Reference conditions and EQOs for aquatic vegetation and macrozoobenthos

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TemaNord 2006:510

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TemaNord 2006:510

ISBN 92-893-1290-4

Copies: Print-on-Demand

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Preface

The project RETRO - ”Reference conditions and typologies for aquatic vegetation and macrozoobenthos in the Skagerrak and Kattegat” - is an 2002-4 RTD-project funded by Nordic Council of Ministers involving partners from Denmark, Norway and Sweden. The following key issues have been addressed by the project:

- Water body classification of the open parts of the Skagerrak/Kattegat.
- Development of quantitative and qualitative ecological relationships that describe interactions between anthropogenic pressures and ecological response.
- Definition of ecological reference conditions for submerged aquatic vegetation and soft-bottom macrozoobenthos.
- Recommendations for regional monitoring and classification of ecological status for submerged aquatic vegetation and soft-bottom macrozoobenthos.

Most of the principles and ideas covered by RETRO originated from the EU Water Framework Directive, which deals with coastal water and not open waters. RETRO will support bridging the gap between coastal and open waters and thus provide a scientific basis for the future work on establishing environmental quality objectives of open marine waters.

The authors would like to thank:

- Nordic Council of Ministers in general and The Air and Sea Working Group in particular for financial support

1. Introduction

The Water Framework Directive (WFD, Anon 2000), adopted by the European Parliament and the Council in 2000, is considered to be the most important piece of European legislation in the field of water policy. The WFD provides a framework for the protection of ground water, inland surface waters, transitional waters (estuaries) and coastal waters.

Open waters are not covered by the WFD. However, information on ecological structure and functioning of neighbouring open waters as well as information of cross-boundary transports of pollution is a pre-requisite if management plans and measures for both coastal and open water are to be informed and effective. This need has been the driver behind RETRO. Therefore, a suite of WFD principles as typology (water body classification), reference conditions, functional relationships and classification of ecological status have been tested by RETRO in order to bridge the gap between coastal waters covered by the WFD and more oceanic waters like the North Sea.

Another reason for focusing on open marine water is the ongoing work in relation to an European Marine Strategy (EMS), which in a longer perspective is likely to result in an European Marine Framework Directive. Both the strategy and the future directive are based on an ecosystem approach to management. This implies that reference conditions, development of Ecological Quality Objective (EQOs) and programmes of measures will be ecosystem-based and consequently build up on our present understanding of ecosystem structure, functioning and stability. By establishing a system for classification of open water areas based on WFD principles, implementation of a marine strategy will be coherent with the strategy applied for coastal waters.

1.1 EU Water Framework Directive

The overall aim of the WFD is (1) to prevent further deterioration and protect and enhance the environmental status of aquatic systems, and (2) to promote the sustainable use of water, while progressively reducing or eliminating discharges, losses and emissions of pollutants and other pressures for the long-term protection and enhancement of the aquatic environment.

The WFD provides national and local authorities with a legislative basis for the maintenance and recovery of water quality to achieve good ecological and chemical status for all surface waters and good chemical status for groundwater. Accordingly, the WFD is considered to be the most significant piece of legislation regarding water policy produced in the last 20 years.

The coastal waters covered by the WFD are limited to the surface water on the landward side of a line, which is one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured. Open marine waters are not covered, but the WFD is likely to influence management of all marine ecosystems because all land-based inputs of pollutants will pass through the coastal zone to the open waters. The WFD requires EU Member States to develop classification systems to describe the ecological status of a given water body at a given time. These systems shall be based on information on reference conditions.

Member States shall also monitor and assess the ecological status of coastal waters. The monitoring activities shall in principle cover ecological status and chemical status, cf. Annex V of the WFD. Monitoring networks shall be established in order to obtain a coherent and comprehensive overview of ecological and chemical status and ecological potential. The networks shall be operational by January 1st 2007 at the latest.

Monitoring shall take place in the coastal waters downstream of each river basin (catchment area) and permit classification of water bodies in five classes consistent with the normative definitions of ecological status.

Monitoring networks shall include both surveillance monitoring and operational monitoring. Surveillance monitoring shall be carried out in areas where the ecological status has been established to be either high or good. The objective of operational monitoring is to establish the status of those water bodies identified as being at risk of failing to meet their ecological objectives, and assess any change in the status of such water bodies. In some cases monitoring networks should include investigative monitoring in areas where i) reasons for not fulfilling ecological objectives are unknown, ii) the ecological objectives are not likely to be met and operational monitoring has not already been established. Investigative monitoring shall be carried out to ascertain the magnitude and impacts of accidental pollution, and shall inform the implementation of measures for achieving the ecological objectives and specific measures to remedy the effects of accidental pollution.

Monitoring networks shall be based on variables/indicators that are indicative of the status of each relevant quality element (biological, hydromorphological or physio-chemical).

The assessment of ecological status of a specific water body will fall into one of five classes (categories): high, good, moderate, poor or bad. The status classes high and good are in general considered to be acceptable. If the monitoring indicates that the ecological status is not acceptable (moderate, poor or bad), the competent authorities have to implement management plans. These plans should include measures, which will result in at least good ecological status before 2015. This is in terms of eutrophication a very short timeframe, due to time lags, internal pools etc. But before deciding on which strategies to choose and which measures to implement, it is critical to understand ecosystem functioning in general.

When it has been confirmed which pressure is responsible for not achieving at least good ecological status, the competent authorities can decide which strategies and measures are relevant. Without a starting point, in practice information on reference conditions and functional relationships, management plans risk having a wrong focus and failing to meet the overall objective of achieving at least good ecological status.

1.2 Objectives and focus of RETRO

The overall objective of RETRO is to develop, test and validate a methodological approach to define and characterise type areas of selected elements of the ecosystems in the open parts of the Skagerrak and Kattegat.

The objectives of RETRO have been selected because the EU Water Framework Directive requires that the ecological state of all coastal waters is quantified by first identifying appropriate type areas (typology) and for each of the type areas establish reference conditions, corresponding to pristine conditions, for different quality elements.

As quality elements, we focus on submerged aquatic vegetation and macrozoobenthos because these organisms are stationary, they respond to time integrated anthropogenic pressures and time series data are available. The ecological state of each quality element is referenced to the pristine condition. Large areas of the Skagerrak and Kattegat have, however, been strongly affected by anthropogenic activities such as nutrient loading, pollution and mechanical impact. Consequently pristine reference conditions can not be identified and measured directly in this region. An alternative method to derive reference conditions is to develop functional relationships that relate anthropogenic pressures to ecosystem responses.

Development of simple conceptual models of the relations between anthropogenic pressure and the functioning of benthic ecosystems in the open parts of Skagerrak and Kattegat are reached through synthesis and analysis of existing monitoring data and other available information in the region. The relationships are quantitative in nature, will use numerical indicators and indices, and are based on current ecological concepts. The partners have access to physical, chemical and biological data from all national monitoring programs in the region. The vast amount of monitoring data collected in the region in the past 20-30 years has not previously been systematically analysed across national borders. The analysis and synthesis of data performed in RETRO will, thus, represent a major scientific achievement and improve our understanding of ecosystem functioning with special empathise on selected quality elements: submerged aquatic vegetation and soft-bottom macrozoobenthos.

1.3 Marine eutrophication

The ecological status of the coastal and open waters of the Skagerrak and Kattegat deviates in many areas from the reference conditions (OSPAR 2003, HELCOM 2001). The impaired ecological status is to a large extent caused by five factors: i) fishing and hunting (top-down control), ii) pollution (nutrients, contaminants, radioactive substances etc.), iii) mechanical destruction of habitats (constructions, extraction of materials), iv) introduction of indigenous species, and v) global change, cf. Jackson et al. (2000).

The ecological responses of the above pressures are in principle covered by the WFD. However, RETRO focuses on key indicators, which are closely associated with nutrient enrichment and eutrophication. This is of course an over-simplification, but it can be argued and documented that coastal eutrophication is widespread and a very visible effect of human activities in the North Sea/Baltic Sea catchment area and perhaps the main reason, that the present ecological status in many areas is far from being good.

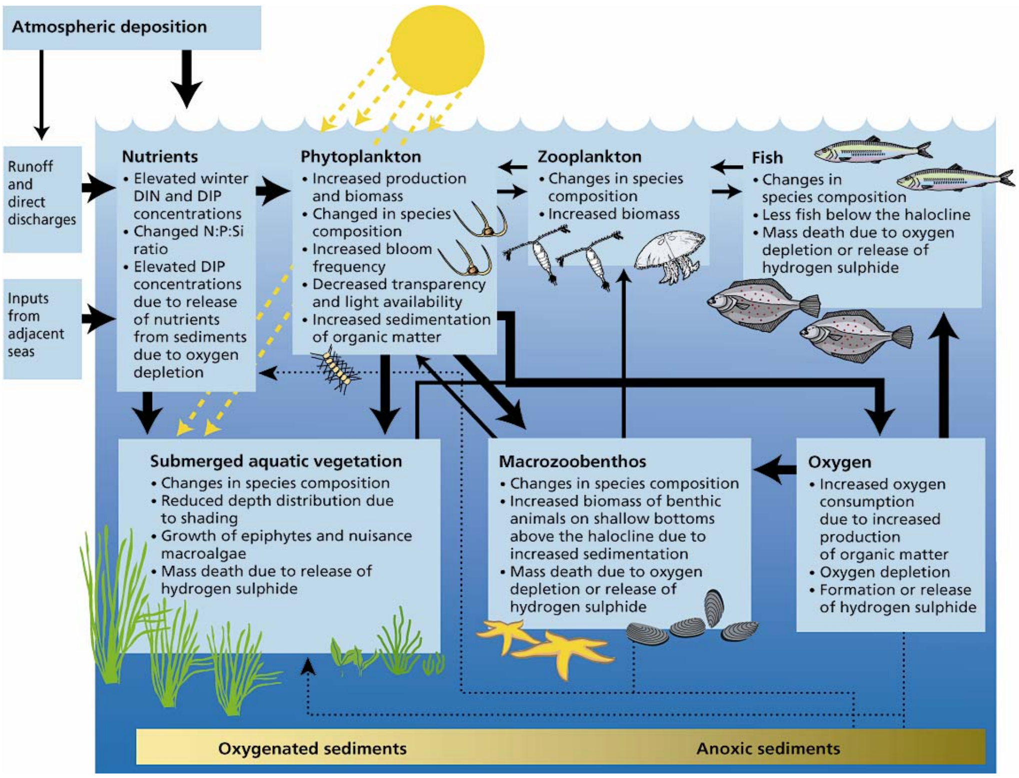
There is at present no single and globally accepted definition of marine eutrophication. The word “eutrophication” has its roots in Greek where “eu” means “well” and “trope” means “nourishment”. Nixon (1995) defines marine eutrophication as “an increase in the supply of organic matter”. The supply is not restricted to pelagic primary production, but also includes bacterial production, primary production of submerged aquatic vegetation, inputs of organic matter from land via rivers and point sources as well as the net advection from adjacent waters. The advantage of this definition is that it is short, simple and does not confuse causes and effects. The limitations of the definition are twofold. It does not take structural or qualitative changes due to nutrient enrichment into account, and it is difficult to make fully operational since the majority of existing marine monitoring programmes seldom include all the variables needed to estimate the total supply of organic matter to a given body of water. Gray (1992) focuses on the direct effects of nutrient enrichment on productivity, the secondary effects where the produced organic material is not consumed by grazers, and the extreme and ultimate effects, which includes the growth of macroalgae, oxygen depletion and mortality of species. Richardson & Jørgensen (1996) focuses both on the process, the associated effects of nutrient enrichment and natural versus cultural caused eutrophication. Prudently, Richardson & Jørgensen point out, that when we speak of eutrophication it is cultural eutrophication that, which is caused by anthropogenic activities, which is of interest.

A number of EU Directives also define eutrophication. In the Urban Wastewater Treatment Directive eutrophication means: "The enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned" (EU 1991). The Nitrates Directives definition is almost identical, except that it is restricted to eutrophication from agriculture (EU 1991). The differences between the various definitions leave the definition open for interpretation. However, this is not critical, as long as there is a common understanding of the effects and agreement upon the acceptable levels of deviations from a healthy marine environment. Eutrophication should be seen both as a process and as a continuum, since the background values may vary from area to area due to natural causes. For example, the productivity in the open Baltic Sea is relatively low compared to the southern and eastern parts of the North Sea. Therefore, when speaking of eutrophication, both the initial process and direct effects (sensu Nixon) and the derived primary and secondary effects should be taken into account, cf. box 1 and Figure 1.1.

Box 1 Definition of coastal eutrophication (from Ærtebjerg et al. 2003).

Eutrophication is the enhanced inputs of nutrients and organic matter leading to changes in primary production, biological structure and turnover and resulting in a higher trophic state. The causative factors are: elevated inputs of nutrients from land, atmosphere or adjacent seas, elevated winter DIN- and DIP concentrations, and increased winter N/P-ratios compared to the Redfield Ratio. In the case of marine waters, the primary or direct effects include: increased primary production, elevated levels of biomass and chlorophyll a concentrations, shift in species composition of phytoplankton, and shift from long lived macroalgae to short lived nuisance species. The secondary or indirect effects include increased or lowered oxygen concentrations, and changes in species composition and biomass of zoobenthos. Low oxygen concentrations in the bottom water (oxygen depletion, hypoxia) can further affect the fish, benthic invertebrates and plants. Total oxygen depletion (anoxia) can result in the release of hydrogen sulphide from the sediment, causing extensive death of organisms associated with the sea floor. As only a few species can survive these extreme conditions, and as it takes time for plants and animals to recolonise damaged areas, eutrophication can result in impoverished biological communities and impaired conditions.

Figure 1.1



Conceptual model of marine eutrophication with lines indicating interactions between the different ecological compartments. Nutrient enrichment results in changes in the structure and function of marine ecosystems as indicated with bold lines. Dashed lines indicate release of hydrogen sulphide (H_2S) and phosphorus, which is positively linked to oxygen depletion. From Ærtebjerg et al. (2003).

Figure 1.1 illustrates in a simplified way the effects and consequences of nutrient enrichment and eutrophication in coastal marine environments. The model is general and does not take into account the difference between shallow waters and deep waters. In general, the Secchi depth (turbidity) of shallow waters in Skagerrak and Kattegat is good and light can reach the sea floor. Submerged aquatic vegetation can thrive on these substrates as long as light is not a limiting factor. Light can not reach the deeper parts of the Skagerrak and Kattegat and consequently there is no macrovegetation in these areas. Soft-bottom macrofauna can be found in both shallow and deep waters. In shallow waters, fauna and flora very often form highly diverse communities. In deepwater fauna often occur without any macrovegetation.

Why does RETRO focus on submerged aquatic vegetation? Submerged vegetation is a robust indicator of ecological quality and of change in the surrounding environment because the vegetation has a relatively long lifetime and therefore reflects an integrated response to physical and chemical conditions in the environment.

The success of the vegetation in a given location depends on the balance between growth- and loss processes. Light and nutrients are main regulators of the growth of submerged macrophytes, while the loss of plant biomass is mainly due to annual life cycles, physical disturbances (e.g. storms, ice scouring, fishing with scraping equipment), grazing and disease. Nutrients affect the vegetation through its stimulating effect on phytoplankton growth that leads to increased light attenuation in the water column (Nielsen *et al.* 2002a) and thereby limits the depth range of the vegetation (Nielsen *et al.* 2002b).

A reduction in the vegetation cover may lead to an increased resuspension of sediments that further reduces the light levels and thereby generates a vicious cycle of vegetation decline (Duarte 1995). Increased nutrient loading also stimulates the growth of opportunistic macroalgae and epiphytes thereby changing the dominance patterns of the vegetation and further shading the perennial seagrasses and macroalgae (Pedersen 1993, Duarte 1995, Middelboe & Sand-Jensen 2004). The total number of macroalgae in the estuarine fjords is also related to nutrient loading as well as to the size of the fjords, the salinity and the availability of substrate (Middelboe *et al.* 1998). Moreover, nutrient loading can also indirectly affect the vegetation by enhancing the risk of oxygen deficit, which can be fatal for e.g. eelgrass (Greve et al. 2003).

Why does RETRO also focus on soft-bottom macrobenthos? Many benthic fauna species play a key role in the marine ecosystem as filter feeders and degraders of organic material produced plankton and macrophytes. They also comprise an important food resource for higher trophic levels such as fish. In shallow waters the benthic fauna metabolizes a large part of the pelagic production. This is particularly the case for the filter feeders, which are potentially able to control the pelagic phytoplankton in many areas (Cloern 1996 and Kaas *et al.* 1996). The benthic fauna in shallow waters is very easily affected by stochastic events such as oxygen deficit and ice winters, with considerable resultant variations in biomass. The fluctuations in benthic biomass are of great significance for the ecosystem's biological structure and hence for the impact of eutrophication in these waters.

1.4 Outline of the report

The introduction outlines the background and rationale behind RETRO and explains why reference conditions and ecological classification are important tool for management of ecological quality in the Skagerrak/Kattegat area.

Chapter 2 focuses on water body classification, which is almost similar to typologies *sensu* the WFD.

Chapter 3 deals with submerged aquatic vegetation, analyses existing macroalgal data and establish models which couples macrophyte communities and two selected species with environmental data.

Chapter 4 deals with soft-bottom macrozoobenthos and analyses patterns in species abundances.

Chapter 5 focuses on management and classification of ecological status in the open parts of the Skagerrak/Kattegat area. Suggestions for improvements of the monitoring and assessment programmes are presented and discussed.

Chapter 6 includes summary and conclusions together with a few recommendations for further Nordic co-ordination and collaboration in relation to co-ordination of principles and tools for assessing the ecological status of marine waters.

The following persons have contributed to the report:

- Chapter 1: Jesper H. Andersen and Jens Kjerulf Petersen
- Chapter 2: Frithjof Moy, Jan Magnusson
- Chapter 3: Karsten Dahl, Jan Karlsson, Frithjof Moy
- Chapter 4: Lars-Ove Loo and Alf B. Josefsson
- Chapter 5: Jens Kjerulf Petersen, Jesper H. Andersen, Karsten Dahl, Alf Josefsson and Lars-Ove Loo
- Chapter 6: Jens Kjerulf Petersen, Jesper H. Andersen, Per Nilsson and Ole Schou Hansen

Preface and references have been written and compiled by Jesper H. Andersen and Jens Kjerulf Petersen. The annex has been compiled by Karsten Dahl

2. Water mass classification

Why “Water mass classification”? Because the EU Water Framework Directive (WFD) recognises that the ecological character of waters will vary according to their different physical regimes (Annex II 1.1(ii)), for instance the biological communities on an exposed Atlantic rocky shore will differ from a fjord or a bay in the Baltic due to different oceanographic conditions. The WFD introduce a set of physical, chemical and morphological factors to define (and describe) the type of natural environment. The purpose of assigning water bodies to a physical type is to ensure that valid comparisons of its ecological status can be made. For each type, reference conditions must also be described as these form the ‘anchor’ for classification of the water bodies’ status or quality.

The water body is the management unit of the Directive and by "water body" means a discrete and significant element of (surface) water (Article 2(10)). Identification of water bodies is of major importance for the WFD because water bodies represent the units that will be used for reporting and assessing compliance with the Directive’s principal environmental objectives.

In the Kattegat-Skagerrak region the high salinity water of the North Sea meets the low salinity water of the Baltic, and a permanent front is present in the area. The frontal movements are controlled by the passage of atmospheric pressure systems and by run-off to the Baltic. In this region there are several dynamic and stationary physical factors that are thought to control benthic community features. The dynamic physical features include light, up- or downwelling, salinity and stratification. The challenge in this project is to map the dynamic features of the Kattegat-Skagerrak and to investigate how the physical variability affects the establishment of benthic communities and the establishment of type specific water bodies in the context of WFD.

2.1 Specific objectives

The key issue addressed in this chapter is characterisation of typologies (water body classification) for the different open areas of the Skagerrak and the Kattegat with focus on salinity, morphology (depth, substrate etc.) and transport (currents, stratification, upwelling etc.). The work includes:

- Assimilation and distribution of data (depth, salinity, temperature, substrate , Secchi depth),

- Map mean surface and bottom salinity and temperature fields and their standard deviations,
- Calculation of stratification and light availability (Secchi depth) indices,
- Map the size distribution of bottom substrates.

The aim of typology is to produce as simple a physical typology as possible that is both ecologically relevant and practical to implement.

2.2 Materials and methods

In this project we have used existing datasets to map the dynamical physical features. The datasets used in this project include salinity, temperature, light-depth, bottom depth and bottom substrate. (The available data only allows us to quantify the light availability, salinity distributions and stratification. Up- and downwelling is not quantified.)

Reference literature used:
- *Horizontal guidance document on the application of the term "water body" in the context of the Water Framework Directive (Guidance document no 2)*
- *Guidance on typology, reference conditions and classification systems for transitional and coastal waters (Guidance document no 5)*

Typology according to WFD: Water types or typology are defined by a given set of obligatory and optional factors to be used by the member states to ensure a common understanding and water type definition. Factors are given in Table 2.1.

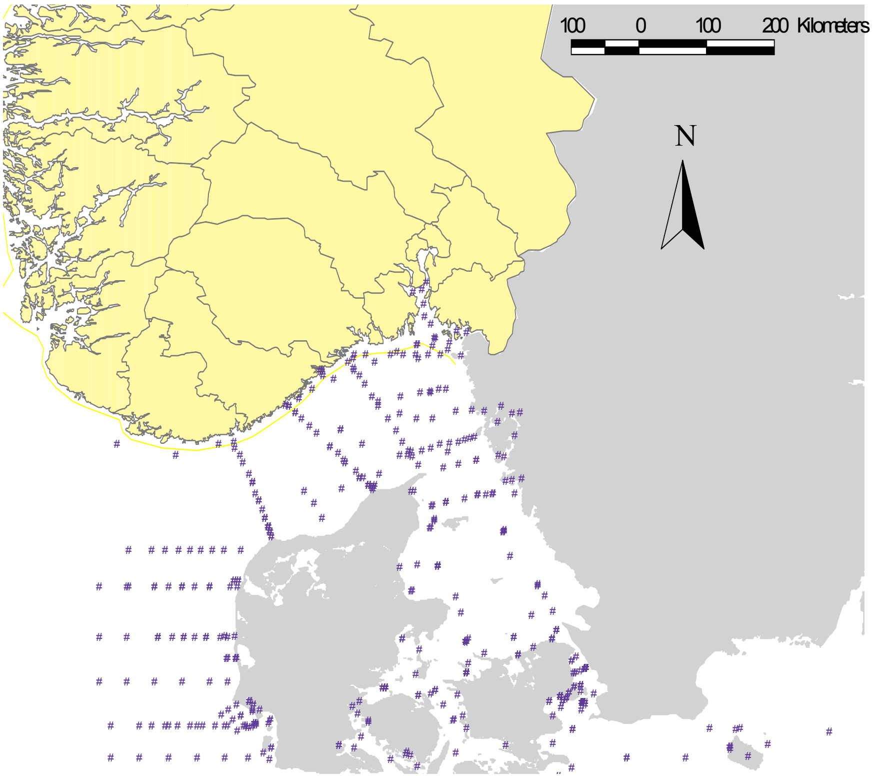
As far as possible the water body classification was done according to the recommendation given in the Guidance document.

Data availability: A total number of 450 hydrographical/chemical stations were available for RETRO evaluation in the Skagerrak / The Kattegat region (Figure 2.1). From this database 80 stations were selected for main water body classification according to WFD obligatory/optional factor, and remaining data were used on necessity. In addition measured light depth data (Secchi depth) were used to define shallow sea bottom areas with sufficient light for potential growth of sea grass or macroalgae. Secchi depth data were delivered by ICES.

Table 2.1. Obligatory and optional factors for defining water types

Type	WFD Annex II System A	System B and Guidance document
Eko region	Barents Sea Norwegian Sea North Sea Baltic Sea Atlantic Ocean Mediterranean Sea (Map B in Annex XI)	Latitude Longitude
Obligatory factors	**Salinity: yearly average** < 0.5 ‰ fresh water 0.5 to <5 ‰ oligohalin 5 to <18 ‰ mesohalin 18 to <30 ‰ polyhalin 30 to <40 ‰ euhalin **Tidal range: mean tidal amp.** < 2 m micro tidal 2 - 4 m meso tidal > 4 m macro tidal	**Salinity: yearly average** < 0.5 ‰ fresh water 0.5 to <5-6 ‰ oligohalin 5-6 to <18-20 ‰ mesohalin 18–20 to <30 ‰ polyhalin > 30 ‰ euhalin **Tidal range: mean spring tidal range** < 1 m micro tidal 1–5 m meso tidal > 5 m macro tidal
Optional factors	**Depth: average depth** Shallow <30m Intermediate 30 – 200m Deep water >200m	**Depth:** Shallow <30m Intermediate 30–50m Deep water >50m
		Exposure: Extremly Exposed Very Exposed Exposed Moderatly Exposed Sheltered Very Sheltered
		Mixing Permanently Fully Mixed Partially Stratified Permanently Stratified
		Residence Time Short = Days Moderate = Weeks Long = Months to Years
		Current velocity Strong >3 knop Mod. 1–3 knop Weak <1 knop
		Substratum Hard (rock, boulders, cobble) Sand – gravel Mud Mixed sediments

Figure 2.1 Map showing location of a total dataset of 450 hydrographic/chemical stations available for RETRO evaluation and typology classification.



2.3 Results

Salinity: First obligatory factor for defining water mass type (typology) is salinity. Salinity defines the physical limit for the biological potential to be found in an area. All species are more or less tolerant or dependent on salinity and fluctuations in salinity.

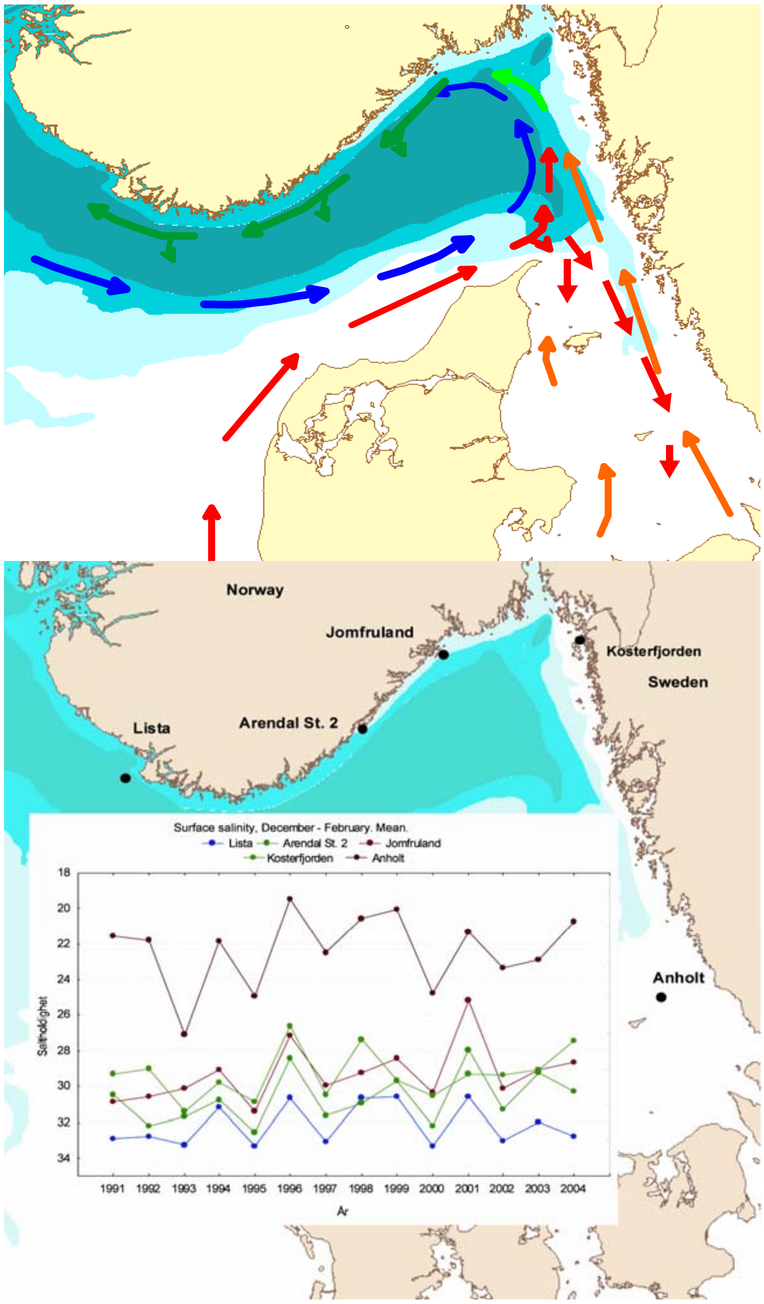
In the Kattegat-Skagerrak region water with high salinity from the Atlantic and the North Sea meet the low salinity water from the Baltic (Figure 2.2) and mix locally with fresh water from river discharges and run-off from land. Due to different density water with lower salinity floats on top of more saline water and the result is a stratified water column with different water masses on top of each other.

In east Skagerrak and the Kattegat shallow areas down to water depth of approximately 15 m consist of brackish water with salinity less than 30 (polyhaline, Table 2.1)(Figure 2.2). The surface water along the Norwegian Skagerrak coast is mainly euhaline but may become polyhaline during spring – summer due to high river discharges. North Sea water with salinity between 30 and 35 (and temperature usually between 3°C and 16°C) dominates the water masses from 15 m depth and down to approximately 200 m depth. Below 200 m depth (mid Skagerrak area) the water origins from the Atlantic and has salinity above 35 (temperature between 5.5°C and 7.5°C) and defines the physical and chemical environment for macrozoobenthos in the deep central part of Skagerrak.

