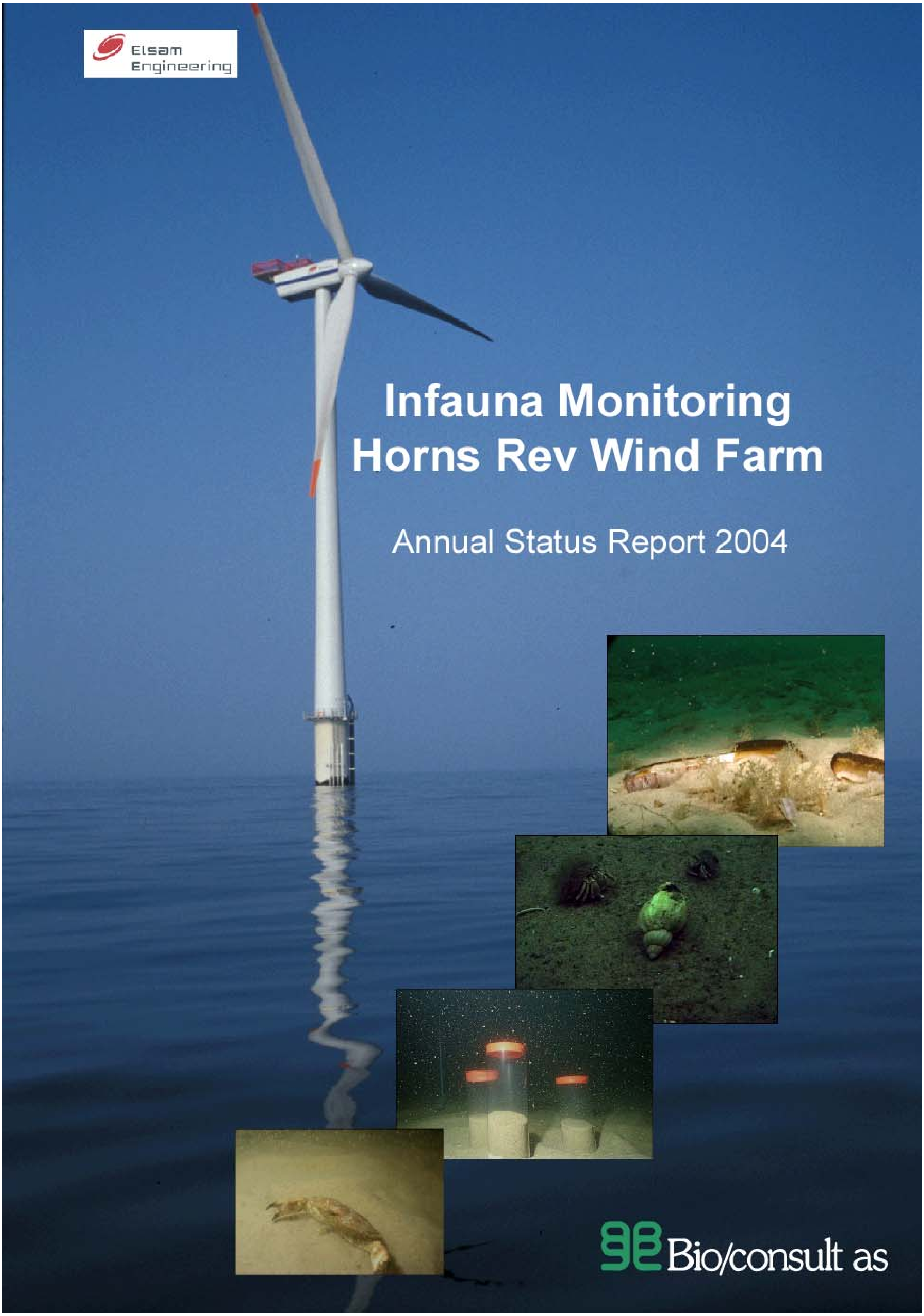

Elsam Engineering

Infauna Monitoring Horns Rev Wind Farm

Annual Status Report 2004

Bio/consult as

Infauna Monitoring
Horns Rev Offshore Wind Farm

Annual Status Report 2004

Published: 21 April 2005

Prepared: Michael Bech
Rune Frederiksen
John Pedersen
Simon B. Leonhard

Editing: Gitte Spanggaard

Checked: Bjarne Moeslund

Artwork: Kirsten Nygaard

Photos: Maks Klaustrup

Approved: Simon B. Leonhard

Cover photos: Jens Christensen
Simon B. Leonhard

English review: Matthew Cochran

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Summary

Introduction

ELSAM and ELTRA have established an offshore wind farm with an output of 160 MW in the waters of Horns Rev 14–20 km off Blåvands Huk, which is the most western point of Denmark. The construction of the turbines started in 2001 and the installation at Horns Rev was initiated in the spring of 2002.

The monitoring programme of the benthic fauna was carried out in September 2003 and 2004 after the wind farm became operational. Baseline surveys for the present monitoring programme were conducted in the wind farm area on three occasions prior to the construction of the offshore wind farm: spring 1999, spring 2001 and September 2001. The results from the baseline surveys in spring and autumn 2001 demonstrated the importance of season with respect to a dramatic change both in abundance and biomass. Therefore, the assessment of possible impacts from the establishment of the wind farm was mainly based on the results from the same time of year by comparing results from September 2003 and 2004 with the results from the baseline study conducted in September 2001.

Methodology

The survey in September 2004 included collection of bottom fauna at 6 turbine sites, a total of 18 stations in the wind farm, and at 6 stations in a designated reference area outside the wind farm area. The stations in the wind farm were situated 5, 25 and 100 metres in a leeward direction from the scour protection of the wind turbine towers at each turbine site. At present, no legislative environmental criteria exists for the possible impacts from the establishment of the wind farm at Horns Rev with respect to indicators and level of significance. Hence, the sampling methodology for the monitoring programme was designed based on an evaluation of the data from 1999 solely to enable detection of major changes in the community structure of the infauna. Multivariate analysis of the combined input from each species with respect to biomass and abundance was used to enhance the sensitivity of the statistical analysis.

The bottom samples were collected by SCUBA divers. Additional samples were collected for sediment analysis. Fauna samples were carefully sieved through a 1.0 mm test sieve. In the laboratory, samples were analysed for identification of species composition, abundance and biomass.

Sediment

The wind farm area and the reference area are characterised by relatively uniform bottom conditions consisting of pure medium-fine sand with no organic matter. The particle size, measured as medium grain size, of the sediment in the wind farm area increased from 350 µm in September 2001 to 515 µm in September 2003 to 503 µm in September 2004. It is unlikely that a change in current conditions as a result of the wind farm caused that change because no difference was found between the particle size in the reference and wind farm areas in 2004.

Fauna

The fauna in the Horns Rev area can be characterised as a *Goniadella-Spisula* community named after characteristic species in the community. In September 2003 and 2004, the most abundant species were the bristle worm *Goniadella bobretzkii* and the mussel *Goodallia triangularis*. The main difference between the surveys in 2001 and 2004 was the decline of the *Pisione remota* and *Goniadella bobretzkii* populations and the massive increase of the *Goodallia triangularis* population.

The decline of these character species was probably a result of the natural variations, demonstrating that pronounced variations even in character species can be found as a result of the highly variable environmental conditions in the area.

Molluscs were the most abundant group in 2004 constituting 66.7% of the total number of individuals and 49.2% of the total biomass in the wind farm area. In 2001, molluscs represented 82% of the total biomass in the area.

Goodallia triangularis was the most numerous species representing 57% of the total number of individuals found, but only less than 1% of the total biomass. In 2001, this species was also one of the most abundant species in the area. The commercially important bivalve *Spisula solida* constituted 77.4% of the biomass in September 2001, 33.7% in 2003 but only 3.3% in 2004. In the 2004 survey, 13.6 ind./m^2 were recorded in both the wind farm and the reference area compared to 20.3 ind./m^2 recorded in the wind farm and 27.1 ind./m^2 in the reference area in 2003. Recruitment of *Spisula solida* is often very irregular and this species has a preference to sediments of grain size 200-300 µm which might explain the decline in abundance.

For the bivalve *Thracia phaseolina*, the reverse development was observed. In the wind farm area, the abundance of *Thracia phaseolina* increased from 36.1 ind./m^2 in 2003 to 58.7 ind./m^2 in 2004, while in the reference area the abundance decreased from 33.9 ind./m^2 to 20.3 ind./m^2 in the same period.

The bristle worms were the second most abundant group constituting 22% of the number of ind./m^2 in both 2003 and 2004 with 2.3% and 8.0% of the total biomass in the wind farm area in 2003 and 2004, respectively. In the survey from September 2001, the bristle worms constituted 44% of the ind./m^2 in the wind farm.

<u>Discussion and conclusion</u>

A total of 40 species were identified from the surveys in the Horns Rev area in September 2004 while 42 species were identified in 2003 and 47 species in September 2001. The decline in the number of species occurred both inside the wind farm and reference areas, which indicates that the decline could be a combination of changes in sediment characteristics and natural variation rather than an effect from the establishment of the wind farm. More species were not associated with the hard substrate at the turbine sites in 2004 compared to 2003, while in 2001, more species were associated with fine-grained sand.

The median sediment grain size increased from 2001 to 2003 to 2004, which suggests that the velocity of the current increased, but modelling calculations on current speed predicted a 2% reduction in the wind farm area and up to a 15% reduction very close to the scour protection. These results agreed with the grain sizes found at the stations 5, 25 and 100 metres from the scour protection. At most stations, the medium grain size was 5 metres lower from the scour protection compared with the station 100 metres from the scour protection, which indicates that the velocity of the current was lower close to the scour protection. No significant impact on the infauna in the wind farm area was detectable concerning distance-related effects.

Though general reductions in the population size of some of the character species in the surveyed areas might be related to changes in the sediment structure, the infauna community at Horns Rev showed no obvious sign of stress response as a consequence of possible impact from construction and operating activities.

New species were observed in 2003 and 2004 and some of these might be a result of sediment characteristics, less predation or natural variation. The recording of other species might be a result of the introduction of hard bottom habitants in the wind farm area.

The density of the most abundant bivalves and bristle worms was higher in the wind farm area indicating that the potential decrease in predation pressure from birds contributed to increasing differences between the densities of their favoured prey. Bird observations showed predominant foraging activity outside the wind farm area. An indirect effect of increased pressure from fish predation due to a ban against fishing inside the wind farm area is considered negligible as the fish attracted to the turbine foundations mainly forage on the foundations.

In general, the abundance of the most common species increased in the wind farm area between 2003 and 2004 whereas the reference area remained unchanged from 2003 to 2004.

*Photo 1. The razor shell (*Ensis sp.).

Sammenfatning (in Danish)

Introduktion

ELSAM og ELTRA har etableret en havbaseret vindmøllepark med en samlet effekt på 160 MW ved Horns Rev, beliggende 14-20 km ud for Blåvands Huk, Danmarks vestligste punkt. Konstruktionen af vindmøllerne startede i 2001 og opstillingen på Horns Rev blev påbegyndt i foråret 2002.

Overvågningsprogrammet for bundfaunaen er gennemført i september 2003 og i 2004, efter vindmølleparken var sat i drift. Basisbeskrivelser af faunaen som grundlag for nærværende overvågningsprogram er gennemført forud for anlæggelsen af havmølleparken i henholdsvis foråret 1999 samt forår og efterår 2001. Resultaterne fra undersøgelserne fra henholdsvis forår og efterår i 2001 viste meget tydeligt at årstid er en vigtig faktor som kan forårsage store ændringer af tæthed og biomasse. Derfor blev undersøgelsen af mulige påvirkninger fra vindmølleparken undersøgt samme årstid ved at sammenligne resultaterne fra undersøgelserne i september 2001, 2003 og 2004.

Metode

I undersøgelsen i september 2004 er der indsamlet bundprøver ved 6 vindmøllelokaliteter, i alt 18 stationer indenfor selve mølleparken, og på 6 stationer i et udvalgt referenceområde udenfor mølleparken. Stationerne i mølleparken blev placeret langs et transekt i læretningen af hver vindmøllelokalitet, henholdsvis 5, 25 og 100 meter fra hver vindmølles fundament.
Der er ikke etableret lovgivningsmæssige rammer for de mulige påvirkninger af etableringen af Horns Rev vindmøllepark med hensyn til indikatorer og signifikans niveau. Derfor blev overvågningsprogrammets prøvetagning designet udfra en vurdering af resultaterne i 1999 udelukkende med henblik på at detektere større ændringer i samfundsstrukturen af infaunaen. Multivariable analyser af de kombinerede bidrag fra hver enkel art med hensyn til biomasse og tæthed blev brugt til at øge følsomheden af de statistiske test. Prøverne blev indsamlet af SCUBA-dykkere. Der er desuden indsamlet prøver fra samtlige stationer til bestemmelse af sedimentkarakteristika. Faunaprøverne blev omhyggeligt sigtet i en 1 mm sigte.

I laboratoriet blev prøverne udsorteret til bestemmelse af artssammensætning, individtæthed og biomasse.

Sediment

Både indenfor mølleområdet og i referenceområdet kan bundforholdene karakteriseres som ensartede med sediment bestående af rent, mellemfint sand uden nævneværdigt indhold af organisk stof. Partikel størrelsen målt som gennemsnitlig median kornstørrelsen i mølleområdet steg fra 345 µm i september 2001 til 515 µm i september 2003 og 503 µm i september 2004. Det er ikke sandsynligt at ændrede strømforhold, som følge af vindmølleparken kan have forårsaget denne stigning, fordi der ikke var forskel på partikel størrelsen i reference og vindmølle området i 2004.

Fauna

Bundfaunaen i Horns Rev-området kan karakteriseres som et *Goniadella-Spisula*-samfund efter de karakteristiske arter. Ved undersøgelserne i september 2003 og 2004 var de mest talrige arter i området havbørsteormen *Goniadella bobretzkii* samt muslingen *Goodallia triangularis*.

Den største forskel i bundfaunasammensætningen ved sammenligning mellem 2001 og 2004 er et fald i individantallet for havbørsteormene *Pisione remota* og *Goniadella bobretzkii* samt den massive stigning af individantallet for muslingen *Goodallia triangularis*.

Molluskerne var den mest talrige gruppe i 2004, og de udgjorde 66,7% af det totale individantal og 49,2% af den totale biomasse i mølleområdet. I undersøgelsen fra september 2001 udgjorde molluskerne 82% af den totale biomasse i området.

Med hensyn til individtæthed var den lille musling *Goodallia triangularis* hyppigste art og repræsenterede 57% af det totale antal individer, men under 1% af den totale biomasse. I 2001 var den ligeledes en af de mest talrige arter i området. Den kommercielt vigtige trugmusling *Spisula solida* udgjorde 77,4% af biomassen ved undersøgelsen i 2001, 33,7% i 2003 og kun 3,3% af biomassen i mølleområdet i 2004.Rekrutteringen af nye muslinger kan være meget irregulær for *Spisula solida* og da samtidig denne art har en præference for sediment med en partikkelstørrelse på 200-300 µm kan dette være forklaringen på nedgangen i individantallet.

I 2004 blev der fundet 13,6 individer per m^2 i både mølle- og referenceområdet, hvor der blev fundet 20,3 individer per m^2 i mølleområdet og 27,1 individer per m^2 i referenceområdet i 2003. Den modsatte udvikling er observeret for papirmuslingen *Thracia phaseolina*, som er steget i antal fra 36,1 individer per m^2 i 2003 til 58,7 individer per m^2 i 2004 i mølleområdet, mens den i referenceområde i den samme periode faldt fra 33,9 til 20,3 individer per m^2.

Havbørsteormene er den næstmest talrige gruppe, der bidrager med 22% af det samlede individantal per m^2 indenfor mølleområdet i både 2003 og 2004. Indenfor mølleområdet bidrog havbørsteormene til den samlede biomasse med henholdsvis 2,3% i 2003 og med 8% i 2004. I undersøgelsen fra september 2001 udgjorde havbørsteorme 44% af det samlede individantal per m^2 indenfor mølleområdet.

Diskussion og konklusion

I alt blev der identificeret 40 arter fra Horns Rev i september 2004, hvor der blev fundet henholdsvis 47 og 42 arter ved de tilsvarende undersøgelser i september 2001 og 2003. Nedgangen af antal arter foregik både i vindmølleparken og i reference området, hvilket tyder på at årsagen nærmere er en kombination af ændringer i sediment karakteristika og naturlig variation fremfor en følge af etableringen af vindmølleparken. Sammenlignet med 2003 blev flere arter, der specielt er knyttet til hårdbundssubstratet på vindmøllelokaliteterne, ikke registreret i 2004 og i forhold til 2001 blev der registreret færre arter, der er knyttet til finere sand.

Median partikel størrelsen i mølleområdet steg fra 2001 til 2003 og 2004, hvilket tyder på at strømhastigheden ligeledes har steget, men beregninger baseret på modeller forudsiger at strømhastigheden falder med maximalt 2 % i vindmølleparken og op til en reduktion med 15 % tæt ved fundamentet. Disse resultater stemmer overens med observationerne fra stationerne 5, 25 og 100 meter fra fundamentet. På de fleste stationer var median partikelstørrelse mindst på stationen 5 meter fra fundamentet i forhold til 100 meter fra fundamentet, hvilket tyder på at strøm hastigheden er lavere tæt ved fundamentet.

Der blev hverken i 2003 eller 2004 konstateret nogen signifikant sammenhæng mellem infaunasamfundet i mølleområdet og afstanden til møllefundamenterne.

Generelle reduktioner i bestandsstørrelser for nogle af karakterarterne kan muligvis relateres til ændringer i sedimentstrukturen. Infaunasamfundet indenfor mølleområdet viser derimod ikke decideret stressreaktion som følge af mulige påvirkninger fra anlægsarbejdet og aktiviteter i tilknytning til driftsfasen.

Nye arter blev registreret i undersøgelserne fra 2003 og 2004, hvilket kan skyldes muligvis ændringen i sedimentsammensætningen, mindre prædation eller naturlig variation En anden årsag kan være indførelsen af nærliggende hårdbundssubstrater indenfor mølleområdet.

Tætheden af de mest talrige muslinger og havbørsteorme var højere indenfor mølleområdet end i referenceområdet, hvilket kan skyldes en formindskelse af predationstrykket fra havfugle, hvilket har medført en forskel mellem mølleområde og referenceområde, idet observationer af havfuglene hovedsageligt har vist at fuglene fouragerer udenfor mølleområdet. En modsat rettet indirekte effekt af et øget prædationstryk fra fisk som følge af fiskeforbudet inden for mølleområdet antages at være minimal, idet fisk som tiltrækkes af møllefundamenterne hovedsageligt søger føde på fundamenterne.

Generelt er individtætheden af de almindeligste arter øget indenfor mølleområdet fra undersøgelsen i 2003 til undersøgelsen i 2004, mens referenceområdet i samme tidsrum er uændret.

1. Introduction

The benthos of the North Sea have been subject to numerous investigations in relation to offshore oil drilling (Ragnarsson and Steingrimsson, 2003), discharge of dredged material (Stronkhorst et al. 2003), trawl fishing (Rumohr and Kujawsky, 2000; Frid et al., 2000; Rosenberg et al. 2003); oxygen deficiency (Powilleit and Graf 1996), inflow of Atlantic water (Basford et al. 1996) or in relation to undisturbed habitats (Pearson et al. 1996). In the present monitoring programme, the benthic infauna was investigated to detect possible effects from the Horns Rev Wind farm. ELSAM and ELTRA have established an offshore wind farm with an output of 160 MW in the waters of Horns Rev 14–20 km off Blåvands Huk, which is the most western point of Denmark.

The construction of the turbines started in 2001 and the installation of the turbines at Horns Rev was initiated in the spring of 2002 (http://www.hornsrev.dk). Before the construction activities took place, a baseline description of the benthos was conducted as part of an environmental monitoring programme for the establishment of the Horns Rev Offshore Wind Farm. The baseline surveys for the present monitoring programme were conducted in the wind farm area on three occasions: spring 1999, spring 2001 and September 2001 (ELSAM, 2000; Leonhard, 2000 and 2001). In designated reference areas, surveys were conducted in spring 1999 and September 2001. The reference areas in 1999 and September 2001 were placed at two different geographical locations because the survey in September 2001 was planned to be a part of a fish monitoring programme. It was still possible to make the most important comparison between the conditions in the wind farm area before and after the construction of the wind farm. A comparison between the baseline study in spring 2001 and the baseline study in autumn 2001 clearly revealed that the biomass of most species increased considerably from spring to September. Despite the increase in biomass, the overall distribution of the species and their relative abundance did not change. In order to use the baseline data to investigate a possible impact after the construction of the wind farm, it was essential to arrange the monitoring programme either in spring or in September 2003 because the baseline studies were conducted in these periods. The monitoring programme was conducted in September 2003 and again in September 2004 after the wind farm had become operational in conjunction with the surveys on hard bottom substrates.

The impacts from the wind farm on the benthic fauna (infauna) in the area were mainly expected to be due to the alteration of the local currents and thereby sediment characteristics. The particle size of the sediment in the wind farm area increased from a range of 228–426 µm in September 2001 to a range of 404–699 µm in September 2003. The main difference between the 2001 survey and the 2003 survey was the decline of the *Pisione remota* population and an increase in the population of *Goodallia triangularis.* The presence of new species to the infauna community at Horns Rev, the bristle worms *Euzonus flabelligerus* and *Polygordius appendiculatus,* typically associated with coarse sand, might be a result of changes in sediment characteristics towards coarser sediments.

No differences in community structure between the wind farm area and reference area were found in 2003 indicating that natural variation rather than effects from the establishment of the wind farm caused changes in community structure between 2001 and 2003. The community structure is a measurement of the relative abundance of each species.

The main objective of the present monitoring programme in 2004 was to investigate these possible changes in the benthic fauna and to compare the distribution, abundance and biomass of the indicator organisms with the results from the previous baseline surveys and the monitoring programme in September 2003.

This report describes the results of the monitoring programme conducted in September 2004. To detect possible impacts from the establishment of the wind farm, the results from September 2004 were mainly compared with the results from the baseline study conducted in September 2001 and the identical monitoring programme in 2003.

Photo 2. General view of bedforms

2. Methods

2.1. Field activities

All bottom samples around the Horns Rev Wind Farm were collected by SCUBA divers. The coordinates of the infauna localities are given in Table 1 (WGS 84). Actual GPS positions and actual depths at sampling dates are presented in Appendix 1. The choice of sampling technique and number of samples was based on a statistical power analysis of the abundance and biomass data from the baseline studies.

