Mapping of seabed habitats at the Goliat Wind area

(Kartlegging av bunnhabitat i Goliat Vind område)

Akvaplan-niva AS Rapport: 66000_2

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This is an updated version of report 66000_1 and includes now section about marine archaeological assessments.

Approvals/signatures:

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1 Terminology

In this report we use the following terminology (thematic order):

Name	***Description***
Goliatvind AS	Client
Goliat Vind område	*Norwegian.* The area where the wind turbines are planned to be installed. Subsequently shortened to Goliat Vind.
Goliat Wind area	English version of above. Subsequently shortened to Goliat Wind.
Goliat FPSO	The Goliat Floating Production, Storage and Offloading (FPSO) facility.
GoliatVIND 1 (SW-NE) GoliatVIND 2 (NE-SW)	Pragmatic labelling of the two survey transects done in the field.

2 Summary and acknowledgements

This assignment was commissioned by Goliatvind AS, in connection with planned installation of five wind turbines to serve the Goliat Floating Production, Storage and Offloading (FPSO) facility. A preliminary reconnaissance survey was conducted by DeepOcean.

The field report (DeepOcean Ref PRJ002017-SUR-COR-0001) states the following with regards to the assignment:

" The purpose of this environmental survey is to give information about the occurrence of sponge communities, corals or other natural values in the area."

This present report is restricted to image analysis of the visual environmental habitat assessment survey conducted by DeepOcean at the proposed Goliat Wind location between 22-23.06.2024. Two survey transects (GoliatVIND 1 and GoliatVIND 2) were surveyed using the ROV Schilling HD60. The vessel used was the *Olympic Ares*, operated and owned by DeepOcean.

The seabed surface at the proposed Goliat Wind location is a primarily homogenous soft mud (clay and silt) with some sandy gravel, scattered with occasional cobbles and boulders. The area is already heavily physically disturbed by industrial activity leaving little untouched ground. Macrofaunal invertebrate burrows, tracks and surface deposits were present throughout the survey area. The scattered burrows, which indicates actively bioturbating communities within the sediments, were most likely constructed by burrowing macrofauna notably crustaceans such as the Norway lobster (*Nephrops norvegicus*) and the amphipod *Neohela monstrosa*. These types of communities generally are relatively resistant to low-level sedimentation deposition and disturbance.

Scattered occurrences of sponges were observed along both transects; in which they were not clustered within a particular area. Singular occurrences were the most numerous, yet on some occasions they were more abundant. Sea pens were numerous across both transects with a more common occurrence in the SW point of GoliatVIND 1, however even within that area they were evenly distributed.

The survey area is considered a regular soft-bottom sea-floor typical of the area at large, without signs of particularly sensitive habitats or species of concern.

We would like to thank Goliatvind AS for awarding us this assignment. We also thank DeepOcean engineers and ROV pilots for collaboration and providing us with the relevant field data and images. We further acknowledge the efforts of the captain and crew of the *Olympic Ares.*

3 Background and aims

3.1 About the assignment

Goliatvind AS plans to install five floating wind turbines located to the north-west of the Goliat FPSO installation. These shall provide onsite renewable energy to the FPSO installation. Each of the turbines shall be moored with six lines, using suction anchor technology.

During the planning phase, a biological survey was conducted, to gather information about the seabed habitat conditions in the general vicinity of the mooring localities.

On 20.06.2024, Goliatvind AS commissioned Akvaplan-niva to analyse over 20 hours of recorded video material from the proposed wind park locality. This involved two transects, leading to approximatly 30 km of seafloor covered by 20 hours of video footage, which encompassed most of the proposed anchor positions. Akvaplan-niva received the data via “We Transfer” from Goliatvind AS on the 17.7.2024. A concise report, suitable to be delivered to the Norwegian Environmental Agency shall be delivered within the 23.8.2024.

The field report (DeepOcean Ref PRJ002017-SUR-COR-0001 Goliatvind) states the following with regards to the assignment: -

"A preliminary recon-survey was carried out by DeepOcean in the Goliat field between the 22nd and 23rd of June 2024. The vessel Olympic Ares and the ROV Schilling HD60 were utilized for the survey. The purpose of this environmental survey is to give information about the occurrence of sponge communities, corals or other natural values in the area.

The survey was carried out without a surveyor on board, due to the preparation time being limited. However, two transects, which covered most of the anchor positions, were surveyed. HD Video and navigation data were logged while the ROV was flying along the transects."

This present report is restricted to image analysis of the visual environmental habitat assessment survey conducted by DeepOcean at the Goliat Wind area on the 23.06.2024. Two survey transects (GoliatVIND 1 and GoliatVIND 2) were surveyed using the ROV Schilling HD60. The vessel used was the *Olympic Ares*, operated and owned by DeepOcean.

3.2 Background information about the Goliat Wind area

Goliat Wind is a collaborative demonstration project for floating offshore wind between Source Galileo Norge, Odfjell Oceanwind and Kansai Electric Power. The goal is to supply the Goliat FPSO installation with onsite renewable energy and demonstrate floating offshore wind technology within the Norwegian market.

The licence area is located in the Barents Sea approximately 82.37 km northwest of Hammerfest (Figure 1), with the shortest distance to land being approximately 51.99 km (Store Kamøya). The water depth at the location is approximately 330 metres.

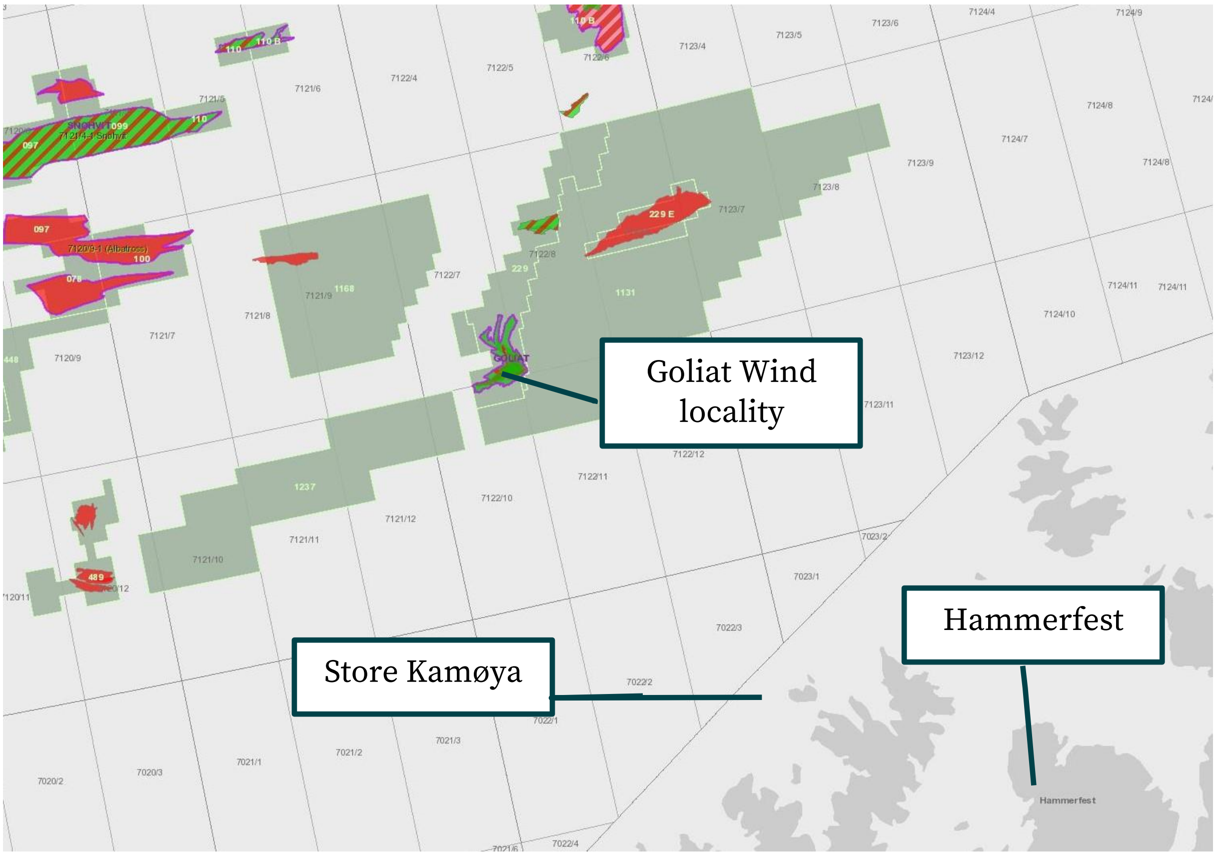

Figure 1. Overview map showing the location of the Goliat Wind area located within PL229. Modified from main source Norwegian Offshore Directorate.

4 Brief overview of sensitive habitats in the Barents Sea

4.1 Corals/ coral garden habitats

Corals belong within the phylum Cnidaria, which also includes sea anemones. They comprise colonies of small individuals with feeding tentacles (polyps) (Figure 2). The polyps are encased within the coral matrix and can retract when not feeding or if disturbed. Like sea anemones (but on a minute scale), the polyps use the tentacles to collect particles and/or zooplankton from the water using specialised stinging cells known as nematocysts, although some also can absorb dissolved carbon or use mucus nets to capture food items (Lewis and Price, 2009).

Figure 2. Close-up of two types of corals, showing the individual anemone-like polyps with their feeding tentacles extended. Illustration figure from www.fishkeepingpeople.com.

When individual coral structures grow together, they can form large gardens or reefs, measuring up to several metres in both vertical and lateral extent (OSPAR, 2008). These form usually colourful assemblages, often comprising several different species, that act as refuges for a wide range of fish and other invertebrates (Figure 3).

Densities of coral species in the habitat vary depending on taxa, food availability and abiotic conditions such as depth, current exposure, and substrate. Smaller species (such as the red tree coral *Primnoa* that frequently occurs on the Norwegian continental shelf/slope) can occur in higher densities, e.g., 50 – 200 colonies per·100m^2, compared to larger species, such as the bubble-gum coral *Paragorgia*, which might not exceed densities of 1 or 2 per 100 m^2, but measure a metre or more in height. The deep-water stone coral *Desmophyllum pertusum* (previously known as *Lophelia pertusa*) has received much attention in recent years, as its status is generally in decline in Atlantic waters, from the Arctic and to mainland Europe (OSPAR, 2022). The precise reasons for this are not known and may even be related to large-scale oceanographic factors such as temperature rise and/or acidification, as the skeletons are made of calcareous/chalky material (Mortensen and Buhl-Mortensen, 2005; Rogers, 1999).