Figure 2.2

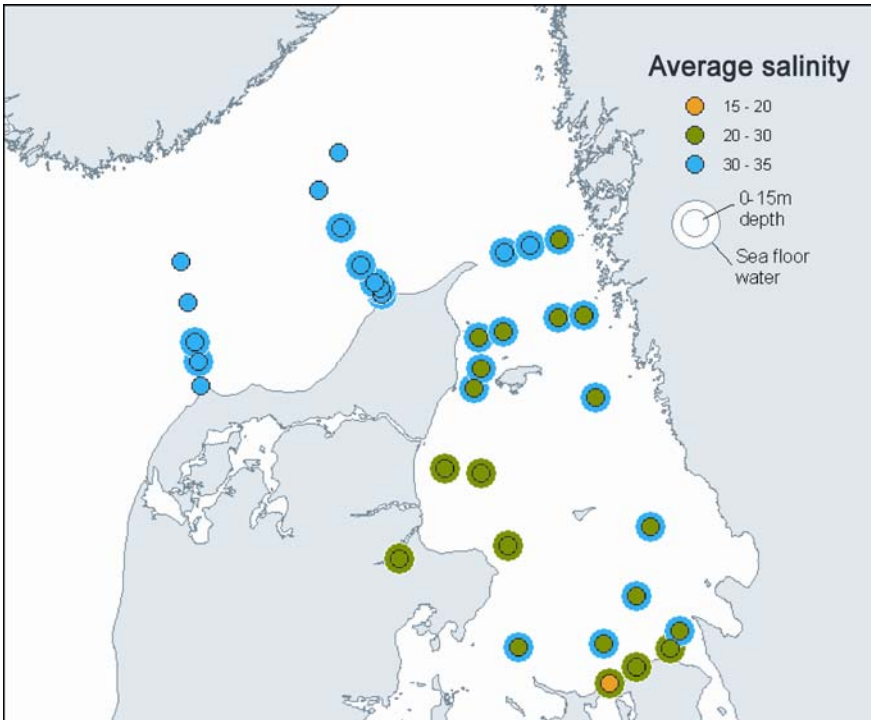
a

b



a) Major currents in the Skagerrak – Kattegat. Arrows: Orange = Baltic low saline water . Red = North Sea euhaline water. Blue = Atlantic euhaline water. Green = mixed water. b) Average surface (0-10m) winter (December-February) salinity measured at Anholt (the Kattegat), Kosterfjorden (east Skagerrak, Sweden), Jomfruland (east Skagerrak, Norway), Arendal (mid Skagerrak, Norway) and Lista (North Sea).

Figure 2.3 Average surface salinity (center ring colour) and sea floor water salinity (outer ring colour) in The Kattegat and southern Skagerrak



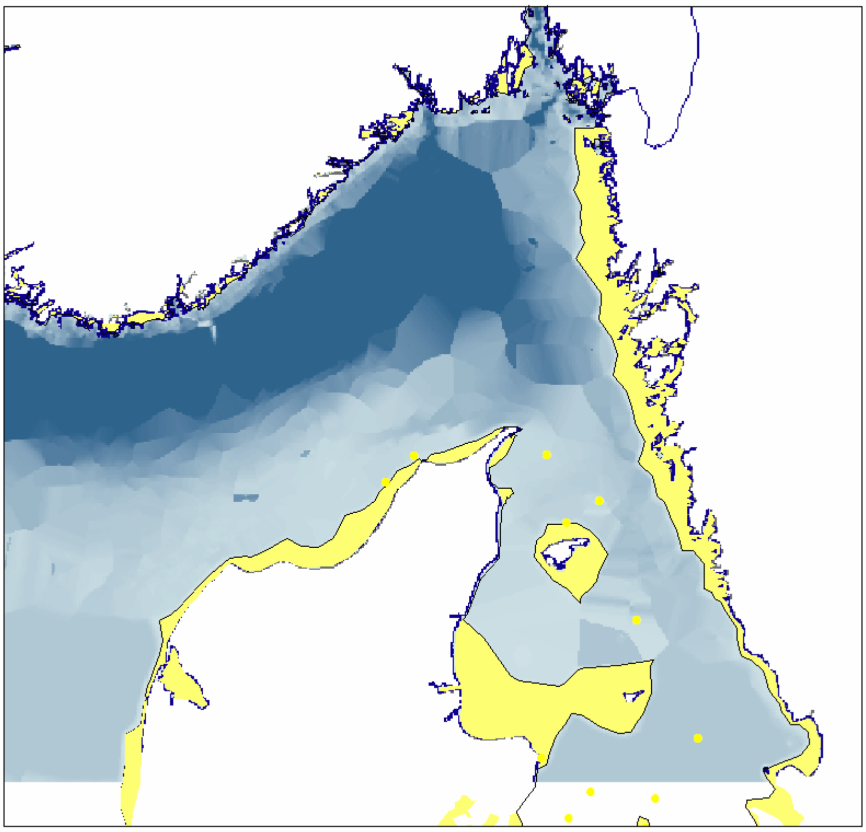
The characteristic, permanent stratified water column in the Kattegat has to be reflected in the water body classification. The pattern is visualised in Figure 2.3 where the colour of the outer ring reflects high salinity in the bottom water while the colour of the centre ring reflects brackish surface water.

On the border between Skagerrak and the Kattegat a permanent front between Baltic and North Sea water is created. The frontal movement are controlled by the passage of atmospheric pressure systems and by run-off to the Baltic and is therefore variable.

As a general pattern there is a stronger influence by North Sea water even in shallow areas of the north west part of the Kattegat (north of Læsø) compared to the Swedish side of the Kattegat (Figure 2.3). This pattern is also included in the water body classification.

Sea bottom depth: The WFD recommend the water masses to be classified according to 3 or 4 depth classes: <30m, 30–50m, 50–200m and >200m. In respect to typology, shallow areas with possible vegetation of sea grasses or macroalgae may be a distinct type and water with depth less than 30m is suggested as a general guidance. Sea grass meadows or macroalgae vegetation are dependent on sun light and we have therefore included light penetration to identify sea floor areas with potential growth of vegetation (Figure 2.4) based on light measurements (Secchi depth). The major sea floor of Skagerrak and the Kattegat is below light penetration depth.

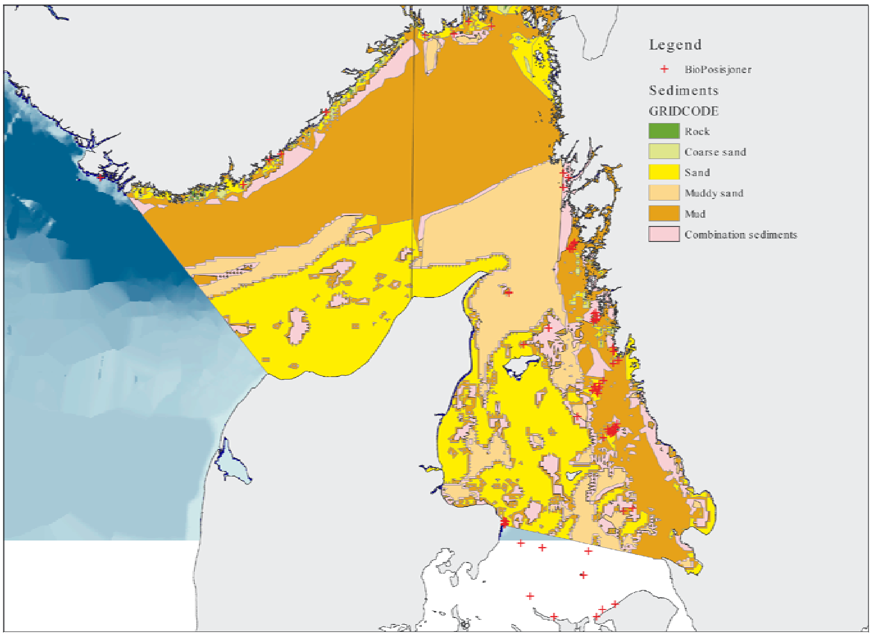
Figure 2.4 Sea floor depth (darker colour is deeper) and shallow areas with sun light (yellow areas) in Skagerrak and the Kattegat (data modelling).



Soft bottom communities are significantly dependent on the water masses nourishing the fauna and consequently strongly depth dependent, especially in the Skagerrak-the Kattegat area where different water masses are stacked on top of each other. Main fauna pattern correlates with water masses dominated by Baltic water, North Sea water and Atlantic water, i.e. shallow areas down to 15m, areas between 15 and 200m and areas below 200m, respectively.

Substratum type: Substratum type is a strong factor modulating the bottom communities and 4 substratum types is recommended in the WFD: Hard (rock, boulders, cobble), Sand-gravel, Mud, and Combination sediments.

Figure 2.5 Substratum types generated from bottom samples (modelled). Red crosses indicate areas with rocks and boulders with macoalgae locations.



In the sea floor model (Figure 2.5) 6 sediment classes (according to EUNIS) was used and the sediment type 'muddy sand' was a distinct part of the Skagerrak - Kattegat.

Large areas of Skagerrak and the Kattegat consist of sand or muddy sand bottom while hard bottom (rocks and boulders) is only found on a few stone reefs in the southern Kattegat and the Skagerrak and on the outer coastline of Sweden and Norway. Most of the Swedish and Norwegian hard bottom areas fall within their national WFD borders, but vegetation data from their outermost coastline is nevertheless included in the vegetation analyses.

Water mass classification: To sum up, there are several possible solutions to water mass classification of Skagerrak and Kattegat. Salinity is the only obligatory factor for this region. Depth and substratum are important optional factors modulating the biology, but the heterogeneity in the area (conf. figure 2.4 and 2.5) add a complexity that violate the purpose of typology, namely to ensure valid comparisons of ecological status of water bodies. From an administrative point of view, few water types provide a better tool if they reflect real environmental conditions controlling the ecology. Based on this, 4 types may be identified in the off-shore Skagerrak – Kattegat area (Figure 2.6). Two of the types are characterised by euhaline salinity (> 30) but with water from different origin that effects the biology: Atlantic water and North Sea water. One type is stratified with polyhaline (salinity 20–30) surface water and euhaline bottom water, and the fourth type is only polyhaline. These types are described in table 2.2. These four water types may be used to predict reference conditions in aquatic vegetation, macrozoobenthos and plankton communities (not included in this project). Within the water types there is a mosaic of substratum types and depth range that in addition must be considered in prediction of biological composition within a given location.

Figure 2.6 Water body classification of Skagerrak and the Kattegat.

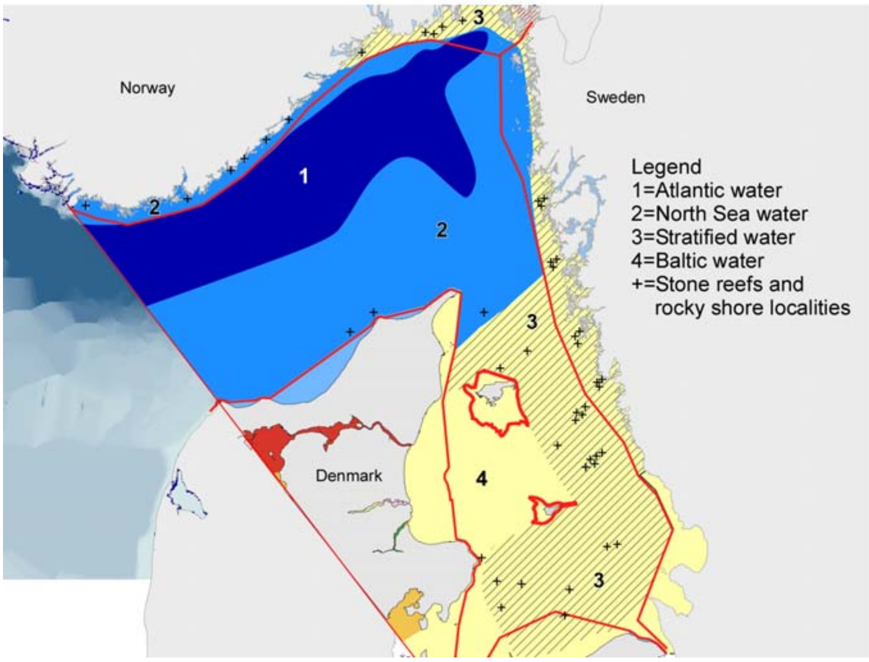


Table 2.2. Water body classification of Skagerrak and the Kattegat.

	Type	Characteristics			Location
		Salinity	Depth m	Water mass and substratum	
1	Atlantic water type	Euhaline	>200	Atlantic water below 100-200m, North Sea water above. Substratum: mud	Central area of Skagerrak with depth from 200 to more than 600m
2	North Sea water type	Euhaline	0-200	Dominated by North Sea water. Substratum: mix of mud, sand and rocks	Costal areas of Skagerrak down to 200m
3	Stratified Baltic/North Sea water type	Poly-haline/ Euhaline	0-200	Brackish surface water and North Sea bottom water. Substratum: mix of mud, sand and rocks	Mid Kattegat and coastal areas of Sweden and Norway
4	Baltic water type	Poly-haline	0-30	Brackish water dominated Baltic water. Substratum: mainly sand bottom	Danish shallow Kattegat coast

2.4 Discussion

The EU Water Framework Directive (WFD) recognises that the ecological character of waters including the benthos will vary according to their different physical regimes. The WFD introduce obligatory and optional physical, chemical and morphological factors to define and describe types of natural environments. For each parameter added to the definition several water types are created, requiring unique definition including reference condition. Obvious there is a trade off between exactness and manageable number of water types. The analyses showed that even though substratum is essential for defining benthos communities the heterogeneity as displayed in figure 2.5 makes it practically impossible to implement substratum to water mass classification and at the same time maintain the overall objective of both typology and the WFD.

3. Submerged aquatic vegetation

Macroalgal vegetation is an important biological component on reefs and rocky seabeds in the shallow transitional waters between the North Sea and the Baltic area. The algal communities function as important primary producers and the canopy hosts a huge variation of sessile fauna. The canopy also provides shelter, nursing and feeding grounds for fish and other mobile fauna.

The algal vegetation is most often fixed to stable substrates and may have life spans ranging from months to years depending on species. This gives macroalgae a great potential as a bioindicators integrating the environmental conditions of a given locality over a long timespan.

3.1.1 Macroalgae in the Skagerrak-Kattegat area

Algae communities in the Skagerrak and the Kattegat grows in a transitional area between the fully marine Atlantic Ocean and the brackish Baltic sea. The influence of tides are sparse (0.2-0.3 m) while the water level may change about a metre or more due to wind or changes in the atmospheric pressure. In the eastern part of the area and along the coasts of Sweden and Norway a pycnocline prevails at depths of 10-20 m, being more stable in the eastern Kattegat. The pycnocline is more pronounced during late-spring-summer. Above the pycnocline the salinity varies between 15-25 psu (SE Kattegat) and 20-30 psu (NE Skagerrak), below between 32-34 psu and 32-35 psu, respectively.

The number of macroalgal species decreases from about 200 in the north-east Skagerrak to approximately 150 at the entrance of the Baltic Proper (Nielsen *et al.* 1995), partially as a result of decreasing salinty. The major part of the reduction in species numbers takes place over a relative short geographic distance in the Sound and Belt Sea area (Nielsen *et al.* 1995).

The presence of hard substrate is the most important factor for development of macroalgal vegetation. On most localities in the Danish monitoring program and in the Swedish part of the Kattegat, coastal as well as open waters, the lack of hard bottom substrate *per se* puts a limit to the maximum depth distribution of benthic algal communities. In Norway and in the Swedish part of the Skagerrak, bedrock and boulders usually reaches depths unsuitable for algal growth.

The vast majority of hard substrate on off-shore localities in the Kattegat consists of pebbles, gravels and boulders. The stability of the substrate is an important factor in structuring the algal community and is also important for the development of the total biomass. Small stones in the photic zone, which are often turned around by waves or currents are dominated by opportunistic algal species and have less biomass than stable boulders which are often dominated by perennial algal species (Dahl et al 2001). In Skagerrak the majority of off-shore hard bottom localities (and all contributed Skagerrak data) consist of stable bedrock and boulders.

Given the necessary substrate for macroalgae, the depth distribution of the vegetation is assumed to reflect a balance between growth, as a result of individual photosynthesis, and colonisation of new individuals on one hand, and a number of different loss processes including respiration, grazing or physical stress like waves or currents on the other.

Photosynthesis is regulated by the presence of nutrients and light. The light conditions at the seabed depend on solar irradiation at the water surface and its penetration through the water column.

Data from the Norwegian and Danish national monitoring programs shows that below the halocline nutrient limitation is a rare problem for macroalgae in the Kattegat-Skagerrak (Moy et al, 2004). In the lower water column, nutrients are constantly re-mineralised from decaying plankton organism and at the same time competition from the pelagic primary producers are small.

Light is assumed to be the most important factor controlling the macroalgal community, as long as suitable substrate is available. An inorganic component of suspended particles and biological components of plankton and particulate and dissolved organic matter cause the light extinction. The nutrient concentration in the photic zone, and in particular above and in the halocline, may indirectly influence growth conditions of the benthic macroalgae communities by controlling the plankton production and biomass. An important component of dissolved organic matter in the water column in the shallow Kattegat waters is so called “yellow substances” (humic acids). The yellow substances are of terrestrial origin, and by their different properties and proportions they characterize the different watermasses in the Skagerrak and the Kattegat. Three unpublished investigations made in Kattegat and Skagerrak showed that “yellow substances” caused 11-20% of the light absorption in the upper 10 meter of the water column. The water itself caused 43-52% of the absorption. Absorption and scatter of particulate organic matter caused the remaining part (Stig Markager, NERI *pers. comm*).

Light penetration measured as mean Secchi depth is generally between 6 to 9 m in both Skagerrak and Kattegat (Aarup 2002) with Secchi depth increasing from the near-shore to off-shore waters. Generally there are no major differences between light penetration characteristics in Danish, Swedish or Norwegian waters.

There is a relationship between light penetration in the water column and the depth limit for macroalgal growth. The typical depth limit for large brown algal species is where 0,5% of the light at the surface is still present. Vegetation of thin foliose algal species ceases at 0,1% of the surface radiation, while crust forming species can manage to grow at levels as low as 0,03% of the surface level (Markager and Sand-Jensen, 1992). The maximum depth for erect macroalgae (*Coccotylus truncata*, *Delesseria sanguinea*, tetrasporophyte of *Bonnemaisonia hamifera*) for localities in the open sea in the central part of the Kattegat recorded so far is 29 m at Lilla Middelgrund (Karlsson 2001). Similar depth distributions exist in the open Skagerrak (Karlsson 1995, Moy et al. 2004). In the open Danish part of the Kattegat erect algal vegetation has been recorded from 22-23 m water depth at Kim's Top and Store Middelgrund (Nielsen & Dahl 1992, Dahl et al 2005), which is as deep as hard substrate has been located. From the Swedish Kattegat coast erect macroalgae have been recorded down to 24–25 m (Gustafsson 1999, Karlsson, Loo & Loo-Lutterwall 2000).

In the open parts of Kattegat and the Eastern part of Skagerrak, the upright vegetation covers about 95-100% of the hard bottom substrate in a complex multilayered pattern down to depths of approximately 15 m. In the western part of Skagerrak it increases to approximately 20 m (Dahl et al 2005, Moy et al. 2004). Below these water depths, the erect vegetation is in general single layered and the cover gradually becomes thinner, ending up with only red and brown crusts remaining.

Most, if not all algal species, has a more or less skewed bell shaped depth distribution, with an optimum controlled or limited by parameters like stress and light. The control is complex and most often also involves competition by other algal species.

Changing environmental conditions is supposed to affect the distribution pattern of the individual species. A general reduction in water transparency is expected to move the optimum distribution of specific algal species to lower water depth. However this expected response might be interfered by a higher physical stress of a lower salinity, especially in the profound halocline in Kattegat and Skagerrak.

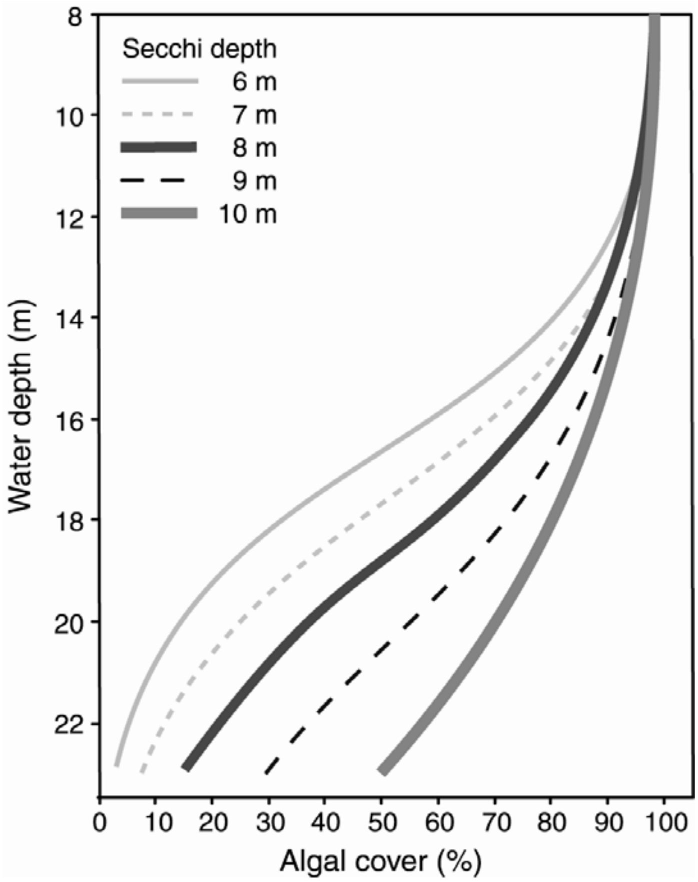
Two water types defined in chapter 2 are relevant for macroalgal growth in Skagerrak and at stone reefs in the open part of Kattegat: Type 2 (North Sea water type) identified as type 5.2 in the macroalgae analyses and type 3 (Stratified water type) identified as type 7.3 in the analyses. Type 2 is characterised by euhaline North Sea surface water (>30) defining the physical environment for the aquatic vegetation. Type 3 is characterised by brackish surface water (salinity <30) and euhaline water (salinity >30) below 10–15m depth. The aquatic vegetation in type 3 is expected to show a polyhaline character in the upper 10m (8–10m macroalgae dataset) and a euhaline character at larger depths (18–20m macroalgae dataset). Stratified water masses are identified in Kattegat, along the vest coast of Sweden and in the outer Oslofjord of Norway. Within type 3 Baltic water and local rivers influence the Kattegat whereas local river discharges influence the Oslofjord area. Macroalgae dataset from the selected depth interval 18–20m was all identified as euhaline type based on local salinity profiles but they all belong to either type 2 or 3 since the WFD do not permit horizontal divided typology. These data (identified as type 4.3 in the macroalgae analyses) were there-fore not tested against water typology of Kattegat and Skagerrak

3.1.2 Modelling reference conditions on macroalgal vegetation in the open Kattegat and Skagerrak

Dahl & Carstensen (2005) have developed highly significant models that couple total vegetation cover at 6 stone reefs in the Danish open part of Kattegat to Secchi depth and total load of TN, TP and water run-off. The models were developed on vegetation data collected at water depth below 10-12 m where total vegetation cover was less than 100 % of suitable area of hard substrate. Large yearly fluctuation in nutrient load from 1994 to 2001 and responses in the total algal cover to the load 6-month prior the yearly vegetation monitoring made this modelling possible.

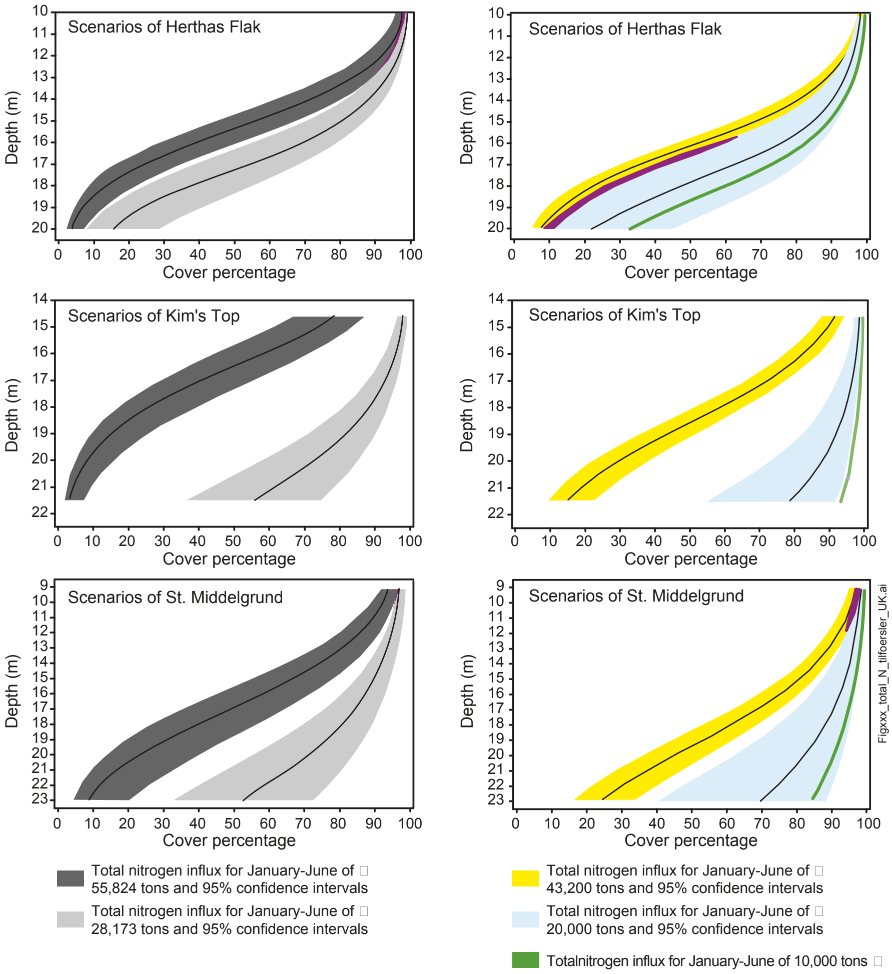
The models were used to predict total algal vegetation cover at specific seabed depth where suitable hard substrate was available. The Secchi depth versus the total vegetation cover model was universal for the Kattegat area (figure 3.1) The load models on the other hand were highly site specific probably reflecting both the distance from sources and the effect of water mixing in the Kattegat-Skagerrak front minimising the effect of total load to Kattegat at the Northern reef Herthas Flak (figure 3.2)

Figure 3.1



Modelled total macroalgal vegetation cover in Kattegat at specific water depth were suitable stable substrate are available at different levels of Secchi depth. (from Dahl and Carstensen, 2005).

Figure 3.2



Modelled total macroalgal vegetation cover (black lines) with 95% confidence intervals (coloured bands), at three reefs in Kattegat at specific water depth were suitable stable substrate are available. The figures show vegetation cover at different levels of total nitrogen load to Kattegat from point sources, freshwater run-off and atmosphere. Left column show vegetation cover at two load situations equal to estimated maximum and minimum loads in 1993–2002 and right column show vegetation cover estimated cover at an average load for the years 1993–2002 and at two hypotethic reduced load situations (reference conditions (from Dahl and Carstensen 2005).

3.2 Specific objectives

The objectives of this chapter are to:

- Assimilate supporting data (salinity, oxygen, light irradiation, and attenuation, wind, freshwater run-off, nitrogen and phosphourous load and concentrations, plankton biomass (chlorophyll)
- Assimilate distributional quantitative data on benthic macrophytes
- Develop a classification system for benthic macrophyte communities and identificy important controlling components like salinity, light and physical stress using multivariate statistical methods
- Establish empirical models coupling nutrient loads and the development of benthic vegetation, including important intervening parameters like plankton biomass and light attenuation for each typology
- Use the model to hindcast the reference situation for benthic vegetation in typologies based on estimates of nutrient loads in (a selected number) of time periods.

We have chosen to focus on macrophyte data at two selected depth intervals with regard to classification of algal communities and identification of important controlling components using multivariate statistic tools.

Attempt to establish empirical models coupling algal vegetation to nutrient loads have been done using two selected species.

3.3 Materials and methods

3.3.1 Compilation of macroalgal data

Two kind of algal dataset was needed for the analysis. One dataset describing whole algal communities and the other describing depth distribution of two selected algal species.

It was decided to focus the community data sets on two depth intervals: 8–10m and 18–20 m. The two intervals were chosen to reflect very different salinity and light regimes.

Laminaria saccharina (L.) Lamour. (a brown alga) and *Delesseria sanguinea* (Huds.) Lamour. (a red alga) were selected as the two species for environmental response analysis. The two species are easily recognised and common in all three countries. Data for *L. saccharina* and *D. sanguinea* were selected from the same locations as chosen for community analysis, however data from the whole range of investigated water depth at each location were included.

In order to achieve a comprehensive view of existing data, a search for reports on macrophytobenthos in the Kattegat-Skagerrak area from 1989 and on was performed. The result was filtered to meet the prerequisites of RETRO:

- The locality should primarily be situated at least 1 nautic mile seawards to the national baseline, or else having properties corresponding to open sea conditions.
- The depth should be at least 8m and/or deeper than 18 m.
- Data on environmental variables like nutrients and salinity should be available from nearby sampling locations.

