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5th BALTIC MSP FORUM

11-12 November 2025 Riga, Latvia

# Flood protection. Modern protection measures and nature-based solutions for adapting to extreme weather events and storm surges.

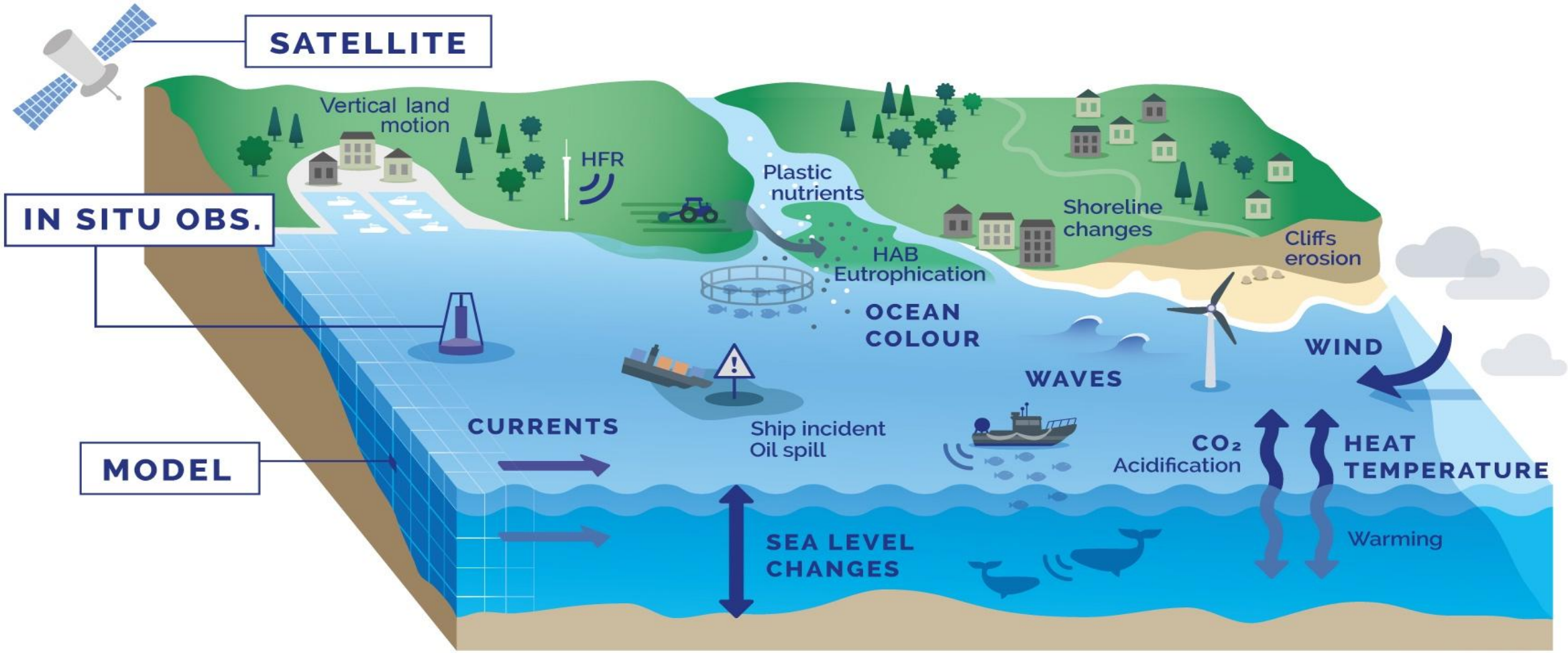
