FRANCE ENERGIES MARINES

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FRANCE 2030

R&D Webinar - BIODHYL Project Outcomes

Enhanced biocolonisation knowledge and optimisation of offshore renewable energy systems monitoring

FRANCE ENERGIES MARINES · EDF power solutions · Ifremer · OW OCEAN WINDS · Rte Le réseau de transport d'électricité · RWE · Shell · TotalEnergies · UNIVERSITÉ DE TOULON

With the financial support of:

Région Bretagne · Région Pays de la Loire · La Région Occitanie Pyrénées - Méditerranée · Région Sud Provence Alpes Côte d'Azur

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In situ data: biofouling variability depending on sites, depth and time

Overall objectives of this part of BIODHYL

→ Designing a system for *in-situ* monitoring of biofouling ahead of the installation of floating OWF enabling sampling at different depths

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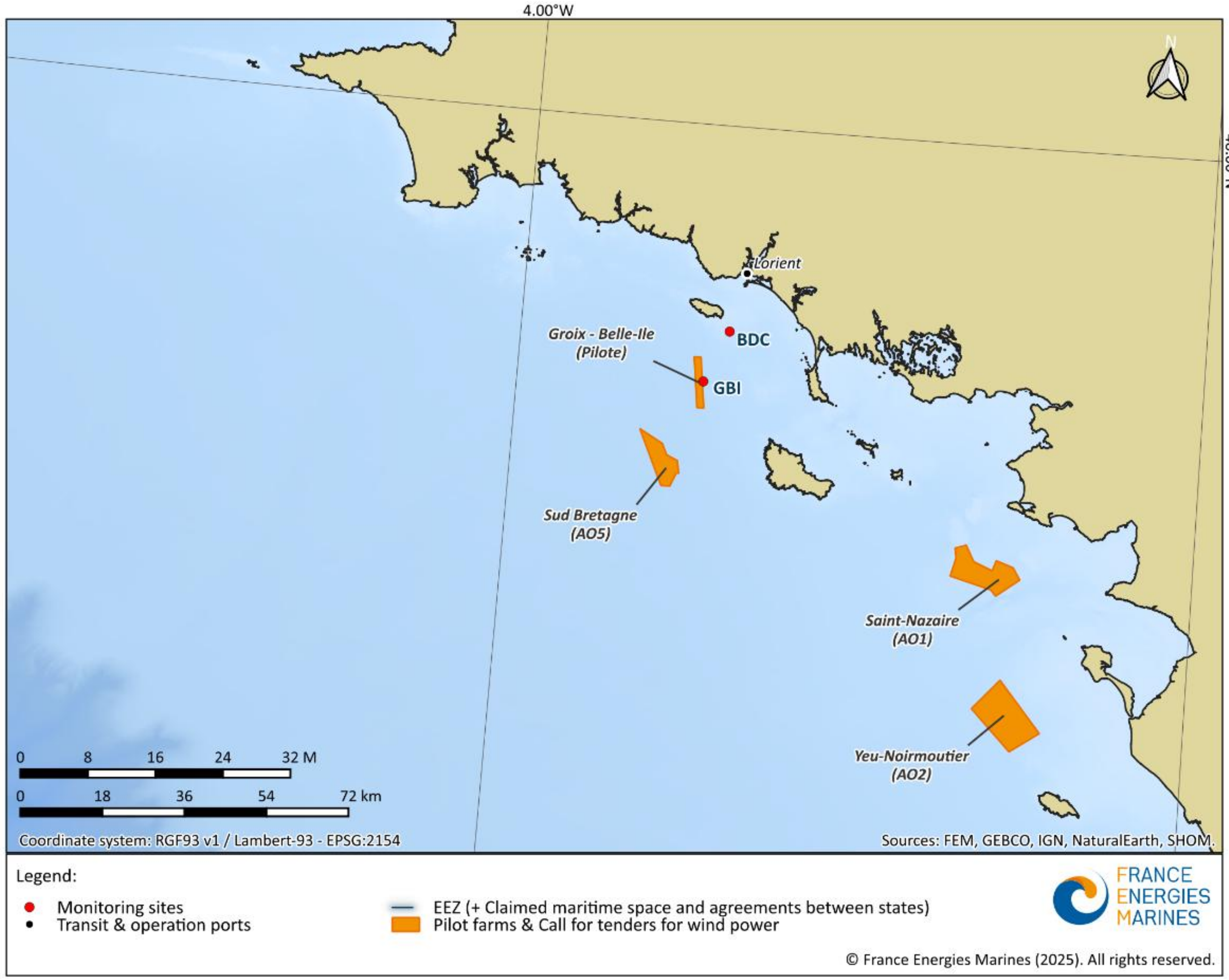
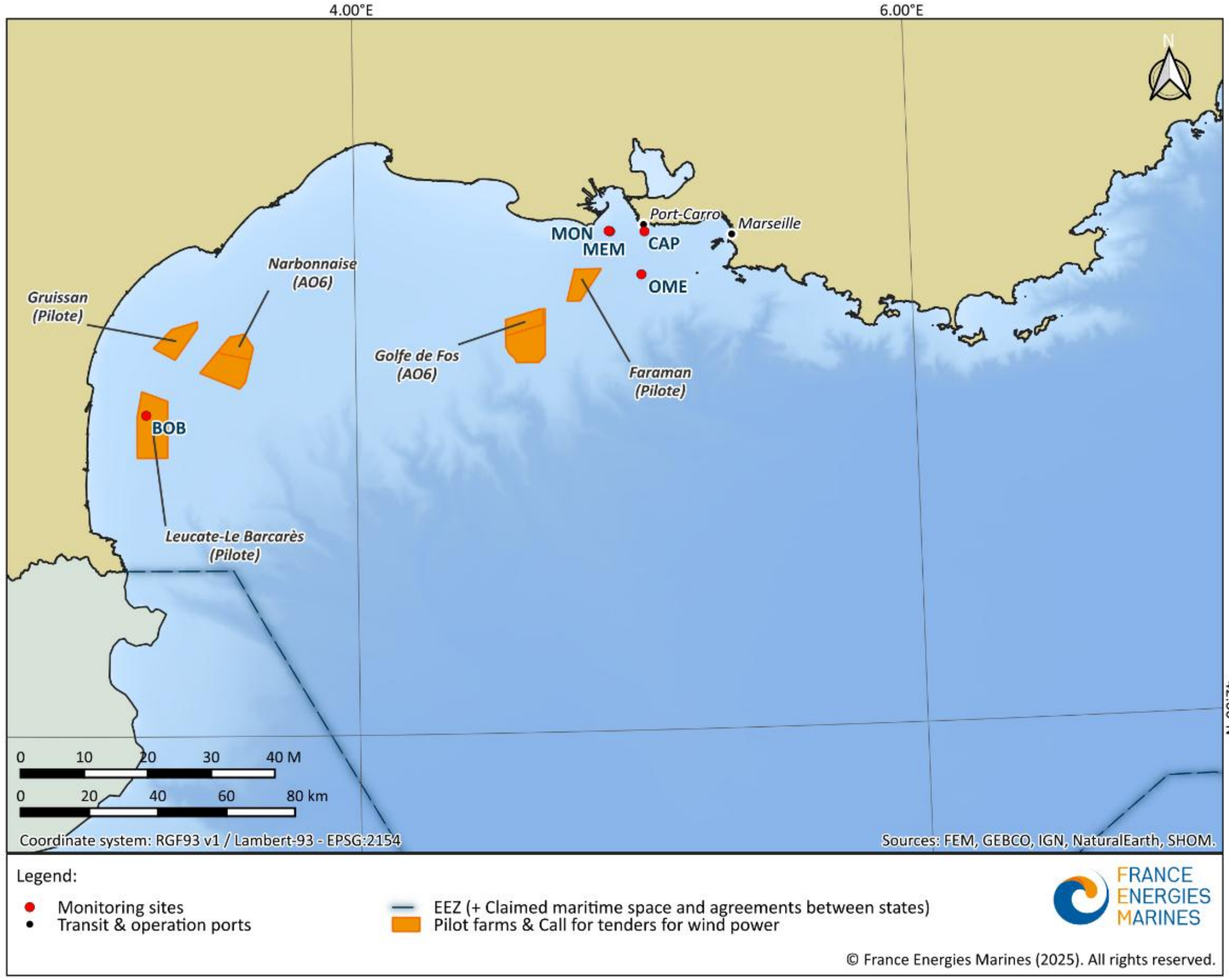
Material and methods





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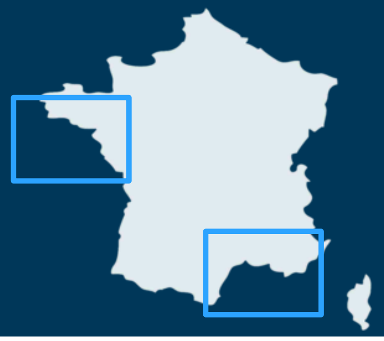

