EU CONEXUS
European University for Smart Urban Coastal Sustainability

Klaipeda University
Marine Research Institute

THE INFLUENCE OF MATERIAL PROPERTIES ON THE RECRUITMENT OF BIOFOULING COMMUNITIES AND NON-INDIGENOUS SPECIES (NIS)

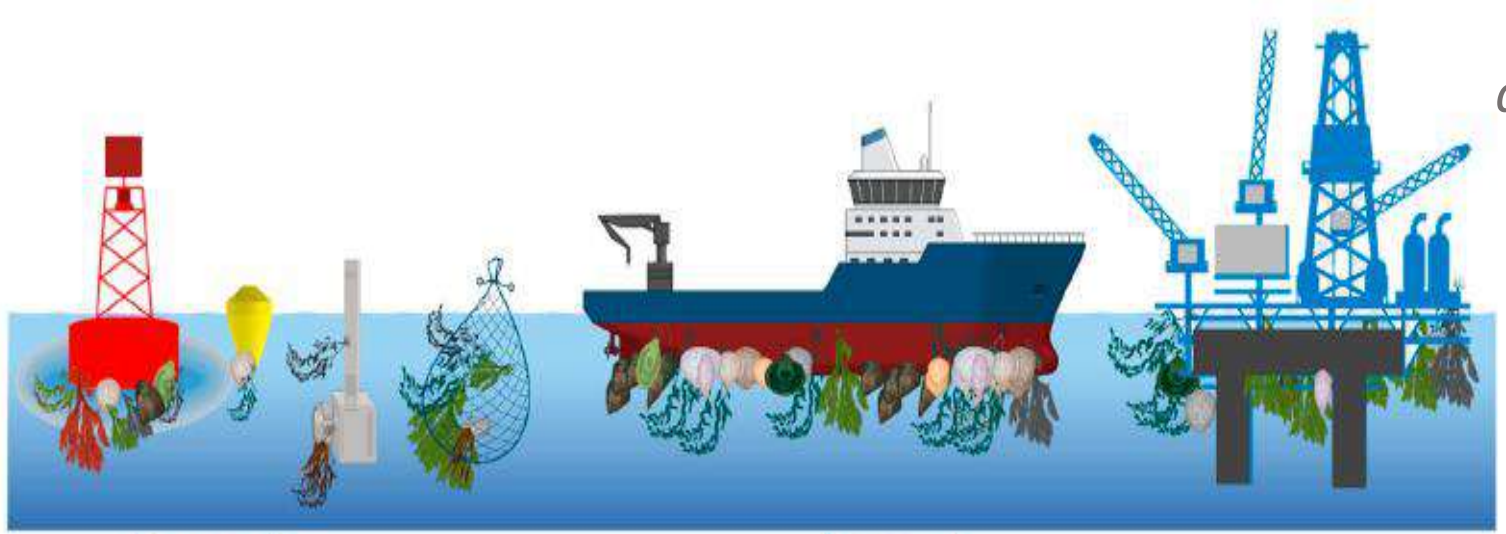
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24th International Conference on Aquatic Invasive Species (ICAIS), 23-27, August, 2026, Belfast, UK

(Oliveira & Granhag, 2016)

BIOFOULING: A STICKY PROBLEM



Decrease in

Heat transfer
Accuracy of measurements by submerged devices
Operational efficiency of propulsion, navigation, and water-intake equipment

Increase in

Hydrodynamic drag
Fuel consumption
Material corrosion
Management-intervention time
Costs related with cleaning, paint removal, and repainting
Marine species invasion
Air pollution and water contamination
Contamination of aquaculture facilities
Cyanobacterial blooms

(Alexande I., 2004, Romeu & Mergulhão, 2023)

