HYWIND-SCOTLAND

Environmental benthos survey, Hywind Scotland

Equinor Energy AS

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Applicable contract(s) governing the provision of this Report:

Objective:

Present results from environmental survey and discusses possible impacts to marine life from floating offshore wind park, Hywind Scotland. This report can be freely distributed by Equinor Energy AS.

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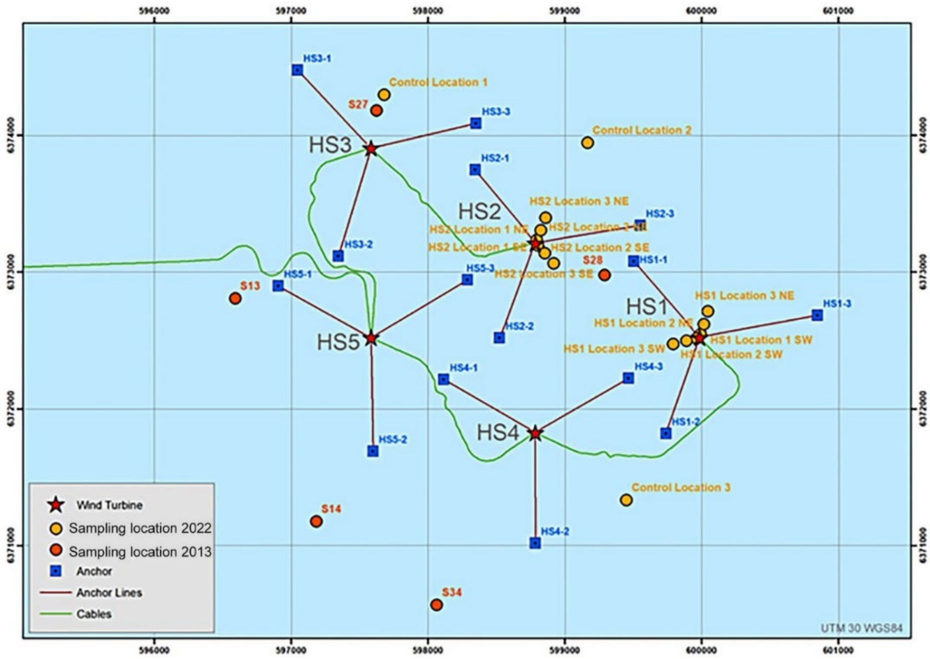
1 EXECUTIVE SUMMARY

DNV AS has carried out an Environmental benthos survey at the Equinor-operated wind farm Hywind Scotland, situated 25 km off the coast of Peterhead in Scotland, UK. There are still uncertainties regarding the potential environmental impact from a floating wind park due to the floating technology being a relative novel development solution. Using the world's first operational floating offshore wind farm, Hywind Scotland, to improve the knowledge base would contribute to build confidence about floating wind and add knowledge to the environmental footprint.

The fieldwork on Hywind Scotland was conducted together with a larger cruise that took part in the Norwegian and Barents Sea in May and June 2022. The survey at Hywind Scotland wind farm area was conducted from the vessel "Olympic Electra" in the period 11-12 of May. An overview of the location of the sampling locations and infrastructure at Hywind Scotland is presented in the figure below. Three main activities were executed in the survey, and which are summarized in this report:

1. Sediment characterization
2. Biological analysis of macrofauna
3. Visual assessment of megafauna and potential influence from the wind park on the seabed



Sediment characterization

The sediment at Hywind Scotland can be characterized as fine sand. The sediment grain size and total organic carbon (TOC) at stations close to the two turbines are in general not deviating compared to the control stations. The content of TOC, silt& clay (pelite) and sand are in general very similar at all sampled stations. Compared to the results in 2013 the results in 2022 are in general similar.

Biological analysis - macrofauna

The macrofauna at Hywind Scotland is species rich and the diversity is high. Species indicating a disturbed sediment were almost absent, only present in a few numbers at some stations which is natural also in undisturbed sediments. The macrofauna at all stations are evaluated as undisturbed and representing natural macrofauna in the area.

Compared to results from 5 stations sampled in 2013 the general trend from 2013 to 2022 is that stations sampled in 2022 have the same amount or more species and individuals compared to 2013. The species diversity also shows that the diversity is the same or higher for all stations sampled in 2022 compared to 2013. It is important to underline that only one replica pr. station was sampled in 2013 and that the stations are not on the same locations as those sampled in 2022. In 2022 5 replica were sampled pr. station which may explain some of the difference in number of individuals and species, despite that the 2022 results were compared on average basis and not total sum.

Biological analysis – megafauna (visual survey)

No red listed species or OSPAR type habitats were registered at the two locations investigated.

The seabed was relatively flat with depth varying between 115 – 118 meters. Ripple marks were evident throughout the sites investigated. The sediment was comprised of almost exclusively fine sand with fragments of shells and aggregation of shell fragments. The seabed closest to the turbines was covered in “low” and “moderate” densities of blue mussel shells originating from the wind turbine and associated anchor chains, the amount of shell debris was not particularly high.

From the current study it is evident that the wind turbines at Hywind Scotland have altered the seabed close to the turbines by introducing organic matter and shell debris originating from the floating structure and chains. This change is seabed characteristic is often followed by changes in seabed community structure and micro and macro benthic biodiversity.

Impact on the macrofauna was not identified in 2022, even at 25 meters distance from the installations. Altered seabed due to shell debris was not registered at 25 m but closer to the installations. If shell debris start to accumulate also at 25 m or further away, alterations in macrofauna communities will probably be registered also at these distances. Studies to assess long term effects from the wind turbines on the seabed habitats is therefore interesting. Offshore artificial structures can support large amounts of marine growth and this growth can create artificial reef ecosystems with introduction of hard bottom macrozoobenthos in otherwise uniform seabed habitats. The growth on the artificial surfaces can also create secondary growth on the outside of mussels and on mussel shells falling to the seabed, thus supporting increased biodiversity.

2 INTRODUCTION

Equinor wants to increase knowledge on implications of floating offshore wind activity to marine life. The Equinor-operated wind farm Hywind Scotland, situated 25 km off the coast of Peterhead in Scotland, UK, is the world's first floating wind farm.

There are still uncertainties regarding the potential environmental impact from a floating wind park due to the floating technology being a relative novel development solution. Using the world's first operational floating offshore wind farm, Hywind Scotland, to improve the knowledge base would contribute to build confidence about floating wind and add knowledge to the environmental footprint.

Considering previous results from the literature, a study of benthos and sediments as well as a visual inspection of the seabed in Hywind Scotland would be of great interest, to increase knowledge on potential implications for permanent fauna living in offshore wind areas. Also, Hywind Scotland is a floating offshore wind park, representing a new solution and technology compared to bottom-fixed parks on shallower depth. This concept might differ when it comes to implications for benthic fauna and more knowledge is of great interest and high value.

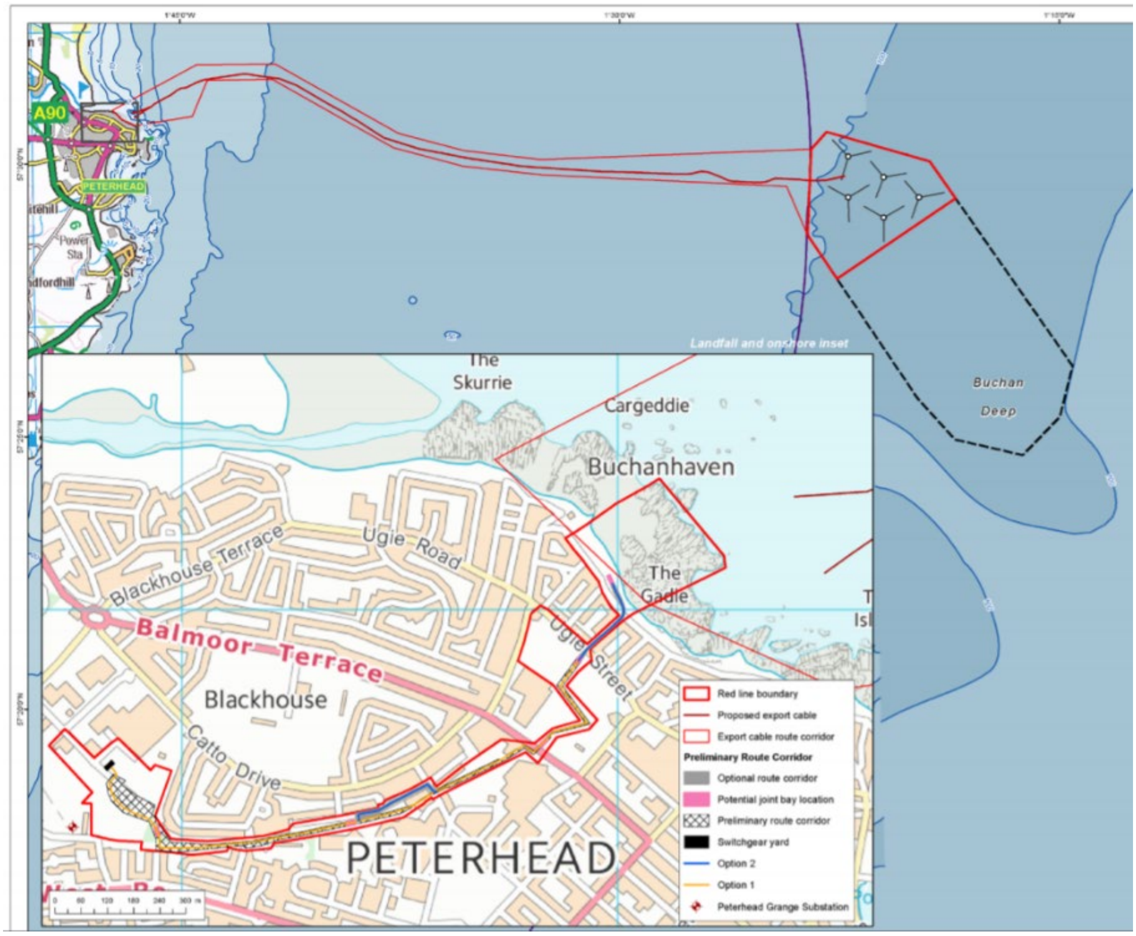


Figure 2-1. Location of the Hywind Scotland offshore floating wind park.

An overview of the sampling stations in relation to the turbines is presented in Figure 2-2. Note that sampling stations from 2013 (MMT 2013) are also included in the map.

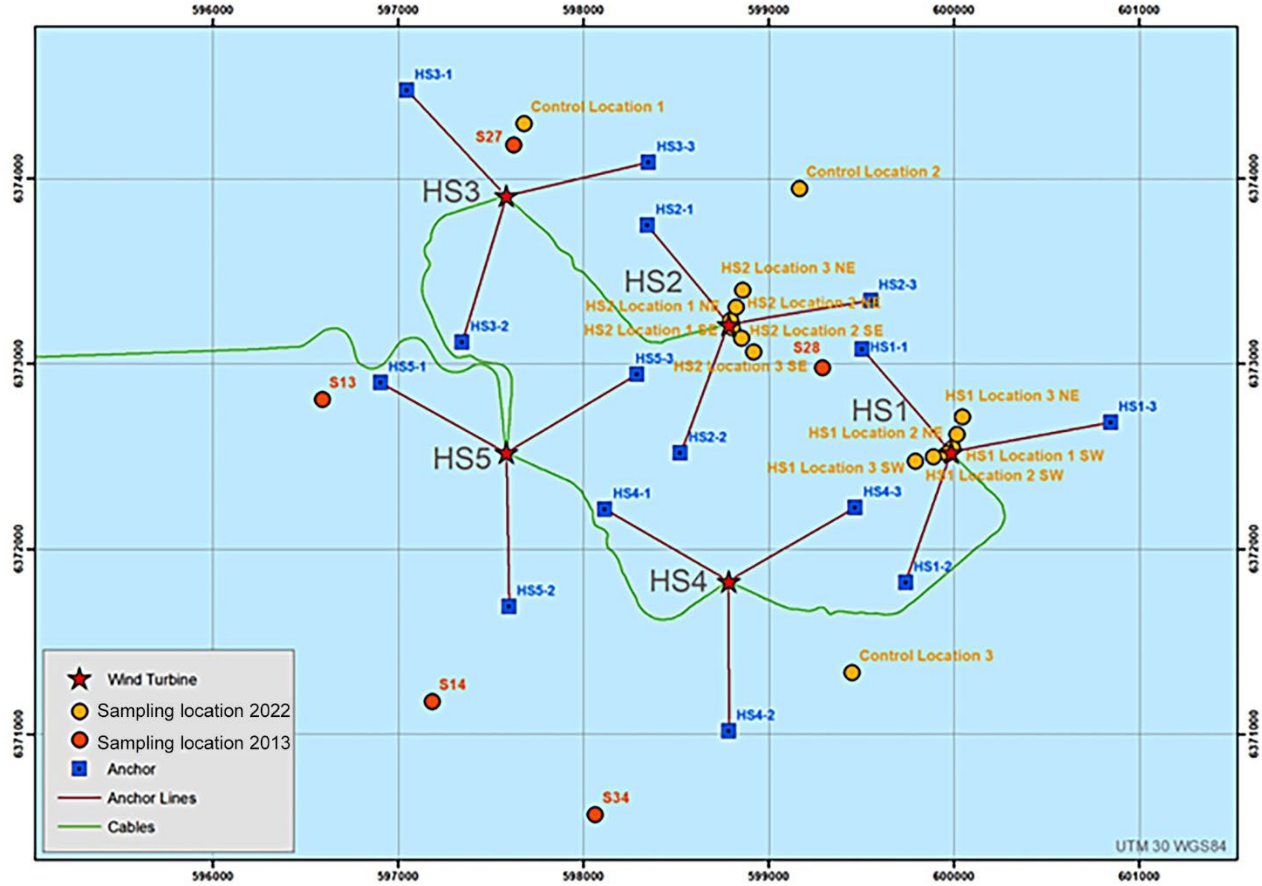


Figure 2-2. Location of sampling stations and infrastructure, Hywind Scotland 2022.

3 MATERIAL AND METHODS

3.1 Cruise information

The fieldwork on Hywind Scotland was conducted together with a larger cruise that took part in the Norwegian and Barents Sea. The survey was conducted from the vessel “Olympic Electra” (Figure 3-1). Personnel onboard during the Hywind Scotland fieldwork is presented in Table 3-1.

Table 3-1 Personnel onboard during Hywind Scotland Cruise.

Personnel	Company	Role
Amund Ulfsnes	DNV	Cruise Leader
Øyvind Fjukmoen	DNV	Shift Leader
Lars Ulvestad	DNV	Shift Leader
Anders Glette Johansen	DNV	Mud skipper
Anders Ommunden	DNV	Mud skipper
Knut Magne Rui	Sintef Norlab	Chemist
Bjørn Brekke	Sintef Norlab	Chemist
Espen Saastad	Spiromarine	ROV pilot/technician
Octavian Banica	Fugro	Surveyor
Rolf C. Sundt	Equinor	Client rep.

