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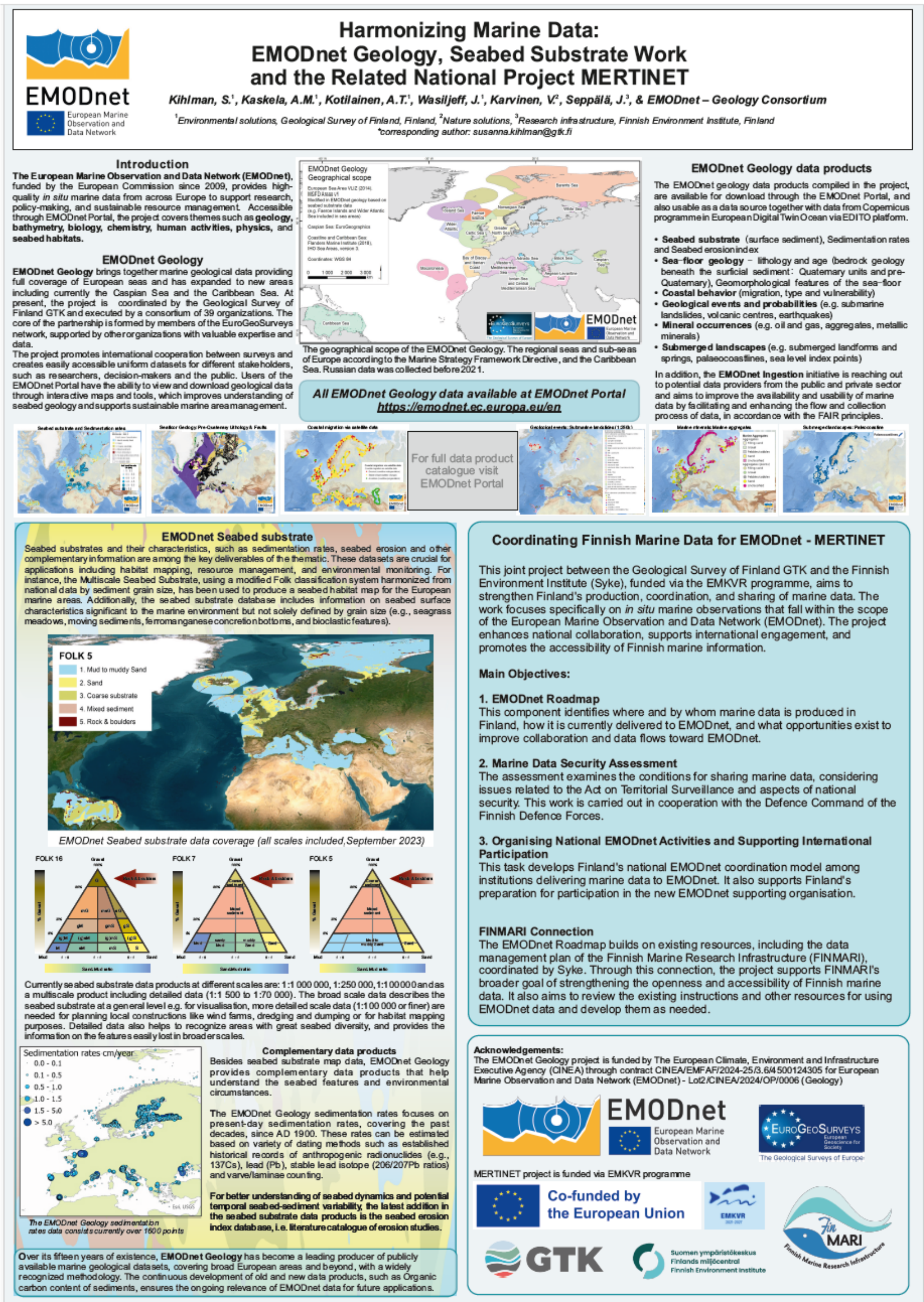
Harmonizing Marine Data: EMODnet Geology, Seabed Substrate Work and the Related National Project MERTINET

Authors: Kihlman, S., Kaskela, A.M., Kotilainen, A.T., Wasiljeff, J., Karvinen, V., & Seppälä, J.
Organizations: Geological survey of Finland GTK, Finnish Environment Institute SYKE

- ✓ EMODnet Geology provides harmonized marine geological data across Europe and Caribbean seas for diverse needs of the societies
- ✓ Multiscale seabed-substrate maps and complementary datasets provide essential environmental insight
- ✓ MERTINET strengthens Finland's marine data coordination and flow of marine data



Harmonizing Marine Data: EMODnet Geology, Seabed Substrate Work and the Related National Project MERTINET

Kihlman, S.[1], Kaskela, A.M.[1], Kotilainen, A.T.[1], Wasiljeff, J.[1], Karvinen, V.[2], Seppälä, J.[3], & EMODnet – Geology Consortium

[1]Environmental solutions, Geological Survey of Finland, Finland, [2]Nature solutions, [3]Research infrastructure, Finnish Environment Institute, Finland
**corresponding author: susanna.kihlman@gtk.fi*

Introduction

The European Marine Observation and Data Network (EMODnet), funded by the European Commission since 2009, provides high-quality *in situ* marine data from across Europe to support research, policy-making, and sustainable resource management. Accessible through EMODnet Portal, the project covers themes such as **geology, bathymetry, biology, chemistry, human activities, physics,** and **seabed habitats.**

EMODnet Geology

EMODnet Geology brings together marine geological data providing full coverage of European seas and has expanded to new areas including currently the Caspian Sea and the Caribbean Sea. At present, the project is coordinated by the Geological Survey of Finland GTK and executed by a consortium of 39 organizations. The core of the partnership is formed by members of the EuroGeoSurveys network, supported by other organizations with valuable expertise and data.

The project promotes international cooperation between surveys and creates easily accessible uniform datasets for different stakeholders, such as researchers, decision-makers and the public. Users of the EMODnet Portal have the ability to view and download geological data through interactive maps and tools, which improves understanding of seabed geology and supports sustainable marine area management.

The geographical scope of the EMODnet Geology. The regional seas and sub-seas of Europe according to the Marine Strategy Framework Directive, and the Caribbean Sea. Russian data was collected before 2021.

All EMODnet Geology data available at EMODnet Portal
https://emodnet.ec.europa.eu/en

EMODnet Geology data products

The EMODnet geology data products compiled in the project, are available for download through the EMODnet Portal, and also usable as a data source together with data from Copernicus programme in European Digital Twin Ocean via EDITO platform.

- **Seabed substrate** (surface sediment), Sedimentation rates and Seabed erosion index
- **Sea-floor geology** – lithology and age (bedrock geology beneath the surficial sediment: Quaternary units and pre-Quaternary), Geomorphological features of the sea-floor
- **Coastal behavior** (migration, type and vulnerability)
- **Geological events and probabilities** (e.g. submarine landslides, volcanic centres, earthquakes)
- **Mineral occurrences** (e.g. oil and gas, aggregates, metallic minerals)
- **Submerged landscapes** (e.g. submerged landforms and springs, palaeocoastlines, sea level index points)

In addition, the **EMODnet Ingestion** initiative is reaching out to potential data providers from the public and private sector and aims to improve the availability and usability of marine data by facilitating and enhancing the flow and collection process of data, in accordance with the FAIR principles.

For full data product catalogue visit EMODnet Portal

EMODnet Seabed substrate

Seabed substrates and their characteristics, such as sedimentation rates, seabed erosion and other complementary information are among the key deliverables of the thematic. These datasets are crucial for applications including habitat mapping, resource management, and environmental monitoring. For instance, the Multiscale Seabed Substrate, using a modified Folk classification system harmonized from national data by sediment grain size, has been used to produce a seabed habitat map for the European marine areas. Additionally, the seabed substrate database includes information on seabed surface characteristics significant to the marine environment but not solely defined by grain size (e.g., seagrass meadows, moving sediments, ferromanganese concretion bottoms, and bioclastic features).

FOLK 5: 1. Mud to muddy Sand; 2. Sand; 3. Coarse substrate; 4. Mixed sediment; 5. Rock & boulders

EMODnet Seabed substrate data coverage (all scales included, September 2023)

FOLK 16 / FOLK 7 / FOLK 5

Currently seabed substrate data products at different scales are: 1:1 000 000, 1:250 000, 1:100 000 and as a multiscale product including detailed data (1:1 500 to 1:70 000). The broad scale data describes the seabed substrate at a general level e.g. for visualisation, more detailed scale data (1:100 000 or finer) are needed for planning local constructions like wind farms, dredging and dumping or for habitat mapping purposes. Detailed data also helps to recognize areas with great seabed diversity, and provides the information on the features easily lost in broader scales.