The data used in this study was compiled from various kinds of investigations in Danish, Norwegian and Swedish waters (appendix 1). Danish and Norwegian data originate from national monitoring programmes in the Skagerrak (NOR) and the Kattegat (DK). Because of low geographical resolution of the Swedish national monitoring programme, data from a number of local surveys were included in the study, although they did not provide temporal variation for the localities visited. Thus, data provided from the Swedish national monitoring programme is from the Swedish part of the Skagerrak only, while the results of the surveys cover both the Skagerrak and the Kattegat.

The use of multinational datasets and the use of results from investigations of different primary objectives involve the use of mainly two different field sampling techniques. Data from the Danish (1990–2001) and Norwegian (1990–2000) national monitoring programmes, as well as the Swedish survey datasets (1997–2001) were collected by SCUBA-divers performing in-situ visual determination of species composition and estimates of the proportion of area covered by vegetation/each taxon at specific depth intervals along a transect following the depth gradient. For a more elaborate description, please refer to the reports Krause-Jensen et al 1995, Krause Jensen et al 2001, Moy et al. 2002 and 2004. In total 12 Danish, 9 Norwegian and 39 Swedish survey localities using this field approach were selected for further analysis (table 3.1).

Table 3.1. Algal sampling locations selected for further multivariate community analysis. The number gives available datasets at each location distributed on depth and sample methodology

			18-20m depth	8-10m depth	
Country	**Location**	**Kategat north KN Kattegat center KC Kattegat south (KS) Skagerrak east: SE Skagerrak mid: SM Skagerrak west: SW**	**Field estimation: F Photogrammetry: P**		**Coupled envionmen-tal station**
DK	Briseis Flak			16F	925
	Herthas Flak		22F	9F	1004+1105+1008
	Hesselø			1F	922
	Kim's Top		18F		905
	Liseleje, Torup Flak			1F	1937
	Schultz's Grund		15F	6F	925
	Store Middelgrund		13F	22F	413+418
NOR	2 Færder fyr	SE	7F	7F	Jomfruland
	3 Lynghlm	SE	10F	10F	Jomfruland
	4 Oddaneskj	SE	10F	10F	Jomfruland
	5 Svenner	SE	5F	5F	Jomfruland
	7 Tromøy	SM	11F	11F	Arendal
	10 Presthlm	SM	11F	11F	Arendal
	11 Humla	SM	11F	11F	Arendal
	12 Meholm	SM	8F	8F	Arendal
	15 Revø	SW	11F	11F	Lista
SWE	Breda Kråkor	KN	1F	1F	P2
	Breda Ulle	SE	1F	1F	Valö
	Bräkebådan	KN	1F	1F	
	Byxeskär	SE	6P	6P	Fladen
	DT1	KN	1F	1F	Fladen
	DT2	KN		1F	Fladen
	DT3	KN	1F		Fladen
	DT4	KN		1F	Fladen
	DT5	KN		1F	Fladen
	DT6	KN		1F	Fladen
	DT7	KN	1F		Fladen
	DT8	KN		1F	Fladen
	Dynan	SE	1F	1F	P2
	Fritt grund "7/8an"	KN		1F	Valö
	Gråurn	SE	9P	9P	P2
	Halseskären	KN	1F	1F	Fladen
	Hamneskär E-point	SE	1F	1F	P2
	Kalvhogeskären	SE		1F	P2
	L1(M1)	KC	1F		Fladen
	L10	KC		1F	Fladen
	L11	KC	1F		Fladen
	L12	KC	1F		Fladen
	L13	KC	1F		Fladen
	L14	KC	1F		Fladen
	L2	KC		1F	Fladen
	L4	KC	1F		Fladen
	L5	KC		1F	Fladen
	L6	KC		1F	Fladen
	L8	KC		1F	Fladen
	L9	KC		1F	Fladen
	Loteskär	KN	1F	1F	Fladen
	Mittskär	SE	5P	9P	P2
	N Nidingen	KN	1F	1F	Fladen
	Nordre Skäret	KN		1F	Valö
	Pynten	SE	1F	1F	P2
	S Malö	KN	1F		Fladen
	St Pottan	SE	1F	1F	P2
	St Snultebådan	KN		1F	Valö
	St. Dödskär	KN		1F	Valö
	Svarten	SE	1F	1F	P2
	Tormund	KN	1F	1F	Valö
	Y Dödskärs Flu	KN		1F	Valö

In the Swedish national monitoring programme data are obtained through image analysis of photographs taken at fixed depths between 0–20 m with 5 transects/locality (Karlsson (2001a), Karlsson et al. (1992) The results between 1994–2002 from three localities using this method were included in the analysis.

The compilation of data also faced the problem of different national approaches when estimating the vegetation cover. Danish data were reported as the proportions of vegetation covering the area of hard-bottom available. In the Norwegian data species abundance for each meter of depth were given as a rank with 4 levels (1=rare, 2=frequent, 3=common and 4=dominant). Calculated average species abundance of selected depth intervals may result in decimal number. When needed rank numbers is converted to %-coverage (1=5%, 2=10%, 3=25%, 4=60%). All Norwegian data are from rocky shores with stable bedrock or boulders down to more than 25m depth. All the localities are situated within 1 nautical sea mile seaward of the Norwegian the national baseline border but they all have properties corresponding to open sea conditions. (Due to the Norwegian geography the national baseline many places runs far out in Skagerrak waters.) Swedish data based on image analysis of bedrock communities were given as proportions per m2, while the survey results used a scale of four intervals (1 =<5%, 2=≥5%<25%, 3= ≥25% <75%, 4=≥75%) describing the algal cover simply projected perpendicular to the bottom area by field estimation using a 0.25 m^2 frame. Notes roughly describing the kind of bottom substrate and proportions were made along with the algal observations.

All data were standardized according to the Swedish four scale system mentioned above which for some datasets involved recalculations and simplifications. This could be easily done with the Danish data were cover are given in % with no classes since 1994. Before 1994 Danish data were grouped in 5 cover degree classes <=2%, >2-25%, >25-50%, >50-75% and >75 %.

3.3.2 Handling of difficult macroalgal taxa and level of identfication

When working in the field it is not always possible to identify a given taxon to the species rank using eyes only. The resulting records are also frequently based on a compromise between the dive-time available and the need for spatial replication. Thus some taxa are reported to the genus level, while other reports are based on shared morphological characters. Calcareous red algae and brown algae that form crusts were treated as “Calcareous red crusts” (*Phymatolithon, Lithothamnion*), “Brown crusts” (*Pseudolithoderma, Petroderma*), soft red crusts as “Cartilagineous red crusts” (*Haemescharia, Cruoria*). In the Kattegat the two red algae *Spermothamnion repens* and the tetrasporophyte of *Bonnemaisonia hamifera* mostly occurs entangled and recordings of these taxa were merged as

"Fine filamentous red algae". The two red algae *Phyllophora pseudoceranoides* and *Coccotylus truncatus* (formerly *P truncata*) are sometimes very hard to distinguish from each other and data on these species were thus merged into the "*Phyllophora*/*Coccotylus* group". In the later case this meant some simplifications when merging proportions.

The nomenclature follows Nielsen *et al*. (1995) and Guiry & Nic Dhonncha (2005).

3.3.3 Historic algal data

There are few historical data on macroalgae available from the off-shore areas of the Skagerrak and the Kattegat accurate enough to provide data for more elaborate comparatively analysis with today's dataset.

The classical works of Rosenvinge and Lund (Rosenvinge 1909–1931, Rosenvinge & Lund 1941, 1943, 1947) described species composition on stone reefs in the Danish and to some extent the Swedish off-shore parts of the Kattegat. Rosenvinge and Lunds data are not quantitative. Furthermore the old method of dredging to collect the samples were not precise regarding sampling depth and its impossible on deck to distinguish fresh drifting algal from those who are fixed and grow on the location. The same holds for Kylin's data from the Swedish west coast (Kylin1944, 1947, 1949) and Sundenes's work in the outer part of the Oslo fjord in Norway (Sundene 1953). In the south-east part of the Kattegat, Wærn visited some off-shore localities in the beginning of the 1960's (unpubl. data). The same localities were visited again by Pedersén & Snoeijs (2001) in 1989–1990, but unfortunately data from these studies has not been available for the present study.

3.3.4 Environmental data

Data from pelagic monitoring stations

Data on selected chemical and physical variables, assumed to influence macrophyte growth, was extracted from Danish, Norwegian and Swedish national monitoring databases. The coupling between reefs and the nearest pelagic monitoring locations are given in table 3.1. In Norway and Sweden, the same pelagic station may be correlated to several vegetation sampling sites and in some cases in Denmark averages of several pelagic stations are correlated to one or more vegetation sites (table 3.1).

Predicted weighted means of the nutrients nitrate + nitrite (n5n), ammonium (nh3n), total nitrogen (TN), total phosphorous (TP), phosphate (PO4P), Secchi depth and chlorophyll were estimated for the upper 10 m of the water column from hydrographic sampling stations located near each stone reef and predicted weighted means of salinity and temperature were calculated in the depth intervals 8–10 and 18–20 m.

The predicted mean values were estimated of the chosen pelagic variables for 12 month periods (July-June) prior to each yearly vegetation investigation in the summer season assumed to reflect nutritional conditions prior to each survey. The prediction was made based on a three-way analysis of variance (ANOVA) for location, month, and yearly variation of each variable. Data on chlorophyll, nutrients and Secchi depth were log-transformed.

Insolation data

Danish data on solar radiation were obtained with a temporal resolution of 30 min. from the Royal Veterinary and Agricultural University, Denmark (measured at Højbakkegård) from 1989 until 1999. Thereafter data representing a temporal resolution of 10 min. were obtained from NERI (measured at the H. C. Ørsted Institute).

Norwegian solar radiation data were only available from 1995. The insolation data are from a weather station situated at the Norwegian Skagerrak coast (in Grimstad) to avoid data influenced by large cities. Danish data were used as substitute from 1990 to 1994.

The Swedish insolation data stems from Gothenburg situated in the middle of the Swedish west coast.

3.3.5 Statistical tools

Multivariate analysis

The statistic analysis of algal communities were performed using the PRIMER software programme (Carr, 1997). Primer is a non-parametric multivariate statistical programme designed for analysis of species communities, requiring no specific distribution patterns of individual species. Comparisons between groups of samples are based on the Bray-Curtis similarity index (Bray & Curtis, 1957), where levels of significances are calculated with the ANOSIM (Analysis of similarity) procedure, a parallel to a common analysis of variance (ANOVAR). The ANOSIM procedure also calculates a Global R-value, which indicates similarities between groups of samples. Global R ranges between 0 (equal) to 1 (all replicates within site are more similar to each other than any replicates from different sites) but Global R can in principle also be –1, if each replicates from one site is more similar to a replicate at another sites.

Similarities between individual samples are visualised in **M**ultidimentional **S**caling **P**lots (MDS-plots) where calculated stress values indicate how well the data are presented in two dimensions. Stress values between 0,10 and 0,20 indicate that the plot gives a reasonable presentation of the similarities. Values between 0,10 and 0,05 give a good presentation and values below 0,05 express that the visualisation is excellent.

The SIMPER analysis in PRIMER calculates the average similarity within groups of samples and the dissimilarity between groups. At the same time the percentage each species contribute to the similarity and dissimilarity is calculated and species are ranked according to their importance.

The PRIMER statistical toolbox also includes the BIOENV analysis. BIOENV compares distributional patterns of biological data expressed as Bray-Curtis similarities with distributional patterns of environmental variables that are linked to each biological sample. In this work PCA are used to describe the environmental variables and weighted euclidian distances are used to cope with the different measurement scale of each input variable. The match between environmental variables and biota are calculated using Sperman-rank correlation (Clarke & Ainsworth, 1993)

Transformation of data may be used to weight less dominant species higher in the analysis. The harmonisation of algaldata from Denmark, Sweden and Norway resulted in a rough cover degree scale from 1-4, upweighting taxa with a low cover degree.Thus, further transformation of algal data was not made.

Data on algal communities from the two selected depth intervals are analysed separately, because it is well known and documented that algal communities differ substantially from 8–10 to 18–20 m water depth.

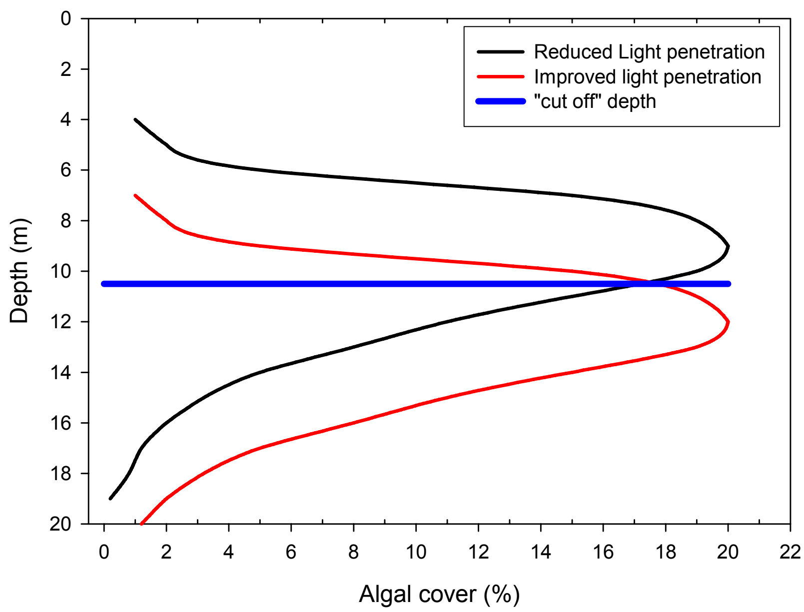
3.3.6 Analysis of Delesseria sanguinea and Laminaria saccharina cover in relation to nutrients, light, Secchi depth etc.

Selection of algal data

The response on each algal species of different or changing water quality with regard to light penetration will be a change in depth distribution. Increased light penetration will ideally result in a deeper optimum distribution. Above the optimum it is most likely that the algae cover decrease and below the optimum it will increase as illustrated in figure 3.3. For this reason data are restricted to sampling locations with water depth below the average optimum depth.

The cut-off depths for *Laminaria saccharina* and *Deleseria sanguinea* was estimated fitting a nonlinier curve (log normal, 4 parameter) to all available data from the surface to the deepest investigated station. This was done separately for Danish, Norwegian and Swedish datasets.

Figure 3.3. Expected response in depth distribution of an algal species due to changing light penetration through the water column. The cut-off level is estimated as the average optimum distribution in the dataset.



Coupling L. Saccharina and D. sanguinea cover to water quality

Algal variables were related to physicochemical variables using multiple regression analysis. The GLM (general linear model) analysis was performed in SAS computer package to analyse relationships between algal cover of *Laminaria* or *Delesseria* and different physical, chemical and biological factors.

Two separate models were formulated and tested. The first model included natural structuring variables, as well as variables directly related to light penetration through the water column:

Algalcover = Nation + depth + Salinity + Temperature + Solar radiation + Secchi depth + Chlorophyll + Depth*Secchi depth + Depth*chlorophyll + Depth*Solar radiation

The * indicates, that two variable are crossed in the analysis. This allows the response of the variable to change with depth.

The second model included natural structuring variables as well as nutrient variables, indirectly related to light penetration through the water column:

Algalcover = Nation + depth + Salinity + Temperature + Solar radiation + n5n + n3hn + Tp + PO4P + Depth*Solar radiation.

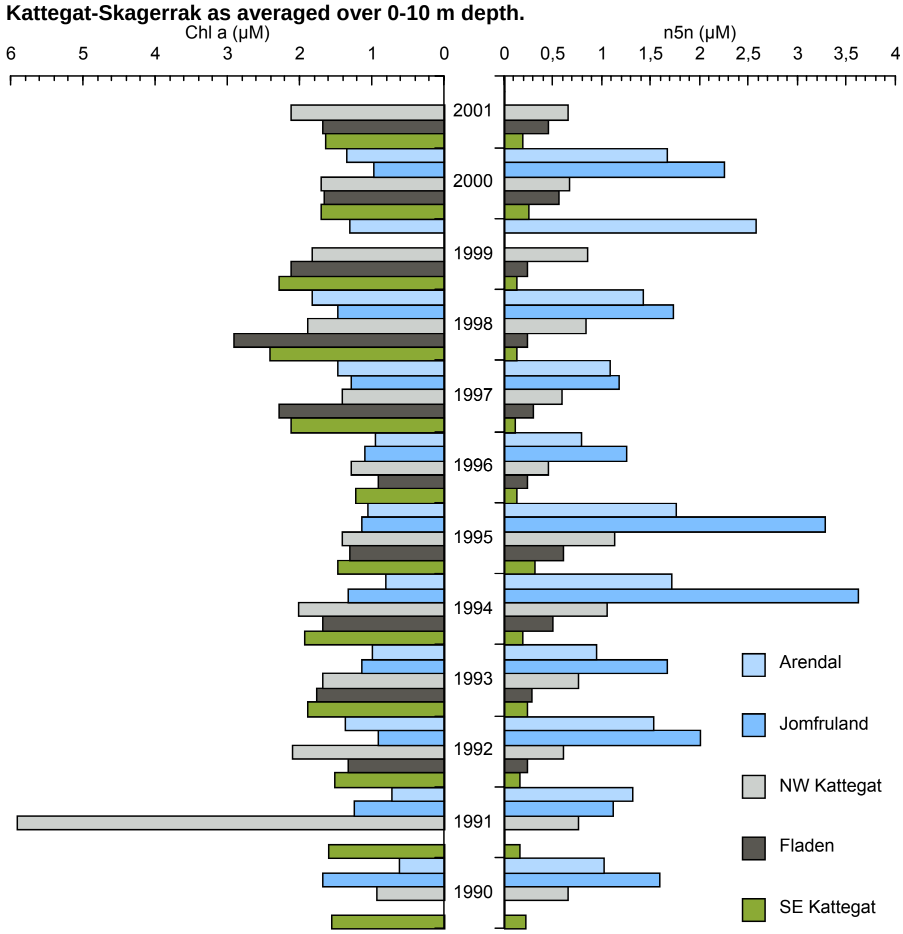
The * indicates that depth is crossed with solar radiation, allowing the response of solar radiation to change with depth.

A backward selection process was performed and all not significant interactions were removed step by step. This resulted in the reduced models with significant variables presented later.

3.3 Results

In the Norwegian part of Skagerrak monthly average nutrient concentrations from 1990–2001 were relative high from October to July and only in August and September concentrations decreased below 0.6 µM.

Figure 3.4 Total nitrogen (n5) and chlorophyll a between 1990-2001 in the offshore Kattegat-Skagerrak as averaged over 0-10 m depth.

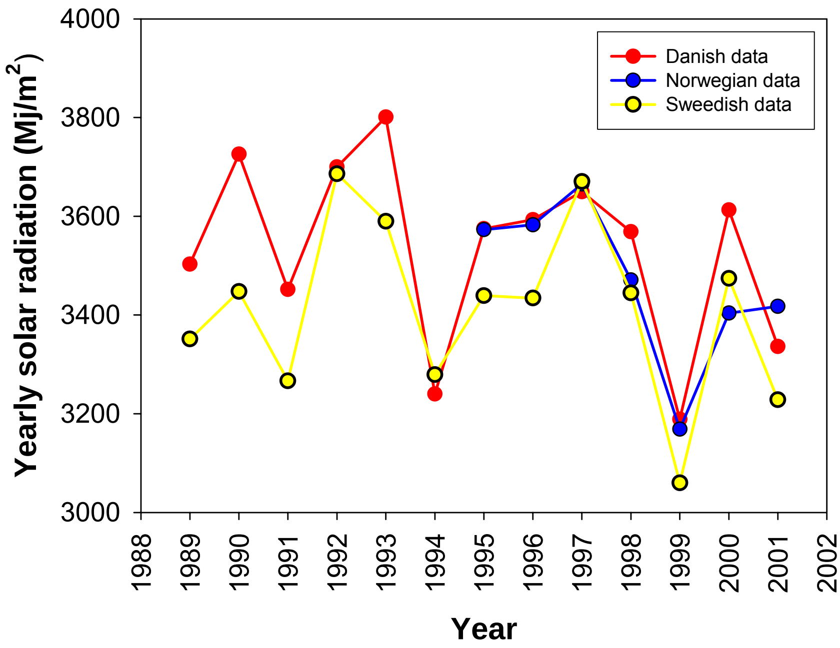


SE Kattegat: stations Lysegrund (413) and Anholt E (418). NW Kattegat: stations: Skagen (1005), Skagen NE (1004) and GF8 (1008)

The comparison of nutrient conditions between the different parts of the Kattegat-Skagerrak area revealed remarkably higher total nitrogen levels in the Norwegian part of the Skagerrak compared to the rest of the area. The concentrations from the Arendal and Jomfruland stations were between 2–3 times higher ((2–2.5 µM) compared to the rest of the area. The higher nitrogen concentration did not fit with a higher primary production as monitored by chlorophyll *a*, which showed concentrations more or less equal (2–3 µM) to the rest of the Kattegat-Skagerrak area (Figure 3.4).

Solar radiation from Denmark, Norway and Sweden differ from year to year, but in this period the largest variation observed was approximately 16%. There are also differences between countries in specific years, but they are typically less than 10 %.

Figur 3.5 Yearly solar radiation in Mj/m2 measured in Denmark, Norway and Sweden.



3.3.1 Multivariate analysis of macrophyte communities

Differences between sampling season and typology

The first analysis was done to verify if the separation of the dataset from the two selected depth intervals (8-10m and 18–20m) in two time periods (May–July and August–October) was reasonable. At the same time data from 8–10m depth interval were tested for differences between the two typologies present.

At 18–20m water depth there were a significant (p=0,2) difference between algal communities described by cover degrees from early and late summer. However the difference was small as indicated by the Global R-value on 0,106.

This difference between seasons was not significant at communities described at 8–10m depth interval (Table 3.2). At this water depth algal communities on the other hand could be distinguished significantly between the two typologies present in Kattegat-Skagerrak (Table 3.2) although the difference was not large as indicated by the global R value.

Table 3.2. Two Way Crossed ANOSIM test for difference between early summer (may-july) and late summer (august october) and typology at 8-10m waterdepth.

	Global R	p-value
8-10 m water depth		
Test for difference between early and late summer Global test:	0,053	6,2 %
Test for difference between typology Global test:	0,182	0,0 %

Differences between “countries” and season

When the same analysis was done separating the algal communities on nationality there was a significant effect of nationality at both depth intervals but sampling season could only be distinguished significantly at 8-10 meters depth (table 3.3).

The difference between sampling periods was very small with Global-R values close to 0 at both depth intervals. This could be an argument for aggregating data in the further analyses, however the differences could also be due to spatial differences, because only the Danish dataset had replicates sampled in the two periods from several years.

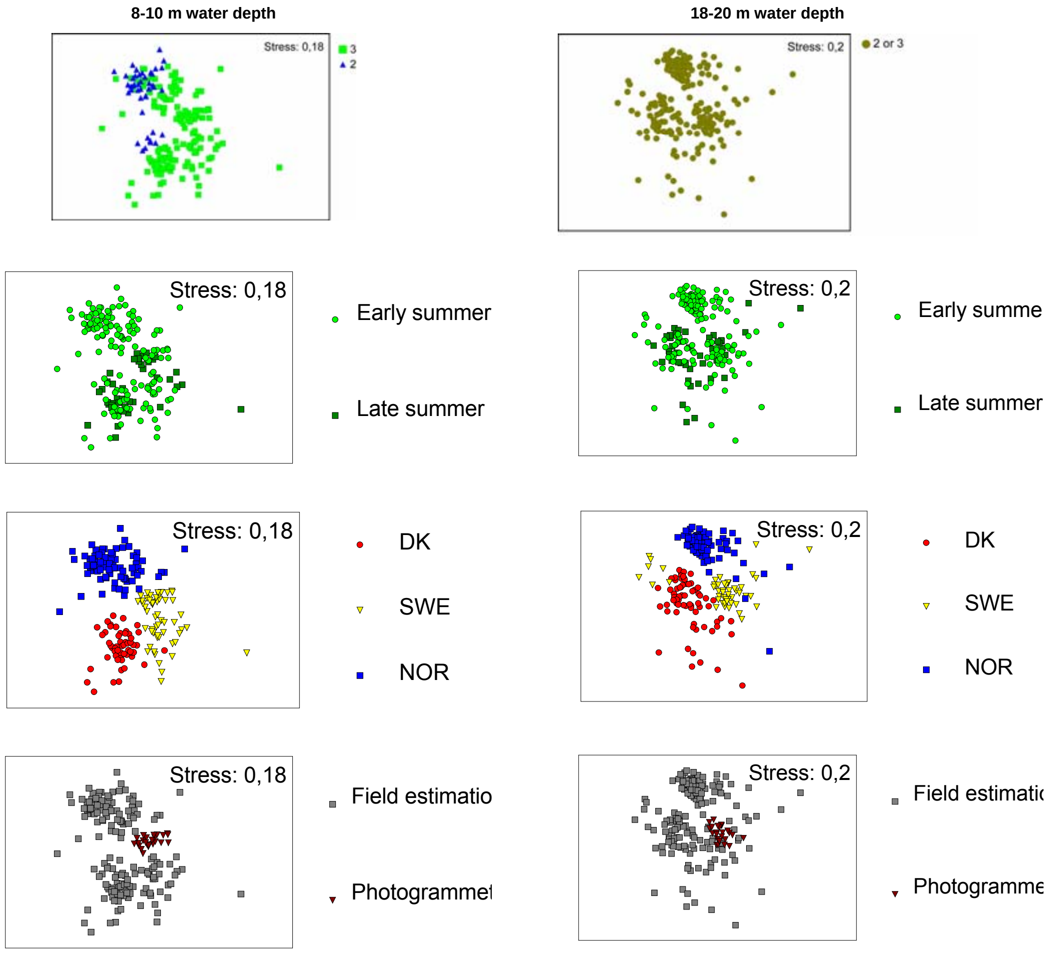
Similarities between algal communities from the different sampling stations separated on season, typology and nationality are visualised in MDS plots in figure 3.6 for the two chosen depth intervals.

Significant national differences may be one factor reducing the differences between the transnational defined water types (2 and 3).

Table 3.3. Two Way Crossed ANOSIM test for difference between early summer (May-July) and late summer (August-October) and nationality at 8–10m and 18–20m water depth.

		Global R	p-value
8-10 m water depth			
Test for difference between early and late summer			
Global test:		0,073	2,7 %
Test for difference between nations			
Global test:		0,779	0,0 %
	Pair wise test		
	DK-SWE	0,590	0,0%
	DK-NOR	0,877	0,0%
	SWE-NOR	0,803	0,0%
18-20m water depth			
Test for difference between early and late summer			
Global test:		0,031	17,5 %
Test for difference between typology			
Global test:		0,650	0,0%
	Pairwise test		
	DK-SWE	0,358	0,0%
	DK-NOR	0,728	0,0%
	SWE-NOR	0,743	0,0%

Figure 3.6 MDS plot of algal cover from the two water depth intervals 8–10m and 18–20m separated by typology, summer season, nationality and methodology. Data on algal cover are not transformed.



Methodologies

The next problem addressed was the use of algal data gathered by two different methods. Photogrammetry has been used to judge algal cover degrees in part of the dataset from Sweden, whereas in situ judgement of vegetation cover by divers have been used in the remaining majority of the dataset. A special analysis of the Swedish dataset from the two depth intervals gave significant differences ($P < 0,1$) between methods as well as time period in a 2-way crossed Anosim test. However those differences could also be due to differences in space rather than methods because there were no data present using both methods on the same location. Sampling sites were the two methods are used are furthermore located distinct from each other with the photogrammetry data closest to the Norwegian border.

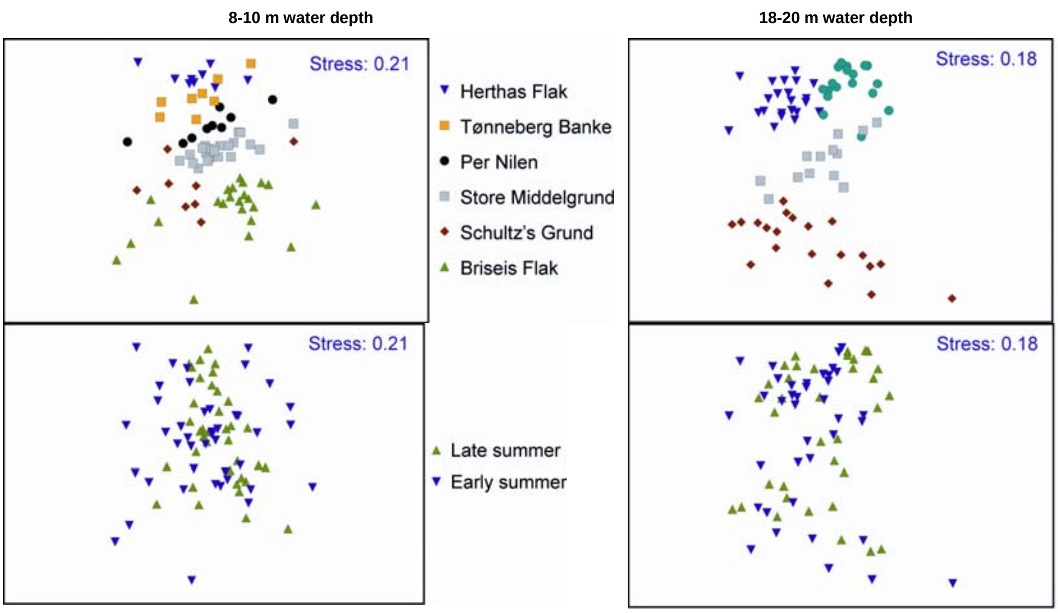
The distribution of samples separated on typology, nationality, sampling period and methodology are all visualised in MDS plots from both sampling depth (Figure 3.6).

