

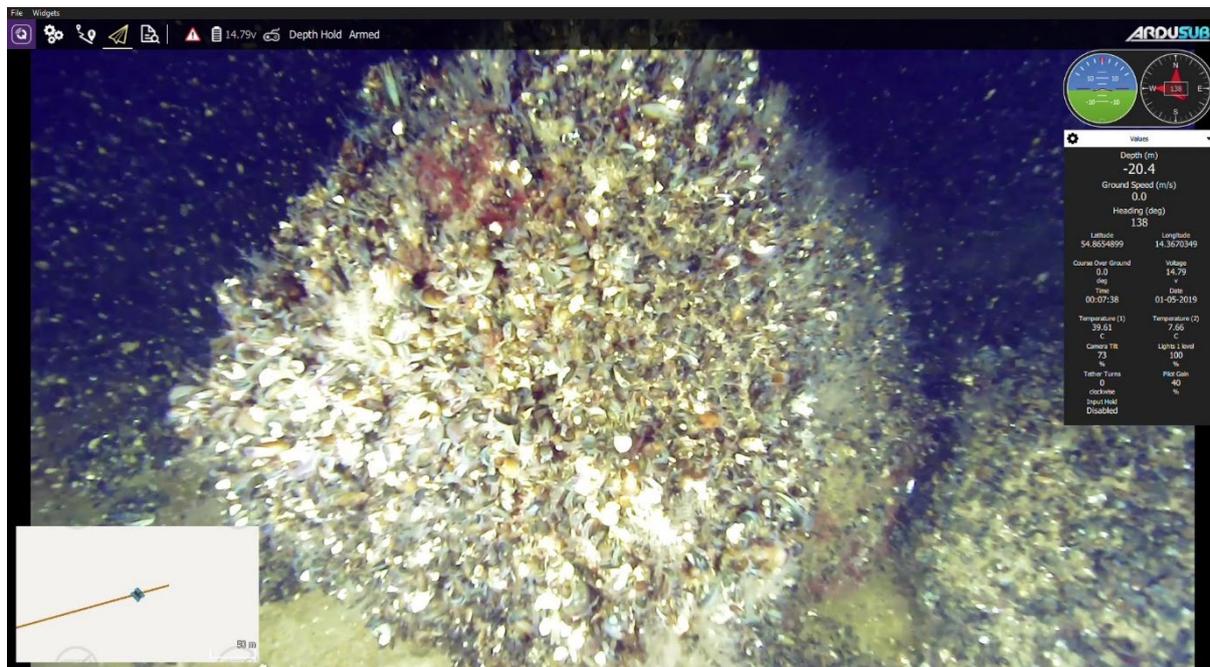
ENERGINET

ENERGY ISLAND BORNHOLM

SCOPE OF WORK

WP-E BENTHIC FLORA AND FAUNA

24-11-2022





ENERGY ISLAND BORNHOLM

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ENERGINET

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Abbreviation	Explanation
AMBI index	AZTI Marine Biotic Index (AMBI) , was designed to establish the ecological quality of European coasts. The index examines the response of soft-bottom benthic communities to natural and man-induced disturbances in coastal and estuarine environments.
Bird SPA site	New bird SPA site (Rønne Banke F129/DK00FC373) for long-tailed duck located between the two wind farm areas.
Bornholm I nord	Bornholm I is divided into two subsections i.e. Bornholm I nord and Bornholm I syd. Both areas are offshore wind farm areas.
Bornholm I syd	Bornholm I is divided into two subsections i.e. Bornholm I nord and Bornholm I syd. Both areas are offshore wind farm areas.
CC	Overlapping area in cable corridors
CC1	Cable corridor from Bornholm I wind farm area to Bornholm
CC2	Cable corridor from Bornholm II wind farm area to Bornholm
Cable corridor	Cable corridor between OWFs and Bornholm
Client	Energinet
CTDO	Conductivity-Temperature-Depth-Optical
DEA	Danish Energy Agency
DKI	The Danish index for benthic infauna used for assessment of infauna condition
DW	Dry weight
EIA	Environmental Impact Assessment
HAPS	Sediment core sampler. Samples a cylinder of sediment in soft to loose seabed sediments
INV	Station prefix for stations placed outside of the OWF, CC and SPA areas.
OWF	Offshore Wind Farm area
OWF1	Bornholm I, Offshore Wind Farm Area 1, is now divided into two subsections: Bornholm I nord and Bornholm I syd
OWF2	Bornholm II, Offshore Wind Farm Area 2
Pre-investigation area	Gross area for the benthic survey including the three wind farm areas (Bornholm I nord, Bornholm I syd and Bornholm II) and the area in between in Danish waters
PA	Pre-investigation area
ROV	Remotely Operated Underwater Vehicle
SEA	Strategic Environmental Assessment
VO	Variation order
WW	Wet weight

1 SUMMARY

Denmark plans to expand the production of energy from offshore wind by developing the so-called energy islands. These energy islands are expected to play a major role in the phasing-out of fossil fuel energy sources in Denmark and Europe. In the Baltic Sea, the energy islands project consists of two offshore wind farm areas (Bornholm I and Bornholm II, OWFs), that will be constructed approximately 15 km south-southwest of the Danish island of Bornholm, and electricity will be routed from the offshore wind farms to Bornholm. Bornholm will act as an electrical hub delivering electricity to grids on Zealand and neighbouring countries. Two cable corridors connect the two wind farm areas with Bornholm. The sampling program for the interconnector cable corridor between Bornholm and Zealand is not included in this scoping report.

This report defines the scope of work for the environmental baseline investigations for WP-E Benthic fauna and flora. The aim of the baseline investigations for Benthic fauna and flora is to map and describe the distribution of seabed sediments, sediment characteristics and the species composition and distribution of benthic fauna and flora. Results from the baseline study will be reported in the technical report.

A bird food mapping program has, furthermore, been assembled to describe the available food for long-tailed duck in the newly appointed bird SPA site (Rønne Banke F129/DK00FC373) and the full pre-investigation area. The SPA site is located in the middle of the pre-investigation area between the two wind farm areas. All stations sampled in the pre-investigation area including in the bird SPA site, the OWFs and cable corridors (CC, CC1 and CC2) are used for bird food mapping in the total pre-investigation area. Mapping of the bird food availability in the pre-investigation area is then compared with the food availability in the two wind farm areas, the cable corridors and the bird SPA site to assess the most important foraging areas for the long-tailed duck in the pre-investigation area.

2 INTRODUCTION

The energy islands mark the beginning of a new era for the generation of energy from offshore wind, aimed at creating a green energy supply for Danish and foreign electricity grids. Operating as green power plants at sea, the islands are expected to play a major role in the phasing-out of fossil fuel energy sources in Denmark and Europe.

After political agreement on the energy islands has been reached, the Danish Energy Agency plays a key role in leading the project that will transform the two energy islands from a vision to reality. The Energy Island projects are pioneer projects that will necessitate the deployment of existing knowledge into an entirely new context.

In the Baltic Sea, the electrotechnical equipment will be placed on the island of Bornholm, where electricity from offshore wind farms will be routed to electricity grids on Zealand and neighbouring countries. The offshore wind farms will be constructed approximately 15 km south-southwest of the coast and will be visible, but not dominate the horizon. The turbines off the coast of Bornholm will have an installed production capacity of up to 3,8 GW including overplanting. The 3 planned windfarm areas for the Energy Island Bornholm are shown in Figure 2-1.