Sedimentation rates cm/year: 0.0 - 0.1; 0.1 - 0.5; 0.5 - 1.0; 1.0 - 1.5; 1.5 - 5.0; > 5.0

The EMODnet Geology sedimentation rates data consists currently over 1600 points

Complementary data products

Besides seabed substrate map data, EMODnet Geology provides complementary data products that help understand the seabed features and environmental circumstances.

The EMODnet Geology sedimentation rates focuses on present-day sedimentation rates, covering the past decades, since AD 1900. These rates can be estimated based on variety of dating methods such as established historical records of anthropogenic radionuclides (e.g., 137Cs), lead (Pb), stable lead isotope (206/207Pb ratios) and varve/laminae counting.

For better understanding of seabed dynamics and potential temporal seabed-sediment variability, the latest addition in the seabed substrate data products is the seabed erosion index database, i.e. literature catalogue of erosion studies.

Over its fifteen years of existence, **EMODnet Geology** has become a leading producer of publicly available marine geological datasets, covering broad European areas and beyond, with a widely recognized methodology. The continuous development of old and new data products, such as Organic carbon content of sediments, ensures the ongoing relevance of EMODnet data for future applications.

Coordinating Finnish Marine Data for EMODnet - MERTINET

This joint project between the Geological Survey of Finland GTK and the Finnish Environment Institute (Syke), funded via the EMKVR programme, aims to strengthen Finland's production, coordination, and sharing of marine data. The work focuses specifically on *in situ* marine observations that fall within the scope of the European Marine Observation and Data Network (EMODnet). The project enhances national collaboration, supports international engagement, and promotes the accessibility of Finnish marine information.

Main Objectives:

1. EMODnet Roadmap
This component identifies where and by whom marine data is produced in Finland, how it is currently delivered to EMODnet, and what opportunities exist to improve collaboration and data flows toward EMODnet.

2. Marine Data Security Assessment
The assessment examines the conditions for sharing marine data, considering issues related to the Act on Territorial Surveillance and aspects of national security. This work is carried out in cooperation with the Defence Command of the Finnish Defence Forces.

3. Organising National EMODnet Activities and Supporting International Participation
This task develops Finland's national EMODnet coordination model among institutions delivering marine data to EMODnet. It also supports Finland's preparation for participation in the new EMODnet supporting organisation.

FINMARI Connection
The EMODnet Roadmap builds on existing resources, including the data management plan of the Finnish Marine Research Infrastructure (FINMARI), coordinated by Syke. Through this connection, the project supports FINMARI's broader goal of strengthening the openness and accessibility of Finnish marine data. It also aims to review the existing instructions and other resources for using EMODnet data and develop them as needed.

Acknowledgements:
The EMODnet Geology project is funded by The European Climate, Environment and Infrastructure Executive Agency (CINEA) through contract CINEA/EMFAF/2024-25/3.6/4500124305 for European Marine Observation and Data Network (EMODnet) - Lot2/CINEA/2024/OP/0006 (Geology)

MERTINET project is funded via EMKVR programme

Co-funded by the European Union

A WEB-BASED TOOL FOR THE EFFECTIVE INTEGRATION OF ECOSYSTEM FUNCTIONING INTO MARINE CONSERVATION AND SPATIAL PLANNING

Marie C. Nordström[1], F.R. Barboza[2], A. Kaasik[2], M. Fetissov[2], J. Kotta[2]

[1]Department of Env. Sciences, University of Helsinki
[2]Estonian Institute of Marine Research, University of Tartu

- ✓ Spatial analysis of biological communities and energy fluxes, aiding in assessments of how cumulative impacts and shifts in biodiversity translate into ecosystem functioning

Analysing Finnish Glider Data with unsupervised Machine Learning Algorithms

Kimmo Tikka, Ivia Closset, Laura Tuomi
Finnish Meteorological Institute

With increasing amount measured profiles we tried to answer a question:
"How do we identify (dis-)similar profiles of glider data?"
For this, we applied unsupervised learning methods to the glider data.

We may use our results to:

1) Quality check (glider) profiles data,
2) Find anomalies using several parameters,
3) Recognize dynamical changes in the ocean,
4) Evaluate ocean models,
5) Automate glider piloting and
6) Optimize data transmission

Analysing Finnish Glider Data with Unsupervised Machine Learning Algorithms

Kimmo Tikka[1], IviaClosset[1]andLauraTuomi[1]
1 Finnish Meteorological Institute, Marine Research, Helsinki, Finland

Introduction

The Baltic Sea is a shallow marginal sea with stratified brackish waters. It consists of consecutive sub-basins that are separated by underwater sills. The Central Baltic Sea's deep waters are in environmentally poor condition, but the basins of the Åland Sea and the Gulf of Bothnia are still ecologically healthy. Thus water exchange, especially deep water exchange is important. Since 2016, as a part of FMIs study on the water exchange between the underwater sills separated sub-basins of the Baltic Sea, we have deployed our Slocum G2 and Slocum G3 gliders for 11 up to one month and several hundreds of kilometres long missions in the Bothnian Sea area collection over 43000 profiles.

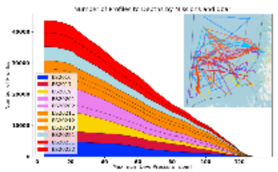


Figure 1:FMI glider missions in the Bothnian Sea.

Autonomous measurements with gliders and ARGO buoys produce the majority of oceanographic observations. Temporally and spatially dense measurements enable a more accurate picture of the state of the sea and subsurface processes. Huge datasets also give opportunities to improve the models in use. However, a large number of profiles means new challenges for quality control. Effective detection of dynamical processes and anomalies from vast datasets requires new processing methods.

Study area and data

Our research area is the Bothnian Sea, the Southern part of the Gulf of Bothnia. Regular monitoring stations are visited three to four times a year in the area. The intermediate, above the halocline waters, of the Baltic Proper usually flow to the North along the basins and are supposed to keep the deep waters of the Bothnian Sea fresh and healthy.

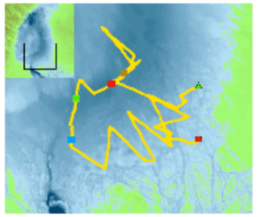


Figure 2:The Bothnian Sea and the path of the BS2019 mission. Profile sample positions marked with a square.

The path of our BS2019 mission first followed the southern slope of the Bothnian Sea's deep and the deep itself, collecting more than 6200 profiles of which we chose four groups of profiles with various profile shapes for further analysis.

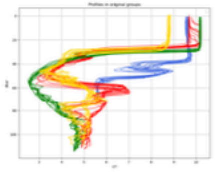


Figure 3:The groups of the study sample CT-profiles.

Methods

This study used unsupervised machine learning algorithms to cluster the profiles according to their shape. Our method, the Dynamic Time Warping (DTW) algorithm and KMeans clustering, has been widely recognized as an efficient but computationally extensive method for clustering.

Results

In cluster analysis, an important decision is how many clusters to use, which metrics and algorithm to use. In our limited test case, using 6 clusters gave satisfactory results. Groups 1 and 4 where classified into two clusters 1&3 and 2&5, and groups 2 and 3 dropped into clusters 4 and 0.

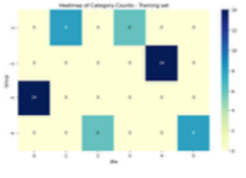


Figure 4:The heat map of the sample of 56 profiles.

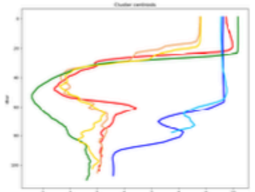


Figure 5:Cluster centroids with 6 clusters.

Using the centroids of the cluster, we can calculate distances between them and the profiles of the example segment.

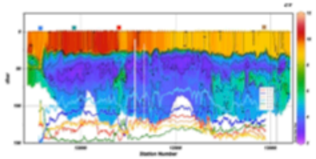


Figure 6:Sample segment of BS2019 and profiles dtw-distances to cluster centroids. Profile sample positions marked with a square.

Conlucions

Our use of KMeans clustering with DTW in analyzing glider datasets is a novel approach. Even with a small test sample and just six clusters, we were able to demonstrate how the profiles of an example segment can be meaningfully classified. This opens up exciting possibilities for further analysis, particularly with multivariate profiles of varying lengths.