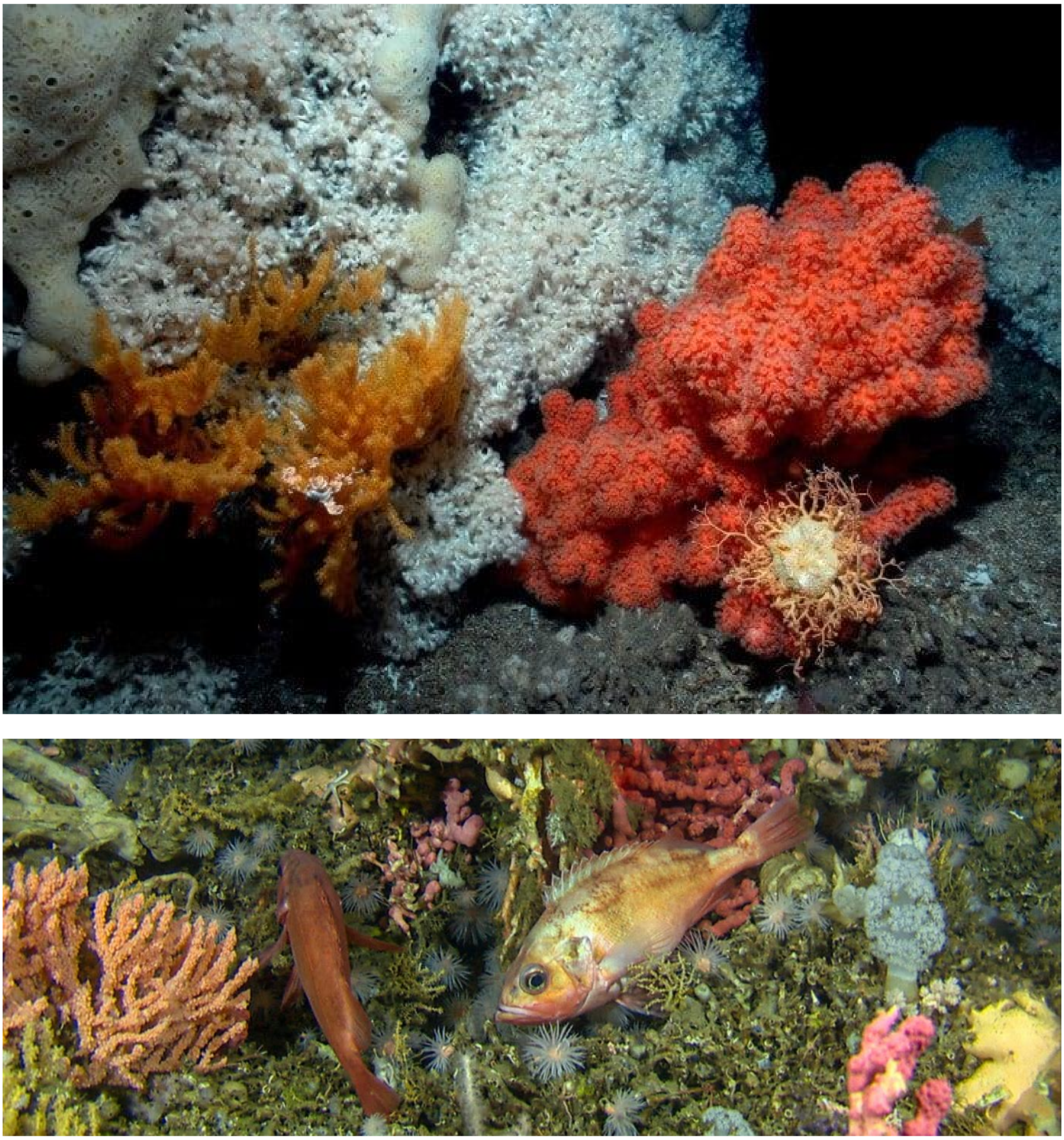

Figure 3. Typical coral assemblages in the Norwegian Sea, including the red variation of the bubble-gum coral *Paragorgia arborea* (upper right), and the white variation of the stone coral *Desmophyllum pertusum*. Lower left is likely the red tree coral *Primnoa*. Also, clearly visible (centre lower image) are sea anemones and a white soft coral, known in Norwegian as a "cauliflower coral" and which could belong to one of several taxa. Note the gorgonian multi-armed starfish in the upper image and the young redfish *Sebastes* in the lower image. Images (upper) Akvaplan-niva/Erling Svendsen and (lower) MAREANO/Norwegian Institute of Marine Research.

Corals grow at very slow rates, such that coral structures or gardens can be tens, hundreds or even thousands of years old, depending on location, oceanographic conditions such as temperature, salinity, pH and food quality, all which will vary according to the species concerned. Until recent technological advances, most of the growth studies reported in the literature have been based on measurements of corals kept in laboratory aquaria, which may not be entirely representative for *in situ* conditions. A review of the literature on coral growth rates is beyond the scope of the present report, but a helpful summary of the main issues surrounding corals in environments which also are subjected to human activities is given in OSPAR (2010c).

Being filter-feeders, corals are sensitive to increased or excessive sedimentation, such as from suspended and settled drill cuttings. Because the structures themselves are relatively brittle, they are vulnerable to physical damage from both bottom trawling and offshore mooring lines. Finally, their slow growth means that any damage incurred will remain on at least a decadal scale. For this reason, most offshore industries readily acknowledge the need to modify their activities to minimise damage to coral structures – and to avoid impacting larger aggregations (coral gardens or reefs).

4.2 Sponges

From around 2012 to around 2019, much attention has been given to sponge assemblages in the offshore operational parts of the Barents Sea (SW area – Norwegian Governmental monitoring area IX) (Offshore Norway 2019). Sponges occur on almost any marine substrate, from coastal habitats and all along the continental shelf. While rocky coastal habitats often support flourishing coral reefs, the largely homogenous soft-sediment areas along the continental shelf generally have low densities of sponges. However, certain areas, notably the south-western parts of the Barents Sea support high densities of sponges, warranting being classified under the OSPAR habitat description as "Deep Sea sponge aggregations" (OSPAR, 2010b). Usually these refer to the large white sponges within the genus *Geodia*, but many smaller forms also occur (Figure 4).

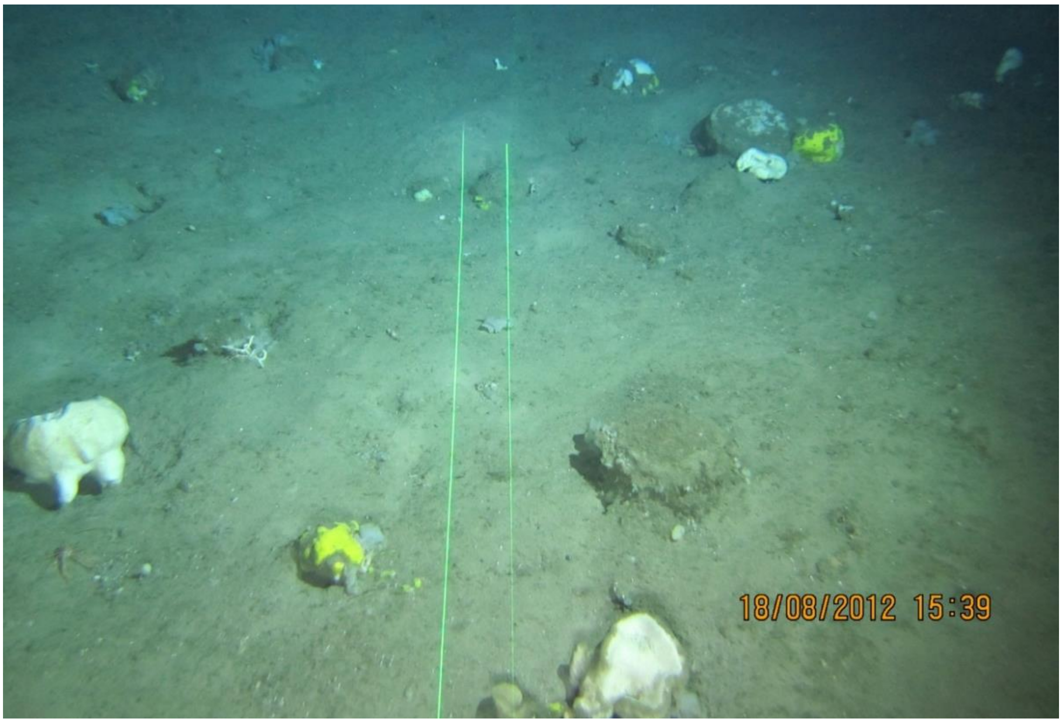

Figure 4. Illustrative image of a typical soft-bottom habitat, with scattered occurrences of the white sponge *Geodia* and the yellow sponge *Aplysilla/Stryphnus*. Distance between the green laser lines is approximately 12 cm (but note that *Geodia* can occur in larger sizes). Image: Cochrane, Akvaplan-niva/Oceaneering AS.

Like corals, sponges are colonial filter-feeding organisms and thus also are sensitive to sedimentation. Also, like corals, sponges have slow growth rates and a long recuperation time in case of mechanical damage (see Klitgaard and Tendal, 2001; Konnecker, 2002; Mortensen and Buhl-Mortensen, 2005).

Dense aggregations of living *Geodia* sponges, such as are reported from the south-western part of the Barents Sea, are not generally prevalent in the Norwegian or North seas (OSPAR 2010b).

Sponges are very complex organisms which are hard to identify down to species with physical samples and even harder via imaging alone. Therefore, within this report all sponges have been divided into five groups consisting of differing morphotypes, following methodology from the Institute of Marine research in Norway (Kutti and Husa, 2021). Table 1 shows division between the morphotypes and examples of species belonging to them.

Table 1 Table showing division of sponges into groups and morphotypes with examples of species. The table is a modified version of Kutti and Husa, 2021.