Location	"WGS84_MIN_Y"	WGS84_MIN_X"	Depth (app. M)
Turbine 26	55°28,707'	07°49,214'	8.0
Turbine 51	55°30,217'	07°50,441'	10.0
Turbine 55	55°29,022'	07°50,736'	10.4
Turbine 58	55°28,124'	07°50,956'	8.2
Turbine 73	55°29,629'	07°51,652'	9.3
Turbine 95	55°29,041'	07°52,862'	9.1
Reference 1	55°30,070'	07°46,640'	10.1
Reference 7	55°29,480'	07°47,320'	9.7
Reference 35	55°27,730'	07°53,080'	7.6
Reference 36	55°30,130'	07°53,030'	6.2
Reference 37	55°29,530'	07°53,170'	6.3
Reference 40	55°27,740'	07°53,610'	8.7

Table 1. Positions of sampling locations for infauna survey 2004.

Weather and wind conditions, as well as hydrographical data such as current direction, approximate current speed, wave height and transparency, were recorded at each sampling site. The Secchi depth was measured by lowering a white Secchi disc (diameter = 30 cm) several times until the disc became invisible. The estimated Secchi depth was adjusted for wave height according to Danish Standard DS 293.

Adjusted Secchi depth = estimated Secchi depth X (1+ 0.4 x wave height).

Depth at each sampling site was measured with an echo-sounder. Data on hydrographics and weather conditions is presented in Appendix 2.

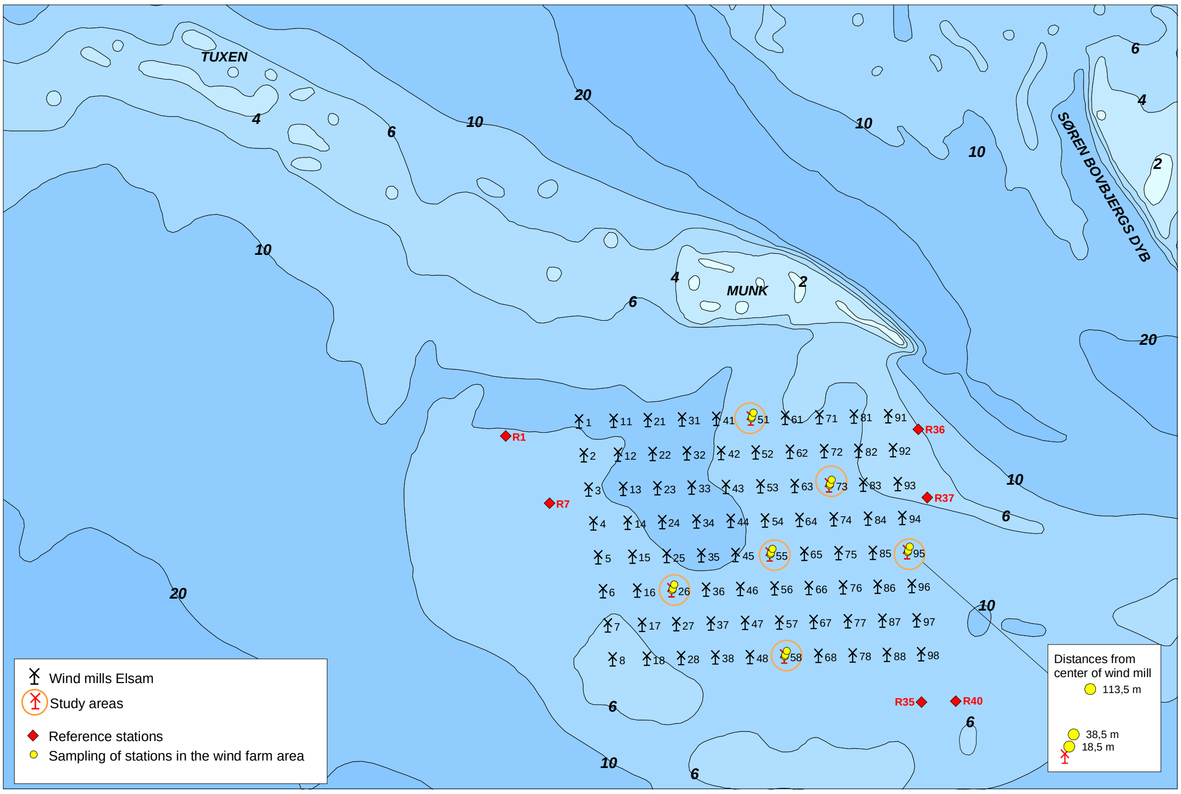


Figure 1. Map of locations sampled in September 2004.

The coordinates of turbine positions are given in Appendix 1.

In September 2004, samples were collected at three stations along transects at each of six individual turbines and at six reference stations, see Figure 1. The transects were placed in the lee of the prevailing current where the impact was expected to be due to the effect of possible changes in currents by the wind turbine foundations. Samples were recovered using a 0.0123 m^2 core sampler to collect the seabed surface area. The three stations were located at distances of 5, 25 and 100 m from the edge of the scour protection.

At each of the 24 stations, a diver collected two replicates of samples for detailed macrofaunal analysis.

The present monitoring programme was mainly compared with the baseline study from September 2001. The reference stations in 2004 were not equal to the reference stations in 2001. In 2004, the reference area was selected at stations identical to stations sampled in 1999 because results from 2001 had shown that the designated reference area in 2001 was not comparable with the wind farm area with respect to infaunal community structure.

In September 2001, samples were recovered from 9 stations at 3 wind turbine locations (55, 58 and 95), see Figure 2.

Samples for identification of species composition, abundance and biomass were carefully sieved through a 1.0 mm test sieve and the material retained was preserved in 96% ethanol, which is equivalent to approx. 80% when taking the water content of the sample into consideration.

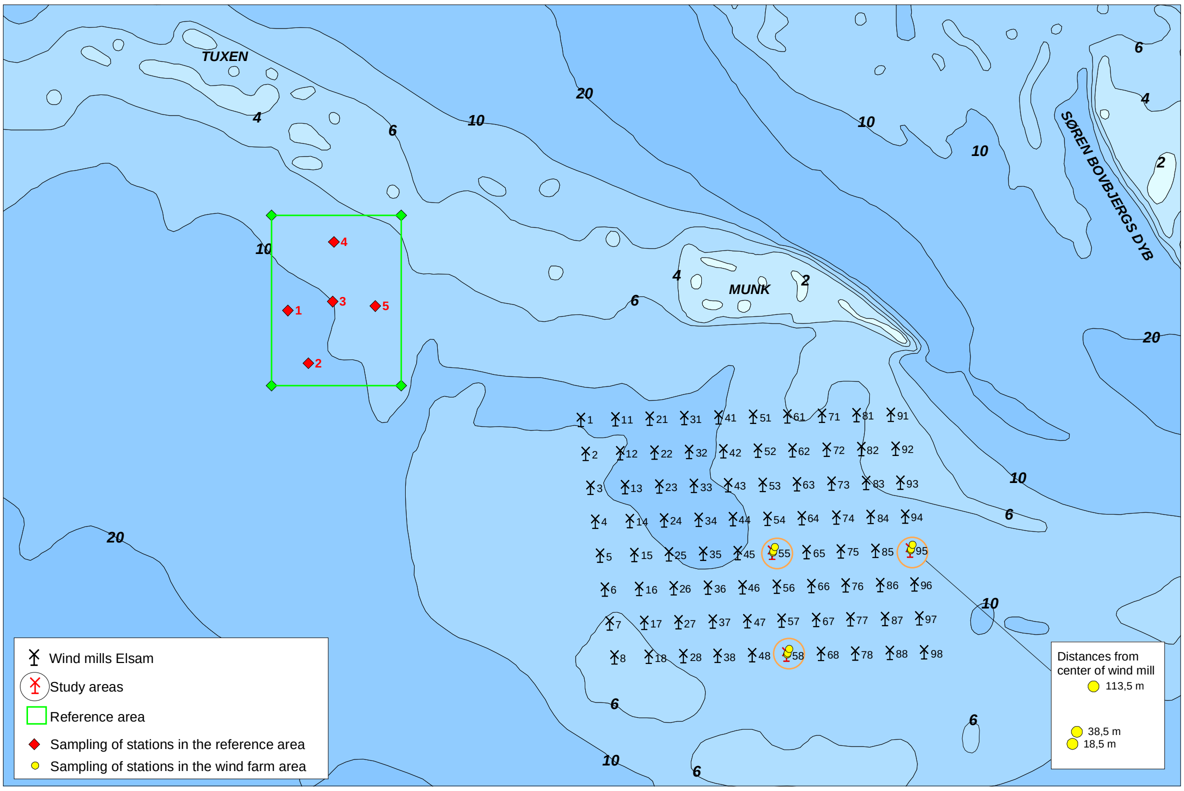


Figure 2. Map of locations sampled in September 2001. The designated reference area was not comparable with the wind farm area with respect to infaunal community structure.

At all stations, both at the wind farm site and in the reference area, an additional core sample was recovered at each station for analysis of sediment characteristics.

2.2. Laboratory activities

2.2.1. Sediment characterisation

Sediment was characterised by analyses for grain size distribution, dry matter content and the amount of organic material measured by combustion loss. Dry matter content was measured as a percentage of the wet weight. The combustion loss was measured as a percentage of the dry weight. Data are presented in Appendices 3 and 4. The samples were treated according to DS 405.11 and DS 204. The sediment was washed in distilled water to remove any remaining salts and dried at 105°C until constant weight was obtained. The sediment was pre-treated with hydrogen peroxide to remove organic material.

Grain size distribution was determined using a combination of sieve analysis and sedigraph technique. Sieve analysis was used for the sand fraction, i.e. all the material retained by a 63µ sieve according to a modified standard DS 405.9 using a total of 15 sieves.

A sedigraph 5100 was used for analysis of the silt/clay fraction, i.e. all the material passing through a 63µ sieve. The sediment was pre-treated with a 0.005 molar solution of sodium pyro phosphate and treated with an ultrasound vibrator for 5 minutes.

Cumulative percentage curves of the sieve and the sedigraph analysis data were prepared and their characteristics described by means of median particle diameter and measured as the point at which the 50% abscissa intersects the cumulative percentage curve. Results of grain size are presented in Appendix 4.

On the basis of sediment statistics, a sorting index was calculated. Sediments with a sorting index less than 0.5 were characterised as well-sorted. A sorting index of 0.5–1 characterises sediments as medium-sorted, while a sorting index of >1 characterises sediments as poorly sorted (modified after Folk & Ward [GEUS, 2002]).

2.2.2. Benthos

In the laboratory, samples for identification of species, composition, abundance and biomass were carefully sieved through a 0.5 mm test sieve. The fauna samples were sorted under a microscope and the animals identified to the lowest possible taxon. The number of individuals and the ethanol wet weight of each taxon were determined. Abundance (ind. m^{-2}) and biomass (g wet weight [ww] m^{-2}) were calculated for the total fauna.

The shell length of the mussels, i.e. the longest distance between anterior end and posterior end, and the disc diameter of the brittle stars were measured by means of electronic slide gauge.

2.3. Statistical analyses

Differences between the wind farm area and reference areas and between survey campaigns were analysed on the basis of the combined data of sediment characteristics and species composition in terms of abundance and biomass.

Due to the nature of the sampling layout, where the reference area was moved between 2001 and 2003 to stations identical with stations surveyed in 1999, the samples were segmented into the following subsets:

1. Wind farm area: 3 campaigns (September 2001, September 2003, September 2004)
2. Reference area: 3 campaigns (spring 1999, September 2003, September 2004)

2.3.1. Sediment characteristics

For each subset, differences in sediment characteristics were analysed using a series of ANOVA tests. Each variable was checked for normality and homogeneity of variance. In addition, the correlations between characteristics were quantified using Pearson's correlation coefficient, also called *linear* or *product-moment* correlation.

For further explanation, see http://www.statsoft.com/textbook/stbasic.html#Correlations.

2.3.2. Species composition

Within each subset, differences in the species compositions between the wind farm area and the reference area and between survey campaigns were quantified using the Bray-Curtis dissimilarity index based on root-root transformed data. Root-root transformation reduces the importance of dominating species, which gives a better reflection of the species composition based on presence/absence compared with non-transformed data.

The Bray-Curtis index is calculated as follows:

$$BC = \frac{\sum_k |x_{ik} - x_{jk}|}{\sum_k x_{ik} + \sum_k x_{jk}}$$

Where i and j are sub-samples, k is the number of species in the sub-samples, and similarity is expressed as 1 – BC. At maximum similarity, BC = 0 and at maximum dissimilarity, BC = 1.

The BC values were used for a data presentation in 2-dimensional plots using a non-metric Multidimensional Scaling (MDS) ordination. For further description of the MDS technique, see http://www.statsoft.com/textbook/stmulsca.html.

A formal test for differences between areas and campaigns was made for each subset using a non-parametric permutation procedure applied to the similarity matrix underlying the ordination. To evaluate the relative importance of the different species, the average contribution to the overall similarity within groups and the average contribution to the overall dissimilarity between groups were calculated for each species. The results are presented listing the most important species first.

To link sediment characteristics to species composition, two different approaches were used. First, a dissimilarity matrix was calculated between samples based on all sediment characteristics using the Euclidean distance as the dissimilarity measure. This matrix was tested for agreement with the dissimilarity matrix based on species composition using the weighted Spearman rank correlation, see:
http://www.statsoft.com/textbook/stnonpar.html#correlations.

Second, the same test for agreement was performed on combinations of sediment characteristics at steadily increasing levels of complexity to find the combination with the highest rank correlation.

No legislative environmental criteria has been established for either the indicators or level of significance for a monitoring programme at Horns Rev. As a consequence, the monitoring programme established for the benthic infauna was reduced to enable major changes in the community structure of the infauna. The present monitoring programme includes multivariate analysis of the combined input from each species with respect to biomass and abundance which increases the sensitivity of the statistical analysis considerably.

Photo 3. Collection of core samples.

3. Results

3.1. Sediment

In September 2004, the sediments in the wind farm area could generally be characterised as ***medium-fine*** sand with a median particle size of 503 µm measured as an average of the 18 stations at the 6 turbine sites. In September 2003, the median particle size was 515 µm. But in 2001, the median particle size was 345 µm, see Table 2. The particle size was found to be in the range from 228 µm to 426 µm in 2001, from 404 µm to 699 µm in 2003 and from 379 µm to 618 µm in 2004. The coarser sand was found at the turbine sites M26 and M58 in the western and southern part of the wind farm area. In the northern part of the wind farm area, the sea bottom consisted of slightly finer sediment. A statistical analysis revealed a significant ($P<0.01$) negative correlation between the depth and the median particle size in the wind farm area.

Campaign	Spring 1999	September 2001	September 2003	September 2004
Average median grain size µm	370	345	515	503

Table 2. Average median grain size in the wind farm area found in survey campaigns from 1999 to 2004.

In the reference area, analysis has also shown a significant ($P<0.05$) negative correlation between depth and particle size. The particle size of the reference areas in 2001 and in 2003 was not compared because new stations were selected in 2003. Between 1999 and 2003 a significant ($P<0.01$) difference in median particle size was shown for the reference area. At the 6 reference stations, the average median particle size was 347 µm and 498 µm in 1999 and 2003, respectively.

No correlation was found between the particle size of sediment and the distance from sampling station to turbine foundation.

Both in the wind farm area and in the reference area, the values for sediment characteristics indicated sediments to be homogeneous and medium sorted. The general characteristic of the sediments was pure sand with an ignition loss of less than 1% (Appendices 3 and 4).

3.2. Fauna

This section presents the results of the macrofaunal analysis of samples taken in the Horns Rev area within the wind farm site and in a reference area in September 2004. The faunal composition in 2004 was compared with the results from the survey in September 2003 and 2001 to identify possible effects from the new environment. The development in faunal composition in the reference area between 1999 and 2004 was partly based on the result from the survey in this area in spring 1999.

The macrofauna was defined as those animals that live in or on the seabed and are retained when sediments are washed on a 1 mm mesh. Where soft sediments occur, the animals are principally infaunal, either burrowing through the sediment or constructing tubes within it. As the sediment provides support and protection, as well as the food source for many species, members of the infauna are particularly vulnerable to external influences, which alter their chemical, physical or biological nature.

As infauna animals are largely sedentary in habit, they are unable to avoid unfavourable conditions. As each species has its own response and degree of sensitivity to changes in various environmental factors, the species composition and relative abundance to the community in a particular location provide a reflection of the environment there, both current and historical.

Previous studies in the Horns Rev area have revealed that the main characteristics of the faunal composition in the area can be described as an *Ophelia borealis* community, or more commonly accepted as the *Goniadella-Spisula* community, named after one or more of the characteristic and important species in the area (Leonhard, 2001). The studies have also shown that the area is very heterogeneous with regards to the faunal composition and that the number of species, density of individuals and biomass of the benthic fauna can vary greatly within the area as also shown for the survey in 2004, see Figures 3 and 4.

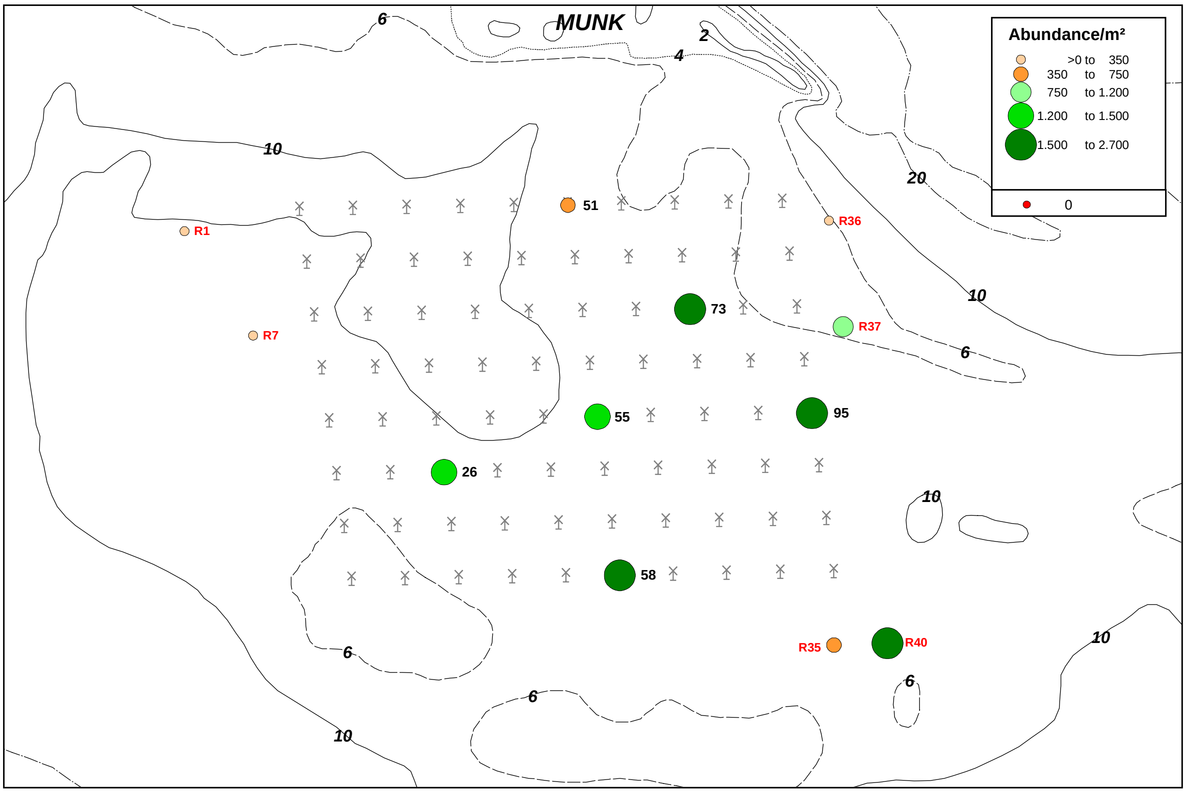


Figure 3. Distribution pattern of total abundance of all species in September 2004, shown as average abundance for the three stations at each turbine site.

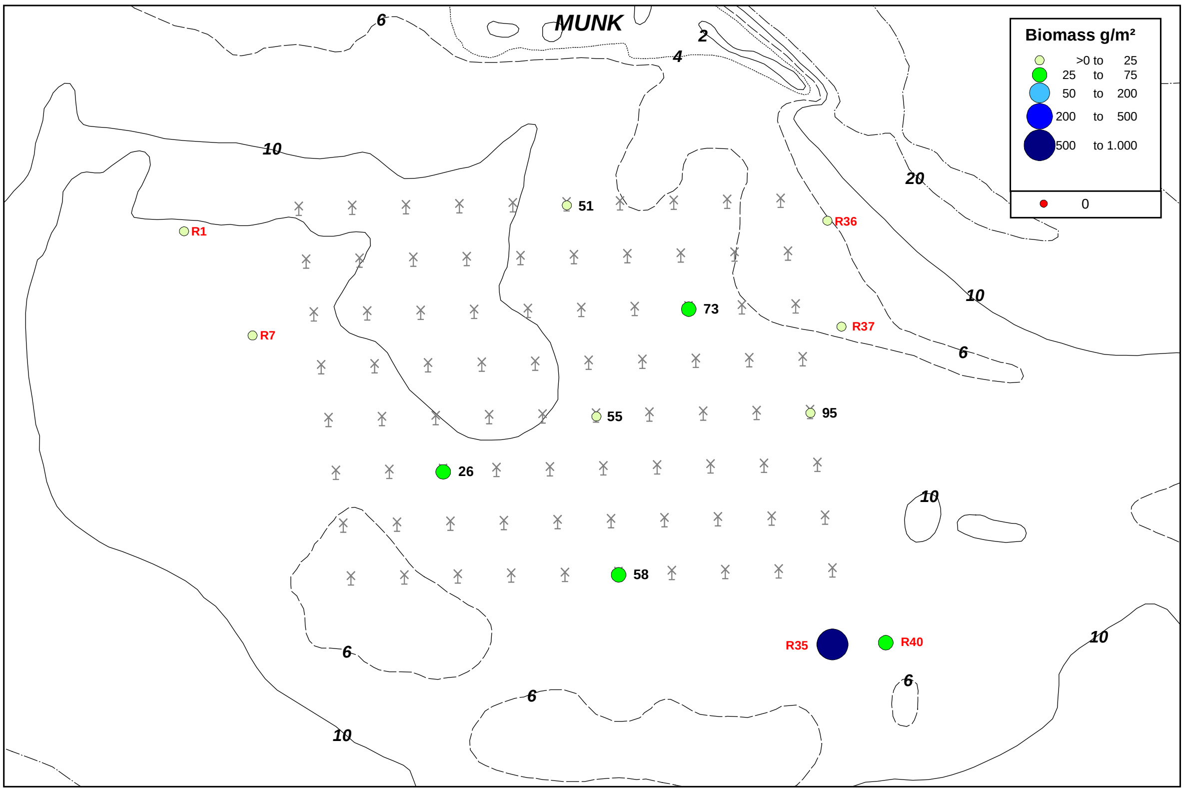


Figure 4. Distribution pattern of total biomass in September 2004, shown as average biomass for the three stations at each turbine site.