"Danish data"

The presentation of algal data from the same sampling sites at both summer seasons from the Danish stone reef monitoring program allows a more detailed analysis of season and differences between sampling sites. Those tests showed significant differences between localities at both depth intervals (p<=0,2% and Global R between 0,616 and 0,693). However the sampling season was only significant different at 8-10m water depth (p=0,1 and Global R= 0,163).

The pronounced and differences between algal communities described at each stone reef are visualised in figure 3.7 for each depth interval. All reefs were significantly separated (P<0,2 %) even neglecting the seasonal differences. Figure 3.7 also shows communities described at each summer season.

Figure 3.7 MDS plot of algal cover from the two water depth intervals 8-10m and 18-20m in the danish part of Kattegat separated by sampling location and summer season. Data on algal cover are not transformed.



"Norwegian data"

A large number of community data exists from both typologies in the Norwegian part of Skagerrak from 8-10 m water depth. A One-Way Anosim test showed significant difference between typologies (p=0.0 with a global R = 0.216). The differences are visualised in figure 3.8 left, however with a high stress.

Further test on differences between sampling locations revealed that all except between 3 and 4 and between 7 and 11 could be distinguished significantly from each other and that the differences, even within typologies, could be quite high as stated by the Global R values (Table 3.4). The differences between locations are visualized in figure 3.8 right.

It is known from Moy et al. 2002 that the biology on these stations reflects a pollution gradient decreasing with increasing station number as well as differences in wave exposure not included in the off shore typology. Also these results indicate that station 7 may have been misclassified as type 3.

Figure 3.8 MDS plot of algal cover from 8–10 m water depth in Norwegian part of Skagerrak. Left split on typologies and right split on sampling localities. Location 2–7 belongs to typology 7.3 and the rest to 4.1.

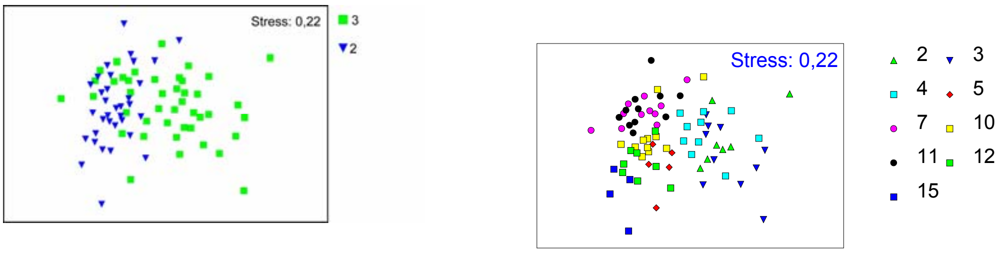


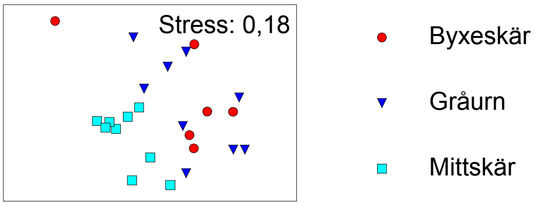
Table 3.4. One Way ANOSIM test for difference between sampling localities in Norwegian part of Skagerrak at 8–10m water depth.

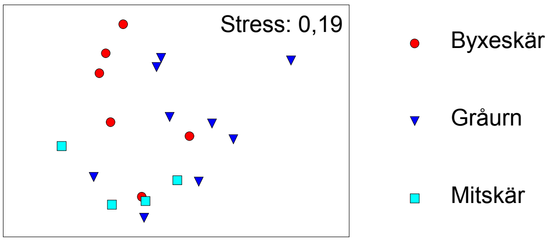
Test for difference between early and late summer		Global R	p-værdi (%)
Global test:		0.530	0.00 %
	Pairwise test 2 - 3	0,231	2,0 %
	2 - 4	0,475	0,0 %
	2 - 5	0,803	0,1 %
	2 - 7	0,877	0,0 %
	2 - 10	0,666	0,0 %
	2 - 11	0,903	0,0 %
	2 - 12	0,87	0,0 %
	2 - 15	0,95	0,3 %
	3 - 4	0,115	5,8 %
	3 - 5	0,530	0,0 %
	3 - 7	0,738	0,0 %
	3 - 10	0,632	0,0 %
	3 - 11	0,760	0,0 %
	3 - 12	0,747	0,0 %
	3 - 15	0,834	0,1 %
	4 - 5	0,477	0,1 %
	4 - 7	0,681	0,0 %
	4 - 10	0,485	0,0 %
	4 - 11	0,613	0,0 %
	4 - 12	0,733	0,0 %
	4 - 15	0,948	0,1 %
	5 - 7	0,503	0,1 %
	5 - 10	0,295	4,3 %
	5 - 11	0,547	0,1 %
	5 - 12	0,575	0,1 %
	5 - 15	0,744	0,8 %
	7 - 10	0,276	0,1 %
	7 - 11	0,071	10,9 %
	7 - 12	0,498	0,0 %
	7 - 15	0,801	0,1 %
	10 - 11	0,291	0,1 %
	10 - 12	0,186	1,9 %
	10 - 15	0,503	1,2 %
	11 - 12	0,508	0,0 %
	11 - 15	0,831	0,1 %
	12 - 15	0,417	1,2 %

"Swedish data"

Swedish data based on photogrammetry can partly be separated on reefs. At 8-10 m the reef Mitskär clearly and significant ($p<0,2$) separates from Büxeskär and Gråurn. At 18-20m water depth the difference between reefs were smaller and not significant (Figure 3.9) .

Figure 3.9 MDS plot of algal cover from Swedish monitoring locations in Skagerrak Left 8–10m water depth. right 18–20m water depth.





Correlation between environmental data and algal communities BIOENV analysis was performed to find rank correlation's between environmental variables and algal communities at the two selected depth intervals. This analysis needs a full and corresponding set of both algal and environmental data.

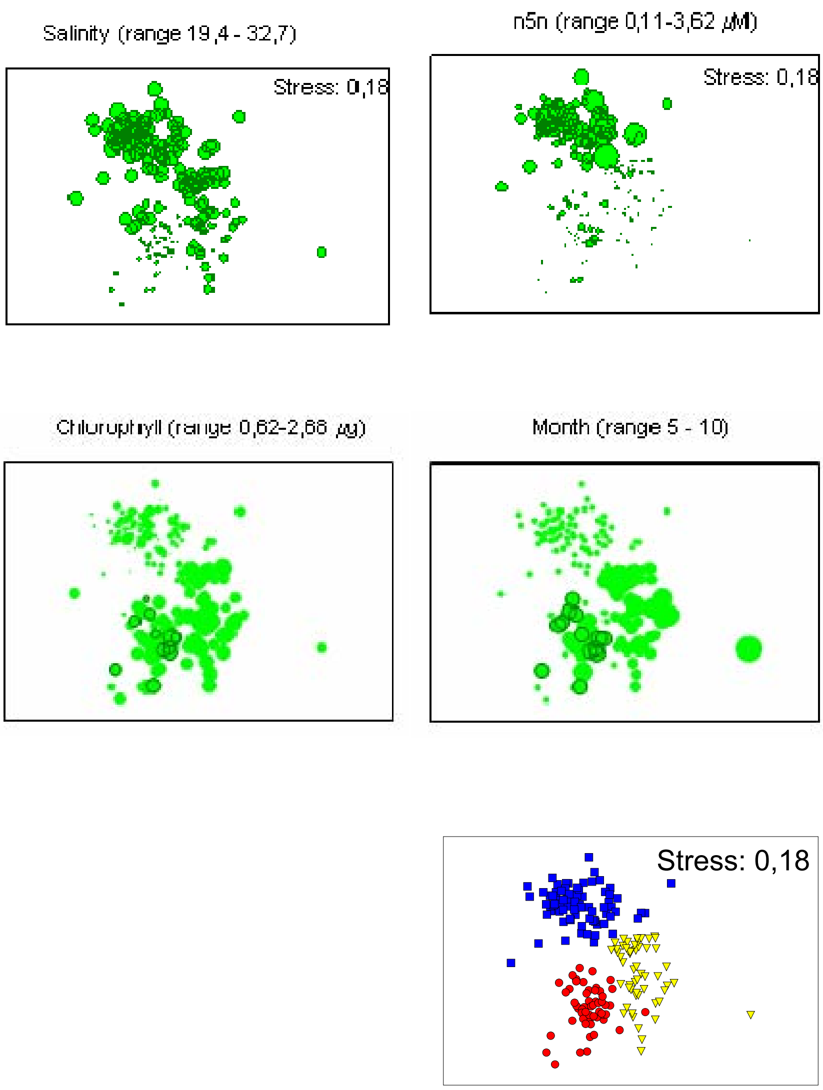
The result of the analysis from 8-10m water depth was that a combination of salinity, n5n, chlorophyll and sampling month and gave the best overall rank correlation with ρ= 0,570. Salinity was the single variable that best correlated with changes in algal communities followed by nh3n and chlorophyll (Table 3.5). This correlates well with the use of surface (0-10m) salinity as the primary factor for identification of water types.

Table 3.5. Rank correlation between community samples from 8–10 meter water depth described by Bray-Curtis similarities and environmental variables described by normalised euclidean distances.

Environmental variables	Rank correlation (ρ)
Several variables	
Salinity, n5n, Chlorophyll and Month	0,570
Single variable	
Salinity	0,485
n5n	0,383
Chlorophyll	0,344
nh3n	0,277
Month	0,247
TP	0,142
PO4P	0,117
Secchi depth	0,063
Solar radiation	0,062
Temperature	0,051
TN	0,047

The similarities between algal communities used in the BIOENV analysis is shown in figure 3.10, which also indicate the size of important environmental variables that correlated with the biota.

Figure 3.10



MDS plot showing the similarities between algal communities at 8-10m water depth and the relative magnitude of the most important variables correlating with the communities. The size of the bubbles reflect relative differences within the rage of the given parameters given on top of each figure. Bubble position may be compared with position of national stations in the lower most MDS.

The result of the BIOENV analysis of the algal and environmental data representing the deeper water depths (18–20m) was that the combination of n5n, sampling month, chlorophyll, TP and temperature gave the best overall rank correlation with $\rho = 0{,}383$.

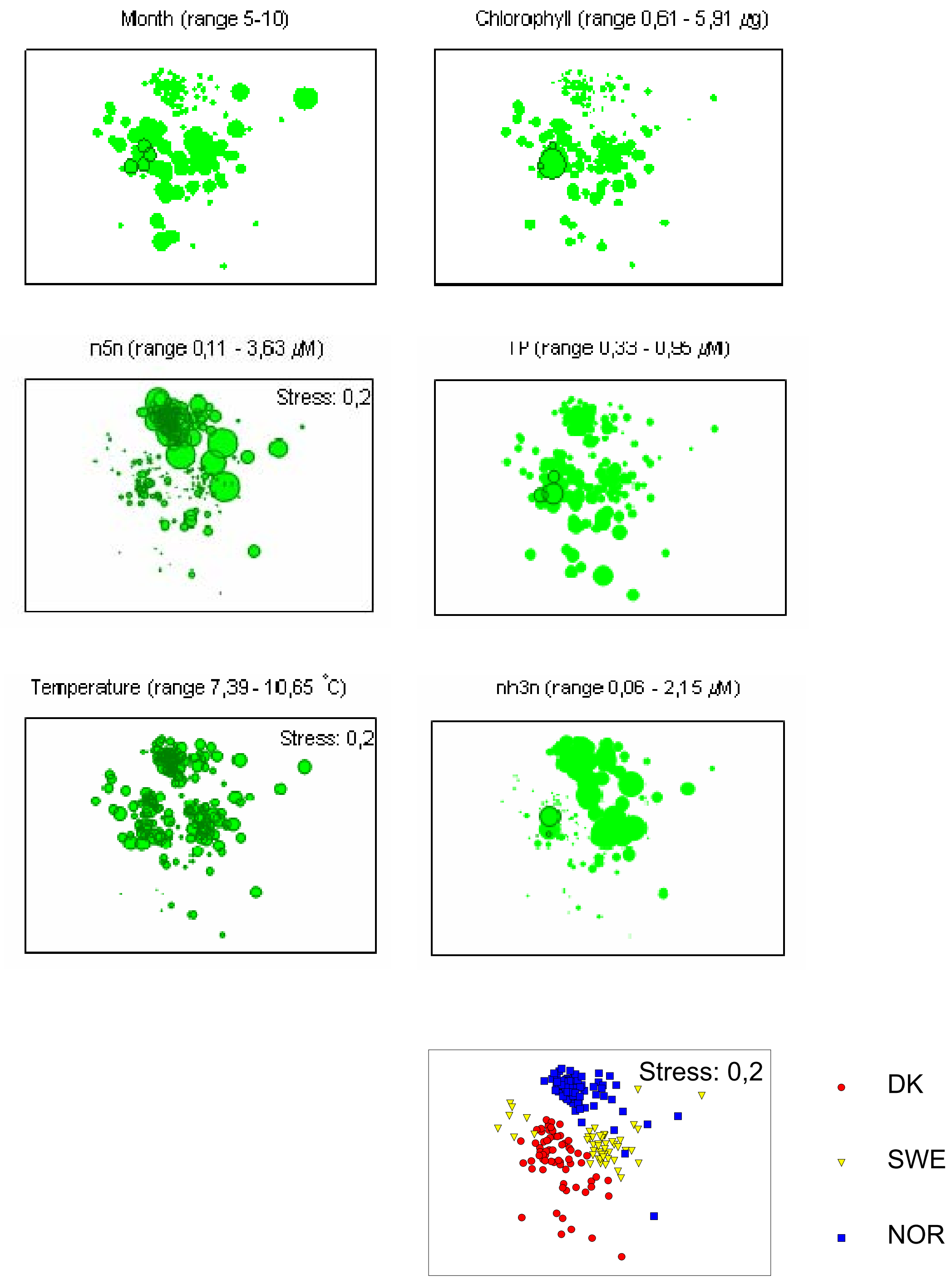
Salinity did not contribute to the overall correlation at this depth interval as expected from the typology, since all deeper waters were identified as euhaline. Month and n5n gave equal and best individual correlation with changes in algal communities followed by nh3n and chlorophyll (Table 3.6).

The similarities between algal communities used in the BIOENV analysis is shown in figure 3.11, which also indicate the size of important environmental variables that correlate best with the biota.

Table 3.6. Rank correlation between community samples from 18–20 meter water depth described by Bray-Curtis similarities and environmental variables described by normalised euclidean distances.

Environmental variables	Rank correlation (ρ)
Several variables	
Month, Chlorophyll, n5n, TP and temperature	0,345
Single variable	
Month	0,257
Chlorophyll	0,218
n5n	0,190
nh3n	0,189
TP	0,142
PO4P	0,137
Temperature	0,135
Salinity	0,124
TN	0,101
Secchi depth	0,068
Solar radiation	0,059

Figure 3.11 MDS plot showing the similarities between algalcommunities at 18–20m water depth and the relative magnitude of the most important variables correlating with the communities. The size of the bubbles reflect relative differences within the rage of the given parameters given on top of each figure. Bubble position may be compared with the position of national stations in the lower most MDS.



3.3.2 Differences in species composition

The differences in species composition between dataset from Denmark, Norway and Sweden was analysed using SIMPER. The average similarity within each national dataset was between 58 and 62% at 8-10 m water depth and between 47 and 56% at 18-20 m (appendix 1). The dissimilarities between the groups are given in table 3.7 and they are not surprisingly quite high.

Table 3.7. Dissimilarity between algal datasets from Denmark, Norway and Sweden estimated by the SIMPER routine.

	8-10m water depth dissimilarity (%)	18-20m water depth dissimilarity (%)
DK-SWE	51,4	61,2
DK-NOR	61,1	65,8
SWE-NOR	57,9	65,2

The most important species contributing to the dissimilarity between the groups are also listed in table 3.8. A more comprehensive list of species and their contribution to the calculated similarities within the national datasets and dissimilarities between countries are presented in appendix 1.

Laminaria hyperboria and *Laminaria digitata* are among the more important species that differ from country to country at 8-10 m water depth. *L. digitata* is most dominating in Denmark but more or less missing in Norway were *L. hyperboria* has a very high cover. Both species have an intermediate cover in Sweden.

At 18-20 m water depth difference in crusts forming species are among the more important species that differ among the countries.

Table 3.8. The ten most important species contributing to dissimilarities between countries at the two selected water depth.

DK and SWE	Contribution in %	DK and NOR	Contribution in %	SWE and NOR	Contribution in %
8-10 m water depth					
Halidrys siliquosa	4,01	Laminaria hyperborea	3,95	Polysiphonia stricta	3,36
Laminaria hyperborea	3,92	Corallina officinalis	3,13	Laminaria hyperborea	3,21
Cartilagineous red crust	2,84	Lomentaria sp.	2,49	Cartilagineous red crusts	3,19
Laminaria digitata	2,82	Ceramium virgatum	2,44	Lomentaria sp.	2,93
Phycodrys rubens	2,77	Audouniella spp. (others)	2,4	Audouniella spp. (others)	2,82
Calcareous red crust	2,66	Fine filamentous red algae	2,2	Fine filamentous red algae	2,57
Phyllophora/Coccotylus GROUP	2,62	Laminaria digitata	2,17	Ceramium virgatum	2,48
Laminaria saccharina	2,51	Dilsea carnosa	2,16	Laminaria saccharina	2,46
Corallina officinalis	2,48	Halidrys siliquosa	2,16	Sphacelaria cf. radicans	2,42
Sphacelaria arctica	2,44	Sphacelaria cf. radicans	2,06	Dilsea carnosa	2,4
18-20 m water depth					
Calcareous red crusts	4,52	Pterothamnion plumula	3,57	Polysiphonia stricta	3,91
Brown crusts	4,22	Brown crusts	3,37	Bonnemaisonia asparagoides	3,71
Cartilagineous red crusts	4,09	Sphacelaria cf. radicans	3,34	Sphacelaria cf. radicans	3,7
Phycodrys rubens	3,36	Calcareous red crusts	3,32	Calcareous red crusts	3,57
Phyllophora/Coccotylus GROUP	3,05	Bonnemaisonia asparagoides	3,3	Fine filamentous red algae	3,54
Fine filamentous red algae	2,58	Fine filamentous red algae	3,19	Cartilagineous red crusts	3,46
Dilsea carnosa	2,48	Lomentaria sp.	3,07	Pterothamnion plumula	3,44
Bonnemaisonia asparagoides	2,3	Polysiphonia stricta	3,03	Lomentaria sp.	3,41
Delesseria sanguinea	2,26	Delesseria sanguinea	2,88	Brown crusts	3,2
Rhodochorton purpureum	2,21	Pterosiphonia parasitica	2,79	Pterosiphonia parasitica	3,1

3.3.3 Delesseria sanguinea and Laminaria saccharina cover

Figure 3.12 gives examples of depth distributions of *Delesseria sanguinea* in the Danish part of Kattegat and the Norwegian part of Skagerrak. Cut-off levels for both species were calculated as the average maximum distribution in each national water body (Table 3.9). Only cover data below the cut-off depth level for each species were used in the GLM-analysis.

Figure 3.12 Cover of Delesseria sanguinea at different water depth from the Danish part of Kattegat and the Norwegian part of Skagerrak. Data from Denmark is given in percentage by the divers whereas the Norwegian data is backcalculated from 4-scale coverdegee classes. Note that several observations often exist “behind” each data-point in the figures. The curve is fitted to the data using a nonliniar regression (log normal, 4-parameters).

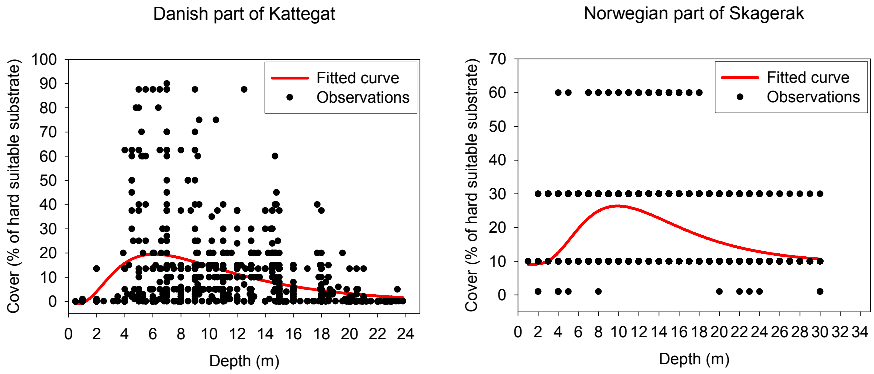


Table 3.9. Estimated Cut-off depth (m) for Laminaria saccharine and Delesseria sanguinea from Danish, Norwegian and Swedish waters.

	Laminaria saccharina	Delesseria sanguinea
Danish Kattegat	7 m	6 m
Swedish Kattegat	10 m	12 m
Swedish Skagerrak	12 m	12 m
Norwegian Skagerrak	11 m	10 m

The models relating cover of *D. sanguinea* and *L. Saccharina* with natural structuring variables as well as variables directly related to light penetration were both significant (P < 0,0001). However the correlation was not high for either species (Model with *D. sanguinea*: $r^2 = 0{,}22$ and model with *L. saccharina*: $R^2 = 0{,}11$) Tabel 3.10 and 3.11 list the variables that significantly contributed to the relationship for each species as well the actual estimate of each parameter.

Table 3.10. Cover of Delesseria sanguinea as function of depth (m), weighted yearly average of Secchi depth (m) from july-june in the surface water, total solar radiation from july to june (Mj/m2), weighted yearly average concentration of chlorophyll-a (μg) in the surface water and nation.

Parameter		Estimate	Biased	StdErr	tValue	Probt
Intercept		36,450489	1,000000	3,072529	11,863352	0,000000
Depth		-1,666932	0,000000	0,348247	-4,786642	0,000002
Secchi depth		-0,554879	0,000000	0,202984	-2,733603	0,006314
Chlorophyll-a		5,244036	0,000000	1,532069	3,422846	0,000631
Depth (m)*Chlorophyll-a		-0,310982	0,000000	0,083534	-3,722807	0,000202
Depth*Solar radiation		0,000273	0,000000	0,000094	2,913023	0,003615
Nation:	Denmark	-13,840930	1,000000	0,867605	-15,953029	0,000000
Nation:	Norway	-2,356164	1,000000	0,826238	-2,851677	0,004389
Nation:	Sweden	0,000000	1,000000			

Table 3.11. Cover of Laminaria saccharina as function of depth (m), total solar radiation from july to june (Mj/m2), weighted yearly average concentration of chlorophyll-a (μg) in the surface water and nation.

Parameter		Estimate	Biased	StdErr	tValue	Probt
Intercept		16,5070224	1	19,0903574	0,8646785	0,38756726
Depth		-2,63740657	0	0,63912781	-4,12657148	4,2131E-05
Chlorophyll-a		-13,5821857	0	5,5073422	-2,46619606	0,01393938
Depth*Chlorophyl-a		0,80142152	0	0,36867984	2,17376010	0,03012072
Solar radiation		0,01239926	0	0,00454551	2,72780420	0,00656590
Nation:	Denmark	-12,2486827	1	1,76447256	-6,94183801	1,025E-11
Nation:	Norway	-2,24630480	1	1,93915940	-1,15839100	0,24717397
Nation:	Sweden	0	1			

Both species increased in abundance (cover) with increasing solar radiation and decreased with increasing sampling depth. Danish cover data were significantly smaller that Norwegian and Swedish cover for both species, given the same conditions of other variables. Norwegian abundance data of *L. saccharina* also differ from Swedish data, but not as much as the Danish data set. The variable Secchi depth was significant and positively correlated with abundance (cover) of *D. sanguinea* but not with *L. saccharina*. The parameter chlorophyll *a* was important for both species but the effect was dependent on depth and the response on algal cover to chlorophyll concentration differed between *D. sanguinea* and *L. saccharina*. In the surface water chlorophyll concentrations were positive for *D. sanguinea* cover but the importance decreased with increasing water depth. Below approximately 17 m chlorophyll had a negative effect. Chlorophyll concentrations had a negative effect on the abundance of L. saccharina in shallow waters but changed to a positive effect below 17 m as for *Delesseria*..

Salinity and temperature were not significant. To some extent the effect of salinity might be hidden in the class variable Nation.

The results of the second model that relates algal cover to natural structuring variables as well as nutrient variables were also significant for both species (P< 0,0001), again with low correlations (Model with *D. sanguinea*: r^2 = 0,21 and model with *L. Saccharina*: R^2 = 0,13). Tabel 3.12 and 3.13 list the variables that significantly contributed to the relationship for each species as well the actual estimate of each parameter.

Table 3.12. Cover of Delesseria sanguinea as function of depth (m), weighted yearly average of Secchi depth (m) from july-june, total solar radiation from july to june (Mj/m2), weighted yearly average concentration of nh3n (μM) in the surface water, and nation.

Parameter	Estimate	Biased	StdErr	tValue	Probt
Intercept	40,591681	1	1,1067004	36,678112	1,561E-230
Depth	-1,8956488	0	0,335430	-5,6514063	1,7964E-08
nh3n	-2,2740789	0	0,5196200	-4,3764271	1,2625E-05
Depth*Solar radiation	0,0002204	0	9,3959E-05	2,3454397	0,0190925
Nation: Denmark	-13,906497	1	0,8498487	-16,363497	6,6522E-57
Nation: Norway	-0,9954107	1	0,8153006	-1,220913	0,22224917
Nation: Sweden	0	1			

Table 3.13. Cover of Laminaria saccharina as function of depth (m), weighted yearly average of Secchi depth (m) from july-june, total solar radiation from july to june (Mj/m2), weighted yearly average concentration of nh3n as well as tp (μM) in the surface water, and nation.

Parameter	Estimate	Biased	StdErr	tValue	Probt
Intercept	-11,7709743	1	17,2376287	-0,68286506	0,49496015
Depth	-1,32353743	0	0,23369528	-5,66351800	2,3190E-08
nh3n	-4,20900665	0	1,8408265	-2,28647660	0,02257984
tp	18,9551172	0	7,84871483	2,41505999	0,01603564
Solar radiation	0,01150633	0	0,00457260	2,51636566	0,01212138
Nation: Denmark	-14,74217003	1	1,9878384	-7,4161814	4,2137E-13
Nation: Norway	0,148949327	1	2,169883222	0,068643937	0,945296302
Nation: Sweden	0	1			

Both species increased in abundance (cover) with increasing solar radiation and decreased with increasing sampling depth. Danish cover data were significantly smaller that Norwegian and Swedish cover for both species, given the same conditions of other variables. Abundance of both species was negatively influenced by the yearly average of ammonium (nh3n) in the surface water. Total phosphorous (tp) concentration in the surface water was positively correlated with abundance of *L. saccharina* (cover). Salinity, temperature, nitrate + nitrite as well as phosphate (po4p) were not significant. To some extent salinity might be hidden in the class variable Nation.

3.4 Discussion

Shallow macroalgal vegetation (8-10m depth) did show a significant difference between the identified water types of Skagerrak and Kattegat, although significant national differences reduced the overall difference between type 2: North Sea water type and type 3: Stratified water type. Type 3 with polyhaline surface water does have a national linked variation that may be reflected in the biology and possibly should be reflected in the typology. Type 3 in Kattegat is mainly influenced by low saline Baltic water running from the Baltic to Skagerrak, while type 3 in Skagerrak mainly is influenced by local river discharges.

Typology does not take pollution into consideration (and should not) and pollution may be one factor causing variance with the defined water types and hence reducing the overall difference between the water types.

The spatial variation in yearly average concentrations of pelagic variables like chlorophyll, nutrients and salinity especially in the surface water was high in the Kattegat and the Skagerrak. Coupling between nutrient concentrations and primary production in the surface water are well documented in Kattegat (Hansen et al, 2000 Carstensen et al, 2003), where dissolved nitrogen controls the primary production from spring to autumn. One surprising finding in this study was that yearly concentration of dissolved nitrogen (n5n) in the surface water was very high in the Norwegian part of Skagerrak compared to Kattegat and the Swedish part of Skagerrak (fig 3.4). This was not, as expected, reflected in variables related to a higher primary production like reduced Secchi depth or a high chlorophyll concentration. In fact yearly average of chlorophyll concentration was lower in the Norwegian part of Skagerrak compared to the other areas. Highest concentrations of dissolved nitrogen are measured during the winter months with low light and temperature.

This raises the question if yearly average concentrations of nutrients and chlorophyll in the top 10 meters of the water column from the selected hydrographic monitoring stations do reflect processes linked to primary production in the Norwegian part of Skagerrak in a satisfying way. The selected Norwegian hydrographic stations are situated in the Norwegian coastal current running more or less like a river from east to west along the Norwegian Skagerrak coast. Long transported nutrients from southern North Sea contribute significantly (up to 80% of nitrate during winter months) to the Norwegian coastal current. A further implication of this question is, that the modelled yearly nutrient and chlorophyll concentrations might not be suitable as indirect measures of light extinction in the water column, at least in the Norwegian part of Skagerrak.