Morfotype/Morphotype	**Eksamplearter for denne morfotypen/ Example for that morphotype**
Skorpedannende/Encrusting	*Hymedesmia* spp., *Hexadella* spp.
Fingerformet/Finger form	*Antho dichotoma*
Massiv/Solid	*Geodia Barretti, Geodia phlegraei, Stryphnus* spp., *Parastrella* spp.
Rund/Round	*Craniella* spp.
Tykk skålformet/Thick bowl shape	*Geodia atlantica, Poecillastra* spp.
Porøs bulkeformet/Porous dented	*Mycale lingua*
Tynne vifteformet/ Thin fan formed	*Phakellia ventilabrum*
Traktformet/ Funnel form	*Axinella infundibulformis*
Stilkformet/Stemmed form	*Haliclona urceolus, Strlocordyla borealis*

4.3 Seapens and burrowing megafauna communities

Seapens are also related to corals and sea anemones, usually (but not always) having a central stalk and the individual polyps either arranged on lateral branches or arising directly from the stalk (Figure 5 and Figure 6). These generally do not occur as grouped assemblages, but as scattered occurrences, distributed over a wider area.

The habitat "seapens and burrowing megafauna communities" is listed as "threatened and/or in decline" (OSPAR 2008, OSPAR 2010a) and, as such, must be taken into consideration when planning seabed operations that may have a negative impact.

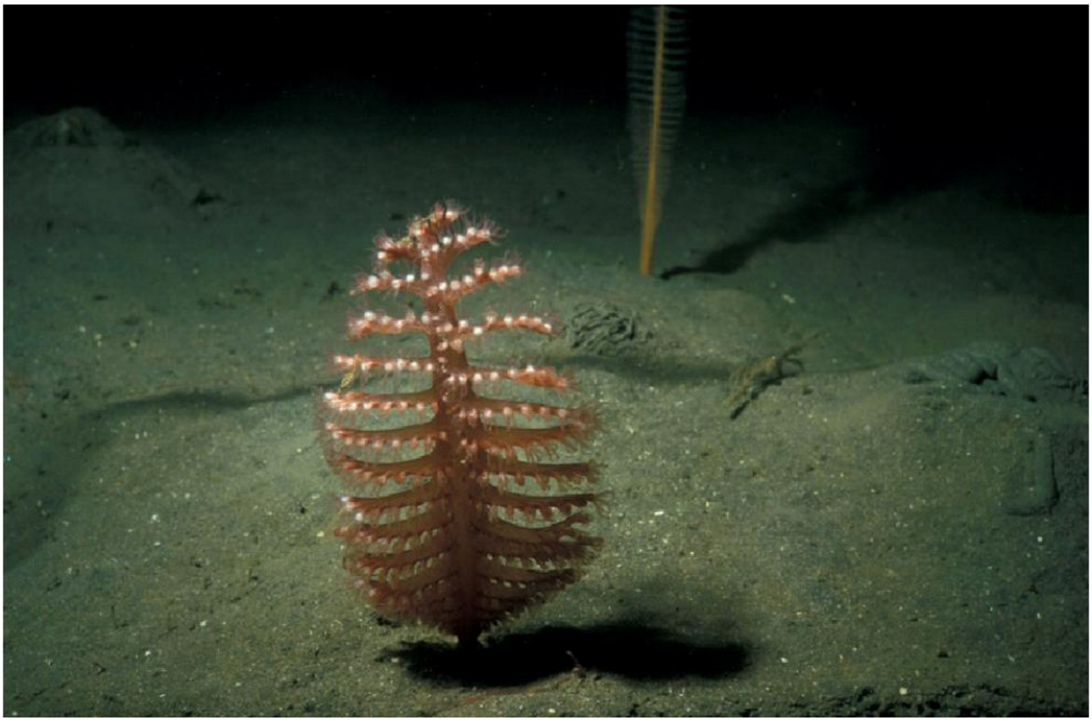

Figure 5. A seapen (likely *Pennatula*), on soft bottom sediments. In the background, likely the Tall seapen Virgularia. Note also the coiled deposits on the sediment surface, left by burrowing organisms such as bristleworms. Image: Dave Mills, jncc.gov.uk – reproduced from OSPAR (2010a).

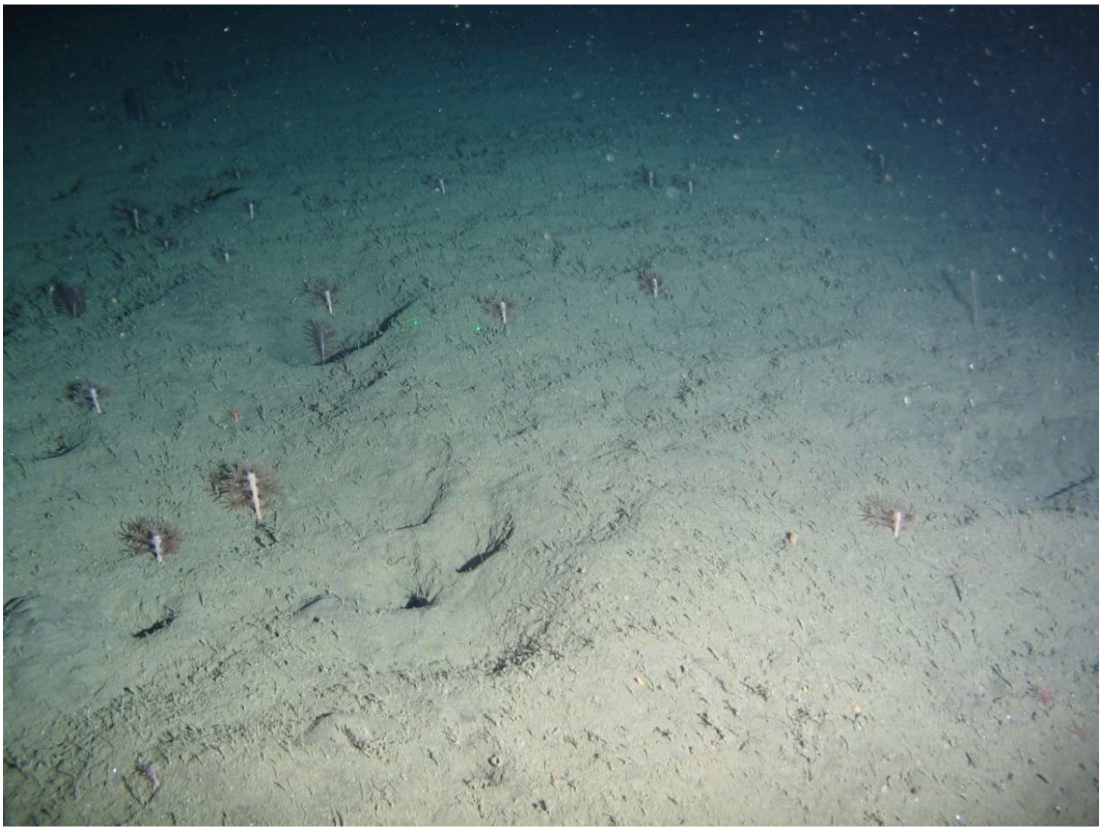

Figure 6. Soft-bottom habitat with seapens and evidence of burrows, made by crustaceans. Image: Icelandic Marine and Freshwater Institute.

Burrowing fauna are rarely captured on images, but the shape and size of their burrows are often characteristic enough to allow a tentative identification of the inhabitants. Along the deep water off the Norwegian coastline the most likely inhabitants of such burrows are the Norway lobster (*Nephrops norvegicus*) or the amphipod *Neohela monstrosa* (Figure 7 and Figure 8).

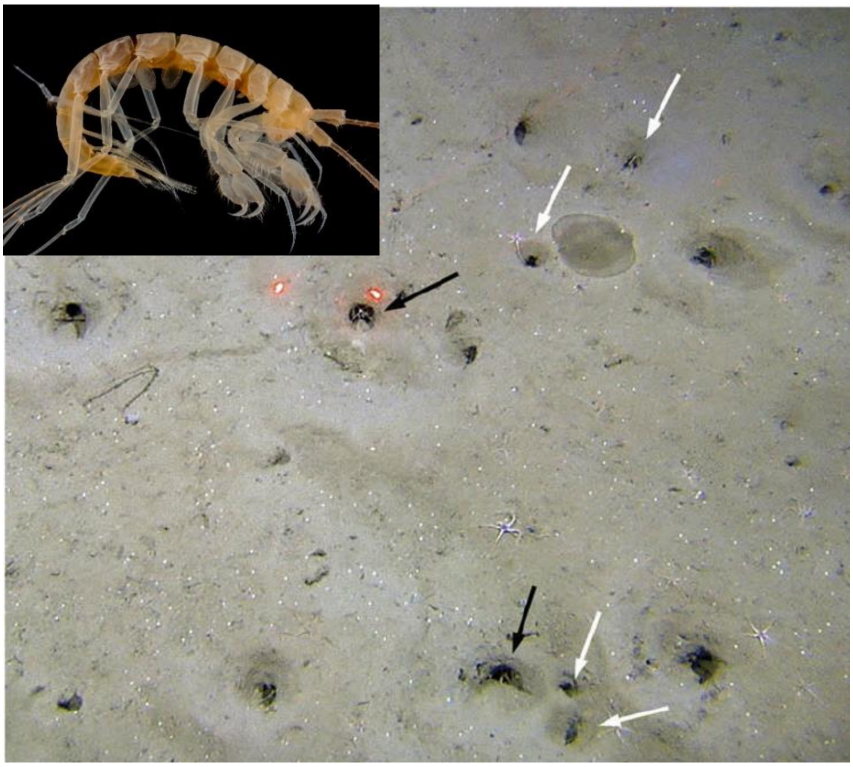

Figure 7. Typical sea-floor sediment inhabited by *Neohela monstrosa*, an amphipod that creates prolific holes and burrows in soft-bottom sediments. Main image from Buhl-Mortensen et al., 2015. Insert from the Swedish Species Register: image ©Fredrik Pleijel.

Figure 8. Norway lobster *Nephrops norvegicus* at the entrance to its burrow. © JNCC/Cefas

4.4 Comments on biological seabed assessment and mitigation measures

Assessing the status of seafloor habitats and then determining any appropriate mitigation measures in areas subject to human pressures, such as exploratory drilling, is influenced by several factors including, but not limited to[1]:

- Uniqueness
- Timescale of expected recovery if impaired
- Ecosystem services provided by the habitat
- Conservation value

Soft-bottom habitats that have an actively bioturbating (digging and mixing) fauna are ecologically important because they irrigate the sediments and transport oxygen relatively deep within the upper sediment layers. Other functions include carbon sequestration and remineralization (releasing minerals ready for the next spring bloom of microalgae).

