

NOTE

DATE: OUR PROJ. NR: YOUR REF. NR: REPORT NR.: AUTHOR: PROJECT LEADER: STATUS: CONTROL: 1 October 2021 21-0452 20190153 21-242 Edwin Kardinaal Edwin Kardinaal Final Wouter Lengkeek

First Inventory of technical performance and biodiversity on structures in the North Sea Farmers' Offshore Test Site

Introduction

The objective of the De Rijke Noordzee programme is to enhance nature in the North Sea. The construction of wind farms at sea offers opportunities to combine these with nature development. The programme focuses on a number of indicator species, biogenic reef builders and indicator species for good ecological functioning. Biogenic reef builders include *Lanice conchilega*, *Sabellaria* sp., mussels and oysters. Indicator species for the development of the North Sea system are predators such as rays and cod, large crustaceans and squids. The enhancement of the North Sea nature can be well realized when the occurrence of the aforementioned organisms is stimulated. It is expected that most of the nature gains can be realized around the hard substrates of the scour protection as they are deposited around the monopiles.

Much attention is paid to the choice of the right substrate on which organisms in general and flat oysters in particular can attach. In addition, prior to projects aimed at nature enhancement, research is conducted around OWFs to determine whether flat oysters and other target organisms remain alive under local conditions. Structures have been developed and special research cages designed for carrying out such studies. Since February 2021, De Rijke Noordzee has deployed some of such structures and cages at the North Sea Farmers Offshore Test Site, about 12 kilometres off the coast near Scheveningen. De Rijke Noordzee now wishes to have the developments around the research cages and artificial reefs investigated with the help of divers.

This report describes the outcome of a field inspection as performed on the 2nd of September 2021 by the diving team and ecologists of Bureau Waardenburg.

Research question

The following research question is central in this study:

What is the physical condition of - and the state of biodiversity development on the 4 structures on the test site?

These questions will be answered by means of the following steps:

- Determine the physical condition of the structures + cages
- Biodiversity measurement using quadrants, with the MOO-method
- Register presence of reef-building indicator species
- Inventory system indicator species (predators)



Execution

All activities described below took place at the Offshore Test Site, approximately 12 kilometres off the coast of Scheveningen. The investigated structures are located in a plot (1x1 km) of De Rijke Noordzee at a depth of 20 meters. Based on diving research, an inventory of the biodiversity around the structures is obtained. The dives took place on 2 September 2021. From the ms Albatros (rederij Vrolijk) two dives were made, one on an artificial reef and one on a research cage. The survey was carried out by 3 SCUBA divers. Visibility was limited and was 1.5 - 2.0 meters. At the time of execution, the depth of the top of the structures was around 20 meters. During the dives, the maximum no-deco dive times were used. Due to currents, poor visibility and anker lines disappearing in the sand bed only two (Cephalopod Reef Cube® by ARC Marine and the Bureau Waardenburg Ecological Research Cage or WERC-dock) out of the four structures could be examined.



Figure 1. Dive attributes ready to perform the dive to the structures at the North Sea Farmers' Offshore Test Site.

The following work was carried out:

- Photo collection of 10 quadrants (20x30cm) at the Reef cube structure, additional video recordings were made separately from the quadrants for biodiversity and abundance according to MOO classification;

- Registration of the presence of reefbuilding indicator species (mussels, oysters, sand mason worm, ross worm);

- Inventory of system indicator species (predators including cod, pollack, stone pounder, brown crab, lobster).

Physical condition of structures + cages At the Offshore Test Site there are four structures (2 Reef Cube® structures, a WERC-dock and a (T)REE(F) cage). We aimed to locate all structures with the help of SCUBA divers and visualized the following. However, due to poor visibility and anchor lines disappearing in the seabed, dive time needed to be spend on searching and only one Reef Cube® and the WERCdock could be located. We focused on the following questions:

- Are the cages and structures straight / how do they stand in relation to the sand?

Both the Reef Cube® and the WERC-dock are in upright position and looked fine.

- Is the buoy stone close to the structure? Is it possible for these to collide with the

structure during heavy wave action?

The buoy stone appeared to be far (> 30 m.) from the structures, the risk of collision of the stones with the structures seems low.