Spatial variation between algal communities as described by Bray-Curtis similarity indices is very high at the two selected depth intervals. In spite of this variation between communities, there were only a weak to moderate correlation between algal communities at the two depth intervals and the environmental variables assumed to control the benthic vegetation. In both depth intervals chlorophyll, as well as nitrate + nitrite (n5n) concentrations were among the variables contributing to the best correlation. Solar radiation and Secchi depth, two variables that are directly coupled to the level of light reaching the seabed, showed only a minor correlation with the benthic algal abundance and none of them were in the group of variables giving the best fit of correlation.

In contrast to our attempts to rank environmental variables to the observed algal communities separation of algal communities by country gave a very clear and significant picture at both 8-10 and 18-20 m water depth. This suggests that certain problems are associated with harmonisation of monitoring methodology between the three Nordic countries. In this project there are several possibilities for introduction of bias or noise in the dataset in the attempt to harmonise the data.

Intercalibration exercises have shown differences between divers judging algal covers using the same national monitoring guideline (Middelboe et al 1997). It is therefore reasonable to expect even larger differences between divers using different national guidelines.

The macroalgal monitoring methodology differs between all three countries and yet we had to squeeze data into the same system with four cover degree classes. In Norway macrophyte vegetation is described with judgement of frequencies and those figures are then translated to cover degrees for this study. Furthermore cover degree classes used in Denmark up to 1994 differ from the Swedish system for species with low cover degrees. This probably led to systematic errors for some species covers in our common dataset. Furthermore species with low cover, where the risk of errors probably are highest, influence the result of multivariate analysis relatively much, due to the use of cover classes 1 to 4 as input parameter, which is a rather high transformation.

A third problem is aggregation of species to a common taxonomic level of recognition. It is questionable if the divers can recognise *Laminaria digitata* from *Laminaria hyperboria* in the Danish part of the Kattegat. This is due to diminishing morphological characteristics between the two species at salinities present in Kattegat. Those two Laminaria species play an important role distinguishing Danish, Norwegian and Swedish algal communities, however it might only be relevant or safe to use both species and not a species group to analyse a subset of data from Norway and Sweden. Other but less important species like the crustforming *Hildenbrandia rubra* should be integrated in the group called Cartilagineous red crusts. In Norway problems exists seperating *Ptilota gunneri* from *Plumaria elegans* again an argument for further species aggregation in the common dataset.

A last possible problem with data harmonisation is our assumption that data collected by divers in the field in principle end up with the same results as the photometrical methodology used at the Swedish monitoring stations. Communities described from photos grouped separately in MDS plots with little variation among samples. On the other hand those data are located between the Norwegian Skagerrak data and more southern Swedish sampling stations as may be expected due to biogeographic variations. Thus the separate grouping might be a result of different sampling technique, geographic location or a combination of both.

Algal communities described from sampling sites in Denmark could easily be distinguished from each other in a multivariate analysis. The same was possible for most sampling sites in Norway and to some extend in Swedish data collected using photogrammetry. This may imply that the differences between sites are huge. Development of common targets for algal community structure within water body typologies covering larger areas are therefore a delicate task requiering a more proper scale of spatial replication. This is in accordance with findings by Dahl & Carstensen (2005) were total vegetation cover differ substantially between reefs in the open parts of Kattegat.

The models describing the cover of *Laminaria saccharina* and *Delesseria sanguinea* as a function of natural and eutrophication dependent variables are all significant but have rather low correlations. Solar radiation and – not surprisingly depth are important factors for the cover development of the two species below the depth of their average maximum distribution. A significant and positive relationship between Secchi depth and development of vegetation cover was only identified for *D. sanguinea*. The relationship between chlorophyll-*a* concentration in the surface water and vegetation cover of the selected two species was more or less the opposite and changed with depth.

Vegetation cover of both species was negatively correlated with yearly average of ammonium concentration in the surface water whereas total phosphorous concentration had a positive influence on the abundance of *Laminaria* (cover). A positive effect of phosphorous concentration in the surface water was not expected and it is questionable if it reflects ecological processes that control the light extinction in the water column.

Part of the project task was to evaluate the possibility to use historic data to set up reference condition for macroalgal vegetation in Kattegat and Skagerrak. In an attempt to apply a classification system to determine the environmental state of different biotopes in Sweden developed by SEPA (Anon 1998) and Toth (1999) address the problem of the lack of accurate historical data. The problem involves methodological constraints as well as design problems such as lack of replication, both spatial and temporal. She concluded that most of the older data, and much of the results in more recent investigations, are not suitable for modern analytical methods. As an example, there are marked differences when comparing historical data of the depth distribution of many species with more recent investigations. In general, the older data implies that the lower growth limit was deeper than what it is today (Kylin 1944, 1947, 1949, Sundene 1953). However, since the historical data was collected by dredging, the figures given are frequently biased. Hence, it is frequently impossible to separate methodological constraints from environmental impact. This is also the main reason for the decision not to use the huge datasets collected by Rosenvinge (Rosenvinge 1909–1931, Rosenvinge & Lund 1941, 1943, 1947) as a baseline in the Danish monitoring programme. The overall conclusion is that no historic data exists that can be used to describe reference conditions of macroalgal vegetation in Kattegat and Skagerrak at reduced human pressure levels.

Use of models describing selected vegetation indicators, as function of pressure factors, seems to be the only way forward to develop useful tools to describe the reference conditions of this important element of the marine ecosystem in Kattegat and Skagerrak. Work done by Dahl and Carstensen (2005) using total vegetation data from Kattegat has shown that development of such models is possible. The results of the present study were not as successful. However a number of problems with data have been addressed and important differences in nutrient concentrations in the surface layer of Kattegat and Skagerrak have been identified which was not reflected in the chlorophyll concentration. That finding was not expected.

Further attempt should be done to improve the models and the estimated parameters. We made a choice to use average concentration of nutrients in the top 10 meter of the water column in Skagerrak, as an indirect indicator of primarily production. It should be evaluated if this water layer is so deep in Skagerrak that in includes nutrient rich water from the North Sea from time to time. The work done on Danish data (Dahl & Carstensen, 2005) that successful link nutrient load to total vegetation cover in Kattegat has shown that only load data from Januar to June correlates with total vegetation cover in the following summers. Load data from summer to January in the previous calendar year was not important. In this work we have used yearly average concentrations and this might introduce noise in the analysis and weaken the correlations. Further analysis should be done based on average concentrations of nutrients, Secchi depth measurements and chlorophyll concentrations calculated on 3–6 month intervals.

Finally if the relationship between concentrations of nutrient and chlorophyll differ substantially from Skagerrak and Kattegat, then separate model estimates should be calculated from each area.

4. Macrozoobenthos

Macrozoobenthos is one quality element in the WFD and the metrics to be used to indicate the quality are based on species abundances, species diversity and proportion of sensitive species. In this study we focus on the first mentioned, species abundances, which determines the species composition.

4.1 Specific objectives

A basic idea in the WFD is that environmental change should be evaluated against reference conditions in separate physico-chemical environments, so called typologies. For this approach to be useful, however, the composition of the biological quality elements like the macrozoobenthos should group in a similar way as the typology, or at least not group in a completely different way. Ideally, similarity within typologies should be greater than between typologies.

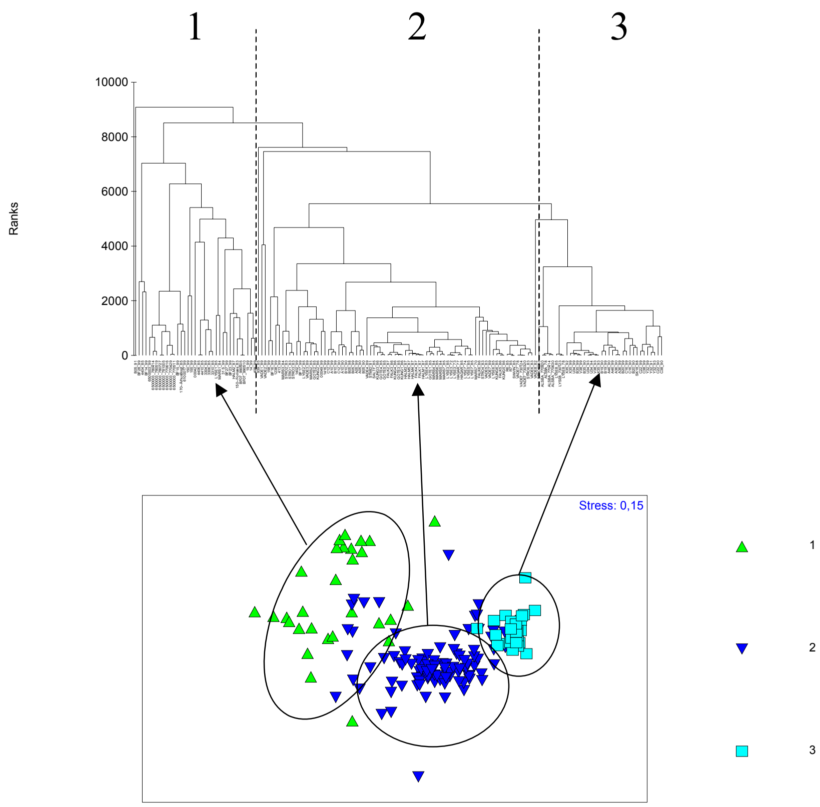
4.2 Materials and methods

To test this in the Skagerrak-Kattegat area, macrozoobenthos data from 107 soft sediment sampling sites (151 samples) from territorial waters of 3 different countries were subjected to ordination analysis (PRIMER package, Clarke & Warwick 1994) in order to reveal patterns in species composition. Biological patterns were subsequently tested for compliance with a typology based on the factors salinity and water depth i.e. with water masses dominated by Baltic water, North Sea water and Atlantic water. The faunal material was collected with several types of quantitative samplers covering 0.0125 to 0.1 m2, collected on the same sieve size (1 mm meshes), preserved in either ethanol or formalin, and sorted under binocular microscope. The material was determined to lowest possible taxon in most cases meaning to species level. Species mean abundance from a number of replicates (number of individuals per m2) were 4root-transformed before calculating the Bray-Curtis similarity coefficients between all samples. The similarity matrix was subjected to both cluster analysis (average sorting method) and multidimensional scaling (MDS). Groupings with respect to typology were tested for difference using the randomization method ANOSIM.

4.3 Results

The samples grouped into three major clusters (Figure 4.1) of which the tightest one was the cluster with stations in the Atlantic water mass, the deepest stations, while the two other the North Sea water sites and the Baltic water sites were more loose. Overall the species composition with respect to abundance grouped reasonably well according to typology and testing for patterns using an two-way ANOSIM showed a highly significant difference between the water masses (P<0.01).

Fig. 4.1 Figure showing result of cluster analysis and MDS analysis of 151 samples from the Skagerrak-Kattegat area. Similarity was based on 4th root transformed species abundances. Note the reasonably clear separation between groups of samples from different water masses (Baltic Water (1), North Sea Water (2) and Atlantic Water (3)).



The geographical extent of the three different water mass regions is indicated in figure 4.2.

The total number of species in the material was 836. Species diversity measured by randomized species sample curves (Figure 4.3) show that high diversity occurred in the North Sea water mass and somewhat lower in the Atlantic water mass and the lowest diversity in the Baltic water mass.

Figure 4.2 The geographical extent of the three different water mass regions. The green colour represent “Baltic water” locations, the blue colour represent “North Sea water” locations and the turquoise colour represent “Atlantic water” locations.

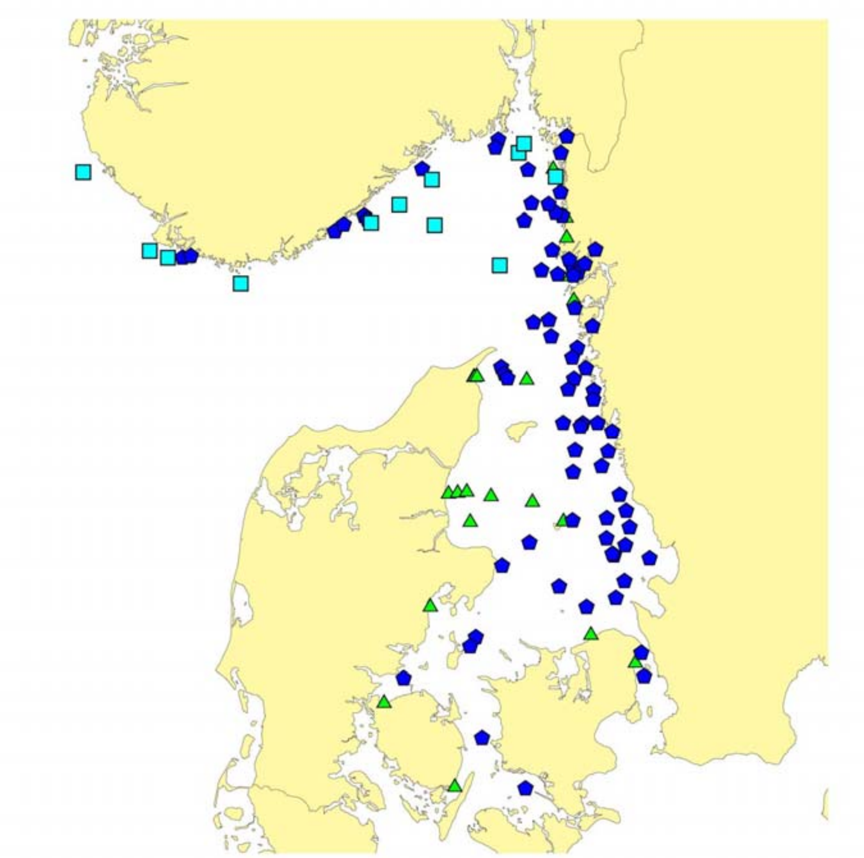
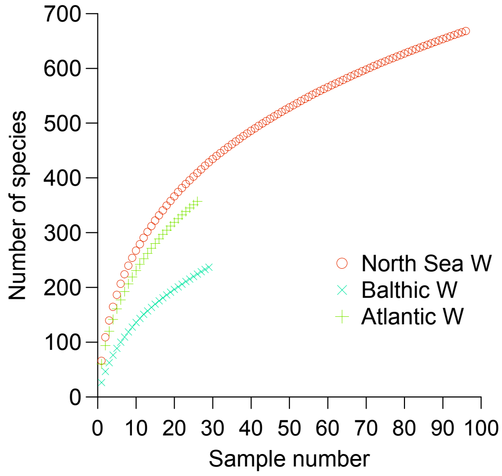
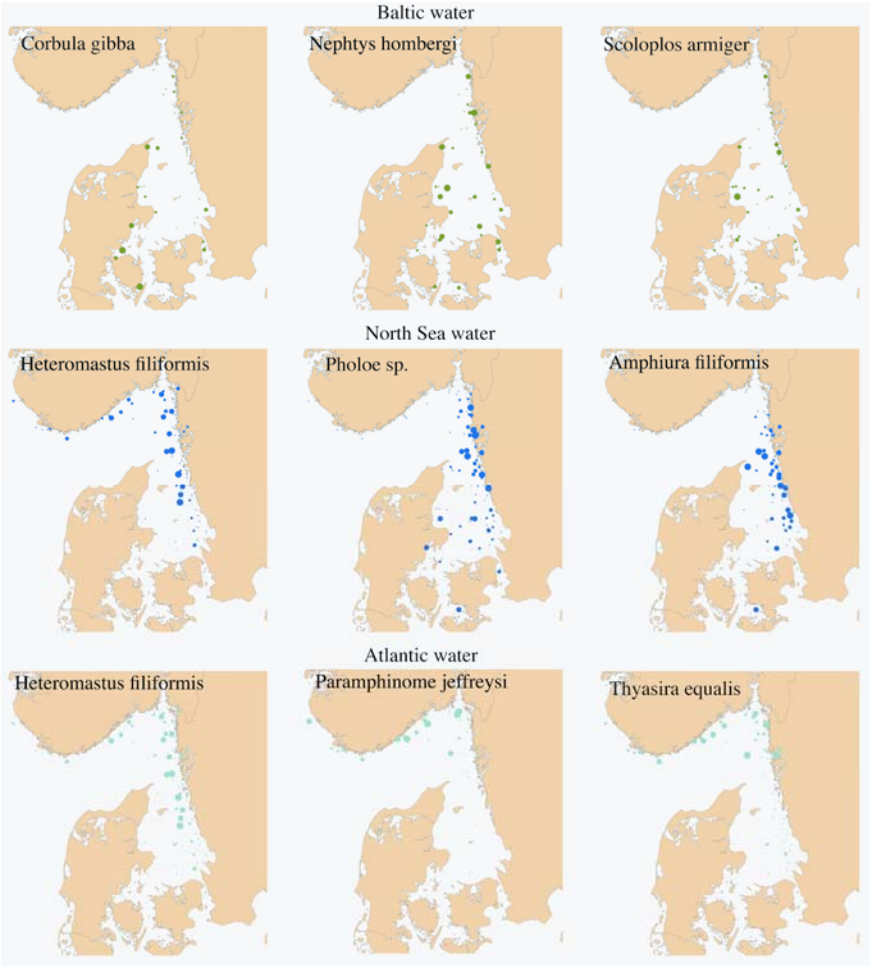


Figure 4.3 Species sample curves from the three different water mass regions.



The three most dominating species from “Baltic water”, “North Sea water and “Atlantic water” mass region were extracted from the species database (Figure 4.4). In the “Baltic water” it was *Corbula gibba*, *Nephtys hombergi* and *Scoloplos armiger*, in “North Sea water” it was *Heteromastus filiformis*, *Pholoe* sp. and *Amphiura filiformis* and in “Atlantic water” it was *Heteromastus filiformis*, *Paramphinome jeffreysi* and *Thyasira equalis*.

Figure 4.4 The maps shows the three most dominating species found in "Baltic water", "North Sea water" and "Atlantic water" mass regions. All locations where the different species were found are presented on the map. Different sizes on the dots represent the relative abundance on each location.



4.4 Discussion

Faunal data in terms of species composition group according to water mass identity. Results, thus, indicate that the proposed water body classification (typology) may give biological meaning in the sense that similarity of species composition within these water mass regions is higher than between the regions. So, the next step is to set reference conditions for these regions. Can this be done in another way than to just accept present status as the Reference State? There could be some sense in choosing this alternative because the investigated areas, all being in the open sea, are little affected by polluting human activities, at least compared to areas closer to the coast and inside the archipelagos. In addition there are three possibilities to establish reference conditions for benthic fauna. 1) One is expert judgement, which means a purely subjective construction of an ideal community, 2) Given that there are data on pressure variables in conjunction with faunal data, “dose-response” relations could be established. Subsequently, from a desired level of the pressure variable the corresponding level of the faunal variable can be established with some certainty. 3) By using data on faunal composition and biomass from pre-industrial time. Alternative 1) is not recommended because there is a great risk of constructing a system that never ever can be retrieved in practice. Alternative 2) is difficult to apply to the present systems because data on pressure variables are highly uncertain and benthos data are scanty in time. Alternative 3) When benthic data exist, it is only biomass data that can be used because of methodological differences between the recent investigations and the old ones. There are some historical faunal data from the area of investigation, some of them from the time of Petersen in the start of the previous century. Some recent investigations, using these data, have indicated that benthic biomass has increased in the Skagerrak area and parts of the Kattegat, (Pearson et al. 1985, Rosenberg et al. 1987). Also comparisons between the 1980s and the 1970s have shown biomass increases of the same order of magnitude in parts of the present area of investigation (Josefson 1990). In these studies biomass in the 1980s had increased with a factor of ca 2 both since the beginning of the previous century and in places also since the early 1970s. Nutrient enrichment was given as one possible cause. A suggestion of reference state for biomass could be the level 30 to 100 years ago, let say for the areas covered by North Sea and Atlantic waters ca. 70 g ww m^{-2} (Rosenberg et al 1987). However, as mentioned before, there are no good data on enrichment, such as area specific loading of nutrients, from the area concerned. One reason for this is that only some sources of nutrient inputs are known. This makes it difficult to give suggestion on management actions how to reach a good ecological status. Still, we will make an attempt as described in 5.2.2.

5. Ecological classification

Management of marine water has for many years been based on a common understanding that the ecological status in many water bodies has been impaired. The response to impaired ecological status has been adoption of various action plans including measure mitigating the causes. In term of eutrophication, the countries around the Skagerrak and Kattegat have adopted plans aimed at a 50% reduction of inputs of nitrogen and phosphorus. Time has shown that parts of these areas are still eutrophic and that additional measures are needed in order to reduce inputs to levels resulting in an acceptable ecological quality. The costs of reducing inputs are increasing and this has lead to a discussion what an acceptable ecological quality really is.

5.1 Specific objectives

A specific objective of RETRO has been to establish scenarios for ecological classification. This has been done by a stepwise approach: Step 1: Definition of reference conditions; Step 2: Definition of acceptable deviation from reference conditions, and Step 3: Setting up scenarios for classification of ecological status for submerged aquatic vegetation at two depths and soft-bottom macrofauna. In this context, the management standard - or the acceptable deviation from reference conditions - is the value at the boundary between good and moderate ecological status.

5.2 Reference conditions

The reference condition is a description of the biological quality elements that exist, or would exist, at high status, that is, with no, or very minor disturbance from human activities. In the Water Framework Directive, the objective of setting reference condition standards is to enable the assessment of ecological quality against these standards.

5.2.1 Reference conditions for submerged aquatic vegetation

The overall conclusion in chapter 3 is that no historic data exists that can be used to describe reference conditions of macroalgal vegetation in Kattegat and Skagerrak at reduced human pressure levels.

Use of models describing selected vegetation indicators, as function of pressure factors, seems to be the only way forward to develop useful tools which can describe reference conditions.

The results of the present study using selected macroalgal indicators gathered by all three countries were not good enough to set up useful models and further work is needed to verify if these indicators are suitable. Not least because work done by Dahl and Carstensen (2005) using total vegetation data from Kattegat has shown that development of such models is possible. Dahl and Carstensen (2005) also modelled total vegetation cover based on a rough estimate of nutrient load to Kattegat in a reference situation (10.000 tons N from Januar to June). Results from Dahl and Carstensen (2005) are used in classification scenarios in this report, however there are a number of factors that limit use of data to reef locations in the central Kattegat. First of all nutrient load data to Skagerrak and nutrient import-export data was not included in the model. Therefore the model is less sensitive describing the relationship between vegetation cover and load in the northern Kattegat around the Kattegat-Skagerrak front and secondly site specific differences in vegetation cover were significant.

5.2.2 Reference conditions for soft-bottom macrozoobenthos

As discussed in chapter 4.4 there could be some sense in choosing the present state of the fauna as the reference condition. If not the only option is to set reference conditions for benthic biomass, a proxy for secondary production, based on historical data. However as also mentioned there are no good historical data on enrichment, such as area specific loading of nutrients, from the area concerned. One reason for this is that only some sources of nutrient inputs are known. This makes it difficult to establish a relationship between the indicated increase in benthic biomass and nutrient loads. Still, we will make an attempt. There have been established quantitative relationships between biomass and nutrient inputs for other systems namely for shallow water Danish estuarine systems (Josefson & Rasmussen 2000). Using these relationships and assuming a similar turnover of biomass, the biomass found in earlier days would suggest a reduction of present loading of N with 60% (from 1.1 – 0.3 gN m-2yr-1) to reach some kind of reference conditions. This is of course highly speculative not the least for the reason that is not likely that turnover of biomass is the same in communities at great depths as in the shallow water systems, which virtually are situated, in the primary production. In fact we know that some deep-water species like the dominating *Amphiura filiformis* have Production/Biomass ratios far below 1 compared to the shallow water systems dominated by *Mytilus edulis* with *P:B* around 2.

5.3 Classification of ecological status

The ecological quality objectives *sensu* the Water Framework Directive are to have an ecological quality corresponding to at least good ecological status. As the contracting parties to OSPAR including the European Commission have agreed that EQOs for eutrophication should be parallel to the classification of the EU WFD, the use of WFD definitions and classes is highly relevant for the open parts of Skagerrak and Kattegat.

5.3.1 Principles

RETRO has based the classification scenarios on reference conditions and a subsequent definition of what an acceptable deviation from reference conditions is. Here, the acceptable deviation is the boundary between good ecological status and moderate ecological status, where "good ecological status" is understood as the values of the biological quality elements show low levels of distortion resulting from human activity and "moderate ecological status" is understood as the values of the biological quality elements deviate moderately form those normally associated with the coastal water body type under undisturbed conditions.

Translation of the terms "low levels of distortion" and "deviate moderately" into operational values is easier said than done. Setting the boundary correct is at present extremely difficult. However, this boundary being the management standard shall be established despite the fact that we do not have established a comprehensive and conceptual understanding of causes and effects in the open water of the Skagerrak and Kattegat. Consequently, the approach used by RETRO should be regarded as a first attempt which requires closer examinations and further fine-tuning.

RETRO has developed three scenarios for acceptable deviations from reference conditions, where scenario A assumes that a 15% deviation from reference conditions is acceptable; scenario B assumes that 25% deviation is acceptable and scenario C assumes that 50% is acceptable. The percentages are in principle arbitrary, but this approach is simple and has already been used for example by OSPAR and others (OSPAR 2003, Ærtebjerg et al. 2003, Andersen et al. 2004 and Krause-Jensen et al. 2005). The approach is also expected to be integrated into the Pan-European Eutrophication Activity, which is an initiative by the European Commission to coordinated eutrophication assessment procedures in the context of all European water policies. Here, the principles will be to justify the percentage defining what an acceptable definition, but not to exceed 50%. The three scenarios (A, B and C) and suggestions for setting the boarders between classes can be positioned as described in Table 5.1.

Table 5.1. Principles and suggestions for different acceptable deviations (in %) from reference conditions used for ecological classification in five quality classes (high, good, moderate, poor and bad ecological status). Modified from Andersen et al. 2004.

	High	Good	Moderate	Poor	Bad
Scenario A	0 – 5	5 – 15	15 – 35	35 – 65	> 65
Scenario B	0 – 10	10 – 25	25 – 45	45 – 70	> 70
Scenario C	0 – 20	20 – 50	50 – 70	70 – 90	> 90

Combining these suggested interim class boundaries in Table 5.1 with information on reference conditions will result in a classification schedule complying with the principles of the Water Framework Directive.

5.3.2 Classification scenarios for submerged aquatic vegetation and soft-bottom macrofauna

For submerged aquatic vegetation, the reference conditions at reefs in the central Kattegat have been established for the coverage of macroalgae at two depths, 15 meters and 20 meters. At 15 meters depth, the coverage of macroalgae in a reference situation is assumed to be 100%. At 20 meters, the reference coverage is assumed to be 90%. Taking these values as anchors, the classifications scenarios A, B and C can be set up, c.f. Table 5.2 and 5.3.

Table 5.2. Scenarios (A, B and C) for classification of ecological status of coverage (%) of macroalgae at 15 meters depth in the open parts of Skagerrak and Kattegat.

	High	Good	Moderate	Poor	Bad
Scenario A	100 – 95	95 – 85	85 – 65	65 – 35	< 35
Scenario B	100 – 90	90 – 75	75 – 55	55 – 30	< 30
Scenario C	100 – 80	80 – 50	50 – 30	30 – 10	< 10

Table 5.3. Scenarios (A, B and C) for classification of ecological status of coverage (%) of macroalgae at 20 meters depth in the open parts of Skagerrak and Kattegat.

	High	Good	Moderate	Poor	Bad
Scenario A	90-86	86-77	77-59	59-32	<32
Scenario B	90-81	81-68	68-50	50-27	<27
Scenario C	90-72	72-45	45-27	27-9	<9

The above classification scenarios should off cause be tested and validated. This is already under way for the Danish waters via projects funded by the Danish Environment Protection Agency and the Danish Forest and Nature Agency. Subsequently, our common understanding of the structure, functioning and stability of macroalgae communities at the seafloor in the Skagerrak and Kattegat will improve to a level where the boundaries can be set more accurate.

Assuming that a tentative value for the reference biomass of soft-bottom macrozoobenthos is 70 g ww m^{-2} and using the approach outlined in 5.3.1, three classification scenarios can be described, c.f. Table 5.4.

Table 5.4. Scenarios (A, B and C) for classification of ecological status of soft-bottom macrofauna biomass (g ww m^{-2}) in the open parts of Skagerrak and Kattegat based.

	High	Good	Moderate	Poor	Bad
Scenario A	< 74	74 – 81	81 – 95	95 – 116	> 116
Scenario B	< 77	77 – 88	88 – 102	102 – 119	> 119
Scenario C	< 84	84 – 105	105 – 119	119 – 133	> 133

As a cautionary note, we are aware of the fact that soft-bottom macrofauna can respond both positively and negatively to increased inputs of nutrients. Normally the biomass of soft-bottom macrofauna responds positively to increased inputs of nutrients as these lead to increase primary production and eventually an increase in the food supply for the fauna living on the seafloor. However, the biomass will reach a maximum where additional inputs of nutrient are likely to result in hypoxia or even anoxic conditions which will reduced the biomass. Based on the available information on the oxygen concentrations in the open parts of Skagerrak and the northern parts of Kattegat, we consider the response of macro fauna to be positively correlated to nutrient inputs. Accordingly, the scenarios have been calculated as a positive deviation from reference conditions, c.f. Table 5.4. However, since biomass data in the RETRO material to a great extent is lacking from the discussed area, we have to rely on literature data also for the present situation. Average biomass form the same area in 1992-1994 was reported to 45 g ww m^{-2} by Rosenberg et al. (1996) and this is even lower than the tentative reference value. For the remaining part of the RETRO area, the open Kattegat the reference value (100 years ago) is likely around 300 g ww m^{-2} (Pearson et al. 1985) and recent values at a similar level (241 g ww m^{-2} Pearson et al. 1985, 360 g 1992-2003 MADS database).