Seapen and burrowing megafauna habitats are relatively homogenous in their distribution, such that mitigation measures such as micrositing (for example, moving anchor locations to avoid occurrences) will not have notable environmental benefits. The same applies to the scattered occurrences of sponges.

Coral occurrences need to be considered based on their size and distribution. Should the occurrences be large and sparsely distributed, due care should be taken to adjust operations to avoid these. However, if the occurrences are small and occur in similar densities across an area, such mitigation measures are not considered to give notable benefits.

[1] According to Convention for Biodiversity (CBD), 1992

5 Fieldwork and methodology

5.1 Fieldwork

5.1.1 Vessel, timeline and infrastructure

The visual survey was carried out onboard the DeepOcean vessel *Olympic Ares* and led by DeepOcean subsea engineers. No biologist was onboard, however the speed and distance from the seafloor was predominantly adhered to following technical specifications/guidance from Akvaplan-niva, provided in advance of the survey. High Definition (HD) video and navigation data were recorded and logged while the ROV was in operation.

The biological visual survey was conducted on 23.06.2024 during a 24-hour period (00:45 - 21:39).

Upon return to port, the visual survey data was converted by DeepOcean and a hard copy was sent to Goliatvind AS. On the 16.07.24 a secure WeTransfer link was established between Goliatvind AS and Akvaplan-niva. The data was downloaded by Akvaplan-niva, within the morning of the 17.07.2024.

5.1.2 Survey transects and numbering codes

The conceptual design of the transects is shown in Figure 9. The transect layout was positioned in NE-SW directions to cover most of the proposed mooring localities of all five wind turbines.

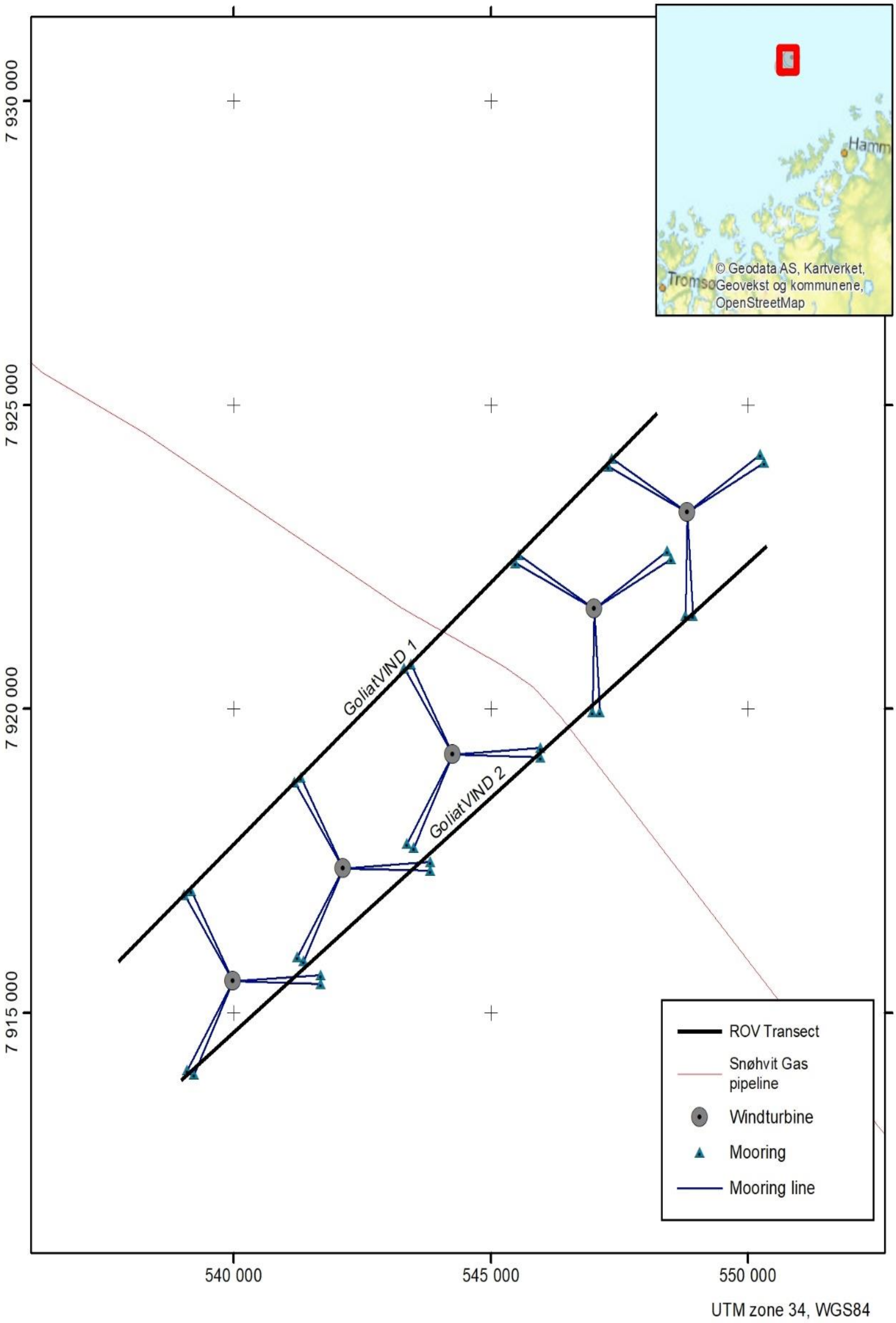

Figure 9. Conceptual illustration of transect design around the moorings of the five planned floating offshore wind turbines at the Goliat Wind area. Note the Snøvit gas pipeline that crosses the area.

The two transects were named as follows:

- GoliatVIND 1 (SW-NE)
- GoliatVIND 2 (NE-SW)

5.1.3 Positioning, data logging and mapping

Positioning and plotting of survey lines on the ship's navigational system was done by DeepOcean engineers/ROV pilots.

The entire survey was position-logged at 1 second intervals.

The logged events (geo-referenced biological observations) were subsequently plotted by Akvaplan-niva during the post processing within the EIVA data-logging package (Figure 10, result section).

5.1.4 ROV Schilling HD60 and visual imagery

DeepOcean personnel can provide technical specifications of the exact equipment used. As far as we understand, a Schilling Robotics Heavy Duty (HD 60) working class ROV was used for the survey, equipped with a suite of camera systems.

It is unknown if lasers were installed on the ROV Schilling HD60 system, but laser marks were not observed within the video footage during transects. Therefore, it was not possible to measure the size of objects of interest from the received footage. Care was taken during the survey to keep the ROV as close to the bottom as possible, without disturbance, while in transit ensuring that most of the video transect showed the seafloor (not horizon) clearly, and to adjust the contrast to maximize presentation of the features. However, there were times in which the ROV was too far above the seafloor for observations to be made.

5.1.5 Field report

A field report produced by DeepOcean is given to Goliatvind AS as a separate document and not included in its entirety within this report. Extracts relevant to this report are given in sections 1 and 2 in this report.

6 Results

6.1 Survey transects completed

Figure 10 shows the layout of the completed survey transect lines with the lines being generated by the logged events. There are two gaps within the survey transect line GoliatVIND 2 which is due to lack of logged data at that time as the ROV was flying too high above the seabed. Transect line GoliatVIND 1 had a length of 13,823.83m, starting at the southwestern point and heading north-eastwards. Transect line GoliatVIND 2 had a length of 14,364.89 m, starting at the northwestern-most point and heading southeast.

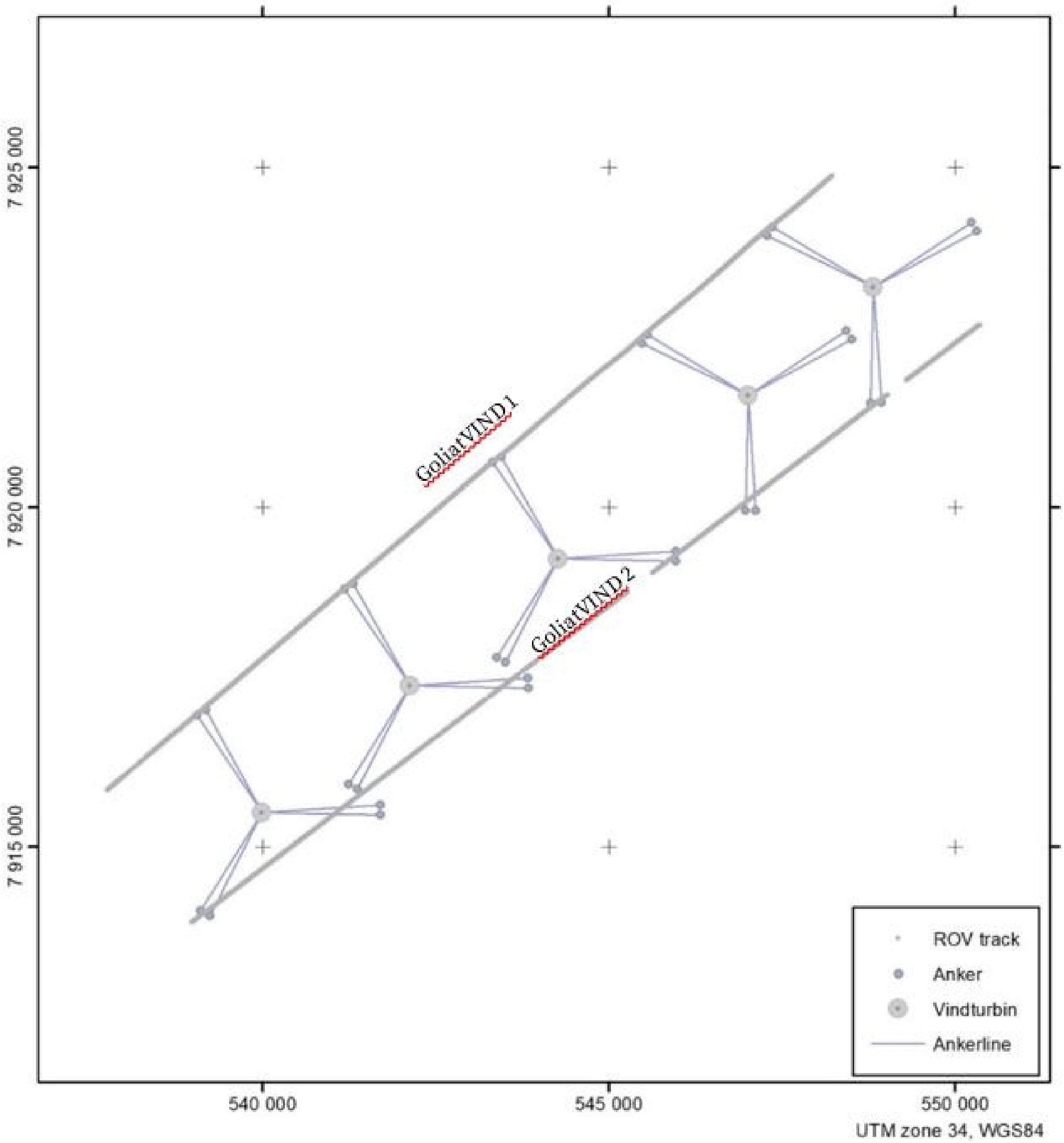

Figure 10. Layout of the completed survey transects lines at the Goliat Wind area with all the recorded events logged. Grey lines consist of all the logged events, the gaps within GoliatVIND 2 transect are due to temporary absence of logging events.

