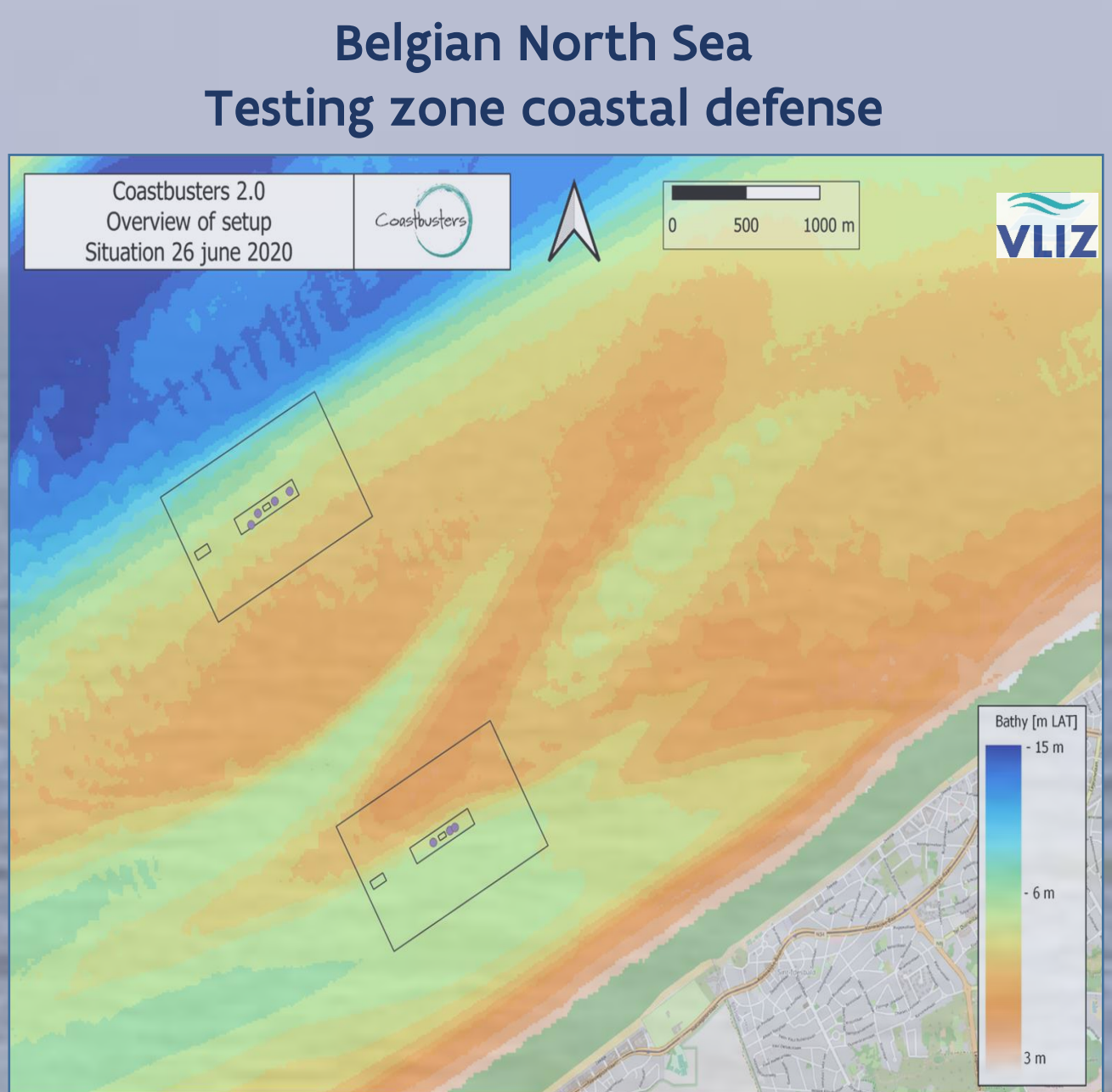# Nature based Solutions for coastal zone management