Finnish Marine Research Infrastructure

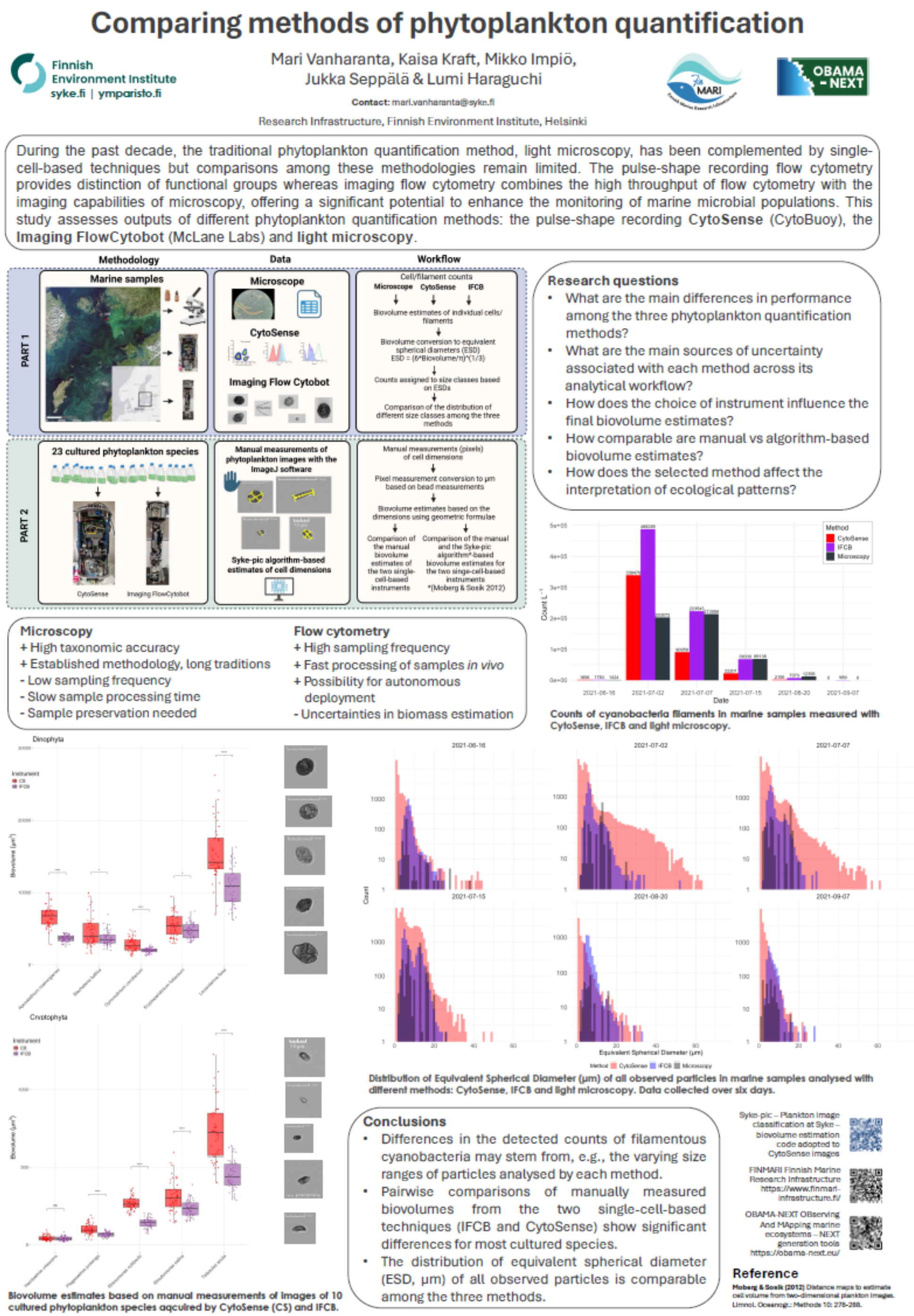
Comparing methods of phytoplankton quantification

Vanharanta M.[1], **Kraft K.**[1], **Impiö M.**[2], **Seppälä J.**[1], **Haraguchi L.**[1]

[1]Research Infrastructure, Finnish Environment Institute

[2]Quality of Information, Finnish Environment Institute

We compare cell counts, particle size distributions, and biovolume estimates obtained using **light microscopy**, **pulse-shape recording flow cytometry**, and **imaging flow cytometry**.



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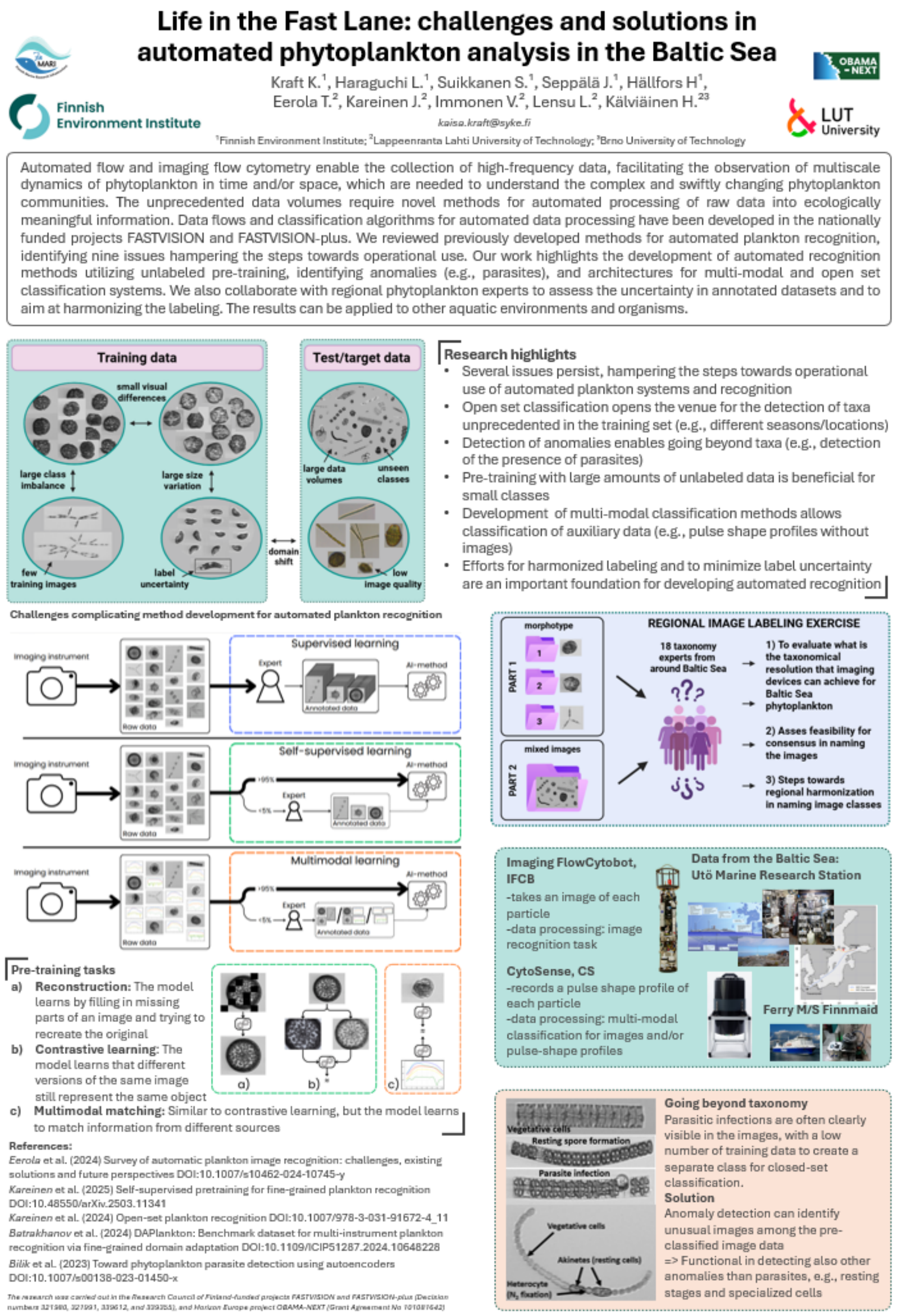
Life in the Fast Lane: challenges and solutions in automated phytoplankton analysis in the Baltic Sea

Kraft K.[1], Haraguchi L.[1], Suikkanen S.[1], Seppälä J.[1], Hällfors H[1], Eerola T.[2], Kareinen J.[2], Immonen V.[2], Lensu L.[2], Kälviäinen H.[23]

[1]Finnish Environment Institute; [2]Lappeenranta Lahti University of Technology; [3]Brno University of Technology

- ✓ Automated flow and imaging flow cytometry instruments enable the collection of novel high-frequency phytoplankton information
- ✓ Several issues persist, hampering the steps towards operational use of automated plankton observations and automated recognition
- ✓ Open set classification opens the venue for the detection of taxa unprecedented in the training set (e.g., different seasons/locations)
- ✓ Detection of anomalies enables going beyond taxa (e.g., detection of the presence of parasites)
- ✓ Pre-training with large amounts of unlabeled data is beneficial for small classes
- ✓ Development of multi-modal classification methods allows classification of auxiliary data (e.g., pulse shape profiles without images)
- ✓ Efforts for harmonized labeling and to minimize label uncertainty are an important foundation for developing automated recognition