Figure 3-1 *The vessel (Olympic Electra) used on Hywind Scotland.*

3.2 Sediment baseline

3.2.1 Biological analyses

3.2.1.1 Macro benthos – an introduction

The macro benthic fauna considered in this survey is found living either in, or on sand, silt or clay sediments. This fauna comprises the following main taxonomic groups: Polychaeta, Crustacea, Mollusca, Echinodermata, and Varia (remaining groups). Only animals more than 1 mm (macro benthos) are included in the analysis.

The methods used are in accordance with guidelines for environmental monitoring of the offshore petroleum activities (M-408) and the procedures described in DNV's Biolaboratoriet's quality system: "Sampling of marine sediment and soft bottom analyses". A general flow chart showing the different steps in the preparation of macrofauna is shown in Figure 3-1.

Macro benthic fauna are traditionally included in offshore environmental monitoring. The reason for this is that the study of benthic communities can give an indication of the effects of pollution from offshore activities, while chemical monitoring of sediments is aimed at assessing the dispersion and concentration levels of pollutants in the vicinity of offshore installations. The benthic fauna is a suitable biological parameter for monitoring the effects of pollution or impact since most of the species have limited mobility and changes in species composition and densities of individuals can therefore be identified and interpreted. The distribution of the fauna can be related to natural variations in environmental parameters such as depth and type of sediment, but also anthropogenic factors such as discharges of drilling fluids, cuttings and others, including accidental releases of oil and physical disturbances.

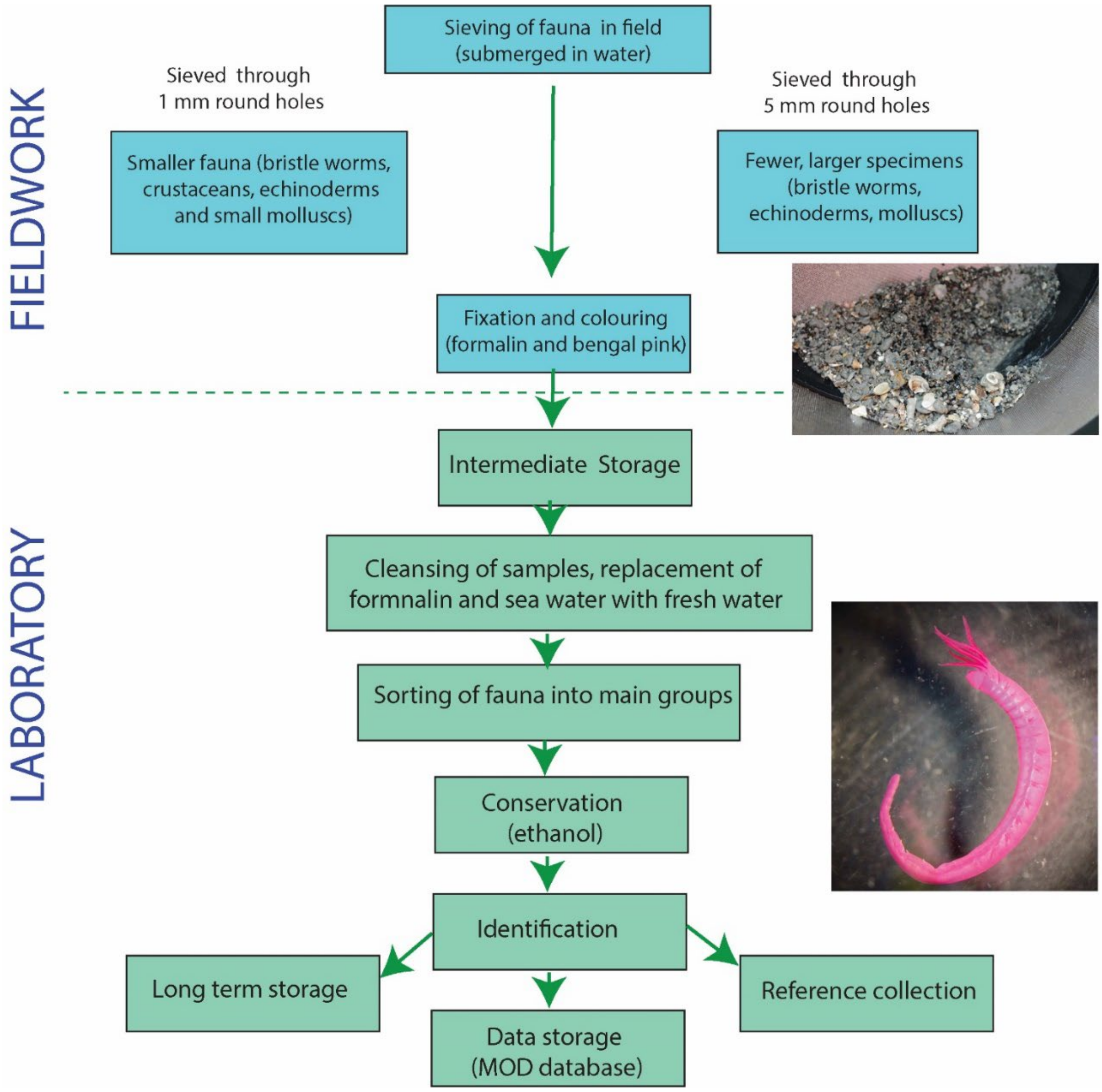


Figure 3-2 General flow chart showing preparation and analyses of sediment macrofauna samples.

3.2.1.2 Sorting and species identification

In the laboratory the samples were washed on 1 mm sieves with (circular holes) to remove formaldehyde and remaining fine sediment, and then sorted by hand under a magnifying glass. The animals were split into the major taxonomic groups; Echinodermata, Polychaeta, Crustacean, Mollusca and Varia and transferred to 70 % ethanol before further identification was undertaken.

All animals were identified to the lowest possible taxonomic level (i.e. generally to species level) and the number of individuals per taxon in each sample was recorded.

Nematoda, Foraminifera and colonial organisms (i.e. Porifera and Bryozoa), were excluded from any data analyses. Some taxa (e.g. Platyhelminthes, Nemertini, Tunicata and Tanaidacea) were registered but were not identified further. A number of representative specimens of each of the species/taxa identified were included in our reference collection.

3.2.1.3 Statistical techniques

The statistical and mathematical methods utilized to aid interpretation of the benthic fauna data are summarized below.

- ✓ Abundance ratio
- ✓ Shannon-Wiener's diversity index, H' (Shannon & Weaver 1963)
- ✓ Evenness calculated by Pielou's "evenness" J' (Pielou 1969)
- ✓ Expected number of species in a sample of 100 individuals (ES100)

Fauna similarity between stations is expressed by Bray-Curtis dissimilarity index d (Bray & Curtis 1957). The resulting similarity matrix was utilized in multivariate analyses to group stations and assess gradients in the benthic communities. These methods were: hierarchical agglomerative classification with group-average sorting (Lance & Williams 1966), ordination with non-metric Multi-Dimensional Scaling (MDS), (Shepard 1962, Kruskal 1964).

Classification and MDS ordination were carried out using the program-package PRIMER (Plymouth Routines in Multivariate Ecological Research).

3.2.1.4 Quality assurance

Procedures including routines for quality assurance related to sorting, species identification and recording of macro benthos samples are given in DNV’s Handbook of the Biology Laboratory’s Quality System; Sampling of marine sediments and soft bottom analyses. A brief summary is given here:

All samples are recorded and double-labelled during fieldwork and transported in wooden boxes in a steel container. During sorting in the laboratory all relevant information about each sample is recorded (who sorted what and when, time spent, number of bottles etc.). After sorting, each sediment sample is examined for remaining organisms by approved personnel. Each identifier establishes a separate reference collection of species for comparison purpose. To maintain traceability each identifier signs a log to keep track over which grab samples and animal group(s) he or she has been working on. The project reference collection is kept at DNV, Høvik, Norway.

3.2.2 Chemical analyses and sediment characterisation

Grain size distribution

The method for grain size distribution analysis is described in Buchanan (1984). The analysis includes a fast mechanical separation of the sand fraction (> 63 µm) from the silt and clay fraction. The sand fraction is then dried and sieved over a series of graded sieves.

From each station subsamples (0-5 cm) were mixed and homogenized, and one homogenized sample from each station was analyzed. Approximately 10 g of the sample was weighed to the nearest 0.01 g before wet sieving on a 63 µm sieve. The fraction passing this sieve was transferred to a plastic bottle. A separate sample was weighed and dried for dry weight determination. The percentage of silt and clay (< 63 µm) of total dry weight in the sample was then calculated.

The fraction > 63 µm was dried at 100 °C for 12 hours and sieved over a series of Retsch graded sieves (Endecott Test Sieves, London) with mesh sizes ranging from 2000 to 63 µm. The sample was shaken on a Retsch KG testing sieve shaker for ten minutes. The weight retained upon each sieve was determined to the nearest 0.01 g. The weight of all size fractions was used to prepare cumulative weight% distribution tables for each sampling site. This table was then used in calculating the median particle diameter and deviation, skewness and kurtosis of the particle size distribution. As the grain size distribution was not determined for the fraction < 63 µm, the □-value for this fraction was given the value 8. The values for Mdϕ, SDϕ, Skϕ, and Kϕ should therefore be considered as extrapolated results.

The mathematical expressions are given below.

Mdϕ (median particle diameter):

Mdϕ = the ϕ-value of the midpoint (i.e. 50 %) of the cumulative % weight curve. This measures the central tendency of the size frequency distribution.

SDϕ (standard deviation):

SDϕ estimated as:

$$\mathrm{SD}\phi = \frac{\phi 84 - \phi 16}{4} + \frac{\phi 95 - \phi 5}{6.6}$$

SDϕ gives a measure of the spread in particle size around the Mdϕ, and thus is a measure of the degree of sorting of the particles.

Skϕ (skewness):

Skϕ estimated as:

$$\mathrm{Sk}\phi = \frac{\phi 16 + \phi 84 - 2\mathrm{Md}\phi}{2(\phi 84 - \phi 16)} + \frac{\phi 5 + \phi 95 - 2\mathrm{Md}\phi}{2(\phi 95 - \phi 5)}$$

Skϕ describes the symmetry of the spread in distribution around the Mdϕ. A completely symmetrical distribution will have Skϕ = 0, negative values indicate displacement of the distribution curve towards coarser sediment, and positive Skϕ indicates displacement towards finer sediment.

Kurtosis, Kϕ:

Kϕ estimated as:

$$K\phi = \frac{\phi 95 - \phi 5}{2.44(\phi 75 - \phi 25)}$$

Kϕ describes the toppedness of the distribution, i.e. how heavy the tails are (expressed by the ϕ5 and ϕ95 fractions) compared to the central portion of the distribution. For a normal distribution the expression above will give a Kϕ value of 1.00.

Table 3-2 Grain size distribution, interpretation (Buchanan, 1984).

Parameter	Index value	Verbal classification
Standard deviation (SDϕ)	< 0.35	Very well sorted
	0.25-0.50	Well sorted
	0.50-0.70	Moderately well sorted
	0.70-1.00	Moderately sorted
	1.00-2.00	Poorly sorted
	2.00-4.00	Very poorly sorted
	> 4.00	Extremely poorly sorted
Skewness (Skϕ)	+1.00 to +0.30	Strongly fine skewed
	+0.30 to +0.10	Fine skewed
	+0.10 to -0.10	Symmetrical
	-0.10 to -0.30	Coarse skewed
	-0.30 to -1.00	Strongly coarse skewed
Kurtosis (Kϕ)	<0.67	Very platykurtic
	0.67-0.90	Platykurtic
	0.90-1.11	Mesokurtic (nearly normal)
	1.11-1.50	Leptokurtic
	1.50-3.00	Very leptokurtic

Table 3-3 Grain size distribution. Mesh sizes used and Wentworth grade classification (Buchanan, 1984).

Mesh diameter (µm)	ϕ	Description
4000	-2	Gravel
2000	-1	Very coarse sand
1000	0	Coarse sand
500	+1.0	
355	+1.5	Medium sand
250	+2.0	
180	+2.5	Fine sand
125	+3.0	
90	+3.5	Very fine sand
63	+4.0	
< 63	> +4.5	Silt and clay

Total organic carbon

The sediments were homogenized and dried. NS-EN13137 were used as the analysis procedure. Total organic carbon was determined by weight loss, inorganic carbon was then determined by solving the sample in phosphoric acid.

3.3 Visual mapping

3.3.1 Survey strategy

The seabed was inspected at two locations, HS1 and HS2. The seabed out to 200 meters from the centre location of the wind turbines were filmed with the ROV going into the centre location and then outwards (Figure 3-3). For safety reasons the start point of the ROV transects were located upstream of the prevailing current direction.

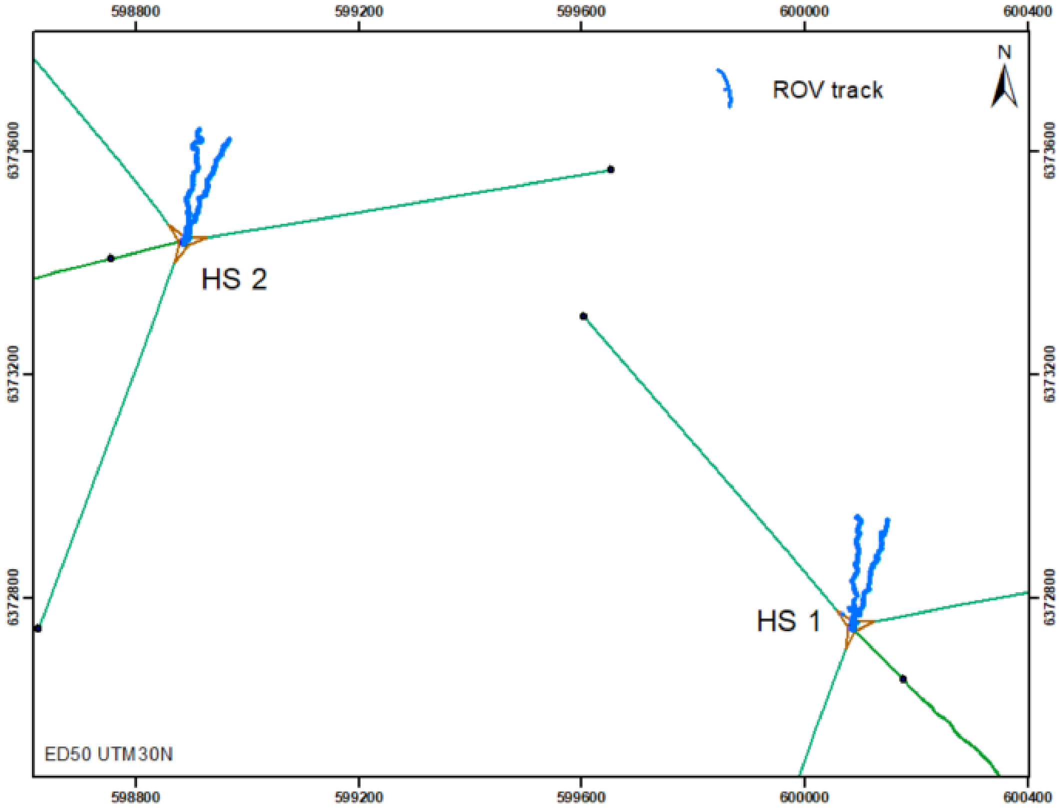


Figure 3-3 ROV survey track at Hywind Scotland, locations HS1 and HS2.