A total of 40 species were identified from the surveys in the Horns Rev area in September 2004 while 42 species were identified in 2003 (Bech et al., 2004) and 47 species were identified in September 2001 (Leonhard, 2001). Compared to 2003, some epifauna species, such as *Tubularia indivisa* and *Crepidula fornicata* typically associated with the hard substrates at the turbine sites and some very mobile species like the harbour crab and the hermit crab, were not recorded in 2004, Appendix 5. This in part might be a result of small stones from the scour protection accidentally represented in the samples from 2003 or very mobile species. Compared to 2001, more species of bristle worms and small crustaceans mostly associated with fine sand were not recorded in 2004, Appendix 5.

The phyletic composition in 2004 was similar to 2003 with 9 species of crustaceans representing 6.5% of the total abundance. A full list of species enumerated from the survey in September 2004 is given in Appendix 5.

The most abundant species found in 2004 are listed in Table 3 and the most dominant species in terms of biomass are listed in Table 4.

Autumn 2004 Abundance, number/m²		**Wind Farm area**		**Reference area**	
		Mean	Col Sum %	Mean	Col Sum %
Goodallia triangularis	BIVALVIA	862.69	58.68	616.53	75.83
Travisia forbesii	POLYCHAETA	94.85	6.45	20.33	2.50
Goniadella bobretzkii	POLYCHAETA	65.49	4.45	33.88	4.17

Autumn 2004 Abundance, number/m²		Wind Farm area		Reference area	
Pisione remota	POLYCHAETA	85.82	5.84	6.78	0.83
Thracia phaseolina	BIVALVIA	58.72	3.99	20.33	2.50
Jassa marmorata	CRUSTACEA	40.65	2.76	20.33	2.50
Spio filicornis	POLYCHAETA	27.10	1.84	13.55	1.67
Mytilus edulis	BIVALVIA	29.36	2.00	6.78	0.83
Gastrosaccus spinifer	CRUSTACEA	24.84	1.69	6.78	0.83
Branchiostoma lanceolatum	CHORDATA	15.81	1.08	.	.
Spisula solida	BIVALVIA	13.55	0.92	13.55	1.67
Total		**1318.88**	**89.71**	**758.81**	**93.33**

Table 3. *Mean abundance of the most abundant species found in the wind farm and reference areas in September 2004.*

Autumn 2004 Biomass. wet weight g/m²		Wind Farm area		Reference area	
		Mean	Col Sum %	Mean	Col Sum %
Spisula solida	BIVALVIA	0.79	3.37	97.25	89.33
Travisia forbesii	POLYCHAETA	4.88	20.85	4.05	3.72
Thracia phaseolina	BIVALVIA	7.47	31.93	1.12	1.03
Crangon crangon	CRUSTACEA	0.55	2.37	3.55	3.26
Goodallia triangularis	BIVALVIA	2.17	9.28	1.75	1.61
Orbinia sertulata	POLYCHAETA	2.37	10.12	0.88	0.81
Actiniaria indet.	ANTHOZOA	1.45	6.19	.	.
Polinices polianus	GASTROPODA	1.05	4.48	0.16	0.15
Electra pilosa	BRYOZOA	0.52	2.24	.	.
Asterias rubens	ECHINODERMATA	0.45	1.94	.	.
Nephtys caeca	POLYCHAETA	0.33	1.41	.	.
Total		**22.02**	**94.19**	**108.75**	**99.90**

Table 4. *Biomass of the most dominant species found in the wind farm and reference areas in September 2004.*

In both 2003 and 2004, the most dominant species was *Goodallia triangularis* and the number of this species increased approximately 30% in the wind farm area whereas it remained at the same level in the reference area. In 2001, the infauna was dominated by the small bristle worm *Pisione remota*, Table 5.

The total number of individuals increased around 40% in the wind farm area and decreased 25% in the reference area from 2003 to 2004. A comparison of the average biomass per area in 2003 and 2004 was biased by the presence of large specimens of the crab *Pagurus bernhardus* in 2003. The presence of this high biomass due to the presence of one individual of this species is considered a coincidence because of its migratory behaviour. The absolute main contribution to this change is the decline in biomass of the edible mussel *Spisula solida* from 231 g/m^2 in 2001 to 62 g/m^2 in 2003 to 0.8 g/m^2 in 2004. The decline from 2003 to 2004 should be considered with some caution because it was based on a small number of specimens in both years. In 2003, only 9 specimen of *S. solida* were found in the wind farm area whereas a total of 6 specimens were found in 2004. The high biomass in the reference area in 2004 was mainly caused by the presence of one large specimen found at reference station 35 (Appendix 7.5 in the Data Report from 2004).

The cumulative percentage abundance of the most common species was high in both areas indicating community domination by few taxa (Table 3).

The most dominant species found in all of the infauna surveys from 2004 are found in Tables 3 and 4 while the data from 1999 and 2003 are shown in Tables 5 and 6.

Abundance, number/m²		**Sampling area**							
		Wind Farm area				**Reference area**			
		2001		**2003**		**1999**		**2003**	
		Campaign		**Campaign**		**Campaign**		**Campaign**	
		Autumn		**Autumn**		**Spring**		**Autumn**	
Species	**Group**	**Mean**	**Relative %**	**Mean**	**Relative %**	**Mean**	**Relative %**	**Mean**	**Relative %**
Goodallia triangularis	Bivalve	203.3	10.9	664.0	58.3	237.1	9.2	630.1	53.8
Pisione remota	Bristle worm	411.0	22.0	22.6	2.0	691.1	26.7	13.6	1.2
Goniadella bobretzkii	Bristle worm	189.7	10.1	146.8	12.9	338.8	13.1	149.1	12.7
Hydractinia echinata	Hydrozoan	225.8	12.1	2.3	0.2	13.6	0.5	6.8	0.6
Ophelia borealis	Bristle worm	72.3	3.9	11.3	1.0	149.1	5.8	13.6	1.2
Spio filicornis	Bristle worm	90.3	4.8	20.3	1.8	27.1	1.0	40.7	3.5
Spisula solida	Bivalve	36.1	1.9	20.3	1.8	33.9	1.3	27.1	2.3
Nemertini indet.	Nemertinean	27.1	1.4	4.5	0.4	40.7	1.6	13.6	1.2
Pontocrates arenarius	Crustacean	4.5	0.2	6.8	0.6	47.4	1.8	20.3	1.7
Branchiostoma lanceolatum	Chordata	9.0	0.5	27.1	2.4	6.8	0.3	27.1	2.3
Polinices polianus	Gastropod	9.0	0.5	11.3	1.0	6.8	0.3	6.8	0.6
Pagurus bernhardus	Crustacean	4.5	0.2	2.3	0.2	13.6	0.5	6.8	0.6
Total		**1,282.7**	**68.6**	**939.5**	**82.5**	**1,605.7**	**62.0**	**955.3**	**81.5**

Table 5. The most dominant species in terms of number per m² found in the wind farm and reference areas in all infauna surveys from 1999 to 2003.

Biomass, wet weight g/m²		**Sampling area**							
		Wind Farm area				**Reference area**			
		2001		**2003**		**1999**		**2003**	
		Campaign		**Campaign**		**Campaign**		**Campaign**	
		Autumn		**Autumn**		**Spring**		**Autumn**	
Species	**Group**	**Mean**	**Relative %**	**Mean**	**Relative %**	**Mean**	**Relative %**	**Mean**	**Relative %**
Spisula solida	Bivalve	231.883	77.4	62.580	33.7	15.413	7.3	77.699	21.7
Pagurus bernhardus	Crustacean	4.503	1.5	66.644	35.9	76.295	36.1	13.311	3.7
Ophelia borealis	Bristle worm	7.405	2.5	0.299	0.2	27.560	13.0	6.654	1.9
Polinices polianus	Gastropod	3.210	1.1	7.881	4.2	0.035	0.0	2.376	0.7
Goodallia triangularis	Bivalve	0.542	0.2	1.504	0.8	0.904	0.4	1.794	0.5
Hydractinia echinata	Hydrozoan	0.000	0.0	0.064	0.0	1.331	0.6	0.001	0.0
Branchiostoma lanceolatum	Chordata	0.080	0.0	0.712	0.4	0.348	0.2	0.078	0.0
Goniadella bobretzkii	Bivalve	0.184	0.1	0.555	0.3	0.245	0.1	0.068	0.0
Spio filicornis	Bristle worm	0.208	0.1	0.068	0.0	0.234	0.1	0.051	0.0
Pisione remota	Bristle worm	0.035	0.0	0.078	0.0	0.174	0.1	0.003	0.0
Pontocrates arenarius	Crustacean	0.004	0.0	0.035	0.0	0.079	0.0	0.030	0.0
Nemertini indet.	Nemertinean	0.038	0.0	0.002	0.0	0.078	0.0	0.019	0.0
Total		**248.093**	**82.8**	**140.422**	**75.7**	**122.696**	**58.1**	**102.085**	**28.5**

Table 6. The most dominant species in terms of biomass found in the wind farm and reference areas in all infauna surveys from 1999 to 2003.

New species not previously registered for the infaunal community in the wind farm area at Horns Rev are shown in Table 7.

New introduced species September 2004		**Abundance Number/m²**		**Biomass g/m²**	
		Mean	Col Sum %	Mean	Col Sum %
Glycera alba	POLYCHAETA	2.26	0.15	0.00	0.00
Hydrobia ulvae	GASTROPODA	6.78	0.46	0.01	0.00
Chamelea gallina	BIVALVIA	2.26	0.15	0.01	0.00
Ophiura albida	ECHINODERMATA	2.26	0.15	0.01	0.00

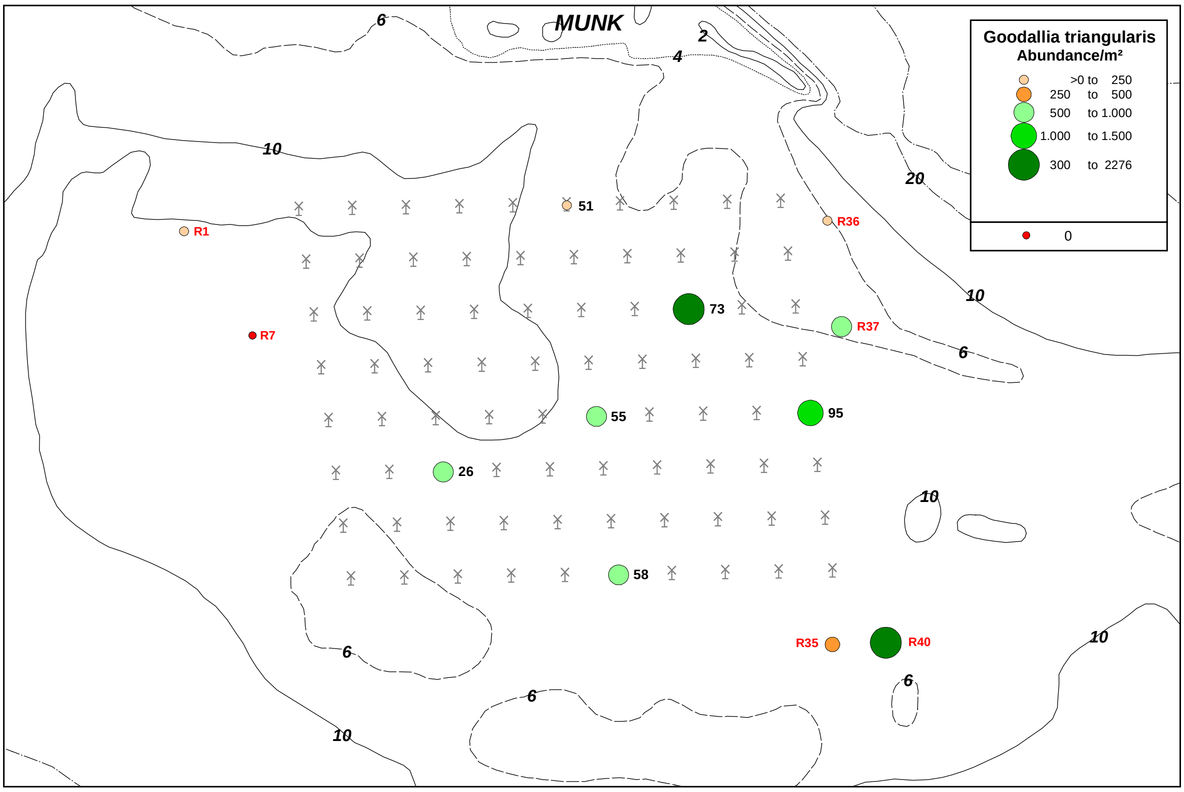
Table 7. New introduced species of the infaunal community in the wind farm area 2004.

Molluscs (Bivalvia & Gastropoda)

Molluscs were the most abundant group in 2003 and 2004 because more than 50% of the individuals were *Goodallia triangularis* both in the wind farm and the reference areas. In 2004, molluscs constituted 66.7% of the average number of individuals and 49.2% of the average biomass per m^2 in the wind farm and 82.5% of the abundance and 92.1% of the biomass in the reference area. In 2001, molluscs represented 82% of the total biomass in the total area.

In terms of abundance, the small bivalve *Goodallia triangularis* was the most numerous species representing 57% of the total individuals found but less than 1% of the total biomass. The abundance and biomass distribution pattern for *G. triangularis* is shown in Figure 5. In 2001, this species was also one of the most abundant species in the area.

The abundance and biomass distribution patterns of the mussels *Spisula solida* and *Thracia phasseolina* are shown in Figures 6 and 7.



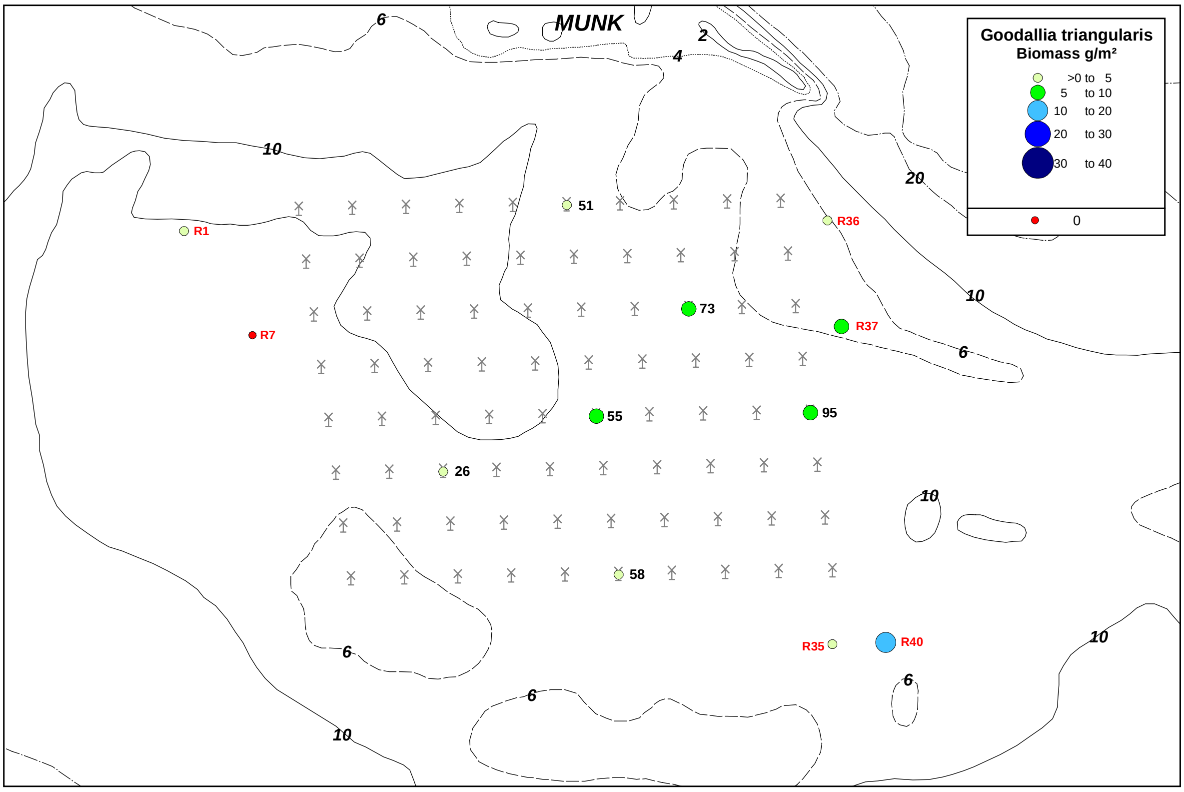
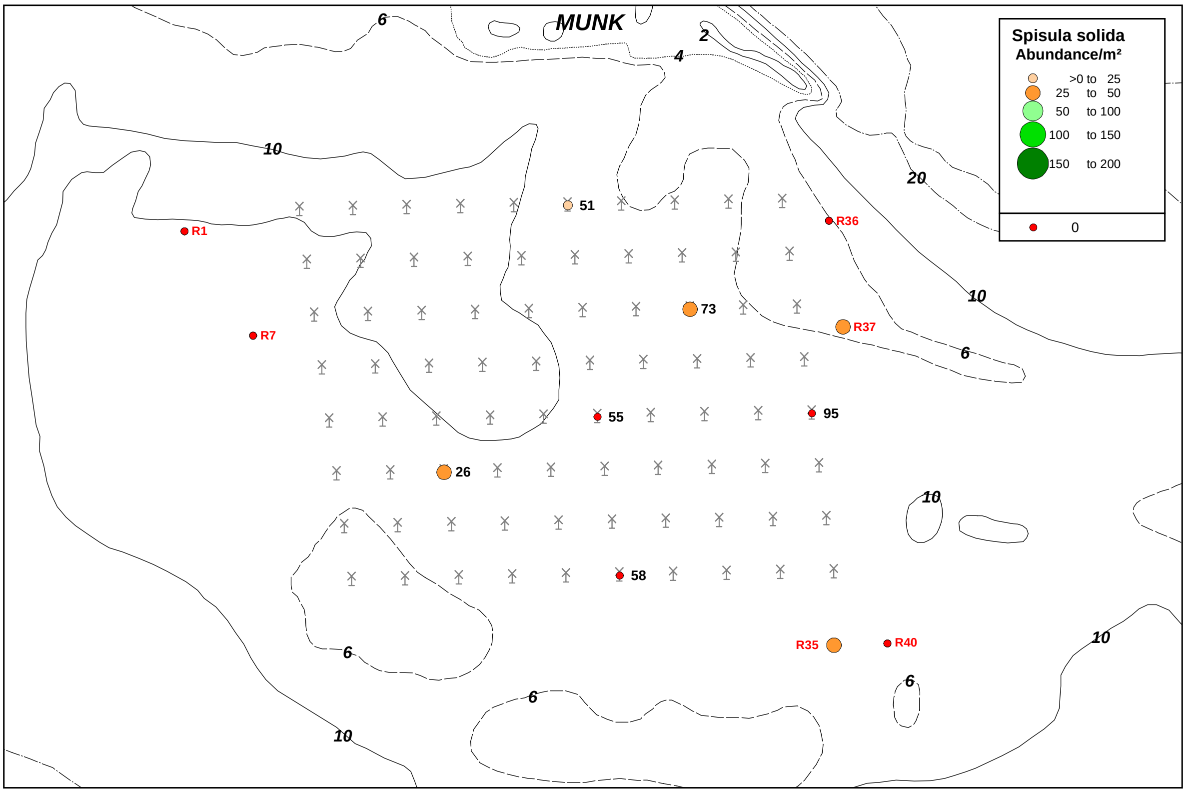


Figure 5. Abundance and biomass of the bivalve Goodallia triangularis *shown as an average for the three stations at each turbine site.*