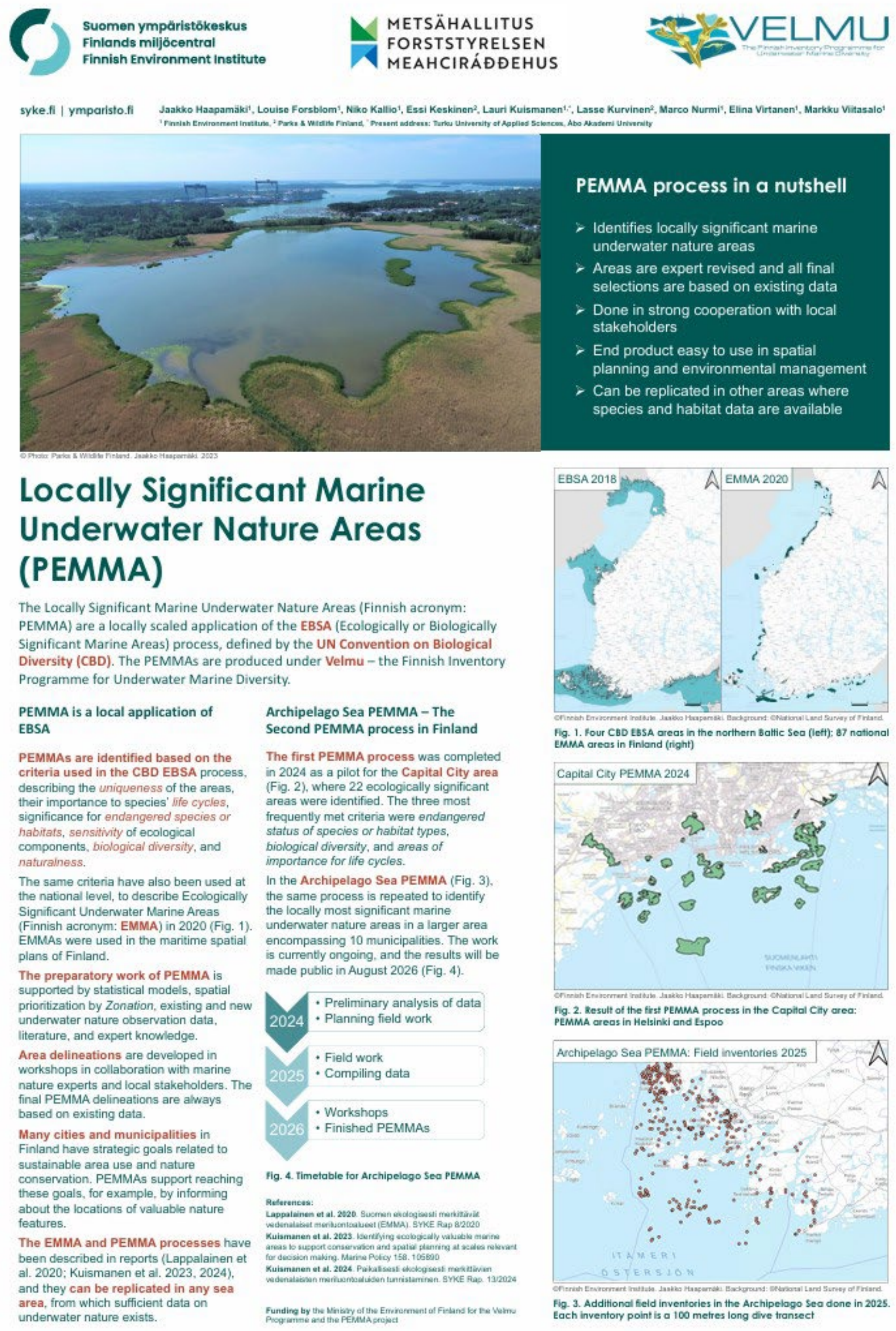


Locally Significant Marine Underwater Nature Areas (PEMMA)

Finnish Environment Institute

Parks & Wildlife Finland

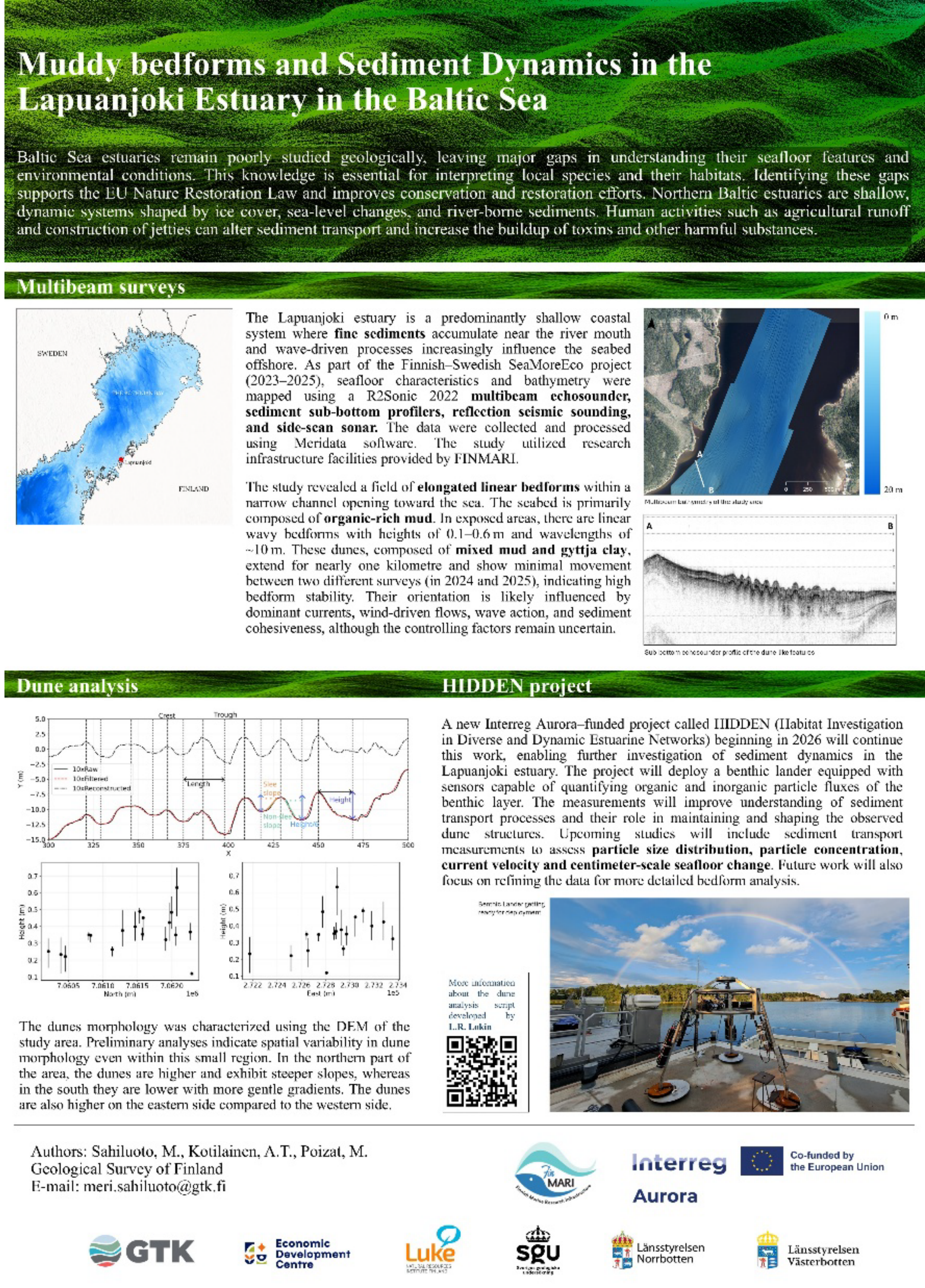
- ➢ Identifies locally significant marine underwater nature areas
- ➢ Areas are expert revised and all final selections are based on existing data
- ➢ Done in strong cooperation with local stakeholders
- ➢ End product easy to use in spatial planning and environmental management
- ➢ Can be replicated in other areas where species and habitat data are available