3.3.2 Equipment

3.3.2.1 ROV

The sea floor was surveyed using DNV's observation class ROV "Chimaera", a SPERRE SUB-fighter (15k, see Figure 4-2) equipped with one high-definition video camera and two conventional resolution video cameras (zoom and wide-angle camera). An 8 megapixel still camera with flash was used for still photos. Simrad 9200 sonar on the ROV ensured identification of large objects within a radius of 50 m in the flight direction. In addition, two lasers with a spacing of 10 cm were used for calculating object's sizes. ROV piloting and logging was performed in a customised ROV container (Figure 3-4).

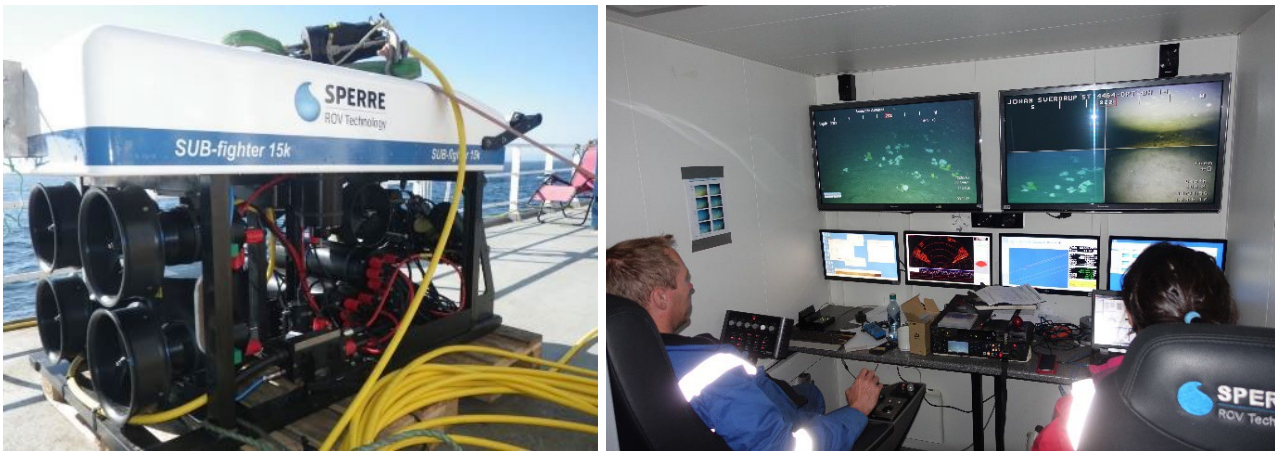


Figure 3-4 *ROV type and ROV container (control room) utilized during Hywind Scotland visual mapping survey. Note that the pictures are not from the Hywind Scotlandsurvey but shown for illustration purposes.*

3.3.2.2 Positioning

A transponder that communicated with the vessel’s HiPAP 500 transducer system was mounted on the ROV. Offset of data between HiPAP 500 and GPS were measured and included in the navigation application. With this system +/- ~ 2 m accuracy in position and depth recording of ROV was obtained.

3.3.3 Data collection

3.3.3.1 Data logging system

An electronic registration form (video log) was used for each ROV dive. The log included date, time, type of seabed substratum, mega-fauna, and any special observations (e.g. debris, fish). In parallel, ROV position was recorded every second in a navigation log. By merging these two logs all registrations from the video material were given a coordinate to be used in mapping. Still camera was synchronized at identical time with navigation logs so that all photos were geo referenced.

3.3.3.2 Substrate and fauna registrations

A modified Udden Wenthworth scale (according to NS-EN 16260) was used in the continuous categorization of the substrate along the seabed (Table 3-4). Grain sizes less than 0.5 cm can be difficult to categorize from video. Substrate categorization in the survey followed categories according to "Mapping/Trend" in Table 3-4.

Shell debris originating from floating structures or e.g., anchor chains can be of interest to map when surveying floating wind turbines, particularly in the light of long-term effects on the seabed. The occurrence of blue mussel debris was mapped according to categories in Figure 3-5.

All megafauna species and habitat types encountered during the surveys were registered. In addition to species registration by review of the video material, the species lists are based on identification from still photos.

The video registrations of sponges were categorised into two groups; “soft bottom sponges” and “hard bottom sponges” (see Figure 3-6). The species abundances were logged using the SACFOR scale ([http://jncc.defra.gov.uk)](http://jncc.defra.gov.uk), which is a relative six graded abundance scale, changing with animal size (Table 3-5).

DNV logs sponges according to (M300/ NOROG, 2019) and following semi quantitative scale when logging sponges: “No sponges”, “single individual”, “scattered”, “common” and” high”. Sponge individuals were logged as single when there were about 10 m or more between individuals (i.e. a couple of viewing frames in video between individuals). For illustrative purposes, “single individuals” and “no sponges” are shown as a combined group in this report, so that seabed sponge cover classification in maps and figures are represented by four semi quantitative groups. Soft bottom sponge classifications used by are given in Figure 3-7. Approximate % cover is given.

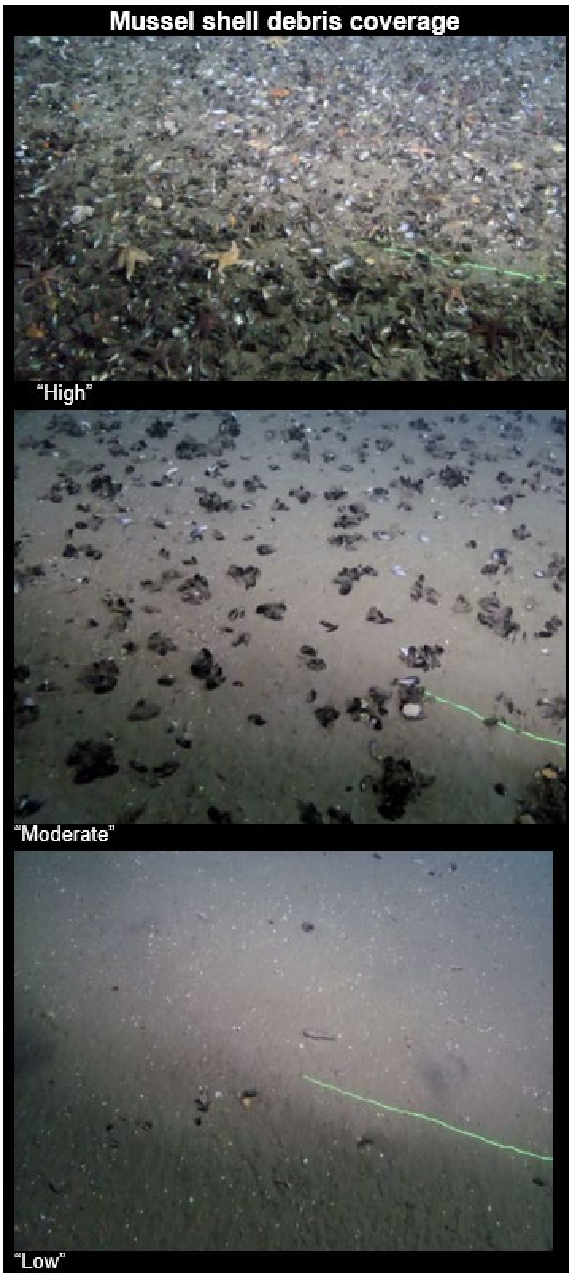


Figure 3-5 Categories used for assessing surface associate mussel shell debris

Table 3-4 *Sediment characterization according to the Udden-Wenthenworth scale, and categories utilized during the 2016 visual survey (NS-EN16260).*

Udden-Wenthworth scale		Type of survey and main category	
Grain size	Bottom substrate	Screening	Mapping/trend
0,6 µm – 3,9 µm	Clay	Mud/sand	Mud
3,9 µm – 63 µm	Silt		
0,063 mm – 2 mm	Sand		Sand
2 mm – 4 mm	Granules		
4 mm – 64 mm	Gravel	Boulder	Gravel
6,4 cm – 25,6 cm	Pebbles		Pebbles
25,6 cm – 410 cm	Boulder		Boulder
> 4 m	Bedrock	Bedrock	Bedrock

Table 3-5 *The SACFOR scale used for logging species abundances. A size relative six graded scale with densities classified as;* ***S****uperabundant–****A****bundant–****C****ommon–****F****requent–****O****ccasional-****R****are (mhc.jncc.gov.uk).*

% cover scale	Growth form		Size of individuals/colonies				Density scale	
	Crust/meadow	Massive/Turf	<1cm	1-3 cm	3-15 cm	>15 cm		
>80%	S		S				>1/0.001 m^2 (1x1 cm)	>10,000 / m^2
40-79%	A	S	A	S			1-9/0.001 m^2	1000-9999 / m^2
20-39%	C	A	C	A	S		1-9 / 0.01 m^2 (10 x 10 cm)	100-999 / m^2
10-19%	F	C	F	C	A	S	1-9 / 0.1 m^2	10-99 / m^2
5-9%	O	F	O	F	C	A	1-9 / m^2	
1-5% or density	R	O	R	O	F	C	1-9 / 10m^2 (3.16 x 3.16 m)	
<1% or density		R		R	O	F	1-9 / 100 m^2 (10 x 10 m)	
					R	O	1-9 / 1000 m^2 (31.6 x 31.6 m)	
						R	<1/1000 m^2	

S	A	C	F	O	R	P
super-abundant	abundant	common	frequent	occasional	rare	present

	
Soft bottom sponges	**Hard bottom sponges**

Figure 3-6 Categorization of main groups of sponges.

No sponge/ single specimen (<~1% coverage)	 0%	 0.4%
Scattered (~1- 5% coverage)	 1.3%	 4.8%

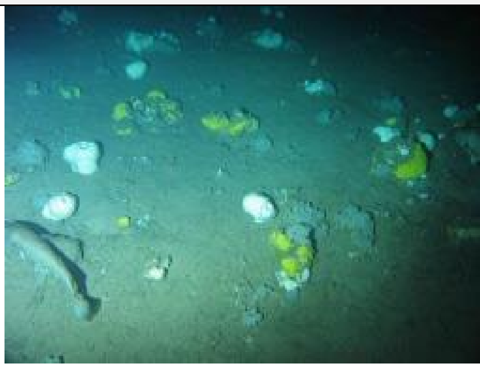
Common (~5-10% coverage)	 5.7%	 7.4%
High >~10% coverage	 10%	 18%

Figure 3-7 Density categories of soft bottom sponges.

4 RESULTS

4.1 Sediment characterization

4.1.1 Grain size and total organic carbon (TOC)

The main results are given in Table 4-1 and Figure 4-1.

In general, the sediment at Hywind Scotland can be characterized as fine sand. The sediment grain size and TOC at stations close to the two turbines are in general not deviating compared to the control stations. The content of TOC, silt & clay (pelite) and sand are in general very similar at all sampled stations, probably because the depth are very similar at all stations and that all stations are in the same area with similar current regime. Station HS2-1 NE, located 25 meters NE of the turbine, is the only station deviating compared to the other stations because the silt &clay content is relatively high (19 %). The control station Control-3 contains a little bit more gravel compared to the other stations, but the gravel content is in general low at all stations.

Compared to the results in 2013 the results are in 2022 are in general similar.

Table 4-1 Hywind Scotland 2022 grain size distribution and total organic carbon (TOC) of dry sediment.

Station	Distance (m)	Depth	TOC	Classification	Silt & clay	Sand	Gravel	Median
		(m)	(%)		%	%	%	(Φ)
HS1-1 NE	25	118	0.18	Fine sand	3.48	96.47	0.05	2.19
HS1-1 SW	25	117	0.40	Fine sand	6.91	93.09		2.52
HS1-2 NE	100	118	0.23	Fine sand	4.15	95.79	0.06	2.63
HS1-2 SW	100	117	0.18	Fine sand	4.26	95.68	0.06	2.62
HS1-3 NE	200	118	0.26	Fine sand	2.68	97.20	0.12	2.7
HS1-3 SW	200	118	0.29	Fine sand	2.67	97.33	0.00	2.65
HS1-3 SE-extra	400	118	0.46	Fine sand	5.18	94.77	0.05	2.58
HS2-1 NE	25	112	0.31	Fine sand	19.03	80.61	0.36	2.41
HS2-1 SE	25	113	0.13	Fine sand	5.93	93.94	0.13	2.52
HS2-2 NE	100	112	0.29	Fine sand	4.19	95.76	0.05	2.58
HS2-2 SE	100	114	0.21	Fine sand	0.71		0.06	2.52
HS2-3 NE	200	112	0.21	Fine sand	5.21	94.34	0.44	2.19
HS2-3 SE	200	116	0.35	Fine sand	3.66	96.13	0.21	2.5
Control-1		106	0.19	Fine sand	0.24	99.35	0.41	2.31
Control-2		119	0.22	Fine sand	2.7	97.30	0.00	2.61
Control-3		118	0.31	Fine sand	4.27	94.09	1.64	2.64
Max.			**0.46**		**19.03**	**99.35**	**1.64**	**2.70**
Min.			**0.13**		**0.24**	**80.61**	**0.00**	**2.19**

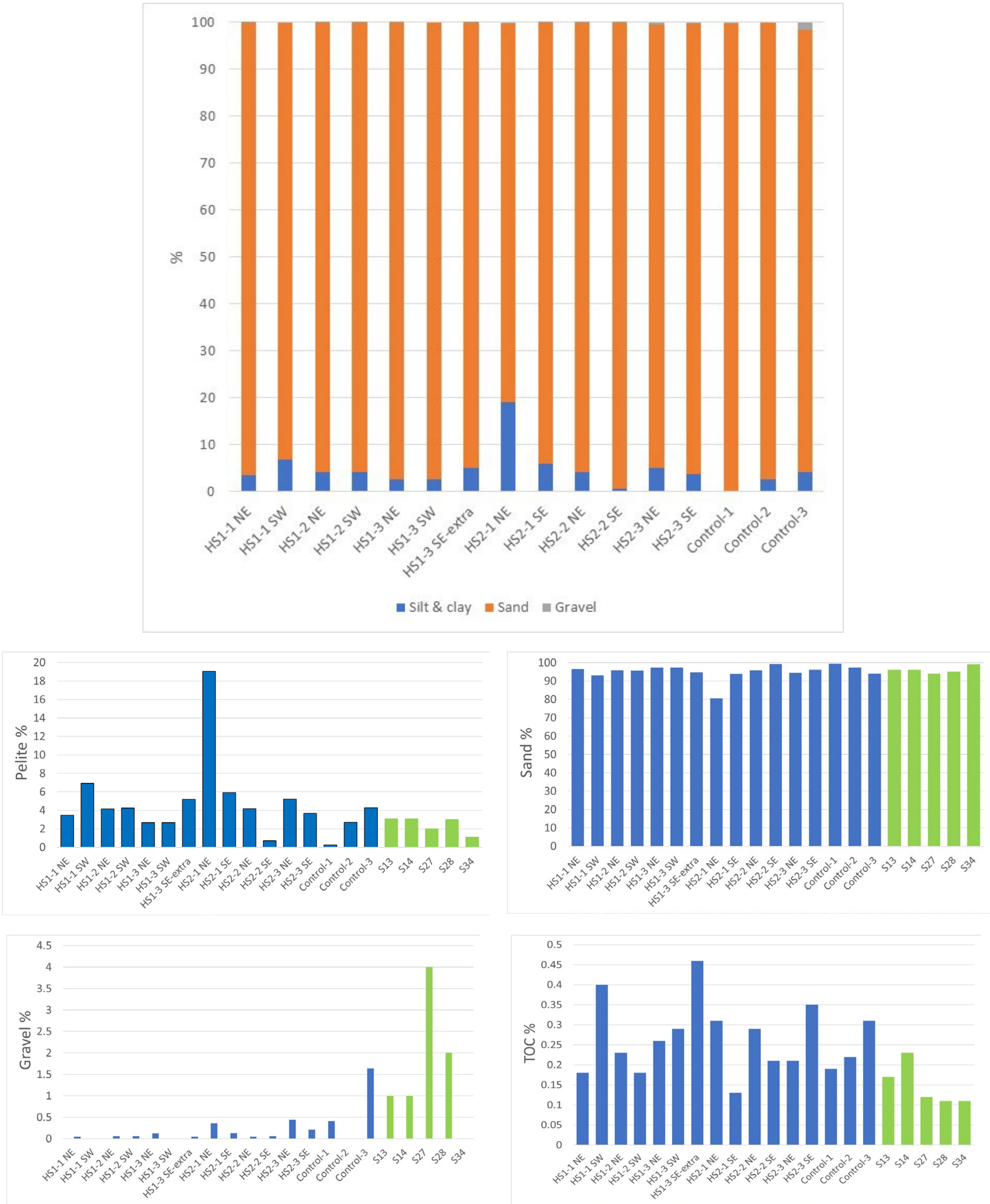


Figure 4-1 Hywind Scotland, sediment characterization. Pelite (Silt & clay), total sand and gravel content. Comparisons with previous sampling (MMT, 2013) is shown in bottom figures (green bars).