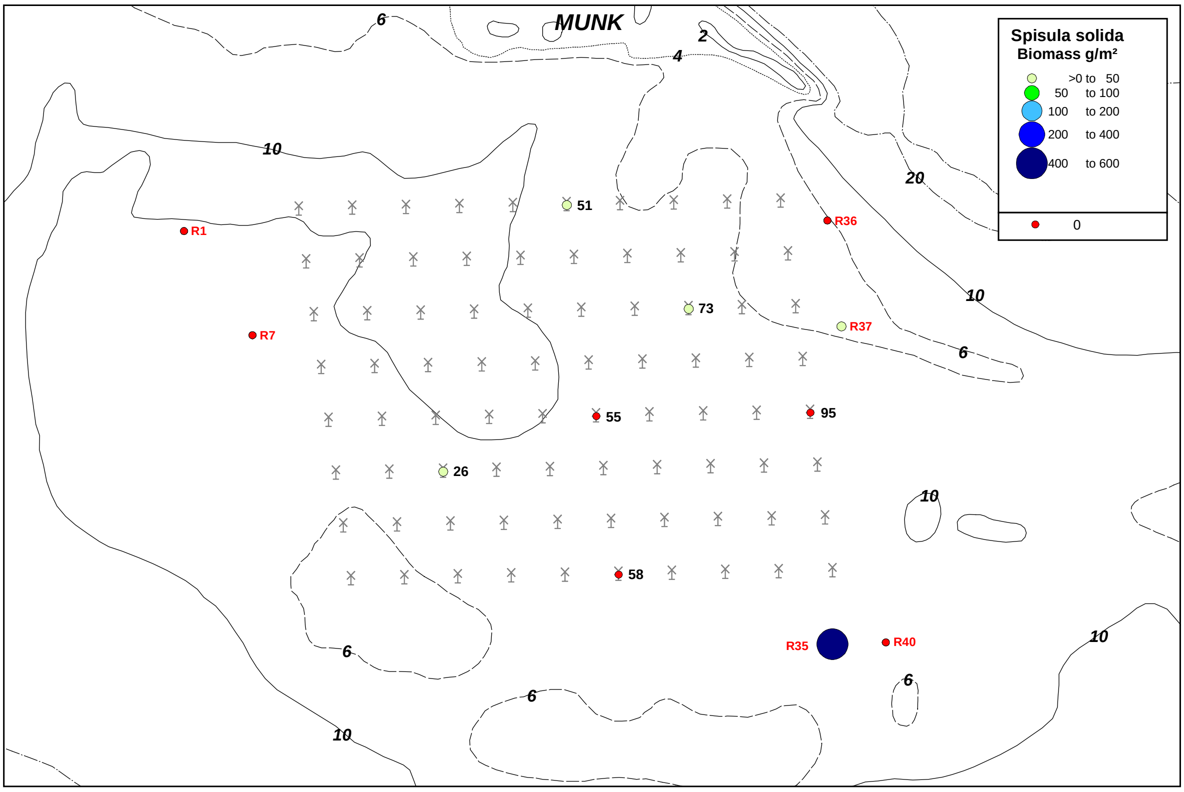
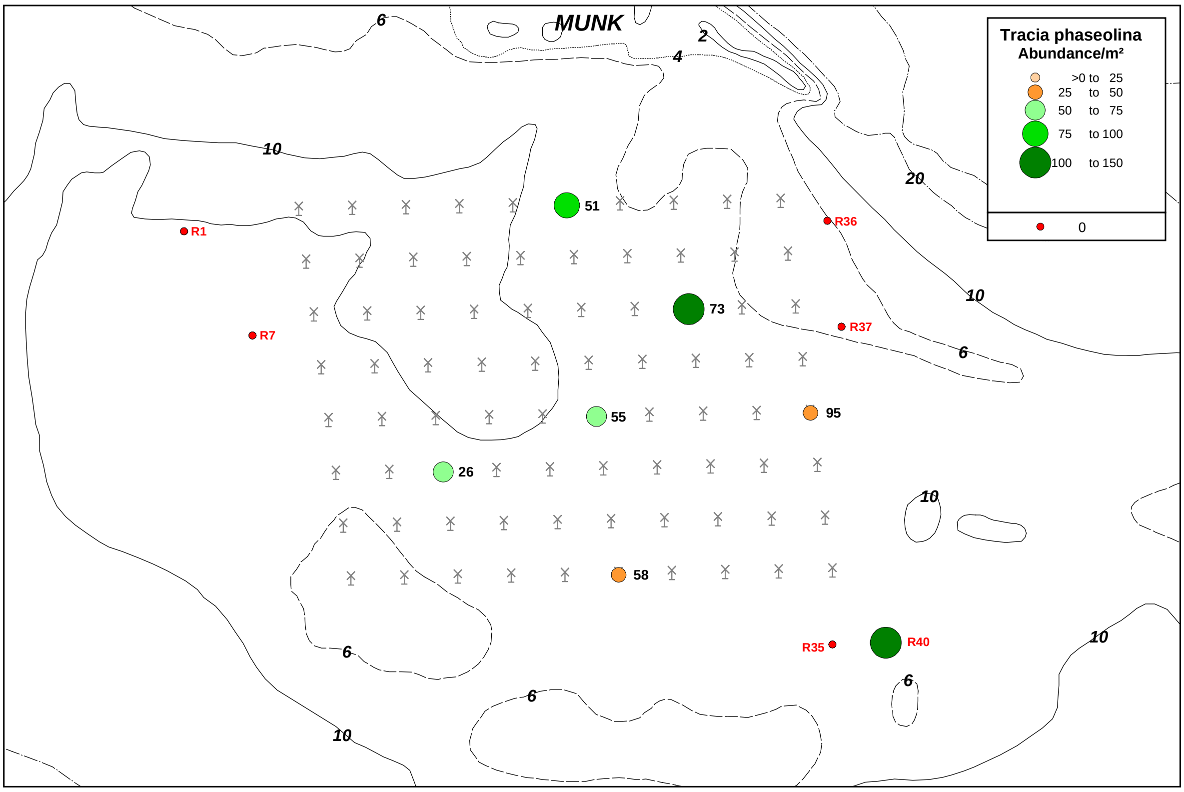


Figure 6. *Abundance and biomass distribution of the mussel* Spisula solida, *shown as an average for the three stations at each turbine site.*



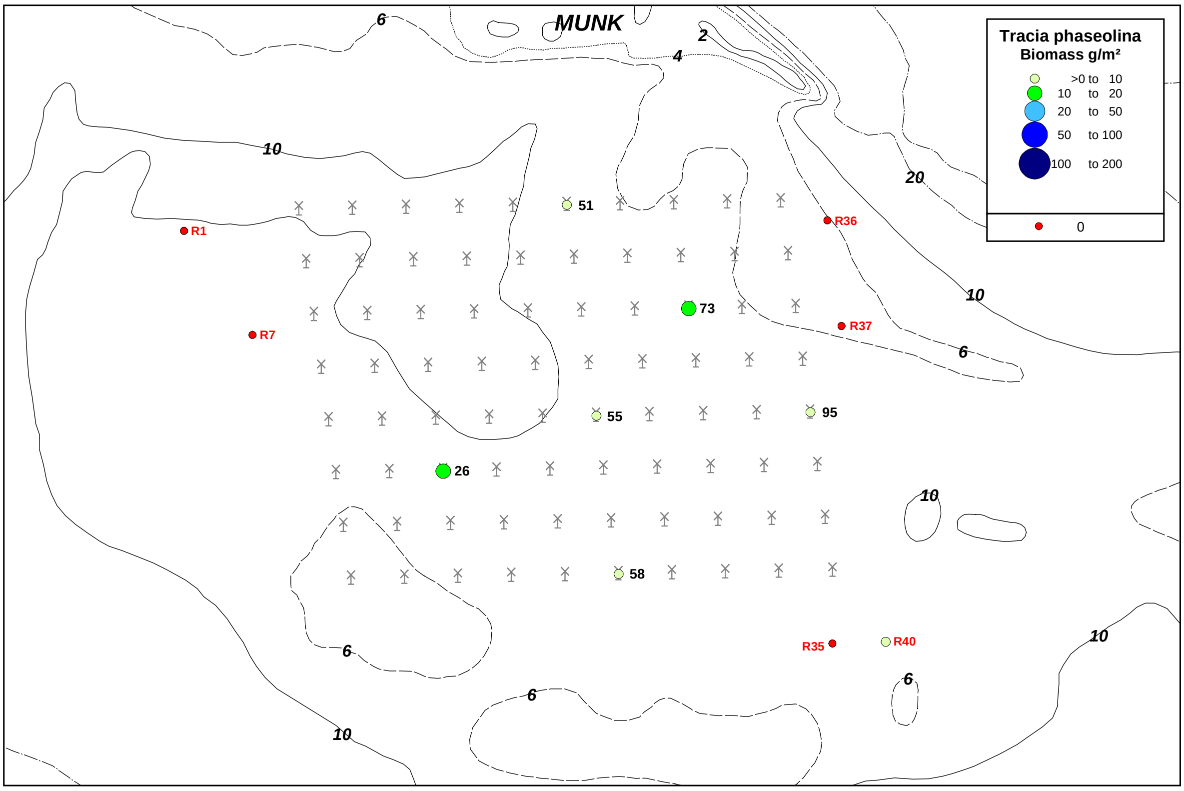


Figure 7. *Abundance and biomass of the mussel* Thracia phaseolina, *shown as an average for the three stations at each turbine site.*

In 2003, two sub-samples from reference station number 1 contained nine adult specimens of the common razor shell *Ensis ensis*, representing a weight of 35.5 g. In

2004, the common razor shell was not found in any of the samples. The highly inhomogeneous distribution of this species in 2003 makes it questionable to draw any statistical conclusions with respect to the distribution in 2004 because it would require a higher number of sub-samples to detect changes in the distribution of species with a highly gregarious distribution. The number of samples used in the baseline and subsequent surveys was carefully selected as the minimum number needed to obtain the optimal statistical resolution based on knowledge about the general number of species and their abundance in this particular area.

Bristle worms (Polychaeta)

Bristle worms were the second most abundant group, as they constituted 22% of the number of ind./m^2 in both 2003 and 2004. In the wind farm area, the bristle worms constituted 2.3% and 8% of the biomass in 2003 and 2004, respectively. In the survey from September 2001, the bristle worms constituted 44% of the ind./m^2 in the wind farm area.

The small bristle worm *Goniadella bobretzkii* was the most abundant in the reference area in 2004, see Figure 8. It was also the most abundant in the survey in 2003. In the wind farm area in 2004, *Travisia forbesii* was the dominant species representing 6.5% of the individuals and 20.8% of the total biomass. Another small bristle worm, *Pisione remota*, which dominated in 2001 with a relative abundance of 22%, represented 2.0% in 2003 and 5.8% of the total number of individuals in 2004.

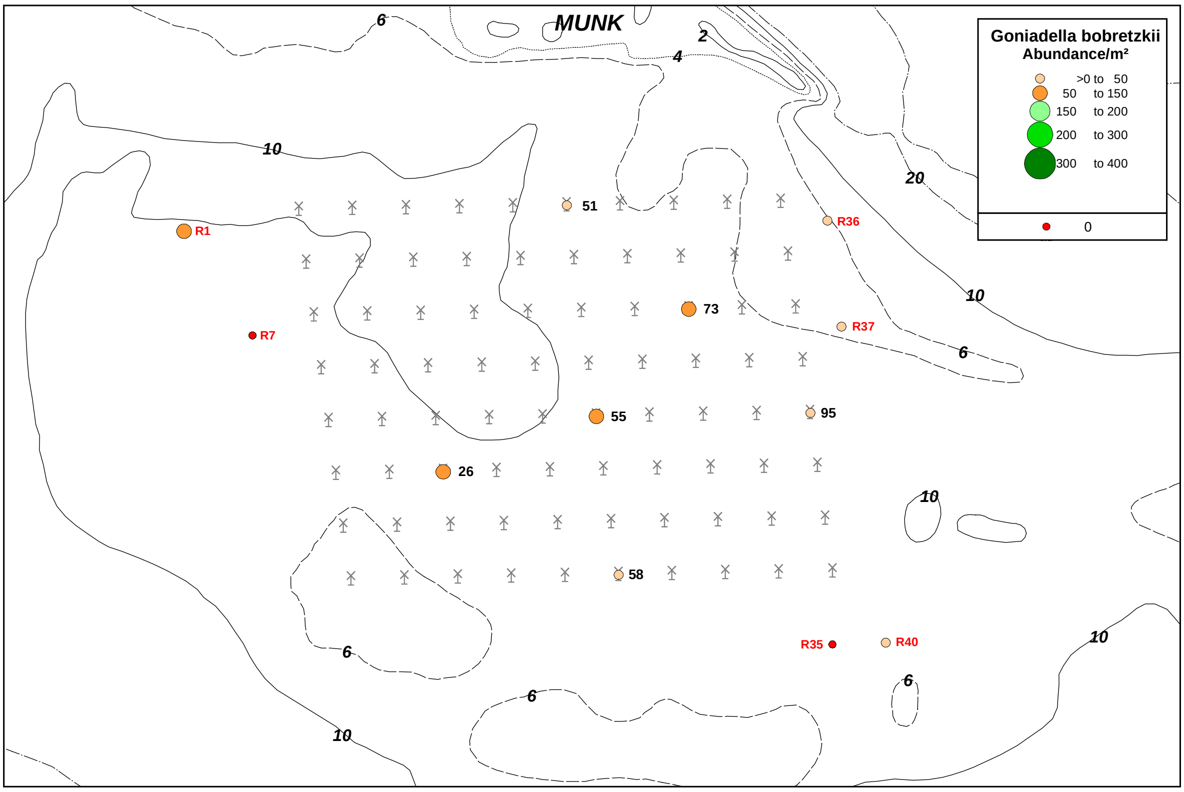


Figure 8. *Abundance of the bristle worm* Goniadella bobretzkii, *shown as an average for the three stations at each turbine site.*

The bristle worm *Ophelia borealis*, was selected as a character species in 2001 because of its relative consistency in abundance, but the relative abundance decreased from 2001 to 2003 and 2004. In both 2003 and 2004, it constituted less than 1% of the abundance compared to 3.9% in 2001. An average of 9.0 ind./m^2 was recorded in 2004, 11.3 ind./m^2 in 2003 and 72.3 ind./m^2 in 2001.

Crustaceans (Crustacea)

Jassa marmorata has not previously been recorded in Denmark, but it was found in high abundances at the scour of the turbines and at the turbine itself in 2003 and 2004 (Leonhard and Pedersen, 2004 and 2005). *J. marmorata* was also found in small numbers closest to the scour protections in the infauna surveys in 2003 and 2004. This species is associated with hard bottoms and most probably ends up outside the scour protection because of the strong currents in the area.

Larger crustaceans such as the hermit crab *Pagurus bernhardus* were the most important species with respect to biomass in the wind farm area in 2003. It was not recorded in the survey in 2004, which was considered as a coincidence without significant importance to the overall interpretation of the faunal distribution because of their mobile behaviour. Hermit crabs has been recorded in relatively small numbers on several occasions around the scour protection (Leonhard et al., 2004) and in the infauna surveys (Bech et al., 2004). *P. bernhardus* has adapted to live in gastropod shells with growing crabs moving to progressively larger shells.

Other species

With respect to biomass, the echinoderms were the fourth most important group with 3.0% of the biomass per m^2, representing less than 1% of the number of individuals. The small sea urchin *Echinocyamus pusillus*, one of the characteristic species of coarse sand habitats in the North Sea area, and the common starfish *Asterias rubens* have not been previously recorded in the infauna samples from the wind farm area before 2003.

3.3. Statistics

The use of multivariate techniques condenses large data matrices such as the list of species into a much more manageable form and compares data from each station and each survey with all other data in the process. This means that subtle trends in the data as a whole may be elucidated by multivariate analyses. Possible impact from the establishment of the wind farm on the infauna is measured as differences in community structure between the reference area and the wind farm area.

ANOSIM analysis	2001 Wind farm	2003 Reference	2003 Wind farm	2004 Reference	2004 Wind farm
2001. Wind farm		0.1**	1.7*	0.1**	0.4*
2003. Reference			15.2	75.6	7.8
2003. Wind farm				2.7*	0.6*
2004. Reference					5,3
2004. Wind farm					

Table 8. Level of significance (p<0.5, **p<0.1) in analysis of differences in community structure between different surveys and sample sites.*

The SIMPER test is an analysis of the species contributions to dissimilarity. Tables 9-11 list the highest contributions to the differences between the community structures of various areas and years.

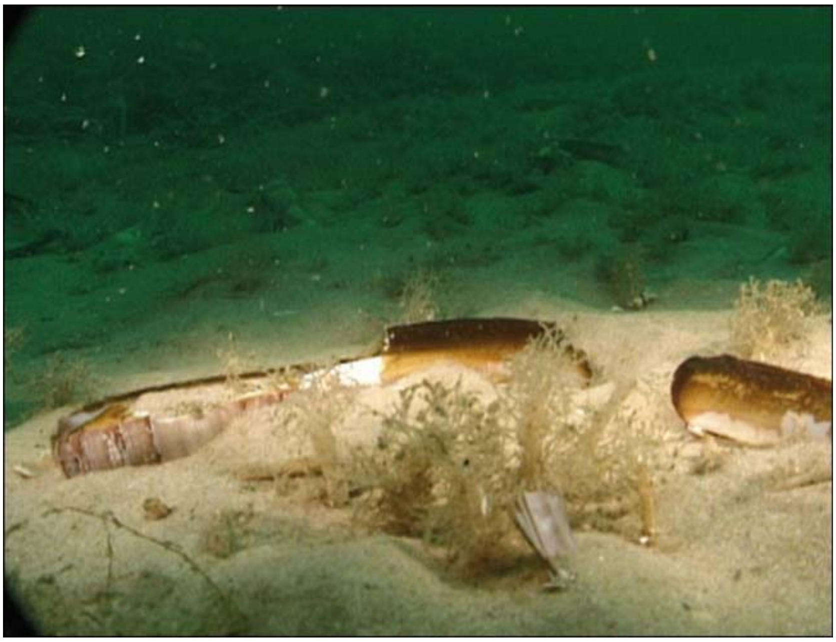


Photo 4. Ensis sp

Species	Abundance ind./m² Wind farm area 2001	Abundance ind./m² Wind farm area 2004	Contribution to dissimilarity (%)
Pisione remota	411.02	85.82	9.59
Goniadella bobretzkii	189.70	65.49	7.17
Goodallia triangularis	203.25	862.69	7.08
Nematoda indet.	121.95	6.78	5.98
Thracia phaseolina	45.17	58.72	5.34
Ophelia borealis	72.27	9.03	5.26
Spio filicornis	90.33	27.10	4.80
Spisula solida	36.13	13.55	4.08
Travisia forbesii	0.00	94.85	4.07
Mytilus edulis	49.68	29.36	4.05
Jassa marmorata	0.00	40.65	3.21

Table 9. The species contributing to the highest dissimilarity in community structure between the wind farm area in September 2001 and 2004.

The most dramatic change was the decline in abundance of *Pisione remota* and *Goniadella bobretzkii* from 2001 to 2004. Both species are bottom dwelling bristle worms and their decline could be a result of the increasing sediment grain size from 2001 to 2004 or predation from the increasing fish populations in the vicinity of the scour protection. Visual observations from divers and the use of biological survey nets indicate that the establishment of the wind farm or mainly scour protection has increased the abundance of fish in the area, which could result in increasing predation on the benthic fauna.

The increase from 203.25 ind./m^2 in 2001 to 862.69 ind./m^2 in 2004 of the suspension feeding bivalve *Goodallia triangularis* could also be caused by the change in sediment characteristics.

Species	Abundance ind./m² Wind farm area 2003	Abundance ind./m² Wind farm area 2004	Contribution to dissimilarity (%)
Goodallia triangularis	663.96	862.69	9.90
Goniadella bobretzkii	146.79	65.49	8.96
Thracia phaseolina	36.13	58.72	7.16
Travisia forbesii	9.03	94.85	5.95
Pisione remota	22.58	85.82	5.58
Jassa marmorata	40.65	40.65	5.36
Branchiostoma lanceolatum	27.10	15.81	4.39
Spio filicornis	20.33	27.10	4.34
Spisula solida	20.33	13.55	3.92
Orbinia sertulata	9.03	15.81	3.48
Mytilus edulis	6.78	29.36	3.39

Table 10. The species contributing to the highest dissimilarity in community structure between the wind farm area in September 2003 and September 2004.

Species	Abundance ind./m² Wind farm area 2004	Abundance ind./m² Reference area 2004	Contribution to dissimilarity (%)
Goodallia triangularis	862.69	616.53	14.77
Goniadella bobretzkii	65.49	33.88	8.49
Thracia phaseolina	58.72	20.33	7.39
Travisia forbesii	94.85	20.33	7.21
Jassa marmorata	40.65	20.33	6.19
Pisione remota	85.82	6.78	5.63
Orbinia sertulata	15.81	6.78	4.33
Mytilus edulis	29.36	6.78	4.25
Spio filicornis	27.10	13.55	4.04
Spisula solida	13.55	13.55	3.98
Gastrosaccus spinifer	24.84	6.78	3.54

Table 11. The species contributing to the highest dissimilarity in community structure between the wind farm area in September 2004 and the reference area in 2004.

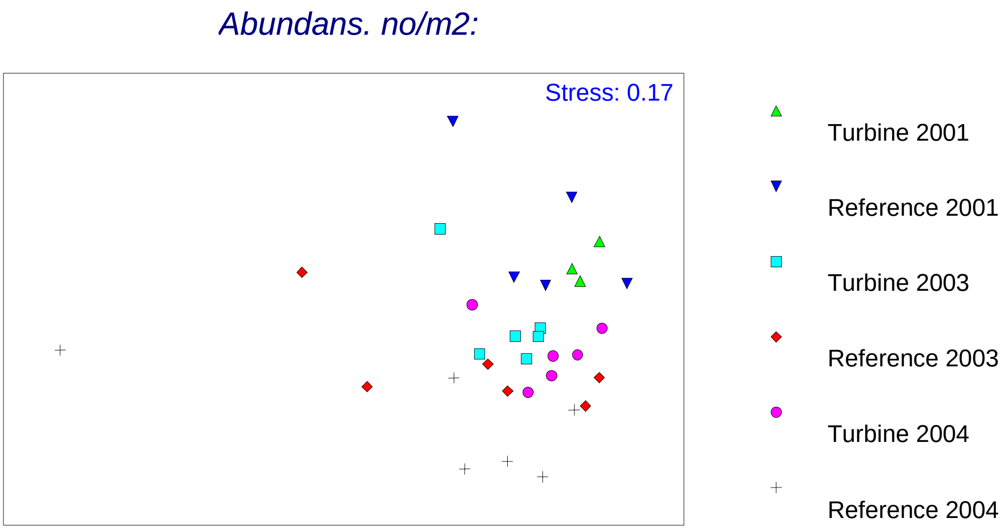


Figure 9. A multidimensional scaling (MDS) plot of the abundance of each species in the wind farm area (Turbine) in September 2001-September 2004 and in the reference area (Ref) in September2001-2004.

The graphic presentation (MDS) of the similarities between the wind farm area and the reference area in each of the 3 years clearly shows that the abundance of the organisms in 2003 and 2004 were different from 2001, see Figure 9[1]. It also shows that the wind farm

[1] A graphic presentation of the similarities as a Multi-Dimensional Scaling plot or MDS-plot is a complex mathematical method to construct a map of the samples in a certain number of dimensions. The purpose of the map is to place the samples on the map in accordance with the calculated distances in similarity. If sample A is more like sample B than C then A should be closer to B than to sample C.

area in 2003 was not different from 2004. Furthermore, it is evident that 4 stations in the reference area in 2004 were quite different from the other areas.

An important measurement of how well the original data is illustrated in 2 or 3 dimension MDS-plots is the stress factor. A stress factor of zero indicates that the similarities have been perfectly illustrated in the MDS-plot whereas a stress factor above 0.3 indicates that the MDS-plot illustrates coincidental positions.

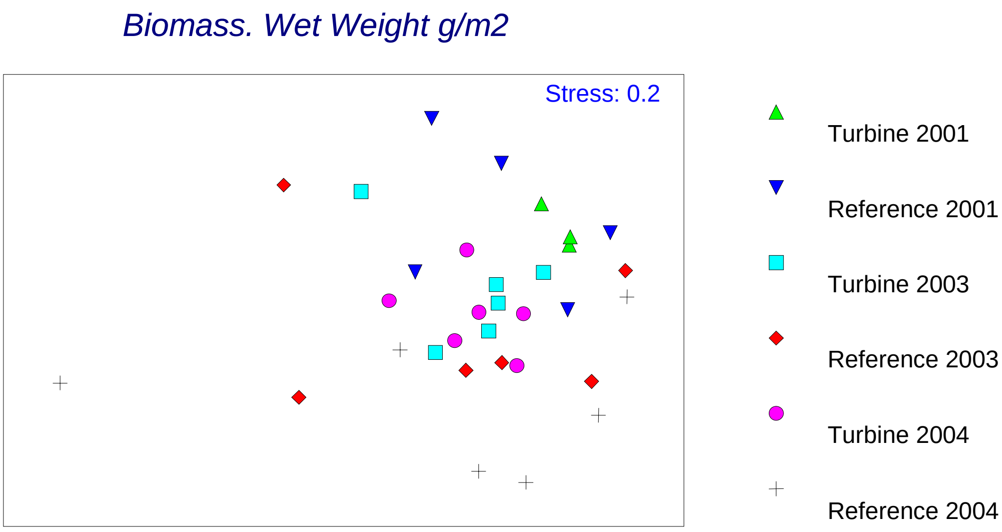


Figure 10. A multidimensional scaling (MDS) plot of the biomass of each species in the wind farm area (Turbine) in September 2001- September 2004 and in the reference area (Ref) in September 2001-2004.

