

**MEMORANDUM****21 January 2002**

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**Job : Horns Rev. Control and monitoring programme. Artificial reef.**

**Subject : Progress memorandum 2**

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**1. Programme objectives**

A control and monitoring programme to evaluate the environmental consequences of the construction and operation of the up to 150 MW demonstration offshore wind farm at Horns Rev was a condition made in the EIA statement (ELSAM, 2000)

Prior to establishing the wind turbines, a baseline description of the benthic fauna (infauna) of the area should be carried out, as the basis for comparison with a subsequent control and monitoring programme. The baseline study should provide sufficient data to evaluate the effects on the composition of species

and individuals of the benthic fauna as a result of the establishment of the turbine foundations, in both the construction and operational phases. This study should also assist in evaluating the benthic fauna of the area as a food source for the area's fish species.

The aim of the control and monitoring programme described below is to document possible changes in the composition of the species and individuals of the benthic fauna, and of following the colonisation of the fouling communities on the turbine foundations in order to evaluate the reef effect on other fauna of the area.

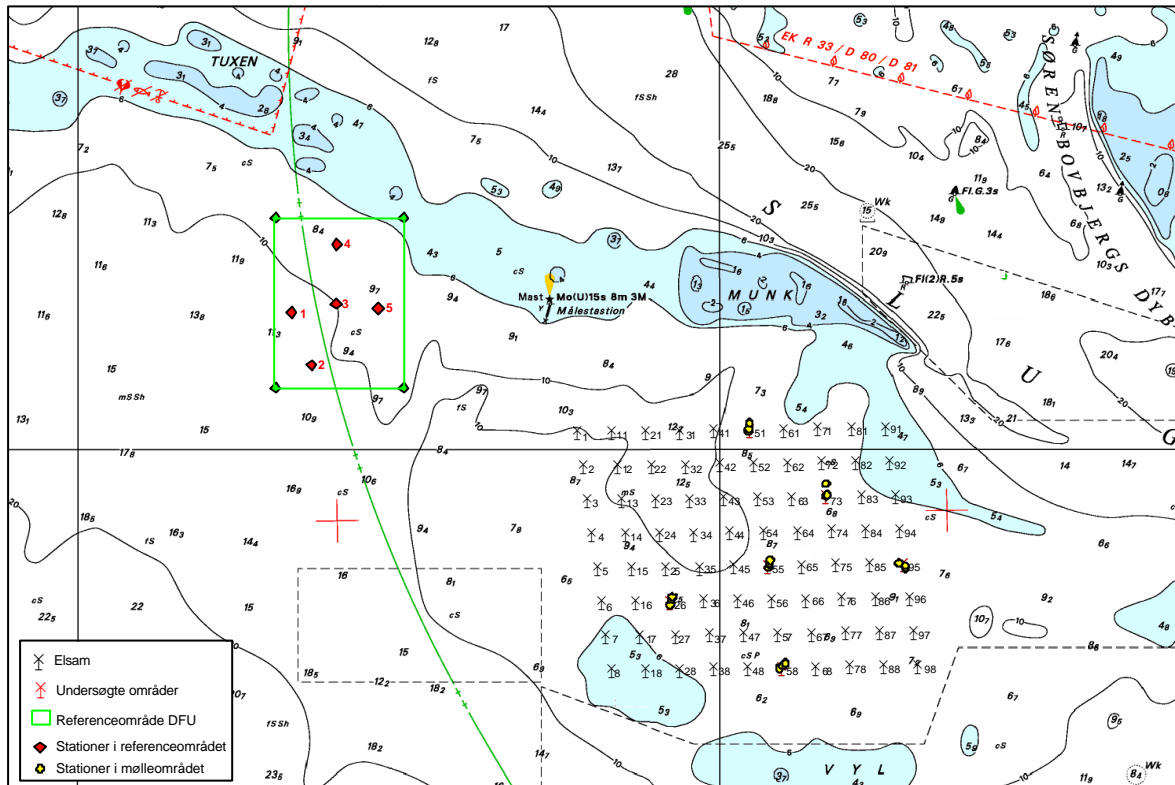
## **2. Programme for 2001**

The investigative programme for 2001 consists of a baseline description of the benthic fauna conditions in the turbine area, and a description of the benthic fauna conditions in relation to the occurrence of potential food items for fish.