4.2 Biological analyses

4.2.1 Biodiversity and dominant species

Sediment samples for fauna analyses were obtained by use of Van Veen grab. Five replicates were analysed at each station.

Table 4-2 shows the distribution of individuals and taxa. A total of 9241 individuals distributed among 199 different taxa were recorded (juveniles excluded).

Number of species, individuals, and the diversity indexes H, J and ES100 for the different environmental stations sampled is given in Table 4-3. All the environmental stations (including the control stations) are species rich, and the diversity is high. Indicator species according to AMBI (for disturbances such as physical disturbance, organic content, heavy metals etc.) were almost absent and only present in very few numbers at stations HS1-2NE, HS1-2SW, HS1-3SW, HS2-2NE and HS2-2SE. The number of indicator species individuals was negligible, with only maximum of two individuals of *Oligochaeta* observed, and therefore not taken into consideration in the analysis.

For detailed species list and the ten most common species at each station see Appendix A Test report.

Table 4-2 Distribution of individuals and taxa within the main taxonomic groups Hywind Scotland 2022 (juveniles excluded).

Faunal groups	Individuals		Taxa	
	Number	%	Number	%
Polychaeta	4610	49,9	101	50,8
Crustacea	1763	19,1	57	28,6
Mollusca	1757	19,0	24	12,1
Echinodermata	634	6,9	8	4,0
Varia	477	5,2	9	4,5
Total	**9241**	**100**	**199**	**100**

Table 4-3 Number of species (S), individuals (N), biodiversity indices (H’), evenness (J) and ES100 Hywind Scotland 2022 (juveniles excluded).

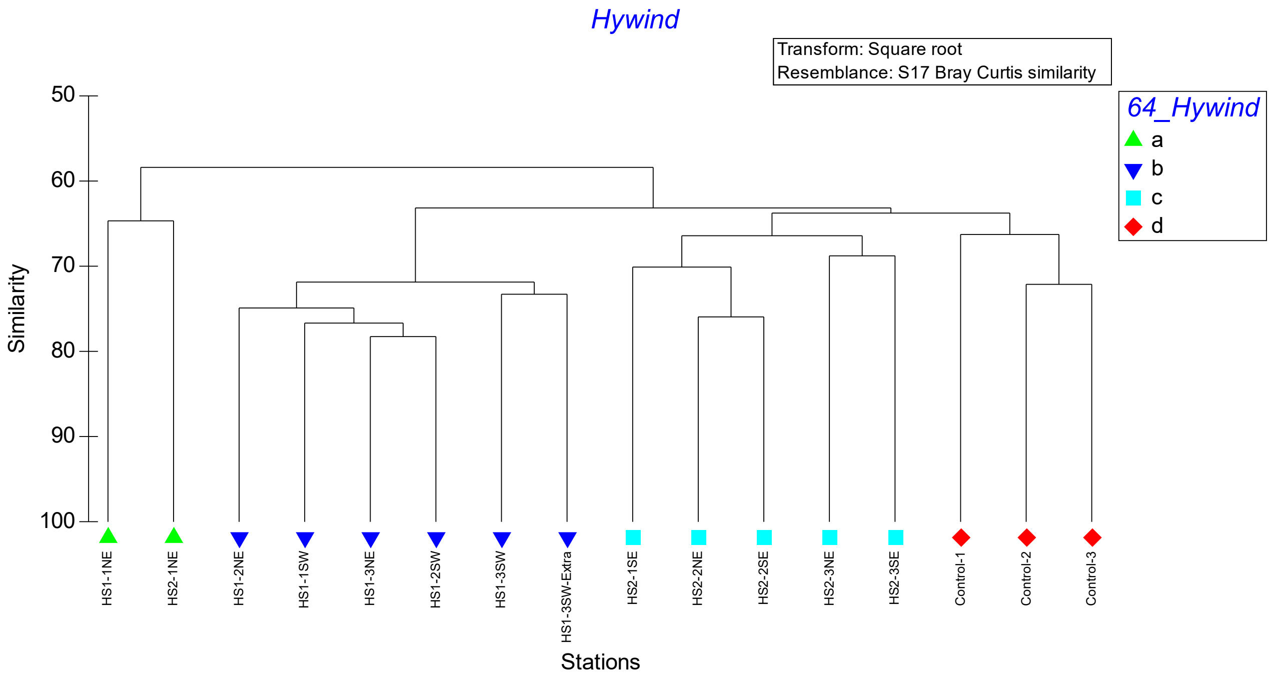
Station	S	N	H'	J'	ES (100)
HS1-1 NE	77	430	5,0	0,80	38
HS1-1 SW	88	707	5,3	0,82	40
HS1-2 NE	86	752	5,0	0,78	36
HS1-2 SW	94	773	5,1	0,78	39
HS1-3 NE	92	747	5,2	0,79	39
HS1-3 SW	89	647	5,3	0,82	42
HS1-3 SW-extra	81	533	5,3	0,83	41
HS2-1 NE	60	340	4,8	0,82	35
HS2-1 SE	76	469	4,9	0,79	38
HS2-2 NE	84	571	5,1	0,79	38
HS2-2 SE	78	657	4,9	0,79	37
HS2-3 NE	75	397	5,1	0,82	41
HS2-3 SE	72	461	4,7	0,77	37
Control-1	74	490	4,7	0,76	35
Control-2	87	642	5,2	0,81	41

Control-3	83	625	5,0	0,79	40
Min	60	340	4,7	0,76	35
Max	94	773	5,3	0,83	42

4.2.2 Multivariate analyses

Cluster diagram and MDS plot resulting from similarity analyses of species composition at the different stations are shown in Figure 4-2. The analyses show that the two stations HS1-1 NE and HS2-1 NE (group a) differ some from the rest of the environmental stations, but not a lot. The main reason for this is due to having generally fewer individuals of the polychaeta *Scoloplos armiger* and more individuals of the polychaeta *Ophelia borealis*. *Ophelia borealis* is a common species found all over the North Sea and is characterized as a sensitive species according to AMBI. Despite these differences, the diversity at these stations remained high, and there were no indicator species present. The remaining three groups, including the control stations, are rather similar and mostly differs by having varying number of individuals of the most common species.

To compare the species composition with the environmental variables (depth, organic content, and grain size) a BioEnv analysis was conducted. There was no evidence of correlation between the environmental variables in this study and species composition that could explain the different cluster-groupings.



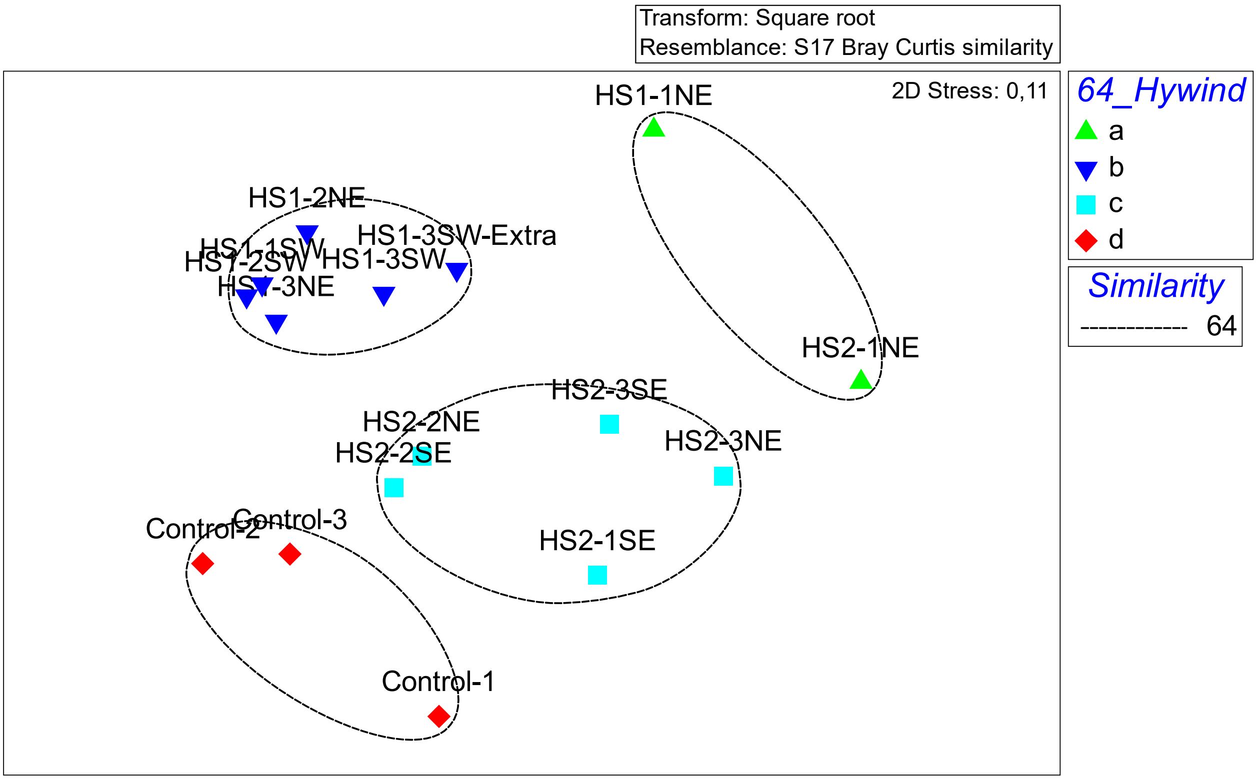


Figure 4-2 Cluster diagram (top) and MDS plot (bottom) resulting from similarity analyses of species composition of macrofauna in sediment samples, Hywind Scotland 2022.

Table 4-4 Table showing main reason for grouping of stations in similarity analyses

Group	Stations	Main reason for grouping
A	HS1-1NE, HS2-1NE	Differs from the rest of the groups by having fewer individuals of the polychaete *Scoloplos armiger* and more of the polychaete *Opehlia borealis*. High diversity.
B	Rest of HS1	Differs from group C and D by having generally more individuals of the most common species. There is also generally more species in this group. High diversity.
C	Rest of HS2	Differs from group D by having a bit less individuals of the polychaete *Scoloplos armiger* and the mollusc *Kurtiella bidentata*. High diversity.
D	Control 1-3	Similar in species composition compared to main groups of HS1 and HS2. High diversity.

4.2.3 Diversity over years

Five sampled stations on Hywind Scotland area from 2013 have been compared to sampled stations in 2022. Only one replicate per station was sampled in 2013 (stations S13, S14, S27, S28, S34), while 5 replicates per station were sampled in 2022. To compare 2013 and 2022-results, mean values have been calculated for 2022-stations. Juveniles have been excluded from the analyses. Number of species, individuals, and diversity indices J (Evenness), ES100 and H'(Shannon-Wiener diversity) are shown in Table 4-5. The general trend from 2013 to 2022 is that stations sampled in 2022 have the same amount or more species and individuals than 2013-stations (Figure 4-3 and Figure 4-4). The Shannon-Wiener Diversity Index (H') also shows that the diversity is the same as in 2013 or higher for all 2022-stations (Figure 4-5).

Table 4-5 Number of species (S), individuals (N), biodiversity indices (H'), evenness (J) and ES100 at Hywind Scotland 2013 and 2022 (juveniles excluded).

Stations	S	N	J'	ES (100)	H'(loge)
S13 (2013)	29	63	0,84	29,00	2,84
S14 (2013)	22	70	0,74	22,00	2,30
S27 (2013)	22	49	0,86	22,00	2,67
S28 (2013)	18	52	0,84	18,00	2,43
S34 (2013)	16	71	0,78	16,00	2,17
HS1-1NE-1	32	86	0,81	32,00	2,82
HS1-2NE-1	42	150	0,85	34,47	3,17
HS1-3NE-1	45	149	0,86	37,70	3,27
HS1-1SW-1	45	141	0,88	38,48	3,33
HS1-2SW-1	46	155	0,84	36,95	3,22
HS1-3SW-1	46	129	0,86	39,03	3,29
HS1-3SW-Extra-1	38	107	0,86	34,74	3,10
HS2-1NE-1	27	68	0,87	27,40	2,86
HS2-2NE-1	37	114	0,86	34,12	3,08
HS2-3NE-1	32	79	0,85	29,98	2,86
HS2-1SE-1	34	94	0,83	32,99	2,91
HS2-2SE-1	39	131	0,83	34,55	3,05
HS2-3SE-1	32	92	0,84	31,03	2,88
Control-1-1	32	98	0,84	29,09	2,85
Control-2-1	45	128	0,86	38,76	3,25
Control-3-1	41	125	0,83	36,38	3,09

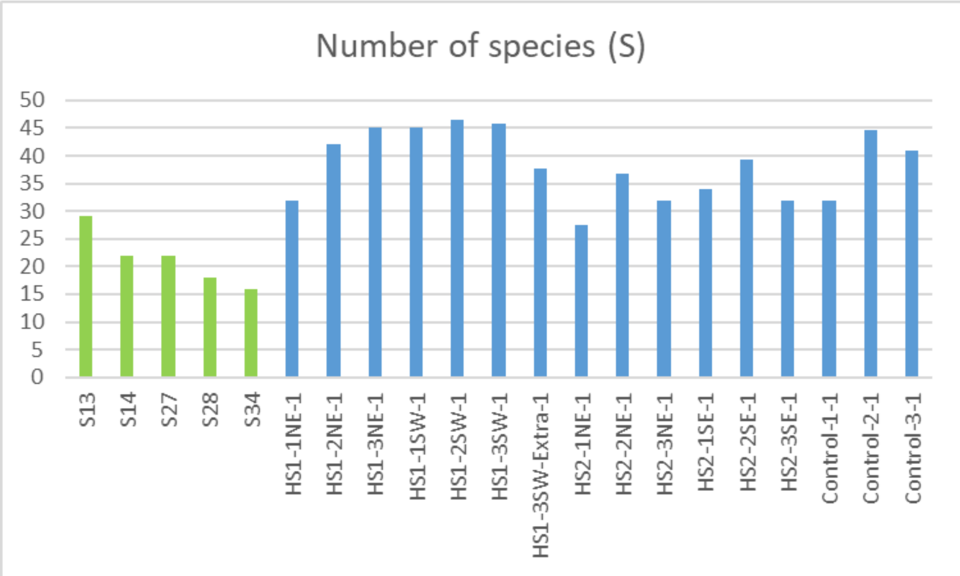


Figure 4-3 Number of species on Hywind Scotland stations, 2013 (green bars) and 2022-stations.

