

Mapping *Sabellaria* *Spinulosa* in the Brown Bank

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BURG**
Ecology

Dit onderzoek is uitgevoerd in opdracht van
het MONS-programma. MONS vormt de
kennisbasis voor het Noordzeeoverleg



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Introduction

Problem definition

- Ross Worms (*Sabellaria Spinulosa*) create conspicuous reefs that stabilize the seabed and potentially increase biodiversity by providing a habitat for a multitude of other species.
- In the greater North Sea these reefs are recognized to be under threat and worthy of protection.
- Knowledge on the settlement requirements and value for improving biodiversity is too limited.
- The ecosystem value (with *Sabellaria Spinulosa* reefs as indicator species) of the Brown bank needs to be better understood to support decision to better protect area (trawling fishery) to meet EU targets.

Project objective

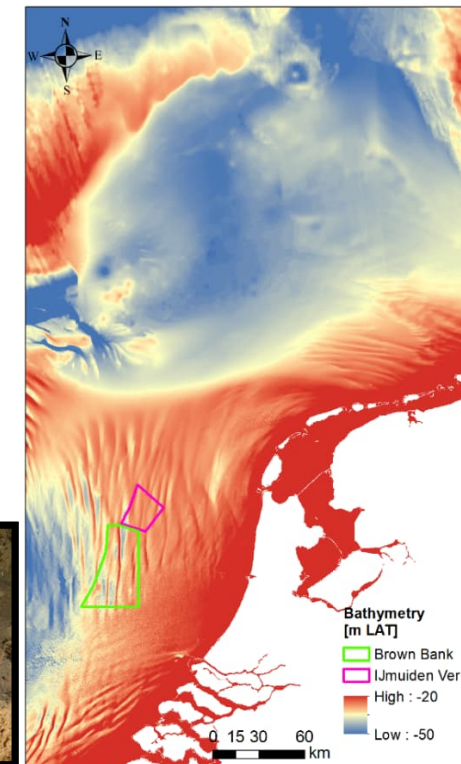
- Evaluate the presence of *Sabellaria Spinulosa* reefs in the Brown Bank
- Evaluate the biodiversity (content) of *Sabellaria Spinulosa* hotspots
- Study the environmental conditions of areas with a *Sabellaria Spinulosa* hotspot



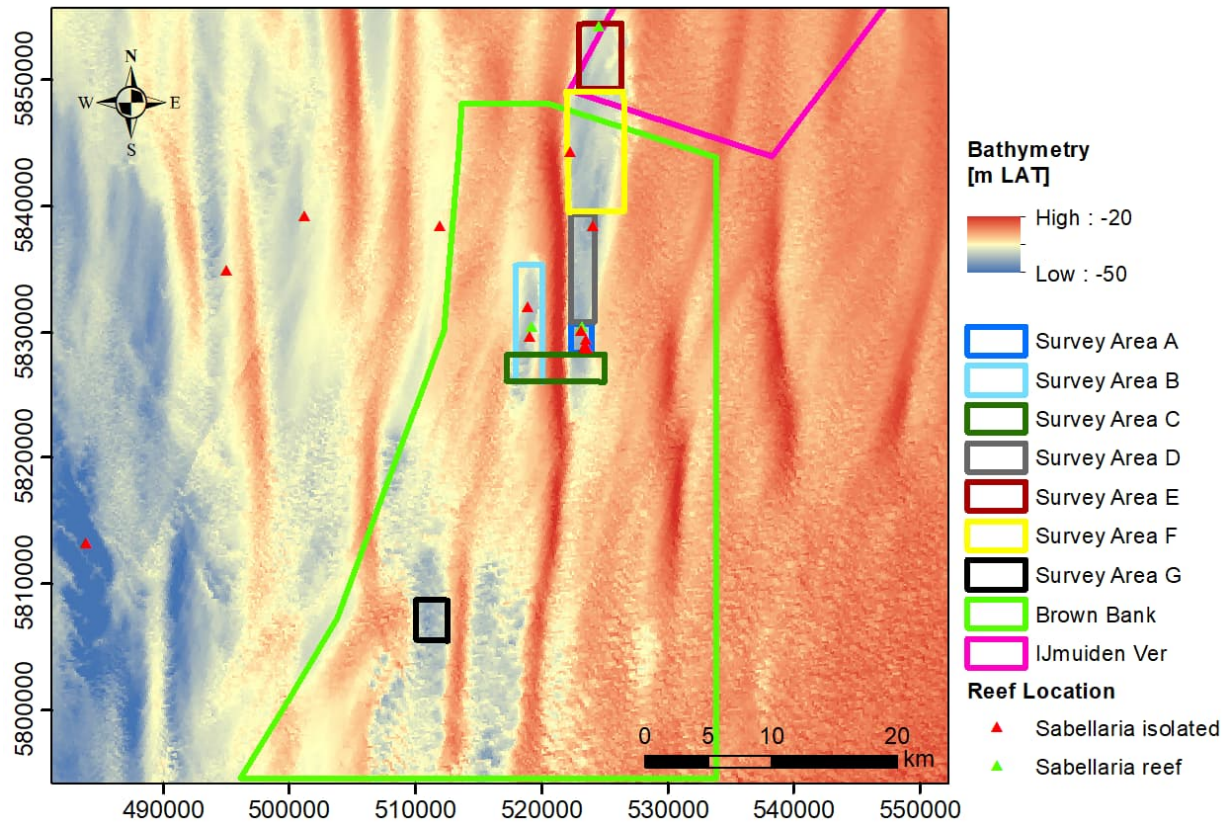
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Expedition area: Brown Bank