6.2 Habitat/ biological assessment along the survey transects

The sediments observed along both transects were similar and can be described as primarily homogenous soft mud, with patches of sandy gravel towards the SW localities, interspersed with occasional cobbles and boulders (Figure 11 and Figure 12).

An area of sandy gravel was recorded at the SE end of the GoliatVIND 1 transect, but still the area can be characterised as regular soft bottom.

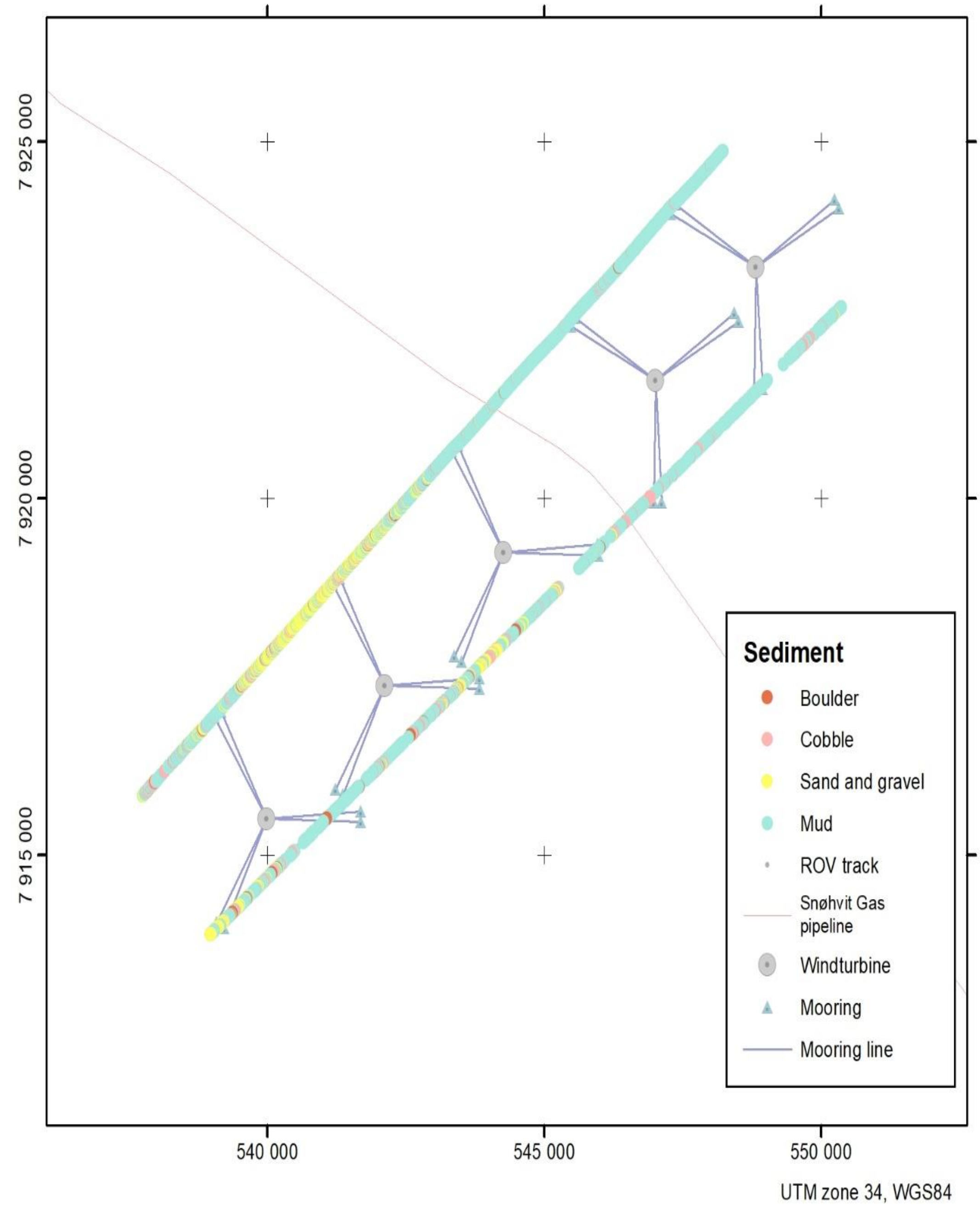

Figure 11. The recorded sediment types found along the transects at the proposed Goliat Wind area.

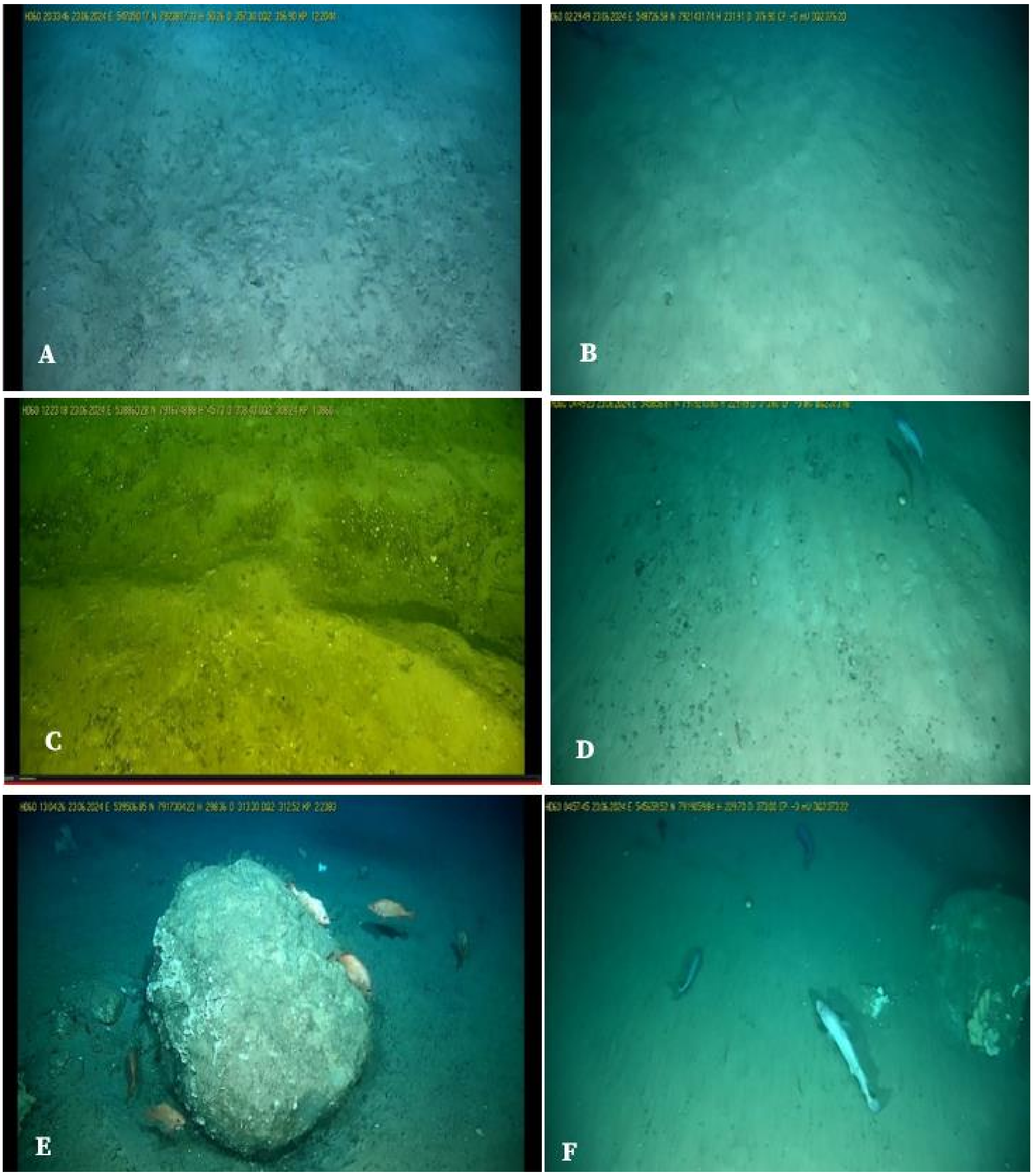

Figure 12. Examples of the different sediment types observed along transects GoliatVIND 1 (left column) and GoliatVIND 2 (right column). Images A/B: Soft mud. Images C/D: Sandy gravel. Images E/F: occasional boulder and cobble. The boulders often acted as an island refuge for several fish species such as Redfish (*Sebastes sp.*) in image E. Note: the images were clipped from the ROV video footage hence the sub-optimal colour and quality.

Along both transects it was observed that the seabed was not pristine and had been physically disturbed by varying degrees of industrial activities. Apart from labelling these disturbances as physical industrial activity we do not speculate the exact origin of these disturbances.

GoliatVIND 1 had more signs of disturbance than GoliatVIND 2 (Figure 13).