Photo 5. A hermit crab (Pagurus bernhardus).

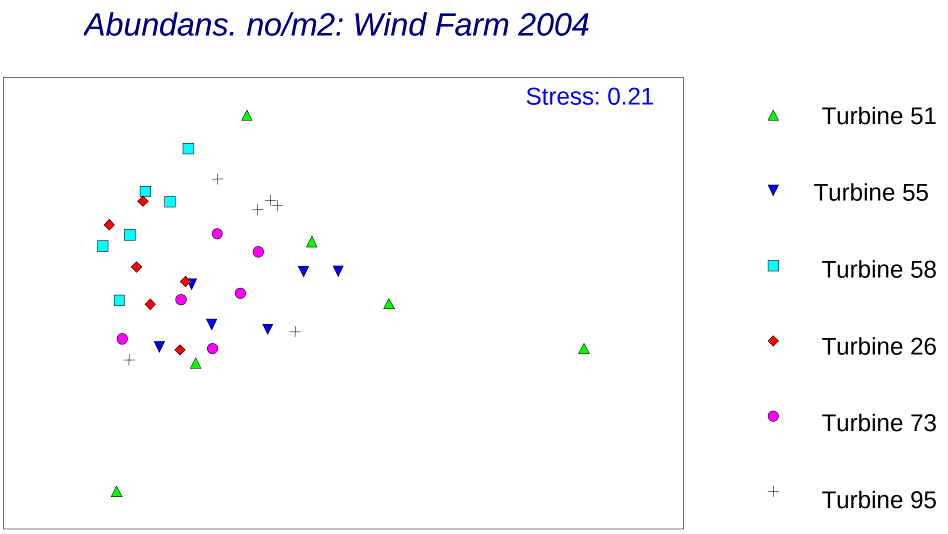


Figure 11. A multidimensional scaling (MDS) plot of the abundance of each species at turbine sites in September 2004.

At each turbine site, three stations were selected along a transect 5, 25 and 100 metres from the edge of the scour protection. A statistical analysis of the effect of distance showed no significant differences between the benthos communities related to the distance from the wind turbine foundations in both 2003 and 2004. A similar community structure was present 5, 25 and 100 metres from the foundation.

In September 2003 and 2004, the community structure at each of the individual six turbines was investigated using multidimensional scaling. The MDS test revealed that the samples from turbine 51 varied from the other samples in both years. The individual distances between each station on the MDS plot represents the relative difference between the stations. In Figure 11, the samples from turbines 55, 58, 26, 73 and 95 are grouped, whereas samples from turbine 51 are placed outside because the density of the main species was different.

3.3.1. Sediment

The sediment characteristics were clearly different in the wind farm area in September 2001 and 2004 and in the reference area in 2004, see Figure 12. The average medium grain size of the sediment in the wind farm area increased from 345 µm in September 2001 to 515 µm in September 2003 to 515 µm in September 2004. The sediment characteristics did not change significantly between 2003 and 2004 with respect to grain size.

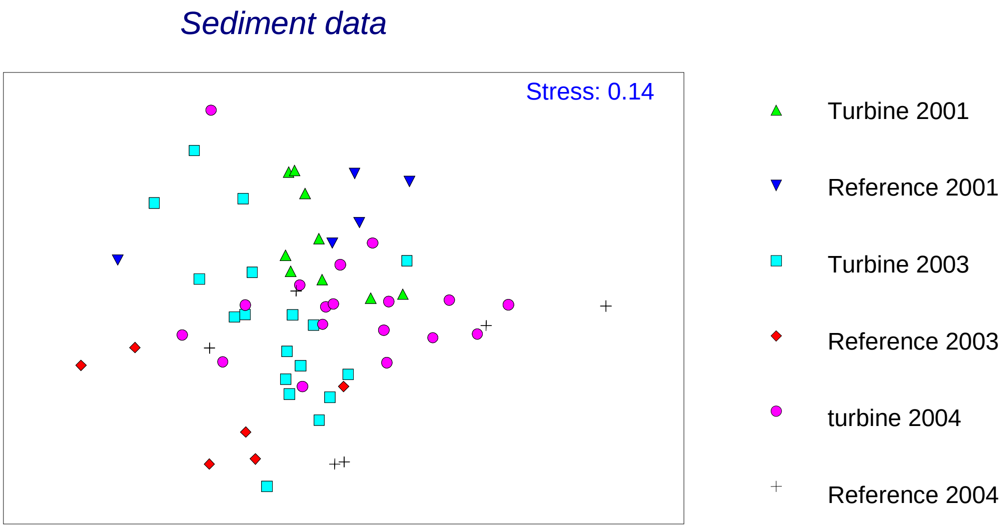


Figure 12. A multidimensional scaling (MDS) plot of the sediment characteristics in the wind farm (Turbine) and reference area (Ref) in September 2001, 2003 and 2004.

The box-plot (Figure 13) illustrates the median grain sizes from the sampling in September 2001, 2003 and 2004. The data from 2003 and 2004 has been reduced to the data from turbine 55, 58 and 95 because the sampling in September 2001 only included these 3 turbines. The dark band in the box plot illustrates the median and the box is the 75% and 25 % fractions. The bars illustrates the minimum and maximum values. The graph clearly illustrate the increasing avarage grain size and the increasing variation.

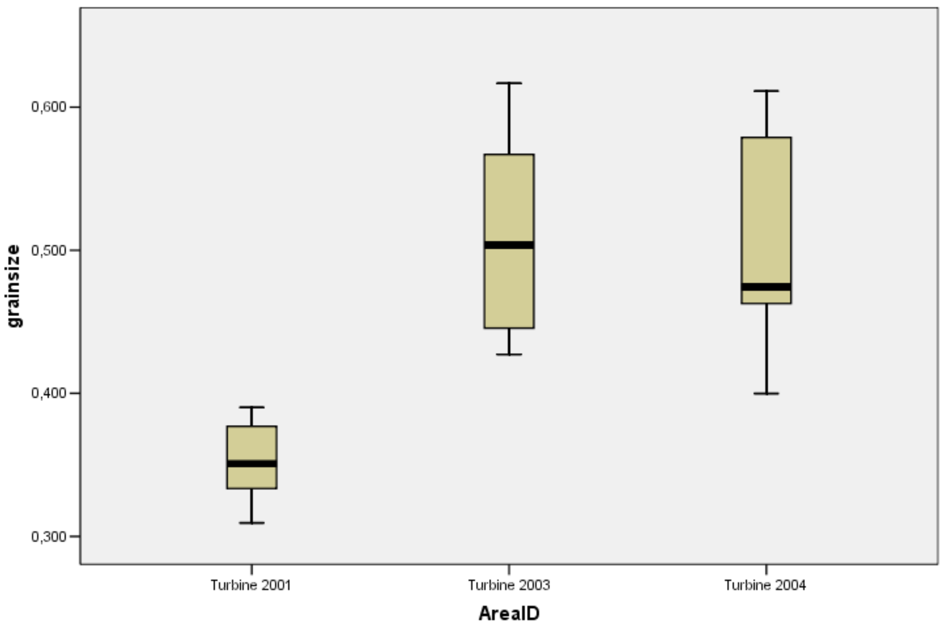


Figure 13. A box plot of the median grain size in the wind farm in September 2001, 2003 and 2004.

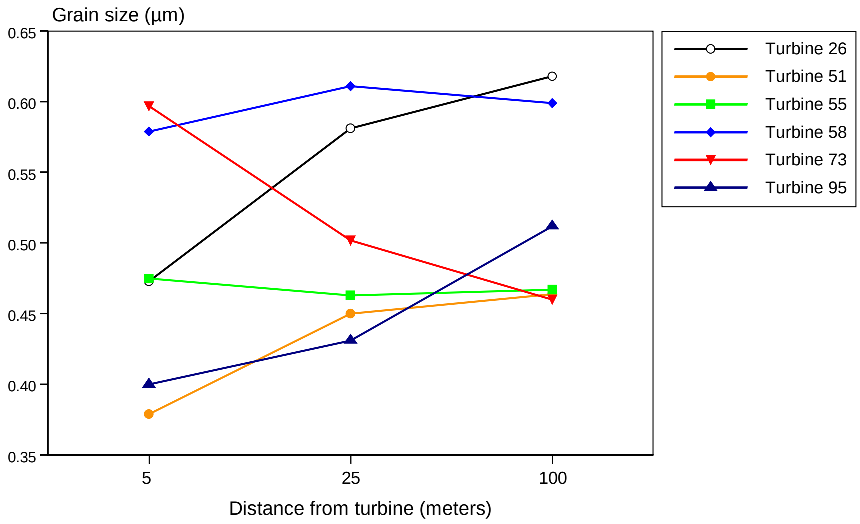


Figure 14.Median grain size in the wind farm in relation to distance from the turbine.

4. Discussion

The average medium grain size of the sediment in the wind farm area increased from 345 µm in September 2001 to 515 µm in September 2003 to 503 µm in September 2004. Increasing grain size suggests that the velocity of the current has increased either by occasional storm events, heavy shipping traffic or hydrodynamic changes due to the establishment of the wind farm. According to calculations based on modelling, the velocity of the current in the wind farm area will be reduced by a maximum of 2% in the area between the turbines (ELSAM, 2000). ELSAM (2000) also found that the current velocity could be reduced up to 15% in close vicinity of the scour protection because of turbulence. This assumption agreed with the grain sizes found at the stations 5, 25 and 100 metres from the scour protection. At most stations the medium grain size was 5 metres lower from the scour protection compared with the station 100 metres from the scour protection, which indicates that the velocity of the current was lower close to the scour protection (Figure 14).

In September 2004, the sediment grain size had declined to a range from 379-618 µm indicating that the transport of sediment caused by new current regimes had stabilised. Furthermore, the average grain size was 503 µm in both the reference and the wind farm areas in 2004 (Figure 13). Corresponding to the increase in particle size in the wind farm area from 2001 to 2003, a comparable increase in particle size was found for the reference area, which makes it unlikely that heavy shipping traffic during the construction phase was responsible for the recorded changes in sediment structure. It is important to note that Horns Rev is a highly dynamic environment with migrating bed forms and, therefore, an area with constant re-suspension and reworking of the sediment.

An extensive amount of literature exists on benthos surveys covering the North Sea in general (Kröncke & Bergfeld, 2001). The data sets from the DANA cruises 1932–1955 (Ursin, 1960; Kirkegaard, 1969; Petersen 1977) and the results of Birkett's (Birkett, 1953) survey are valuable historical baselines of the community structure of North Sea benthos but very few data are available from more regional shallow sandbank areas such as Horns Rev. Other studies on sublittoral sandbanks in the North Sea have shown that the fauna on the sandbanks is both variable and heterogeneous and that the fauna of these areas are difficult to compare with other sandbanks and adjoining deeper areas (Vanosmael et al. 1982; Salzwedel et al. 1985; Degraer et al. 1999). The benthos community at Horns Rev has a great similarity with the benthos communities described in other shallow coastal waters of the North Sea where the sediment consists of medium–coarse sand. The community in such areas can be described as the *Ophelia borealis* community (Dewarumez et al. 1992) or, more commonly accepted, as the *Goniadella-Spisula* community (Kingston & Rachor 1982; Salzwedel at al. 1985).

In 2001, results revealed that the following species could be used as indicator organisms of environmental changes in the wind farm area due to relative uniformity in dominance relations: *Pisione remota*, *Goodallia triangularis*, *Goniadella bobretzkii*, *Ophelia borealis*, *Orbinia sertulata* and *Nephtys longosetosa.* Although dominant in biomass, the character species *Spisula solida* showed a more aggregated distribution in 2001.

In September 2003, the surveyed area could also be characterised by the presence of character species like the bristle worm *Goniadella bobretzkii* and the mussels *Spisula solida* and *Goodallia triangularis* because they were the most important species in respect of abundance or biomass.

The main difference between the survey in 2001 and 2003 was the decline of the *Pisione remota* population from an average abundance of 411 ind./m^2 in 2001 to an average abundance of 22 ind./m^2 in 2003. In the same period, the population of *Goodallia triangularis* increased from an average of 203 ind./m^2 in September 2001 to an average of 663 ind./m^2 in 2003.

Molluscs were the most abundant group in 2003 and 2004 because more than 50% of the individuals were *Goodallia triangularis*, both in the wind farm and the reference area. In 2004, molluscs constituted 66.7% of the average number of individuals and 49.2% of the average biomass per m^2 in the wind farm and 82.5% of the abundance and 92.1% of the biomass in the reference area. In 2001, molluscs represented 82% of the total biomass in the total area.

In terms of abundance, the small bivalve *Goodallia triangularis* was the most numerous specie representing 57% of the total individuals found, but only less than 1% of the total biomass. The commercially important bivalve *Spisula solida*, which is a common species in the North Sea, constituted 77.4% of the biomass in the survey from September 2001, 33.7% in 2003 but only 3.3% of the biomass in the wind farm area in 2004. This dramatic decline did not occur in the reference area in 2004 where the biomass increased to 92.1% of the total biomass despite the fact that the abundance of *S. solida* in the reference area decreased from 27.1 ind./m^2 in 2003 to 13.6 ind./m^2 in 2004. The increase in biomass in the reference area should be considered as a coincidence because the occurrence of one large specimen of 142.95 grams at reference station 35 had unreasonable impact on the overall results. An average of 13.6 ind./m^2 of *S. solida* was found in both areas. In 2003, *S. spisula* was slightly more abundant with 20.3 ind./m^2 in the wind farm and 27.1 ind./m^2 in the reference area. In 2001, an average of 36 individuals or 231.9 g/m^2 of *S. solida* were found. The decline from 2003 to 2004 was based on a small number of specimens in both years and the high biomass in the reference area in 2004 was mainly caused by the presence of one large specimen. Recruitment of *Spisula solida* is often very irregular and this species has a preference to sediments of grain size 200-300 µm that might explain the decline in abundance (Sabatini, 2004).

The reverse development occurred with the bivalve *Thracia phaseolina* because the abundance increased from 36.1 ind./m^2 in 2003 to 58.7 ind./m^2 in the wind farm area in 2004 and decreased from 33.9 ind./m^2 to 20.3 ind./m^2 in the reference area in the same period.

A statistical ANOSIM analysis between the combined contribution of abundance from each species at the 18 stations in the wind farm compared to the six stations in the reference area showed no significant difference in September 2003 or in September 2004, but the level of significance between the two areas had increased from 2003 to 2004. The statistical analysis revealed a trend toward an increasing effect from the wind farm on the benthic community. The density of the eleven most common species was higher in the wind farm area compared to the reference area, which could be caused by increased predation from birds in the reference area compared to the wind farm area

During a survey on the bird populations around the wind farm in 2002 and 2003, the common scoter (*Melanitta nigra*) was found to be the most numerous species. Approximately 575,000 individuals of the common scoter were observed in 2003 (Petersen et al., 2004). The common scoter feeds mainly on the sea bottom by diving but it was observed during the bird surveys that they rarely feed inside the wind farm area (Petersen et al., 2004). Furthermore, the common scoters were observed trying to avoid flying between the wind turbines, which will influence where they settle and rest (Christensen et al., 2004). In general, the density of the most abundant bivalves and bristle worms was higher in the wind farm area indicating that the potential predation pressure from the huge amount of birds could contribute to increasing differences between the density of their favoured prey inside and outside the wind farm area. The contribution to dissimilarity of the abundance of the 10 most important species between the reference and the wind farm area were consistent with this theory, which indicates that the effect of bird predation might be detected. An indirect effect of an increased pressure from fish predation due to a ban against fishing inside the wind farm area is considered negligible as the fish attracted to the turbine foundations mainly forage on the foundations (Leonhard and Pedersen, 2005).

In terms of abundance, using a SIMPER and ANOSIM statistical analysis, a significant difference in community structure was found between the wind farm area in 2001 and both the reference and wind farm areas in September 2003 and 2004. A significant difference was also found if the same analysis was performed using biomass instead of abundance to express community structure. Significant changes were also found in community structure between the wind farm area in September 2003 and the wind farm area in September 2004 (p=0.6), but the reference area remained not significantly different from 2003 to 2004 with a highly convincing level of significance (p=75.5). The difference in abundance of the most common species in the wind farm area between 2003 and 2004 was caused by an increase in the most common species. Apparently the wind farm at Horns Rev might have an effect on the abundance of these species in that area from September 2003 to 2004.

The foundation and the turbine itself are modelled to result in minor reductions, less than 15%, in current speed within 5 metres from the edge of the scour protection of turbine foundations (Elsam, 2000). Changes in hydrodynamic regimes due to deployment of “artificial reefs” in the North Sea were found to have only a small impact on the infauna community very close to the reef (Leewis & Hallie, 2000). Statistical analysis of the correlation between the various sediment parameters and the abundance of the fauna in the wind farm area at Horns Rev was not significant and no significant impact on the fauna was detectable concerning distance-related effects.

Stress-induced changes in infaunal communities resulted in rather complex sequential shifts in species abundance and biomass interactions (Boesch & Rosenberg, 1981; Pearson, 1981). In general, few species that are high in abundance and low in biomass dominate in high-impacted areas, whereas more species in relatively lower abundance and biomass ratios characterise unstressed natural habitats. Differences in species abundance and biomass relations were not found between the wind farm area and the reference area at Horns Rev.

Although general reductions in population size of some of the character species in the surveyed areas might be related to the changes in sediment structure, more data sets on sediment characteristics and species abundance relations are required for more detailed analysis and conclusions. The infaunal community at Horns Rev shows no obvious sign of stress response, but longer time series analysis must be established to monitor possible impact as a result of the construction and operating activities.

The crustaceans *Jassa marmorata* and *Caprella linearis*, typically associated with hard substrate habitats, were found dominating the epifouling communities at the wind turbine foundations and turbine towers in 2003 with abundances over 1,200,000 ind./m^2 (Leonhard and Pedersen, 2005). Patches of small stones or shell assemblages on the seabed between the wind turbine sites are easily colonised by these epifaunal species drifting from the turbine foundations. It is most likely that *J. marmorata* cannot build tubes and establish itself on the sandy bottom. The presence of *J. marmorata* and other epifouling species found on the seabed was presumably caused by drifting organisms caught by the current at the foundations or the occurrence of small stones or shells colonised by epifouling species. In 2004, *J. marmorata* was even found in the reference area indicating that the “drifting” effect is more distinct than anticipated.

5. Conclusion

The wind farm area and the reference area are characterised by bottom conditions that are relatively uniform with sediments consisting of pure medium-fine sand with no organic matter. The mean particle size increased from 345 µm in 2001 to 515µm in September 2003 in both the reference and the wind farm area. But in September 2004, the mean sediment grain size had declined to 503µm verifying the very shifting current regimes and shifting sediment transportation relations in the Horns Rev area. The particle size of the sediment in the reference area was not different from the wind farm in 2004.

There was no significant difference in benthos community structure related to the distance from the wind turbine foundations in 2003 or in 2004.

The main difference between the survey in 2001 and 2004 was the decline of the *Pisione remota* and *Goniadella bobretzkii* populations and the massive increase of the *Goodallia triangularis* population.

New species were introduced in 2003 and 2004. The occurrence of some of these might be a result of changes in sediment characteristics. Others may be a result of the introduction of hard bottom habitants in the wind farm area.

The statistical analysis indicated a trend toward an increasing effect from the wind farm on the community, because the abundance of the eleven most common species was higher in the wind farm area compared to the reference area, despite the observations of increasing fish populations in the wind farm area.

In general, the abundance of the most abundant bivalves and bristle worms was higher in the wind farm area indicating that the potential predation pressure from birds could contribute to increasing differences between the densities of their favoured prey because they mainly feed outside the wind farm area.

In general, the abundance of the most common species increased in the wind farm area between 2003 and 2004 whereas the reference area remained unchanged from 2003 to 2004.

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Appendices

Appendix 1. List of positions

Sampling was performed at the following locations presented. Positions and actual depth are registered at the position by the sampling vessel.