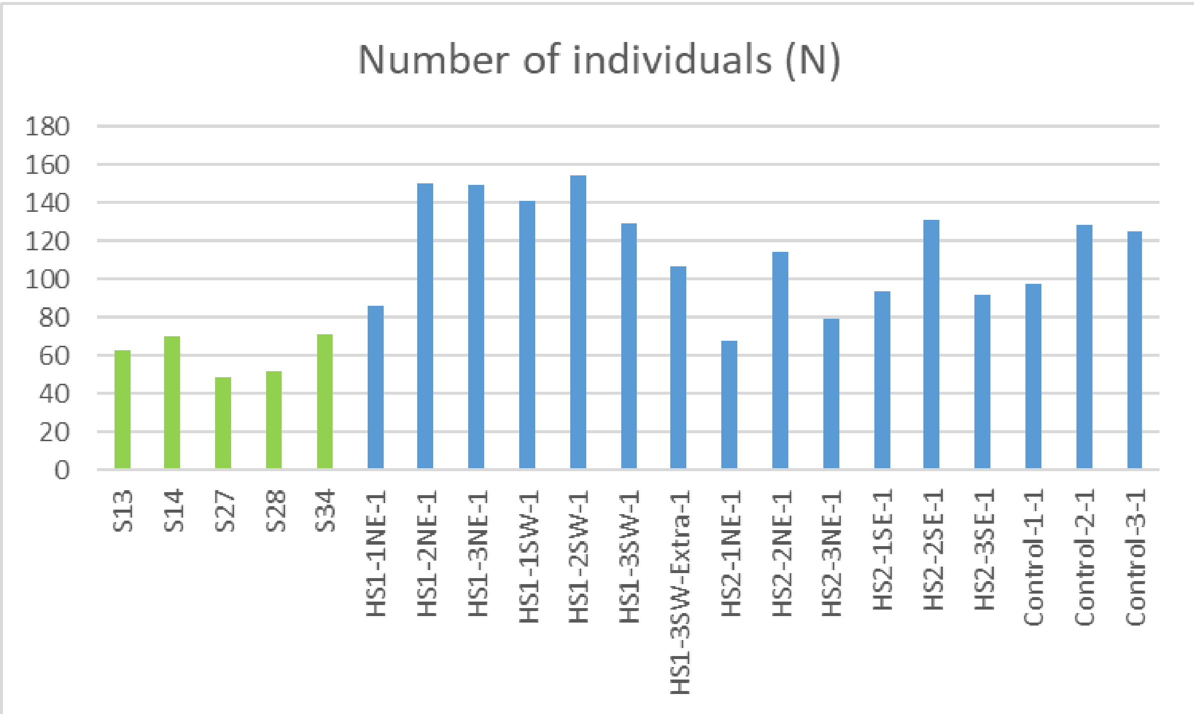


Figure 4-4 Number of individuals on Hywind Scotland stations, 2013 (green bars) and 2022-stations.

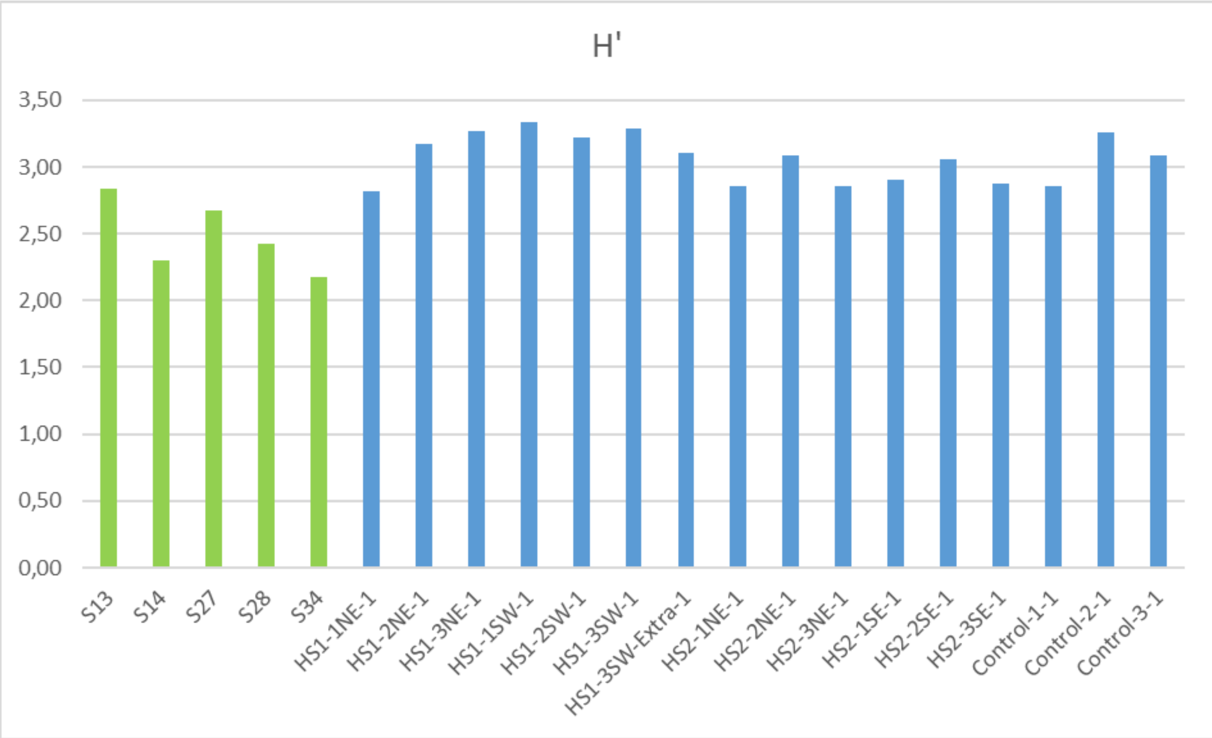


Figure 4-5 The Shannon-Wiener Diversity Index (H) showing equivalent or higher diversity in 2022-stations compared to stations sampled in 2013 (green bars), Hywind Scotland.

4.3 Visual survey of megafauna and debris

4.3.1 General description

The seabed was relatively flat with depth varying between 115 – 118 meters. Ripple marks were evident throughout the sites investigated. Maps summarizing findings in the visual surveys at HS1 and HS2 are given in Figure 4-6 and Figure 4-7. Example images of the seabed at different distances from the wind turbines is given in Figure 4-8.

4.3.2 Sediment characteristics

The sediment was comprised of almost exclusively fine sand with fragments of shells. EUNIS habitat classification (pan European system for habitat classification) corresponds to “Infralittoral fine sand” (EUNIS A5.23). The seabed closest to the turbines had “low” and “moderate” densities of blue mussel shells originating from the wind turbine and associated anchor chains. The amount of shell debris was not particularly high. This is more discussed in Chapter 5.

4.3.3 Fauna description

No red listed species or OSPAR type habitats were registered (Table 4-7). Density of seabed megafauna was in general scattered to moderate. Twenty species were recorded at the sites investigated (5 fish species included). The seabed was dominated by scattered occurrences of sea stars *Asterias rubens* and *Luidia sarsii*, sea anemones *Urticina* sp. and *Edwardsia* sp. a few sea pens and single individuals of sponges. The two visual transects investigated were very similar, with a few more “dead mans fingers” (*Alcyonium*) being registered at HS1 compared to HS2. A species list summarizing findings is given in Table 4-8.

Table 4-6 Compilation of relevant potentially vulnerable species and nature types known to occur in UK waters

Habitat/ species name	Presence
Carbonate mounds	Not observed
Coral gardens	Not observed
Deep-sea sponge aggregations	Not observed
Haploops habitat	Not observed
Lophelia pertusa reefs	Not observed
Maerl beds	Not observed
Ostrea edulis beds	Not observed
Sabellaria spinulosa reefs	Not observed
Sea-pen & burrowing megafauna	Single specimens of sea pens
Ocean quahog (*Arctica islandica*)	Not observed
Stony reef	Not observed

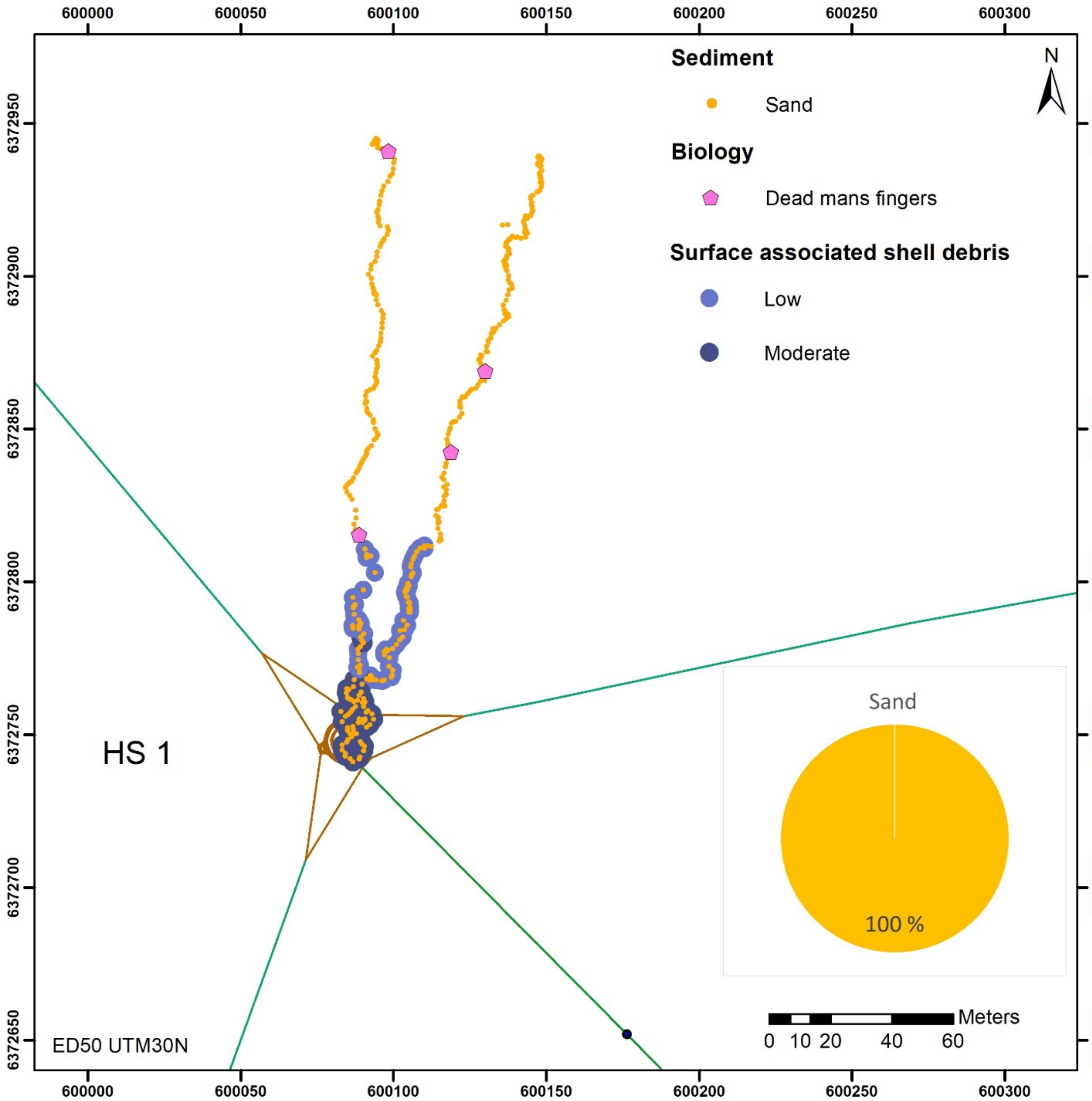


Figure 4-6 Map showing main findings from the visual survey at turbine HS1, Hywind Scotland. Sediment composition is presented in cake diagram.

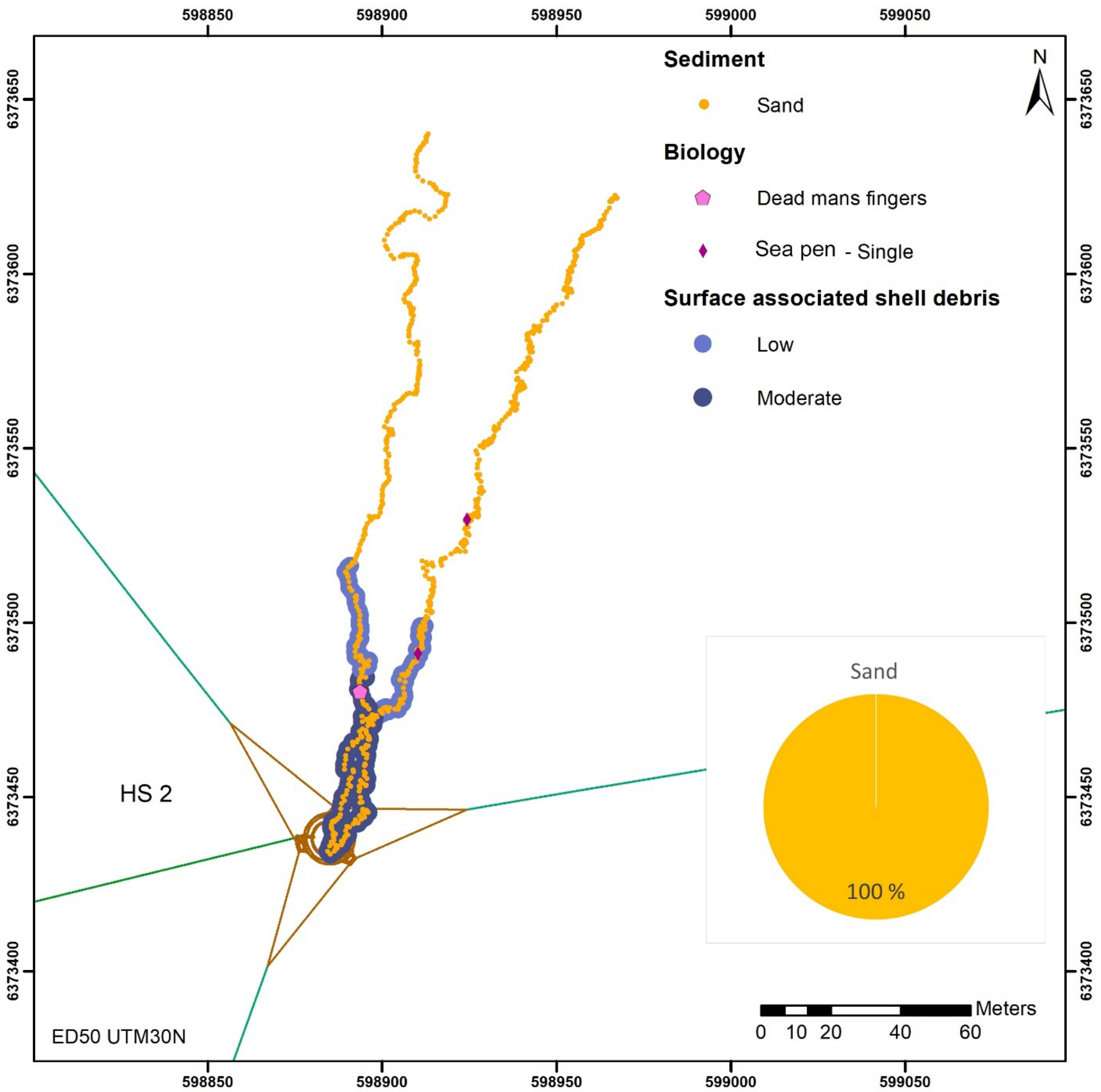


Figure 4-7 Map showing main findings from the visual survey at turbine HS2, Hywind Scotland. Sediment composition is presented in cake diagram.