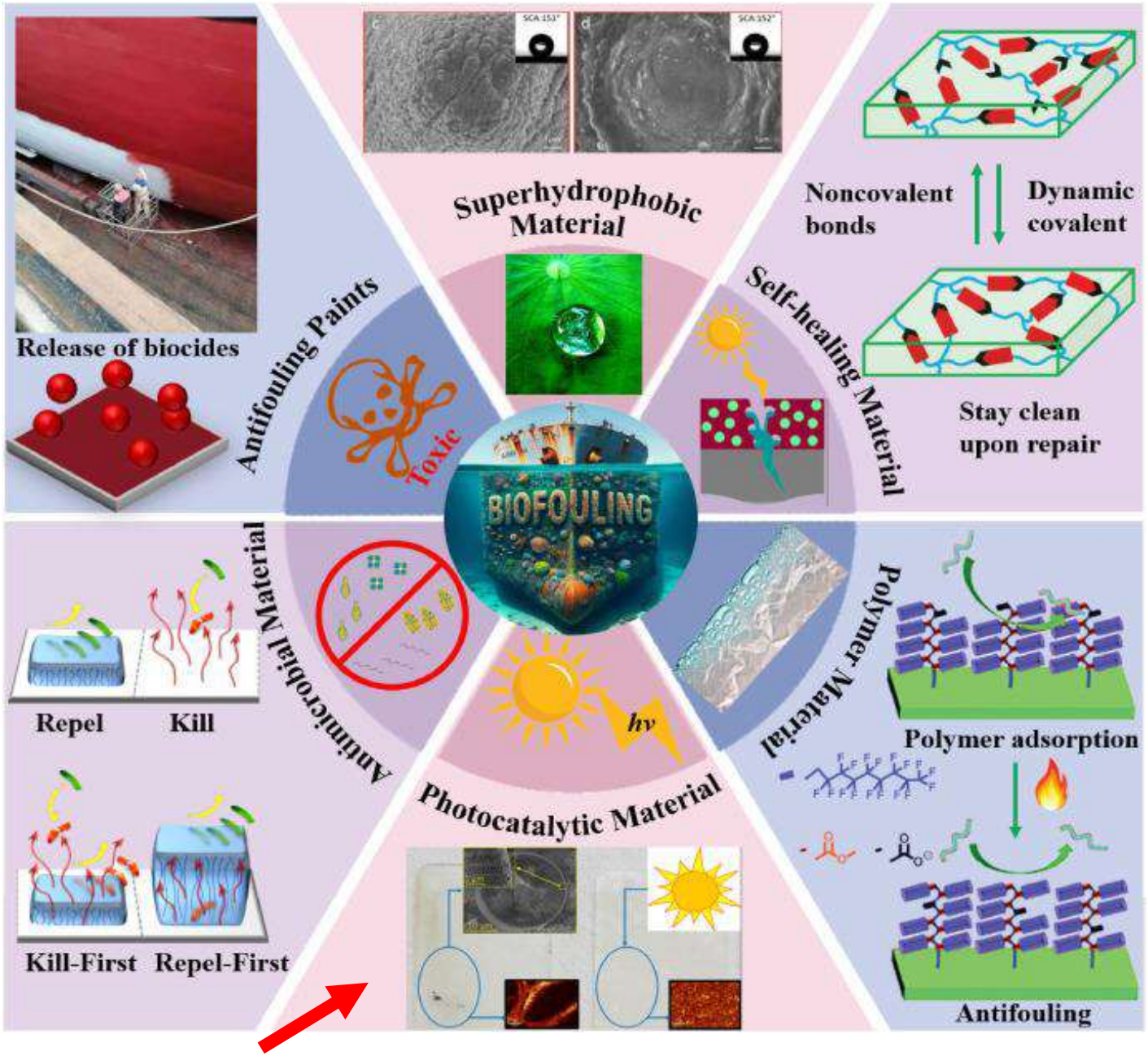
Biofouling refers to "*the undesirable accumulation of microorganisms, algae, plants, and animals on submerged structures, especially on ships' hulls*"

The global economic cost of biofouling across various sectors is estimated to range between **1.5 and 3 billion USD per year**

Globally, biofouling via ship hulls is estimated to be responsible for **56–70%** of established coastal/estuarine **non-indigenous species (NIS)**