Multi-modal & Multi-scale sensors deployed from RWS ARCA vessel

- Hull mounted MBES + towed SSS + CTD
 - 45 km² sonar coverage
- ROV video
 - 13.4 km video tracks
- Grab sample
 - 45 box-core samples

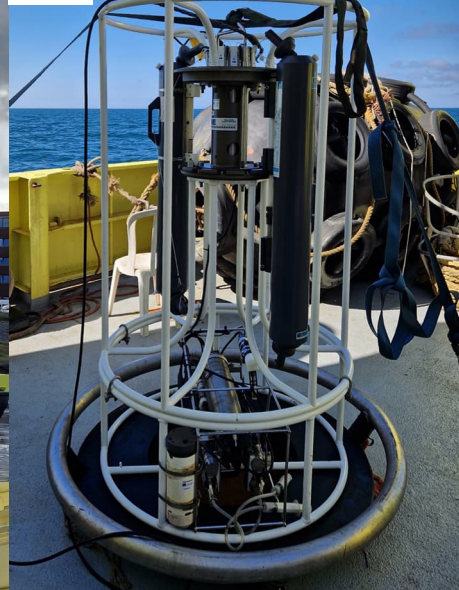
Multi-disciplinary (cross sectorial)

- **TNO A&UW:** Sonar data processing and interpretation
- **WE/EF:** Video analysis & box coring
- **RWS:** operational deployment of MBES, SSS and ROV

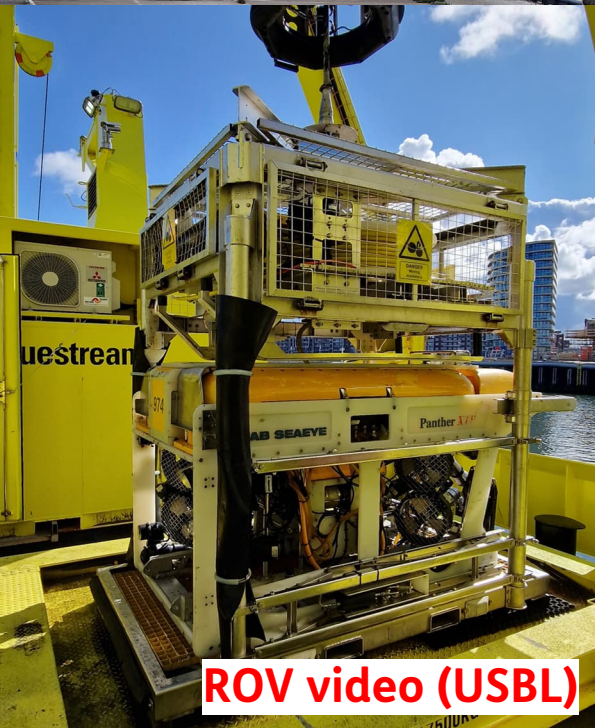
ARCA with hull-mounted Multibeam sonar (PPK)



CTD



Grab Sampler



ROV video (USBL)