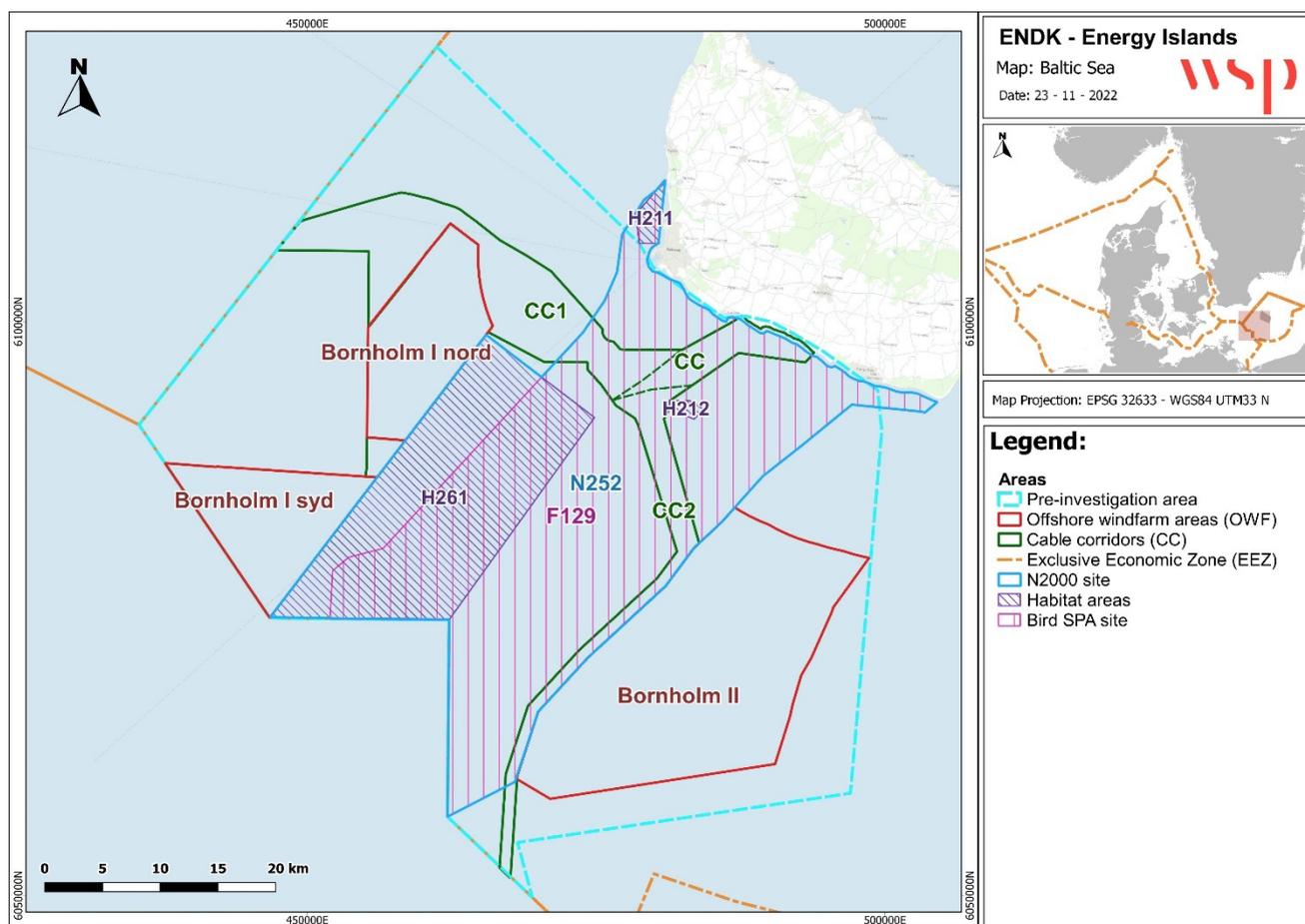


Figure 2-1. Energy Island Bornholm (OWF1 and OWF2).

This report defines the scope of work for WP-E Benthic fauna and flora. The scope for WP-E is to survey, sample, map and report on the distribution of sediment types and species composition and distribution of benthic fauna and flora communities in the pre-investigation area. The pre-investigation area includes a new bird SPA site (Rønne Banke F129/DK00FC373) for long-tailed duck. The pre-investigation area including the bird SPA site is, therefore, sampled to map bird food distribution and availability for long-tailed duck.

3 METHODOLOGY

3.1 SAMPLING PROGRAM

The scope of work is presented separately for the two wind farm areas: Bornholm I (nord and syd) and Bornholm II (OWFs), and for the cable corridors (CC, CC1 and CC2). The sampling program for the interconnector cable corridor between Bornholm and Zealand is not included in this scoping report.

A bird food mapping program has, furthermore, been assembled to describe the available food for long-tailed duck in the newly appointed bird SPA site (Rønne Banke F129/DK00FC373) and the full pre-investigation area (Figure 3-2). The SPA site is located in the middle of the pre-investigation area between the two wind farm areas (Figure 3-2). All stations sampled in the pre-investigation area including in the bird SPA site, the OWFs and cable corridors are used for bird food mapping in the total pre-investigation area. The background for including this program in the benthic survey and baseline report is detailed below in the section for the “Bird food program” page 11.

3.1.1 PRE-INVESTIGATION AREA

The sampling program for the pre-investigation area, including the two wind farm areas (Bornholm I and Bornholm II), the cable corridors (CC, CC1 and CC2) and the bird SPA site (F129) are presented in Figure 3-2 and Table 3-1. The sampling program is assembled to sufficiently cover and describe sediment and biological communities in all substrate types in the pre-investigation area. Substrate types are based on the GEUS maps (Martha-database). Stations have furthermore been placed within the shallow depth range (0-20 m) and deeper depth range (>20 m) and the 20 m depth curve is shown on the figures to illustrate this.

Observed fish, infauna, epi-fauna and -flora species distribution, coverage and biomass (only infauna) are then used to describe and map the distribution of these groups in the pre-investigation area including the OWFs, cable corridors and the bird SPA site.

The number of HAPS, ROV and CTDO stations that are sampled within the two wind farm areas (Bornholm I nord and syd and Bornholm II, Figure 3-4), the cable corridors (Figure 3-5), the bird SPA site (Figure 3-3) and the remaining part of the pre-investigation area are presented in Table 3-1 and in Figure 3-2.

Table 3-1. Distribution of sample stations within the offshore wind farm areas (Bornholm I and II), The cable corridors (CC, CC1 and CC2), the bird SPA site and in the remaining pre-investigation area. CC is where the cable corridors overlap.

Area	HAPS samples infauna	HAPS samples Chemical analyses	ROV stations	CTDO stations
Wind farm areas (Bornholm I (nord + syd)/ and Bornholm II)	41/60	7/10	41/60	12
Pre-investigation area excl. SPA (INV stations)	40	3	58	20
SPA site (SPA stations)	168	-	242	14
Cable corridors (CC, CC1 and CC2)	29	18	43	0
Total	337	38	444	46

The CTDO program has been changed from originally 200 stations to 46 stations placed in 4 specific transects transversing the pre-investigation area to illustrate the change in salinity and temperature and oxygen from the deep outer areas to the central, shallow Rønne Bank area. The CTDO transects and stations are presented below in Figure 3-1.

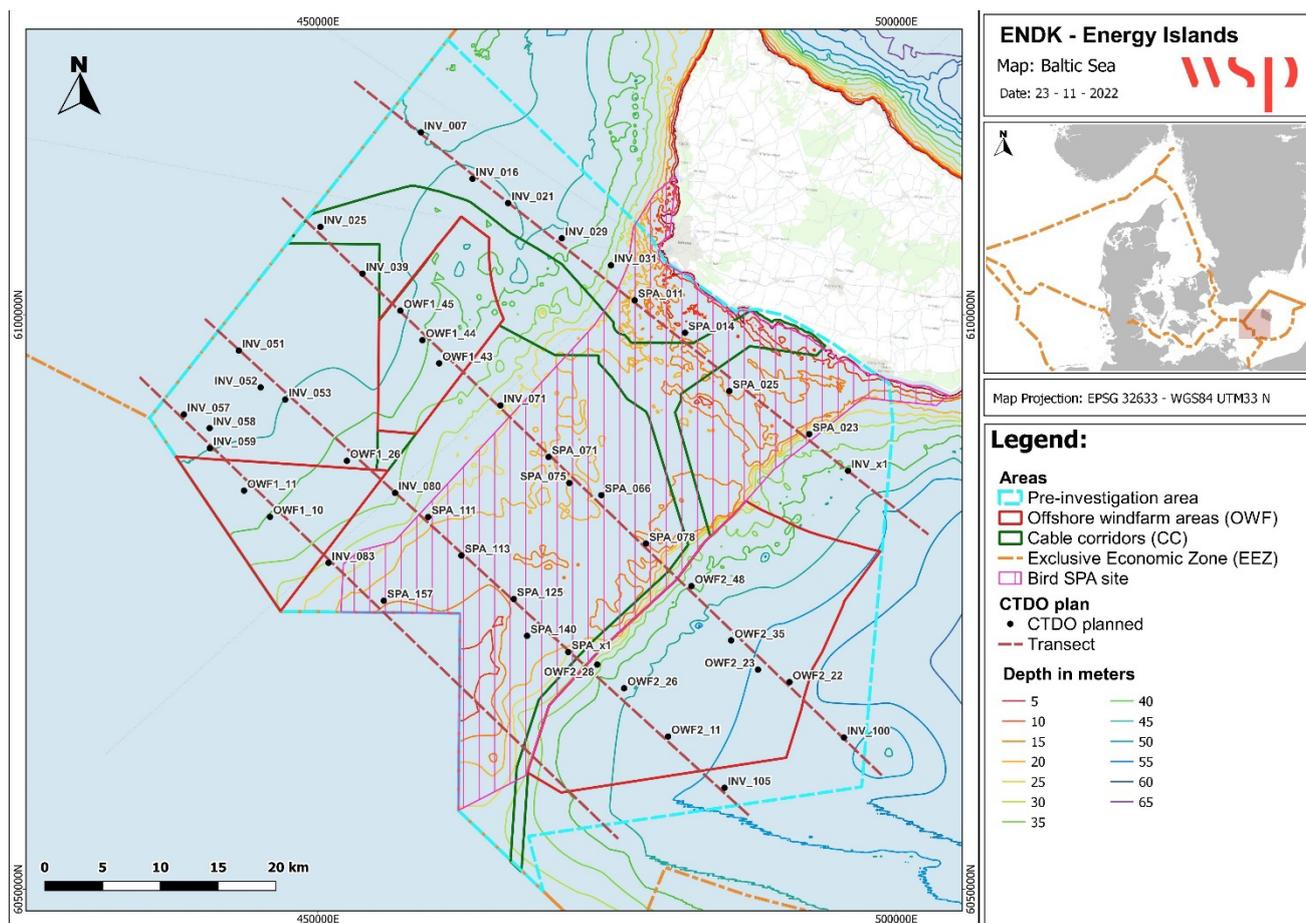


Figure 3-1. Illustration of new CTDO transects with related stations. The CTDO-samples describe temperature, salinity and oxygen profiles in the water column along three transects crossing the wind farm areas.