**Tymon Zielinski**

Institute of Oceanology Polish Academy of Sciences



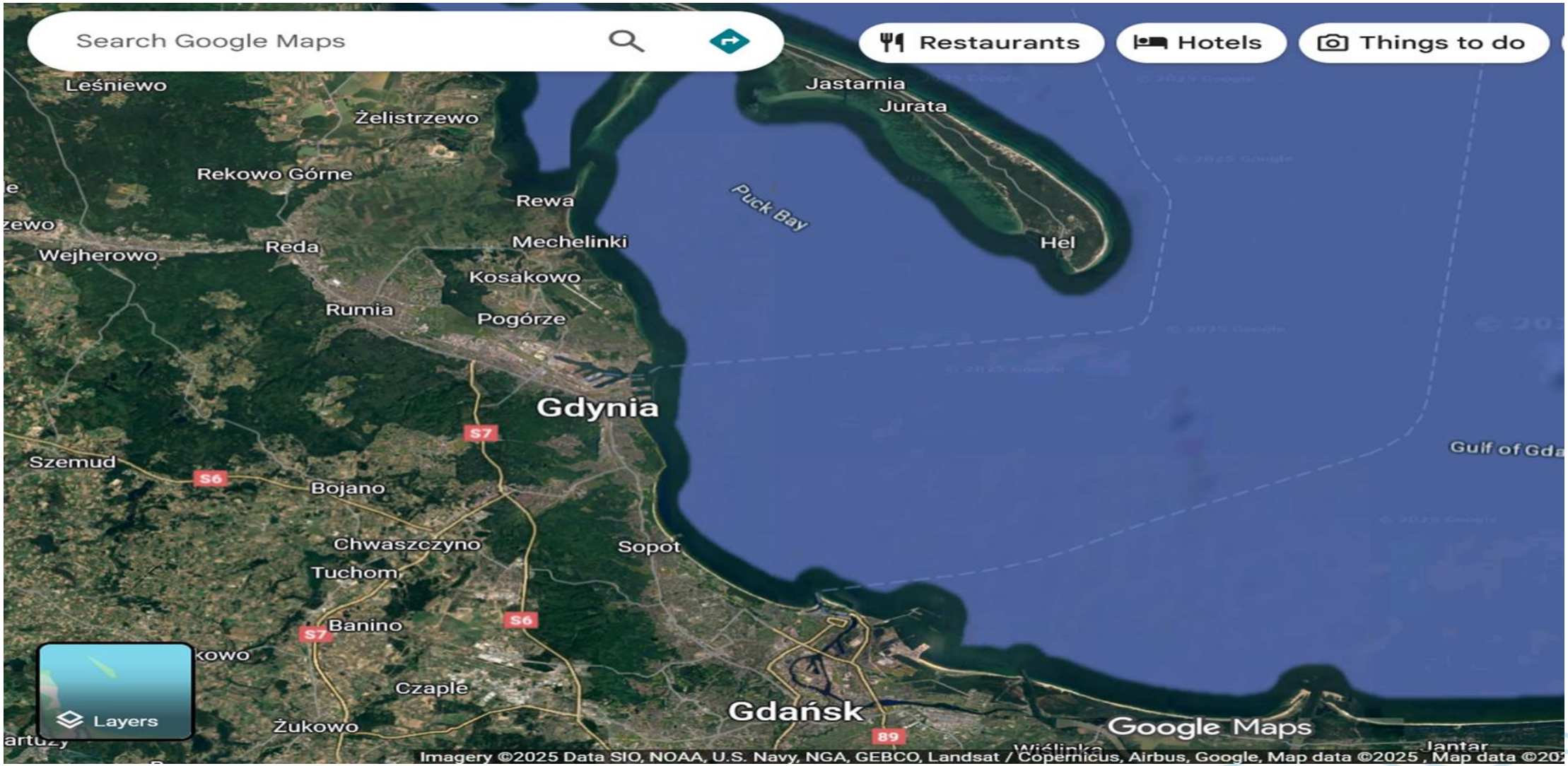
Climate and Ocean Research and Education Laboratory
Institute of Oceanology PAN

# Coastal area




Source: Melet et al. (2020).