The suggested class boundaries for soft-bottom macrofauna are of cause tentative. As for the macroalgae, the suggested classification scenarios should be tested and validated and it will likely be necessary to increase the tolerated deviation from the reference biomass considerably. The reason for this is that benthic biomass on a large scale can vary with a factor of 2 or more between recent decades without any negative impact of hypoxia (Josefson 1990).

5.4 Assessment of ecological status

The suggested scenarios can be used for an assessment of the ecological status of the open parts of the Skagerrak and Kattegat.

The total vegetation cover at reefs in the central Kattegat changes a lot from year to year due to variations in precipitation induced nutrient load. This is the actual reason why empirical models could be established. The average modelled vegetation cover at reefs in the central cover in the period from 1994 to 2001 was 88% at 15m water depth and 38% at 20m.

At 15m water depth the conditions are regarded as ”good” in scenarios 1 and 2 and even ”high” in scenario 3. At 20 m water depth on the other hand the conditions are regarded as ”poor” in scenarios 1 and 2 and ”moderate” in scenario 3. This does not make much sense and looking at the modelled response in total vegetation cover (figure 3.2) it is obvious that the response in the vegetation cover increase with increasing depth.

Since recent biomass values of macrobenthic fauna seems to be of similar magnitude as 100 years ago, both in the open Skagerrak and the open Kattegat, we consider the ecological status to be ”High” with respect to biomass. Whether or not the status level is different for other faunal variables, such as species diversity etc. can not be judged from the RETRO material.

5.5 Discussion

The approach for defining acceptable deviation is simple and has proven to work well in relation to assessment of eutrophication status in the North Sea, Skagerrak, Kattegat and Baltic Sea.

We think the work within RETRO is a very good basis for further development of EQOs and management standards for the open parts of the Skagerrak and Kattegat. The indicators used are:

- responsive to nutrient enrichment and as such indicators of eutrophication status and the general dose-response relationships and the root causes are well known, and
- considered to be robust and therefore included in national and regional monitoring programmes.

The approach of establishing reference conditions and defining acceptable deviation from these is generally accepted, e.g. by the Water Framework Directive, OSPAR and HELCOM. Compiling information of reference conditions via historical data, reference sites, modelling or expert judgement is a process involving scientists and as such not a political process. This is convenient and should not be changed. On the contrary, deciding on how to set the boarders is not only a scientific/technical process. Setting up EQOs and class boundaries should be based on as much scientific and technical information as possible.

However, a total understanding of structure, functioning and stability of the habitats in the open parts of the Skagerrak and Kattegat is not available at present. This should not prevent managers and even politicians from making decisions as long as these are regarded as interim decisions which should be evaluated and amended with regular internals and in accordance with “new” knowledge. By doing so, the management will be stepwise. This is also termed “adaptive management”.

The adaptive management of the open parts of the Skagerrak and Kattegat should as a guiding principle also be informed and based on information of ecosystem structure, functioning and stability. RETRO has compiled a lot of information in relation to submerged aquatic vegetation and to some degree on soft-bottom macrofauna. More information should be compiled and integrated, e.g. nutrient concentrations and phytoplankton.

Other important issues to discuss and decide upon are related to seasonal variations and year-to-year variation. What should the monitoring frequencies be in case of strong seasonal signals? How should fulfilment of EQOs be addresses if there are profound year-to-year variations? Should the assessment then be based on a 5 year mean?

Perhaps the most important question is how to interpret an acceptable deviation. At present, 50% is considered to be an upper limit. Recent work indicate that even 25% should be considered as a maximum value (Krause-Jensen et al. 2005 and HELCOM 2005) at which structural changes in ecosystem structure and stability are taking place. Such decision are to taken by competent authorities and be based on as much available scientific and technical information as possible.

By compiling and integrating information on nutrient concentrations, phytoplankton (productivity, biomass and species composition) and combining this with information on submerged aquatic vegetation and soft-bottom macrofauna, the future assessments could be based on the “one out – all out” principle *sensu* the Water Framwork Directive. At present, the tools developed in RETRO are focusing on single indicators and not on an understanding of structure and functioning. By combining indicators, the Ecosystem Approach will be implemented.

6. Summary, conclusions and perspectives

An overall objective of RETRO was to develop, test and validate a methodological approach to define and characterise type areas of selected elements of the ecosystems in the open parts of the Skagerrak and the Kattegat. The work was based on the vast amount of monitoring data collected in the region by Norway, Sweden and Denmark in the past 20-30 years. An analysis like this has not previously been performed and a major achievement of RETRO was this systematically analysis of data across national borders.

Further more it is the hope that the analysis and synthesis of these data performed in RETRO to some extent will represent a major scientific achievement and not least improve our understanding of this ecosystem functioning.

The specific focus has been on submerged aquatic vegetation and macrozoobenthos, where main reasons for choosing these organisms are that they are stationary, respond to time integrated anthropogenic pressures and that time series data are available.

As identification of water bodies is of major importance for the WFD, characterisation of typologies, that is water body classification, for the open areas of the Skagerrak and the Kattegat has also been a key issue within this report.

More specifically the work on the water body classification of the different open areas of the Skagerrak and the Kattegat has focused on depth and substrate and not least on currents and stratification. With an overall aim to produce a water body classification as simple as possible that is both ecologically relevant and practical to implement.

The work on submerged macro vegetation has focused on macrophyte data at two selected depth intervals with regard to the development of a classification of algal communities and identification of important controlling components. Apart from the assimilation of data, including the possible use of historic data to set up reference conditions the aim has been to establish empirical models coupling nutrient loads and the development of benthic vegetation and use the models to hindcast the reference situation for benthic vegetation in typologies based on estimates of nutrient loads in selected time periods.

The analytical approach on macrobethos has been some what different from the macro vegetation approach in the respect that patterns in species abundance were tested for compliance with a typology based on the factors salinity and water depth i.e. with water masses dominated by Baltic water, North Sea water and Atlantic water. The approach was chosen to test if the basic idea of the WFD that environmental change should be evaluated against reference conditions in typologies is applicable. This means that a prerequisite is that the composition of the biological quality elements like the macrozoobenthos should group in a similar way as the typology, or at least not group in a completely different way.

6.1 Summary and conclusions

Water masses

In this project existing datasets were used to map the dynamical physical features of the Skagerrak and Kattegat water masses. Datasets included salinity, temperature, light-depth, bottom depth and bottom substrate while up- and downwelling was not quantified.

The analysis showed that there are several possible ways of classifying water masses in the region with salinity as the only obligatory factor. While depth and substratum where important optional factors potentially modulating the biology they also added a higher level of complexity due to the heterogeneity of these factors. So even though it is well known and the analysis showed that substratum is essential for defining benthos communities the heterogeneity made it practically impossible to implement substratum to water mass classification and at the same time maintain the overall objective of typology that is to ensure valid comparisons of ecological status of water bodies.

The final out come of these reflections were that 4 water body types were identified in the off-shore Skagerrak – Kattegat area. Two of the types where characterised by euhaline salinity (> 30) but with water of Atlantic water and North Sea water respectively an origin that affects the biology. The third type is stratified with polyhaline (salinity 20-30) surface water and euhaline bottom water, and the fourth type is only polyhaline. The four water types was suggested to be used to predict reference conditions in the biological indicators of aquatic vegetation, macrozoobenthos as well as the plankton which is not included in this project.

Submerged macro vegetation

Macroalgal vegetation at the shallow depth interval (8-10m) did show a significant difference between the identified water types, typologies of Skagerrak and Kattegat (see chapter 2), although significant national differences reduced the overall difference between type 2: North Sea water type and type 3: Stratified water type. Type 3 with polyhaline surface water does have a national linked variation that may be reflected in the biology and possibly should be reflected in the typology.

Spatial variation between algal communities was very high at the two depth intervals. This variation was not reflected in the correlation between algal communities at the two depth intervals and the environmental variables assumed to control the benthic vegetation as only a weak to moderate correlation was found. Amongst the environmental variables chlorophyll and nitrate + nitrite showed the best correlation, while solar radiation and Secchi depth only showed a minor correlation with the abundance of benthic algae.

The fact that algal communities within each country could easily or to some extend be distinguished from each other may imply that differences between sites are huge. The implication of this finding is that development of common targets for algal community structure within typologies covering larger areas will require a more proper scale of spatial replication.

It was suggested that certain problems are associated with harmonisation of monitoring methodology between the three Nordic countries. This idea was based on the fact that separation of algal communities by country gave a very clear and significant picture at both water depth intervals and several explanations for these problems was suggested:

Well known differences between divers judgement of algal cover is enhanced by the use of different national guidelines. The squeezing of macroalgal monitoring data with methodology differences between the three countries into the same system probably led to systematic errors for some species covers in the common dataset.

The question if the divers can recognise eg. *Laminaria digitata* from Laminaria hyperboria in Danish waters and *Ptilota gunneri* from *Plumaria elegans* in Norwegian waters and other species due to diminishing morphological characteristics between the two species at salinities present in Kattegat.

The assumption that results from the photometrical methodology used at Swedish monitoring stations are the same as data collected by divers.

The establishment of empirical models describing the vegetation cover of the two selected species *Laminaria saccharina* and *Delesseria sanguinea* as function of natural and eutrophication dependent variables showed significant correlations. However correlations were not high for either species.

The most important factors for the cover development of both species below the depth of their average maximum distribution were solar radiation and depth while a significant and positive relationship between Secchi depth and development of vegetation cover was only identified for *D. sanguinea*.

Chlorophyll *a* and vegetation was important for both species but the effect was dependent on depth and the relationship between algal cover and chlorophyll concentration differed between *D. sanguinea* and *L. saccharina*.

Cover of both species was negatively correlated with yearly average of ammonium concentration in the surface water whereas total phosphorous concentration had a questionable positive influence on Laminaria cover.

Part of the project was to evaluate the possible use of historic data to set up reference condition for macroalgal vegetation in Kattegat and Skagerrak. The main problem stated was that accurate data from off shore areas are scarce supported by a previous investigation which concluded that most of the older data are not suitable for modern analytical methods. An example was the bias that older methods like dredging inflict on the data consequently making it difficult to separate methodological constraints from environmental impact comparing with modern data.

A somewhat similar conclusion was the basis for not using historical data within the danish monitoring programme and the overall conclusion on historical data in this report therefore is that no such data on macroalgal vegetation exists that can be used to describe reference conditions of macroalgal vegetation in Kattegat and Skagerrak.

In the absence of useful historical data it is argued that the only way forward to describe the reference conditions of this important element of the marine ecosystem in Kattegat and Skagerrak seems to be the use of models describing selected vegetation indicators as function of environmental pressure factors.

Macrobenthic fauna

The analysis of macrobenthic fauna, not strictly referring to the water bodies defined in chapter 2, showed that data from the sampling sites grouped into three major clusters with one cluster of stations in the Atlantic water, one in the North Sea water sites and one in the Baltic water. The species composition also grouped according to these water masses with a highly significant difference between the water masses. This grouping of data according to water bodies (with reference to chapter they are Atlantic water = type 1, North Sea water = type 2 + 3, Baltic water = type 4) thereby indicated that typologies may be applicable for the biological parameter macrobenthic fauna (indicator according to WFD) in the sense that similarity of species composition within the water bodies was higher than between the water bodies.

Setting up reference conditions turned out to be major problem as there were no good historical data on nutrient loading. Consequently it became difficult to establish a relationship between an indicated increase in benthic biomass and enrichment, that is, primarily nutrient loads.

A highly speculative alternative approach in setting up reference conditions for the off shore Skagerrak-Kattegat region macrobenthos was performed by applying quantitative relationships between biomass and nutrient inputs from shallow water Danish estuarine systems. The approach assumed that turnover of biomass is the same in communities at great depths as in the water systems. An assumption which is not likely to be true.

Without considering the problem of this assumption the result of this relationships based on earlier days macro benthic biomass suggested that historical loading of N was 60% of the present loading.

6.2 Recommendations

The recommendations in this report may in many respects deviate from the original objectives. One main reason is the fact that results did not come out as complete as expected and conclusions were therefore not as simple to draw. As an example the development of conceptual models of the relations between anthropogenic pressure and the functioning of benthic ecosystems is not as complete as expected.

There are several reasons to this problem but examples are problems with the comparison of national data and lack of good historical data.

Never the less an overall recommendation from chapter 2, which addressed the characterisation of typologies in the open areas of the Skagerrak and the Kattegat, is that 4 off-shore water bodies based on significant water mass characteristics should be applied.

It was within the analysis and comparison of algal data that most unexpected problems arose. As presented in the previous section there seemed to be several problems related to harmonisation of monitoring methodology between the three Nordic countries in the of shore waters due to use of different techniques and guidelines.

It is obvious that a better coordination of regional monitoring and specifically a harmonisation of methodology and guidelines would be a step in the right direction. More specifically an example of a problem that should be taken into account are that development of common targets for algal community structure within water body typologies covering larger areas require a more proper scale of spatial replication.

It is on the other hand also important to be aware that harmonisation could impose a new problem. Namely the obvious risk that the changes could devaluate the national monitoring time series if continuity on data is broken on a national level.

Apart from a harmonisation of guidelines further species aggregation in the common dataset is recommended, not least to exclude methodological problems in separating species.

It is also recommended that further attempts should be done to improve the use of models and the estimated parameters. Not least because a conclusion is that models describing selected vegetation indicators, as function of pressure factors, seems to be the only way forward to develop useful tools to describe the reference conditions of macroalgae in the marine ecosystem in Kattegat and Skagerrak. With reference to models it is possible that substantial differences in the relationship between concentrations of nutrient and chlorophyll will imply that separate model estimates should be calculated from each area.

With reference to estimated parameters further analysis of particularly how to analyse average concentrations of nutrients, Secchi depth measurements and chlorophyll concentrations is essential.

A possible recommendation on the macrobenthic fauna is to include more historical data in the analysis. That is looking at data, as example from C.G. Johannes Petersen, that does not apply to modern sampling techniques.

6.3 Perspectives

Management of marine ecosystems should as a guiding principle aim at securing stability and that the structure and functioning of the ecosystems and habitats do not deviate unacceptable from reference conditions. The management plans and the measure to implement to reach the objectives of the plans should always be ecosystem based. This is sometimes referred to as the Ecosystem Approach to Management.

The Ecosystem Approach is when focusing on marine water a strategy for integrated management of all activities influencing the water body in question. An ecosystem based management will always have to be based on a scientific understanding of how biological communities are organised, including an understanding of structure, processes, functioning and interactions between organisms and their environment. This implies that humans are an integral component of many ecosystems.

The focus on structure, processes, functioning and interactions is in accordance with the definition of "ecosystem", c.f. article 2 in the Convention on Biodiversity:

> "'Ecosystem' means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit."

This definition is not specific in terms of unit or scale. Consequently, the term 'ecosystem' can refer to any functional unit at any temporal or spatial scale.

Ecosystem based management will be adaptive as a result of the complexity of the problems in question and the lack of complete knowledge or understanding of ecosystem structure and functioning.

Ecological processes are often non-linear and the results of such processes include point-of-no-returns and time lags. This can result in discontinuities and various types of uncertainty. Management plans have to be adaptive in order to deal uncertainty and at the same time include elements of “learning-by-doing” and feedback from research and monitoring activities. Action plans should be adopted and programmes of measures should be implemented, also when cause-effect relationships are not 100% scientifically documented. The plans and programmes must be updated as new knowledge is generated or produced and the cause-effects relationships are documented.

As a precautionary note, it should be emphasised that application of the ecosystem approach does not imply that other management or protection programmes should be stopped. Ideally, programmes aiming at protection Natura 2000 areas and programmes of reducing eutrophication effects should be integrated. If so, the ecosystem approach is implemented.

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Dansk resumé

Det overordnede mål med RETRO var at udvikle en metodisk tilgang til at karakterisere typeområder for de udvalgte elementer, vandmassetypologi, makroalgevegetationen og makrobentisk fauna i økosystemet i Skagerrak og Kattegats åbne havområder. Analyserne af vandmasser, med målet at fremstille en simpel og implementerbar klassifikation, viste at salinitet var den eneste anvendelige parameter og 4 vandmassetyper blev identificeret på basis af denne. For makroalgevegetation var mål at identificere vigtige styrende faktorer og fremstille empiriske modeller som koblede næringsstofbelasning med udviklingen i vegetationen. I mangel på anvendelige historiske data blev det anbefalet at referencetilstande bliver beskrevet ved hjælp af modeller for udvalgte vegetationsindikatorer som funktion af styrende miljøfaktorer. Udbredelsen og sammensætning af bentisk fauna blev undersøgt i forhold til vandmassetypologier og viste at fordele sig i 3 større grupper i forhold til Atlantisk, Nordsø og Baltiske vandmassetyper.

Annex 1: Macroalgal investigations evaluated as part of RETRO

abbreviation used: Nat. = national, Reg. = Regional, loc. = local, no. = number, veg. = Vegetation, tr. = transect, loc. = location,

seasonal sampling is split on 1=des(prev.yr)-feb; 2=mar-mai;3=jun-aug; 4=sep-nov

Country	Type of investiga-tion	Part of Kattegat or Skagerak	IN WGS84, NATIONAL GRID Locality Name	Lat. WGS84	Long WGS84	Depth range (m)	First year sampled	Latest year sampled	No. years sampled	Seasonal sampling	Data collected	Sampling Design	Customer	Contractor
N	Nat. monitring	NW Ska-gerrak	Tisler	58,98417	10,965333	0-20	1990	1993	4	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
N	Nat. monitring	NW Ska-gerrak	Færder	59,026683	10,52675	0-30	1990	2001	8	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
N	Nat. monitring	NW Ska-gerrak	Lynghlm	59,04315	10,29625	0-30	1990	2001	12	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
N	Nat. monitring	NW Ska-gerrak	Oddaneskj	58,954683	9,8642167	0-30	1990	2001	12	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
N	Nat. monitring	NW Ska-gerrak	O-skjær	58,973083	10,154783	0-30	1995	2001	7	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
N	Nat. monitring	NW Ska-gerrak	Arøy	58,891667	9,5791667	0-30	1990	1991	2	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
N	Nat. monitring	NW Ska-gerrak	Varøy	58,973083	9,2966667	0-30	1990	1991	2	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
N	Nat. monitring	NW Ska-gerrak	Tromøy N.	58,513217	8,94425	0-30	1990	2001	12	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
N	Nat. monitring	NW Ska-gerrak	Presthlm	58,2732	8,53715	0-30	1990	2001	12	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
N	Nat. monitring	NW Ska-gerrak	Humleøy	58,238233	8,4289333	0-30	1990	2001	12	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
N	Nat. monitring	NW Ska-gerrak	Mehlm	58,094667	8,2108333	0-30	1990	2001	9	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
N	Nat. monitring	NW Ska-gerrak	Hærhlm	57,995667	7,66	0-30	1990	1991	2	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
N	Nat. monitring	NW Ska-gerrak	Revøy	58,048033	6,79595	0-30	1990	2001	12	3	Taxa, abundance, no of kelp ind/m2	Transect 0-30m depth x 4 m wide	SFT	NIVA
DK	Nat. monitring	NW Katte-gat	Herthas Flak	5738,5925	1052,1177	10-20	1990	2001	12	(2)-3	Taxa, vegetation cover	Point investigation	Miljømini-steriet	DMU
DK	Nat. monitring	NW Katte-gat	Tønneberg banke	5728,321	1116,254	10-15	1990	2001	12	(2)-3	Taxa, vegetation cover	Point investigation	Miljømini-steriet	DMU
DK	Nat. monitring	NW Katte-gat	Læsø trindel	5725,3855	1114,698	3,5-18	1991	2001	10	(2)-3	Taxa, vegetation cover	Point investigation	Miljømini-steriet	DMU

DK	Nat. monitring	NW Kattegat	Per Nilen	5722,6913	1102,5088	6-11	1990	2001	4	3	Taxa, vegetation cover	Point investigation	Miljøministeriet	DMU
DK	Nat. monitring	Central Kattegat	Kim's Top	5700,767	1135,416	14,5-22	1992	2001	10	(2)-3	Taxa, vegetation cover	Point investigation	Miljøministeriet	DMU
DK	Nat. monitring	Central Kattegat	Store Middelgrund	5633,313	1204,175	10-23	1990	2001	12	(2)-3	Taxa, vegetation cover	Point investigation	Miljøministeriet	DMU
DK	Nat. monitring	SW Kattegat	Briseis Flak	5619,565	1119,566	4-9	1990	2001	12	(2)-3	Taxa, vegetation cover	Point investigation	Miljøministeriet	DMU
DK	Nat. monitring	SW Kattegat	Schultz's grund	5609,588	1111,265	4,5-18	1990	2001	12	(2)-3	Taxa, vegetation cover	Point investigation	Miljøministeriet	DMU
DK	Nat. monitring	S Kattegat	Gilleleje	5607,85	1218,55	1-13	1994	1999	5	(2)-3	Taxa, vegetation cover	Transect	Frederiksborg Amt	Consulting firms
DK	Nat. monitring	S Kattegat	Hesselø	5611,67	1143,06	1-13	1994	1999	4	(2)-3	Taxa, vegetation cover	Transect	Frederiksborg Amt	Consulting firms
DK	Reg. Monitoring	W-Kattegat	Fornæs Tr-1	56,26109	10,57504	0-13 ?	1983	1986	2	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Fornæs Tr-2	56,26329	10,58034	0-13 ?	1983	1986	2	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Fornæs Tr-3	56,26589	10,58164	0-13 ?	1983	1986	2	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Fornæs Tr-4	56,27249	10,57483	0-13 ?	1983	1986	2	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Fornæs Tr-5	56,27469	10,57393	0-13 ?	1989	1989	1	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Fornæs Tr-6	56,27229	10,58343	0-13 ?	1999	1999	1	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Fornæs Tr-7	56,28239	10,56093	0-13 ?	1999	1999	1	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Fornæs Tr-8	56,28489	10,27423	0-13 ?	1999	1999	1	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Fornæs Tr-9	56,28489	10,55213	0-13 ?	1999	1999	1	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Fornæs Tr-10	56,29199	10,54063	0-13 ?	1999	1999	1	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Fornæs Tr-11	56,29279	10,53233	0-13 ?	1999	1999	1	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Djursland Nordstrand	56,3215	10,5023	0-6	1990	1996	4	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Hevring Bugt	56,3465	10,22695	0-6	1990	1996	4	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult

DK	Reg. Monitoring	W-Kattegat	Hevring Bugt	56,31295	10,30905	0-6	1990	1996	4	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Hevring Bugt	56,3184	10,3742	0-6	1990	1996	4	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Hevring Bugt	56,3215	10,5023	0-6	1990	1996	4	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	W-Kattegat	Hevring Bugt	56,3852	10,2493	2-4	1992	1992	1	3	Taxa, vegetation cover	Transect	Århus Amt	Bioconsult
DK	Reg. Monitoring	N-Kattegat	Læsø tr. 2	57,21648	11,08016	9-15	1988	1994	5	3	Taxa, vegetation cover	Transect	Nordjyl-lands Amt	Nordjyllands Amt
DK	Reg. Monitoring	N-Kattegat	Læsø tr. 3	57,21305	11,05575	1-15	1988	1994	7	3	Taxa, vegetation cover	Transect	Nordjyl-lands Amt	Nordjyllands Amt
Dk	Reg. Monitoring	N-Kattegat	Læsø tr. 4	57,2169	11,0315	9-15	1988	1994	6	3	Taxa, vegetation cover	Transect	Nordjyl-lands Amt	Nordjyllands Amt
S	Nat. monitoring	NE Ska-gerrack	Mittskär	58,21048	11,34243	0-20	1994	2001	8	3	Taxa, veg. cover, strata, no. patches, no. of ind. for kelp	Hier. repl.-5 tr/loc., 14 depths (0-20 m)/tr, 2 rep./depth/tr->10 rep./depth/loc.	SEPA	GMF
S	Nat. monitoring	NE Ska-gerrack	Byxeskär	58,26148	11,38608	0-20	1994	2001	8	3	Taxa, veg. cover, strata, no. patches, no. of ind. for kelp	Hier. repl.-5 tr/loc., 14 depths (0-20 m)/tr, 2 rep./depth/tr->10 rep./depth/loc.	SEPA	GMF
S	Nat. monitoring	NE Ska-gerrack	Gråurn	58,28575	11,33527	0-20	1993	2001	9	3	Taxa, veg. cover, strata, no. patches, no. of ind. for kelp	Hier. repl.-5 tr/loc., 14 depths (0-20 m)/tr, 2 rep./depth/tr->10 rep./depth/loc.	SEPA	GMF
S	Nat. monitoring	NE Ska-gerrack	Tån	58,29883	11,33105	0-20	1993	2001	9	3	Taxa, veg. cover, strata, no. patches, no. of ind. for kelp	Hier. repl.-5 tr/loc., 14 depths (0-20 m)/tr, 2 rep./depth/tr->10 rep./depth/loc.	SEPA	GMF
S	Nat. monitoring	NE Ska-gerrack	Långö	58,25098	11,37778	0-20	1993	2001	9	3	Taxa, veg. cover, strata, no. patches, no. of ind. for kelp	Hier. repl.-5 tr/loc., 14 depths (0-20 m)/tr, 2 rep./depth/tr->10 rep./depth/loc.	SEPA	GMF
S	Nat. monitoring	NE Ska-gerrack	Namnlösen	58,24377	11,37232	0-20	1993	2001	9	3	Taxa, veg. cover, strata, no. patches, no. of ind. for kelp	Hier. repl.-5 tr/loc., 14 depths (0-20 m)/tr, 2 rep./depth/tr->10 rep./depth/loc.	SEPA	GMF
S	Survey	E Kattegat	Kattskallen	57,13523	1,03056	18-25	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	Ullharen	57,11212	12,11803	16-30	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	Havskat-teknölarna	57,08635	1,69792	20-23	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.

S	Survey	E Kattegat	Nord Fårnyet	57,14075	12,12538	18	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	Syd S Kråkan	57,12187	12,15563	17	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	Prästskär	57,19195	1,33889	0-15	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	Knarrskär	57,19037	12,14187	0-10	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	Balgö	57,16478	12,16017	0-5	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	Grässkär	57,15418	1,56111	0-10	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	N. Kråkor-na	57,14120	12,15562	0-10	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	Kampavi-ken	57,11493	1,86736	0-5	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	Espevik	57,18673	12,17695	0-4	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	Nisseholm	57,17918	12,20362	0-3	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	Stenskär	57,15392	12,18242	0-3	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	Bondhol-men	57,14078	12,20075	0-1(4)	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.
S	Survey	E Kattegat	N Eneskär	57,13353	12,18657	0-3.5	1983	1983	1	3	Taxa, veg. cover (% at a three level scale), depth limits	1 transect/locality	Varbergs kommun	Dep. of Mar. Bot. Göte-borg Univ.