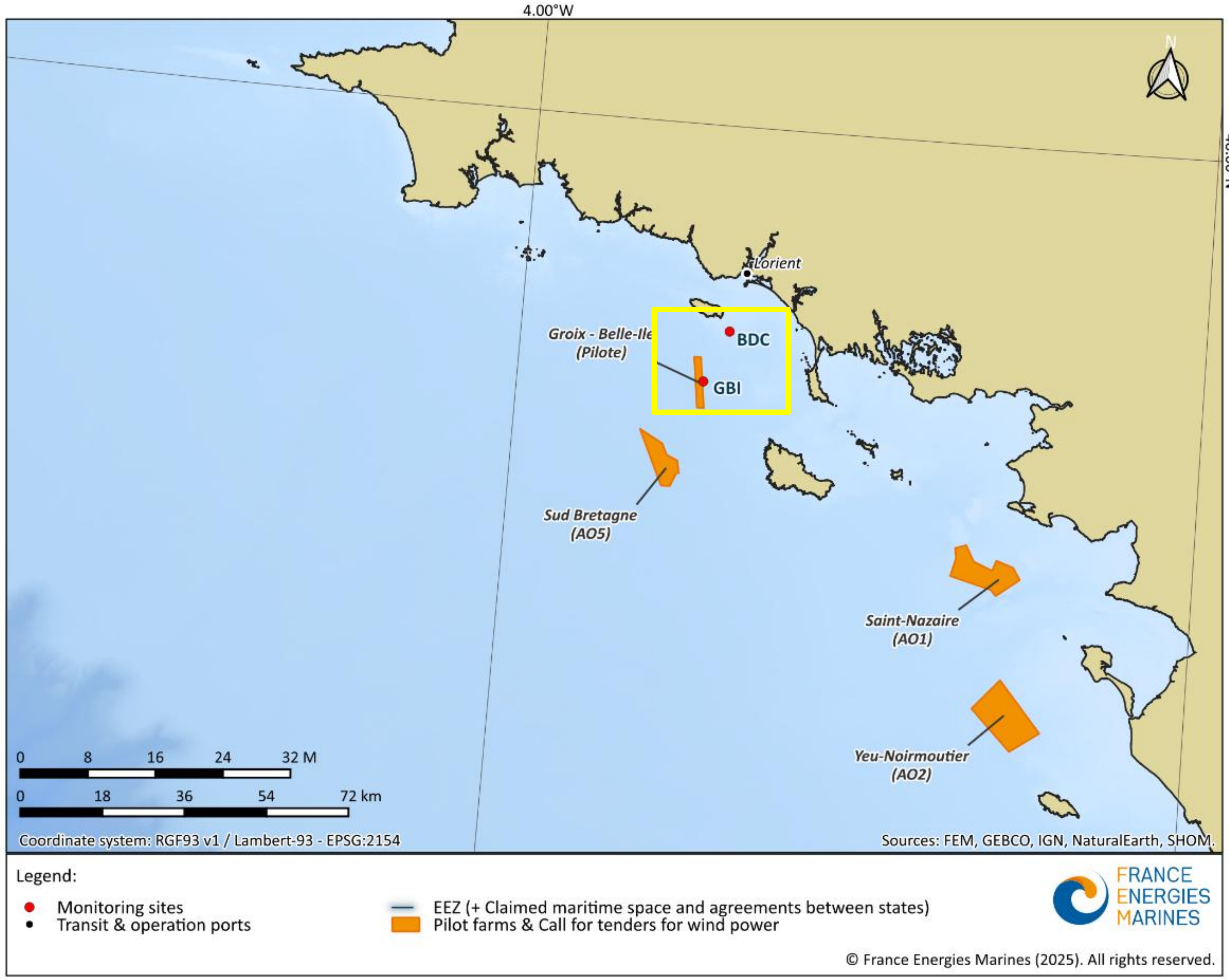

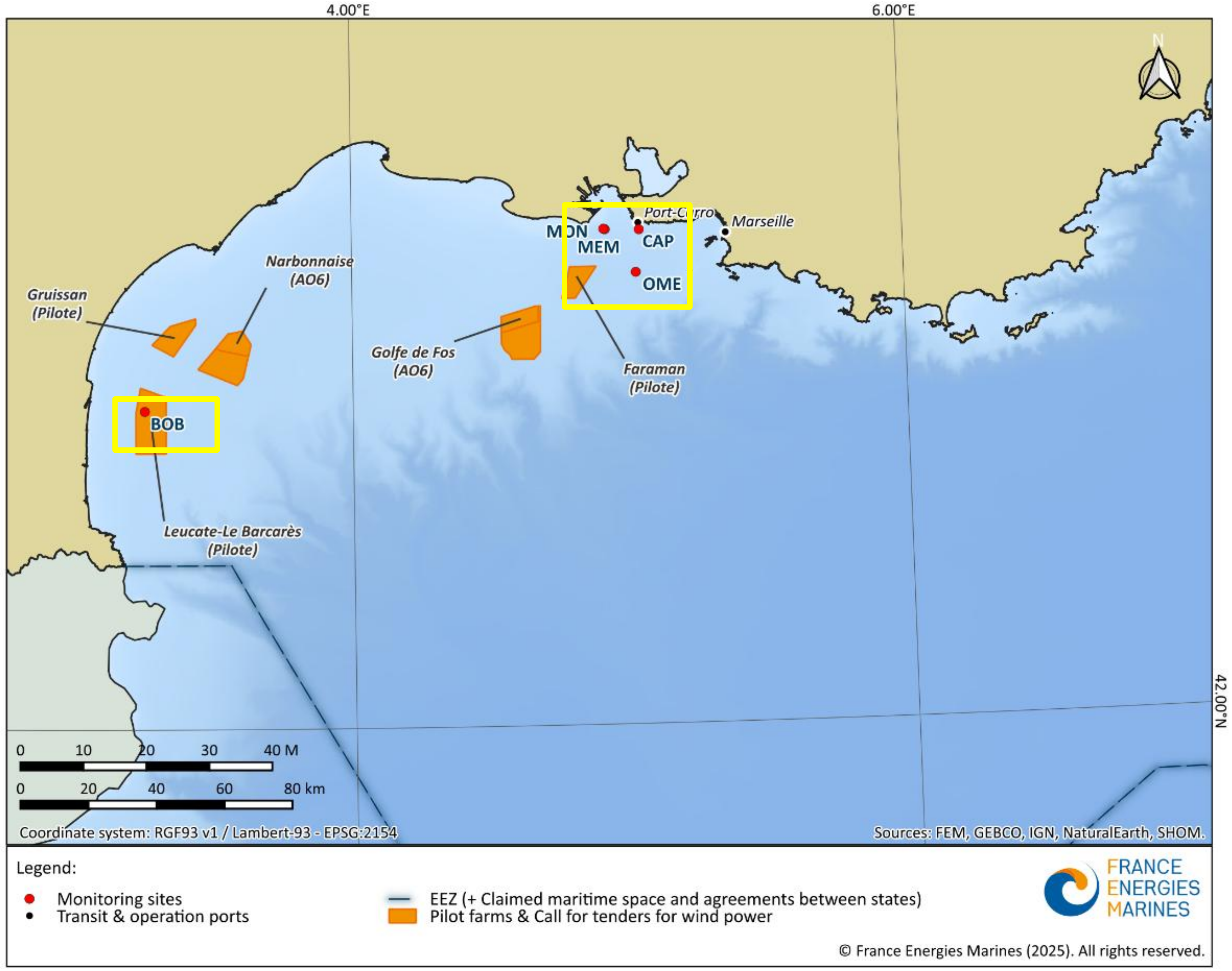

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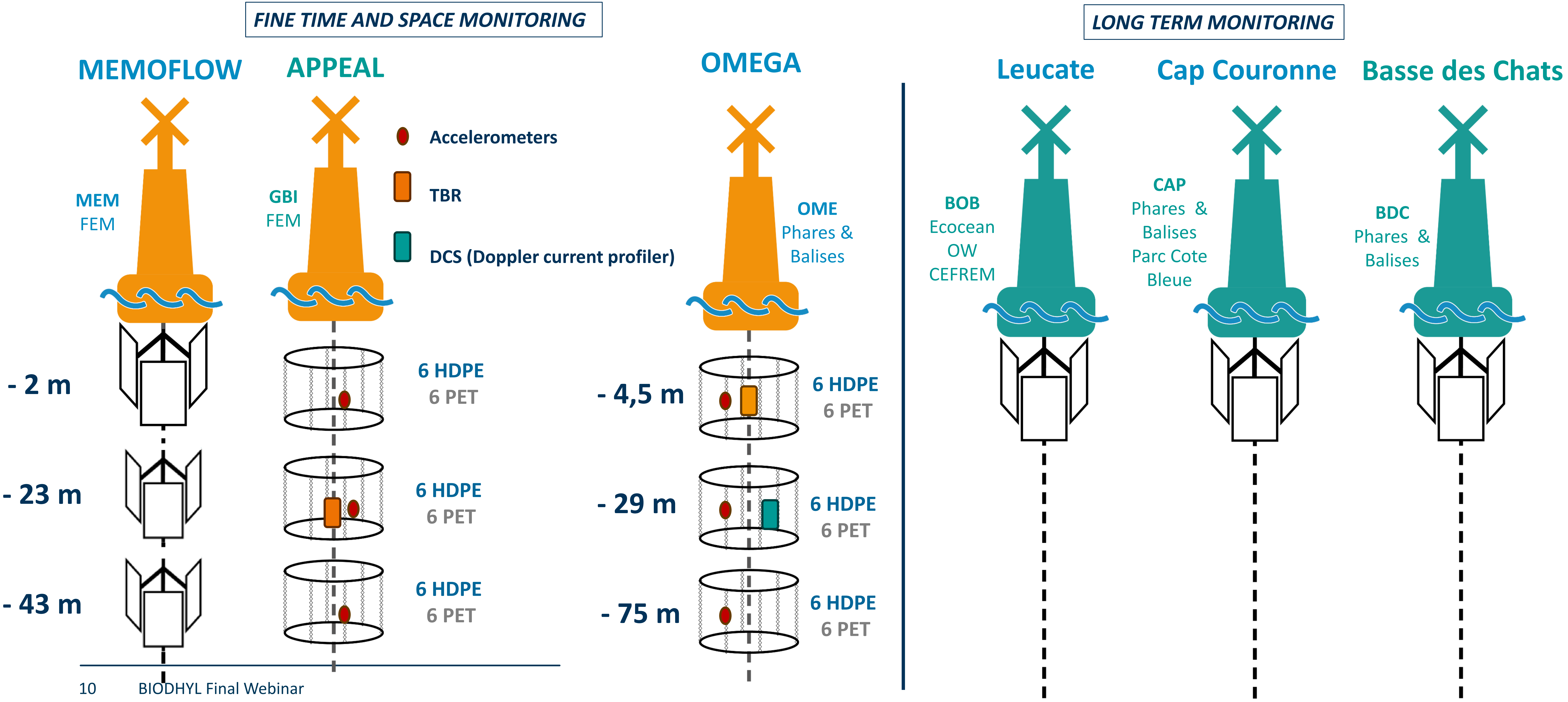

Material and methods

PHARES ET BALISES
ecocean
Raised to be wild
CEFREM
PARC MARIN CÔTE BLEUE
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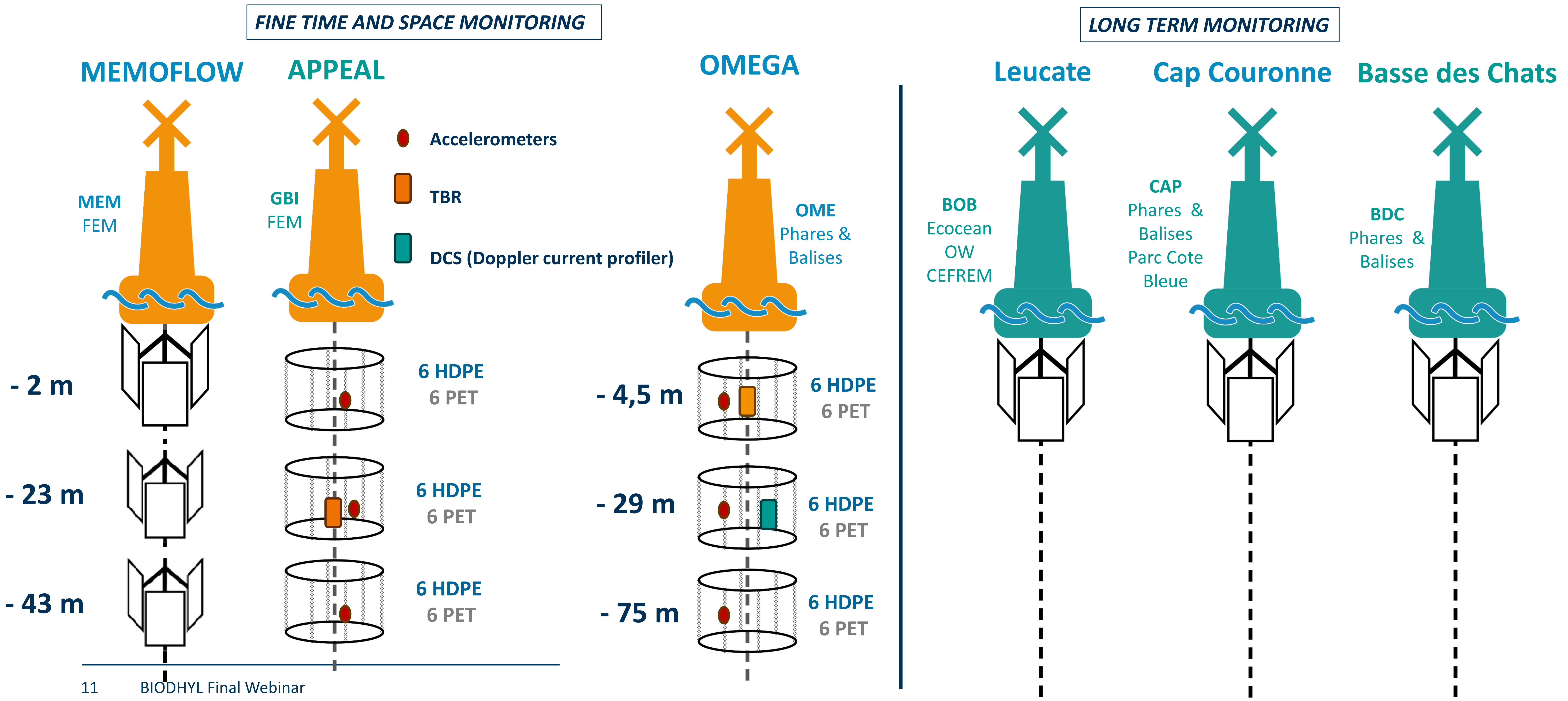