Since the first edition of the scope report the Bornholm I wind farm area has been divided into two sub areas called Bornholm I nord og Bornholm I syd and the cable corridor area CC1 has also been changed in outline. Station numbers in the different areas have therefore been adjusted to the change in the planned areas for Bornholm I and cable corridor CC1. Thus, station names from the original Bornholm I area are called OWF1_xx, which include Bornholm I nord and syd and the area inbetween. Furthermore, the 10 chemical HAPS samples from the former OWF1 area is now placed in and between the two Bornholm I sub areas (Bornholm I nord and syd) (see Figure 3-4).

Sampling stations in the pre-investigation area are distributed accordingly:

The two wind farm areas (Figure 3-4):

- 101 HAPS samples – 41 in Bornholm I (nord+syd) and 60 in Bornholm II for sediment type description and infauna analysis
- 17 HAPS samples - 7 in Bornholm I (nord+syd) and 10 in Bornholm II for chemical analysis
- 101 ROV-video stations (41 in Bornholm I and 60 in Bornholm II) i.e. one ROV station pr HAPS station to verify sediment type and quantify epiflora, epifauna and fish (species and area coverage%)

- 12 CTDO stations - to describe temperature, salinity and oxygen profiles in the water column along three transects crossing the wind farm areas.

The cable corridors (Figure 3-5):

- 29 HAPS samples – distributed within the total cable corridor area for sediment type description and infauna analysis (+2 extra stations, CC1_01x and _02x)
- 18 HAPS samples - distributed within the total cable corridor area for chemical analysis. Original plan was 20 chemical samples along the cable corridors, but 2 samples could not be taken due to rocky seabed (CC1_06 and CC1_09)
- 43 ROV-video stations - distributed within the total cable corridor area to verify sediment type and quantify epiflora, epifauna and fish (species and area coverage%)(+2 extra stations, CC1_01x and _02x)
- 0 CTDO stations

SPA site (Figure 3-3):

- 168 HAPS samples - 42 in each of the 4 loose sediment types for sediment type description and infauna analysis)
- 242 ROV-stations in total:
- 168 ROV-stations - one pr HAPS station to verify sediment type and quantify epiflora, epifauna and fish (species and area coverage%)
- 75 ROV-stations on hard substrate (25*3 hard substrate types)
- 14 CTDO stations to describe temperature, salinity and oxygen profiles in the water column along the four transects

Rest of pre-investigation area (Figure 3-2):

- 40 HAPS samples - for sediment type description and infauna analysis
- 3 HAPS samples for chemical analysis. Originally within Bornholm I area (OWF1) but inbetween after division into two subareas (Bornholm I nord and syd)
- 58 ROV-stations - one pr HAPS station to verify sediment type and quantify epiflora, epifauna and fish (species and area coverage%)
- 20 CTDO stations to describe temperature, salinity and oxygen profiles in the water column along the four transects

During the survey, stations position may be changed if relevant to ensure the best possible mapping of the sediment types and biological community. If fx. ROV video at a station shows, that it is not possible to take HAPS samples, the position is moved three times = three attempts before sampling is abandoned (see section 3.2.4).

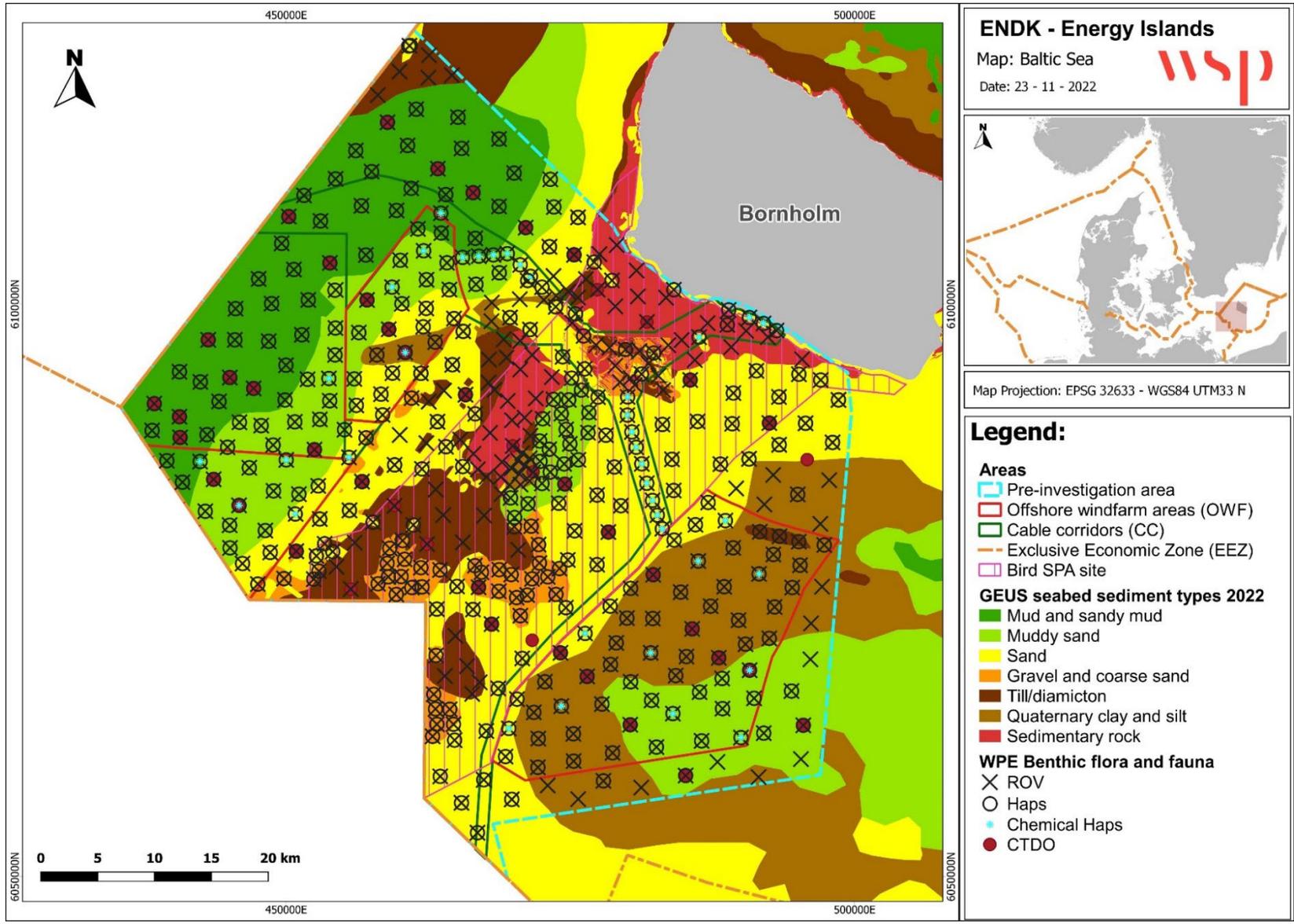


Figure 3-2. Sampling program for the pre-investigation area. The 20 m depth curve is also shown. The background seabed sediment map is from GEUS, Marta-database.

