Corbula gibba 1990	P g AFDW		*Corbula gibba 1991*	P g AFDW
Year class 1989	0.05		Year class 1989	0.04
Total 1990	0.05		Total 1991	0.04
$P/\bar{B}$ 1990	0.63		$P/\bar{B}$ 1991	0.22

Table 5.5
The production of *Corbula gibba* in 1990 and 1991 estimated by the Crisp method.

Total production at stn. 6

The production estimates for species and taxonomic groups at stn. 6 are given in table 5.6. *Abra alba* was the main contributor to production in 1990 as well as in 1991 and made up 62% and 51%, respectively, of the total annual production. The production of *Corbula gibba* was negligible whilst *Macoma calcarea* contributed notably to the total production. All in all Mollusca, primarily Bivalvia, were the most productive group followed by the polychaetes. More than half of the computed polychaete production was due to *Nephtys spp.*. Crustacea and Echinodermata etc. contributed very little to the total annual production.

Species / group	P g AFDW 1990	P g AFDW 1991	Method
Abra alba	10.99	5.40	Crisp (1984)
Corbula gibba	0.05	0.04	Crisp (1984)
Macoma calcarea	2.69	1.60	Brey (1990)
Other Mollusca	1.18	1.57	Brey (1990)
Nephtys ciliata	1.22	0.68	Fallesen & Jørgensen (1984)
Nephtys hombergii	0.02	0.09	
Other Polychaeta etc.	1.11	0.61	Brey (1990)
Crustacea	0.05	0.03	Brey (1990)
Echinodermata etc.	0.29	0.62	Brey (1990)
Total	17.60	10.64	
Mean annual biomass	15.98	6.34	
$P/\bar{B}$	1.10	1.68	

Table 5.6
Total annual production at stn. 6, Århus Bay 1990 and 1991.

Discussion

Methods

The Brey method was chosen among other short-cut-methods because it is based on two independent variables: mean individual weight and mean annual biomass, and not only one independent variable like mean body masss (Schwinghamer *et al.* 1986) or life span (Robertson 1979). The attempt by Robertson (1979) to relate the annual population $P/\bar{B}$ to maximum life span, using a log-log regression equation, has been strongly criticised by Warwick (1980) who found that the relationship between $P/\bar{B}$ and life span was so poor as to be almost useless for the prediction of P/B. The relation found by Schwinghamer *et al.* (1986) between annual $P/\bar{B}$ and mean individual body mass is also based on a log-log regression. Warwick (1980) and Brey (1990) have pointed out that these relations between $P/\bar{B}$-ratio and one independent variable may not be valid for an accurate estimation of the productivity of a single population, because the confidence intervals of the log-log regression lines may cover a range of more than a hundred percent on the linear scale. When considering a number of species for the purposes of estimating whole community production, the errors involved in applying this relationship for individual species may balance out, but for single species the estimate may be wildly wrong (Warwick 1980). Despite the attempts by Brey to improve the estimation of production based on two independent variables comparison of calculated production values with estimated values showed large differences at the species level, although the estimates of community production were reasonable (Brey 1990). A comparison of the total community production at stn. 6 in 1990 and 1991, estimated by the Crisp method and the Brey method, is shown in table 5.7.

	"Crisp" 1990	"Brey" 1990	"Crisp" 1991	"Brey" 1991
Total community production	17.60	16.83	10.64	7.87

Table 5.7
Total community production in g AFDW per m^2 estimated by the Crisp method and the Brey method for stn. 6, Århus Bay in 1990 and 1991.

The differences between the calculated and estimated productions was 4% in 1990 and 26% in 1991. Based on these results from stn. 6 the Brey method seems reasonable for estimating total community production of the entire area.

For a single population like *Abra alba* the production estimated by the Crisp method at stn. 6 in 1990 and 1991 (table 5.3) was compared with production estimated by the Brey method based on a single annual sampling and on a true annual mean, respectively.

Abra alba	1990	1991
Crisp method	10.99	5.40
Brey method Monthly samplings	3.95	4.69
Brey method One annual sampling	7.17	3.03

Table 5.7
Estimates of production of *Abra alba* in g AFDW per m^2 using different methods.

The results in table 5.7 show that the production estimates obtained by the Brey method based on monthly samplings were very similar to the production estimated by the Crisp method for 1991 whereas the Brey result was much lower than the Crisp result for 1990. The reason why the Brey method underestimates the production in 1990 is that during the first half part of the year relatively old individuals with low productivity considerably influenced the mean individual weight W and biomass and therefore masked the productivity of the 1990 year class which only appeared later. When the production computed by the Brey method was based exclusively on data from the annual sampling in October then the production estimate was closer to the total annual production computed by the Crisp method in 1990. The opposite is, however, true for 1991. These results demonstrate the limitations of the method described by Brey and similar methods. The age structure is simply not mirrored satifactory and this inevitably gives rise to deviations from results obtained by the Crisp method.

The relatively high abundance of *Abra alba* in Århus Bay combined with easy separable year classes and monthly samplings made this species ideal for computing production by the Crisp method. Production of *Corbula gibba* could likewise be estimated, but the continuous decline in abundance of this species made the calculations of production increasingly uncertain during the sampling period. A prerequisite for calculation of production by the Crisp method is a relation between the length and the weight of the population. No length-weight relationships were established for either of the two species as studies of secondary production were not included initially in the aims of the monthly sampling. Length-weight relationships therefore had to be obtained from the literature.

Several regressions of weight on length are available for *Abra alba* (Brunswig in Rumohr *et al.* 1987, Cornet 1986, Larsen 1988 and Aksglæde 1992). The regression equations are either based on animals collected at one date (Aksglæde) or animals from different dates (Brunswig, Cornet, Larsen). The equation given by Brunswig was chosen because when the biomass was calculated using this equation the result was very near the observed biomass. It would have been more obvious to choose one of the length-weight relationships from Århus Bay but Larsen (1988) seems to overestimate the weight of the small individuals while Aksglæde generally underestimated the weight. If the Larsen L-W-relationship was applied to the 1990 data which included many small individuals the estimated production would be 15.13 g AFDW per m^2 while the production in 1991 would be similar to the one given in table 7.12, namely 5.34 g AFDW per m^2. If the Aksglæde relation, based of one sampling in October, was used the estimated production turned out to be half of that found in table 7.12, namely 5.90 and 2.35 g AFDW per m^2 for 1990 and 1991, respectively. All in all the regression on length on weight seems very important for the estimation of production of *Abra alba*. Zwarts (1991) showed that in the Dutch Wadden Sea the body weight of the soft parts of four bivalve species peaked in May and June at a level approximately twice the lowest value, which occurred in November to March. On the other hand Jensen (1990) found no seasonal variation in the regressions of weight on length for *Corbula gibba* on the basis of samples taken in April, July and September.

An alternative and easy way to obtain production estimates is to use $P/\bar{B}$ ratios derived from other studies. $P/\bar{B}$ ratios may, however, be very different from one area to another (Warwick 1980, Elliott & McLusky 1985) or even among stations within the same area (Rainer 1985, Jensen 1990). The age structure of a population influences the species $P/\bar{B}$ such that differences in cohort strength will invalidate production estimation based on $P/\bar{B}$ values derived elsewhere. If for example the $P/\bar{B}$-ratio calculated for *Abra alba* in 1990 had been used to estimate the production of *A. alba* in 1991 the result would have been a production of 13.02 g AFDW per m^2 instead of the calculated 5.40 g AFDW per m^2. On the other hand if populations, like the *Nephtys spp.* populations in Århus Bay, exhibit a fairly constant age structure from year to year $P/\bar{B}$-ratios from earlier studies of production (Fallesen & Jørgensen, 1984) can be used.

From the above discussion it can be concluded that the methods used to estimate the production for a single population or for a whole community greatly influence the results. Sampling procedure (frequency, screen size etc.) also has an important impact on the results. All these factors must be born in mind when results from different investigations are compared. Based on the results from stn. 6 the method described by Brey (1990) for estimation of community production seems to be a reasonable alternative when the methods described by Crisp cannot be used. The Brey method is less reliable for single populations but the use of two independent variables in the empirical regression equations and separate equations for the main taxonomic groups makes the method more sophisticated than the methods given by Robertson (1979) and Schwinghamer *et al.* (1986).

Production of *Abra alba* and *Corbula gibba* at station 6, Århus Bay compared to other areas

In table 5.8 the production of *Abra alba* at stn. 6 is compared with production estimates from other areas and earlier studies from Århus Bay. As can be seen from the table the production varies widely within areas and among areas. The production of *A. alba* in Århus Bay is relatively high compared with other areas.

The production of *Corbula gibba* is very low (0.04 - 0.05 g AFDW m^{-2}) when compared to *Abra alba* in Århus Bay. The production of *C. gibba* is, however, at the same level as the production of *A. alba* from other areas (table 5.8). Jensen (1990) found a very high production and also a high $P/\bar{B}$ ratio of *C. gibba* in the Limfjord (Nissum Bredning). Mean value of 6 stations: P = 26.8 g AFDW m^{-2}, $P/\bar{B}$ ratio = 4.2.

Locality	$\bar{B}$ g AFDW m^{-2}	P g AFDW m^{-2}	P/$\bar{B}$	Reference
Swansea Bay	0.06	0.07	1.35	Warwick & George 1980
Baie de Concarneau	0.01 - 0.14	0.04 - 0.60	2.01 - 6.09	Menesquen 1985
Baie de Morlaix	0.02 - 0.35	0.05 - 0.69	1.70 - 2.85	Dauvin 1986
Kiel Bay	0.11 - 2.74	0.22 - 6.04	1.35 - 3.36	Rainer 1985
Embouchure Gironde	0.02 - 4.44	0.10 - 10.48	1.65 - 4.63	Bachelet 1981
La Salie	0.81	2.34	2.87	Cornet 1986
Århus Bay 1987	1.68	4.44	2.64	Larsen 1988
Århus Bay 1986	9.35	6.73	0.72	Larsen 1988
Århus Bay 1991	3.83	5.40	1.41	Present study
Århus Bay 1990	3.24	10.99	3.40	Present study

Table 5.8
Annual production (g AFDW m^{-2}), mean annual biomass (g AFDW m^{-2}) and P/$\bar{B}$-ratio for *Abra alba* from different areas organized after increasing production.

Secondary production in Århus Bay compared to other areas

In comparison with other macrofauna communities (table 5.9) standing crop and annual production is high at most stations in Århus Bay (table 5.2). The variation in biomass and production among stations in Århus Bay is very similar to the variation found among *intertidal* stations in the Forth Estuary (Scotland). Compared to other *subtidal* areas the total annual biomass and production is very high in Århus Bay and is only exceeded by the Bristol Channel. In shallow waters between 0 and 1 m depths on the Swedish west coast

Möller and Rosenberg (1983) recorded a very high production of 22-273 g AFDW m^{-2} y^{-1}. Warwick *et al.* (1978) discussed comparative values of $P/\bar{B}$ for a number of communities. They found that *Abra* communities (locality 2 and 6) generally had higher $P/\bar{B}$ values than *Brissopsis lyrifera/Amphiura chiajei* and *Venus* communities (locality 1 and 7, respectively in table 5.9). The higher production in relation to standing crop in *Abra* communities is related to the shorter lifespan and smaller size of the dominant species in the *Abra* communities compared to the other two community types (Warwick *et al.* 1978).

Locality	$\bar{B}$ g AFDW m^{-2}	P g AFDW m^{-2}	$P/\bar{B}$	Reference
1. Northumberland coast	3.98	1.74	0.44	Buchanan & Warwick 1974
2. Swansea Bay	2.55	3.14	1.28	Warwick & George 1980
3. Baltic Sea	4.3	6.8	1.6	Cederwall 1977
4. Yorkshire Coast	1.97 - 6.61	3.42 - 7.38	0.90 - 1.73	Rees 1983
5. Forth Estuary	0.10 - 7.02	0.23 - 14.97	0.70 - 2.39	Elliott & Taylor 1989
6. Århus Bay	0.08 - 30.00	0.17 - 25.49	0.81 - 2.52	Present study
7. Bristol Channel	45.79	25.82	0.56	Warwick *et al.* 1978
8. Swedish west coast		22-273		Möller & Rosenberg 1983
9. Lynher Estuary	13.24	13.31	1.00	Warwick & Price 1975
10. Forth Estuary	1.93 - 43.17	3.82 - 30.21	0.69 - 3.68	McLusky 1987
11. Dutch Wadden Sea	c. 15 - 40	c. 27 - 88		Beukema & Cadée 1986

Table 5.9
Total annual production (g AFDW m^{-2}), mean annual biomass (g AFDW m^{-2}) and $P/\bar{B}$ ratio for different subtidal (1-8) and intertidal (9-11) benthic communities organized after increasing production.

Spatial and temporal differences in secondary production in Århus Bay

The relatively high secondary production in Århus Bay is based on the amount of organic matter available to the animals. Organic matter available to the macrozoobenthos stems from 4 different sources 1) the water column, sedimentation of phytoplankton, zooplankton excretion, etc., 2) waste water discharge, 3) organic matter from rivers, 4) resuspension of sedimented organic material. The last source originates, of course, from the other sources but for suspension feeders a resuspension of sedimented material can be very important for growth (Jensen 1990).

The input from the water column to the bottom has already been discussed in chapter 4 in connection with the discussion of the growth rate of *Abra alba* at stn. 6. From the measurements of fluoresence and primary production (figure 2.12 and table 2.2) the organic input from the pelagos to the bottom sediments seems to vary considerably seasonally and between years. Hydrographic conditions like the vertical position and tilting of the halocline, the bottom current, wind and wave action may, moreover, strongly influence the time and place of sedimentation of organic matter. The spatial differences in the sedimentation of organic matter are not known but may be part of the explanation for the variation in secondary production among the stations in Århus Bay. For example stns. 6, 24, 29 and 30 had a notably higher production in 1990 than in 1989 and 1991 (figure 5.1) while no such differences were found at the neighbouring stns. 15 and 25 where the size of the secondary production was very stable during the period 1989-1991.

The organic input from the sewage outlet explains some of the spatial differences in secondary production. Near the sewage outlet, at stns. 51 and 64, the environment was too harsh to support any production in 1989. Elliott & Taylor (1989) found that poor communities in stressed environments can have a relatively high productivity, but this does not seem to be the case in Århus Bay. The low productivity near the outlet was probably partly caused by reccurring oxygen deficiencies and partly by the use of a 1 mm sieve which excluded some of the small opportunistic polychaetes from being sampled leading to an underestimation of the production. When the discharge of waste water was reduced by the beginning of 1990 the environment improved considerably at stn. 51 north of the outlet and gave rise to a relatively high production in 1990 and 1991 mainly due to *Abra alba*. A slight improvement could be seen at stn. 64 just south of the sewage outlet in 1991. As the current moves southward along the coast, stn. 64 has always been more severely affected by the sewage outlet than stn. 51, and one would therefore expect the recovery time to be longer at stn. 64 than at stn. 51. The benthic secondary production further south of the outlet (stns. 71, 77, 84) was lower in 1989 than in 1990 and 1991 which could be due to oxygen stress caused by the organic enrichment. The production at the southermost stations (stns. 91, 97 and 103) was generally higher than in the rest of the bay. The reason for this could be that the organic enrichment from the sewage outlet enhances the production in this area but causes no severe oxygen deficiencies. On the other hand the production continued to increase after the discharge was reduced, so sewage cannot be the sole explanation.

The River Århus discharges into the harbour and River Giber reach Århus Bay just south of stn. 103. The organic material carried by these rivers may therefore mainly settle in the same area as the sewage and contribute further to the production at stns. 91, 97 and 103. The input from the rivers, especially River Giber, is, however, fairly limited. At the near shore stations degraded plant material from macroalgae and eelgrass growing along the coast may also contribute to an increase in the food supply and hence the production.

That resuspension can be a very import factor for growth and production was demonstrated by Jensen (1990) who suggested that the between-year variation in growth rate of *Corbula* *gibba* in a shallow part of the eutrophic Limfjord (Denmark) was caused by variable frequences of wind-induced resuspension of settled organic matter. The depth at stns. 91, 97 and 103 is 13-14 m while the depth at the stations in the central part of the bay is 15-16 m. Strong wind and tilting haloclines would therefore more often resuspend organic particles at stns. 91, 97 and 103 compared to stations in the central part of the bay and this would favour suspension and surface deposit feeders at the near shore stations.

The slightly higher organic content in the sediment in the central part of the bay (table 2.3) does not favour secondary production. Organic content measured as ignition loss gives no information about the quality of the organic matter, and as the differences are small among stations, no clear correlation between organic content of the sediment and production could be expected. Nakaoka (1992) found that differences in size, growth rate and production of *Yoldia notabilis* between 2 stations in Otsuchi Bay, Japan were consistent with the local difference in food supply from the water column to the bottom, but not related to other environmental factors such as temperature, salinity or organic content in the sediment.

Apart from the area near the waste water outlet there is no simple explanations for the observed spatial and temporal differences in secondary production among stations in Århus Bay. A combination of hydrography and the dynamics of the overlying water column seems to be the main cause of variability in benthic secondary production.

The use of secondary production for monitoring purposes

Elliott and McLusky (1985) proposed the use of production ecology of estuarine macrobenthic invertebrates as a measure of detecting sub-lethal stress within those populations. Their data on *Macoma balthica* from the Forth Estuary, Scotland indicated that when compared to other similar areas the *M. balthica* population studied was under stress as indicated by reduced productivity. Stress could not be explained by the environmental variables studied but the authors found that the level of pollution was of most concern in view of the known levels of heavy metal and other pollutant accumulation. McLusky (1987) found that the productivity of the intertidal benthic populations was depressed in the Forth Estuary compared to other estuaries and that the depression could not be explained adequately by a consideration of natural environmental variables. McLusky suggested that low levels of pollutants were responsible for the lower $P/\bar{B}$ values.

Rees (1983) emphasized that: "an attractive feature of the estimate of community production is that it is comparable with other regions which can be defined as exhibiting broadly similar environmental features, irrespective of the number and type of species present, or the numerical abundance". Comparisons of production estimates among regions are not without problems. In addition to the difficulties of defining "similar environmental features" the above discussion of methods has shown that production estimates are highly influenced by the method used. This should not prevent production estimates being made and compared with other regions, but care should be exercised in the interpretation of observed differences/similarities.

Rees (1983) also suggested that: "comparative studies of the growth of major benthic organisms could offer advantages in pollution investigations, as spatial distinctions between sites are generally persistent with time and, it is presumed, will alter only in response to significant changes in environmental influences, including pollution". The study of *Abra alba* in Århus Bay shows that it *is* an advantage to study growth and production as part of pollution investigations because the variability in the benthic environment can then be related to the dynamics of the water column, nutrient level, phytoplankton, zooplankton etc.. Whether the spatial distinctions between sites are persistent with time is too early to say for

Århus Bay. Seen in a wider perspective estimates of secondary production are important in relation to fish food and as parts of energy budgets (Arntz 1980, Pearson & Rosenberg 1992).

6. Multivariate analyses

Introduction

In the preceeding chapters spatial and temporal patterns and trends in the Århus Bay and Fornæs data have been discussed on the basis of variation in abundance and biomass of taxonomic and trophic groups (chapter 3) or single species (chapter 4) and when possible related to variations in environmental factors. In the present chapter the data from the two study areas are analyzed by means of multivariate analyses to deal with the examination of many variables simultaneously. The Århus Bay and Fornæs data are multivariate because each sample is described by the abundances of a number of species and because numerous environmental factors affect the communities.

Multivariate analysis has the following purposes (Randerson, 1993):

- describing or summarizing the data efficiently to reduce the data matrix to a more manageable form,
- searching for pattern of structure in a set of data,
- searching for possible causal relationships between the distribution of the biota and that of environmental factors.

The application of multivariate analyses to the data from Århus Bay and Fornæs also had the purpose to assess the applicability of the different multivariate techniques.

For these purposes I have chosen to use the following types of multivariate analysis:

Ordination techniques:

Principal Component Analysis (PCA)

Detrended Correspondence Analysis (DCA)

Canonical Correspondence Analysis (CCA)

Non-metric Multidimensional Scaling (MDS)

Classification techniques:

Two Way INdicator SPecies ANalysis (TWINSPAN)

Introduction to techniques

Ordination techniques

Ordination is a common term for multivariate techniques that arrange sites along axes on the basis of data on species composition. The word ordination stems from the German "Ordnung" meaning "arrangment". Ordination is based on the idea of a continuum in the data.

The most popular *metric* ordination techniques among community ecologists are Principal Components Analasys (PCA), Correspondence Analysis (CA) (= also called reciprocal averaging), and techniques related to CA, such as Detrended Correspondence Analysis (DCA) (Jongman *et al.* 1987). *Non-metric* Multidimensional Scaling MDS is popular among marine biologists (Field *et al.* 1982, Gray *et al.* 1988, Austen *et al.* 1991, Warwick & Clarke 1991, Clarke 1993, Warwick & Clarke 1993).

To be strictly applicable to metric ordination techniques (PCA and CA/DCA) the data sets must meet several assumptions, primarily that the species have normal distributions and are uncorrelated. Field data sets rarely, if ever, meet the requirements precisely (Gauch 1982). For merely descriptive purposes, larger departures from ideal data structure are tolerable (Greig-Smith 1980). Even for descriptive purposes, however, it must be remembered that PCA and CA/DCA have underlying mathematical models and, consequently, may be applicable to one data set but not another (Gauch 1982).

Extensive descriptions of PCA and CA/DCA are found in Gauch (1982) and Jongman *et al.* (1987). Both analyses are eigenvector ordinations. The algorithms of the two analyses are given in Jongman *et al.* (1987). The algorithm of each of the analyses is carried out by an iteration process which stops at convergence i.e. if an extra iteration cycle is carried out the result will be the same. The result of the algorithm is the ordination axes. In mathematics, the ordination axes are termed eigenvectors because after convergence additional iteration cycles will transform the vector into itself. Each eigenvector has a corresponding eigenvalue which is a measure of the importance of the ordination axis.

Ordination serves to summarize community data by producing a low-dimensional ordination space, 2 or 3 dimensions, in which similar species and samples are close together and dissimilar entities far apart. Ordination axes can be considered as theoretical environmental variables, constructed in such a way as to optimize the fit of the species data to a particular (linear or unimodal) statistical model of how species abundance varies along gradients. These theoretical environmental variables are constructed without reference to environmental measurements, but subsequently they can be compared with actual environmental data.

The central theme in non-metric MDS is the use of only rank order information in a (dis)similarity matrix, rather than its metric information. The intention behind nonmetric methods is to replace the strong and problematic assumption of linearity (of species response curves to underlying community gradients) made by PCA, for example, with an asssumption of monotonicity (Gauch 1982). By assuming monotonicity nonmetric MDS is not able to handle unimodal (Gaussian) species response curves as these are not monotonous (Gauch 1982).

Principal component analysis (PCA)

PCA relates to a linear response model in which the abundance of any species either increases or decreases with the value of each of the theoretical environmental variables. A linear response model may be a reasonable basis for analysing quantitative abundance data spanning a narrow range of environmental variation (Ter Braak & Prentice 1988). PCA can be considered to be an extension of fitting straight lines by least-squares regression. For example, assume that depth is a major factor for the distribution of species. From a linear least-squares regression of the abundance of each species against the depth, the residual sum of squares, i.e. the sum of squared vertical distances between the observed abundance values and the fitted line, is a measure of how well depth explains the data of a single species. To measure how well depth explains the data of all species the total residual sum of squares is calculated (i.e. the total of the separate residual sums of squares over all species). If the total residual sum of squares is small then it is considered that depth explains the variance in the data well.

Instead of using a known variable, such as depth, PCA constructs a theoretical variable that minimizes the total residual sum of squares after fitting straight lines to the species data. PCA does so by choosing best values for the samples, the sample scores. The theoretical variable that best explains the variance in the species data is the first PCA axis.

The score of species in PCA is the slope of the line fitted for the species against the PCA axis (Jongman *et al.* 1987, figure 5.11). A positive species score thus means that the abundance increases along the axis; a negative score means that the abundance decreases along the axis and a score near 0 means that the abundance is poorly related to the axis. If a single variable cannot explain the species data sufficiently well more axes can be extracted, but they are subjected to the constraint of being uncorrelated with previous PCA axes. In practice only the first and the second PCA axes are taken into account as higher numbered PCA axes only explain a small proportion of variance in the species data.

Sample points projected into the first two dimensions of a PCA ordination often show an arch effect. The second PCA axis in this case does not convey meaningful or independent information: it is merely a quadratic distortion of the valid first PCA axis, due to a mismatch between the community model (Gaussian response curves) and the underlying model of PCA where PCA assumes that variables (here, species abundance) change linearly along an underlying gradient (Gauch 1982).

(Detrended) Correspondence Analysis (CA/DCA)

The concept of CA is different from the PCA. While PCA is related to a linear response model CA, is related, though in a less unequivocal way, to an unimodal response model (Jongman *et al.* 1987 p 93). In order to develop a measure of how well a factor such as depth explains species data the following procedure is carried out. A measure of where along a depth gradient a species occurs is obtained by taking the average of the depth value of the samples (= stations) where the species is present. The average is called the species score. The procedure is repeated for all species. As a measure of how well depth explains the species data dispersion of the species scores on a "depth axis" is used. If the dispersion is large, depth explains the species data well. If the dispersion is small, then depth explains less.

As in PCA, CA constructs a theoretical variable that best explains the species data. CA does so by choosing the best values for the samples, i.e. values that maximize the dispersion of the species scores. The theoretical variable is the first CA axis. A second and further CA axes can also be constructed, but subject to the constraint of being uncorrelated with previous axes to ensure that new information is expressed on the later axes.

CA has two major drawbacks: 1) the ends of the axes are often compressed relative to their central area 2) the second axis frequently shows a systematic, often quadratic relation with the first axis, the arch effect. In Detrended Correspondence Analysis (DCA) the two faults are corrected by detrending and rescaling of the axis (Hill 1979b, Gauch 1982, Jongman *et al.* 1987). I therefore used DCA. The scaling of the axes in DCA moreover has the advantage of being similar from data set to data set which allows comparison of ordination results from different data sets (Gauch 1982). While some authors, thus, recommend the use of DCA rather than CA, others warn the user to be careful with the use of detrending (Raffaelli *et al.* 1991).

Canonical ordination (CCA)

Canonical ordination also constructs axes of variation in overall community composition, but does so in such a way as to optimize explicitly the fit to the environmental data supplied (Ter Braak & Prentice 1988). Only the canonical form of CA will be presented here. For a presentation and discussion of the canonical form of PCA see Jongman *et al.* (1987) and Ter Braak & Prentice (1988).

Canonical correspondence analysis (CCA) is the technique that selects the linear combination of environmental variables, that maximizes the dispersion of the species scores. In other words, CCA chooses the best weights for the environmental variables. This gives the first CCA axis. The second and further CCA axes also select linear combinations of environmental variables that maximize the dispersion of the species scores, but are subjected to the constraint of being uncorrelated with previous CCA axes. As many axes can be extracted as there are environmental variables. Like CA, CCA is influenced by the edge effect and the arch effect. The edge effect is a minor problem and is best left untreated (Ter Braak & Prentice 1988). The arch effect can be removed by detrending but can be eliminated more elegantly by dropping superfluous environmental variables. If the number of environmental variables is small enough for the relationship of individual variables to the ordination axes to be significant, the arch effect is not likely to occur at all (Jongman *et al.* 1987, Ter Braak & Prentice 1988).

Non-metric Multidimensional Scaling (MDS)

Non-metric Multidimensional Scaling is based on a (dis)similarity matrix between samples constructed from the sample/species matrix on species abundance (or biomass) data usually employing the Bray-Curtis similarity measure. The Bray-Curtis index is not affected by joint absence (Clarke 1993), like PCA and CA, which means that the similarity between two samples is not dependant on those species that are absent from both. Bray-Curtis gives more weight to an abundant species (in comparing samples) than to rare ones (Field *et al.* 1982). This can be altered by transformation of the data.

The level of similarity between two samples has no particular meaning and care should be taken in defining similarity to reflect biological reality (Clark 1993). The *absolute* levels of similarity among samples depends markedly on the chosen similarity coefficient and transformation (typically Bray-Curtis similarities will tend to increase with increasing severity of transformation). It is the *relative* levels which have a straightforward interpretation, particularly the ranks of the similarity matrix, which summarize the data through statements such as "sample A is more similar to sample B than it is to sample C" (Clark 1993).

MDS attemps to construct a "map" of samples in which the more similar two samples are in terms of species abundances (or biomass) the nearer they are to each other on the "map". The extent to which the relations can be adequately represented in a 2-dimensional map is summarised by a "stress-coefficient" (Gray *et al.* 1988). If stress is large the "map" tallies poorly with the observed dissimilarities; conversely, low stress indicates that the sample relationships can be well represented by a station "map" in the specified dimensionality (Field *et al.* 1982). Clark (1993) gives a rule-of-thumb suggestion for stress level. The guidelines are, however, oversimplistic. For example, stress tends to increase with increasing number of samples. Like PCA and CA MDS suffer from arch distortion.

MDS plots of samples can be interpreted in terms of environmental varibles by superimposing the values for one variable at a time on the MDS plot (Field *et al.* 1982). This graphic technique has the limitation of relating only *one* environmental variable at a time to the biotic ordination. Clarke & Ainsworth (1993) suggest a new method to compare separate sample ordinations (MDS) from biotic and abiotic variables and choose that subset of environmental varibles which "best explains" the biotic structure.

Classification techniques

In general, classification or cluster analysis is based on the idea that community types exist, and that each can be characterized by characteristic species combinations. Even if there is a continuous structure in the data, classsification may impose a group structure: a contiuum is then arbitrarily partitioned into a discontinuous system of classes (or types) (Jongman *et al.* 1987). For the purpose of describing community types classification techniques thus attempt to form groups of samples in such a way that the community-composititon of sites varies most between groups and varies least within groups. A large number of classification techniques exist. For a presentation and discussion of the different methods see Gauch (1982) and Jongman *et al.* (1987). I chose to use the method of TWINSPAN, because it not only classifies the samples, but uses this classification to obtain a classification of the species according to their ecological preferences (Hill 1979a).

TWINSPAN

One of the basic ideas in TWINSPAN is that each group of samples can be characterized by a group of differential species (Jongman *et al.* 1987). A differential species is one with clear ecological preferences, so that its presence can be used to identify particular environmental conditions (Hill 1979a). Since the idea of a differential species is essentially qualitative, quantitative data must be transformed to qualitative data. This is done by means of pseudo-species, where each species abundance is replaced by the presence of one or more pseudo-species. To determine the correspondence between abundance and pseudo-species "cut levels" are introduced. The default cut levels for the pseudospecies in the TWINSPAN programme are 0, 2, 5, 10, 20 (Hill 1979a). This means that for example an abundance of 6 *Abra alba* per sample will result in 3 pseudo-species, because it exceeds the first three levels (0, 2, 5), while 16 *Abra alba* wil result in 4 pseudospecies.

The TWINSPAN programme first ordinates the data by means of correspondence analysis and the stations are divided into two clusters (Hill 1979a). The division process is then repeated on the two station subsets to give four clusters, and so on, until each cluster is reduced to a chosen minimum number of members. After completing the station classification, the species are classified in the light of the station classification. The classification is based on fidelity i.e. the degree to which species are confined to particular groups of stations (see Hill 1979a).

Transformation of raw data

Samples generally consist of a few abundant species and a large number of more or less rare species. Biomass data are likewise very often dominated by a few large species/specimens. This makes density and biomass data very skewed and it is often advisable to transform the raw data (Field *et al.* 1982).
The transformation sequence of $y^{0.5}$, $y^{0.25}$, log(y) and ultimately simple presence/absence, allows progressively greater contribution from the rarer species (Clark & Green 1988). Logarithmic transformations are widely used but have some drawbacks in multivariate analyses. Because of the many zeroes in species data log(y+c) is used instead of log(y). For species data c is set to 1 but this is not satisfactory when y is, for example, species biomass. Log(y+0.001) or log(y+0.0001) can be used instead but there is a degree of arbitrariness in the choice (Clarke & Green 1988). In CA and DCA negative values are not acceptable which means that log(y+c) must be > 0 (Ter Braak 1988). As the transformations $y^{0.5}$ and $y^{0.25}$ (=single and double-square-root transformations) do not suffer from the problems mentioned above many authors prefer to use them instead of logarithmic transformations (Field *et al.* 1982, Clarke & Green 1988, Austen 1991, Warwick & Clarke 1991). According to Clarke & Green (1988) double-square-root transformation and log(y+c) are rarely distinguishable in practice.

Methods

The multivariate analysis were performed on abundance data from Fornæs from the whole sampling period 1986-1990. For Århus Bay multivariate analyses were only applied to abundance data from the period where the Haps core sampler had been used, namely 1989-1991 (see chapter 3).

Principal Component Analysis

The computer programme CANOCO (version 3.10) was used to carry out Principal Component Analyses, PCA, on a correlation matrix. The programme contains a number of options for scaling and centring/standardization the data (Ter Braak 1988). I used the Euclidian distances in scaling the ordination axes, which is optimal for interpreting distance between samples (Jongman *et al.* 1987 p 129, Ter Braak 1990) and the option centring and standardization (Ter Braak 1988). The PCA's were carried out on untransformed data and log(y+1) transformed data as root-root transformation is not available in the CANOCO package.

Detrended Correspondence Analysis

CANOCO (version 3.10) was also used to carry out Detrended Correspondence Analysis, DCA. There are two options for detrending in the programme "detrending-by-segment" and "detrending-by-polynominals". Detrending-by-segment was chosen because this method has been shown to perform consistently better than detrending-by-polynomials (Ter Braak

1990). Default values for the number of segments (26), the number of rescalings to be done (4) and the rescaling threshold (0.0) were used in the analysis. The analysis was thus similar to DECORANA (Hill 1979b). The DCA's were carried out on untransformed and log(y+1) transformed data. The DCA-programme contains an option to downweight rare species in proportion to their frequency. Samples with rare species may distort the analysis and it may be desired to give rare species less weight while still retaining them in the analysis (Hill 1979b). Downweighting was used in some of the analyses (see below).

Canonical Correspondence Analysis

Canonical Correspondence Analysis, CCA, is also included in CANOCO (version 3.10). The analyses were only carried out on untransformed data. The following environmental variables were included in the analyses: Depth, "distance to outlet", organic content of the sediment and additionally for Århus Bay the percentage of silt-clay and the C/N-ratio.

Non-metric Multidimensional Scaling

The programme PRIMER (Plymouth Routines in Multivariate Ecological Research) was used to perform non-metric MDS. The Bray-Curtis coefficient (Field *et al.*, 1982) was used as a measure of similarity between samples. Application of the measure of similarity results in a triangular matrix whose entries compare each sample with every other sample. In order to assess the similarity between samples a dendrogram can be made from the matrix. Dendrograms were constructed using group-average sorting which joins 2 groups of samples together at the average level of similarity between all members of one group and all members of the other.

Instead of a classification of the samples, sample inter-relationships can be "mapped" in an ordination by non-metric MDS. To construct the "map" of samples MDS starts with an initially arbitrary configuration of samples. This is successively refined (by iteration of the MDS algorithm) until the stress function reach a minimum. To make sure that the minimum is the global minimum and not a local one Clark (1993) advises a repetition of the iterative process 8 or 9 times. If the same (lowest) stress value, to three decimal places, is achieved in several of the repetitions, the configurations are almost always identical and the global minimum has been reached. I used 19 random starting configurations in order to find the global minimum.

Non-metric MDS was performed on both transformed and untransformed data. Data from Århus Bay underwent double root transformation while the data from Fornæs only were single root transformed.

Values of environmental variables were superimposed on the MDS plots using the programme CONPLOT (from the PRIMER package).

TWINSPAN

The microcomputer version of TWINSPAN (Hill 1979a) from Cornell Ecological Programs was used to analyse the data. The following cut-levels were used for the Århus Bay data: 0, 24, 60, 120, 240 because the data were entered as abundance per m^2 and the lowest abundance was 12. At Fornæs the lowest abundance was 10 (per m^2) and the cut-levels chosen were: 0, 20, 50, 100, 200. The number of species printed in the two-way tables was reduced to the 30 commonest species instead of the default 100.

Results, Århus Bay

Principal Component Analysis

The percentages of variation accounted for by the first and second PCA axis is given in table 6.1. The 1st axis accounted for a slightly higher percentage of the variation than the 2nd axis. The percentages may seem low but there is no tight relationship between the percentages accounted for and the ecological value of the result, so an assessment of the results must be in terms of the ecological insight afforded (Gauch 1982). The percentage of variation accounted for by the 1st axis is higher for log transformed data than untransformed data while the opposite is true for the 2nd axis apart from 1991.

Untransformed data	1989	1990	1991	1989-1991
Axis 1	17.4	18.8	19.6	9.1
Axis 2	16.1	11.6	17.6	8.3
Log-transformed data	1989	1990	1991	1989-1991
Axis 1	20.3	21.3	19.8	10.5
Axis 2	15.0	11.2	17.9	8.1

Table 6.1
The percentage of variation in the species data accounted for by the 1st and 2nd PCA axis for untransformed and log-transformed data.

The PCA diagrams for untransformed abundance data are shown on figure 6.1. Sampling stations which were near each other geographically (figure 3.2) were also close in the PCA diagram for 1989. Stns. 51 and 64 near the sewage outlet were close together and the stations south and east of the outlet (stns. 29, 71, 77, 84, 91) formed a cluster. The two southermost stations (stns. 97 and 103) were also close to each other. The stations in the central and eastern part of the bay were relatively dispersed but still in the same quadrant.

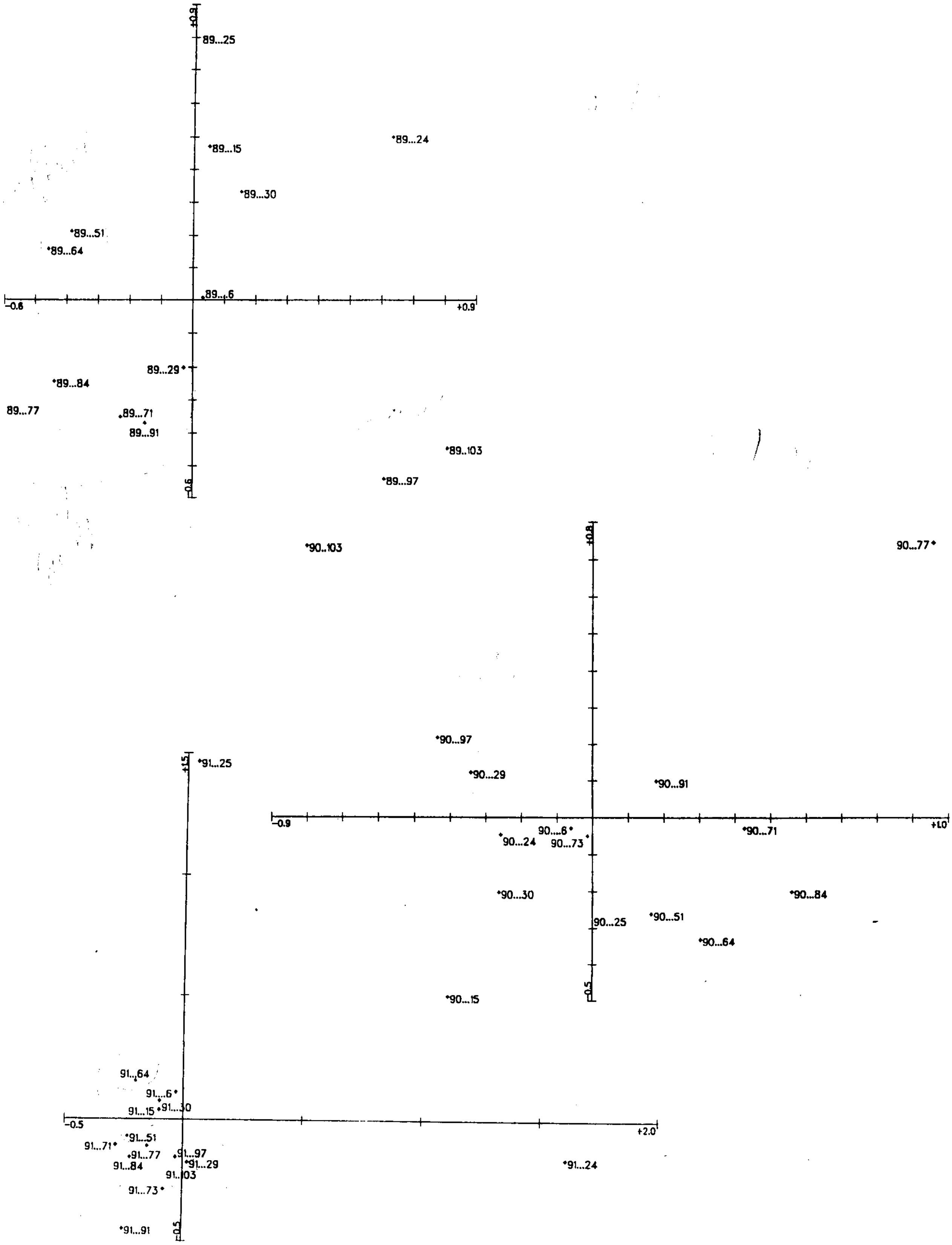


Figure 6.1
PCA ordination diagrams based on untransformed abundance data from Århus Bay 1989, 1990 and 1991.

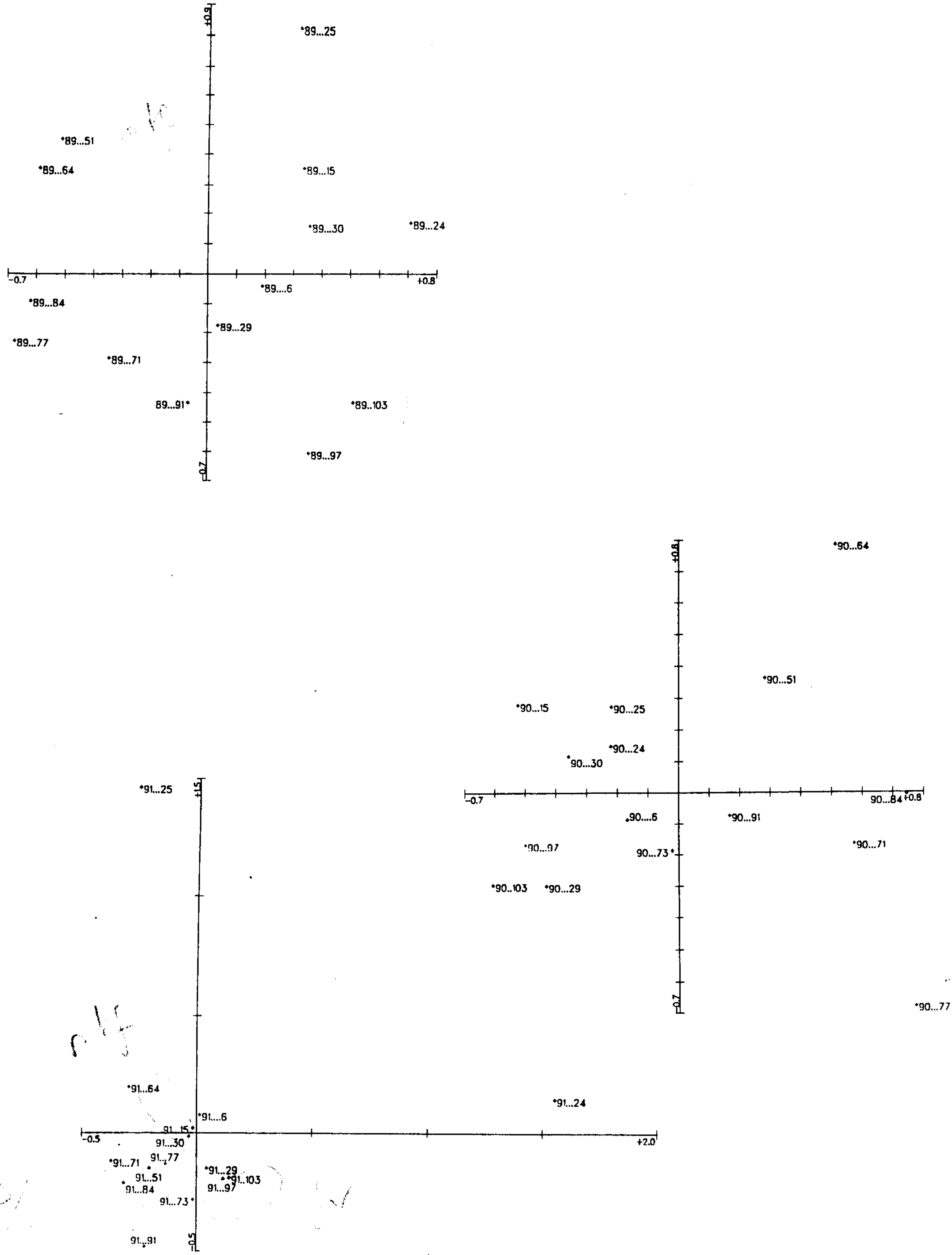


Figure 6.2
PCA ordination diagrams based on log-transformed abundance data from Århus Bay 1989, 1990 and 1991.

In 1990 the stations furthest from the outlet were found in the left part of the diagram while stations nearest to the outlet were found to the right. Stations 77 and 103 were far away from the other stations. In 1991 the majority of stations were clumped together in the diagram apart from stns. 24 and 25.

PCA applied to log-transformed abundance data gave results similar to PCA on untransformed data for 1989 and 1991 (figure 6.2) while 1990 was different. PCA carried out on data from all 3 years together failed to show any dispersion of the sampling stations (not shown).

Detrended Correspondence Analysis

The percentages of variation accounted for by the first and second DCA axis is given in table 6.2.

Untransformed data	1989	1990	1991	1991 DW	1989-1991
Axis 1	37.6	33.5	30.8	30.4	19.9
Axis 2	6.5	7.8	18.5	17.5	9.0
Log-transformed data	1989	1990	1991		1989-1991
Axis 1	19.9	20.0	18.5		9.7
Axis 2	7.9	8.2	10.7		4.8

Table 6.2
The percentage of variation in the species data accounted for by the 1st and 2nd DCA axis for untransformed and log-transformed data.
DW = the precentage of variation after downweighting of rare species.

For untransformed abundance data the 1st DCA axis explained a fairly high percentage of the variance in the species data while the 2nd axis accounts for a relatively low percentage. For log-transformed abundance data the precentage of variation accounted for by the 1st axis is much less than for untransformed data. Because species data rarely are consistent, an ordination axis that explains only a low percentage may still be quite informative (Ter Braak 1990).

Downweighting of rare species only had a negligible impact on the results in 1989, 1990 and the three years together but had some influence on the results in 1991. The result of DCA without downweighting are shown on figure 6.3 a-c and with downweighting in 1991 in on figure 6.3 d. In 1989 stns. 51 and 64, closest to the sewage discharge, were far away from the other stations (figure 6.3 a). The rest of the stations were ordered in accordance with their distance to the outlet. Stations 71, 77 and 84, were found to the right in the diagram followed by stns. 29, 91, 97 and 103 while stations in the central and eastern part of the bay (stns. 6, 15, 24, 25 and 30) were found to the left. After the reduction in discharge at the beginning of 1990 stn. 64 and especially stn. 51 came closer to the other stations (figure 6.3 b) while the grouping of the remaining stations were very similar to 1989. The stations were much closer in 1991 than in the previous two years (figure 6.3 c) apart from stns. 24 and 25. These stations differed from the remaining stations by having a low number of *Mysella bidentata* and *Abra alba* and a high number of *Prionospio fallax* and various rare species not occurring elsewhere in the bay. By downweighting the rare species in 1991 the stations became more dispersed, as differences in abundance of frequent species became more important. Stns. 6, 15, 29, 30, 73, 97 and 103 were still very close after downweighting (figure 6.3 d) and stns. 64, 71, 77, 84 and 91 south of the outlet could also be grouped while stn. 51 was found between the two groups. Stns. 24 and 25 came close together by the downweighting of rare species but remained far from the other stations.

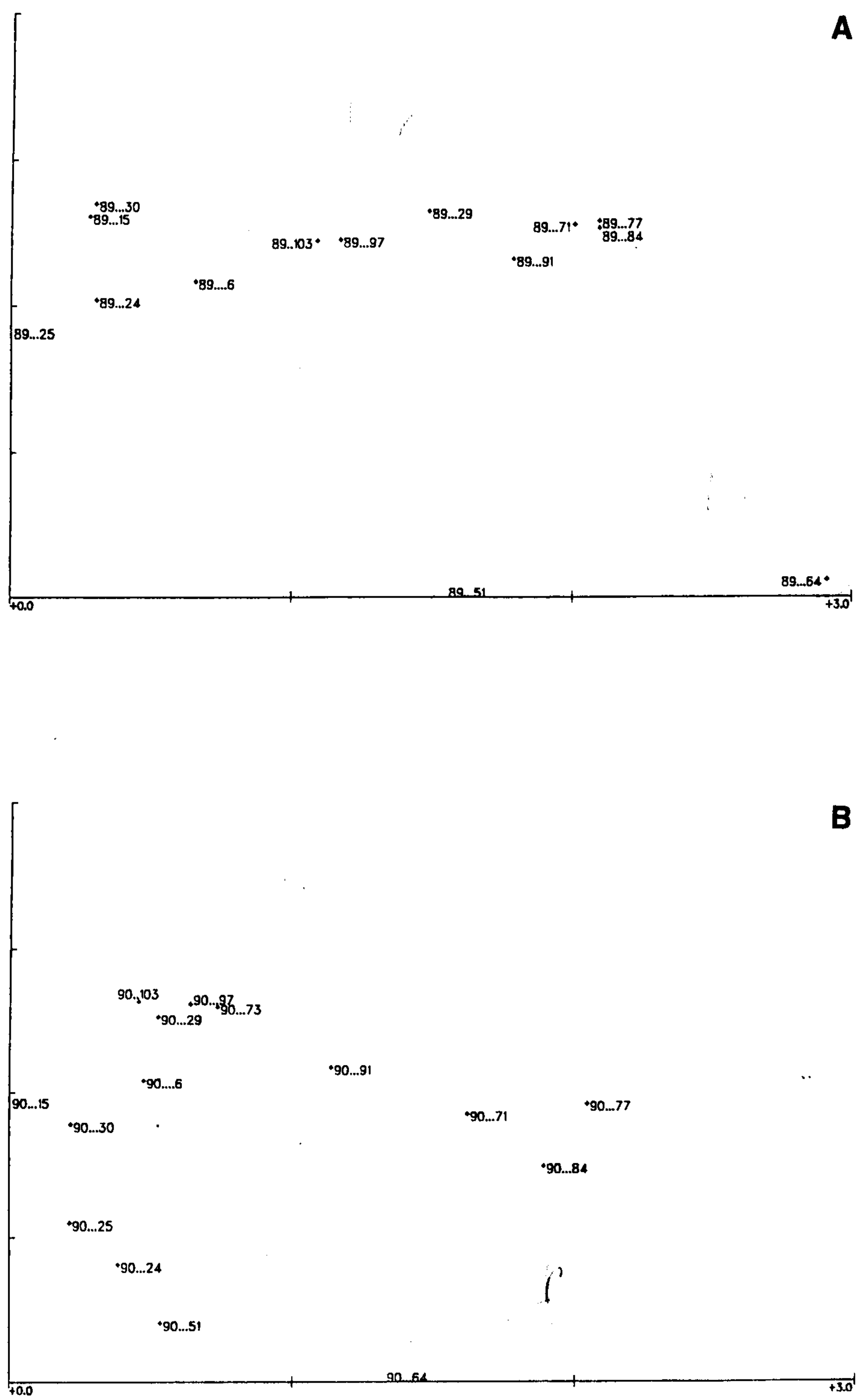


Figure 6.3 a-b
(a-b) DCA ordination diagrams based on untransformed abundance data from Århus Bay 1989 and 1990.

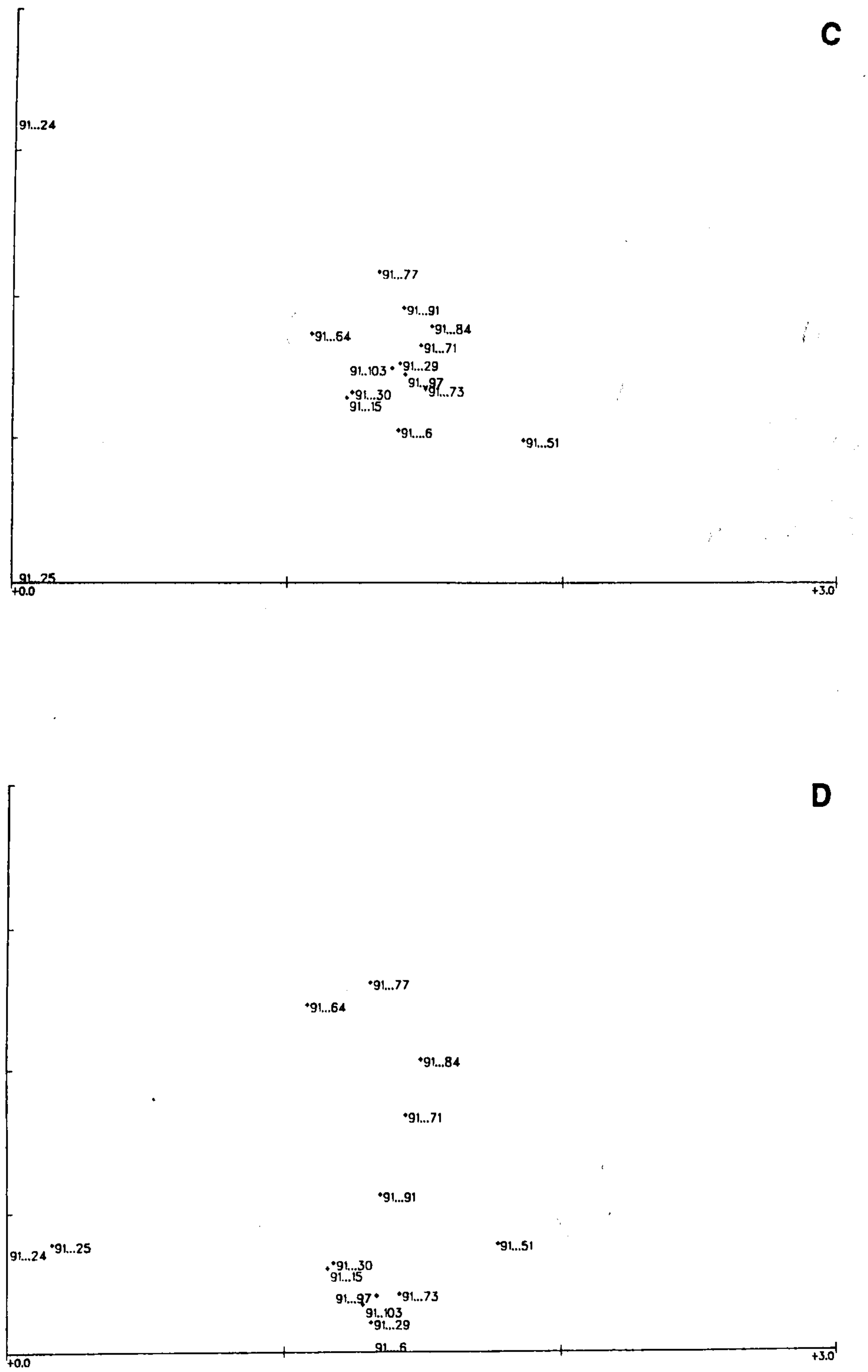


Figure 6.3 c-d
(c) DCA ordination diagrams based on untransformed abundance data from Århus Bay 1991. (d) DCA ordination diagrams based on untransformed abundance data with downweighting of rare species in 1991.

The result of DCA for the 3 years analysed together (untransformed data) are shown in figure 6.4. The DCA diagram shows that there was a cluster including stns. 15, 24, 25 and 30 from all 3 years and another cluster of stns. 29, 73, 91, 97, 103 and 6 (apart from 1989). Stns. 71, 77 and 84 occurred together each year but at different positions in the diagram. Station 64 in 1989 was far away from the other stations.

The analyses of the 3 years separately and together showed very similar results. Stations near to each other geographically formed clusters. Although the same clusters could be recognized in each diagram from 1989 to 1991 the distance between stations showed that some changes had taken place. Stns. 51 and 64 became gradually more like the other stations. In 1991 stns. 24 and 25 were different from the other stations which on the other hand were close together. Figure 6.4 shows that in the analysis of the 3 years together the stations closest to the outlet (stns. 51, 64, 71, 77, 84) changed position in the diagram from year to year while the positions of other stations remained almost the same throughout the period.

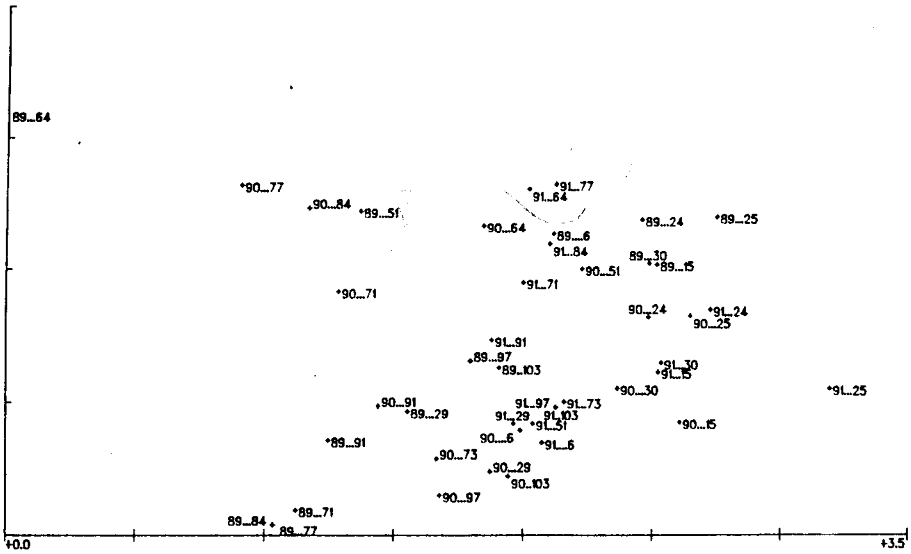


Figure 6.4
DCA ordination diagram based on untransformed abundance data from Århus Bay 1989, 1990 and 1991 together.

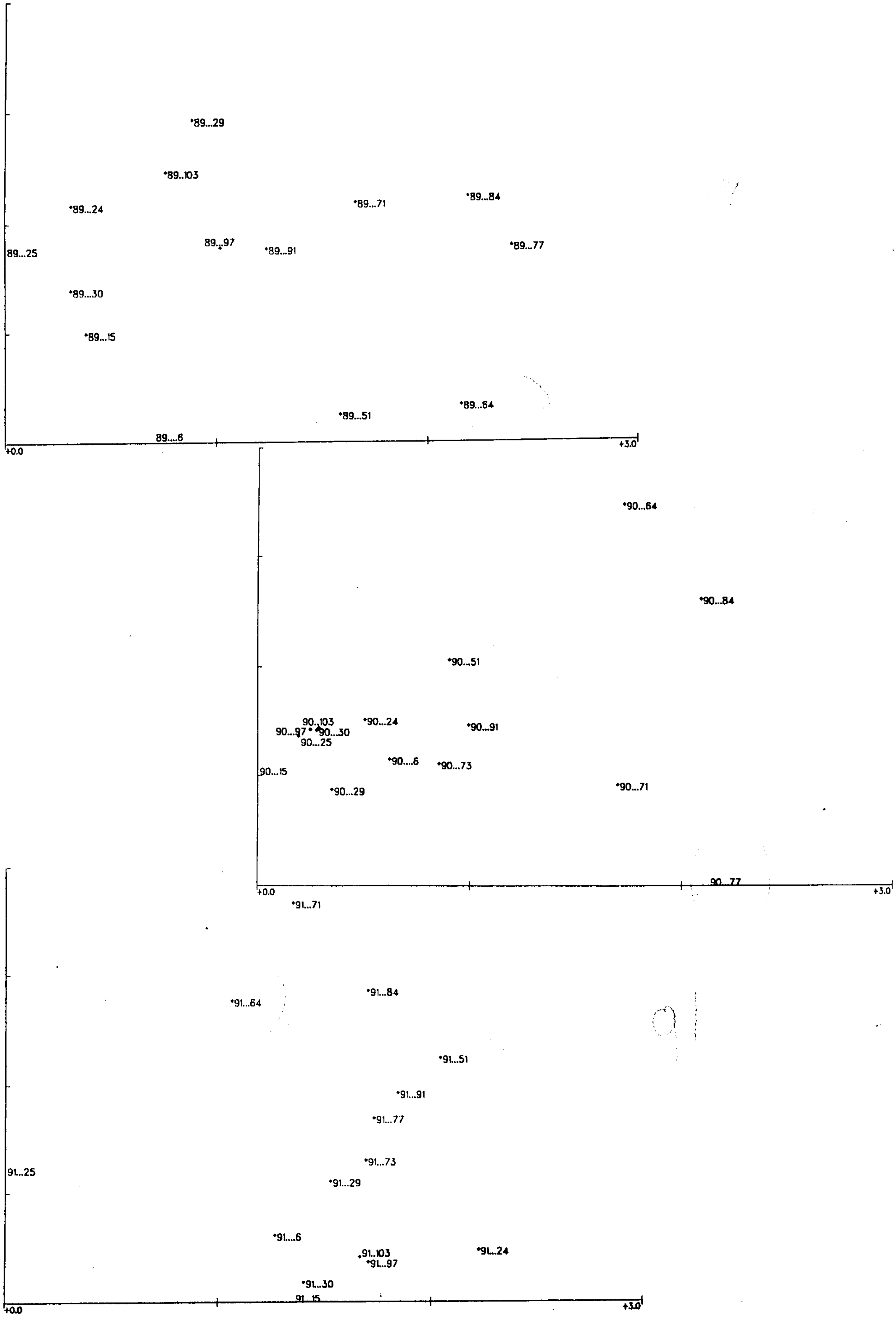


Figure 6.5
DCA ordination diagrams based on log-transformed abundance data from Århus Bay 1989, 1990 and 1991.

The results of the DCA on log-transformed data are shown in figure 6.5. The ordinations of stations based on log-transformed data were similar to the one based on untransformed data in 1989 although the samples were more dispersed in relation to the 2nd axis. In 1990 the majority of stations occurred in one group apart from the stations just south of the outlet (stns. 64, 71, 77 and 84). Station 84 was much nearer to stn. 64 in the diagram than one would expect from the species list. In 1991 stations were more dispersed when DCA were applied to log-transformed data than to untransformed data.

Canonical Correspondence Analysis

Canonical Correspondence Analysis was only carried out on untransformed abundance data. The CANOCO program standardizes the environmental variables to a mean of 0 and a variance 1 before the analysis to remove arbitrariness in the unit of measurement of the environmental variables and to make the canonical coefficients comparable to one another (Jongman *et al.* 1987 p 150). The canonical coefficients define the ordination axes as linear combinations of the environmental variables. The intra-set correlations give the correlation coefficients between the environmental variables and these ordination axes (Jongman *et al.* 1987 p 150).

The intra-set correlation coefficients are given in table 6.3 for the first two canonical axes. The intra-set correlations from 1989 show that distance and depth were highly correlated with axis 1. The ordination diagram of the first two axes is shown in figure 6.6. Environmental variables with long arrows are more strongly correlated with the ordination axes than those with short arrows and therefore more closely related to the pattern of variation in species composition shown in the ordination diagram. In 1990 distance was

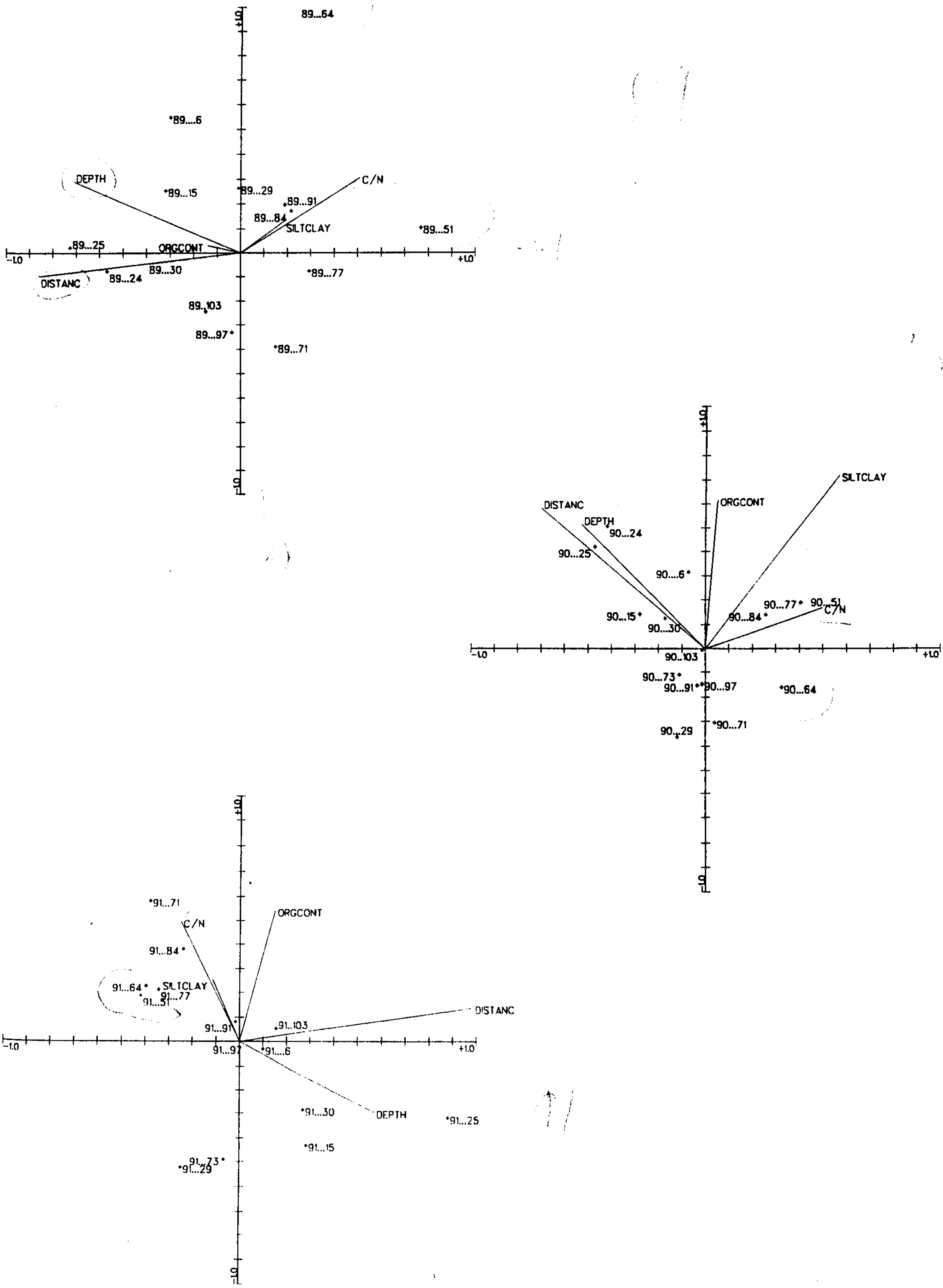


Figure 6.6
CCA ordination diagram based on untransformed abundance data from Århus Bay 1989, 1990 and 1991 and the environmental variables: distance to outlet, depth, organic content, silt-clay % and C/N-ratio.

highly negative correlated with axis 1 (table 6.4) while the correlation between depth and the 1st axis was less than in 1989. There was a fairly high correlation between the 2nd axis and organic content and silt-clay%. The ordination diagram is shown in figure 6.6.

Environmental variables	Canonical axes	
	Axis 1	Axis 2
Distance	-0.8605	-0.0981
Depth	-0.7113	0.2895
Organic content	-0.1399	0.0299
Silt-clay %	0.1846	0.1291
C/N-ratio	0.5083	0.3059

Table 6.3
Intra-set correlations between environmental variables and the first two canonical axes 1989.

Environmental variables	Canonical axes	
	Axis 1	Axis 2
Distance	-0.7014	0.5823
Depth	-0.5283	0.5133
Organic content	0,0523	0.6151
Silt-clay %	0,5673	0.7193
C/N-ratio	0.4983	0.1683

Table 6.4
Intra-set correlations between environmental variables and the first two canonical axes 1990.

In 1991 distance was again highly correlated with the 1st axis (table 6.5, figure 6.6). Depth was also correlated with the 1st axis and organic content with the 2nd axis.

Environmental variables	Canonical axes	
	Axis 1	Axis 2
Distance	0.9874	0.1365
Depth	0.5716	-0.2973
Organic content	0.1479	0.5419
Silt-clay %	-0.1138	0.2537
C/N-ratio	-0.2492	0.4937

Table 6.5
Intra-set correlations between environmental variables and the first two canonical axes 1991.

Table 6.6 shows the percentage of variation accounted for by the 1st and 2nd CCA axes. The precentages in table 6.6 for the 1st axes are lower than than the percentages in table 6.2 because the environmental variables cannot explain all the variation in the species compostion extracted by DCA. The environmental variables explained, however, the main variation in the species composition. The most important of the environmental variables measured were "distance from outlet" and "depth". The percentages in table 6.6 for the 2nd axes are higher in 1989 and 1990 than in table 6.2. Mortensen & Høisæter (1993) made the same observation but did not explain the phenomenon. Jongman *et al.* (1987) states that "the eigenvalue in CCA (from which the percentages af variation are calculated) are *usually* smaller than the CA because of the restrictions imposed on the site scores in CCA". As the 1st axes are far the most important it is probably best to focus on the correlation between these axes and the envionmental variables for the Århus Bay data sets.

	1989	1990	1991	1989-1991
Axis 1	32.2	16.7	25.1	14.7
Axis 2	3.7	6.9	9.6	2.9

Table 6.6
The percentage of variation in the species data accounted for by the 1st and 2nd CCA axis.

Non-metric Multidimensional Scaling

Dendrograms showning group average clustering of Bray-Curtis similarities based on untransformed and root-root transformed abundance data from Århus Bay 1989-1991 are given in appendix 6.1. For the untransformed data there was a high similarity between some of the stations because one or two bivalves occurred in very high numbers at these stations. When the effect of numerically dominant species was dampened by a root-root transformation the result was a lower similarity between samples. The similarity between clusters on the other hand was lower for untransformed data than for transformed data. The dendrograms for the 3 years together showed the same pattern (appendix 6.2). The untransformed data had a higher within cluster similarity but a lower between cluster similarity than the root-root transformed data.

The non-metric MDS ordinations of the untransformed and root-root transformed data from Århus Bay 1989-1991 are shown in figure 6.7. The ordinations were fairly similar for transformed and untransformed data during the 3 years. In 1989 the stations nearest the outlet (stns. 51 and 64) were separated from the rest of the stations (figure 6.7). The stations south of the outlet, stns. 71, 77, 84 and 91 formed a cluster which was near the cluster containing stns. 97 and 103 furthest south and stn. 29 east of the outlet. The

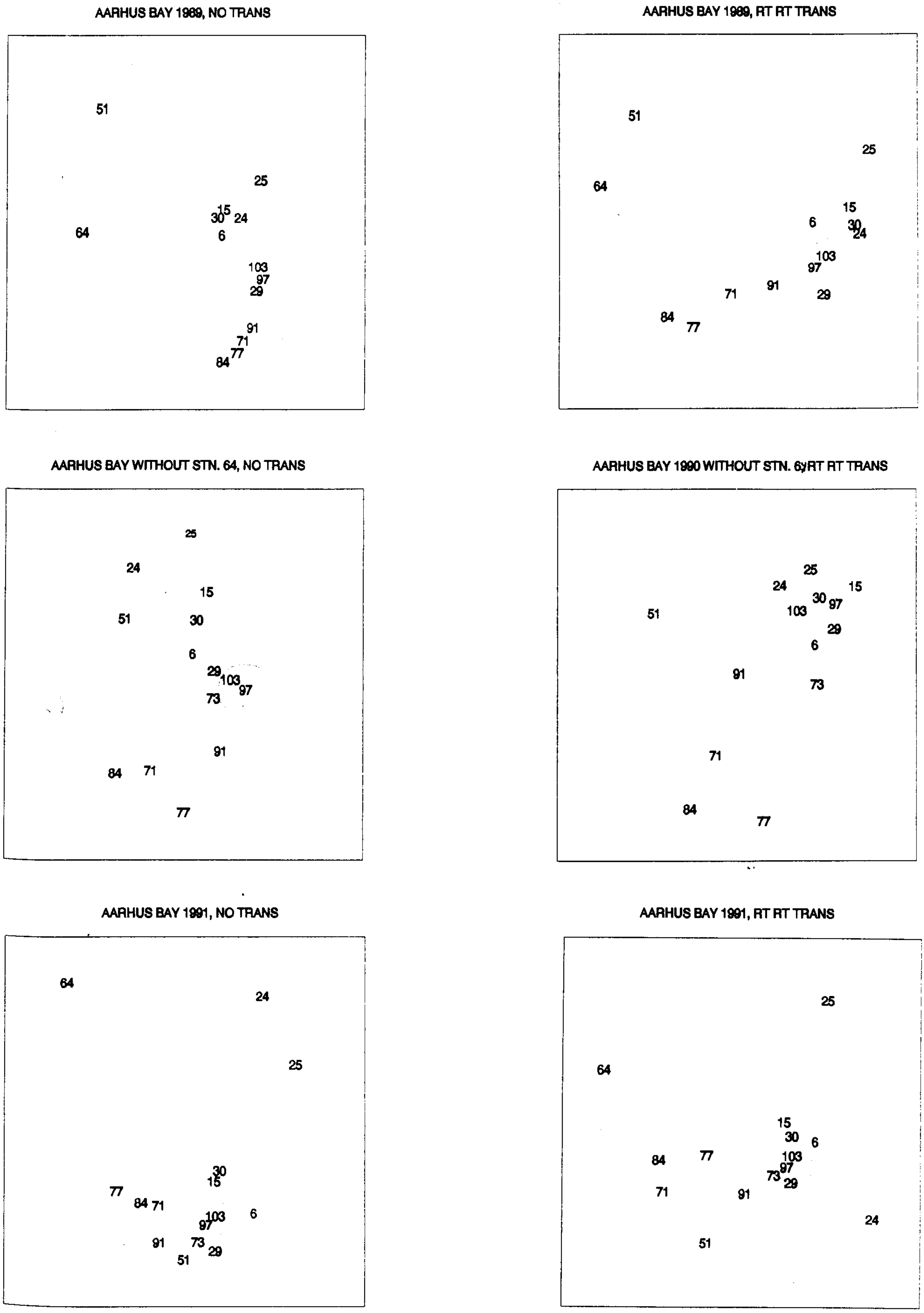


Figure 6.7
Non-metric MDS of untransformed and root root transformed abundance data from Århus Bay 1989, 1990 and 1991. Stn. 64 omitted from the ordination in 1990.

stations in the the central and eastern part of the bay were grouped in a cluster. Station 64 had to be omitted from the ordination in 1990 because it was so different from all the other stations that they ended up in one clump. In the ordination of 1990 data without stn. 64 the stns. 71, 77 and 84 again formed a cluster and stn. 91 created a transition to the rest of the stations (figure 6.7). Station 51 was separated from the other stations. In 1991 stn. 51 was part of the cluster containing stns. 71, 77, 84, and 91 (figure 6.7). Station 64 was still different from the other stations. Stations 24 and 25 were separated from the stations they normally cluster with, due to a relatively low number of *Mysella bidentata* and *Abra alba* and a high number of *Prionospio fallax* and a number of rare species only occurring at these stations. Root-root transformation of the data had the same effect on the distance between stns. 24 and 25 as log-transformation had in DCA. When the rare species were emphasized the distance between the two stations increased.