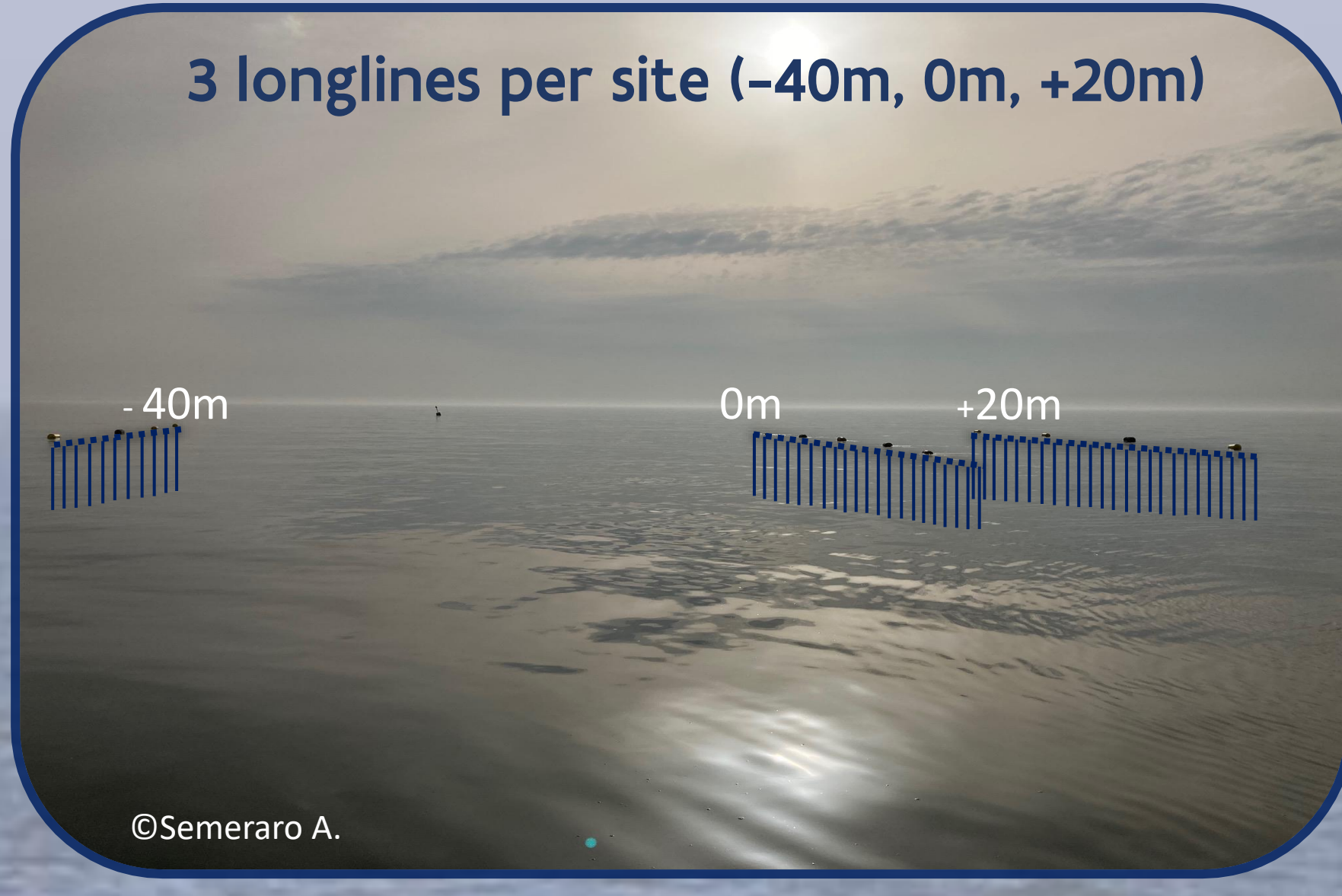# Biogenic Mussel reef concept