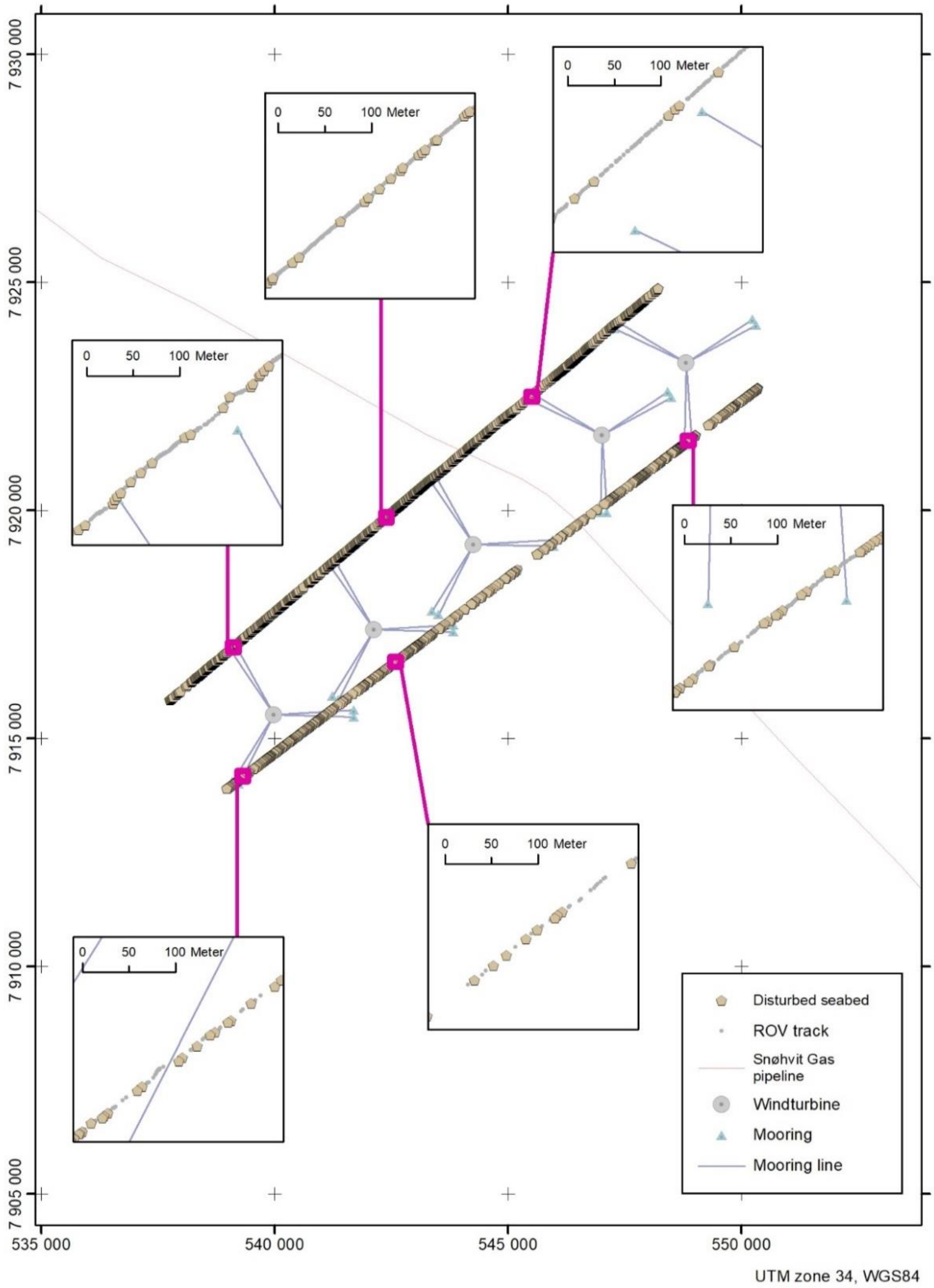

Figure 13. Traces of physical industrial disturbance recorded along the seafloor for both transects at the proposed Goliat Wind locality. The observed evidence of physical industrial disturbance occurs regularly along both transects.

The physical industrial disturbance events were classed as low to high and were often localised occurring as singular straight lines crossing the ROV transect area. There were also occasions where what appeared to be sediment deposits were observed (Figure 14).

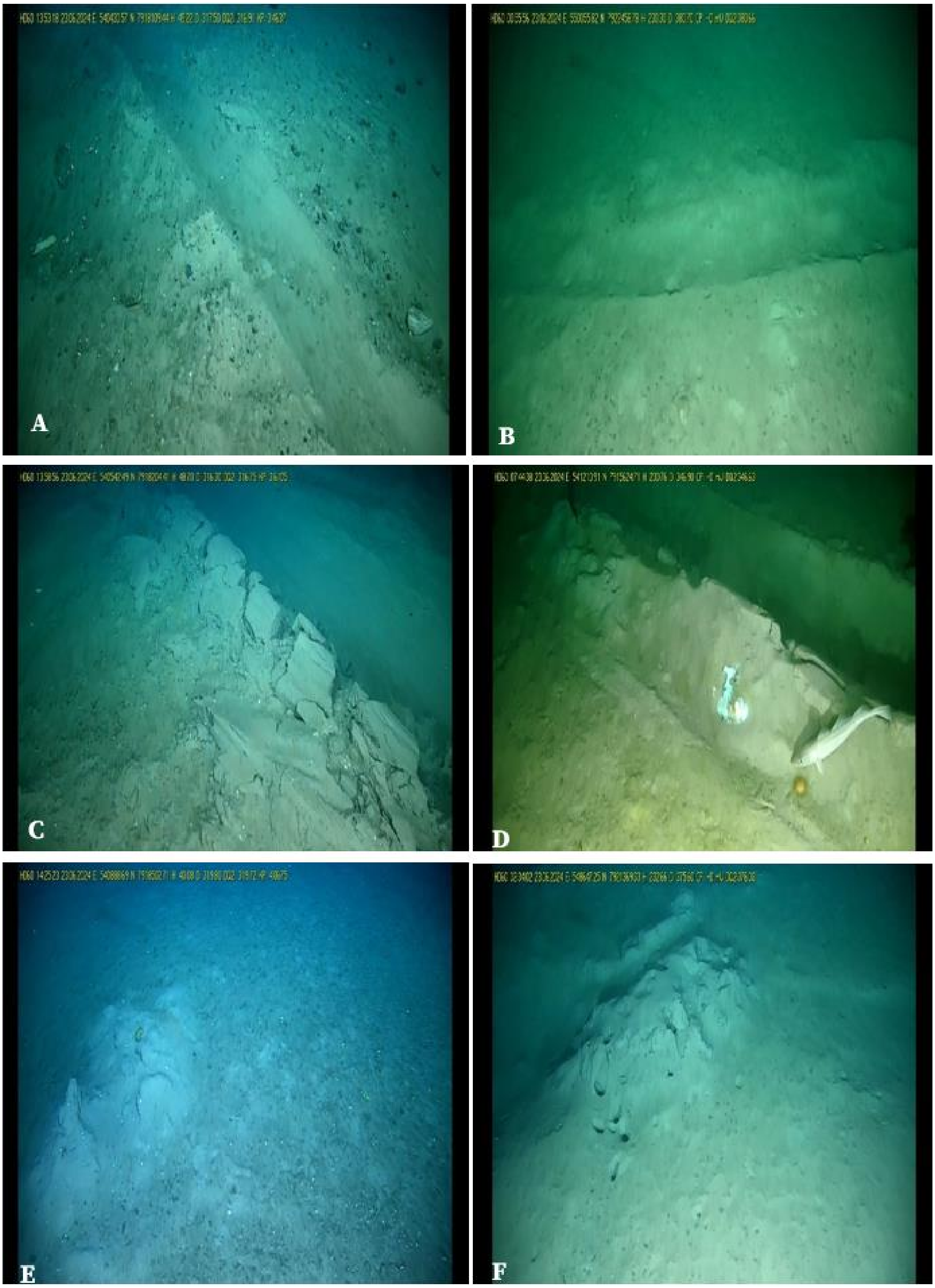

Figure 14. Examples of physical industrial disturbance to the seafloor observed along transect GoliatVIND 1 (left column) and GoliatVIND 2 (right column). A/B: The most observed disturbance being shallow straight lines crossing the ROV transect, considered as low disturbance. C/D: Deep straight lines occasionally observed crossing the ROV transect, considered as relatively high local disturbance. E/F: Examples of what appears to be a sediment deposit on the seafloor indicated by the light coloured "recent" sediment on top of the discoloured "old" sediment (ie. glacio-marine clay), classed as low disturbance. Note: the images were clipped from the ROV video footage hence the sub-optimal colour and quality.

Along the GoliatVIND 2 transect occasionally there were patches of seafloor with shallow parallel striations, which was not seen along GoliatVIND 1 (Figure 15).

Figure 15. Example of parallel striations observed along the GoliatVIND 2 transect caused by physical industrial disturbance. Note: the image was clipped from the ROV video footage hence the sub-optimal colour and quality.

Both transects can be regarded as having a background level of preexisting physical industrial disturbance. Signs of biological disturbance in the form of track marks, surface deposits and burrows were also frequently observed throughout both transects, yet these were easily distinguished from the physical industrial disturbance. The macrofaunal burrows appeared in three forms 1) Singular, 2) Conjoined, and 3) Colonial consisting of numerous burrows that may or may not be conjoined (Figure 16).

Although all three forms of the burrows appeared along both transects GoliatVIND 1 had more of the singular and conjoined burrows whereas GoliatVIND 2 had more colonial burrows. In all, burrows were more prevalent along the GoliatVIND 2 transect.