Location	"WGS84_MIN_Y"	WGS84_MIN_X"	Depth (app. m)
M26_005	07°49.220'	55°28.717'	8.4
M26_025	07°49.227'	55°28.727'	8.6
M26_100	07°49.251'	55°28.765'	8.4
M51_005	07°50.447'	55°30.227'	8.1
M51_025	07°50.454'	55°30.237'	9.0
M51_100	07°50.478'	55°30.275'	8.6
M55_005	07°50.742'	55°29.031'	10,0
M55_025	07°50.748'	55°29.041'	9.2
M55_100	07°50.772'	55°29.079'	9.5
M58_005	07°50.962'	55°28.134'	8.2
M58_025	07°50.969'	55°28.144'	8.6
M58_100	07°50.993'	55°28.182'	8.5
M73_005	07°51.658'	55°29.639'	7.9
M73_025	07°51.665'	55°29.649'	7.8
M73_100	07°51.689'	55°29.687'	8.1
M95_005	07°52.868'	55°29.051'	8.2
M95_025	07°52.874'	55°29.061'	9.2
M95_100	07°52.899'	55°29.099'	8.7
Reference 1	07°46.640'	55°30.070'	9.4
Reference 7	07°47.320'	55°29.480'	8.2
Reference 35	07°53.080'	55°27.730'	8.7
Reference 36	07°53.030'	55°30.130'	6.1
Reference 37	07°53.170'	55°29.530'	6.2
Reference 40	07°53.610'	55°27.740'	9.2

Appendix 2. Meteorological and hydrographical data

Location	Date	Current		Wind		Secchi depth m	Wave height	Adjusted Sec-chi depth m
		Direction	m/sec	Direction	m/sec			
M26_005	20904	SSW	0.75	S	3-4	4.5	0.75	5.9
M26_025	20904	SSW	0.75	S	3-4	4.5	0.75	5.9
M26_100	20904	SSW	0.75	S	3-4	4.5	0.75	5.9
M51_005	20904	SSW	0.75	SW	4-5	4.2	1.0	5.9
M51_025	20904	SSW	0.75	SW	4-5	4.2	1.0	5.9
M51_100	20904	SSW	0.75	SW	4-5	4.2	1.0	5.9
M55_005	30904	NNE	0.05	SW	5-6	4.5	1.5	7.2
M55_025	30904	NNE	0.05	SW	5-6	4.5	1.5	7.2
M55_100	30904	NNE	0.05	SW	5-6	4.5	1.5	7.2
M58_005	20904	SSW	1.0	S	2-3	4.5	0.75	5.9
M58_025	20904	SSW	1.0	S	2-3	4.5	0.75	5.9
M58_100	20904	SSW	1.0	S	2-3	4.5	0.75	5.9
M73_005	30904	SSW	0.05	SW	4-5	4.5	1.0	6.3
M73_025	30904	SSW	0.05	SW	4-5	4.5	1.0	6.3
M73_100	30904	SSW	0.05	SW	4-5	4.5	1.0	6.3
M95_005	30904	SSW	0.75	SSW	3-4	4.5	0.75	5.9
M95_025	30904	SSW	0.75	SSW	3-4	4.5	0.75	5.9
M95_100	30904	SSW	0.75	SSW	3-4	4.5	0.75	5.9
Reference 1	20904	SSW	0.25	SW	4-5	4.5	1.5	7.2
Reference 7	20904	SW	0.5	SW	4-5	4.4	0.5	5.3
Reference 35	20904	SSW	1.25	S	3-4	4.4	0.75	5.7
Reference 36	30904	SSW	1.25	S	5-6	4.5	1.25	6.8
Reference 37	30904	SSW	1.25	S	4-5	4.5	1.5	7.2
Reference 40	20904	SSW	1.25	S	3-4	4.5	0.75	5.9

Appendix 3. Sediment characteristics. Content of dry matter and organic matter

Horns Rev **Sediment characteristics September 2004**

Station	Water content	Loss of combustion		
			DS 204	
			Loss of combustion	
StatID	Water content %	Dry matter %	Organics %	Rest %
M26_005	12.4	87.6	0.19	99.81
M26_025	8.4	91.6	0.24	99.76
M26_100	6.8	93.2	0.23	99.77
M51_005	14.4	85.6	0.24	99.76
M51_025	11.2	88.8	0.26	99.74
M51_100	12.0	88.0	0.21	99.79
M55_005	14.3	85.7	0.42	99.58
M55_025	10.6	89.4	0.13	99.87
M55_100	13.0	87.0	0.22	99.78
M58_005	7.5	92.5	0.18	99.82
M58_025	9.3	90.7	0.21	99.79
M58_100	11.1	88.9	0.17	99.83
M73_005	13.9	86.1	0.22	99.78
M73_025	10.2	89.8	0.22	99.78
M73_100	16.2	83.8	0.19	99.81
M95_005	17.1	82.9	0.23	99.77
M95_025	9.9	90.1	0.26	99.74
M95_100	12.0	88.0	0.26	99.74
Ref. 01	12.9	87.1	0.17	99.83
Ref. 07	15.8	84.2	0.16	99.84
Ref. 35	7.7	92.3	0.11	99.89
Ref. 36	13.0	87.0	0.15	99.85
Ref. 37	13.2	86.8	0.14	99.86
Ref. 40	4.2	95.8	0.11	99.89
Mean	**11.5**	**88.5**	**0.2**	**99.8**

Appendix 4. Grain size of sediments in September 2004

		Median grain size
Station	Depth	50% percentile
M26_005	8.4	0.473
M26_025	8.6	0.581
M26_100	8.4	0.618
M51_005	8.1	0.379
M51_025	9.0	0.450
M51_100	8.6	0.464
M55_005	10.0	0.475
M55_025	9.2	0.463
M55_100	9.5	0.467
M58_005	8.2	0.579
M58_025	8.6	0.611
M58_100	8.5	0.599
M73_005	7.9	0.597
M73_025	7.8	0.502
M73_100	8.1	0.460
M95_005	8.2	0.400
M95_025	9.2	0.431
M95_100	8.7	0.512
Ref. 01	9.4	0.433
Ref. 07	8.2	0.385
Ref. 35	8.7	0.513
Ref. 36	6.1	0.543
Ref. 37	6.2	0.556
Ref. 40	9.2	0.591
Average reference area	8.6	0.503
Average wind farm	8.0	0.503

Appendix 5. Benthos. Complete list of species 2001-2004.

Wind farm area (Turbine), Reference area (Ref.)

Gruppe	Art	Author	2001	2003	2003	2004	2004	Common danish name	Common English name
HYDROZOA			Turbi	Ref.	Turbi	Ref.	Turbi	**Polypdyr**	**Hydroids**
	Tubularia indivisa				x				
	Hydractinia echinata	Fleming	x	x	x				
	Campanulariidae indet.				x		x		
ANTHOZOA								**Søanemoner**	**Sea anemones**
	Actiniaria indet.				x		x		
NEMERTINI								**Slimbændler**	**Ribbon worms**
	Nemertini indet.		x	x	x	x	x		
NEMATODA									
	Nematoda indet.		x		x		x	**Rundorme**	**Nematodes**
POLYCHAETA									
	Polychaeta indet.		x					**Havbørsteorme**	**Bristle worms**
	Pisione remota	(Southern)	x	x	x	x	x		
	Eulalia viridis	(L.)	x						
	Nephtys caeca	(Fabricius)		x	x		x		
	Nephtys longosetosa	Ørsted	x						
	Nephtys sp.			x	x				
	Glycera alba	(O.F. Müller)					x		
	Goniadella bobretzkii	(Annenkova)	x	x	x	x	x		
	Scoloplos armiger	O.F. Müller	x				x		
	Orbinia sertulata	(Savigny)		x	x	x	x		
	Spionidae indet.						x		
	Spio filicornis	(O.F. Müller)	x	x	x	x	x		
	Aonides paucibranchiata	Southern					x		
	Scolelepis bonnieri	Mesnil	x				x		
	Euzonus flabelligerus	(Ziegelmeier)		x		x			
	Travisia forbesii	Johnston	x	x	x	x	x		
	Ophelia borealis	Quatrefages	x	x	x		x		
	Polygordius appendiculatus	Fraipont		x	x		x		
	Arenicola marina	(L.)			x			Sandorm	Blow lug
	Lanice conchilega	(Pallas)		x					
HYDRACARINA								**Vandmider**	**Mites**
	Halacaridae indet.				x				
COPEPODA								**Vandlopper**	**Copepods**
	Cyclopoida indet.		x						
	Harpacticoida indet.		x		x		x		
CUMACEA								**Kommakrebs**	**Cumaceans**
	Diastylis sp.		x						
	Pseudocuma longicornis	Bate	x						
CIRRIPEDIA								**Rurer**	**Barnacles**
	Balanus sp.		x						
DECAPODA								**Tibenede krebsdyr**	**Shrimps, Crabs & Lobsters**
	Crangon crangon	L.		x		x	x	Hestereje	Brown shrimp
	Liocarcinus pusillus	(Leach)			x			Svømmekrabbe	Habour crab
	Pagurus bernhardus	L.	x	x	x			Eremitkrebs	Hermit crab
MYSIDACEA								**Mysider**	**Opossum shrimps**
	Mysidacea indet.		x				x		
	Gastrosaccus spinifer	Göes	x			x	x		
AMPHIPODA								**Tanglopper**	**Sand hoppers**
	Bathyporeia guilliamsoniana	Bate	x				x		
	Bathyporeia sp.						x		
	Haustorius arenarius	Slabber	x		x				
	Eurysteus nitida	(Stimpson)	x						
	Metopa sp.		x						
	Stenothoe sp.		x						
	Pontocrates arenarius	Bate	x	x	x	x	x		
	Pontocrates sp.		x						
	Westwoodilla caecula	Bate	x						
	Jassa marmorata	Holmes			x	x	x		
	Atylus swammerdami	Milne-Edwards	x				x		
	Caprella linearis	L.			x				
GASTROPODA								**Snegle**	**Snails**
	Hydrobia ulvae	Montagu				x	x		
	Crepidula fornicata	(L.)			x			Tøffelsnegl	Slipper limpet
	Polinices polianus	(delle Chiaje)	x	x	x	x	x		
BIVALVIA								**Muslinger**	**Mussels**
	Bivalvia indet.		x	x					
	Mytilus edulis	L.	x	x	x	x	x	Blåmusling	Common Mussel
	Goodallia triangularis	(Montagu	x	x	x	x	x		
	Spisula elliptica	(Brown)			x				
	Spisula solida	(L.)	X	x	x	x	x	Tykskallet trugmusling	Thick trough shell
	Angulus tenuis	(Da Costa)			x			Alm. Tallerkenmusling	Thin Tellin
	Arctica islandica	(L.)	X						
	Chamelea gallina	(L.)					x		
	Thracia phaseolina	(Lamarck)	X	x	x	x	x	Papirmusling	
	Ensis ensis	(L.)		x				Sværdskedemusling	Razor shell
BRYOZOA								**Mosdyr**	**Bryozoans**
	Bryozoa indet.				x				
	Electra pilosa	(L.)	X				x		
ECHINODERMATA								**Pighude**	**Echinoderms**
	Asterias rubens	L.			x		x	Alm. søstjerne	Common starfish
	Ophiura albida	Forbes					x		
	Ophiura ophiura			x					
	Echinocyamus pusillus	O.F. Müller			x		x		
	Echinocardium cordatum	(Pennant)					x		
CHAETOGHNATHA								**Pilorme**	**Arrow worms**
	Sagitta sp.		x						
CORDATA								**Trævlemunde**	**Cephalocordata**
	Branchiostoma lanceolatum	(Pallas)	x	x	x		x	Lancetfisk	Amphioxus

Appendix 6. Benthos. Abundance

Appendix 6.1. Total mean abundance

Abundance, number/m²		Total		
		no./m²	Kol Sum %	N
HYDROZOA	Campanulariidae indet.	3.39	.3%	48
ANTHOZOA	Actiniaria indet.	1.69	.1%	48
NEMERTINI	Nemertini indet.	8.47	.6%	48
NEMATODA	Nematoda indet.	5.08	.4%	48
POLYCHAETA	Pisione remota	66.06	5.1%	48
	Nephtys caeca	5.08	.4%	48
	Glycera alba	1.69	.1%	48
	Goniadella bobretzkii	57.59	4.4%	48
	Scoloplos armiger	1.69	.1%	48
	Orbinia sertulata	13.55	1.0%	48
	Spionidae indet.	6.78	.5%	48
	Spio filicornis	23.71	1.8%	48
	Aonides paucibranchiata	1.69	.1%	48
	Scolelepis bonnieri	1.69	.1%	48
	Euzonus flabelligerus	1.69	.1%	48
	Travisia forbesii	76.22	5.8%	48
	Ophelia borealis	6.78	.5%	48
	Polygordius appendiculatus	5.08	.4%	48
CRUSTACEA	Harpacticoida indet.	3.39	.3%	48
	Crangon crangon	5.08	.4%	48
	Mysidacea indet.	1.69	.1%	48
	Gastrosaccus spinifer	20.33	1.6%	48
	Bathyporeia guilliamsoniana	6.78	.5%	48
	Bathyporeia sp.	6.78	.5%	48
	Pontocrates arenarius	6.78	.5%	48
	Jassa marmorata	35.57	2.7%	48
	Atylus swammerdami	1.69	.1%	48
GASTROPODA	Hydrobia ulvae	6.78	.5%	48
	Polinices polianus	6.78	.5%	48
BIVALVIA	Mytilus edulis	23.71	1.8%	48
	Goodallia triangularis	801.15	61.3%	48
	Spisula solida	13.55	1.0%	48
	Chamelea gallina	1.69	.1%	48
	Thracia phaseolina	49.12	3.8%	48
BRYOZOA	Electra pilosa	6.78	.5%	48
ECHINODERMATA	Asterias rubens	1.69	.1%	48
	Ophiura albida	1.69	.1%	48
	Echinocyamus pusillus	3.39	.3%	48
	Echinocardium cordatum	1.69	.1%	48
CHORDATA	Branchiostoma lanceolatum	11.86	.9%	48

Appendix 6.2. Mean abundance. Wind farm area – reference area

Abundance - 4 years: Year

		Sampling area											
		Wind Farm area						Reference area					
		2001		2003		2004		1999		2003		2004	
		Campaign		Campaign		Campaign		Campaign		Campaign		Campaign	
		Autumn		Autumn		Autumn		Spring		Autumn		Autumn	
Abundance, number/m²		Mean	Relative %	Mean	Relative %	Mean	Relative %	Mean	Relative %	Mean	Relative %	Mean	Relative %
HYDROZOA	Hydractinia echinata	225,84	12,1%	2,26	,2%	.	.	13,55	,5%	6,78	,6%	.	.
	Campanulariidae indet.	.	.	4,52	,4%	4,52	,3%	.	.	.	.	.	.
	Tubularia indivisa	.	.	2,26	,2%	.	.	.	.	.	.	.	.
ANTHOZOA	Actiniaria indet.	.	.	2,26	,2%	2,26	,2%	.	.	.	.	.	.
GOPLER	Beroe cucumis	.	.	.	.	.	.	13,55	,5%	.	.	.	.
NEMERTINI	Nemertini indet.	27,10	1,4%	4,52	,4%	9,03	,6%	40,65	1,6%	13,55	1,2%	6,78	,8%
NEMATODA	Nematoda indet.	121,95	6,5%	4,52	,4%	6,78	,5%	40,65	1,6%	.	.	.	.
POLYCHAETA	Protodorvillea kefersteini	.	.	.	.	.	.	440,38	17,0%	.	.	.	.
	Pisione remota	411,02	22,0%	22,58	2,0%	85,82	5,8%	691,06	26,7%	13,55	1,2%	6,78	,8%
	Goniadella bobretzkii	189,70	10,1%	146,79	12,9%	65,49	4,5%	338,75	13,1%	149,05	12,7%	33,88	4,2%
	Travisia forbesii	.	.	9,03	,8%	94,85	6,5%	155,83	6,0%	20,33	1,7%	20,33	2,5%
	Ophelia borealis	72,27	3,9%	11,29	1,0%	9,03	,6%	149,05	5,8%	13,55	1,2%	.	.
	Spio filicornis	90,33	4,8%	20,33	1,8%	27,10	1,8%	27,10	1,0%	40,65	3,5%	13,55	1,7%
	Orbinia sertulata	.	.	9,03	,8%	15,81	1,1%	101,63	3,9%	13,55	1,2%	6,78	,8%
	Nephtys hombergii	.	.	.	.	.	.	20,33	,8%	.	.	.	.
	Nephtys longosetosa	4,52	,2%	.	.	.	.	33,88	1,3%	.	.	.	.
	Scolelepis bonnieri	36,13	1,9%	.	.	2,26	,2%	6,78	,3%	.	.	.	.
	Nephtys sp,	.	.	15,81	1,4%	.	.	6,78	,3%	13,55	1,2%	.	.
	Eulalia viridis	9,03	,5%	.	.	.	.	.	.	.	.	.	.
	Spionidae indet.	.	.	.	.	9,03	,6%	.	.	.	.	.	.
	Polygordius appendiculatus	.	.	13,55	1,2%	6,78	,5%	.	.	6,78	,6%	.	.
	Nephtys caeca	.	.	4,52	,4%	6,78	,5%	.	.	13,55	1,2%	.	.
	Pholoe sp.	.	.	.	.	.	.	6,78	,3%	.	.	.	.
	Magelona mirabilis	.	.	.	.	.	.	6,78	,3%	.	.	.	.
	Euzonus flabelligerus	.	.	.	.	.	.	.	.	6,78	,6%	6,78	,8%
	Lanice conchilega	.	.	.	.	.	.	.	.	6,78	,6%	.	.
	Polychaeta indet.	4,52	,2%	.	.	.	.	.	.	.	.	.	.
	Arenicola marina	.	.	4,52	,4%	.	.	.	.	.	.	.	.
	Scoloplos armiger	4,52	,2%	.	.	2,26	,2%	.	.	.	.	.	.
	Glycera alba	.	.	.	.	2,26	,2%	.	.	.	.	.	.
	Aonides paucibranchiata	.	.	.	.	2,26	,2%	.	.	.	.	.	.
	Glycera sp.	.	.	.	.	.	.	.	.	.	.	.	.
	Polygordius sp.	.	.	.	.	.	.	.	.	.	.	.	.
HYDROCARINA	Halacaridae indet,	.	.	2,26	,2%	.	.	.	.	.	.	.	.
CRUSTACEA	Balanus sp.	135,50	7,2%	.	.	.	.	.	.	.	.	.	.
	Metopidae indet.	.	.	.	.	.	.	40,65	1,6%	.	.	.	.
	Cyclopoida indet.	36,13	1,9%	.	.	.	.	.	.	.	.	.	.
	Jassa marmorata	.	.	40,65	3,6%	40,65	2,8%	.	.	.	.	20,33	2,5%
	Haustorius arenarius	4,52	,2%	2,26	,2%	.	.	47,43	1,8%	.	.	.	.
	Westwoodilla caecula	18,07	1,0%	.	.	.	.	.	.	.	.	.	.
	Pontocrates arenarius	4,52	,2%	6,78	,6%	6,78	,5%	47,43	1,8%	20,33	1,7%	6,78	,8%
	Gastrosaccus spinifer	13,55	,7%	.	.	24,84	1,7%	.	.	.	.	6,78	,8%
	Crangon crangon	.	.	.	.	2,26	,2%	13,55	,5%	6,78	,6%	13,55	1,7%
	Bathyporeia sp.	.	.	.	.	9,03	,6%	.	.	.	.	.	.
	Eurysteus nitida	4,52	,2%	.	.	.	.	13,55	,5%	.	.	.	.
	Pontocrates sp.	9,03	,5%	.	.	.	.	.	.	.	.	.	.
	Caprella linearis	.	.	9,03	,8%	.	.	.	.	.	.	.	.
	Harpacticoida indet.	4,52	,2%	11,29	1,0%	4,52	,3%	13,55	,5%	.	.	.	.
	Carcinus maenas	.	.	.	.	.	.	6,78	,3%	.	.	.	.
	Pagurus bernhardus	4,52	,2%	2,26	,2%	.	.	13,55	,5%	6,78	,6%	.	.
	Bathyporeia guilliamsoniana	4,52	,2%	.	.	9,03	,6%	.	.	.	.	.	.
	Oedicerotidae indet.	.	.	.	.	.	.	6,78	,3%	.	.	.	.
	Mysidacea indet.	9,03	,5%	.	.	2,26	,2%	.	.	.	.	.	.
	Atylus swammerdami	9,03	,5%	.	.	2,26	,2%	.	.	.	.	.	.
	Diastylis sp.	4,52	,2%	.	.	.	.	.	.	.	.	.	.
	Pseudocuma longicornis	4,52	,2%	.	.	.	.	.	.	.	.	.	.
	Metopa sp.	4,52	,2%	.	.	.	.	.	.	.	.	.	.
	Stenothoe sp.	4,52	,2%	.	.	.	.	.	.	.	.	.	.
	Liocarcinus pusillus	.	.	2,26	,2%	.	.	.	.	.	.	.	.
GASTROPODA	Polinices polianus	9,03	,5%	11,29	1,0%	6,78	,5%	6,78	,3%	6,78	,6%	6,78	,8%
	Hydrobia ulvae	.	.	.	.	6,78	,5%	.	.	.	.	6,78	,8%
	Crepidula fornicata	.	.	2,26	,2%	.	.	.	.	.	.	.	.
BIVALVIA	Goodallia triangularis	203,25	10,9%	663,96	58,3%	862,69	58,7%	237,13	9,2%	630,08	53,8%	616,53	75,8%
	Ensis ensis	.	.	.	.	.	.	.	.	60,98	5,2%	.	.
	Thracia phaseolina	45,17	2,4%	36,13	3,2%	58,72	4,0%	.	.	33,88	2,9%	20,33	2,5%
	Arctica islandica	31,62	1,7%	.	.	.	.	.	.	.	.	.	.
	Spisula solida	36,13	1,9%	20,33	1,8%	13,55	,9%	33,88	1,3%	27,10	2,3%	13,55	1,7%
	Mytilus edulis	49,68	2,7%	6,78	,6%	29,36	2,0%	.	.	13,55	1,2%	6,78	,8%
	Bivalvia indet,	4,52	,2%	.	.	.	.	.	.	13,55	1,2%	.	.
	Fabulina fabula	.	.	.	.	.	.	6,78	,3%	.	.	.	.
	Angulus tenuis	.	.	2,26	,2%	.	.	.	.	.	.	.	.
	Chamelea gallina	.	.	.	.	2,26	,2%	.	.	.	.	.	.
	Spisula elliptica	.	.	,00	,0%	.	.	.	.	.	.	.	.
BRYOZOA	Electra pilosa	4,52	,2%	.	.	9,03	,6%	.	.	.	.	.	.
	Bryozoa indet,	.	.	2,26	,2%	.	.	.	.	.	.	.	.
ECHINODERMATA	Ophiura ophiura	.	.	.	.	.	.	.	.	6,78	,6%	.	.
	Asterias rubens	.	.	6,78	,6%	2,26	,2%	.	.	.	.	.	.
	Echinocyamus pusillus	.	.	4,52	,4%	4,52	,3%	.	.	.	.	.	.
	Ophiura albida	.	.	.	.	2,26	,2%	.	.	.	.	.	.
	Echinocardium cordatum	.	.	.	.	2,26	,2%	.	.	.	.	.	.
CHAETOGHNATHA	Sagitta sp.	4,52	,2%	.	.	.	.	.	.	.	.	.	.
CHORDATA	Branchiostoma lanceolatum	9,03	,5%	27,10	2,4%	15,81	1,1%	6,78	,3%	27,10	2,3%	.	.