# Orlowo beach, Poland



# Orlowo beach, Poland


# Orlowo beach, March, 2022

# Options: Grey (engineered) measures

- Sea-walls, levees/dikes, seawalls, storm-surge barriers and gates.

- These provide high, immediate protection and are widely used for critical infrastructure and dense urban areas. They require major capital, ongoing maintenance and can transfer risk elsewhere.

# Options: Nature-based solutions (NbS)

- Mangroves and coastal wetlands.
- Coral reefs and oyster/biogenic reefs.
- Dunes and beach nourishment / living shorelines.
- Floodplain reconnection / “managed realignment” / “Room for the River”.

# Options: Hybrid (green-grey) solutions

- Combining tidal marshes or reefs in front of seawalls, or engineered dunes planted with native vegetation, reduces wave loads on hard infrastructure and extends asset lifetimes.

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# THANK YOU!

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# Nature-based sandy beach and foredune management: Presentation for the 5th Baltic MSP Forum

## Case study from Nature Park “Piejūra”, Gulf of Riga

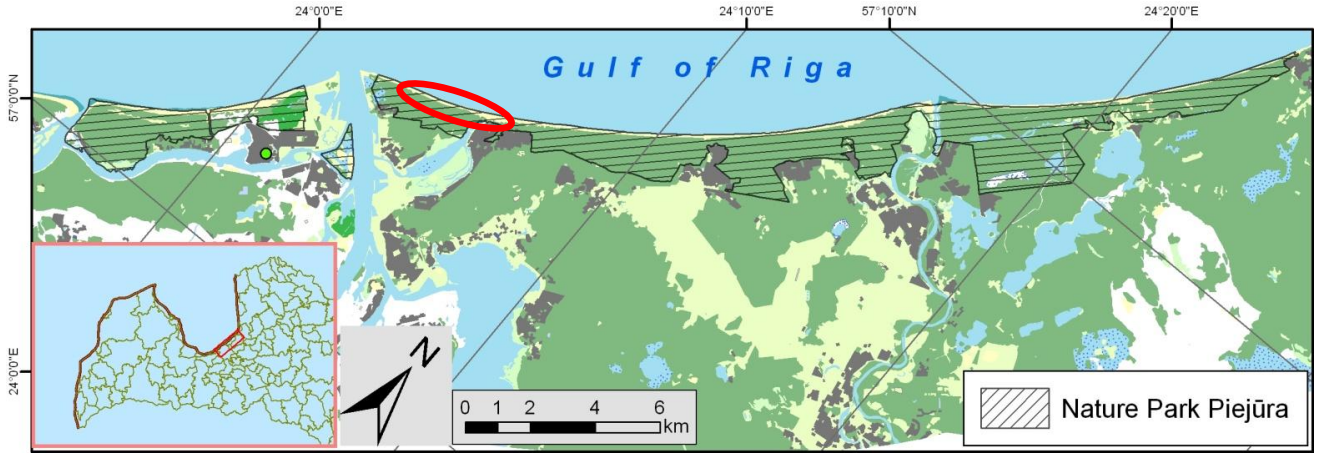
**Jānis, Lapinskis**

Assist. Prof., University of Latvia

# Case study area status I

Low coastal landscape in the southern part of the Gulf of Riga, which historically has been dominated by sediment accumulation.

As a result of various anthropogenic pressures, coastal erosion intensified at the end of the 20th century.



# Case study area status II

Significant impact by several storms at the end of the 20th century and the beginning of the 21st century.

Expected retreat of the coastline due to erosion and inundation by the year 2099 – 15 to 50 m.

# Implementation of coastal management measures in 2018 and 2019

"Dune planting", "branching" and "dune fencing" were implemented in key sections (total area covered and affected – approx. 200000 $m^2$) to:

- reduce the risk of wind erosion in the existing affected areas,
- improve the quality of recreation in the area, in parallel with the restoration of dune habitats in places where they have been damaged.