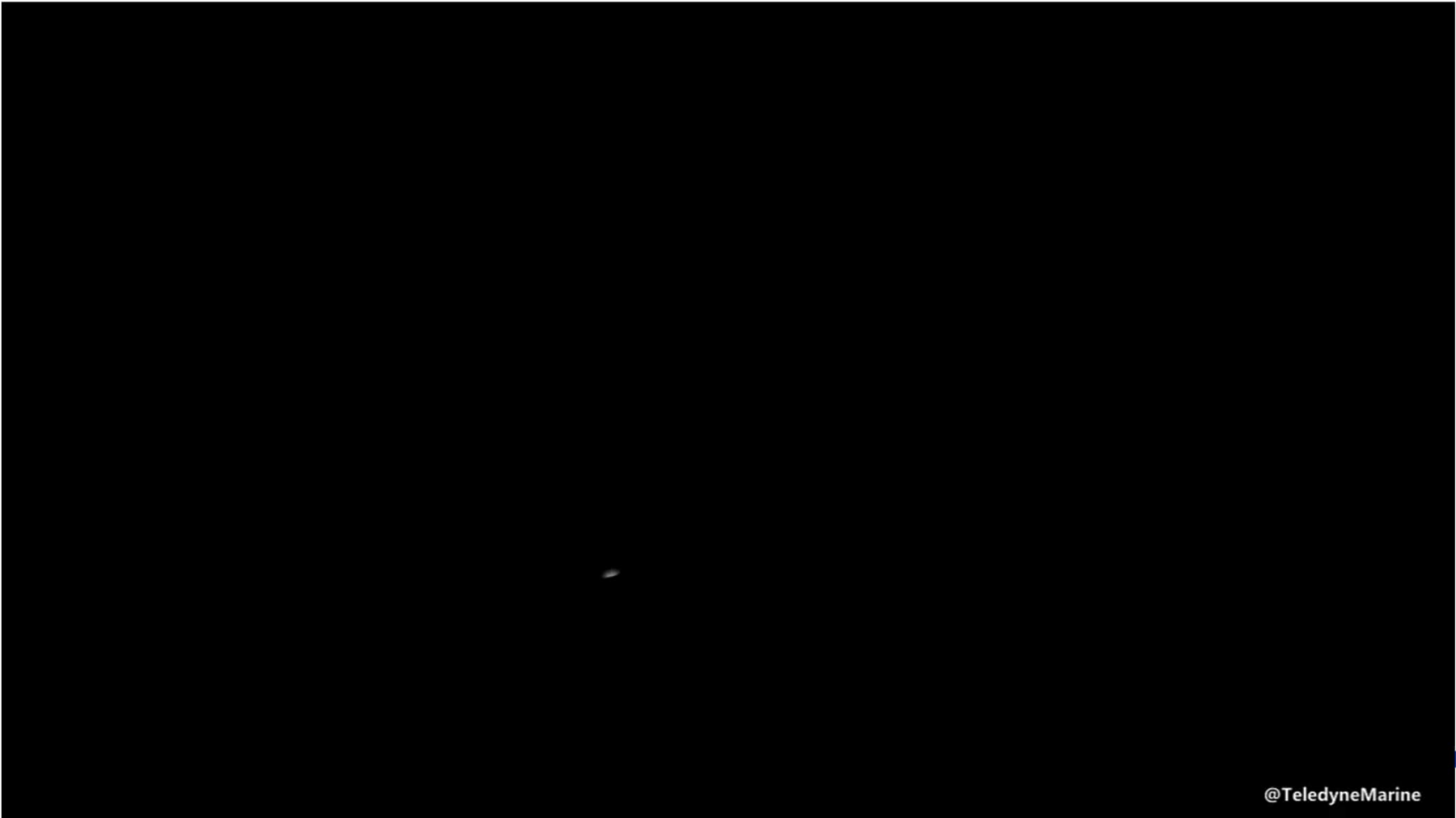


Towed Sidescan sonar (USBL)

MONS

Mapping *Sabellaria Spinulosa* in the Brown Bank

Working principle of Multibeam and Side-Scan Sonar

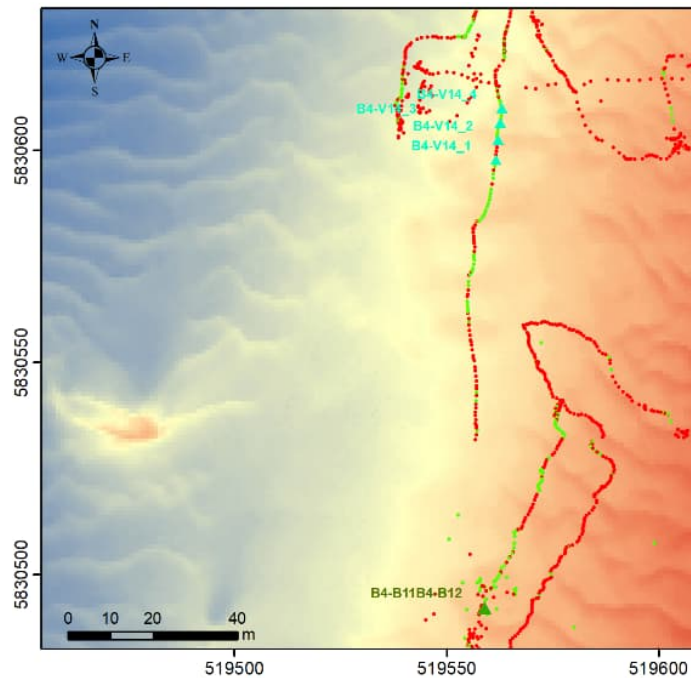


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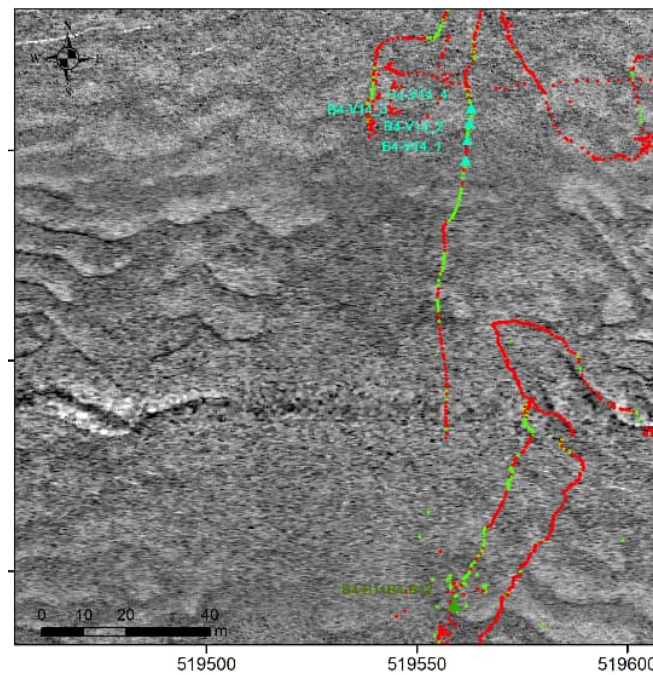
Multibeam vs. Side-Scan Sonar