- Are there any physical damages?

The cages and the buoy stones didn't show any signs of damage.

We aimed to generate some overview photo and video images, the success of which depends on the local visibility at the time of the activity (see fig. 3).

Inventory of technical performance and biodiversity on structures in the North Sea Farmers' Offshore Test Site 2



Biodiversity measurement with quadrants

Biodiversity measurements on the Reef Cube® in particular were carried out by SCUBA divers. The biodiversity present is recorded within quadrants (20*30 cm) by means of photography (see fig. 2). In total, at least 10 quadrants per structure were photographed for onshore analysis. Apart from the quadrants divers noted additional organisms. For this monitoring, the standardised Monitoring Underwater Banks (MOO) forms of the ANEMOON foundation were used. The results are delivered as digital MOO-forms (see Table 1).

The growth on the WERC-dock was not explicitly examined, however the hydroid ringed tubularia (*Ectopleura larynx*) was observed on the structure while not present at the Reef Cube®.

During the dive inventory in total 25 species were identified (table 1).



Figure 2. Example of quadrant at Reef cube structure.



Figuur 3. Overview images of organisms living around the Reef cube.

Reef-building indicator species

The presence of reef-building indicator species is a start for increased biodiversity, the species offer food and spawning and hiding possibilities, so it is relevant to map out such organisms. The species in question are mainly the Ross worm (*Sabellaria spinulosa*), the Sand mason worm (*Lanice conchilega*), the Common mussel (*Mytilus edulis*) and Oysters



(Ostrea edulis and Crassostrea gigas). In the dive survey the presence of these biogenic reef builders on and around the structures and cages were recorded. Around and on the Reef Cube® only *M. edulis* was identified. The presence of other reef building organisms was not recorded. Additionally, eggs of cephalopods and elasmobranchs were absent.

Inventory system indicator species (mobile species)

The SCUBA divers also made an inventory of the presence of mobile species. The inventory was performed while following the buoy anker line towards the Reef Cubes®. Unfortunately, the anker line appeared to be buried in the sediment and the second artificial reef structure could not be located. As far as possible divers swam back and forth along the anker line. On the way, all species of free-swimming predators were recorded. On the way back, along both sides of the line (approx. 1m) the species and numbers of mobile species on the bottom were noted, including the crustaceans *Cancer pagurus* (Brown crab) and *Homarus gammarus* (European lobster). The intended aim to investigate at least 2 such transects (especially in the vicinity of the Reef Cubes®) could not be performed.

System indicator species

The organisms noted along the anker line were: pouting, common dab, red mullet, gobies, common dragonet, starfish, serpent stars and velvet crabs. Lots of skeletons of the common heart urchin were observed.

Ray, cod, other large crustaceans, cuttlefish and squids have not been observed.



Dutch name Scientific name RC Μ Species group Zeeanjelier Metridium dianthus Sea anemones Slibanemoon Sagartia troglodytes Ruwe zeerasp Hvdractinia echinata Jellyfisch and hydrozoans Haringgraat Halecium halecinum Snails Fuikhoren (Onb) Nassarius spec Mossel Mytilus edulis х Bivalves Zwaardschede (Onb.) Ensis spec. Strandkrab Carcinus maenas Penseelkrab Hemigrapsus takanoi Fluwelen zwemkrab Necora puber Large crustaceans Gewone zwemkrab Liocarcinus holsatus Porceleinkrabbetje Pisidia longicomis Hooiwagenkrab (Onb.) Macropodia spec. Shrimps Gewone gamaal Crangon crangon x Moss animals Harig mosdiertje Electra pilosa х Gewone zeester Asterias rubens Echinodermata Gewone slangster Ophiura ophiura x Gewone zeeappel Psammechinus miliaris Tunicates Ascidiella spec. Ascidiella (Onb.) Steenbolk Trisopterus luscus x Gewone zeedonderpad Myoxocephalus scorpius Taurulus bubalis Groene zeedonderpad Fishes Pitvis Callionymus lyro Dikkopje / bodemgrondel Pomatoschistus spec Schar Limanda limanda R Rare: 1 - 9 living individuals/colonies С Common: 10-99 living individuals/colonies Massive: more than 100 living individuals/colonies Μ

Table 1. Species abundant on and around the reef cube structure, observed by scuba divers.