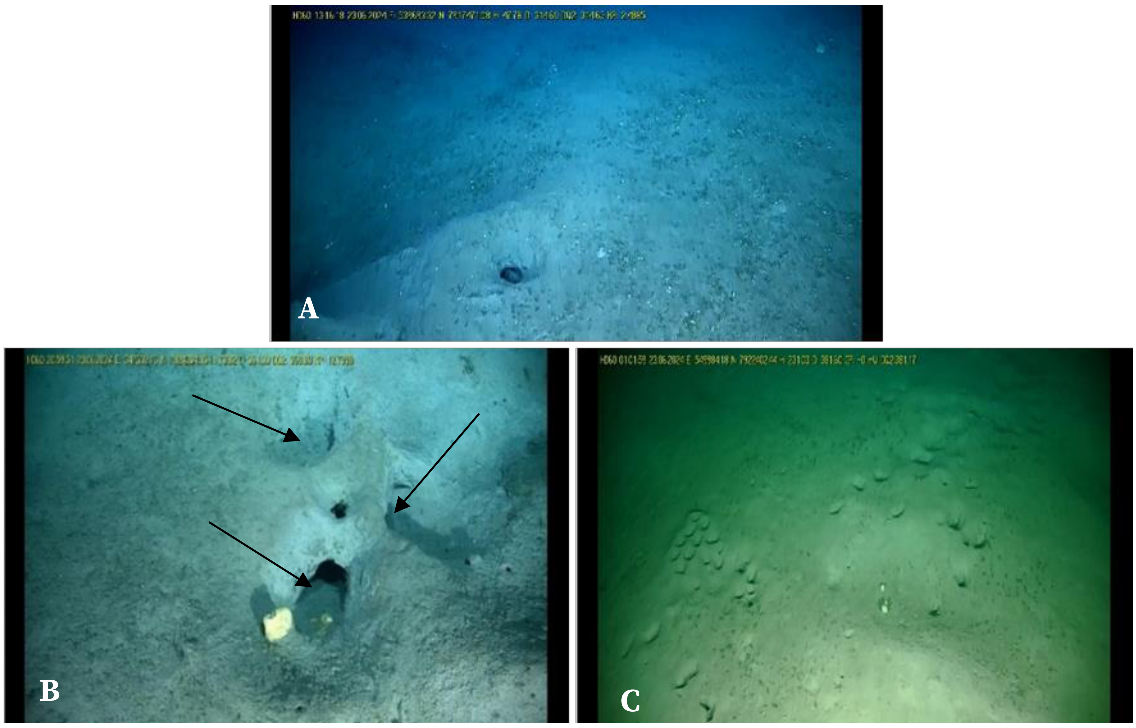

Figure 16. Example of the macrofaunal burrows observed along the GoliatVIND transects. **A**: Singular burrow. **B**: Conjoined burrows note the sponge that has fallen into the entrance of the burrow. **C:** Colonial burrows. Note: the images were clipped from the ROV video footage hence the sub-optimal colour and quality.

It is likely that the singular and conjoined burrows belong to the Norway lobster (*Nephrops norvegicus*). These typically have cruciform burrow entrances, where paler sediment from deeper layers is deposited outside the burrow as the animals excavate their complex tunnel system. The smaller colonial burrows may be made by the amphipod *Neohela monstrosa*. Although no original inhabitants were observed within the burrows on several separate occurrences the entrance was occupied by other non-burrowing macrofaunal crustaceans seeking shelter (Figure 17).

Figure 17. Left: A species of squat lobster (Munida sp.) Right: The deep-water shrimp Pandalus borealis both individuals are taking refuge inside the entrance of burrowing megafauna. Note the image was clipped and further cropped from the ROV video footage hence the sub-optimal colour and quality.

Sponges (Porifera) were the most abundant group of organisms found along both transects. There were more individuals observed along transect GoliatVIND 1 than GoliatVIND 2, however for both transects the observations were rather evenly spread out along the full length of the transect (Figure 18). Along both transects the number of sponges at the proposed mooring locations were no more concentrated than the areas in between them.

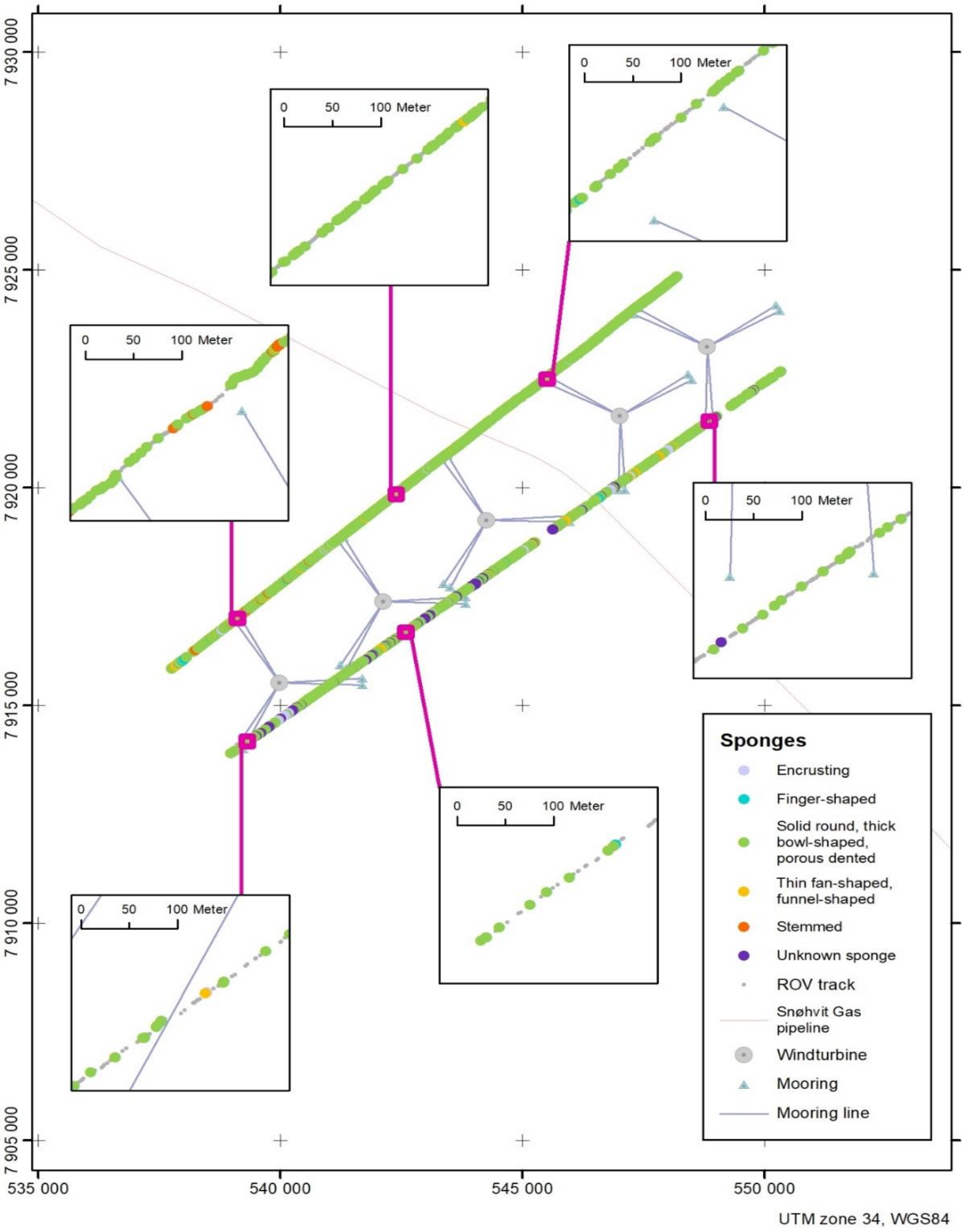

Figure 18. Sponge observations along both transects at the Goliat Wind area. The occurrences of sponges along the transects are approximately similar at the proposed mooring localities as well as between the mooring localities.

Sponges were divided into morphotypes based on their form and appearance (Table 1, fieldwork and methodology section). All five morphotype groups were observed along both transects. The dominating morphotype was "Solid/Round/Thick bowl shaped/Porous dented", followed by "Stemmed", "Thin fan/Funnel shaped", "Encrusting" (Figure 19) and "Finger-shaped".

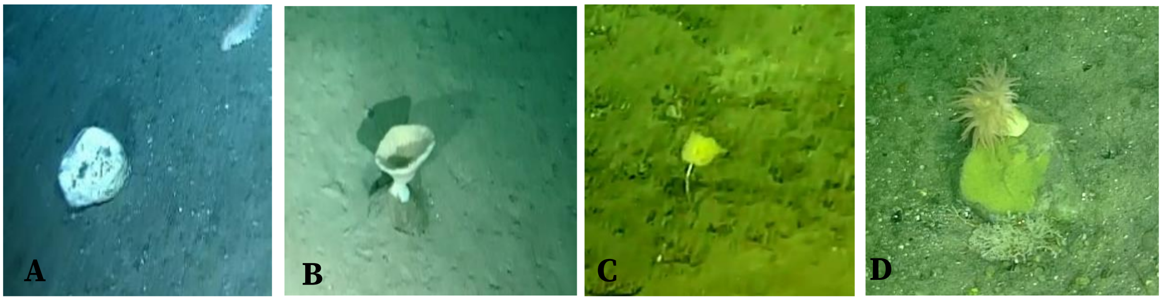

Figure 19. Examples of dominating morphotypes of sponges at the Goliat Wind area: A: "Solid/round/thick bowl shaped/porous dented" morphotypes. B: "Thin fan/funnel shaped" morphotypes. C: "Stemmed". D: "Encrusting". Note the image was clipped and cropped from the ROV video footage hence the nonoptimal colour and quality.

Singular occurrences of sponges were the most commonly observed. However, on some occasions along both transects, when the ROV flew higher, there were areas in which more individuals were viewed Figure 20.