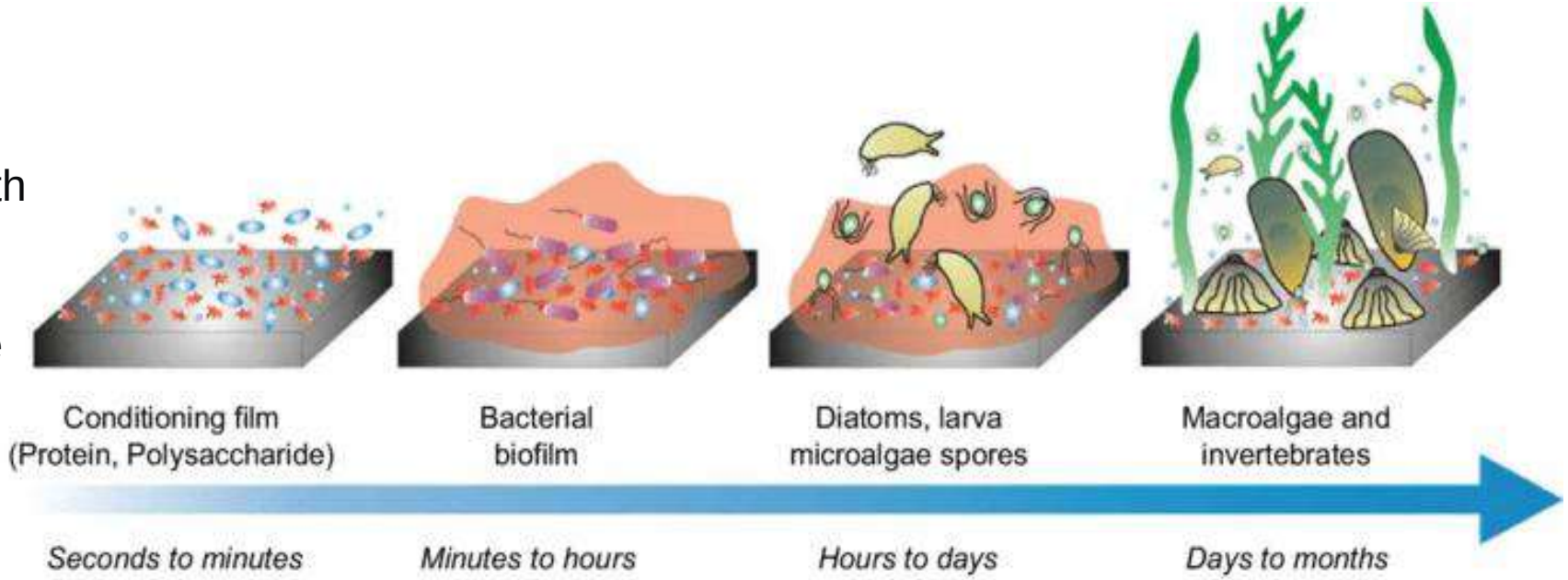
HOW TO "DEAL" WITH IT...



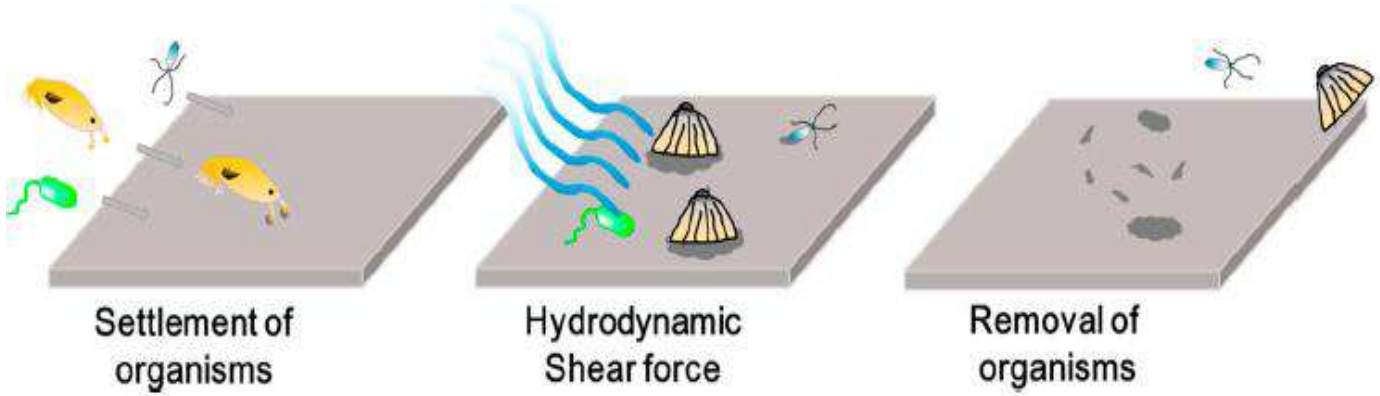
(Hong et al. 2024)

DO SURFACE CHARACTERISTICS INFLUENCE BIOFOULING?