The MDS ordinations (untransformed and root-root transformed abundance data) of the 3 years together are given in appendix 6.3. Station 64 was very different from all the other stations in 1989 and 1990 but approached them in 1991. Station 51 was only different in 1989. After the reduction in discharge of organic matter at the beginning of 1990 stn. 51 was no longer an outlier.

To assess how well the MDS ordinate the samples the stress values are given in table 6.7. Clarke (1993) gives som rule-of-thumb for the interpretation of stress levels: Stress < 0.05 gives an excellent representation with no prospect of misintepretation. This is the case for untransformed data in 1989. Stress < 0.1 corresponds to a good ordination with no real risk of drawing false inferences. Apart from the 3 years analysed together the rest are lower than 0.1. Stress < 0.2 can still lead to a usable picture. It has to be taken into account that stress tends to increase with increasing number of samples and there are 3 times as many samples from the 3 years together as for a single year.

	1989	1990	1991	1989-1991
Untransformed	0.031	0.059	0.092	0.110
√√ transformed	0.072	0.071	0.093	0.150

Table 6.7
Stress values for the MDS for Århus Bay 1989, 1990, 1991 and the three years together.

The MDS plots of stations were interpreted in terms of environmental varibles by superimposing the values for depth, distance to outlet, organic content, the percentage of silt-clay and the C/N-ratio on the MDS plots. The environmental variables were superimposed on the MDS ordinations based on root-root transformed data to emphazise the relation between environmental variables and all species not only the dominant ones. The results are shown in figure 6.8 a-c. There is a correlation between the biotic ordination and depth, distance to outlet and C/N-ratio in all 3 years. Organic content and percentage silt-clay, on the other hand, showed no correlation with the biotic MDS plot.

TWINSPAN

The result of TWINSPAN applied to abundance data from 1989 is shown as a dendrogram and a two-way table in figure 6.9. The dendrogram shows that the 1st level of division separated the stations into two groups. One group consisted of the stations 51, 64, 71, 77, 84 which are nearest to the sewage outlet while the other group consisted of the rest. 2nd and 3rd level of division are also shown, but the ecological meaning of these divisions is doubtful.

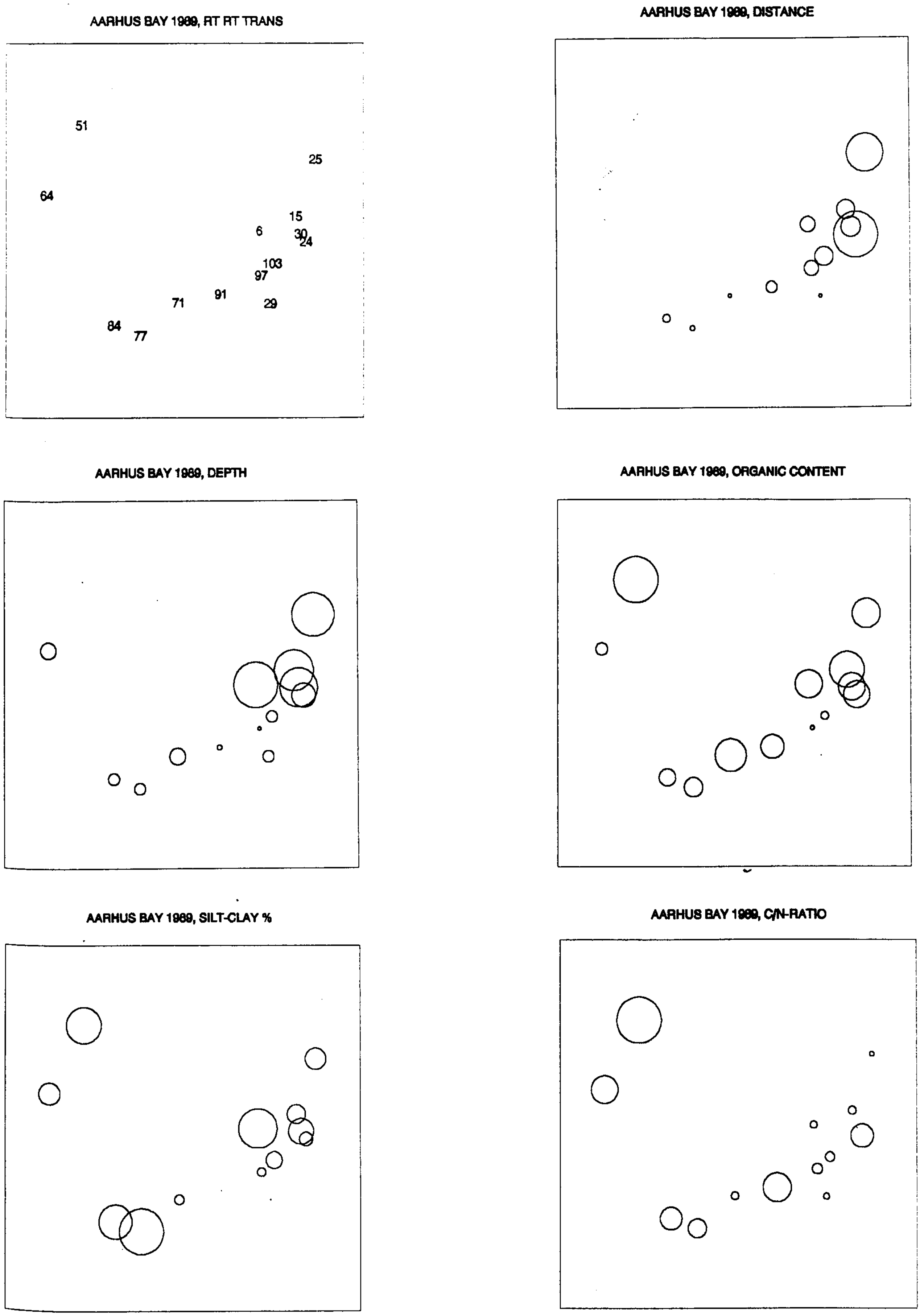


Figure 6.8 a
The environmental variables: distance to outlet, depth, organic content, silt-clay % and C/N-ratio superimposed on the MDS ordination (root root transformed data) from Århus Bay 1989. The diameter of the circles are proportional to the value of the variable.

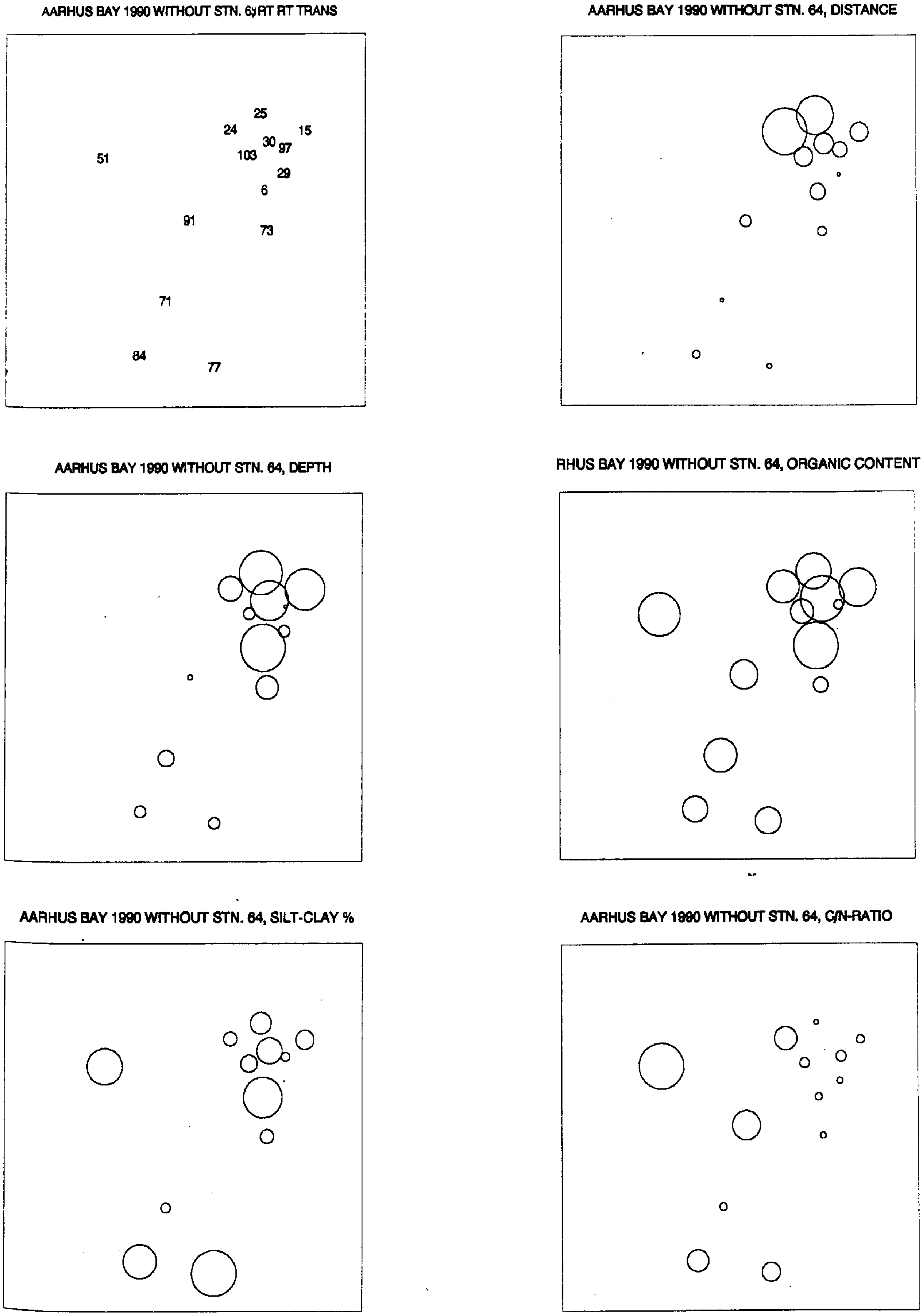


Figure 6.8 b
The environmental variables: distance to outlet, depth, organic content, silt-clay % and C/N-ratio superimposed on the MDS ordination (root root transformed data) from Århus Bay 1990. The diameter of the circles are proportional to the value of the variable.

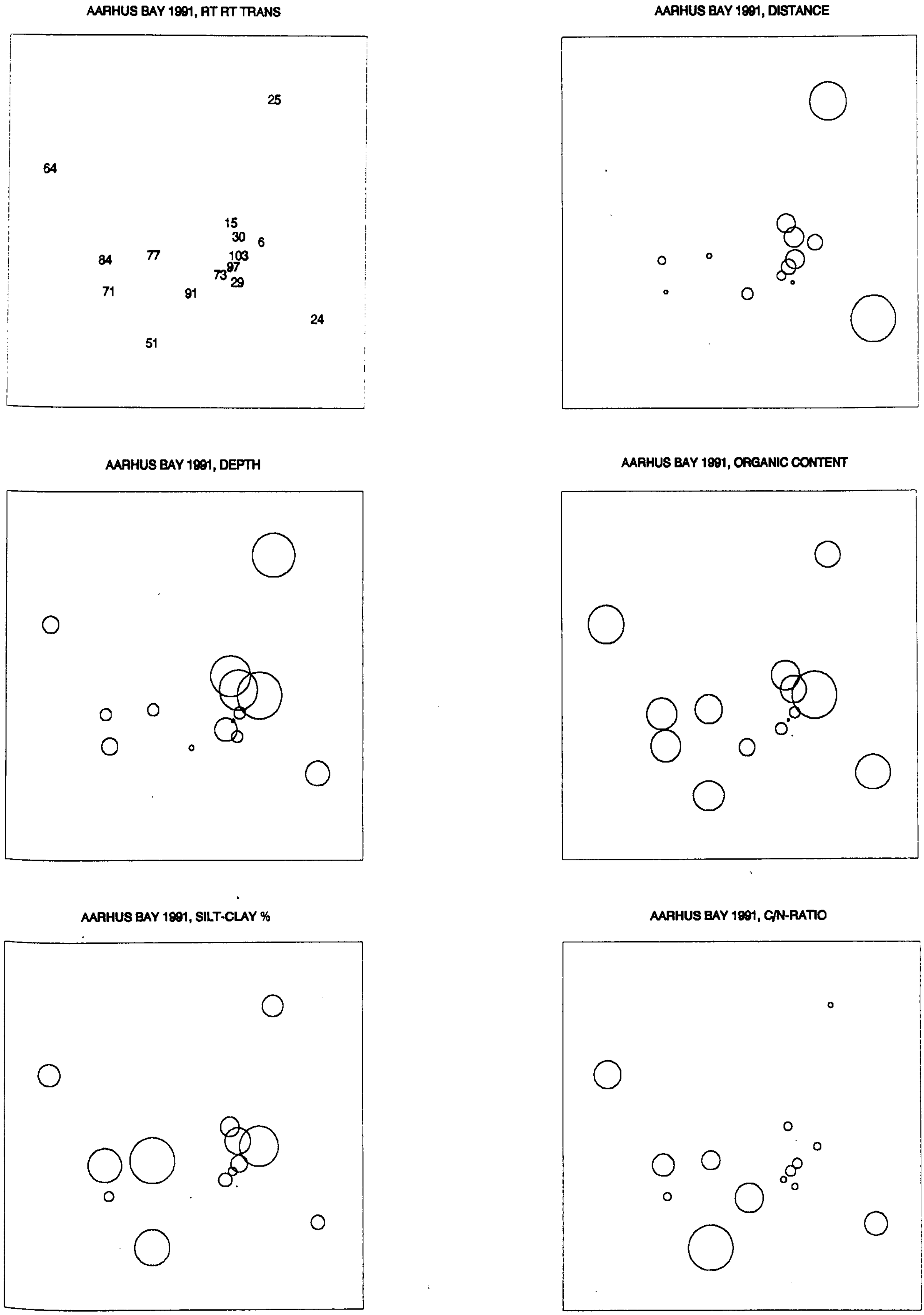
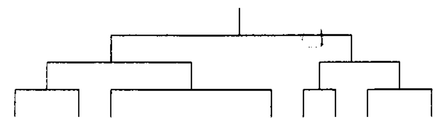
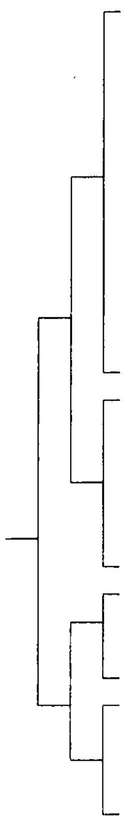


Figure 6.8 c
The environmental variables: distance to outlet, depth, organic content, silt-clay % and C/N-ratio superimposed on the MDS ordination (root root transformed data) from Århus Bay 1991. The diameter of the circles are proportional to the value of the variable.

Some species were confined to particular groups of sites (preferential species) while others occured at all stations e.g. *Mysella bidentata, Corbula gibba, Pholoe inornata* and *Phoronis mülleri*. The species that were preferential to the 5 stations near the outlet were: *Hydrobia ulva* and *Tubificoides benedeni*. These are both know to be tolerant to pollution (Pearson & Rosenberg 1978). *Abra alba, Nucula tenuis, Phaxas pellucidus, Prionospio fallax* and *Ophiura albida* were not found at the 5 most polluted stations and were thus negative

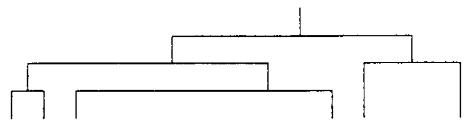




						1								
	1	2	3	2	9	0		2	9	5	7	6	7	8
	5	5	0	4	7	3	6	9	1	1	1	4	7	4
PHIL APE	-	1	1	1	-	1	-	-	-	-	-	-	-	-	0000
NUCU TEN	1	4	3	1	1	2	1	1	1	-	-	-	-	-	0000
TERE STR	4	3	3	2	2	1	1	-	-	-	-	-	-	-	0000
ARCT ISL	2	2	1	3	1	2	1	-	3	-	1	-	-	1	0001
PARV OVA	1	-	1	1	1	2	-	-	-	-	-	-	-	-	0001
ABRA ALB	5	5	5	5	5	5	5	5	5	-	-	-	-	-	0001
PHAX PEL	2	-	3	2	3	1	2	1	1	-	-	-	-	-	0001
NEPH CIL	2	1	-	2	-	1	2	-	-	-	-	-	-	-	0001
NEPH TYS	1	1	-	2	1	-	1	-	-	-	-	-	-	-	0001
ARIC SUE	-	1	1	1	2	-	1	-	1	-	-	-	-	-	0001
OPHI ALB	3	3	2	4	2	3	2	1	-	-	-	-	-	-	0001
PRIO FAL	-	1	-	1	2	2	-	3	1	-	-	-	-	-	0010
MUSC NIG	1	-	3	4	3	4	1	2	1	-	1	-	-	-	0011
SCOL ARM	2	-	1	3	3	4	1	1	-	-	-	-	-	-	0011
MACO CAL	1	-	1	-	3	4	3	2	2	1	3	-	-	-	0100
PECT KOR	2	1	1	3	4	2	1	3	3	1	2	1	2	-	0100
DIAS RAT	1	-	2	2	2	2	2	1	1	1	2	-	1	-	0100
PHOR MUE	3	1	3	2	4	4	4	4	2	-	2	-	3	3	0100
SPIS SUB	1	1	-	-	-	1	-	1	-	-	1	-	-	-	0101
MYAA REN	-	-	-	-	1	1	1	-	1	-	1	-	-	-	011
PSEU PUL	-	-	-	-	1	2	1	-	-	-	-	-	-	1	011
MYSE BID	5	1	5	3	5	5	5	5	5	2	5	4	5	5	10
CORB GIB	5	5	5	5	5	5	5	5	5	3	5	2	5	5	10
PHOL INO	1	1	2	2	4	4	2	4	3	-	4	1	2	1	10
HETE FIL	-	2	-	2	3	2	-	-	1	1	-	-	2	2	10
NEPH HOM	-	-	-	1	1	1	-	-	2	-	1	-	2	2	1100
TROC MUL	-	-	-	-	1	2	-	2	-	-	3	-	3	2	1100
HYDR ULV	-	-	-	-	-	-	-	-	-	-	-	-	4	-	1110
POLY CAE	1	-	-	-	-	1	1	-	-	-	-	1	1	1	1110
TUBI BEN	-	-	-	-	1	-	1	-	1	1	1	5	3	4	1110
	0	0	0	0	0	0	0	0	0	1	1	1	1	1	
	0	0	0	1	1	1	1	1	1	0	0	1	1	1	
				0	0	0	1	1	1						

Figure 6.9
Two-way table of the 30 most common species in Århus Bay 1989.
Species names and numbers are shown at the left; station numbers along top.
Because of lack of space e.g. sample 15 is written: 1 over 5.
The classification of species and samples are indicated along the right and bottom margins.
Value (1-5) indicate a scale of abundance according to cut levels.
Absence of a species is represented by "-".

preferentials.The classification of stations from 1990 is also shown as a dendrogram and a two-way table in figure 6.10. The 1st level of division separated stns. 64, 71, 77 and 84 from the rest of the stations while division 2 isolated stn. 51 and 91. Stn. 51 was no longer classified together with the other stations near the sewage outlet. The ecological meaning of division 3 is questionable. The only true preferential species at stns. 64, 71, 77 and 84 among the species listed in 6.10 was *Tubificoides benedeni.* The most common non-preferential species were again: *Mysella bidentata, Corbula gibba, Pholoe inornata* and



	51	91	24	103	6	15	25	29	30	97	73	64	71	77	84	
PHAX PEL	-	-	1	2	2	3	1	4	3	2	2	-	-	-	-	0001
NEPH CIL	-	-	3	3	-	2	2	2	2	2	-	-	-	-	-	0001
SCOL ARM	-	-	2	1	1	2	1	1	1	3	-	-	-	-	-	0001
PSEU PUL	-	1	3	4	2	2	1	2	3	3	2	-	-	-	-	0001
OPHI ALB	-	-	5	4	3	3	3	4	3	2	-	-	-	-	-	0001
SPIS SUB	2	1	3	2	-	-	1	-	1	-	-	-	-	-	1	0010
ABRA ALB	5	5	5	5	5	5	5	5	5	5	5	-	-	-	-	0010
NEPH TYS	2	-	1	-	1	1	1	-	1	-	2	-	-	-	-	0010
PRIO FAL	-	3	2	4	3	3	2	2	3	1	4	-	-	-	-	0010
PHIL SCA	-	1	2	2	1	3	1	1	1	1	1	1	-	-	-	0011
NUCU TEN	-	2	1	-	1	3	3	3	2	1	2	-	-	-	-	0011
ABRA NIT	-	-	1	1	-	1	3	3	2	2	-	-	1	-	-	0011
MACO CAL	1	1	-	5	2	2	1	2	2	3	3	-	-	-	1	0011
ARIC SUR	-	-	1	1	2	1	1	1	1	2	1	-	-	1	-	0011
PHIL APE	1	1	2	2	3	-	1	2	-	1	-	-	1	-	-	0100
HINI RET	-	2	1	2	-	1	1	2	1	1	-	-	1	1	-	0101
ARTC ISL	2	3	5	2	2	1	2	4	2	4	3	-	2	2	1	0101
TROC MUL	-	1	1	1	1	-	-	3	-	-	2	-	1	-	1	0101
PECT KOR	3	3	1	3	2	1	-	2	1	4	2	1	1	1	1	0101
DIAS RAT	2	1	2	4	1	2	1	2	1	1	3	-	1	2	-	0101
PARV OVA	-	-	1	1	1	1	-	-	2	1	-	-	1	1	-	011
PHOR MUE	-	3	-	4	3	4	2	4	3	4	5	-	4	3	3	011
HETE FIL	-	1	1	2	3	2	2	2	3	3	3	-	2	2	3	011
MYSI BID	5	5	5	5	5	5	3	5	5	5	5	2	5	5	5	100
CORB GIB	5	5	5	3	3	2	4	4	4	3	4	1	5	5	5	1011
PHOL INO	4	4	3	4	4	2	4	3	2	3	3	-	4	5	2	1011
OLIG OCH	1	2	2	2	-	1	2	3	1	2	2	-	3	3	1	1011
NEPH HOM	1	1	1	-	1	1	1	1	1	1	1	1	1	1	2	110
GLYC ALB	3	2	-	-	2	-	-	1	1	-	-	-	1	2	1	110
TUBI BEN	-	-	-	-	1	-	-	-	-	-	2	-	3	5	4	1111
	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	
	0	0	1	1	1	1	1	1	1	1	1					
			0	0	1	1	1	1	1	1	1					
					0	0	0	0	0	0	1					

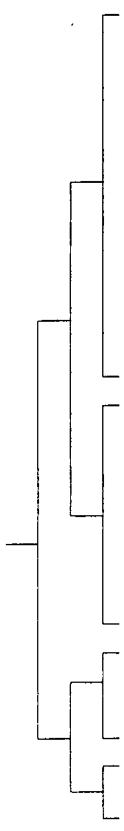
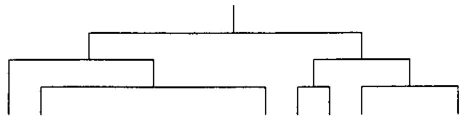
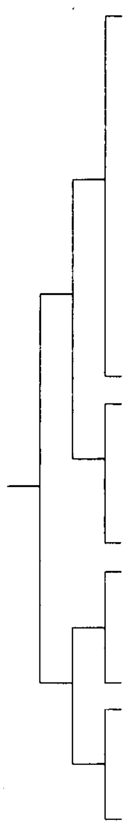


Figure 6.10
Two-way table of the 30 most common species in Århus Bay 1990.
For explanation see figure 6.9.

Phoronis mülleri. Among the most common preferentials for group of stations some distance fromthe outlet were: *Abra alba, Phaxas pellucidus, Nucula tenuis, Prionospio fallax, Nephtys ciliata, Scoloplos armiger* and *Ophiura albida.*

The dendrogram of stations in 1991 shows that the 1st level of division splits the stations into two groups (figure 6.11). One group consisted of stns. 51, 64, 71, 77, 84 and 91. By the 2. division stns. 77 and 91 were separated from the other stations. In the other group





	25	24	6	15	30	97	103	29	73	77	91	51	64	71	84	
NUCU TEN	4	2	2	2	3	2	1	-	1	-	-	-	-	-	-	0000
PARV OVA	-	3	-	2	-	2	-	-	2	-	-	-	-	-	-	0001
ABRA NIT	-	1	-	1	2	-	-	1	1	-	-	-	-	-	-	0001
NEPH CIL	1	1	2	-	1	1	2	2	1	-	-	-	-	-	-	0001
ARIC SUE	-	3	-	-	-	1	-	2	1	-	-	-	-	-	-	0001
PHIL APE	-	1	-	2	-	2	2	-	1	-	1	-	-	-	-	0010
MUSC NIG	-	1	-	2	1	2	1	1	1	-	1	-	-	-	-	0010
MACO CAL	-	1	1	2	1	4	4	-	1	2	1	-	-	-	-	0010
PHAX PEL	2	-	2	1	2	2	2	3	2	1	1	-	-	-	-	0010
SCOL ARM	-	4	-	-	2	1	1	2	3	1	1	1	-	-	-	0010
OPHI ALB	4	5	3	5	4	4	4	5	4	-	5	-	-	-	-	0010
HETE FIL	1	3	1	3	2	2	2	4	4	1	3	-	-	-	-	0010
PRIO FAL	5	5	3	3	2	2	2	3	2	1	1	2	1	1	-	0011
ECHI COR	1	1	2	2	-	-	1	-	-	-	-	1	-	-	-	0011
HINI RET	-	2	1	2	2	2	2	2	2	-	1	1	-	2	3	0100
ARČT ISL	2	3	1	1	2	4	3	3	2	1	4	1	1	3	1	0100
PHOL INO	-	3	4	3	4	4	4	4	3	2	4	2	1	3	2	0100
NEPH TYS	-	2	-	2	1	2	1	3	-	1	1	2	1	-	3	0100
PHOR MUE	-	1	2	3	3	3	4	5	5	3	3	1	1	3	3	0100
SPIS SUB	1	1	1	1	-	1	-	-	-	-	-	1	-	1	-	0101
PECT KOR	1	4	3	2	2	3	4	4	4	3	4	2	-	3	4	100
DIAS RAT	-	2	1	-	-	1	2	2	3	2	2	1	-	1	1	100
MYSE BID	4	2	5	5	5	5	5	5	5	4	5	5	2	5	5	101
ABRA ALB	5	2	5	5	5	5	5	5	5	5	5	5	4	5	5	101
CORB GIB	4	5	1	2	2	4	4	5	2	5	5	2	4	5	5	101
NEPH HOM	1	-	-	2	-	-	-	-	2	1	-	-	2	2	2	1110
HYDR ULV	-	-	-	-	-	-	-	-	1	-	1	3	-	1	1	1111
TROC MUL	-	-	1	-	-	-	-	1	-	2	2	2	-	1	1	1111
TUBI BEN	-	-	-	-	-	-	-	-	1	-	1	-	1	1	3	1111
OLIG OCH	1	-	-	1	-	-	-	-	-	3	2	-	-	-	3	1111
	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	
	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	
		0	1	1	1	1	1	1	1							
			0	0	0	0	0	1	1							

Figure 6.11
Two-way table of the 30 most common species in Århus Bay 1991. For explanation see figure 6.9.

stns. 24 and 25 were separated from the remaining stations by division 2 and 3. The most abundant preferential species for the group of stations near the outlet were: *Hydrobia ulva, Trochochaeta multisetosa, Oligochaeta sp.* and *Tubificoides benedeni. Abra alba* had become a non-preferential species together with e.g. *Mysella bidentata, Corbula gibba, Arctica islandica* and *Pectinaria koreni. Nucula tenuis, Parvicardium ovale, Abra nitida, Aricidia suecica* and *Nephtys ciliata* were exclusively found in group of stations furthest from the outlet. The classification of stations from all 3 years together is shown as a dendrogram (figure 6.12). The 1st level of division split the 5 stations near the sewage outlet (stns. 51, 64, 71, 77 and 84) from the rest of the stations in all 3 years (apart from stns. 51 in 1990). The 2nd level of division in the group of stations near the outlet was nearly a division of 1991 on one side and 1989 and 1990 on the other. From the 30 stations in the other group 5 stations were isolated in the 2nd division and one and two stations were isolated in the 3rd and 4th level of division, respectively. Again only the 1st and the 2nd division seemed to be meaningful. The most common preferential species for the group of stations near the outlet were: *Tubificoides benedeni*, while the most abundant non-preferential species were: *Mysella bidentata* and *Corbula gibba. Nucula tenuis, Nephtys ciliata, Terebellides stroemi* and *Ophiura albida* were exclusively found in the other group.

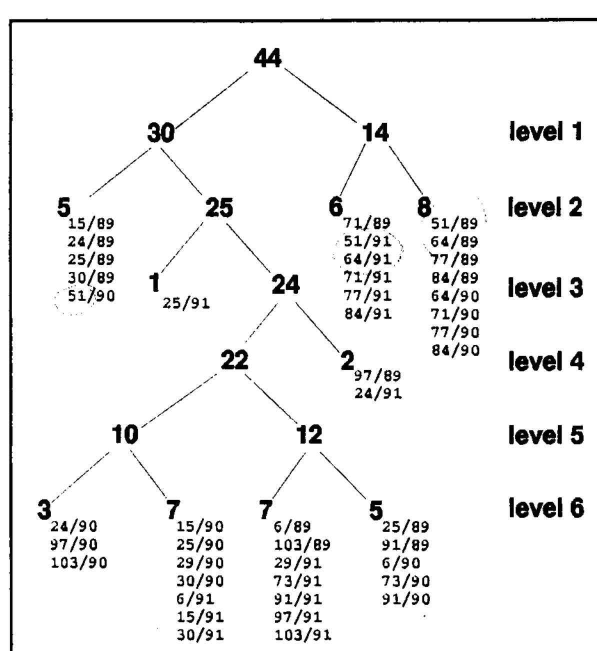


Figure 6.12
Dendrogram of TWINSPAN classification of the 1989, 1990 and 1991 together.

Results, Fornæs

Principal Component analysis

PCA carried out on abundance data from Fornæs (1986-90) failed to show a dispersion of the sampling stations. The results are not shown. Apart from a few exceptions stations were clumped together at nearly the same point every year. The most frequent exceptions were stns. 86, 94, 95, 97, 112 in the south eastern corner of the sampling area. These stations had a different species composition compared to the rest of the sampling area, mainly due to the fairly high abundance of species nearly exclusively found in this area, for example, *Amphiura filiformis*. The species composition at the remaining stations was apparently too similar to be ordinated by PCA.

Detrended Correspondence Analysis

DCA was performed on untransformed abundance data, log-transformed abundance data and untransformed abundance data with downweighting of rare species. The percentages of variation accounted for by the first and second DCA axis are given in table 6.8. The DCA axes on untransformed data with downweighting of rare species accounted for the highest percentage of variation in the data. By downweighting the rare species, the analysis is primarily based on the abundant and very abundant species. It is therefore not surprising that a higher percentage of the variation in the species data can be accounted for when all the rare, unevenly distributed species are not distorting the analysis. By log-transforming the data the effect of the abundant species is dampened and the rare species are emphasized. The result is a low percentage of variation accounted for by the axes. The percentages accounted for by the DCA axes for untransfomed data were somewhere between the percentages for untransformed data with downweighting of rare species and log-transformed data.

Untrans	1986	1987	1988	1989	1990
Axis 1	13.7	12.4	16.4	18.4	11.4
Axis 2	6.8	7.6	6.8	6.4	10.0
Log-trans	1986	1987	1988	1989	1990
Axis 1	7.9	6.9	7.0	6.3	8.5
Axis 2	4.3	5.0	5.0	4.2	5.0
Untrans DW	1986	1987	1988	1989	1990
Axis 1	20.0	17.6	19.3	20.0	16.0
Axis 2	9.0	11.3	9.0	8.6	14.6

Table 6.8
The percentage of variation in the species data accounted for by the 1st and 2nd DCA axes for untransformed data, log-tansformed data and untransformed data with downweighting of rare species.

The results of the three "different" DCA's for Fornæs 1986 are shown in figure 6.13 a-c. Generally the ordination diagrams for untransformed data and data with downweighting were fairly similar although the stations were slightly more dispersed when the rare species were downweighted. In the DCA diagrams for log-transformed data most stations were compressed into a single large group. Stations with species composition different from the majority of station could be found in the periphery. The results from 1987-1990 on untransformed data are shown in appendix 6.4.

The ordination diagrams from DCA on untransformed data with downweighting of rare species were the easiest to interpretate because stations were most dispersed. The

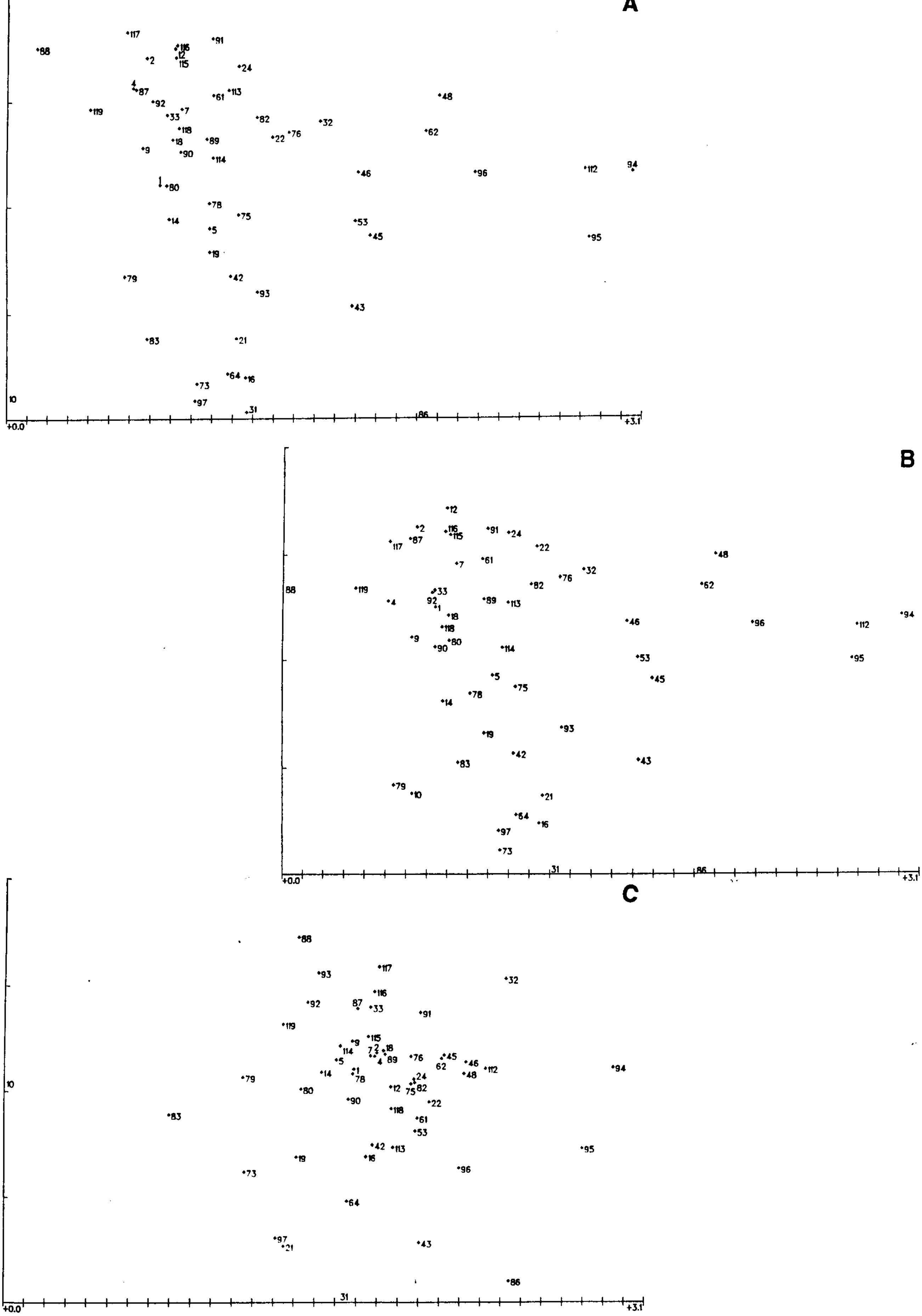


Figure 6.13 a-c
DCA ordination diagram based on a) untransformed abundance data, b) untransformed abundance data with downweighting and c) log-transformed abundance data from Fornæs 1986.

stations in the deeper south eastern part of the sampling area, stns. 94, 95 and 112, occurred together in all the ordination diagrams apart from 1989 where stn. 95 was separated from stns. 94 and 112 on the 2nd axis. Even though there was some variation from year to year, there was a tendency towards a grouping of the coastal stations. The remaining stations were difficult to divide into groups. Stations near each other geographically were generally also found close to each other in the ordination diagrams.

Canonical Correspondence Analysis

Two out of three environmental variables (depth and distance to outlet) were constant from year to year, only the organic content of the sediment changed slightly between years (appendix 2.1). The results of CCA applied to the Fornæs data (untransformed) were therefore consequently very similar for the 5 years. The result from 1986 is shown as an example. The intra-set correlations obtained between the environmental varibles and the canonical axes are shown in table 6.9. The intra-set correlations show that depth has a high negative correlation with the first axis. The 2nd axis has a weak negative correlation with distance and an even weaker positive correlation with the organic content.

Environmental variables	Canonical axes	
	Axis 1	Axis 2
Distance	-0.5994	-0.7770
Depth	-0.9291	-0.2439
Organic content	-0.4437	0.7140

Table 6.9
Intra-set correlations between environmental variables and the first two canonical axes Fornæs 1986.

The ordination diagram of the first two CCA axes is shown in figure 6.14. The percentage variation accounted for by the 1st and the 2nd CCA axes is 13,0% and 4.4% respectively. The percentages were slightly lower than those obtained by DCA (compare table 6.8). This is because the environmental varibles are not able to explain all of the variation in the species data.

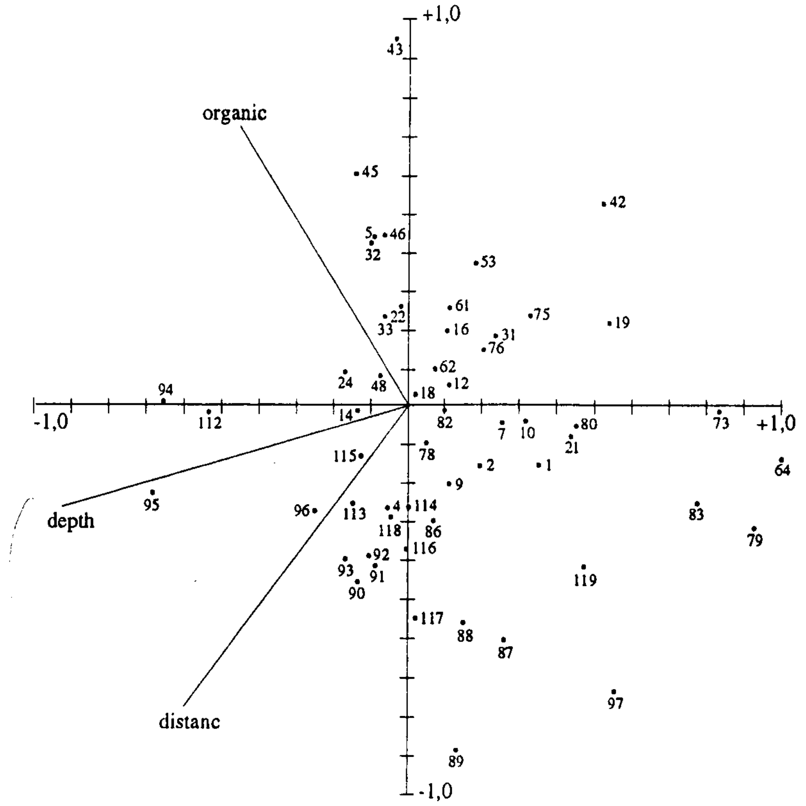


Figure 6.14
CCA ordination diagram based on untransformed abundance data from Fornæs 1986 and environmental variables: distance to outlet, depth and organic content of the sediment.

Non-metric Multidimensional Scaling

The group average clustering of Bray-Curtis similarities for the root transformed Fornæs data have been produced as dendrograms. The results for 1986-1990 are shown in appendix 6.5. The dendrograms showed a high level of similarity among stations. The level of similarity was very similar from year to year, apart from 1986 where the similarity among stations seemed to be slightly lower than the following years.

The result of non-metric MDS applied to root transformed data are shown in figure 6.15 for 1986 and in appendix 6.6 for 1987-90. In order to make the figures easier to compare with each other the plots were reflected in the axes and rotated until stns. 94, 95 and 112 were situated to the right in the diagram and stns. 88 and 117 at the top. There was no obvious grouping of the stations apart from the three stations (94, 95 and 112) in the south eastern corner of the sampling area.

The remaining stations did not occur randomly, however. Many northern stations appeared close to stns. 88 and 117 and many of the coastal stations could be found below the middle to the left in the diagrams. Stations near to each other geographically were, thus, also near each other in the diagram. Stress values ranged between 0.162 and 0.197 which means that the MDS plots are usable.

Values of depth, distance to outlet and organic content of the sediment were superimposed on the MDS plot of stations for 1986 (figure 6.15). As depth and distance to outlet were correlated, the ordination diagrams with these two variables superimposed were very similar.

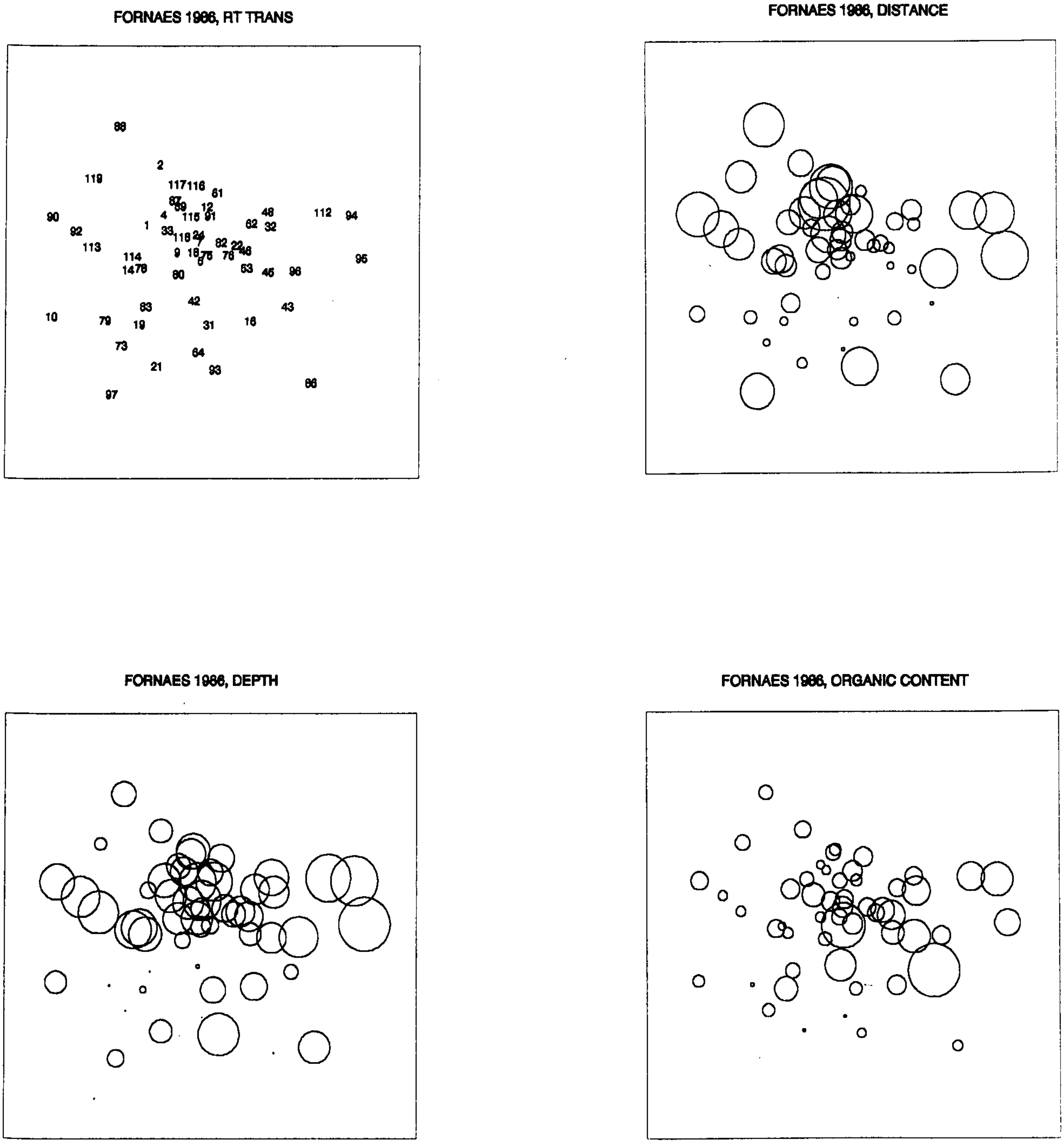


Figure 6.15
Non-metric MDS ordination of root transformed abundance data from Fornæs 1986 and the environmental variables: distance to outlet, depth and organic content superimposed on the MDS ordinations. The diameter of the circles are proportional to the values of the variables.

TWINSPAN

It was difficult to assess from the dendrograms whether the classification of the Fornæs stations (1986-90) were meaningful. To make the interpretation easier the clusters obtained from the 1st and 2nd division of the stations are shown on maps in figure 6.16 for 1986 and in appendix 6.7 for 1987-90. In order to compare the 5 years, the clusters that contained stns. 94, 95 and 112 after the 1st division were given a grey colour. Within the white area stations were split by the 2nd division into two groups marked with circles and dots, while stations in the grey area were split by the 2nd division into groups of stations marked with big and small triangels. No 2nd division were performed in the clusters containing stns. 94, 95 and 112 in 1989 and 1990 due to the limited number of stations.

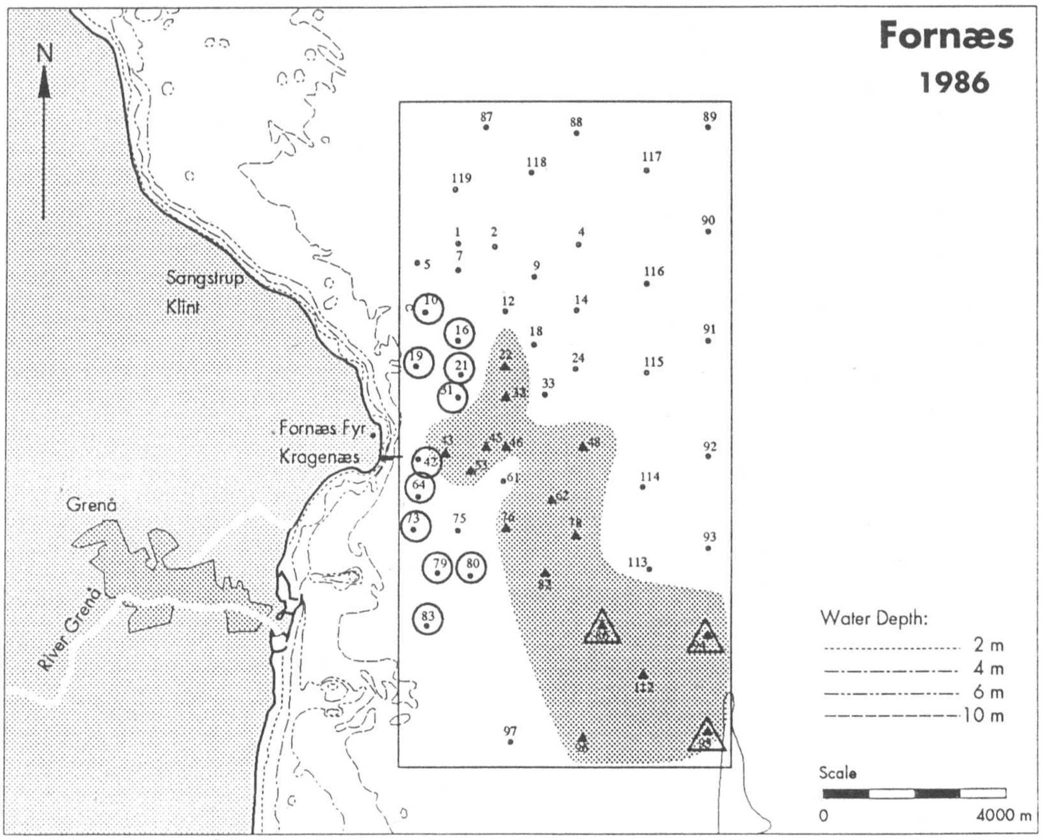


Figure 6.16
Map illustration 1st and 2nd level of TWINSPAN classification of Fornæs data 1986. The cluster that contains stn. 94, 95 and 112 after the 1st division is grey. Within the white area stations were split by the 2nd division into groups of stations marked with circles and dots, while stations in the grey area were split by the 2nd division into groups of stations marked with big and small triangels.

It was difficult to find a clear trend in the clustering of stations. Only stns. 94, 95 and 112 occured together in the same cluster throughout the period. There was a tendency towards the coastal stations belonging to the same cluster in 1986, 1987 and 1988 but not in 1989 and 1990.

Discussion

The "discussion" is divided into two parts where the first part comprises a discussion of the results and applicability of each of the methods whereas the second part includes a comparison of the different methods and a assessment of multivariate analyses in community studies.

Principal Component Analysis

PCA applied to untransformed and log-transformed data from Århus Bay was only able to scatter the stations in the diagrams in 1989 and 1990. In 1991 and for the 3 years together the diagrams showed very little dispersion of the stations. Although the stations became more similar with time, the species list revealed that there were still some substantial differences among stations in 1991. PCA also failed to show any dispersion of the Fornæs data. This is not a unique outcome of PCA. Gamito & Raffaelli (1992) also found that PCA compressed their sampling stations into a tight grouping which made interpretation difficult.

According to Ter Braak & Prentice (1988) ordination methods that assume linear relationships among variables (as PCA does) have found limited application in ecology because of the generally non-linear non-monotone response of species to environmental variables. Linear methods are appropriate to community analysis only when the species data are quantitative abundances (with few zeroes) and the range of environmental variation in the sample set is narrow (Ter Braak & Prentice1988). The Århus Bay and Fornæs data are quantitative species data but there are a lot of zeroes in the data set and this joint absence of species among stations may be the explanation for the unsatisfactory results of the PCA analyses. There is no guidelines in Ter Braak & Prentice (1988) for what "a narrow range of environmental variation" is and it is therefore impossible to know whether this criterion has been fulfilled. It is notable that the log-transformation of data had very little impact on the results. This could indicate that the analysis is more sensitive to the all the zeroes in the data set than to the actual data.

In conclusion, PCA was not an adequate technique to handle data sets like Århus Bay and Fornæs.

Detrended Correspondence Analysis

The form of DCA I have used is similar to the program DECORANA (Hill 1979b). DECORANA has become popular among marine benthic biologists recently. Basford *et al.* (1990) used DECORANA to identify environmental gradients underlying the distributions of epifaunal and infaunal assemblages in the northern North Sea. Meire *et al.* (1991) likewise used DECORANA to correlate the ordination axis with environmental parameters and to determine similarities between stations in the Wester- and Oostershelde.

The results of DCA on untransformed as well as log-transformed data from Århus Bay showed ecologically meaningful clustering of stations when applied to the 3 years separately and together. Although DCA managed to cluster the stations in an meaningful way in the diagram, the ordination of some of stations were slightly surprising compared to the species lists. At Fornæs the ordination diagrams generally reflected the geographical distribution of the stations. DCA with downweighting of rare species showed most clearly a clustering of the three stations in the south eastern part of the sampling area and a tendency towards a clustering of the coastal stations.

Log-transformation and downweighting of rare species had a notable impact on the Århus Bay data from 1991 and all the Fornæs data but very little impact on the Århus Bay data from 1989 and 1990. This observation indicates that transformations have little impact on the ordination of stations when there is a major gradient in the data set but more impact when the differences among stations are more subtle.

In conclusion, DCA managed to ordinate the Århus Bay and Fornæs stations in an ecologically meaningful way. DCA must therefore be regarded as an adequate technique to use with data sets like Århus Bay and Fornæs. DCA was superior to PCA for both the Århus Bay and the Fornæs data. According to Gauch (1982) this is the case for most data sets.

Canonical Correspondence Analysis

Canonical Correspondence Analysis is a relatively new technique which up till now has been little used by marine benthic biologists (Rodrigues 1992, Verdonschot 1992). A more widely used method to interpret the CA/DCA ordination axes is to correlate the axes with environmental variables using Spearman's Rank Correlation (Jongman *et al.* 1987 p 132, Basford *et al.* 1991, Meire *et al.* 1991). This method only considers one environmental variable at a time, while CCA considers the variables together.

Only 3-5 environmental variables were included in the CCA applied to the Århus Bay and Fornæs data. The environmental variables explained, however, the main variation in the species composition in Århus Bay and at Fornæs. The most important of the environmental variables were "distance from outlet" and "depth" in Århus Bay and "depth" at Fornæs.

Non-metric Multidimensional Scaling

Non-metric MDS has been widely used among marine benthic biologists (Field *et al.* 1982, Gray *et al.* 1988, Heip *et al.* 1988, Warwick *et al.* 1988, Austen *et al.* 1991, Raffaelli *et al.* 1991, Warwick & Clarke 1991, Gamito & Raffaelli 1992, Warwick & Clark 1993).

MDS plots based on the Århus Bay data showed ecologically meaningful ordinations of stations for the 3 years separately and together. The MDS plots seemed to reflect the differences and similarities among stations very well. By comparing MDS plots based on untransformed and root-root-transformed data the impact of dominant species could be assessed. Environmental data superimposed on the biotic ordinations showed that there was a correlation between both distance to outlet, depth and C/N-ratio and the biotic MDS plots.

The MDS plots based on the Fornæs data were more difficult to interpret as there were no obvious grouping of stations apart from the 3 stations in the south eastern corner of the sampling area. The remaining stations did not occur randomly, however. Stations near to each other geographically were also near each other in the diagram.

The Århus Bay MDS plot were in many respects similar to the DCA diagrams. The Fornæs MDS plots also resembled the DCA plots although it was impossible to determine which of the 3 types of DCA plots (untransformed, log-transformed or downweighting of rare species) was most similar to the MDS plots. Heip *et al.* (1988) and Gray *et al.* (1988) likewise found that MDS and DECORANA (special form of DCA) gave similar results for meiofaunal and macrofaunal community analysis, respectively.

In conclusion, MDS gave ecologically meaningful results when applied to the Århus Bay and Fornæs data sets. It is useful to try different transformations of the raw data to compare the impact of dominant species.

TWINSPAN

In some recent surveys, covering large areas and a number of different habitats, TWINSPAN (Hill 1979a) has been used succesfully to identify benthic assemblages. McLusky & McCrory (1989) used TWINSPAN to find gradients or groupings on an intertidal mudflat subjected to industrial pollution. Basford *et al.* (1990) and Künitzer *et al.* (1992) separated the benthic infauna of the North Sea into assemblages by means of TWINSPAN classification.

For the Århus Bay data an ecologically meaningful grouping of stations was obtained by TWINSPAN. The results of TWINSPAN corresponded well with the results obtained by DCA and MDS. The classification of species that followed the station classification was able to find preferential species for different clusters of stations despite the relatively limited variation in species data. The advantage of TWINSPAN compared to a careful examination of the species lists is that associations between less common/rare species and particular stations becomes more obvious in a two-way table. These less common and rare species and their relation to certain stations could otherwise easily be overlooked and the focus would only be on the dominant species.

The results of TWINSPAN applied to the Fornæs data showed no convincing classification of stations. There was some correspondence with the results of DCA, but the grouping of stations were less consistent. The inadequacy of TWINSPAN to cluster the stations was caused by the limited variation in the species composition and abundance among stations.

This was underlined by the fact that it was difficult to find good preferential species for the station clusters.

In conclusion, TWINSPAN can only be used meaningfully if community types exist (at least to a certain degree) within the data set as in Århus Bay.

Comparison and assessment of multivariate analyses

Unlike most statistical analysis where the approach is deductive, based on experiment, multivariate analysis uses an inductive, non-experimental approach to generate rather than to test hypotheses (Randerson 1993). Although the hypotheses generated cannot be tested in a formal way, the outcome of multivariate analysis must necessarily be assessed. A major problem for comparison and assessment of multivariate analyses is the lack of external standards to compare with. Which multivariate technique is the more appropriate depends partly on the data in question, but also on the investigator's view of the nature of variation in the data.

With large data sets the nature of variation in the data can be difficult to elucidate and one of the purposes of multivariate analysis was exactly to summarize the data efficiently and reduce the data matrix to a more manageable form. When this has been done the search for pattern in the data sets can be initiated. The only kind of "check" for the patterns found is a careful examination of the species lists combined with the knowledge and experience of the investigator. Another kind of check is a comparison of the results of various types of multivariate analyses based on different concepts. If the analyses show similar results the patterns are probably genuine. If the analyses show different results then the only possible check is the species list.

The first thing to consider before applying a multivariate technique to a data set is which of the two complementary approaches to multivariate analysis, classification and ordination, would be the most appropriate. This may not always be simple to predict. With computers at hand a pragmatic way to find out is to run the various analyses and look critically at the results. The classification technique, TWINSPAN, turned out to be appropriate for the Århus Bay data set because samples and species could be assigned to ecologically meaningful groups. In data sets like the Fornæs data sets where there is a continuous variation in the distribution of species between samples TWINSPAN imposed discontinuities on the data. The ensuing groups had to be rejected as meaningless after consulting the species list. If community types exist in a data set TWINSPAN is, however, a very useful way to elucidate the relationships among samples and among species.

Among the ordination techniques DCA and non-metric MDS represent different approches. DCA is based on assumptions about species respons to community gradients and the axes in DCA can delineate real environmental axes. These can be difficult to identify but instead real environmental data can be incorporated in the analyses. Non-metric MDS is based on rank information in a similarity matrix and demonstrates the relative separation of stations in hypothetical space. MDS plots of samples can be interpreted in terms of environmental variables by superimposing the values for one variable at a time on the biotic MDS plot. For the Århus Bay data DCA and MDS gave very similar results. DCA and MDS applied to the Fornæs data largely reflected the geographically distribution of stations. The fact that the DCA and MDS did not find major gradients in the data sets or split the stations in easily distinguishable groups must be regarded as an asset not a weakness by the analyses. Because there seems to be a high degree of continuum in the data from Fornæs, groups or gradients recognized by DCA and MDS would have been artefacts.

Another thing to consider before performing a multivariate analysis is the transformation of data which again depends on the data set and whether dominant or rare species should be emphasized. By trying different types of transformations and comparing the results, the influence of dominant/rare species can be assessed. For the metric analyses (DCA, etc.) there is a large number of options for scaling of axes, standardization and centring of species/sample data that also affects the emphasis put on dominant/rare species in the analysis. For non-metric MDS the results are highly influenced by the choice of similarity measure.

Returning to the aims of multivariate analysis listed in the beginning of the chapter, the first aim was to summarize the data efficiently in order to reduce the data matrix to a more manageable form. All the different techniques did that; the interesting point is, however, the way they summarize the data and the interpretations of the results.

The second aim was to search for pattern or structure in the data sets. As already discussed above PCA generally fails to give some satisfactory results with quantitative species data because of a mismatch between the community model of species in their environment and the underlying model of PCA. The remaining two ordination techniques, DCA and non-metric MDS, both found some ecologically meaningful patterns in the Århus Bay and Fornæs data sets while the classification technique, TWINSPAN, only was appropriate for the Århus Bay data.

The third aim concerned possible causal relationships between the distibution of the biota and that of environmental factors. The importance of the relationships found are, of course, dependent on the environmental factors measured and their importance for the distribution of species. In Århus Bay the 5 environmental variables included in the CCA explained most of the variation found in the species composition in the bay. The most important environmental variables were "distance to outlet" followed by "depth" and "C/N-ratio". At

Fornæs the 3 environmental variables incorporated in the CCA also explained most of the variation in the species data. The most important factor was "depth". Superimposing values of environmental variables on the biotic MDS plots also showed that "distance to outlet", "depth" and "C/N-ratio" were the most important factors for species distribution in Århus Bay, while it was difficult to interpret the results from Fornæs.

In conclusion, multivariate analyses are useful techniques for analysing large data sets because they can summarize a data matrix to a manageable form, find possible patterns in the data set and find relationships between the distribution of the biota and that of environmental factors. Because of the lack of external standards to compare with, the results of multivariate analyses should be assessed critically on the basis of a careful examination of the species list combined with the knowledge and experience of the investigator.

7. Final discussion

The purpose of this chapter is to summarize the main points from the preceeding chapters and to attempt a synthesis of the results. The results and discussions are also evaluated in relation to the aims of the thesis, which were to:

1) assess the state of pollution in the two study areas and relate them to the recent changes found in the Kattegat - Belt Sea area;

2) examine the observed spatial and temporal variability in species composition, abundance and biomass in Århus Bay and the Fornæs area and relate the variability to antropogenic and natural causes,

3) discuss and assess the methods used, particularly for the estimation of secondary production and the use of multivariate analyses as methods for examination of changes in macrozoobenthic communities.

Description of Århus Bay and Fornæs

The two study areas, Århus Bay and Fornæs, are both situated on the eastcoast of Jutland in the Kattegat - Belt Sea area at 13-17 m depth and both receive waste water from long sea out-falls. Although both areas are subjected to salinity stratification for most of the year, the exposed position of the Fornæs area on the open Kattegat coast prevents it from suffering from severe oxygen deficiencies, unlike the Århus Bay which is a sheltered, semi-enclosed sedimentation area where oxygen concentrations in the bottom water can be very low. The worst recorded oxygen deficiency in Århus Bay took place in autumn 1981 which killed most of the benthic fauna below 10 m. Oxygen depletion under the ice cover in early spring 1987 was also fatal for a number of species. In autumn 1989 and 1990 "local" oxygen deficiencies in the area south of the waste water outlet killed *Abra alba*. Close to the outlet the oxygen conditions has been permanently low and only a few species were able to live there.

The sediments are quite different in the two areas. In Århus Bay the sediment is silty with an organic content of 5.0-14.0%, which is highest south of the outlet and at the deepest stations. The percentage of silt-clay is around 85% at all stations while the C/N-ratios were highest at the stations near and south of the outlet. The distribution of *Clostridium perfringens* indicated that organic matter from the sewage is distributed throughout the bay, although the highest numbers were found near the outlet and off the the rivers Eg, Århus and Giber. The sediment at Fornæs is generally sandy although a number of stations have slightly coarser sediment and the southeastern stations more silty sediment. The organic content is low compared to Århus Bay and varies between 0.5-2.0%, being highest close to the outlet and in the deeper south eastern part of the area.

The discharge of organic matter from waste water to Århus Bay amounted to 3500 t BOD per year throughout the 1980s but was reduced to 150 t BOD per year from the beginning of 1990 due to improved waste water treatment. At the same time the discharge of nitrogen and phosphorus from waste water was reduced by 50% and 80%, respectively, in accordance with the Danish Action Plan for the Aquatic environment. The total discharge of nitrogen to Århus Bay was not reduced, however, as the main nitrogen source, the leaching of nitrogen from fields, has not been reduced. There is thus no sign that the objective for reduction of levels of nitrogen by the deadline of 1993 can be fulfilled. The discharge of organic matter from waste water to the Fornæs area was 2500 t BOD per year in the second half of the 1980s but was reduced to 1400 t BOD by the middle of 1991. The discharge of nitrogen and phosphorus was small compared to Århus Bay.

The discharge of organic matter has a direct effect on the macrozoobenthos as a possible food source and consumer of oxygen while the discharge of nutrients enhances the primary production and thus has an indirect impact on food availability and oxygen concentrations. Primary production was only measured in Århus Bay (c. 200 g C m^{-2} $year^{-1}$) but was probably underestimated by at least 30% due to the sampling method. The distribution of fluorescence throughout the water column was therefore used as a simple measure of the amount of phytoplankton present. The distribution of fluorescence showed great differences in both study areas between years but also showed that a considerable amount of phytoplankton was situated around the halocline. In Århus Bay very high concentrations of phytoplankton were found in and below the halocline in July and August 1990. In 1991 the spring bloom was more pronounced than in 1990 while the concentration of phytoplankton in late summer was much lower. Grazing by zooplankton was much higher in 1991 than in 1990 which meant that the sedimentation of organic matter to the bottom from the water column was lower in 1991 than in 1990.

Based on the differences in exposure, hydrography, sediment, etc. it would be expected that the discharge of organic matter would have the greatest effect on the macrozoobenthos in Århus Bay while a more limited effect would be expected in the Fornæs area.

Spatial and temporal variability in the benthic fauna

Data on macrozoobenthos were obtained from 15 stations in Århus Bay from 1985 to 1991 while data from the Fornæs area included 55 sampling stations from 1986 to 1990. Monthly samples were collected at one station in Århus Bay in 1990 and 1991. Data from before 1985 in Århus Bay and 1986 at Fornæs have been included when appropiate.

The Århus Bay is inhabited by an *Abra* community dominated by bivalves, especially *Abra alba*, *Mysella bidentata* and *Corbula gibba*. The fluctuations in abundance and biomass of these three species had a great impact on the total abundance and biomass in the bay. The distribution of abundance and biomass of trophic groups showed that deposit feeders was the dominant feeding type, mainly due to *A. alba* and *M. bidentata*.

The Fornæs area is inhabited by a *Venus* community. Polychaetes were often the numerically dominant group, although bivalves were also well represented. The polychaetes *Myriochele oculata*, *Polydora caeca* and *Prionospio fallax* occurred alternately in very high numbers from 1980 to 1990. Generally the abundance and biomass decreased in the first half of the 1980s and increased in the second half. Deposit feeders also dominated the abundance and biomass at Fornæs but contrary to Århus Bay the majority of the deposit feeders were polychaetes.

Population dynamics in Århus Bay

The spatial and temporal variability in the macrozoobenthos in Århus Bay can be explained to a great extent by the variation in a few important species. *Abra alba*, *Nephtys ciliata*, *Ophiura albida* and *Echinocardium cordatum* were not able to live or maintain permanent populations near and south of the sewage outlet because this area was greatly affected by adverse oxygen conditions. The station just north of the outlet was also notably affected by hypoxic conditions until the waste water treatment was improved at the beginning of 1990 whereafter the number of *A. alba* increased rapidly. South of the outlet *Mysella bidentata* occurred in high densities, probably because this species is tolerant to adverse oxygen conditions and at the same time able to reap the benefit of the enhanced food supply. *Corbula gibba* also thrived better south of the outlet than in the rest of the bay. *Nephtys hombergii* which is more tolerant to low oxygen concentrations than *N. ciliata* occurred south of the outlet but not close to the discharge point.

The fluctuations in the numbers and biomass of *A. alba* had a pronounced effect on the total abundance and biomass in Århus Bay. The severe winter of 1986/87 with low temperatures and oxygen depletion under the ice cover practically eliminated *A. alba* from the bay but it quickly recolonized the area and was found in high numbers in 1988. Studies of the growth of *A. alba* in 1990 and 1991 showed that by the end of 1990 the population had reached an average length of 10 mm while the average shell length was only 5 mm by the end of 1991. The difference between the two years could be attributed to the difference in sedimentation of phytoplankton from the water column. The very high growth rate of *A. alba* in 1990 coincided with an extended phytoplankton bloom and limited grazing from zooplankton, while the much lower growth rate of *A. alba* in 1991 corresponded with a much more limited algal bloom and much higher grazing rates. These results indicate competition between the zooplankton and the macrozoobenthos for food.

C. gibba had an erratic occurrence in Århus Bay. A succesful recruitment took place in 1989 but the species disappeared quickly from most of the bay apart from the stations south of the outlet. The irregular appearence of *C. gibba* could not be explained by either oxygen deficiencies or cold winters.

Ophiura albida was also eliminated from most of the bay after the winter 1986/87 but returned in 1989. The occurrence of a high number of juveniles in 1991 at stations in the western part of the bay where *O. albida* has been sparsely represented during the sampling period may indicate an improvement of the oxygen conditions in this area.

Echinocardium cordatum did not reestablish permanently in Århus Bay until 1990 due to a mixture of recruitment failure, adverse oxygen conditions and the severe winter 1986/87.

Secondary production in Århus Bay

Secondary production was estimated for single species in 1990 and 1991 based on the monthly samples at stn. 6 in Århus Bay. For the total macrobenthic community at the 15 stations in Århus Bay in 1989, 1990 and 1991 it was based on the annual samplings.

The secondary production of *A. alba* and *C. gibba* was estimated using the methods described by Crisp (1984). The annual production of *A. alba* at stn. 6 in Århus Bay amounted to 11.0 and 5.4 g AFDW per m^2 in 1990 and 1991, respectively. The production of *C. gibba* was much lower: 0.63 g AFDW m^2 in 1990 and 0.22 g AFDW m^2 in 1991. The production of *A. alba* in Århus Bay was relatively high compared with other areas while the production of *C. gibba* was low.

In order to estimate the secondary production of the 15 stations in Århus Bay a "short-cut" method described by Brey (1990) was used. The "Brey method" was found acceptable on the basis of a comparison with the "Crisp method" of the total community production at stn. 6 in 1990 and 1991. The differences between the estimated total productions were 4% in 1990 and 26% in 1991.

The most important contributors to the total annual secondary production in Århus Bay were *A. alba* and other bivalves. The highest production of polychaetes was found in the central and southern part of the bay. The secondary production was very low near the outlet until the reduction in discharge of waste water in 1990 when the production on the stations north of the outlet increased dramatically mainly due to *A. alba*. The highest total annual secondary productions were found in the southern part of the study area where *Macoma calcarea* contributed considerably to the total production. Compared to other subtidal areas the total annual biomass and secondary production was relatively high in

Århus Bay.

Apart from the area near the waste water outlet there is no simple explanation for the observed spatial and temporal differences in secondary production among stations in Århus Bay. A combination of hydrography and the dynamics of the overlying water column seems to be the main cause of variability in benthic secondary production.

Multivariate analyses

The use of multivariate analyses on the data from Århus Bay and Fornæs had the purpose of summarizing the data efficiently to reduce the data matrix to a more manageable form, searching for patterns in the data sets and possible causal relationships between the distribution of the biota and that of environmental factors. Another important purpose was to assess the applicability of different multivariate techniques.

Three different ordination techniques and one classification technique were used on the data. Ordination is based on the idea of a continuum in the data; classification is based on the idea that community types exist and that each can be characterized by particular species combinations. The concepts of the three ordination techniques are fundamentaly different. Principal Component Analysis (PCA) and Detrended Correspondence Analysis (DCA) are both metric techniques assuming that species have normal distribution and are uncorrelated. PCA assume linear relationships among variables while DCA is based on a unimodal response of species to environmental variables. The central theme in non-metric Multidimensional Scaling (MDS) is the use of rank order information in a (dis)similarity matrix. The classification technique, Two Way INdicator SPecies Analysis (TWINSPAN), not only classifies the samples, but uses this classification to obtain a classification of the species according to their ecological preferences.

PCA was not an adequate technique to be used with data sets like Århus Bay and Fornæs probably because the analysis could not handle the many zeroes in the data matrices.

DCA and MDS worked well with the Århus Bay data and gave very similar results. In 1989 stns. 51 and 64 close to the outlet were very different from the other stations while the remaining stations were ordinated along a gradient of increasing distance to the outlet. In 1990 stn. 64 was very different from the remaining stations in the DCA and MDS ordination diagrams while stn. 51 had become more similar to the central and eastern stations. Stns. 71, 77, 84 and 91 were close to each other in the diagrams. In 1991 the two easternmost stations (stns. 24 and 25) were recognized as very different from the other stations by both DCA and MDS while the remaining stations were ordinated along a gradient of increasing distance to the outlet. In 1989 TWINSPAN classified the 5 stations nearest the outlet (stn. 51, 64, 71, 77 and 84) in one group by the 1st division. In 1990 stn. 51 was no longer part of the group. In 1991 TWINSPAN also recognized stns. 24 and especially 25 as very different from the other stations.

DCA and MDS gave also very similar results when applied to the Fornæs data; both analyses reflected, to a high degree, the geographical distribution of the stations. TWINSPAN did not work well with these data because the analysis imposed discontinuities on data sets where there was a continuous variation in the distribution of species among samples.

Five environmental variables were included in the Canonical Correspondence Analysis (CCA) and superimposed on the MDS plots from Århus Bay. The most important environmental varibles were "distance to outlet" followed by "depth" and "C/N-ratio". For the Fornæs data the CCA analysis showed that "depth" was the most important factor for species distribution while it was difficult to interpret the results of superimposed values of environmental variables on the biotic MDS plots from Fornæs.

<u>The state of pollution at Fornæs and in Århus Bay</u>

The number of species, abundance and biomass decreased at Fornæs from 1980 to 1985 while the discharge of BOD was fairly constant during the same period. From 1986 there was a slight decrease in the discharge of BOD but a considerable increase in the number of species, abundance and biomass. The stations most likely to be affected by the discharge were the stations nearest to the outlet but neither the DCA nor the MDS analyses from 1986 to 1990 separated the stations near the outlet from the other stations. This indicates that, at least for the second half of the 1980s, there was no straightforward relation between the organic enrichment from the outlet and species composition, abundance and biomass and suggests that other factors are also important influencing fluctuations in the benthic fauna.