Conclusions

A diving inventory of the physical condition and biodiversity on and around the Reef Cube® and the WERC-dock research cage, both located at the Offshore Test Site, was used to gain insight into the development in biodiversity of the artificial reef. Apart from the biodiversity inventory the dives aimed to monitor the integrity of the structures and the infrastructure.

During the survey, in two dives of which only 15 minutes could be spend on inventory, a total of 25 species were found, on and around the Reef Cubes®and the WERC-dock. By comparison, the total number of species on and around objects within 75 km of the coast, as surveyed in 2013 (Didderen *et al.*), is between 11 and 75, which is partly based on volunteer data and collected in several dives per object (like wrecks) and several dives during the season. In doing so, some of the species were also determined after examination in the lab and not only based on visual observations.

Visibility on 2 September 2021 was suboptimal, which means that mobile species could have been missed. All in all, the finding of 25 (fairly common) species is a good indication of the species richness that can be realized in the area on and around artificial hard substrate, as it may be introduced with addition of artificial structures (and research cages).



Moreover, the species list will become even longer after studying the photos of the quadrants.

The strengthening of the North Sea nature can be well realized when the occurrence of biogenic reef builders or system indicator species is stimulated. No *Lanice conchilega*, *Sabellaria sp.*, or oysters were found on and around the structures. Mussels (*E. edulis*) were found at the Reef Cubes[®].

The indicator species found for the development of the North Sea system is the predator stone pout *Trisopterus luscus*. A possible explanation for the absence of other predators is the limited visibility (1.5-2.0 meters) in combination with the shyness of such animals. Based on previous sightings of the European lobster *Homarus gammarus* on wrecks along the coast, it is to be expected that this species occurs in the area. A study by Mavraki (2020) shows that cod are attracted by the food supply in wind farms. This observation can also be expected in the no-fisheries area of the Offshore Test Site.

References

- Didderen, K., W. Lengkeek, J.W.P. Coolen, H.W. Waardenburg (2013) Harde substraten en biodiversiteit: Vooronderzoek naar kunstmatige objecten in de Noordzee (NCP), Bureau Waardenburg, rapp. nr 12-181, i.o.v. RWS Waterdienst.
- Mavraki, O. (2020) On the food-web ecology of offshore wind farms, the kingdom of suspension feeders. PhD Thesis, Ghent University.



Voor vragen over deze notitie kunt u contact opnemen met Edwin Kardinaal (w.e.a.kardinaal@buwa.nl).

Akkoord voor uitgave: Directeur Bureau Waardenburg dr. W. Lengkeek Paraaf:

Bureau Waardenburg bv is niet aansprakelijk voor gevolgschade, alsmede voor schade welke voortvloeit uit toepassingen van de resultaten van werkzaamheden of andere gegevens verkregen van Bureau Waardenburg bv; opdrachtgever vrijwaart Bureau Waardenburg bv voor aanspraken van derden in verband met deze toepassing.

© Bureau Waardenburg bv / De Rijke Noordzee

Dit rapport is vervaardigd op verzoek van opdrachtgever en is zijn eigendom. Niets uit dit rapport mag worden verveelvoudigd en/of openbaar gemaakt worden d.m.v. druk, fotokopie, digitale kopie of op welke andere wijze dan ook, zonder voorafgaande schriftelijke toestemming van de opdrachtgever hierboven aangegeven en Bureau Waardenburg bv, noch mag het zonder een dergelijke toestemming worden gebruikt voor enig ander werk dan waarvoor het is vervaardigd.

Lid van de branchevereniging Netwerk Groene Bureaus. Het kwaliteitsmanagementsysteem van Bureau Waardenburg bv is gecertificeerd door EIK Certificering overeenkomstig ISO 9001:2015. Bureau Waardenburg bv hanteert als algemene voorwaarden de DNR 2011, tenzij schriftelijk anders wordt overeengekomen.



Bureau Waardenburg, Varkensmarkt 9 4101 CK Culemborg, 0345 51 27 10, info@buwa.nl, www.buwa.nl