- Surface properties, together with features of the fouling microorganisms, have a considerable **impact** on marine biofouling potential



- Marine organisms employ **strategies** to select surfaces for colonization



(Rosenhahn et al. 2012, Vijayan P. et al. 2021)

AIM OF THE STUDY

WHAT? *Assess the role of texture and surface properties in biofouling recruitment in the context of bioinvasions*

WHY? *to evaluate the effectiveness of surface and artificial nano-structured materials in recruiting biofouling organisms identifying approaches that minimize ecological impact*

HOW? *testing and analysing the new technology, focusing on the performance*



STUDY AREA

SMILTYNĖ MARINA – KLAIPĖDA – SPRING/SUMMER 2025



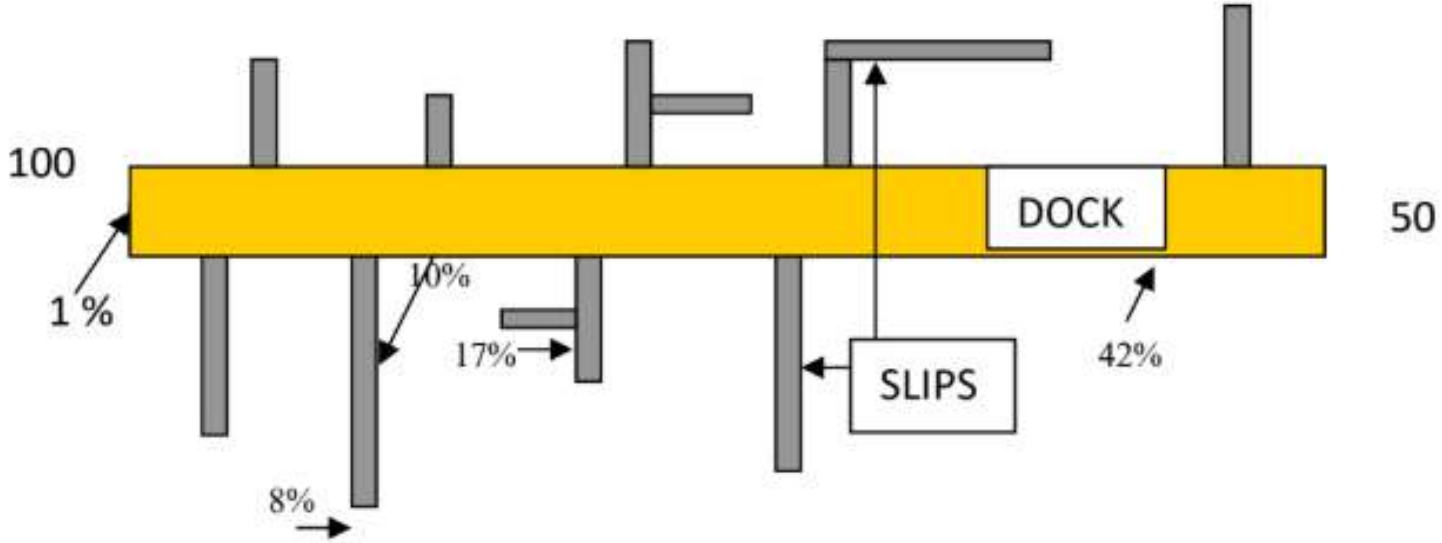
Salinity 0-6 PSU

Temperature 0-20 °C

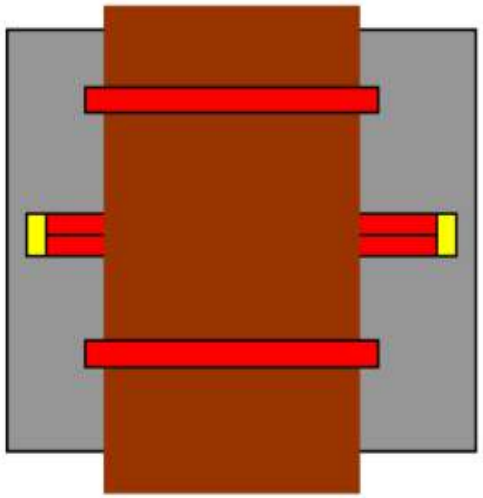


HOW?