Semeraro A. & Langedock L., Boone W., Delbare D., Fordeyn J., Geldhof R., Groenendaal B., Huygens M., Mascart T., Moulaert I., Stratigaki V., Van Hoey G. & Sterckx T.

Coastbusters

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Belgian North Sea
Testing zone coastal defense

Coastbusters testzone with 2 sites: sheltered (2km) & exposed (5km off the coast)

Coastbusters (2017-2020) – Investigating overall feasibility of three Nature Based Solutions (NbS) biogenic reef designs (Flora, Sand mason worm [*Lanice conchilega*] and Blue mussel [*Mytilus edulis*]) to enhance coastal resilience.
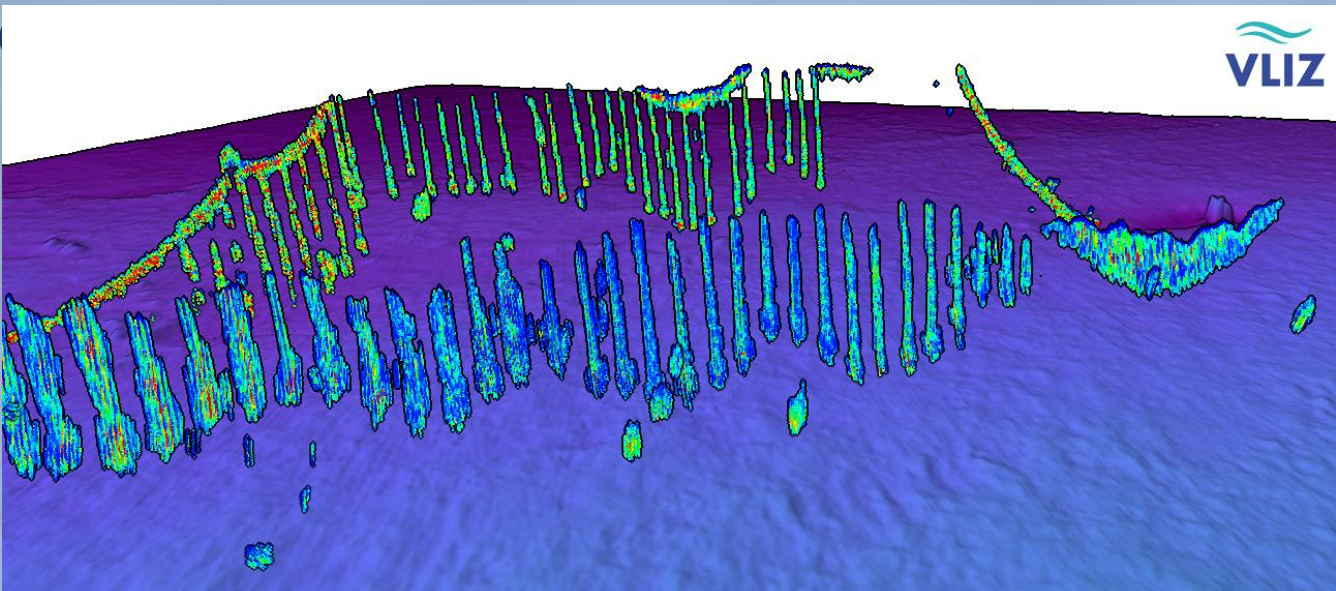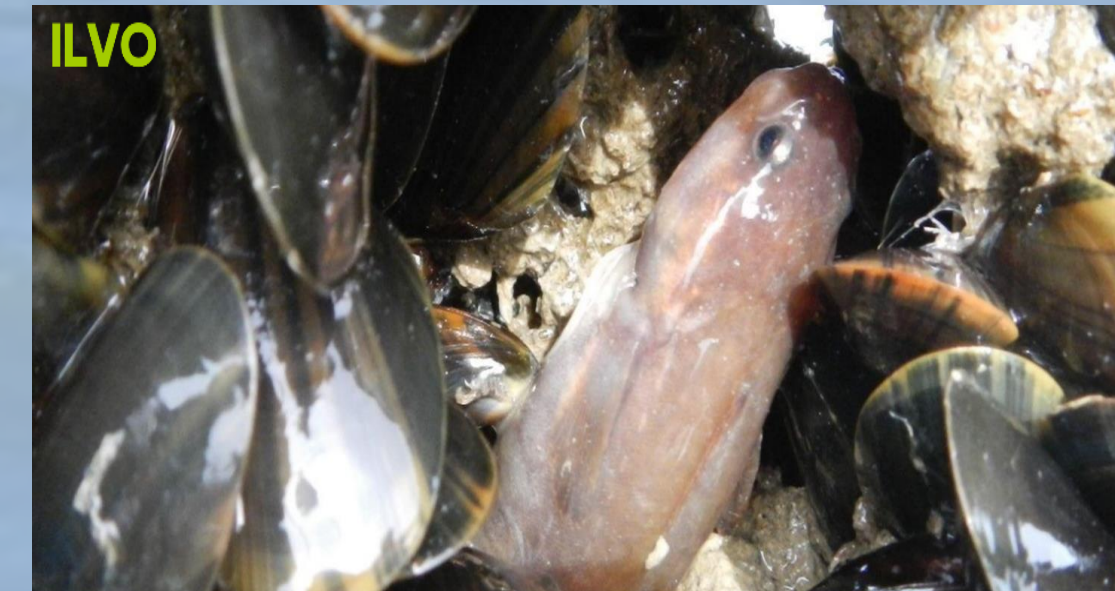
Coastbusters 2.0 (2020-2023) - Blue Mussel biogenic reef concept taken forward as subtidal most promising innovative bio-stabilization solution. Different materials and setups were being deployed to induce and facilitate the early stages of mussel biogenic reef formation in different hydrodynamic coastal environments.