Muddy bedforms and Sediment Dynamics in the Lapuanjoki Estuary in the Baltic Sea

Meri Sahiluoto, Aarno Kotilainen, Marine Poizat
Geological Survey of Finland

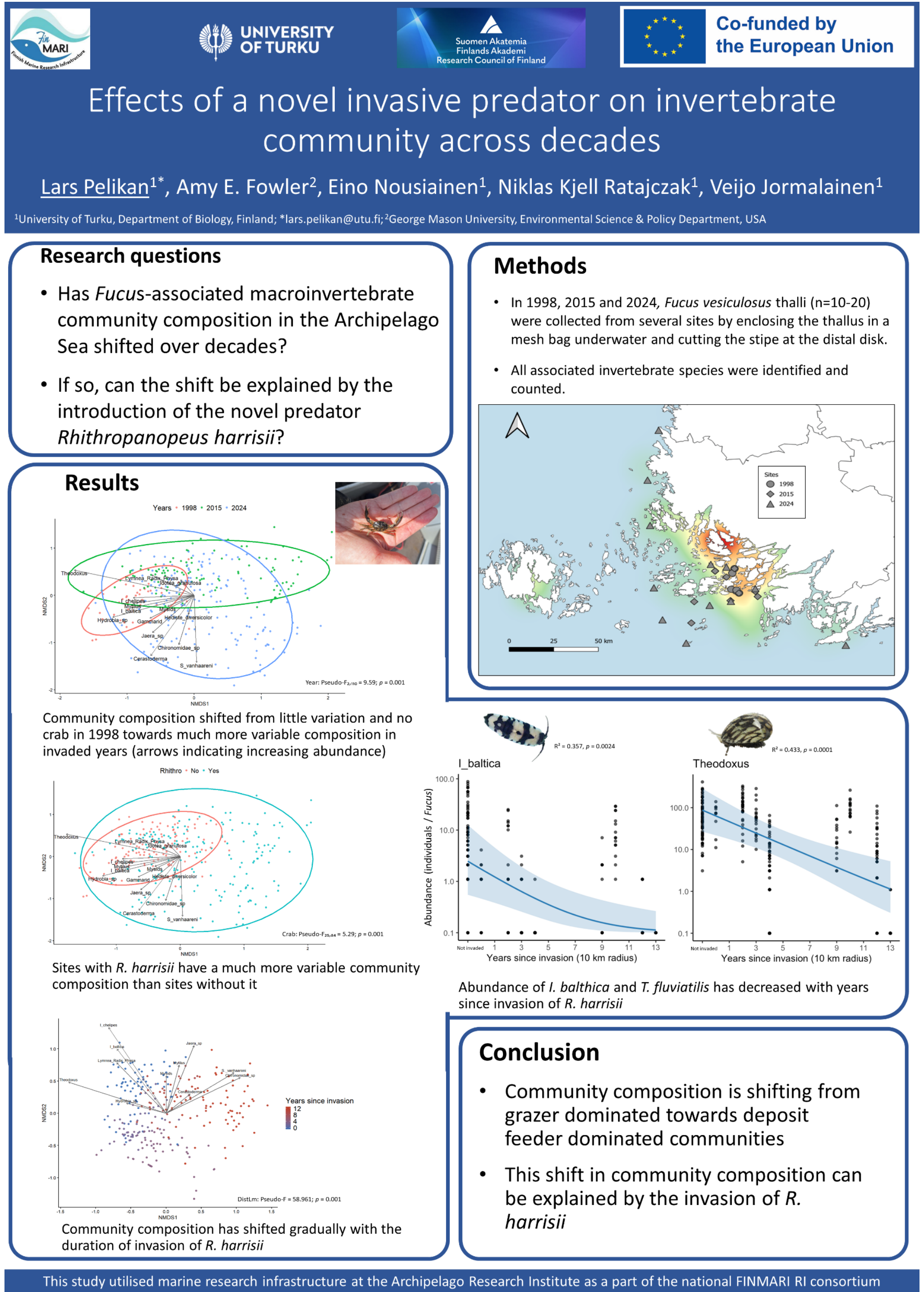
- ✓ Elongated muddy dune-like formations were revealed in the Lapuanjoki estuary during multibeam surveys
- ✓ Preliminary analyses show trends consistent with the bathymetry
- ✓ Further work requires detailed information on sediment transport
- ✓ The Interreg Aurora–funded HIDDEN project will continue this research using a benthic lander



Effects of a novel invasive predator on invertebrate community across decades

Lars Pelikan[1], Amy E. Fowler[2], Eino Nousiainen[1], Niklas Kjell Ratajczak[1], Veijo Jormalainen[1]
[1]University of Turku, Department of Biology, Vesilinnantie 5, FI-20014 Turku, Finland
[2]George Mason University, Environmental Science & Policy Department, 4400 University Drive, Fairfax, VA 22030, USA

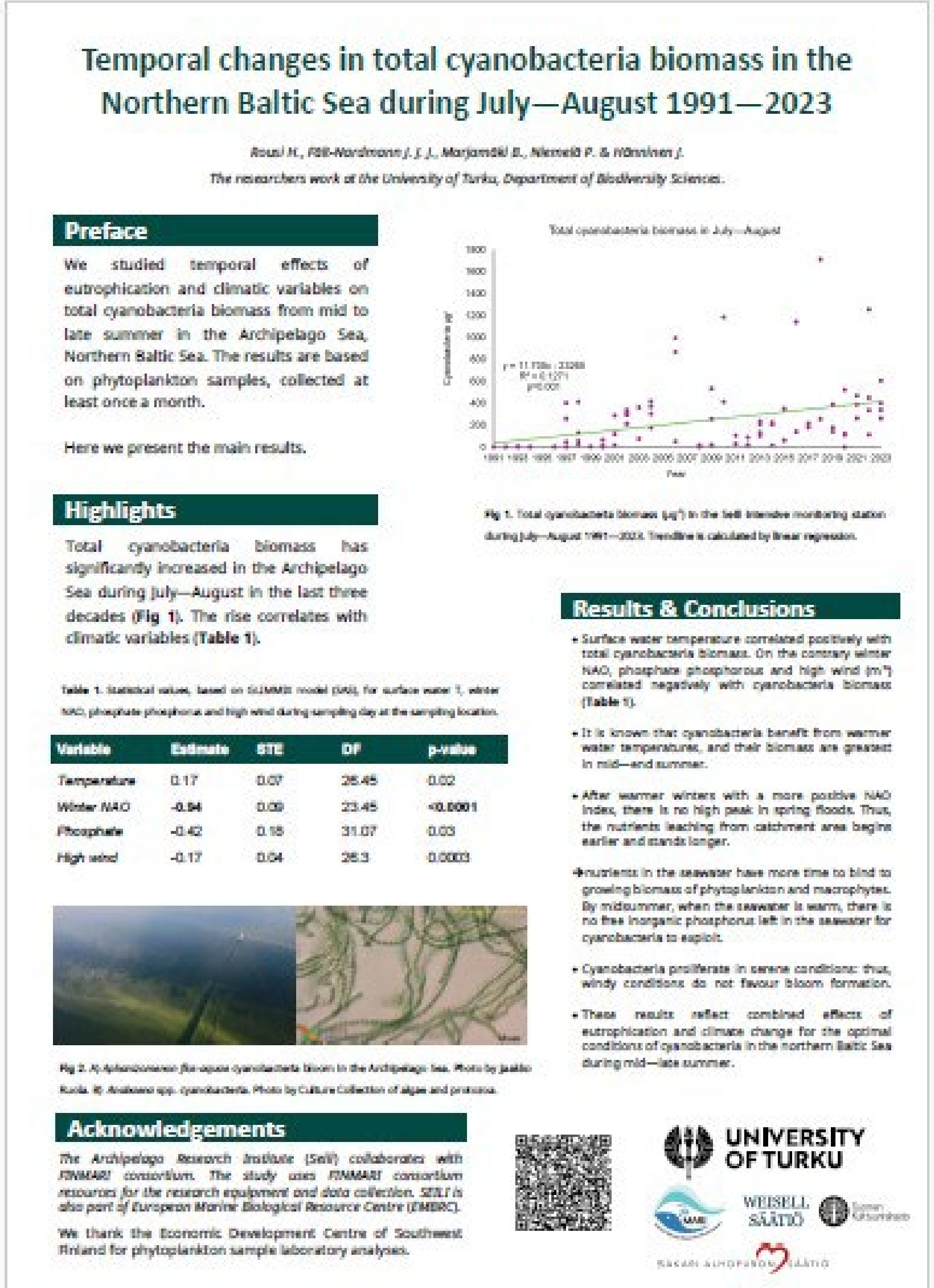
- ✓ The invasive crab *Rhithropanopeus harrisii*, a novel predator, is increasing its distribution range in the Archipelago Sea
- ✓ Many native littoral invertebrate species decrease in abundance following the invasion
- ✓ Community composition shifts from grazer dominated towards deposit feeder dominated communities



Temporal changes in total cyanobacteria biomass in the Northern Baltic Sea during July—August 1991—2023

Rousi H., Fält-Nardmann J., Marjamäki B., Niemelä P., Hänninen J.
University of Turku, Department of Biodiversity Sciences

- ✓ Samples collected1—3 times a month
- ✓ Total cyanobacteria biomass increased
- ✓ Biomass change correlated with climatic variables
- ✓ Strong response to winter NAO
- ✓ Also a response to SST, phosphate and wind speed



Temporal changes in total cyanobacteria biomass in the Northern Baltic Sea during July—August 1991—2023

The researchers work at the University of Turku, Department of Biodiversity Sciences.