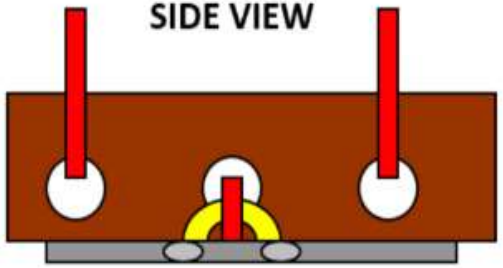
Using SERC (Smithsonian **E**nvironmental **R**esearch **C**enter**) protocol..**



14cm x 14cm



TOP VIEW



SIDE VIEW

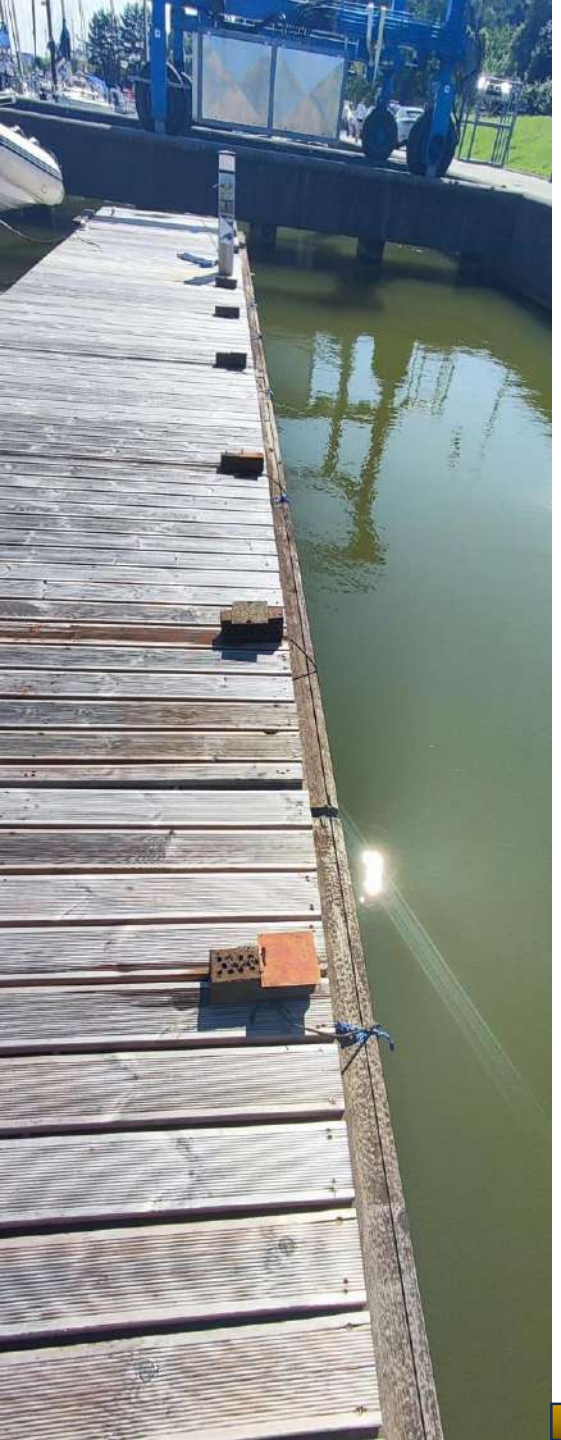
= Extra-large cable ties

= Large cable ties

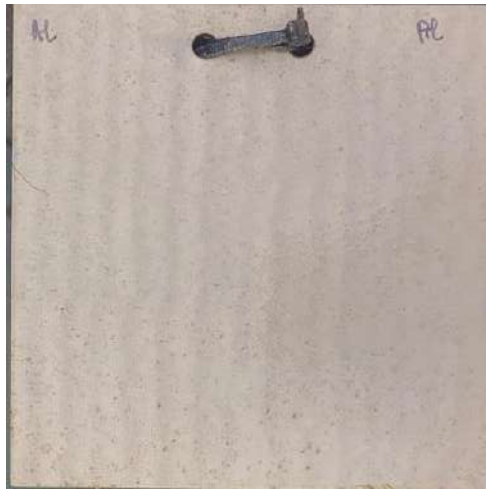
= Brick

= PVC plate









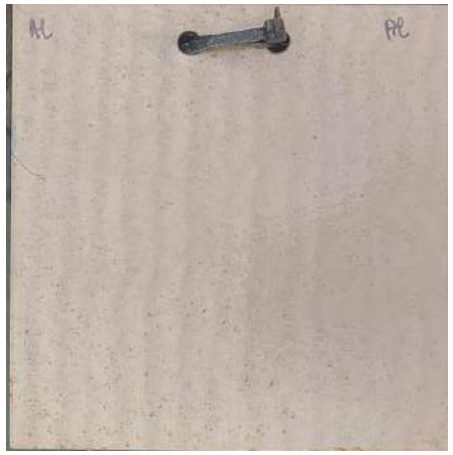


COPPER **ALUMINIUM** **BARE PVC**

	Chemically textured	Superhydrophobic coating	Chemically textured + Superhydrophobic coating
1.			
2.			
3.	1. Al–NaOH	1. Al+ZnO_{PMHS}	1. Al–NaOH+ZnO_{PMHS}
4.	2. Cu-$FeCl_3$	2. Cu+ZnO_{PMHS}	2. Cu–$FeCl_3$+ZnO_{PMHS}
5.		3. Al+OTS	3. Al–NaOH+OTS
6.		4. Cu+OTS	4. Cu–$FeCl_3$+OTS

..18 panels in tot.

Al 99,5% purity



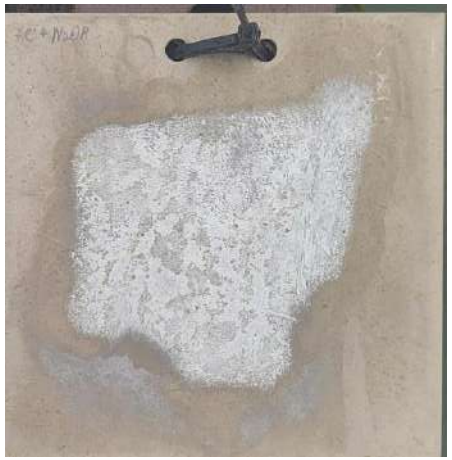
Al+ZnO$_{PMHS}$



Al+OTS



Al–NaOH



PVC



Al–NaOH+OTS



Al–NaOH+ZnO$_{PMHS}$



Cu