Appendix 6.3. Mean abundance. Total distance

		Sampling area							
		Wind Farm area						Reference area	
		Campaign						Campaign	
		Autumn 2004						Autumn 2004	
		Distance (m)						Distance (m)	
		5		25		100		Reference	
Abundance, number/m²		no./m²	Kol Sum %	no./m²	Kol Sum %	no./m²	Kol Sum %	no./m²	Kol Sum %
HYDROZOA	Campanulariidae indet.	.	.	.	.	13.55	1.1%	.	.
ANTHOZOA	Actiniaria indet.	6.78	.4%	.	.	.	.	.	.
NEMERTINI	Nemertini indet.	13.55	.9%	13.55	.9%	.	.	6.78	.8%
NEMATODA	Nematoda indet.	.	.	6.78	.4%	13.55	1.1%	.	.
POLYCHAETA	Pisione remota	115.18	7.4%	47.43	3.0%	94.85	7.4%	6.78	.8%
	Nephtys caeca	6.78	.4%	13.55	.9%	.	.	.	.
	Glycera alba	6.78	.4%	.	.	.	.	.	.
	Goniadella bobretzkii	54.20	3.5%	67.75	4.3%	74.53	5.9%	33.88	4.2%
	Scoloplos armiger	.	.	6.78	.4%	.	.	.	.
	Orbinia sertulata	27.10	1.7%	13.55	.9%	6.78	.5%	6.78	.8%
	Spionidae indet.	.	.	20.33	1.3%	6.78	.5%	.	.
	Spio filicornis	40.65	2.6%	33.88	2.1%	6.78	.5%	13.55	1.7%
	Aonides paucibranchiata	6.78	.4%	.	.	.	.	.	.
	Scolelepis bonnieri	6.78	.4%	.	.	.	.	.	.
	Euzonus flabelligerus	.	.	.	.	.	.	6.78	.8%
	Travisia forbesii	101.63	6.5%	88.08	5.6%	94.85	7.4%	20.33	2.5%
	Ophelia borealis	13.55	.9%	6.78	.4%	6.78	.5%	.	.
	Polygordius appendiculatus	.	.	13.55	.9%	6.78	.5%	.	.
CRUSTACEA	Harpacticoida indet.	6.78	.4%	6.78	.4%	.	.	.	.
	Crangon crangon	.	.	.	.	6.78	.5%	13.55	1.7%
	Mysidacea indet.	.	.	6.78	.4%	.	.	.	.
	Gastrosaccus spinifer	33.88	2.2%	13.55	.9%	27.10	2.1%	6.78	.8%
	Bathyporeia guilliamsoniana	20.33	1.3%	6.78	.4%	.	.	.	.
	Bathyporeia sp.	27.10	1.7%	.	.	.	.	.	.
	Pontocrates arenarius	.	.	13.55	.9%	6.78	.5%	6.78	.8%
	Jassa marmorata	60.98	3.9%	27.10	1.7%	33.88	2.7%	20.33	2.5%
	Atylus swammerdami	.	.	6.78	.4%	.	.	.	.
GASTROPODA	Hydrobia ulvae	.	.	6.78	.4%	13.55	1.1%	6.78	.8%
	Polinices polianus	20.33	1.3%	.	.	.	.	6.78	.8%
BIVALVIA	Mytilus edulis	13.55	.9%	27.10	1.7%	47.43	3.7%	6.78	.8%
	Goodallia triangularis	846.88	54.3%	1016.26	64.4%	724.93	56.9%	616.53	75.8%
	Spisula solida	6.78	.4%	13.55	.9%	20.33	1.6%	13.55	1.7%
	Chamelea gallina	.	.	.	.	6.78	.5%	.	.
	Thracia phaseolina	101.63	6.5%	40.65	2.6%	33.88	2.7%	20.33	2.5%
BRYOZOA	Electra pilosa	.	.	6.78	.4%	20.33	1.6%	.	.
ECHINODERMATA	Asterias rubens	6.78	.4%	.	.	.	.	.	.
	Ophiura albida	.	.	.	.	6.78	.5%	.	.
	Echinocyamus pusillus	6.78	.4%	6.78	.4%	.	.	.	.
	Echinocardium cordatum	6.78	.4%	.	.	.	.	.	.
CHORDATA	Branchiostoma lanceolatum	.	.	47.43	3.0%	.	.	.	.

Appendix 6.4. Mean abundance

		Wind Farm area					
		Autumn 2004					
		Turbine 51					
		Distance (m)					
		5		25		100	
Abundance, number/m²		no./m²	Kol Sum %	no./m²	Kol Sum %	no./m²	Kol Sum %
NEMERTINI	Nemertini indet.	.	.	40.7	6.7%	.	.
POLYCHAETA	Pisione remota	.	.	40.7	6.7%	.	.
	Goniadella bobretzkii	.	.	40.7	6.7%	81.3	66.7%
	Orbinia sertulata	40.7	6.7%	.	.	40.7	33.3%
CRUSTACEA	Gastrosaccus spinifer	81.3	13.3%	81.3	13.3%	.	.
	Bathyporeia guilliamsoniana	40.7	6.7%	.	.	.	.
	Pontocrates arenarius	.	.	40.7	6.7%	.	.
	Jassa marmorata	122.0	20.0%	40.7	6.7%	.	.
BIVALVIA	Goodallia triangularis	40.7	6.7%	162.6	26.7%	.	.
	Spisula solida	.	.	40.7	6.7%	.	.
	Thracia phaseolina	243.9	40.0%	.	.	.	.
ECHINODERMATA	Echinocyamus pusillus	40.7	6.7%	.	.	.	.
CHORDATA	Branchiostoma lanceolatum	.	.	122.0	20.0%	.	.
Total		**609.8**	**100.0%**	**609.8**	**100.0%**	**122.0**	**100.0%**

		Wind Farm area					
		Autumn 2004					
		Turbine 55					
		Distance (m)					
		5		25		100	
Abundance, number/m²		no./m²	Kol Sum %	no./m²	Kol Sum %	no./m²	Kol Sum %
HYDROZOA	Campanulariidae indet.	.	.	.	.	40.7	2.0%
NEMATODA	Nematoda indet.	.	.	.	.	81.3	4.1%
POLYCHAETA	Pisione remota	.	.	40.7	4.8%	40.7	2.0%
	Nephtys caeca	.	.	40.7	4.8%	.	.
	Goniadella bobretzkii	40.7	5.0%	40.7	4.8%	122.0	6.1%
	Orbinia sertulata	81.3	10.0%	81.3	9.5%	.	.
	Travisia forbesii	.	.	.	.	40.7	2.0%
CRUSTACEA	Gastrosaccus spinifer	.	.	.	.	81.3	4.1%
	Jassa marmorata	.	.	.	.	40.7	2.0%
BIVALVIA	Goodallia triangularis	528.5	65.0%	650.4	76.2%	1422.8	71.4%
	Thracia phaseolina	81.3	10.0%	.	.	81.3	4.1%
BRYOZOA	Electra pilosa	.	.	.	.	40.7	2.0%
ECHINODERMATA	Asterias rubens	40.7	5.0%	.	.	.	.
	Echinocardium cordatum	40.7	5.0%	.	.	.	.
Total		**813.0**	**100.0%**	**853.7**	**100.0%**	**1991.9**	**100.0%**

		Wind Farm area					
		Autumn 2004					
		Turbine 58					
		Distance (m)					
		5		25		100	
Abundance, number/m²		no./m²	Kol Sum %	no./m²	Kol Sum %	no./m²	Kol Sum %
HYDROZOA	Campanulariidae indet.	.	.	.	.	40.7	2.4%
NEMERTINI	Nemertini indet.	.	.	40.7	2.6%	.	.
NEMATODA	Nematoda indet.	.	.	40.7	2.6%	.	.
POLYCHAETA	Pisione remota	650.4	33.3%	.	.	284.6	16.7%
	Goniadella bobretzkii	.	.	.	.	40.7	2.4%
	Scoloplos armiger	.	.	40.7	2.6%	.	.
	Spionidae indet.	.	.	40.7	2.6%	.	.
	Spio filicornis	203.3	10.4%	81.3	5.3%	.	.
	Travisia forbesii	284.6	14.6%	325.2	21.1%	406.5	23.8%
	Polygordius appendiculatus	.	.	81.3	5.3%	.	.
CRUSTACEA	Gastrosaccus spinifer	122.0	6.2%	.	.	40.7	2.4%
	Jassa marmorata	122.0	6.2%	81.3	5.3%	.	.
	Atylus swammerdami	.	.	40.7	2.6%	.	.
BIVALVIA	Mytilus edulis	.	.	40.7	2.6%	162.6	9.5%
	Goodallia triangularis	569.1	29.2%	487.8	31.6%	650.4	38.1%
	Thracia phaseolina	.	.	81.3	5.3%	.	.
BRYOZOA	Electra pilosa	.	.	40.7	2.6%	40.7	2.4%
ECHINODERMATA	Ophiura albida	.	.	.	.	40.7	2.4%
CHORDATA	Branchiostoma lanceolatum	.	.	122.0	7.9%	.	.
Total		**1951.2**	**100.0%**	**1544.7**	**100.0%**	**1707.3**	**100.0%**

		Wind Farm area					
		Autumn 2004					
		Turbine 26					
		Distance (m)					
		5		25		100	
Abundance, number/m²		no./m²	Kol Sum %	no./m²	Kol Sum %	no./m²	Kol Sum %
POLYCHAETA	Pisione remota	.	.	40.7	2.8%	162.6	12.5%
	Nephtys caeca	40.7	3.0%	40.7	2.8%	.	.
	Goniadella bobretzkii	162.6	12.1%	162.6	11.1%	81.3	6.3%
	Spionidae indet.	.	.	.	.	40.7	3.1%
	Spio filicornis	.	.	.	.	40.7	3.1%
	Travisia forbesii	325.2	24.2%	203.3	13.9%	81.3	6.3%
	Polygordius appendiculatus	.	.	.	.	40.7	3.1%
CRUSTACEA	Mysidacea indet.	.	.	40.7	2.8%	.	.
	Pontocrates arenarius	.	.	40.7	2.8%	.	.
	Jassa marmorata	.	.	.	.	122.0	9.4%
GASTROPODA	Polinices polianus	40.7	3.0%	.	.	.	.
BIVALVIA	Mytilus edulis	.	.	81.3	5.6%	81.3	6.3%
	Goodallia triangularis	650.4	48.5%	772.4	52.8%	609.8	46.9%
	Spisula solida	40.7	3.0%	.	.	40.7	3.1%
	Thracia phaseolina	81.3	6.1%	81.3	5.6%	.	.
Total		**1341.5**	**100.0%**	**1463.4**	**100.0%**	**1300.8**	**100.0%**

		Wind Farm area					
		Autumn 2004					
		Turbine 73					
		Distance (m)					
		5		25		100	
Abundance, number/m²		no./m²	Kol Sum %	no./m²	Kol Sum %	no./m²	Kol Sum %
NEMERTINI	Nemertini indet.	81.3	3.0%	.	.	.	.
POLYCHAETA	Pisione remota	40.7	1.5%	162.6	5.3%	40.7	3.2%
	Glycera alba	40.7	1.5%	.	.	.	.
	Goniadella bobretzkii	81.3	3.0%	162.6	5.3%	40.7	3.2%
	Spionidae indet.	.	.	81.3	2.6%	.	.
	Travisia forbesii	.	.	.	.	40.7	3.2%
CRUSTACEA	Harpacticoida indet.	40.7	1.5%	.	.	.	.
	Gastrosaccus spinifer	.	.	.	.	40.7	3.2%
	Jassa marmorata	.	.	40.7	1.3%	40.7	3.2%
GASTROPODA	Hydrobia ulvae	.	.	40.7	1.3%	40.7	3.2%
	Polinices polianus	40.7	1.5%	.	.	.	.
BIVALVIA	Mytilus edulis	81.3	3.0%	40.7	1.3%	.	.
	Goodallia triangularis	2154.5	80.3%	2357.7	76.3%	772.4	61.3%
	Spisula solida	.	.	40.7	1.3%	81.3	6.5%
	Thracia phaseolina	122.0	4.5%	81.3	2.6%	122.0	9.7%
BRYOZOA	Electra pilosa	.	.	.	.	40.7	3.2%
ECHINODERMATA	Echinocyamus pusillus	.	.	40.7	1.3%	.	.
CHORDATA	Branchiostoma lanceolatum	.	.	40.7	1.3%	.	.
Total		**2682.9**	**100.0%**	**3089.4**	**100.0%**	**1260.2**	**100.0%**

		Wind Farm area					
		Autumn 2004					
		Turbine 95					
		Distance (m)					
		5		25		100	
Abundance, number/m²		no./m²	Kol Sum %	no./m²	Kol Sum %	no./m²	Kol Sum %
ANTHOZOA	Actiniaria indet.	40.7	2.1%	.	.	.	.
POLYCHAETA	Pisione remota	.	.	.	.	40.7	3.2%
	Goniadella bobretzkii	40.7	2.1%	.	.	81.3	6.5%
	Orbinia sertulata	40.7	2.1%	.	.	.	.
	Spio filicornis	40.7	2.1%	122.0	6.4%	.	.
	Aonides paucibranchiata	40.7	2.1%	.	.	.	.
	Scolelepis bonnieri	40.7	2.1%	.	.	.	.
	Ophelia borealis	81.3	4.2%	40.7	2.1%	40.7	3.2%
CRUSTACEA	Harpacticoida indet.	.	.	40.7	2.1%	.	.
	Crangon crangon	.	.	.	.	40.7	3.2%
	Bathyporeia guilliamsoniana	81.3	4.2%	40.7	2.1%	.	.
	Bathyporeia sp.	162.6	8.3%	.	.	.	.
	Pontocrates arenarius	.	.	.	.	40.7	3.2%
	Jassa marmorata	122.0	6.3%	.	.	.	.
GASTROPODA	Hydrobia ulvae	.	.	.	.	40.7	3.2%
	Polinices polianus	40.7	2.1%	.	.	.	.
BIVALVIA	Mytilus edulis	.	.	.	.	40.7	3.2%
	Goodallia triangularis	1138.2	58.3%	1666.7	87.2%	894.3	71.0%
	Chamelea gallina	.	.	.	.	40.7	3.2%
	Thracia phaseolina	81.3	4.2%	.	.	.	.
Total		**1951.2**	**100.0%**	**1910.6**	**100.0%**	**1260.2**	**100.0%**

		Reference area											
		Autumn 2004											
		Ref01		Ref07		Ref35		Ref36		Ref37		Ref40	
Abundance, number/m²		no./m²	Kol Sum %	no./m²	Kol Sum %	no./m²	Kol Sum %	no./m²	Kol Sum %	no./m²	Kol Sum %	no./m²	Kol Sum %
NEMERTINI	Nemertini indet.	40.7	16.7%	.	.	.	.	.	.	.	.	.	.
POLYCHAETA	Pisione remota	.	.	.	.	40.7	5.9%	.	.	.	.	.	.
	Goniadella bobretzkii	81.3	33.3%	.	.	.	.	40.7	12.5%	40.7	4.3%	40.7	1.6%
	Orbinia sertulata	40.7	16.7%	.	.	.	.	.	.	.	.	.	.
	Spio filicornis	.	.	.	.	40.7	5.9%	.	.	.	.	40.7	1.6%
	Euzonus flabelligerus	.	.	40.7	50.0%	.	.	.	.	.	.	.	.
	Travisia forbesii	.	.	.	.	81.3	11.8%	40.7	12.5%	.	.	.	.
CRUSTACEA	Crangon crangon	.	.	40.7	50.0%	.	.	.	.	.	.	40.7	1.6%
	Gastrosaccus spinifer	.	.	.	.	40.7	5.9%	.	.	.	.	.	.
	Pontocrates arenarius	.	.	.	.	.	.	.	.	.	.	40.7	1.6%
	Jassa marmorata	.	.	.	.	40.7	5.9%	40.7	12.5%	.	.	40.7	1.6%
GASTROPODA	Hydrobia ulvae	.	.	.	.	.	.	40.7	12.5%	.	.	.	.
	Polinices polianus	.	.	.	.	40.7	5.9%	.	.	.	.	.	.
BIVALVIA	Mytilus edulis	.	.	.	.	.	.	40.7	12.5%	.	.	.	.
	Goodallia triangularis	81.3	33.3%	.	.	365.9	52.9%	122.0	37.5%	853.7	91.3%	2276.4	87.5%
	Spisula solida	.	.	.	.	40.7	5.9%	.	.	40.7	4.3%	.	.
	Thracia phaseolina	.	.	.	.	.	.	.	.	.	.	122.0	4.7%
Total		**243.9**	**100.0%**	**81.3**	**100.0%**	**691.1**	**100.0%**	**325.2**	**100.0%**	**935.0**	**100.0%**	**2601.6**	**100.0%**

Appendix 7. Benthos. Biomass

Appendix 7.1. Total mean biomass

Biomass, wet weight g/m²		Total		
		g/m²	Kol Sum %	N
HYDROZOA	Campanulariidae indet.	.180	.4%	48
ANTHOZOA	Actiniaria indet.	1.086	2.4%	48
NEMERTINI	Nemertini indet.	.010	.0%	48
NEMATODA	Nematoda indet.	.002	.0%	48
POLYCHAETA	Pisione remota	.014	.0%	48
	Nephtys caeca	.247	.6%	48
	Glycera alba	.003	.0%	48
	Goniadella bobretzkii	.040	.1%	48
	Scoloplos armiger	.063	.1%	48
	Orbinia sertulata	1.995	4.5%	48
	Spionidae indet.	.029	.1%	48
	Spio filicornis	.040	.1%	48
	Aonides paucibranchiata	.006	.0%	48
	Scolelepis bonnieri	.087	.2%	48
	Euzonus flabelligerus	.007	.0%	48
	Travisia forbesii	4.669	10.4%	48
	Ophelia borealis	.040	.1%	48
	Polygordius appendiculatus	.002	.0%	48
CRUSTACEA	Harpacticoida indet.	.001	.0%	48
	Crangon crangon	1.303	2.9%	48
	Mysidacea indet.	.021	.0%	48
	Gastrosaccus spinifer	.134	.3%	48
	Bathyporeia guilliamsoniana	.041	.1%	48
	Bathyporeia sp.	.013	.0%	48
	Pontocrates arenarius	.005	.0%	48
	Jassa marmorata	.042	.1%	48
	Atylus swammerdami	.000	.0%	48
GASTROPODA	Hydrobia ulvae	.014	.0%	48
	Polinices polianus	.826	1.8%	48
BIVALVIA	Mytilus edulis	.003	.0%	48
	Goodallia triangularis	2.064	4.6%	48
	Spisula solida	24.901	55.6%	48
	Chamelea gallina	.009	.0%	48
	Thracia phaseolina	5.880	13.1%	48
BRYOZOA	Electra pilosa	.393	.9%	48
ECHINODERMATA	Asterias rubens	.340	.8%	48
	Ophiura albida	.001	.0%	48
	Echinocyamus pusillus	.047	.1%	48
	Echinocardium cordatum	.147	.3%	48
CHORDATA	Branchiostoma lanceolatum	.047	.1%	48

Appendix 7.2. Mean biomass. Wind farm area – reference area

Biomass - 4 years: Year

		Sampling area											
		Wind Farm area						Reference area					
		2001		2003		2004		1999		2003		2004	
		Campaign		Campaign		Campaign		Campaign		Campaign		Campaign	
		Autumn		Autumn		Autumn		Spring		Autumn		Autumn	
Biomass, wet weight g/m²		Mean	Relative %	Mean	Relative %	Mean	Relative %	Mean	Relative %	Mean	Relative %	Mean	Relative %
HYDROZOA	Hydractinia echinata	,000	,0%	,064	,0%	.	.	1,331	,6%	,001	,0%	.	.
	Campanulariidae indet.	.	.	,026	,0%	,240	1,0%	.	.	.	.	.	.
	Tubularia indivisa	.	.	,022	,0%	.	.	.	.	.	.	.	.
ANTHOZOA	Actiniaria indet.	.	.	22,482	12,1%	1,448	6,2%	.	.	.	.	.	.
GOPLER	Beroe cucumis	.	.	.	.	.	.	,265	,1%	.	.	.	.
NEMERTINI	Nemertini indet.	,038	,0%	,002	,0%	,013	,1%	,078	,0%	,019	,0%	,001	,0%
NEMATODA	Nematoda indet.	,007	,0%	,003	,0%	,003	,0%	,003	,0%	.	.	.	.
POLYCHAETA	Ophelia borealis	7,405	2,5%	,299	,2%	,054	,2%	27,560	13,0%	6,654	1,9%	.	.
	Nephtys longosetosa	,940	,3%	.	.	.	.	10,184	4,8%	.	.	.	.
	Travisia forbesii	.	.	,725	,4%	4,876	20,9%	8,249	3,9%	,259	,1%	4,048	3,7%
	Orbinia sertulata	.	.	1,834	1,0%	2,367	10,1%	9,194	4,4%	,614	,2%	,879	,8%
	Nephtys hombergii	.	.	.	.	.	.	,428	,2%	.	.	.	.
	Lanice conchilega	.	.	.	.	.	.	.	.	,387	,1%	.	.
	Protodorvillea kefersteini	.	.	.	.	.	.	,322	,2%	.	.	.	.
	Polychaeta indet.	,298	,1%	.	.	.	.	.	.	.	.	.	.
	Scoloplos armiger	,449	,1%	.	.	,084	,4%	.	.	.	.	.	.
	Nephtys caeca	.	.	,266	,1%	,330	1,4%	.	.	,158	,0%	.	.
	Scolelepis bonnieri	,068	,0%	.	.	,116	,5%	,476	,2%	.	.	.	.
	Arenicola marina	.	.	,218	,1%	.	.	.	.	.	.	.	.
	Goniadella bobretzkii	,184	,1%	,555	,3%	,049	,2%	,245	,1%	,068	,0%	,014	,0%
	Nephtys sp,	.	.	,204	,1%	.	.	,046	,0%	,215	,1%	.	.
	Magelona mirabilis	.	.	.	.	.	.	,137	,1%	.	.	.	.
	Spio filicornis	,208	,1%	,068	,0%	,051	,2%	,234	,1%	,051	,0%	,009	,0%
	Pisione remota	,035	,0%	,078	,0%	,018	,1%	,174	,1%	,003	,0%	,001	,0%
	Spionidae indet.	.	.	.	.	,039	,2%	.	.	.	.	.	.
	Euzonus flabelligerus	.	.	.	.	.	.	.	.	,050	,0%	,027	,0%
	Aonides paucibranchiata	.	.	.	.	,007	,0%	.	.	.	.	.	.
	Polygordius appendiculatus	.	.	,007	,0%	,003	,0%	.	.	,005	,0%	.	.
	Glycera alba	.	.	.	.	,003	,0%	.	.	.	.	.	.
	Pholoe sp.	.	.	.	.	.	.	,001	,0%	.	.	.	.
	Eulalia viridis	,001	,0%	.	.	.	.	.	.	.	.	.	.
	Glycera sp.	.	.	.	.	.	.	.	.	.	.	.	.
	Polygordius sp.	.	.	.	.	.	.	.	.	.	.	.	.
HYDROCARINA	Halacaridae indet,	.	.	,000	,0%	.	.	.	.	.	.	.	.
CRUSTACEA	Pagurus bernhardus	4,503	1,5%	66,644	35,9%	.	.	76,295	36,1%	13,311	3,7%	.	.
	Balanus sp.	37,229	12,4%	.	.	.	.	.	.	.	.	.	.
	Carcinus maenas	.	.	.	.	.	.	28,392	13,4%	.	.	.	.
	Crangon crangon	.	.	.	.	,554	2,4%	24,765	11,7%	1,165	,3%	3,548	3,3%
	Haustorius arenarius	,003	,0%	,482	,3%	.	.	5,044	2,4%	.	.	.	.
	Gastrosaccus spinifer	2,363	,8%	.	.	,175	,7%	.	.	.	.	,014	,0%
	Liocarcinus pusillus	.	.	,177	,1%	.	.	.	.	.	.	.	.
	Mysidacea indet.	,089	,0%	.	.	,028	,1%	.	.	.	.	.	.
	Bathyporeia guilliamsoniana	,003	,0%	.	.	,054	,2%	.	.	.	.	.	.
	Jassa marmorata	.	.	,016	,0%	,052	,2%	.	.	.	.	,013	,0%
	Pontocrates arenarius	,004	,0%	,035	,0%	,006	,0%	,079	,0%	,030	,0%	,005	,0%
	Bathyporeia sp.	.	.	.	.	,017	,1%	.	.	.	.	.	.
	Caprella linearis	.	.	,017	,0%	.	.	.	.	.	.	.	.
	Harpacticoida indet.	,000	,0%	,012	,0%	,002	,0%	,001	,0%	.	.	.	.
	Eurysteus nitida	,000	,0%	.	.	.	.	,007	,0%	.	.	.	.
	Atylus swammerdami	,007	,0%	.	.	,000	,0%	.	.	.	.	.	.
	Metopa sp.	,003	,0%	.	.	.	.	.	.	.	.	.	.
	Oedicerotidae indet.	.	.	.	.	.	.	,003	,0%	.	.	.	.
	Westwoodilla caecula	,002	,0%	.	.	.	.	.	.	.	.	.	.
	Metopidae indet.	.	.	.	.	.	.	,001	,0%	.	.	.	.
	Cyclopoida indet.	,001	,0%	.	.	.	.	.	.	.	.	.	.
	Diastylis sp.	,000	,0%	.	.	.	.	.	.	.	.	.	.
	Pseudocuma longicornis	,000	,0%	.	.	.	.	.	.	.	.	.	.
	Stenothoe sp.	,000	,0%	.	.	.	.	.	.	.	.	.	.
	Pontocrates sp.	,000	,0%	.	.	.	.	.	.	.	.	.	.
GASTROPODA	Polinices polianus	3,210	1,1%	7,881	4,2%	1,047	4,5%	,035	,0%	2,376	,7%	,162	,1%
	Crepidula fornicata	.	.	,069	,0%	.	.	.	.	.	.	.	.
	Hydrobia ulvae	.	.	.	.	,008	,0%	.	.	.	.	,029	,0%
BIVALVIA	Ensis ensis	.	.	.	.	.	.	.	.	240,718	67,1%	.	.
	Spisula solida	231,883	77,4%	62,580	33,7%	,787	3,4%	15,413	7,3%	77,699	21,7%	97,245	89,3%
	Thracia phaseolina	10,004	3,3%	7,203	3,9%	7,466	31,9%	.	.	9,458	2,6%	1,121	1,0%
	Goodallia triangularis	,542	,2%	1,504	,8%	2,169	9,3%	,904	,4%	1,794	,5%	1,749	1,6%
	Fabulina fabula	.	.	.	.	.	.	1,022	,5%	.	.	.	.
	Bivalvia indet,	,001	,0%	.	.	.	.	.	.	,438	,1%	.	.
	Arctica islandica	,055	,0%	.	.	.	.	.	.	.	.	.	.
	Spisula elliptica	.	.	,030	,0%	.	.	.	.	.	.	.	.
	Chamelea gallina	.	.	.	.	,012	,1%	.	.	.	.	.	.
	Angulus tenuis	.	.	,009	,0%	.	.	.	.	.	.	.	.
	Mytilus edulis	,015	,0%	,003	,0%	,003	,0%	.	.	,008	,0%	,001	,0%
BRYOZOA	Electra pilosa	,049	,0%	.	.	,524	2,2%	.	.	.	.	.	.
	Bryozoa indet,	.	.	,018	,0%	.	.	.	.	.	.	.	.
ECHINODERMATA	Asterias rubens	.	.	10,974	5,9%	,453	1,9%	.	.	.	.	.	.
	Ophiura ophiura	.	.	.	.	.	.	.	.	3,169	,9%	.	.
	Echinocardium cordatum	.	.	.	.	,195	,8%	.	.	.	.	.	.
	Echinocyamus pusillus	.	.	,259	,1%	,063	,3%	.	.	.	.	.	.
	Ophiura albida	.	.	.	.	,001	,0%	.	.	.	.	.	.
CHAETOGHNATHA	Sagitta sp.	,000	,0%	.	.	.	.	.	.	.	.	.	.
CHORDATA	Branchiostoma lanceolatum	,080	,0%	,712	,4%	,063	,3%	,348	,2%	,078	,0%	.	.