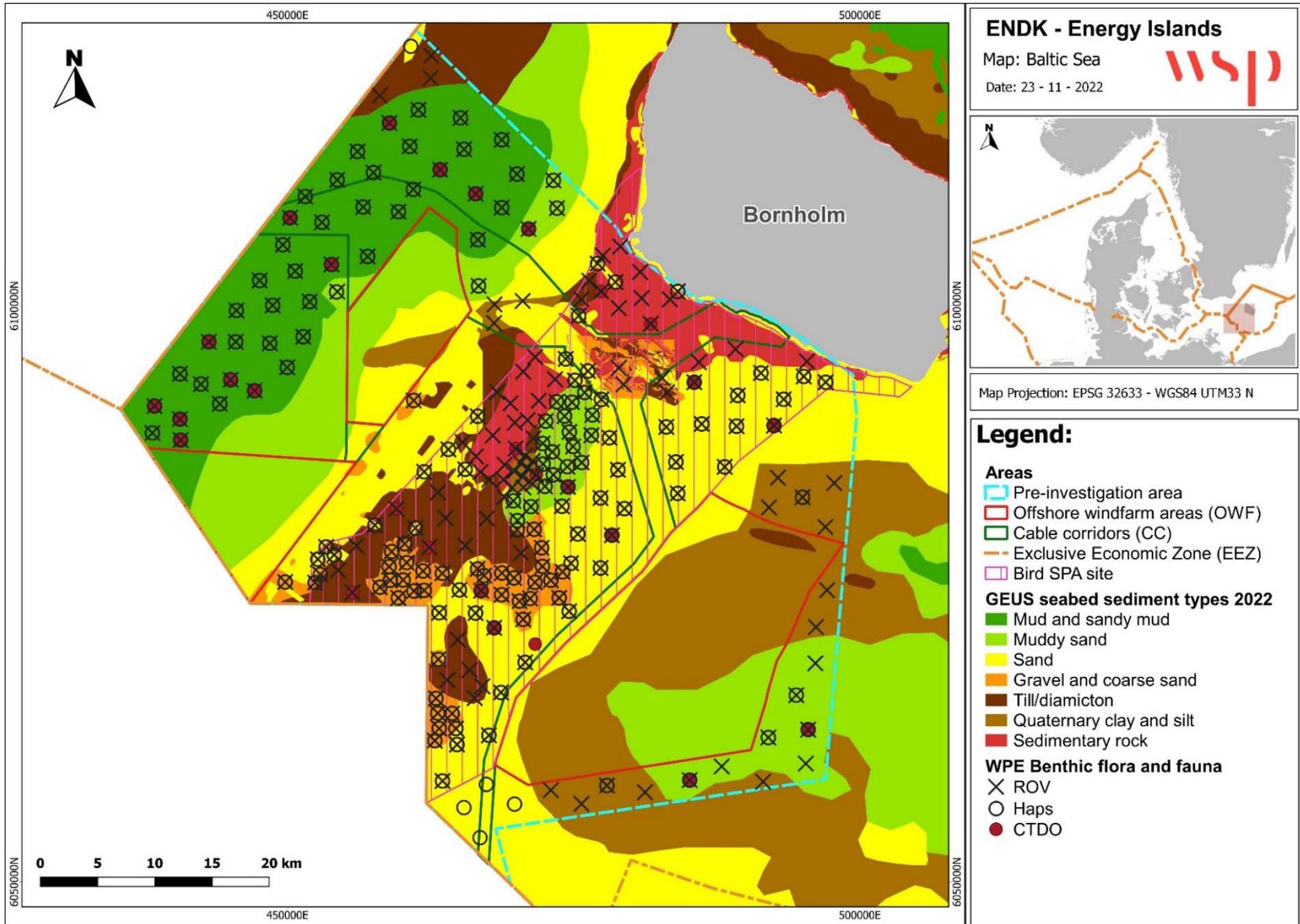


Figure 3-3. Sampling program for bird food mapping mainly in the bird SPA site, but also in the rest of the pre-investigation area. There are placed 25 ROV stations per hard substrate type, i.e. in total 3 hard substrate types and 75 ROV stations. There are placed 42 ROV/HAPS stations per loose sediment type, i.e. in total 4 loose sediment types and 168 HAPS samples. Where station where too many within the SPA site some stations where distributed in areas with low-station coverage in the pre-investigation area. "Mud and sandy mud" were only found outside the SPA site and stations were therefore placed in the western part of the pre-investigation area. The background seabed sediment map is from GEUS, Marta-database.

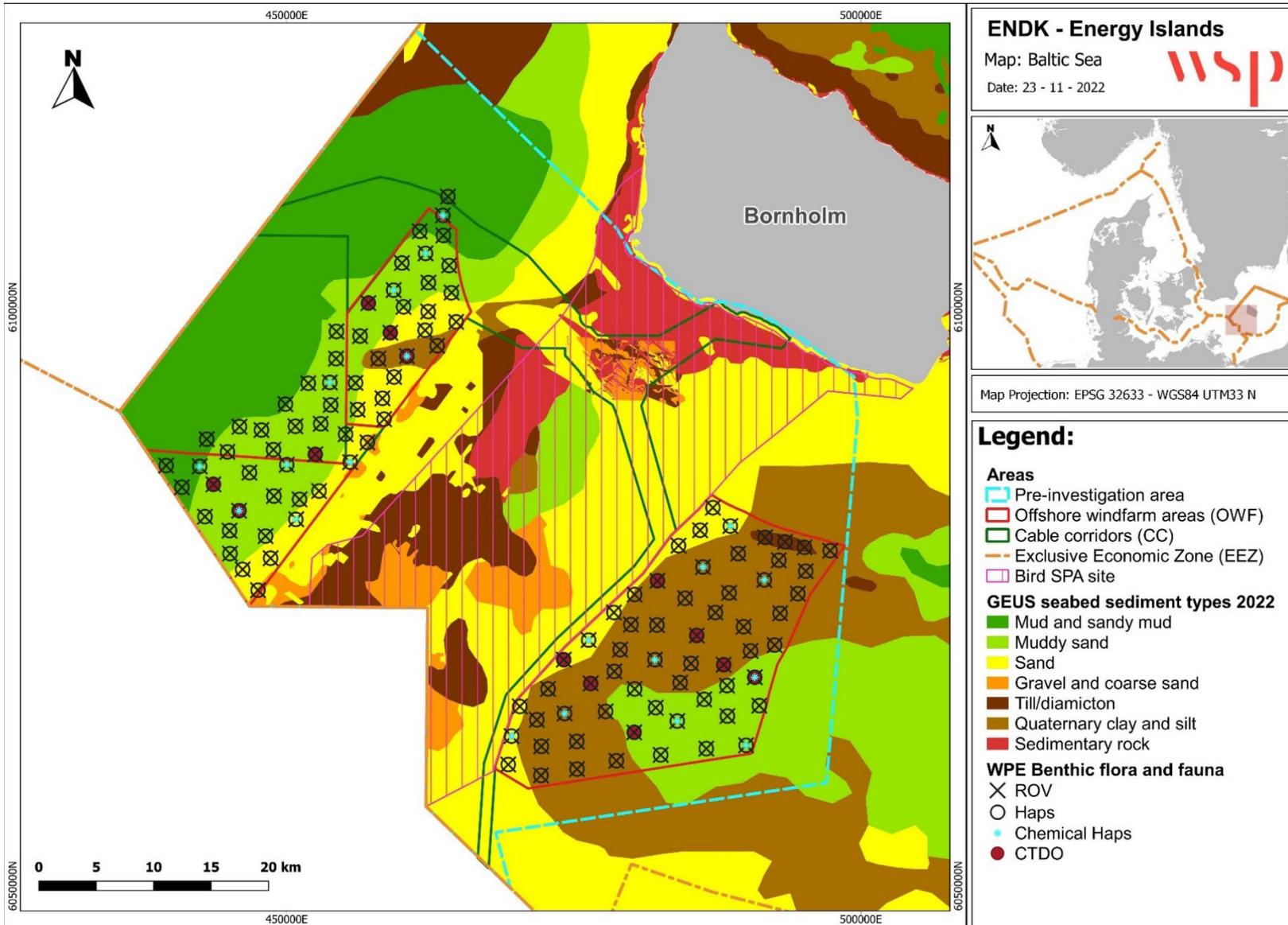


Figure 3-4. Sampling program for the two wind farm areas (Bornholm I and II).

In total 101 ROV/ HAPS stations. 12 CTDO stations and in total 17 HAPS samples for chemical analysis.

The background seabed sediment map is from GEUS, Marta-database.