Plates after 4 weeks of immersion



Cu



AL



AL

…after 6 months



PVC

RESULTS...

PLATE_ID	M1_KL_LT	M2_KL_LT	M3_KL_LT	M4_KL_LT	M5_KL_LT	M6_KL_LT	A.1_KL_LT	A.2_KL_LT	A.3_KL_LT	A.4_KL_LT	A.5_KL_LT	A.7_KL_LT
SESSILE (P/A)												
Amphibalanus improvisus	1	1	1	1	1	1	1	1	1		1	
Dreissena polymorpha	1	1	1	1	1	1	1	1	1		1	
Cordylophora caspia	1	1	1	1	1	1	1	1	1		1	
Dreissena sp.	1	1		1	1		1	1	1		1	
Ciliate Stentor			1		1	1						
MOBILE												
Chironomidae	24	14	10	26	15	40	20	13	11	20	6	
Gammarus tigrinus	105	100	20	21	41	45						
Echinogammarus warpachowskyi				1								
Chelicorophium curvispinum	1				1							
Sinelobus sp.	1	4										1
Hydracarina	1	1			1	1					1	
Oligochaeta	8		4	7	8						5	4
Nematoda	2											3
Ostracoda	1											
Hydrobia sp.		1										
Radix balthica					1							
Idotea baltica							1					
Platyhelminthes												