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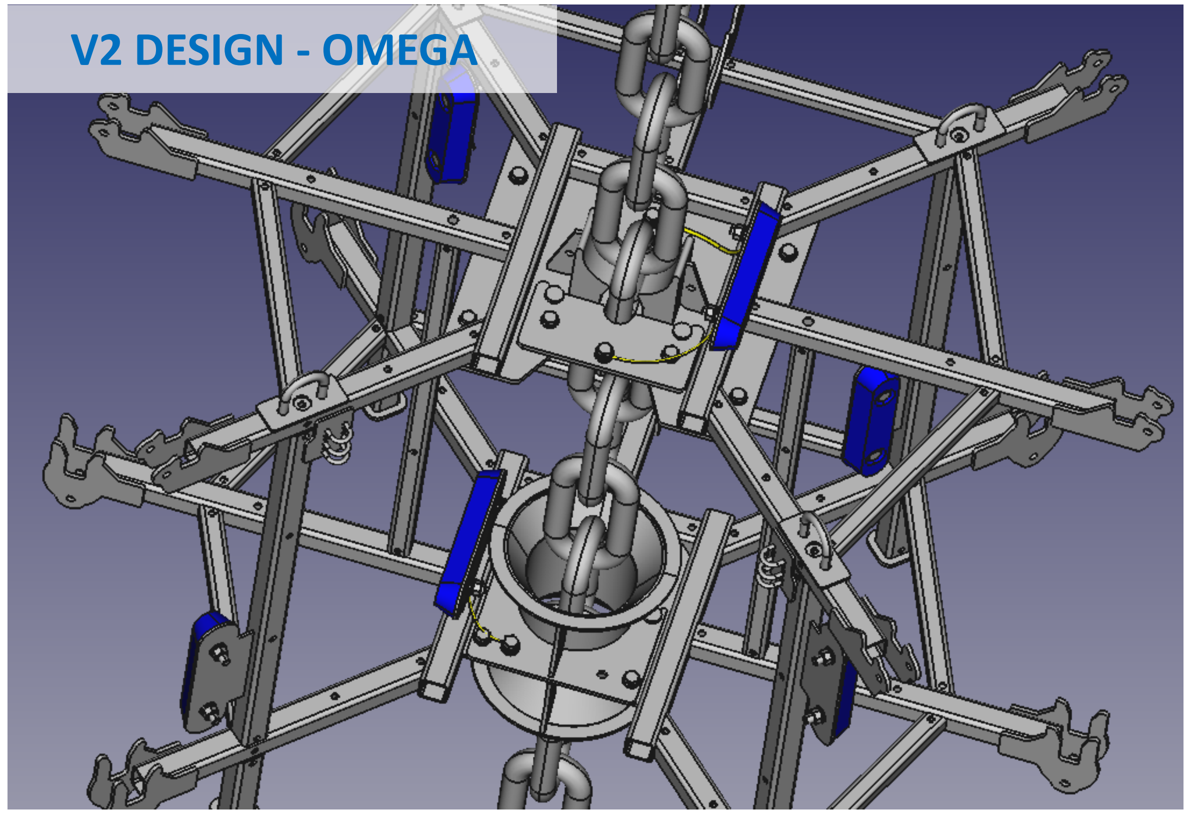

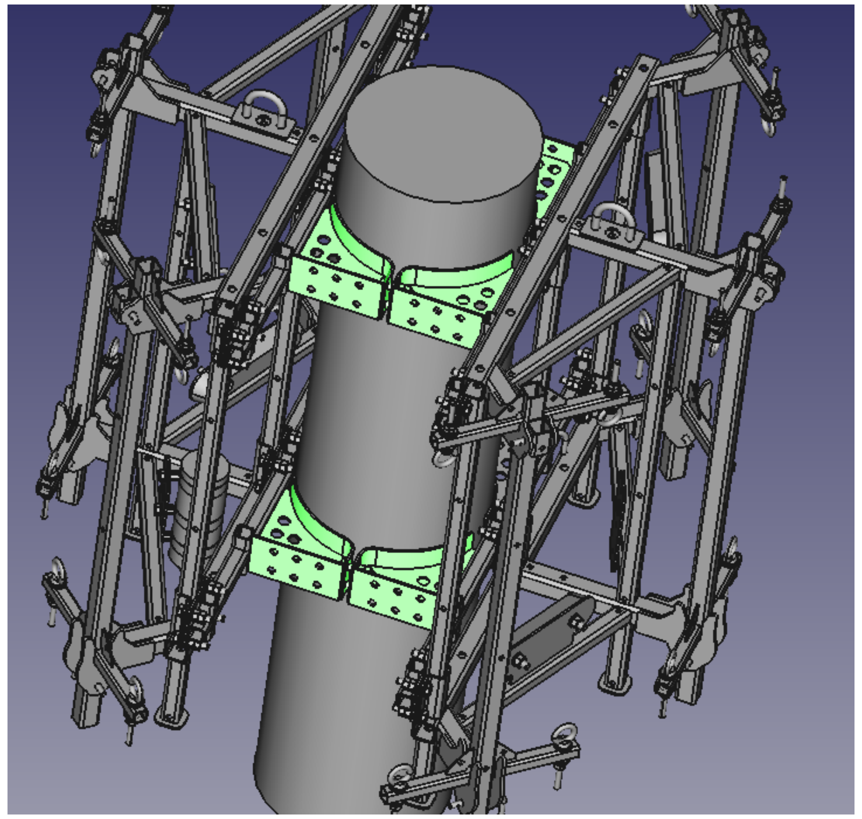

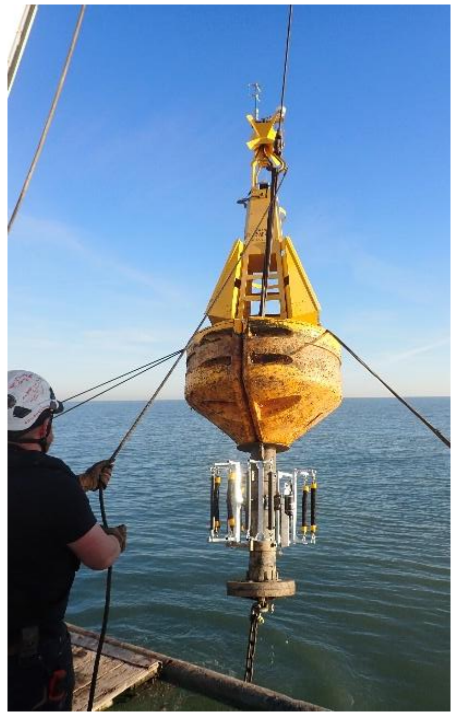

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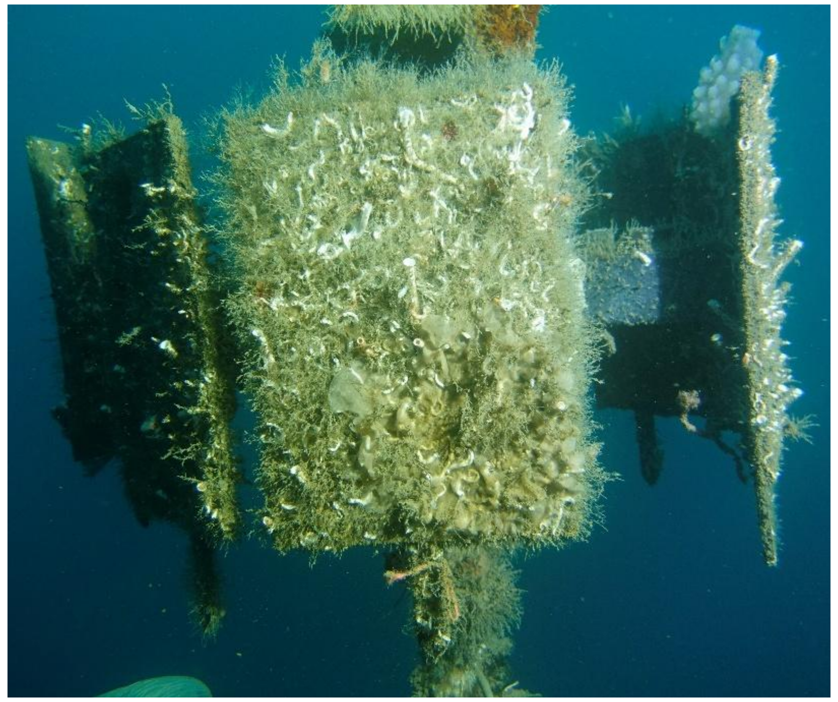
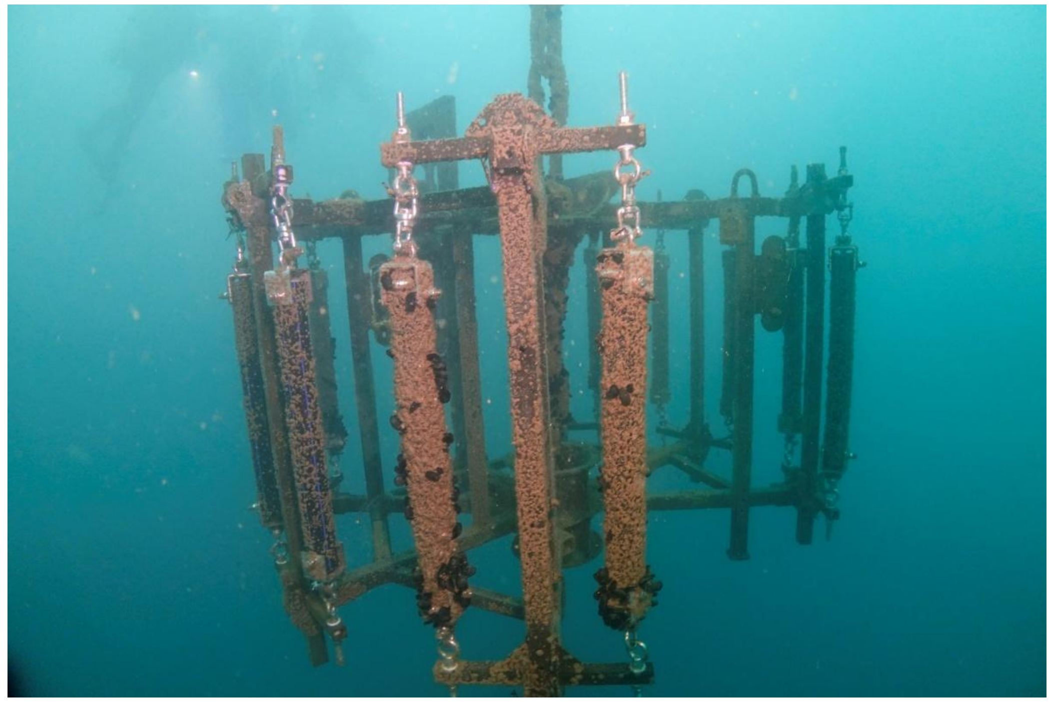
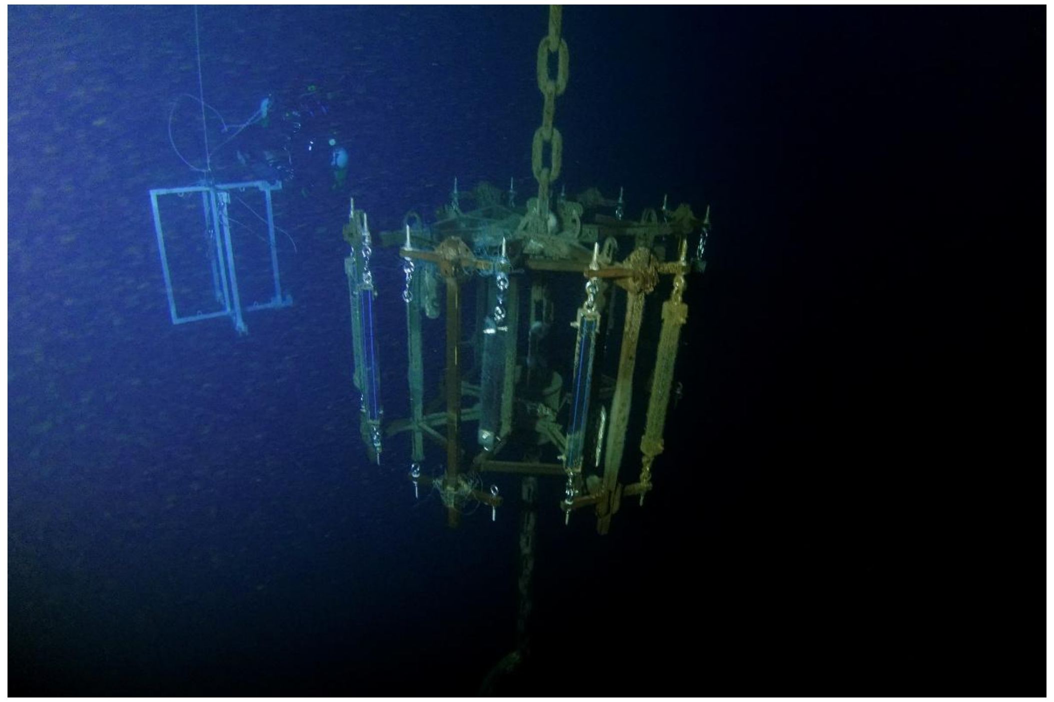
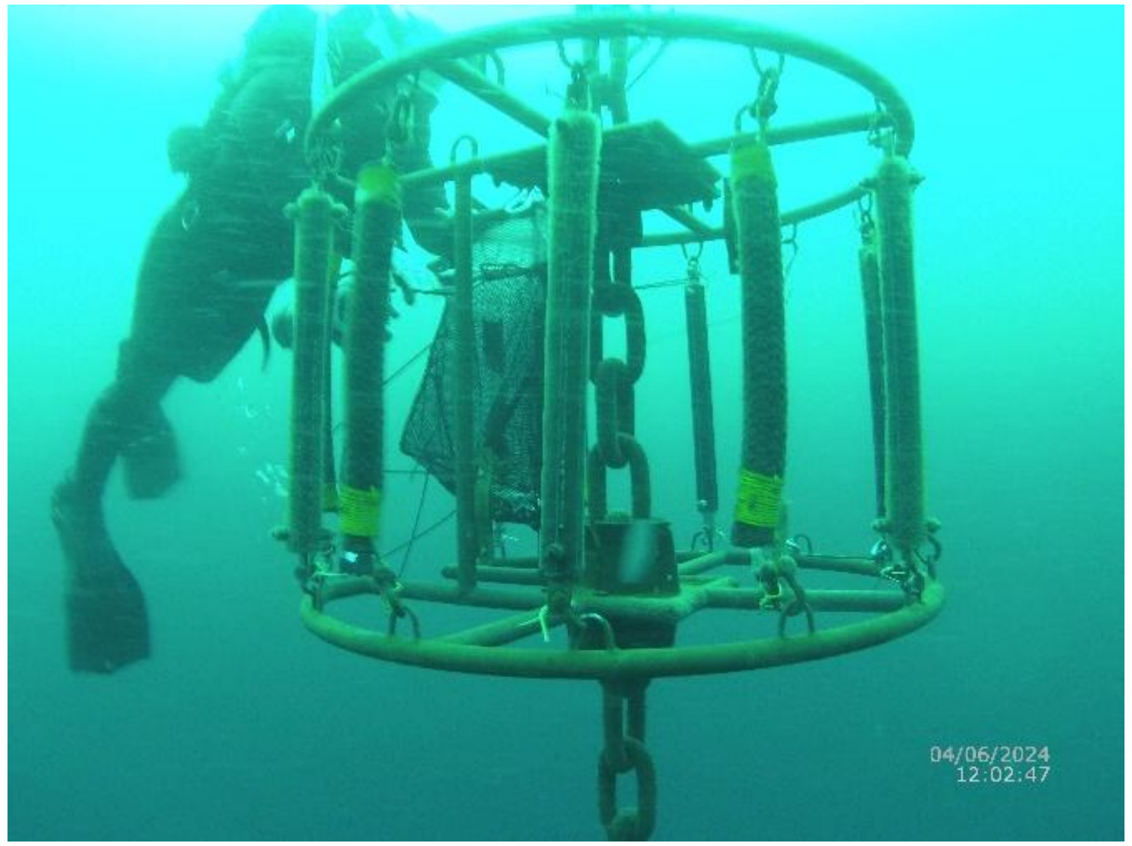
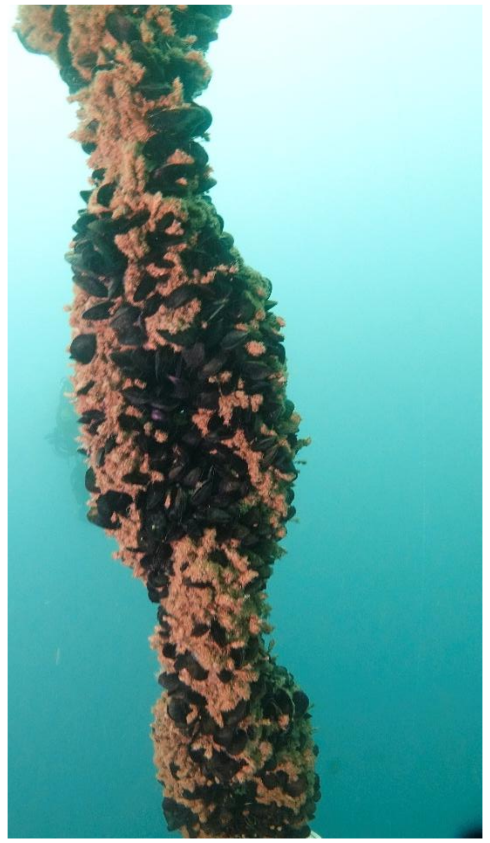
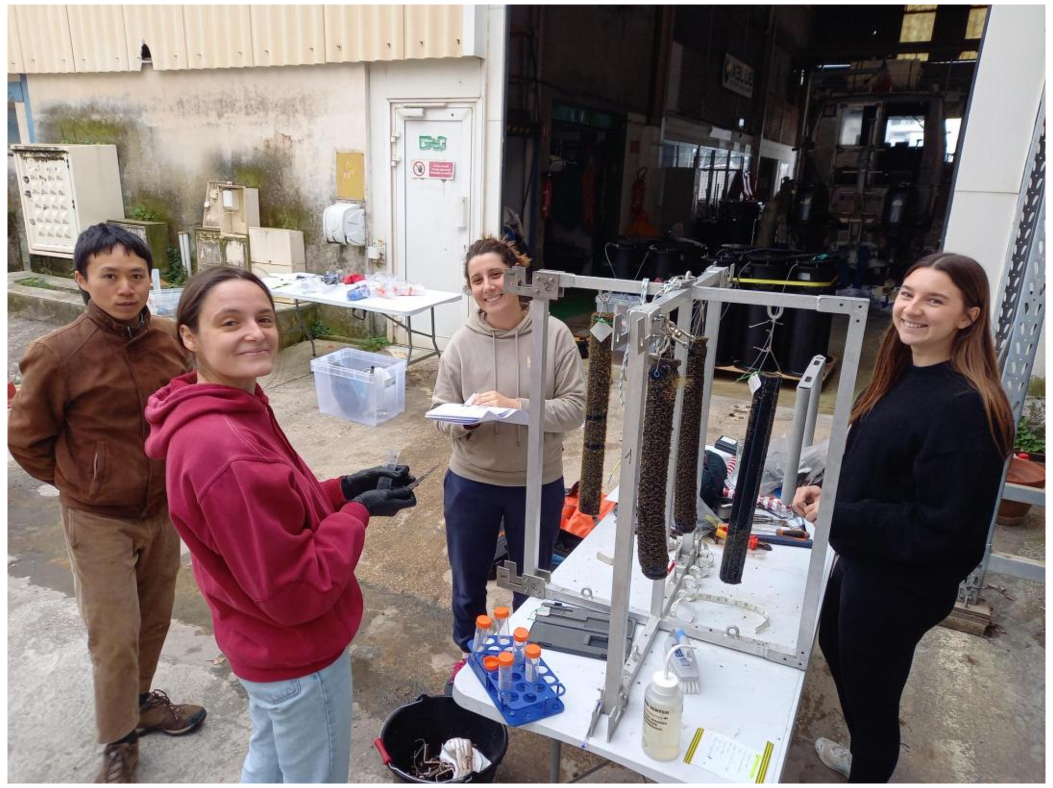




