



## NOTE

DATE: 12 May 2023  
OUR PROJ NR.: 22-0340  
REPORT NR: 23-194  
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STATUS: Final  
CONTROL: Edwin Kardinaal

# Second inventory of technical performance and biodiversity on structures at 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 mentioned 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 wishes to have the developments around the research cages and artificial reefs investigated with the help of divers, two years after deployment. This report describes the outcome of a field inspection as performed on the 3th and 4th of April 2023 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?

The question 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)



Figure 1. Impression of the fouling on the structures in the offshore test site April 2023.

## Conclusions

A diving inventory of the physical condition and biodiversity (see Figure 1) on and around the Reef Cubes® 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 three dives of which around 20 minutes could be spend on inventory, a total of 17 species were found on and around the Reef Cubes® and the WERC-dock. In comparison: in 2021 around 25 species were detected, probably as a result of a better visibility. Also, seasonality and the succession, including the competitive replacement, on the structures can be driving forces in less species present in 2023. The fourth dive window was spent on searching for the (T)ree(F) cage without success.

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 under water.

Visibility on the 3<sup>th</sup> and 4<sup>th</sup> of April 2023 was poor, which means that mobile species could have been missed. All in all, the finding of 18 (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 and videos in more detail (not part of this project).

The strengthening of the North Sea nature can be well realized when the occurrence of biogenic reef builders or system indicator species is stimulated. This year 2023 *Lanice conchilega* and *Sabellaria sp.*, were found around the structures, where they were not found in 2021. Also this year, no blue mussels (*E. edulis*) or (flat) oysters were found during this inventory.

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 (0.5-1.5 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.

## Clarification

### 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 around 20 meters. Based on diving research, an inventory of the biodiversity around the structures is obtained. Before diving, sonar was used to identify the exact locations of the objects. The dives took place on the 3th and 4th of April 2023. From the ms Tender two dives were made each day (see Figure 2). One research cage and two artificial reefs were visited. The survey was carried out by 2 SCUBA divers. Visibility was limited to 0.5 – 1.5 meters. At the time of execution, the depth on top of the structures was around 21 meter. During the dives, the maximum no-deco dive times were used. As the (T)Ree(F) couldn't be located by sonar nor by searching in circles with divers, only three (Cephalopod and Mussel Reef Cube® by ARC Marine and the Waardenburg Ecology Research Cage (WERC-dock) out of the four structures could be examined.

The following work was carried out:

- Photo collection of quadrants (20x30cm): due to technical problems and the loss of the quadrant at the Mussel Reef Cube the quality of photographs are not optimal, and no photo quadrants, but only overview photos of the structures were made;
- Additional video recordings were made by the technical diver. These can be



Figure 2. Divers preparing the dive at the North Sea Farmers' Offshore Test Site.



- used for biodiversity and abundance according to MOO classification.
- Additional video recordings were made separately from the quadrants by the technical diver. These can be used for biodiversity and abundance according to MOO classification.
- Registration of the presence of reef building indicator species (mussels, oysters, sand mason worm, ross worm);
- Inventory of reef-associated and reef-benefitting species (Bureau Waardenburg, 2020) like predators including cod, pollack, stone pounder, brown crab, lobster.

### **Physical condition of structures**

At the Offshore Test Site four structures are situated in the plat (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, the (T)REE(F) cage could not be located. At the observed structures, we focused on the following questions:

- *Are the cages and structures straight / how do they stand in relation to the sand?*  
Both the Reef Cubes® and the WERC-dock are in upright position and looked fine.
- *Around Reefcube Egg® there is a scour trench of ca. 1m width.*
- *At the WERC-dock, the pole was movable and the platform rotatable. The legs of the construction are under the sand. The lower plateau emerges 20cm above the sand.*
- *Is the buoy stone close to the structure? Is it possible for these to collide with the structure during heavy wave action?*

All structures, excluding (T)REE(F), are located on the original coordinates. The buoy stones of the three structures were not visited by the diver. The risk of collision of the buoy stones with the structures seems unlikely.

- *Are there any physical damages?*

The cages and the reef cubes didn't show any signs of damage.

### (T)REE(F)

The (T)REE(F) seems to have disappeared: the object could not be located by the diver searching and neither with the side scan sonar of the ms Tender. Possibly the (T)REE(F) construction was moved due to heavy currents or upwards water force and not anchored enough to the buoy stone, due to the applied buoyancy with the wood. Other hypothesis is that the cage is buried by sand movements or sinking into the sea floor.

We aimed to generate some overview photo and video images, the success of which depended on the local visibility at the time of the activity.