# Implementation of coastal management measures in 2018 and 2019

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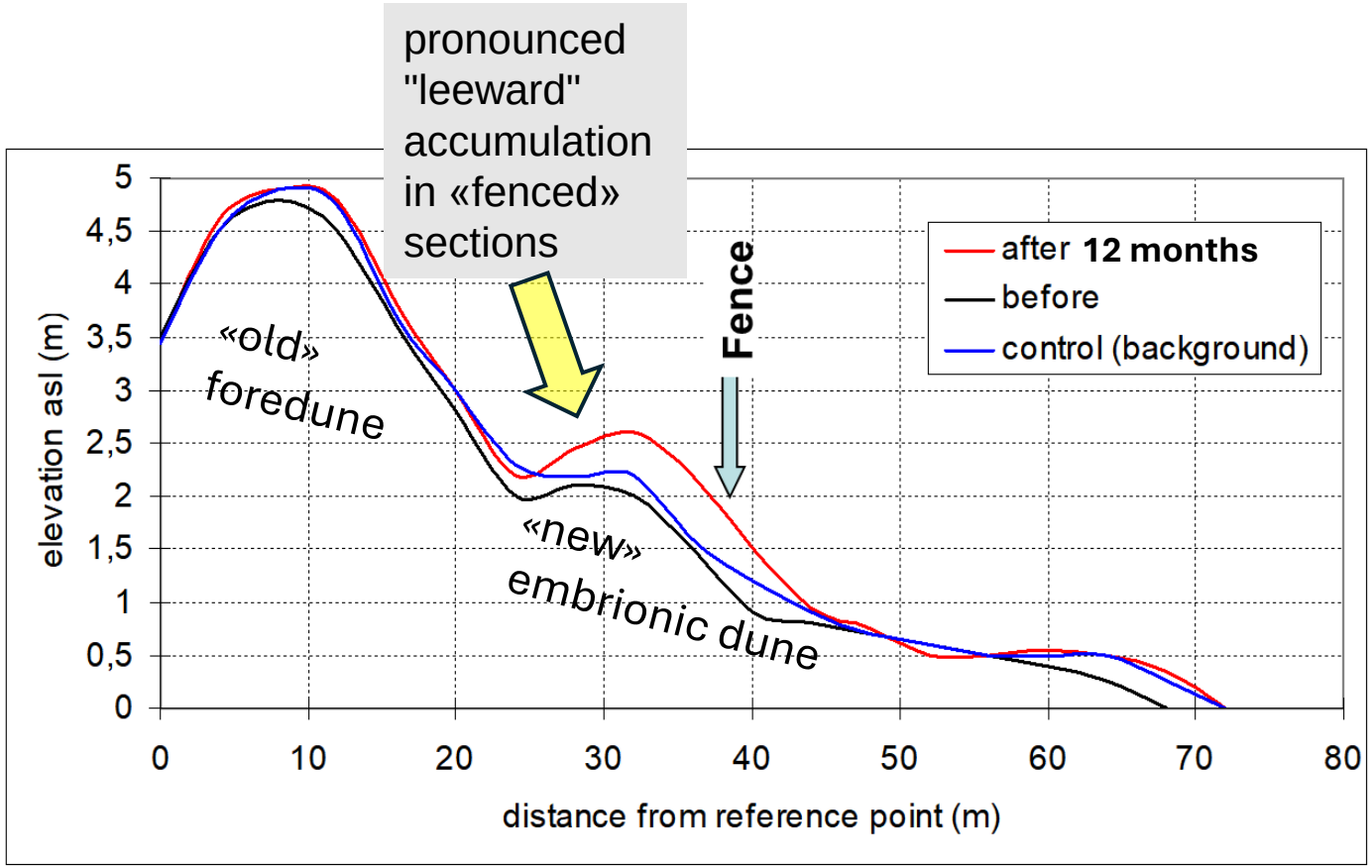
# Situation 12 months after implementation of measures

# Results

Visualization of an agglomerate of coastal cross-sections approximately characterizing the entirity of the case study area.