As possible factor is the enhanced sedimentation of phytoplankton as has been observed in general in the Kattegat area. Contrary to the deeper, eastern parts of Kattegat, the shallow western parts are greatly influenced by rapidly changing hydrographic conditions which have a large impact on sedimentation of phytoplankton, transport and settling of larvae in the area and growth and survival of juvenile and adult macrozoobenthos. The fluctuations in species richness, abundance and biomass must, therefore, largely be attributed to random variations. This does not preclude that enhanced food supply has an impact on the benthic fauna nor does it exclude the possibility that the high abundance of certain polychaete species in the beginning of the 1980s was a consequence of an organic enrichment of the area, but the importance of these factors are difficult to measure.

In contrast to the Fornæs area, a great deal of the variation in the benthic fauna in Århus

Bay can be satisfactorily explained. This is partly because more is known about the environmental variables in Århus Bay and partly because the bay is dominated by a few species whose biology and ecology are fairly well known.

There is no doubt that stns. 51 and 64, near the outlet, were severely affected by the discharge of organic matter, as the number of species, abundance, biomass and secondary production were very low throughout the sampling period from 1985 to 1991. After the reduction in the discharge of BOD in the beginning of 1990 the number of species, abundance, biomass and production increased rapidly at stn. 51 north of the outlet.

Stations 71, 77, 84 and to a certain extent stn. 91 were also notably affected by the organic enrichment. The occurrence of *Mysella bidentata* in high densities and the longer lasting appearance of *Corbula gibba* in this area were probably related to the enhanced food availability from the outlet. Other species which are less tolerant to adverse oxygen conditions such as *Abra alba*, *Nephtys ciliata*, *Ophiura albida* and *Echinocardium cordatum* were not found at stns. 71, 77 and 84.

At the two southernmost stations (97 and 103) the biomass and secondary production were relatively high compared to the rest of the bay. The food availability may also have been enhanced by the outlet in this area but this cannot be the sole explanation as biomass and production continued to increase after the discharge was reduced. An enhanced sedimentation of phytoplankton in the area cause by topographic and hydrographic conditions is likely.

In the central and eastern part of the bay the lower abundance, biomass and production and the occurrence of *Nephtys ciliata*, *Ophiura albida* and *Echinocardium cordatum* and the stable occurrence of *Abra alba* showed that this part of the bay was less affected by organic enrichment and oxygen deficiencies than the western part. The main effect of the waste water discharge on the stations in the central and eastern part of the bay was therefore the discharge of nutrients resulting in enhanced growth and production of phytoplankton. As mentioned above, the growth and production of *Abra alba* showed a close coupling to the events in the pelagos.

As in other parts of the Kattegat - Belt Sea area Århus Bay has experienced low oxygen concentrations in the bottom water in late summer and early autumn throughout the 1980s. Only the oxygen depletion under the ice cover in early spring 1987 and the local oxygen deficiencies south of the outlet in 1989 and 1990 actually killed parts of the benthic fauna. Thus, other than in the 1981 event, the oxygen deficiencies have been less severe in Århus Bay than in other parts of the southern Kattegat in the 1980s.

Discussion and assessment of methods

The distribution of abundance and biomass in taxonomic and trophic groups along gradients and the SAB-curves are all very simple graphic data treatment methods that, none the less, give a good impression of the faunal characteristics and their variability in space and time.

The investigation of the population dynamics of some of the prominent species in Århus Bay gave valuable information on how different species populations were affected by adverse oxygen conditions, severe winters and enhanced food availability. This insight into possible causes of variability in the abundance and biomass of important species is a great help in the interpretation of fluctuations. The monthly length measurements of bivalves made it possible to estimate growth, which could then be directly related to the dynamics of the pelagic environment.

Estimates of total secondary community production are generally very dependent on the method used. The method described by Brey was found acceptable for estimating secondary production in Århus Bay, but care should be exercised when comparisons are made with other areas where different methods have been used to estimate production. Secondary production was estimated more accurately for some of the abundant species in Århus Bay on the basis of monthly sampling by the method described by Crisp. Seen in a wider perspective estimates of secondary production are important in relation to availability of food for exploited fish species and as quantitative information for energy budgets.

Among the multivariate analyses the Detrended Correspondence Analysis (DCA) and non-metric Multidimensional Scaling (MDS) proved to be the most useful for assessments of the Århus Bay and Fornæs data sets. Principal Components Analysis (PCA) could not handle the joint absence of species among samples. Two Way INdicator SPecies ANalysis (TWINSPAN) did not work well with the Fornæs data because it imposed discontinuities on data sets with continous variation in distribution of species among samples. As community types existed to a certain degree in Århus Bay TWINSPAN worked well with these data.

DCA and MDS are useful techniques for analysing large data sets because they can summarize the data matrices in a manageable form and find possible patterns in the data sets. The results of the analyses can then be used as a starting point for more detailed investigations of single species/samples or groups of species/samples. By using different transformations of the raw data the role of dominant or rare species can be assessed. One of the major problems in the assessment of multivariate techniques is the lack of any external standards for comparison. The results of multivariate analyses must therefore be assessed critically on the basis of a careful examination of the species list combined with the knowledge and experience of the investigator.

Every method thus had its advantages and limitations but each of the different methods used has added some important information to the picture of the benthic community in Århus Bay and Fornæs. It is therefore a considerable advantage to use several different methods to analyse the spatial and temporal variability in benthic fauna in relation to antropogenic and natural causes. In summary the following results were obtained:

- the spatial and temporal variability in the benthos in Århus Bay could to a great extent be explained by the population dynamics of 7 important species. The most important factors for the variation were food supply, oxygen deficiencies and severe winters;
- the monthly sampling gave valuable information on the growth and production of the abundant species;
- differences in growth of *Abra alba* could be attributed to the difference in sedimentation of phytoplankton from the water column;
- there was no straightforward relation between the organic enrichment from the outlet at Fornæs in the scond half of the 1980s and species composition, abundance and biomass and suggests that other factors are also important influencing the fluctuations in the benthic fauna;
- estimates of total secondary community production were found to be very dependent on the method used. Compared to other subtidal areas Århus Bay had a fairly had production.
- the multivariate analyses DCA and MDS proved to be the most successful with the Århus Bay and Fornæs data sets. As community types existed to a certain degree in Århus Bay TWINSPAN worked well with these data.
- DCA and MDS were useful techniques for analyzing the large data sets from Århus Bay and Fornæs because they summarized the data matrices to a mangeable form and found patterns in the data sets.

In the future the use of macrozoobenthos as indicators for organic pollution from long-sea outfalls will be less important in Denmark as the discharges are now being brought under control. Leaching of nitrogen from fields has not been reduced in accordance with the Danish Action Plan for the Aquatic Environment and the monitoring of the Danish waters is therefore expected to concentrate on the effects of nitrogen discharge. Studies of the coupling between the pelagic and benthic environment, for example in the form of estimates of growth and production in the macrozoobenthos, in relation to phytoplankton sedimentation, of the role of macrozoobenthos in resuspension and regeneration of nutrients from the sediment and of the burial of nutrients in the sediments will become important topics for investigations.

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Appendices

Appendices *224*

station	1986	1987	1988	1989	1990	Mean	S.D.
1	1.10	0.96	0.93	0.89	1.10	1.00	0.10
2	1.02	1.04	0.95	0.91	1.04	0.99	0.06
4	0.93	0.97	0.98	0.93	1.25	1.01	0.13
5	2.00	0.97	0.95	1.54	1.03	1.30	0.46
7	1.14	1.04	1.06	0.89	1.07	1.04	0.09
9	0.79	0.78	0.99	0.67	0.79	0.80	0.12
10	0.85	0.73	0.69	0.78	0.81	0.77	0.06
12	1.13	1.07	1.03	1.07	1.00	1.06	0.05
14	1.04	0.96	0.86	0.84	1.14	0.97	0.13
16	1.11	0.97	0.81	1.18	1.27	1.07	0.18
18	0.98	1.08	1.02	0.79	1.02	0.98	0.11
19	1.27	0.80	1.03	1.57	1.60	1.25	0.35
21	0.53	0.67	0.60	0.82	1.14	0.75	0.24
22	1.28	1.23	1.07	1.09	1.03	1.14	0.11
24	1.06	1.18	1.14	1.04	1.11	1.11	0.06
31	0.88	0.91	0.95	0.72	1.34	0.96	0.23
32	1.43	1.17	1.19	1.17	1.18	1.23	0.11
33	1.24	1.14	1.11	0.97	1.16	1.12	0.10
42	1.55	1.76	1.37	1.31	2.01	1.60	0.29
43	2.30	1.72	1.90	1.94	1.66	1.90	0.25
45	1.59	1.30	1.43	1.16	1.28	1.35	0.16
46	1.43	1.20	1.14	0.97	1.21	1.19	0.17
48	1.05	1.10	1.28	1.10	1.13	1.13	0.09
53	1.24	1.29	1.21	1.20	1.18	1.22	0.04
61	1.10	1.08	1.11	0.91	1.15	1.07	0.09
62	1.03	1.19	1.15	1.07	1.12	1.11	0.06
64	0.52	0.74	0.47	0.71	0.86	0.66	0.16
73	0.88	0.82	0.78	0.90	1.06	0.89	0.11
75	1.15	0.95	0.64	1.38	1.52	1.13	0.35
76	1.03	1.01	1.00	1.10	1.21	1.07	0.09
78	0.80	0.82	0.86	0.77	0.53	0.76	0.13
79	0.56	0.60	0.67	0.69	0.83	0.67	0.10
80	0.90	0.90	0.74	0.74	1.10	0.88	0.15
82	1.05	1.05	0.98	0.95	1.03	1.01	0.04
83	0.95	0.89	1.67	1.34	0.91	1.15	0.34
86	0.79	0.89	1.09	0.77	1.02	0.91	0.14
87	0.72	0.75	0.71	0.77	0.73	0.74	0.02
88	0.93	0.93	0.97	0.88	1.11	0.96	0.09
89	0.74	0.71	0.77	0.74	0.72	0.74	0.02
90	1.05	1.13	1.08	0.98	1.22	1.09	0.09
91	0.83	0.89	0.93	0.94	0.94	0.91	0.05
92	0.76	0.93	0.83	0.91	0.97	0.88	0.08
93	0.75	0.83	1.01	0.80	0.88	0.85	0.10
94	1.58	1.57	2.70	1.66	2.05	1.91	0.48
95	1.35	1.22	1.47	1.51	1.90	1.49	0.26
96	1.08	1.12	1.26	1.06	1.12	1.13	0.08
97	0.43	0.46	0.58	0.46	0.52	0.49	0.06
112	1.42	1.41	1.69	1.46	1.70	1.54	0.15
113	0.78	0.84	0.97	0.70	0.88	0.83	0.10
114	0.70	0.58	0.78	0.68	0.58	0.66	0.09
115	0.95	0.91	0.94	0.99	0.93	0.94	0.03
116	0.84	0.82	0.85	0.78	0.83	0.82	0.03
117	0.96	0.96	1.02	0.91	1.35	1.04	0.18
118	1.08	0.99	0.98	1.15	1.16	1.07	0.09
119	0.96	0.99	0.91	0.88	1.14	0.98	0.10

Appendix 2.1
Organic content in % of sediment dry weight, Fornæs 1986-1990.

Station	North	East	Depth
6	56° 09. 32	10° 19. 17	16.4
15	56° 07. 19	10° 20. 04	15.5
24	56° 09. 62	10° 28. 03	14.9
25	56° 08. 27	10° 25. 85	16.9
29	56° 08. 63	10° 16. 90	13.5
30	56° 08. 56	10° 21. 01	15.8
51	56° 08. 66	10° 14. 70	12.8
64	56° 08. 01	10° 14. 79	13.8
71	56° 07. 81	10° 15. 73	14.2
73	56° 07. 76	10° 17. 41	14.3
77	56° 07. 35	10° 14. 92	14.1
84	56° 06. 93	10° 14. 85	14.0
91	56° 06. 50	10° 15. 73	13.8
97	56° 06. 29	10° 16. 60	13.7
103	56° 05. 61	10° 17. 46	13.8

Appendix 3.1
Position and depth of stations in Århus Bay.

continues

Station	North	East	Depth
1	56° 28. 91	10° 59. 03	14.8
2	56° 28. 90	11° 00. 39	16.6
4	56° 28. 92	11° 01. 82	17.9
5	56° 28. 51	10° 57. 96	15.8
7	56° 28. 54	10° 59. 05	15.6
9	56° 28. 52	10° 59. 05	17.2
10	56° 28. 06	11° 00. 97	16.0
12	56° 28. 04	10° 58. 63	16.6
14	56° 28. 16	10° 59. 91	18.0
16	56° 27. 62	11° 01. 85	15.8
18	56° 27. 69	10° 59. 06	17.2
19	56° 27. 18	11° 00. 96	13.6
21	56° 27. 18	10° 58. 10	16.2
22	56° 27. 34	10° 59. 11	16.9
24	56° 28. 32	11° 01. 87	18.2
31	56° 26. 78	10° 59. 14	16.6
32	56° 26. 76	11° 00. 08	17.1
33	56° 26. 85	11° 01. 01	17.2
42	56° 26. 32	10° 58. 28	13.5
43	56° 26. 38	10° 58. 78	15.7
45	56° 26. 43	10° 59. 65	17.0
46	56° 26. 41	11° 00. 11	17.6
48	56° 26. 44	11° 01. 98	16.3
53	56° 26. 19	10° 59. 23	16.7
61	56° 25. 97	11° 00. 15	17.1
62	56° 25. 87	11° 01.12	13.6
64	56° 25. 52	10° 58. 38	13.6

Appendix 3.1 (continued)
Position and depth of stations at Fornæs.

continues

Station	North	East	Depth
73	56° 95. 35	10° 58. 37	13.6
75	56° 25. 43	10° 59. 35	15.4
76	56° 25. 38	11° 00. 22	16.3
78	56° 23. 38	11° 01. 97	17.5
79	56° 24. 95	10° 58. 48	13.7
80	56° 24. 90	10° 59. 30	18.0
82	56° 24. 89	11° 01. 10	17.0
83	56° 24. 27	11° 58. 53	13.6
86	56° 24. 25	11° 02. 02	18.6
87	56° 30. 19	10° 59. 87	16.6
88	56° 30. 23	11° 01. 82	16.6
89	56° 30. 31	11° 04. 58	17.0
90	56° 28. 97	11° 04. 55	18.0
91	56° 27. 68	11° 04. 58	18.4
92	56° 26. 37	11° 04. 62	18.7
93	56° 25. 29	11° 04. 58	19.0
94	56° 24. 26	11° 04. 61	20.0
95	56° 22. 90	11° 04. 53	20.3
96	56° 22. 97	11° 01. 94	18.6
97	56° 23. 06	11° 00. 33	15.7
112	56° 23. 65	11° 03. 32	19.4
113	56° 24. 89	11° 03. 30	19.0
114	56° 25. 98	11° 03. 33	18.4
115	56° 27. 27	11° 03. 19	18.7
116	56° 28. 56	11° 03. 22	18.0
117	56° 29. 59	11° 03. 16	17.6
118	56° 29. 51	11° 00. 79	17.2
119	56° 29. 53	10° 58. 84	14.5

Appendix 3.1 (continued)
Position and depth of stations at Fornæs.

Appendix 3.2

Species list, individuals per m^2, Århus Bay 1985-1991

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179006 28/10/85	179006 24/09/86	179006 04/11/87	179006 07/11/88	179006 31/10/89
NEMERTINEA			10		12
RETUSA TRUNCATULA			30		
PHILINE APERTA	10			30	
NUCULA TENUIS		10	30	10	12
MUSCULUS NIGER				30	23
MYSELLA BIDENTATA	130	160	70	60	290
ARCTICA ISLANDICA	10	70			23
PARVICARDIUM OVALE		20	10		
SPISULA SUBTRUNCATA	10		10		
ABRA ALBA	1650	760	70	1970	848
MACOMA CALCAREA	150	140	130	30	93
FABULINA FABULA			10		
PHAXAS PELLUCIDUS	60	10	10	10	35
MYA ARENARIA		20			12
CORBULA GIBBA	20	10	50	20	801
PHOLOE INORNATA			30	40	58
NEPHTYS CILIATA	30	40	20		35
NEPHTYS SP.					23
SCOLOPLOS ARMIGER	20	250	130	130	23
ARICIDEA SUECICA					12
PARAONIS FULGENS		10			
TROCHOCHAETA MULTISETOSA				60	
SPIO FILICORNIS	10				
POLYDORA CAECA	10				12
PSEUDOPOLYDORA PULCHRA	20			10	12
PHERUSA PLUMOSA					12
HETEROMASTUS FILIFORMIS		90	30	20	
MYRIOCHELE OCULATA	10	30		10	
PECTINARIA KORENI	30	20			12
AMPHARETE ACUTIFRONS				10	
ANOBOTHRUS GRACILIS		10			
TEREBELLIDES STROEMI	10				23
TUBIFICOIDES BENEDENI					12
BALANUS CRENATUS			10		
LEUCON NASICA					12
DIASTYLIS RATHKEI	30	30	10		46
DIASTYLIS LUCIFERA			10		
PHORONIS MUELLERI	10	10		30	116
PHORONIS SP.					46
OPHIURA ALBIDA	40	10		20	35
OPHIURA JUV.				10	
ECHINOCARDIUM CORDATUM	10				

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	179006 29/01/90	179006 06/03/90	179006 26/03/90	179006 06/05/90	179006 11/06/90
ANTHOZOA					
EDWARDSIA SP.	8		8		
NEMERTINEA					
RISSOA SP.				8	
HYDROBIA SP.					
HINIA RETICULATA			8	8	
RETUSA TRUNCATULA					
PHILINE APERTA					
PHILINE SCABRA					
BIVALVIA					
NUCULA TENUIS	41	41	90	66	66
NUCULA NITIDOSA					
MODIOLUS MODIOLUS					
MUSCULUS DISCOR		8			
MUSCULUS NIGER	33	25	49	25	16
MYTILIS EDULIS	8				
ASTARTE BOREALIS					
MYSELLA BIDENTATA	656	361	377	525	459
ARCTICA ISLANDICA	25	25			8
PARVICARDIUM OVALE				8	
SPISULA SUBTRUNCATA		8	8	16	16
ABRA NITIDA					
ABRA ALBA	459	426	303	377	918
MACOMA CALCAREA	74	57	41	8	74
FABULINA FABULA		8			
TELLINA TENUIS					
PHAXAS PELLUCIDUS	33	25		8	
MYA ARENARIA	8				
CORBULA GIBBA	672	811	721	525	320
HARMOTHOE IMPAR					
ANTINOELLA SARSI					
PHOLOE INORNATA	66	49	16	33	25
PHYLLODOCE MUCOSA					
PHYLLODOCE GROENLANDICA					
PHYLLODOCE SP.					
OPHIODROMUS FLEXUOSUS					
NEANTHES VIRENS					8
NEPHTYS HOMBERGII	8	8	8		16
NEPHTYS CILIATA	25	66	74	82	16
NEPHTYS PENTE					8
NEPHTYS CAECA					
NEPHTYS SP.			25	8	8
GLYCERA ALBA					
GONIADA MACULATA					
SCOLOPLOS ARMIGER	66	107	139	49	74
ARICIDEA SUECICA		49	90	25	8
TROCHOCHAETA MULTISETOSA		16	8		
SPIONIDAE					
SPIO FILICORNIS					
POLYDORA CAECA	8			16	
PSEUDOPOLYDORA PULCHRA	8	8			
PRIONOSPIO FALLAX	8	57	66	8	
CHAETOZONE SETOSA					8
OPHELINA ACUMINATA	8				
CAPITELLIDAE					
CAPITELLA CAPITATA					25
CAPITELLA SP.					
HETEROMASTUS FILIFORMIS	16	16	8		25
OWENIA FUSIFORMIS					
MYRIOCHELE OCULATA					
PECTINARIA KORENI	33				
PECTINARIA AURICOMA					
PECTINARIA SP.					
AMPHARETE FINMARCHICA					
AMPHARETE SP.					
TEREBELLIDAE		8			
LANICE CONCHILEGA					8
TEREBELLIDES STROEMI			8	8	

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	179006 29/01/90	179006 06/03/90	179006 26/03/90	179006 06/05/90	179006 11/06/90
OLIGOCHAETA					
TUBIFICOIDES BENEDENI					
GASTROSACCUS SPINIFER					
LEUCON NASICA					
EUDORELLA TRUNCATULA	8	8	8	8	
DIASTYLIS RATHKEI		8	16	25	33
DIASTYLIS BRADYI	8				
ARCTURELLA DILETATA					
PARIAMBUS TYPICUS					41
AMPELISCA BREVICORNIS					
MICROPROTOPUS MACULATUS					8
PHOTIS RHEINHARDI					16
PROTOMEDEIA FASCIATA					
COROPHIUM SP.					
MELITA OBTUSATA					
MICRODEUTOPUS ANOMALUS		16	8		
CRANGON CRANGON		8			
PHORONIS MUELLERI	90	74	213	123	90
PHORONIS SP.					
ASTERIAS RUBENS					8
AMPHIURA JUV.					
OPHIURA OPHIURA					
OPHIURA ALBIDA	16	33	49	41	25
OPHIURA JUV.	16	123	90	49	41
OPHIURA SP.					
ECHINOIDEA					
ECHINOCARDIUM CORDATUM					

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	179006 19/07/90	179006 21/08/90	179006 17/09/90	179006 05/11/90	179006 04/12/90
ANTHOZOA					
EDWARDSIA SP.				12	
NEMERTINEA		27		12	
RISSOA SP.					
HYDROBIA SP.					
HINIA RETICULATA					65
RETUSA TRUNCATULA					
PHILINE APERTA				81	
PHILINE SCABRA		18	73	12	
BIVALVIA					
NUCULA TENUIS	57	126	57	23	24
NUCULA NITIDOSA					8
MODIOLUS MODIOLUS					
MUSCULUS DISCOR					
MUSCULUS NIGER	33	9	16	12	8
MYTILIS EDULIS					
ASTARTE BOREALIS		9			
MYSELLA BIDENTATA	549	1084	959	1452	1244
ARCTICA ISLANDICA	25	45	49	58	16
PARVICARDIUM OVALE	8			12	
SPISULA SUBTRUNCATA		72	8		8
ABRA NITIDA					
ABRA ALBA	1205	1427	1081	941	1041
MACOMA CALCAREA	107	54	33	58	16
FABULINA FABULA					
TELLINA TENUIS					
PHAXAS PELLUCIDUS		9	24	35	16
MYA ARENARIA	8				
CORBULA GIBBA	254	63	89	105	65
HARMOTHOE IMPAR					
ANTINOELLA SARSI				12	
PHOLOE INORNATA	49	27		128	33
PHYLLODOCE MUCOSA					
PHYLLODOCE GROENLANDICA	8				
PHYLLODOCE SP.					
OPHIODROMUS FLEXUOSUS					
NEANTHES VIRENS	8				
NEPHTYS HOMBERGII	8			23	
NEPHTYS CILIATA	74	63	33		33
NEPHTYS PENTE					
NEPHTYS CAECA					
NEPHTYS SP.		9		12	
GLYCERA ALBA		9	8	35	
GONIADA MACULATA			8		
SCOLOPLOS ARMIGER	33	27	24	23	
ARICIDEA SUECICA	49	18	8	35	8
TROCHOCHAETA MULTISETOSA	25	81	8	12	8
SPIONIDAE	8				
SPIO FILICORNIS	8				
POLYDORA CAECA	8	9			
PSEUDOPOLYDORA PULCHRA				46	8
PRIONOSPIO FALLAX	33	27		105	
CHAETOZONE SETOSA	8				
OPHELINA ACUMINATA					
CAPITELLIDAE					
CAPITELLA CAPITATA					16
CAPITELLA SP.					
HETEROMASTUS FILIFORMIS	49	54	24	70	8
OWENIA FUSIFORMIS		9			
MYRIOCHELE OCULATA		45			
PECTINARIA KORENI			33	35	33
PECTINARIA AURICOMA					
PECTINARIA SP.					
AMPHARETE FINMARCHICA			8		
AMPHARETE SP.				12	
TEREBELLIDAE					
LANICE CONCHILEGA					
TEREBELLIDES STROEMI		18			

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179006 19/07/90	179006 21/08/90	179006 17/09/90	179006 05/11/90	179006 04/12/90
OLIGOCHAETA					
TUBIFICOIDES BENEDENI				12	
GASTROSACCUS SPINIFER					
LEUCON NASICA			8		
EUDORELLA TRUNCATULA	8				
DIASTYLIS RATHKEI	8	18	8	23	16
DIASTYLIS BRADYI					
ARCTURELLA DILETATA					
PARIAMBUS TYPICUS					
AMPELISCA BREVICORNIS					8
MICROPROTOPUS MACULATUS					
PHOTIS RHEINHARDI					
PROTOMEDEIA FASCIATA					
COROPHIUM SP.					
MELITA OBTUSATA		18			
MICRODEUTOPUS ANOMALUS					
CRANGON CRANGON					
PHORONIS MUELLERI	74			58	
PHORONIS SP.			65	12	24
ASTERIAS RUBENS		9			
AMPHIURA JUV.					
OPHIURA OPHIURA					
OPHIURA ALBIDA	8	45	24		16
OPHIURA JUV.	57			70	57
OPHIURA SP.					
ECHINOIDEA					8
ECHINOCARDIUM CORDATUM				12	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179006 21/01/91	179006 26/02/91	179006 25/03/91	179006 03/05/91	179006 29/05/91
ANTHOZOA					
EDWARDSIA SP.			8		
NEMERTINEA					
RISSOA SP.					
HYDROBIA SP.					
HINIA RETICULATA	41	27	24	16	8
RETUSA TRUNCATULA			8		8
PHILINE APERTA	8				
PHILINE SCABRA	8				
BIVALVIA					
NUCULA TENUIS	49	36	41	41	41
NUCULA NITIDOSA					
MODIOLUS MODIOLUS					
MUSCULUS DISCOR					
MUSCULUS NIGER			8	8	8
MYTILIS EDULIS					
ASTARTE BOREALIS					
MYSELLA BIDENTATA	1041	1192	821	659	447
ARCTICA ISLANDICA	16	18	33	33	24
PARVICARDIUM OVALE		9		8	
SPISULA SUBTRUNCATA					
ABRA NITIDA					
ABRA ALBA	829	515	593	423	358
MACOMA CALCAREA	16	9	24	8	16
FABULINA FABULA					
TELLINA TENUIS			8		
PHAXAS PELLUCIDUS		9	16	24	
MYA ARENARIA					
CORBULA GIBBA	98	81	16	49	33
HARMOTHOE IMPAR					
ANTINOELLA SARSI					
PHOLOE INORNATA	187	154	65	130	81
PHYLLODOCE MUCOSA	8				
PHYLLODOCE GROENLANDICA					
PHYLLODOCE SP.		9			
OPHIODROMUS FLEXUOSUS		9			
NEANTHES VIRENS					
NEPHTYS HOMBERGII	8				
NEPHTYS CILIATA	33	18	24	24	24
NEPHTYS PENTE					
NEPHTYS CAECA					
NEPHTYS SP.	8	27	16	33	8
GLYCERA ALBA					
GONIADA MACULATA					
SCOLOPLOS ARMIGER	65	27		8	16
ARICIDEA SUECICA	8		8	49	16
TROCHOCHAETA MULTISETOSA		27	24	16	
SPIONIDAE					
SPIO FILICORNIS					
POLYDORA CAECA	16				
PSEUDOPOLYDORA PULCHRA	8	9			16
PRIONOSPIO FALLAX	81	27	41	98	57
CHAETOZONE SETOSA					
OPHELINA ACUMINATA					
CAPITELLIDAE	8				
CAPITELLA CAPITATA		9			
CAPITELLA SP.	8				
HETEROMASTUS FILIFORMIS	49	18		16	8
OWENIA FUSIFORMIS					
MYRIOCHELE OCULATA					
PECTINARIA KORENI		9			
PECTINARIA AURICOMA					
PECTINARIA SP.					
AMPHARETE FINMARCHICA					
AMPHARETE SP.					
TEREBELLIDAE					
LANICE CONCHILEGA					
TEREBELLIDES STROEMI					

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179006 21/01/91	179006 26/02/91	179006 25/03/91	179006 03/05/91	179006 29/05/91
OLIGOCHAETA			8	8	
TUBIFICOIDES BENEDENI				8	
GASTROSACCUS SPINIFER					
LEUCON NASICA					
EUDORELLA TRUNCATULA				49	
DIASTYLIS RATHKEI	16				41
DIASTYLIS BRADYI					
ARCTURELLA DILETATA					
PARIAMBUS TYPICUS					
AMPELISCA BREVICORNIS		9			
MICROPROTOPUS MACULATUS					
PHOTIS RHEINHARDI					
PROTOMEDEIA FASCIATA					
COROPHIUM SP.					
MELITA OBTUSATA					
MICRODEUTOPUS ANOMALUS					
CRANGON CRANGON					
PHORONIS MUELLERI	24	9	8	16	16
PHORONIS SP.	49		57	41	8
ASTERIAS RUBENS					
AMPHIURA JUV.	24				
OPHIURA OPHIURA				8	
OPHIURA ALBIDA	24	9	24	8	16
OPHIURA JUV.	130	172	122	81	24
OPHIURA SP.					
ECHINOIDEA					
ECHINOCARDIUM CORDATUM	8				

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179006 25/06/91	179006 05/08/91	179006 13/09/91	179006 23/10/91	179006 15/11/91
ANTHOZOA	8				
EDWARDSIA SP.			8		
NEMERTINEA	8				
RISSOA SP.					
HYDROBIA SP.					8
HINIA RETICULATA	16	33	8	12	41
RETUSA TRUNCATULA					
PHILINE APERTA					
PHILINE SCABRA					
BIVALVIA	8				
NUCULA TENUIS	41	65	33	35	33
NUCULA NITIDOSA					
MODIOLUS MODIOLUS					8
MUSCULUS DISCOR					
MUSCULUS NIGER	16	24	8		8
MYTILIS EDULIS					
ASTARTE BOREALIS					
MYSELLA BIDENTATA	691	1065	618	1057	837
ARCTICA ISLANDICA	16	41	49	23	8
PARVICARDIUM OVALE					
SPISULA SUBTRUNCATA	8		8	12	
ABRA NITIDA			8		
ABRA ALBA	667	1764	1179	743	650
MACOMA CALCAREA	24	24	49	12	41
FABULINA FABULA					
TELLINA TENUIS				23	
PHAXAS PELLUCIDUS			8	58	16
MYA ARENARIA					
CORBULA GIBBA	49	8		23	24
HARMOTHOE IMPAR		8			
ANTINOELLA SARSI					
PHOLOE INORNATA	122	163	106	139	89
PHYLLODOCE MUCOSA					
PHYLLODOCE GROENLANDICA					
PHYLLODOCE SP.		8			
OPHIODROMUS FLEXUOSUS					
NEANTHES VIRENS					
NEPHTYS HOMBERGII					
NEPHTYS CILIATA	8	41	8	35	16
NEPHTYS PENTE					
NEPHTYS CAECA			8		
NEPHTYS SP.	24	8	8		
GLYCERA ALBA					
GONIADA MACULATA					
SCOLOPLOS ARMIGER	49	33	16		16
ARICIDEA SUECICA	41	49	8	12	8
TROCHOCHAETA MULTISETOSA	24	24		12	8
SPIONIDAE					
SPIO FILICORNIS					
POLYDORA CAECA					
PSEUDOPOLYDORA PULCHRA				12	
PRIONOSPIO FALLAX	98	49	49	81	49
CHAETOZONE SETOSA					
OPHELINA ACUMINATA					
CAPITELLIDAE					
CAPITELLA CAPITATA					8
CAPITELLA SP.					
HETEROMASTUS FILIFORMIS	16	41		23	
OWENIA FUSIFORMIS					
MYRIOCHELE OCULATA					
PECTINARIA KORENI		8		105	16
PECTINARIA AURICOMA				12	49
PECTINARIA SP.		8			
AMPHARETE FINMARCHICA					
AMPHARETE SP.					
TEREBELLIDAE					
LANICE CONCHILEGA					
TEREBELLIDES STROEMI					

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179006 25/06/91	179006 05/08/91	179006 13/09/91	179006 23/10/91	179006 15/11/91
OLIGOCHAETA					
TUBIFICOIDES BENEDENI					
GASTROSACCUS SPINIFER				23	
LEUCON NASICA					
EUDORELLA TRUNCATULA	8	8	8		
DIASTYLIS RATHKEI				12	
DIASTYLIS BRADYI					
ARCTURELLA DILETATA				12	
PARIAMBUS TYPICUS					
AMPELISCA BREVICORNIS					
MICROPROTOPUS MACULATUS					
PHOTIS RHEINHARDI					
PROTOMEDEIA FASCIATA	8				
COROPHIUM SP.	8				
MELITA OBTUSATA			16		
MICRODEUTOPUS ANOMALUS					
CRANGON CRANGON					
PHORONIS MUELLERI	24			35	
PHORONIS SP.	24		16	12	24
ASTERIAS RUBENS			8		
AMPHIURA JUV.	16				
OPHIURA OPHIURA					
OPHIURA ALBIDA	24	24	16		
OPHIURA JUV.	41			81	122
OPHIURA SP.			8		
ECHINOIDEA					
ECHINOCARDIUM CORDATUM		16		58	8

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	179006 16/12/91				
ANTHOZOA					
EDWARDSIA SP.					
NEMERTINEA					
RISSOA SP.					
HYDROBIA SP.					
HINIA RETICULATA	8				
RETUSA TRUNCATULA					
PHILINE APERTA					
PHILINE SCABRA					
BIVALVIA					
NUCULA TENUIS	24				
NUCULA NITIDOSA					
MODIOLUS MODIOLUS					
MUSCULUS DISCOR					
MUSCULUS NIGER					
MYTILIS EDULIS					
ASTARTE BOREALIS					
MYSELLA BIDENTATA	463				
ARCTICA ISLANDICA	8				
PARVICARDIUM OVALE					
SPISULA SUBTRUNCATA					
ABRA NITIDA	16				
ABRA ALBA	512				
MACOMA CALCAREA	41				
FABULINA FABULA					
TELLINA TENUIS	8				
PHAXAS PELLUCIDUS	16				
MYA ARENARIA					
CORBULA GIBBA	24				
HARMOTHOE IMPAR					
ANTINOELLA SARSI					
PHOLOE INORNATA	114				
PHYLLODOCE MUCOSA					
PHYLLODOCE GROENLANDICA	8				
PHYLLODOCE SP.					
OPHIODROMUS FLEXUOSUS					
NEANTHES VIRENS					
NEPHTYS HOMBERGII	8				
NEPHTYS CILIATA	24				
NEPHTYS PENTE					
NEPHTYS CAECA					
NEPHTYS SP.	16				
GLYCERA ALBA					
GONIADA MACULATA					
SCOLOPLOS ARMIGER	8				
ARICIDEA SUECICA	16				
TROCHOCHAETA MULTISETOSA					
SPIONIDAE					
SPIO FILICORNIS					
POLYDORA CAECA					
PSEUDOPOLYDORA PULCHRA					
PRIONOSPIO FALLAX	130				
CHAETOZONE SETOSA					
OPHELINA ACUMINATA					
CAPITELLIDAE					
CAPITELLA CAPITATA	24				
CAPITELLA SP.					
HETEROMASTUS FILIFORMIS	8				
OWENIA FUSIFORMIS					
MYRIOCHELE OCULATA					
PECTINARIA KORENI	33				
PECTINARIA AURICOMA					
PECTINARIA SP.					
AMPHARETE FINMARCHICA					
AMPHARETE SP.					
TEREBELLIDAE					
LANICE CONCHILEGA					
TEREBELLIDES STROEMI					

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	179006 16/12/91				
OLIGOCHAETA					
TUBIFICOIDES BENEDENI					
GASTROSACCUS SPINIFER					
LEUCON NASICA					
EUDORELLA TRUNCATULA					
DIASTYLIS RATHKEI	16				
DIASTYLIS BRADYI					
ARCTURELLA DILETATA					
PARIAMBUS TYPICUS					
AMPELISCA BREVICORNIS	8				
MICROPROTOPUS MACULATUS					
PHOTIS RHEINHARDI					
PROTOMEDEIA FASCIATA					
COROPHIUM SP.					
MELITA OBTUSATA					
MICRODEUTOPUS ANOMALUS					
CRANGON CRANGON					
PHORONIS MUELLERI	8				
PHORONIS SP.	8				
ASTERIAS RUBENS					
AMPHIURA JUV.					
OPHIURA OPHIURA					
OPHIURA ALBIDA	8				
OPHIURA JUV.	203				
OPHIURA SP.					
ECHINOIDEA					
ECHINOCARDIUM CORDATUM	8				

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179015 28/10/85	179015 22/09/86	179015 04/11/87	179015 07/11/88	
RETUSA TRUNCATULA			50		
PHILINE APERTA	30				
NUCULA TENUIS		10	20	20	
MUSCULUS NIGER			10		
MYSELLA BIDENTATA	20		10	10	
ARCTICA ISLANDICA		30			
PARVICARDIUM OVALE		10			
ABRA ALBA	1730	530	610	350	
MACOMA CALCAREA	40	10	30	30	
PHAXAS PELLUCIDUS	20	10	10		
MYA ARENARIA			10		
CORBULA GIBBA	100	30	10	30	
PHOLOE INORNATA	10	10	10	110	
NEPHTYS HOMBERGII			10		
NEPHTYS CILIATA	40	10	20		
SCOLOPLOS ARMIGER	10		20	30	
ARICIDEA SUECICA		10			
TROCHOCHAETA MULTISETOSA		20			
PSEUDOPOLYDORA PULCHRA	20			50	
HETEROMASTUS FILIFORMIS	10	110	220	20	
MYRIOCHELE OCULATA		20	30		
PECTINARIA KORENI	30	20			
TEREBELLIDES STROEMI				20	
DIASTYLIS RATHKEI	30	30			
CAPRELLA SP.			10		
AMPELISCA BREVICORNIS		10			
PHORONIS MUELLERI	20	10		50	
OPHIURA OPHIURA			10		
OPHIURA ALBIDA	180	180	90	10	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179015 01/11/89	179015 01/11/90	179015 23/10/91		
PLATYHELMINTHES			12		
HINIA RETICULATA		12	23		
RETUSA TRUNCATULA	14				
PHILINE APERTA			35		
PHILINE SCABRA		93			
NUCULA TENUIS	27	93	23		
MUSCULUS NIGER	14		46		
MYSELLA BIDENTATA	285	488	465		
ARCTICA ISLANDICA	41	23	12		
PARVICARDIUM OVALE	27	23	23		
SPISULA SUBTRUNCATA	14		12		
ABRA NITIDA		12	12		
ABRA ALBA	1314	859	1045		
MACOMA CALCAREA	27	46	46		
TELLINA TENUIS	14				
PHAXAS PELLUCIDUS	54	81	12		
CORBULA GIBBA	434	46	23		
PHOLOE INORNATA	14	46	70		
HEDISTE DIVERSICOLOR		12			
NEPHTYS HOMBERGII		12	35		
NEPHTYS CILIATA	41	58			
NEPHTYS SP.	27	23	23		
SCOLOPLOS ARMIGER	68	46			
ARICIDEA SUECICA		23			
LEVINSENIA GRACILIS		12			
POLYDORA CAECA	14				
PSEUDOPOLYDORA PULCHRA		58			
PRIONOSPIO FALLAX		116	93		
STREBLOSPIO SHRUBSOLII		12			
BRADA VILLOSA	14				
HETEROMASTUS FILIFORMIS		58	70		
PECTINARIA KORENI	54	12	46		
PECTINARIA AURICOMA	14	12			
AMPHARETE FINMARCHICA		23			
AMPHARETE SP.	14				
AMPHICTEIS GUNNERI			12		
TEREBELLIDES STROEMI	149				
OLIGOCHAETA		23	12		
EUDORELLA TRUNCATULA			12		
DIASTYLIS RATHKEI	27	35			
GAMMARUS SALINUS	14				
PHORONIS MUELLERI	27	46	12		
PHORONIS SP.	54	116	81		
AMPHIURA JUV.		12			
OPHIURA ALBIDA	27	58	23		
OPHIURA JUV.	54	46	186		
ECHINOIDEA		12			
ECHINOCARDIUM CORDATUM		12	23		

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179024 28/10/85	179024 24/09/86	179024 04/11/87	179024 07/11/88	
PHILINE APERTA	20				
PHILINE SCABRA	20				
NUCULA TENUIS	10	10		20	
MODIOLUS MODIOLUS	10		10		
MUSCULUS NIGER	40		20	10	
MYSELLA BIDENTATA	70	10	30		
ARCTICA ISLANDICA	50	40	30	80	
SPISULA SUBTRUNCATA	10				
ABRA ALBA	1350	880	250	230	
MACOMA CALCAREA		30	20		
PHAXAS PELLUCIDUS	30				
CORBULA GIBBA	350	10	50	50	
PHOLOE INORNATA	10			20	
PHYLLODOCE MACULATA				10	
NEPHTYS HOMBERGII		10			
NEPHTYS CILIATA	80	20	40		
GLYCERA ALBA	10				
SCOLOPLOS ARMIGER	50		30		
TROCHOCHAETA MULTISETOSA	10	40			
PSEUDOPOLYDORA PULCHRA	10				
HETEROMASTUS FILIFORMIS	60	10	40		
MYRIOCHELE OCULATA	110	10	20		
PECTINARIA KORENI	90				
TEREBELLIDES STROEMI	60	40	30	10	
EUCHONE PAPILLOSA	10	10			
LEUCON NASICA	10				
DIASTYLIS RATHKEI	40	30	10		
PHORONIS MUELLERI	10				
ASTERIAS RUBENS	10				
OPHIURA ALBIDA	510	130	50	30	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179024 31/10/89	179024 01/11/90	179024 23/10/91		
HINIA RETICULATA		12	35		
PHILINE APERTA	23	46	23		
PHILINE SCABRA		46			
NUCULA TENUIS	12	12	46		
MODIOLUS MODIOLUS	12	12	12		
MUSCULUS NIGER	128	23	12		
MYTILIS EDULIS	12	35	105		
MYSELLA BIDENTATA	105	244	58		
ARCTICA ISLANDICA	105	244	116		
PARVICARDIUM OVALE	12	23	70		
SPISULA SUBTRUNCATA		81	12		
ABRA NITIDA		12	12		
ABRA ALBA	1092	488	58		
MACOMA CALCAREA			12		
PHAXAS PELLUCIDUS	35	12			
MYA ARENARIA		12			
CORBULA GIBBA	801	441	453		
HARMOTHOE IMPAR			12		
ANTINOELLA SARSI			12		
PHOLOE INORNATA	46	70	93		
PHYLLODICIDAE	12				
PHYLLODOCE MACULATA	12				
NEREIMYRA PUNCTATA			12		
NEPHTYS HOMBERGII	12	12			
NEPHTYS CILIATA	35	70	23		
NEPHTYS SP.	46	23	35		
GLYCERA ALBA			12		
SCOLOPLOS ARMIGER	93	35	151		
ARICIDEA SUECICA	12	12	81		
TROCHOCHAETA MULTISETOSA		12			
SPIO FILICORNIS			12		
POLYDORA CAECA			12		
PSEUDOPOLYDORA PULCHRA		105			
PRIONOSPIO FALLAX	23	58	383		
CAPITELLA CAPITATA		35			
HETEROMASTUS FILIFORMIS	35	23	93		
MYRIOCHELE OCULATA	23		12		
PECTINARIA KORENI	70	23	151		
TEREBELLIDES STROEMI	46		12		
OLIGOCHAETA		46			
AORIDAE SP.			12		
BALANUS CRENATUS		639	46		
GASTROSACCUS SPINIFER			12		
EUDORELLA TRUNCATULA	23				
DIASTYLIS RATHKEI	35	46	46		
ARCTURELLA DILETATA			12		
PHTISICA MARINA			12		
PARIAMBUS TYPICUS			12		
PHORONIS MUELLERI	12				
PHORONIS SP.	35		12		
OPHIURA OPHIURA	12				
OPHIURA ALBIDA	105	151	23		
OPHIURA JUV.	105	174	476		
OPHIURA SP.		12			
PSAMMECHINUS MILIARIS			12		
ECHINOCARDIUM CORDATUM		12	12		

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179025 28/10/85	179025 24/09/86	179025 04/11/87	179025 07/11/88	
RETUSA TRUNCATULA			40		
PHILINE APERTA	10				
PHILINE SCABRA	20	10			
NUCULA TENUIS	20		40	80	
MUSCULUS NIGER	20				
MYSELLA BIDENTATA	70	70	60		
ARCTICA ISLANDICA	30	20	10		
ABRA ALBA	1450	450	590	100	
MACOMA CALCAREA	40	90		10	
PHAXAS PELLUCIDUS	50				
CORBULA GIBBA	150		50		
PHOLOE INORNATA		10	10		
NEPHTYS CILIATA	50	20	20		
SCOLOPLOS ARMIGER			20	10	
TROCHOCHAETA MULTISETOSA	30	40	10		
PSEUDOPOLYDORA PULCHRA	10			10	
BRADA VILLOSA	10		10		
HETEROMASTUS FILIFORMIS	40	60	260	50	
MYRIOCHELE OCULATA	10	20	10		
PECTINARIA KORENI	20	10	10		
AMPHERETE BALTICA	10				
TEREBELLIDES STROEMI			30	10	
DIASTYLIS RATHKEI	10	20		30	
CRANGON CRANGON	10				
PHORONIS MUELLERI		40	10		
OPHIURA OPHIURA		10			
OPHIURA ALBIDA	210	10	70	100	
ECHINOCARDIUM CORDATUM	10				

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179025 31/10/89	179025 01/11/90	179025 23/10/91		
VIRGULARIA MIRABILIS		23	46		
PLATYHELMINTHES	12				
HINIA RETICULATA		12			
PHILINE APERTA	12	23			
PHILINE SCABRA		12			
NUCULA TENUIS	221	70	139		
MUSCULUS NIGER		12			
MYTILIS EDULIS	23				
TELLIMYA FERRUGINOSA			12		
MYSELLA BIDENTATA	23	81	151		
ARCTICA ISLANDICA	35	35	58		
SPISULA SUBTRUNCATA	12	23	23		
ABRA NITIDA		93			
ABRA ALBA	685	499	488		
MACOMA CALCAREA		12			
PHAXAS PELLUCIDUS		23	23		
CORBULA GIBBA	418	174	151		
HARMOTHOE SP.			12		
PHOLOE INORNATA	12	128			
NEPHTYS HOMBERGII		12	23		
NEPHTYS CILIATA	23	35	23		
NEPHTYS CAECA	46				
NEPHTYS LONGOSETOSA			23		
NEPHTYS SP.	23	23			
SCOLOPLOS ARMIGER		12			
ARICIDEA SUECICA	12	12			
PSEUDOPOLYDORA PULCHRA		23	12		
PRIONOSPIO FALLAX	12	46	221		
BRADA VILLOSA	23		12		
CAPITELLIDAE	23				
NOTOMASTUS LATERICEUS			12		
HETEROMASTUS FILIFORMIS	35	46	12		
MYRIOCHELE OCULATA	12				
PECTINARIA KORENI	23		12		
AMPHARETE ACUTIFRONS		12			
TEREBELLIDES STROEMI	70				
OLIGOCHAETA		35	12		
AORIDAE SP.			12		
EUDORELLA TRUNCATULA			23		
DIASTYLIS RATHKEI		12			
DIASTYLIS BRADYI			12		
ARGISSA HAMATIPES			12		
AMPELISCA BREVICORNIS			46		
PHORONIS MUELLERI	12	35			
PHORONIS SP.	12				
AMPHIURA FILIFORMIS	12				
AMPHIURA JUV.			12		
OPHIURA ALBIDA	58	23	58		
OPHIURA JUV.	58	58	174		
ECHINOCARDIUM CORDATUM			12		
BRISSOPSIS LYRIFERA		81			

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179029 28/10/85	179029 22/09/86	179029 04/11/87	179029 07/11/88
PLATYHELMINTHES				10
RETUSA TRUNCATULA			90	
PHILINE SCABRA	10			
NUCULA TENUIS		10		
MUSCULUS NIGER		40		10
MYSELLA BIDENTATA	70	130	40	510
ARCTICA ISLANDICA	20	70	20	
PARVICARDIUM OVALE		10	20	
ABRA ALBA	450	810	40	3470
MACOMA CALCAREA	210	100	80	170
FABULINA FABULA	10			
PHAXAS PELLUCIDUS			10	10
MYA TRUNCATA				10
CORBULA GIBBA	40	40		140
PHOLOE INORNATA	10	20	20	140
NEPHTYS HOMBERGII	10		20	
NEPHTYS CILIATA	10	10	10	
SCOLOPLOS ARMIGER			90	50
TROCHOCHAETA MULTISETOSA		20		360
PSEUDOPOLYDORA PULCHRA				40
CAPITELLA CAPITATA				10
HETEROMASTUS FILIFORMIS	10	110	10	10
MYRIOCHELE OCULATA	10	60		
PECTINARIA KORENI	10	50		60
TEREBELLIDES STROEMI				10
TUBIFICOIDES BENEDENI				10
DIASTYLIS RATHKEI	10	50		
PRIAPULUS CAUDATUS				10
PHORONIS MUELLERI	20	20	60	70
ASTERIAS RUBENS		10		
OPHIURA ALBIDA	60	50		
OPHIOCTEN GRACILIS				10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179029 31/10/89	179029 02/11/90	179029 22/10/91		
HINIA RETICULATA		46	54		
PHILINE APERTA		46			
PHILINE SCABRA		23			
NUCULA TENUIS	23	70			
MUSCULUS NIGER	35		14		
MYSELLA BIDENTATA	2846	2625	2263		
ARCTICA ISLANDICA		128	68		
SPISULA SUBTRUNCATA	12				
ABRA NITIDA		70	14		
ABRA ALBA	743	1022	1138		
MACOMA CALCAREA	46	35			
FABULINA FABULA	12				
PHAXAS PELLUCIDUS	12	128	95		
CORBULA GIBBA	859	139	298		
ANTINOELLA SARSI		12			
PHOLOE INORNATA	151	105	136		
PHYLLODICIDAE		12			
PHYLLODOCE MUCOSA		12			
PHYLLODOCE MACULATA			14		
SYNELMIS KLATTI		12			
NEANTHES VIRENS		12			
NEPHTYS HOMBERGII		23			
NEPHTYS CILIATA		58	41		
NEPHTYS CAECA	46				
NEPHTYS SP.			68		
GLYCERA ALBA		23			
SCOLOPLOS ARMIGER	23	23	41		
ARICIDEA SUECICA		23	41		
TROCHOCHAETA MULTISETOSA	46	70	14		
PSEUDOPOLYDORA PULCHRA		35	14		
PRIONOSPIO FALLAX	70	35	81		
CAPITELLA CAPITATA	23				
HETEROMASTUS FILIFORMIS		58	149		
PECTINARIA KORENI	105	46	176		
PECTINARIA AURICOMA		46			
OLIGOCHAETA		70			
BALANUS SP.			41		
EUDORELLA TRUNCATULA	12				
DIASTYLIS RATHKEI	23	35	41		
AMPELISCA BREVICORNIS	23		14		
PHORONIS MUELLERI	139	105	95		
PHORONIS SP.	46	58	163		
OPHIURA ALBIDA	12				
OPHIURA JUV.	12	174	339		
ECHINOCARDIUM CORDATUM		23			

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179030 28/10/85	179030 24/09/86	179030 04/11/87	179030 07/11/88	
PLATYHELMINTHES				10	
RETUSA TRUNCATULA			40		
PHILINE SCABRA	10				
NUCULA TENUIS		10	10	20	
MUSCULUS NIGER		20	10		
MYSELLA BIDENTATA		140		10	
ARCTICA ISLANDICA		20			
PARVICARDIUM OVALE			10		
ABRA ALBA	1530	1100	150	640	
MACOMA CALCAREA	10	230	30	40	
PHAXAS PELLUCIDUS	130		10		
CORBULA GIBBA	80		10		
PHOLOE INORNATA		10	40	10	
NEPHTYS HOMBERGII		10			
NEPHTYS CILIATA	40	50	20		
SCOLOPLOS ARMIGER		10	50		
TROCHOCHAETA MULTISETOSA	20	100			
PSEUDOPOLYDORA PULCHRA	20				
HETEROMASTUS FILIFORMIS	30	20	90		
MYRIOCHELE OCULATA	20	20	10		
PECTINARIA KORENI		30		10	
TEREBELLIDES STROEMI				20	
DIASTYLIS RATHKEI		50		10	
IDOTEA BALTHICA				10	
PHORONIS MUELLERI	10	20	10	20	
ASTERIAS RUBENS		10			
OPHIURA ALBIDA	110	100			

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
	Individantal /m2				
Art	179030 31/10/89	179030 01/11/90	179030 23/10/91		
NEMERTINEA		12			
HINIA RETICULATA		12	27		
PHILINE APERTA	23				
PHILINE SCABRA	23	23			
NUCULA TENUIS	81	58	68		
MUSCULUS NIGER	81	23	14		
MYSELLA BIDENTATA	279	801	420		
ARCTICA ISLANDICA	12	46	27		
PARVICARDIUM OVALE	12	35			
SPISULA SUBTRUNCATA		12			
ABRA NITIDA		46	27		
ABRA ALBA	1510	1185	1003		
MACOMA CALCAREA	23	46	14		
PHAXAS PELLUCIDUS	81	93	27		
CORBULA GIBBA	523	221	41		
PHOLOE INORNATA	46	35	122		
NEPHTYS HOMBERGII		12			
NEPHTYS CILIATA		46	14		
NEPHTYS SP.		12	14		
GLYCERA ALBA		12			
SCOLOPLOS ARMIGER	23	23	27		
ARICIDEA SUECICA	12	23			
LEVINSENIA GRACILIS			14		
PSEUDOPOLYDORA PULCHRA		81			
PRIONOSPIO FALLAX		116	27		
HETEROMASTUS FILIFORMIS		81	41		
PECTINARIA KORENI	12	12	27		
PECTINARIA AURICOMA	12	12			
TEREBELLIDES STROEMI	70	12			
OLIGOCHAETA		23			
EUDORELLA TRUNCATULA		12	14		
DIASTYLIS RATHKEI	35	23			
COROPHIUM CRASSICORNE		12			
PHORONIS MUELLERI	81	70	27		
PHORONIS SP.	12		54		
OPHIURA OPHIURA	12				
OPHIURA ALBIDA	23	70			
OPHIURA JUV.	35	35	217		

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179051 28/10/85	179051 22/09/86	179051 04/11/87	179051 07/11/88	
			20		
HYDROBIA SP.		10			
MODIOLUS MODIOLUS			50		
MYSELLA BIDENTATA	10	50	60		
ARCTICA ISLANDICA	10				
SPISULA ELLIPTICA	10				
ABRA ALBA	110	20	30		
MACOMA CALCAREA	30		50		
PHAXAS PELLUCIDUS	10				
CORBULA GIBBA			40		
NEANTHES VIRENS			90		
NEPHTYS HOMBERGII			20		
NEPHTYS CILIATA	10				
TROCHOCHAETA MULTISETOSA		80			
CAPITELLA CAPITATA	10	20			
MYRIOCHELE OCULATA		10			
PECTINARIA KORENI		50	10		
TUBIFICOIDES BENEDENI		10	20		
PHORONIS MUELLERI	10				
OPHIURA ALBIDA	10				

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179051 30/10/89	179051 04/10/90	179051 25/10/91		
PLATYHELMINTHES	23				
HYDROBIA ULVAE			116		
HINIA RETICULATA			23		
PHILINE APERTA		12			
MYTILIS EDULIS		12			
MYSELLA BIDENTATA	46	407	1533		
ARCTICA ISLANDICA		46	12		
SPISULA SUBTRUNCATA		58	23		
ABRA ALBA		906	1812		
MACOMA BALTHICA			23		
MACOMA CALCAREA	12	23			
MYA ARENARIA			12		
CORBULA GIBBA	70	325	46		
ANTINOELLA SARSI			12		
PHOLOE INORNATA		163	35		
NEREIDIDAE			12		
HEDISTE DIVERSICOLOR		23			
NEPHTYS HOMBERGII		12			
NEPHTYS SP.		35	58		
GLYCERA ALBA		70			
SCOLOPLOS ARMIGER			12		
TROCHOCHAETA MULTISETOSA			58		
POLYDORA CAECA			12		
PRIONOSPIO FALLAX			35		
CAPITELLA CAPITATA		12	12		
HETEROMASTUS FILIFORMIS	12				
PECTINARIA KORENI	12	116	35		
TEREBELLIDES STROEMI		70			
TUBIFICOIDES BENEDENI	23				
DIASTYLIS RATHKEI	12	35	12		
PHORONIS SP.			12		
ECHINOCARDIUM CORDATUM			12		

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179064 28/10/85	179064 22/09/86	179064 04/11/87	179064 07/11/88	
HYDROBIA SP.				10	
MYSELLA BIDENTATA			10		
ARCTICA ISLANDICA	10				
ABRA ALBA				10	
CORBULA GIBBA	10				
NEPHTYS HOMBERGII			10		
SCOLOPLOS ARMIGER		10			
CAPITELLA CAPITATA			10		
HETEROMASTUS FILIFORMIS				40	
MYRIOCHELE OCULATA			10		
TUBIFICOIDES BENEDENI	10				
DIASTYLIS RATHKEI				20	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179064 31/10/89	179064 09/10/90	179069 22/10/91		
PHILINE SCABRA		12			
MYTILIS EDULIS		12			
MYSELLA BIDENTATA	174	35	58		
ARCTICA ISLANDICA			23		
ABRA ALBA			151		
TELLINA TENUIS		12			
CORBULA GIBBA	58	23	174		
PHOLOE INORNATA	12		23		
NEPHTYS HOMBERGII		23	46		
NEPHTYS SP.			23		
POLYDORA CAECA	12				
PRIONOSPIO FALLAX			23		
CAPITELLA CAPITATA		23			
PECTINARIA KORENI	23	12			
OLIGOCHAETA		12			
TUBIFICOIDES BENEDENI	546		23		
BALANUS CRENATUS		23			
DIASTYLIS BRADYI			35		
AMPELISCA BREVICORNIS			12		
PHORONIS MUELLERI			23		

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179071 28/10/85	179071 22/09/86	179071 04/11/87	179071 07/11/88	
HYDROBIA SP.	10				
OPISTHOBRANCHIA				10	
RETUSA TRUNCATULA			30		
PHILINE APERTA	10				
NUCULA TENUIS			10		
MODIOLUS MODIOLUS			10		
MYSELLA BIDENTATA	660	730	1360	140	
ARCTICA ISLANDICA	10	10	30	20	
PARVICARDIUM OVALE			50		
SPISULA SUBTRUNCATA	10		20		
ABRA ALBA	1290	820	60	1940	
MACOMA BALTHICA			10		
MACOMA CALCAREA	770	40	150	20	
FABULINA FABULA	10		10		
PHAXAS PELLUCIDUS	150				
MYA ARENARIA		10			
MYA TRUNCATA				10	
CORBULA GIBBA	190	70	100	140	
EUNOE NODOSA	10				
PHOLOE INORNATA	50	90	130	100	
PHYLLODOCE MACULATA		10			
NEANTHES VIRENS			10		
NEPHTYS HOMBERGII	10	60	30		
NEPHTYS CILIATA	10				
SCOLOPLOS ARMIGER	10	20	130		
TROCHOCHAETA MULTISETOSA	10	160	30	300	
POLYDORA CAECA				20	
PSEUDOPOLYDORA PULCHRA				20	
HETEROMASTUS FILIFORMIS	10	10	40		
MYRIOCHELE OCULATA			80	10	
PECTINARIA KORENI	100		130	40	
LANICE CONCHILEGA		10			
TUBIFICOIDES BENEDENI			10	10	
DIASTYLIS RATHKEI		40		10	
PHORONIS MUELLERI	10	10		40	
OPHIURA ALBIDA	20				

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179071 31/10/89	179071 09/10/90	179071 22/10/91		
EDWARDSIA SP.		12			
HYDROBIA ULVAE			12		
HINIA RETICULATA		12	35		
PHILINE APERTA		12			
PHILINE SCABRA			12		
MODIOLUS MODIOLUS		12			
MUSCULUS NIGER	12				
MYTILIS EDULIS		12			
MYSELLA BIDENTATA	5261	1765	859		
ARCTICA ISLANDICA	23	46	70		
PARVICARDIUM OVALE		12			
SPISULA SUBTRUNCATA	12		12		
ABRA NITIDA		12			
ABRA ALBA			1324		
MACOMA CALCAREA	70				
TELLINA TENUIS			35		
MYA ARENARIA	12		12		
CORBULA GIBBA	767	1626	825		
ANTINOELLA SARSI	23				
PHOLOE INORNATA	209	139	70		
ETEONE LONGA		12			
NEANTHES VIRENS			12		
NEPHTYS HOMBERGII	23	12	35		
GLYCERA ALBA		23			
TROCHOCHAETA MULTISETOSA	81	23	23		
SPIO FILICORNIS		12			
PRIONOSPIO FALLAX			23		
SCALIBREGMA INFLATUM			23		
CAPITELLA CAPITATA	23	23			
HETEROMASTUS FILIFORMIS		46			
PECTINARIA KORENI	58	12	93		
PECTINARIA SP.			12		
OLIGOCHAETA		93			
TUBIFICOIDES BENEDENI	23	70	12		
AORIDAE SP.		12			
BALANUS CRENATUS		2393	12		
DIASTYLIS RATHKEI	35	12	23		
DIASTYLIS BRADYI			58		
PARIAMBUS TYPICUS		12			
BATHYPOREIA ELEGANS			12		
PHORONIS MUELLERI		163	35		
PHORONIS SP.	46	23	58		

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179073 28/10/85	179073 22/09/86	179073 04/11/87	179073 07/11/88	
EDWARDSIA SP.		20			
RETUSA TRUNCATULA			180		
PHILINE SCABRA		10			
NUCULA TENUIS		10		40	
MYSELLA BIDENTATA	630	1010	350	90	
ARCTICA ISLANDICA		30			
PARVICARDIUM OVALE			40	10	
SPISULA SUBTRUNCATA	20	10			
ABRA ALBA	2510	450	160	1220	
MACOMA CALCAREA	230	240	210	80	
FABULINA FABULA	10				
PHAXAS PELLUCIDUS	90	10	10	10	
MYA ARENARIA	10		10		
CORBULA GIBBA	40	90	50	150	
PHOLOE INORNATA	20	260	50	40	
NEPHTYS HOMBERGII	40	50	30		
NEPHTYS CILIATA	20	10			
SCOLOPLOS ARMIGER	50	180	140	80	
TROCHOCHAETA MULTISETOSA	10	130		20	
PSEUDOPOLYDORA PULCHRA	20			30	
CAPITELLA CAPITATA				10	
HETEROMASTUS FILIFORMIS	40		20	10	
PRAXILLELLA PRAETERMISSA			10	10	
MYRIOCHELE OCULATA	10	10		10	
PECTINARIA KORENI		10		40	
AMPHARETE ACUTIFRONS	20				
ANOBOTHRUS GRACILIS		20			
TEREBELLIDES STROEMI				10	
DIASTYLIS RATHKEI			20	10	
PHORONIS MUELLERI	90	10	60	30	
OPHIURA ALBIDA	110	10		50	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179073 01/11/90	179073 22/10/91			
EDWARDSIA SP.	12				
PLATYHELMINTHES	12				
NEMERTINEA	23				
HYDROBIA ULVAE		12			
HINIA RETICULATA		35			
PHILINE APERTA		23			
PHILINE SCABRA	12				
CORYPHELLA SP	12				
NUCULA TENUIS	35	12			
MUSCULUS NIGER		12			
MYSELLA BIDENTATA	2625	1638			
ARCTICA ISLANDICA	81	35			
PARVICARDIUM OVALE		35			
ABRA NITIDA		12			
ABRA ALBA	732	1777			
MACOMA CALCAREA	70	23			
TELLINA TENUIS		12			
PHAXAS PELLUCIDUS	35	46			
MYA ARENARIA		12			
CORBULA GIBBA	232	35			
PHOLOE INORNATA	70	93			
SYNELMIS KLATTI	12				
NEPHTYS HOMBERGII	12	35			
NEPHTYS CILIATA		12			
NEPHTYS SP.	35				
SCOLOPLOS ARMIGER		70			
ARICIDEA SUECICA	12	23			
TROCHOCHAETA MULTISETOSA	46				
PSEUDOPOLYDORA PULCHRA	46				
PRIONOSPIO FALLAX	163	46			
MAGELONA PAPILLICORNIS		12			
CAPITELLA CAPITATA	23				
HETEROMASTUS FILIFORMIS	81	151			
PECTINARIA KORENI	46	197			
AMPHARETE FINMARCHICA	12				
OLIGOCHAETA	46				
TUBIFICOIDES BENEDENI	35	12			
DIASTYLIS RATHKEI	81	81			
BATHYPOREIA SP.		12			
MICRODEUTOPUS GRYLLOTALPA	12				
PHORONIS MUELLERI	302				
PHORONIS SP.		244			
OPHIURA ALBIDA		12			
OPHIURA JUV.		139			

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179077 28/10/85	179077 22/09/86	179077 04/11/87	179077 07/11/88	
HYDROBIA SP.		10			
RETUSA TRUNCATULA			20		
MYSELLA BIDENTATA	90	70	1870	320	
ARCTICA ISLANDICA	10				
SPISULA SUBTRUNCATA			20		
ABRA ALBA	60	680	40	2970	
MACOMA BALTHICA				20	
MACOMA CALCAREA	40	60	190	10	
FABULINA FABULA	10			20	
CORBULA GIBBA	20		350	110	
ANTINOELLA SARSI	20	10	100		
PHOLOE INORNATA		10	30	30	
NEPHTYS HOMBERGII	10	10	70		
GLYCERA ALBA				10	
SCOLOPLOS ARMIGER			10		
PARAONIS FULGENS		10			
TROCHOCHAETA MULTISETOSA	10	650	1100	310	
PSEUDOPOLYDORA PULCHRA				10	
CHAETOZONE SETOSA				10	
HETEROMASTUS FILIFORMIS		40	30		
MYRIOCHELE OCULATA			40		
PECTINARIA KORENI	10	20	70	80	
ANOBOTHRUS GRACILIS		10			
TUBIFICOIDES BENEDENI	10	10		10	
PHORONIS MUELLERI			10	10	

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	179077 30/10/89	179077 09/10/90	179077 22/10/91		
ANTHOZOA		12			
EDWARDSIA SP.		35			
NEMERTINEA	12				
HYDROBIA ULVAE	128				
HINIA RETICULATA		12			
MODIOLUS MODIOLUS	35	918			
MYSELLA BIDENTATA	7073	2288	163		
ARCTICA ISLANDICA		46	23		
PARVICARDIUM OVALE		12			
ABRA ALBA			1475		
MACOMA CALCAREA			46		
FABULINA FABULA	12				
TELLINA TENUIS	23				
PHAXAS PELLUCIDUS			12		
MYA TRUNCATA	12				
CORBULA GIBBA	767	2091	1254		
ANTINOELLA SARSI		12			
PHOLOE INORNATA	58	441	58		
PHYLLODOCE GROENLANDICA		23			
EUMIDA SANGUINEA		12			
NEPHTYS HOMBERGII	46	23	23		
NEPHTYS SP.			12		
GLYCERA ALBA		35			
SCOLOPLOS ARMIGER			23		
ARICIDEA SUECICA		12			
TROCHOCHAETA MULTISETOSA	70		58		
SPIO FILICORNIS			12		
POLYDORA CAECA	12	93	12		
POLYDORA CILIATA			12		
PRIONOSPIO FALLAX			12		
CAPITELLA CAPITATA	12				
HETEROMASTUS FILIFORMIS	46	46	23		
PECTINARIA KORENI	35	23	70		
OLIGOCHAETA		116	70		
TUBIFICOIDES BENEDENI	93	453			
BALANUS CRENATUS		6388			
GASTROSACCUS SPINIFER		23			
DIASTYLIS RATHKEI	23	35	46		
MICRODEUTOPUS GRYLLOTALPA		12			
CRANGON CRANGON			12		
PHORONIS MUELLERI	93	70	46		
PHORONIS SP.			46		

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179084 28/10/85	179084 22/09/86	179084 04/11/87	179084 07/11/88	
RETUSA TRUNCATULA			90		
PHILINE APERTA				10	
ONCHIDORIS MURICATA			10		
MODIOLUS MODIOLUS			40		
MYSELLA BIDENTATA	220	170	3170	480	
ARCTICA ISLANDICA			20	10	
PARVICARDIUM OVALE			90		
SPISULA SUBTRUNCATA			70		
ABRA ALBA	210	110	80	5010	
MACOMA BALTHICA			10	40	
MACOMA CALCAREA	130	260	260	40	
PHAXAS PELLUCIDUS		10			
MYA ARENARIA			20		
CORBULA GIBBA	140	100	470	250	
ANTINOELLA SARSI		10	100	10	
PHOLOE INORNATA			10	130	
NEANTHES VIRENS			10		
NEPHTYS HOMBERGII	40		70		
SCOLOPLOS ARMIGER			10		
TROCHOCHAETA MULTISETOSA	10	140	940	400	
HETEROMASTUS FILIFORMIS			60	20	
MYRIOCHELE OCULATA		30	30	20	
PECTINARIA KORENI	40	70	320	40	
TUBIFICOIDES BENEDENI	10	10		30	
BALANUS CRENATUS			1210		
DIASTYLIS RATHKEI	10	10	20	10	
PRIAPULUS CAUDATUS				10	
PHORONIS MUELLERI	40	10	20	40	
ASTERIAS RUBENS			10		
OPHIURA JUV.				10	

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
	Individantal /m2				
Art	179084 01/11/89	179084 09/10/90	179084 22/10/91		
COELENTERATA		12			
EDWARDSIA SP.			12		
NEMERTINEA		12			
HYDROBIA ULVAE			12		
HINIA RETICULATA			70		
MODIOLUS MODIOLUS		23	12		
MYSELLA BIDENTATA	7201	1034	523		
ARCTICA ISLANDICA	12	12	12		
SPISULA SUBTRUNCATA		12			
ABRA ALBA			1638		
MACOMA CALCAREA		12			
CORBULA GIBBA	883	1672	778		
ANTINOELLA SARSI	12				
PHOLOE INORNATA	12	58	35		
NEREIS SP	12	23			
NEPHTYS HOMBERGII	58	35	35		
NEPHTYS JUVENIL			70		
GLYCERA ALBA		12			
TROCHOCHAETA MULTISETOSA	46	12	12		
SPIO FILICORNIS	12				
POLYDORA CAECA	12	12			
PSEUDOPOLYDORA PULCHRA	23				
HETEROMASTUS FILIFORMIS	46	105			
PECTINARIA KORENI		23	128		
OLIGOCHAETA		12	93		
TUBIFICOIDES BENEDENI	163	221	81		
BALANUS CRENATUS		35			
GASTROSACCUS SPINIFER		12			
DIASTYLIS RATHKEI			12		
PHORONIS MUELLERI	12	116	58		
PHORONIS SP.	93		12		

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179091 28/10/85	179091 22/09/86	179091 04/11/87	179091 07/11/88	
HYDROBIA SP.			40		
RETUSA TRUNCATULA			170		
PHILINE APERTA	10				
NUCULA TENUIS		30		30	
MODIOLUS MODIOLUS	10	50	10		
MYTILIS EDULIS	10		20		
MYSELLA BIDENTATA	590	410	810	280	
ARCTICA ISLANDICA			10	60	
PARVICARDIUM OVALE			50		
SPISULA SUBTRUNCATA			20		
ABRA ALBA	1310	520		2870	
MACOMA BALTHICA				40	
MACOMA CALCAREA	850	270	220	20	
TELLINA PYGMAEA	20				
PHAXAS PELLUCIDUS	30			10	
MYA ARENARIA			10	10	
CORBULA GIBBA		20	50	1530	
HARMOTHOE IMBRICATA	10				
HARMOTHOE SP.			10		
PHOLOE INORNATA		20		70	
PHYLLODOCE MACULATA	50		60		
EUMIDA SANGUINEA			10		
NEPHTYS HOMBERGII	50	30	30		
NEPHTYS CILIATA		10	10		
SCOLOPLOS ARMIGER		70	60	30	
TROCHOCHAETA MULTISETOSA		70	20	20	
HETEROMASTUS FILIFORMIS	10	50	10	20	
MYRIOCHELE OCULATA		10			
PECTINARIA KORENI	40	20	30	30	
AMPHERETE BALTICA				10	
TEREBELLIDES STROEMI				10	
TUBIFICOIDES BENEDENI	10	10		10	
BALANUS CRENATUS			200		
DIASTYLIS RATHKEI		30	20		
DIASTYLIS BRADYI		10			
PHORONIS MUELLERI	10			110	
ASTERIAS RUBENS	10		40		

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179091 01/11/89	179091 08/10/90	179091 22/10/91		
EDWARDSIA SP.		12			
HYDROBIA ULVAE		12	12		
HINIA RETICULATA		46	23		
PHILINE APERTA		23	12		
PHILINE SCABRA		12			
NUCULA TENUIS	23	58			
MUSCULUS NIGER	23	12	23		
MYTILIS EDULIS		12			
MYSELLA BIDENTATA	4588	4564	2276		
ARCTICA ISLANDICA	105	81	105		
SPISULA SUBTRUNCATA		12			
ABRA ALBA	267	848	1626		
MACOMA CALCAREA	46	23	12		
FABULINA FABULA	35		23		
PHAXAS PELLUCIDUS	12		12		
MYA ARENARIA	12		12		
CORBULA GIBBA	1452	1719	1301		
HARMOTHOE IMBRICATA		12			
HARMOTHOE SP.	12				
PHOLOE INORNATA	93	209	232		
ETEONE LONGA			12		
PHYLLODOCE GROENLANDICA			12		
NEANTHES VIRENS	12				
NEPHTYS HOMBERGII	46	12			
NEPHTYS SP.			23		
GLYCERA ALBA	12	58			
SCOLOPLOS ARMIGER			12		
ARICIDEA SUECICA	12				
TROCHOCHAETA MULTISETOSA		23	35		
PSEUDOPOLYDORA PULCHRA		12			
PRIONOSPIO FALLAX	12	116	23		
SCALIBREGMA INFLATUM			23		
CAPITELLA CAPITATA		35			
HETEROMASTUS FILIFORMIS	12	12	70		
PECTINARIA KORENI	93	81	209		
AMPHARETE SP.		12	23		
OLIGOCHAETA		46	46		
TUBIFICOIDES BENEDENI	12		23		
BALANUS CRENATUS		1487			
DIASTYLIS RATHKEI	12	12	35		
COROPHIUM VOLUTATOR		12			
PHORONIS MUELLERI	12	81	12		
PHORONIS SP.	12	12	93		
ASTERIAS RUBENS	12				