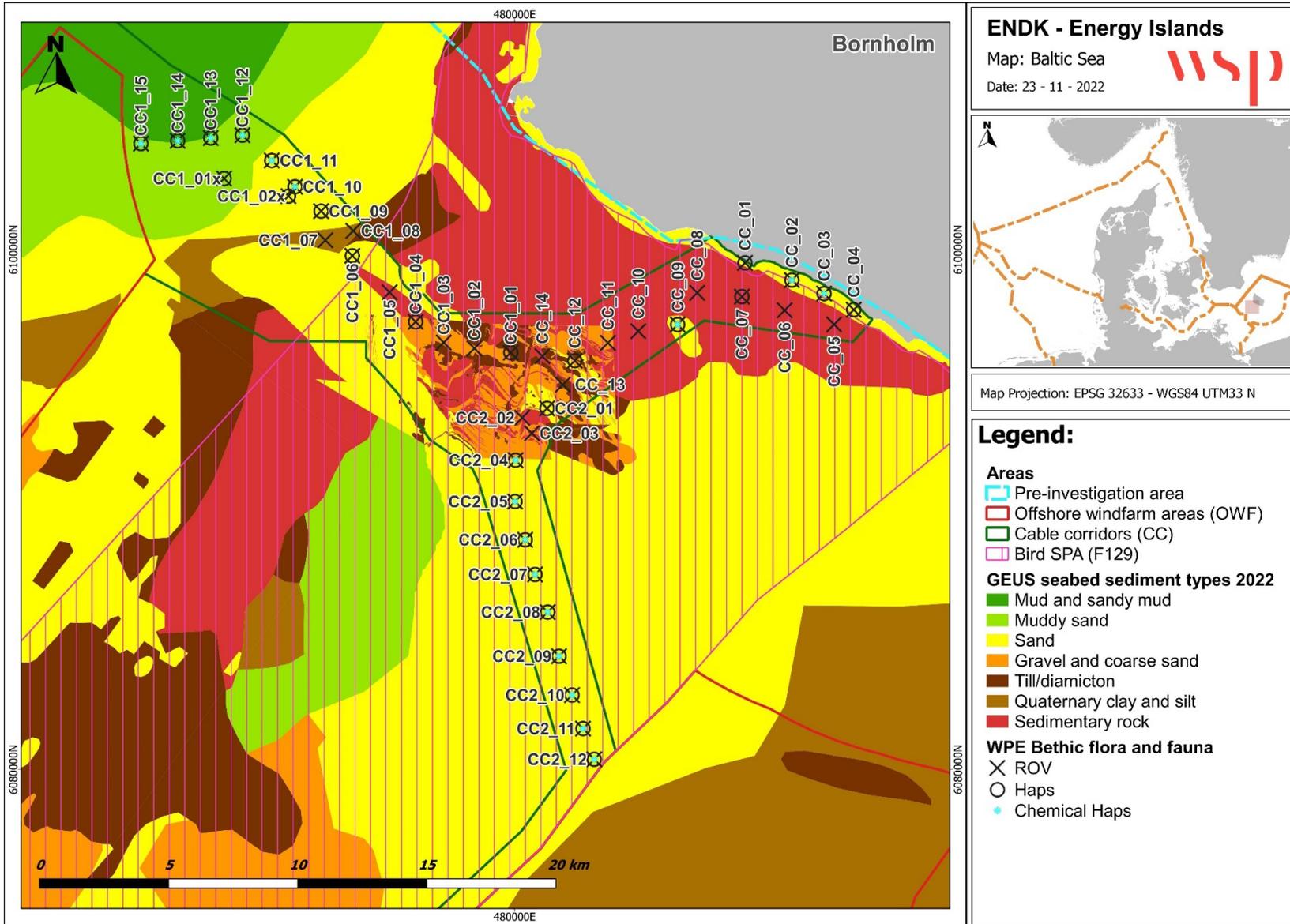


Figure 3-5. Stations placed within the two cable corridors CC1 and CC2. Where the pre-investigation area for the two cable corridors overlap stations are called CC.

In total 43 ROV stations, 0 CTDO stations, 29 HAPS stations and 18 HAPS samples for chemical analysis.

The background seabed sediment map is from GEUS, Marta-database.

WIND FARM AREAS (BORNHOLM I AND BORNHOLM II)

Sampling in the two offshore wind farm areas (OWFs, Bornholm I and Bornholm II) are presented in Table 3-1 and Figure 3-4. Stations are placed to ensure sufficient coverage of all sediment types in the two areas. Station placement is based on GEUS Martha-database substrate types.

Data for grain size and organic content at 254 stations sampled within the wind farm areas are described, as relevant, from data delivered by Energinet, which have been collected during the geophysical survey by GEOxyz (see Figure 3-10).

CABLE CORRIDORS (CC, CC1 AND CC2)

The export cable corridors from the two wind farm areas (Bornholm I and Bornholm II) to Bornholm are shown in Figure 3-5. The interconnector cable from Bornholm to Zealand is not included.

In the cable corridor in total 43 ROV stations, 0 CTDO stations, 29 HAPS stations and 18 HAPS samples for chemical analysis are collected (Table 3-1 and Figure 3-4).

The proposed program is based on our current available knowledge of sediment types in the area, represented by the GEUS seabed sediment map used as background in Figure 3-5). Based on this the HAPS samples are placed in areas with loose sediments – thus avoiding areas of till and rocky seabed, which instead will be pointed out for some of the ROV stations.

The 18 HAPS samples for chemical analysis of the sediment are divided between the two cable corridors according to the area of loose sediment. The area of loose sediment along the cable corridor is larger for CC2 than CC1. There are therefore appointed 6 HAPS samples and 9 HAPS samples for chemical analysis respectively for CC1 and CC2 (see Figure 3-4). Along the coast of Bornholm in the landfall area, further 3 HAPS samples for chemical analysis are placed to assess chemical concentrations in this area as well. Two HAPS samples for chemical analysis could not be taken in the CC1 cable corridor due to rocky substrate (CC1_06 and CC1_09).

BIRD FOOD PROGRAM

The Danish Environmental Agency has appointed a number of new Special Protection Areas for birds (SPAs) under the Habitats Directive (Habitats Directive 92/43/EEC)

Relevant for Energy Island Bornholm is a new Bird SPA (Rønne Banke F129/DK00FC373) in the Natura 2000 site no. 252/H261 "Adler Grund og Rønne Banke". The SPA site is placed on Rønne Banke in the middle of the pre-investigation area between the two wind farm areas (Figure 3-3). This SPA is designated to protect one bird species - long-tailed duck. Natura 2000 impact assessment of the plan for Energy Island Bornholm, therefore, has to include an impact assessment for Bird SPA F129 and long-tailed duck.

Relevant for the scope of work of WP-E benthic flora and fauna is the mapping and assessment of bird food in the SPA site and the pre-investigation area for long-tailed duck (and possibly other birds from the nearby Natura 2000 sites). Long-tailed duck feeds on different mussel types, snails, shrimps, small fish, and other benthic fauna including infauna such as brushworms. Relevant sampling therefore includes both HAPS samples for infauna and burying mussels and ROV for epifauna and blue mussels. Long-tailed duck can dive to a depth of 100 meters while foraging, thus all depths in the SPA site and the pre-investigation area are, therefore, possible foraging areas for the birds. Samples and stations are therefore distributed at all depth intervals.

The sampling program is assembled to sufficiently describe and map the biological communities and, thus, the bird food availability for the sediment types in the pre-investigation area including the bird SPA site (Figure 3-3).

There is expected to be a high variation of the substrate within the SPA site in general, which is not illustrated in sufficient detail on the GEUS Martha-database map in Figure 3-3. The GEUS map is our only source of information for the substrate types in the area, since there are no geophysical data available for the bird SPA. It is thus recommended to ensure a sampling size that takes this discrepancy into account and ensures sufficient sampling in the bird SPA site.

42 HAPS samples per loose sediment type in the bird SPA site are chosen according to the technical requirements for soft bottom fauna sampling in the NOVANA program (Hansen & Josefson, 2020) to ensure sufficient samples to describe infauna and epifauna communities in each of the loose sediment types. One loose sediment type (“Mud and sandy mud”) is not represented in the large-scale map of sediment types within the bird SPA site and 42 stations are therefore placed in the area west of Bornholm I (nord and syd), to ensure sampling of this sediment type (Figure 3-3) (Table 3-1).

For the hard substrate types in the bird SPA site 25 ROV-stations are chosen per hard substrate type to describe the substrate type (sand, silt and rock coverage%) and epifauna community (Table 3-1). The epifauna community on hard substrate types is less diverse with fewer species compared to the infauna and epifauna community in loose sediment types, and fewer stations are therefore needed to sufficiently describe this community.

Where stations were too closely placed within a substrate type in the bird SPA site, some stations were distributed in areas with low-station coverage in the pre-investigation area outside of the bird SPA area (see Figure 3-3):

- This way 15 out of the 42 HAPS samples for “Mud and sandy mud” were placed in the pre-investigation area outside the SPA site.
- 2 out of 42 HAPS samples for “Gravel and coarse sand” were likewise relocated.
- 15 out of 25 ROV stations for “Quaternary clay and silt” were relocated to ensure mapping of this substrate type in the eastern and western part of the pre-investigation area.
- “Mud and sandy mud” were only found outside the SPA site and the 42 HAPS sample stations were therefore placed in the western part of the pre-investigation area, west of Bornholm I nord and syd.

Bird food mapping is done using all stations sampled for infauna and epifauna in the pre-investigation area. Bird food mapping will result in a map showing nature types (biological communities) and their value as bird foraging areas. Also, a map showing the number of species and infauna biomass at stations in the pre-investigation area will be made. The area coverage of nature types in relation to their food value in the entire pre-investigation area, in the OWFs and the bird SPA site will be approximated. This way it is possible to assess the impact of the footprint of the OWFs on the bird food areas available to the birds for foraging in the pre-investigation area. As well as assessing the relative value of the OWF areas in comparison to the total pre-investigation area and the SPA site.