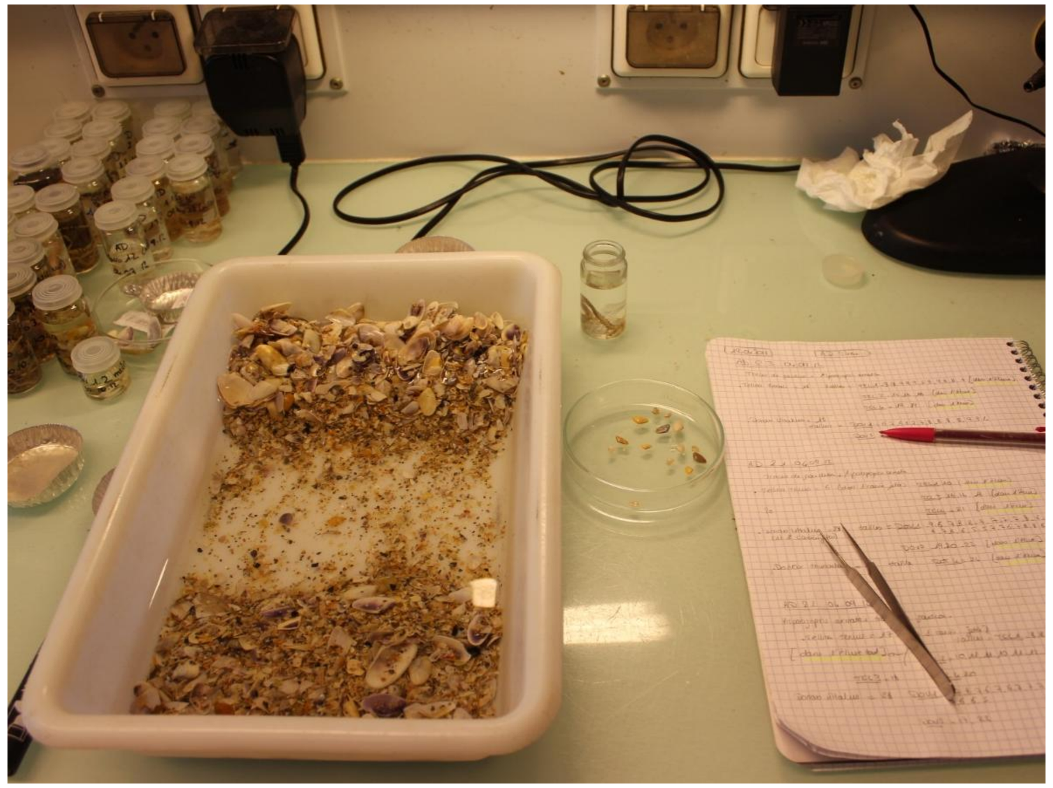





Variables measured:

- Weight in air
- Weight in water
- Thickness
  - length of organisms
  - perimeters
- Volume
  - water displacement
  - calculations based on thicknesses
- Species richness
- Abundance
- Coverage
- Physico-chemical parameters
  - T°C, sal., dissolved O2, pH, nut., buoys movments





Biofouling variability – overview of samples and data gathered

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Number of environmental measures:

- Using multiparameter probes = 1 396 useful data
- Based on water samplings = 126 (21 measures for each nutrient)
- Using accelerometers = 730 842

Number of direct measures:

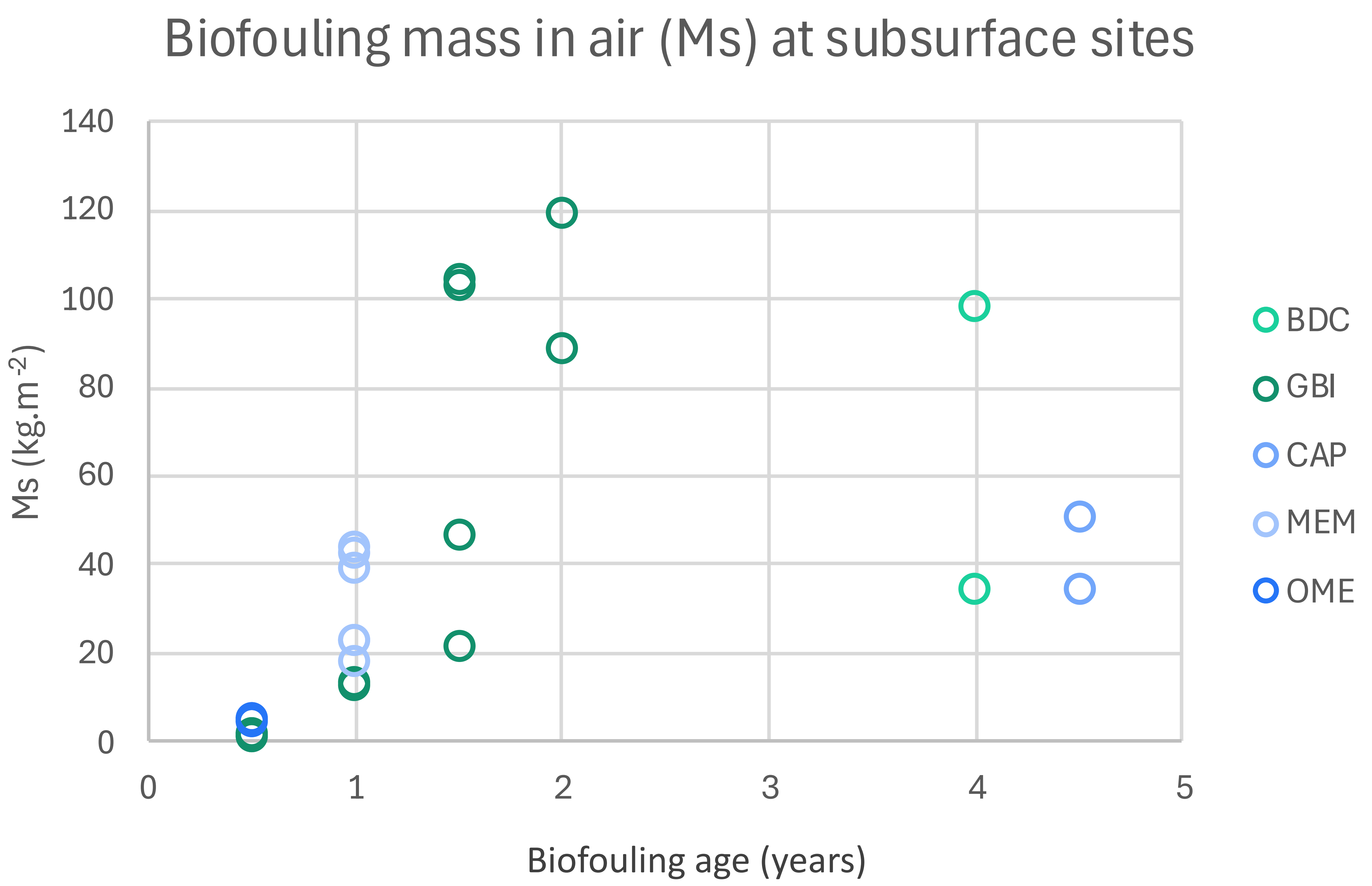
- Biofouling volume = **102**
- Biofouling weights = **169**
- Biofouling thickness = **1 134** (thickness samples and mooring lines)
- Biofouling pictures > **1 800** (including 364 pictures at known distance & 750 pictures taken in the lab)