### **2.1. Baseline description**

Field studies for the baseline description of the benthic fauna conditions in the turbine area were carried out during the spring and summer of 2001 at 6 selected turbine locations. The 6 locations are in areas where the depth is less than 10 metres, and thus representative of the whole turbine area.

Two benthic fauna samples were collected by a diver at each of 3 stations along a transect in the lee of the prevailing current, using a Haps sampler (0.0123m<sup>2</sup>). The 3 stations are located at a distance of 5, 25 and 100 m, respectively, from the edge of the planned scour protection. A further Haps sample was collected at each station to determine the grain-size distribution of the sediment, the dry matter content and the amount of organic material, measured by combustion loss. Samples for identification of species composition, abundance and biomass were sieved with a 1 mm mesh size.



Map of the studied localities, June 2001.

The coordinates of turbine positions are given in the following table (WGS 84):

### Turbine positions

Horns Rev	Turbine 26	55°28.596'	07°49.139'
Horns Rev	Turbine 51	55°30.106'	07°50.366'
Horns Rev	Turbine 55	55°28.910'	07°50.660'
Horns Rev	Turbine 58	55°28.013'	07°50.881'
Horns Rev	Turbine 73	55°29.518'	07°51.576'
Horns Rev	Turbine 95	55°28.930'	07°52.786'

A video recording was made at each sampling station as documentation of the bottom conditions, weather and visibility permitting.

Among the analysis techniques used were grain-size distribution using a sedigraph, and biomass analysis measured as wet weight.

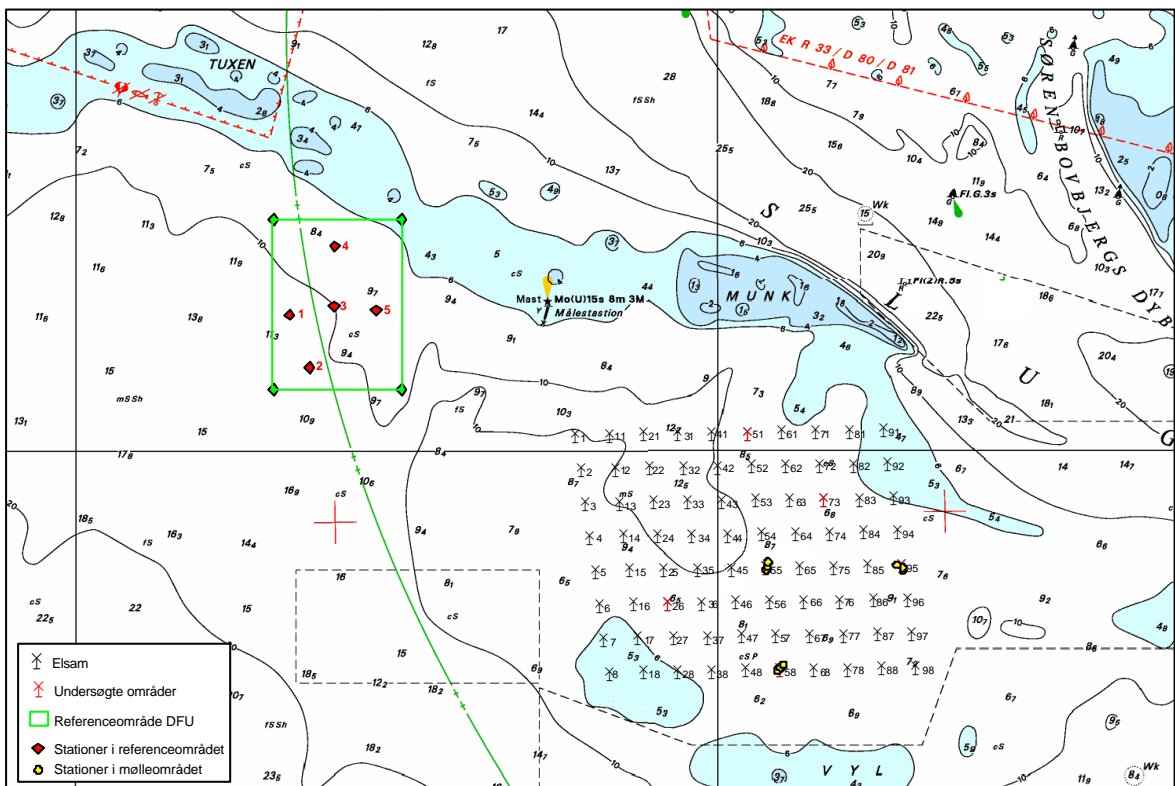
Data manipulation included use of statistical tools, such as multi-variate analysis.