# Results – «dune fencing»

- In most of the implementation areas the accumulation of sand brought by the wind took place in the amount of approximately 3.0-5.0 $m^3$/m/year, which initialy significantly exceeded the background level (0.5-2.5 $m^3$/m/year).
- Rapid reduction in the effectiveness:
  - «extra» sand accumulated after  first 12 months was approx. 25000 $m^3$,
  - «extra» sand accumulated during the following 12 months was approx. 5000 $m^3$,
  - «extra» sand accumulated during the following 48 months (2021-2025) was approx. 7000 $m^3$.

# Results – «dune planting»

- Foredune growth also intensified where dune grasses were planted.
- There were very significant variations in effectiveness and plant survival rates in different locations.
- As opposed to fencing sites, the effect was observed later and was stretched over several years.
- The accumulation of sand within a six-year period after implementation took place: approximately 0.5-3.5 $m^3$/m/year (background level - 0.5-2.5 $m^3$/m/year).

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# Fehmarn Seagrass Project 2025

## How citizen science can make an impact

Tobias Pootz & Martin Noel Lampe



just 1 ocean Diver e.V.

# Who we are

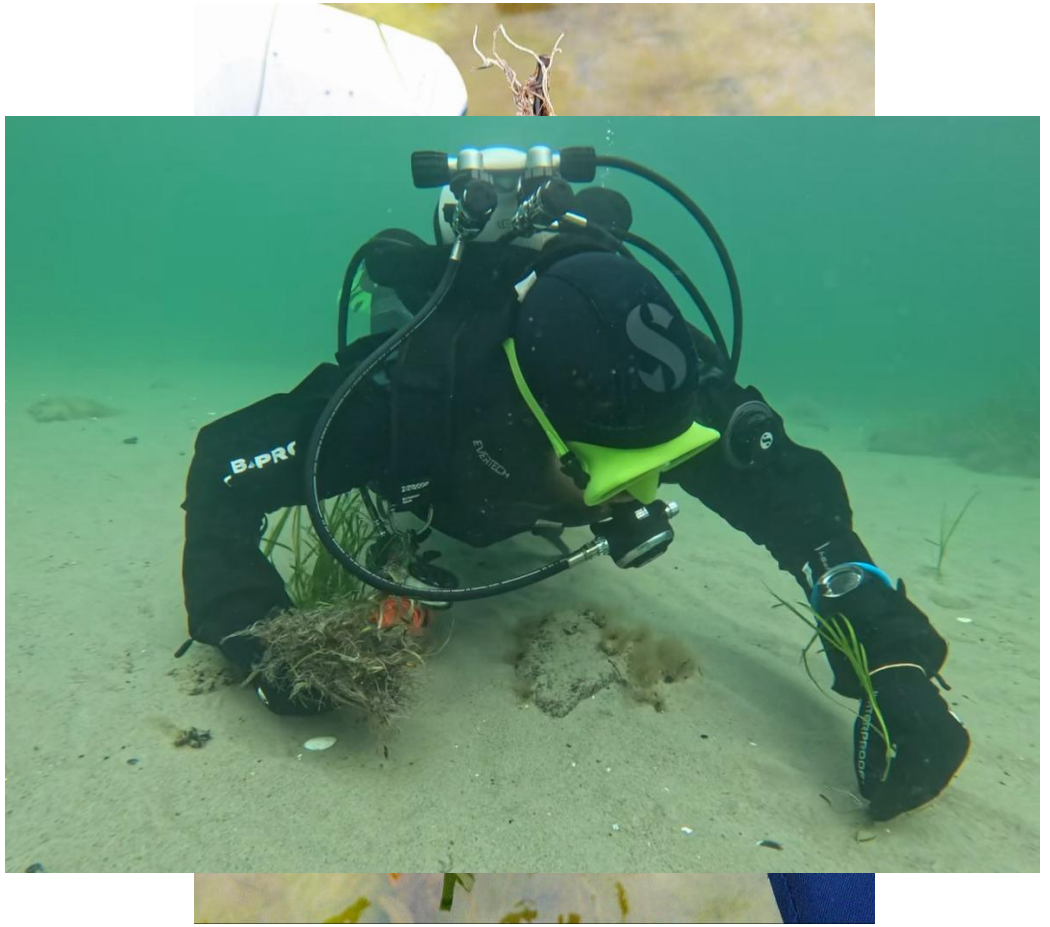
- Diving club from northern Germany
- Sustainability rebranding in 2023
- Focus on garbage collection, ghost net retrieval and seagrass reforestation
- 67 active members
- Part of a diving club network in northern Germany