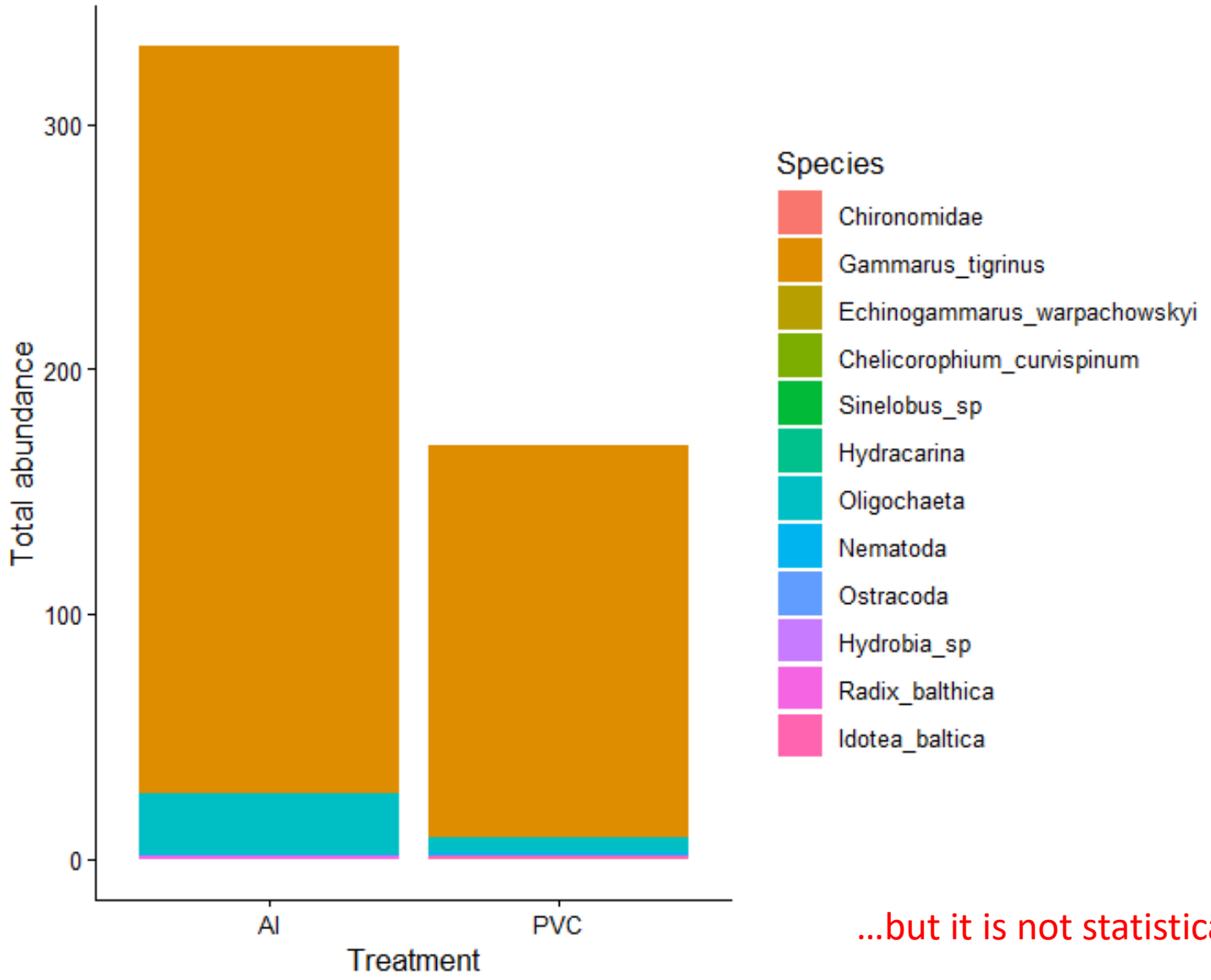
Dreissena polymorpha (Pallas, 1771)



Cordylophora caspia (Pallas, 1771)



Amphibalanus improvisus (Darwin, 1854)