## 2.2. Food items for fish

The study of the benthic fauna conditions in relation to the occurrence of potential fish food items was carried out during the autumn of 2001 and was coordinated with DFU's fish studies. These studies ana-

lysed the stomach contents of selected fish species to provide the baseline for evaluating fish food availability in the investigated areas. The stomach content studies were carried out by DFU, as part of the fish studies programme.

At 3 of the 6 turbine locations used in the baseline description, benthic fauna and sediment samples were taken. At each turbine location, 3 stations were marked, using the same positioning as for the baseline description study. The method for collecting and treating the samples was also identical with the baseline methodology. In addition, sediment and benthic fauna samples were also collected at 5 stations in the designated reference area. The 5 stations are distributed over two different depth intervals that are representative of the reference area.



Map of the studied localities, September 2001.

Coordinates for the reference area are given by DFU as:

"ID"	"WGS84_DEC_X"	"WGS84_DEC_Y"	WGS84_MIN_X"	"WGS84_MIN_Y"
1	7.71667	55.5083	"07°43.000"	"55°30.500"
2	7.71667	55.5333	"07°43.000"	"55°32.000"
3	7.75	55.5333	"07°45.000"	"55°32.000"
4	7.75	55.5083	"07°45.000"	"55°30.500"

Coordinates for the 5 stations in the reference area are as follows:

"ID"	"WGS84_DEC_X"	"WGS84_DEC_Y"	"WGS84_MIN_X"	"WGS84_MIN_Y"
1	7.72087	55.5194	"07°43.252"	"55°31.162"
2	7.72613	55.5116	"07°43.568"	"55°30.698"
3	7.73238	55.5207	"07°43.943"	"55°31.241"
4	7.73271	55.5294	"07°43.963"	"55°31.767"
5	7.7434	55.52	"07°44.604"	"55°31.202"

In accordance with the baseline description, video recordings were made at each sampling station as documentation of the bottom conditions, weather and visibility permitting.

Analysis and data manipulation methods follow exactly those used for the baseline description.

### 2.3. Reporting

Cruise and data reports were written for each of the studies.

A collated report was made combining the status descriptions of the benthic fauna conditions for both the baseline description and the studies on potential food items.

### 2.4. Time schedule

	2001							
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Infauna								
Baseline description								
• Field studies		■						
• Cruise report			■					
• Data report					■			
• Situation report							■	
Food resource								
• Field studies					■			
• Cruise report						■		
• Data report							■	

## 3. Programme status

### 3.1. Baseline description, spring 2001

On 6<sup>th</sup> June 2001, studies were carried out along transects laid out in the lee of 6 turbine locations, where a total of 36 samples were collected for analysis of the composition of species and individuals in the benthic fauna, as well as 18 samples for analysis of sediment characteristics.