# The idea

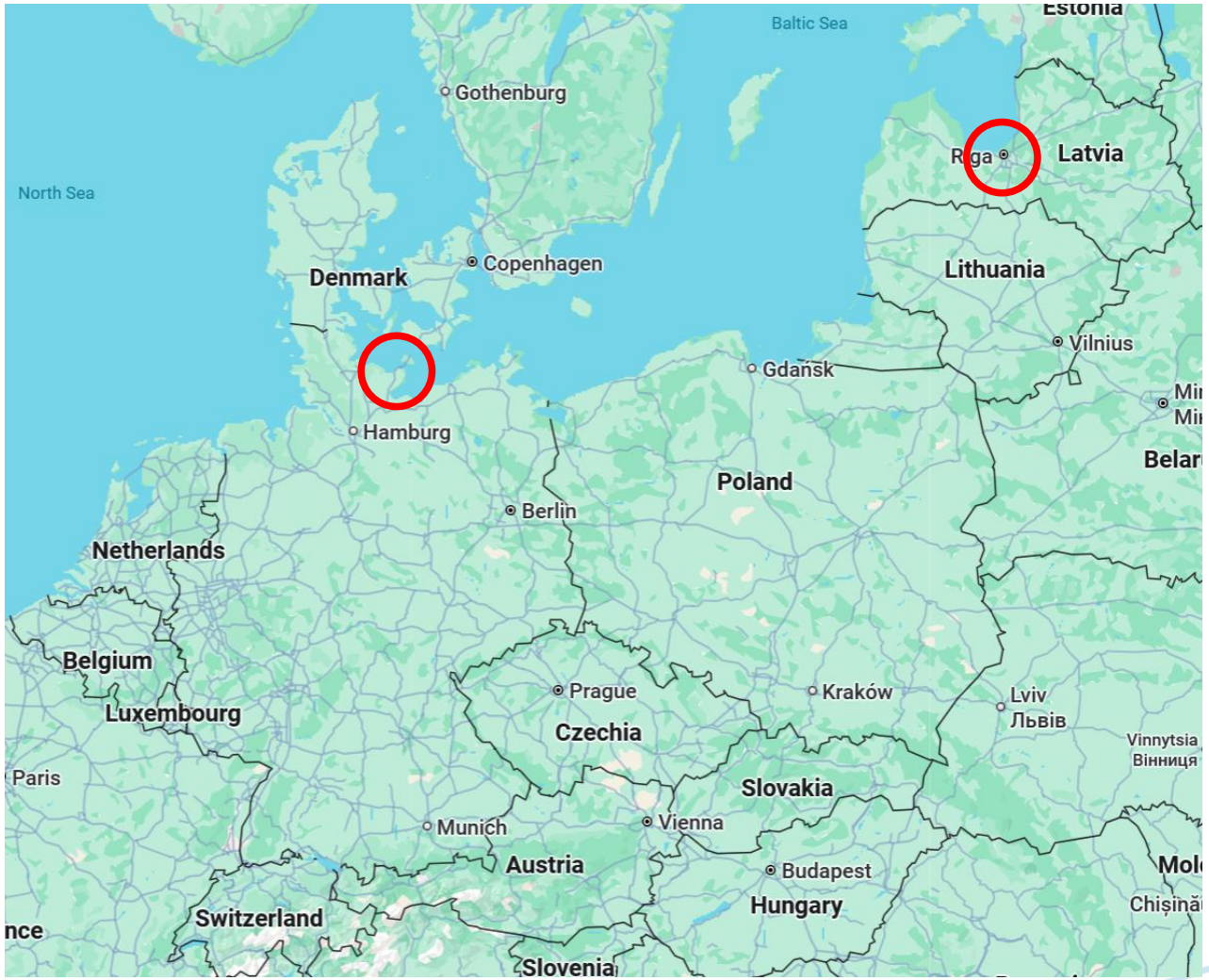
- Reforestation of seagrass meadows in ideal locations
- Target vulnearble costal areas
- Collaboration with Geomar Kiel
- Build on previous experience in Denmark and Germany since 2021
- Monitor development over the years