Preface

We studied temporal effects of eutrophication and climatic variables on total cyanobacteria biomass from mid to late summer in the Archipelago Sea, Northern Baltic Sea. The results are based on phytoplankton samples, collected at least once a month.

Here we present the main results.

Highlights

Total cyanobacteria biomass has significantly increased in the Archipelago Sea during July—August in the last three decades (**Fig 1**). The rise correlates with climatic variables (**Table 1**).

Total cyanobacteria biomass in July—August

Fig 1. Total cyanobacteria biomass in the Seili intensive monitoring station during July—August 1991—2023. Trendline is calculated by linear regression.

Table 1. Statistical values, based on GLMM model (SAS), for surface water T, winter NAO, phosphate phosphorus and high wind during sampling day at the sampling location.

Variable	Estimate	STE	DF	p-value
Temperature	0.17	0.07	26.45	0.02
Winter NAO	-0.84	0.09	23.45	<0.0001
Phosphate	-0.42	0.18	31.07	0.03
High wind	-0.17	0.04	26.3	0.0003

Results & Conclusions

- Surface water temperature correlated positively with total cyanobacteria biomass. On the contrary winter NAO, phosphate phosphorous and high wind correlated negatively with cyanobacteria biomass (**Table 1**).
- It is known that cyanobacteria benefit from warmer water temperatures, and their biomass are greatest in mid—end summer.
- After warmer winters with a more positive NAO index, there is no high peak in spring floods. Thus, the nutrients leaching from catchment area begins earlier and stands longer.
- nutrients in the seawater have more time to bind to growing biomass of phytoplankton and macrophytes. By midsummer, when the seawater is warm, there is no free inorganic phosphorus left in the seawater for cyanobacteria to exploit.
- Cyanobacteria proliferate in serene conditions: thus, windy conditions do not favour bloom formation.
- These results reflect combined effects of eutrophication and climate change for the optimal conditions of cyanobacteria in the northern Baltic Sea during mid—late summer.

Fig 2. A) *Aphanizomenon flos-aquae* cyanobacteria bloom in the Archipelago Sea. B) *Anabaena* spp. cyanobacteria. Photo by Culture Collection of algae and protozoa.

Acknowledgements

The Archipelago Research Institute (Seili) collaborates with FINMARI consortium. The study uses FINMARI consortium resources for the research equipment and data collection. SEILI is also part of European Marine Biological Resource Centre (EMBRC).

We thank the Economic Development Centre of Southwest Finland for phytoplankton sample laboratory analyses.

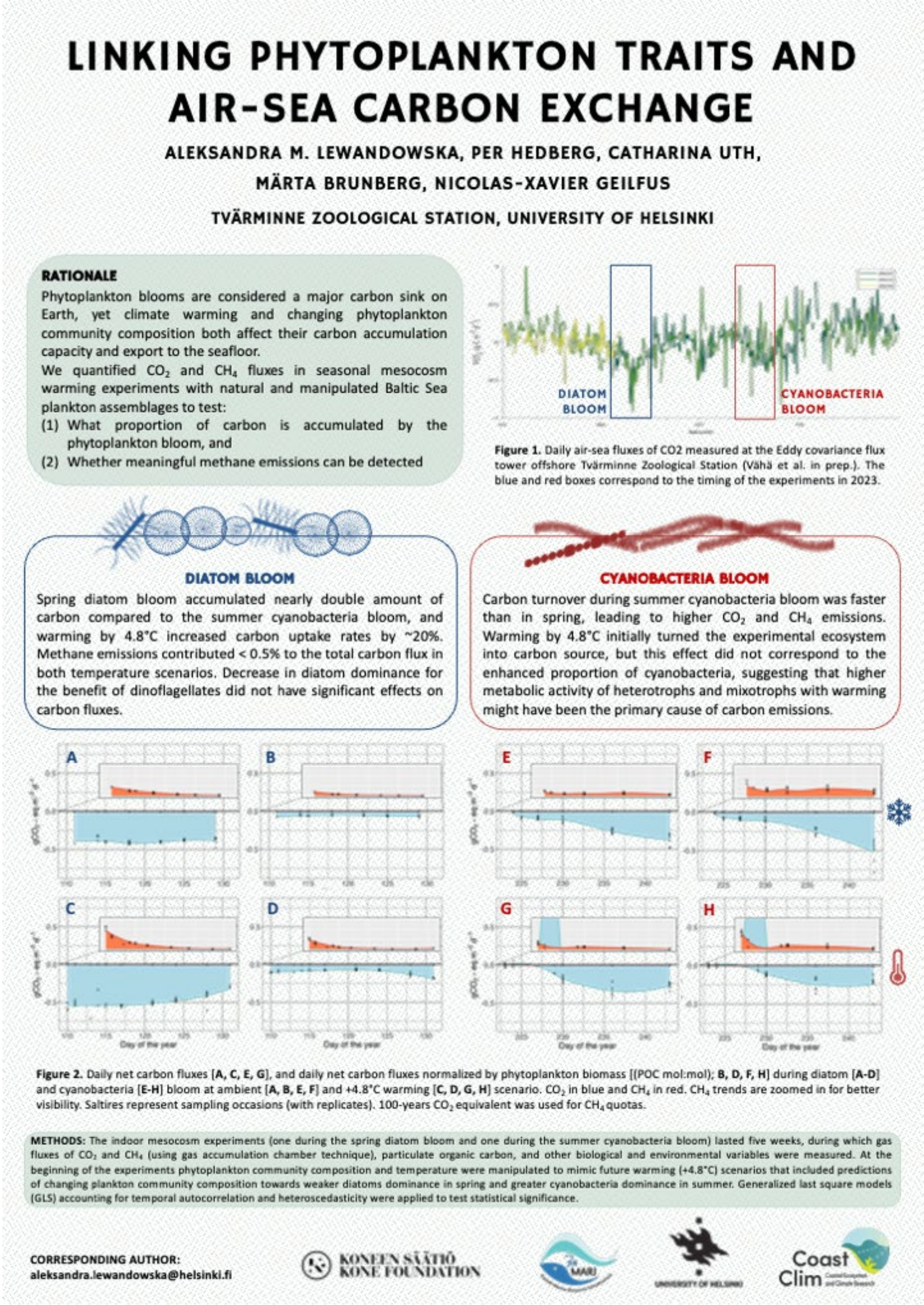
UNIVERSITY OF TURKU

Linking phytoplankton traits and air-sea carbon exchange

A.M. Lewandowska, P. Hedberg, C. Uth, M. Brunberg, N-X. Geilfus

Tvärminne Zoological Station, University of Helsinki

- ✓ Spring diatom bloom accumulates nearly double amount of carbon compared to cyanobacteria bloom
- ✓ Methane emissions contribute < 0.5% to the total carbon flux, even under most extreme warming scenario with the highest cyanobacteria dominance



Integrating Molecular and Physiological Approaches for Climate-change Tolerance in Seagrass

Sarah Rühmkorff, Giannina Hattich, Christian Pansch
Åbo Akademi University

- ✓ Microclimates shape thermal performance of seagrass
- ✓ Seagrass interaction with bivalves can influence seagrass thermal performance
- ✓ Non structural carbohydrates in seagrass below and aboveground biomass can help to predict seagrass performance
- ✓ Investigation of thermal performance of seagrass is important to determine seagrass ability to tolerate changing temperatures in future

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Geodiversity of the Åland Seafloor: Geological Mapping for Biodiversea LIFE IP

Virtanen, S., Jokinen, S., Kaskela, A., Sahiluoto, M., Sainio, A. and Sanila, N.
Geological Survey of Finland

- ✓ The aim of the project is to strengthen the ecological state of the Baltic Sea
- ✓ Fieldwork in the four study areas combined seismo-acoustic methods and surface sediment sampling
- ✓ Geological mapping revealed a diverse and active seabed, with contrasting hard and soft substrates that can support a wide range of seafloor habitats

Geodiversity of the Åland Seafloor: Geological Mapping for Biodiversea LIFE IP

Authors: Virtanen, S., Jokinen, S., Kaskela, A., Sahiluoto, M., Sainio, A. and Sanila N.
Geological Survey of Finland, Environmental Solutions,
Marine Geology Research Services, Espoo, Finland
*Corresponding author: satu.virtanen@gtk.fi

Introduction

The Biodiversea LIFE IP project (2021–2029) brings together a broad group of organizations working to strengthen the ecological state of the Baltic Sea and promote sustainable marine use. As part of this project, GTK has conducted detailed marine geological surveys in the waters surrounding the Åland Islands, producing information that supports local conservation and planning (Fig. 1). The project is coordinated by Metsähallitus and implemented in cooperation with GTK, BSAG, SYKE, the Ministry of the Environment, LuKe, Turku University of Applied Sciences, Åbo Akademi University and the Åland Provincial Government.