S	Survey	Middle Kattegat	LaM01	56,91750	11,85167	18-20	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	Middle Kattegat	LaM02	56,94267	11,93217	6.6-9	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	Middle Kattegat	LaM03	56,95217	11,94417	12.0-13.0	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	Middle Kattegat	LaM04	56,99267	11,97683	14.6-32	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	Middle Kattegat	LaM05	56,93917	11,91917	7.2-12.1	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	Middle Kattegat	LaM06	56,94750	11,94333	8.0-12.0	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	Middle Kattegat	LaM07	56,94833	11,86833	14-16	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	Middle Kattegat	LaM08	56,94883	11,90333	10.0-11.0	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	Middle Kattegat	LaM09	56,95167	11,95667	9.9-15	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	Middle Kattegat	LaM010	56,95783	11,93983	10	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	Middle Kattegat	LaM011	56,97633	11,95767	13-20	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	Middle Kattegat	LaM012	56,96267	11,89267	11.0-19.0	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	Middle Kattegat	LaM013	56,97000	11,93833	14-20	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL

S	Survey	Middle Kattegat	LaM014	56,97100	11,96967	13-20	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Hållsundsudde 1	57,34167	12,00700	0-19	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Hållsundsudde 2	57,34417	7,38542	0-13.5	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Hållsundsudde 3	57,34833	11,99667	0-13	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Skalla fyr	57,35750	1,14236	0-8	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Tångholm	57,36517	7,30208	0-6	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Knaståsberget	57,36950	0,52569	0-6	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	NE Kohuvudet	57,35267	11,97117	0-7	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Hästholm	57,35167	11,96667	0-22	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Halseskären	57,38950	11,90333	0-20	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Breda Kråkor	57,36833	11,91167	0-20	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Loteskär	57,36833	11,91833	0-21	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Smetholm	57,38583	11,91917	0-13	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL

S	Survey	NE Kattegat	Vikaholm	57,38417	11,94917	0-5	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	N Öckerö	57,37883	11,94417	0-3.5	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Lyngås	57,37417	11,95667	0-5(9)	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Hästebådan	57,36083	11,94133	0-12.5	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	N Nidingen	57,30500	11,91467	0-7(25)	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	W Hållsundsudde	57,34583	1,14236	14-18	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Syd Malö	57,32250	11,96167	14-30	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	NE Kattegat	Korallgrund	57,33333	12,33817	11.0-20.0	1997	1997	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Halland	TMBL
S	Survey	SE Skagerrack	Höga Ulle	57,91678	3,71319	0-19.3	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skagerrack	Sundet Skintorna (Westside)	57,90937	11,48682	0-10.5	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skagerrack	Sundet Skintorna (Eastside)	57,90937	11,48682	0-11	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skagerrack	Tjuderhälen	57,90335	11,50207	0-24.5	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skagerrack	St Buskär	57,91862	11,50388	0-23.8	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL

S	Survey	SE Skager-rack	Hamneskär	57,89140	11,46767	0-16	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Alnen	57,90010	3,73889	0-14.4	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Breda Ulle	57,92002	11,47152	0-22	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Broke	57,91785	11,48825	0-20.3	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Mellan Testehol-marna	57,92323	11,50547	0-13.8	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Gula Skären	57,92637	11,50083	0-24.5	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Rön	57,90140	11,48817	0-19.3	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	St Skintan	57,90775	0,79653	0-28.1	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Skuteskär	57,92058	11,48832	0-27	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Humleskär	57,92063	3,99722	0-22.3	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Y Vann-holmen (Westside)	57,92598	11,50855	0-20.3	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Y Vann-holmen (Northside)	57,93487	6,98264	0-20.6	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	I Vannhol-men (Northside)	57,93448	11,52103	0-17.5	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL

S	Survey	SE Skager-rack	Pynten	57,89117	11,44267	0-30	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Dynan	57,89533	11,43533	0-25.3	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Kalvho-geskären	57,89283	11,45317	0-30	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	St Pottan	57,90783	11,45667	0-27.3	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Skager-rack	Svarten	57,92900	0,79306	0-25	2000	2000	1	3	Taxa, veg. cover (% at a three level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	SE Katte-gat	Ransvik	56,29111	12,43167	1.0-15	1988	1990	2	3+2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Katte-gat	Åkersber-get	56,29806	12,45222	0-21	1989	1989	1	3	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Katte-gat	Para-dishamnen	56,30361	12,45194	0-21	1989	1990	2	2,3+1,2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Katte-gat	Visitgrottan	56,30361	12,46583	0-13	1988	1988	1	3	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Katte-gat	Ablahamn	56,30222	12,47417	0-20	1988	1990	3	2+2,3+1,2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Katte-gat	Grytgrun-den	56,34611	12,71194	1.0-10	1990	1990	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Katte-gat	Svarteskär	56,43639	12,54389	0-11	1988	1989	2	2+3	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Katte-gat	Hovs hallar	56,47056	12,70667	0-13	1988	1989	2	2+3	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU

S	Survey	SE Katte-gat	Påarpsre-vet	56,61833	12,87917	3.0-10	1988	1990	3	3+2,3+2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Katte-gat	Tyludden	56,64111	12,74139	0-6	1988	1990	3	3+2,3+2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Kattegat	Glomma-ryggen	56,93028	12,32972	5.0-7	1988	1988	1	3	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Kattegat	Glommens fyr	56,93083	12,35056	0-5	1988	1988	1	3	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Kattegat	Äspevik	57,18944	12,18444	0-5	1988	1990	2	3+2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Kattegat	Östra Sandan	57,21556	12,15639	0-5	1988	1990	3	3+2+2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Kattegat	Arvaskär	57,22556	12,08500	0-18	1990	1990	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Kattegat	Lilleland	57,30639	11,92889	0.5-25	1989	1989	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Kattegat	Ölmeudde	57,35778	12,01472	0-12	1989	1989	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Kattegat	Kyrkefjäll-sund	57,37139	11,94139	0-5	1988	1988	1	3	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Katte-gat	NW of Hallands Väderö	56,46889	12,56944	10.0-18	1989	1989	1	3	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Katte-gat	Stora Middel-grund	56,54833	12,05833	8.0-12	1989	1990	2	2+2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Kattegat	Knölagrund	56,84694	12,48639	4.0-11	1990	1990	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU

S	Survey	E Kattegat	Morups bank	56,87667	12,22444	12.0-26	1989	1990	2	2,3+2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Kattegat	Lilla Mid-delgrund	56,91667	11,85083	7.0-10	1989	1990	2	3+2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Kattegat	Fladen	57,14667	3,55903	8.0-20	1989	1990	2	2,3+2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Skager-rack	Marstrand-sön	57,89111	11,56056	0-10	1989	1989	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Skager-rack	Klä-desholmen	57,94472	11,54306	8.0-18	1989	1989	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	SE Skager-rack	Skaphol-men	57,94556	11,53528	0-18	1989	1989	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Skager-rack	Bonden	58,20972	11,31833	0-18	1989	1989	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Skager-rack	Skällhol-men NW	58,24972	11,38167	0-10	1990	1990	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Skager-rack	Skällhol-men S	58,24833	11,38333	0-15	1990	1990	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Skager-rack	Smed-jebrottet	58,25778	11,36667	0-23	1990	1990	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Skager-rack	Harpöbå-dar	58,26167	11,36806	5.0-24	1989	1990	2	2+2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	E Skager-rack	Flatholmen	58,26194	3,32292	0-7	1989	1989	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	NE Ska-gerrack	Sörgrunds-berget	58,28889	11,18361	10.0-27	1990	1990	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU

S	Survey	NE Ska-gerrack	Hållö	58,34278	11,21194	8.0-22	1989	1989	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	NE Ska-gerrack	Brimskär	58,35056	11,20972	0-17	1990	1990	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	NE Ska-gerrack	Ärholmen	58,57944	11,07861	0-24	1989	1989	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	NE Ska-gerrack	Valön NW	58,58889	11,24111	0-17	1989	1989	1	2	Taxa, abundance(5 level scale), up/low distributional limit	1 transect/locality/visit	WWF+FR N/Sweden	M. Pedersén, Dep. of Bot./SU
S	Survey	NE Katte-gat	Tormund	57,56025	0,94792	0-20.8	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Katte-gat	Y Dödskärs flu	57,53117	11,71067	3-23.5	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Katte-gat	St Snulte-bådan	57,53667	11,70192	3.6-15	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Katte-gat	Y Tistlarna nordudden	57,50050	11,73483	0-17.1	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Katte-gat	Y Tistlarna sydvästud-den	57,50783	11,72583	0-18	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Katte-gat	St. Va-lebräken	57,54350	11,78617	0-16	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Katte-gat	I Tistlarna ostudden	57,52433	11,75917	0-25.2	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Katte-gat	Nordre skäret	57,53383	0,97014	0-18.2	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Katte-gat	Knalleskär	57,52900	11,74567	0-16.5	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL

S	Survey	NE Kattegat	St. Dödskär	57,52700	11,72783	0-16	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Kattegat	Klåback	57,54983	11,75767	0-20	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Kattegat	Bräkeskär	57,55600	11,08217	0-17	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Kattegat	Måvholmen	57,58542	11,74725	0-21	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Kattegat	St Stenskär Kl	57,56583	5,67014	0-13	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Kattegat	Manneskär	57,56367	11,76333	0-17	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Kattegat	Kungsnabba	57,56267	1,00069	0-20	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Kattegat	Valö västudden	57,55433	11,79967	0-13	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Kattegat	Kalvholmen sydostsidan	57,54133	11,76917	0-19	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Kattegat	Vrångöknapp	57,58400	0,99167	0-10	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Kattegat	Klubbholmen	57,57900	11,76733	0-8.5	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Kattegat	Lökholmen ostsidan	57,57850	0,98472	0-4.5	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Kattegat	S Varskär	57,57217	11,76833	0-5.5	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL

S	Survey	NE Katte-gat	Fritt belä-get grund "7,8 m"	57,56758	11,72258	7.8-25	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Katte-gat	Bräkebå-dan	57,54950	0,97153	3.0-24	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Katte-gat	St Matskär	57,50733	11,74333	0-24	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Katte-gat	Ärnen	57,54867	1,03056	0-16	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	NE Katte-gat	Fjordholms skären östligaste skäret	57,56300	6,26736	0-17	2000	2000	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Västra Götaland	TMBL
S	Survey	E Skager-rack		2,44028	11,90833	0-6	1970	1973	4	4+3+3+3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	1 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	E Skager-rack		58,34500	0,46458	0-2	1971	1973	2	3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	2 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	E Skager-rack	Lillön	58,33500	11,90667	0-4	1970	1973	4	3+2,3+3+3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	3 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	E Skager-rack	St Kärra holme	58,33583	0,52014	0-5	1970	1973	3	2,3+3,4+3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	4 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	E Skager-rack	Rödön	58,33333	11,89167	0-4	1970	1973	4	1,2,3,4+1,2+1,2,3+4	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	5 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	E Skager-rack	Ringburen	58,33167	0,51944	0-5	1970	1973	4	2,3+2,3+2,3+2,3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	6 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	E Skager-rack		58,32500	1,06597	0-7	1970	1973	2	4+3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	7 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	E Skager-rack		58,33667	11,86167	0-7	1970	1973	3	2,3+2,4+3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	8 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU

S	Survey	E Skager-rack		58,33167	0,51806	0-3	1970	1973	4	2+3+3+3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	9 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	E Skager-rack		58,32667	0,51667	0-5.5	1970	1973	3	3+4+3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	10 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	E Skager-rack		58,31667	11,81833	0-8	1970	1973	2	3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	11 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	E Skager-rack	Brattön	2,43819	11,78667	0-13	1970	1973	3	3+3+4	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	12 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	E Skager-rack	Kråkan	58,31667	11,76333	0-8	1970	1973	4	2,3+2,3+3,4+3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	13 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	E Skager-rack	Havstensklippan	58,31667	11,74167	0-8	1971	1973	2	2,3+3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	14 fixed tr./locality, 1 quadrat (1x1m)/mark at fixed transect positions	SEPA	Dep of Marine Botany, GU
S	Survey	NE Katte-gat	Näsungen	57,35072	12,06925	0-8	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Inre Lön	57,35658	12,04375	0-15	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Falkasand	57,35805	12,07543	0-6	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Vindö	57,36243	12,06028	0-13	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Österby	57,36850	12,08542	0-5	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Stora Brattaskär (Eastside)	57,37272	12,07083	0-7	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Stora Brattaskär (Westside)	57,37315	12,06992	0-7	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL

S	Survey	NE Katte-gat	Långskär	57,37963	1,08889	0-9	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Lyngskär(Westside)	57,38117	12,07008	0-6	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Lyngskär(Eastside)	57,38087	12,07128	0-5	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Baggaskär	57,38253	12,08005	0-6	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Södra Karsholm	57,38858	12,07637	0-5	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Torkelskär	57,39180	12,09593	0-3	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Fjordskär	57,35138	12,01912	0-18	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Ölmeudde	57,35655	12,01088	0-11	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Yttre Lön	57,35575	12,03613	0-15	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Krokudden	57,35987	12,01288	0-7	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Ramnö kalv	57,37003	12,04002	0-5	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Brämud-den	57,37513	12,02652	0-11	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Kisteskär	57,37650	12,04972	0-6	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL

S	Survey	NE Katte-gat	Brokö	57,38437	0,83056	0-7	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Sälsflu	57,39015	12,03138	0-10	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Stora Fäholmen	57,39747	12,06892	0-5	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Rågskytten	57,40242	0,00625	0-7	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Enens små-båtshamn	57,40305	12,03078	0-4	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Onsala	57,41167	12,03663	0-4	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Orsnäs	57,41867	12,04228	0-5	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Kal-vö(Eastside)	57,42200	0,96458	0-4	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Kalvö sydspets	57,41922	12,06235	0-6	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Kal-vö(Westside)	57,42238	0,91389	0-7	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Spekedal	57,42897	0,81597	0-4	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	NE Katte-gat	Passberg	57,44592	12,06433	0-3	1999	1999	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Kungs-backa	TMBL
S	Survey	E Skager-rack	Lilla Fjä-dern	58,57707	11,02402	?	1983	1983	1	3	Taxa, veg cover (% at a four level scale), depth limits, photo	1 fixed tr/locality, 1 quadrat (1x1m)/mark at fixed tr positions	Thesis, 20 p	Thesis, 20 p

S	Survey	E Skager-rack	Lilla Va-leskär	58,57908	11,03618	?	1983	1983	1	3	Taxa, veg cover (% at a four level scale), depth limits, photo	2 fixed tr/locality, 1 quadrat (1x1m)/mark at fixed tr positions	Thesis, 20 p	Thesis, 20 p
S	Survey	E Skager-rack	Mellersta Valeskär	58,57707	11,03945	?	1983	1983	1	3	Taxa, veg cover (% at a four level scale), depth limits, photo	3 fixed tr/locality, 1 quadrat (1x1m)/mark at fixed tr positions	Thesis, 20 p	Thesis, 20 p
S	Survey	E Skager-rack	Åltinehol-men	58,58552	11,06257	?	1983	1983	1	3	Taxa, veg cover (% at a four level scale), depth limits, photo	4 fixed tr/locality, 1 quadrat (1x1m)/mark at fixed tr positions	Thesis, 20 p	Thesis, 20 p
S	Survey	E Skager-rack	Ärholmen	58,57885	11,07672	?	1983	1983	1	3	Taxa, veg cover (% at a four level scale), depth limits, photo	5 fixed tr/locality, 1 quadrat (1x1m)/mark at fixed tr positions	Thesis, 20 p	Thesis, 20 p
S	Survey	E Skager-rack	Bredbågen	58,57653	11,06775	?	1983	1983	1	3	Taxa, veg cover (% at a four level scale), depth limits, photo	6 fixed tr/locality, 1 quadrat (1x1m)/mark at fixed tr positions	Thesis, 20 p	Thesis, 20 p
S	Survey	E Skager-rack	Stora Sundskär	58,54452	11,05305	?	1983	1983	1	3	Taxa, veg cover (% at a four level scale), depth limits, photo	7 fixed tr/locality, 1 quadrat (1x1m)/mark at fixed tr positions	Thesis, 20 p	Thesis, 20 p
S	Methode study	NE Ska-gerrack	St Snart	58,80702	11,14483	0-20	1989	1991	3	4+2,3+2	Taxa, veg. cover, strata, no. patches, no. of ind. for kelp	Hierarc. rep.-3 tr./loc., 14 depths (0-20 m)/tr., 2 rep./depth/tr.->6 rep./depth/loc.	SEPA	Dep. of Mar. Bot. Göte-borg Univ.
S	Methode study	NE Ska-gerrack	S. Gå-sö=S. Trinisla	58,56385	11,23088	0-16	1990	1991	2	2,3+2	Taxa, veg. cover, strata, no. patches, no. of ind. for kelp	Hierarc. rep.-3 tr./loc., 12 depths (0-16 m)/tr., 2 rep./depth/tr.->6 rep./depth/loc.	SEPA	Dep. of Mar. Bot. Göte-borg Univ.
S	Methode study	NE Ska-gerrack	Sälö	58,33917	11,20853	0-16	1990	1991	2	2,3+2	Taxa, veg. cover, strata, no. patches, no. of ind. for kelp	Hierarc. rep.-3 tr./loc., 12 depths (0-16 m)/tr., 2 rep./depth/tr.->6 rep./depth/loc.	SEPA	Dep. of Mar. Bot. Göte-borg Univ.
S	Methode study	NE Ska-gerrack	Skällhol-men	58,24922	11,38257	0-18	1989	1991	3	4+2,3+2	Taxa, veg. cover, strata, no. patches, no. of ind. for kelp	Hierarc. rep.-3 tr./loc., 13 depths (0-18 m)/tr., 2 rep./depth/tr.->6 rep./depth/loc.	SEPA	Dep. of Mar. Bot. Göte-borg Univ.
S	Methode study	NE Ska-gerrack	St Snart	58,80702	11,14483	0-20	1989	1992	4	2,4	Taxa, covered area, no. patches	Hierarc. rep.-3 tr./loc., 14 depths (0-20 m)/tr., 2 rep./depth/tr.->6 rep./depth/loc.	SEPA	KMF
S	Methode study	NE Ska-gerrack	E Galge-berget	58,56202	11,23883	0-20	1989	1992	4	2,4	Taxa, covered area, no. patches	Hierarc. rep.-3 tr./loc., 14 depths (0-20 m)/tr., 2 rep./depth/tr.->6 rep./depth/loc.	SEPA	KMF
S	Methode study	NE Ska-gerrack	Sälö	58,33745	11,20762	0-20	1989	1992	4	2,4	Taxa, covered area, no. patches	Hierarc. rep.-3 tr./loc., 14 depths (0-20 m)/tr., 2 rep./depth/tr.->6 rep./depth/loc.	SEPA	KMF

S	Methode study	NE Skagerrack	Skällholmen	58,24855	11,38145	0-20	1989	1992	4	2,4	Taxa, covered area, no. patches	Hierarc. rep.-3 tr./loc., 14 depths (0-20 m)/tr., 2 rep./depth/tr.->6 rep./depth/loc.	SEPA	KMF
N	Survey	NE Skagerrack	Torbjørnskjær	58,99632	10,78395	0-24	1995	1995	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL
N	Survey	NE Skagerrack	Store Kollen	58,99018	10,83047	0-25	1995	1995	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL
N	Survey	NE Skagerrack	Flate Kollen	58,98490	10,82135	0-21	1995	1995	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL
N	Survey	NE Skagerrack	Kuskjærs Kummel	58,97900	10,83197	0-25	1995	1995	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL
N	Survey	NE Skagerrack	Djupe Flu	58,96990	6,04306	0-23	1995	1995	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL
N	Survey	NE Skagerrack	Store Ribba	58,97340	10,84883	0-19	1995	1995	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL
N	Survey	NE Skagerrack	Lille Ribba	58,97018	10,86683	0-23	1995	1995	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL
N	Survey	NE Skagerrack	Graabein	58,96273	10,84622	0-25	1995	1995	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL
N	Survey	NE Skagerrack	Heiahamnen	58,95900	10,87408	0-6	1995	1995	1	3,4	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL
N	Survey	NE Skagerrack	Heiahamnen NE	58,95962	10,87693	6.0-23	1995	1995	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL
N	Survey	NE Skagerrack	Heia SE	58,95727	10,87507	0-24	1995	1995	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL
N	Survey	NE Skagerrack	Heiknubben	58,95358	10,87797	0-22	1995	1995	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL

N	Survey	NE Ska-gerrack	Skjøt-tegrunn	58,93528	10,83195	0-25	1995	1995	1	4	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	CAB of Østfold, Norway	TMBL
S	Pre-exp. study	Middle Kattegat		57,14500	5,89097	9.5-26	2001	2001	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Göteborg Energi AB	Mar. Mon. AB vid Kristineberg
S	Pre-exp. study	Middle Kattegat		57,15487	11,76883	8.0-14	2001	2001	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Göteborg Energi AB	Mar. Mon. AB vid Kristineberg
S	Pre-exp. study	Middle Kattegat		57,18017	11,79433	11-26.6	2001	2001	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Göteborg Energi AB	Mar. Mon. AB vid Kristineberg
S	Pre-exp. study	Middle Kattegat		57,18023	5,59514	6.5-12	2001	2001	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Göteborg Energi AB	Mar. Mon. AB vid Kristineberg
S	Pre-exp. study	Middle Kattegat		57,17977	11,75298	9.5-14	2001	2001	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Göteborg Energi AB	Mar. Mon. AB vid Kristineberg
S	Pre-exp. study	Middle Kattegat		57,17012	11,78242	9.0-13	2001	2001	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Göteborg Energi AB	Mar. Mon. AB vid Kristineberg
S	Pre-exp. study	Middle Kattegat		57,19748	11,78925	19-20	2001	2001	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Göteborg Energi AB	Mar. Mon. AB vid Kristineberg
S	Pre-exp. study	Middle Kattegat	Fladen fyr	57,21555	11,82845	0-14	2001	2001	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Göteborg Energi AB	Mar. Mon. AB vid Kristineberg
S	Pre-exp. study	Middle Kattegat		57,21638	11,79153	11.0-17	2001	2001	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Göteborg Energi AB	Mar. Mon. AB vid Kristineberg
S	Pre-exp. study	Middle Kattegat		57,16683	11,74997	16	2001	2001	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Göteborg Energi AB	Mar. Mon. AB vid Kristineberg
S	Pre-exp. study	Middle Kattegat		2,38611	11,72833	19-20	2001	2001	1	3	Taxa, veg. cover (% at a four level scale), depth limits	2 transects/locality	Göteborg Energi AB	Mar. Mon. AB vid Kristineberg
S	Reg. monitoring	NE Ska-gerrack	Stora Brattskär	58,86167	0,46389	0-20	1991	2001	11	3	Taxa, covered area, no. of patches	Hierarc. rep.-5 tr./loc., 13 depths (0.5-20 m)/tr., 1 rep./depth/tr.->5 rep./depth/loc.	BVVF	KMF

S	Reg. monitoring	NE Ska-gerrack	Has-stenshol-men	58,61500	0,62847	0-20	1991	2001	11	3	Taxa, covered area, no. of patches	Hierarc. rep.-3 tr./loc., 13 depths (0-20 m)/tr., 1 rep./depth/tr.->3 rep./depth/loc.	BVVF	KMF
S	Reg. monitoring	SE Skager-rack	Djurnäs udde	58,15667	0,51736	0-20	1994	2001	8	3	Taxa, covered area, no. of patches	Hierarc. rep.-3 tr./loc., 13 depths (0-20 m)/tr., 1 rep./depth/tr.->3 rep./depth/loc.	BVVF	KMF
S	Reg. monitoring	SE Skager-rack	Fiolklippan	57,93833	11,61167	0-20	1991	2001	11	3	Taxa, covered area, no. of patches	Hierarc. rep.-3 tr./loc., 13 depths (0-20 m)/tr., 1 rep./depth/tr.->3 rep./depth/loc.	BVVF	KMF
S	Reg. monitoring	E Kattegat	Kalvö SW-udde	57,42167	12,06667	0-3	1993	1996	2	3	Veg. cover (5 levels), low/up growth limit, zon. pat., biomass	1 fixed transect/loc., 3 replicate quadrats/veg. type zone (cf. "Kautsky method")	CAB of Halland	LeCa Marin
S	Reg. monitoring	E Kattegat	Lerkil	57,43167	11,91167	0-6.5	1993	1996	2	3	Veg. cover (5 levels), low/up growth limit, zon. pat., biomass	1 fixed transect/loc., 3 replicate quadrats/veg. type zone (cf. "Kautsky method")	CAB of Halland	LeCa Marin
S	Reg. monitoring	E Kattegat	Bua	2,39097	0,51597	0-5	1993	1996	2	3	Veg. cover (5 levels), low/up growth limit, zon. pat., biomass	1 fixed transect/loc., 3 replicate quadrats/veg. type zone (cf. "Kautsky method")	CAB of Halland	LeCa Marin
S	Reg. monitoring	E Kattegat	Morups Tånge	2,38125	12,36167	0-3.5	1993	1996	2	3	Veg. cover (5 levels), low/up growth limit, zon. pat., biomass	1 fixed transect/loc., 3 replicate quadrats/veg. type zone (cf. "Kautsky method")	CAB of Halland	LeCa Marin
S	Reg. monitoring	E Kattegat	Örnäs udde	56,63667	12,81667	0-3	1993	1996	2	3	Veg. cover (5 levels), low/up growth limit, zon. pat., biomass	1 fixed transect/loc., 3 replicate quadrats/veg. type zone (cf. "Kautsky method")	CAB of Halland	LeCa Marin
S	Survey	E Kattegat	Kullaback-en	57,12333	12,19417	0-3.7	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?
S	Survey	E Kattegat	Norra Eneskär	57,13417	12,18833	0-4.5	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?
S	Survey	E Kattegat	Stenskär	57,15417	12,18333	0-4.7	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?
S	Survey	E Kattegat	Espevik	57,18667	12,17917	0-3.5	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?
S	Survey	E Kattegat	Kalkgrun-det	57,10967	1,82292	1.5-10.5	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?

S	Survey	E Kattegat	Fårnyet	57,13167	12,14583	0-13.6	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?
S	Survey	E Kattegat	Klåback	57,15333	12,11167	0-13.2	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?
S	Survey	E Kattegat	Isak Lars grund	57,16467	12,12167	4.5-14.7	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?
S	Survey	E Kattegat	Prästskär	57,19250	12,12333	0-14.2	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?
S	Survey	E Kattegat	Yttre Havskat-teknölen	57,08600	0,60972	15-24.2	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?
S	Survey	E Kattegat	Ullharen	57,11533	12,11283	15.5-24.5	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?
S	Survey	E Kattegat	Kattskallen	57,13483	12,07817	16.8-23.8	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?
S	Survey	E Kattegat	WSW Klåback	57,11533	12,11283	16.5-22	1997	1997	1	3	Taxa, vegetational cover (% at a four level scale), depth limits	2 transects/locality	Varbergs kommun	?
S	Loc. survey	N Kattegat	Norra Ledskär	57,27325	12,05043	0-18	1998	1998	1	3	Taxa, covered area, no. of patches	Hierarc. rep.-5 tr./loc., 10 depths (0,5-14m)/tr., 1 rep./depth/tr.->5 rep./depth/loc.	BVVF	KMF
S	Loc. survey	N Kattegat	Ustö	2,39514	1,07292	0-12	1998	1998	1	4	Taxa, covered area, no. of patches	Hierarc. rep.-5 tr./loc., 10 depths (0-12m)/tr., 1 rep./depth/tr.->5 rep./depth/loc.	BVVF	KMF
S	Loc. survey	N Kattegat	Norra Horta	2,39028	1,14236	0-14	1998	1998	1	4	Taxa, covered area, no. of patches	Hierarc rep.-5 tr./loc., 11 depths (0-14m)/tr., 1 rep./depth/tr.->5 rep./depth/loc.	BVVF	KMF
S	Loc. survey	N Kattegat	Grytan	57,23500	1,07292	0-13	1998	1998	1	4	Taxa, covered area, no. of patches	Hierarc rep.-5 tr./loc., 10 depths (0-12m)/tr., 1 rep./depth/tr.->5 rep./depth/loc.	BVVF	KMF
S	Loc. survey	N Kattegat	Ringhals udde	57,25583	12,08667	0-10	1998	1998	1	3	Taxa, covered area, no. of patches	Hierarc. rep.-5 tr./loc., 9 depths (0-10m)/tr., 1 rep./depth/tr.->5 rep./depth/loc.	BVVF	KMF

S	Loc. survey	N Kattegat	Krogsta-dudde fyr	57,24167	12,09917	0-8	1998	1998	1	4	Taxa, covered area, no. of patches	Hierarc rep.-5 tr./loc., 7 depths (0,5-8 m)/tr., 1 rep./depth/tr.->5 rep./depth/loc.	BVVF	KMF
S	Loc. survey	N Kattegat	Stalpeskä-ren	2,39236	0,50625	0-8	1998	1998	1	4	Taxa, covered area, no. of patches	Hierarc rep.-5 tr./loc., 8 depths (0-8 m)/tr., 1 rep./depth/tr.->5 rep./depth/loc.	BVVF	KMF
S	Loc. survey	N Kattegat	Utsläpp400	57,24833	12,09333	0-6	1998	1998	1	4	Taxa, covered area, no. of patches	Hierarc rep.-5 tr./loc., 5 depths (0,5-4m)/tr., 1 rep./depth/tr.->5 rep./depth/loc.	BVVF	KMF
S	Loc. survey	N Kattegat	Utsläpp100	57,25167	12,09333	0-5	1998	1998	1	4	Taxa, covered area, no. of patches	Hierarc. rep.-5 tr./loc., 6 depths (0-4 m)/tr., 1 rep./depth/tr.->5 rep./depth/loc.	BVVF	KMF
S	Loc. monitoring	E Kattegat	N Årnä-sudde	57,19792	12,15605	?	1971	1975	3	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Prästskär NE-udden	57,19355	12,12215	?	1971	1971	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	S Horta	57,21032	12,11465	?	1970	1979	2	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	N Horta	57,22362	1,17083	?	1968	1979	7	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Arvaskär	57,22592	12,08287	?	1971	1979	3	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Långabå-dan	57,22867	12,09383	?	1971	1979	3	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Uggleviken	57,24038	12,09785	?	1971	1979	3	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Grytan	57,24490	1,06736	?	1971	1979	4	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Baggen	57,24522	12,06712	?	1971	1979	4	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Stalpeskä-ren	57,25162	12,08877	?	1971	1978	3	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat		0,00000	0,00000	?	1978	1978	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Utlopp 01	0,00000	0,00000	?	1977	1977	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Utlopp 02	0,00000	0,00000	?	1977	1977	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Utlopp 03	0,00000	0,00000	?	1977	1977	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU

S	Loc. monitoring	E Kattegat	Utlopp 04	0,00000	0,00000	?	1979	1979	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Utlopp 04	0,00000	0,00000	?	1979	1979	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Utlopp 04	0,00000	0,00000	?	1978	1978	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Utlopp 04	0,00000	0,00000	?	1977	1977	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Utlopp 04	0,00000	0,00000	?	1977	1977	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Utlopp 05	57,24858	12,09182	?	1977	1977	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Utlopp 04	0,00000	0,00000	?	1979	1979	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Ringhals udde W-udden	57,25590	1,08889	?				3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Ringhals udde N-sidan	57,25640	1,12986	?				3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	N. Ring-hals	57,26130	12,10097	?	1968	1977	7	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	N Skarvik-sudden	57,27042	12,10947	?	1971	1977	2	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	N Fågel-viksudde	57,27768	1,35278	?	1968	1977	7	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Knarrskär	57,29070	12,11817	?	1968	1972	4	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Nordsten	57,31283	12,09238	?	1968	1971	4	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Ustö	57,29208	12,08600	?	1968	1979	7	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	N Ledskär	57,27313	12,05117	?	1968	1971	3	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	S Ledskär	57,26018	12,05228	?	1971	1971	1	3	Taxa, biomass, depth distribution	None	SEPA	Dep of Botany, SU
S	Loc. monitoring	E Kattegat	Inre Stal-peskäret	57,25357	12,08785	0-2	1977	1978	2	1,2,3,4	Taxa, area covered, depth distribution, temporal variation	1 transect/locality	?	Dep of Marine Botany, GU

S	Loc. monitoring	E Kattegat	Mellersta Stalpeskä-ret	57,25162	12,08877	0-2	1977	1978	2	1,2,3,4	Taxa, area covered, depth distribution, temporal variation	1 transect/locality	?	Dep of Marine Botany, GU
S	Loc. monitoring	E Kattegat	Ringhals udde	57,25437	12,08508	0-3.2	1977	1978	2	1,2,3,4	Taxa, area covered, depth distribution, temporal variation	1 transect/locality	?	Dep of Marine Botany, GU
S	Loc. monitoring	E Kattegat	Ustö	57,29060	12,08288	0-2.3	1977	1978	2	1,2,3,4	Taxa, area covered, depth distribution, temporal variation	1 transect/locality	?	Dep of Marine Botany, GU
S	Loc. monitoring	E Kattegat	Kalvö SW-udde	57,42167	12,06667	0-7	1978	1996	7	?	Taxa, biomass, abun-dance	1 transect/locality?	Kungs-backa kommun	
S	Loc. monitoring	E Kattegat	Gottskär	57,39332	0,68194	?	1987	1996	6	?	Taxa, biomass, abun-dance	1 transect/locality?	Kungs-backa kommun	
S	Loc. monitoring	E Kattegat	Karse-gårdsvä-gen	57,40688	12,03137	?	1987	1990	4	?	Taxa, biomass, abun-dance	1 transect/locality?	Kungs-backa kommun	
S	Loc. monitoring	E Kattegat	Forsbäck	57,45447	12,05283	?	1987	1996	6	?	Taxa, biomass, abun-dance	1 transect/locality?	Kungs-backa kommun	
S	Loc. monitoring	E Kattegat	Han-halsholme	57,44770	12,06775	?	1988	1996	5	?	Taxa, biomass, abun-dance	1 transect/locality?	Kungs-backa kommun	
S	Loc. monitoring	E Kattegat	Passberg	57,44595	12,06412	0-3	1977	1996	5	?	Taxa, biomass, abun-dance	1 transect/locality?	Kungs-backa kommun	
S	Survey	NE Katte-gat	N Röden	57,75585	11,73858	0-7	1974?	1982?	1		Taxa, abundance, depth distribution		?	?
S	Survey	NE Katte-gat	Sillvik	57,74135	11,73435	0-4	1974?	1982?	?	1,2,3,4	Taxa, abundance, depth distribution		?	?
S	Survey	NE Katte-gat	Bammevi-ken	57,78680	11,73217	0-2	1974?	1982?	1		Taxa, abundance, depth distribution		?	?
S	Survey	NE Katte-gat	Stora Kalven S-side	57,77940	5,49722	0≤5	1974?	1982?	?		Taxa, abundance, depth distribution		?	?
S	Survey	NE Katte-gat	Stora Kalven N-side	57,78075	11,72567	0≤5	1974?	1982?	?		Taxa, abundance, depth distribution		?	?