Appendix 7.3. Mean biomass. Total distance

		Sampling area							
		Wind Farm area						Reference area	
		Campaign						Campaign	
		Autumn 2004						Autumn 2004	
		Distance (m)						Distance (m)	
		5		25		100		Reference	
Biomass, wet weight g/m²		g/m²	Kol Sum %	g/m²	Kol Sum %	g/m²	Kol Sum %	g/m²	Kol Sum %
HYDROZOA	Campanulariidae indet.	.	.	.	.	.720	3.7%	.	.
ANTHOZOA	Actiniaria indet.	4.343	13.5%	.	.	.	.	.	.
NEMERTINI	Nemertini indet.	.014	.0%	.026	.1%	.	.	.001	.0%
NEMATODA	Nematoda indet.	.	.	.008	.0%	.001	.0%	.	.
POLYCHAETA	Pisione remota	.012	.0%	.010	.1%	.033	.2%	.001	.0%
	Nephtys caeca	.731	2.3%	.259	1.4%	.	.	.	.
	Glycera alba	.010	.0%	.	.	.	.	.	.
	Goniadella bobretzkii	.068	.2%	.030	.2%	.050	.3%	.014	.0%
	Scoloplos armiger	.	.	.252	1.4%	.	.	.	.
	Orbinia sertulata	4.616	14.3%	2.249	12.1%	.236	1.2%	.879	.8%
	Spionidae indet.	.	.	.022	.1%	.093	.5%	.	.
	Spio filicornis	.072	.2%	.067	.4%	.013	.1%	.009	.0%
	Aonides paucibranchiata	.022	.1%	.	.	.	.	.	.
	Scolelepis bonnieri	.348	1.1%	.	.	.	.	.	.
	Euzonus flabelligerus	.	.	.	.	.	.	.027	.0%
	Travisia forbesii	5.562	17.2%	3.556	19.1%	5.512	28.5%	4.048	3.7%
	Ophelia borealis	.060	.2%	.057	.3%	.045	.2%	.	.
	Polygordius appendiculatus	.	.	.001	.0%	.008	.0%	.	.
CRUSTACEA	Harpacticoida indet.	.003	.0%	.003	.0%	.	.	.	.
	Crangon crangon	.	.	.	.	1.663	8.6%	3.548	3.3%
	Mysidacea indet.	.	.	.085	.5%	.	.	.	.
	Gastrosaccus spinifer	.251	.8%	.026	.1%	.246	1.3%	.014	.0%
	Bathyporeia guilliamsoniana	.102	.3%	.061	.3%	.	.	.	.
	Bathyporeia sp.	.051	.2%	.	.	.	.	.	.
	Pontocrates arenarius	.	.	.009	.0%	.008	.0%	.005	.0%
	Jassa marmorata	.112	.3%	.031	.2%	.014	.1%	.013	.0%
	Atylus swammerdami	.	.	.000	.0%	.	.	.	.
GASTROPODA	Hydrobia ulvae	.	.	.004	.0%	.021	.1%	.029	.0%
	Polinices polianus	3.141	9.7%	.	.	.	.	.162	.1%
BIVALVIA	Mytilus edulis	.001	.0%	.004	.0%	.005	.0%	.001	.0%
	Goodallia triangularis	2.345	7.3%	2.523	13.6%	1.640	8.5%	1.749	1.6%
	Spisula solida	.026	.1%	.271	1.5%	2.063	10.7%	97.245	89.3%
	Chamelea gallina	.	.	.	.	.037	.2%	.	.
	Thracia phaseolina	8.333	25.8%	8.739	47.0%	5.327	27.6%	1.121	1.0%
BRYOZOA	Electra pilosa	.	.	.001	.0%	1.572	8.1%	.	.
ECHINODERMATA	Asterias rubens	1.360	4.2%	.	.	.	.	.	.
	Ophiura albida	.	.	.	.	.002	.0%	.	.
	Echinocyamus pusillus	.085	.3%	.104	.6%	.	.	.	.
	Echinocardium cordatum	.586	1.8%	.	.	.	.	.	.
CHORDATA	Branchiostoma lanceolatum	.	.	.188	1.0%	.	.	.	.

Appendix 7.4. Mean biomass

Biomass, wet weight g/m²		Wind Farm area Autumn 2004 Turbine 51 Distance (m) 5		25		100	
		g/m²	Kol Sum %	g/m²	Kol Sum %	g/m²	Kol Sum %
NEMERTINI	Nemertini indet.	.	.	.130	7.5%	.	.
POLYCHAETA	Pisione remota	.	.	.004	.2%	.	.
	Goniadella bobretzkii	.	.	.012	.7%	.045	3.1%
	Orbinia sertulata	14.439	47.7%	.	.	1.415	96.9%
CRUSTACEA	Gastrosaccus spinifer	.484	1.6%	.159	9.1%	.	.
	Bathyporeia guilliamsoniana	.484	1.6%	.	.	.	.
	Pontocrates arenarius	.	.	.049	2.8%	.	.
	Jassa marmorata	.415	1.4%	.045	2.6%	.	.
BIVALVIA	Goodallia triangularis	.159	.5%	.407	23.3%	.	.
	Spisula solida	.	.	.923	52.9%	.	.
	Thracia phaseolina	13.785	45.5%	.	.	.	.
ECHINODERMATA	Echinocyamus pusillus	.508	1.7%	.	.	.	.
CHORDATA	Branchiostoma lanceolatum	.	.	.016	.9%	.	.
Total		**30.272**	**100.0%**	**1.744**	**100.0%**	**1.459**	**100.0%**

Biomass, wet weight g/m²		Wind Farm area Autumn 2004 Turbine 55 Distance (m) 5		25		100	
		g/m²	Kol Sum %	g/m²	Kol Sum %	g/m²	Kol Sum %
HYDROZOA	Campanulariidae indet.	.	.	.	.	.183	2.0%
NEMATODA	Nematoda indet.	.	.	.	.	.004	.0%
POLYCHAETA	Pisione remota	.	.	.012	.1%	.012	.1%
	Nephtys caeca	.	.	.890	5.7%	.	.
	Goniadella bobretzkii	.073	.2%	.024	.2%	.000	.0%
	Orbinia sertulata	12.837	32.0%	13.496	85.8%	.	.
	Travisia forbesii	.	.	.	.	.138	1.5%
CRUSTACEA	Gastrosaccus spinifer	.	.	.	.	.638	7.0%
	Jassa marmorata	.	.	.	.	.041	.4%
BIVALVIA	Goodallia triangularis	2.033	5.1%	1.301	8.3%	2.711	29.8%
	Thracia phaseolina	13.463	33.6%	.	.	5.366	58.9%
BRYOZOA	Electra pilosa	.	.	.	.	.016	.2%
ECHINODERMATA	Asterias rubens	8.159	20.4%	.	.	.	.
	Echinocardium cordatum	3.516	8.8%	.	.	.	.
Total		**40.081**	**100.0%**	**15.724**	**100.0%**	**9.110**	**100.0%**

		Wind Farm area					
		Autumn 2004					
		Turbine 58					
		Distance (m)					
		5		25		100	
Biomass, wet weight g/m²		g/m²	Kol Sum %	g/m²	Kol Sum %	g/m²	Kol Sum %
HYDROZOA	Campanulariidae indet.	.	.	.	.	4.134	9.7%
NEMERTINI	Nemertini indet.	.	.	.028	.1%	.	.
NEMATODA	Nematoda indet.	.	.	.049	.3%	.	.
POLYCHAETA	Pisione remota	.065	.4%	.	.	.130	.3%
	Goniadella bobretzkii	.	.	.	.	.008	.0%
	Scoloplos armiger	.	.	1.512	8.0%	.	.
	Spionidae indet.	.	.	.016	.1%	.	.
	Spio filicornis	.394	2.6%	.118	.6%	.	.
	Travisia forbesii	11.992	77.7%	10.992	57.9%	27.073	63.5%
	Polygordius appendiculatus	.	.	.004	.0%	.	.
CRUSTACEA	Gastrosaccus spinifer	1.024	6.6%	.	.	.309	.7%
	Jassa marmorata	.024	.2%	.012	.1%	.	.
	Atylus swammerdami	.	.	.000	.0%	.	.
BIVALVIA	Mytilus edulis	.	.	.004	.0%	.008	.0%
	Goodallia triangularis	1.931	12.5%	1.602	8.4%	1.638	3.8%
	Thracia phaseolina	.	.	4.622	24.4%	.	.
BRYOZOA	Electra pilosa	.	.	.004	.0%	9.297	21.8%
ECHINODERMATA	Ophiura albida	.	.	.	.	.012	.0%
CHORDATA	Branchiostoma lanceolatum	.	.	.008	.0%	.	.
Total		**15.431**	**100.0%**	**18.972**	**100.0%**	**42.610**	**100.0%**

		Wind Farm area					
		Autumn 2004					
		Turbine 26					
		Distance (m)					
		5		25		100	
Biomass, wet weight g/m²		g/m²	Kol Sum %	g/m²	Kol Sum %	g/m²	Kol Sum %
POLYCHAETA	Pisione remota	.	.	.008	.0%	.020	.5%
	Nephtys caeca	4.386	13.0%	.663	1.1%	.	.
	Goniadella bobretzkii	.240	.7%	.093	.2%	.199	5.3%
	Spionidae indet.	.	.	.	.	.561	14.9%
	Spio filicornis	.	.	.	.	.077	2.0%
	Travisia forbesii	21.378	63.3%	10.341	16.9%	.878	23.3%
	Polygordius appendiculatus	.	.	.	.	.049	1.3%
CRUSTACEA	Mysidacea indet.	.	.	.508	.8%	.	.
	Pontocrates arenarius	.	.	.004	.0%	.	.
	Jassa marmorata	.	.	.	.	.028	.8%
GASTROPODA	Polinices polianus	2.955	8.7%	.	.	.	.
BIVALVIA	Mytilus edulis	.	.	.016	.0%	.004	.1%
	Goodallia triangularis	1.764	5.2%	1.963	3.2%	1.833	48.5%
	Spisula solida	.159	.5%	.	.	.126	3.3%
	Thracia phaseolina	2.907	8.6%	47.545	77.8%	.	.
Total		**33.789**	**100.0%**	**61.142**	**100.0%**	**3.776**	**100.0%**

		Wind Farm area					
		Autumn 2004					
		Turbine 73					
		Distance (m)					
		5		25		100	
Biomass, wet weight g/m²		g/m²	Kol Sum %	g/m²	Kol Sum %	g/m²	Kol Sum %
NEMERTINI	Nemertini indet.	.081	.2%	.	.	.	.
POLYCHAETA	Pisione remota	.008	.0%	.037	.4%	.016	.0%
	Glycera alba	.061	.2%	.	.	.	.
	Goniadella bobretzkii	.085	.2%	.049	.5%	.024	.1%
	Spionidae indet.	.	.	.118	1.3%	.	.
	Travisia forbesii	.	.	.	.	4.980	10.7%
CRUSTACEA	Harpacticoida indet.	.016	.0%	.	.	.	.
	Gastrosaccus spinifer	.	.	.	.	.528	1.1%
	Jassa marmorata	.	.	.130	1.5%	.012	.0%
GASTROPODA	Hydrobia ulvae	.	.	.024	.3%	.093	.2%
	Polinices polianus	15.268	38.2%	.	.	.	.
BIVALVIA	Mytilus edulis	.004	.0%	.004	.0%	.	.
	Goodallia triangularis	5.407	13.5%	5.878	65.8%	1.768	3.8%
	Spisula solida	.	.	.703	7.9%	12.252	26.4%
	Thracia phaseolina	19.008	47.6%	.268	3.0%	26.593	57.3%
BRYOZOA	Electra pilosa	.	.	.	.	.122	.3%
ECHINODERMATA	Echinocyamus pusillus	.	.	.622	7.0%	.	.
CHORDATA	Branchiostoma lanceolatum	.	.	1.102	12.3%	.	.
Total		**39.939**	**100.0%**	**8.935**	**100.0%**	**46.390**	**100.0%**

Biomass, wet weight g/m²		Wind Farm area, Autumn 2004, Turbine 95, Distance (m): 5		25		100	
		g/m²	Kol Sum %	g/m²	Kol Sum %	g/m²	Kol Sum %
ANTHOZOA	Actiniaria indet.	26.061	76.6%	.	.	.	.
POLYCHAETA	Pisione remota	.	.	.	.	.016	.1%
	Goniadella bobretzkii	.012	.0%	.	.	.024	.2%
	Orbinia sertulata	.419	1.2%	.	.	.	.
	Spio filicornis	.037	.1%	.285	5.7%	.	.
	Aonides paucibranchiata	.134	.4%	.	.	.	.
	Scolelepis bonnieri	2.085	6.1%	.	.	.	.
	Ophelia borealis	.358	1.1%	.341	6.8%	.268	2.1%
CRUSTACEA	Harpacticoida indet.	.	.	.016	.3%	.	.
	Crangon crangon	.	.	.	.	9.976	79.8%
	Bathyporeia guilliamsoniana	.130	.4%	.366	7.3%	.	.
	Bathyporeia sp.	.305	.9%	.	.	.	.
	Pontocrates arenarius	.	.	.	.	.049	.4%
	Jassa marmorata	.232	.7%	.	.	.	.
GASTROPODA	Hydrobia ulvae	.	.	.	.	.033	.3%
	Polinices polianus	.622	1.8%	.	.	.	.
BIVALVIA	Mytilus edulis	.	.	.	.	.020	.2%
	Goodallia triangularis	2.776	8.2%	3.988	79.8%	1.890	15.1%
	Chamelea gallina	.	.	.	.	.220	1.8%
	Thracia phaseolina	.837	2.5%	.	.	.	.
Total		**34.008**	**100.0%**	**4.996**	**100.0%**	**12.496**	**100.0%**

		Reference area											
		Autumn 2004											
		Ref01		Ref07		Ref35		Ref36		Ref37		Ref40	
Biomass, wet weight g/m²		g/m²	Kol Sum %	g/m²	Kol Sum %	g/m²	Kol Sum %	g/m²	Kol Sum %	g/m²	Kol Sum %	g/m²	Kol Sum %
NEMERTINI	Nemertini indet.	.008	.1%	.	.	.	.	.	.	.	.	.	.
POLYCHAETA	Pisione remota	.	.	.	.	.004	.0%	.	.	.	.	.	.
	Goniadella bobretzkii	.033	.6%	.	.	.	.	.033	.5%	.004	.1%	.012	.0%
	Orbinia sertulata	5.272	95.0%	.	.	.	.	.	.	.	.	.	.
	Spio filicornis	.	.	.	.	.008	.0%	.	.	.	.	.049	.2%
	Euzonus flabelligerus	.	.	.163	3.5%	.	.	.	.	.	.	.	.
	Travisia forbesii	.	.	.	.	18.057	3.0%	6.232	91.4%	.	.	.	.
CRUSTACEA	Crangon crangon	.	.	4.463	96.5%	.	.	.	.	.	.	16.825	55.5%
	Gastrosaccus spinifer	.	.	.	.	.081	.0%	.	.	.	.	.	.
	Pontocrates arenarius	.	.	.	.	.	.	.	.	.	.	.028	.1%
	Jassa marmorata	.	.	.	.	.004	.0%	.049	.7%	.	.	.024	.1%
GASTROPODA	Hydrobia ulvae	.	.	.	.	.	.	.175	2.6%	.	.	.	.
	Polinices polianus	.	.	.	.	.972	.2%	.	.	.	.	.	.
BIVALVIA	Mytilus edulis	.	.	.	.	.	.	.004	.1%	.	.	.	.
	Goodallia triangularis	.236	4.2%	.	.	.980	.2%	.325	4.8%	2.305	49.3%	6.650	21.9%
	Spisula solida	.	.	.	.	581.106	96.7%	.	.	2.366	50.6%	.	.
	Thracia phaseolina	.	.	.	.	.	.	.	.	.	.	6.724	22.2%
Total		**5.549**	**100.0%**	**4.626**	**100.0%**	**601.211**	**100.0%**	**6.817**	**100.0%**	**4.675**	**100.0%**	**30.313**	**100.0%**

Appendix 8. Mussels

Horns Rev, 2004
Mussels
Length in mm[a]

			Mean	Std.v.	N	Min	Max
Mytilus edulis	Station	Ref36	1.28	.	N=1	1.28	1.28
		Mill58	.77	.09	N=5	.65	.86
		Mill26	1.22	.	N=1	1.22	1.22
		Mill73	.79	.36	N=3	.52	1.20
		Mill95	.85	.	N=1	.85	.85
	ART total		.87	.26	N=11	.52	1.28
Goodallia triangularis	Station	Ref01	2.20	.49	N=2	1.85	2.54
		Ref35	1.97	.30	N=9	1.52	2.53
		Ref36	1.93	.07	N=3	1.86	2.00
		Ref37	1.66	.57	N=21	.00	2.61
		Ref40	1.63	.46	N=58	.80	2.63
		Mill51	2.13	.45	N=5	1.37	2.51
		Mill55	1.71	.35	N=73	1.11	2.96
		Mill58	1.85	.44	N=34	.83	3.19
		Mill26	2.00	.43	N=50	1.16	3.21
		Mill73	1.72	.38	N=129	.67	3.32
		Mill95	1.64	.46	N=91	.02	2.86
	ART total		1.74	.43	N=475	.00	3.32
Spisula solida	Station	Ref35	42.32	.	N=1	42.32	42.32
		Ref37	7.28	.	N=1	7.28	7.28
		Mill51	5.04	.	N=1	5.04	5.04
		Mill26	3.45	.42	N=2	3.15	3.75
		Mill73	4.83	.	N=1	4.83	4.83
	ART total		11.06	15.38	N=6	3.15	42.32
Chamelea gallina	Station	Mill95	1.50	.	N=1	1.50	1.50
	ART total		1.50	.	N=1	1.50	1.50
Thracia phaseolina	Station	Ref40	6.95	1.25	N=3	5.67	8.17
		Mill51	8.94	1.82	N=6	6.49	12.08
		Mill55	10.70	2.06	N=4	9.18	13.67
		Mill58	6.37	.	N=1	6.37	6.37
		Mill26	8.41	8.11	N=4	2.89	20.29
		Mill73	8.73	5.48	N=8	2.86	17.27
		Mill95	3.91	1.31	N=2	2.98	4.83
	ART total		8.39	4.37	N=28	2.86	20.29
Ophiura albida	Station	Mill58	2.20	.	N=1	2.20	2.20
	ART total		2.20	.	N=1	2.20	2.20