Taxonomic analyses:

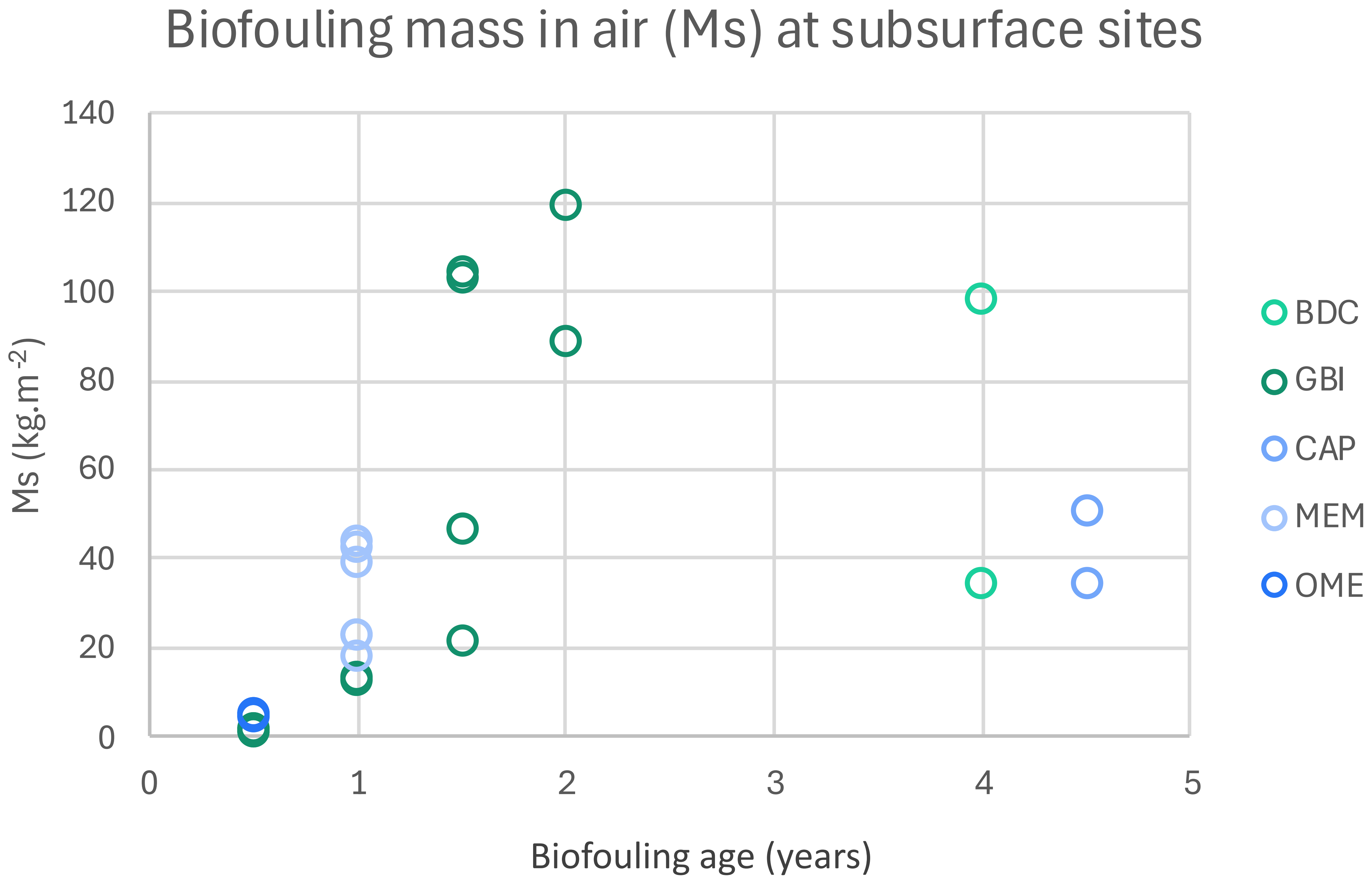
- Number of species identified (morphological taxonomy) = **246**
- Number of species identified (metabarcoding) = 397
- Number of lines of the database = 1 110

Selection of some key results

Biofouling variability – weight ~ time



Biofouling variability – weight ~ time



- Global ↗ along time
- Differences across sites

Biofouling variability – weight ~ depth

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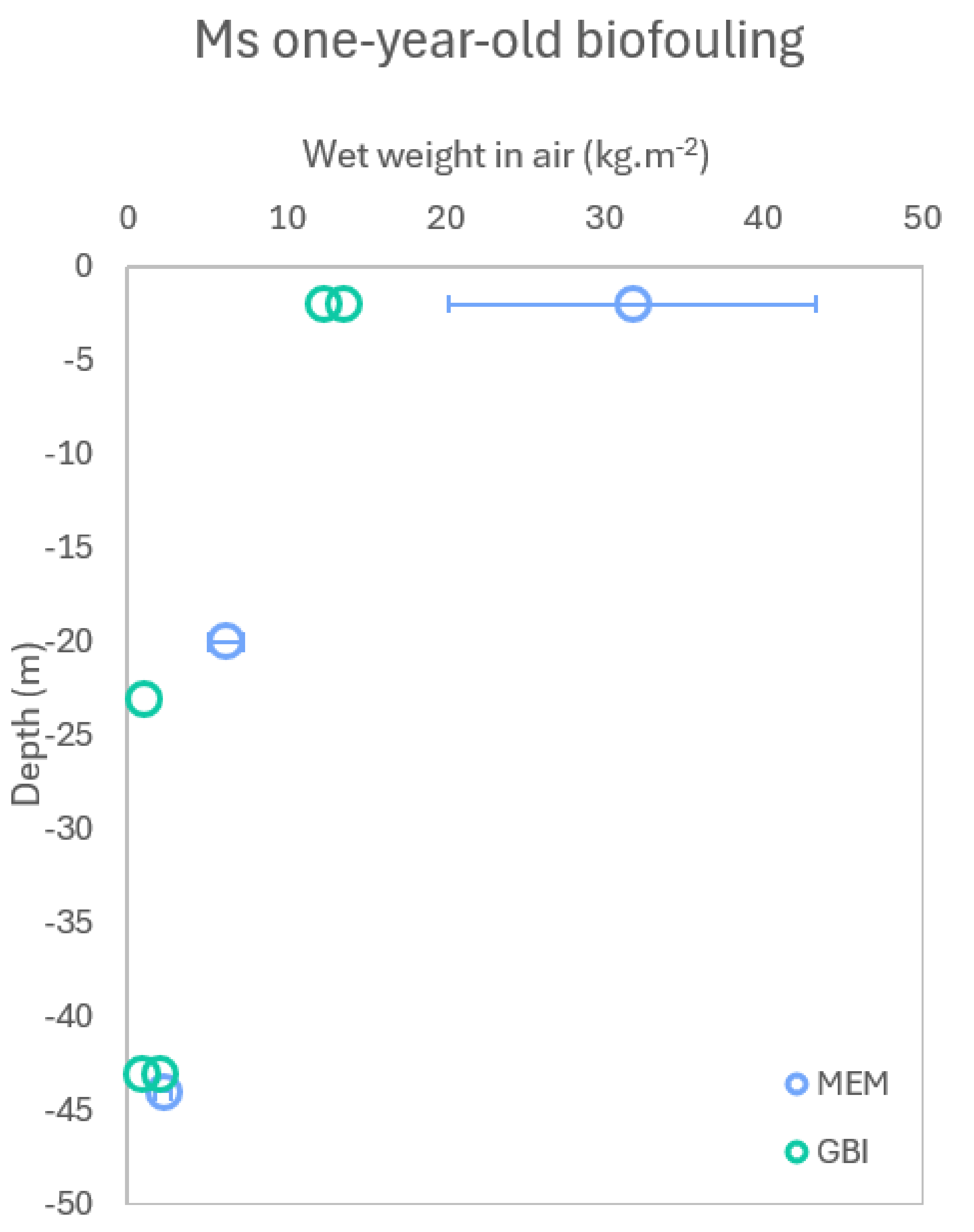

Biofouling variability – weight ~ depth

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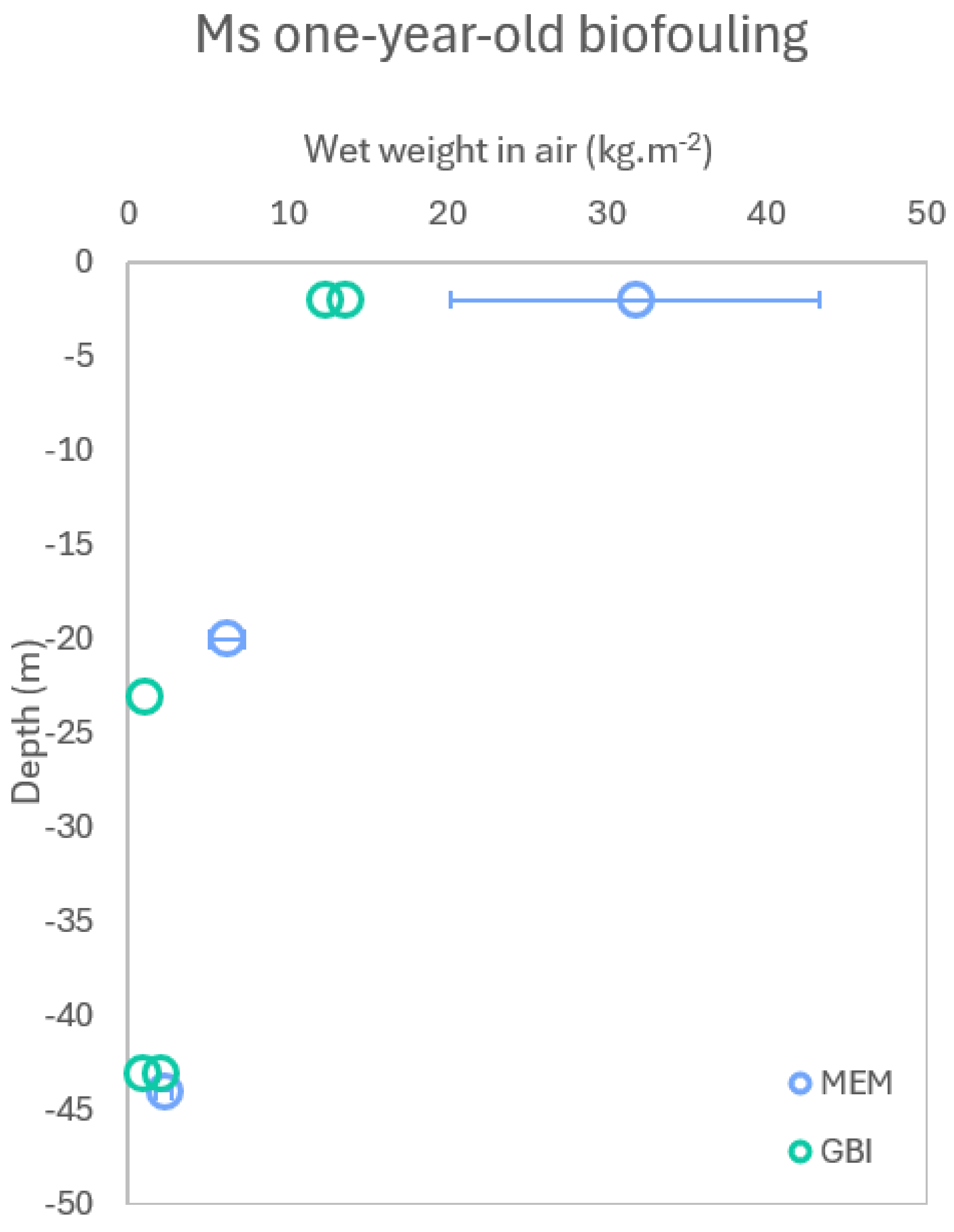