# The procedure

- Harvesting from healthy donor meadows
- Transportation in buckets of water
- Separation into individual seedlings
- Counting and bundling
- Planting
- Monitoring



# The location



# The location - Fehmarn

- Small german island
- Shallow, cold water
- Some healthy meadows
- 2025: Southern coast
- 2026:
  - South and west coast
  - East trial (no seagrass)

# Goals of the 2025 project

- Spot ideal locations: Sandy, shallow, little rivaling aquatic life
- 4 plating Sessions (2-3 days)
- 2 monitoring Sessions
- All in all with 63 divers (1,500 h)
- 38,100 seedlings
- Planted: 3930 $m^2$, 3400 $m^2$ grown after 8 weeks
- Cumulating reproduction rate: 1,95

# The current status

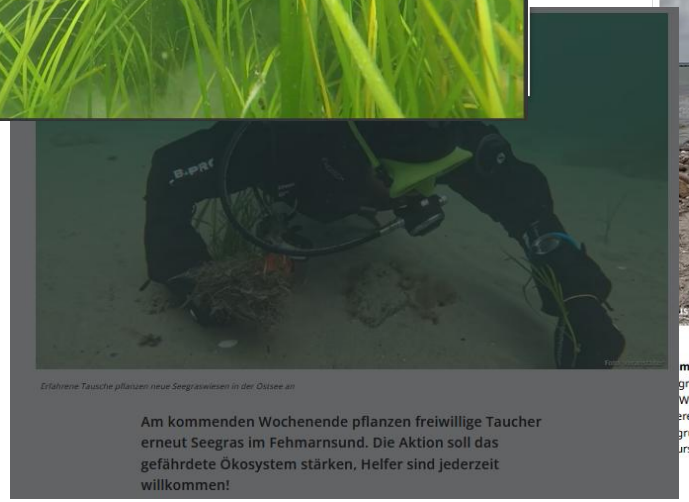
- 2025 area mostly covered
- Procedures have been optimised
- Areas for next year scouted
- Overall project cost 52 k€
- 15,45 € per $m^2$ of planted seaweed meadow
- Divers, contributers, donors need to individually approach us if they want to help
- Data is sent individually and not broadly accessable