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179097 28/10/85	179097 22/09/86	179097 04/11/87	179097 07/11/88
NEMERTINEA		10		
RETUSA TRUNCATULA			250	
PHILINE APERTA	20			
NUCULA TENUIS		10		
MODIOLUS MODIOLUS		10		
MUSCULUS NIGER		30	10	
MYSELLA BIDENTATA	90	330	730	50
ARCTICA ISLANDICA		20	20	
ACANTHOCARDIA ECHINATA	10	10		
PARVICARDIUM OVALE	10	30	40	
ABRA ALBA	1730	790	50	930
MACOMA BALTHICA				20
MACOMA CALCAREA	110	240	190	80
FABULINA FABULA	10			
PHAXAS PELLUCIDUS	180		20	
MYA ARENARIA		20		
CORBULA GIBBA	310	110	230	20
HARMOTHOE IMPAR			10	
PHOLOE INORNATA		10	90	50
NEPHTYS HOMBERGII			10	
NEPHTYS CILIATA	60	30	40	
SCOLOPLOS ARMIGER	20	240	420	80
ARICIDEA SUECICA		10	20	10
TROCHOCHAETA MULTISETOSA		180		40
PSEUDOPOLYDORA PULCHRA		10		
HETEROMASTUS FILIFORMIS	10	60	100	
EUCLYMENE DROEBACHIENSIS			10	
MYRIOCHELE OCULATA	10	30	50	
PECTINARIA KORENI	20	10		20
AMPHARETIDAE				10
AMPHARETE SP.			10	
LANICE CONCHILEGA	10			
TEREBELLIDES STROEMI		10		
TUBIFICOIDES BENEDENI		10	10	
DIASTYLIS RATHKEI	10	10		
PHORONIS MUELLERI	30	40	40	30
ASTERIAS RUBENS		10		
OPHIURA ALBIDA	170			

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179097 01/11/89	179097 02/11/90	179097 22/10/91		
NEMERTINEA		12			
HINIA RETICULATA		23	35		
RETUSA TRUNCATULA		12			
PHILINE APERTA		23	35		
PHILINE SCABRA		23			
NUCULA TENUIS	12	12	35		
MODIOLUS MODIOLUS	12				
MUSCULUS NIGER	116	23	35		
MYSELLA BIDENTATA	2660	3821	1580		
ARCTICA ISLANDICA	23	163	163		
PARVICARDIUM OVALE	12	23	46		
SPISULA SUBTRUNCATA			12		
ABRA NITIDA		46			
ABRA ALBA	1521	1022	1359		
MACOMA BALTHICA		23	12		
MACOMA CALCAREA	81	93	139		
PHAXAS PELLUCIDUS	105	46	35		
MYA ARENARIA	12				
MYA TRUNCATA		12			
CORBULA GIBBA	1150	116	163		
ANTINOELLA SARSI	12				
PHOLOE INORNATA	174	70	151		
HEDISTE DIVERSICOLOR		12			
NEPHTYS HOMBERGII	12	23			
NEPHTYS CILIATA		46	12		
NEPHTYS SP.	12		58		
GLYCERA SP.	12				
SCOLOPLOS ARMIGER	116	81	23		
ARICIDEA SUECICA	46	35	23		
TROCHOCHAETA MULTISETOSA	12				
SPIO FILICORNIS	12				
PSEUDOPOLYDORA PULCHRA	12	81			
PRIONOSPIO FALLAX	46	23	46		
CAPITELLA CAPITATA	12				
HETEROMASTUS FILIFORMIS	93	116	35		
MYRIOCHELE OCULATA	23				
PECTINARIA KORENI	128	186	81		
TEREBELLIDES STROEMI	35				
OLIGOCHAETA		46			
TUBIFICOIDES BENEDENI	23				
DIASTYLIS RATHKEI	46	12	12		
DIASTYLIS BRADYI		12			
PHORONIS MUELLERI	163	70	23		
PHORONIS SP.	12	93	81		
ASTERIAS RUBENS	23				
OPHIURA OPHIURA			12		
OPHIURA ALBIDA	35				
OPHIURA JUV.		46	209		
ECHINOCARDIUM CORDATUM		12			

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179103 28/10/85	179103 22/09/86	179103 04/11/87	179103 07/11/88	
ANTHOZOA				10	
NEMERTINEA				10	
RETUSA TRUNCATULA			400		
NUCULA TENUIS			20	30	
MUSCULUS NIGER			20	10	
MYSELLA BIDENTATA	330	280	720	90	
ARCTICA ISLANDICA	20	20	40		
PARVICARDIUM OVALE		10	40		
SPISULA SUBTRUNCATA	90		50		
ABRA ALBA	2640	880	130	1530	
MACOMA CALCAREA	150	120	210	130	
FABULINA FABULA	10				
PHAXAS PELLUCIDUS	130	10		30	
MYA ARENARIA		10	10		
CORBULA GIBBA	190	30	160	110	
ANTINOELLA SARSI			10		
PHOLOE INORNATA	10	20	20	40	
NEPHTYS HOMBERGII	10		10		
NEPHTYS CILIATA	20	10			
SCOLOPLOS ARMIGER	50	80	260	30	
TROCHOCHAETA MULTISETOSA	10	50	10	10	
PSEUDOPOLYDORA PULCHRA				30	
HETEROMASTUS FILIFORMIS	20	80	50	10	
MYRIOCHELE OCULATA	10	10	10	10	
PECTINARIA KORENI	40	10	20	20	
LANICE CONCHILEGA	10				
TEREBELLIDES STROEMI	10			10	
DIASTYLIS RATHKEI		10	10		
CRANGON CRANGON	10				
PHORONIS MUELLERI	20	10	10	90	
OPHIURA ALBIDA	60		10	30	
OPHIOCTEN GRACILIS				10	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	179103 01/11/89	179103 02/11/90	179103 22/10/91		
EDWARDSIA SP.		12	12		
HINIA RETICULATA		46	35		
RETUSA TRUNCATULA		12			
PHILINE APERTA	12	46	46		
PHILINE SCABRA		35			
NUCULA TENUIS	58		23		
MUSCULUS NIGER	209	35	23		
MYTILIS EDULIS		12			
MYSELLA BIDENTATA	2009	2648	1254		
ARCTICA ISLANDICA	35	58	81		
PARVICARDIUM OVALE	58	12			
SPISULA SUBTRUNCATA	23	35			
ABRA NITIDA		12			
ABRA ALBA	1161	883	1103		
MACOMA CALCAREA	163	290	163		
PHAXAS PELLUCIDUS	12	58	46		
MYA ARENARIA	12				
MYA TRUNCATA		12			
CORBULA GIBBA	813	105	128		
PHOLOE INORNATA	128	186	151		
NEPHTYS HOMBERGII	12				
NEPHTYS CILIATA	12	105	58		
NEPHTYS SP.			23		
GLYCERA ALBA	12				
SCOLOPLOS ARMIGER	151	23	12		
ARICIDEA SUECICA		12			
TROCHOCHAETA MULTISETOSA	46	23			
POLYDORA CAECA	12				
PSEUDOPOLYDORA PULCHRA	46	174			
PRIONOSPIO FALLAX	58	151	46		
CAPITELLA CAPITATA		23			
HETEROMASTUS FILIFORMIS	46	58	46		
MYRIOCHELE OCULATA	23	23			
PECTINARIA KORENI	35	105	163		
AMPHARETE ACUTIFRONS	12				
TEREBELLIDES STROEMI	12		12		
OLIGOCHAETA		35			
GASTROSACCUS SPINIFER			12		
DIASTYLIS RATHKEI	58	163	46		
DIASTYLIS BRADYI		46			
COROPHIUM SP.	12				
CRANGON CRANGON			12		
PHORONIS MUELLERI	163	174	81		
PHORONIS SP.			46		
OPHIURA ALBIDA	35	12	35		
OPHIURA JUV.	46	221	174		
PSAMMECHINUS MILIARIS		12			
ECHINOCARDIUM CORDATUM		35	12		

Appendix 3.3

Species list, individuals per m^2, Fornæs, 1986-1990

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2					
	159001	159001	159001	159001	159001
Art	23/05/86	26/05/87	25/05/88	18/05/89	21/05/90
EDWARDSIA SP.		20	10		
PLATYHELMINTHES	10				
NEMERTINEA		10			60
PHILINE APERTA		10			10
TELLIMYA FERRUGINOSA		20	70	10	10
MYSELLA BIDENTATA	10		20	20	50
ARCTICA ISLANDICA	40	80	30	40	
CHAMELEA STRIATULA		180	30	40	10
SPISULA SUBTRUNCATA		10			
ABRA ALBA	10	70	10		
MACOMA BALTHICA	40				
MACOMA CALCAREA		190	30	30	
FABULINA FABULA	100	420	580	990	440
PHAXAS PELLUCIDUS		10		10	30
CORBULA GIBBA					690
THRACIA PHASEOLINA		10		10	30
HARMOTHOE IMPAR					10
ANTINOELLA SARSI		20			
PHOLOE INORNATA		40	10	50	50
ETEONE LONGA			10		30
PHYLLODOCE GROENLANDICA		30			
PHYLLODOCE LAMINOSA					10
PHYLLODOCE MACULATA				20	
EUMIDA SANGUINEA				20	
EUMIDA BAHUSIENSIS					40
EUMIDA SP.					10
NEPHTYS HOMBERGII	20	60	20	50	
NEPHTYS CAECA			10	10	10
NEPHTYS LONGOSETOSA				20	40
NEPHTYS SP.					20
GLYCERA ALBA					30
SCOLOPLOS ARMIGER	40	70	20	190	190
SPIO FILICORNIS	10	20		80	10
POLYDORA CAECA	180	310	60	240	
PRIONOSPIO FALLAX	10	10	20	250	1830
SPIOPHANES BOMBYX	30	50	70	180	90
CHAETOZONE SETOSA	10	40	10	40	10
MYRIOCHELE OCULATA	10	10	20	10	20
PECTINARIA KORENI		10	20	10	30
PECTINARIA AURICOMA					20
LANICE CONCHILEGA				40	
CHONE INFUNDIBULIFORMIS		10			
GASTROSACCUS SPINIFER				10	
DIASTYLIS RATHKEI	10	10	50	20	
AMPELISCA BREVICORNIS	20	20	10	80	
PERICULODES LONGIMANUS				30	
PHORONIS MUELLERI		20	10	70	110
PHORONIS SP.					20
AMPHIURA JUV.					30
OPHIURA ALBIDA	10	10	20	70	50
OPHIURA JUV.					20
ECHINOCARDIUM CORDATUM	10	40	40	10	20

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159002 26/05/86	159002 26/05/87	159002 25/05/88	159002 18/05/89	159002 21/05/90
CERIANTHUS LLOYDII				10	
PLATYHELMINTHES	10				
NEMERTINEA					20
HYDROBIA ULVAE		10			
HINIA RETICULATA				20	
NUCULA TENUIS					10
MODIOLUS MODIOLUS		10			
TELLIMYA FERRUGINOSA	20		10		
MYSELLA BIDENTATA		10	20	20	20
ARCTICA ISLANDICA	10	10	30	20	20
CHAMELEA STRIATULA	10	100	50	50	10
ABRA ALBA		120	120		
MACOMA CALCAREA		60	90	30	20
FABULINA FABULA	240	290	680	790	580
TELLINA TENUIS				30	
CORBULA GIBBA		10			90
THRACIA PHASEOLINA			10		
HARMOTHOE IMPAR					10
ANTINOELLA SARSI		10			
PHOLOE INORNATA	10	30	50	20	40
PHYLLODOCE MUCOSA				10	
EUMIDA SANGUINEA				20	20
EUMIDA BAHUSIENSIS		10	50		
EUMIDA SP.					50
NEPHTYS HOMBERGII	30	50	10	60	30
NEPHTYS CAECA		10	10	30	
NEPHTYS LONGOSETOSA					10
NEPHTYS SP.					20
GLYCERA ALBA	10		10		70
SCOLOPLOS ARMIGER	30	10	170	60	270
SPIO FILICORNIS	10		10	20	70
POLYDORA CAECA	60	800	1010	150	
PRIONOSPIO FALLAX		20	200	160	2170
SPIOPHANES BOMBYX	10	60	40	40	150
CHAETOZONE SETOSA	10	50	50	70	220
OPHELINA ACUMINATA			10		
OWENIA FUSIFORMIS	10		10		
MYRIOCHELE OCULATA		20	20		40
PECTINARIA KORENI		10	30	30	
PECTINARIA AURICOMA					30
LANICE CONCHILEGA			30	30	
GASTROSACCUS SPINIFER				20	
DIASTYLIS RATHKEI.		10	60	70	
PARIAMBUS TYPICUS				20	
ARGISSA HAMATIPES				10	
AMPELISCA BREVICORNIS	10	30	30	40	
PERICULODES LONGIMANUS				20	
MICROPROTOPUS MACULATUS				30	
CARCINUS MAENAS				10	
PHORONIS MUELLERI		60		110	90
PHORONIS SP.			20		
AMPHIURA FILIFORMIS					30
AMPHIURA JUV.					90
OPHIURA ALBIDA	100	50	30	80	90
OPHIURA JUV.					30
ECHINOCARDIUM CORDATUM	10	10	10	10	

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159004 29/05/86	159004 26/05/87	159004 25/05/88	159004 18/05/89	159004 22/05/90
ANTHOZOA		10			10
PLATYHELMINTHES		10			
NEMERTINEA				40	10
TELLIMYA FERRUGINOSA	30			10	
MYSELLA BIDENTATA		10	30		
ARCTICA ISLANDICA	160	70	180	350	320
CHAMELEA STRIATULA	10	90	20	10	10
SPISULA SUBTRUNCATA		20		20	
ABRA ALBA	20	90	40		
MACOMA BALTHICA	20				
MACOMA CALCAREA		50	110	40	70
FABULINA FABULA	190	240	480	530	470
PHAXAS PELLUCIDUS				10	
CORBULA GIBBA				20	10
THRACIA PHASEOLINA		10			
ANTINOELLA SARSI					10
GATTYANA CIRROSA			10		
PHOLOE INORNATA	10			30	20
ETEONE LONGA			10		
PHYLLODOCE MUCOSA					10
EUMIDA SANGUINEA					50
EUMIDA BAHUSIENSIS			10		
NEPHTYS HOMBERGII	40	20	30		
NEPHTYS CAECA		20	20	10	40
NEPHTYS LONGOSETOSA			10		
NEPHTYS SP.					10
SPHAERODORUM FLAVUM				10	
GLYCERA ALBA			10		
GONIADA MACULATA	10				
SCOLOPLOS ARMIGER	40	30	120	160	390
SPIO FILICORNIS		10			50
POLYDORA CAECA		110	80	20	
PSEUDOPOLYDORA PULCHRA					10
PRIONOSPIO FALLAX	10		30	10	340
SPIOPHANES BOMBYX			20	40	50
CHAETOZONE SETOSA		10	20	20	70
MYRIOCHELE OCULATA		30			
PECTINARIA KORENI			20		
AMPHARETE SP.			10		
LANICE CONCHILEGA		10	10	50	50
OLIGOCHAETA					10
HIRUDINEA					10
NYMPHON SP.				20	
DIASTYLIS RATHKEI			30		
PARIAMBUS TYPICUS				20	
AMPELISCA BREVICORNIS	20	30	70	10	
PERICULODES LONGIMANUS				10	
DEXAMINE SPINOSA			10		
MICROPROTOPUS MACULATUS				10	
PHORONIS MUELLERI					20
OPHIURA ROBUSTA					10
OPHIURA ALBIDA	40	20	40	220	10
OPHIURA JUV.					30
ECHINOCARDIUM CORDATUM	10			10	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159005 22/05/86	159005 26/05/87	159005 25/05/88	159005 18/05/89	159005 21/05/90
EDWARDSIA SP.	10	10			50
PLATYHELMINTHES				10	
NEMERTINEA		10	10	10	30
VITREOLINA PHILIPPII					20
HINIA RETICULATA				10	40
PHILINE APERTA					10
MODIOLUS MODIOLUS				10	
MUSCULUS NIGER		10			10
TELLIMYA FERRUGINOSA	40	10			
MYSELLA BIDENTATA		10	20		90
ARCTICA ISLANDICA	10	10			50
CHAMELEA STRIATULA	30	100	90	100	70
ABRA ALBA	80	70	10		60
MACOMA BALTHICA	80				
MACOMA CALCAREA		180	40	70	40
FABULINA FABULA	140	120	120	300	110
TELLINA TENUIS				10	
PHAXAS PELLUCIDUS				10	
MYA ARENARIA		20			130
CORBULA GIBBA		40		40	1350
THRACIA PHASEOLINA				30	10
ANTINOELLA SARSI		10			30
PHOLOE INORNATA	10	30		10	100
ETEONE LONGA		20			10
PHYLLODOCE MUCOSA				10	
EUMIDA BAHUSIENSIS		20			
NEPHTYS HOMBERGII	50	10	20	60	
NEPHTYS CAECA	10			40	40
NEPHTYS LONGOSETOSA	30	10	10		
NEPHTYS SP.					20
GLYCERA ALBA			10		20
GONIADA MACULATA				10	
SCOLOPLOS ARMIGER	150	50	10	130	320
SPIO FILICORNIS	10	10		10	30
POLYDORA CAECA	130	530	70	30	40
PYGOSPIO ELEGANS					10
PRIONOSPIO FALLAX	20	10		60	1700
SPIOPHANES BOMBYX	20	20		70	20
CHAETOZONE SETOSA	10	10			40
OPHELINA ACUMINATA					10
HETEROMASTUS FILIFORMIS		20			10
MYRIOCHELE OCULATA	40	110	30	80	70
PECTINARIA KORENI				30	
PECTINARIA AURICOMA					40
AMPHARETE FINMARCHICA					20
LANICE CONCHILEGA	10	10	40	20	10
OLIGOCHAETA					20
GASTROSACCUS SPINIFER		20			10
PSEUDOCUMA LONGICORNIS					10
LAMPROPS FASCIATA			30		
DIASTYLIS RATHKEI		70	30	20	
AMPHIPODA		10			
PARIAMBUS TYPICUS					20
ARGISSA HAMATIPES					10
AMPELISCA BREVICORNIS	40		220	50	90
PODOCERIDAE		10			
PERICULODES LONGIMANUS					20
COROPHIUM MULTISETOSUM					10
PHORONIS MUELLERI	20	10	20	70	140
AMPHIURA JUV.					120
OPHIURA ALBIDA	50	40	20	50	10
OPHIURA JUV.					70
ECHINOCYAMUS PUSILLUS					20
ECHINOCARDIUM CORDATUM	10		10		

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159007 23/05/86	159007 26/05/87	159007 25/05/88	159007 22/05/89	159007 21/05/90
					10
ANTHOZOA	10				
EDWARDSIA SP.	10	10	10		10
PLATYHELMINTHES			10		
NEMERTINEA				40	20
HINIA PYGMAEA					10
RETUSA OBTUSATA		20			
NUCULA TENUIS	10				
MODIOLUS MODIOLUS				20	10
TELLIMYA FERRUGINOSA	30		60		10
MYSELLA BIDENTATA		10		40	10
ARCTICA ISLANDICA	10	20	10	20	20
CHAMELEA STRIATULA	20	220	30	50	70
SPISULA SUBTRUNCATA				10	
ABRA ALBA	80	110	60		40
MACOMA BALTHICA	90				
MACOMA CALCAREA	10	140	80	20	
FABULINA FABULA	350	740	970	1010	670
PHAXAS PELLUCIDUS				10	
MYA ARENARIA		10			
CORBULA GIBBA		10	10	40	240
ANTINOELLA SARSI		50			10
PHOLOE ASSIMILIT			10		
PHOLOE INORNATA		30	10	50	10
PHYLLODOCE MUCOSA				10	10
EUMIDA SANGUINEA					10
EUMIDA BAHUSIENSIS		60	30		10
NEPHTYS HOMBERGII	110	70		70	90
NEPHTYS CILIATA		10			
NEPHTYS CAECA	10	30	10	10	
NEPHTYS SP.					20
SPHAERODORUM FLAVUM					10
GLYCERA ALBA			10		30
GONIADA MACULATA		20			10
SCOLOPLOS ARMIGER	60	170	50	140	210
SPIO FILICORNIS	20	20	10	40	60
POLYDORA CAECA	110	550	830	90	
PSEUDOPOLYDORA PULCHRA		10		10	
PRIONOSPIO FALLAX	60	60	30	190	2790
SPIOPHANES BOMBYX	30	80	100	130	60
CHAETOZONE SETOSA	10	20	40	50	240
SCALIBREGMA INFLATUM		10			
OPHELIA LIMACINA		10			
MYRIOCHELE OCULATA	10	40	10		
PECTINARIA KORENI		10		40	
PECTINARIA AURICOMA				50	40
AMPHARETE SP.		10			
LANICE CONCHILEGA		30	40	10	30
LAMPROPS FASCIATA			20		
DIASTYLIS RATHKEI	30	20	30		
PARIAMBUS TYPICUS		20			110
AMPELISCA BREVICORNIS	30	70	180	70	90
JASSA PUSILA			10		
DYOPEDOS MONACANTHUS		10			
PERICULODES LONGIMANUS					10
CHAETOGAMMARUS MARINUS			10		
PHORONIS MUELLERI		20	20	40	60
PHORONIS SP.					30
AMPHIURA JUV.					40
OPHIURA ALBIDA	50	90	10	20	80
OPHIURA JUV.					30
ECHINOCARDIUM CORDATUM	20		30	20	20

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159009 29/05/86	159009 26/05/87	159009 25/05/88	159009 22/05/89	159009 23/05/90
EDWARDSIA SP.					40
NEMERTINEA		10	40		
RETUSA TRUNCATULA					20
PHILINE APERTA				10	10
MODIOLUS MODIOLUS					10
MYSELLA BIDENTATA		30	70	30	
ARCTICA ISLANDICA	130	150	110	60	20
CHAMELEA STRIATULA		110	50	80	60
SPISULA SUBTRUNCATA		10			
ABRA ALBA	10	50	190		
MACOMA BALTHICA	10				
MACOMA CALCAREA	10	70	190	30	90
FABULINA FABULA	180	120	600	500	410
PHAXAS PELLUCIDUS		10			20
MYA ARENARIA					10
MYA TRUNCATA	20				
CORBULA GIBBA					60
THRACIA PHASEOLINA		10	60	30	10
ANTINOELLA SARSI		10		20	
PHOLOE INORNATA			50	30	40
ETEONE LONGA					10
PHYLLODOCE MUCOSA					10
PHYLLODOCE GROENLANDICA		10			
EUMIDA SANGUINEA			10	10	10
EUMIDA BAHUSIENSIS			60		
EUMIDA SP.			20		
SYLLIDAE	10				
NEPHTYS HOMBERGII		10			10
NEPHTYS CAECA	20	20	30	40	20
NEPHTYS LONGOSETOSA			20	10	
NEPHTYS SP.		10			
GLYCERA ALBA			10		10
GONIADA MACULATA	10		20	10	
SCOLOPLOS ARMIGER	50	40	250	160	210
SPIO FILICORNIS	10	10		40	70
POLYDORA CAECA	20	510	1480	220	10
PSEUDOPOLYDORA PULCHRA	10		60		
PRIONOSPIO FALLAX	20	30	190		260
SPIOPHANES BOMBYX	50	30	160	60	30
CHAETOZONE SETOSA	20	30	50	30	30
OPHELIA LIMACINA			20		10
HETEROMASTUS FILIFORMIS	10				
MYRIOCHELE OCULATA	40	30	20	10	40
PECTINARIA KORENI		10	10	20	
PECTINARIA AURICOMA				20	40
AMPHARETE FINMARCHICA					10
POECILOCHAETUS SERPENS				10	
LANICE CONCHILEGA		10		30	20
OLIGOCHAETA					10
TUBIFICOIDES BENEDENI					20
DIASTYLIS RATHKEI	10		100		10
PARIAMBUS TYPICUS					10
ARGISSA HAMATIPES			10		20
AMPELISCA BREVICORNIS	30		30	20	70
PERICULODES LONGIMANUS				10	10
PHORONIS MUELLERI	10	10	20	10	170
PHORONIS SP.					10
AMPHIURA FILIFORMIS	20				
OPHIURA OPHIURA			10		
OPHIURA ROBUSTA					10
OPHIURA ALBIDA	40	50	10	20	30
ECHINOCYAMUS PUSILLUS				10	
ECHINOCARDIUM CORDATUM	10	10			

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159010 22/05/86	159010 26/05/87	159010 25/05/88	159010 18/05/89	159010 21/05/90
EDWARDSIA SP.					10
NEMERTINEA		20			
HINIA RETICULATA	10				10
OENOPOTA ELEGANS	10				
MODIOLUS MODIOLUS		10		20	
TELLIMYA FERRUGINOSA					20
MYSELLA BIDENTATA				40	10
ARCTICA ISLANDICA	10	10			30
CHAMELEA STRIATULA		50	60	150	150
SPISULA SUBTRUNCATA		10	10		
ABRA ALBA		70	10		60
MACOMA CALCAREA		120	50	30	40
FABULINA FABULA	60	10	90	140	80
PHAXAS PELLUCIDUS					10
HIATELLA ARCTICA		10			
MYA ARENARIA		30			30
CORBULA GIBBA		10	10		690
THRACIA PHASEOLINA		20	10	20	
HARMOTHOE IMPAR		10			
ANTINOELLA SARSI		20			
PHOLOE INORNATA		20	10	10	20
ETEONE LONGA	10		20		10
PHYLLODOCE GROENLANDICA		10			
EUMIDA SANGUINEA			10		
NEPHTYS HOMBERGII				20	
NEPHTYS CAECA	20	10	20	30	10
NEPHTYS LONGOSETOSA	10			20	40
GLYCERA ALBA			10		10
SCOLOPLOS ARMIGER	50	110	180	70	280
SPIO FILICORNIS		170			50
POLYDORA CAECA		200	380	40	
PRIONOSPIO FALLAX			10	80	140
SPIOPHANES BOMBYX			40	50	
CHAETOZONE SETOSA		20	20		20
CAPITELLA CAPITATA		10			
HETEROMASTUS FILIFORMIS				10	10
MYRIOCHELE OCULATA	50	20	60	10	30
PECTINARIA AURICOMA					40
AMPHERETE BALTICA		10			
AMPHARETE SP.		20			10
LANICE CONCHILEGA			10	30	10
CHONE DUNERI				10	
OLIGOCHAETA					20
BALANUS CRENATUS	80				
LAMPROPS FASCIATA	20	10			
DIASTYLIS RATHKEI	10	20	30	10	10
DIASTYLIS LUCIFERA		10			10
PARIAMBUS TYPICUS					20
PHOXOCEPHALUS HOLBOELLI				10	
ARGISSA HAMATIPES					30
AMPELISCA BREVICORNIS	50	10	40	40	90
BATHYPOREIA PELAGICA					10
DYOPEDOS MONACANTHUS		10			
PHORONIS MUELLERI		10		10	90
AMPHIURA JUV.					20
OPHIURA ALBIDA	40	20	30	40	30
OPHIURA JUV.					40
ECHINOCYAMUS PUSILLUS		20			10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159012 26/05/86	159012 26/05/87	159012 25/05/88	159012 22/05/89	159012 30/05/90
PLATYHELMINTHES			10		
NEMERTINEA		10	10		40
NUCULA TENUIS					10
TELLIMYA FERRUGINOSA	70		20		20
MYSELLA BIDENTATA	10		10	50	
ARCTICA ISLANDICA	20	10	10	30	40
CHAMELEA STRIATULA	10	70	60	30	30
ABRA ALBA	60	50	20		
MACOMA BALTHICA			40		
MACOMA CALCAREA	30	70		30	40
FABULINA FABULA	470	150	780	870	1130
PHAXAS PELLUCIDUS	20			10	10
CORBULA GIBBA			10	10	80
THRACIA PHASEOLINA	10		10		
HARMOTHOE IMPAR					10
ANTINOELLA SARSI		10			
GATTYANA CIRROSA			10		
PHOLOE INORNATA			10	10	40
ETEONE SP.					10
PHYLLODOCE SP.					30
EUMIDA SANGUINEA			30	10	
EUMIDA BAHUSIENSIS		10			10
EUMIDA SP.					20
NEPHTYS HOMBERGII	90	20	60	40	10
NEPHTYS CAECA	10		20	10	
NEPHTYS LONGOSETOSA			10		60
NEPHTYS SP.					20
GLYCERA ALBA					10
GONIADA MACULATA	20			10	20
SCOLOPLOS ARMIGER	30	10	60	90	250
SPIO FILICORNIS				30	30
POLYDORA CAECA	60	40	180	50	
PSEUDOPOLYDORA PULCHRA	10				10
PRIONOSPIO FALLAX	40	10	200	150	650
SPIOPHANES BOMBYX		10	10	20	90
CHAETOZONE SETOSA	10	10	60	60	60
MYRIOCHELE OCULATA	10	10	30	20	30
PECTINARIA KORENI			20	40	10
PECTINARIA AURICOMA				20	20
LANICE CONCHILEGA	10			40	40
BALANUS CRENATUS		30			
GASTROSACCUS SPINIFER					10
PSEUDOCUMA LONGICORNIS					10
DIASTYLIS RATHKEI		10	30	20	
DIASTYLIS SP.					10
PARIAMBUS TYPICUS					30
AMPELISCA BREVICORNIS		10	70	20	40
PROTOMEDEIA FASCIATA					70
PHORONIS MUELLERI	10	10	10	30	100
PHORONIS SP.					40
AMPHIURA JUV.					10
OPHIURA ALBIDA	50		50	40	30
ECHINOCARDIUM CORDATUM	20		10	10	20

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159014 29/05/86	159014 26/05/87	159014 25/05/88	159014 22/05/89	159014 23/05/90
ANTHOZOA	10		10		
CERIANTHUS LLOYDII			10		
PLATYHELMINTHES		10			10
NEMERTINEA			20		40
RETUSA TRUNCATULA					10
MODIOLUS MODIOLUS		10	10		
MYSELLA BIDENTATA		30		30	
ARCTICA ISLANDICA	60	60	10	40	130
PARVICARDIUM OVALE					10
CHAMELEA STRIATULA	10	170	30	20	20
SPISULA SUBTRUNCATA		20	10		
ABRA ALBA	50	260	30		90
MACOMA CALCAREA	10	100	150	20	20
FABULINA FABULA	60	140	380	330	370
PHAXAS PELLUCIDUS	10		10		
MYA ARENARIA		10		10	
CORBULA GIBBA				20	10
THRACIA PHASEOLINA		10	10	10	
HARMOTHOE IMPAR		20			
ANTINOELLA SARSI		10			10
PHOLOE INORNATA		30		20	10
ETEONE LONGA			20		
EUMIDA SANGUINEA	10			50	50
EUMIDA BAHUSIENSIS		10	10		
NEPHTYS HOMBERGII	10	10	40	10	20
NEPHTYS CAECA	10	10	20	40	
NEPHTYS SP.			10		
GLYCERA SP.			10		
GONIADA MACULATA				20	
SCOLOPLOS ARMIGER	80	80	160	100	180
SPIO FILICORNIS	10	40	10	20	70
POLYDORA CAECA		380	50	220	
PRIONOSPIO FALLAX	10	10	80	50	260
SPIOPHANES BOMBYX	10	40	40	30	60
MALACOCEROS TETRACERUS			10		
CHAETOZONE SETOSA			20		10
SCALIBREGMA INFLATUM		10			
OPHELIA LIMACINA					20
MYRIOCHELE OCULATA	20	20	10	10	10
PECTINARIA KORENI	10				
PECTINARIA AURICOMA				10	
AMPHERETE BALTICA		10			
POECILOCHAETUS SERPENS					20
LANICE CONCHILEGA	20	50	50	10	80
DIASTYLIS TUMIDA		10			
PARIAMBUS TYPICUS					10
AMPELISCA BREVICORNIS	20	20	160	10	40
CHEIROCRATUS SUNDEVALLEI			10		
LEMBOS LONGIPES					20
PAGURUS SP.				10	
PHORONIS MUELLERI		30		20	40
PHORONIS SP.					10
OPHIURA ALBIDA	20	100	70	20	10
OPHIURA JUV.			10		40

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159016 23/05/86	159016 26/05/87	159016 20/05/88	159016 22/05/89	159016 23/05/90
ANTHOZOA		10			
EDWARDSIA SP.		10			
NEMERTINEA	20				50
HINIA RETICULATA				10	10
OPISTHOBRANCHIA					10
CHAETODERMA NITIDULUM					10
BIVALVIA					20
MODIOLUS MODIOLUS				20	
MUSCULUS NIGER	10	10			20
TELLIMYA FERRUGINOSA	10			30	
MYSELLA BIDENTATA		10		30	10
ARCTICA ISLANDICA	10	10	20		60
PARVICARDIUM OVALE	10	30	10	20	60
CHAMELEA STRIATULA		20	20	10	60
TIMOCLEA OVATA				10	
SPISULA SUBTRUNCATA				10	
ABRA ALBA	180	70			
MACOMA CALCAREA		150	10	10	
FABULINA FABULA		40		80	10
PHAXAS PELLUCIDUS	10		10		20
MYA ARENARIA		140		10	170
CORBULA GIBBA					550
THRACIA PHASEOLINA		30			
HARMOTHOE IMPAR				10	
HARMOTHOE LONGISETIS		10			
GATTYANA CIRROSA			10		
PHOLOE INORNATA	10	90		40	60
ETEONE LONGA		20			
EUMIDA SANGUINEA					10
EUMIDA BAHUSIENSIS		10			
NEPHTYS HOMBERGII	30	10	10	30	40
NEPHTYS PENTE		20			
NEPHTYS CAECA	20	20	10		
GLYCERA ALBA	20			20	10
GONIADA MACULATA			10	20	
SCOLOPLOS ARMIGER	40	110	60	90	170
ARICIDEA SUECICA					30
TROCHOCHAETA MULTISETOSA					10
SPIONIDAE					10
SPIO FILICORNIS	10	20		10	20
POLYDORA CAECA	120	410		140	
PSEUDOPOLYDORA PULCHRA		20		20	
PRIONOSPIO FALLAX	20	10		40	260
SPIOPHANES BOMBYX					10
CHAETOZONE SETOSA		20			30
SCALIBREGMA INFLATUM		10			
OPHELIA LIMACINA					20
TRAVISIA FORBESII		10			
CAPITELLA CAPITATA	10				
MYRIOCHELE OCULATA	290	210	60	150	70
PECTINARIA KORENI				10	
PECTINARIA AURICOMA					100
AMPHERETE BALTICA		10			
AMPHARETE SP.					20
LANICE CONCHILEGA				20	
PSEUDOCUMA LONGICORNIS					10
DIASTYLIS RATHKEI	10	80		70	40
DIASTYLIS SP.					10
ARGISSA HAMATIPES				10	
AMPELISCA BREVICORNIS	60	60		10	90
PERICULODES LONGIMANUS					20
PROTOMEDEIA FASCIATA					70
PHORONIS MUELLERI	30	20		100	80
AMPHIURA FILIFORMIS	10				
OPHIURA AFFINIS	20				
OPHIURA ALBIDA	10	130	20	30	30
OPHIURA JUV.				10	50
OPHIOCTEN GRACILIS		10			

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2					
Art	159016 23/05/86	159016 26/05/87	159016 20/05/88	159016 22/05/89	159016 23/05/90
ECHINOCYAMUS PUSILLUS	20				10
ECHINOCARDIUM CORDATUM	10		10	10	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159018 29/05/86	159018 26/05/87	159018 26/05/88	159018 22/05/89	159018 30/05/90
ANTHOZOA		10			30
NEMERTINEA	10			20	
HYDROBIA SP.	10				
HINIA RETICULATA					10
PHILINE SCABRA					10
TELLIMYA FERRUGINOSA	10	30		50	10
MYSELLA BIDENTATA				30	50
ARCTICA ISLANDICA	30	20		50	60
CHAMELEA STRIATULA	20	30		20	40
SPISULA SUBTRUNCATA					10
ABRA ALBA	80	50			10
MACOMA BALTHICA	40				
MACOMA CALCAREA		80		60	40
FABULINA FABULA	310	290		1100	480
PHAXAS PELLUCIDUS	20	20		20	40
MYA ARENARIA					20
CORBULA GIBBA				10	90
THRACIA PHASEOLINA				10	
EUNOE NODOSA					10
PHOLOE INORNATA		10		20	20
PHYLLODOCE MUCOSA					10
EUMIDA SANGUINEA				30	50
EUMIDA BAHUSIENSIS					50
EUMIDA SP.				10	
NEPHTYS HOMBERGII	40	40			30
NEPHTYS CAECA	10			40	
NEPHTYS LONGOSETOSA					10
GLYCERA ALBA	10				20
GONIADA MACULATA	10	10		10	
SCOLOPLOS ARMIGER	30	10		30	330
SPIO FILICORNIS				30	60
POLYDORA CAECA	10	130		400	
PSEUDOPOLYDORA PULCHRA	10				10
PRIONOSPIO FALLAX	20			190	380
SPIOPHANES BOMBYX	30			120	90
CHAETOZONE SETOSA		10		30	30
MYRIOCHELE OCULATA	70	20		10	10
PECTINARIA KORENI				20	10
PECTINARIA AURICOMA				10	60
AMPHARETE FINMARCHICA					20
POECILOCHAETUS SERPENS					10
LANICE CONCHILEGA	10	20		30	30
ISOPODA		10			
PARIAMBUS TYPICUS					20
AMPELISCA BREVICORNIS	30	20		30	30
MICROPROTOPUS MACULATUS					10
PHORONIS MUELLERI	20	10		30	40
AMPHIURA FILIFORMIS	20				
AMPHIURA JUV.					110
OPHIURA ALBIDA	90	70		60	70
ECHINOCARDIUM CORDATUM	20			20	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159019 22/05/86	159019 01/06/87	159019 19/05/88	159019 18/05/89	159019 21/05/90
ANTHOZOA					10
EDWARDSIA SP.		20			
PLATYHELMINTHES			20		20
HINIA RETICULATA					10
PHILINE APERTA					20
NUCULA TENUIS			10		
MODIOLUS MODIOLUS			10		
TELLIMYA FERRUGINOSA	20				10
MYSELLA BIDENTATA		30	20	20	90
ARCTICA ISLANDICA	80		20	20	90
CHAMELEA STRIATULA		20	40	10	10
SPISULA SUBTRUNCATA		10			120
ABRA ALBA	70	80			
MACOMA CALCAREA		230	30	20	110
FABULINA FABULA	10	20	290	40	80
TELLINA TENUIS					30
PHAXAS PELLUCIDUS	10			10	
MYA ARENARIA		30			20
CORBULA GIBBA	20	20	10	20	460
THRACIA PHASEOLINA		30			
ANTINOELLA SARSI		10			
PHOLOE INORNATA		10			10
ETEONE LONGA			30		10
PHYLLODOCE MUCOSA					50
PHYLLODOCE GROENLANDICA	10		10		
EUMIDA SANGUINEA					10
EUMIDA BAHUSIENSIS		10			
NEPHTYS HOMBERGII	70	20	30	20	80
NEPHTYS CILIATA					10
NEPHTYS CAECA	10	20	20	30	10
GLYCERA ALBA					30
GONIADA MACULATA		10		10	
SCOLOPLOS ARMIGER	40	50	50	20	150
ARICIDEA SUECICA					10
TROCHOCHAETA MULTISETOSA					30
SPIO FILICORNIS		30	20		10
POLYDORA CAECA	20	260	40	10	50
PRIONOSPIO FALLAX					1060
SPIOPHANES BOMBYX		20			
CHAETOZONE SETOSA			10		20
HETEROMASTUS FILIFORMIS	10				30
MYRIOCHELE OCULATA	30	230	190	10	60
PECTINARIA KORENI	10	10	10	10	
PECTINARIA AURICOMA					20
AMPHARETIDAE			10		
AMPHARETE ACUTIFRONS		10			
AMPHARETE SP.					20
LANICE CONCHILEGA		10			
OLIGOCHAETA					10
TUBIFICOIDES BENEDENI					10
GASTROSACCUS SPINIFER					10
LAMPROPS FASCIATA			10		
DIASTYLIS RATHKEI	20	200	10	30	130
DIASTYLIS BRADYI	10				
PARIAMBUS TYPICUS		10			
AMPELISCA BREVICORNIS	10	10	140	10	40
PERICULODES LONGIMANUS		10	10		60
PROTOMEDEIA FASCIATA			10		
PHORONIS MUELLERI		10	10		10
OPHIURA ALBIDA			10		
OPHIURA JUV.		10	20		20
ECHINOCARDIUM CORDATUM					10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159021 23/05/86	159021 01/06/87	159021 20/05/88	159021 22/05/89	159021 21/05/90
ANTHOZOA		10	10		
CERIANTHUS LLOYDII				10	
EDWARDSIA SP.		10			20
PLATYHELMINTHES	10		20		
NEMERTINEA					30
APORRHAIS PESPELICANI	10				
NUCULA TENUIS		10			
MODIOLUS MODIOLUS			10		
MUSCULUS NIGER		20			
TELLIMYA FERRUGINOSA	30				
MYSELLA BIDENTATA			50		30
ARCTICA ISLANDICA	10	30	20		20
PARVICARDIUM OVALE		30			20
CHAMELEA STRIATULA	20	30	40	10	40
ABRA ALBA		10	10		30
MACOMA CALCAREA	10	40	20		
FABULINA FABULA	10			10	30
PHAXAS PELLUCIDUS					10
MYA ARENARIA		10		10	140
MYA TRUNCATA	10				
CORBULA GIBBA		10	10		450
THRACIA PHASEOLINA	10	20	30		20
EUNOE NODOSA					10
ANTINOELLA SARSI		10			20
PHOLOE INORNATA	10				40
ETEONE LONGA			20		
EUMIDA BAHUSIENSIS			10		
NEPHTYS HOMBERGII	20				
NEPHTYS CAECA	10		10		
NEPHTYS SP.	30				
GLYCERA ALBA					30
GLYCERA SP.			10		
GONIADA MACULATA			20	20	20
SCOLOPLOS ARMIGER	100	100	120	20	240
TROCHOCHAETA MULTISETOSA				10	
SPIO FILICORNIS		10		10	
POLYDORA CAECA		60	140	10	
PRIONOSPIO FALLAX					160
SPIOPHANES BOMBYX	30	10	10		
CHAETOZONE SETOSA			10		10
HETEROMASTUS FILIFORMIS		10			10
MYRIOCHELE OCULATA	50	200	170	170	90
PECTINARIA AURICOMA					70
PECTINARIA SP.					10
AMPHARETE SP.					30
LANICE CONCHILEGA			10		20
TUBIFICOIDES BENEDENI					10
BALANUS CRENATUS		10			
DIASTYLIS RATHKEI	10	10	30		20
DIASTYLIS LAEVIS					10
PARIAMBUS TYPICUS					20
PHOXOCEPHALUS HOLBOELLI	10				
ARGISSA HAMATIPES					10
AMPELISCA BREVICORNIS			20		10
PERICULODES LONGIMANUS					10
COROPHIUM INSIDIOSUM		10			
CHEIROCRATUS SUNDEVALLEI			20		
PHORONIS MUELLERI	20	10		30	60
PHORONIS SP.					10
AMPHIURA JUV.					20
OPHIURA ALBIDA	70	50	50	20	40
OPHIURA JUV.			10		60
OPHIOCTEN GRACILIS		20			
ECHINOCYAMUS PUSILLUS	10	10			10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159022 26/05/86	159022 01/06/87	159022 20/05/88	159022 22/05/89	159022 30/05/90
ANTHOZOA	10				
EDWARDSIA SP.					10
PLATYHELMINTHES					10
NEMERTINEA			10	20	20
HINIA RETICULATA				10	
RETUSA TRUNCATULA			10		
TELLIMYA FERRUGINOSA	50			10	10
MYSELLA BIDENTATA	100	40	80		
ARCTICA ISLANDICA		30		30	60
CHAMELEA STRIATULA		100	30	20	60
ABRA ALBA	80	70	170		10
MACOMA BALTHICA	20				
MACOMA CALCAREA		170	40	20	40
FABULINA FABULA	380	430	770	790	850
PHAXAS PELLUCIDUS	20	10	20		20
MYA ARENARIA		10			10
CORBULA GIBBA		10		30	200
EUNOE NODOSA		10			10
ANTINOELLA SARSI		10			20
GATTYANA CIRROSA				10	
PHOLOE INORNATA	10	80	60	10	40
ETEONE LONGA					10
PHYLLODOCE ROSEA			10		
PHYLLODOCE MUCOSA					30
EUMIDA SANGUINEA			30	10	30
EUMIDA BAHUSIENSIS		10	10		40
EUMIDA SP.	10				
NEPHTYS HOMBERGII	90	60	100	50	80
NEPHTYS CAECA	10				10
NEPHTYS SP.					10
GLYCERA ALBA					60
GONIADA MACULATA	10		10		
SCOLOPLOS ARMIGER	70	50	90	100	350
TROCHOCHAETA MULTISETOSA	10				
SPIO FILICORNIS	10	10	10	10	80
POLYDORA CAECA	180	170	280	60	
PRIONOSPIO FALLAX	260	30	60	200	2720
SPIOPHANES BOMBYX	20	30	150	20	40
MAGELONA MIRABILIS		10			
CHAETOZONE SETOSA	20	30	30	60	160
SCALIBREGMA INFLATUM	10				
OWENIA FUSIFORMIS		10			
MYRIOCHELE OCULATA	70	70	80	20	90
PECTINARIA KORENI			20		
PECTINARIA AURICOMA				10	20
AMPHARETE SP.	10				10
LANICE CONCHILEGA		20	50	20	10
OLIGOCHAETA					10
BALANUS CRENATUS		10			
PSEUDOCUMA LONGICORNIS					10
DIASTYLIS RATHKEI	10	10	10		
PARIAMBUS TYPICUS					30
AMPELISCA BREVICORNIS	30		70		30
PERICULODES LONGIMANUS					10
UNCIOLA PLANIPES		10			
PHORONIS MUELLERI	20	30	50	10	450
PHORONIS SP.					10
AMPHIURA FILIFORMIS	50				
AMPHIURA JUV.					60
OPHIURA ALBIDA	30	40	80	60	90
OPHIURA JUV.				10	30
ECHINOCARDIUM CORDATUM	30			20	10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159024 29/05/86	159024 01/06/87	159024 26/05/88	159024 22/05/89	159024 23/05/90
ANTHOZOA			10		
VIRGULARIA MIRABILIS			10		
CERIANTHUS LLOYDII				20	
EDWARDSIA SP.		20			
NEMERTINEA				40	50
RETUSA TRUNCATULA		10			
PHILINE APERTA					10
NUCULA TENUIS	10		10		
TELLIMYA FERRUGINOSA	50				
MYSELLA BIDENTATA		10		20	30
ARCTICA ISLANDICA	30	10	40	20	60
PARVICARDIUM OVALE				10	
CHAMELEA STRIATULA		80	60	70	90
ABRA ALBA	20	300	270		
MACOMA BALTHICA	10				
MACOMA CALCAREA	10	50	30	130	40
FABULINA FABULA	220	260	500	990	880
PHAXAS PELLUCIDUS	40		10	10	20
MYA TRUNCATA	10				
CORBULA GIBBA		30	20	30	30
THRACIA PHASEOLINA		20		50	10
ANTINOELLA SARSI		10			
PHOLOE INORNATA	10	10	10	110	60
PHYLLODOCE GROENLANDICA		10		20	
PHYLLODOCE SP.					60
EUMIDA BAHUSIENSIS			20		30
EUMIDA SP.					40
NEPHTYS HOMBERGII	70	70		10	
NEPHTYS CAECA	10			10	20
NEPHTYS LONGOSETOSA			10		
NEPHTYS SP.					20
GLYCERA ALBA					30
GONIADA MACULATA				10	
SCOLOPLOS ARMIGER	40	20	110	270	270
SPIO FILICORNIS	10		10	30	70
POLYDORA CAECA	10	190	460	830	
PSEUDOPOLYDORA PULCHRA		10			
PRIONOSPIO FALLAX	50	10	30	430	1510
SPIOPHANES BOMBYX		30	60	70	60
CHAETOZONE SETOSA	10	10	20	60	140
SCALIBREGMA INFLATUM		10			
HETEROMASTUS FILIFORMIS	10				
MYRIOCHELE OCULATA	10	30	60	90	20
PECTINARIA KORENI			10	100	10
PECTINARIA AURICOMA				30	10
AMPHARETE ACUTIFRONS					30
LANICE CONCHILEGA		10	40	30	30
CHONE DUNERI			10		
DIASTYLIS RATHKEI			20	20	10
DIASTYLIS LUCIFERA					10
PARIAMBUS TYPICUS					60
AMPELISCA BREVICORNIS	10	50	80	30	90
PERICULODES LONGIMANUS					10
STENOTHOE MARINA					10
PROTOMEDEIA FASCIATA					10
PAGURUS BERNHARDUS					10
PHORONIS MUELLERI		10	20	180	220
AMPHIURA FILIFORMIS	20				
AMPHIURA JUV.					20
OPHIURA ALBIDA	30	110	70	120	50
OPHIURA JUV.					60
ECHINOCARDIUM CORDATUM	10				10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159031 26/05/86	159031 01/06/87	159031 20/05/88	159031 22/05/89	159031 21/05/90
EDWARDSIA SP.	30		20		20
PLATYHELMINTHES	10				
NEMERTINEA			10	50	80
BUCCINUM UNDATUM	10				
PHILINE APERTA	10			10	20
NUCULA TENUIS			10		
MODIOLUS MODIOLUS					40
TELLIMYA FERRUGINOSA	30		40		10
MYSELLA BIDENTATA			70	40	30
ARCTICA ISLANDICA	20		20		150
PARVICARDIUM OVALE		10			10
CHAMELEA STRIATULA	10	130	60	20	80
ABRA ALBA	160	40	30	30	
MACOMA BALTHICA	20				
MACOMA CALCAREA	10	80	110	60	10
FABULINA FABULA	30	20	160	140	80
PHAXAS PELLUCIDUS	20				
MYA ARENARIA		20			
MYA TRUNCATA	10				
CORBULA GIBBA				20	850
THRACIA PHASEOLINA			10		160
APHRODITA ACULEATA	10				
HARMOTHOE IMPAR					20
ANTINOELLA SARSI		10			
GATTYANA CIRROSA	10				
PHOLOE INORNATA		10	20	20	90
ETEONE LONGA			10		10
PHYLLODOCE MACULATA				20	10
PHYLLODOCE SP.					10
EUMIDA SANGUINEA					10
EUMIDA BAHUSIENSIS		10	10		10
OPHIODROMUS FLEXUOSUS	20				
NEPHTYS HOMBERGII	20	20	30		10
NEPHTYS CILIATA	20				
NEPHTYS CAECA	10	20	30	30	10
NEPHTYS LONGOSETOSA					40
GLYCERA ALBA					10
SCOLOPLOS ARMIGER	180	120	140	110	760
TROCHOCHAETIDAE				10	
SPIO FILICORNIS			30	10	50
POLYDORA CAECA	30	210	70	530	
PRIONOSPIO FALLAX				10	1110
SPIOPHANES BOMBYX	20	30	10	30	50
CHAETOZONE SETOSA	20	20		10	10
SCALIBREGMA INFLATUM		10			
PRAXILLELLA PRAETERMISSA			10		
OWENIA FUSIFORMIS	10				10
MYRIOCHELE OCULATA	470	280	190	100	620
PECTINARIA KORENI	10				10
PECTINARIA AURICOMA				20	
AMPHERETE BALTICA		20			
ANOBOTHRUS GRACILIS	10				
POECILOCHAETUS SERPENS				10	
LANICE CONCHILEGA				30	10
GASTROSACCUS SPINIFER					10
LAMPROPS FASCIATA			10		
DIASTYLIS RATHKEI	10		10	70	30
PARIAMBUS TYPICUS					60
AMPELISCA BREVICORNIS	20	40	140	40	180
MICROPROTOPUS MACULATUS					10
PROTOMEDEIA FASCIATA			30		
PAGURUS BERNHARDUS			10		
PHORONIS MUELLERI		10		40	230
AMPHIURA FILIFORMIS	20				
AMPHIURA JUV.					60
OPHIURA ALBIDA	70	60	70	50	110
OPHIURA JUV.				10	80
ECHINOCYAMUS PUSILLUS	10		10		

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159031 26/05/86	159031 01/06/87	159031 20/05/88	159031 22/05/89	159031 21/05/90
ECHINOCARDIUM CORDATUM			10	20	20

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159032 26/05/86	159032 01/06/87	159032 20/05/88	159032 22/05/89	159032 30/05/90
ANTHOZOA	20	10		10	
VIRGULARIA MIRABILIS	10	10			10
PLATYHELMINTHES			10		
NEMERTINEA	20	10		20	
PHILINE APERTA	10				10
NUCULA TENUIS		10			
NUCULA NITIDOSA					10
TELLIMYA FERRUGINOSA	140		30	50	
MYSELLA BIDENTATA	30	110	30	30	
ARCTICA ISLANDICA	50		20		30
PARVICARDIUM OVALE					10
CHAMELEA STRIATULA		80	10	80	40
SPISULA SUBTRUNCATA		10			
ABRA ALBA	100	70	140		20
MACOMA BALTHICA	10				
MACOMA CALCAREA		30	50	10	
FABULINA FABULA	130	290	550	600	290
PHAXAS PELLUCIDUS				20	20
MYA ARENARIA		20			
CORBULA GIBBA				40	160
THRACIA PHASEOLINA				30	10
HARMOTHOE IMPAR					10
ANTINOELLA SARSI		20			
GATTYANA CIRROSA	10			10	
PHOLOE INORNATA	10	30		20	40
ETEONE LONGA		10			
PHYLLODOCE MUCOSA				10	
EUMIDA SANGUINEA					10
EUMIDA BAHUSIENSIS		30	10		
EUMIDA SP.					10
NEPHTYS HOMBERGII	70	70	80	70	
NEPHTYS CAECA	30			10	
NEPHTYS SP.					50
GLYCERA ALBA					20
GONIADA MACULATA				10	
SCOLOPLOS ARMIGER	110	110	130	210	360
SPIO FILICORNIS	40	10	20		10
POLYDORA CAECA	200	380	60	50	
PSEUDOPOLYDORA PULCHRA		20		20	
PRIONOSPIO FALLAX	130	50	150	170	2320
SPIOPHANES BOMBYX	50	80	80	100	40
CHAETOZONE SETOSA	10	40	10	40	50
SCALIBREGMA INFLATUM		30			
HETEROMASTUS FILIFORMIS		20			
MYRIOCHELE OCULATA	20	90	90	100	100
PECTINARIA KORENI		10	10	30	10
PECTINARIA AURICOMA				30	40
PECTINARIA SP.					10
AMPHARETE ACUTIFRONS	10				
LANICE CONCHILEGA		10	10	50	40
BALANUS BALANUS	150				
PSEUDOCUMA LONGICORNIS					10
DIASTYLIS RATHKEI		70	20		10
PARIAMBUS TYPICUS					50
AMPELISCA BREVICORNIS	10	20	100	20	110
PAGURUS BERNHARDUS	10		10		
PHORONIS MUELLERI	10	50	10	10	270
AMPHIURA FILIFORMIS	70				
AMPHIURA JUV.					150
OPHIURA ALBIDA	10	80	20	80	130
OPHIURA JUV.			10	20	
ECHINOCARDIUM CORDATUM	20		30	30	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159033 29/05/86	159033 01/06/87	159033 26/05/88	159033 22/05/89	159033 30/05/90
ANTHOZOA		20		20	
VIRGULARIA MIRABILIS				10	
EDWARDSIA SP.		10			20
NEMERTINEA	10	10			10
AMAUROPSIS ISLANDICUS				10	
BUCCINUM UNDATUM	10				
PHILINE APERTA					20
MODIOLUS MODIOLUS				10	
TELLIMYA FERRUGINOSA		20	20	30	
MYSELLA BIDENTATA	20	100	10		20
ARCTICA ISLANDICA	50	70	30	40	20
PARVICARDIUM OVALE					10
CHAMELEA STRIATULA		90	10	80	20
SPISULA SUBTRUNCATA		10			20
ABRA ALBA	50	160	190		10
MACOMA BALTHICA	10				
MACOMA CALCAREA		70	40	10	20
FABULINA FABULA	200	550	900	790	440
PHAXAS PELLUCIDUS		10	10		
MYA ARENARIA		10			10
CORBULA GIBBA				10	40
THRACIA PHASEOLINA				20	20
EUNOE NODOSA					10
PHOLOE INORNATA		40		30	50
ETEONE LONGA					10
PHYLLODOCE MUCOSA					50
PHYLLODOCE GROENLANDICA		20	10		
EUMIDA BAHUSIENSIS		10	10		70
NEPHTYS HOMBERGII	70	50	80	20	30
NEPHTYS CAECA			10	20	
NEPHTYS SP.					30
SPHAERODORUM FLAVUM					10
GLYCERA ALBA					40
GONIADA MACULATA		20	70		
SCOLOPLOS ARMIGER	30	170	150	40	250
SPIO FILICORNIS		10	10		30
POLYDORA CAECA	20	330	220	70	
PSEUDOPOLYDORA PULCHRA		10	10		
PRIONOSPIO FALLAX	10	100	270	210	1510
SPIOPHANES BOMBYX		70	60	20	60
CHAETOZONE SETOSA	10	70	40	50	80
SCALIBREGMA INFLATUM		10			
MYRIOCHELE OCULATA	30	20		10	100
PECTINARIA KORENI		10	10	40	
PECTINARIA AURICOMA			10	40	30
AMPHERETE BALTICA		10			
LANICE CONCHILEGA		30	30	30	10
HIRUDINEA					10
DIASTYLIS RATHKEI			10	10	20
DIASTYLIS LUCIFERA		10			
PHTISICA MARINA					10
PARIAMBUS TYPICUS		10			70
AMPELISCA BREVICORNIS	10	40	20	20	50
PERICULODES LONGIMANUS					10
PONTOCRATES ALTAMARINUS				10	
COROPHIUM CRASSICORNE					10
PHORONIS MUELLERI		50	30	30	120
PHORONIS SP.					50
ASTROPECTEN IRREGULARIS	10				
ASTERIAS RUBENS	10				
AMPHIURA JUV.					80
OPHIURA ALBIDA	50	60	80	10	50
OPHIURA JUV.					10
ECHINOCARDIUM CORDATUM	20	10	20	30	

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159042 22/05/86	159042 10/06/87	159042 19/05/88	159042 17/05/89	159042 21/05/90
EDWARDSIA SP.	10				20
PLATYHELMINTHES				10	
NEMERTINEA	10	10	10		30
RISSOA ALBELLA				10	
HINIA RETICULATA					20
PHILINE APERTA					20
MUSCULUS NIGER					10
TELLIMYA FERRUGINOSA	10				
MYSELLA BIDENTATA		50	130	50	130
ARCTICA ISLANDICA	10	70	50	10	150
PARVICARDIUM OVALE		10			
CHAMELEA STRIATULA	40	200	130	40	120
SPISULA SOLIDA					30
ABRA ALBA	30	110	50		10
MACOMA BALTHICA	100				
MACOMA CALCAREA	20	300	70	20	30
FABULINA FABULA	70	20	340	170	150
PHAXAS PELLUCIDUS	20				
MYA ARENARIA		10			40
MYA TRUNCATA	10				
CORBULA GIBBA	20	380	260	90	1320
THRACIA PHASEOLINA		20			
HARMOTHOE IMPAR					20
PHOLOE INORNATA		100	10	20	20
PHYLLODICIDAE		20			
ETEONE LONGA		30			
PHYLLODOCE SP.					50
NEPHTYS HOMBERGII	50	40	120	90	120
NEPHTYS CILIATA	10	10			
NEPHTYS CAECA	20	40	30	10	
NEPHTYS LONGOSETOSA	10				
NEPHTYS SP.		10			40
GONIADA MACULATA		10			
SCOLOPLOS ARMIGER	90	190	260	180	460
SPIO FILICORNIS					70
POLYDORA CAECA	20	690	490	20	20
POLYDORA SP.		10			
PRIONOSPIO FALLAX		10	30	20	1610
SPIOPHANES BOMBYX	20	30	10	20	40
MAGELONA PAPILLICORNIS					10
CHAETOZONE SETOSA	20		20		30
BRADA VILLOSA	10				
POLYPHYSIA CRASSA					10
CAPITELLA CAPITATA				10	
HETEROMASTUS FILIFORMIS		10			
MYRIOCHELE OCULATA	100	340	70	40	90
PECTINARIA KORENI			20	40	10
PECTINARIA AURICOMA				10	
AMPHARETE FINMARCHICA	10				
LANICE CONCHILEGA	10	20	10		
GASTROSACCUS SPINIFER			10		
PSEUDOCUMA LONGICORNIS					10
LAMPROPS FASCIATA			10		10
DIASTYLIS RATHKEI	40	490	20	50	190
PARIAMBUS TYPICUS					30
AMPELISCA BREVICORNIS	30	160	120		60
PONTOPOREIA FEMORATA				10	
PERICULODES LONGIMANUS		10		10	40
MICROPROTOPUS MACULATUS					50
GAMMARUS SALINUS				10	
PHORONIS MUELLERI	10	10		60	70
AMPHIURA FILIFORMIS					20
OPHIURA ALBIDA	70	90	10	30	80
OPHIURA JUV.			10	10	30
OPHIOCTEN GRACILIS		10			
ECHINOCARDIUM CORDATUM	10			10	10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159043 23/05/86	159043 10/06/87	159043 19/05/88	159043 19/05/89	159043 21/05/90
EDWARDSIA SP.			20		
NEMERTINEA	10	10	10	110	70
HINIA RETICULATA					40
RETUSA TRUNCATULA					10
NUCULA TENUIS		10			
MUSCULUS TUMIDA					20
MUSCULUS NIGER		10			
TELLIMYA FERRUGINOSA	240		10		
MYSELLA BIDENTATA	30	190	70	20	60
ARCTICA ISLANDICA	30	30	50	30	50
CHAMELEA STRIATULA	10	110	80	30	20
ABRA ALBA	250	270	420	30	20
MACOMA CALCAREA	10	340	40		60
FABULINA FABULA		60	120	50	90
PHAXAS PELLUCIDUS					10
MYA ARENARIA		30			60
CORBULA GIBBA	10	70	80	10	480
THRACIA PHASEOLINA			10		
HARMOTHOE IMPAR		10			
EUNOE NODOSA			10		
ANTINOELLA SARSI	10	30			50
PHOLOE INORNATA	60	200	10	20	30
ETEONE LONGA					10
ETEONE SP.					10
PHYLLODOCE MUCOSA					10
PHYLLODOCE GROENLANDICA	10		10		
PHYLLODOCE SP.					20
EUMIDA SANGUINEA	10				
EUMIDA BAHUSIENSIS					20
NEPHTYS HOMBERGII	30	40			30
NEPHTYS CILIATA	30	40	50	60	
NEPHTYS CAECA					50
NEPHTYS LONGOSETOSA					10
NEPHTYS SP.		10			
GONIADA MACULATA		20			
SCOLOPLOS ARMIGER	150	370	450	340	460
SPIO FILICORNIS			10		60
POLYDORA CAECA	40	1020	440	350	30
PRIONOSPIO FALLAX	30	40	10	30	1470
SPIOPHANES BOMBYX			90	20	90
CIRRATULIDAE		10			
CHAETOZONE SETOSA		20		20	70
OPHELINA ACUMINATA					10
CAPITELLA CAPITATA	20	10			10
HETEROMASTUS FILIFORMIS	20	30	30		20
PRAXILLELLA PRAETERMISSA	10				
MYRIOCHELE OCULATA	200	400	510	80	310
PECTINARIA KORENI	10			10	
PECTINARIA AURICOMA				10	30
AMPHERETE BALTICA		20			
LANICE CONCHILEGA	10	10	20	10	10
CHONE INFUNDIBULIFORMIS	10				
TUBIFICOIDES BENEDENI					10
BALANUS CRENATUS		250			
LAMPROPS FASCIATA			10		
DIASTYLIS RATHKEI	100	250	350	60	120
AMPELISCA BREVICORNIS		10	80	10	120
PERICULODES LONGIMANUS					30
MICROPROTOPUS MACULATUS					10
PHORONIS MUELLERI		10	10	10	100
AMPHIURA FILIFORMIS	70				
OPHIURA ALBIDA	100	120	60	70	90
OPHIURA JUV.			20		90
ECHINOCARDIUM CORDATUM	20	10	10	10	
ASCIDIACEA					10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159045 26/05/86	159045 10/06/87	159045 25/05/88	159045 22/05/89	159045 30/05/90
ANTHOZOA	20	10	10		
CERIANTHUS LLOYDII				10	
EDWARDSIA SP.			10		20
PLATYHELMINTHES					10
NEMERTINEA	20	10	40	100	40
TURRITELLA COMMUNIS				10	
RETUSA TRUNCATULA				10	
NUCULA NITIDOSA		10			
MUSCULUS NIGER		10			
TELLIMYA FERRUGINOSA	280			10	10
MYSELLA BIDENTATA		60	10	180	20
ARCTICA ISLANDICA	20	20	30	40	90
CHAMELEA STRIATULA		10	10	60	60
SPISULA SUBTRUNCATA	30	10			
ABRA ALBA	290	210	310		
MACOMA CALCAREA	10	80	160	60	10
FABULINA FABULA	10	100	160	490	360
PHAXAS PELLUCIDUS	30		10		10
MYA ARENARIA		10			
CORBULA GIBBA	10	10		50	240
THRACIA PHASEOLINA			10		10
HARMOTHOE IMPAR					10
ANTINOELLA SARSI			10		
PHOLOE INORNATA	30	80	40	60	20
ETEONE LONGA			60	10	
ETEONE SP.	10	10			
EUMIDA SP.					20
NEPHTYS HOMBERGII	30			50	40
NEPHTYS CILIATA		10	10		
NEPHTYS CAECA			20	10	30
NEPHTYS LONGOSETOSA					10
NEPHTYS SP.					20
SPHAERODORUM FLAVUM			10		
GLYCERA ALBA					10
GONIADA MACULATA		10	10		10
SCOLOPLOS ARMIGER	170	470	390	400	300
TROCHOCHAETA MULTISETOSA				10	
SPIO FILICORNIS	10	10	30		70
POLYDORA CAECA	70	380	1240	990	20
PRIONOSPIO FALLAX	80	60	530	270	2800
SPIOPHANES BOMBYX	20	30	40	120	100
MAGELONA MIRABILIS	10				
CHAETOZONE SETOSA		50	10	10	40
SCALIBREGMA INFLATUM		40			
OPHELINA ACUMINATA		10	10		
CAPITELLA CAPITATA		10			
HETEROMASTUS FILIFORMIS		10	10		
PRAXILLELLA PRAETERMISSA				10	
MYRIOCHELE OCULATA	110	140	220	750	200
PECTINARIA KORENI	10			100	10
PECTINARIA AURICOMA				30	20
AMPHARETE FINMARCHICA		10			
AMPHARETE ACUTIFRONS				10	
LANICE CONCHILEGA	30		30	30	
BALANUS CRENATUS		40			
DIASTYLIS RATHKEI		10	40	30	
DIASTYLIS BRADYI					10
PARIAMBUS TYPICUS				10	
ARGISSA HAMATIPES					10
AMPELISCA BREVICORNIS	70		100	10	70
PERICULODES LONGIMANUS					30
PONTOCRATES ALTAMARINUS			10		
MACROPIPUS PUSILLUS	10				
PHORONIS MUELLERI	10	30	80	370	210
AMPHIURA FILIFORMIS	110				
AMPHIURA JUV.					100
OPHIURA ALBIDA	60	30	70	60	100
OPHIURA JUV.			10	40	20

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159045 26/05/86	159045 10/06/87	159045 25/05/88	159045 22/05/89	159045 30/05/90
ECHINOCARDIUM CORDATUM	20	20	10	10	10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159046 26/05/86	159046 10/06/87	159046 20/05/88	159046 22/05/89	159046 30/05/90
ANTHOZOA	10	20		10	10
EDWARDSIA SP.					10
PLATYHELMINTHES			10	10	
NEMERTINEA	10			20	
PHILINE APERTA					10
MODIOLUS MODIOLUS					10
TELLIMYA FERRUGINOSA	190				40
MYSELLA BIDENTATA	50	250	20	10	30
ARCTICA ISLANDICA	10	30	40	10	
CHAMELEA STRIATULA	10	50	10	60	100
SPISULA SUBTRUNCATA		10			10
ABRA ALBA	40	150	50		50
MACOMA BALTHICA	50				
MACOMA CALCAREA		150	50	50	40
FABULINA FABULA	120	410	550	800	790
PHAXAS PELLUCIDUS	20	10			30
MYA ARENARIA					20
CORBULA GIBBA					170
THRACIA PHASEOLINA		10		10	
APHRODITA ACULEATA					10
ANTINOELLA SARSI		10			40
PHOLOE INORNATA	50	60	20	40	20
PHYLLODICIDAE					20
ETEONE LONGA		10			30
ETEONE SP.	10				
EUMIDA SANGUINEA			20		30
EUMIDA BAHUSIENSIS		10	40		
NEPHTYS HOMBERGII	70	20	100	70	80
NEPHTYS CILIATA		10			
NEPHTYS CAECA		20		10	20
NEPHTYS SP.		10	10		
GLYCERA ALBA					30
GONIADA MACULATA	10	10			
SCOLOPLOS ARMIGER	110	130	190	170	210
SPIO FILICORNIS	20	40			50
POLYDORA CAECA	70	620	90	40	
PSEUDOPOLYDORA PULCHRA		50		30	
PRIONOSPIO FALLAX	60	50	180	170	1550
SPIOPHANES BOMBYX	30	30	20	80	30
CHAETOZONE SETOSA	10	50	30	30	100
SCALIBREGMA INFLATUM		10		10	
PRAXILLELLA PRAETERMISSA	10				
RHODINE SP				20	
OWENIA FUSIFORMIS	10				
MYRIOCHELE OCULATA	50	40	60	30	50
PECTINARIA KORENI		20		60	
PECTINARIA AURICOMA				30	60
AMPHERETE BALTICA		20			
AMPHARETE SP.				10	
LANICE CONCHILEGA	10		20	10	30
BALANUS CRENATUS		20			
DIASTYLIS RATHKEI		20		20	
DIASTYLIS LAEVIS					10
PARIAMBUS TYPICUS					110
AMPELISCA BREVICORNIS	110		90	50	120
PERICULODES LONGIMANUS					10
PROTOMEDEIA FASCIATA	20				
PHORONIS MUELLERI	10	30		30	100
PHORONIS SP.			10		
AMPHIURA FILIFORMIS	90				
AMPHIURA JUV.					80
OPHIURA OPHIURA					80
OPHIURA ALBIDA	80	20	20	60	
OPHIURA JUV.				20	
ECHINOCARDIUM CORDATUM	30	10			10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159048 29/05/86	159048 10/06/87	159048 26/05/88	159048 19/05/89	159048 23/05/90
ANTHOZOA		10			
VIRGULARIA MIRABILIS			10		10
EDWARDSIA SP.		10			10
PLATYHELMINTHES				10	
NEMERTINEA		30		30	40
PHILINE APERTA					10
NUCULA TENUIS	10	10		10	10
MODIOLUS MODIOLUS		10			
TELLIMYA FERRUGINOSA	670		10	10	
MYSELLA BIDENTATA		190	140	40	40
ARCTICA ISLANDICA	20	20	30	50	30
CHAMELEA STRIATULA		110	60	60	20
SPISULA SUBTRUNCATA	10		20		
ABRA ALBA	10	310	200	10	10
MACOMA CALCAREA	60	150	110	80	60
FABULINA FABULA	260	240	870	880	830
PHAXAS PELLUCIDUS	20	10	10	10	
MYA ARENARIA					30
MYA TRUNCATA	20				
CORBULA GIBBA		20	30	40	50
THRACIA PHASEOLINA		20	10	40	
APHRODITA ACULEATA				10	
ANTINOELLA SARSI		20			
PHOLOE INORNATA	90	130	40	10	60
ETEONE LONGA				10	10
PHYLLODOCE MUCOSA					50
EUMIDA SANGUINEA			10	10	20
EUMIDA BAHUSIENSIS		10			
NEPHTYS HOMBERGII	130	80		30	30
NEPHTYS CAECA		10	50		10
NEPHTYS SP.					20
GLYCERA ALBA			20		20
GONIADA MACULATA	10	10		20	20
SCOLOPLOS ARMIGER	120	140	210	180	210
SPIO FILICORNIS	10	10	10		60
POLYDORA CAECA	20	890	1150	540	10
PSEUDOPOLYDORA PULCHRA	10			10	
PRIONOSPIO FALLAX	70	10	280	140	1090
SPIOPHANES BOMBYX	50	20	60	130	60
CHAETOZONE SETOSA		80	50	20	160
HETEROMASTUS FILIFORMIS					10
EUCLYMENE DROEBACHIENSIS				10	
MYRIOCHELE OCULATA	40	40	100	260	10
PECTINARIA KORENI		10	50	60	
PECTINARIA AURICOMA				30	50
AMPHERETE BALTICA			10		
AMPHARETE SP.		10			
LANICE CONCHILEGA		10	70	200	10
OLIGOCHAETA					10
TUBIFICOIDES BENEDENI				10	
DIASTYLIS RATHKEI			20	20	10
PARIAMBUS TYPICUS					20
AMPELISCA BREVICORNIS		10	80	30	50
PERICULODES LONGIMANUS					10
WESTWOODILLA CAECULA					10
STENOTHOE MARINA					10
PHOTIS RHEINHARDI			10		
PHORONIS MUELLERI	20	30	140	350	180
ASTERIAS RUBENS			10		
AMPHIURA FILIFORMIS	320				
AMPHIURA JUV.					90
OPHIURA ALBIDA	30	100	40	140	10
OPHIURA JUV.			30	20	90
ECHINOCARDIUM CORDATUM	10	10	10	10	