3.2 EQUIPMENT AND METHODS

Equipment and vessels used for the benthic survey are presented below.

3.2.1 VESSELS

The survey vessels M/S Skoven (Figure 3-6) and Sephia (Figure 3-7) is used to accommodate the technical requirements for WP-E. Skoven is used for the entire offshore part for WP-E whereas Sephia is used for the investigations in the coastal area with sedimentary rock.

Skoven has excellent facilities regarding lifting equipment and deck area, as well as launch and recovery systems (LARS). The benthic survey for WP-E will, if possible, be operated on a 24-hour basis, with 12-hour shifts. Skoven is equipped with an Azimuth thruster in front, keeping the vessel in position during HAPS sampling and deployment of ROV/CTDO if needed. Experience shows that the weather limitations for Skoven during survey operations is about 2.0-2.5 meters of wave height – depending on the actual task. Experience from similar seabed investigations from Skoven shows that good data quality (ROV video) is achievable up to a wave height of approximately 2.0 meters. Skoven has an adequate size for operating in the Baltic Sea and appropriate working space on deck for handling of relevant equipment and handling of samples as well as good experiences with similar tasks for WSP. M/S Skoven can accommodate a contractor benthic survey inspector during surveys if needed and an IMCA/CMID (Common marine inspection document for small boats and small working boats), which will be renewed if needed during the survey.

Foto 14 af 14



Figure 3-6. Research vessel M/S Skoven.

Sephia has excellent experience with seabed mapping and has been used in seabed investigations related to wind farms, pipelines and raw material extraction areas. In relation to previous seabed investigations Sephia has been HSE approved by Ørsted A/S and Nord Stream 2 AG (NSP2) and is IMCA/CMID approved. Sephia has been used in connection with a wide range of wind farms in the Danish Waters, i.e. diving inspections, ROV inspections, sediment samplings, navigation channels etc. Sephia will only be used in survey operations in coastal areas from 1 meter depth. The survey operations on Sephia related to WP-E will be operated on a 12-14 hour basis.



Figure 3-7. Research vessel Sephia.

3.2.2 ROV – VISUAL VERIFICATION/QUANTIFICATION

A ROV is used for visual inspection of the seabed and quantification of seabed type and characteristics, benthic flora and fauna including species/taxa number and coverage (%) and the number of fish species and coverage (%). The first activity on each station is a ROV inspection showing the seabed characteristics, flora and fauna live on deck. Visual inspection of the seabed with ROV is always done before HAPS sampling to ensure sampling on loose sediment.

A BlueROV2 (Figure 3-8) with positioning system is used, which gives information of the exact position of the ROV as well as showing the position in each frame/photography. A complete Digital Video System will be provided, including all equipment, laptops, cabling, connections, screens, spares etc. WSP has two complete ROV systems, thus, an identical backup will be brought in case of equipment failure. The equipment will be set up so both the helmsman and the camera operator can see the image/video in real time. WSP is highly experienced in speaking the video while recording as well as filling out a field log for each station. The log-book includes: position, depth, seabed sediment types/composition, habitat types and determination of species (flora and fauna) and coverage of species and biogenic structures observed on the seabed surface (e.g. sandworms (also coverage), fish foraging, holes in the seabed, mysids/shrimps etc.). Other parameter targets, at the same station will also be included in the field log. Both the speaking and a detailed field log are invaluable to enhance the quality when the videos are reviewed in detail later in the office. Sufficient storage media will be ensured, and back-up of all data will be performed at least twice a day on two hard discs.

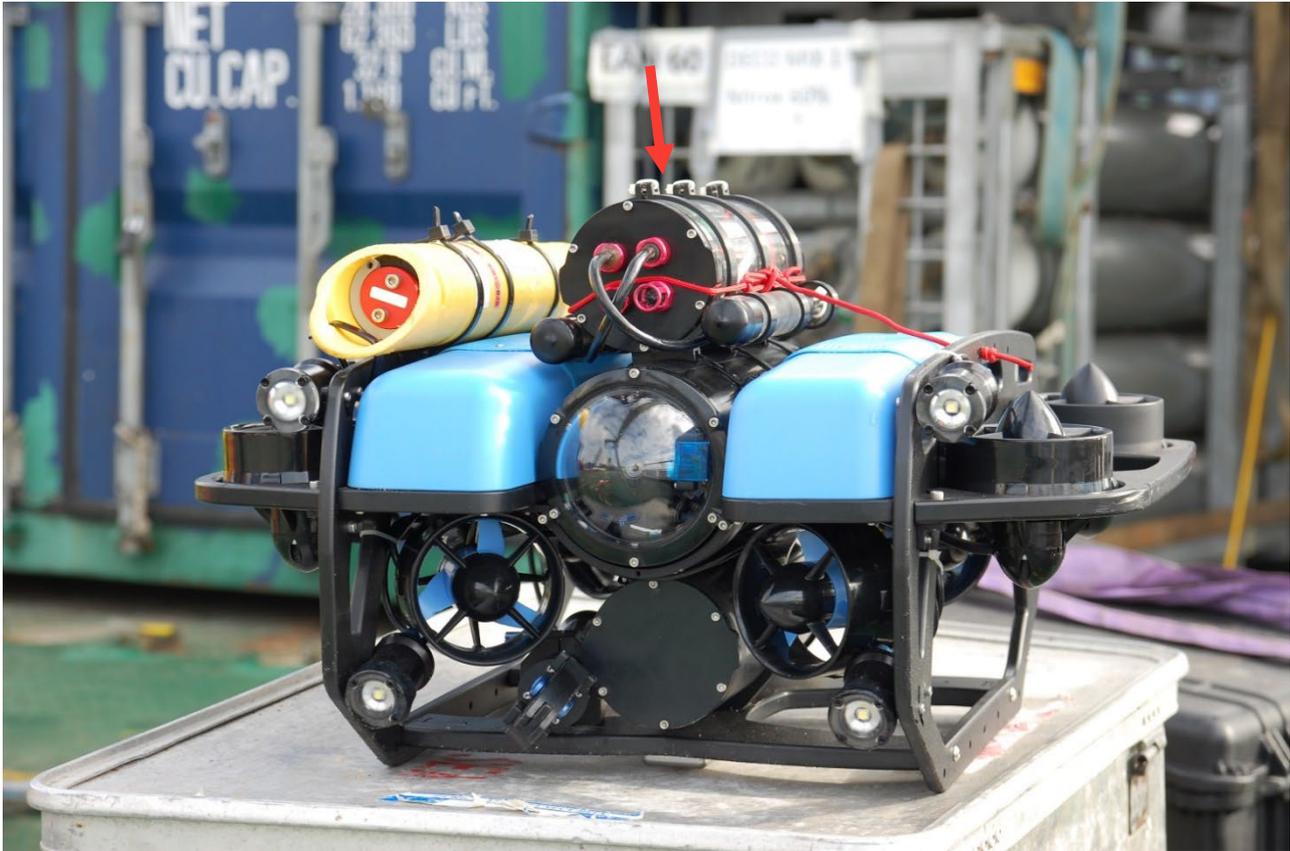


Figure 3-8. ROV with mounted/integrated online CTDO system sensors (red arrow). The yellow cylinder is an acoustic device used for accurate positioning relative to the ships position.

3.2.3 CTDO – PROFILING IN THE WATER COLUMN

A CTDO is used for profiling of temperature, salinity and oxygen concentration and saturation in the water column. Based on previous good experiences, a CTDO with optional water sampler will be used. This unit can be used as a standalone CTDO unit, or as an ROV integrated CTDO (see Figure 3-8.). The core element in the CTDO is a Campbell Scientific CR310 datalogger with online ethernet connection to the surface, which can host a wide variety of sensors. For this specific task the following sensors are used: conductivity with a digital Ponsel C4E sensor, fast responding temperature sensor (I2C, ± 0.1 °C), Bar30 pressure sensor (MS5837-30BA), Oxygen with a Ponsel OPTOD (Optical Dissolved Oxygen) sensor and water sampling with a General Oceanics 1.7 L model 1010 Niskin Water Sampler.

3.2.4 HAPS – SEDIMENT CORE SAMPLING

SAMPLING METHOD

A HAPS core sampler (Figure 3-9.) is used for sampling of sediment characteristics and infauna quantification. The HAPS core sampler samples a seabed area of 0.0145 m². This instrument complies with the technical requirements for soft bottom fauna sampling in the NOVANA program. A HAPS core sampler will be used for sediment sampling as the sediment gets less disturbed. This makes it easier to describe sediment composition and texture compared to samples collected with a Van Veen grab sampler. Three attempts will be made before moving to the next location including the use of a vibrating unit.