### **Biodiversity**

Biodiversity measurements on the Reef Cubes® and WERC-dock and on the sand around the structures were carried out by SCUBA divers. The biodiversity is monitored using the standardized Monitoring Underwater Organisms (MOO) forms of the ANEMOON foundation. The results are delivered as digital MOO-forms (see Table 1). During the dive inventory in total 18 species were identified (Table 1).

All structures were fully covered with faunal growth (see Figure 3 and 4). Hydroids (*Tubulariidae*) were the dominant organisms. Additionally, on the WERC-dock also the plumose anemone (*Metridium senile*) dominated.





Figure 3. Faunal growth on the WERC-dock.

These hydroid species are additional findings when compared to the first inventory in 2021, probably as a result of seasonality. Also sand related species such as *Euspira sp.*, sand mason worm (*Lanice conchilega*), and *Sabellaria sp.*, were now present in the grinding trench and on the seabed near the structures and were not identified in the earlier monitoring in 2021.



Table 1. Species abundance on and around the structures, observed by SCUBA divers. Species marked black were found both in 2021 and 2023, species marked grey were only observed in 2021, species marked green were only observed in 2023.

Species group	Dutch name	Scientific name	Cube Egg			Cube Mussel			WERC-dock		
			R	C	M	R	C	M	R	C	M
Sea anemones	Zeeanjelier	<i>Metridium senile</i>	1			1					1
	Slibanemoon	<i>Sagartia troglodytes</i>							1		
Jellyfish and hydrozoans	Ruwe zeerasp	<i>Hydractinia echinata</i>									
	Haringgraat	<i>Halecium halecinum</i>									
	Gorgelpijp-poliep	<i>Ectopleura larynx</i>		1			1			1	
	Penneschaft	<i>Tubularia indivisa</i>		1		1			1		
Snails	Fuikhoren (Onb)	<i>Nassarius spec.</i>				1					
	Tepelhoren	<i>Euspira spec.</i>		1		1					
Bivalves	Mossel	<i>Mytilus edulis</i>									
	Zwaardschede (Onb.)	<i>Ensis spec.</i>									
Crustaceans	Gewone gamaal	<i>Crangon crangon</i>									
	Zeepok (Onb.)	<i>Sessilia spec.</i>								1	
	Strandkrab	<i>Carcinus maenas</i>									
	Penseelkrab	<i>Hemigrapsus takanoi</i>									
	Fluwelen zwemkrab	<i>Necora puber</i>	1			1					
	Gewone zwemkrab	<i>Liocarcinus holsatus</i>	1			1					
	Porceleinkrabbetje	<i>Pisidia longicomis</i>									
	Hooiwagenkrab (Onb.)	<i>Macropodia spec.</i>									
Worms	Schelpkokerworm	<i>Lanice conchilega</i>		1						1	
	Zandkokerworm	<i>Sabellaria spec.</i>				1					
Moss animals	Hang mosdierkje	<i>Electra pilosa</i>									
Echinodermata	Gewone zeester	<i>Asterias rubens</i>	1				1			1	
	Brokkelster	<i>Ophiothrix fragilis</i>					1				
	Gewone slangster	<i>Ophiura ophiura</i>	1				1			1	
	Gewone zeeappel	<i>Psammechinus miliaris</i>	1				1			1	
Tunicates	Asciidiella (Onb.)	<i>Asciidiella spec.</i>									
Fishes	Steenbolk	<i>Trisopterus luscus</i>				1					
	Gewone zeedonderpad	<i>Myoxocephalus scorpius</i>									
	Groene zeedonderpad	<i>Taurulus bubalis</i>									
	Pitvis	<i>Callionymus lyra</i>	1			1					
	Dikkopje / bodemgrondel	<i>Pomatoschistus spec.</i>								1	
	Schar	<i>Limanda limanda</i>									
<b>Total</b>			11			14			10		
R	Rare: 1 - 9 living individuals/colonies										
C	Common: 10-99 living individuals/colonies										
M	Massive: more than 100 living individuals/colonies										





Figure 4. Overview images of organisms living on the Reef cube egg (left) and WERC-dock (right).

#### 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 Reef Cube Egg® and WERC-dock only *L. conchilega* was identified. Around Reef Cube Mussel® only *Sabellaria sp.* were found. The presence of other reef building organisms was not recorded. 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 along a line (approx. 25m length). 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 organisms noted along the lines were: pouting, gobies, starfish, serpent stars, velvet crabs and flying crabs.

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

## References

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Approved for publication: Director Waardenburg Ecology  
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