3 longlines per site (-40m, 0m, +20m)

©Semeraro A.

BIVALVE REEF
shellfish type mussels and oysters

Backbone with dropper lines

©Vuylsteke D.

Having a pilot case in place - today's Coastbusters 2.0 building blocks form a fundamental kick-off for bringing these NbS concepts to the market.

Dropper line full of Mussels

©Van Haelst S.

Gaining insight in the highly dynamic behavior of the <u>aquaculture line system</u> and occurrence of Blue mussel. Having an operational follow-up and to identify maintenance, repair or adaptation needs.

➢ Image-based estimation of biomass on the dropperlines. The build-up and drop-off of biomass on this installation will enable the reef to develop.
➢ Research into the movements of dropper lines based on accelerometer data. Sensors measure temperature, depth, accelerations and tilt, providing insight in the dynamics of the installation. Some values might serve as a proxy for biomass.
➢ 3D sonar imaging. By capturing additional reflections in the water column, the installations can be 3D visualized as they hang in the water.
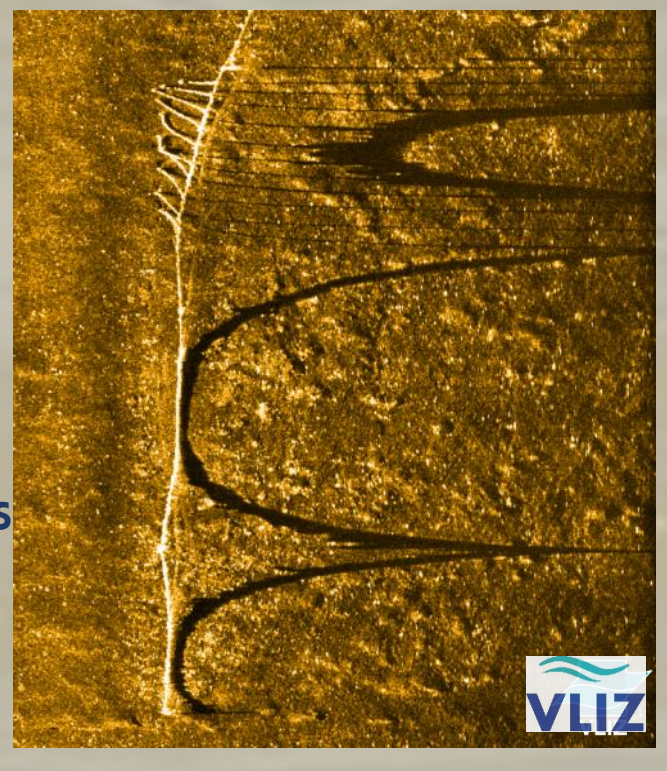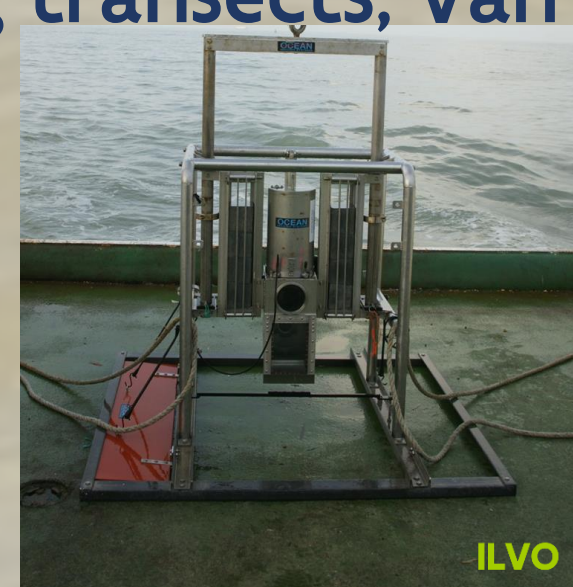

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The fouling communities dominated by amphipods with a high presence of *Lepidonotus* sp. and other polychaetes indicate the dropper lines' potential to provide food and boost local fisheries and epibenthic macrofauna.


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Sea bottom with induced reef