Multibeam bathymetry



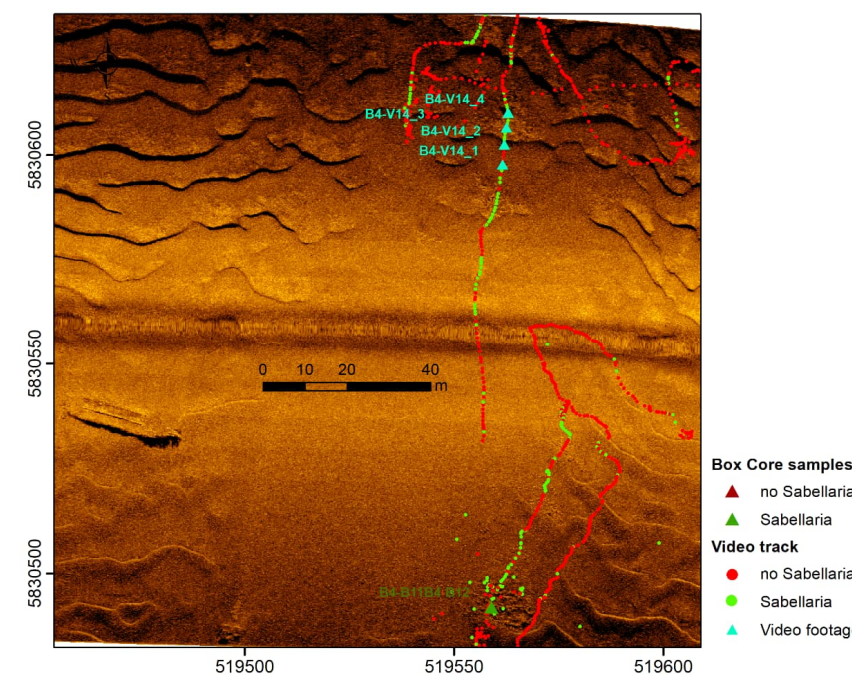
- *Sabellaria Spinulosa* (Elevation)
- Seabed morphology

Multibeam backscatter



- Soil type

SSS backscatter

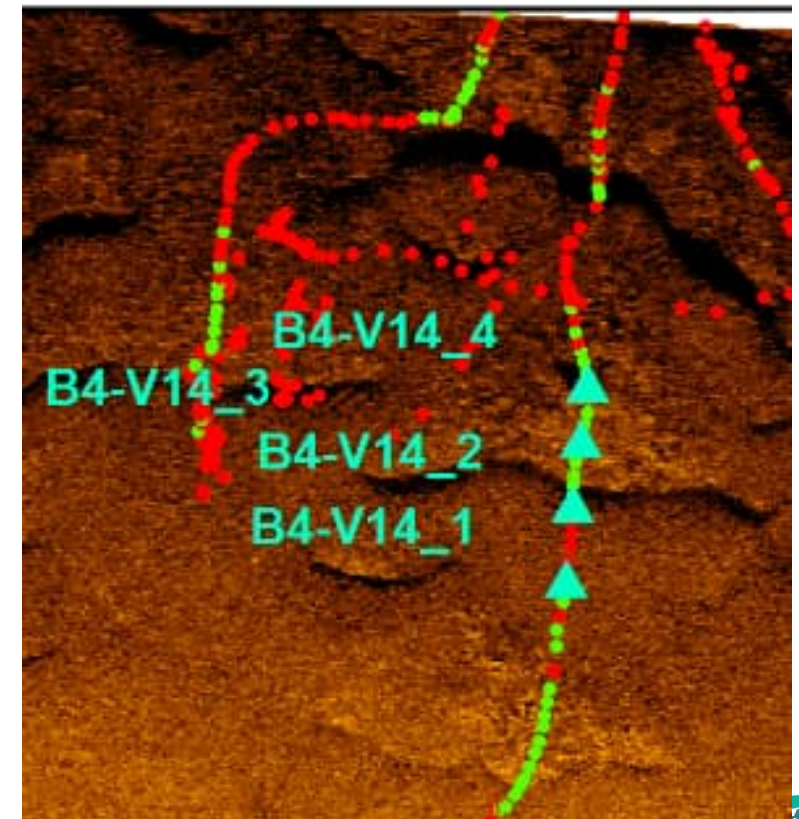
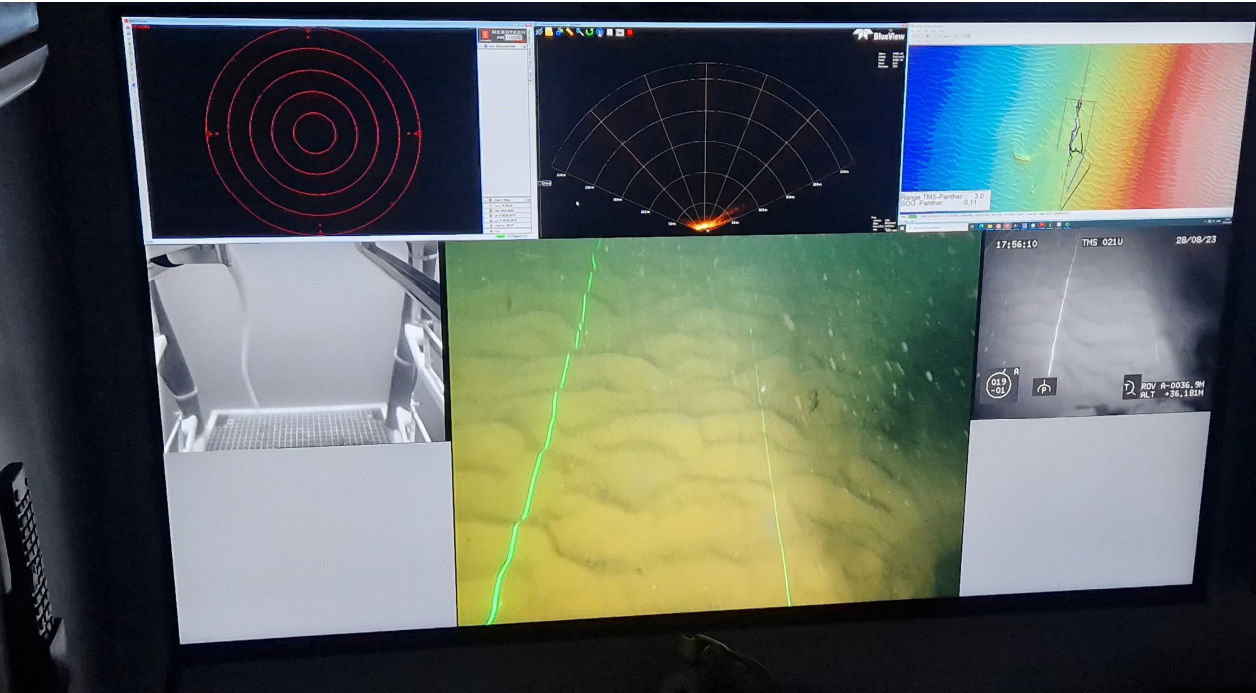