Gammarus tigrinus Sexton, 1939



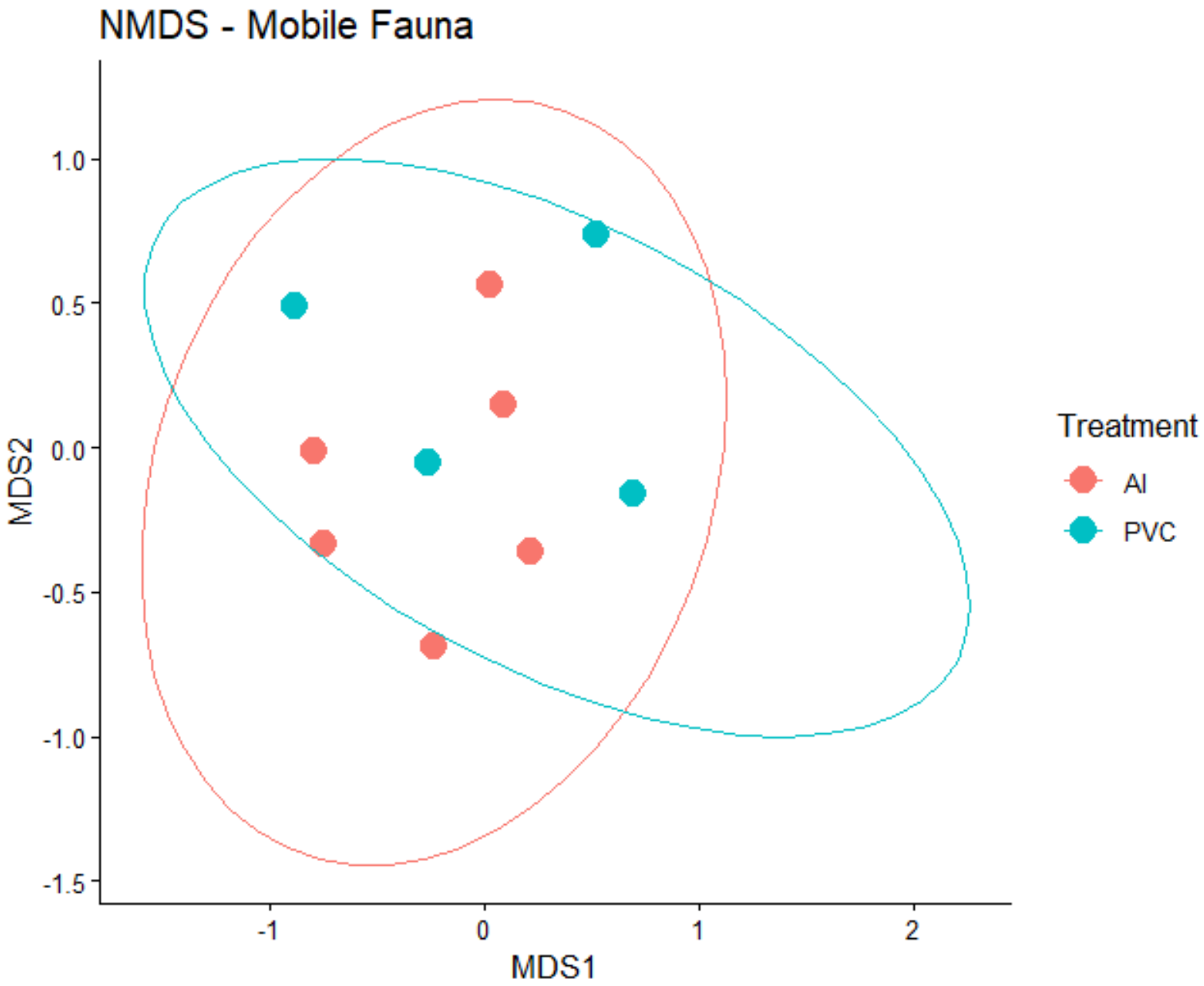
dominates both treatments

The community is driven by a **dominant colonizer**.

…but it is not statistically significant

There were **no distinct clustering** of Al and PVC samples.

The community composition is largely similar between treatments.



CONCLUSION

Pilot study

Preliminary data

further analyses are needed to evaluate the surface properties and the efficiency of the new nano-structures

- **NIS (7) are not only present but play a major ecological role** in structuring the fouling communities on the panels
- Sessile assemblages showed no response to treatment across any metric, likely due to limited taxonomic richness and low statistical power
- Differences between treatments in the mobile fauna were primarily driven by dominant taxa



WHAT'S NEXT…

- Deployed new **steel** plates this year 2026 featuring novel coatings and surface textures
- Plates will remain submerged for six months
- Evaluate the efficiency of the treatments in limiting biofouling





SVENCELĖ



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THANK YOU!
ANY QUESTIONS?

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OLAMUR

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