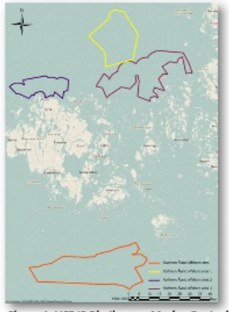


Figure 1. LIFE IP Biodiversea Marine Geological study areas

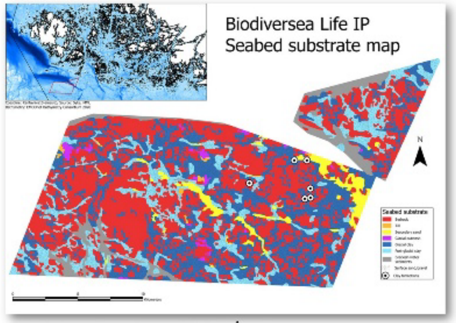


Figure 3. Seabed substrate map of Southern Åland study area.

Methods

Fieldwork in the four study areas combined several seismo-acoustic methods to map the seafloor (Fig. 1 & 2). Surface sediment samples were collected to confirm and refine the geological interpretations derived from the acoustic data. Together, these datasets provide a detailed picture of seabed geodiversity, seafloor topography, and the range of seabed substrates present.

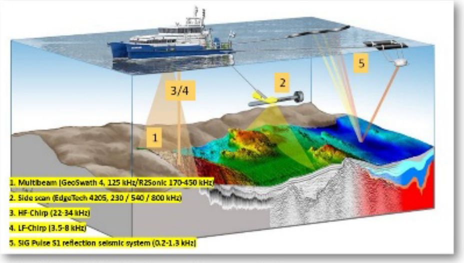


Figure 2. Marine Geological seismo-acoustic survey methods.

Results & Discussion

The Southern study area (Fig. 3) is dominated by rocky reefs formed by exposed bedrock, with clay-filled depressions between them typically covered by a thin layer of sand. These sediment patterns indicate an energetic environment where waves and currents actively rework the seafloor, limiting the accumulation of finer material.

Ferromanganese concretions occurred at a few sites, indicating locally low sedimentation rates and oxygenated bottom conditions that allow their slow formation. In the northeast, clay labyrinths were identified, likely formed by erosion of exposed clay surfaces and reflecting long-term stability of these deposits. Their overall occurrence in the Baltic Sea is poorly known, as only a few such features have been documented.

Together, these features show a geologically diverse and active seabed, with contrasting hard and soft substrates that can support a wide range of seafloor habitats.

The LIFE IP Biodiversea project has received funding from the LIFE Programme of the European Union. The material reflects the views by the authors, and the European Commission or the CINEA is not responsible for any use that may be made of the information it contains. Marine geological surveys have utilized research infrastructure facilities provided by FINMARI (Finnish Marine Research Infrastructure Network).

BIODIVERSEA for marine nature · Life · NATURA 2000 · FinMARI · VELMU · GTK

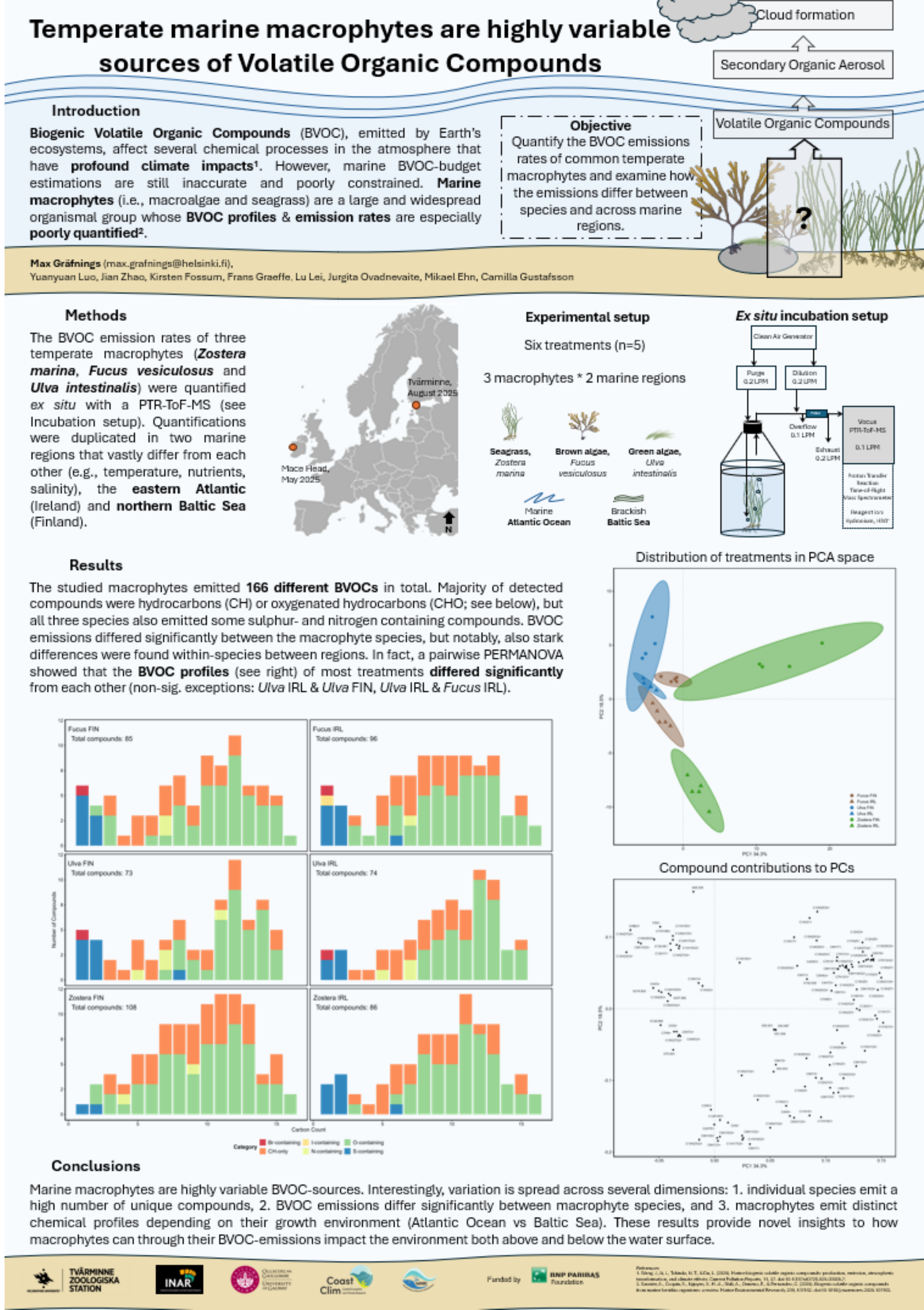
FinMARI Finnish Marine Research Infrastructure

Temperate marine macrophytes are highly variable sources of Volatile Organic Compounds

Max Gräfnings, Yuanyuan Luo, Jian Zhao, Kirsten Fossum, Frans Graeffe, Lu Lei, Jurgita Ovadnevaite, Mikael Ehn, Camilla Gustafsson

Tvärminne Zoological Station, University of Helsinki, University of Galway

- ✓ VOCs affect several chemical processes in the atmosphere that have profound climate impacts.
- ✓ Coastal VOC emissions are poorly constrained.
- ✓ Our results show that marine macrophytes emit diverse and atmospherically relevant VOC-profiles.