Table 4-7 Species list from visual surveys at Hywind Scotland turbines (HS1 and HS2). Abundances given according to the SACFOR scale O: "Occasional", R: "Rare"

Species	HS1	HS2
Porifera		
Axinella spp.	R	R
Tethya sp.	R	R
Cnidaria		
Pennatulacea indet.	R	R
Alcyonium digitatum	R	R
Tubularia larynx	R	
Urticina spp.	R	R
Edwarsiidae indet.		R
Actinaria indet.		R
Annelida		
Aphrodite aculeata	O	R
Sabellidae indet.		R
Ditrupa arietina	O	O
Crustacea		
Pagurus sp.		R
Mollusca		
Acanthocardia echinata	O	O
Colus sp.		R
Echinodermata		
Asterias rubens	O	R
Echinocardium flavescens	O	O
Echinus esculentus	R	
Luidia sarsii	R	O
Hippasterias phrygiana	R	
Pisces		
Merlangius merlangius	R	R
Lophius piscatorius	R	
Cf. *Microstomus kitt*	R	O
Gadus morhua	R	
Eutrigla gurnardus	R	

Figure 4-8 Example images from seabed close to turbines (HS1 and HS2), Hywind Scotland. Top: outermost part of transect, Bottom: images from closest to the turbines.

5 DISCUSSION AND CONCLUSIONS

Sediment characterization

The sediment at Hywind Scotland can be characterized as fine sand. The sediment grain size and TOC at stations close to the two turbines are in general not deviating compared to the control stations. The content of TOC, silt& clay (pelite) and sand are in general very similar at all sampled stations. Compared to the results in 2013 the results in 2022 are in general similar.

Biological analysis - macrofauna

The macrofauna at Hywind Scotland is species rich and the diversity is high. The number of indicator species individuals was negligible, with only maximum of two individuals of *Oligochaeta* observed, and therefore not taken into consideration in the analysis. The macrofauna at all stations are evaluated as undisturbed and representing natural macrofauna in the area.

The multivariate analyses of species composition at different stations showed that stations HS1-1 NE and HS2-1 NE (group a), closest to the turbines, differed slightly due to fewer individuals of *Scoloplos armiger* and more individuals of *Ophelia borealis*, while the remaining groups were similar. A BioEnv analysis revealed no significant correlation between species composition and environmental variables (depth, organic content, and grain size).

Compared to results from 5 stations sampled in 2013 the general trend from 2013 to 2022 is that stations sampled in 2022 have the same amount or more species and individuals compared to 2013.The species diversity also shows that the diversity is the same or higher for all stations sampled in 2022 compared to 2013. It is important to underline that only one replica pr. station was sampled in 2013 and that the stations are not the same as those sampled in 2022. In 2022 5 replica were sampled pr. station which may explain some of the difference in number of individuals and species, despite that the 2022 results were compared on average basis and not total sum.

Biological analysis – megafauna and debris (visual survey)

No red listed species or OSPAR type habitats were registered at the two locations investigated.

The seabed was relatively flat with depth varying between 115 – 118 meters. Ripple marks were evident throughout the sites investigated. The sediment was comprised of almost exclusively fine sand with fragments of shells and aggregation of shell fragments. The seabed closest to the turbines was covered in “low” and “moderate” densities of blue mussel shells originating from the wind turbine and associated anchor chains, the amount of shell debris was not particularly high.

From the current study it is evident that the wind turbines at Hywind Scotland have the potential to alter the seabed characteristics, by introducing organic matter and shell debris originating from the floating structure and chains, as well as inducing changes in the seabed sediment characteristics. Over time it is expected that the seabed habitat will change in the immediate area surrounding the wind turbines. Alterations in seabed community structure and micro and macro benthic biodiversity has been reported in several studies (e.g. Leonhard and Petersen, 2006; Coates et al., 2014; Lefiable et al., 2018, 2019). The current study showed moderate amounts of shell debris out to ~20-30 meter from the turbine centre location, and low amounts of debris out to ~60 meter from the centre. At Hywind Scotland about 10 000 m^2 can be assumed to be impacted by moderate to high amounts of shell debris on the seabed (assuming a radius of 25 meter around each of the 5 turbines at Hywind Scotland will be subject to future accumulation of debris). In a future scenario the seabed can also be expected to be impacted by fall off from mussels directly beneath anchor chains. The blue mussels are expected to grow on structures and chains at depths down to a maximum of 15-20 meters depth on offshore installations in the North Sea, with the densest aggregations occurring in the shallowest parts.

The amount of shell debris, and other fall-off from the structures, is expected to increase over time in the area close to the centre. Increased density of debris, and perhaps a larger footprint of the denser coverage is expected. Over time a build-up of a “mound” of shell debris including alive and dying blue mussels and associated fauna near the centre and perhaps under chain segments closest to the turbine may be expected. The size and extent of the seabed footprint is expected to be governed by the prevailing current direction. The epifauna and macrofauna communities within the sediments will probably be affected by increased organic loads, increased heterogeneity within the shell debris, and potential reduced oxygenation of buried seabed. Biodiversity can be impacted both positively or negatively, depending on fauna types and actual changes on the surrounding seabed (see e.g. Wilhelmsson and Malm, 2008).
The impact on the seabed macrofauna can be studied in the sediment samples taken close to the installation. No impact on the macrofauna was identified in 2022, even at 25 meters distance. As shell debris start to accumulate, alterations in macrofauna communities will probably be registered also at a distance of 25 meters. The most noticeable changes in sediment dwelling macrofauna will probably take place closest to the turbine where amount of organic enrichment (from dead mussels falling straight down and other organic material) will be higher.

Studies to assess long term effects from the wind turbines on the seabed habitats is therefore interesting.
Numerous studies (see e.g. Krone et al., 2013; Bray et al., 2016; Gates et al., 2019) have pointed out offshore artificial structures’ role in supporting large amounts of marine growth and how this growth can create artificial reef ecosystems and with introduction of hard bottom macrozoobenthos in otherwise uniform seabed habitats. The growth on the artificial surfaces can also create secondary growth on the outside of mussels and on mussel shells falling to the seabed, thus supporting increased biodiversity.

It is growing concern that artificial surfaces from e.g. wind farms might also can function as stepping stones for potential spreading of alien species (Langhamer, 2012; .Adams et al., 2014) via increased connectivity between hard substrate islands in the open ocean. Increased risk of introduction of alien species might also be expected to arise from decommissioning activities where offshore installations are transported to shore and cleaned. No invasive species were, however, detected in this survey.

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APPENDIX A
Test report

EQUINOR – HYWIND UK

Test report; Equinor Hywind

10334737

Report nr.: 2023-0282, Rev. 1

Date: 2023-03-17

NORSK AKKREDITERING TEST 083

Project name:	Equinor – Hywind UK	DNV AS Energy Systems
Report title::	Test report; Equinor Hywind	Environmental Risk Mgt Nordics
Customer:	10334737	Veritasveien Høvik 1363
Customer contact:	Thomas Møskeland	
Date of issue:	2023-03-17	Norway
Project No..:	10334737	Tel: +47 67 57 99 00
Organisation unit:	Environmental Risk Mgt Nordics	945 748 931
Report nr.:	2023-0282, Rev. 1	

Summary: On behalf of the "Equinor – Hywind UK" project, DNV's Biolaboratory has conducted monitoring surveys (collection and analysis of marine sediments) on the fields “Hywind 1”, “Hywind 2” and the reference stations “Hywind control” in 2022. Sorting took place at the Biolaboratory from 03.11 – 21.11.22. Species identification was conducted from 01.10.22 – 15.02.23. Indices and evaluations were performed from 14.02 – 01.03.22.

The following procedures were used: OP-BIOLAB-BS-3-1-02, OP-BIOLAB-BS-3-3-02, OP-BIOLAB-EM-18-05, OP-BIOLAB-BS-5-01, OP-BIOLAB-BS-12-04, OP-BIOLAB-BS-4-01 og OP-BIOLAB-HB-2-2-20

Prepared by:	Verified by:	Approved by:
		Tor Jensen
Fredrik Melsom Senior Consultant, Marine biologist	Anders Ommundsen Senior Consultant, Marine biologist	Tor Jensen Vice President - Head of Section

Keywords:
Soft bottom, benthic fauna, species list, environmental monitoring, Hywind

Rev.nr.	Date	Reason for issue	Prepared by	Verified by	Approved by
1	2023-03-17	First issue	Fredrik Melsom	Anders Ommundsen	Tor Jensen

Innholdsfortegnelse

1 FIELD WORK

DNV's Biolaboratory has conducted monitoring surveys (collection and analysis of marine sediments) on the fields «Hywind 1», «Hywind 2» as well as control stations «Hywind-control».

The survey was conducted in accordance with the program presented to the Norwegian Environmental Agency/expert group before the survey started. See Table 1-1 for an overview of fields and samples, as well as Chapter 7 for details regarding stations and sampling.

The sampling was carried out with the vessel "Olympic Electra" during the period from May 9 to June 1, 2022. Samples were collected from a total of 16 stations.

Sediment was collected using grabbs of the type "combigrabb" (0.15 m2) and ordinary "Van-veen" (0.1 m2). Fieldwork was carried out in accordance with the "Guidelines for Environmental Monitoring" (M-300, 2015) and DNV's accredited methods for this type of work (Test 083).

The fauna samples were transported to DNV's Biolaboratory for processing and biological analysis. Chemical samples were frozen and sent to Sintef Norlab for analysis.

Results from chemical analyses are not reported in this test report.

Table 1-1 Fields and analyses, Hywind, 2022.

Field	Bio	Grain/ TOC	DNA*
Hywind 1	35	6	21
Hywind 2	30	5	18
Hywind control	15	3	9
Total	**80**	**14**	**48**

*Not accredited

Locality: Offshore UK sector
Date: 09.May – 01. June 2022
Survey participants: The survey was conducted on a 6-hour shift system with the following personnel:

Personnel	Company	Role	Period
Amund Ulfsnes	DNV	Survey leader	9.5.22 - 1.6.22
Øyvind Fjukmoen	DNV	Shift leader	9.5.22 - 20.5.22
Tormod Glette	DNV	Shift leader	20.5.22 - 1.6.22
Lars Ulvestad	DNV	Shift leader	9.5.22 - 1.6.22
Anders Glette Johnsen	DNV		9.5.22 - 1.6.22
Ludvig Søgnen Jensen	DNV		20.5.22 - 1.6.22
Anders Ommundsen	DNV		9.5.22 - 20.5.22
Knut Magne Rui	Sintef Norlab		9.5.22 - 20.5.22
Bjørn Brekke	Sintef Norlab		9.5.22 - 20.5.22
Einar Vidarsson	Sintef Norlab		20.5.22 - 1.6.22
Thomas Trulsen	Sintef Norlab		20.5.22 - 1.6.22

Used procedures: OP-BIOLAB-BS-2-2-01 and OP-BIOLAB-BS-2-2-02.

This report is written in accordance with OP-BIOLAB-BS-5-01.

Critical equipment ID:

- Grabs: B25, B29, B33, B34
- Sieve: B-7.1, B-7.2, B-7.3, B-7.6

All exceptions to relevant procedures are recorded in DNV's non-conformance management system "Synergi Life". No registered non-conformities.

2 SORTING

Sorting was conducted in the biolaboratory in the period 03.11 – 21.11.22 of the following personnel:

Sorters: Ludvig Søgnen Jensen (responsible sorter), Anders Glette Johnsen (RS), Matias Egeberg (RS), Johanne Søgnen Jensen (RS), Erik Skultety (RS), Hedda Jendem, Eivind Øftshus Gravir, Emma Høgh Åslein, Simen Knoph, Astrid Kirkemo Wermåker, Rebekka Hofstad, Karoline Mikalsen, Karma Rørnes, Martinus Nissen-Lie, Elise Eckhoff, Katrine Falck Heggen, William Rinaldo, Martin Hofstad, Jenny Myklebust Ulfsnes, Oda Kristiansen, Johanne Paaske, Vilde Rørnes, Simen Busengdal, Ida Serine Bjørgo, Kornelius Glette Lindberg.

Used procedure: OP-BIOLAB-BS-3-1-02.

All exceptions to relevant procedures are recorded in DNV's non-conformance management system "Synergi Life". One non-conformity was recorded for HS1-1NE which had no effect on the results. See Synergi Life case #66645.

3 TAXONOMY

Species identification was conducted 01.10.22 – 15.02.23.

The following personnel have participated in the species identification:

Polychaeta: Anders Ommundsen and Fredrik Melsom

Varia: Anders Ommundsen and Fredrik Melsom

Crustacea: Jon Kristian Haugland

Echinodermata: Fredrik Melsom

Mollusca: Amund Ulfsnes

Used procedures: OP-BIOLAB-BS-3-3-02 og OP-BIOLAB-EM-18-05.

See chapter 6 for species lists. Species lists are also stored at:

P:\OENNO610\NCGNO615\Biolab\Biologiske_analyser\Artsbestemmelse\2022\Offshore\Barents

All exceptions to relevant procedures are recorded in DNV's non-conformance management system "Synergi Life". No registered non-conformities.

4 INDICES AND EVALUATIONS

Calculations of indices and evaluations have been carried out by Fredrik Melsom during the period of 14.02 – 01.03.22. Table 4-1 displays calculations of diversity indices on station level.