- *Sabellaria Spinulosa* (Elevation)
- + highest resolution
- blind zones, lower signal quality

Results: ROV validation

ROV Video example of discovering reefs 2023-08-28
17:05-17:07

~37m depth; location B4

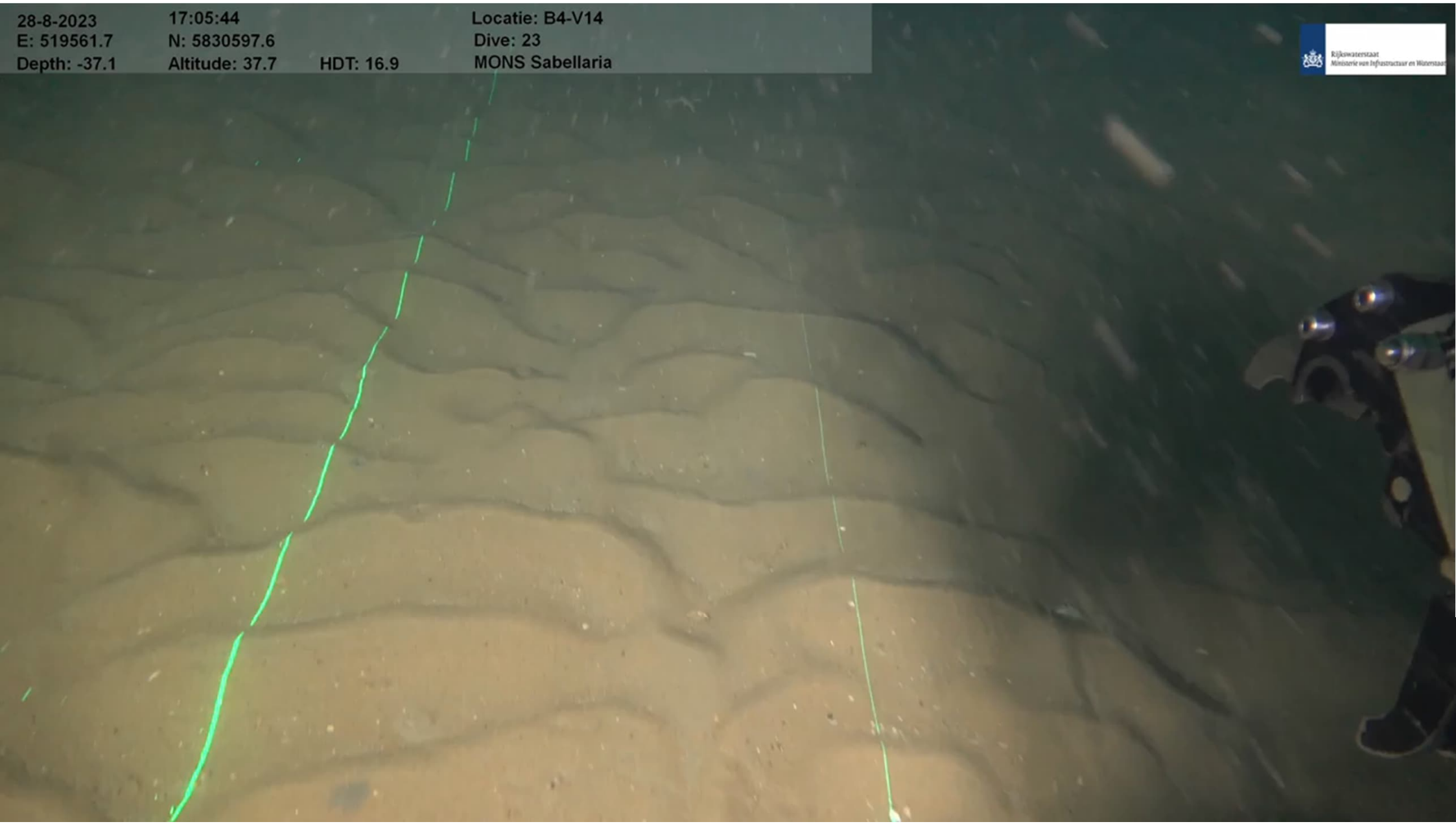


28-8-2023
E: 519561.7
Depth: -37.1

17:05:44
N: 5830597.6
Altitude: 37.7

HDT: 16.9

Locatie: B4-V14
Dive: 23
MONS Sabellaria

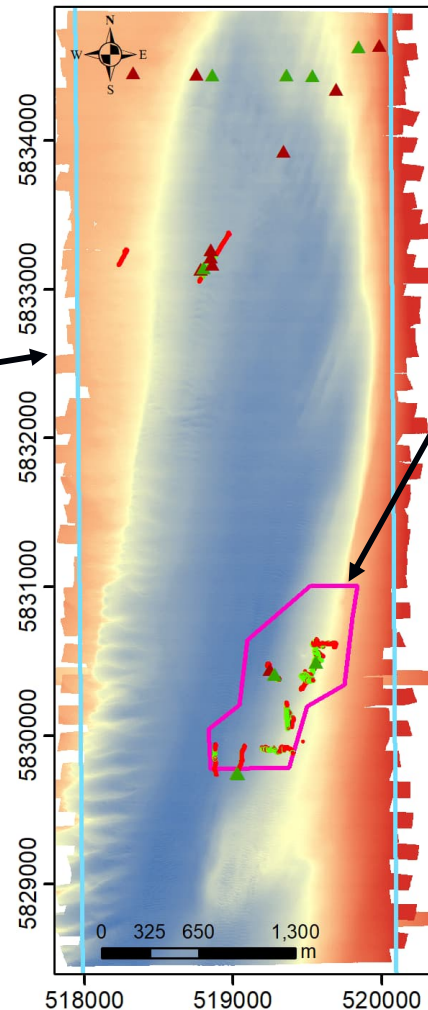
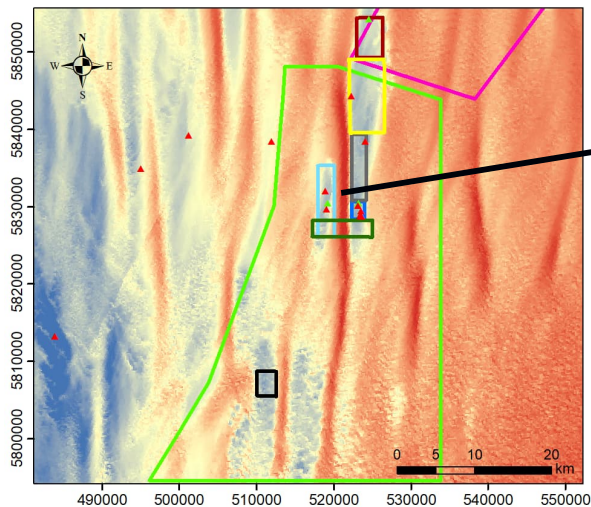


Results: Grab sample validation

- 36 samples for grainsize determination (MBES backscatter relative calibration & validation) and 9 samples for biodiversity quantification
- In total 19 grab samples (42%) contained *Sabellaria*
- “Elevated” vs. flat/Buried *Sabellaria Spinulosa*
- Data used by WE/EF to assess true ecosystem value of *Sabellaria Spinulosa* reefs



Mapping distribution of Sabellaria



- Size of manually mapped area with *Sabellaria* is 1.7 x 0.7 km
- Rough boundary around locations with indicative acoustic pattern for *Sabellaria Spinulosa*
- However, manual mapping is time consuming task and expert eye might miss valuable information
- Therefore, semi-automatic process is developed

SSS classification workflow

SSS image processing

- (1) Reading raw SSS data
- (2) Processing SSS data
 - Trend removal
 - Range and nadir filter
 - Layback correction
- (3) Seabed projection
 - Interpolating data on a regular grid