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159053 03/06/86	159053 10/06/87	159053 20/05/88	159053 22/05/89	159053 21/05/90
ANTHOZOA			10		
EDWARDSIA SP.	10				50
NEMERTINEA		10	20	10	80
BUCCINUM UNDATUM		10			
RETUSA TRUNCATULA					10
PHILINE APERTA					10
MODIOLUS MODIOLUS			10	10	
TELLIMYA FERRUGINOSA	170		10		
MYSELLA BIDENTATA		100	200	70	100
ARCTICA ISLANDICA			70		80
CHAMELEA STRIATULA		100	70	130	80
SPISULA SUBTRUNCATA		10			
ABRA ALBA	130	110	100	20	10
MACOMA CALCAREA	10	210	80	40	20
FABULINA FABULA	60	110	450	480	270
PHAXAS PELLUCIDUS	50				10
MYA ARENARIA		20			90
MYA TRUNCATA	10				
CORBULA GIBBA			30	70	260
THRACIA PHASEOLINA			10		
APHRODITA ACULEATA			10		
HARMOTHOE LONGISETIS					10
ANTINOELLA SARSI		30			
PHOLOE INORNATA	10	100	50	40	50
ETEONE LONGA					20
PHYLLODOCE GROENLANDICA		10	10		
PHYLLODOCE SP.					20
EUMIDA SANGUINEA				30	
EUMIDA BAHUSIENSIS			10		
EUMIDA SP.					20
NEPHTYS HOMBERGII	50		20	20	20
NEPHTYS CAECA	20	20	10	20	
NEPHTYS LONGOSETOSA					70
GLYCERA ALBA					10
GONIADA MACULATA	30			10	
SCOLOPLOS ARMIGER	240	250	280	410	520
ARICIDEA SUECICA				10	
SPIO FILICORNIS				10	70
POLYDORA CAECA	60	540	630	880	
PRIONOSPIO FALLAX	130	30	80	100	4160
SPIOPHANES BOMBYX	10	20	190	120	140
CHAETOZONE SETOSA	10	20	20	20	50
SCALIBREGMA INFLATUM		10			
OPHELINA ACUMINATA		10			
PRAXILLELLA PRAETERMISSA			10		
MYRIOCHELE OCULATA	130	90	390	370	640
PECTINARIA KORENI	10		20	40	40
PECTINARIA AURICOMA				30	30
PECTINARIA SP.				20	
AMPHARETE FINMARCHICA			10		
AMPHARETE SP.	10				
LANICE CONCHILEGA				20	
BALANUS CRENATUS		190			
GASTROSACCUS SPINIFER					10
DIASTYLIS RATHKEI		10	30	20	20
ARGISSA HAMATIPES					10
AMPELISCA BREVICORNIS	40	80	120	60	190
PERICULODES LONGIMANUS					10
PHORONIS MUELLERI	10	40	10	60	130
AMPHIURA FILIFORMIS	90				
AMPHIURA JUV.					10
AMPHIURA SP.			10		
OPHIURA ALBIDA	30	30	30	90	80
OPHIURA JUV.				80	60
ECHINOCARDIUM CORDATUM	20		10		

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159061 03/06/86	159061 10/06/87	159061 20/05/88	159061 23/05/89	159061 30/05/90
EDWARDSIA SP.					30
NEMERTINEA			10		40
PHILINE APERTA	10				
TELLIMYA FERRUGINOSA	60				40
MYSELLA BIDENTATA	40		40	20	20
ARCTICA ISLANDICA			10		10
PARVICARDIUM OVALE					10
CHAMELEA STRIATULA		40	10	100	60
SPISULA SUBTRUNCATA		10			30
ABRA ALBA	40	70	110	20	
MACOMA CALCAREA		120		40	20
FABULINA FABULA	340	400	460	1090	510
PHAXAS PELLUCIDUS	30			20	10
HIATELLA ARCTICA					20
MYA ARENARIA		30			50
CORBULA GIBBA			10	20	260
THRACIA PHASEOLINA	30		20	10	
ANTINOELLA SARSI					20
PHOLOE INORNATA		30			10
ETEONE LONGA					40
PHYLLODOCE GROENLANDICA			10	10	
PHYLLODOCE SP.					50
EUMIDA SANGUINEA				10	
EUMIDA BAHUSIENSIS		10			
SYNELMIS KLATTI	10				
NEPHTYS HOMBERGII	80	110	20	160	90
NEPHTYS CILIATA					10
NEPHTYS CAECA		20	10		
NEPHTYS SP.		10			30
GLYCERA ALBA					90
GONIADA MACULATA	10	10	10	10	10
SCOLOPLOS ARMIGER	30	50	130	150	390
SPIO FILICORNIS			20	30	140
POLYDORA CAECA	50	570	330	10	
PRIONOSPIO FALLAX	10	30	100	150	4830
SPIOPHANES BOMBYX			30	40	80
CHAETOZONE SETOSA	10	30	30		150
MYRIOCHELE OCULATA		70	40	40	20
PECTINARIA KORENI				30	
PECTINARIA AURICOMA				30	80
POECILOCHAETUS SERPENS					10
LANICE CONCHILEGA				20	10
DIASTYLIS RATHKEI		40	20	10	10
DIASTYLIS LUCIFERA				10	
PARIAMBUS TYPICUS					20
AMPELISCA BREVICORNIS	30	80	140	20	250
PERICULODES LONGIMANUS			10		30
CRANGON VULGARIS				10	
PHORONIS MUELLERI		10	20	40	100
AMPHIURA FILIFORMIS	20				
AMPHIURA JUV.					150
OPHIURA ALBIDA	70	40		10	20
OPHIURA JUV.					170
STRONGYLOCENTROTUS DROEBACH	10				
ECHINOCARDIUM CORDATUM	10		10	10	10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159062 03/06/86	159062 10/06/87	159062 26/05/88	159062 19/05/89	159062 30/05/90
ANTHOZOA	60		10		
VIRGULARIA MIRABILIS	10	10	10	10	
CERIANTHUS LLOYDII				10	10
EDWARDSIA SP.		10			
PLATYHELMINTHES			10		
NEMERTINEA				10	
PHILINE APERTA					10
NUCULA TENUIS					10
NUCULA NITIDOSA		10			
MODIOLUS MODIOLUS			10		
TELLIMYA FERRUGINOSA	950			20	10
MYSELLA BIDENTATA		240	40	40	10
ARCTICA ISLANDICA	30	20	20	50	
CHAMELEA STRIATULA	10	80	10	10	20
SPISULA SUBTRUNCATA		10			
ABRA ALBA	180	170	190		20
MACOMA CALCAREA	30	110	40	70	50
FABULINA FABULA	220	310	870	980	420
PHAXAS PELLUCIDUS	20			40	20
MYA ARENARIA					30
CORBULA GIBBA					40
THRACIA PHASEOLINA			10		
HARMOTHOE LONGISETIS		10			
ANTINOELLA SARSI		20			
PHOLOE INORNATA	200	90	40	50	20
ETEONE LONGA			30		
PHYLLODOCE GROENLANDICA		10			
EUMIDA SANGUINEA			10		20
NEPHTYS HOMBERGII	80	70	40	10	50
NEPHTYS CAECA	10		10	30	
NEPHTYS SP.		20			40
GLYCERA CAPITATA			10		
GONIADA MACULATA	10		20	10	10
SCOLOPLOS ARMIGER	190	130	300	120	130
SPIO FILICORNIS	30	10		20	50
POLYDORA CAECA	100	890	300	70	
PSEUDOPOLYDORA PULCHRA	10			10	
PRIONOSPIO FALLAX	60	40	170	70	600
SPIOPHANES BOMBYX	30	30	80	50	100
CHAETOZONE SETOSA	10	70	90	60	40
SCALIBREGMA INFLATUM		30			
TRAVISIA FORBESII		10			
CAPITELLA CAPITATA		10			
OWENIA FUSIFORMIS		10			
MYRIOCHELE OCULATA		40	60	40	50
PECTINARIA KORENI			30	40	
PECTINARIA AURICOMA				20	
AMPHARETE FINMARCHICA			10		10
AMPHERETE BALTICA		10			
AMPHARETE SP.					10
LANICE CONCHILEGA		30	20	10	10
OLIGOCHAETA					10
DIASTYLIS RATHKEI		20	10	20	
PARIAMBUS TYPICUS			10		
ARGISSA HAMATIPES			10		
AMPELISCA BREVICORNIS	30	20	40	20	90
PERICULODES LONGIMANUS	10		10		10
GAMMARUS SP.				10	
PHORONIS MUELLERI	10	40	30	20	100
AMPHIURA FILIFORMIS	200				
AMPHIURA JUV.					50
OPHIURA ALBIDA	60	80	60	50	70
OPHIURA JUV.			10		60
ECHINOCARDIUM CORDATUM	10			30	30

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159073 23/05/86	159073 11/06/87	159073 19/05/88	159073 23/05/89	159073 21/05/90
ANTHOZOA			10		
EDWARDSIA SP.		30	40		70
PLATYHELMINTHES					10
NEMERTINEA		10			
HYDROBIA ULVAE		10			
HINIA RETICULATA					10
PHILINE APERTA					10
MODIOLUS MODIOLUS			10		10
MUSCULUS NIGER			10		
MYSELLA BIDENTATA			100		60
ARCTICA ISLANDICA		20	80	20	210
CHAMELEA STRIATULA	10	90	60	10	50
DOSINIA LUPINUS					10
SPISULA SUBTRUNCATA			10		100
ABRA ALBA	10	10	130		20
MACOMA CALCAREA		230	40	50	30
FABULINA FABULA	20	90	200	40	140
PHAXAS PELLUCIDUS					10
MYA ARENARIA			10		10
CORBULA GIBBA		30	20		1370
THRACIA PHASEOLINA			40		
ANTINOELLA SARSI		30			20
GATTYANA CIRROSA					30
PHOLOE INORNATA		30	60		90
ETEONE LONGA		10	10		
PHYLLODOCE GROENLANDICA		10			
PHYLLODOCE SP.					10
EUMIDA SANGUINEA	10		50		40
EUMIDA BAHUSIENSIS					40
NEPHTYS HOMBERGII	30	10	10	40	80
NEPHTYS CAECA			30		
NEPHTYS LONGOSETOSA		10			
NEPHTYS SP.					40
GLYCERA ALBA			10		20
SCOLOPLOS ARMIGER	20	50	60	10	420
SPIO FILICORNIS		70			
POLYDORA CAECA	10	960	310	10	130
PSEUDOPOLYDORA PULCHRA					70
PRIONOSPIO FALLAX			10		830
SPIOPHANES BOMBYX	10		70	30	190
CHAETOZONE SETOSA	10	10			70
OPHELINA ACUMINATA		10			
HETEROMASTUS FILIFORMIS					20
MYRIOCHELE OCULATA	110	100	190	10	160
PECTINARIA KORENI				30	20
PECTINARIA AURICOMA				10	60
AMPHARETE FINMARCHICA		10			
AMPHARETE SP.		10			10
POECILOCHAETUS SERPENS					10
LANICE CONCHILEGA	10	10	60	10	10
TUBIFICOIDES BENEDENI					20
GASTROSACCUS SPINIFER	10				
PRAUNUS INERMIS			10		
LAMPROPS FASCIATA		10	40		
DIASTYLIS RATHKEI	10	210	90		120
DIASTYLIS SP.				10	
PARIAMBUS TYPICUS					60
HIPPOMEDON DENTICULATUS			10		
PHOXOCEPHALUS HOLBOELLI			10		
ARGISSA HAMATIPES					10
AMPELISCA BREVICORNIS	20	50	280		10
PERICULODES LONGIMANUS					40
MEGAMPHORUS CORNUTUS					10
PHORONIS MUELLERI		20	10		110
PHORONIS SP.					160
AMPHIURA JUV.					60
OPHIURA AFFINIS	10				
OPHIURA ALBIDA	20	20	50	60	30

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159073 23/05/86	159073 11/06/87	159073 19/05/88	159073 23/05/89	159073 21/05/90
OPHIURA JUV.				50	80
ECHINOCYAMUS PUSILLUS	10	10			
ECHINOCARDIUM CORDATUM			10	10	30

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159075 03/06/86	159075 11/06/87	159075 19/05/88	159075 23/05/89	159075 29/05/90
ANTHOZOA			10		
CERIANTHUS LLOYDII				10	
EDWARDSIA SP.				10	20
PLATYHELMINTHES			10		
PHILINE APERTA	20				
LEPIDOPLEURUS ASELLUS		10			
MODIOLUS MODIOLUS		10			
MUSCULUS NIGER		30			30
TELLIMYA FERRUGINOSA	70			20	
MYSELLA BIDENTATA	20	110	60	10	30
ARCTICA ISLANDICA	10		10		70
PARVICARDIUM OVALE		30			
CHAMELEA STRIATULA	20	50	10	10	20
SPISULA SUBTRUNCATA		10			20
ABRA NITIDA					10
ABRA ALBA	40	20	40		20
MACOMA BALTHICA	30				
MACOMA CALCAREA		220	20		
FABULINA FABULA	170	30	10	10	110
PHAXAS PELLUCIDUS	10				30
HIATELLA ARCTICA		10			
MYA ARENARIA		120			170
MYA TRUNCATA					10
CORBULA GIBBA		10			400
THRACIA PHASEOLINA			10		20
HARMOTHOE IMPAR			20		
PHOLOE INORNATA	30	70	70		50
PHYLLODOCE MUCOSA					20
PHYLLODOCE GROENLANDICA			10		
EUMIDA SP.	10				
NEPHTYS HOMBERGII	40				
NEPHTYS PENTE		10			
NEPHTYS CAECA	10	10	30	40	
NEPHTYS SP.		10			20
GLYCERA ALBA					100
GONIADA MACULATA	10			20	10
SCOLOPLOS ARMIGER	80	110	80	80	290
ARICIDEA SUECICA					20
SPIO FILICORNIS	20	210			40
POLYDORA CAECA	10	390	100	10	
PSEUDOPOLYDORA PULCHRA					140
PRIONOSPIO FALLAX		20	20		880
SPIOPHANES KROYERI					20
SPIOPHANES BOMBYX	40		10	10	
MAGELONA PAPILLICORNIS					10
CHAETOZONE SETOSA	20				100
PHERUSA PLUMOSA		60		10	
SCALIBREGMA INFLATUM		70			
OPHELINA ACUMINATA			10		
HETEROMASTUS FILIFORMIS		20			
OWENIA FUSIFORMIS					10
MYRIOCHELE OCULATA	170	70	320	20	310
PECTINARIA KORENI	10				30
PECTINARIA AURICOMA				20	10
AMPHERETE BALTICA		60			
AMPHARETE SP.			10		20
LANICE CONCHILEGA				10	
DIASTYLIS RATHKEI		100	240	60	140
PARIAMBUS TYPICUS					40
ARGISSA HAMATIPES					20
AMPELISCA BREVICORNIS	10	20	180	140	190
DYOPEDOS PORRECTUS	10				
PROTOMEDEIA FASCIATA			140		70
UNCIOLA PLANIPES		40			
MELITA DENTATA		10			
PAGURUS BERNHARDUS	10				
CRANGON VULGARIS				10	
PHORONIS MUELLERI				20	280

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159075 03/06/86	159075 11/06/87	159075 19/05/88	159075 23/05/89	159075 29/05/90
OPHIOPHOLIS ACULEATA			10		
AMPHIURA FILIFORMIS	10				
AMPHIURA JUV.					430
OPHIURA ALBIDA	30	40	40	40	30
OPHIURA JUV.			20		60
ECHINOCYAMUS PUSILLUS					20
ECHINOCARDIUM CORDATUM	30				10
ASCIDIACEA		10			

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159076 03/06/86	159076 11/06/87	159076 19/05/88	159076 23/05/89	159076 30/05/90
ANTHOZOA			10		10
EDWARDSIA SP.	10	30	20		50
PLATYHELMINTHES					10
NEMERTINEA	10			20	50
ACTEON TORNATILIS					10
PHILINE APERTA		10			20
NUCULA TENUIS	10		10		
TELLIMYA FERRUGINOSA	20				20
MYSELLA BIDENTATA	30	10	40	40	30
ARCTICA ISLANDICA	30		20	20	30
PARVICARDIUM OVALE					10
CHAMELEA STRIATULA		40	20	30	60
ABRA ALBA	120	10	170		70
MACOMA CALCAREA	10	110	40	30	40
FABULINA FABULA	360	240	660	760	670
PHAXAS PELLUCIDUS	20			20	10
MYA ARENARIA					30
CORBULA GIBBA				40	250
ANTINOELLA SARSI		20		20	
PHOLOE INORNATA	70	40	40	20	40
ETEONE LONGA		10			20
PHYLLODOCE MUCOSA					30
PHYLLODOCE GROENLANDICA			10		
EUMIDA SANGUINEA			10		10
EUMIDA SP.	10				
NEPHTYS HOMBERGII	80	80	60	20	80
NEPHTYS CAECA	10	10	10	40	40
NEPHTYS SP.				10	
GLYCERA ALBA			10		30
GONIADA MACULATA		10	30	10	20
SCOLOPLOS ARMIGER	60	40	90	80	130
PARAONIS FULGENS					20
SPIONIDAE	10				
SPIO FILICORNIS			10	30	70
POLYDORA CAECA	30	850	50	80	
PSEUDOPOLYDORA PULCHRA	20	10			
PRIONOSPIO FALLAX	190	20	30	260	1380
SPIOPHANES BOMBYX	30	30	80	120	120
CHAETOZONE SETOSA	10	30	10	100	160
TRAVISIA FORBESII		10			
OPHELINA ACUMINATA	10				
OWENIA FUSIFORMIS					10
MYRIOCHELE OCULATA	100	90	90	60	140
PECTINARIA KORENI	10			60	
PECTINARIA AURICOMA				30	70
AMPHERETE BALTICA					20
TEREBELLIDAE					10
LANICE CONCHILEGA			10	20	20
GASTROSACCUS SPINIFER					10
DIASTYLIS RATHKEI		10	60	10	10
AMPHIPODA		10			
PARIAMBUS TYPICUS					110
AMPELISCA BREVICORNIS	30	30	50	110	200
BATHYPOREIA ELEGANS				10	
PODOCERIDAE		20			
PERICULODES LONGIMANUS			30		30
PONTOCRATES ALTAMARINUS			10		
PROTOMEDEIA FASCIATA					10
GAMMARUS SP.			10		
PHORONIS MUELLERI	10	50	10	10	480
AMPHIURA FILIFORMIS	130				
AMPHIURA JUV.					20
OPHIURA ALBIDA	80	10	40	60	20
OPHIURA JUV.					40
ECHINOCYAMUS PUSILLUS					10
ECHINOCARDIUM CORDATUM	10		10		10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159078 29/05/86	159078 11/06/87	159078 19/05/88	159078 23/05/89	159078 23/05/90
NEMERTINEA	10			10	70
RETUSA TRUNCATULA				10	
NUCULA TENUIS	10	10	10		
MODIOLUS MODIOLUS		10			
MUSCULUS NIGER					10
TELLIMYA FERRUGINOSA			10		
MYSELLA BIDENTATA	20	60	80		
ARCTICA ISLANDICA	70	20	40	40	80
CHAMELEA STRIATULA	10	70	30	20	70
SPISULA SUBTRUNCATA		10			
SPISULA ELLIPTICA					10
ABRA ALBA	40	130	120		
MACOMA CALCAREA	10	100	50	110	
FABULINA FABULA	50	120	380	290	140
PHAXAS PELLUCIDUS		20		10	
MYA ARENARIA		20			
MYA SP.				10	
CORBULA GIBBA		10			10
THRACIA PHASEOLINA		20	10	20	40
HARMOTHOE LONGISETIS		10			
ANTINOELLA SARSI		20			
PHOLOE INORNATA		40	10		30
ETEONE SP.					10
PHYLLODOCE GROENLANDICA		10			
PHYLLODOCE MACULATA				10	
EUMIDA SANGUINEA					30
EUMIDA SP.	10				10
NEPHTYS HOMBERGII	20	30	10	10	20
NEPHTYS CAECA	30	10	30	50	
NEPHTYS LONGOSETOSA					20
GLYCERA ALBA			10		20
GONIADA MACULATA		10		10	
SCOLOPLOS ARMIGER	40	100	60	50	170
SPIO FILICORNIS		10	10	30	50
POLYDORA CAECA		1100	70	120	
PRIONOSPIO FALLAX	10			10	120
SPIOPHANES BOMBYX		30	30	30	50
CHAETOZONE SETOSA		50	80	10	20
OPHELIA LIMACINA					10
TRAVISIA FORBESII					10
MYRIOCHELE OCULATA	10	30	30	30	50
PECTINARIA KORENI				10	
PECTINARIA AURICOMA			10	10	
AMPHARETE ACUTIFRONS		10			10
LANICE CONCHILEGA	10		10	50	20
CHONE INFUNDIBULIFORMIS		10			
PYGNOGONIDA					10
PSEUDOCUMA LONGICORNIS					10
DIASTYLIS RATHKEI		10	10	10	
PARIAMBUS TYPICUS					50
PHOXOCEPHALUS HOLBOELLI			10		
ARGISSA HAMATIPES					10
AMPELISCA BREVICORNIS	20	10	20	50	50
BATHYPOREIA PELAGICA					10
DYOPEDOS MONACANTHUS		10			
PERICULODES LONGIMANUS					10
LILJEBORGIIDAE					10
MEGAMPHORUS CORNUTUS					10
PHORONIS MUELLERI		20		10	60
AMPHIURA FILIFORMIS	20				10
OPHIURA ALBIDA	70	40	50	30	120
OPHIURA JUV.					50
ECHINOCYAMUS PUSILLUS		10		10	
ECHINOCARDIUM CORDATUM			10		20

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159079 29/05/86	159079 11/06/87	159079 20/05/88	159079 23/05/89	159079 29/05/90
ANTHOZOA	10		10		
EDWARDSIA SP.		10	40		20
PLATYHELMINTHES			10		
NEMERTINEA		20	10	20	20
HINIA RETICULATA					30
PHILINE APERTA					10
TELLIMYA FERRUGINOSA	30				10
MYSELLA BIDENTATA		30	130	150	10
ARCTICA ISLANDICA	160	70	90	30	260
CHAMELEA STRIATULA	30	180	150	20	60
ABRA ALBA		60	120	10	90
MACOMA BALTHICA	20				
MACOMA CALCAREA	10	110	100	50	30
FABULINA FABULA	40	40	30	30	50
PHAXAS PELLUCIDUS					20
MYA ARENARIA					30
CORBULA GIBBA		20	90	20	820
THRACIA PHASEOLINA		10	50	10	50
EUNOE NODOSA		20			
ANTINOELLA SARSI		40			20
PHOLOE INORNATA			40	10	30
ETEONE LONGA			40		
ETEONE SP.	10				
PHYLLODOCE GROENLANDICA		40			
PHYLLODOCE SP.					20
EUMIDA SANGUINEA			10		30
EUMIDA BAHUSIENSIS		10	40		
NEPHTYS HOMBERGII		20	10		10
NEPHTYS CAECA	20	10	30	20	60
NEPHTYS LONGOSETOSA	10				
GLYCERA ALBA					10
GONIADA MACULATA		20	10		10
SCOLOPLOS ARMIGER	50	140	80	230	320
PARAONIS FULGENS		20			
SPIO FILICORNIS		60		20	40
POLYDORA CAECA	20	530	1250	10	30
PRIONOSPIO FALLAX					120
SPIOPHANES BOMBYX	10	30	140	80	280
CHAETOZONE SETOSA		10	60	20	
SCALIBREGMA INFLATUM		20			
TRAVISIA FORBESII				10	
OPHELINA ACUMINATA					20
HETEROMASTUS FILIFORMIS		90			
PRAXILLELLA PRAETERMISSA		10			
RHODINE GRACILIOR		140			
MYRIOCHELE OCULATA	70	70	150	30	90
PECTINARIA AURICOMA				10	10
AMPHARETE SP.					30
POECILOCHAETUS SERPENS				10	
LANICE CONCHILEGA	10	20	20		
PYGNOGONIDA					10
LAMPROPS FASCIATA		50	110	10	
DIASTYLIS RATHKEI	20	100	60	70	70
DIASTYLIS BRADYI	10				
PARIAMBUS TYPICUS			10		
PHOXOCEPHALUS HOLBOELLI	10				
ARGISSA HAMATIPES			10		
AMPELISCA BREVICORNIS		10			70
PERICULODES LONGIMANUS					30
MICROPROTOPUS MACULATUS					10
PROTOMEDEIA FASCIATA					10
MEGANYCTIPHANES NORVEGICA	10				
PHORONIS MUELLERI			10	40	70
OPHIURA ALBIDA	30		40	20	
OPHIURA JUV.					40
OPHIURA SP.		20			
ECHINOCYAMUS PUSILLUS			10		
ECHINOCARDIUM CORDATUM				10	40

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159080 29/05/86	159080 11/06/87	159080 20/05/88	159080 23/05/89	159080 30/05/90
EDWARDSIA SP.		10	20		40
PLATYHELMINTHES					10
NEMERTINEA	30	20		10	30
HYDROBIA ULVAE		10			
DIAPHANA MINUTA		10			
RETUSA TRUNCATULA					10
MODIOLUS MODIOLUS		20			
TELLIMYA FERRUGINOSA	20	10		20	
MYSELLA BIDENTATA		120	20	10	10
ARCTICA ISLANDICA	10	40	40		60
PARVICARDIUM OVALE					10
CHAMELEA STRIATULA	10	120	80	10	60
ABRA ALBA		40	20		
MACOMA CALCAREA		80	30	20	
FABULINA FABULA	210	40	310	30	90
PHAXAS PELLUCIDUS					10
MYA ARENARIA		20			150
CORBULA GIBBA					460
THRACIA PHASEOLINA				10	10
HARMOTHOE IMPAR					30
HARMOTHOE LONGISETIS		10			
ANTINOELLA SARSI		20			
PHOLOE INORNATA		40	10		20
ETEONE LONGA					10
PHYLLODOCE GROENLANDICA		10	10		
PHYLLODOCE SP.					20
EUMIDA SANGUINEA			10		
EUMIDA BAHUSIENSIS		10	10		
NEPHTYS HOMBERGII	60	10	10		10
NEPHTYS CAECA	40	10	10	10	20
NEPHTYS LONGOSETOSA			10	20	
NEPHTYS SP.					10
GLYCERA ALBA					30
GONIADA MACULATA			10		20
SCOLOPLOS ARMIGER	30	80	30	30	190
SPIO FILICORNIS	10		10	10	60
POLYDORA CAECA	110	300	160		
PSEUDOPOLYDORA PULCHRA					10
PRIONOSPIO FALLAX		10	40		1370
SPIOPHANES BOMBYX		10	30		10
CHAETOZONE SETOSA	20	10	30		20
SCALIBREGMA INFLATUM		20			
CAPITELLA CAPITATA		10			
OWENIA FUSIFORMIS	10				
MYRIOCHELE OCULATA	80	90	140	10	80
PECTINARIA KORENI		10			20
PECTINARIA AURICOMA					10
AMPHICTEIS GUNNERI					20
LANICE CONCHILEGA	10		20	10	10
PYGNOGONIDA					10
AORIDAE SP.					10
PSEUDOCUMA LONGICORNIS					30
LAMPROPS FASCIATA			10		
DIASTYLIS RATHKEI	10	100	20	20	80
PARIAMBUS TYPICUS					40
AMPELISCA BREVICORNIS	80	50	130	10	100
DYOPEDOS MONACANTHUS		30			
PERICULODES LONGIMANUS					10
ATYLUS VEDLOMENSIS					10
ISAEIDAE					10
MICROPROTOPUS MACULATUS					40
PROTOMEDEIA FASCIATA					10
UNCIOLA PLANIPES		10			
PHORONIS MUELLERI		10	10	10	120
AMPHIURA FILIFORMIS					10
AMPHIURA JUV.					240
OPHIURA AFFINIS	20	10			
OPHIURA ALBIDA	80	50	30	10	220

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159080 29/05/86	159080 11/06/87	159080 20/05/88	159080 23/05/89	159080 30/05/90
ECHINOCYAMUS PUSILLUS					30
ECHINOCARDIUM CORDATUM	20	10		10	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159082 29/05/86	159082 11/06/87	159082 26/05/88	159082 23/05/89	159082 30/05/90
EDWARDSIA SP.		10			
PLATYHELMINTHES					10
NEMERTINEA				10	80
NUCULA TENUIS		10			
TELLIMYA FERRUGINOSA	50			50	
MYSELLA BIDENTATA	10	120	20	20	
ARCTICA ISLANDICA		20	20		20
CHAMELEA STRIATULA		10	50	30	50
ABRA ALBA	50	80	240		
MACOMA CALCAREA	20	130	150	40	50
FABULINA FABULA	350	200	730	1010	950
PHAXAS PELLUCIDUS	20	10			
MYA ARENARIA		20			
CORBULA GIBBA					60
THRACIA PHASEOLINA					10
ANTINOELLA SARSI		10			
PHOLOE INORNATA	20	40		30	
ETEONE LONGA		20			
PHYLLODOCE MUCOSA				10	
PHYLLODOCE GROENLANDICA		10		10	
EUMIDA BAHUSIENSIS			20		10
NEPHTYS HOMBERGII	80	10	100	80	
NEPHTYS CAECA				10	20
GLYCERA ALBA				10	20
GONIADA MACULATA	10				10
SCOLOPLOS ARMIGER	70	30	90	90	150
SPIO FILICORNIS				30	70
POLYDORA CAECA		590	60	130	10
PRIONOSPIO FALLAX	50	10	40	200	730
SPIOPHANES BOMBYX	20	30	90	90	10
MAGELONA PAPILLICORNIS				10	
CHAETOZONE SETOSA	30	60	10	30	50
OPHELIA LIMACINA		10			
TRAVISIA FORBESII					10
MYRIOCHELE OCULATA	90	30	20	20	20
PECTINARIA KORENI				20	10
PECTINARIA AURICOMA				20	
LANICE CONCHILEGA			20	10	
PYGNOGONIDA				10	
DIASTYLIS RATHKEI		10	30		
PARIAMBUS TYPICUS		10			
ARGISSA HAMATIPES				10	
AMPELISCA BREVICORNIS	60		80	120	
PERICULODES LONGIMANUS				20	
COROPHIUM AFFINE	10				
COROPHIUM CRASSICORNE				20	10
PHORONIS MUELLERI	10		10	50	250
ASTERIAS RUBENS			10		
AMPHIURA FILIFORMIS	90				
AMPHIURA JUV.					20
OPHIURA ALBIDA	60	70	30	50	
OPHIURA JUV.					100
OPHIURA SP.					10
ECHINOCARDIUM CORDATUM				10	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159083 20/05/86	159083 11/06/87	159083 06/06/88	159083 23/05/89	159083 22/05/90
ANTHOZOA			20		
EDWARDSIA SP.	20	20			
PLATYHELMINTHES					10
NEMERTINEA				30	20
MODIOLUS MODIOLUS				10	10
MYSELLA BIDENTATA		50	90	110	30
ARCTICA ISLANDICA	30	70	70	40	110
PARVICARDIUM OVALE					10
CHAMELEA STRIATULA	20	150	50	20	30
SPISULA SUBTRUNCATA		10	10		
ABRA ALBA	30	40	30		
MACOMA CALCAREA		100	170	20	
FABULINA FABULA	80	90	20	220	90
PHAXAS PELLUCIDUS			10		20
CORBULA GIBBA		10	40	70	920
THRACIA PHASEOLINA		10		20	40
HARMOTHOE IMPAR					10
ANTINOELLA SARSI		30			
PHOLOE INORNATA		10	10	30	30
ETEONE LONGA	10	10	20		
PHYLLODOCE GROENLANDICA		60	20		
EUMIDA BAHUSIENSIS		10			
NEPHTYS HOMBERGII	40	50		60	50
NEPHTYS CAECA	10	10	20		
NEPHTYS LONGOSETOSA	10				
NEPHTYS SP.				20	
SCOLOPLOS ARMIGER	30	120	180	150	110
SPIO FILICORNIS		80	10		30
POLYDORA CAECA	50	640	800	550	
PRIONOSPIO FALLAX		10		40	430
SPIOPHANES BOMBYX		50	10	40	130
CHAETOZONE SETOSA	60	30	10	30	10
PHERUSA PLUMOSA	20				
OPHELIA LIMACINA		10			
TRAVISIA FORBESII		10			
MYRIOCHELE OCULATA	70	40	70	10	70
PECTINARIA KORENI				40	
PECTINARIA AURICOMA				50	
AMPHARETE ACUTIFRONS					10
LANICE CONCHILEGA				10	
OLIGOCHAETA		10			
LAMPROPS FASCIATA	20	20	20		
DIASTYLIS RATHKEI	20	100	110	30	90
PARIAMBUS TYPICUS					10
ARGISSA HAMATIPES			10		10
AMPELISCA BREVICORNIS	20	10	210	10	140
PONTOCRATES ARENARIUS			30		
MELITA DENTATA	10				
MEGANYCTIPHANES NORVEGICA	10				
PAGURUS BERNHARDUS		10			
PHORONIS MUELLERI		30	10	20	110
AMPHIURA FILIFORMIS	10				
AMPHIURA JUV.					20
OPHIURA ALBIDA	10	40	30	50	70
OPHIURA JUV.				30	
ECHINOCYAMUS PUSILLUS	10				
ECHINOCARDIUM CORDATUM	10			30	

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159086 27/05/86	159086 12/06/87	159086 26/05/88	159086 23/05/89	159086 22/05/90
ANTHOZOA	60	10			10
CERIANTHUS LLOYDII			10	20	
EDWARDSIA SP.	30	20			50
PLATYHELMINTHES			10		
NEMERTINEA				10	
ACTEON TORNATILIS		10			
CYLICHNA CYLINDRACEA	10				
PHILINE APERTA				20	
BERTHELLA PLUMULA					10
POLYPLACOPHORA					20
LEPIDOPLEURUS ASELLUS		10		10	
CHAETODERMA NITIDULUM	20				
NUCULA TENUIS	10		20		
NUCULA NITIDOSA			10		
MODIOLUS MODIOLUS					10
ASTARTE BOREALIS					10
ASTARTE MONTAGUI		30			
ASTARTE SULCATA				10	
MYSELLA BIDENTATA	100	40	860	70	10
ARCTICA ISLANDICA		10		10	
PARVICARDIUM OVALE		20			10
LAEVICARDIUM CRASSUM					10
CHAMELEA STRIATULA	10		10	30	10
SPISULA SUBTRUNCATA			10		
SPISULA ELLIPTICA		10			
GARI FERVENSIS					20
ABRA ALBA		90	60	20	
MACOMA BALTHICA	20				
MACOMA CALCAREA		140	120		
FABULINA FABULA				40	
PHAXAS PELLUCIDUS		10			
MYA ARENARIA		40			
CORBULA GIBBA					10
THRACIA PHASEOLINA		10	10	20	30
HARMOTHOE IMPAR					10
HARMOTHOE LONGISETIS		10			
EUNOE NODOSA		10			
ANTINOELLA SARSI		10			
GATTYANA CIRROSA	10			10	
PHOLOE INORNATA	40	80	60	90	60
ETEONE LONGA		10			
PHYLLODOCE MUCOSA			10		
PHYLLODOCE GROENLANDICA		10			
PHYLLODOCE MACULATA				20	
EUMIDA SP.					10
SYNELMIS KLATTI		10			
NEPHTYS HOMBERGII	10	10	10		10
NEPHTYS CILIATA			10		
NEPHTYS CAECA	10	20	20	30	
NEPHTYS LONGOSETOSA					10
NEPHTYS SP.					20
GLYCERA CAPITATA			10		
GLYCERA ALBA				10	
GONIADA MACULATA	40		40	30	20
SCOLOPLOS ARMIGER	40	120	40	100	20
PARAONIS FULGENS	10	10	20		
SPIO FILICORNIS		70		40	10
POLYDORA CAECA		1120	100	40	
PRIONOSPIO FALLAX		10	30		40
SPIOPHANES BOMBYX				10	
CHAETOZONE SETOSA		10	30	20	
PHERUSA PLUMOSA				10	
SCALIBREGMA INFLATUM		10			
OPHELINA ACUMINATA			30		
MYRIOCHELE OCULATA	310	120	290	110	160
PECTINARIA KORENI					50
PECTINARIA AURICOMA	10			10	10
AMPHERETE BALTICA		20			

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159086 27/05/86	159086 12/06/87	159086 26/05/88	159086 23/05/89	159086 22/05/90
AMPHARETE SP.		10			
AMPHITRITE CIRRATA				10	
LAONOME KROEYERI	10				
CHONE DUNERI			10		
OLIGOCHAETA			10		
DIASTYLIS RATHKEI		10	70	40	10
DIASTYLIS LUCIFERA					10
PARIAMBUS TYPICUS					10
ARGISSA HAMATIPES			20		10
AMPELISCA BREVICORNIS	10		100	30	100
AMPHILTOCHOIDES SERRATIPES		10			
DYOPEDOS PORRECTUS					30
PERICULODES LONGIMANUS	10				
STENOTHOE MARINA					10
ISAEIDAE		20			
PROTOMEDEIA FASCIATA			150		90
GAMMAROPSIS MACULATA				10	
COROPHIUM BONNELLI					30
COROPHIUM CRASSICORNE					110
COROPHIUM VOLUTATOR		20			
MELITA DENTATA		10			
MACROPODIA ROSTRATA					10
PHORONIS MUELLERI	30	10	40	10	10
OPHIOPHOLIS ACULEATA				30	
AMPHIURA FILIFORMIS	170				20
AMPHIURA JUV.					10
OPHIURA AFFINIS			20		
OPHIURA ALBIDA	40	20	50	110	70
OPHIURA JUV.					50
OPHIOCTEN GRACILIS		10			
ECHINOIDEA				10	
STRONGYLOCENTROTUS DROEBACH					10
ECHINOCYAMUS PUSILLUS	20	70		10	30
ECHINOCARDIUM CORDATUM	10		10	20	10
HOLOTHUROIDEA					10
PSOLUS PHANTAPUS	10				
ASCIDIACEA					10

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
	Individantal /m2				
Art	159087 26/05/86	159087 25/05/87	159087 17/05/88	159087 18/05/89	159087 21/05/90
EDWARDSIA SP.		10	10		
PLATYHELMINTHES				10	
NEMERTINEA			10		40
RETUSA TRUNCATULA		10			
TELLIMYA FERRUGINOSA	20	40			10
MYSELLA BIDENTATA		30	60	110	50
ARCTICA ISLANDICA	20		40		30
CHAMELEA STRIATULA	20	200	80	120	50
SPISULA SUBTRUNCATA		20		10	
ABRA ALBA	40	140	40		
MACOMA BALTHICA				30	
MACOMA CALCAREA		190	110		20
FABULINA FABULA	280	320	390	630	450
PHAXAS PELLUCIDUS	10	10			10
MYA ARENARIA				60	40
CORBULA GIBBA					180
THRACIA PHASEOLINA		120	50		40
ANTINOELLA SARSI		20			
PHOLOE INORNATA	10	20	10	10	20
PHOLOE SP			10		
ETEONE LONGA			20		
PHYLLODOCE MUCOSA			10	10	
EUMIDA SANGUINEA			20	10	10
EUMIDA BAHUSIENSIS			10		
EUMIDA SP.	30				
NEPHTYS HOMBERGII	50	20	80	50	20
NEPHTYS CAECA	10	10	20	20	30
GLYCERA ALBA	10				
GONIADA MACULATA	20	10	20	10	
SCOLOPLOS ARMIGER	20	50	20	50	150
SPIO FILICORNIS	40	70	50	20	30
POLYDORA CAECA	110	740	550	70	
PRIONOSPIO FALLAX			10	10	100
SPIOPHANES BOMBYX	10	50	40	40	30
MAGELONA MIRABILIS	10				
CHAETOZONE SETOSA	10	20	40	20	10
OPHELIA LIMACINA				10	10
MYRIOCHELE OCULATA		20	30	20	10
PECTINARIA KORENI			10	10	10
AMPHARETE FINMARCHICA	10				
LANICE CONCHILEGA	10	10	20	30	10
LAMPROPS FASCIATA	10				
PHTISICA MARINA.					10
PARIAMBUS TYPICUS					20
ARGISSA HAMATIPES					10
AMPELISCA BREVICORNIS	40	50	150	10	40
PERICULODES LONGIMANUS			10		20
MICROPROTOPUS MACULATUS					20
PHORONIS MUELLERI		50	30	200	70
AMPHIURA JUV.					20
OPHIURA ALBIDA	10	40	60	20	20
OPHIURA JUV.				20	
OPHIOCTEN GRACILIS		10			
ECHINOIDEA				10	
ECHINOCYAMUS PUSILLUS			20		10
ECHINOCARDIUM CORDATUM	10	10			10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159088 26/05/86	159088 25/05/87	159088 17/05/88	159088 18/05/89	159088 22/05/90
NEMERTINEA					30
TELLIMYA FERRUGINOSA		10		20	
MYSELLA BIDENTATA		10		30	10
ARCTICA ISLANDICA	260	250	180	170	320
CHAMELEA STRIATULA		100	20	30	10
SPISULA SUBTRUNCATA				10	
ABRA ALBA		60	90	10	
MACOMA CALCAREA		30	80	70	
FABULINA FABULA	270	220	740	700	300
THRACIA PHASEOLINA			10		
PHOLOE INORNATA		10			10
ETEONE LONGA				10	
PHYLLODOCE GROENLANDICA		10			
PHYLLODOCE SP.					10
EUMIDA SP.					10
NEPHTYS HOMBERGII			20		
NEPHTYS CAECA	30	10	10	20	30
NEPHTYS SP.					10
GLYCERA ALBA			10		
SCOLOPLOS ARMIGER		30	80	160	220
SPIO FILICORNIS	20			30	
POLYDORA CAECA		60	30		
PRIONOSPIO FALLAX	10		20	40	60
SPIOPHANES BOMBYX	30	30	30	50	10
CHAETOZONE SETOSA	10	10	40	30	30
PECTINARIA KORENI				10	
LANICE CONCHILEGA		20		10	30
CHONE INFUNDIBULIFORMIS		10			
PARIAMBUS TYPICUS					10
DYOPEDOS PORRECTUS					20
PHORONIS MUELLERI		10			
OPHIURA ALBIDA	70	10	10	10	50
ECHINOCARDIUM CORDATUM	30	10		10	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159089 27/05/86	159089 25/05/87	159089 17/05/88	159089 18/05/89	159089 22/05/90
ANTHOZOA					10
NEMERTINEA				10	
PHILINE APERTA					10
TELLIMYA FERRUGINOSA	40	40	10	50	
MYSELLA BIDENTATA	10	60	80	30	
ARCTICA ISLANDICA	20	30	150	180	30
PARVICARDIUM OVALE					10
CHAMELEA STRIATULA	10	120	10	50	30
ABRA ALBA	170	30	30		
MACOMA CALCAREA			60	70	
FABULINA FABULA	150	170	890	790	430
PHAXAS PELLUCIDUS	20				
CORBULA GIBBA			20		20
THRACIA PHASEOLINA	10		30		30
ANTINOELLA SARSI		10			
PHOLOE INORNATA		10	10	40	20
PHYLLODOCE MUCOSA					40
PHYLLODOCE GROENLANDICA			10		
EUMIDA SANGUINEA			10		10
EUMIDA BAHUSIENSIS		10	10		10
NEPHTYS HOMBERGII	40	20	20	10	20
NEPHTYS CAECA		10	30		10
NEPHTYS LONGOSETOSA			10		10
NEPHTYS SP.					10
GONIADA MACULATA	10				
SCOLOPLOS ARMIGER	20	10	70	90	70
SPIO FILICORNIS	40	10	80	20	140
POLYDORA CAECA	30	100	50		10
PRIONOSPIO FALLAX		10	20	30	80
SPIOPHANES BOMBYX		10	30	110	60
CHAETOZONE SETOSA		10	20	10	30
OPHELIA LIMACINA					40
OPHELINA ACUMINATA			10		
CAPITELLA CAPITATA					10
MYRIOCHELE OCULATA					10
PECTINARIA KORENI		10	30		10
LANICE CONCHILEGA			30	20	20
PHILOMEDES GLOBOSUS			10		
AMPELISCA BREVICORNIS	70		100		80
PERICULODES LONGIMANUS					10
ATYLUS VEDLOMENSIS					10
MICROPROTOPUS MACULATUS					10
PHORONIS MUELLERI		30	50	10	60
AMPHIURA FILIFORMIS					10
OPHIURA ALBIDA	40	20			30
OPHIURA JUV.				20	
ECHINOCYAMUS PUSILLUS					10
ECHINOCARDIUM CORDATUM	20	10	10	30	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159090 27/05/86	159090 25/05/87	159090 17/05/88	159090 18/05/89	159090 22/05/90
ANTHOZOA					20
PLATYHELMINTHES	10		10		
TELLIMYA FERRUGINOSA					10
MYSELLA BIDENTATA		10	70	70	
ARCTICA ISLANDICA	30	270	200	170	300
ABRA ALBA	20	50	100		10
MACOMA CALCAREA		90	110	40	90
FABULINA FABULA	50	160	460	720	610
PHAXAS PELLUCIDUS	10				
HARMOTHOE IMBRICATA				10	
PHOLOE INORNATA		10	20	30	10
ETEONE LONGA					10
PHYLLODOCE MUCOSA					10
PHYLLODOCE GROENLANDICA			10		
EUMIDA SANGUINEA					10
EUMIDA BAHUSIENSIS			20		20
NEREIMYRA PUNCTATA			10		
NEPHTYS HOMBERGII	20	10	10		10
NEPHTYS CAECA	10	20	10	10	20
NEPHTYS SP.					10
GLYCERA ALBA					20
SCOLOPLOS ARMIGER	10	50	90	150	360
SPIO FILICORNIS					20
POLYDORA CAECA		90	30	40	
PRIONOSPIO FALLAX		10	100	30	730
SPIOPHANES BOMBYX			10	30	30
CHAETOZONE SETOSA		20	40	40	70
HETEROMASTUS FILIFORMIS			10		
MYRIOCHELE OCULATA					10
PECTINARIA KORENI			20		
PECTINARIA AURICOMA				10	
LANICE CONCHILEGA		20	30	10	80
BALANUS CRENATUS		10			
AMPELISCA BREVICORNIS					20
PERICULODES LONGIMANUS	10				20
PROTOMEDEIA FASCIATA					10
PODOCEROPSIS NITIDA		50			
PAGURUS BERNHARDUS	10	10			
PHORONIS MUELLERI					50
ASTERIAS RUBENS			10		
AMPHIURA JUV.					10
OPHIURA ALBIDA	60	20	30	20	
OPHIURA JUV.				10	40
ECHINOCYAMUS PUSILLUS					10
ECHINOCARDIUM CORDATUM				10	30
ASCIDIACEA					10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159091 27/05/86	159091 25/05/87	159091 17/05/88	159091 19/05/89	159091 22/05/90
EDWARDSIA SP.		20			10
NEMERTINEA		10	10		20
POLYGIREULIMA SINUOSA					10
NUCULA TENUIS	30		30		
TELLIMYA FERRUGINOSA	30	10		10	
MYSELLA BIDENTATA		20	40	70	10
ARCTICA ISLANDICA	10	10	70	40	60
CHAMELEA STRIATULA		60	30	70	140
SPISULA SUBTRUNCATA			10		
ABRA ALBA	10	60	110		10
MACOMA CALCAREA	50	90	110	30	130
FABULINA FABULA	330	260	670	850	840
PHAXAS PELLUCIDUS	60	10	10		40
CORBULA GIBBA			20	30	40
THRACIA PHASEOLINA		10		60	10
COCHLODESMA PRAETENUE				10	
ANTINOELLA SARSI		10			10
PHOLOE INORNATA	30	10	10	50	20
PHOLOE SP			10		
ETEONE LONGA					10
PHYLLODOCE SP.					40
EUMIDA SANGUINEA				10	30
EUMIDA BAHUSIENSIS		10			
NEPHTYS HOMBERGII	40	40	40	60	60
NEPHTYS CAECA	10	10	20	20	
NEPHTYS SP.					10
GLYCERA ALBA			20		50
SCOLOPLOS ARMIGER	40	30	80	80	290
SPIO FILICORNIS	10			40	130
POLYDORA CAECA	10	290	210	570	
PSEUDOPOLYDORA PULCHRA				20	
PRIONOSPIO FALLAX	30	20	180	270	910
SPIOPHANES BOMBYX	30	80	60	80	80
MAGELONA PAPILLICORNIS				10	
MAGELONA MIRABILIS			10		
CHAETOZONE SETOSA	10	20	120	40	70
OPHELINA ACUMINATA	10				
OWENIA FUSIFORMIS	10				10
MYRIOCHELE OCULATA				10	10
PECTINARIA KORENI		10	10	10	
PECTINARIA AURIÇOMA				20	20
POECILOCHAETUS SERPENS					10
LANICE CONCHILEGA	30	30	20	30	10
PARIAMBUS TYPICUS					30
AMPELISCA BREVICORNIS	60	40	50	120	290
MACROPIUS DEPURATOR	10				
ECHIUROIDA				10	
PHORONIS MUELLERI	10	30	110	90	
PHORONIS SP.					120
AMPHIURA FILIFORMIS	30				10
AMPHIURA JUV.					50
OPHIURA ROBUSTA				10	
OPHIURA ALBIDA	90	60	30	60	40
OPHIURA JUV.					130
ECHINOCARDIUM CORDATUM	20	20		10	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159092 27/05/86	159092 25/05/87	159092 19/05/88	159092 19/05/89	159092 22/05/90
	10				
EDWARDSIA SP.	10				40
NEMERTINEA			40		60
ACTEON TORNATILIS		10			
RETUSA TRUNCATULA					30
CYLICHNA CYLINDRACEA		10			
NUCULA TENUIS	20	10	40	10	10
NUCULA NITIDOSA				10	
MODIOLUS MODIOLUS			10		
MUSCULUS NIGER		10	10		
TELLIMYA FERRUGINOSA			40	10	
MYSELLA BIDENTATA		30	30	170	10
ARCTICA ISLANDICA	10	10	70	60	110
PARVICARDIUM OVALE					10
CHAMELEA STRIATULA		50	110	80	40
SPISULA SUBTRUNCATA		30			
GARI FERVENSIS					20
ABRA ALBA	10	120	100		30
MACOMA CALCAREA	20	90	160	50	130
FABULINA FABULA	80	140	450	440	780
PHAXAS PELLUCIDUS	10		20		60
MYA ARENARIA			10	10	10
CORBULA GIBBA			30	70	10
THRACIA PHASEOLINA	20	20	60	180	100
ANTINOELLA SARSI		10			
PHOLOE INORNATA		70	30	10	100
ETEONE LONGA			10		
PHYLLODOCE MUCOSA				10	
PHYLLODOCE SP.					10
EUMIDA SANGUINEA					30
EUMIDA BAHUSIENSIS			40	30	
EUMIDA SP.					10
NEPHTYS HOMBERGII	30	30	20	30	40
NEPHTYS CAECA	30	20	30	30	
NEPHTYS LONGOSETOSA	10				
SPHAERODORUM FLAVUM			20		
GLYCERA ALBA					30
GONIADA MACULATA			10	10	
SCOLOPLOS ARMIGER	20	10	140	100	110
SPIO FILICORNIS		10	10	60	60
POLYDORA CAECA		820		820	30
PSEUDOPOLYDORA PULCHRA	10				20
PRIONOSPIO FALLAX		20	10	20	180
SPIOPHANES BOMBYX	10	60	30	100	70
CHAETOZONE SETOSA		20	70	30	10
OPHELIA LIMACINA		10			20
TRAVISIA FORBESII					10
OPHELINA ACUMINATA	10				
RHODINE GRACILIOR					10
MYRIOCHELE OCULATA		10			
PECTINARIA KORENI			20	50	
PECTINARIA AURICOMA				20	10
AMPHARETE ACUTIFRONS					10
LANICE CONCHILEGA			30	20	
HIRUDINEA				10	
PYGNOGONIDA					20
DIASTYLIS RATHKEI			10		
PARIAMBUS TYPICUS					30
HIPPOMEDON DENTICULATUS					20
AMPELISCA BREVICORNIS	30	40	50	70	270
PERICULODES LONGIMANUS					10
PROTOMEDEIA FASCIATA					20
COROPHIUM CRASSICORNE		10			40
COROPHIUM SP.		10		30	
PHORONIS MUELLERI		90	10	90	90
PHORONIS SP.				10	
AMPHIURA FILIFORMIS				50	20
OPHIURA ALBIDA	10	110	70	60	140

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159092 27/05/86	159092 25/05/87	159092 19/05/88	159092 19/05/89	159092 22/05/90
OPHIURA JUV.				10	
ECHINOCYAMUS PUSILLUS					30
ECHINOCARDIUM CORDATUM		10	10		10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159093 27/05/86	159093 11/06/87	159093 19/05/88	159093 19/05/89	159093 22/05/90
NEMERTINEA	20	10	20	20	20
RETUSA OBTUSATA	10				
RETUSA TRUNCATULA				10	20
PHILINE APERTA			10		
NUCULA TENUIS				10	
MUSCULUS NIGER		80	20		10
TELLIMYA FERRUGINOSA					20
MYSELLA BIDENTATA		60	50	130	30
ARCTICA ISLANDICA			110	70	70
PARVICARDIUM OVALE			50	10	
CHAMELEA STRIATULA		90	80	100	40
SPISULA SUBTRUNCATA		30			
SPISULA ELLIPTICA	10		10		
ABRA NITIDA				10	
ABRA ALBA		170	510	10	
MACOMA BALTHICA	10				
MACOMA CALCAREA		60	60	40	40
FABULINA FABULA	10	20	60	120	110
PHAXAS PELLUCIDUS	20	10	10		10
MYA ARENARIA		40		10	70
CORBULA GIBBA	10		30	20	60
THRACIA PHASEOLINA		10	30	40	20
ANTINOELLA SARSI		20			
PHOLOE INORNATA		70	140	80	60
ETEONE LONGA			20		
ETEONE SP.	10				
PHYLLODOCE GROENLANDICA		20	10		
PHYLLODOCE MACULATA	10				
EUMIDA SANGUINEA			10		10
NEPHTYS HOMBERGII	10				20
NEPHTYS PENTE			10		
NEPHTYS CAECA			20	20	20
NEPHTYS LONGOSETOSA	10				
SPHAERODORUM FLAVUM			10		
GLYCERA ALBA				10	
GONIADA MACULATA	10			10	40
SCOLOPLOS ARMIGER	60	60	280	90	110
PARAONIS FULGENS		10			
SPIO FILICORNIS	20	30	20	10	10
POLYDORA CAECA		1460	680	690	
PSEUDOPOLYDORA PULCHRA	30	10			
PRIONOSPIO FALLAX	10			30	30
SPIOPHANES BOMBYX	10	20		30	10
CHAETOZONE SETOSA	10	10	30	10	
SCALIBREGMA INFLATUM		10			
OPHELIA LIMACINA			20	20	10
OPHELINA ACUMINATA		10			
HETEROMASTUS FILIFORMIS			10		10
PRAXILLELLA PRAETERMISSA			10		
MYRIOCHELE OCULATA	50	70	40	50	70
PECTINARIA KORENI			10	20	
PECTINARIA AURICOMA				50	40
AMPHERETE BALTICA		90			
AMPHARETE SP.				20	
ANOBOTHRUS GRACILIS	10				
AMPHICTEIS GUNNERI					10
LANICE CONCHILEGA				10	
AORIDAE SP.					30
DIASTYLIS RATHKEI	10		10	10	
ARCTURELLA DILETATA					10
PARIAMBUS TYPICUS					10
ARGISSA HAMATIPES			20		
AMPELISCA BREVICORNIS	50	20	90	80	170
ATYLUS SWAMMERDAMI					10
PROTOMEDEIA FASCIATA		10	90		10
COROPHIUM AFFINE			10		
COROPHIUM CRASSICORNE			20	40	20

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159093 27/05/86	159093 11/06/87	159093 19/05/88	159093 19/05/89	159093 22/05/90
COROPHIUM SP.				10	
CHEIROCRATUS ROBUSTUS			10		
LEMBOS LONGIPES			20		
PHORONIS MUELLERI		10	10	10	40
ASTROPECTEN IRREGULARIS				10	
AMPHIURA FILIFORMIS	30			50	60
OPHIURA AFFINIS			40		
OPHIURA ALBIDA	50	170	90	50	120
OPHIURA JUV.				20	
ECHINOCYAMUS PUSILLUS		10	10	30	30
ECHINOCARDIUM CORDATUM		10			10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159094 27/05/86	159094 12/06/87	159094 06/06/88	159094 19/05/89	159094 22/05/90
ANTHOZOA		10			
VIRGULARIA MIRABILIS	30		40	20	30
CERIANTHUS LLOYDII			10		
NEMERTINEA				280	10
RETUSA TRUNCATULA	10				10
CYLICHNA CYLINDRACEA		20	10		
PHILINE APERTA			10	10	
CHAETODERMA NITIDULUM	10	20	10		10
NUCULA TENUIS	20	10	70	40	50
THYASIRA FLEXUOSA					20
TELLIMYA FERRUGINOSA	500			60	
MYSELLA BIDENTATA		350	790	70	260
ARCTICA ISLANDICA		20	80	290	240
ACANTHOCARDIA ECHINATA			10		
PARVICARDIUM OVALE			10		
CHAMELEA STRIATULA		20			30
SPISULA SUBTRUNCATA			10		
ABRA NITIDA			20		10
ABRA ALBA	40	480	940	160	160
MACOMA CALCAREA		120	60	10	30
FABULINA FABULA				230	180
PHAXAS PELLUCIDUS		20		20	50
MYA ARENARIA		10	50		40
CORBULA GIBBA			10		20
THRACIA PHASEOLINA					10
APHRODITA ACULEATA		10	10		10
PHOLOE INORNATA	460	370	250	360	310
ETEONE LONGA			10		
PHYLLODOCE GROENLANDICA			10	10	
PHYLLODOCE SP.			10	20	30
EUMIDA SANGUINEA			10	40	10
EUMIDA BAHUSIENSIS			30		
NEPHTYS HOMBERGII	60	50	80	80	100
NEPHTYS CILIATA			10		
NEPHTYS CAECA			50	10	
NEPHTYS LONGOSETOSA			10	10	
NEPHTYS SP.		30	20	20	10
SPHAERODORUM FLAVUM	20				
GLYCERA ALBA			20		20
GONIADA MACULATA	10		10	10	10
SCOLOPLOS ARMIGER	70	100	180	210	180
TROCHOCHAETA MULTISETOSA			10		
SPIO FILICORNIS			40	40	20
POLYDORA CAECA		4720	1850	4390	30
PSEUDOPOLYDORA PULCHRA				70	
PRIONOSPIO FALLAX	100	10	40	60	700
SPIOPHANES KROYERI			10		
SPIOPHANES BOMBYX		10	30	40	20
CHAETOZONE SETOSA	10	10	20		60
OPHELINA ACUMINATA					10
HETEROMASTUS FILIFORMIS					30
MALDANIDAE	10				
MYRIOCHELE OCULATA	10	10	60	100	40
PECTINARIA KORENI			310	70	50
PECTINARIA AURICOMA			10	10	120
AMPHARETE FINMARCHICA					10
AMPHERETE BALTICA		10			
LYSILLA LOVENI			10		
DIASTYLIS RATHKEI			50	60	
PARIAMBUS TYPICUS					50
PHOXOCEPHALUS HOLBOELLI			10		
HARPINIA ANTENNARIA					40
AMPELISCA BREVICORNIS	30	20	20	90	90
AMPELISCA MACROCEPHALA			10		
PROTOMEDEIA FASCIATA					20
PODOCEROPSIS NITIDA	10				
UNCIOLA PLANIPES		10			
PAGURUS BERNHARDUS	10				

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159094 27/05/86	159094 12/06/87	159094 06/06/88	159094 19/05/89	159094 22/05/90
PHORONIS MUELLERI		10	10	480	230
PHORONIS SP.				140	
AMPHIURA FILIFORMIS	920			830	1060
AMPHIURA JUV.				30	
OPHIURA ROBUSTA					10
OPHIURA ALBIDA	10	90	240	100	60
OPHIURA JUV.					20
ECHINOCARDIUM CORDATUM	10				50
HOLOTHUROIDEA					10

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159095 20/05/86	159095 12/06/87	159095 06/06/88	159095 19/05/89	159095 22/05/90
VIRGULARIA MIRABILIS	10				
EDWARDSIA SP.				10	
PLATYHELMINTHES			10		
NEMERTINEA			10	40	10
ACLIS MINOR			10		
RETUSA TRUNCATULA				10	
CYLICHNA CYLINDRACEA	10				
PHILINE APERTA				10	
CHAETODERMA NITIDULUM	10	10	30		
NUCULA TENUIS	40		10	30	40
THYASIRA FLEXUOSA	20				20
TELLIMYA FERRUGINOSA				20	
MYSELLA BIDENTATA	480	190	390	120	370
ARCTICA ISLANDICA	20		260	100	70
ACANTHOCARDIA ECHINATA			20		10
PARVICARDIUM OVALE		10	80	10	
CHAMELEA STRIATULA		40	80	20	
SPISULA SUBTRUNCATA		10	10		
ABRA ALBA		200	850	100	80
MACOMA BALTHICA	20				
MACOMA CALCAREA		110	30	20	10
FABULINA FABULA			10	230	10
PHAXAS PELLUCIDUS	50	30	50	20	10
MYA ARENARIA		10	10	10	
CORBULA GIBBA		10		40	10
THRACIA PHASEOLINA	10				
ANTINOELLA SARSI					10
PHOLOE INORNATA	720	260	240	360	190
ETEONE LONGA		10			
PHYLLODOCE MACULATA			20		
PHYLLODOCE SP.				10	
EUMIDA SANGUINEA			20	10	
NEPHTYS HOMBERGII	80	30	40	40	30
NEPHTYS CILIATA			20	30	
NEPHTYS CAECA				20	
NEPHTYS SP.		10		20	
SPHAERODORUM FLAVUM	20		10	10	
GLYCERA ALBA	20		20	40	10
GONIADA MACULATA				10	10
SCOLOPLOS ARMIGER	60	60	200	230	70
PARAONIS FULGENS	10				
TROCHOCHAETA MULTISETOSA			10		
SPIO FILICORNIS		10		10	
POLYDORA CAECA	20	1220	800	260	20
PSEUDOPOLYDORA PULCHRA				20	
PRIONOSPIO FALLAX	180	20	40	1230	450
SPIOPHANES BOMBYX	10	10	50	70	10
CHAETOZONE SETOSA	50	10	60	100	40
BRADA VILLOSA	20				
SCALIBREGMA INFLATUM		20			
OPHELINA ACUMINATA		10			
HETEROMASTUS FILIFORMIS	30	30			
PRAXILLELLA PRAETERMISSA		10			10
OWENIA FUSIFORMIS		10			
MYRIOCHELE OCULATA	70	10	20	20	30
PECTINARIA KORENI			140	70	
PECTINARIA AURICOMA	10			60	40
AMPHARETE FINMARCHICA	10		10		
AMPHARETE SP.		10			
OLIGOCHAETA					10
HIRUDINEA				10	
BALANUS BALANUS		30			
LAMPROPS FASCIATA			10		
DIASTYLIS LUCIFERA			10		
ARCTURELLA DILETATA			10		
PARIAMBUS TYPICUS					10
HARPINIA ANTENNARIA				30	
AMPELISCA BREVICORNIS	80	30	30	140	50

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159095 20/05/86	159095 12/06/87	159095 06/06/88	159095 19/05/89	159095 22/05/90
DYOPEDOS MONACANTHUS			10		
WESTWOODILLA CAECULA	10				
PROTOMEDEIA FASCIATA	20		30	70	20
UNCIOLA PLANIPES		20			
CRANGON CRANGON				10	
PHORONIS MUELLERI		20	10	180	110
OPHIOPHOLIS ACULEATA					10
AMPHIURA FILIFORMIS	1010		20	3550	1170
AMPHIURA JUV.				90	
OPHIURA ALBIDA	230	170	250		20
ECHINOCARDIUM CORDATUM	60			40	
HOLOTHUROIDEA					10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159096 20/05/86	159096 12/06/87	159096 06/06/88	159096 19/05/89	159096 22/05/90
ANTHOZOA			10		10
VIRGULARIA MIRABILIS	20	50	30	10	10
EDWARDSIA SP.	30				10
NEMERTINEA	10		10	30	20
RETUSA TRUNCATULA					10
CYLICHNA CYLINDRACEA	10				
PHILINE APERTA				10	10
NUCULA TENUIS	10		20	20	
MUSCULUS NIGER		30			
TELLIMYA FERRUGINOSA	990				
MYSELLA BIDENTATA		710	270	30	
ARCTICA ISLANDICA	20	20	90	40	20
CHAMELEA STRIATULA	30	80	20		50
SPISULA SUBTRUNCATA		10			
ABRA NITIDA				20	
ABRA ALBA	160	110	390	10	110
MACOMA CALCAREA	20	170	150	80	
FABULINA FABULA	10	20	340	810	610
PHAXAS PELLUCIDUS		10	10	20	10
MYA ARENARIA		10	10		40
MYA TRUNCATA	10				
CORBULA GIBBA	10		10	40	20
THRACIA PHASEOLINA		10	40	40	30
PHOLOE INORNATA	220	190	40	40	10
ETEONE LONGA			10		
ETEONE FOLIOSA					10
ETEONE SP.	20				
PHYLLODOCE MUCOSA					10
NEPHTYS HOMBERGII	140	60	60	50	70
NEPHTYS CAECA					30
GLYCERA ALBA			10		30
GONIADA MACULATA	10	10		10	10
SCOLOPLOS ARMIGER	190	210	240	170	100
PARAONIS FULGENS	10				
SPIO FILICORNIS		20		10	40
POLYDORA CAECA	30	1020	430	200	10
PSEUDOPOLYDORA PULCHRA		10			
PRIONOSPIO FALLAX	120	40	10	140	570
SPIOPHANES BOMBYX	10	50	30	100	100
CHAETOZONE SETOSA	40	70		20	90
SCALIBREGMA INFLATUM		60			
HETEROMASTUS FILIFORMIS	10	10			
PRAXILLELLA PRAETERMISSA		10			
RHODINE GRACILIOR		10			
MYRIOCHELE OCULATA	40	60	140	40	40
PECTINARIA KORENI		30	40	40	
PECTINARIA AURICOMA				20	10
ANOBOTHRUS GRACILIS		10			
LANICE CONCHILEGA			10	10	
HIRUDINEA				10	
DIASTYLIS RATHKEI	10		30		
PARIAMBUS TYPICUS					30
PHOXOCEPHALUS HOLBOELLI	10				
AMPELISCA BREVICORNIS	40		90		130
DYOPEDOS PORRECTUS		10			
PERICULODES LONGIMANUS	10				10
PROTOMEDEIA FASCIATA			10		
MEGAMPHORUS CORNUTUS	10				
UNCIOLA PLANIPES	10				
PHORONIS MUELLERI	40	70	60	20	100
AMPHIURA FILIFORMIS	240			40	10
AMPHIURA JUV.					60
OPHIURA ALBIDA	140	50	110	80	20
OPHIURA JUV.					90
ECHINOCYAMUS PUSILLUS					10
ECHINOCARDIUM CORDATUM	10		20		
ASCIDIACEA		10			

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159097 20/05/86	159097 12/06/87	159097 06/06/88	159097 19/05/89	159097 22/05/90
SCYPHOZOA					10
EDWARDSIA SP.	10			30	10
PLATYHELMINTHES			10		
NEMERTINEA					10
CRENELLA DECUSSATA			20	20	
MYTILIS EDULIS			10		
ASTARTE MONTAGUI			10		
MYSELLA BIDENTATA		70	110	110	30
ARCTICA ISLANDICA	60	40	90	40	20
CHAMELEA STRIATULA	20	30	50	80	10
SPISULA SOLIDA		10			
SPISULA SUBTRUNCATA	10	310	80		
SPISULA ELLIPTICA			30	10	10
GARI FERVENSIS				10	
ABRA ALBA			50	10	
MACOMA CALCAREA	10	40	40	20	
FABULINA FABULA	10				20
MYA ARENARIA			10		10
MYA TRUNCATA					10
CORBULA GIBBA			20		100
THRACIA PHASEOLINA			40	30	10
HARMOTHOE IMPAR					10
EUNOE NODOSA		10			
PHOLOE INORNATA		10	10	40	30
ETEONE LONGA				10	
ETEONE FOLIOSA		10			
EUMIDA SP.					10
EXOGONE SP.				10	
NEPHTYS HOMBERGII	10				
NEPHTYS CAECA	10		40	10	
NEPHTYS LONGOSETOSA				10	50
GLYCERA ALBA				10	
GONIADA MACULATA	10	20	20	30	
SCOLOPLOS ARMIGER	220	130	190	110	140
SPIO FILICORNIS		150	50	40	70
POLYDORA CAECA		70	210	50	
PSEUDOPOLYDORA PULCHRA					10
PRIONOSPIO FALLAX				60	110
SPIOPHANES BOMBYX			40		40
MAGELONA PAPILLICORNIS				10	
CHAETOZONE SETOSA	10	10	10	10	
OPHELIA LIMACINA	50	70	40	40	60
HETEROMASTUS FILIFORMIS	10				
MYRIOCHELE OCULATA	10	50	40	40	20
PECTINARIA KORENI	10				
PECTINARIA AURICOMA				10	
AMPHERETE BALTICA		10			
LANICE CONCHILEGA					10
CHONE DUNERI			10		
PYGNOGONIDA		10			
GASTROSACCUS SPINIFER	10		10		
LAMPROPS FASCIATA		20			
DIASTYLIS RATHKEI		20	40	10	
AMPHIPODA		10			
PARIAMBUS TYPICUS					10
PHOXOCEPHALUS HOLBOELLI	20		150	10	10
ARGISSA HAMATIPES			70		20
AMPELISCA BREVICORNIS				20	40
BATHYPOREIA GUILLIAMSONIANA			10		
PERICULODES LONGIMANUS					30
MEGAMPHORUS CORNUTUS			10		30
COROPHIUM CRASSICORNE			10		
CRANGON CRANGON				10	
PHORONIS MUELLERI				50	20
AMPHIURA FILIFORMIS					10
AMPHIURA JUV.					10
OPHIURA ROBUSTA				10	
OPHIURA ALBIDA	20	30	20	30	20

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159097 20/05/86	159097 12/06/87	159097 06/06/88	159097 19/05/89	159097 22/05/90
ECHINOCYAMUS PUSILLUS	10	40	10	40	10
ECHINOCARDIUM CORDATUM				10	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159112 20/05/86	159112 12/06/87	159112 06/06/88	159112 19/05/89	159112 22/05/90
VIRGULARIA MIRABILIS	10	30	10	10	70
PLATYHELMINTHES					10
NEMERTINEA	10			50	130
PHILINE APERTA				10	20
PHILINE SCABRA			10		
CHAETODERMA NITIDULUM		10			10
NUCULA TENUIS	10	10	70	30	80
NUCULA NUCLEUS					30
MODIOLUS MODIOLUS			10		
THYASIRA FLEXUOSA					10
TELLIMYA FERRUGINOSA	330		30	20	30
MYSELLA BIDENTATA		460	920		90
ARCTICA ISLANDICA	30	50	210	180	110
ACANTHOCARDIA ECHINATA	20			10	
PARVICARDIUM OVALE		10	80		
CHAMELEA STRIATULA		20	50	40	10
SPISULA SUBTRUNCATA		30	20		
ABRA ALBA		390	1030	150	70
MACOMA CALCAREA		160	130	40	130
FABULINA FABULA			50	460	310
PHAXAS PELLUCIDUS			20	50	50
MYA ARENARIA		10			40
CORBULA GIBBA		30	70	20	10
THRACIA PHASEOLINA				40	
APHRODITA ACULEATA			20		
EUNOE NODOSA		10			
PHOLOE INORNATA	160	430	370	240	250
ETEONE LONGA				30	10
PHYLLODOCE MUCOSA				50	20
PHYLLODOCE GROENLANDICA				10	
EUMIDA SANGUINEA				40	
EUMIDA BAHUSIENSIS			10		
EUMIDA SP.					30
EXOGONE SP.		20			
NEPHTYS HOMBERGII	80	10	40	100	100
NEPHTYS CAECA				10	
SPHAERODORUM FLAVUM			10		
GLYCERA ALBA			20	10	30
GONIADA MACULATA					10
SCOLOPLOS ARMIGER	90	140	380	340	140
SPIO FILICORNIS		10	10	10	
POLYDORA CAECA		2040	1640	3040	
POLYDORA CILIATA					30
PSEUDOPOLYDORA PULCHRA		30	10	10	10
PRIONOSPIO FALLAX	30	30	70	980	1390
SPIOPHANES KROYERI		10			
SPIOPHANES BOMBYX		30	40	30	10
CHAETOZONE SETOSA		20	10	110	30
SCALIBREGMA INFLATUM		40			
CAPITELLA CAPITATA		20			20
HETEROMASTUS FILIFORMIS			10		
MALDANIDAE				10	
MALDANE SARSI			10		
PRAXILLELLA PRAETERMISSA		10		10	40
OWENIA FUSIFORMIS	10				20
MYRIOCHELE OCULATA		20	90	60	130
PECTINARIA KORENI			200	100	40
PECTINARIA AURICOMA				80	30
AMPHARETE SP.		20			
LANICE CONCHILEGA	10			10	
CHONE INFUNDIBULIFORMIS				10	
OLIGOCHAETA				10	
HYDRACARINA				10	
DIASTYLIS RATHKEI	10		60	10	40
DIASTYLIS LUCIFERA					10
DIASTYLIS LAEVIS					10
ARGISSA HAMATIPES				10	
AMPELISCA BREVICORNIS	10	20			60