©Van Haelst S.
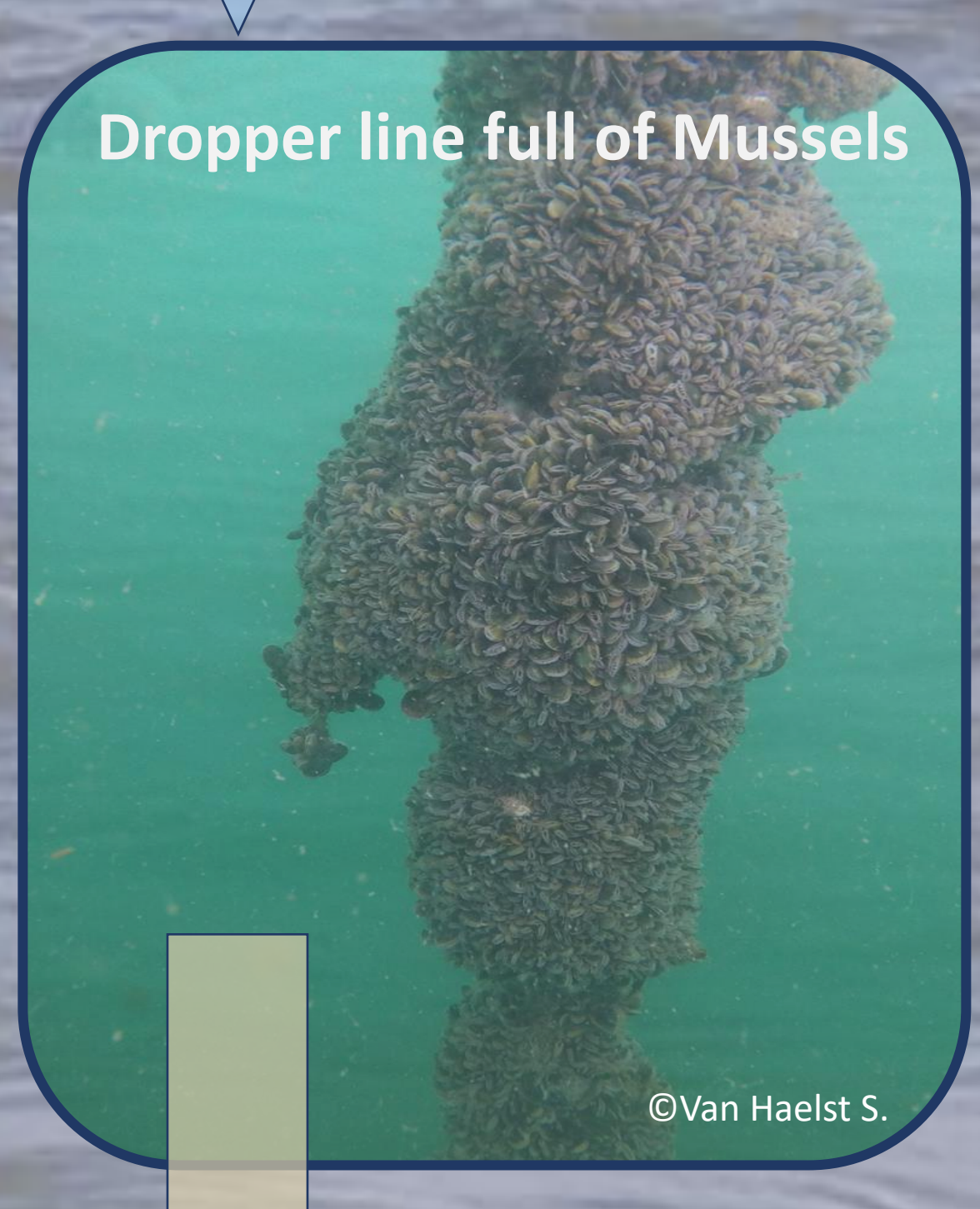
Monitoring the morphological and ecological changes on the seabed - <u>biogenic reef development</u> and evaluating the survivability of the mussel reefs under changing conditions.

➢ Testing new advanced techniques to record measurements in dynamic, turbid environment:
• Autonomous Underwater Vehicles (AUV's)
• Unmanned Surface Vehicles (USV's)

USV Adhemar

• Bottom moored sensor
Bottom frame equipped with an ADCP, fish tracker, scanning sonar and acoustic release

Longline with 10 droppers touching the ground due to their weight (Side Scan Sonar by AUV)

➢ Deploying field measurement techniques: diving transects, Van Veen Grabs, Sediment Profile Imaging.