Classification

Generation of feature layers

- Amplitude, STD
- GLCM
 - "wavelength"
 - homogeneity, correlation, contrast, energy
- Gabor filter
 - wavelength, orientation
- Wavenumber domain filter
 - wavelength

Feature space reduction

- PCA

Classification method

- Unsupervised
 - K-means
- Supervised
 - Simple supervised segmentation
 - Random forest
 - Matlab classification learner
 - Decision tree
 - Support Vector machine
 - Naive Bayes
 - Nearest Neighbour classifiers
 - Neural Network

Evaluation

Confusion matrix

Training/Validation

Ground truth dataset

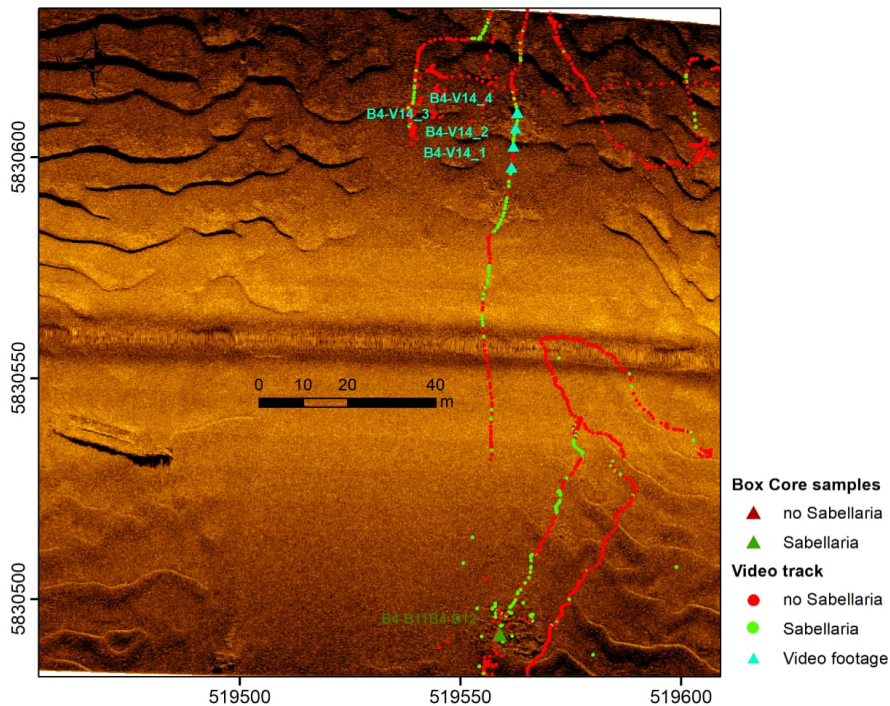
- Hybrid approach
 - Expert adjusted ROV video data classes
 - Expert picking of additional classes

Training supervised

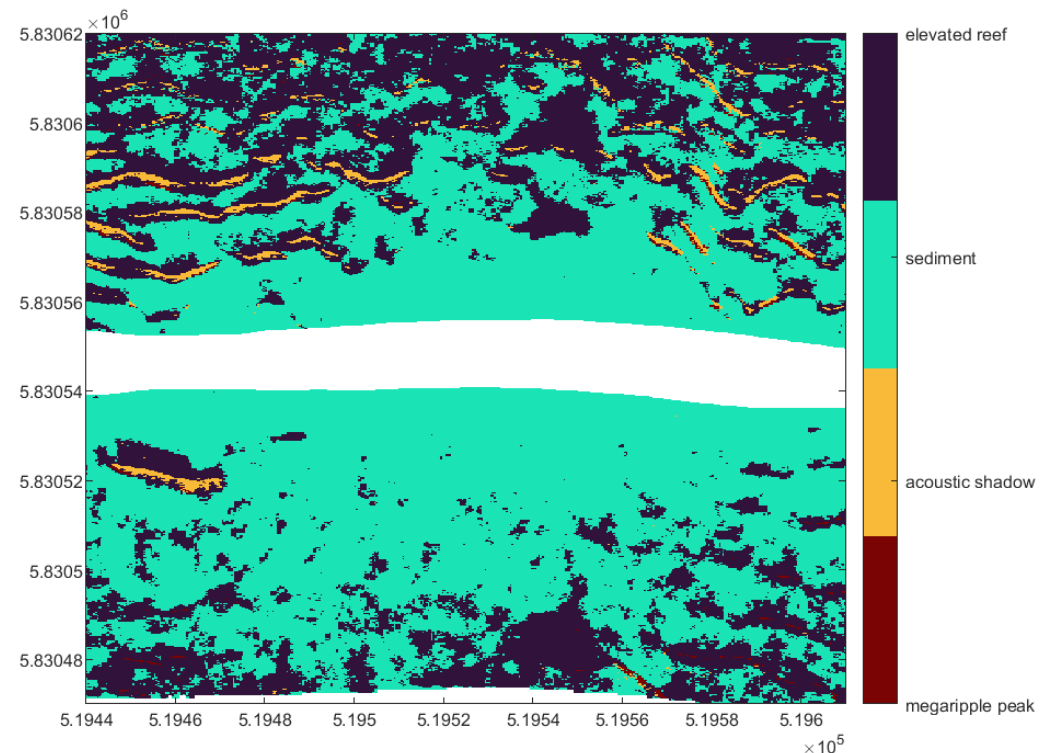
Labelling + testing supervised

Semi-automatic mapping of *Sabellaria Spinulosa*

Side-Scan Sonar image



Neural Network classification (Preliminary results)