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
	Individantal /m2				
Art	159112 20/05/86	159112 12/06/87	159112 06/06/88	159112 19/05/89	159112 22/05/90
WESTWOODILLA CAECULA					10
PROTOMEDEIA FASCIATA			10		
PHORONIS MUELLERI		60	20	70	500
AMPHIURA FILIFORMIS	590			480	350
AMPHIURA JUV.					60
OPHIURA ALBIDA	30	110	190	160	70
OPHIURA JUV.					90
ECHINOCARDIUM CORDATUM	20		10	10	10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159113 27/05/86	159113 11/06/87	159113 19/05/88	159113 19/05/89	159113 22/05/90
ANTHOZOA	10				
NEMERTINEA				10	20
NUCULA TENUIS	20	10	10	10	
THYASIRA FLEXUOSA					10
TELLIMYA FERRUGINOSA				10	
MYSELLA BIDENTATA		10	280	40	20
ARCTICA ISLANDICA	10	10	30	20	90
PARVICARDIUM OVALE					10
CHAMELEA STRIATULA	10	20	90	160	40
DOSINIA LUPINUS	10				
SPISULA SUBTRUNCATA		40	10		
ABRA ALBA	10	110	330		
MACOMA CALCAREA	40	120	60	40	120
FABULINA FABULA	70	20	60	720	410
PHAXAS PELLUCIDUS	30		20		10
MYA ARENARIA		10			20
CORBULA GIBBA			10	10	
THRACIA PHASEOLINA			20	60	50
HARMOTHOE IMBRICATA					10
EUNOE NODOSA		10			
PHOLOE INORNATA	10	100	110	30	30
PHYLLODOCE SP.			10		
NEPHTYS HOMBERGII	20	50		10	10
NEPHTYS CAECA			50	40	10
NEPHTYS LONGOSETOSA			10	10	10
GONIADA MACULATA			30	10	
SCOLOPLOS ARMIGER	20	60	140	150	190
SPIO FILICORNIS		40	10	20	10
POLYDORA CAECA		470	440	360	
PSEUDOPOLYDORA PULCHRA		30			
PRIONOSPIO FALLAX				30	10
SPIOPHANES BOMBYX		20	50	30	20
CHAETOZONE SETOSA		100	10	10	
OPHELIA LIMACINA		10	20		
OPHELINA ACUMINATA					10
CAPITELLA CAPITATA					10
HETEROMASTUS FILIFORMIS			10		10
PRAXILLELLA PRAETERMISSA					10
MYRIOCHELE OCULATA	10	20	90	10	30
PECTINARIA KORENI	10			10	
PECTINARIA AURICOMA			10		20
AMPHARETE ACUTIFRONS					20
AMPHARETE SP.		20			
LANICE CONCHILEGA				10	
CHONE INFUNDIBULIFORMIS	10				
AORIDAE SP.					10
DIASTYLIS RATHKEI		10	10		
DIASTYLIS SP.					10
AMPHIPODA			10		
PARIAMBUS TYPICUS					10
AMPELISCA BREVICORNIS	10		10		90
PERICULODES LONGIMANUS					10
COROPHIUM CRASSICORNE		10	100		
PHASCOLION STROMBI			10		
PHORONIS MUELLERI		10	30	120	10
AMPHIURA FILIFORMIS				10	10
OPHIURA ALBIDA	70	20	50	40	70
OPHIURA JUV.				10	30
OPHIOCTEN GRACILIS			10		
ECHINOCYAMUS PUSILLUS				10	
ECHINOCARDIUM CORDATUM				20	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159114 27/05/86	159114 25/05/87	159114 19/05/88	159114 19/05/89	159114 22/05/90
	20				
EDWARDSIA SP.		10	10	10	10
NEMERTINEA			10		20
PHILINE APERTA				20	
LEPIDOPLEURUS ASELLUS		20			
MUSCULUS NIGER		30			
OSTREA EDULIS		10			
TELLIMYA FERRUGINOSA	30				
MYSELLA BIDENTATA		50	140	100	
ARCTICA ISLANDICA	30	10	90	50	10
CHAMELEA STRIATULA	10	110	90	150	20
SPISULA SUBTRUNCATA		70	50		
SPISULA ELLIPTICA			10		
ABRA NITIDA			10		
ABRA ALBA		130	270	20	
MACOMA BALTHICA	20			10	
MACOMA CALCAREA	50	30	190	30	
FABULINA FABULA	60	10	100	180	80
MYA ARENARIA		20			
CORBULA GIBBA			40		20
THRACIA PHASEOLINA	50	20	20	140	
APHRODITA ACULEATA	10				
HARMOTHOE IMBRICATA					10
HARMOTHOE IMPAR		10			
ANTINOELLA SARSI		10		10	
PHOLOE INORNATA		60	70	60	30
PHYLLODOCE GROENLANDICA		10	10		
NEPHTYS HOMBERGII				10	
NEPHTYS CAECA	20	20	40	30	30
NEPHTYS LONGOSETOSA	10				
GLYCERA ALBA					20
GONIADA MACULATA		10	20		10
SCOLOPLOS ARMIGER	20	110	350	100	90
SPIO FILICORNIS	20	10		40	10
POLYDORA CAECA		690	440	30	
PSEUDOPOLYDORA PULCHRA				30	
PYGOSPIO ELEGANS				10	
PRIONOSPIO FALLAX	10		10	20	
SPIOPHANES BOMBYX	10			10	
SCOLELEPIS FOLIOSA	10				
CHAETOZONE SETOSA	10		30	30	
OPHELIA LIMACINA	10	50	20	40	30
OWENIA FUSIFORMIS				10	
MYRIOCHELE OCULATA	40	140	70	80	10
PECTINARIA KORENI		10	10		
PECTINARIA AURICOMA				30	10
AMPHERETE BALTICA			20		
AMPHARETE SP.				10	
ANOBOTHRUS GRACILIS		10			
AMPHITRITE CIRRATA					10
LANICE CONCHILEGA	10		20	40	
DIASTYLIS RATHKEI			20	10	
AMPHIPODA		10			
PARIAMBUS TYPICUS		20			10
AMPELISCA BREVICORNIS	30		10	10	10
BATHYPOREIA SP.			10		
PROTOMEDEIA FASCIATA					10
COROPHIUM AFFINE			10		
COROPHIUM CRASSICORNE				10	30
MELITA DENTATA		10			
PHORONIS MUELLERI		10		60	
PHORONIS SP.				40	
OPHIUROIDEA			10		
AMPHIURA FILIFORMIS	40				10
AMPHIURA JUV.				20	
OPHIURA ROBUSTA				10	
OPHIURA ALBIDA	70	80	40	30	80
OPHIURA JUV.				30	

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159114 27/05/86	159114 25/05/87	159114 19/05/88	159114 19/05/89	159114 22/05/90
ECHINOIDEA				20	
ECHINOCYAMUS PUSILLUS		10		40	40
ECHINOCARDIUM CORDATUM				20	

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159115 27/05/86	159115 25/05/87	159115 17/05/88	159115 19/05/89	159115 22/05/90
	10				
ANTHOZOA			10		
VIRGULARIA MIRABILIS				10	10
EDWARDSIA SP.			20		
PLATYHELMINTHES					20
NEMERTINEA			30		40
PHILINE APERTA				10	
NUCULA TENUIS		10			20
NUCULA NITIDOSA			10		
THYASIRA FLEXUOSA					10
TELLIMYA FERRUGINOSA	40		10	10	
MYSELLA BIDENTATA		30	50	40	
ARCTICA ISLANDICA	20	10	20	10	40
PARVICARDIUM OVALE					10
CHAMELEA STRIATULA	10	200	110	110	40
SPISULA SUBTRUNCATA		20	10		
ABRA NITIDA			10		
ABRA ALBA	20	320	60		
MACOMA CALCAREA	20	80	130	60	40
FABULINA FABULA	430	290	430	1140	860
PHAXAS PELLUCIDUS	10	20	30	10	30
MYA ARENARIA			10		
CORBULA GIBBA	10	20	50		30
THRACIA PHASEOLINA		10	20	10	10
HARMOTHOE IMPAR					20
ANTINOELLA SARSI		20			
PHOLOE INORNATA		20	60	50	30
ETEONE LONGA			10		
PHYLLODOCE MUCOSA				20	
PHYLLODOCE SP.					10
EUMIDA SANGUINEA					10
EUMIDA BAHUSIENSIS		10			
EUMIDA SP.					30
NEPHTYS HOMBERGII	100	40	100	30	80
NEPHTYS CAECA	10		20	20	
NEPHTYS LONGOSETOSA				20	
GLYCERA ALBA					60
GONIADA MACULATA			10	10	10
SCOLOPLOS ARMIGER	90	50	290	310	200
SPIO FILICORNIS	20	10			30
POLYDORA CAECA		430	310	190	10
PSEUDOPOLYDORA PULCHRA	10				
PRIONOSPIO FALLAX	30	20	290	460	1180
SPIOPHANES BOMBYX	10	50	30	130	50
CHAETOZONE SETOSA		40	50		90
MALDANIDAE		10			
OWENIA FUSIFORMIS			10		
MYRIOCHELE OCULATA			10	10	20
PECTINARIA KORENI	10		30	100	70
PECTINARIA AURICOMA				50	50
AMPHARETE SP.		10			
LANICE CONCHILEGA			180		
DIASTYLIS RATHKEI			30	20	
DIASTYLIS BRADYI					20
PARIAMBUS TYPICUS					10
AMPELISCA BREVICORNIS	70	50	80	20	60
PERICULODES LONGIMANUS			10		10
STENOTHOE MARINA					10
MICROPROTOPUS MACULATUS					10
PHORONIS MUELLERI		60	10	70	180
PHORONIS SP.				20	
AMPHIURA FILIFORMIS	10				20
AMPHIURA JUV.					90
OPHIURA ALBIDA	150	50	20	60	20
OPHIURA JUV.				10	80
ECHINOCARDIUM CORDATUM	30		10	30	10

ARTSSKEMA					
Udtrækstype : Alle arter medtaget					
Individantal /m2					
Art	159116 27/05/86	159116 25/05/87	159116 17/05/88	159116 18/05/89	159116 22/05/90
ANTHOZOA			10		
CERIANTHUS LLOYDII				10	
EDWARDSIA SP.					20
PLATYHELMINTHES		10			
NEMERTINEA				10	
DIAPHANA MINUTA			20		
MODIOLUS MODIOLUS		10			
TELLIMYA FERRUGINOSA	50				
MYSELLA BIDENTATA			40		
ARCTICA ISLANDICA	90	60	10	20	70
CHAMELEA STRIATULA		210	90	60	50
SPISULA SUBTRUNCATA		10			
ABRA ALBA		140	140		10
MACOMA BALTHICA				20	
MACOMA CALCAREA	40	120	90	10	140
FABULINA FABULA	240	260	810	450	470
PHAXAS PELLUCIDUS		10	10	10	
CORBULA GIBBA			10		20
THRACIA PHASEOLINA		20	60	10	
ANTINOELLA SARSI		10			
PHOLOE INORNATA		10	40	60	20
PHYLLODOCE MUCOSA				20	
PHYLLODOCE MACULATA				20	
EUMIDA SANGUINEA			10	10	10
EUMIDA BAHUSIENSIS		40			10
NEPHTYS HOMBERGII	100	50	30	40	20
NEPHTYS CAECA		10	30	10	40
NEPHTYS LONGOSETOSA				10	
GLYCERA ALBA			30		30
GONIADA MACULATA					10
SCOLOPLOS ARMIGER	60		100	90	170
SPIO FILICORNIS	10	30	70	70	70
POLYDORA CAECA		560	1060	320	
PRIONOSPIO FALLAX	50	20	380	90	50
SPIOPHANES BOMBYX	30	20	110	30	80
MAGELONA MIRABILIS			10		
CHAETOZONE SETOSA	10	10	130	20	50
OWENIA FUSIFORMIS			10	10	
MYRIOCHELE OCULATA				20	
PECTINARIA KORENI			10		
AMPHARETE FINMARCHICA		10	10		
LANICE CONCHILEGA		10	40	30	10
OLIGOCHAETA					10
HIRUDINEA					10
BALANUS CRENATUS		120			
LAMPROPS FASCIATA					10
DIASTYLIS RATHKEI			10		
PARIAMBUS TYPICUS					10
AMPELISCA BREVICORNIS	50	30	100	60	190
BATHYPOREIA PELAGICA			10		
WESTWOODILLA CAECULA					10
PHORONIS MUELLERI	10	30	30	40	70
AMPHIURA JUV.					30
OPHIURA AFFINIS					10
OPHIURA ALBIDA	10	50	30	30	10
OPHIURA JUV.					40
OPHIURA SP.			10		
ECHINOCYAMUS PUSILLUS				10	
ECHINOCARDIUM CORDATUM	10		10		

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159117 27/05/86	159117 25/05/87	159117 17/05/88	159117 18/05/89	159117 22/05/90
ANTHOZOA		10			10
EDWARDSIA SP.					10
NEMERTINEA					30
PHILINE APERTA				10	10
TELLIMYA FERRUGINOSA	60				10
MYSELLA BIDENTATA			30		
ARCTICA ISLANDICA	200	410	730	660	260
CHAMELEA STRIATULA		30		10	10
ABRA ALBA	10	50	10		
MACOMA CALCAREA	50	30	70	20	30
FABULINA FABULA	370	370	550	590	340
PHAXAS PELLUCIDUS				10	
HIATELLA ARCTICA					10
CORBULA GIBBA					10
ANTINOELLA SARSI		10			
PHOLOE INORNATA	30		10	10	20
EUMIDA BAHUSIENSIS		10			20
SYNELMIS KLATTI	10				
NEPHTYS HOMBERGII	10	20	20	20	
NEPHTYS CAECA	10		30	10	10
NEPHTYS SP.					30
GLYCERA ALBA					10
SCOLOPLOS ARMIGER	60	50	80	130	430
SPIO FILICORNIS	40				80
POLYDORA CAECA	20	50			
PSEUDOPOLYDORA PULCHRA	20				10
PRIONOSPIO FALLAX	30		40	10	360
SPIOPHANES BOMBYX	10	20	40	10	20
CHAETOZONE SETOSA		60		20	50
PECTINARIA KORENI	20			10	10
AMPHARETE ACUTIFRONS					20
LANICE CONCHILEGA			30	30	50
OLIGOCHAETA					10
HIRUDINEA			10		
AMPELISCA BREVICORNIS	40	10	10		
ATYLUS VEDLOMENSIS	10				
PROTOMEDEIA FASCIATA					20
PHORONIS MUELLERI					10
PHORONIS SP.				10	
OPHIURA ALBIDA	40	10	10		50
OPHIURA JUV.				10	
ECHINOCARDIUM CORDATUM	40		10		10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159118 26/05/86	159118 25/05/87	159118 17/05/88	159118 18/05/89	159118 22/05/90
PHILINE APERTA	10				10
TELLIMYA FERRUGINOSA	50		10	30	40
MYSELLA BIDENTATA		40	20	30	
ARCTICA ISLANDICA	160	130	220	190	150
CHAMELEA STRIATULA	10	50		30	
SPISULA SUBTRUNCATA		10			
ABRA ALBA	90	90	180		
MACOMA BALTHICA	50				
MACOMA CALCAREA	10	90	110	20	20
FABULINA FABULA	220	420	640	740	630
PHAXAS PELLUCIDUS	10	10		10	
CORBULA GIBBA		10			
THRACIA PHASEOLINA		20			
ANTINOELLA SARSI		10			20
PHOLOE INORNATA	20	30	30	30	30
PHYLLODOCE MUCOSA					10
EUMIDA BAHUSIENSIS			50		40
NEPHTYS HOMBERGII	30	30	20	20	20
NEPHTYS CAECA		30	30	10	20
NEPHTYS SP.				30	
GLYCERA ALBA	10				10
GONIADA MACULATA			10		
SCOLOPLOS ARMIGER	50	70	50	170	380
SPIO FILICORNIS				30	60
POLYDORA CAECA		10	440	160	
PSEUDOPOLYDORA PULCHRA		10		20	
PRIONOSPIO FALLAX	10		90	70	690
SPIOPHANES BOMBYX		10	10	30	20
CHAETOZONE SETOSA		20	20		60
OPHELINA ACUMINATA		10			10
CAPITELLA CAPITATA	10				
MYRIOCHELE OCULATA	10				10
PECTINARIA KORENI			20	20	
LANICE CONCHILEGA			80	60	
OLIGOCHAETA					10
HIRUDINEA					10
BALANUS CRENATUS		40			
DIASTYLIS RATHKEI	10		20	10	
PARIAMBUS TYPICUS					10
AMPELISCA BREVICORNIS	50	20	10		60
PONTOCRATES ALTAMARINUS			30		
WESTWOODILLA CAECULA			10		
PROTOMEDEIA FASCIATA					10
CALLIOPIUS LAEVIUSCULUS			10		
PHORONIS MUELLERI				10	20
PHORONIS SP.				30	
AMPHIURA FILIFORMIS	10				
AMPHIURA JUV.					10
OPHIURA ALBIDA	40	20	50	40	10
OPHIURA JUV.					40
ECHINOCARDIUM CORDATUM	30	10	20	20	10

ARTSSKEMA

Udtrækstype : Alle arter medtaget

Individantal /m2

Art	159119 26/05/86	159119 25/05/87	159119 17/05/88	159119 18/05/89	159119 21/05/90
CERIANTHUS LLOYDII			10		
EDWARDSIA SP.					10
NEMERTINEA		10		20	
HYDROBIA ULVAE					10
HINIA RETICULATA					40
MODIOLUS MODIOLUS			20		
MUSCULUS NIGER			10		
TELLIMYA FERRUGINOSA			10	40	
MYSELLA BIDENTATA		40	40		10
ARCTICA ISLANDICA	50	160	160	170	50
CHAMELEA STRIATULA		240	160	70	50
SPISULA SUBTRUNCATA		10			
ABRA ALBA		80	40		10
MACOMA CALCAREA		280	30		20
FABULINA FABULA	100	530	740	590	520
MYA ARENARIA		10			
CORBULA GIBBA					330
THRACIA PHASEOLINA				10	
ANTINOELLA SARSI		20			20
PHOLOE INORNATA		10	30	10	50
PHYLLODICIDAE			10		
ETEONE LONGA					20
PHYLLODOCE MUCOSA					20
EUMIDA SANGUINEA	10				80
EUMIDA BAHUSIENSIS			10		
NEPHTYS HOMBERGII	10	40	60	70	30
NEPHTYS CAECA		50		10	
NEPHTYS SP.					30
GLYCERA ALBA					20
GONIADA MACULATA			10		
SCOLOPLOS ARMIGER		120	80	180	390
SPIO FILICORNIS		20		10	10
POLYDORA CAECA	60	390	440	30	
PRIONOSPIO FALLAX		10	60	60	1120
SPIOPHANES BOMBYX	20	30	120	80	80
CHAETOZONE SETOSA		20	60	30	110
OPHELIA LIMACINA			10		
HETEROMASTUS FILIFORMIS					10
MYRIOCHELE OCULATA	10		10	10	
PECTINARIA KORENI			40	20	
PECTINARIA AURICOMA				10	
PECTINARIA BELGICA				10	
PECTINARIA SP.				10	
AMPHARETIDAE		10			
LANICE CONCHILEGA		20	10	40	
GASTROSACCUS SPINIFER			10		
LAMPROPS FASCIATA			10		
DIASTYLIS RATHKEI		30	70	30	
DIASTYLIS BRADYI		10			
DIASTYLIS LUCIFERA			10		
IDOTEA VIRIDIS			60		
PARIAMBUS TYPICUS		10	10		10
LYSIANASSIDAE			10		
AMPELISCA BREVICORNIS	10	50	40	10	
PERICULODES LONGIMANUS			10		
ISAEIDAE					10
PHORONIS MUELLERI		10	40	10	60
PHORONIS SP.				10	
AMPHIURA JUV.					30
OPHIURA ALBIDA	40	40	10	20	20
OPHIURA JUV.					80
ECHINOCYAMUS PUSILLUS		10			
ECHINOCARDIUM CORDATUM	10	30	20	20	

Appendix 3.4

Total number of species, mean abundance per m^2 (± S.E.) and mean biomass (AFDW) per m^2 (± S.E.), Århus Bay 1985-1991.

"$_*$" means that the ash free dry weight has been calculated from dry weight.

Large specimens have been omitted from the biomass.

STATISTISK BEARBEJDNING : OVERSIGTSSKEMA

Biomasse type : ASKEFRI TØRVÆGT
Udtrækstype : Kun opdaterede arter medtaget

Station	Dato	Antal arter	Middel antal individer/m2	S.E. Individer	Middel biomasse g/m2	S.E. Biomasse
179006	28/10/85	20	2270	0	* 19.8791	0.0000
179006	24/09/86	19	1700	0	* 6.6914	0.0000
179006	04/11/87	18	670	0	* 5.6589	0.0000
179006	07/11/88	18	2500	0	* 26.9974	0.0000
179006	31/10/89	26	2636	141	* 8.0430	2.4261
179006	29/01/90	26	2402	128	* 9.9413	2.7508
179006	06/03/90	28	2451	184	* 8.4940	1.6923
179006	26/03/90	25	2434	296	* 8.7010	2.2909
179006	06/05/90	24	2049	280	* 8.9185	2.7167
179006	11/06/90	27	2361	285	* 17.8010	8.0814
179006	19/07/90	28	2770	196	* 11.5542	3.7560
179006	21/08/90	28	3424	365	* 7.4280	2.2749
179006	17/09/90	23	2650	265	* 9.1008	1.9300
179006	05/11/90	32	3542	390	* 16.8179	2.9006
179006	04/12/90	25	2789	214	* 10.1924	1.2738
179006	21/01/91	29	2870	262	* 11.3876	2.2975
179006	26/02/91	25	2439	412	* 6.5101	1.6201
179006	25/03/91	23	2000	141	* 10.3251	2.2292
179006	03/05/91	26	1862	252	* 7.9583	1.5694
179006	29/05/91	22	1276	164	* 7.8688	1.4451
179006	25/06/91	28	2089	197	* 8.3396	3.1583
179006	05/08/91	23	3512	432	* 11.0536	2.0103
179006	13/09/91	24	2228	140	* 14.2801	6.4705
179006	23/10/91	26	2660	206	* 6.2379	1.8842
179006	15/11/91	23	2089	213	* 11.5215	2.6124
179006	16/12/91	27	1764	134	* 13.1589	2.8391
179015	28/10/85	15	2290	0	* 15.0866	0.0000
179015	22/09/86	18	1060	0	* 4.2202	0.0000
179015	04/11/87	18	1180	0	* 8.4358	0.0000
179015	07/11/88	12	730	0	* 9.4351	0.0000
179015	01/11/89	28	2873	621	* 6.4223	1.9345
179015	01/11/90	35	2660	470	* 6.7579	1.2517
179015	23/10/91	28	2485	417	* 9.1886	2.2791
179024	28/10/85	27	3040	0	* 13.5981	0.0000
179024	24/09/86	15	1280	0	* 9.5190	0.0000
179024	04/11/87	14	620	0	* 5.7146	0.0000
179024	07/11/88	9	460	0	* 21.7321	0.0000
179024	31/10/89	31	3043	255	* 5.6401	0.8764
179024	01/11/90	35	3240	633	* 8.9064	1.1158
179024	23/10/91	42	2764	343	* 7.5830	2.4319
179025	28/10/85	22	2280	0	* 13.0893	0.0000
179025	24/09/86	15	880	0	* 2.7202	0.0000
179025	04/11/87	17	1250	0	* 5.5743	0.0000
179025	07/11/88	9	400	0	* 4.4586	0.0000
179025	31/10/89	26	1905	189	* 3.8734	0.6110
179025	01/11/90	29	1603	158	* 6.6825	1.2719
179025	23/10/91	29	1812	250	* 5.5547	0.9357
179029	28/10/85	15	940	0	* 4.2769	0.0000
179029	22/09/86	18	1600	0	* 20.4334	0.0000
179029	04/11/87	12	490	0	* 2.8940	0.0000
179029	07/11/88	20	5110	0	* 29.9062	0.0000
179029	31/10/89	23	5319	353	* 12.7178	1.7118
179029	02/11/90	33	5331	567	* 12.1612	1.7095
179029	22/10/91	25	5393	545	* 6.9819	1.0262
179030	28/10/85	12	2010	0	* 21.8704	0.0000
179030	24/09/86	18	1950	0	* 11.7950	0.0000
179030	04/11/87	14	490	0	* 4.1411	0.0000
179030	07/11/88	11	800	0	* 14.9494	0.0000
179030	31/10/89	23	3020	225	* 5.5524	0.5201
179030	01/11/90	34	3333	345	* 13.0885	1.8492
179030	23/10/91	22	2263	166	* 7.2313	2.4294
179051	28/10/85	10	220	0	* 0.9570	0.0000
179051	22/09/86	8	250	0	* 0.1525	0.0000
179051	04/11/87	10	370	0	* 3.0331	0.0000
179051	07/11/88	0	0	0	0.0000	0.0000
179051	30/10/89	8	209	46	* 0.1880	0.0967
179051	04/10/90	17	2323	235	* 8.4207	0.8650
179051	25/10/91	22	3914	558	* 6.4028	0.7992
179064	28/10/85	2	20	0	0.0000	0.0000
179064	22/09/86	1	10	0	0.0000	0.0000
179064	04/11/87	4	40	0	0.0000	0.0000
179064	07/11/88	4	80	0	* 0.2307	0.0000
179064	31/10/89	6	825	534	* 0.2153	0.1658

STATISTISK BEARBEJDNING : OVERSIGTSSKEMA

Biomasse type : ASKEFRI TØRVÆGT
Udtrækstype : Kun opdaterede arter medtaget

Station	Dato	Antal arter	Middel antal individer/m2	S.E. Individer	Middel biomasse g/m2	S.E. Biomasse
179064	09/10/90	10	186	56	* 0.0762	0.0457
179069	22/10/91	12	616	82	* 1.3411	0.2448
179071	28/10/85	20	3350	0	* 17.7088	0.0000
179071	22/09/86	14	2080	0	* 11.9716	0.0000
179071	04/11/87	21	2410	0	* 9.4461	0.0000
179071	07/11/88	16	2830	0	* 34.0719	0.0000
179071	31/10/89	16	6678	612	* 6.1458	2.1987
179071	09/10/90	27	6597	2435	* 7.0906	1.3160
179071	22/10/91	24	3659	601	* 7.5559	0.8366
179073	28/10/85	19	3970	0	* 21.3141	0.0000
179073	22/09/86	20	2570	0	* 14.3667	0.0000
179073	04/11/87	15	1340	0	* 7.7964	0.0000
179073	07/11/88	20	1950	0	* 24.2353	0.0000
179073	01/11/90	29	4901	251	* 16.0299	3.5594
179073	22/10/91	30	4843	273	* 11.1213	2.4651
179077	28/10/85	11	290	0	* 3.9068	0.0000
179077	22/09/86	13	1590	0	* 5.8816	0.0000
179077	04/11/87	15	3950	0	* 9.0776	0.0000
179077	07/11/88	14	3920	0	* 24.4883	0.0000
179077	30/10/89	17	8537	1349	* 2.3029	0.3570
179077	09/10/90	25	6307	1220	* 7.3839	1.3116
179077	22/10/91	22	3496	367	* 7.8896	0.7782
179084	28/10/85	10	850	0	* 3.0602	0.0000
179084	22/09/86	12	930	0	* 1.1965	0.0000
179084	04/11/87	24	5920	0	* 10.3137	0.0000
179084	07/11/88	17	6550	0	* 38.8498	0.0000
179084	01/11/89	14	8583	2401	* 3.0517	0.7499
179084	09/10/90	20	3449	531	* 5.1177	0.6894
179084	22/10/91	17	3577	425	* 6.8569	0.7078
179091	28/10/85	16	3020	0	* 12.9647	0.0000
179091	22/09/86	17	1630	0	* 6.2813	0.0000
179091	04/11/87	22	1710	0	* 5.0889	0.0000
179091	07/11/88	18	5160	0	* 22.4664	0.0000
179091	01/11/89	24	6852	622	* 4.7973	0.9350
179091	08/10/90	30	8130	1038	* 12.5806	2.7881
179091	22/10/91	28	6272	527	* 9.9068	1.7696
179097	28/10/85	18	2810	0	* 16.8872	0.0000
179097	22/09/86	26	2260	0	* 8.7832	0.0000
179097	04/11/87	21	2340	0	* 15.8035	0.0000
179097	07/11/88	12	1340	0	* 22.2823	0.0000
179097	01/11/89	33	6760	751	* 7.8869	0.9934
179097	02/11/90	34	6446	675	* 16.0411	3.2836
179097	22/10/91	26	4286	323	* 16.9644	2.8970
179103	28/10/85	21	3840	0	* 17.1126	0.0000
179103	22/09/86	17	1640	0	* 12.7371	0.0000
179103	04/11/87	22	2220	0	* 6.0804	0.0000
179103	07/11/88	20	2240	0	* 23.4743	0.0000
179103	01/11/89	31	5482	890	* 18.7520	3.7765
179103	02/11/90	36	5865	325	* 22.6289	3.1752
179103	22/10/91	27	3798	352	* 29.8471	6.5591

I de med '*' mærkede resultater er en eller flere af biomasserne beregnet

Appendix 3.5

Total number of species, mean abundance per m^2 (± S.E.) and mean biomass (AFDW) per m^2 (± S.E.), Fornæs 1986-1990.

"*" means that the ash free dry weight has been calculated from dry weight.

Large specimens have been omitted from the biomass.

STATISTISK BEARBEJDNING : OVERSIGTSSKEMA
Biomasse type : ASKEFRI TØRVÆGT Udtrækstype : Kun opdaterede arter medtaget

Station	Dato	Antal arter	Middel antal individer/m2	S.E. Individer	Middel biomasse g/m2	S.E. Biomasse
159001	23/05/86	17	530	0	* 1.3205	0.0000
159001	26/05/87	29	1700	0	* 4.1659	0.0000
159001	25/05/88	22	1110	0	* 4.8637	0.0000
159001	18/05/89	29	2610	0	* 13.2009	0.0000
159001	21/05/90	33	4030	0	* 5.6802	0.0000
159002	26/05/86	14	540	0	* 4.6512	0.0000
159002	26/05/87	24	1840	0	* 5.1892	0.0000
159002	25/05/88	28	2840	0	* 7.5076	0.0000
159002	18/05/89	29	2050	0	* 10.7026	0.0000
159002	21/05/90	27	4280	0	* 4.7121	0.0000
159004	29/05/86	12	440	0	* 2.9709	0.0000
159004	26/05/87	19	820	0	* 5.8268	0.0000
159004	25/05/88	24	1240	0	* 6.6818	0.0000
159004	18/05/89	24	1330	0	* 15.3237	0.0000
159004	22/05/90	25	1770	0	* 4.6281	0.0000
159005	22/05/86	21	980	0	* 5.3914	0.0000
159005	26/05/87	32	1610	0	* 3.2382	0.0000
159005	25/05/88	19	810	0	* 7.5985	0.0000
159005	18/05/89	28	1350	0	* 6.5625	0.0000
159005	21/05/90	47	5150	0	* 5.1045	0.0000
159007	23/05/86	21	1140	0	* 8.2583	0.0000
159007	26/05/87	36	2800	0	* 6.4576	0.0000
159007	25/05/88	28	2690	0	* 15.5663	0.0000
159007	22/05/89	28	2290	0	* 18.2143	0.0000
159007	21/05/90	36	5180	0	* 9.0893	0.0000
159009	29/05/86	22	610	0	* 5.3068	0.0000
159009	26/05/87	26	1250	0	* 7.0742	0.0000
159009	25/05/88	30	3840	0	* 6.8810	0.0000
159009	22/05/89	27	1470	0	* 10.7227	0.0000
159009	23/05/90	40	1950	0	* 17.0369	0.0000
159010	22/05/86	13	420	0	* 2.8846	0.0000
159010	26/05/87	33	1110	0	* 1.1201	0.0000
159010	25/05/88	22	1110	0	* 5.9014	0.0000
159010	18/05/89	23	890	0	* 12.2496	0.0000
159010	21/05/90	38	2200	0	* 10.2590	0.0000
159012	26/05/86	20	1030	0	* 5.2126	0.0000
159012	26/05/87	18	540	0	* 0.5051	0.0000
159012	25/05/88	27	1830	0	* 6.4490	0.0000
159012	22/05/89	26	1720	0	* 8.3764	0.0000
159012	30/05/90	39	3140	0	* 8.6829	0.0000
159014	29/05/86	18	380	0	* 4.3769	0.0000
159014	26/05/87	29	1650	0	* 2.8012	0.0000
159014	25/05/88	31	1470	0	* 12.5020	0.0000
159014	22/05/89	24	1090	0	* 18.0500	0.0000
159014	23/05/90	30	1570	0	* 56.2601	0.0000
159016	23/05/86	23	970	0	* 2.6598	0.0000
159016	26/05/87	34	1840	0	* 4.8625	0.0000
159016	20/05/88	12	240	0	* 6.9482	0.0000
159016	22/05/89	31	1080	0	* 11.5383	0.0000
159016	23/05/90	40	2320	0	* 6.7533	0.0000
159018	29/05/86	23	910	0	* 6.6476	0.0000
159018	26/05/87	19	870	0	* 3.8607	0.0000
159018	26/05/88	0	0	0	0.0000	0.0000
159018	22/05/89	28	2440	0	* 22.8269	0.0000
159018	30/05/90	39	2360	0	* 11.4883	0.0000
159019	22/05/86	17	450	0	* 5.0739	0.0000
159019	01/06/87	30	1440	0	* 5.0966	0.0000
159019	19/05/88	28	1090	0	* 2.5833	0.0000
159019	18/05/89	16	290	0	* 1.3317	0.0000
159019	21/05/90	42	3050	0	* 2.9674	0.0000
159021	23/05/86	19	470	0	* 7.2691	0.0000
159021	01/06/87	26	750	0	* 1.0365	0.0000
159021	20/05/88	26	880	0	* 3.3546	0.0000
159021	22/05/89	12	330	0	* 2.2189	0.0000
159021	21/05/90	39	1890	0	* 5.9421	0.0000
159022	26/05/86	27	1590	0	* 5.0932	0.0000
159022	01/06/87	29	1550	0	* 6.9904	0.0000
159022	20/05/88	27	2330	0	* 4.8754	0.0000
159022	22/05/89	24	1580	0	* 12.1354	0.0000
159022	30/05/90	42	5830	0	* 21.8024	0.0000
159024	29/05/86	21	660	0	* 5.9519	0.0000
159024	01/06/87	25	1370	0	* 2.7411	0.0000
159024	26/05/88	27	1990	0	* 4.9567	0.0000

STATISTISK BEARBEJDNING : OVERSIGTSSKEMA

Biomasse type : ASKEFRI TØRVÆGT
Udtrækstype : Kun opdaterede arter medtaget

Station	Dato	Antal arter	Middel antal individer/m2	S.E. Individer	Middel biomasse g/m2	S.E. Biomasse
159024	22/05/89	29	3820	0	* 34.5326	0.0000
159024	23/05/90	40	4150	0	* 21.2446	0.0000
159031	26/05/86	30	1310	0	* 18.0641	0.0000
159031	01/06/87	21	1170	0	* 3.2651	0.0000
159031	20/05/88	28	1350	0	* 3.1372	0.0000
159031	22/05/89	28	1540	0	* 8.8262	0.0000
159031	21/05/90	43	5180	0	* 9.7360	0.0000
159032	26/05/86	26	1410	0	* 4.9659	0.0000
159032	01/06/87	32	1880	0	* 2.6689	0.0000
159032	20/05/88	23	1630	0	* 5.9524	0.0000
159032	22/05/89	31	1980	0	* 18.9285	0.0000
159032	30/05/90	34	4440	0	* 9.5573	0.0000
159033	29/05/86	13	520	0	* 2.6434	0.0000
159033	01/06/87	35	2230	0	* 6.6132	0.0000
159033	26/05/88	26	2310	0	* 20.3588	0.0000
159033	22/05/89	28	1670	0	* 19.6341	0.0000
159033	30/05/90	43	3530	0	* 4.8005	0.0000
159042	22/05/86	28	870	0	* 4.6826	0.0000
159042	10/06/87	33	3500	0	* 4.8690	0.0000
159042	19/05/88	25	2280	0	* 10.6787	0.0000
159042	17/05/89	26	1040	0	* 13.6770	0.0000
159042	21/05/90	41	5260	0	* 13.4785	0.0000
159043	23/05/86	26	1480	0	* 7.8981	0.0000
159043	10/06/87	33	4040	0	* 7.5372	0.0000
159043	19/05/88	29	3040	0	* 7.7290	0.0000
159043	19/05/89	22	1360	0	* 5.9842	0.0000
159043	21/05/90	44	4350	0	* 8.4722	0.0000
159045	26/05/86	26	1540	0	* 19.1835	0.0000
159045	10/06/87	32	1970	0	* 2.6632	0.0000
159045	25/05/88	34	3730	0	* 6.1930	0.0000
159045	22/05/89	33	4370	0	* 17.7006	0.0000
159045	30/05/90	39	5150	0	* 12.7841	0.0000
159046	26/05/86	28	1330	0	* 6.6837	0.0000
159046	10/06/87	34	2390	0	* 5.3538	0.0000
159046	20/05/88	21	1590	0	* 4.7357	0.0000
159046	22/05/89	29	1960	0	* 13.1024	0.0000
159046	30/05/90	39	4200	0	* 22.3331	0.0000
159048	29/05/86	21	1980	0	* 21.5736	0.0000
159048	10/06/87	33	2750	0	* 3.9011	0.0000
159048	26/05/88	34	3940	0	* 9.2372	0.0000
159048	19/05/89	36	3470	0	* 24.5810	0.0000
159048	23/05/90	43	3550	0	* 18.5464	0.0000
159053	03/06/86	22	1310	0	* 8.6279	0.0000
159053	10/06/87	26	2160	0	* 2.1743	0.0000
159053	20/05/88	32	2990	0	* 8.2181	0.0000
159053	22/05/89	30	3290	0	* 10.8634	0.0000
159053	21/05/90	38	7460	0	* 8.7678	0.0000
159061	03/06/86	17	870	0	* 4.7722	0.0000
159061	10/06/87	21	1780	0	* 3.8630	0.0000
159061	20/05/88	23	1590	0	* 2.8688	0.0000
159061	23/05/89	28	2120	0	* 7.5145	0.0000
159061	30/05/90	41	7930	0	* 13.1899	0.0000
159062	03/06/86	24	2520	0	* 18.0888	0.0000
159062	10/06/87	32	2640	0	* 3.4041	0.0000
159062	26/05/88	34	2600	0	* 9.2623	0.0000
159062	19/05/89	30	1950	0	* 27.3853	0.0000
159062	30/05/90	34	2190	0	* 10.2841	0.0000
159064	22/05/86	20	570	0	* 1.8559	0.0000
159064	11/06/87	35	1590	0	* 3.7645	0.0000
159064	17/05/88	20	1090	0	* 1.6864	0.0000
159064	17/05/89	25	570	0	* 22.9009	0.0000
159064	21/05/90	35	3840	0	* 9.4461	0.0000
159073	23/05/86	17	330	0	* 1.6296	0.0000
159073	11/06/87	30	2160	0	* 3.5196	0.0000
159073	19/05/88	35	2130	0	* 3.5642	0.0000
159073	23/05/89	16	390	0	* 11.9194	0.0000
159073	21/05/90	51	5230	0	* 11.9843	0.0000
159075	03/06/86	24	890	0	* 3.3558	0.0000
159075	11/06/87	31	1980	0	* 2.2027	0.0000
159075	19/05/88	25	1480	0	* 2.7138	0.0000
159075	23/05/89	20	560	0	* 4.2492	0.0000
159075	29/05/90	43	4330	0	* 8.8011	0.0000
159076	03/06/86	27	1480	0	* 8.8403	0.0000

STATISTISK BEARBEJDNING : OVERSIGTSSKEMA

Biomasse type : ASKEFRI TØRVÆGT
Udtrækstype : Kun opdaterede arter medtaget

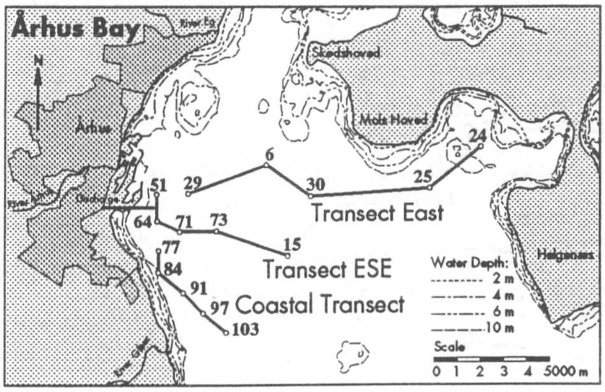
Station	Dato	Antal arter	Middel antal individer/m2	S.E. Individer	Middel biomasse g/m2	S.E. Biomasse
159076	11/06/87	27	1830	0	* 5.4651	0.0000
159076	19/05/88	30	1720	0	* 6.4099	0.0000
159076	23/05/89	28	2100	0	* 9.3180	0.0000
159076	30/05/90	49	4740	0	* 24.4706	0.0000
159078	29/05/86	17	390	0	* 8.9601	0.0000
159078	11/06/87	33	2150	0	* 12.4924	0.0000
159078	19/05/88	25	1150	0	* 5.0556	0.0000
159078	23/05/89	27	1020	0	* 17.5250	0.0000
159078	23/05/90	38	1470	0	* 26.1822	0.0000
159079	29/05/86	20	540	0	* 3.6183	0.0000
159079	11/06/87	33	2030	0	* 7.1567	0.0000
159079	20/05/88	32	2930	0	* 4.5009	0.0000
159079	23/05/89	25	930	0	* 3.2251	0.0000
159079	29/05/90	41	2940	0	* 8.9164	0.0000
159080	29/05/86	18	840	0	* 4.2116	0.0000
159080	11/06/87	36	1430	0	* 1.3651	0.0000
159080	20/05/88	28	1250	0	* 7.1937	0.0000
159080	23/05/89	17	250	0	* 3.6074	0.0000
159080	30/05/90	49	3890	0	* 3.3416	0.0000
159082	29/05/86	19	1100	0	* 11.0013	0.0000
159082	11/06/87	25	1540	0	* 2.8301	0.0000
159082	26/05/88	20	1820	0	* 5.6960	0.0000
159082	23/05/89	31	2250	0	* 14.9033	0.0000
159082	30/05/90	26	2740	0	* 12.2343	0.0000
159083	20/05/86	22	590	0	* 3.2718	0.0000
159083	11/06/87	32	1920	0	* 5.5512	0.0000
159083	06/06/88	27	2080	0	* 5.7852	0.0000
159083	23/05/89	27	1740	0	* 6.6878	0.0000
159083	22/05/90	28	2620	0	* 4.6499	0.0000
159083	08/05/91	0	0	0	0.0000	0.0000
159086	27/05/86	25	1040	0	* 8.6478	0.0000
159086	12/06/87	41	2290	0	* 2.3075	0.0000
159086	26/05/88	33	2290	0	* 3.1408	0.0000
159086	23/05/89	35	1070	0	* 10.5772	0.0000
159086	22/05/90	47	1290	0	* 6.3341	0.0000
159087	26/05/86	22	780	0	* 3.7962	0.0000
159087	25/05/87	27	2280	0	* 4.4914	0.0000
159087	17/05/88	32	2020	0	* 4.5130	0.0000
159087	18/05/89	28	1620	0	* 10.7328	0.0000
159087	21/05/90	34	1600	0	* 7.3330	0.0000
159088	26/05/86	7	440	0	* 7.3545	0.0000
159088	25/05/87	17	640	0	* 4.6642	0.0000
159088	17/05/88	14	1190	0	* 4.7562	0.0000
159088	18/05/89	17	1240	0	* 9.3988	0.0000
159088	22/05/90	17	850	0	* 4.2533	0.0000
159089	27/05/86	15	670	0	* 2.8472	0.0000
159089	25/05/87	19	690	0	* 1.1669	0.0000
159089	17/05/88	28	1740	0	* 7.4659	0.0000
159089	18/05/89	15	1290	0	* 6.0520	0.0000
159089	22/05/90	35	1380	0	* 15.4020	0.0000
159090	27/05/86	9	200	0	* 1.4711	0.0000
159090	25/05/87	15	620	0	* 1.0230	0.0000
159090	17/05/88	21	1200	0	* 4.2278	0.0000
159090	18/05/89	13	1110	0	* 2.7615	0.0000
159090	22/05/90	30	2360	0	* 34.8500	0.0000
159091	27/05/86	24	970	0	* 14.1171	0.0000
159091	25/05/87	25	1240	0	* 4.3445	0.0000
159091	17/05/88	27	2080	0	* 11.2394	0.0000
159091	19/05/89	31	2770	0	* 16.4327	0.0000
159091	22/05/90	37	3710	0	* 20.5633	0.0000
159092	27/05/86	17	330	0	* 2.9390	0.0000
159092	25/05/87	29	1880	0	* 4.3940	0.0000
159092	19/05/88	33	1790	0	* 5.9261	0.0000
159092	19/05/89	34	2740	0	* 13.9773	0.0000
159092	22/05/90	46	2900	0	* 23.0996	0.0000
159093	27/05/86	25	480	0	* 3.1885	0.0000
159093	11/06/87	31	2700	0	* 1.6490	0.0000
159093	19/05/88	42	2790	0	* 7.7324	0.0000
159093	19/05/89	41	2060	0	* 8.5254	0.0000
159093	22/05/90	39	1480	0	* 13.4183	0.0000
159094	27/05/86	19	2330	0	* 36.9998	0.0000
159094	12/06/87	26	6540	0	* 8.4134	0.0000
159094	06/06/88	48	5560	0	* 22.1559	0.0000

STATISTISK BEARBEJDNING : OVERSIGTSSKEMA

Biomasse type : ASKEFRI TØRVÆGT
Udtrækstype : Kun opdaterede arter medtaget

Station	Dato	Antal arter	Middel antal individer/m2	S.E. Individer	Middel biomasse g/m2	S.E. Biomasse
159094	19/05/89	36	8470	0	* 37.2360	0.0000
159094	22/05/90	47	4330	0	* 15.8459	0.0000
159095	20/05/86	29	3310	0	* 29.1979	0.0000
159095	12/06/87	32	2630	0	* 6.5626	0.0000
159095	06/06/88	41	3920	0	* 17.7464	0.0000
159095	19/05/89	45	7520	0	* 22.4355	0.0000
159095	22/05/90	32	2910	0	* 5.6596	0.0000
159096	20/05/86	33	2660	0	* 16.9174	0.0000
159096	12/06/87	32	3220	0	* 11.8248	0.0000
159096	06/06/88	30	2700	0	* 10.8148	0.0000
159096	19/05/89	30	2150	0	* 21.8962	0.0000
159096	22/05/90	39	2540	0	* 9.3135	0.0000
159097	20/05/86	18	460	0	* 4.9185	0.0000
159097	12/06/87	23	1140	0	* 3.5886	0.0000
159097	06/06/88	32	1390	0	* 7.9359	0.0000
159097	19/05/89	35	1010	0	* 14.1793	0.0000
159097	22/05/90	35	1020	0	* 10.1812	0.0000
159112	20/05/86	14	1380	0	* 48.8064	0.0000
159112	12/06/87	32	4250	0	* 3.5573	0.0000
159112	06/06/88	35	5710	0	* 14.4991	0.0000
159112	19/05/89	44	7120	0	* 42.0339	0.0000
159112	22/05/90	48	4690	0	* 31.7357	0.0000
159113	27/05/86	15	350	0	* 2.7456	0.0000
159113	11/06/87	25	1330	0	* 2.5509	0.0000
159113	19/05/88	33	2130	0	* 5.5585	0.0000
159113	19/05/89	29	1990	0	* 21.3752	0.0000
159113	22/05/90	36	1420	0	* 12.0129	0.0000
159114	27/05/86	21	530	0	* 13.9556	0.0000
159114	25/05/87	32	1800	0	* 1.4717	0.0000
159114	19/05/88	32	2240	0	* 6.7299	0.0000
159114	19/05/89	40	1590	0	* 8.5895	0.0000
159114	22/05/90	23	600	0	* 3.0207	0.0000
159115	27/05/86	19	1050	0	* 11.3380	0.0000
159115	25/05/87	26	1880	0	* 3.4013	0.0000
159115	17/05/88	36	2560	0	* 14.0846	0.0000
159115	19/05/89	28	3020	0	* 21.9544	0.0000
159115	22/05/90	42	3620	0	* 16.1713	0.0000
159116	27/05/86	12	660	0	* 10.9344	0.0000
159116	25/05/87	25	1800	0	* 6.2212	0.0000
159116	17/05/88	34	3560	0	* 8.4433	0.0000
159116	18/05/89	28	1570	0	* 8.9083	0.0000
159116	22/05/90	31	1690	0	* 12.3864	0.0000
159117	27/05/86	18	840	0	* 6.7963	0.0000
159117	25/05/87	14	730	0	* 4.8201	0.0000
159117	17/05/88	14	940	0	* 4.4676	0.0000
159117	18/05/89	16	910	0	* 3.4411	0.0000
159117	22/05/90	28	1680	0	* 5.5758	0.0000
159118	26/05/86	19	700	0	* 7.0363	0.0000
159118	25/05/87	22	1050	0	* 1.9445	0.0000
159118	17/05/88	23	1940	0	* 5.1890	0.0000
159118	18/05/89	23	1620	0	* 16.4482	0.0000
159118	22/05/90	27	2260	0	* 6.1072	0.0000
159119	26/05/86	8	260	0	* 1.1096	0.0000
159119	25/05/87	27	2100	0	* 4.3603	0.0000
159119	17/05/88	34	2290	0	* 5.5737	0.0000
159119	18/05/89	26	1410	0	* 18.5304	0.0000
159119	21/05/90	29	3200	0	* 3.7395	0.0000

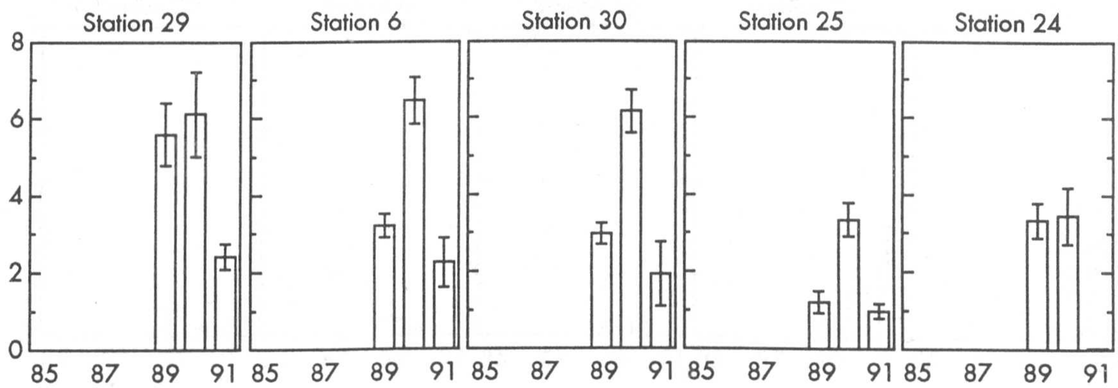
I de med '*' mærkede resultater er en eller flere af biomasserne beregnet



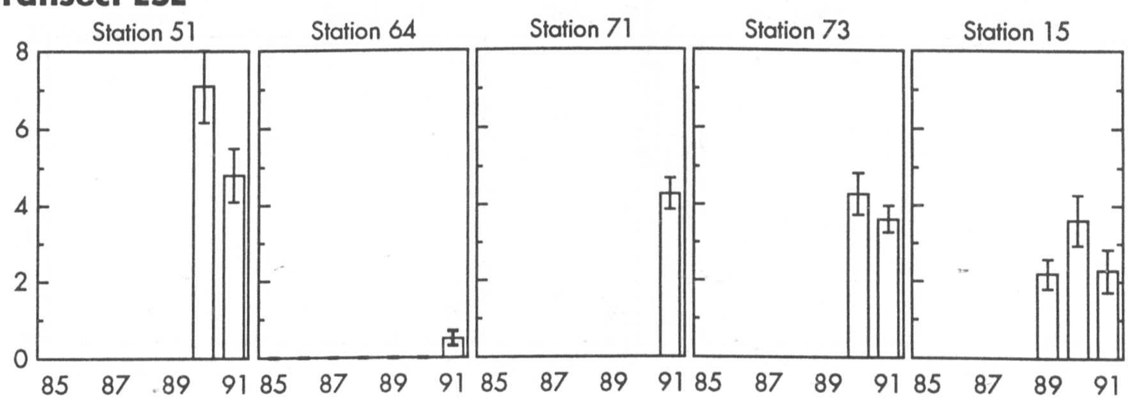
Biomass of Abra alba 1989–1991

g AFDW$\cdot$m^{-2}

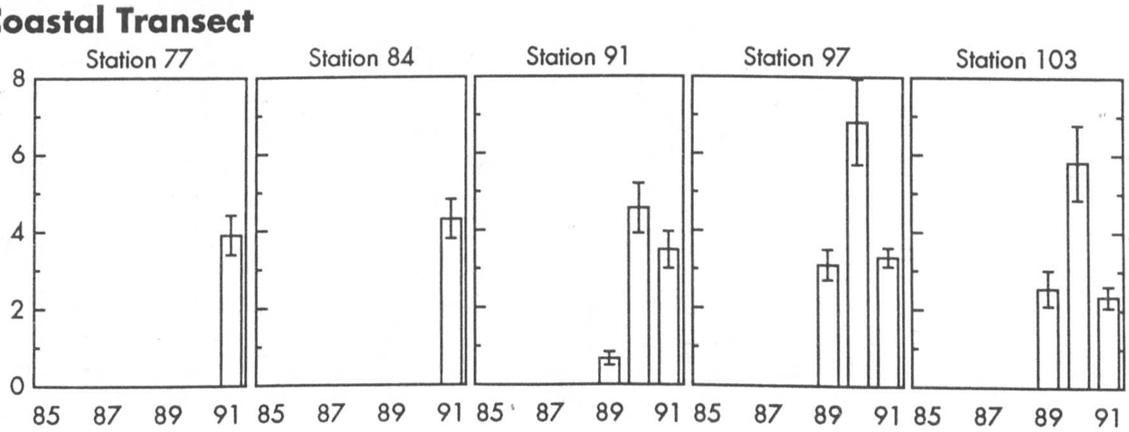
Transect East



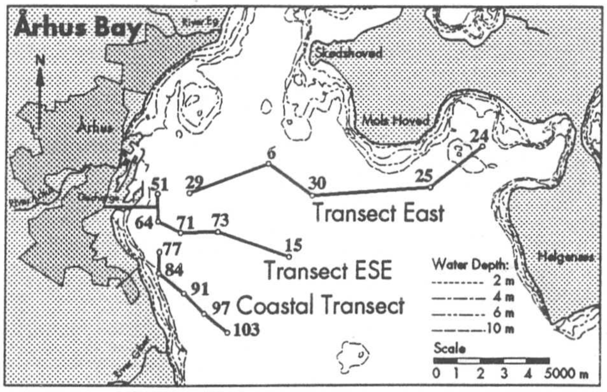
Transect ESE



Coastal Transect

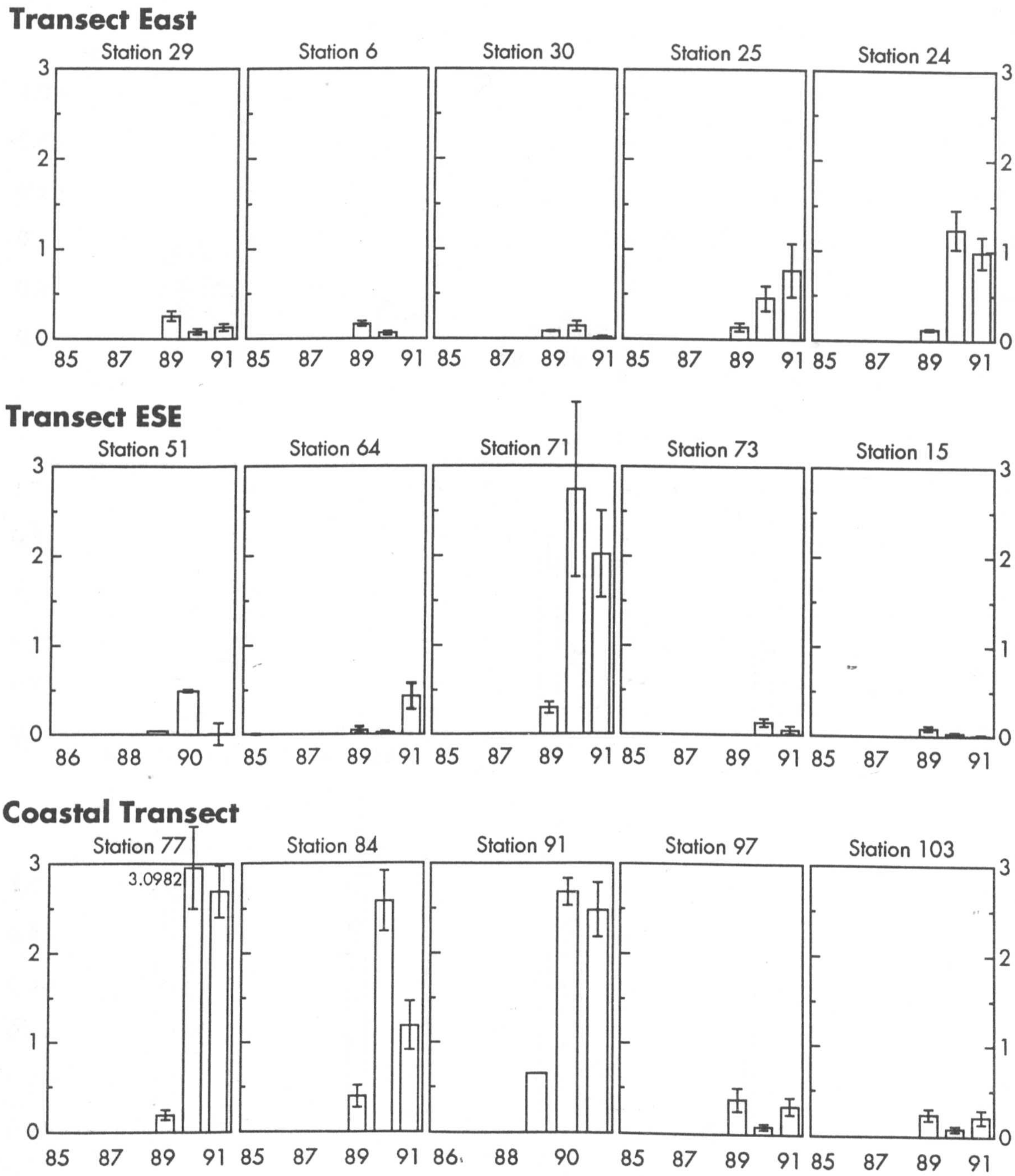


Appendix 4.1
Variation in abundance of *Abra alba* at the 15 stations in Århus Bay 1985-1991.
Error bars are sampling error, S.E.

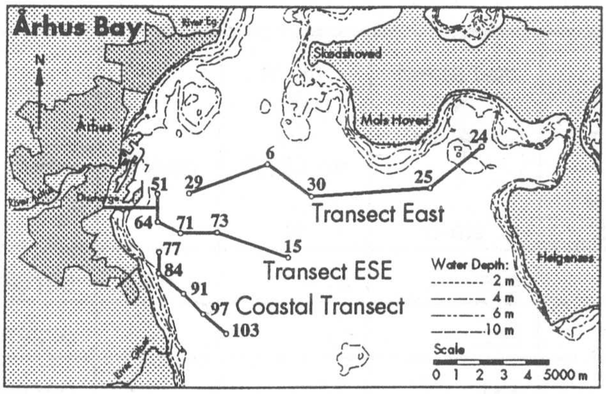


Biomass of Corbula gibba 1989–1991

g AFDW·m^{-2}

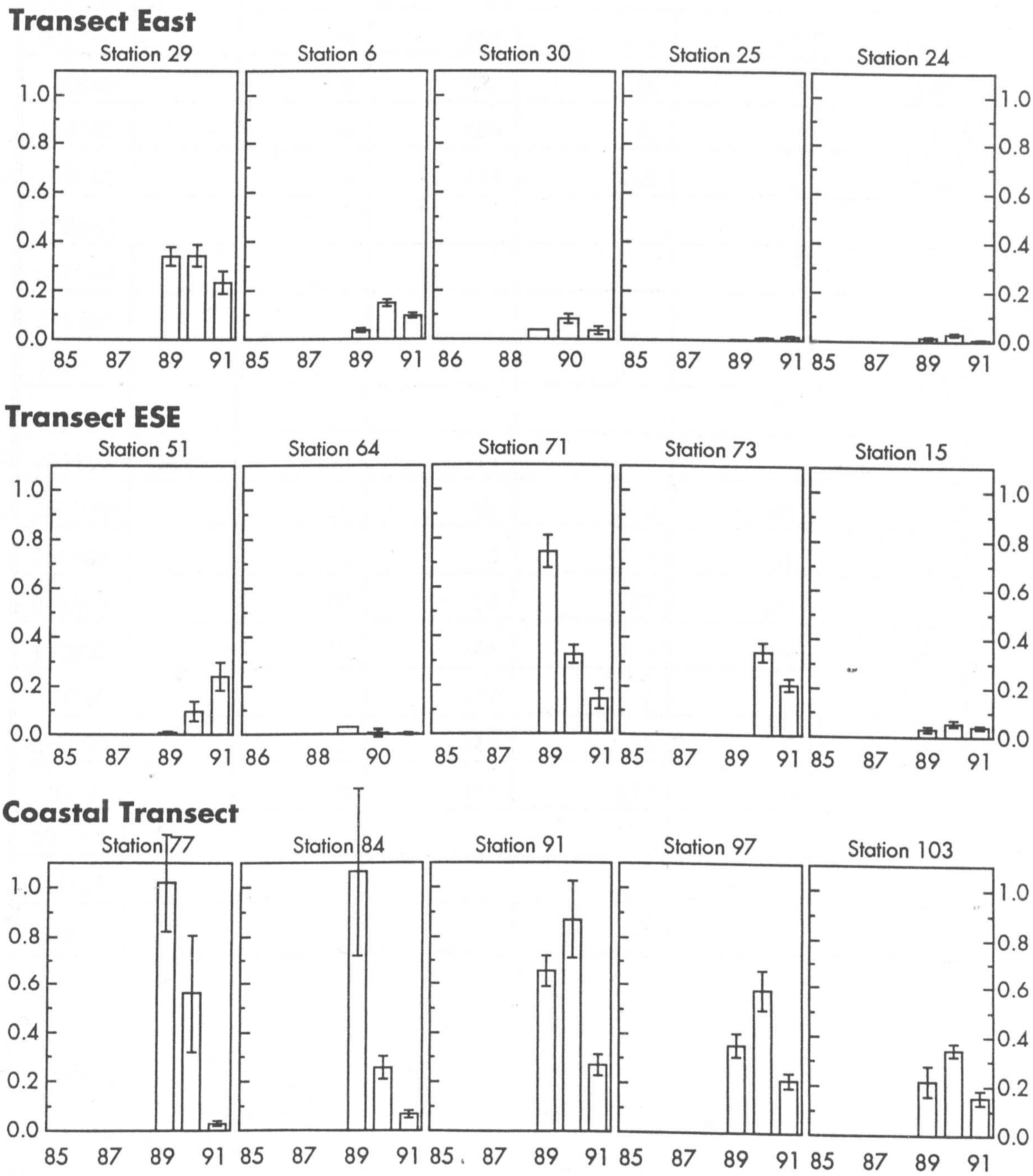


Appendix 4.2
Variation in biomass of *Corbula gibba* at the 15 stations in Århus Bay 1989-1991. Error bars are sampling error, S.E.



Biomass of Mysella bidentata 1989–1991

g AFDW·m^{-2}



Appendix 4.3
Variation in biomass of *Mysellla bidentata* at the 15 stations in Århus Bay 1989-1991. Error bars are sampling error, S.E.

Date	Cohort	No in cohort per 0.123 m² N	Mean wet wt per indv. $\bar{w}$·mg	Wt. increment since previous sample Δw·mg	Mean no. per 0.123 m² during period t $\bar{N}$	Production increment mg per 0.123 m² $\Delta\bar{N}\cdot\bar{w}$
290190	1988	14	319			
060390		13	333	14	14	187
260390		14	343	10	14	134
060590		6	597	255	10	2547
110690		8	635	38	7	266
190790		10	606	-30	9	-267
210890		2	715	109	6	654
170990						
051190						
041290						
Total						3521
290190	1989	43	14			
060390		39	14	0	41	7
260390		23	13	-1	31	-27
060590		22	60	47	23	1056
110690		16	165	104	19	1979
190790		6	171	7	11	74
210890		8	243	72	7	504
170990		3	494	250	6	1377
051190						
041290						
Total						4969

Appendix 5.1
***Abra alba* production estimated by the Crisp method at stn. 6, Århus Bay 1990.**

(continues)

Date	Cohort	No in cohort per 0.123 m² N	Mean wet wt per indv. $\bar{w}$·mg	Wt. increment since previous sample Δw·mg	Mean no. per 0.123 m² during period t $\bar{N}$	Production increment mg per 0.123 m² $\Delta\bar{N}\cdot\bar{w}$
290190	1990					
060390						
260390						
060590		17	1			
110690		87	1	1	52	26
190790		129	2	1	108	113
210890		146	10	8	138	1077
170990		114	45	35	130	4528
051190		115	128	83	115	9447
041290		129	130	3	122	320
Total						15513
Total annual production 1990 mg WW per 0.123 m2						24003
Total annual production 1990 g AFDW per m2						10.99
Observed mean annual biomass 1990 g AFDW per m2						3.24
P/$\bar{B}$ 1990						3.40

Appendix 5.1 (continued)
***Abra alba* production estimated by the Crisp method at stn. 6, Århus Bay 1990.**

continues

Date	Cohort	No in cohort per 0.123 m² N	Mean wet wt per indv. $\bar{w}$·mg	Wt. increment since previous sample Δw·mg	Mean no. per 0.123 m² during period t $\bar{N}$	Production increment mg per 0.123 m² Δ$\bar{N}$·$\bar{w}$
210191	1990	101	155	25	115	2875
260291		63	138	-17	82	-1408
250391		73	158	19	68	1313
030591		50	218	60	62	3710
290591		41	220	2	46	97
250691		38	266	46	40	1822
050891		46	263	-4	42	-152
130991		20	349	87	33	2859
231091		16	311	-38	18	-678
151191		6	188	-124	11	-1363
161291		13	292	104	10	990
Total						10064
210191	1991					
260291						
250391						
030591		2	1			
290591		2	0	-1	2	-2
250691		42	1	0	22	7
050891		171	1	0	107	17
130991		125	3	2	148	287
231091		76	10	7	101	722
151191		55	17	7	66	443
161291		51	21	5	53	242
Total						1716
Total annual production 1991 mg WW per 0.123 m2						11780
Total annual production 1991 g AFDW per m2						5.40
Observed mean annual biomass 1991 g AFDW per m2						3.83
P/$\bar{B}$ 1991						1.41

Appendix 5.1 (continued)
Abra alba **production estimated by the Crisp method at stn. 6, Århus Bay 1991.**

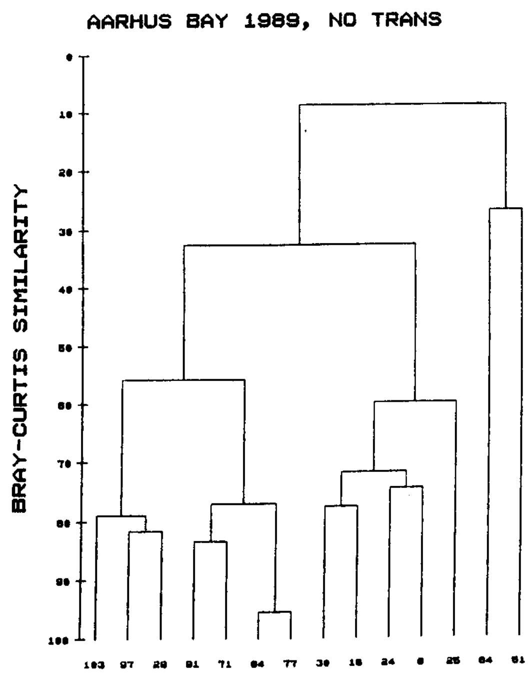
Date	Cohort	No in cohort per 0.123 m^2 N	Mean wet wt per indv. $\bar{w}$·mg	Wt. increment since previous sample Δw·mg	Mean no. per 0.123 m^2 during period t $\bar{N}$	Production increment mg per 0.123 m^2 $\Delta\bar{N}\cdot\bar{w}$
290190	1989	81	0.16			
060390		100	0.19	0.03	91	2.87
260390		88	0.18	-0.01	94	-1.32
060590		60	0.15	-0.03	74	-2.38
110690		38	0.23	0.08	49	3.88
190790		31	0.38	0.15	35	5.18
210890		8	0.37	-0.01	20	-0.15
170990		11	0.67	0.30	10	2.82
051190		11	0.48	-0.19	11	-2.07
041290		7	0.18	-0.30	9	-2.67
Total						6.17
Total annual production 1990 mg AFDW per 0.123 m2						6.17
Total annual production 1990 g AFDW per m2						0.05
Observed mean annual biomass 1990 g AFDW per m2						0.08
P/$\bar{B}$ 1990						0.63

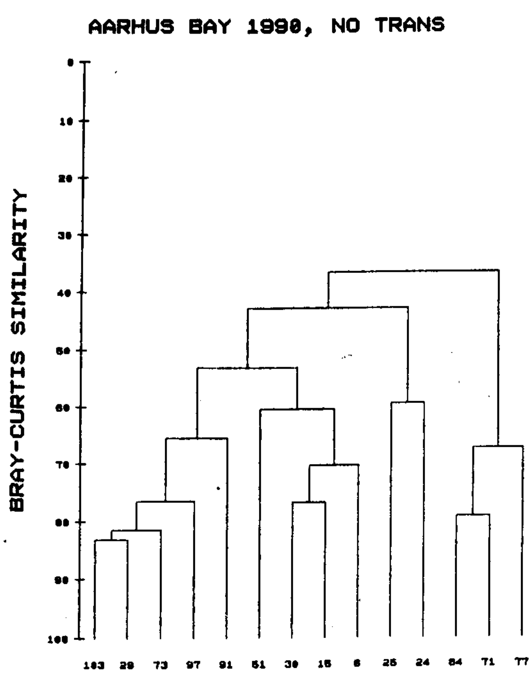
Appendix 5.2
***Corbula gibba* production estimated by the Crisp method at stn. 6, Århus Bay 1990.**

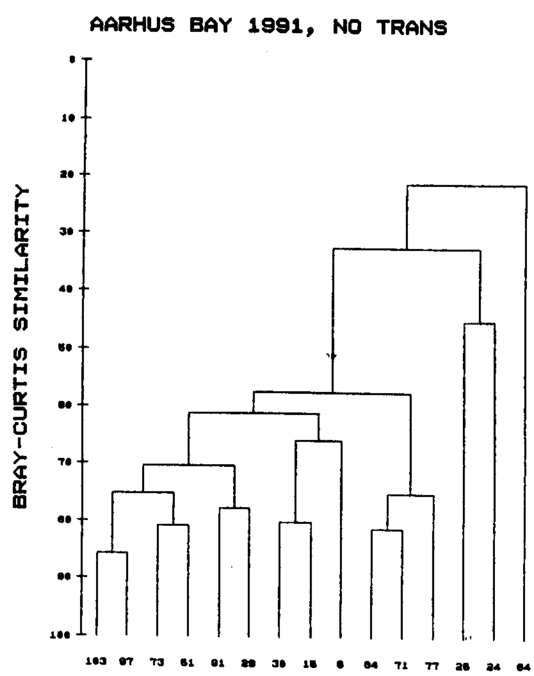
continues

Date	Cohort	No in cohort per 0.123 m² N	Mean wet wt per indv. $\bar{w}$·mg	Wt. increment since previous sample Δw·mg	Mean no. per 0.123 m² during period t $\bar{N}$	Production increment mg per 0.123 m² $\Delta\bar{N}\cdot\bar{w}$
210191	1989	9	0.38	0.20	8	1.59
260291		2	0.40	0.02	6	0.13
250391		6	0.28	-0.13	4	-0.51
030591		6	0.25	-0.03	6	-0.18
290591		4	0.30	0.05	5	0.27
250691		6	0.55	0.25	5	1.24
050891		1	1.21	0.66	4	2.32
130991						
231091						
151191						
161291						
Total						4.86
Total annual production 1991 mg AFDW per 0.123 m2						4.86
Total annual production 1991 g AFDW per m2						0.04
Observed mean annual biomass 1991 g AFDW per m2						0.18
P/$\bar{B}$ 1991						0.22

Appendix 5.2 (continued)
Corbula gibba **production estimated by the Crisp method at stn. 6, Århus Bay 1991.**

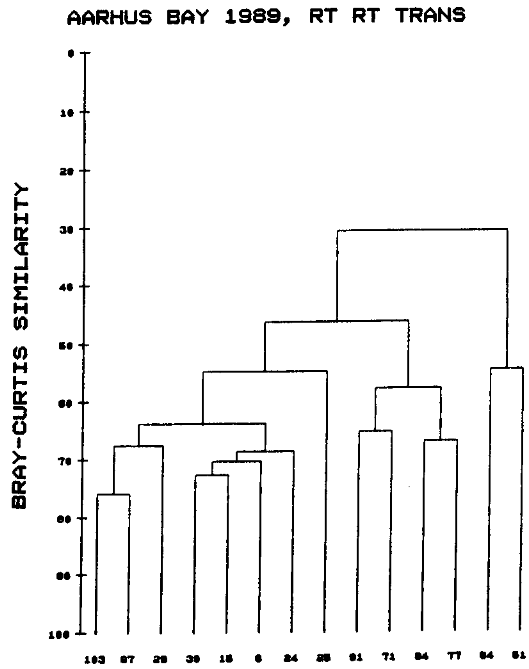


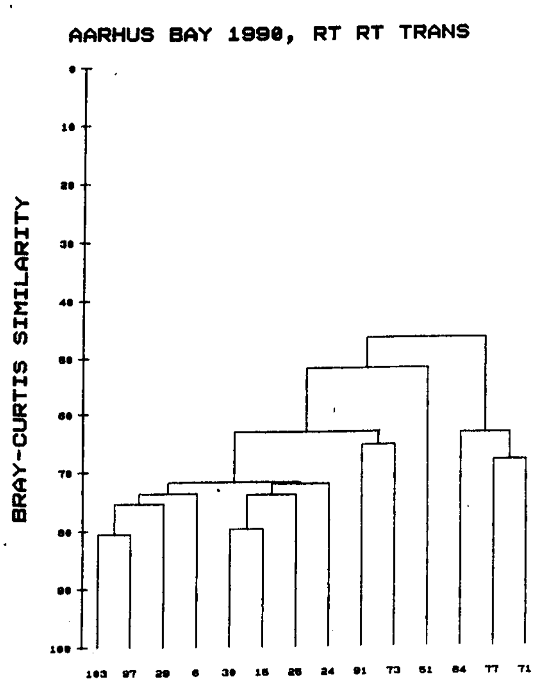


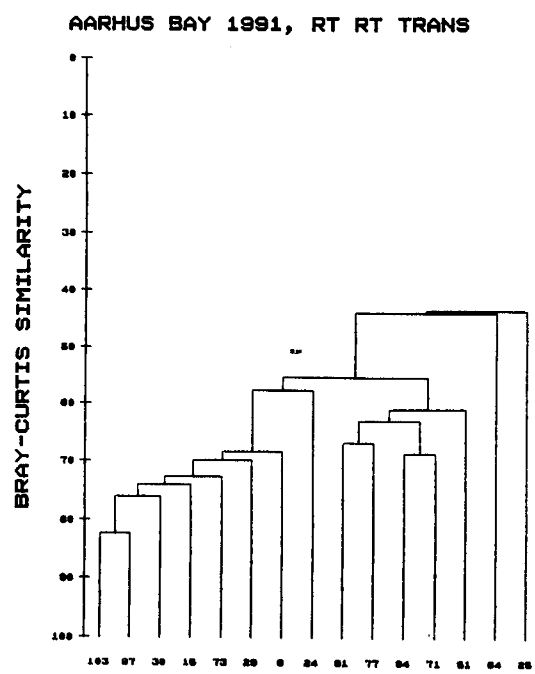


Appendix 6.1
Dendrograms showing group average clustering of Bray-Curtis similarities based on untransformed abundance data from Århus Bay 1989-1991.

continues

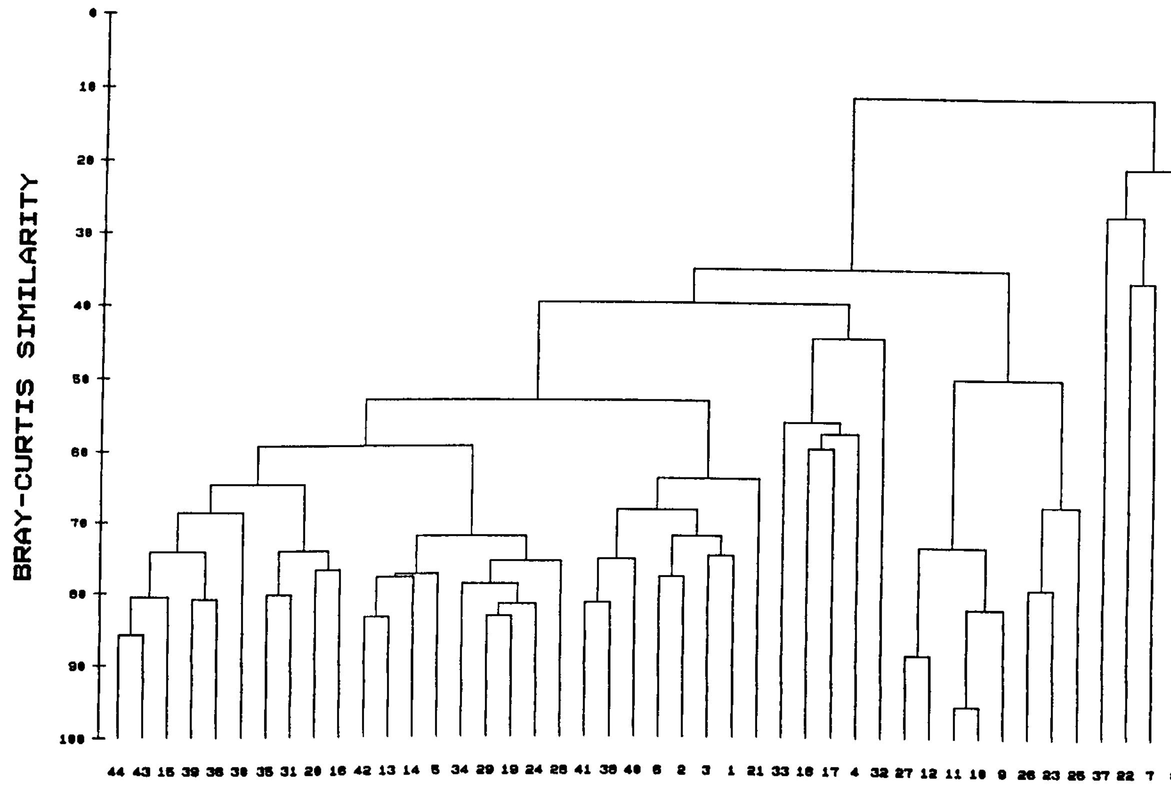




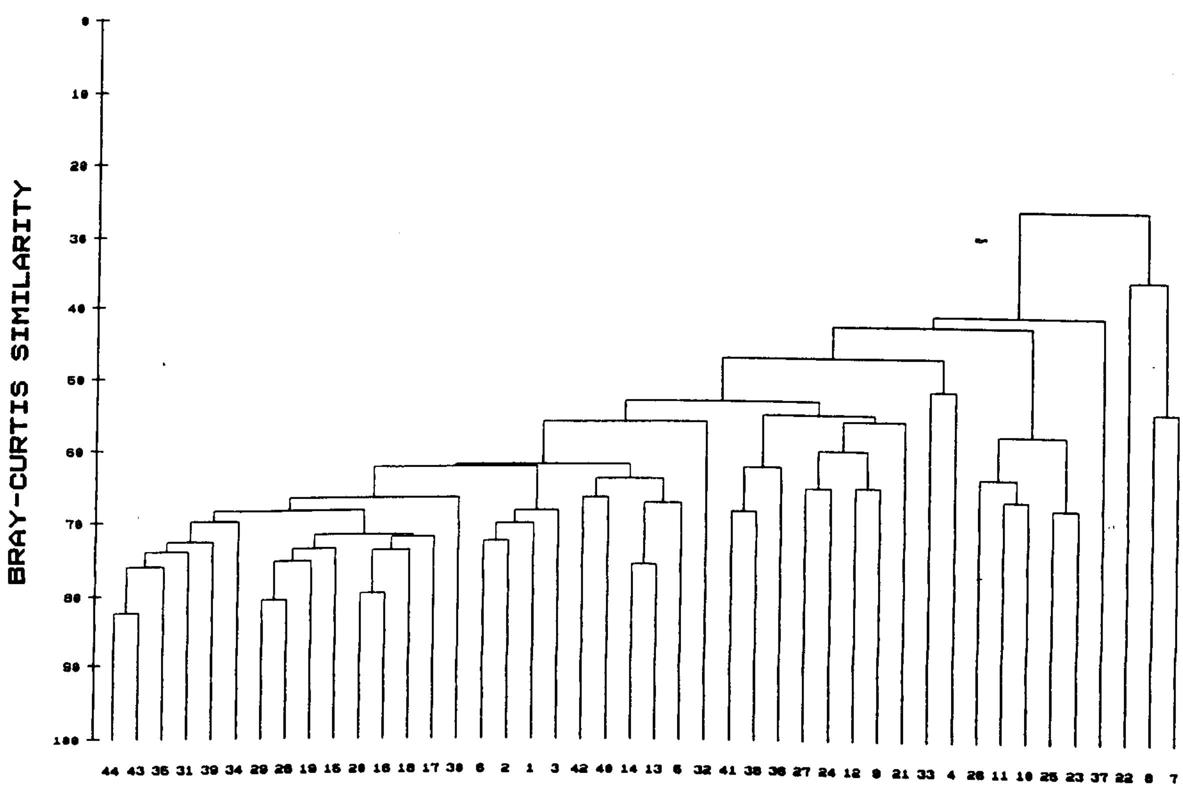


Appendix 6.1 (continued)
Dendrograms showing group average clustering of Bray-Curtis similarities based on root root transformed abundance data from Århus Bay 1989-1991.