S	Survey	NE Kattegat	Stora Kalven W-side	57,77997	11,72325	0≤5	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Barlind S-side	57,79100	11,69132	0≤8	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Barlind N-side	57,79307	5,24583	0≤8	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Barlind W-side	57,79172	11,68862	0≤8	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rävungarna	57,78237	5,20069	0-2	1974?	1982?	1		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rammen E-side	57,78328	11,63692	0≤8	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rammen SW-side	57,78118	4,85903	0≤8	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rammen W-side	57,78298	4,82847	0≤8	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	St Svarten	57,79255	11,62368	0-2	1974?	1982?	1		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rörö	57,77487	0,89306	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rörö	57,78050	4,72361	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rörö	57,78463	11,61215	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rörö	57,78778	11,60987	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rörö	57,78877	11,61023	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rörö	57,77028	11,61027	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rörö	57,76938	0,63542	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rörö	57,77093	11,60542	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rörö	57,77833	11,59932	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rörö	57,78005	11,59918	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Kattegat	Rörö	57,78397	11,59918	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?

S	Survey	NE Katte-gat	Rörö	57,78772	11,60147	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Katte-gat	Rörö	57,78948	11,60262	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Katte-gat	Rörö	57,79012	11,59913	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Katte-gat	Rörö	57,79075	11,59748	0-18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Katte-gat	Rörö N-point	57,79272	11,60092	0≤18	1974?	1982?	?		Taxa, abundance, depth distribution	?	?
S	Survey	NE Katte-gat	Stora Pölsan	57,77510	11,52322	0≤17	1974?	1982?	1		Taxa, abundance, depth distribution	?	?
S	Survey	NE Katte-gat	Stora Pölsan	57,77510	11,52322	0≤17	1974?	1982?	1		Taxa, abundance, depth distribution	?	?
S	Survey	NE Katte-gat	Stora Pölsan	57,77510	11,52322	0≤17	1974?	1982?	1		Taxa, abundance, depth distribution	?	?
S	Survey	E Skager-rack	Ärholmen	58,57900	11,07635	0-5	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Ärholmen	58,57885	0,98264	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Storö	58,57833	0,95208	4	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Storö	58,57643	11,06825	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Storö	58,57500	11,06703	3.0-4	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Storö	58,57433	11,06277	5	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA

S	Survey	E Skager-rack	Storö	58,58028	11,06307	0-8	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Storö	58,57297	11,06497	2.0-20	1983	1984	2	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Storö	58,58378	11,06627	4.0-10	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	St Valeskär	58,57768	11,04002	5.0-8	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	St Valeskär	58,57710	11,03952	3.0-17	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	St Valeskär	58,57865	0,71944	3.0-6	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	St Valeskär	58,57820	11,04237	6.0-24	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Sollidskor-ven	58,58337	11,07223	3.0-20	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Torsö	58,58775	11,06457	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Torsö	58,59037	11,06173	5.0-20	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA

S	Survey	E Skager-rack	Bot	58,59533	11,05213	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Knappen	58,59802	11,05748	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Boteskäret	58,59682	0,78681	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Kolter	58,60133	11,04803	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Väderöbod	58,54135	11,03357	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Väderöbod	58,54272	11,03427	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Skitrarna	58,53515	11,03148	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Mittskär	58,55753	11,05043	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Guleskär	58,53208	11,03575	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Lilla Fjä-dern	58,57752	11,02452	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA

S	Survey	E Skager-rack	Fjäderfluna	58,58880	11,02333	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	St Holmen grå	58,59252	11,03493	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Bot	58,59585	11,04837	?	1983	1984	2	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Torsö, Åletinan	58,58555	0,88056	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Lilla Fjä-dern, Fjäderbrot-ten	58,58027	11,02438	?	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Fjäderbrot-ten	58,58295	11,02318	5.0-10	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	St Fjädern	58,58545	11,02865	10	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Lilla Fjä-dern	58,57715	11,02125	30	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Skålhol-men	58,54442	11,09563	22	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	S Rågstu-ten	58,52838	11,08238	16-50	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA

S	Survey	E Skager-rack	Tallriken	58,54588	1,10764	?	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Ärholmen (S Väde-röarna)	58,54865	11,09117	?	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Gåsöskä-ren	58,54762	11,09217	?	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Kolter	58,60182	0,78542	?	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Hamnerö	58,55008	11,08953	?	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Rörskär	58,54707	11,08703	1.0-13	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Rörskär	58,54737	11,08782	?	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Grötskär	58,55505	11,07945	2.0-20	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	St Björnen	58,57948	11,06008	2.0-18	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	St Tobaks-skär	58,58347	11,03932	10.0-14	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA

S	Survey	E Skager-rack	Ärholmen	58,57565	11,07748	2-35	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Bot	58,59320	11,05307	3.0-26	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Bot	58,59287	11,04987	?	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Små Tobaks-skären	58,58857	0,80208	3.0-16	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Små Tobaks-skären	58,58750	0,82569	8.0-30	1984	1984	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	E Skager-rack	Stånghol-men	58,57503	11,07102	?	1983	1983	1	3	Taxa, abundance, depth distribution	CAB of Göteborgs & Bohus län	AKVATISK VIDEODATA
S	Survey	SE Skager-rack	NO St Silleskär	58,34002	11,24877	≈25	1987	1987	1		Taxa, abundance, depth distribution	Sotenäs kommun	AKVATISK VIDEODATA
S	Survey	SE Skager-rack	Stenskär	58,33465	11,23128	≈40	1987	1987	1		Taxa, abundance, depth distribution	Sotenäs kommun	AKVATISK VIDEODATA
S	Survey	SE Skager-rack	Ägglös	58,38357	11,23398	?	1987	1987	1		Taxa, abundance, depth distribution	Sotenäs kommun	AKVATISK VIDEODATA
S	Survey	SE Skager-rack	SW Kniv-holmen	58,45110	11,28302	≤20	1987	1987	1		Taxa, abundance, depth distribution	Sotenäs kommun	AKVATISK VIDEODATA
S	Survey	NE Katte-gat	W Kna-peskären	57,82122	2,85764	≤28	1990	1990	1		Taxa, abundance, depth distribution	Kungälvs kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	NE Katte-gat	St Ryttern-Gulskären	57,83348	11,61915	≤22	1990	1990	1		Taxa, abundance, depth distribution	Kungälvs kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	NE Katte-gat	S Sälö	57,80945	11,61653	≤25	1990	1990	1		Taxa, abundance, depth distribution	Kungälvs kommun	BBK Arkitek-ter & Ingen-jörer

S	Survey	NE Katte-gat	W Lövön	57,94328	11,70275	≤50	1990	1990	1		Taxa, abundance, depth distribution		Kungälvs kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	E Kattegat	Lilla Bryg-gan	57,30278	6,73125	0-3	1982	1982	1	2	Taxa, dominance, depth intervals		CAB of Halland	Dep of Marine Botany, GU
S	Survey	E Kattegat	Klockfots-revet A	57,29827	11,90282	3	1982	1982	1	2	Taxa, dominance, depth intervals		CAB of Halland	Dep of Marine Botany, GU
S	Survey	E Kattegat	Klockfots-revet B	57,29753	11,90055	3	1982	1982	1	2	Taxa, dominance, depth intervals		CAB of Halland	Dep of Marine Botany, GU
S	Survey	E Kattegat	Klockfots-revet C	57,29622	11,89785	3	1982	1982	1	2	Taxa, dominance, depth intervals		CAB of Halland	Dep of Marine Botany, GU
S	Survey	E Kattegat	I Kausa-hamnen	57,30098	11,89968	0-3	1982	1982	1	2	Taxa, dominance, depth intervals		CAB of Halland	Dep of Marine Botany, GU
S	Survey	E Kattegat	Y Kausa-hamnen	57,29975	11,89698	3	1982	1982	1	2	Taxa, dominance, depth intervals		CAB of Halland	Dep of Marine Botany, GU
S	Survey	E Kattegat	NW-udden	57,30500	11,90058	0-3	1982	1982	1	2	Taxa, dominance, depth intervals		CAB of Halland	Dep of Marine Botany, GU
S	Survey	E Kattegat	NW-revet A	57,30603	11,90093	5	1982	1982	1	2	Taxa, dominance, depth intervals		CAB of Halland	Dep of Marine Botany, GU
S	Survey	E Kattegat	NW-revet B	57,30752	1,08194	16	1982	1982	1	2	Taxa, dominance, depth intervals		CAB of Halland	Dep of Marine Botany, GU
S	Survey	E Kattegat	Nordsidan	57,30487	11,90742	0-3	1982	1982	1	4	Taxa, dominance, depth intervals		CAB of Halland	Dep of Marine Botany, GU
S	Loc. monitoring	NE Ska-gerrack	Knäham-mar	58,40908	4,92431	0.5-20	1990	2001	12	2	Taxa, covered area, no. of patches	Hierarc. rep.-3 tr./loc., 13 depths (0,5-20 m)/tr., 1 rep./depth/tr.->3 rep./depth/loc.	GVVF	KMF
S	Loc. monitoring	NE Ska-gerrack	Dännäs huvud	58,38620	11,63093	0.5-20	1990	2001	12	2	Taxa, covered area, no. of patches	Hierarc. rep.-3 tr./loc., 13 depths (0,5-20 m)/tr., 1 rep./depth/tr.->3 rep./depth/loc.	GVVF	KMF

S	Loc. monitoring	NE Ska-gerrack	Gåsklåvan	58,30897	4,19028	0.5-20	1990	2001	12	2	Taxa, covered area, no. of patches	Hierarc. rep.-3 tr./loc., 13 depths (0,5-20 m)/tr., 1 rep./depth/tr.->3 rep./depth/loc.	GVVF	KMF
S	Loc. monitoring	NE Ska-gerrack	Skällhol-men	58,24855	11,38145	0.5-20	1990	2001	≤12	2	Taxa, covered area, no. of patches	Hierarc. rep.-3 tr./loc., 13 depths (0,5-20 m)/tr., 1 rep./depth/tr.->3 rep./depth/loc.	GVVF	KMF
S	Reg. monitoring	NE Katte-gat	Valö	57,55417	11,80333	0-4	1992	1995	4	3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	1 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	BVVF, Uddevalla	Marininvent
S	Reg. monitoring	SE Skager-rack	Galterö	58,10250	11,81167	0-6	1992	1995	4	3,4	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	2 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	BVVF, Uddevalla	Marininvent
S	Reg. monitoring	NE Ska-gerrack	Yttre Vattenhol-men	58,87667	11,11167	0-12	1992	1995	4	3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	3 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	BVVF, Uddevalla	Marininvent
S	Loc. monitoring	E Skager-rack	Bro01	58,38150	11,43573		?	?	?	?	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	4 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	?	?
S	Loc. monitoring	E Skager-rack	Bro02	58,37960	11,44352		?	?	?	?	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	5 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	?	?
S	Loc. monitoring	E Skager-rack	Bro03	58,36160	11,43217		1992	?	?	3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	6 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	BVVF, Uddevalla	Marininvent
S	Loc. monitoring	E Skager-rack	Bro04	58,35500	0,48819	0-20	1973?	2001	≥8	3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	7 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	BVVF, Uddevalla	HydroGIS AB
S	Loc. monitoring	E Skager-rack	Bro05	58,34583	11,39917	0-6	1973?	2001	≥8	3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	8 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	BVVF, Uddevalla	HydroGIS AB
S	Loc. monitoring	E Skager-rack	Bro06	58,34183	11,40248		?	?	?	?	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	9 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	?	?
S	Loc. monitoring	E Skager-rack	Bro07	58,34023	11,37523		1992	?	?	3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	10 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	BVVF, Uddevalla	
S	Loc. monitoring	E Skager-rack	Bro08	58,33222	3,23681		?	?	?	?	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	11 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	?	?

S	Loc. monitoring	E Skager-rack	Bro09	58,32763	2,97639		1992	?	?	3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	12 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	BVVF, Uddevalla	
S	Loc. monitoring	E Skager-rack	Bro10	58,32480	11,37938		?	?	?	?	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	13 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	?	?
S	Loc. monitoring	E Skager-rack	BroExtra	58,35250	0,48750	0-4	1973?	2001	≥8	3	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	14 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	BVVF, Uddevalla	HydroGIS AB
S	Loc. monitoring	NE Ska-gerrack	Byxeskär	58,26148	11,38608	0-30	1986	1987	2	3	Taxa, vegetational cover	Hierarc rep.-1 tr./loc., 15 depths (0-30 m)/tr., 2 rep./depth/tr.->2 rep./depth/loc.	?	?
S	Loc. monitoring	NE Ska-gerrack	Gåseklå-van	58,30897	4,19028	0-30	1986	1987	2	3	Taxa, vegetational cover	Hierarc. rep.-1 tr./loc., 15 depths (0-30 m)/tr., 2 rep./depth/tr.->2 rep./depth/loc.	?	?
S	Loc. monitoring	NE Ska-gerrack	Smörkullen	58,39550	11,62922	0-30	1986	1987	2	3	Taxa, vegetational cover	Hierarc. rep.-1 tr./loc., 15 depths (0-30 m)/tr., 2 rep./depth/tr.->2 rep./depth/loc.	?	?
S	Survey	SE Skager-rack	Halsbäck W	58,05432	11,52407	?	1990	1990	1	?	Taxa, abundance, depth distribution		Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Björholmen SW	58,04768	11,50293	?	1990	1990	1	?	Taxa, abundance, depth distribution		Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Skabohol-men NE	58,04260	11,50302	?	1990	1990	1	?	Taxa, abundance, depth distribution		Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Kaurö E	58,03853	11,47867	?	1990	1990	1	?	Taxa, abundance, depth distribution		Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Skabohol-men S	58,03287	11,49152	?	1990	1990	1	?	Taxa, abundance, depth distribution		Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Koön SE	58,02932	11,50683	?	1990	1990	1	?	Taxa, abundance, depth distribution		Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Kyrkesund NE	58,02077	11,51507	?	1990	1990	1	?	Taxa, abundance, depth distribution		Tjörns kommun	BBK Arkitek-ter & Ingen-jörer

S	Survey	SE Skager-rack	N Bågaren N	58,00998	11,49738	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	N Bågaren W	58,01153	11,48987	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Hisingsvi-ken SE	58,00470	11,48855	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Sunna holme W	58,00503	4,00556	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Sunna holme S	58,00522	4,09236	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Sunna holme NE	58,01190	4,12153	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Säby ö SW	58,00902	11,54612	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Manskär SE	58,00673	11,54148	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	S Röd S	57,99513	11,50037	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	L Rön	57,99383	11,51188	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Toftö SE	57,99330	4,16806	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Skärhamn N	57,99195	11,53988	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Skärhamn NW	57,99017	11,53512	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer

S	Survey	SE Skager-rack	Sandhol-men E	57,98192	11,53675	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Hjärterö N	57,98105	11,52215	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	I Syster NE	57,98565	4,05694	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Hjärterö E	57,97377	11,52833	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Flatholmen N	57,96662	0,49444	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Flatholmen SE	57,96095	11,51748	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Stockevik W	57,95797	11,53925	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Grimshol-men SE	57,95445	11,56445	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Grimshol-men SW	57,95343	11,55652	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Klä-desholmen NW	57,94918	11,53848	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Bratten N	57,95073	11,51307	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Ängholmen NE	57,94537	11,56363	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Bockhol-men SW	57,94668	11,55577	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer

S	Survey	SE Skager-rack	Tjörnekalv N	57,94250	11,54798	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Tjörnekalv NE	57,93978	11,56413	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Berlin NE	57,93410	11,55312	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Väggen NE	57,92983	11,54785	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	I Vannhol-men NE	57,93452	11,52665	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	I Vannhol-men S	57,93218	11,52553	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	S Teste SW	57,92385	11,50448	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Åstol NNW	57,92447	11,58318	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Kalvesund S	57,93127	11,57958	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	St Dyröns norra hamn N	57,93382	11,60113	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Kråkan E	57,95800	11,67705	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Viten W	57,96645	11,69728	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Torkels huvud N	57,97293	11,69047	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer

S	Survey	SE Skager-rack	N Lyng-holmen N	57,98120	11,70282	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Svälte W	57,98612	11,69945	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Dukeskär S	57,98890	11,72128	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Son E	57,99415	11,74438	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Wallhamn Tången S	58,00253	11,70065	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Brattholmen N	58,00480	11,71427	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Höviks holme S	58,03155	11,77225	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Höviksnäs N	58,03692	11,76622	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	Styrsö	58,03883	5,77639	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	S Saltholmen S	58,04292	5,79097	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	L Brattön SE	58,04665	5,90069	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	L Brattön W	58,05017	0,99653	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Survey	SE Skager-rack	L Brattön N	58,05295	11,77583	?	1990	1990	1	?	Taxa, abundance, depth distribution	Tjörns kommun	BBK Arkitek-ter & Ingen-jörer

S	Survey	SE Skager-rack	Källön SW	58,05518	11,78348	?	1990	1990	1	?	Taxa, abundance, depth distribution		Tjörns kommun	BBK Arkitek-ter & Ingen-jörer
S	Reg. monitoring	SE Skager-rack	Källön S	58,05550	11,78892	0-8	1979?	1988?	≤10?	2,4	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	1 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	?	Marininvent
S	Reg. monitoring	SE Skager-rack	Havden N	58,08603	11,80512	0-8	1979?	1988?	≤10?	2,4	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	2 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	?	Marininvent
S	Reg. monitoring	SE Skager-rack	Galterön	58,10212	11,80868	0-6	1979?	1996?	≤10?	2,4	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	3 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	?	Marininvent
S	Reg. monitoring	SE Skager-rack	Kalven E	58,09245	11,79338	0-7	1979?	1988?	≤10?	2,4	Taxa,veg. cover (4 levels), low/up growth limit, zon. pat.	4 fixed transect/locality, 1 quadrat (1x1m)/mark at fixed transect positions	?	Marininvent
S	Survey	NE Ska-gerrack	Nord-koster, Valnäs	58,91167	10,99083	?	1932	1978					SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Ska-gerrack	Kostersun-det	58,89333	11,01167	?	1932	1978					SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Ska-gerrack	Mörholmen	58,88367	10,96197	?	1932	1978					SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Ska-gerrack	Mörholmen	58,88333	10,96917	Litoral	1932	1978					SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Ska-gerrack	Sydkoster, Segesäta	58,87500	11,00917	5-8	1932	1978					SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Ska-gerrack	Kostersun-det,	58,89318	11,01148	?	1932	1978					SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Ska-gerrack	Krugglö	58,89000	11,09417	15-20	1932	1978					SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Ska-gerrack	Kostergrun det	58,87550	11,08600	?	1932	1978					SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Ska-gerrack	V om Matkullen	58,88367	11,11733	15	1932	1978					SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Ska-gerrack	Vattenhol-mene.	58,87667	0,53819	10-15	1932	1978					SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Ska-gerrack	Kilen, NV om Väde-röarna	58,61083	10,99917	< 4.5	1932	1978					SEPA	Dep. of Fys. Bot., UU

S	Survey	NE Skagerrack	NO-sidan av Väderö Storö	58,58417	11,07500	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	Väderö Storö	58,57750	11,07333	< 18	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	Väderö Storö	58,57167	11,06833	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	Södra Väderöarna	58,55118	1,09792	14-20	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	N och NV om Södra Syster	58,59333	0,56597	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	NO och O om Södra Syster.	58,59333	11,15667	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	Fjärden utanför Fläskön	2,45764	11,21333	9-19	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	Kalköbåde	58,57750	11,20167	15-20	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	Skäret NNV om Bogen	58,57750	1,89931	0-2	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	Getryggen	2,45625	2,00347	10-12	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	V om Kalvöskärs fyr	58,58250	11,25083	15	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	Mellan Kalvöskärs fyr och Kalvö	58,58200	2,23264	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	V om Rågö, mot 1.8 m:s grundet	58,57583	11,25033	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	Stora Håskär	58,54417	11,17367	0-2	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Skagerrack	Stora Klåveskär	58,53950	11,19083	0-2	1932	1978	SEPA	Dep. of Fys. Bot., UU

S	Survey	E Skager-rack	Stora Bornö, södra udden	58,36147	11,58063	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Stora Bornö	58,37647	11,57877	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Stora Bornö	58,38005	11,57883	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Sörgrunds-berget	58,28967	11,18333	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Flatbon-den, Bondebrot-ten	58,29583	11,29833	20	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Tova	58,23117	11,29617	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Tova, grunden strax S om skäret	58,23083	11,29667	4-6	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Bondens utsida	58,20695	11,30885	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Bondens utsida, du Rietz` profil	58,20900	11,31217	0-3.5	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Bondens NO-sida. Berg.	58,21250	0,67708	20	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Innanför Bonden	58,21167	11,31667	14	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	NO om Bonden	58,21667	11,31667	21-26	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Innanför Bonden, brant berg	58,21500	11,31917	25	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Mellan Ällskär och Bonden	58,21583	11,33333	15-18	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Bonden	58,20870	11,31412	12	1932	1978	SEPA	Dep. of Fys. Bot., UU

S	Survey	E Skagerrack	Smedjepricken. Smedjan.	58,26167	11,36867	20	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Smedjan	58,25998	11,36373	30	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Stora Harpö	2,43403	11,35833	Litoral	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Testholmensundet	58,23017	11,37783	10-12	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Testholmen	58,22732	11,37533	Litoral	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Jämningarna, SV om Lysekil	58,26552	11,39023	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Byxeskären, SV om Lysekil	58,26083	11,38615	Sublitoral	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Mosseberget, SV om Flatholmen	58,25417	0,48542	15	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Flatholmen, skåran	58,26267	11,41333	0-2	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Flatholmens utsida	58,25917	11,39933	10-15	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Mellan Spättasbådan och Flatholmen	58,25800	11,42083	>14	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Humlesäcken	58,26617	11,41667	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Lyseki	58,27667	11,42667	13-14	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Stånge huvud	58,26917	11,41583	18-20	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skagerrack	Lysekil, Kyrkviksbukten	58,26917	11,43667	?	1932	1978	SEPA	Dep. of Fys. Bot., UU

S	Survey	E Skager-rack	Gåsö, NO-änden. Zosterabot-ten.	58,24383	11,41667	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Gåsö, NO-änden.	58,24333	11,42117	(12-)15	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Gåsö, Vässvik	58,24083	11,41867	8-10	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Gåsö, Svennin-geskären	58,22917	11,41417	10	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Gåsö ränna, Rian	58,22700	11,41417	15-18	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Blå-bergshol-men	58,25233	11,44083	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Mellan Råttholmen och Manshol-men	58,25250	11,45833	20	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Manshol-men, NV-sidan	58,25217	11,46167	1-4	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Fiske-bäckskil, vid restau-rangen	2,43403	0,49028	4-10	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Kvarnbuk-ten	58,25883	11,47167	(6-8)	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Strömmar-na, Nordström-marna	58,24783	11,50283	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Strömmar-na	58,24563	11,49458	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Skager-rack	Borgilefjor-den, Göden	58,25833	11,65167	?	1932	1978	SEPA	Dep. of Fys. Bot., UU

S	Survey	SE Skager-rack	Borgilefjor-den, Bårholmen	58,25417	0,50417	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Skager-rack	Borgilefjor-den, NV om Henån	58,24752	11,63637	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Ljungskile	58,22450	6,79514	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	E Skager-rack	Ljungskile, stranden	58,22583	0,52222	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Skager-rack	Halsbäck, Tjörn, utanför bryggan	58,05550	0,82986	7-11	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Katte-gat	Göteborg, Stockhol-men	57,67583	6,21875	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Katte-gat	Göteborg, Hunneskär	57,67833	11,83333	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Katte-gat	Göteborg	57,67900	0,30208	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Katte-gat	N om Nidingen, V om Mönster	57,36283	6,82986	?	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Katte-gat	N om Nidingen, V om Mönster	57,35867	1,10069	14-18	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Katte-gat	N om Nidingen, V om Mönster	57,35500	11,93617	21	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Katte-gat	NO om Nidingen	57,34583	11,97167	11-13	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Katte-gat	NO om Nidingen	57,33950	1,13542	0-2	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Katte-gat	NO om Nidingen	57,35500	1,12639	0-3	1932	1978	SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Katte-gat	NO om Nidingen	57,35917	1,12986	3.0-10	1932	1978	SEPA	Dep. of Fys. Bot., UU

S	Survey	NE Kattegat	Kungsbackafjorden	57,35217	12,01117	12	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	NE Kattegat	Kungsbackafjorden	57,38900	0,65625	?	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	E Kattegat	Glommaryggen	56,93333	12,30417	13	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	E Kattegat	Glommaryggen	56,92667	12,32917	?	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Kattegat	Laholmsbukten, torvbotten	56,52250	12,78333	?	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Kattegat	Laholmsbukten, torvbotten	56,51667	12,79833	?	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Kattegat	N om Hallands Väderö	56,46867	4,51042	21	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Kattegat	V om Hallands Väderö, Svarteskär	56,43667	0,87847	0-1.5	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Kattegat	O om Hallands Väderö	56,43500	0,50417	?	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Kattegat	O om Hallands Väderö	56,43500	0,50417	17	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Kattegat	O om Hallands Väderö	56,43333	12,59667	12.5	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Kattegat	O om Hallands Väderö	56,43333	0,54097	6	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Kattegat	O om Hallands Väderö	56,43083	0,50417	12.5	1932	1978		SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Kattegat	SO om Hallands Väderö	56,42383	12,59667	8-12	1932	1978		SEPA	Dep. of Fys. Bot., UU

S	Survey	SE Kattegat	SO om Hallands Väderö	56,41783	4,54514	16-17	1932	1978					SEPA	Dep. of Fys. Bot., UU
S	Survey	SE Kattegat	Kullen, nedanför fyren	56,30300	12,44833	?	1932	1978					SEPA	Dep. of Fys. Bot., UU
S	Loc. monitoring	NE Skagerrack	St Sundskär	58,54437	11,05262	0-30	1969	2001	32	1,2,3,4	Taxa, area covered, no. patches, no. of ind.	Fixed sampling sites w 6 depthintervals->4-6 replicates/depth/locality	WWF	Proj. Väderöarna
S	Loc. monitoring	NE Skagerrack	St Knappen	58,59798	11,05712	0-30	1986	2001	15	1,2,3,4	Taxa, area covered, no. patches, no. of ind.	Fixed sampling sites w 6 depthintervals->4-6 replicates/depth/locality	WWF	Proj. Väderöarna
S	Loc. monitoring	NE Skagerrack	Bot	58,59317		5	1986	2001	15	1,2,3,4	Taxa, area covered, no. patches, no. of ind.	Fixed sampling sites w 6 depthintervals->4-6 replicates/depth/locality	WWF	Proj. Väderöarna