Accuracy

	TPR	FNR
elevated reef	78.3%	21.7%
sediment	83.8%	16.2%
acoustic shadow	71.4%	28.6%
megaripple peak	32.4%	67.6%

- Promising results but classifier requires more robustness by testing more input layers and eventually classifier need to be test on full dataset
- Limited number of validation tracks and diversity in environment and data quality will likely remain an uncertainty

Current Conclusions

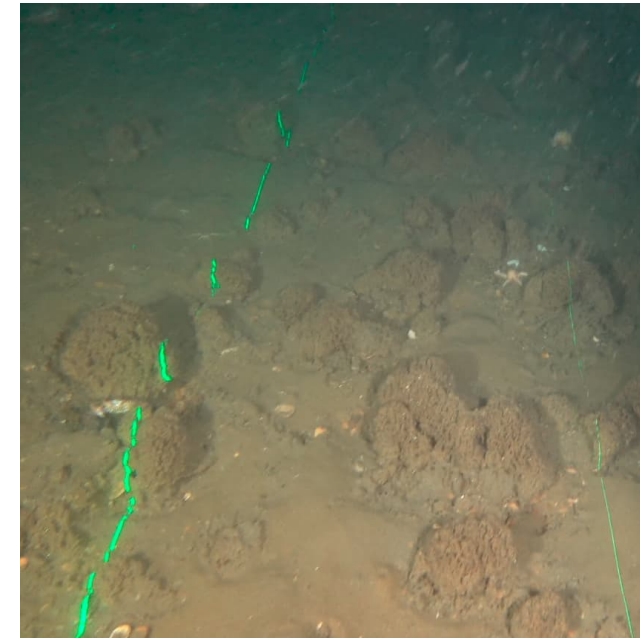
The goal of the expedition was to acquire the data needed to:

1. Evaluate the presence of *Sabellaria Spinulosa* reefs in the Brown Bank and IJVER areas.
2. Evaluate the biodiversity (content) of *Sabellaria Spinulosa* hotspots
3. Study the environmental conditions of areas with a *Sabellaria Spinulosa* hotspot

Regarding the first goal: *Sabellaria Spinulosa* reefs were detected where they were discovered in the past and in new places in the Brown Bank region. However, the preliminary analysis also shows that in one area where *Sabellaria Spinulosa* was previously found, the reefs have disappeared.

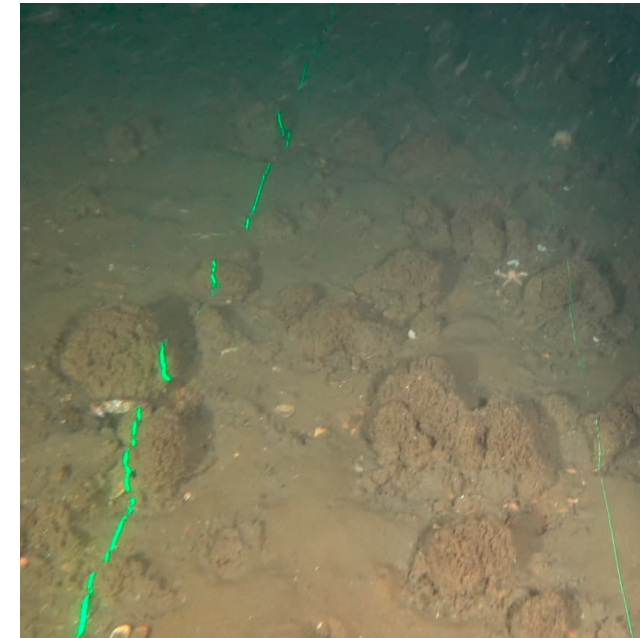
Regarding the second goal: acoustic detection of potential *Sabellaria Spinulosa* hotspots made extensive ROV video collection and benthos sampling more focused and efficient. The volume and quality of this data are considered sufficient to realize this goal.

Regarding the third goal: detailed sonar surveys (MBES and SSS) supplemented by ROV video tracks and Box core samples add to the understanding of the environmental conditions that support the settlement of *Sabellaria Spinulosa*.



Way ahead

- Quantification of presence and absence of *Sabellaria Spinulosa* based on semi-automatic classification tools
- Optimising data fusion strategies to better understand the parameters influencing *Sabellaria Spinulosa* settlement in the Brown Bank region
- Creation of map output to allow for the validation of habitat suitability maps



A photograph of a sunset or moon over the ocean. The sun or moon is a bright, glowing orb in the center of the sky, with a long, shimmering reflection on the water's surface. The sky is a deep blue, and the water is dark with some ripples. There are some faint lights on the horizon to the left.

Questions?

Special thanks for providing support to TU Delft, WMR, Deltares and the RWS ARCA crew!!!