The following programs/templates have been used:

- Primer version 6.1.6
- AMBI version 6.0 (Species list v. May2022)
- Fo-BIOLAB-BS-4-04 rev3

Used procedure: OP-BIOLAB-BS-4-01.

Table 4-1 *The number of species (S) and individuals (N) per 0.5 m2, Shannon Wiener's diversity index (H'), ES100 and evenness (J') have been calculated. NQI1, NSI, ISI, and AMBI have been calculated as specified in the "Klassifisering av miljøtilstand I vann - Veileder 02:2018" and "Environmental monitoring of offshore petroleum activities - M300". Presented station wise.*

Station	S	N	H	J'	ES100	NQI1	NSI	ISI	AMBI
HS1-1NE	77	430	5,0	0,80	38	0,86	37	11	1,19
HS1-1SW	88	707	5,3	0,82	40	0,81	28	10	1,76
HS1-2NE	86	752	5,0	0,78	36	0,81	27	11	1,72
HS1-2SW	94	773	5,1	0,78	39	0,82	27	10	1,65
HS1-3NE	92	747	5,2	0,79	39	0,82	26	11	1,72
HS1-3SW	89	647	5,3	0,82	42	0,82	28	11	1,67
HS1-3SW-Extra	81	533	5,3	0,83	41	0,83	29	11	1,57
HS2-1NE	60	340	4,8	0,82	35	0,84	31	11	1,13
HS2-1SE	76	469	4,9	0,79	38	0,82	27	11	1,62
HS2-2NE	84	571	5,1	0,79	38	0,82	27	11	1,68
HS2-2SE	78	657	4,9	0,79	37	0,80	27	10	1,74
HS2-3NE	75	397	5,1	0,82	41	0,83	27	11	1,58
HS2-3SE	72	461	4,7	0,77	37	0,82	29	11	1,62

Control-1	74	490	4,7	0,76	35	0,82	28	11	1,64
Control-2	87	642	5,2	0,81	41	0,82	28	11	1,68
Control-3	83	625	5,0	0,79	40	0,81	27	10	1,83

5 TOP 10 SPECIES

Table 5-1. *Ten most dominant taxa at each station (incl. Juveniles), Hywind 2022*.

HS1-1 NE	No.ind	%	Cum%
Ophelia borealis	77	17	17
Scoloplos armiger	48	11	29
Amphiura filiformis	34	7	36
Echinocyamus pusillus	24	5	42
Bathyporeia elegans	18	4	46
Antalis	17	3	50
Lanice conchilega	13	3	53
Kurtiella bidentata	11	2	56
Chaetozone	10	2	58
Gari fervensis	9	2	60
Number of taxa 77			

HS1-1 SW	No.ind	%	Cum%
Scoloplos armiger	108	15	15
Amphiura filiformis	49	6	22
Spiophanes kroyeri	40	5	27
Eudorellopsis deformis	33	4	32
Bathyporeia elegans	30	4	36
Harpinia antennaria	27	3	40
Kurtiella bidentata	26	3	44
Cerianthus lloydii	24	3	47
Nemertea	21	2	50
Chaetozone	21	2	53
Number of taxa 88			

HS1-2 NE	No.ind	%	Cum%
Scoloplos armiger	126	16	16
Kurtiella bidentata	56	7	24
Amphiura filiformis	54	7	31
Bathyporeia elegans	50	6	38
Eudorellopsis deformis	42	5	43
Cerianthus lloydii	35	4	48
Chaetozone	30	3	52
Spiophanes kroyeri	29	3	56
Antalis	23	3	59
Lanice conchilega	22	2	62
Number of taxa 86			

HS1-2 SW	No.ind	%	Cum%
Scoloplos armiger	167	21	21
Amphiura filiformis	40	5	26
Cerianthus lloydii	37	4	31
Bathyporeia elegans	36	4	36
Antalis	34	4	40
Eudorellopsis deformis	25	3	43
Kurtiella bidentata	25	3	47
Spiophanes kroyeri	24	3	50
Ennucula tenuis	23	2	53
Nemertea	22	2	56
Number of taxa 94			

HS1-3 NE	No.ind	%	Cum%
Scoloplos armiger	138	18	18
Kurtiella bidentata	53	7	25
Bathyporeia elegans	41	5	31
Eudorellopsis deformis	40	5	36
Amphiura filiformis	36	4	41
Cerianthus lloydii	33	4	45
Spiophanes kroyeri	29	3	49

HS1-3 SW	No.ind	%	Cum%
Scoloplos armiger	115	17	17
Bathyporeia elegans	36	5	23
Kurtiella bidentata	31	4	28
Amphiura filiformis	31	4	32
Eudorellopsis deformis	25	3	36
Ophelia borealis	24	3	40
Antalis	20	3	43

Harpinia antennaria	24	3	52
Nemertea	19	2	55
Lanice conchilega	19	2	57
Number of taxa 92			

HS1-3 SW-extra	No.ind	%	Cum%
Scoloplos armiger	85	15	15
Amphiura filiformis	39	7	23
Kurtiella bidentata	29	5	28
Bathyporeia elegans	24	4	33
Diplocirrus glaucus	20	3	36
Ophelia borealis	18	3	40
Antalis	18	3	43
Cerianthus lloydii	17	3	46
Eudorellopsis deformis	17	3	50
Ennucula tenuis	17	3	53
Number of taxa 81			

HS2-1 SE	No.ind	%	Cum%
Scoloplos armiger	103	21	21
Kurtiella bidentata	34	7	29
Amphiura filiformis	33	7	36
Eudorellopsis deformis	29	6	42
Ophelia borealis	26	5	47
Bathyporeia elegans	23	4	52
Cerianthus lloydii	12	2	55
Spiophanes kroyeri	11	2	57
Goniada maculata	9	1	59
Nephtys cirrosa	9	1	61
Number of taxa 76			

HS2-2 SE	No.ind	%	Cum%
Scoloplos armiger	154	23	23
Eudorellopsis deformis	38	5	29
Kurtiella bidentata	35	5	34
Amphiura filiformis	31	4	39
Spiophanes kroyeri	28	4	43
Harpinia antennaria	26	3	47

Nemertea	19	2	46
Abra prismatica	19	2	49
Prionospio fallax	18	2	52
Number of taxa 89			

HS2-1 NE	No.ind	%	Cum%
Ophelia borealis	45	13	13
Bathyporeia elegans	44	12	26
Scoloplos armiger	39	11	37
Antalis	19	5	43
Eudorellopsis deformis	13	3	47
Nephtys cirrosa	12	3	50
Cerianthus lloydii	11	3	53
Amphiura filiformis	11	3	57
Magelona filiformis	9	2	59
Kurtiella bidentata	9	2	62
Number of taxa 60			

HS2-2 NE	No.ind	%	Cum%
Scoloplos armiger	95	16	16
Kurtiella bidentata	66	11	28
Bathyporeia elegans	27	4	32
Eudorellopsis deformis	27	4	37
Diplocirrus glaucus	23	4	41
Harpinia antennaria	23	4	45
Amphiura filiformis	23	4	49
Chaetozone	22	3	53
Spiophanes kroyeri	19	3	56
Ennucula tenuis	18	3	60
Number of taxa 35			

HS2-3 NE	No.ind	%	Cum%
Scoloplos armiger	76	19	19
Ophelia borealis	41	10	29
Spiophanes kroyeri	17	4	33
Kurtiella bidentata	17	4	38
Antalis	16	4	42
Amphiura filiformis	15	3	45

Antalis	21	3	50
Bathyporeia elegans	19	2	53
Cerianthus lloydii	15	2	55
Chaetozone	15	2	58
Number of taxa 78			

Cerianthus lloydii	13	3	49
Nephtys cirrosa	11	2	51
Petalosarsia declivis	10	2	54
Diastyloides serratus	8	2	56
Number of taxa 75			

HS2-3 SE	No.ind	%	Cum%
Scoloplos armiger	125	27	27
Bathyporeia elegans	36	7	34
Amphiura filiformis	25	5	40
Ophelia borealis	20	4	44
Antalis	17	3	48
Chaetozone	15	3	51
Magelona filiformis	15	3	54
Eudorellopsis deformis	15	3	58
Cerianthus lloydii	13	2	60
Ennucula tenuis	11	2	63
Number of taxa 72			

Control 1	No.ind	%	Cum%
Scoloplos armiger	116	23	23
Bathyporeia elegans	46	9	33
Kurtiella bidentata	44	8	42
Amphiura filiformis	32	6	48
Ophelia borealis	15	3	51
Eudorellopsis deformis	14	2	54
Thracia villosiuscula	14	2	57
Antalis entalis	13	2	59
Abra prismatica	13	2	62
Lumbrineris	11	2	64
Number of taxa 74			

Control 2	No.ind	%	Cum%
Scoloplos armiger	120	18	18
Kurtiella bidentata	41	6	25
Spiophanes kroyeri	36	5	30
Amphiura filiformis	31	4	35
Tellimya ferruginosa	21	3	38
Abra prismatica	21	3	42
Eudorellopsis deformis	20	3	45
Bathyporeia elegans	18	2	47
Harpinia antennaria	18	2	50
Diplocirrus glaucus	17	2	53
Number of taxa 87			

Control 3	No.ind	%	Cum%
Scoloplos armiger	148	23	23
Amphiura filiformis	47	7	31
Kurtiella bidentata	40	6	37
Antalis entalis	30	4	42
Spiophanes kroyeri	23	3	46
Bathyporeia elegans	19	3	49
Prionospio fallax	13	2	51
Ennucula tenuis	13	2	53
Chaetozone	12	1	55
Pholoe assimilis	12	1	57
Number of taxa 83			

6 SPECIES LIST

Hywind 1	HS1-1NE	HS1-2NE	HS1-3NE	HS1-1SW	HS1-2SW	HS1-3SW	HS1-3SW-Extra
Oligochaeta		1				2	
Cerianthus lloydii	7	35	33	24	37	16	17
Edwardsia	1	1			2	1	
Nemertea	8	17	19	21	22	19	8
Phoronis	2	4	6	3	5	4	2
Platyhelminthes		2	1		1	1	
Golfingiidae							1
Nephasoma			2				
Phascolion (Phascolion) strombus strombus	3	2		1			
Anobothrus gracilis			2	1	1		1
Paramphinome jeffreysii				2	1	1	
Heteromastus filiformis		3	3	2	4	3	5
Notomastus	1	3	1	3	2	2	2
Aphelochaeta	2	14		10	4		2
Chaetozone	10	30	18	21	13	14	16
Cirratulus cirratus				1			
Tharyx killariensis			11	11		3	3
Diplocirrus glaucus	1	12	10	8	14	9	20
Glycera lapidum	4	1	3	2		1	3
Glycera unicornis	1		1	3		2	
Glycinde nordmanni	2	2	2	2	5	2	1
Goniada maculata	2	2	10	8	10	6	6
Podarkeopsis helgolandicus		1	4	4	1	3	4
Lumbrineris	2	8	2	11	4	2	1
Magelona filiformis	5	1	3	2	2	2	
Magelona minuta	2	6	3	11	2	12	4

Magelona mirabilis			1	1	1		
Nephtys juv.	5	6	2	3	3	7	4
Nephtys assimilis		1	3		1	1	2
Nephtys caeca			1				
Nephtys cirrosa	3	1			1	2	3
Nephtys hombergii	3	2		1	1	4	2
Nephtys kersivalensis	1			1			
Nephtys longosetosa							1
Hyalinoecia tubicola				1			
Ophelia borealis	77	8	2	6	3	24	18
Opheliidae juv.	1						
Ophelina acuminata			2		1		1
Ophelina modesta			2				
Galathowenia oculata		2	1	1	2		1
Owenia	1						
Aricidea (Acmira) catherinae		1	2	4			4
Aricidea (Acmira) simonae						2	
Aricidea (Aricidea) wassi	1	11	5	4	8	9	2
Aricidea (Strelzovia) suecica		2		1			3
Paradoneis lyra	4		5	2	3	2	2
Pholoe assimilis			2			3	1
Pholoe baltica		4	12	9	8	4	6
Pholoe pallida					1		
Eteone	1					2	
Eulalia bilineata						1	
Hypereteone foliosa						1	
Phyllodoce juv.					1		
Phyllodoce groenlandica		2					
Sige fusigera				2			

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Ancistrosyllis	1						
Glyphohesione klatti		5	6		2	8	7
Sigalionidae juv.		1	1		1		
Poecilochaetus serpens	1	1		1			
Enipo kinbergi	1		1		1	3	2
Harmothoe				1			
Malmgrenia andreapolis						1	
Malmgrenia castanea		1	2	1	2	1	
Malmgrenia ljungmani		2					
Polynoidae juv.	1	1	2	3	3	2	
Chone		1		1		2	
Scalibregma inflatum				1	2		
Pisione remota							3
Sthenelais limicola	3	2	2	8	7	2	2
Sphaerodorum gracilis	1	1	4	1	2	5	1
Aonides paucibranchiata	1	11	1			6	4
Dipolydora		2	1	1	1	3	1
Prionospio cirrifera	1		6	7	9	3	5
Prionospio fallax	2	6	14	10	13	18	6
Pseudopolydora pulchra	1	1					
Scolelepis (Parascolelepis) tridentata		2					
Scolelepis bonnieri	2	2	3	4	3	6	4
Scolelepis korsuni						1	
Spio	1		1		1		1
Spiophanes bombyx	2	7	4	11	7	8	3
Spiophanes kroyeri	7	29	29	40	24	16	14
Exogone verugera		1				2	
Parexogone hebes	2	2	4	1	2	5	7
Sphaerosyllis hystrix	1						

Syllidae			1		1		
Syllidae juv.							1
Lanice conchilega	13	22	19	20	21	9	6
Lanice conchilega juv.					2		
Lysilla loveni	1		1			1	
Paramphitrite birulai	1						
Pista						1	
Polycirrus		1	2	1	1	5	2
Travisia forbesii	2		1			2	12
Terebellides					1		
Neogyptis rosea					1		
Oxydromus vittatus			2		1		
Scoloplos armiger	48	126	138	108	167	115	85
Spio decorata	2						1
Ampelisca brevicornis							3
Amphilochoides boecki	1				1	1	
Autonoe longipes					3		
Bathyporeia elegans	18	50	41	30	36	36	24
Caprellidae		1	1	1	1		
Crassicorophium crassicorne		1	3	3	4		
Diastylis laevis		2	1	2	3	2	
Diastyloides biplicatus			3	1	1	1	1
Diastyloides serratus	3	2	7	2	7	3	2
Eusirus propinquus							1
Themisto abyssorum		1		1			
Jassa falcata					1		
Hemilamprops roseus			1			1	
Leptognathia	1		1	3		11	
Eudorella truncatula		5	10	4	8	3	5