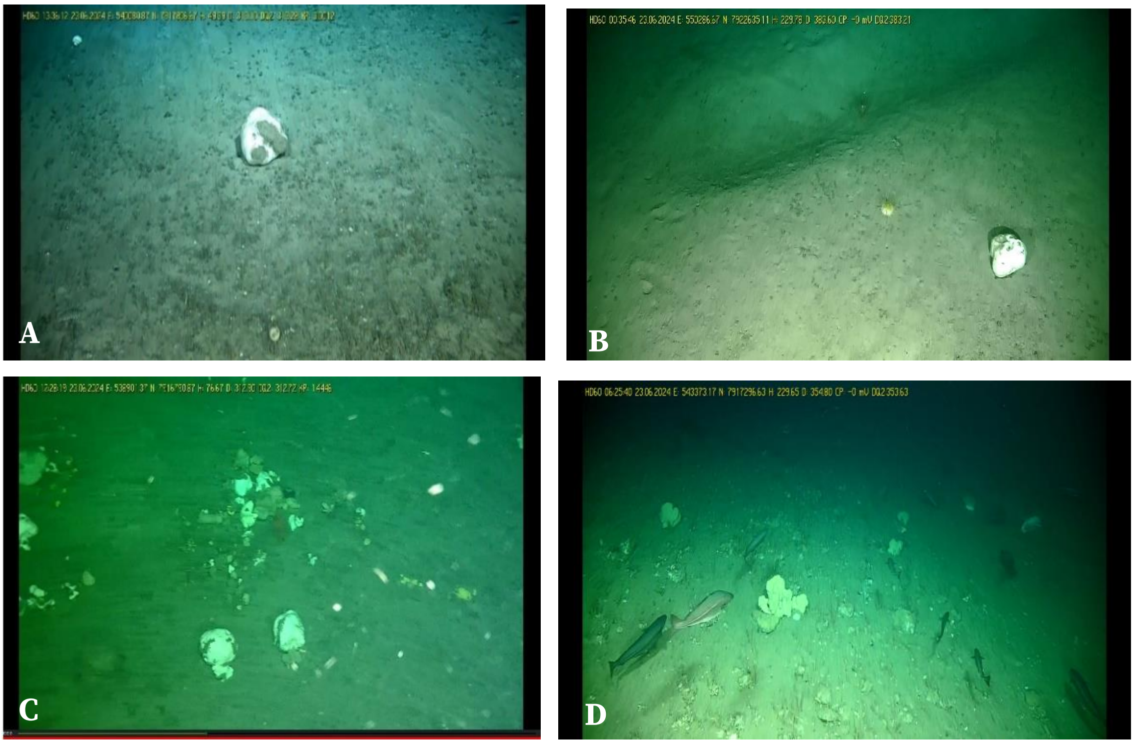

Figure 20. Examples of sponge observations along both GoliatVIND transects. A/B: one of the more common observations of a singular sponge (*Geodia sp*). C: One of the few examples of more individuals observed all at once along GoliatVIND 1. D: One of the few examples of more individuals observed all at once along GoliatVIND 2. Note: the images were clipped from the ROV video footage hence the sub-optimal colour and quality.

Sea pens were also observed along both transects with the most observations being at the SE end of GoliatVIND 1 (Figure 21).

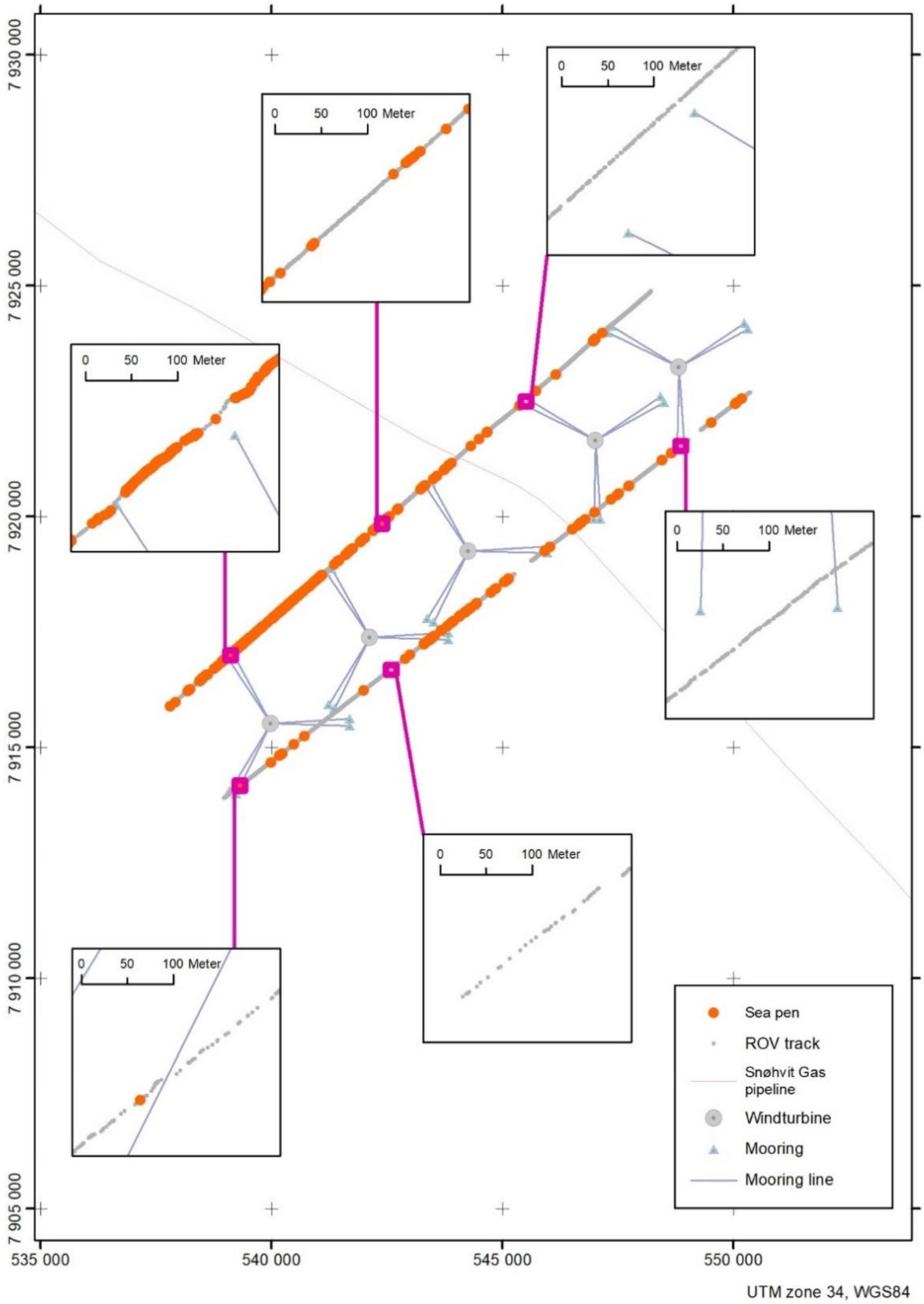

Figure 21. Seapen observations along both transects at the proposed Goliat Wind area.

Although most observations took place within this SW area of the transect sea pens were not found in dense aggregations but were more evenly spread out occurring as either individuals or in small clusters of 4 – 5 individuals in the field of view (Figure 22 and Figure 23).

Figure 22. Example of the highest density of seapens observed within the Goliat Wind area. Black arrows indicate the individuals found within the field of view. Note: the image was clipped from the ROV video footage hence the sub-optimal colour and quality.

Figure 23. Example of a small cluster of seapens (encircled). Note: the images were clipped from the ROV video footage hence the sub-optimal colour and quality.

Echinoderms were also relatively common along the transects, with the three most common groups being:

- Sea cucumbers (Holothuroidea)
- Sea urchins (Echinoidea)
- Starfish (Asteroidea)

The sea cucumber *Parastichopus tremulus* and sea urchin *Gracilechinus acutus* (Figure 24) occurred at regular intervals along both transects, these were not mapped in the results section due to not being part of the organisms considered indicative of sensitive habitats.

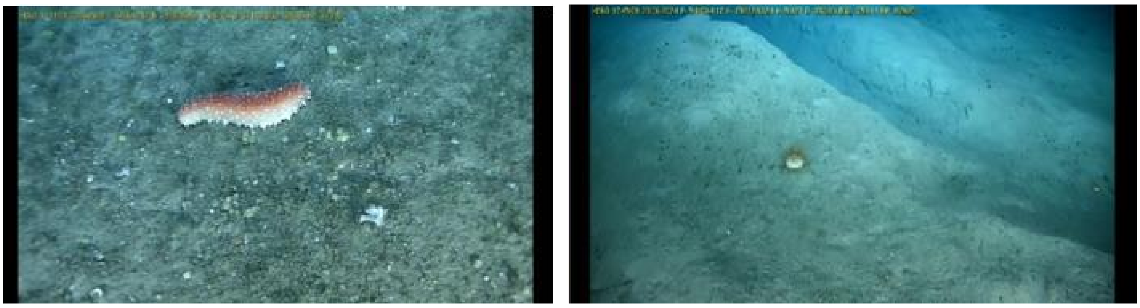

Figure 24. Left: a sea cucumber (*Parastichopus tremulus*) at the Goliat Wind area. Right a sea urchin (*Gracilechinus acutus*) alongside traces of industrial disturbance. Note the images were clipped from the ROV video footage hence the sub-optimal colour and quality.

6.3 Marine archaeological assessment

A marine-archaeological assessment was carried out based on the ROV recordings. The methodology was discussed with an expert (Stephen Wickler, researcher/marine archaeologist, University of Tromsø) prior to analysis, who gave an indication of which types of objects or findings could be relevant for further investigation by the expert himself.

No objects of archaeological interest were found during the visual seabed mapping.

7 Conclusions

The seafloor sediments at the proposed Goliat Wind area are in general comprised of mud (clay and silt) with some sandy gravel areas, scattered with occasional cobbles and boulders.

Scattered occurrences of sponges were observed along the full length of both transects and were the dominant organisms recorded. Although all five different morphotype groups were recorded, most of the observations were with the morphotypes "Solid round/thick bowl shaped/porous dented". Most of the observations along both transects comprised of singular occurrences yet, some areas with higher abundances did occur. Sponges are a common feature across the entire Goliat area, the densities are lower than those classified under the OSPAR habitat description as "Deep Sea sponge aggregations" (OSPAR, 2010b).

Sea pens were observed scattered along both transects however, most of the observations were in the SW part of GoliatVIND 1. Although they were more abundant within this area, they were evenly spread out over the entire SW area of GoliatVIND 1 being found in small clusters or as single individuals i.e. not in densities that would fall under the OSPAR classification of habitat of concern (OSPAR, 2010b).

Soft-bottom sediments all along the Norwegian continental shelf typically are inhabited by diverse communities of invertebrates (bristleworms, bivalves, crustaceans, sea cucumbers, brittlestars etc.). Most of these live burrowed within the sediment, contributing to sediment oxygenation, and are only visible by the holes and tracks at the sediment surface. Burrows from such organisms were observed along both transects with the greatest observations being along GoliatVIND 2. Although it was often that more than a singular burrow observed at any one time, the occurrences of these burrows were not such as to be classified as a particularly sensitive habitat.

The largest burrows likely belong to the Norway lobster (*Nephrops norvegicus*), while many of the slightly smaller ones are typical of the amphipod *Neohela monstrosa*. The sediments otherwise show signs of abundant invertebrate life both on the surface and burrowing within it.

The seafloor at the Goliat Wind area shows obvious signs of previous physical industrial disturbance by activities that physically influence the seafloor. This will form the baseline for further development. The areas of planned anchor deployments are typical of the area at large, and the necessary further disturbance associated with installation of anchors is considered to be at a local level.

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