- After *one-year of immersion*
- Global ↘ with increasing depth
- Weight variation tended to decrease along depth
- More data needed to confirm the trend

Biofouling variability – density ~ depth & sites

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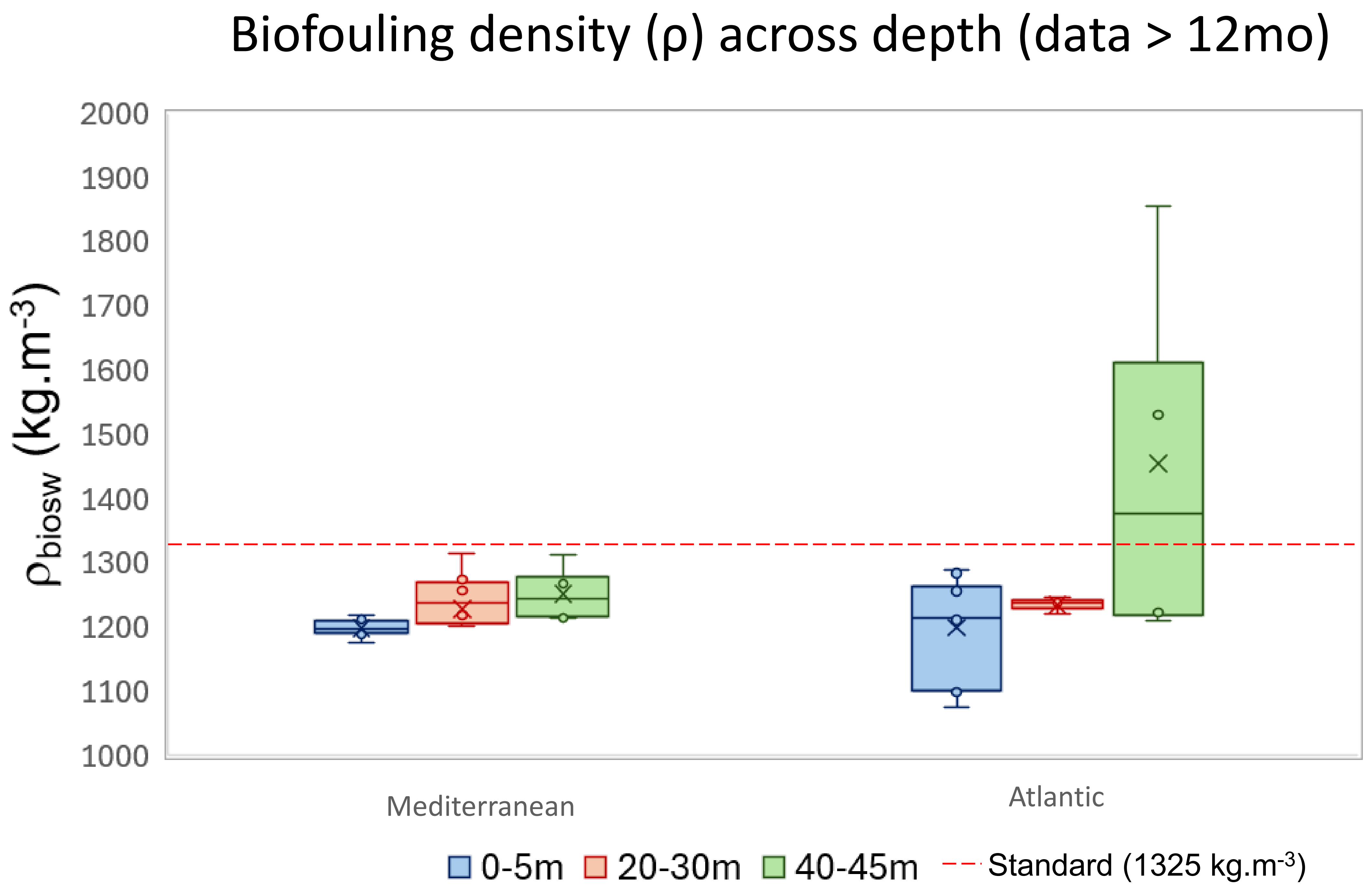
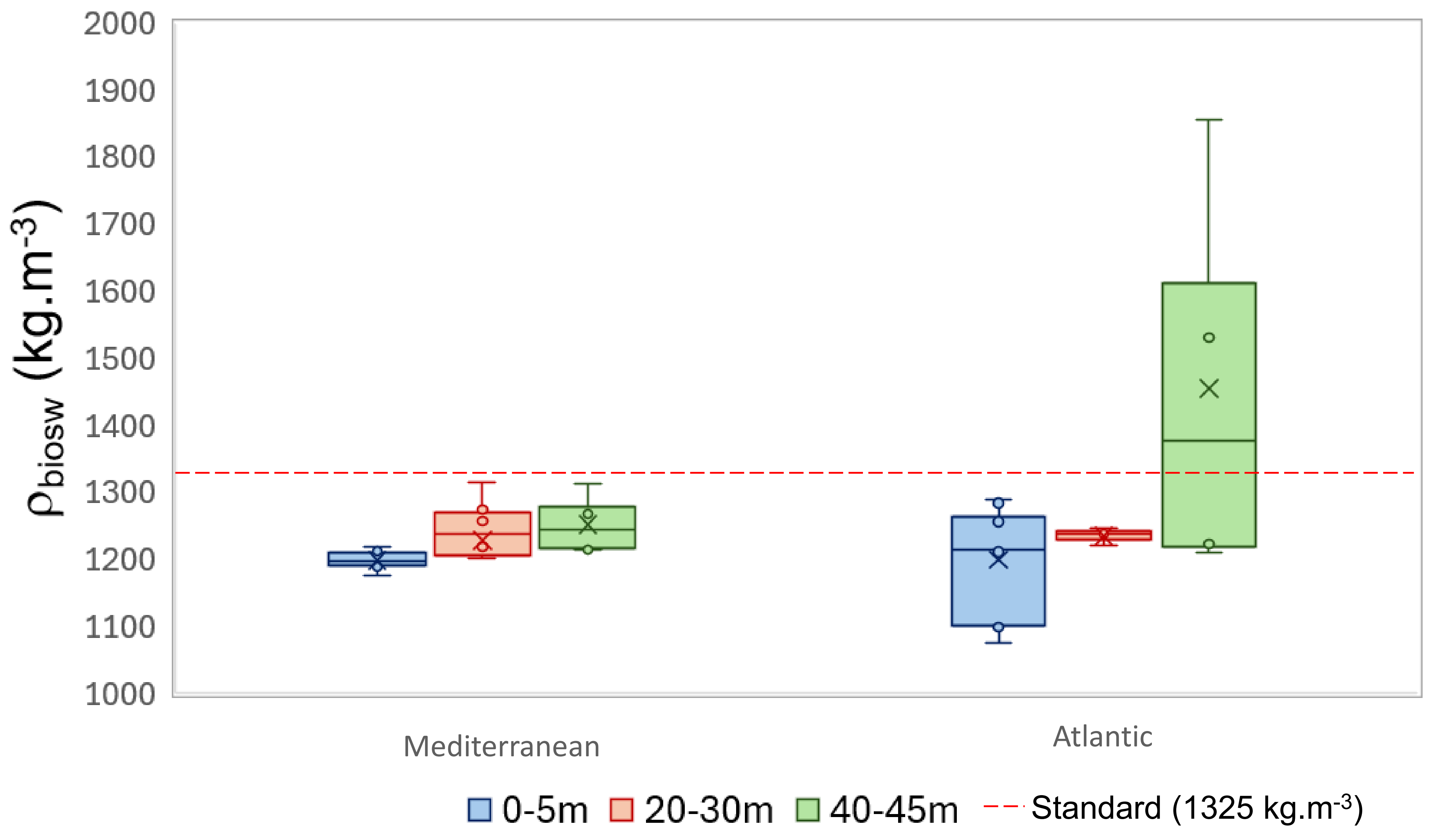


Biofouling variability – density ~ depth & sites

Biofouling density (ρ) across depth (data > 12mo)



- Biofouling density globally lower than value provided by standards
- Biofouling density @40m in Atlantic: sensitivity of the measure when biofouling amount is low
- Density ↗ with water depth (tendency, not significant)
- Overall mean biofouling density is 1 215 $kg.m^{-3}$

Biofouling variability – diversity ~ time

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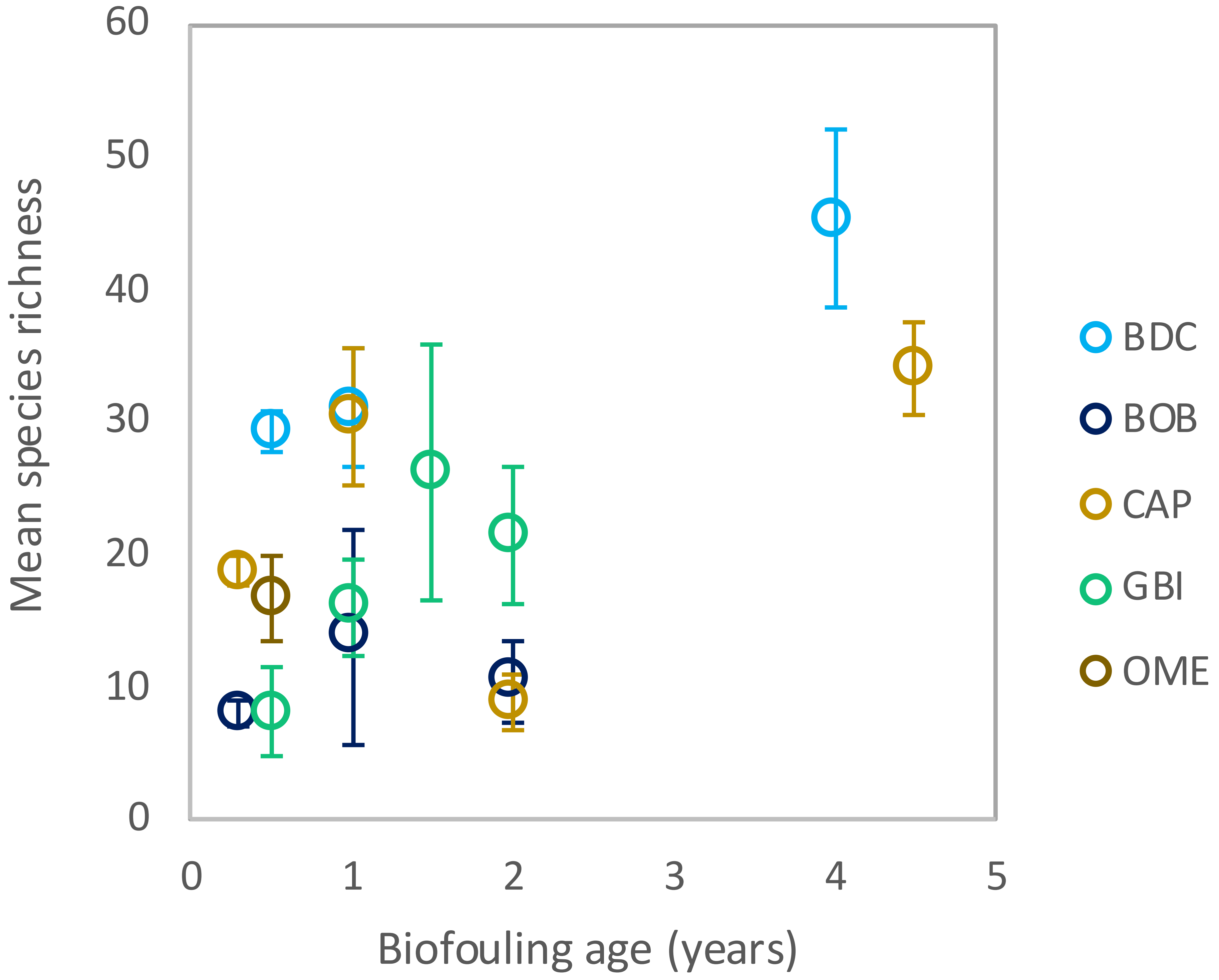