AARHUS BAY 1989, 1990, 1991, NO TRANS

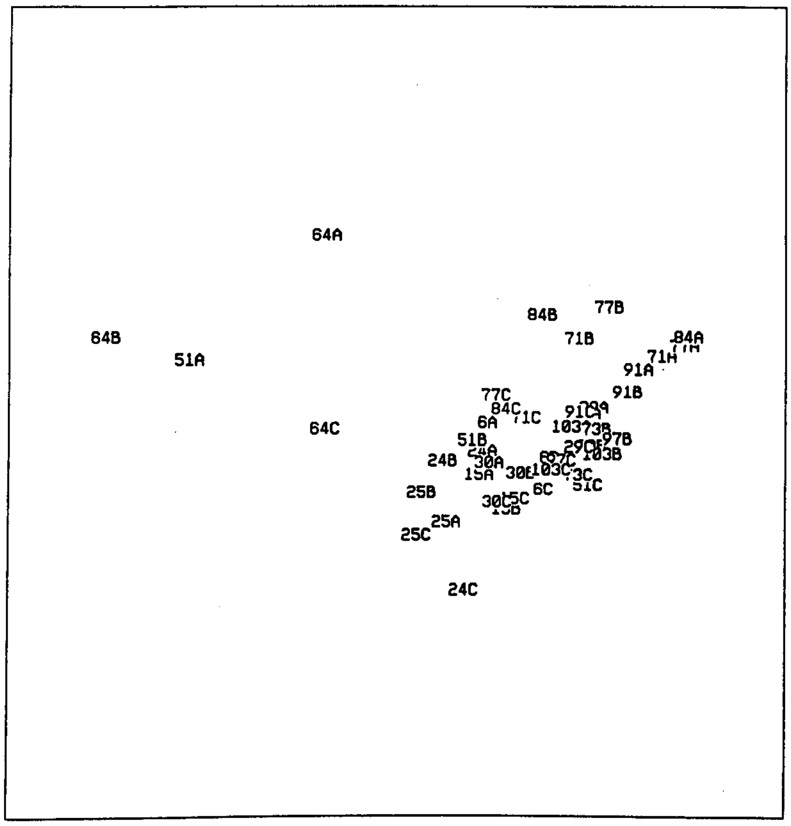


AARHUS BAY 1989, 1990, 1991, RT RT TRANS

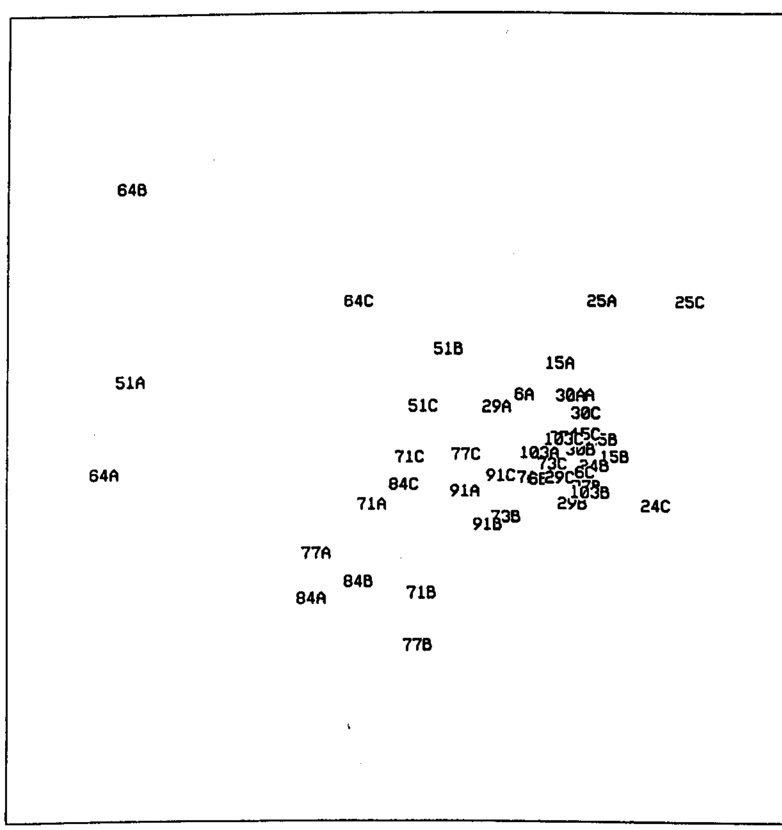


Appendix 6.2
Dendrograms showing group average clustering of Bray-Curtis similarities based on untransformed and root root transformed abundance data from Århus Bay for the 3 years 1989, 1990 and 1991 together.

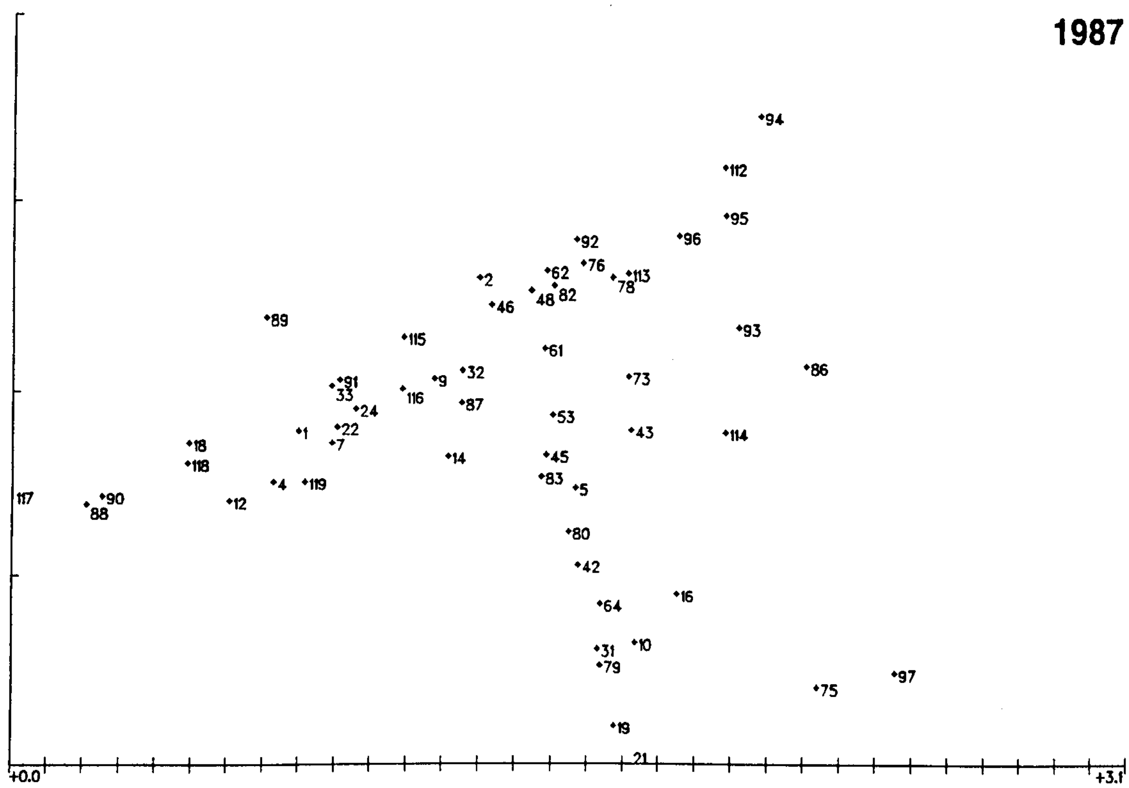
AARHUS BAY 1989,90,91, NO TRANS

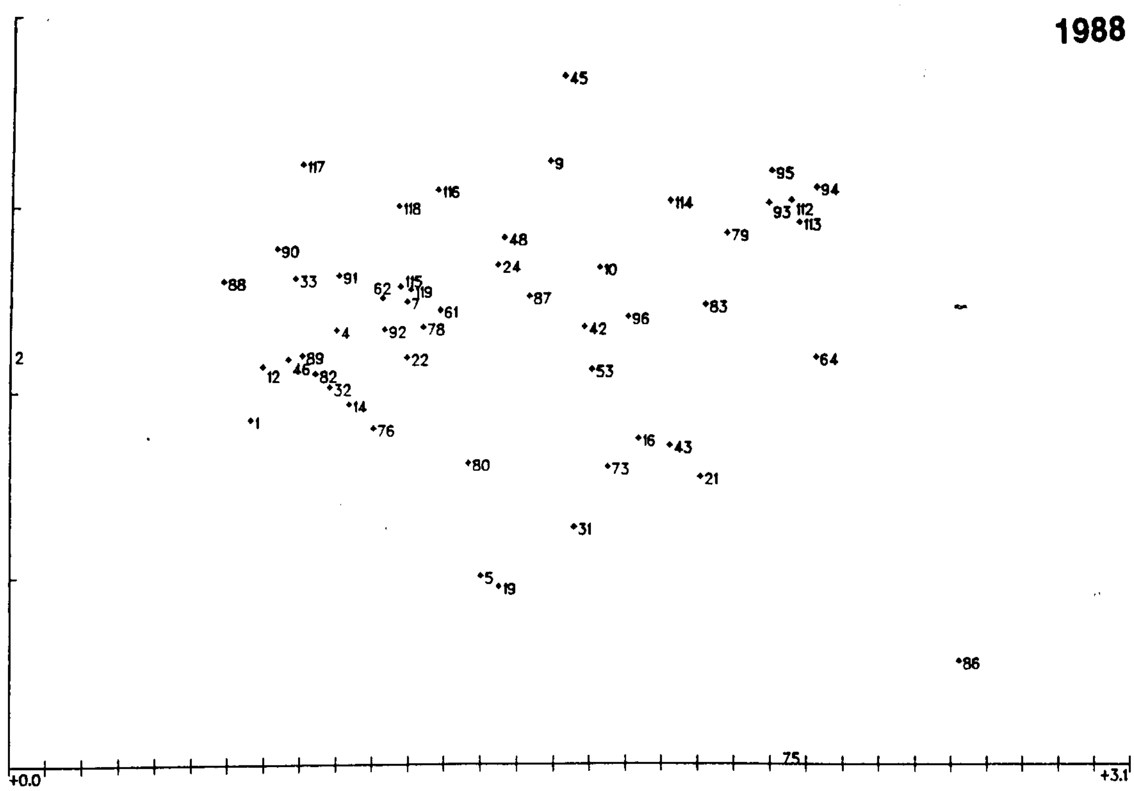


AARHUS BAY 1989,90,91, RT RT TRANS



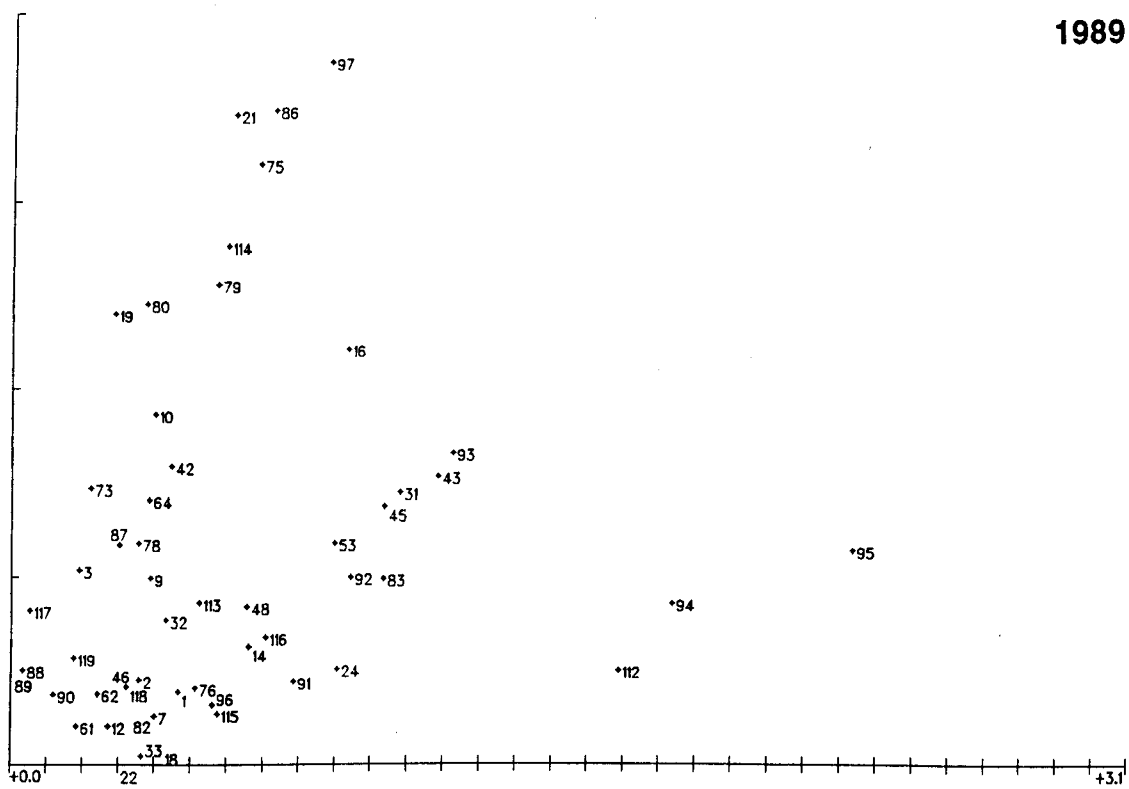
Appendix 6.3
Non-metric MDS ordination of untransformed and root root transformed abundance data of the 3 years together. A = 1989, B = 1990 and C = 1991.

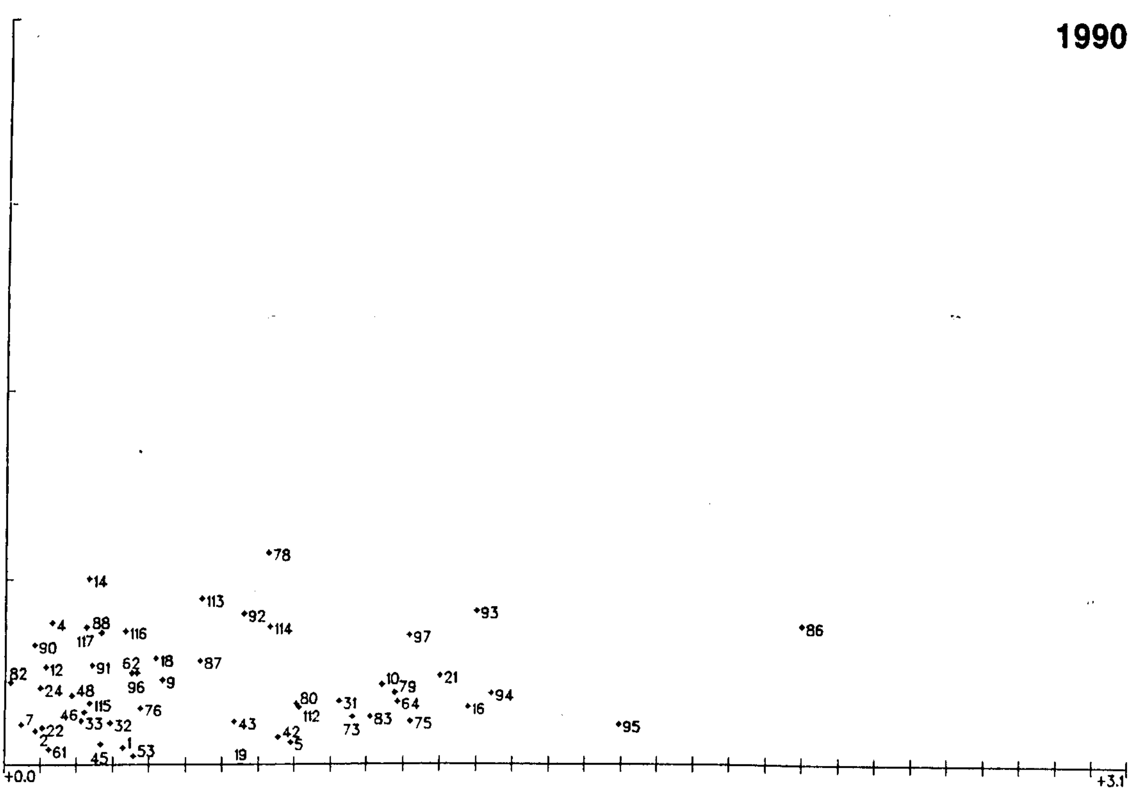




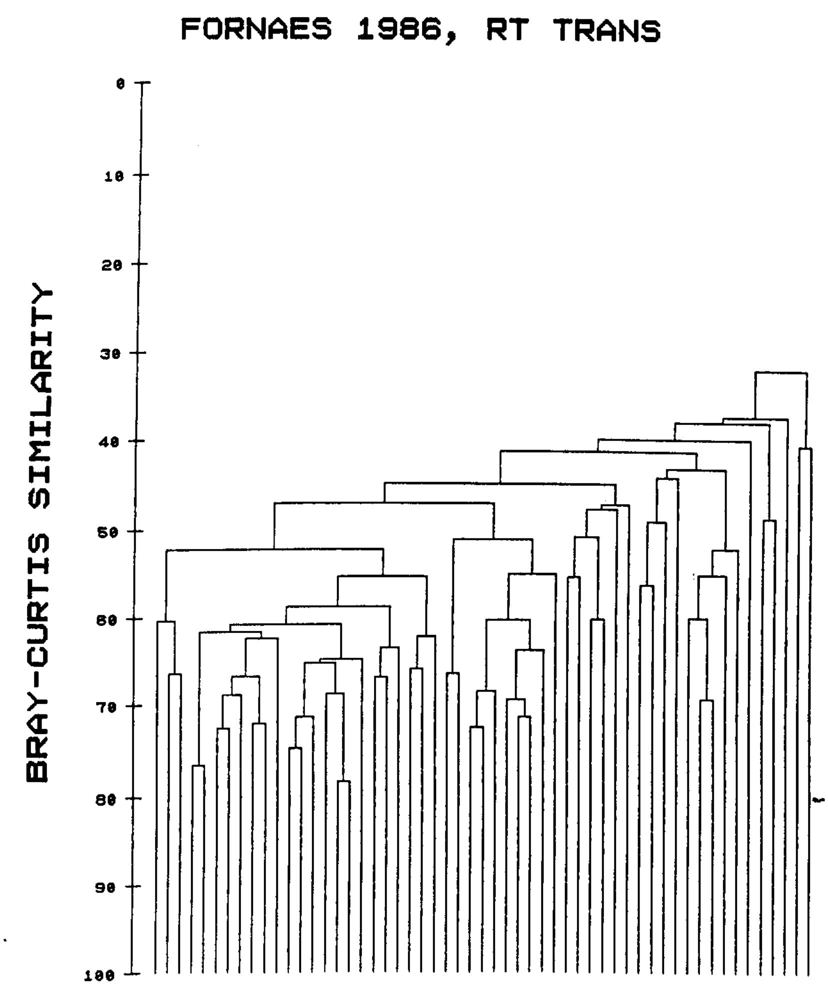
Appendix 6.4
DCA ordination diagrams based on untransformed abundance data from Fornæs 1987-1988.

continues



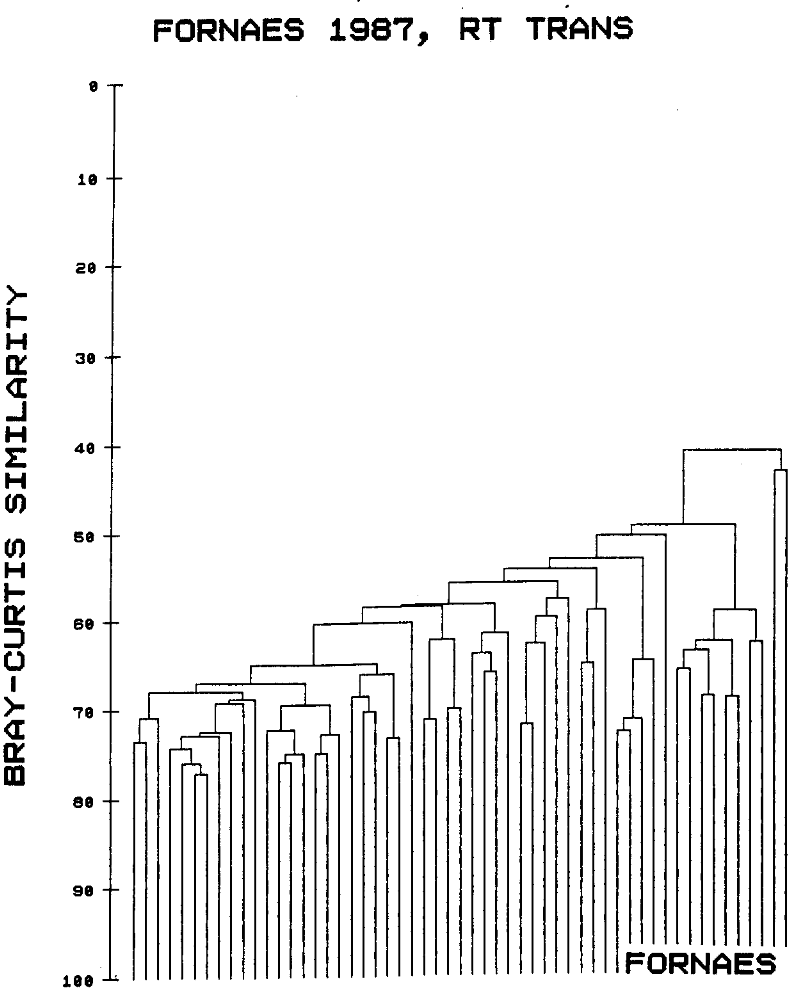


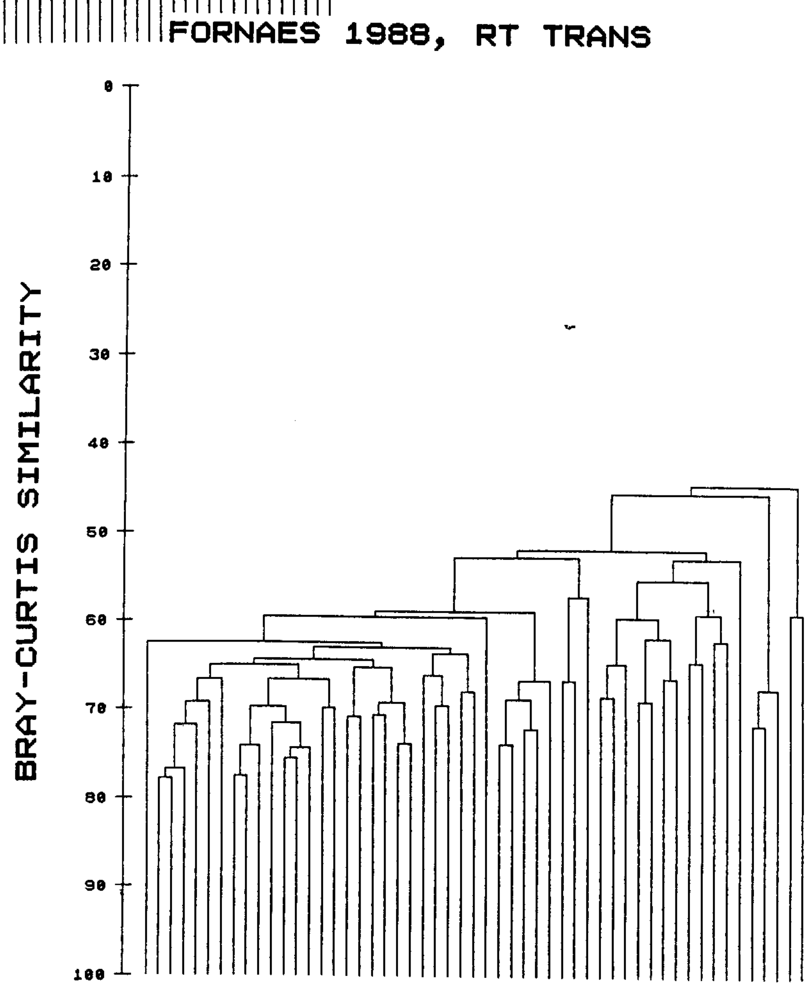
Appendix 6.4 (continued)
DCA ordination diagrams based on untransformed abundance data from Fornæs 1989-1990.



Appendix 6.5
Dendrograms showing group average clustering of Bray-Curtis similarities based on root transformed abundance data from Fornæs 1986.

continues

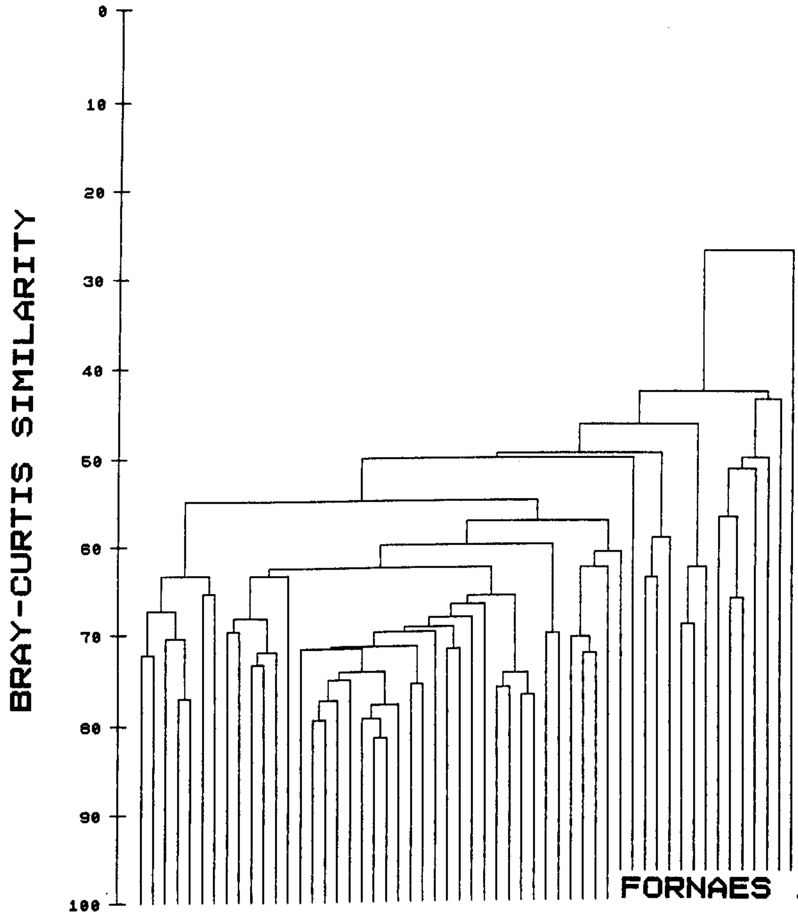




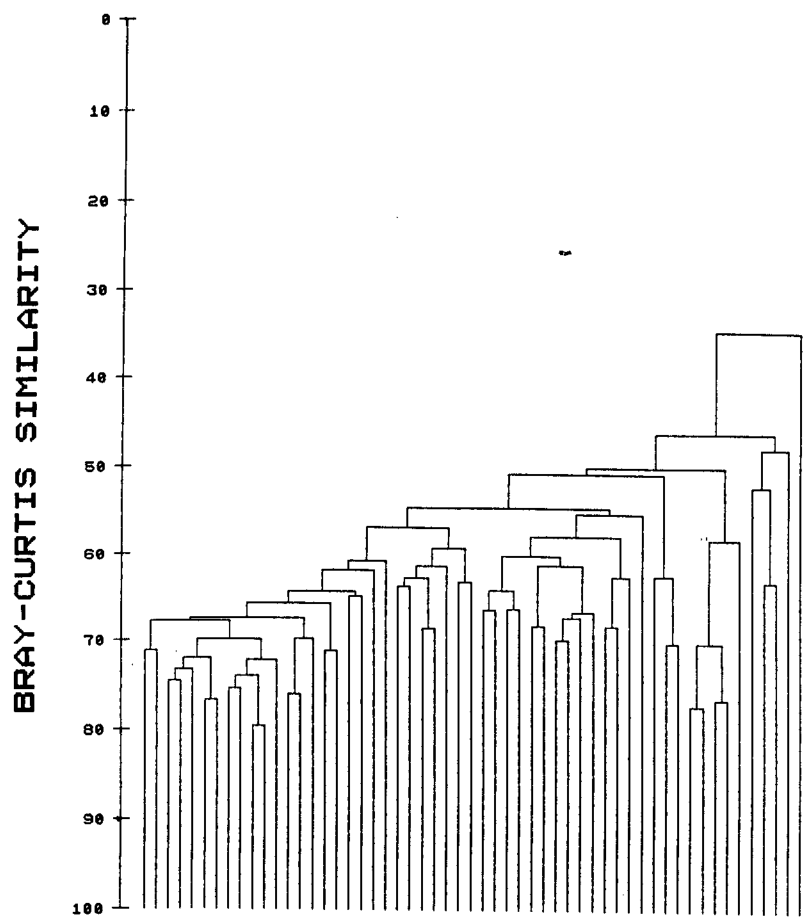
Appendix 6.5 (continued)
Dendrograms showing group average clustering of Bray-Curtis similarities based on root transformed abundance data from Fornæs 1987-1988.

continues

FORNAES 1989, RT TRANS

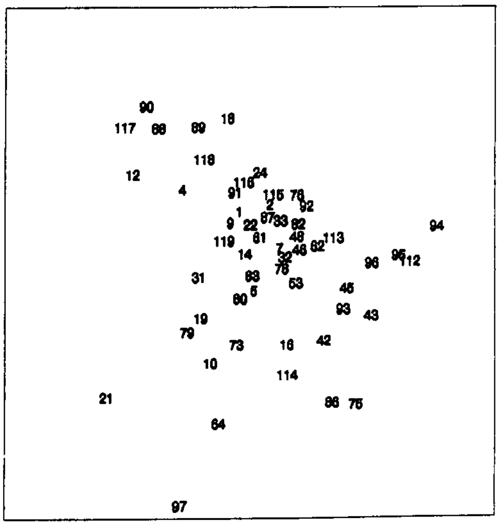


FORNAES 1990, RT TRANS

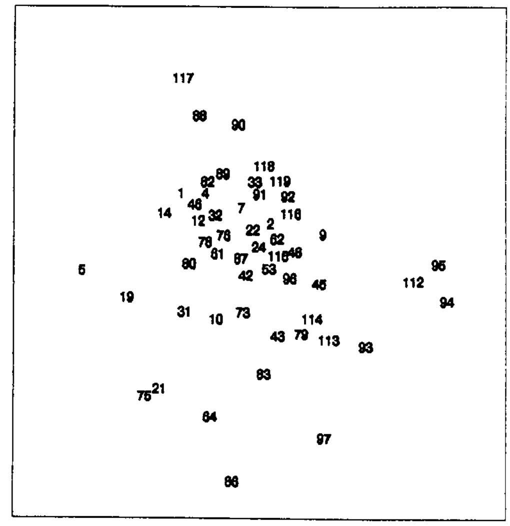


Appendix 6.5 (continued)
Dendrograms showing group average clustering of Bray-Curtis similarities based on root transformed abundance data from Fornæs 1989-1990.

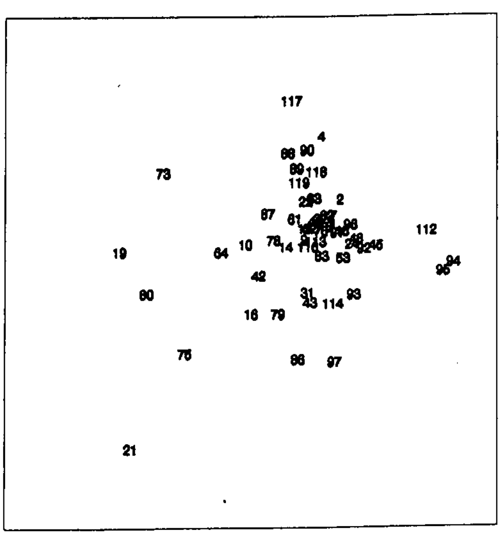
FORNAES 1987, RT TRANS



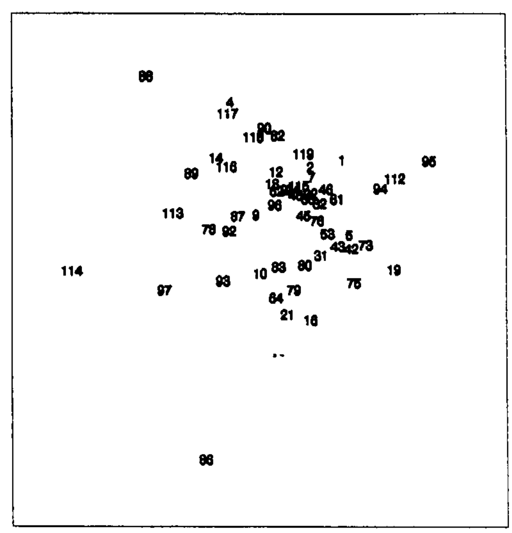
FORNAES 1988 WITHOUT STN. 16, RT TRANS



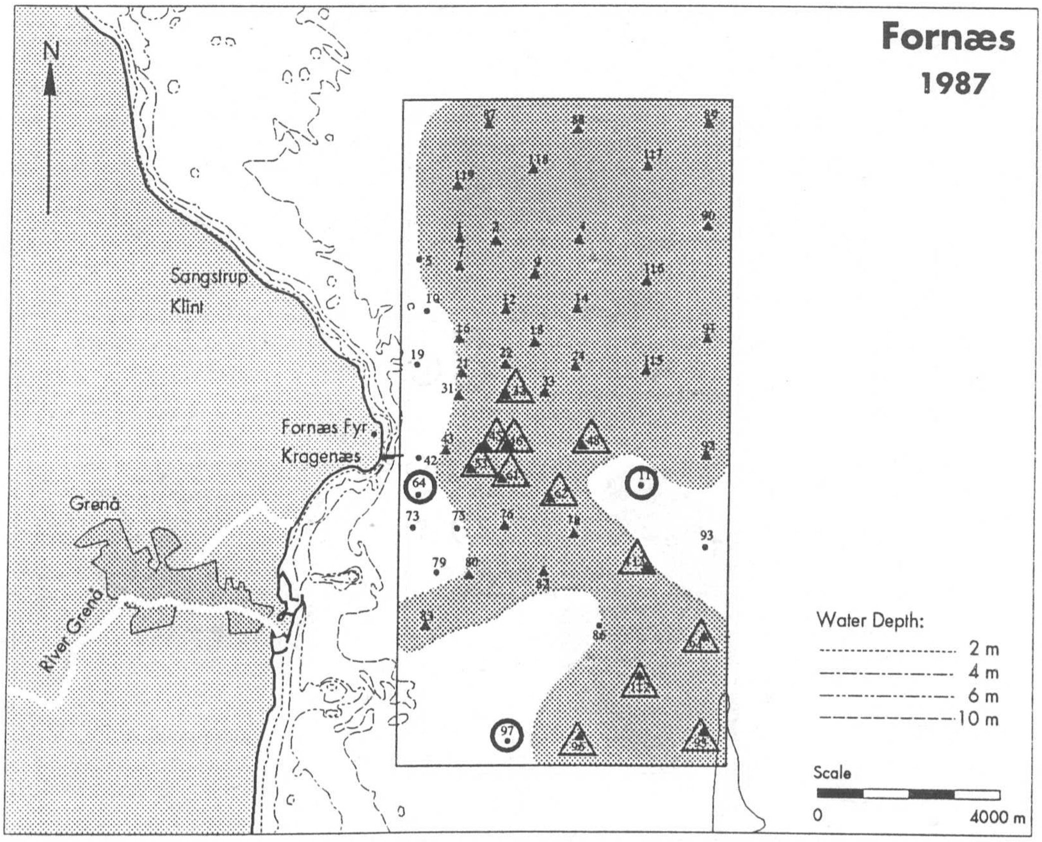
FORNAES 1989, RT TRANS

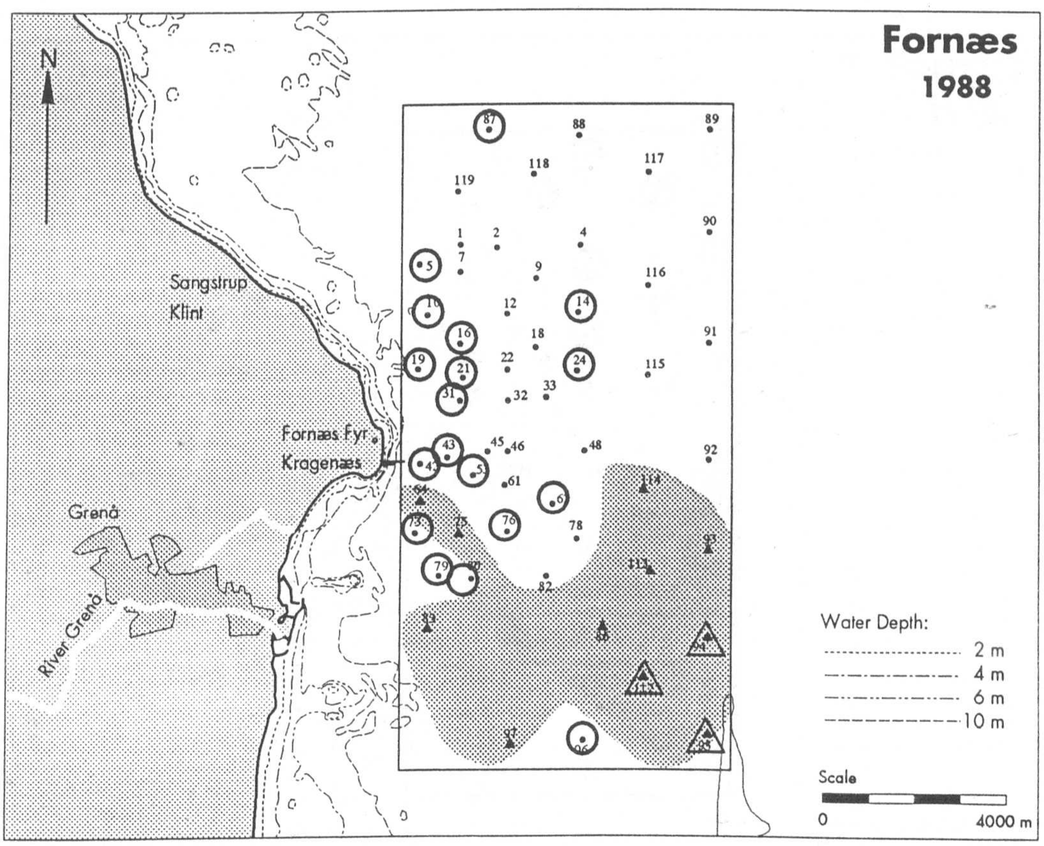


FORNAES 1990, RT TRANS



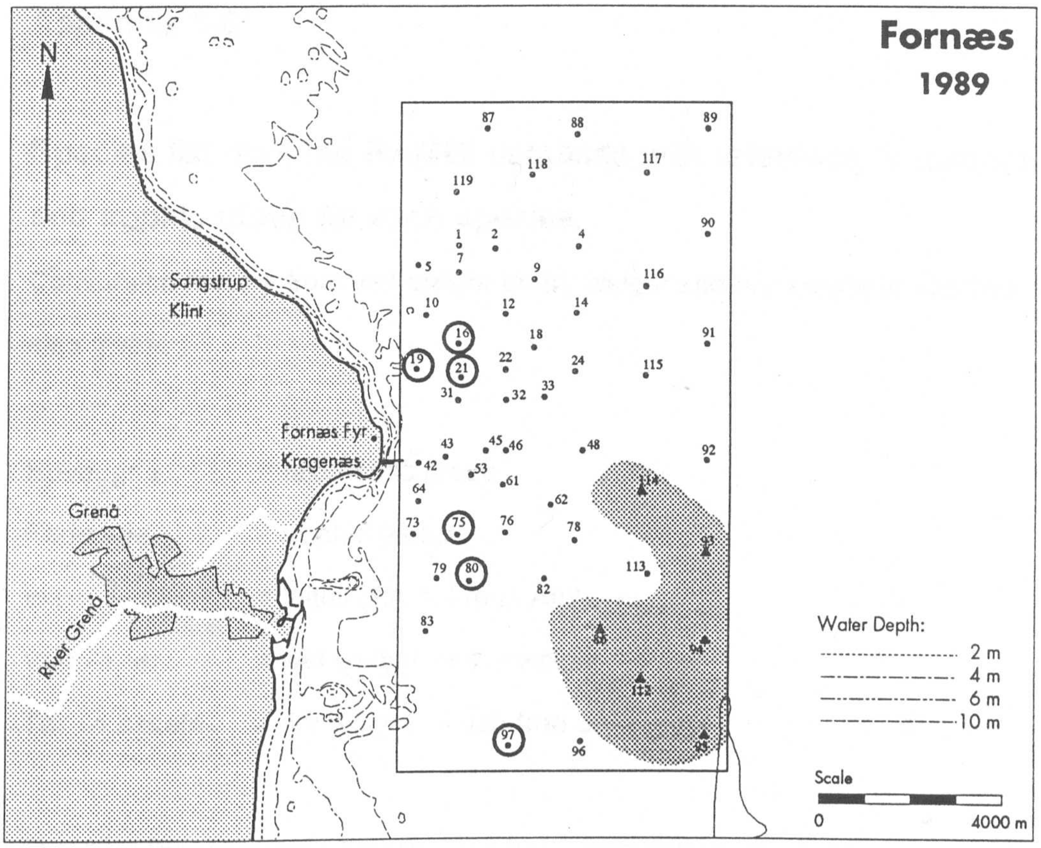
Appendix 6.6
Non-metric MDS ordination of root transformed abundance data from Fornæs 1987-1990.

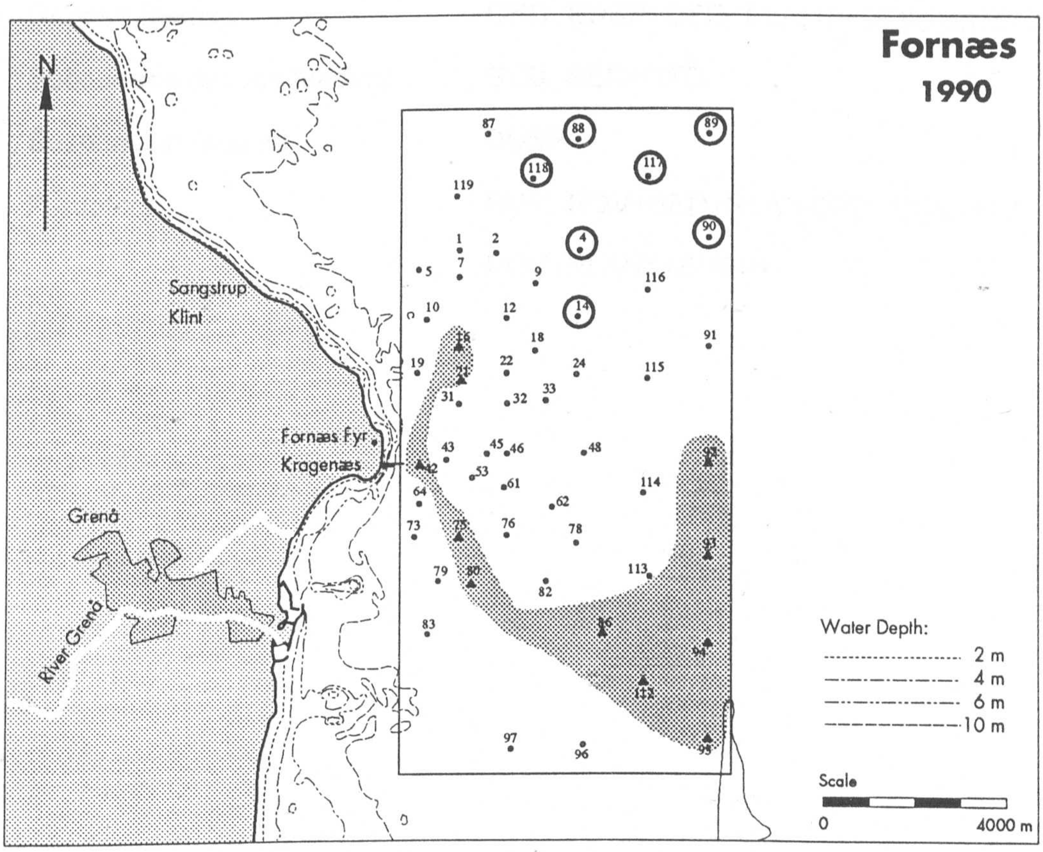




Appendix 6.7
Map illustration 1st and 2nd level of TWINSPAN classification of Fornæs data 1987-1988. The clusters that contain stn. 94, 95 and 112 after the 1st division are grey. Within the white area stations were split by the 2nd division into groups of stations marked with circles and dots, while stations in the grey area were split by the 2nd division into groups of stations marked with big and small triangels.

continues





Appendix 6.7 (continued)
Map illustration 1st and 2nd level of TWINSPAN classification of Fornæs data 1989-1990. The clusters that contain stn. 94, 95 and 112 after the 1st division are grey. Within the white area stations were split by the 2nd division into groups of stations marked with circles and dots, while stations in the grey area were split by the 2nd division into groups of stations marked with big and small triangels.

Appendix 3.6

Species list from the RAMBI database with reference to taxonomic group and trophic group for each species.

Conversion factors from wet weight to dry weight and dry weight to ash free dry weight are also given.

Hovedgr.	= taxonomic group
Fødetype	= trophic group
Init	= Initial (AA = Århus Amt)
Våd → tør	= wet weight → dry weight
Tør → askefri	= dry weight → ash free dry weight

The 13 different trophic groups have been aggregated into 4 groups:

Deposit feeders:	OFD, SUSP+OFD, PLANT+OFD, UKENDT
Subsurface deposit feeders:	SED, SED+OFD
Suspension feeders:	SUSP
Predators:	ROV, ROV+SED, ROV+OFD, ROV+PLANT, PLANT, ROV+PLANT+SUSP

RAMBI : Artsliste

Kode	Artsnavn		Hovedgr.		Fødetype	Init	Omregning Våd -> Tør	Omregning Tør -> Askefri
10	PORIFERA	1	PORIFERA	1	SUSP	AA	0,1760	0,7520
20	COELENTERATA	2	COELENTE	1	SUSP	AA	0,1760	0,7520
30	HYDROZOA	2	COELENTE	1	SUSP	AA	0,1760	0,7520
40	CORYMORPHA NUTANS	2	COELENTE	1	SUSP	AA	0,1760	0,7520
50	SCYPHOZOA	2	COELENTE	1	SUSP	AA	0,1760	0,7520
60	ANTHOZOA	2	COELENTE	8	ROV	AA	0,1760	0,7520
70	ALCYONIUM DIGITATUM	2	COELENTE	1	SUSP	AA	0,1760	0,7520
80	PENNATULACEA	2	COELENTE	1	SUSP	AA	0,1760	0,7520
90	PENNATULA PHOSPHOREA	2	COELENTE	1	SUSP	AA	0,1760	0,7520
100	VIRGULARIUM SP.	2	COELENTE	1	SUSP	AA	0,1760	0,7520
110	VIRGULARIA MIRABILIS	2	COELENTE	1	SUSP	AA	0,1760	0,7520
115	CERIANTHUS SP.	2	COELENTE	8	ROV	AA	0,0000	0,0000
120	CERIANTHUS LLOYDII	2	COELENTE	8	ROV	AA	0,1760	0,7520
130	TEALIA FELINA	2	COELENTE	8	ROV	AA	0,1760	0,7520
140	METRIDIUM SENILE	2	COELENTE	8	ROV	AA	0,1760	0,7520
150	SAGARTIOGETON SP.	2	COELENTE	8	ROV	AA	0,1760	0,7520
160	EDWARDSIA TUBERCULATA	2	COELENTE	8	ROV	AA	0,1760	0,7520
170	EDWARDSIA SP.	2	COELENTE	8	ROV	AA	0,1760	0,7520
180	PERIGONIMUS REPENS	2	COELENTE	8	ROV	AA	0,1760	0,7520
190	LEUCKARTIARA OCTONA	2	COELENTE	8	ROV	AA	0,1760	0,7520
200	HALCAMPA DUODECIMCIRRATA	2	COELENTE	8	ROV	AA	0,1760	0,7520
210	PLATYHELMINTHES	3	PLATYHEL	8	ROV	AA	0,2360	0,7800
220	TURBELLARIA	3	PLATYHEL	8	ROV	AA	0,2360	0,7800
230	NEMERTINEA	4	NEMERTIN	8	ROV	AA	0,2550	0,8620
240	MALACOBDELLA GROSSA	4	NEMERTIN	8	ROV	AA	0,2550	0,8620
250	NEMATODA	5	NEMATODA	8	ROV	AA	0,2300	0,8000
255	GASTROPODA	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
260	PROSOBRANCHIA	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
270	ACMAEA TESSULATA	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
280	ACMAEA VIRGINEA	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
290	ACMAEA SP.	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
295	DIODORA APERTURA	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
300	MARGARITES HELICINUS	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
305	CALLIOSTOMA OCCIDENTALE	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
310	GIBBULA CINERARIA	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
320	GIBBULA TUMIDA	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
330	GIBBULA SP.	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
340	THEODOXUS FLUVIATILIS	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
345	VALVATA SP.	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
346	VALVATA CRISTATA	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
349	RISSOA SARSI	6	PROSOBRA	7	PLANT	AA	0,0000	0,0000
350	RISSOA INCONSPICUA	6	PROSOBRA	7	PLANT	AA	0,3620	0,2350
360	RISSOA MEMBRANACEA	6	PROSOBRA	7	PLANT	AA	0,3620	0,2350
370	RISSOA ALBELLA	6	PROSOBRA	7	PLANT	AA	0,3620	0,2350
380	RISSOA SP.	6	PROSOBRA	7	PLANT	AA	0,3620	0,2350
383	ONOBA STRIATA	6	PROSOBRA	7	PLANT	AA	0,3620	0,2350
385	ACLIS MINOR	6	PROSOBRA	7	PLANT	AA	0,3620	0,2350
390	CINGULA SEMISTRIATA	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
400	HYDROBIA ULVAE	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
410	HYDROBIA VENTROSA	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
420	HYDROBIA NEGLECTA	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
430	HYDROBIA SP.	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
431	BITHYNIA SP.	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
432	BITHYNIA LEACHII	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
433	BITHYNIA TENTACULATA	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
435	COLUS SARSI	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
440	POTAMOPYRGUS JENKINSI	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
450	SKENEOPSIS PLANORBIS	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
460	BOREOTROPHON TRUNCATUS	6	PROSOBRA	8	ROV	AA	0,3620	0,2350
470	LACUNA PALLIDULA	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
480	LACUNA PARVA	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
490	LACUNA SP.	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
500	LITTORINA OBTUSATA	6	PROSOBRA	7	PLANT	AA	0,3620	0,2350
510	LITTORINA SAXATILIS	6	PROSOBRA	7	PLANT	AA	0,3620	0,2350
520	LITTORINA LITTOREA	6	PROSOBRA	7	PLANT	AA	0,3620	0,2350
530	LITTORINA SP.	6	PROSOBRA	7	PLANT	AA	0,3620	0,2350

RAMBI : Artsliste

Kode	Artsnavn		Hovedgr.		Fødetype	Init	Omregning Våd -▸ Tør	Omregning Tør -▸ Askefri
535	AMAUROPSIS ISLANDICUS	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
540	TURRITELLA COMMUNIS	6	PROSOBRA	1	SUSP	AA	0,3620	0,2350
545	CYTHARA ATTENUATA	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
547	CYTHARA COSTATA	6	PROSOBRA	99	UKENDT	AA	0,0000	0,0000
550	BITTIUM RETICULATUM	6	PROSOBRA	1	SUSP	AA	0,3620	0,2350
560	LUNATIA CATENA	6	PROSOBRA	8	ROV	AA	0,3620	0,2350
570	LUNATIA ALDERI	6	PROSOBRA	8	ROV	AA	0,3620	0,2350
580	LUNATIA PALLIDA	6	PROSOBRA	8	ROV	AA	0,3620	0,2350
590	LUNATIA SP.	6	PROSOBRA	8	ROV	AA	0,3620	0,2350
600	VELUTINA VELUTINA	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
610	CREPIDULA FORNICATA	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
620	APORRHAIS PESPELICANI	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
625	VITREOLINA PHILIPPII	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
626	POLYGIREULIMA SINUOSA	6	PROSOBRA	2	OFD	AA	0,3620	0,2350
630	BUCCINUM UNDATUM	6	PROSOBRA	8	ROV	AA	0,3620	0,2350
640	NEPTUNEA ANTIQUA	6	PROSOBRA	8	ROV	AA	0,3620	0,2350
650	HINIA RETICULATA	6	PROSOBRA	8	ROV	AA	0,3620	0,2350
660	HINIA INCRASSATA	6	PROSOBRA	8	ROV	AA	0,3620	0,2350
670	HINIA PYGMAEA	6	PROSOBRA	8	ROV	AA	0,3620	0,2350
680	HINIA SP.	6	PROSOBRA	8	ROV	AA	0,3620	0,2350
690	OENOPOTA TURRICOLA	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
700	OENOPOTA ELEGANS	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
705	MELANELLA ALBA	6	PROSOBRA	99	UKENDT	AA	0,3620	0,2350
710	OPISTHOBRANCHIA	7	OPISTHOB	99	UKENDT	AA	0,3620	0,2350
720	ACTEON TORNATILIS	7	OPISTHOB	8	ROV	AA	0,3620	0,2350
721	DIAPHANA MINUTA	7	OPISTHOB	99	UKENDT	AA	0,3620	0,2350
730	RETUSA OBTUSATA	7	OPISTHOB	8	ROV	AA	0,3620	0,2350
740	RETUSA TRUNCATULA	7	OPISTHOB	8	ROV	AA	0,3620	0,2350
745	RETUSA UMBILICATA	7	OPISTHOB	99	UKENDT	AA	0,3620	0,2350
750	RETUSA SP.	7	OPISTHOB	8	ROV	AA	0,3620	0,2350
760	CYLICHNA CYLINDRACEA	7	OPISTHOB	8	ROV	AA	0,3620	0,2350
770	AKERA BULLATA	7	OPISTHOB	7	PLANT	AA	0,3620	0,2350
780	PHILINE APERTA	7	OPISTHOB	8	ROV	AA	0,3620	0,2350
790	PHILINE SCABRA	7	OPISTHOB	8	ROV	AA	0,3620	0,2350
800	PHILINE SP.	7	OPISTHOB	8	ROV	AA	0,3620	0,2350
805	PLEUROBRANCHIDAE SP.	7	OPISTHOB	99	UKENDT	AA	0,3620	0,2350
806	BERTHELLA PLUMULA	7	OPISTHOB	99	UKENDT	AA	0,3620	0,2350
810	NUDIBRANCHIA	7	OPISTHOB	2	OFD	AA	0,3620	0,2350
820	ONCHIDORIS MURICATA	7	OPISTHOB	2	OFD	AA	0,3620	0,2350
825	CORYPHELLA SP	7	OPISTHOB	8	ROV	AA	0,3620	0,2350
830	POLYPLACOPHORA	8	POLYPLAC	7	PLANT	AA	0,3620	0,2350
840	LEPIDOPLEURUS ASELLUS	8	POLYPLAC	7	PLANT	AA	0,3620	0,2350
850	LEPIDOCHITON CINEREUS	8	POLYPLAC	7	PLANT	AA	0,3620	0,2350
860	LEPIDOCHITON SP.	8	POLYPLAC	7	PLANT	AA	0,3620	0,2350
870	TONICELLA RUBRA	8	POLYPLAC	7	PLANT	AA	0,3620	0,2350
880	TONICELLA SP.	8	POLYPLAC	7	PLANT	AA	0,3620	0,2350
890	ISCHNOCHITON ALBUS	8	POLYPLAC	7	PLANT	AA	0,3620	0,2350
895	ISCHNOCHITON	8	POLYPLAC	7	PLANT	AA	0,3620	0,2350
900	APLACOPHORA	9	APLACOPH	5	SED	AA	0,3620	0,2350
910	CHAETODERMA NITIDULUM	9	APLACOPH	5	SED	AA	0,3620	0,2350
920	BIVALVIA	10	BIVALVIA	99	UKENDT	AA	0,4420	0,1560
925	PISIDIUM SP.	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
930	NUCULA TENUIS	10	BIVALVIA	2	OFD	AA	0,4420	0,1560
940	NUCULA NUCLEUS	10	BIVALVIA	2	OFD	AA	0,4420	0,1560
950	NUCULA NITIDOSA	10	BIVALVIA	2	OFD	AA	0,4420	0,1560
960	NUCULA SP.	10	BIVALVIA	2	OFD	AA	0,4420	0,1560
970	NUCULANA PERNULA	10	BIVALVIA	2	OFD	AA	0,4420	0,1560
980	NUCULANA MINUTA	10	BIVALVIA	2	OFD	AA	0,4420	0,1560
990	CRENELLA DECUSSATA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1000	LIMEA LOSCOMBII	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1010	MODIOLUS MODIOLUS	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1020	MUSCULUS TUMIDA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1030	MUSCULUS DISCOR	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1040	MUSCULUS NIGER	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1050	MUSCULUS SP.	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1060	MYTILIS EDULIS	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560

RAMBI : Artsliste

Kode	Artsnavn		Hovedgr.		Fødetype	Init	Omregning Våd -> Tør	Omregning Tør -> Askefri
1065	MYTILIDAE	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1067	MYTILACEA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1070	OSTREA EDULIS	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1080	PECTEN SEPTEMRADIATUS	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1090	ASTARTE BOREALIS	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1100	ASTARTE MONTAGUI	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1110	ASTARTE ELLIPTICA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1120	ASTARTE SP.	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1125	ASTARTE SULCATA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1130	THYASIRA SARSI	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1140	THYASIRA FLEXUOSA	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1150	THYASIRA SP.	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1160	TELLIMYA FERRUGINOSA	10	BIVALVIA	2	OFD	AA	0,4420	0,1560
1170	MYSELLA BIDENTATA	10	BIVALVIA	2	OFD	AA	0,4790	0,1510
1180	ARCTICA ISLANDICA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1185	ACANTHOCARDIA ECHINATA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1190	CERASTODERMA EDULE	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1200	CERASTODERMA GLAUCUM	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1210	CERASTODERMA SP.	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1220	PARVICARDIUM SCABRUM	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1230	PARVICARDIUM OVALE	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1240	PARVICARDIUM MINIMUM	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1250	PARVICARDIUM SP.	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1255	VENUS FASCIATA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1257	LAEVICARDIUM CRASSUM	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1260	CHAMELEA STRIATULA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1262	TIMOCLEA OVATA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1265	DOSINIA LUPINUS	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1270	VENERUPIS PULLASTRA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1280	PETRICOLA PHOLADIFORMIS	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1285	MYSIA UNDATA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1290	MACTRA CORALLINA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1300	SPISULA SOLIDA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1310	SPISULA SUBTRUNCATA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1320	SPISULA ELLIPTICA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1330	SPISULA SP.	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1340	GARI FERVENSIS	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1350	SCROBICULARIA PLANA	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1360	ABRA PRISMATICA	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1370	ABRA NITIDA	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1380	ABRA ALBA	10	BIVALVIA	3	SUSP OFD	AA	0,3130	0,1800
1390	MACOMA BALTHICA	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1400	MACOMA CALCAREA	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1410	MACOMA SP.	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1420	ANGULUS TENUIS	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1430	FABULINA FABULA	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1435	TELLINA TENUIS	10	BIVALVIA	99	UKENDT	AA	0,4420	0,1560
1440	TELLINA PYGMAEA	10	BIVALVIA	3	SUSP OFD	AA	0,4420	0,1560
1445	TELLINIDAE	10	BIVALVIA	99	UKENDT	AA	0,4420	0,1560
1450	PHAXAS PELLUCIDUS	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1460	ENSIS ENSIS	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1465	ENSIS SILIQUA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1467	ENSIS SP	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1470	HIATELLA ARCTICA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1480	HIATELLA SP.	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1490	MYA ARENARIA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1500	MYA TRUNCATA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1510	MYA SP.	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1520	CORBULA GIBBA	10	BIVALVIA	1	SUSP	AA	0,5670	0,1220
1530	BARNEA CANDIDA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1540	BARNEA SP.	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1550	ZIRPHAEA CRISPATA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1560	THRACIA PHASEOLINA	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1570	THRACIA SP.	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1580	COCHLODESMA PRAETENUE	10	BIVALVIA	1	SUSP	AA	0,4420	0,1560
1590	SCAPHOPODA	11	SCAPHOPO	12	ROV OFD	AA	0,4420	0,1560

Kode	Artsnavn		Hovedgr.		Fødetype	Init	Omregning Våd -► Tør	Omregning Tør -► Askefri
1600	DENTALIUM ENTALE	11	SCAPHOPO	12	ROV OFD	AA	0,4420	0,1560
1610	POLYCHAETA	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
1615	POLYNOIDAE	12	POLYCHAE	99	UKENDT	AA	0,0000	0,0000
1620	APHRODITA ACULEATA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1630	LEPIDONOTUS SQUAMATUS	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1635	STHENELAIS LIMICOLA	12	POLYCHAE	99	UKENDT	AA	0,0000	0,0000
1640	HARMOTHOE IMBRICATA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1650	HARMOTHOE IMPAR	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1660	HARMOTHOE LJUNGMANI	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1670	HARMOTHOE LONGISETIS	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1680	HARMOTHOE SP.	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1690	EUNOE NODOSA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1700	ANTINOELLA SARSI	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1705	GATTYANA AMONDSENI	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1710	GATTYANA CIRROSA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1715	PHOLOE ASSIMILIT	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1730	PHOLOE INORNATA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1735	PHOLOE SP	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1740	PHYLLODICIDAE	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
1750	ETEONE LONGA	12	POLYCHAE	9	ROV SED	AA	0,1760	0,7520
1760	ETEONE FLAVA	12	POLYCHAE	9	ROV SED	AA	0,1760	0,7520
1770	ETEONE LACTEA	12	POLYCHAE	9	ROV SED	AA	0,1760	0,7520
1780	ETEONE FOLIOSA	12	POLYCHAE	9	ROV SED	AA	0,1760	0,7520
1790	ETEONE SP.	12	POLYCHAE	9	ROV SED	AA	0,1760	0,7520
1800	MYSTA BARBATA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1810	PSEUDOMYSTIDES SOUTHERNI	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
1820	PHYLLODOCE ROSEA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1825	PHYLLODOCE MUCOSA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1826	PHYLLODOCE GROENLANDICA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1827	PHYLLODOCE LAMINOSA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1828	PHYLLODOCE LONGIPES	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1830	PHYLLODOCE SUBLIFERA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1850	PHYLLODOCE MACULATA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1870	PHYLLODOCE SP.	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1875	EUMIDA PUNCTIFERA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1880	EUMIDA FUSIGERA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1890	EUMIDA SANGUINEA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1900	EUMIDA BAHUSIENSIS	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1910	EUMIDA SP.	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1920	EULALIA VIRIDIS	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1930	EULALIA BILINEATA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1940	EULALIA SP.	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1950	HESIONIDAE	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
1960	SYLLIDIA ARMATA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1970	NEREIMYRA PUNCTATA	12	POLYCHAE	12	ROV OFD	AA	0,1760	0,7520
1980	OPHIODROMUS FLEXUOSUS	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1990	KEFERSTEINIA CIRRHATA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
1995	MICROPHTHALMUS SP.	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
2000	SYNELMIS KLATTI	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2010	SYLLIDAE	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2015	STREPTOSYLLIS WEBSTERI	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
2020	EXOGONE HEBES	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2025	EXOGONE NAIDINA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2030	EXOGONE SP.	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2040	AUTOLYTUS SP.	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
2050	NEREIDIDAE	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
2060	NEREIS PELAGICA	12	POLYCHAE	12	ROV OFD	AA	0,1760	0,7520
2065	NEREIS SP	12	POLYCHAE	12	ROV OFD	AA	0,1760	0,7520
2070	HEDISTE DIVERSICOLOR	12	POLYCHAE	11	ROVPLSUS	AA	0,1760	0,7520
2080	NEANTHES SUCCINEA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2090	NEANTHES VIRENS	12	POLYCHAE	10	ROV PLAN	AA	0,1760	0,7520
2095	NEANTHES SP	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
2100	PLATYNEREIS DUMERILII	12	POLYCHAE	12	ROV OFD	AA	0,1760	0,7520
2110	NEPHTYS CIRROSA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2120	NEPHTYS HOMBERGII	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2124	NEPHTYS KERSIVALENSIS	12	POLYCHAE	8	ROV	AA	0,1760	0,7520

Kode	Artsnavn		Hovedgr.		Fødetype	Init	Omregning Våd -▸ Tør	Omregning Tør -▸ Askefri
2126	NEPHTYS ASSIMILIS	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2130	NEPHTYS CILIATA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2140	NEPHTYS PENTE	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2150	NEPHTYS CAECA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2160	NEPHTYS LONGOSETOSA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2170	NEPHTYS INCISA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2180	NEPHTYS SP.	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2185	NEPHTYS JUVENIL	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2186	AGLAOPHANUS RUBELLA	12	POLYCHAE	8	ROV	AA	0,0000	0,0000
2190	SPHAERODORUM FLAVUM	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2200	SPHAERODORIDIUM MINUTUM	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2210	SPHAERODORIDIUM SP.	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2215	GLYCINDE NORDMANNI	12	POLYCHAE	8	ROV	AA	0,0000	0,0000
2220	GLYCERA CAPITATA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2230	GLYCERA ALBA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2240	GLYCERA ROUXII	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2250	GLYCERA SP.	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2260	GONIADA MACULATA	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2265	GONIADA SP	12	POLYCHAE	8	ROV	AA	0,0000	0,0000
2270	GONIADELLA BOBRETZKII	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2280	LUMBRINERIS FRAGILIS	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2290	PROTODORVILLEA KEFERSTEINI	12	POLYCHAE	8	ROV	AA	0,1760	0,7520
2300	SCOLOPLOS ARMIGER	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2310	ARICIA CUVIERI	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2320	ORBINIA SP.	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2330	PARAONIDAE	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
2340	ARICIDEA SUECICA	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
2350	ARICIDEA MINUTA	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
2360	PARAONIS FULGENS	12	POLYCHAE	6	SED OFD	AA	0,1760	0,7520
2370	LEVINSENIA GRACILIS	12	POLYCHAE	6	SED OFD	AA	0,1760	0,7520
2380	PARADONEIS LYRA	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
2390	TROCHOCHAETA MULTISETOSA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2395	TROCHOCHAETIDAE	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2400	SPIONIDAE	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
2410	SPIO FILICORNIS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2420	SPIO GONIOCEPHALA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2430	SPIO ARMATA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2440	SPIO SP.	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2450	POLYDORA LIMICOLA	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
2460	POLYDORA CAECA	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
2470	POLYDORA QUADRILOBATA	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
2480	POLYDORA CAULLERYI	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
2490	POLYDORA CORNUTA	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
2500	POLYDORA CILIATA	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
2510	POLYDORA SP.	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
2520	PSEUDOPOLYDORA ANTENNATA	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
2530	PSEUDOPOLYDORA PULCHRA	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
2540	PSEUDOPOLYDORA SP.	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
2550	PYGOSPIO ELEGANS	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
2560	PRIONOSPIO FALLAX	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2570	PRIONOSPIO STEENSTRUPI	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2580	SPIOPHANES KROYERI	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2590	SPIOPHANES BOMBYX	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2600	SCOLELEPIS FOLIOSA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2610	SCOLELEPIS SQUAMATA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2620	SCOLELEPIS BONNIERI	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2630	SCOLELEPIS SP.	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2640	MALACOCEROS TETRACERUS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2650	MALACOCEROS FULIGINOSUS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2660	STREBLOSPIO SHRUBSOLII	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2670	MAGELONA MINUTA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2675	MAGELONA PAPILLICORNIS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2680	MAGELONA MIRABILIS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2685	FLABELLIGERA AFFINIS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2690	CIRRATULIDAE	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2700	CIRRATULUS CIRRATUS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520