Figure 3-9. HAPS core sampler.

WSP has two HAPS Core sampling systems (and can get an extra HAPS from DHI and University of Aarhus – if needed), thus an identical backup will be brought in case of equipment failure. Furthermore, WSP has a vibrating unit for the HAPS sampler, increasing its performance in compact sandy sediments.

The first activity at each station will be a ROV inspection showing the seabed characteristics, flora and fauna live on deck. In case a station is designated to include a HAPS sample and appears to be unsuitable for HAPS sampling (fx. till or rocky seabed) the station will be relocated. However, representative (substrate and depth intervals) HAPS samples will be guaranteed within the pre-investigation area. The number of HAPS samples collected in the pre-investigation area are listed in Table 3-1 and shown in Figure 3-2.

SEDIMENT CHARACTERISTICS

On deck, each successful HAPS-core sediment sample will be described and photographed while the sample is in the HAPS-core cylinder together with descriptions of sediment composition, color (a color scale will be visible on each photo), smell and visible fauna.

Further characteristic of sediment grain size and organic content are done based on data sampled during the geophysical survey in the two wind farm areas by GEOxyz (OWF1 and OWF2). Sampling stations for grain size and organic content (254 stations) are shown in Figure 3-10 below.

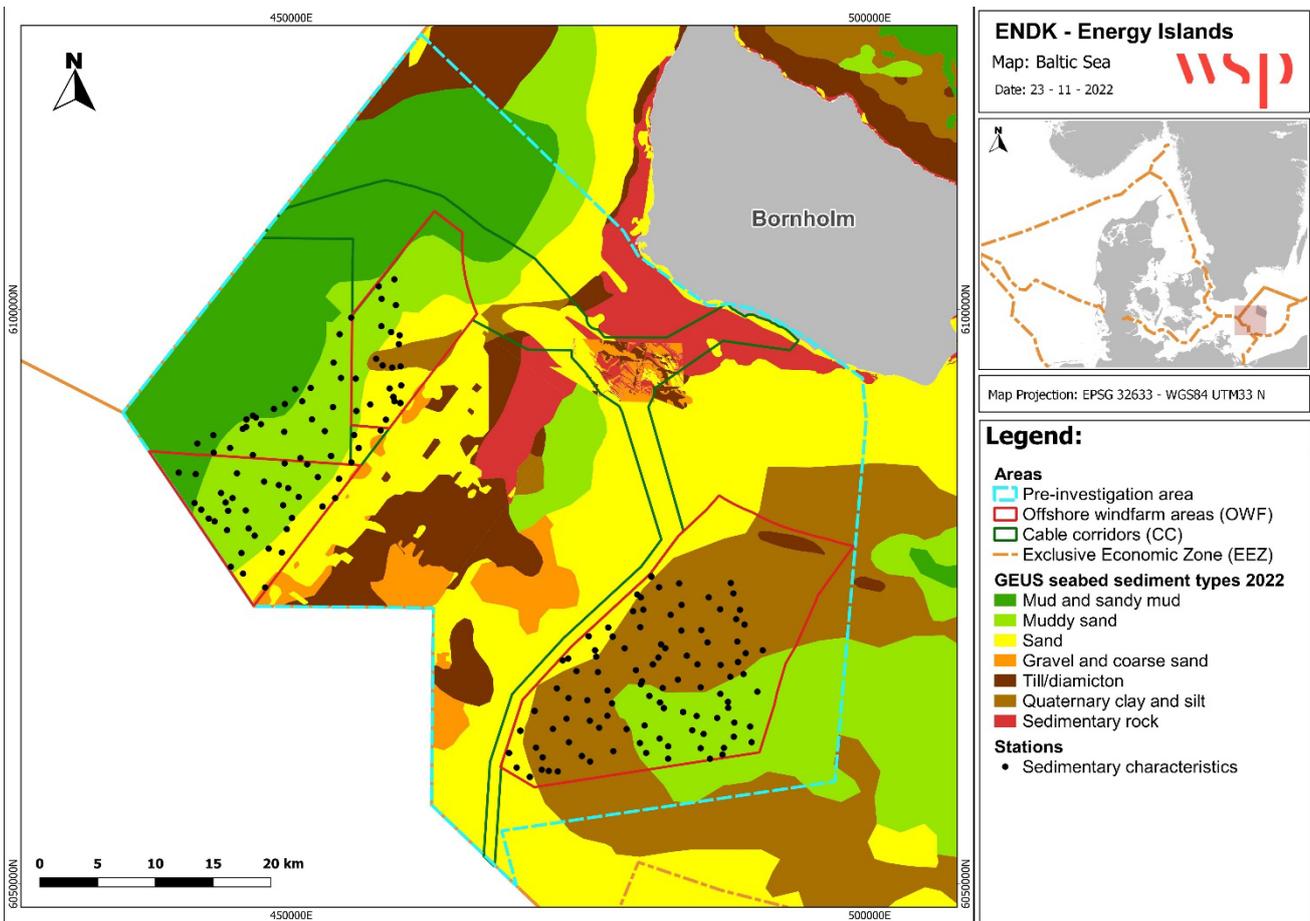


Figure 3-10. Geophysical sampling stations (GEOxyz) for sediment characteristics in the two wind farm areas (Bornholm I (nord and syd) and Bornholm II).

CHEMICAL ANALYSIS

Chemical analysis of the concentration of nutrients and pollutants in the sediment is performed in the two wind farm areas (Bornholm I and Bornholm II.) and the two export cable corridors, where sediment may be suspended due to digging, cable trenching, cable flushing or other sediment disturbing activities, that may bring nutrients and pollutants in suspension in the water column. Release of nutrients and pollutants through resuspension of sediment from wind farm activities are potential impacts for the environmental parameters, that will be assessed in the SEA and eventually in the EIA.

Wind farm areas (Bornholm I and Bornholm II)

10 HAPS sediment samples are taken in Bornholm II for chemical analysis. After subdivision of Bornholm I, 3 chemical samples were taken within Bornholm I nord and 4 samples within Bornholm I syd. In total 17 chemical analyses for the two wind farm areas (Figure 3-4).

Furthermore, the 10 chemical HAPS samples from the former OWF1 area is now placed in and between the two Bornholm I sub areas (Bornholm I nord and syd) (see Figure 3-4).

Cable corridors

Similarly, 18 HAPS samples are taken in the cable corridor area for chemical analysis. The area of loose sediment along the cable corridor is larger for CC2 than CC1. There are therefore appointed 9 HAPS samples and 6 HAPS samples for chemical analysis respectively for CC2 and CC1. Two samples in CC1 were not sampled due to rocky substrate (CC1_06, CC1_09). Along the coast of Bornholm in the overlapping cable

corridor area (CC), further 3 HAPS samples for chemical analysis are placed to assess chemical load in this area as well (Figure 3-5).

Chemical analysis per sample follows requirements in the Danish Dredging Manual (Miljøstyrelsen, 2015) and includes:

- Total Organic Carbon (TOC) by LOI, Total nitrogen (TN) and total phosphorus (TP)
- Heavy metals (8): Arsenic (As), lead (Pb), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni) and zinc (Zn)
- Sum of PAH compounds (9): Phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benz(a)pyrene, indeno(123cd)pyrene and benzo(ghi)perylene
- Sum of PCB compounds (7): 28, 52, 101, 118, 138, 153 og 180
- TBT and degradation products: DBT and MBT

INFAUNA QUANTIFICATION

Sample sieving (1 mm sieve) and storage/preservation of samples will be carried out in accordance with technical requirements for soft bottom fauna. All samples will be stored in plastic buckets with a tight lid and secured in a dedicated safe area on the vessel. The buckets will have labels inside and labelling on the lid. All samples will be treated individually in WSP's laboratory by a certified Danish infauna expert. The samples will be sieved in a 0.5 mm sieve to remove ethanol before sorting. All animals will be sorted out using a low power stereo microscope and identified to species level where possible. The total biomass of the individual species, including shells of bivalves, will be determined as total wet weight and dry weight after 105°C for 18-24 hours or until stable weight is reached. The polychaete *Pygospio elegans* will be weighed with tubes after prior removal of "excess tube material" without content. Barnacles will be counted and indicated as being present, i.e. no biomass determination. The infauna data will be analysed both qualitatively and quantitatively. WSP is prequalified to collect, and species determine infauna samples. Data of common parameters will be presented when reporting in connection with the technical report.

Data presented will include species present, species number, abundance and biomass (wet and dry weight), species diversity (Shannon-Wiener index) as well as relevant index and plot if appropriate: AMBI, DKI and Multidimensional scaling plots (MDS-plot).

During survey operations related to WP-E, the quality of the acquired data is monitored on continuous basis, in order to ensure that the technical requirements are met.