Biofouling variability – diversity ~ time

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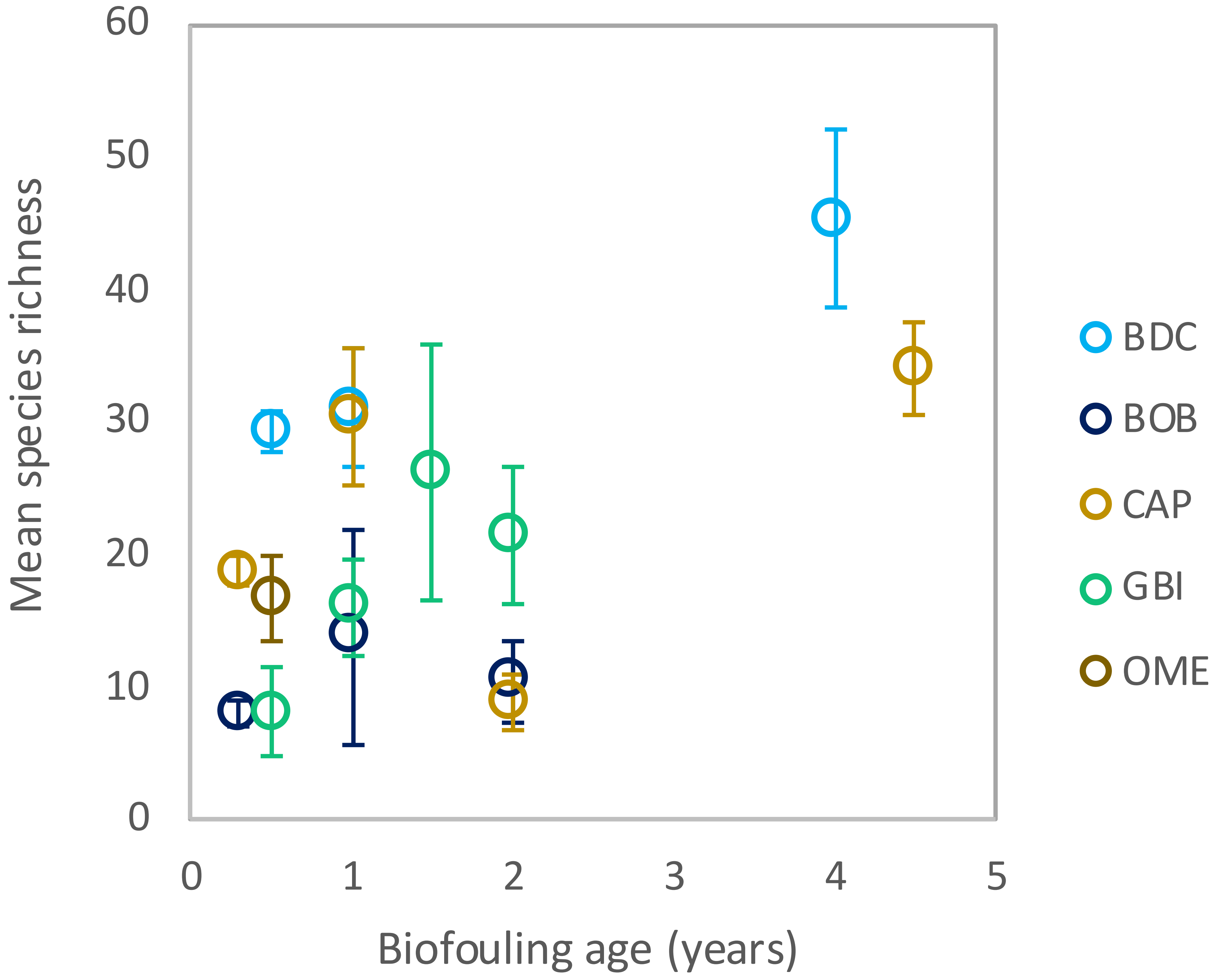

- Mean S varied between 8.0 (± 1.0) and 45.3 (± 6.6)
- Mean S ↗ along time
- Decrease at 2 years for CAP, BOB and BDC: step in the succession

Biofouling variability – diversity ~ time & depth

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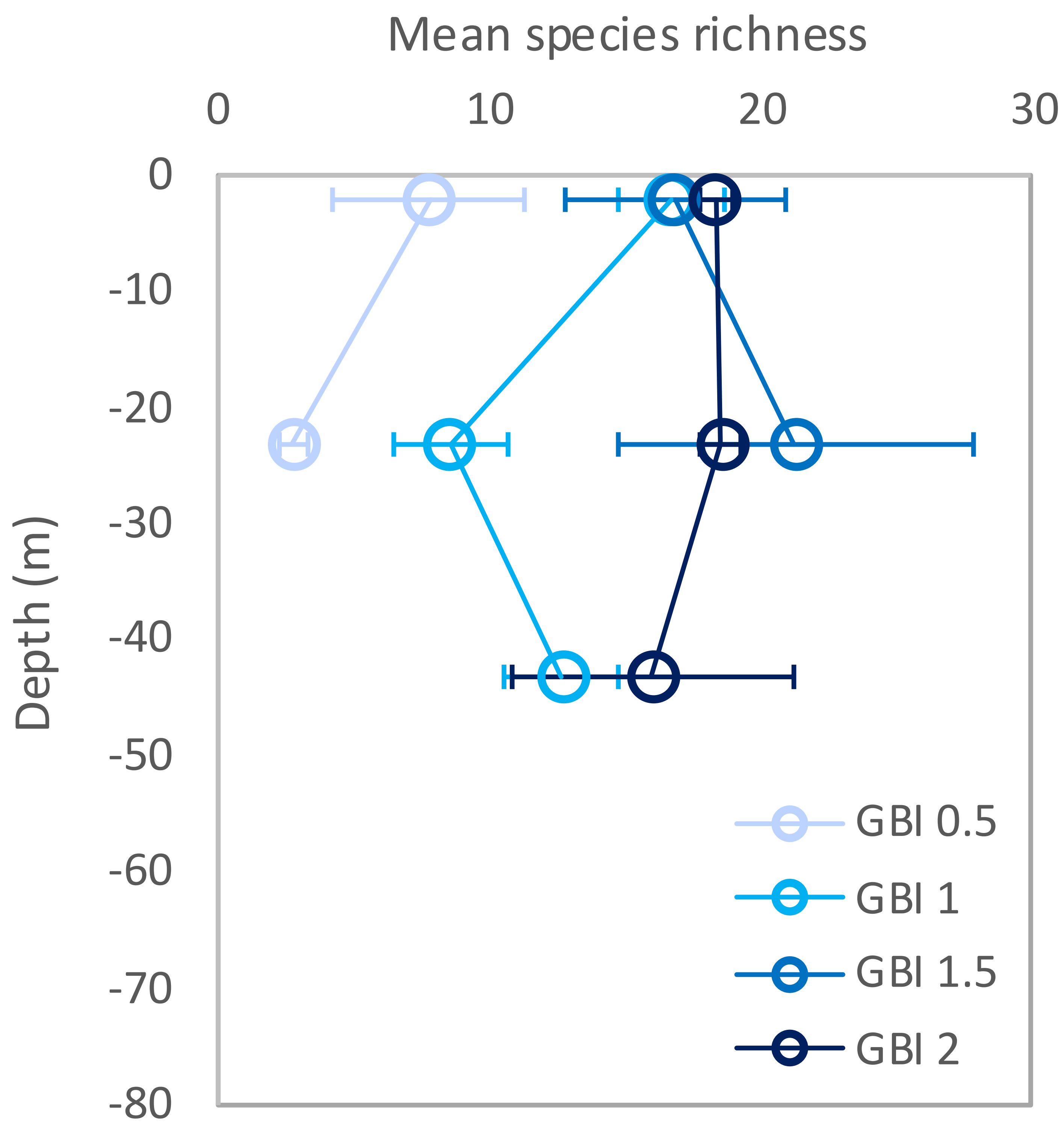
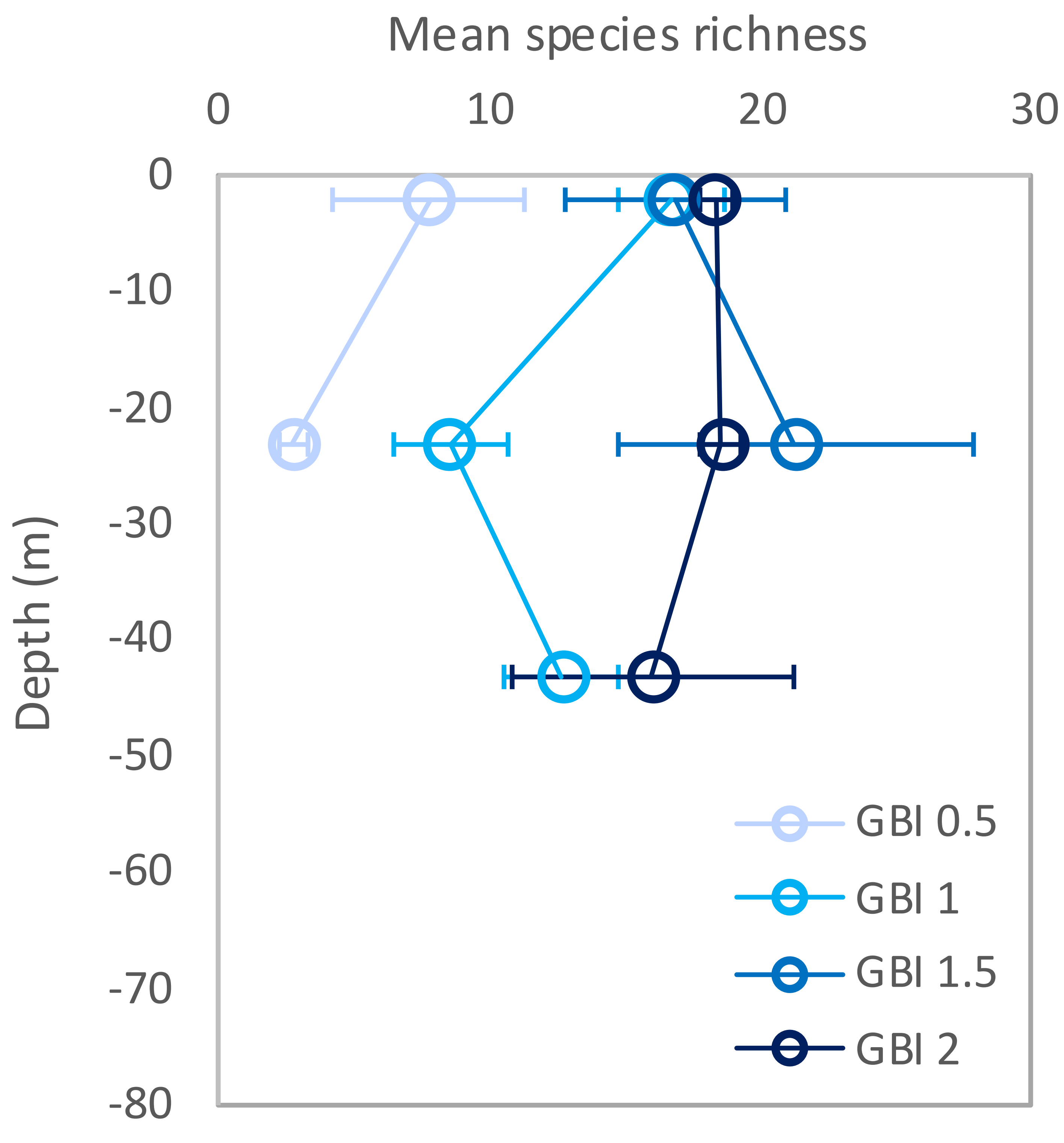