Kode	Artsnavn		Hovedgr.		Fødetype	Init	Omregning Våd -> Tør	Omregning Tør -> Askefri
2710	THARYX MULTIBRANCHIS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2720	THARYX SP.	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2730	CHAETOZONE SETOSA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2735	COSSURA LONGOCIRRATA	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2740	PHERUSA PLUMOSA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2750	PHERUSA SP.	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2760	DIPLOCIRRUS GLAUCUS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2770	BRADA VILLOSA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2780	POLYPHYSIA CRASSA	12	POLYCHAE	6	SED OFD	AA	0,1760	0,7520
2790	SCALIBREGMA INFLATUM	12	POLYCHAE	6	SED OFD	AA	0,1760	0,7520
2800	OPHELIA LIMACINA	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2810	OPHELIA RATHKEI	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2820	TRAVISIA FORBESII	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2830	OPHELINA ACUMINATA	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2840	CAPITELLIDAE	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2850	CAPITELLA CAPITATA	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2860	CAPITELLA SP.	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2865	CAPITOMASTUS SP	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2870	NOTOMASTUS LATERICEUS	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2880	HETEROMASTUS FILIFORMIS	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2890	MEDIOMASTUS FRAGILIS	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2900	ARENICOLA MARINA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
2910	MALDANIDAE	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2920	MALDANE SARSI	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2930	PRAXILLELLA PRAETERMISSA	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2940	PRAXILLELLA AFFINIS	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2950	EUCLYMENE OERSTEDI	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2960	EUCLYMENE DROEBACHIENSIS	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2965	EUCLEMENE SP	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2970	NICOMACHE PERSONATA	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2980	NICOMACHE SP.	12	POLYCHAE	5	SED	AA	0,1760	0,7520
2990	PETALOPROCTUS TENUIS BOREALIS	12	POLYCHAE	5	SED	AA	0,1760	0,7520
3000	RHODINE GRACILIOR	12	POLYCHAE	5	SED	AA	0,1760	0,7520
3001	RHODINE LOVENI	12	POLYCHAE	5	SED	aa	0,1760	0,7520
3005	RHODINE SP	12	POLYCHAE	5	SED	AA	0,1760	0,7520
3010	OWENIA FUSIFORMIS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3020	MYRIOCHELE OCULATA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3025	MYRIOCHELE SP.	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
3030	PECTINARIA KORENI	12	POLYCHAE	5	SED	AA	0,1760	0,7520
3040	PECTINARIA AURICOMA	12	POLYCHAE	5	SED	AA	0,1760	0,7520
3050	PECTINARIA BELGICA	12	POLYCHAE	5	SED	AA	0,1760	0,7520
3060	PECTINARIA SP.	12	POLYCHAE	5	SED	AA	0,1760	0,7520
3065	MELINNA CRISTATA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3067	TEREBELLOMORPHA	12	POLYCHAE	0		AA	0,1760	0,7520
3070	AMPHARETIDAE	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3080	AMPHARETE FINMARCHICA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3090	AMPHARETE ACUTIFRONS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3100	AMPHERETE BALTICA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3110	AMPHARETE SP.	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3115	SOSANE GRACILIS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3120	ANOBOTHRUS GRACILIS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3130	AMPHICTEIS GUNNERI	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3140	TEREBELLIDAE	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
3145	POECILOCHAETUS SERPENS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3150	ARTACAMA PROBOSCIDEA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3160	AMPHITRITE CIRRATA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3170	NEOAMPHITRITE FIGULUS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3180	AMPHITRITE SP.	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3190	AMPHITRITIDES GRACILIS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3200	EUPOLYMNIA NESIDENSIS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3210	NICOLEA ZOSTERICOLA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3220	LANICE CONCHILEGA	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
3230	POLYCIRRUS MEDUSA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3240	POLYCIRRUS SP.	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3250	LYSILLA LOVENI	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3260	THELEPUS CINCINNATUS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520

Kode	Artsnavn		Hovedgr.		Fødetype	Init	Omregning Våd -> Tør	Omregning Tør -> Askefri
3270	TRICHOBRANCHUS GLACIALIS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3280	TEREBELLIDES STROEMI	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3290	SABELLIDAE	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
3300	PSEUDOPOTAMILLA RENIFORMIS	12	POLYCHAE	1	SUSP	AA	0,1760	0,7520
3310	LAONOME KROEYERI	12	POLYCHAE	1	SUSP	AA	0,1760	0,7520
3315	LAONICE CIRRATA	12	POLYCHAE	1	SUSP	AA	0,1760	0,7520
3320	FABRICIA SABELLA	12	POLYCHAE	1	SUSP	AA	0,1760	0,7520
3330	FABRICIOLA BALTICA	12	POLYCHAE	1	SUSP	AA	0,1760	0,7520
3340	MANAYUNKIA AESTUARINA	12	POLYCHAE	3	SUSP OFD	AA	0,1760	0,7520
3350	CHONE DUNERI	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3360	CHONE INFUNDIBULIFORMIS	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3370	CHONE SP.	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3380	EUCHONE PAPILLOSA	12	POLYCHAE	2	OFD	AA	0,1760	0,7520
3390	SERPULIDAE	12	POLYCHAE	99	UKENDT	AA	0,1760	0,7520
3400	POMATOCEROS TRIQUETER	12	POLYCHAE	1	SUSP	AA	0,1760	0,7520
3410	SPIRORBIS SPIRORBIS	12	POLYCHAE	1	SUSP	AA	0,1760	0,7520
3420	SPIRORBIS SP.	12	POLYCHAE	1	SUSP	AA	0,1760	0,7520
3430	OLIGOCHAETA	13	OLIGOCHA	5	SED	AA	0,1760	0,7520
3440	TUBIFICOIDES BENEDENI	13	OLIGOCHA	5	SED	AA	0,1760	0,7520
3450	HIRUDINEA	14	HIRUDINE	99	UKENDT	AA	0,1760	0,7520
3455	GLOSSIPHONIA COMPLANATA	14	HIRUDINE	8	ROV	AA	0,1760	0,7520
3456	HELOBDELLA STAGNALIS	14	HIRUDINE	8	ROV	AA	0,1760	0,7520
3459	HYDRACARINA	15	PYGNOGON	8	ROV	AA	0,2020	0,7170
3460	PYGNOGONIDA	15	PYGNOGON	8	ROV	AA	0,2020	0,7170
3470	NYMPHON RUBRUM	15	PYGNOGON	8	ROV	AA	0,2020	0,7170
3480	NYMPHON BREVIROSTRE	15	PYGNOGON	8	ROV	AA	0,2020	0,7170
3490	NYMPHON SP.	15	PYGNOGON	8	ROV	AA	0,2020	0,7170
3500	PHOXICHILIDIUM FEMORATUM	15	PYGNOGON	8	ROV	AA	0,2020	0,7170
3510	PYGNOGONUM LITTORALE	15	PYGNOGON	8	ROV	AA	0,2020	0,7170
3515	ANOPLODACTYLUS PETIOLATUS	15	PYGNOGON	8	ROV	AA	0,2020	0,7170
3520	CRUSTACEA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3525	AORIDAE SP.	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3530	COPEPODA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3540	RHODINICOLA GIBBOSA	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3550	OSTRACODA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3560	PHILOMEDES GLOBOSUS	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3570	CIRRIPEDIA	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3575	BALANOMORPHA	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3580	BALANIDAE	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3590	BALANUS CRENATUS	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3600	BALANUS IMPROVISUS	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3610	BALANUS BALANOIDES	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3620	BALANUS BALANUS	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3630	BALANUS SP.	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3640	MYSIDACEA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3645	SCHISTOMYSIS ORNATA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3650	GASTROSACCUS SPINIFER	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3660	PRAUNUS FLEXUOSA	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3670	PRAUNUS INERMIS	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3675	MESOPODOPSIS SLABBERI	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3680	NEOMYSIS INTEGER	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3690	CUMACEA	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3700	BODOTRIA SCORPIOIDES	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3710	LEUCON NASICA	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3720	EUDORELLA TRUNCATULA	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3730	EUDORELLA EMARGINATA	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3740	EUDORELLA SP.	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3750	EUDORELLOPSIS DEFORMIS	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3760	PSEUDOCUMA LONGICORNIS	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3765	PSEUDOCUMA GILSONI	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3770	LAMPROPS FASCIATA	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3780	HEMILAMPROPS ROSEA	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3790	DIASTYLIS RATHKEI	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3800	DIASTYLIS BRADYI	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3810	DIASTYLIS LUCIFERA	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3820	DIASTYLIS TUMIDA	16	CRUSTACE	2	OFD	AA	0,2020	0,7170

Kode	Artsnavn		Hovedgr.		Fødetype	Init	Omregning Våd -> Tør	Omregning Tør -> Askefri
3825	DIASTYLIS LAEVIS	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3830	DIASTYLIS SP.	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3835	DIASTYLOIDES BIPLICATA	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
3840	TANAIDACEA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3850	TANAISSUS LILLJEBORG	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3860	HETEROTANAIS OERSTEDI	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3870	ISOPODA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3880	IDOTEA BALTHICA	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
3890	IDOTEA CHELIPES	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
3900	IDOTEA GRANULOSA	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
3910	IDOTEA SP.	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
3915	IDOTEA VIRIDIS	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
3917	MUNNA MINUTA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3920	JANIRA MACULOSA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3925	JAERA SP.	16	CRUSTACE	7	PLANT	ÅA	0,2020	0,7170
3930	JAERA ALBIFRONS	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
3940	JAERA ISCHIOSETOSA	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
3950	JAERA PRAEHIRSUTA	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
3955	ARCTURELLA DILETATA	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
3956	ASTACILLA AFFINIS	16	CRUSTACE	7	PLANT	ÅÅ	0,2020	0,7170
3960	AMPHIPODA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
3970	PHTISICA MARINA	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3980	CAPRELLA LINEARIS	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
3990	CAPRELLA SEPTENTRIONALIS	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4000	CAPRELLA SP.	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4010	PARIAMBUS TYPICUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4015	HYPERIA GALBA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4017	LYSIANASSIDAE	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4018	ORCHOMENE NANA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4020	METOPA BOREALIS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4030	METOPA SOELSBERGI	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4040	METOPA SP.	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4045	HIPPOMEDON DENTICULATUS	16	CRUSTACE	4	PLAN OFD	AA	0,2020	0,7170
4050	PHOXOCEPHALUS HOLBOELLI	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4060	HARPINIA PECTINATA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4065	HARPINIA ANTENNARIA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4070	ARGISSA HAMATIPES	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4080	HAPLOOPS TUBICOLA	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4090	AMPELISCA BREVICORNIS	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4095	AMPELISCA DIADEMA	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4100	AMPELISCA TYPICA	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4105	AMPELISCA SPINIPES	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4110	AMPELISCA MACROCEPHALA	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4120	BATHYPOREIA ELEGANS	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
4130	BATHYPOREIA GUILLIAMSONIANA	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
4140	BATHYPOREIA PELAGICA	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
4150	BATHYPOREIA PILOSA	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
4160	BATHYPOREIA SARSI	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
4170	BATHYPOREIA SP.	16	CRUSTACE	2	OFD	AA	0,2020	0,7170
4180	HAUSTORIUS ARENARIUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4190	PONTOPOREIA FEMORATA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4200	PONTOPOREIA AFFINIS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4210	AMPHILTOCHOIDES SERRATIPES	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4215	AMPHILTOCHOIDES ODONTONYX	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4220	JASSA FALCATA	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4225	JASSA PUSILA	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4230	JASSA SP.	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4235	ISCHYROCERUS ANGUIPES	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4240	PARAJASSA PELAGICA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4250	AMPHITHOE RUBRICATA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4260	PODOCERIDAE	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4270	DYOPEDOS MONACANTHUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4280	DYOPEDOS PORRECTUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4285	DULICHIA SP	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4290	MONOCULODES SP.	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4300	PERICULODES LONGIMANUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170

Kode	Artsnavn		Hovedgr.		Fødetype	Init	Omregning Våd -► Tør	Omregning Tør -► Askefri
4310	PONTOCRATES ALTAMARINUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4320	PONTOCRATES ARENARIUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4330	SYNCHELIDIUM HAPLOCHELES	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4340	WESTWOODILLA CAECULA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4345	STENOTHOE MARINA	16	CRUSTACE	99	UKENDT	ÅÅ	0,2020	0,7170
4350	ATYLUS SWAMMERDAMI	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4360	ATYLUS VEDLOMENSIS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4370	DEXAMINE SPINOSA	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
4380	ISAEIDAE	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4385	LILJEBORGIIDAE	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4390	MICROPROTOPUS MACULATUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4400	PHOTIS RHEINHARDI	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4405	PHOTIS LONGICAUDATA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4410	PROTOMEDEIA FASCIATA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4411	MEGAMPHORUS CORNUTUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4415	EURYSTEUS MELANOPS	16	CRUSTACE	4	PLAN OFD	AA	0,2020	0,7170
4420	GAMMAROPSIS NITIDA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4430	GAMMAROPSIS MELANOPS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4435	GAMMAROPSIS MACULATA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4440	PODOCEROPSIS NITIDA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4445	COROPHIUM AFFINE	16	CRUSTACE	4	PLAN OFD	AA	0,2020	0,7170
4446	COROPHIUM ACHERUSICUM	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4450	COROPHIUM BONNELLI	16	CRUSTACE	3	SUSP OFD	AA	0,2020	0,7170
4460	COROPHIUM CRASSICORNE	16	CRUSTACE	3	SUSP OFD	AA	0,2020	0,7170
4470	COROPHIUM INSIDIOSUM	16	CRUSTACE	3	SUSP OFD	AA	0,2020	0,7170
4480	COROPHIUM VOLUTATOR	16	CRUSTACE	3	SUSP OFD	AA	0,2020	0,7170
4485	COROPHIUM MULTISETOSUM	16	CRUSTACE	3	SUSP OFD	AA	0,2020	0,7170
4490	COROPHIUM SP.	16	CRUSTACE	3	SUSP OFD	AA	0,2020	0,7170
4500	UNCIOLA PLANIPES	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4510	UNCIOLA SP.	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4515	ERICTHONIUS DIFFORMIS	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4516	ERICTHONIUS BRASILIENSIS	16	CRUSTACE	1	SUSP	AA	0,2020	0,7170
4517	ERICTHONIUS SP	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4520	SIPHONOECETES KROYERANUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4530	GAMMARELLUS CARINATUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4540	GAMMARELLUS HOMARI	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4550	ERIOPISA ELONGATA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4560	CHEIROCRATUS SUNDEVALLEI	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
4565	CHEIROCRATUS ROBUSTUS	16	CRUSTACE	4	PLAN OFD	AA	0,2020	0,7170
4566	CHEIROCRATUS SP.	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
4567	CHAETOGAMMARUS MARINUS	16	CRUSTACE	4	PLAN OFD	AA	0,2020	0,7170
4570	GAMMARUS LOCUSTA	16	CRUSTACE	10	ROV PLAN	AA	0,2020	0,7170
4575	GAMMARUS FINMARCHICUS	16	CRUSTACE	10	ROV PLAN	AA	0,2020	0,7170
4580	GAMMARUS OCEANICUS	16	CRUSTACE	10	ROV PLAN	AA	0,2020	0,7170
4585	GAMMARUS TIGRINUS	16	CRUSTACE	10	ROV PLAN	AA	0,2020	0,7170
4590	GAMMARUS SALINUS	16	CRUSTACE	10	ROV PLAN	AA	0,2020	0,7170
4600	GAMMARUS ZADDACHI	16	CRUSTACE	10	ROV PLAN	AA	0,2020	0,7170
4610	GAMMARUS SP.	16	CRUSTACE	10	ROV PLAN	AA	0,2020	0,7170
4620	MELITA DENTATA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4625	MELITA OBTUSATA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4630	MELITA PALMATA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4640	AORA TYPICA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4650	MICRODEUTOPUS ANOMALUS	16	CRUSTACE	3	SUSP OFD	AA	0,2020	0,7170
4660	MICRODEUTOPUS GRYLLOTALPA	16	CRUSTACE	3	SUSP OFD	AA	0,2020	0,7170
4670	MICRODEUTOPUS SP.	16	CRUSTACE	3	SUSP OFD	AA	0,2020	0,7170
4680	LEMBOS LONGIPES	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4685	LEPTOCHEIRUS PILOSUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4690	CALLIOPIUS LAEVIUSCULUS	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
4700	CALLIOPIUS SP.	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
4710	APHERUSA BISPINOSA	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
4715	APHERUSA JURINEI	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4720	APHERUSA SP.	16	CRUSTACE	7	PLANT	AA	0,2020	0,7170
4730	EUPHAUSIACEA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4740	MEGANYCTIPHANES NORVEGICA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4750	DECAPODA	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4755	GALATHEIDAE	16	CRUSTACE	99	UKENDT	AA	0,0000	0,0000

RAMBI : Artsliste

Kode	Artsnavn		Hovedgr.		Fødetype	Init	Omregning Våd -> Tør	Omregning Tør -> Askefri
4760	PAGURUS BERNHARDUS	16	CRUSTACE	8	ROV	AA	0,2020	0,7170
4770	PAGURUS SP.	16	CRUSTACE	8	ROV	AA	0,2020	0,7170
4780	MACROPODIA ROSTRATA	16	CRUSTACE	8	ROV	AA	0,2020	0,7170
4790	HYAS ARANEUS	16	CRUSTACE	8	ROV	AA	0,2020	0,7170
4800	MACROPIUS DEPURATOR	16	CRUSTACE	8	ROV	AA	0,2020	0,7170
4810	MACROPIUS ARCUATUS	16	CRUSTACE	8	ROV	AA	0,2020	0,7170
4820	MACROPIUS HOLSATUS	16	CRUSTACE	8	ROV	AA	0,2020	0,7170
4825	MACROPIPUS PUSILLUS	16	CRUSTACE	8	ROV	AA	0,2020	0,7170
4830	CARCINUS MAENAS	16	CRUSTACE	8	ROV	AA	0,2020	0,7170
4840	CRANGON CRANGON	16	CRUSTACE	10	ROV PLAN	AA	0,2020	0,7170
4845	CRANGON VULGARIS	16	CRUSTACE	10	ROV PLAN	AA	0,2020	0,7170
4850	PALAEMON ADSPERSUS	16	CRUSTACE	10	ROV PLAN	AA	0,2020	0,7170
4855	PALAEMON SERRATUS	16	CRUSTACE	99	UKENDT	AA	0,2020	0,7170
4860	INSECTA	17	INSECTA	99	UKENDT	AA	0,2020	0,7170
4861	TRICHOPTERA	17	INSECTA	99	UKENDT	AA	0,2020	0,7170
4862	PLECTROCNEMIA CONSPERSA	17	INSECTA	8	ROV	AA	0,2020	0,7170
4865	DIPTERA	17	INSECTA	99	UKENDT	AA	0,2020	0,7170
4866	DIPTERA (PUPPER)	17	INSECTA	99	UKENDT	AA	0,2020	0,7170
4867	SIMULIIDAE	17	INSECTA	1	SUSP	AA	0,2020	0,7170
4868	CERATOPOGINIDAE	17	INSECTA	99	UKENDT	AA	0,2020	0,7170
4870	CHIRONOMIDAE	17	INSECTA	99	UKENDT	AA	0,2020	0,7170
4871	CHIRONOMINAE	17	INSECTA	99	UKENDT	AA	0,2020	0,7170
4872	CHIRONOMINI	17	INSECTA	1	SUSP	AA	0,2020	0,7170
4873	CHIRONOMUS-PLUMOSUS-GRP	17	INSECTA	1	SUSP	AA	0,2020	0,7170
4874	CHIRONOMUS-THUMMI-GRP	17	INSECTA	99	UKENDT	AA	0,2020	0,7170
4877	TANYTARSINI	17	INSECTA	1	SUSP	AA	0,2020	0,7170
4880	TANYPODINAE	17	INSECTA	8	ROV	AA	0,2020	0,7170
4885	DIAMESINAE	17	INSECTA	4	PLAN OFD	AA	0,2020	0,7170
4890	COLEOPTERA	17	INSECTA	99	UKENDT	AA	0,2020	0,7170
4895	OULIMNIUS SP.	17	INSECTA	4	PLAN OFD	AA	0,2020	0,7170
4900	ORTHOCLADINAE	17	INSECTA	2	OFD	AA	0,2020	0,7170
4901	EPHEMEROPTERA	17	INSECTA	99	UKENDT	AA	0,2020	0,7170
4902	BAETIS SP.	17	INSECTA	4	PLAN OFD	AA	0,2020	0,7170
4903	CENTROPTILUM LUTEOLUM	17	INSECTA	4	PLAN OFD	AA	0,2020	0,7170
4905	PLECOPTERA	17	INSECTA	99	UKENDT	AA	0,2020	0,7170
4906	BRACHYPTERA RISI	17	INSECTA	4	PLAN OFD	AA	0,2020	0,7170
4907	NEMOURA FLEXUOSA	17	INSECTA	4	PLAN OFD	AA	0,2020	0,7170
4910	SIPUNCULA	18	SIPUNCUL	99	UKENDT	AA	0,0760	0,8610
4920	PHASCOLION STROMBI	18	SIPUNCUL	2	OFD	AA	0,0760	0,8610
4930	ECHIUROIDA	19	ECHIUROI	99	UKENDT	AA	0,0760	0,8610
4940	ECHIURUS ECHIURUS	19	ECHIUROI	12	ROV OFD	AA	0,0760	0,8610
4950	PRIAPULOIDA	20	PRIAPULO	99	UKENDT	AA	0,0760	0,8610
4960	PRIAPULUS CAUDATUS	20	PRIAPULO	12	ROV OFD	AA	0,0760	0,8610
4970	HALICRYPTUS SPINULOSUS	20	PRIAPULO	12	ROV OFD	AA	0,0760	0,8610
4980	PHORONIDA	21	PHORONID	1	SUSP	AA	0,1760	0,7520
4990	PHORONIS MUELLERI	21	PHORONID	1	SUSP	AA	0,1760	0,7520
5000	PHORONIS SP.	21	PHORONID	1	SUSP	AA	0,1760	0,7520
5010	BRYOZOA	22	BRYOZOA	1	SUSP	AA	0,2000	0,8000
5020	ASTEROIDEA	23	ASTEROID	99	UKENDT	AA	0,2430	0,3800
5030	ASTROPECTEN IRREGULARIS	23	ASTEROID	8	ROV	AA	0,2430	0,3800
5040	CROSSASTER PAPPOSUS	23	ASTEROID	8	ROV	AA	0,2430	0,3800
5050	ASTERIAS RUBENS	23	ASTEROID	8	ROV	AA	0,2430	0,3800
5060	OPHIUROIDEA	24	OPHIUROI	99	UKENDT	AA	0,6600	0,1270
5070	OPHIOTHRIX FRAGILIS	24	OPHIUROI	9	ROV SED	AA	0,6600	0,1270
5080	OPHIOCOMINA NIGRA	24	OPHIUROI	10	ROV PLAN	AA	0,6600	0,1270
5090	OPHIOPHOLIS ACULEATA	24	OPHIUROI	2	OFD	AA	0,6600	0,1270
5100	AMPHIURA FILIFORMIS	24	OPHIUROI	1	SUSP	AA	0,6600	0,1270
5110	AMPHIURA CHIAJEI	24	OPHIUROI	1	SUSP	AA	0,6600	0,1270
5120	AMPHIURA JUV.	24	OPHIUROI	1	SUSP	AA	0,6600	0,1270
5130	AMPHIURA SP.	24	OPHIUROI	1	SUSP	AA	0,6600	0,1270
5140	AXIOGNATHUS SQUAMATA	24	OPHIUROI	12	ROV OFD	AA	0,6600	0,1270
5150	OPHIURA OPHIURA	24	OPHIUROI	12	ROV OFD	AA	0,6600	0,1270
5160	OPHIURA SARSI	24	OPHIUROI	12	ROV OFD	AA	0,6600	0,1270
5170	OPHIURA AFFINIS	24	OPHIUROI	12	ROV OFD	AA	0,6600	0,1270
5180	OPHIURA ROBUSTA	24	OPHIUROI	12	ROV OFD	AA	0,6600	0,1270
5190	OPHIURA ALBIDA	24	OPHIUROI	12	ROV OFD	AA	0,6600	0,1270

Kode	Artsnavn		Hovedgr.		Fødetype	Init	Omregning Våd -> Tør	Omregning Tør -> Askefri
5200	OPHIURA JUV.	24	OPHIUROI	12	ROV OFD	AA	0,6600	0,1270
5210	OPHIURA SP.	24	OPHIUROI	12	ROV OFD	AA	0,6600	0,1270
5220	OPHIOCTEN GRACILIS	24	OPHIUROI	12	ROV OFD	AA	0,6600	0,1270
5230	ECHINOIDEA	25	ECHINOID	99	UKENDT	AA	0,2000	0,1530
5240	PSAMMECHINUS MILIARIS	25	ECHINOID	10	ROV PLAN	AA	0,2000	0,1530
5250	ECHINUS ESCULENTUS	25	ECHINOID	10	ROV PLAN	AA	0,2000	0,1530
5260	ECHINUS SP.	25	ECHINOID	99	UKENDT	AA	0,2000	0,1530
5270	STRONGYLOCENTROTUS DROEBACHIENSIS	25	ECHINOID	11	ROVPLSUS	AA	0,2000	0,1530
5280	ECHINOCYAMUS PUSILLUS	25	ECHINOID	11	ROVPLSUS	AA	0,2000	0,1530
5290	ECHINOCARDIUM CORDATUM	25	ECHINOID	2	OFD	AA	0,2000	0,1530
5300	BRISSOPSIS LYRIFERA	25	ECHINOID	2	OFD	AA	0,2000	0,1530
5310	HOLOTHUROIDEA	26	HOLOTHUR	99	UKENDT	AA	0,4780	0,1720
5320	PHYLLOPHORUS COMMUNIS	26	HOLOTHUR	1	SUSP	AA	0,4780	0,1720
5330	PSOLUS PHANTAPUS	26	HOLOTHUR	1	SUSP	AA	0,4780	0,1720
5340	PSOLUS SP.	26	HOLOTHUR	1	SUSP	AA	0,4780	0,1720
5350	LABIDOPLAX BUSKII	26	HOLOTHUR	1	SUSP	AA	0,4780	0,1720
5360	ASCIDIACEA	27	ASCIDIAC	99	UKENDT	AA	0,1000	0,8500
5370	CIONA INTESTINALIS	27	ASCIDIAC	1	SUSP	AA	0,1000	0,8500
5380	ASCIDIELLA ASPERSA	27	ASCIDIAC	1	SUSP	AA	0,1000	0,8500
5390	STYELA CLAVA	27	ASCIDIAC	1	SUSP	AA	0,1000	0,8500
5400	STYELA CORIACEA	27	ASCIDIAC	1	SUSP	AA	0,1000	0,8500
5410	STYELA SP.	27	ASCIDIAC	1	SUSP	AA	0,1000	0,8500
5420	DENDRODOA GROSSULARIA	27	ASCIDIAC	1	SUSP	AA	0,1000	0,8500
5430	BOTRYLLUS SCHLOSSERI	27	ASCIDIAC	1	SUSP	AA	0,1000	0,8500
5440	MOLGULA MANHATTENSIS	27	ASCIDIAC	1	SUSP	AA	0,1000	0,8500
5450	MOLGULA CITRINA	27	ASCIDIAC	1	SUSP	AA	0,1000	0,8500
5460	MOLGULA SP.	27	ASCIDIAC	1	SUSP	AA	0,1000	0,8500

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Distribution of *Nephtys hombergii* and *N. ciliata* (Polychaeta: Nephtyidae) in Århus Bay, Denmark, with Emphasis on the Effect of severe Oxygen Deficiency

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ABSTRACT

Under normal environmental conditions the distributions of *Nephtys hombergii* and *N. ciliata* in Århus Bay, Denmark are almost complementary, *N. hombergii* inhabiting the more coarse sediments at shallow depths and *N. ciliata* occupying the deeper areas with fine deposits. Nevertheless, *N. hombergii* dominates, regardless of depth, at localities where oxygen concentrations are permanently or regularly low. During late summer 1981 a period of severe oxygen deficiency killed off the *Nephtys* populations in major parts of the bay below the pycnocline. In October 1982 recolonization had occurred, but only by *N. hombergii*, now totally dominating areas formerly occupied by *N. ciliata*. Between 1983 and 1985 *N. ciliata* slowly gained in abundance, while *N. hombergii* decreased in the area. It is argued that the complementary distribution of the two species is mainly due to: 1) differences in sediment preference and tolerance of low oxygen content and 2) differences in size and life span combined with interspecific predation between the two species.

Keywords: Polychaeta, *Nephtys hombergii*, *Nephtys ciliata*, oxygen deficiency, life history, distribution.

INTRODUCTION

Århus Bay is inhabited by an *Abra* community of which *Nephtys hombergii* (Savigny, 1818) and *Nephtys ciliata* (O.F. Müller, 1789) are prominent members (Fallesen & Jørgensen 1984). Long-term monitoring investigations have revealed that the distribution of the two species is almost complementary in the area: *N. hombergii* inhabits the coarser sediments at shallow depths (<12 m) and *N. ciliata* the deeper areas with fine deposits (8-17 m) (Vandkvalitetsinstituttet 1976, Jespersen 1980). Nevertheless, *N. hombergii* is overall dominant where oxygen concentrations are permanently or regularly diminished due to organic enrichment and/or low rates of water exchange. In late summer 1981 Århus Bay suffered from a severe oxygen deficiency which killed most of the macrofauna (Århus Amtskommune 1981). After this catastrophic event the distribution of the two species of *Nephtys* had completely changed, *N. hombergii* now dominating in most of the area. Slowly, the normal distribution pattern was gradually reestablished in the following years.

The aim of this paper is to evaluate which factors might determine the distribution pattern in Århus Bay. To do so we present data on abundance and distribution from 1976 to 1985. The bulk of these data originate from monitoring surveys (once-a-year sampling) made by the county environmental authorities. Our own field work, focussing on seasonal events in life history and on population structure of the two species, was carried out in 1983-84. The field work was supplemented with laboratory experiments concerning sediment preference and tolerance to low oxygen concentration.

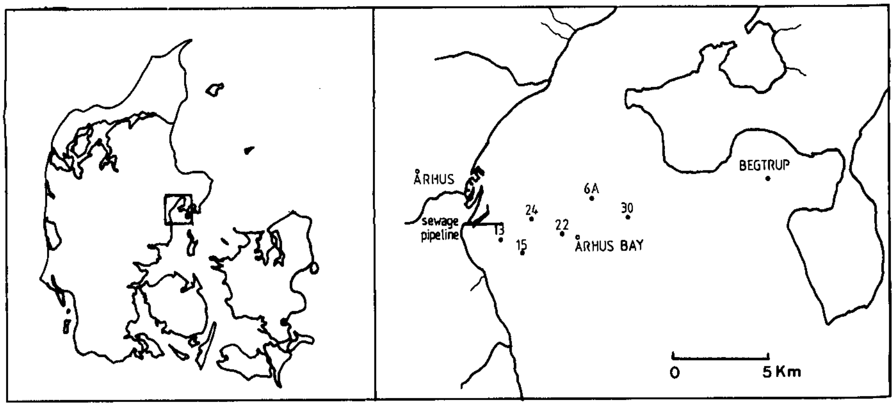


Fig. 1. Map of Århus Bay, Denmark, showing sampling stations.

MATERIALS AND METHODS

Sublittoral populations of *N. hombergii* and *N. ciliata* were investigated in the shallow Århus Bay on the east coast of Jutland, Denmark (Fig. 1). The position of the bay, between the brackish Baltic Sea and the fully marine North Sea, strongly influences the hydrographic conditions, generating salinity stratification 85% of the year. From west to east, water depth gently increases from c. 8 to 17 m. The sediment is silty sand and generally the silt content increases with depth. Århus Bay is affected by sewage discharges, especially the western part close to the city of Århus, and by terrestrial run-off (Dansk Hydraulisk Institut 1980, Vandkvalitetsinstituttet 1980). As a part of the monitoring investigations carried out by the county environmental authorities, bottom fauna has been sampled once a year since 1976. Data on abundance and distribution of *N. hombergii* and *N. ciliata* originate to a great extent from these monitoring surveys (Vandkvalitetsinstituttet 1976, 1980; Jespersen 1980).

Seven stations were chosen for a more intensive investigation in 1983-84: two stations within the area most heavily affected by sewage (st. 13 & 15), two stations outside this area (st. 6A & 30), and two stations in the transition zone (st. 22 & 24). The last station was located in Begtrup cove, which is almost unaffected by pollution and was only slightly affected by the oxygen deficiency in 1981. All 7 stations are situated at the same depth, 14-16 m, and the sediment consists of silty sand at all stations. The content of silt and clay is slightly higher at st. 13 and Begtrup.

Five replicate samples were taken each month from March 1983 to February 1984 by using a Petersen grab 0.1 m^2. The samples were washed through a 1 mm sieve and animals fixed in 4% formalin. All specimens of *Nephtys* were counted, investigated for contents of eggs/sperm and their body width measured (Olive 1977). On a few occasions age determination of individuals by means of their jaws was attempted, and at intervals additional samples were taken with a mousetrap sampler (Muus 1964) to catch newly settled juveniles.

Experiments were carried out to examine the resistance of *N. hombergii* and *N. ciliata* to oxygen-free conditions: 100 specimens of each species were placed individually in glass bottles with oxygen-free seawater (O_2 < 0.2 mg/l) at 8°C. Glass bottles of 25, 50 and 100 ml were used to compensate for the differences in size of the animals. At suitable intervals, 10 specimens of each species were removed and transferred to oxygenated seawater.

After a recovery period of 24 hours the number of surviving animals was recorded. The criterion for survival was the ability for active movement.

Sediment preferences were tested in experimental containers with sediments of different grain size. The animals could move freely between 5 fractions ranging from clean sand to silt/clay. The experiment was repeated several times with animals either starting in the coarsest or finest fraction. Each experiment lasted for 6 days and at the end, the positions of the animals were recorded.

Investigations of food preference of the two species were carried out by examination of gut contents of more than 100 specimens of *N. hombergii* and *N. ciliata*.

RESULTS

In autumn 1976 the distributions of *N. hombergii* and *N. ciliata* were almost complementary (Fig. 2a). *N. ciliata* completely dominated the deeper central part of the bay while *N. hombergii* dominated the near-shore areas and the area south of the sewage outfall. In 1979, minor changes in their distributions were apparent, mainly due to increasing dominance of *N. hombergii* south of the sewage outfall (Fig. 2b). During late summer 1981 a severe oxygen deficiency killed off most of the macrofauna, including the *Nephtys* populations in major parts of the bay below the pycnocline (Fig. 2c). By October 1982, recolonization had occurred, but only by *N. hombergii*, which now totally dominated the areas formerly occupied by *N. ciliata* (Fig. 2d). Samples from October 1983 showed that *N. ciliata* had increased in abundance in the central part of the bay, while *N. hombergii* had decreased and now only dominated in the western part (Fig. 2e). By October 1985, *N. ciliata* had regained its dominance in the central and eastern parts of the bay, while *N. hombergii* had maintained its dominance in the western part (Fig. 2f).

At the commencement of monthly sampling in March 1983, the two species were found in approximately equal numbers at the 4 stations in the central part of the bay (st. 22, 24, 6A and 30). *N. hombergii* dominated at st. 13 and 15, while *N. ciliata* dominated at st. Begtrup.

Size-frequency distributions are given for st. 13, 24 and Begtrup (Fig. 3). At st. 13 the first representatives of the 1983 year-class of *N. hombergii* occur in the samples in September although the bulk appears in December. Abundance is fairly stable throughout the year except for the main recruitment period. In October 1985 only one *N. hombergii* was found, perhaps a result of a local oxygen deficiency in the late summer. Specimens of *N. ciliata* were found only very rarely during the sampling period at this station.

Also at st. 24 the 1983 year-class of *N. hombergii* appears in the samples in September, but recruitment was poor. This seems to be true for 1984 too, and in October 1985 only very few *N. hombergii* were found at this locality. A group of newly settled *N. ciliata* was found at st. 24 in March 1983. Its growth is easily followed during the sampling period. This is also true for the new year-class appearing in the samples from November 1983. The abundance of *N. ciliata* rises steadily at this locality from March 1983 to October 1985.

The *N. ciliata* population at st. Begtrup consists of many year-classes that cannot be separated properly. As at st. 24, the new year-class appears in the samples from November to February.

Apart from the new recruitment class there is a strong tendency for year-classes to merge in the populations of both *N. hombergii* and *N. ciliata*.

Attempts were made on a few dates to age the animals by means of rings in the jaws (Kirkegaard 1970, Olive 1977). In Århus Bay the first ring generally develops in the jaws

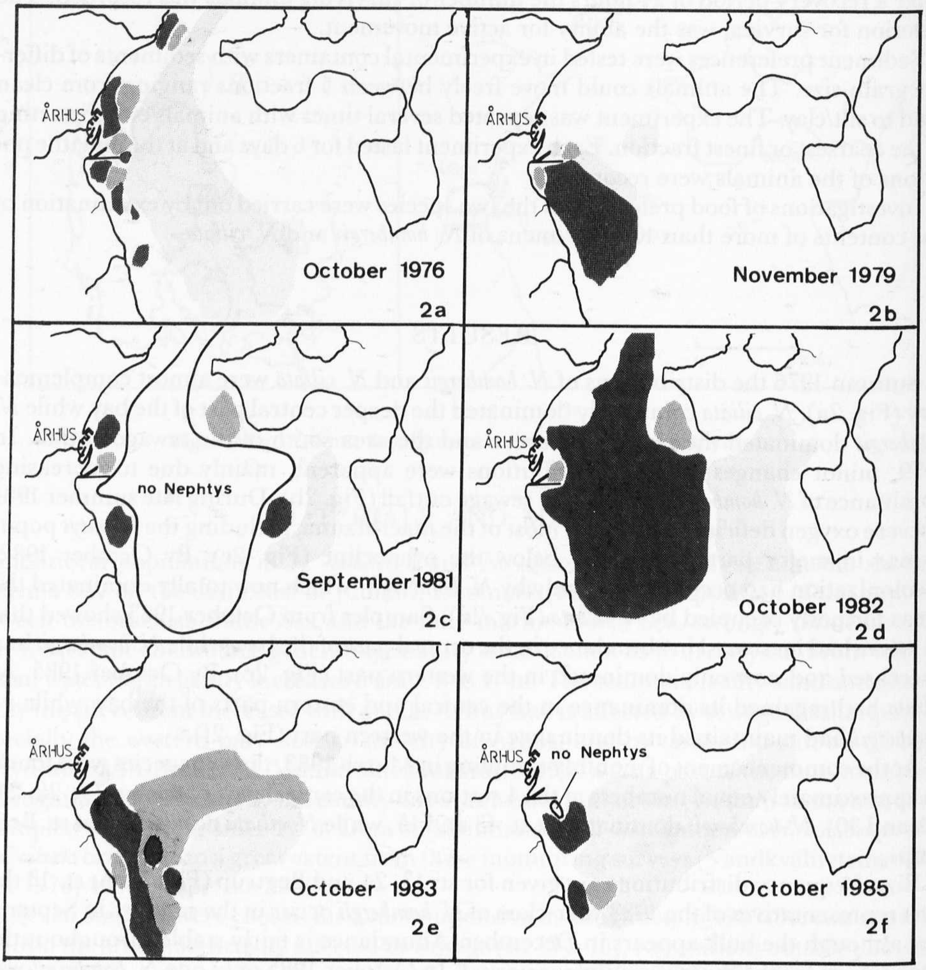


Fig. 2 a-f. Distribution of *N. hombergii* and *N. ciliata* in Aarhus Bay 1976-85. — Dark hatching = *N. hombergii* dominant. — Light hatching = *N. ciliata* dominant. — Medium hatching = *N. hombergii* and *N. ciliata*. — If more than 90% of the *Nephtys* belong to one of the two species, the species is regarded as dominant. Often only one of the two species occurs.

of *N. hombergii* during the first summer, when it is nearly one year old and before it breeds for the first time. As already found by Alheit in Kiel Bay (Alheit 1980), the relation between age and number of rings is not so obvious as regards *N. ciliata*. Nevertheless, *N. ciliata* seems to produce its first ring during its second summer, when it is around 1.5 years old, and it probably does not breed before it is almost 3 years old (the smallest *N. ciliata* with gametes has 2 rings). The rings seem to be added yearly. In Århus Bay *N. hombergii* seems to live for at least 3 years and *N. ciliata* for at least 7 years.

Figure 4 shows that *N. ciliata* spawns in November-December and that *N. hombergii* spawns in August-September. A decrease in the number of *N. hombergii* bearing gametes in May-June suggests that at least a part of the populations spawn in the early summer;

this is supported by findings of small individuals in both mousetrap and grab samples. This might indicate that the *N. hombergii* populations actually consist of a mixture of two species (*N. hombergii* and *N.* sp. nr. *hombergii*). But the material has been re-examined and all specimens turned out to be *N. hombergii* (Rainer pers. comm.). Although all mature specimens of *N. hombergii* and *N. ciliata* seem to spawn in Århus Bay, not all specimens of proper size or age reach maturity. At present we cannot explain this phenomenon.

DISCUSSION

Based on his work on the distribution of the genus *Nephtys* in Kiel Bay, Alheit (1978) concluded that niche separation between species resulted from differences in sediment preferences and in tolerance of low salinity and oxygen concentrations. In Kiel Bay *N. hombergii* appeared over a wide range of sediment types whereas *N. ciliata* was confined to sediment types with small grain size. However, no co-occurrence was observed on fine sediments, because *N. ciliata* only occurred in areas with high salinity and oxygen concentrations, while *N. hombergii* showed greater tolerance to reduced concentrations of salinity and oxygen (probably combined with higher resistance to hydrogen sulphide) (Alheit 1978).

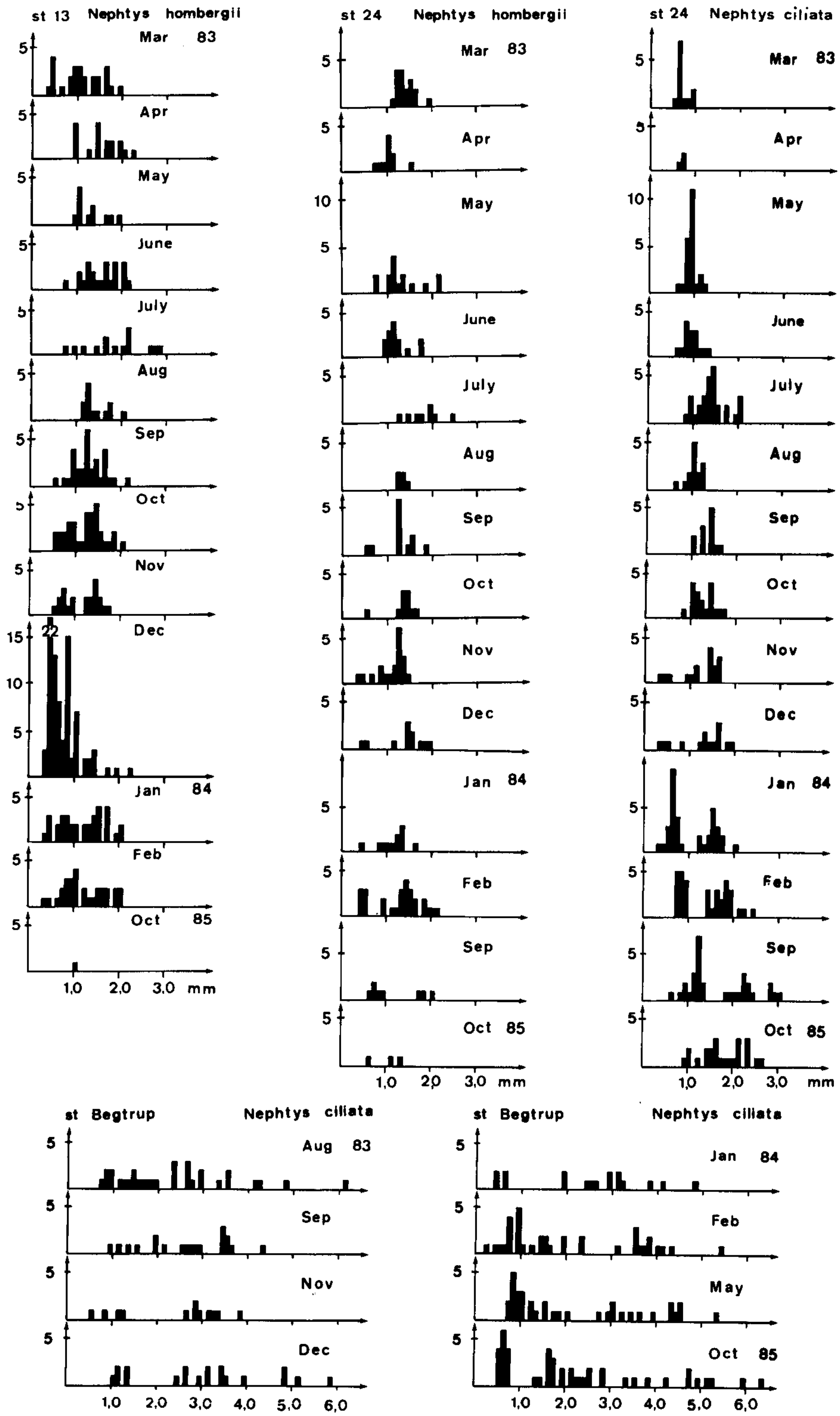
The distribution pattern of *N. hombergii* and *N. ciliata* in Århus Bay before 1981 resembles that in Kiel Bay. *N. ciliata* is dominant on fine sediments except in areas where oxygen concentrations are permanently or regularly low (e.g., in the vicinity of the sewage outfall and in areas with a low rate of water exchange), where *N. hombergii* is dominant.

Our experiments support these observations. Given the choice, *N. ciliata* prefers fine sediments whereas *N. hombergii* seems indifferent. Under anaerobic conditions *N. hombergii* survives twice as long as *N. ciliata*. LD_{50}-values at 8°C: *N. hombergii* = 23 days, *N. ciliata* = 11 days.

Although sediment structure and oxygen conditions to a great extent influence distribution of the two species in Århus Bay (salinity differences would have no influence at the depths considered), these factors cannot explain the lack of co-occurrence of the two species on fine sediments under well oxygenated conditions, nor can they explain the distribution of the two species after the oxygen deficiency in 1981.

Interspecific differences in the time of spawning seem to be an important part of the explanation of the distribution pattern after the oxygen deficiency in 1981. The catastrophic oxygen conditions had effectively killed off the *N. ciliata* populations before their spawning period in November-December. It is significant that up to the recruitment of winter 1982/83, *N. ciliata* was not able to establish permanent populations in the central part of the bay. On the other hand, the *N. hombergii* populations or part of them had spawned just before the oxygen deficiency. Furthermore, part of the *N. hombergii* populations were living above the pycnocline and therefore not affected by the oxygen deficiency. As a result, larvae of only *N. hombergii* were present in the defaunated area, ready to settle at the start of recolonization.

Until October 1985 the numbers of *N. hombergii* and *N. ciliata* followed opposite trends at st. 24: *N. ciliata* increased, recruiting successfully each year, while the numbers of *N. hombergii* decreased due to poor recruitment and high mortality of older animals. The same was observed at st. 22, 6A and 30. However, poor recruitment of *N. hombergii* was not general for the area investigated. *N. hombergii* has recruited successfully at st. 13 and 15 and maintained stable populations at stations where *N. ciliata* is absent. This suggests some kind of interspecific relation between the two species at stations where the oxygen conditions do not determine the distribution pattern.


st 13 Nephtys hombergii
Mar 83
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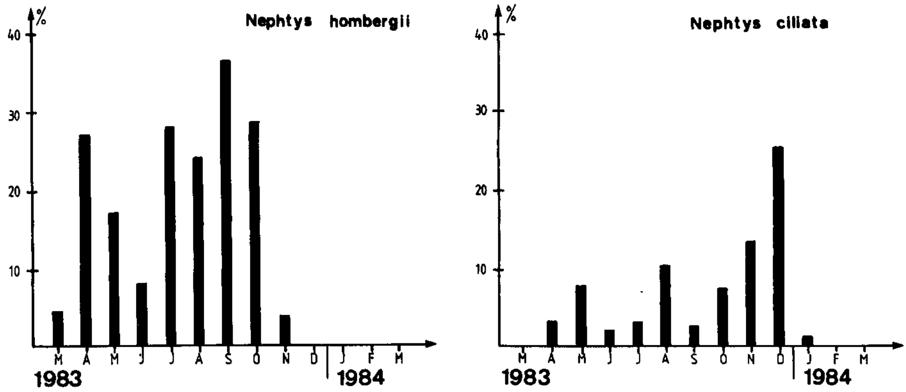

Fig. 4. Percentage of gravid *N. hombergii* and *N. ciliata* (stations pooled).

Most investigations into the food of *Nephtys* spp., based on examinations of gut contents, reveal that they are predators (Blegvad 1914, Scheibel 1981). This is also true for the specimens in Århus Bay (Fallesen & Jørgensen 1984). Thus, competition for food could result in a slow elimination of *N. hombergii*, assuming that *N. ciliata* is the stronger competitor.

Alheit (1980) and Olive (1977) suggest that the stable population density of *Nephtys* populations is caused by density-dependent mortality due to cannibalism and adult predation on juveniles. As *N. ciliata* grow to a larger size than *N. hombergii*, *N. hombergii* would more often be a prey item for *N. ciliata* than *N. ciliata* for *N. hombergii*. Cannibalism and/or predation are confirmed by findings of remnants of smaller specimens of *Nephtys* in the gut contents of *Nephtys* spp.

But how can *N. ciliata* become established among *N. hombergii* populations at st. 22, 24, 6A and 30? The only explanation we can see is that *N. ciliata* is superior to *N. hombergii* on fine sediments under normal environmental conditions. This means that *N. hombergii* sooner or later will be outcompeted by *N. ciliata* on these kinds of sediments. Once the *N. ciliata* populations have reached a certain size and age structure, interference from *N. hombergii* is no longer possible.

Coexistence between the two species will only occur in areas which are disturbed regularly (e.g., in the transition zone between the heavily affected and the not affected area close to the sewage outfall). Under such circumstances *N. ciliata* would never reap the benefit of its larger size, longer life span and superiority on fine sediments since the population would be killed off by oxygen deficiency at intervals. After a large catastrophic event like the oxygen deficiency in Århus Bay in 1981, *N. hombergii* may be dominant for a few years until the *N. ciliata* populations are able to eliminate *N. hombergii*.

Fig. 3. Size-frequency histograms for *N. hombergii* and *N. ciliata*. Body width is measured shoulder to shoulder at the widest part of the body (excluding parapodia) immediately posterior to the pharynx.

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How sewage discharge, terrestrial run-off and oxygen deficiencies affect the bottom fauna in Århus Bay, Denmark

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Abstract

In Århus Bay the macrozoobenthos has been monitored nearly once a year in the period 1975-88. Throughout the sampling period the bay has received a constant input of waste water and nutrients that is regarded as the main reason for the recurring oxygen deficiencies in the 1980s. In 1981 an extraordinary oxygen depletion killed most of the benthic fauna in Århus Bay below the halocline (< 10 m). Species such as *Abra alba*, *Corbula gibba*, *Mysella bidentata* and *Nephtys hombergii* quickly recolonized the defaunated sea bottom and were found in high numbers in 1982. In 1983 *Ophiura albida* and *Echinocardium cordatum* reappeared in the samples whereas *Macoma calcarea* did not occur until 1985. The recovery process was completed in about four years with respect to the important species. However, because of the continuous organic input and the consequent recurring adverse oxygen conditions during the 1980s, the final macrobenthic community differs from the one found before the oxygen deficiency in 1981 in the following respects: 1) *Echinocardium cordatum* has disappeared from Århus Bay. 2) *Ophiura albida* occurs in reduced numbers. 3) The bottom fauna is heavily affected nearest to the outlet where species richness, abundance and biomass are very reduced.

Keywords: sewage discharge, oxygen deficiency, macrozoobenthos, recolonization.

Introduction

Århus Bay (Figure 1) is a shallow bay on the east coast of Jutland, Denmark, inhabited by an *Abra* community. Most of the year the bay is subjected to salinity stratification that strongly influences the oxygen conditions in the bottom water.

Monitoring of the macrozoobenthos began in 1975 when a new 2 km long sewage pipeline south of the harbour of Århus was taken into use. Prior to this sewage was discharged 20 m off the beach. Throughout the sampling period (1975-88) the amount of waste water (Figure 1) has been nearly constant, and has undergone primary treatment prior to discharge. The contribution of nutrients and BOD from rivers has also been fairly constant during the sampling period (Nielsen *et al.* 1990).

In the 1980s adverse oxygen conditions of long duration have occurred at least once a year in Århus Bay (Sørensen 1990). In comparison oxygen deficiency was recorded only twice in the 1970s and lasted only a few days. Organic matter from waste water discharges and nutrients from terrestrial run-off have probably been the main reason for the recurring oxygen deficiencies in the 1980s, but the eutrophication of the Kattegat is also likely to have contributed significantly to the oxygen deficiencies in Århus Bay (Sørensen 1990). The most severe oxygen deficiency in Århus Bay occurred in September 1981. This extraordinary and wide-ranging oxygen depletion also occurred in many other parts of the Baltic area (Miljøstyrelsen 1984, Weigelt & Rumohr 1986). The anoxia killed most of the benthic fauna in Århus Bay below the halocline (< 10 m) (Fallesen 1990).

This paper deals with the faunal changes during the sampling period 1975-88 with special emphasis on the recovery of the benthos after the disastrous oxygen deficiency in 1981, and the impact of recurring oxygen deficiencies during the 1980s.

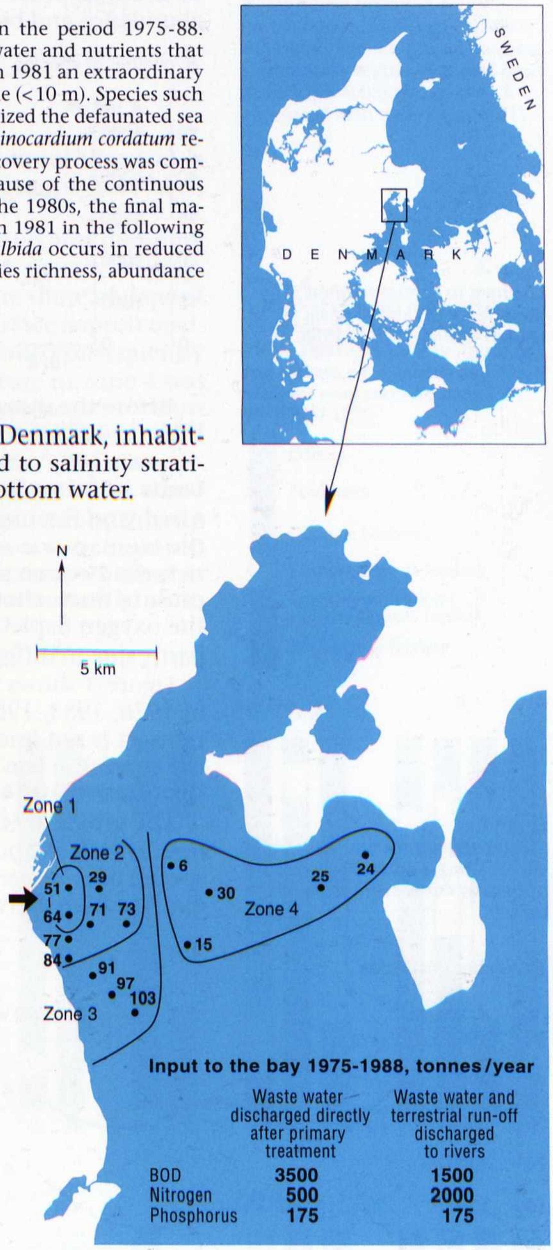


Figure 1.
Map of Århus Bay, Denmark, showing sampling stations (aggregated into four zones; zone 1 closest to the outlet) and the input of BOD, nitrogen and phosphorus to the bay from waste water and terrestrial run-off.

Methods

Since 1975 the benthos has been sampled almost annually between September and November. Only in 1977, 1980 and 1984 were no surveys carried out.

Samples were mainly taken with a 0.1-m^2 Van Veen grab but also a small Van Veen grab (0.045 m^2) and a Haps core sampler (0.0123 m^2) have been used. All samples were washed through a 1-mm mesh sieve and preserved in either formalin or alcohol. The fauna was identified to species level, counted and wet weight estimated within taxonomic groups.

Through the investigation period many different stations were sampled and both the number of stations per survey as well as the number of samples per station have changed. However, from the comprehensive material it is possible to use for analysis 15 stations which occur in nearly all investigations. The 15 stations have been grouped in four zones (Figure 1) based on the distance to the outlet, the organic content of the sediment (Heslop 1983) and the faunal composition of the dominant species (Fallesen 1990). Significant differences in number of species, abundance and biomass between the four zones were determined using a Mann-Whitney *U*-test.

Results

Temporal and spatial changes in species richness, abundance and biomass

Figure 2 shows the *SAB* curve (Pearson & Rosenberg, 1978) for station 6 from 1976 to 1988, in order to give a general impression of the changes in species richness, abundance and biomass during the sampling period.

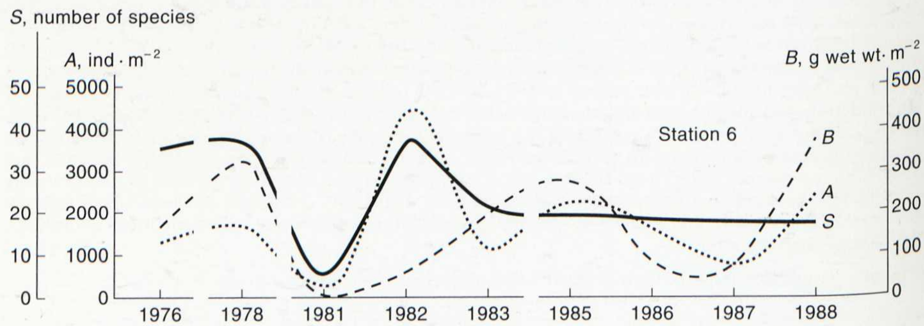


Figure 2.
Changes in species richness (*S*), abundance (*A*) and biomass (*B*) at station 6 from 1976 to 1988.

Before the disastrous oxygen deficiency in 1981 the number of species was very high. In 1978 the biomass was relatively high because of a large population of adult *Abra alba*. The catastrophic oxygen deficiency in September 1981 killed most of the fauna in Århus Bay. In 1982 the almost defaunated sea bottom had been recolonized, and the number of species as well as the abundance were very high whereas the biomass was still low at this stage of the recovery process. From 1983 species richness became stable whereas abundance and biomass oscillated principally because of fluctuations in the density of *A. alba*. In comparison with the period before the oxygen depletion, the number of species was low in 1983-88; however, this is partly due to differences in the number of subsamples between the two periods.

Figure 3 shows the spatial changes in species richness, abundance and biomass in 1976, 1983, 1985 and 1988 along the transect – station 64, 71, 91, 103, 6. This transect is not linear but reflects the decreasing impact of the sewage discharge. As the current in the bay moves counter-clockwise station 6 is less affected by sewage than station 103 although station 6 is slightly nearer to the discharge point.

The sewage discharge through the pipe started in 1975 and in 1976 species richness as well as abundance remained high near the outlet. In 1983 the number of species became very low nearest to the outlet whereas the abundance was very high due to a high density of oligochaetes (*Peloscolex benedeni*). After this peak of oppor-

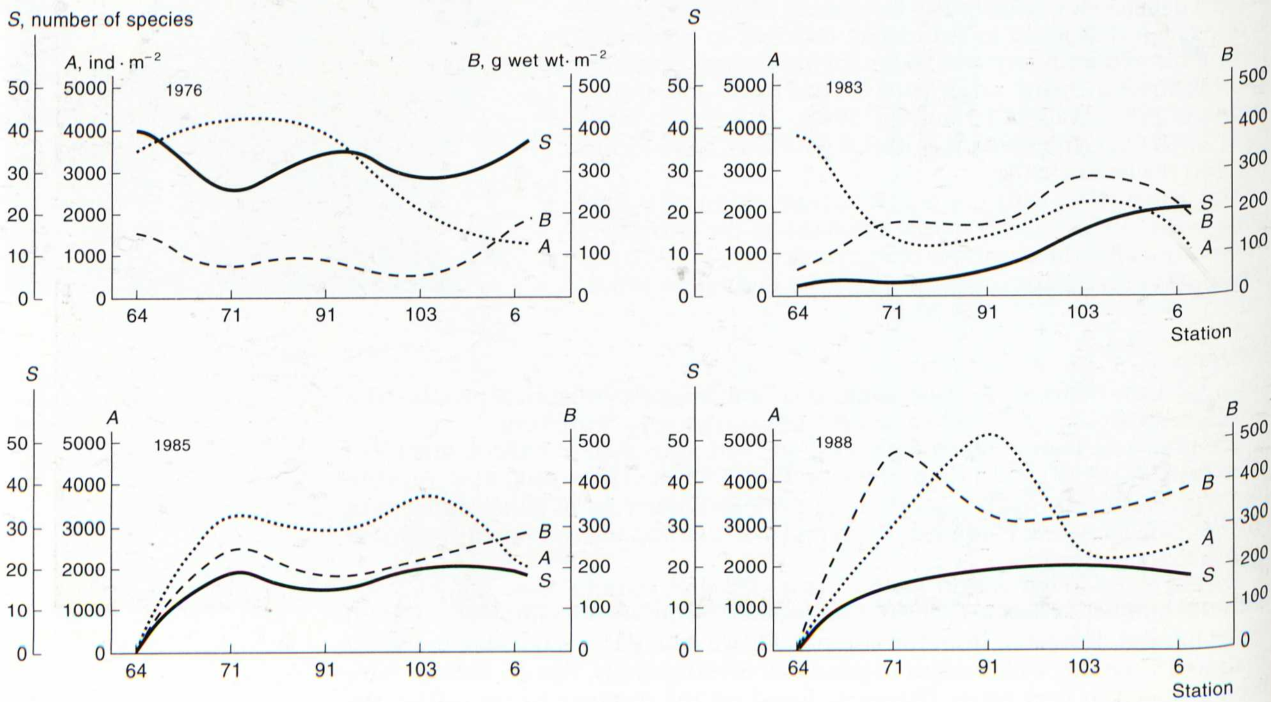


Figure 3.
Species-abundance-biomass (*SAB*) curves along a decreasing gradient of organic enrichment from left to right.

tunists, species richness, abundance and biomass increased until station 6 where all three parameters decreased. In 1985 and 1988 station 64 was nearly devoided of fauna. At some distance from the discharge point (station 71, 91 og 103) a peak in abundance and biomass could be recognized. During the period 1985-88 the abundance was significantly higher in zones 2 and 3 than in zone 4 (Table 1).

		No. of species	Abundance, $ind \cdot m^{-2}$	Biomass, w.w. $g \cdot m^{-2}$
Zone 1	1985-1988	5±4	126±143	5±9
Zone 2	1985-1988	16±4	2668±1947	198±160
Zone 3	1985-1988	19±4	2518±1084	193±93
Zone 4	1985-1988	16±4	1393±799	150±98

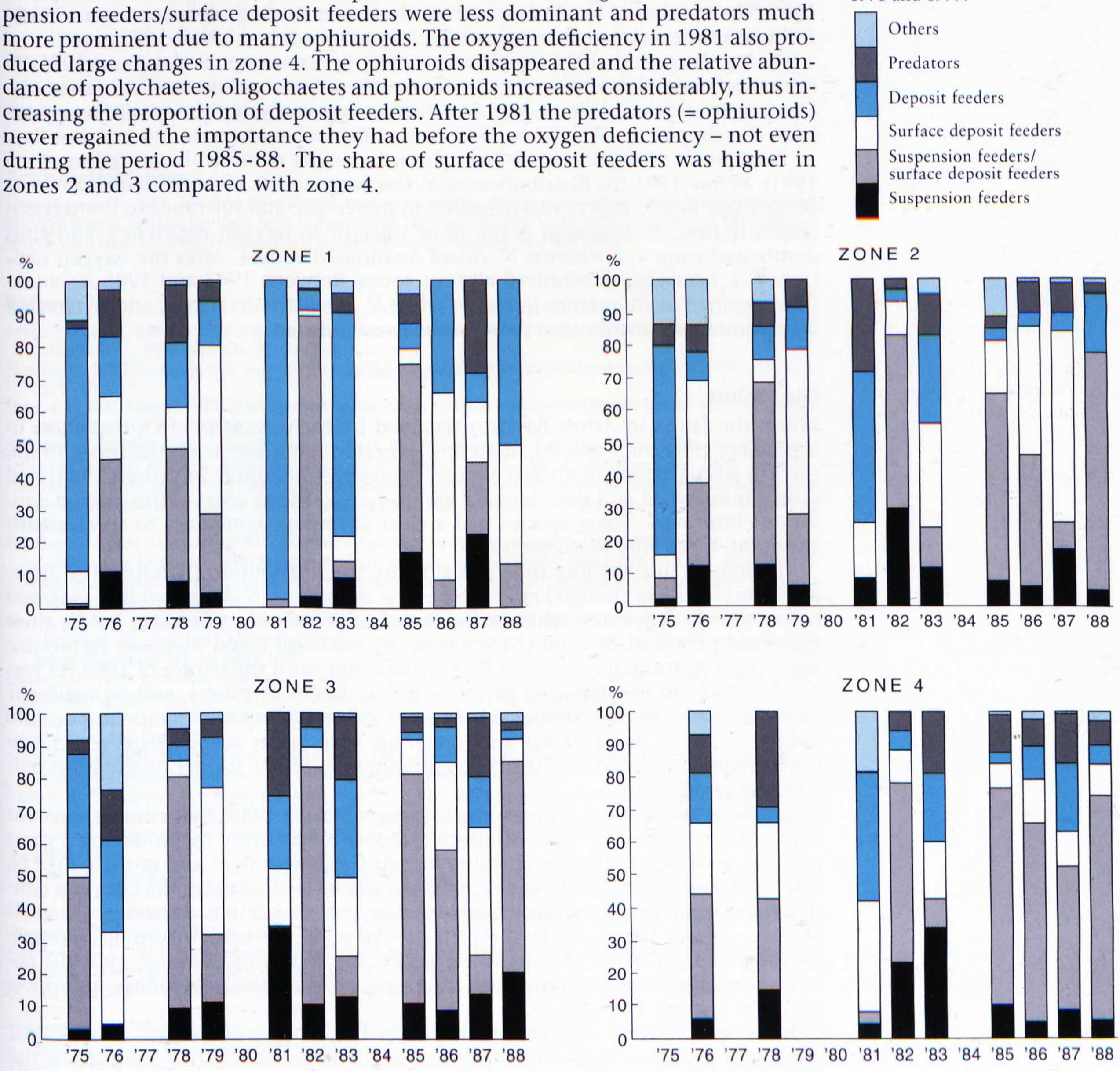
Table 1.
Mean and standard deviation for the number of species, abundance and biomass in zones 1-4 from 1985 to 1988. Number of species, abundance and biomass were significantly higher in zones 2, 3 and 4 than in zone 1 ($p < 0.0001$) during the period. Abundance was significantly higher in zone 2 than zone 4 ($p < 0.05$) and in zone 2 compared with zone 3 ($p < 0.01$).

Changes in trophic groups

Trophic relationships are influenced by the gradient of organic input (Pearson & Rosenberg 1978), and thus the relative abundance of trophic groups have been calculated for each zone (Fig 4).

Zones 1, 2 and 3 were more or less greatly affected by dredging and dumping in 1975 and 1976. The fauna was dominated by opportunistic species of polychaetes and by oligochaetes and phoronids and consequently the share of deposit feeders was high. The bivalve *Abra alba* is a suspension feeder/surface deposit feeder and in years where *A. alba* was very abundant this trophic group consequently dominated as in 1978, 1982, 1985 and 1988. The trophic structure in zone 4 was similar in 1976 and 1978, but compared with the remaining three zones the suspension feeders/surface deposit feeders were less dominant and predators much more prominent due to many ophiuroids. The oxygen deficiency in 1981 also produced large changes in zone 4. The ophiuroids disappeared and the relative abundance of polychaetes, oligochaetes and phoronids increased considerably, thus increasing the proportion of deposit feeders. After 1981 the predators (=ophiuroids) never regained the importance they had before the oxygen deficiency – not even during the period 1985-88. The share of surface deposit feeders was higher in zones 2 and 3 compared with zone 4.

Figure 4.
Temporal changes in relative abundance of trophic groups. In 1977, 1980 and 1984 no monitoring surveys were carried out. No samples were taken in zone 4 in 1975 and 1979.



Changes at species level

A more detailed picture of the faunal changes 1975-88 can be obtained by assessing changes in the abundance and occurrence of some common species.

After the O_2 deficiency *Abra alba* quickly recolonized the defaunated sea bottom and a huge amount of juvenile *A. alba* was found in 1982. *A. alba* is a volatile species and density fluctuates considerably from year to year (Arntz & Rumohr 1986). In Århus Bay the population dynamics of *A. alba* is controlled by inter- and intra-specific competition, predation, oxygen deficiency and low bottom water temperature (Larsen 1988). Although *A. alba* is sensitive to oxygen deficiency (Dries & Theede 1974) the recurrent adverse oxygen conditions in Århus Bay seem to be within the tolerance of *A. alba*. However, in the beginning of 1987 *A. alba* was subjected to both low temperature and low O_2 and most of the population died.

Corbula gibba also recolonized Århus Bay very quickly and the abundance was very high in 1982. The fluctuations in density of *C. gibba* follow the oscillations of *A. alba* to a certain degree.

Mysella bidentata re-established in zone 2 in 1982 and maintained a stable population in this zone throughout the sampling period. In zone 3 *M. bidentata* did not re-appear until 1985. As before the severe oxygen deficiency, *M. bidentata* only occurred in very low numbers in zone 4.

After the oxygen deficiency in 1981 it was about four years before juvenile *Macoma calcarea* occurred in zones 2, 3 and 4. *M. calcarea* never re-appeared in zone 1. Generally the density of *M. calcarea* decreased from zone 2 to zone 4.

Juvenile *Ophiura albida* re-appeared in the samples in 1983 apart from in zone 1. However, *O. albida* was not able to re-establish a permanent population in zones 2 and 3, and specimens of *O. albida* were only occasionally found in these zones after 1985. The number of *O. albida* in zone 4 show a decreasing tendency from 1985 to 1988 and the species never regained the importance it had before 1981.

During the periods 1911-25 (Petersen 1913; Petersen unpubl. data) and 1975-79 *Echinocardium cordatum* was a prominent member of the bottom fauna in Århus Bay. The oxygen deficiency eliminated *E. cordatum* temporarily, but the species re-appeared in the samples in 1983. Since 1985 no *E. cordatum* have been found in Århus Bay.

Two species of *Nephtys* have been studied in more detail (Fallesen & Jørgensen 1991). Before 1981 the distribution of *N. hombergii* and *N. ciliata* were almost complementary due to differences in sediment preference and tolerance to low oxygen concentration. *N. hombergii* is the most tolerant to oxygen deficiency, and thus dominated zone 1-3 whereas *N. ciliata* dominated zone 4. After the oxygen deficiency *N. hombergii* recolonized all four zones. Between 1983 and 1985 *N. ciliata* slowly gained in abundance in zone 4 while *N. hombergii* decreased, and the former complementary distribution pattern was re-established.

Discussion

When the fauna in Århus Bay was removed by the catastrophic O_2 depletion in September 1981 some species, including important ones like *A. alba* (Blanner 1982), *Corbula gibba* (Jensen 1990) and *Nephtys hombergii* (Fallesen & Jørgensen 1984) had probably spawned and their larvae were ready to settle as soon as the oxygen conditions improved. These species had a clear advantage compared to species with spawning times after the depletion.

Differences in spawning time explain why the distribution patterns of *N. hombergii* and *N. ciliata* changed after the oxygen deficiency. *N. hombergii* had spawned before the O_2 deficiency, whereas the *N. ciliata* population was killed before their spawning period in November-December. *N. hombergii* could therefore recolonize areas (zone 4) formerly occupied by *N. ciliata*. Not until the winter of 1982/83 was *N. ciliata* able to re-establish a permanent population in zone 4, and *N. hombergii* was then gradually out-competed because *N. ciliata* is a superior competitor on fine sediment, due to its larger size and longer life span under adequate oxygen conditions (Fallesen & Jørgensen 1991). Eventually in 1985 the former distribution pattern was re-established.

A. alba is known as an opportunistic species (Rainer 1985) that compensates for its sensitivity to low O_2 concentrations and low temperature by producing a great number of larvae and by its capability for rapid establishment and growth. Like *N. hombergii*, *A. alba* had larvae in the plankton when the disastrous 1981 oxygen deficiency occurred and could quickly recolonize the sea bottom. However, when *A. alba* was removed in winter 1987 it is likely that no larvae were present. Recolonization was dependent on the spawning period the following summer, and this absence of *A. alba* seems to have given other species, e.g. *Mysella bidentata*, an opportunity to increase in numbers.

Some species recovered very slowly after the oxygen deficiency. It took four years before *Macoma calcarea* re-appeared in the samples, and this seems to be the 'normal' recovery time for *M. calcarea* in Århus Bay: after removal due to dredging and dumping in 1975 *M. calcarea* did not re-appear in the samples until 1979 (Fallesen 1990).

In Kiel Bay *Ophiura albida* is reported to have a recovery time of 4-5 years (Arntz & Rumohr 1986), but in Århus Bay the recovery time seems to be about two years as specimens were found in 1983. *O. albida*, like *A. alba*, is sensitive to low O_2, and the recurring periods with adverse oxygen conditions during the 1980s probably explains why *O. albida* never regained the importance it had before 1981.

Echinocardium cordatum also re-appeared in the samples in 1983, but the species was unable to establish a permanent population, and since 1985 *E. cordatum* has not been found in Århus Bay. This species is known to be sensitive to organic enrichment (Pearson *et al.* 1985) and since 1983 the environmental conditions apparently are no longer suitable for *E. cordatum*.

On the basis of these observations the recovery process in Århus Bay can be regarded as taking about four years as regards the important species. Species richness, abundance and biomass seem to have reached a dynamic equilibrium after 1985 (Figure 2) and the same is true for the trophic structure in zones 2, 3 and 4 (Figure 4). In 1985 zone 1 has been subjected to a massive organic enrichment for 10 years and the bottom fauna had become very reduced. At some distance from the outlet (zones 2 and 3) the organic enrichment was sufficient to provide a rich food source but not large enough to cause permanent oxygen depletion. Abundance and biomass was therefore higher in zones 2 and 3 than in zone 4 which is less directly affected by the waste water.

It is obvious that the very large changes near the outlet and the organic enrichment some distance from the outlet (zones 2 and 3) are caused by the sewage discharge. However, the causes of the faunal changes in zone 4 are much more difficult to explain. It is not known to what extent the recurring oxygen deficiencies in the 1980s are generated in Århus Bay (and caused by local discharges), and to what extent they are imported from the Kattegat (and caused by the general eutrophication of Kattegat). However, the recurring oxygen deficiencies in the 1980s have led to the elimination of *E. cordatum*, a reduction of the number of *O. albida* and a severe reduction of the bottom fauna closest to the outlet.

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