Eudorellopsis deformis	7	42	40	33	25	25	17
Ebalia cranchii			1				
Leucothoe lilljeborgi		2	1			2	1
Hippomedon denticulatus	1	5	7	15	18		2
Lepidepecreum longicornis	2	8	4	1	2	4	2
Tryphosites longipes	1	2		4	1		1
Monoculodes			1				
Perioculodes longimanus	6	8	7	15	14	5	2
Pontocrates arcticus	2			2	2	2	
Synchelidium tenuimanum		1	2	1		2	
Westwoodilla caecula	2	1	2		6		
Paguridae		1	1	1	2	1	1
Pleurogonium	1	2	1		2		2
Megamphopus cornutus	5						
Harpinia antennaria	4	4	24	27	19	3	7
Petalosarsia declivis	4	8	1	3	4	11	2
Pseudocuma (Pseudocuma) simile	2	3	2	2	1	1	1
Unciola planipes	1						
Urothoe elegans				1	1		
Centraloecetes kroyeranus		1	1				
Caudofoveata					1		
Acanthocardia echinata					2		
Cylichna cylindracea		3	3	5	5	3	2
Antalis	17	23	18	15	34	20	18
Lucinoma borealis	2	1	7	1	1	1	14
Spisula elliptica				2	2	3	
Kurtiella bidentata	11	56	53	26	25	31	29
Montacuta substriata			1				
Tellimya ferruginosa	1	1		6	3		2

Euspira montagui	1	2					
Euspira nitida	1	1		3	2	3	1
Ennucula tenuis	8	15	19	20	23	11	17
Phaxas pellucidus			1		2		1
Gari fervensis	9	6	5	4	3	8	2
Abra prismatica	9	14	6	4	9	19	10
Fabulina fabula	2	5	6		13	6	3
Thracia convexa					1		
Thracia villosiuscula	5	8	6	8	9	6	10
Thyasira flexuosa			3	1			
Chamelea striatula				2			
Timoclea ovata	5	2	4	3	4	3	
Ophiuroidea juv.	20	54	43	27	34	46	32
Amphiura filiformis	34	54	36	49	40	31	39
Echinocyamus pusillus	24	6	1	3	1	3	2
Echinocardium flavescens		1	1	2	1		
Ophiura (Dictenophiura) carnea					1		
Ophiura sarsii	2					1	1
Labidoplax buskii						1	

Hywind 2	**HS2-1NE**	**HS2-2NE**	**HS2-3NE**	**HS2-1SE**	**HS2-2SE**	**HS2-3SE**
Cerianthus lloydii	11	12	13	12	15	13
Edwardsia	1			1	6	
Nemertea	4	3	2	1	4	
Phoronis	1	5	1	2	2	1
Phascolion (Phascolion) strombus strombus		1	1			
Anobothrus gracilis		1		2	2	

Capitella					1	
Heteromastus filiformis	4	1		2	5	2
Notomastus	1	2		5	3	2
Chaetozone	5	22	6	4	15	15
Cirratulus caudatus				1		
Cirratulus cirratus				1		
Tharyx killariensis	6	3	5	3	5	5
Diplocirrus glaucus	3	23	6	3	11	5
Glycera lapidum	4	2	5			
Glycera unicornis		2	2	1	2	4
Goniada maculata	3	3	3	9	13	4
Oxydromus flexuosus	1	2	1	1	3	
Oxydromus pallidus	1					
Podarkeopsis helgolandicus		4	1	3		
Lumbrineris		2	2	4	1	
Magelona filiformis	9	6	2	5	4	15
Magelona minuta		1		1	1	
Magelona mirabilis	1					
Euclymene droebachiensis	1					
Nephtys juv.	4	4		10	5	7
Nephtys assimilis						1
Nephtys cirrosa	12	2	11	9	2	4
Nephtys hombergii	1	1		2	1	
Nephtys longosetosa			1	1		
Nothria conchylega					1	
Ophelia borealis	45	10	41	26	12	20
Ophelina acuminata		1			1	1
Orbiniidae juv.			2			
Owenia		1	1			

Aricidea			1	1		
Aricidea (Acmira) catherinae		1			2	
Aricidea (Acmira) simonae	2	3		2	2	2
Aricidea (Aricidea) wassi	2	3	1	3	7	2
Paradoneis lyra	1	1	1		3	1
Pholoe baltica		10	2	2	8	3
Eteone						2
Eumida bahusiensis				1		
Hypereteone foliosa					1	
Phyllodoce juv.				1		
Glyphohesione klatti		2		3		1
Poecilochaetus serpens			1			
Bylgides	1					
Enipo			1			1
Gattyana cirrhosa					1	
Harmothoe		1				
Harmothoe glabra	5	6	4	2	2	2
Malmgrenia castanea		1				2
Polynoidae						1
Polynoidae juv.		1			2	
Scalibregma inflatum				1		
Pisione remota			2			
Sthenelais limicola		2	2	5	4	2
Sphaerodorum gracilis						1
Aonides paucibranchiata	1	1	5	2	4	5
Dipolydora socialis			2	3	6	3
Prionospio	1					
Prionospio cirrifera	1	6	3			1
Prionospio fallax	2	8	4	6	14	7

Pseudopolydora pulchra						1
Scolelepis juv.	6	1			3	1
Scolelepis bonnieri	3	1	1	2	1	1
Spio			5	2		3
Spiophanes bombyx	5	1	3	1		3
Spiophanes kroyeri	7	19	17	11	28	6
Exogone verugera		1	3		1	
Parexogone hebes	1	1	2		1	3
Sphaerosyllis hystrix	2					
Lanice conchilega			2			2
Lanice conchilega juv.	13	10	11	18	11	9
Lysilla loveni					1	1
Terebellidae juv.	1	1	12	3	3	
Travisia forbesii	3		4	8		
Scoloplos armiger	39	95	76	103	154	125
Ampelisca brevicornis	1			1		
Ampelisca tenuicornis				1	1	
Gitanopsis				1		
Autonoe longipes	1		1		1	
Argissa hamatipes		1				
Bathyporeia elegans	44	27	6	23	19	36
Caprellidae			1		1	
Eurydice pulchra						1
Crassicorophium crassicorne	1	3		3	3	2
Vargula norvegica		1				
Diastylis laevis			2	1	2	
Diastyloides biplicatus						1
Diastyloides serratus	1	1	8	1	4	3
Themisto abyssorum		1			2	

Ischyrocerus megacheir				1		
Hemilamprops				1		
Hemilamprops roseus			1			
Leptognathia		5				
Eudorella truncatula		2	1			1
Eudorellopsis deformis	13	27	7	29	38	15
Leucothoe lilljeborgi		2			1	
Hippomedon denticulatus	2	1	2	3	8	7
Tryphosites longipes		2		2	6	
Abludomelita obtusata				1		
Nebalia bipes		1				
Odius carinatus		2	7	2	2	2
Perioculodes longimanus	3	5	4	7	11	2
Pontocrates arenarius			1	3	2	3
Synchelidium tenuimanum	1	1	3	1		
Westwoodilla caecula		1	2		1	1
Paguridae		1				
Pagurus		1				
Gammaropsis palmata			2	1		
Harpinia antennaria		23	1	4	26	5
Petalosarsia declivis	2	2	10	4	4	1
Pseudocuma (Pseudocuma) simile	2	1	2			1
Typhlotanais		1				
Unciola planipes			8			1
Urothoe elegans				1	1	
Centraloecetes kroyeranus				2		
Megamoera dentata	1					
Caudofoveata					3	1
Cylichna cylindracea		10	1	4	6	

Antalis	19	11	16	9	21	17
Hiatella arctica		1	1			1
Lucinoma borealis	4	3		8	2	4
Spisula elliptica	1		1			1
Kurtiella bidentata	9	66	17	34	35	2
Montacuta substriata		1				2
Tellimya ferruginosa		8	4	2	13	5
Modiolula phaseolina	1			1		
Euspira nitida		2	2	1	1	
Ennucula tenuis	8	18	6	5	14	11
Phaxas pellucidus		1			1	
Gari fervensis	2	4	2		2	3
Abra prismatica	5	11	1	5	8	9
Fabulina fabula	1	4	3	4	8	3
Thracia villosiuscula	6	6	5	8	15	8
Thyasira flexuosa		1			2	
Timoclea ovata	2	6	4		6	7
Ophiuroidea juv.	17	23	19	25	30	22
Amphiura filiformis	11	23	15	33	31	25
Echinocyamus pusillus	9	6	3	5	4	3
Echinocardium flavescens		4	1		1	4
Ophiura (Dictenophiura) carnea					1	

Hywind control	**Control-1**	**Control-2**	**Control-3**
Cerianthus lloydii	2	8	8
Edwardsia	1	3	1
Nemertea	2	1	1
Phoronis	2	2	2
Phascolion (Phascolion) strombus strombus		1	

Anobothrus gracilis	1	6	1
Heteromastus filiformis	9		2
Mediomastus fragilis		3	6
Notomastus	1	2	6
Chaetozone	9	13	12
Tharyx killariensis	3	8	9
Diplocirrus glaucus	5	17	8
Glycera unicornis	2	2	4
Glyceridae juv.		2	
Goniada maculata	3	13	8
Oxydromus flexuosus	1		1
Podarkeopsis helgolandicus	4	3	1
Lumbrineris	11		3
Magelona filiformis	11	4	4
Magelona minuta	2		
Leiochone johnstoni	1		
Nephtys juv.	11	3	2
Nephtys assimilis		1	
Nephtys caeca			1
Nephtys cirrosa	6	2	2
Nephtys hombergii			4
Nephtys kersivalensis		1	
Nephtys longosetosa	1		
Ophelia borealis	15	11	9
Ophelina acuminata		1	
Ophelina modesta		2	1
Owenia	1		1
Aricidea (Acmira) catherinae	1		3
Aricidea (Acmira) simonae	2		2

Aricidea (Aricidea) wassi	1	5	3
Paradoneis lyra			4
Amphictene auricoma			1
Pholoe assimilis	1	4	12
Pholoe baltica	6	10	9
Eteone			2
Eulalia bilineata	1		
Hypereteone foliosa	1		1
Phyllodoce		1	
Phyllodoce groenlandica			1
Phyllodocidae juv.	1		
Glyphohesione klatti	5		2
Sigalionidae juv.		1	
Poecilochaetus serpens			1
Enipo	1	1	
Gattyana cirrhosa		1	
Harmothoe	2	3	
Harmothoe glabra			3
Malmgrenia andreapolis		1	
Polynoidae juv.		2	1
Sthenelais limicola		2	4
Sphaerodorum gracilis		1	1
Aonides paucibranchiata	2		8
Dipolydora socialis	2	2	
Prionospio cirrifera		8	5
Prionospio fallax		5	13
Scolelepis juv.	4	4	2
Scolelepis bonnieri	4	1	1
Spiophanes bombyx	2	3	2

Spiophanes kroyeri	8	36	23
Exogone verugera	4	3	
Parexogone hebes	1	2	2
Sphaerosyllis hystrix		1	
Syllidae	1	1	
Lanice conchilega juv.	16	30	14
Lysilla loveni	3	3	
Terebellidae juv.	9		3
Scoloplos armiger	116	120	148
Amphilochoides boecki		1	
Autonoe longipes	1		1
Argissa hamatipes	1	1	
Bathyporeia elegans	46	18	19
Crassicorophium crassicorne		5	
Vargula norvegica		1	
Diastylis laevis		2	3
Diastyloides biplicatus		2	
Diastyloides serratus		7	8
Eriopisa elongata			1
Rhachotropis		1	
Themisto	1		
Hemilamprops cristatus			1
Leptognathia	2	8	5
Eudorella truncatula	1	7	4
Eudorellopsis deformis	14	20	11
Leucothoe lilljeborgi	1	3	
Hippomedon denticulatus	5	4	4
Hippomedon propinqvus		1	
Lepidepecreum longicornis	5	9	2

Monoculodes			2
Perioculodes longimanus	4	11	10
Synchelidium tenuimanum	6	3	2
Westwoodilla caecula		1	1
Paguridae		2	3
Harpinia antennaria	1	18	7
Harpinia pectinata			3
Petalosarsia declivis	3	9	5
Unciola planipes	1		1
Anonyx lilljeborgi		1	6
Caudofoveata			2
Acanthocardia echinata		1	
Cylichna cylindracea	1	8	6
Antalis entalis	13	16	30
Lucinoma borealis	4	1	6
Spisula elliptica	3	2	1
Kurtiella bidentata	44	41	40
Montacuta substriata	1		
Tellimya ferruginosa	2	21	2
Euspira nitida		1	
Ennucula tenuis	5	17	13
Phaxas pellucidus		1	
Gari fervensis		1	3
Abra prismatica	13	21	10
Fabulina fabula	4	5	8
Thracia convexa	1	1	
Thracia villosiuscula	14	7	5
Thyasira flexuosa		3	2
Timoclea ovata	1	4	4

Ophiuroidea juv.	23	29	31
Amphiura filiformis	32	31	47
Echinocyamus pusillus	1		
Echinocardium flavescens	1	3	1
Ophiocten affinis	1		
Ophiura (Dictenophiura) carnea		2	
Ophiura albida		2	

7 DETAILS FROM SURVEY

Name	Chem #1	Chem #2	Chem #3	Bio# 1	Bio# 2	Bio# 3	Bio# 4	Bio# 5	Grabb*	Bom	Depth	Heading	Distance	Lat_WGS84	Long_WGS84	Station comment
Control-1 NEW	10	9	11	10	9	11	11	11	B33/B34		106			57,50222	-1,37111	Station inside 500 zone HS3 and therefore moved 200. Position and new named required
Control-2	9	9	8	9	8	9	11	8	B33/B34		119,5			57,49727	-1,34538	
Control-3 New	13	9	13	13	12	9	7	9	B25/B33	0	117,5			57,47175	-1,34346	200m offset. New name
HS1-1 NE	7	10	10	7	9	10	7	10	B33/B34	0	117,5	18	25	57,4845	-1,33214	
HS1-1 SW	7	9	6	7	9	9	9	6	B33/B34	0	116,5	255	25	57,48424	-1,33267	
HS1-2 NE	9	7	7	9	8	7	9	7	B33/B34	0	117,5	18	100	57,48514	-1,33174	
HS1-2 SW	9	8	9	9	6	8	9	9	B33/B34	0	116,5	255	100	57,48409	-1,33389	
HS1-3 NE	12	11	10	12	12	11	11	10	B33/B34	0	118	18	200	57,48599	-1,3312	
HS1-3 SW	8	10	9	8	10	9	9	10	B25/B33/B34	3	117,5	255	200	57,48389	-1,33552	
HS1-3 SW - extra	13	11	12	13	10	11	11	12	B25/B33	2	118	229	400	57,48192	-1,3373	200m offset. New station and name
HS2-1 NE	9	7	8	9	7	7	8	8	B25/B33	1	111,5	19	25	57,49095	-1,35184	
HS2-1 SE	12	12	12	12	11	12	14	12	B33/B34	2	113	140	25	57,49057	-1,35173	
HS2-2 NE	9	9	9	9	9	9	8	9	B25/B33	2	112,5	19	100	57,49157	-1,35134	
HS2-2 SE	10	9	10	10	8	9	10	10	B33/B34	2	114	140	100	57,49006	-1,35092	
HS2-3 NE	9	8	6	9	9	8	9	6	B25/B33	1	112,5	19	200	57,4924	-1,35068	
HS2-3 SE	11	9	10	11	9	9	10	10	B33/B34	4	116	140	200	57,48938	-1,34983	

About DNV

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