Biofouling variability – diversity ~ time & depth



- Patterns observed differed depending on the age of the biofouling

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Community structure at long-term monitoring site: BDC

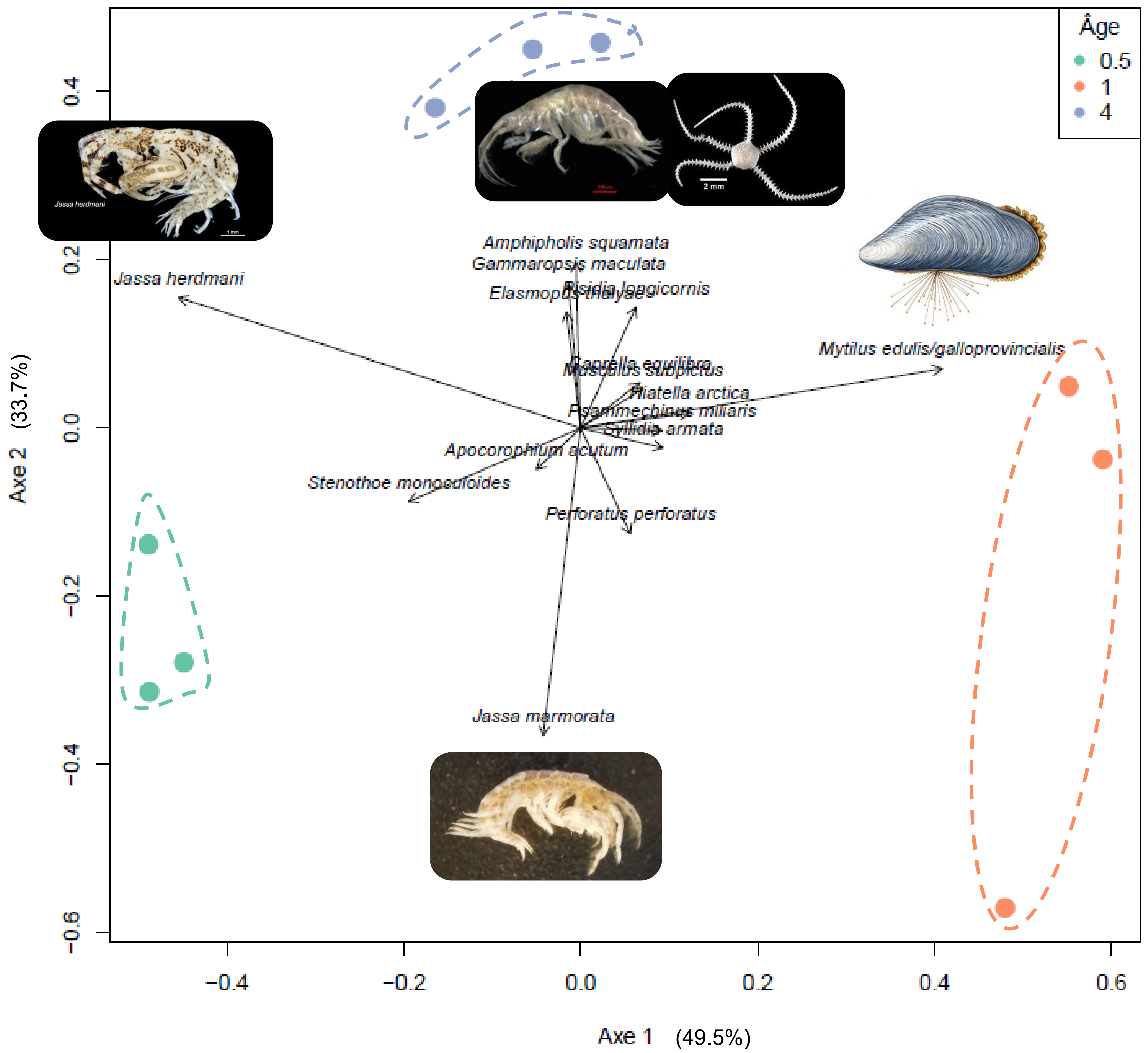
→ Change in community structure over time

→ Different species drive the structure

6 mo.

1 y.

4 y.



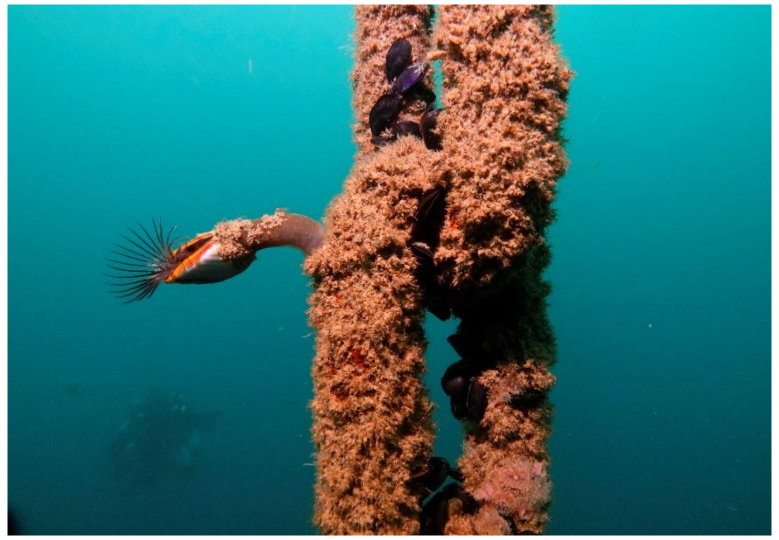
Biofouling variability – overview of the diversity











Biofouling variability – overview of the diversity

Jassa marmorata © C. Frejefond

Amphipholis squamata © L. Pinsivy

Caprella equilibra © L. Pinsivy

Jassa spp. and their tubes © L. Pinsivy

Phyllodoce madeirensis © L. Pinsivy

Pachygrapsus marmoratus © C. Frejefond

Musculus subpictus © C. Frejefond

Take home messages and perspectives

- Design of **sampling devices adapted** to dynamic offshore environment and at different depths

Take home messages and perspectives

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- Biofouling **wet mass ↗ over time** (to reach a probable dynamic equilibrium) and **↘ along depth**
- Biofouling **density** tended to decrease with depth and **varied across sites**
- Biofouling **species richness ↗ over time**
- Biofouling **community structure changed over time** with the general succession: *Jassa* spp. → *Mytilus* → species associated with *Mytilus*

Take home messages and perspectives

- Design of **sampling devices adapted** to dynamic offshore environment and at different depths
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- Biofouling **species richness ↗ over time**
- Biofouling **community structure changed over time** with the general succession: *Jassa* spp. → *Mytilus* → species associated with *Mytilus*
- Acquisition of **robust quantitative data** on two façades of interest for offshore wind: Atlantic and Mediterranean (~ depth & ~ time)
- The deployment of BIODHYL **devices is relevant for environmental characterization phases** to refine structure design to specific site and to measure part of the reef effect

Take home messages and perspectives

→ Use this approach **more offshore** and at **larger spatial scale** to measure biofouling potential

→ Need for **longer-term surveys** (identification of succession steps, effect of climate change)

→ Gain data on biofouling communities **within OWF** by developing adapted methodological approaches

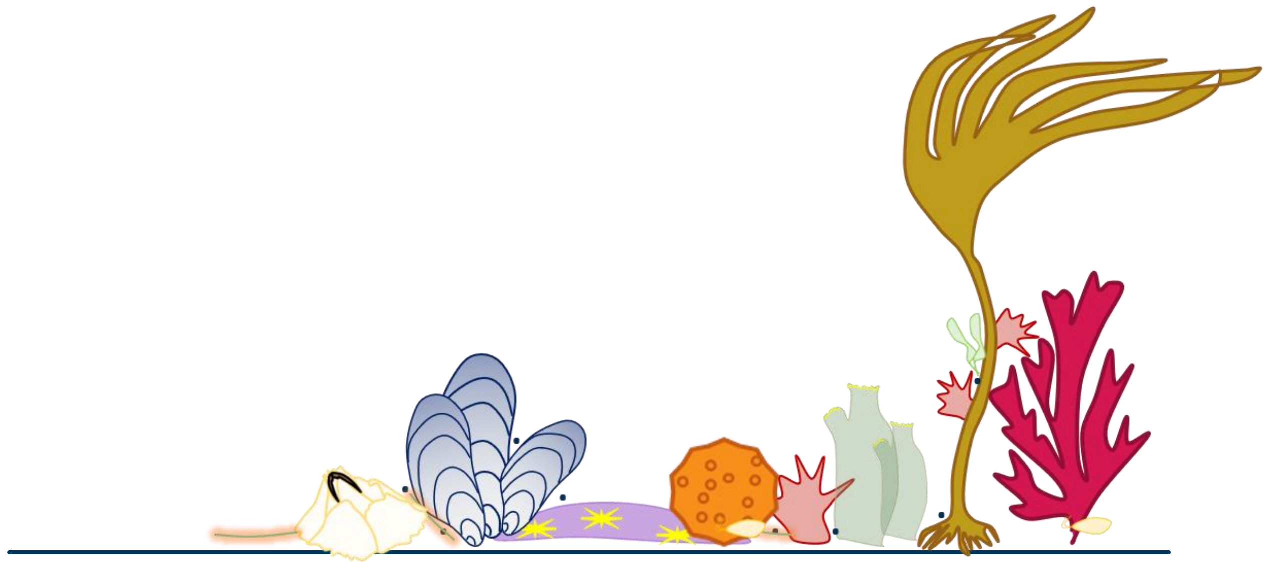
→ Development towards a **tool integrating variability and uncertainty** for design

→ Extend the biodiversity surveys to **biocolonisation**

Biofouling

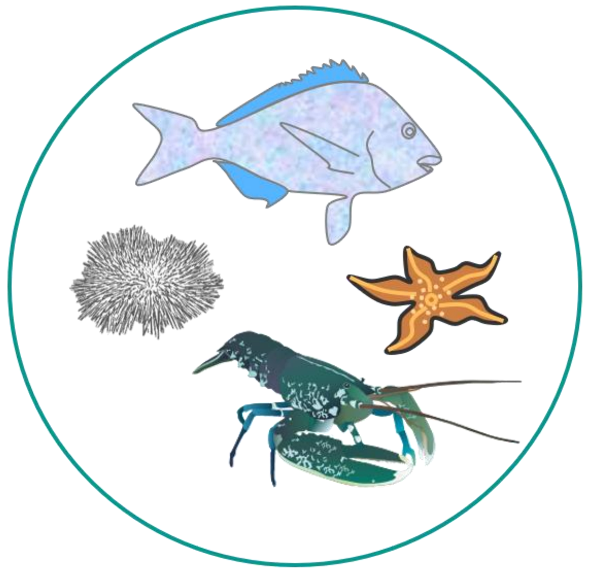
Also called *marine growth*

→ Organisms that develop and live attached to the structures



Mobile species

attracted by the structures and the biofouling (for food, habitat, reproduction site, refuge)



Biocolonisation

Also called *reef effect*

→ Biofouling + mobile species

ACKNOWLEDGMENTS

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This work is part of the BIODHYL project led by France Energies Marines, funded by the **French National Research Agency** (ANR-10-IEED-0006-34) and with partners **EDF Renouvelables**, **EOLFI/Shell**, Ifremer, **Ocean Winds**, **RTE**, **RWE**, **Total Energies**, **University of Toulon**. It also benefits from the financial support of **Bretagne**, **Pays de la Loire**, **Occitanie** and **Sud Regions**

- Co-authors: **Guillaume Damblans** and **Aurélie Portas** (postdoc at FEM & UTLN)
- **Partners** of the project
- Numerous colleagues at FEM & UTLN involved for field work, communication, material renting, management: **Lénaïg M.**, **Olivier B.**, **Jean-François B.**, **Olivier M.**, **Antoine M.**, **Alice**, **Romane**, **Grégoire**, **Benjamin**, **Mélusine**, **Vincent**, **Laetitia**, **Jean**, **Laure Ci.**, **Laure Co.**, **Jade**, **Yansong**, **Eva**
- Operations at sea: **Sensea, EXAIL, Ship As A Service**
- Taxonomic identification: **Lucas Pinsivy (independant)** and **Charlène Frejefond (BIOTOPE)**

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Thank you for your attention!