Analysis was made of the qualitative and quantitative composition of the benthic fauna. The sediment analysis was also completed.

#### 3.1.1. Deviation

It was not possible to adhere to the planned time schedule, as delays were experienced in delivery of cruise and data reports, as well as in the delivery of an edited videotape. Delays were not caused by problems with analysis, etc.

### 3.2. Food resource for fish, autumn 2001

On 27<sup>th</sup> September 2001 diver observations, including photographic documentation and collection of benthic-faunal and sediment samples, were carried out at 3 turbine locations in the wind farm area, and at 5 locations in the reference area. Samples were collected at 3 stations along the study transect for each of the three locations in the wind farm area.

The sampling was coordinated with DFU's studies on the fish fauna.

Analysis was made of the qualitative and quantitative composition of the benthic fauna. The sediment analysis was also completed.

**3.2.1. Deviation**

It was not possible to adhere to the planned time schedule as delays were experienced in delivery of cruise and data reports, as well as in the delivery of an edited videotape. Delays were not caused by problems with analysis, etc.

**3.3. Reporting**

Data analysis has not been completed. Report not yet available.

**3.3.1. Deviation**

As a result of delays with data analysis, the report is delayed in respect of the time schedule. A revised time schedule is put forward for approval.

**3.4.1 Revised time schedule**

	2001								2002			
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April
Infauna												
Baseline description												
• Field studies												
• Cruise report												
• Data report												
• Situation report												
Food resource												
• Field studies												
• Cruise report												
• Data report												

**4. Results**

Due to delays in data processing, the only observations that can be used are those from field studies.

Investigations of the bottom composition in the reference area in connection with the food resource studies appear to show that the sediment in this area is slightly coarser than in the wind farm area. There is, however, no immediate difference between the two areas in the amount of sediment dry matter and combustion loss. Closer examination of the sediment characteristics revealed that there is only a very slight difference in the median grain size of the reference and wind farm areas. However, the sediments within the reference area at stations 3–5, which lie in the shallower water, are markedly coarser than at stations 1–2, which lie in the deeper area.

The video recording in November was carried out in good visibility. Several larger epifauna species were recorded.

Large trough shells (*Spisula*) were observed at several stations during the June visits.

## 5. Studies planned for 2002

Aside from completion of the report on the benthic fauna studies from 2001, the following activities are planned for 2002.

### 5.1. Control and monitoring programme for benthic fauna

The aim of the programme is to evaluate the impact of the construction of the wind farm on the benthic fauna resource.

No studies are planned during the actual construction period in 2002. The planned start for the studies is spring 2003.

### 5.2. Control and monitoring programme for fouling communities

The aim of the study is to evaluate the effect of the establishment of artificial reefs on fouling communities. The planned starting date is September 2002.

Studies on fouling communities will be carried out at the 6 selected turbine locations. Studies will concentrate on both the tower of the turbine and on the scour protection. Methods will follow the descriptions given in ELSAM (2001).

Studies will consist of sampling, analysis of faunal material and data reporting, in accordance with the time schedule.

#### Turbine positions

Horns Rev	Turbine 26	55°28.596'	07°49.139'
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Horns Rev	Turbine 73	55°29.518'	07°51.576'
Horns Rev	Turbine 95	55°28.930'	07°52.786'

#### 5.2.1. Time schedule

	2002											
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Control and monitoring												
• Field studies												
• Cruise report												

• Data report													
• Situation report													

### 5.3. Control and monitoring programme on the food resource for fish

The aim of this study is to supplement the fish studies and to evaluate possible changes in food choice by the existing fish fauna, following construction of the wind farm. Studies are planned to start in the autumn of 2003.

### 6. References

ELSAM 2001. Horns Rev. Monitoring programme. Artificial reef. Description of assignment: 1–13.