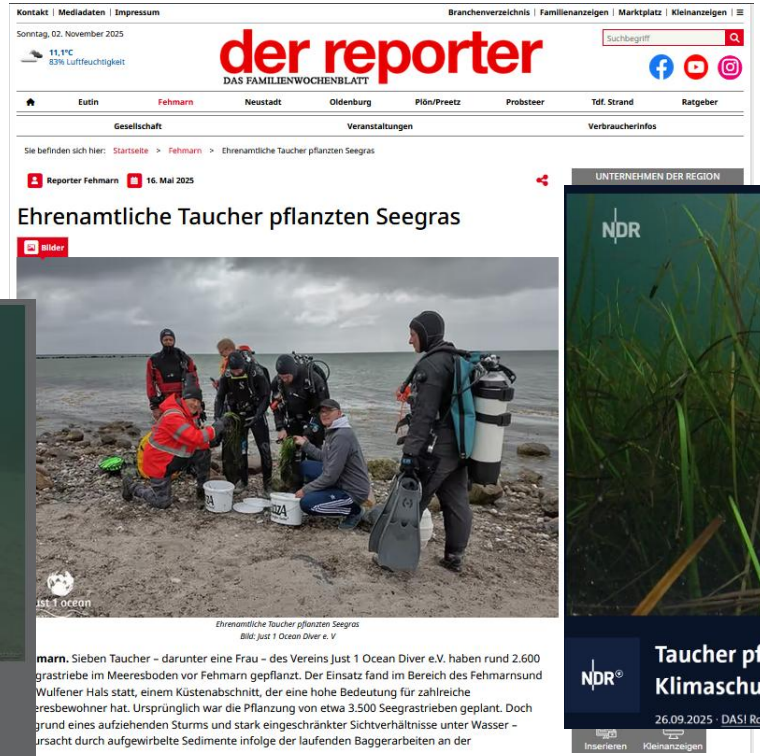
# Future development

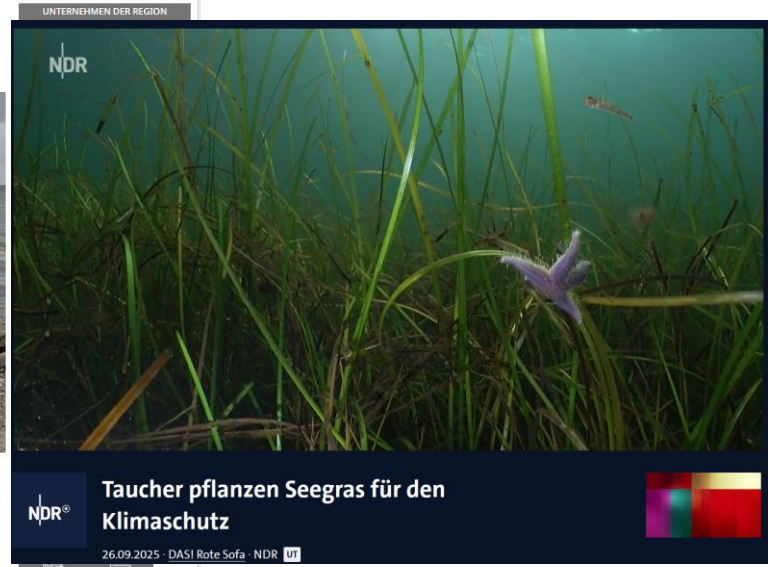
- Just one Ocean Divers acts as a coordinating instance
- Individual diving clubs and local diving shops are more involved
- Online database and access for monitoring and planning
- Seagrass diving tourism “Stay one day, help one beach”

# Outreach Public reception

- 6 News articles, 2 TV shows, multiple local politicians and NGOs offered support

# Reintroduction and Maintenance

- What other methods for planting seagrass meadows would be useful?

  ? *Use of robots, Sowing seeds, …*

- What optimization options are possible when planting seagrass?

- What measures should/must be implemented to protect seagrass meadows?

  ? *Mooring buoys, Marker buoys and information signs, …*

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just 1 ocean
Diver e.V.

# Thank you

More information:

www.just1.world/

www.just1oceandiver.org/

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# Issues to discuss – barriers and solutions

1. Sand beach management: Discussion of techniques for the conservation and regeneration of beaches in the face of rising sea levels and increasing coastal erosion.

2. Flood protection: Modern protection measures and nature-based solutions for adapting to extreme weather events and storm surges.

3. Seagrass restoration: Ecological and coastal protection significance of seagrass meadows and methods for their reintroduction and maintenance.