3.2.5 SUBSTRATE-TYPE MAPPING

The substrate-type map shows the distribution of substrate types within the windfarm areas and cable corridors of the pre-investigation area and is based on the geophysical mapping in the area.

The 1st generation substrate type map is produced by GEOxyz (the geophysical contractor) and delivered to WSP. Alternatively, WSP can take on this work if this is agreed with Energinet and the work will in that case be a variation order.

1st generation mapping – Side scan data interpretation

The 1st generation substrate map is based on the interpretation of side scan sonar data, in order to determine the roughness of the seabed and coverage of cobbles and boulders as defined by the Danish Authorities in statutory order no. 780 of 20-06-2017 (Ministry of Environment of Denmark, 2018). Based on the side scan data the different types of sediments are then subdivided into the following categories:

- **Type 1 – Sand and soft sediments:** Can be dynamic and is chiefly composed of fine-grained material from mud to firm sands. Subtypes 1a, 1b and 1c are dominated by silt, sand or clay, respectively. The substrate may contain some gravel (0,2-2 cm) and pebbles/small cobbles (2-10 cm). Further, the substrate may contain a few (<1 %) boulders (>100 mm).
- **Type 2 – Sand, gravel and small rocks with a few larger rocks (area coverage 1-10 %):** Composed chiefly of sand but with varying amounts of gravel and pebbles/small cobbles. The substrate may contain some (<1-10 %) scattered boulders (>10 cm).
- **Type 3 – Sand, gravel, small rocks and several larger rocks (coverage 10-25 %):** Composed of varying amounts of sand, gravel, pebbles/small cobbles as well as larger cobbles and boulders (>10 cm), with boulders covering 10-25 % of the sea floor. Also includes pebble fields and scatterings of small cobbles.
- **Type 4 – Rocky areas (reefs), consisting of many larger boulders (coverage >25 %):** Dominated by cobbles and boulders, from close scatterings to reefs rising from the sea floor, with or without cavity forming elements. Boulders (>10 cm) cover 25-100 % of the sea floor. Other substrates may be sand, gravel and pebbles in varying amounts. Also includes sedimentary rock as present around Bornholm.

2nd generation mapping – Side scan data interpretation in windfarm areas and cable corridors

WSP produces a 2nd generation substrate map for the wind farm and cable corridor areas. WSP's ability to make a 2nd generation substrate map is conditioned by the Geophysical contractor delivering a 1st generation substrate map of sufficient quality.

Wind farm areas and cable corridor:

WSP produces a 2nd generation substrate map from the 1st generation map and data delivered by the geophysical contractor, GEUS substrate map (Martha database) and the ROV-videos as verification of the substrate type on the seabed (ground truthing).

Other areas within the pre-investigation area (SPA and INV stations):

These areas were not mapped by the geophysical contractor and 2nd generation maps can therefore not be made in these areas. Here the GEUS map will be used to describe the substrate types.

3.2.6 NATURE TYPE MAPPING

The nature type map shows the distribution of benthic flora and fauna communities within the pre-investigation area.

Wind farm areas and cable corridor:

The nature type map is based on the 2nd generation substrate type map within the wind farm areas and the cable corridors as well as the flora and fauna communities observed from the ROV-videos in each of the substrate types. Each substrate type will be converted to the appropriate nature type according to the observed (ROV video) benthic flora and fauna community on the substrate type.

Other areas within the pre-investigation area (SPA and INV stations):

In the areas within the pre-investigation area, which were not mapped by the geophysical contractor, the GEUS substrate type map will be used and the flora and fauna observed on ROV-video living on these substrate types will be converted to nature types.

When assigning the nature types based on the substrate type maps, several substrate types with the same benthic flora and -fauna communities observed on the ROV-videos will be merged into one nature type representative for one benthic flora and -fauna community. As an example the nature type "Stone reef communities" are usually based on several substrate types (substrate type 3 and 4/till/diamiction and

sedimentary rock), due to the flora and fauna communities being the same on hard substrates such as large stones and sedimentary rock.

4 DELIVERABLES

Deliverables included in this work package:

- A benthic survey scope report
- An environmental baseline note
- An operational report for the survey
- A technical report
- Data from field investigations of benthic fauna and flora

4.1 BENTHIC SCOPE REPORT

This document constitutes the final version of the benthic survey scope report. First draft was delivered to Energinet in week 38.

4.2 ENVIRONMENTAL BASELINE NOTE

WSP will deliver an environmental baseline note to Energinet during Q1 2022. This report will present the existing data for abiotic parameters, seabed sediment characteristics, benthic fauna and flora in the investigation area based on baseline mappings from other projects in the area on similar substrate types. This report will support the writing of the SEA.

The environmental baseline note includes existing data for the pre-investigation area, the two wind farm areas (Bornholm I and II) and the export cable corridors (CC, CC1 and CC2) to Bornholm.

4.3 OPERATIONAL REPORT FOR SURVEY

During the field work, daily updates from the vessel will be sent from the Survey Manager by e-mail to the Client. The reports will contain information regarding:

- Project
- Survey number and purpose of survey
- Name of vessel
- Name of harbour
- Dates and time for when the vessel leaves and returns to harbour
- Survey date and time (excluding arrival and return time to and from the survey area) incl. weather down time
- Name of captain
- Names of scientific crew and their respective roles
- Weather information
- Information on abandoned survey procedures in respect to the methods outlined in the scope of works
- Description of what has been done, when and for how long
- Experienced limitations and/or special events and/or sightings
- Description of sightings, incidents or special events

After the benthic survey has been completed, the information from the daily updates is combined in an operational report and delivered as agreed with Energinet.

4.4 TECHNICAL REPORT

The Technical report will be delivered as a final and approved version to Energinet (in English) during Q2 2023 including a review process. The technical report describes the baseline situation for the seabed and benthic flora and -fauna communities in the pre-investigation area and provides maps illustrating the availability of food organisms for long-tailed duck in the pre-investigation area.

The report includes the mapping and baseline description of the following:

- Abiotic parameters including depth, salinity, temperature, oxygen
- Seabed sediment characteristics such as sediment types, physical parameters (depth, grain size, organic content) and chemical parameters (nutrients and pollutants, see 3.2.4 – Chemical analysis)
- Benthic flora
- Benthic fauna (epifauna and infauna)
- Benthic communities
- Maps of bird food organisms in the pre-investigation area

5 MILESTONES

Reporting and time schedules for WP-E will strictly follow the deadlines stipulated in the tender documentation, a summary of these is shown in Table 5-1. A Client Review period of 15 days has been incorporated into the schedule to review the 1st Draft Version of the Benthic Report (M22). For the second Client Review a period of 10 days has been incorporated to review the Final Draft Version of the Benthic Report (M23).

Table 5-1. Milestones and deadlines for all work packages.

Work package	Milestone No.	Milestone	Deadline
WP-E	M20	Scope Report, 1 st Draft	Week 38 - 2021
WP-E	M21	Scope Report, Final Version	Q1 - 2022
WP-E		Environmental Baseline Note, 1 st Draft	Q1 - 2022
WP-E		Environmental Baseline Note, Final version	Q2 - 2022
WP-E	M22	Technical report, 1 st Draft	Q1 - 2023
WP-E	M23	Technical report, Final draft	Q2 - 2023
WP-E	M24	Technical report, Final version	Q2 - 2023

5.1 BENTHIC SURVEY

WSP will start the field operations on the 1st of March 2022, to comply with the technical requirements for soft bottom fauna sampling program (1st of March – 31st of May) (Hansen & Josefson, 2020) within the NOVANA program and to provide as much time as possible to field work contingencies, data analysis as well as reporting. The survey is estimated to be completed in 13 days including transit + 3 days mob/demob and 5 days of weather stand-by, with the vessel Skoven, and 4 days (including mob/demob) with the vessel Sephia on the rocky parts in the pre-investigation area + 1 day for weather stand-by. This leaves a very robust contingency for unforeseen events within the NOVANA sampling period (1st of March – 31st of May) for the fieldwork on Skoven and Sephia. The vessel “Sephia” will only be used for the ROV investigations in the coastal area with sedimentary rock.

All field work will be finished in Q1 November 2022.

6 PERMITS

Energinet obtains the necessary permits for sampling before the benthic survey starts around the 1st of March 2022.

7 REFERENCES

- Hansen & Josefson. (2020). Hansen JS, Josefson A (2014): Bilag 5 Teknisk anvisning m19 Blødbundsfauna. *version 3 gyldig fra 19.10.2020*. Aarhus Universitet, DCE.
- Miljøstyrelsen. (2015). Klapvejledningen. <https://naturstyrelsen.dk/media/nst/Attachments/Klapvejledning.pdf>.
- Ministry of Environment and food of Denmark. (2017). Statutory order on exploration and dredging of raw materials from the sea territory and continental shelf. *BEK nr. 780 af 20/06/2017, Miljøstyrelsen, j.nr. SVANA-700-00004*.