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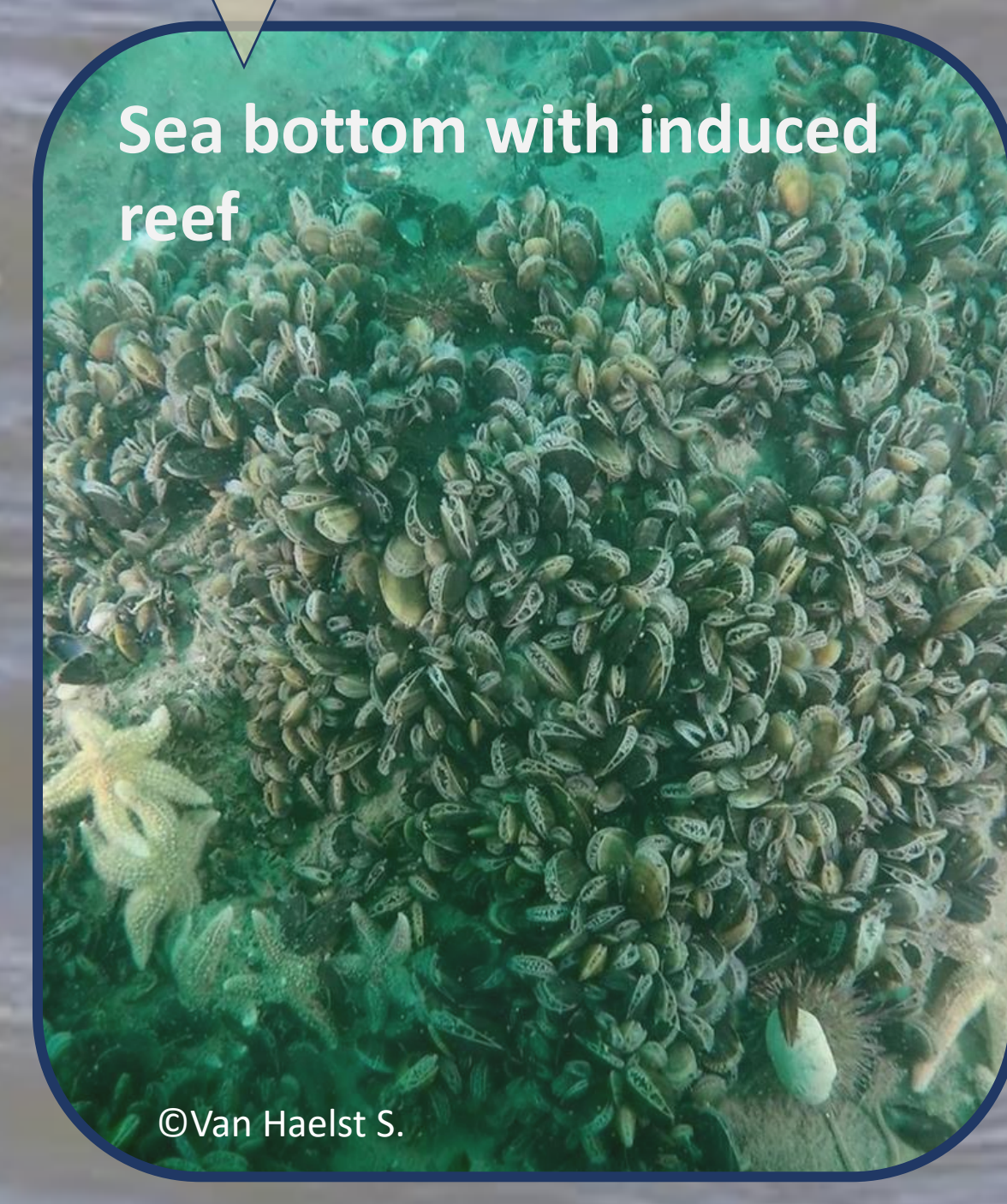
Innovative field observations clearly show the implementation of NbS is a dynamic, interactive and adaptative process whereby a complex series of criteria and indicators are interacting (IUCN, 2020a).
The blue mussel biogenic reef on the foreshore of the sandy Belgian coast fully reflects our strive towards an Ecosystem-based Coastal Zone Management solution - inducing natural accretion and (bio)stabilization of sediment, enhancing (local) biodiversity (and ecosystem services) and delivering a more resilient coastal (protection) ecosystem.

Scientifically underpinned data analysis reveal essential insights to optimize the NbS design of the blue mussel biogenic reef. The pilot project in front of the Belgian Coast delivers a proof of concept for these biogenic reefs and serves as a blueprint to further upscale the Coastbusters-concept, which will lead to future business applications. Both a North Sea -scale habitat suitability model for biogenic mussel reefs and a dedicated DPSIR framework to assess the added value of the Coastbusters concept are just growing steps towards a more efficient field implementation along sandy beaches.

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Partners

ILVO - Flanders Research Institute for Agriculture, Fisheries and Food

VLIZ

DEME - Dredging, Environmental & Marine Engineering

DN - Jan De Nul GROUP

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