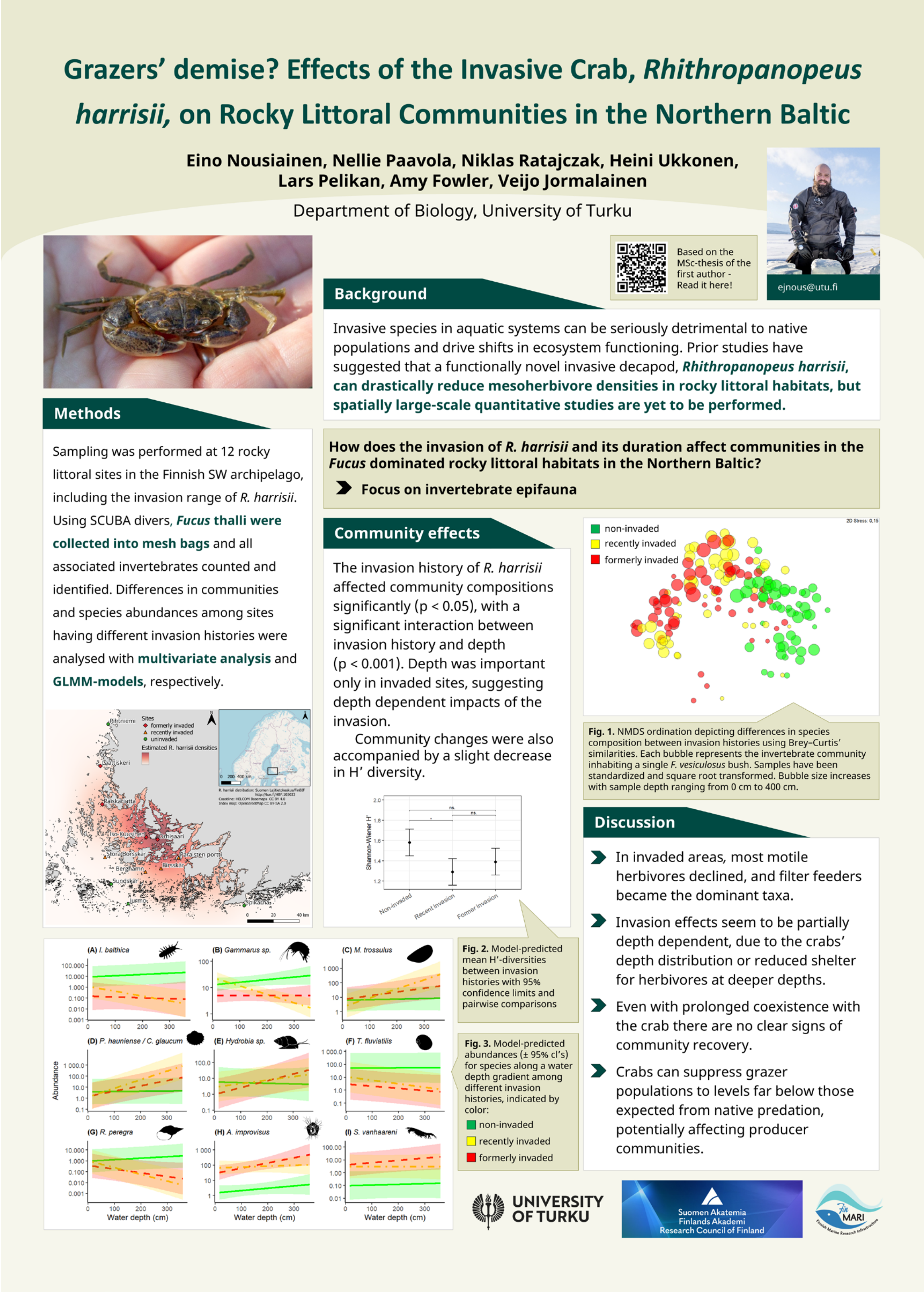


Grazers' demise? Effects of the Invasive Crab, *Rhithropanopeus harrisii*, on Rocky Littoral Communities in the Northern Baltic

Eino Nousiainen, Nellie Paavola, Niklas Ratajczak, Heini Ukkonen, Lars Pelikan, Amy Fowler, Veijo Jormalainen

Department of Biology, University of Turku

- ✓ Spatially large-scale, quantitative study of the effects of the invasion of *R. harrisii* and its duration to epifaunal communities.
- ✓ Clear and fast changes to communities and species abundances in response to the invasion.
- ✓ No signs of community recovery with prolonged coexistence with the crab.
- ✓ Possible cascading effects to producer communities.



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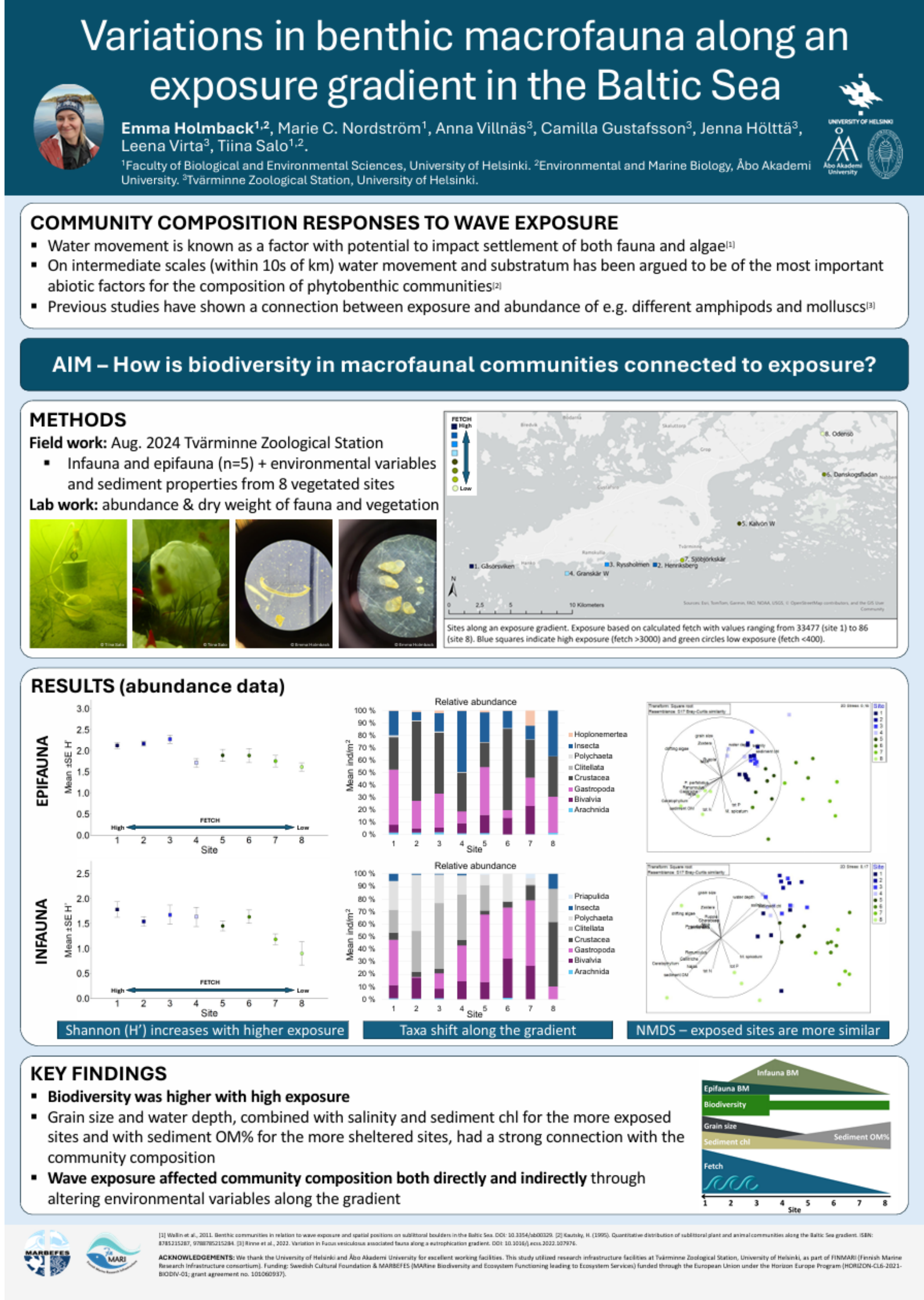
Variations in benthic macrofauna along an exposure gradient in the Baltic Sea

Emma Holmback[1,2], Marie C. Nordström[1], Anna Villnäs[3], Camilla Gustafsson[3], Jenna Hölttä[3], Leena Virta[3], Tiina Salo[1,2].

[1]Faculty of Biological and Environmental Sciences, University of Helsinki. [2]Environmental and Marine Biology, Åbo Akademi University. [3]Tvärminne Zoological Station, University of Helsinki.

- Water movement is known as a factor with potential to impact settlement of both fauna and vegetation, especially on intermediate scales
- **AIM** – explore how biodiversity in benthic macrofaunal communities is connected to exposure
- Infauna and epifauna from eight vegetated sites (n=5) along an exposure gradient



How Phytoplankton community shape Carbon Flux in the Baltic Sea

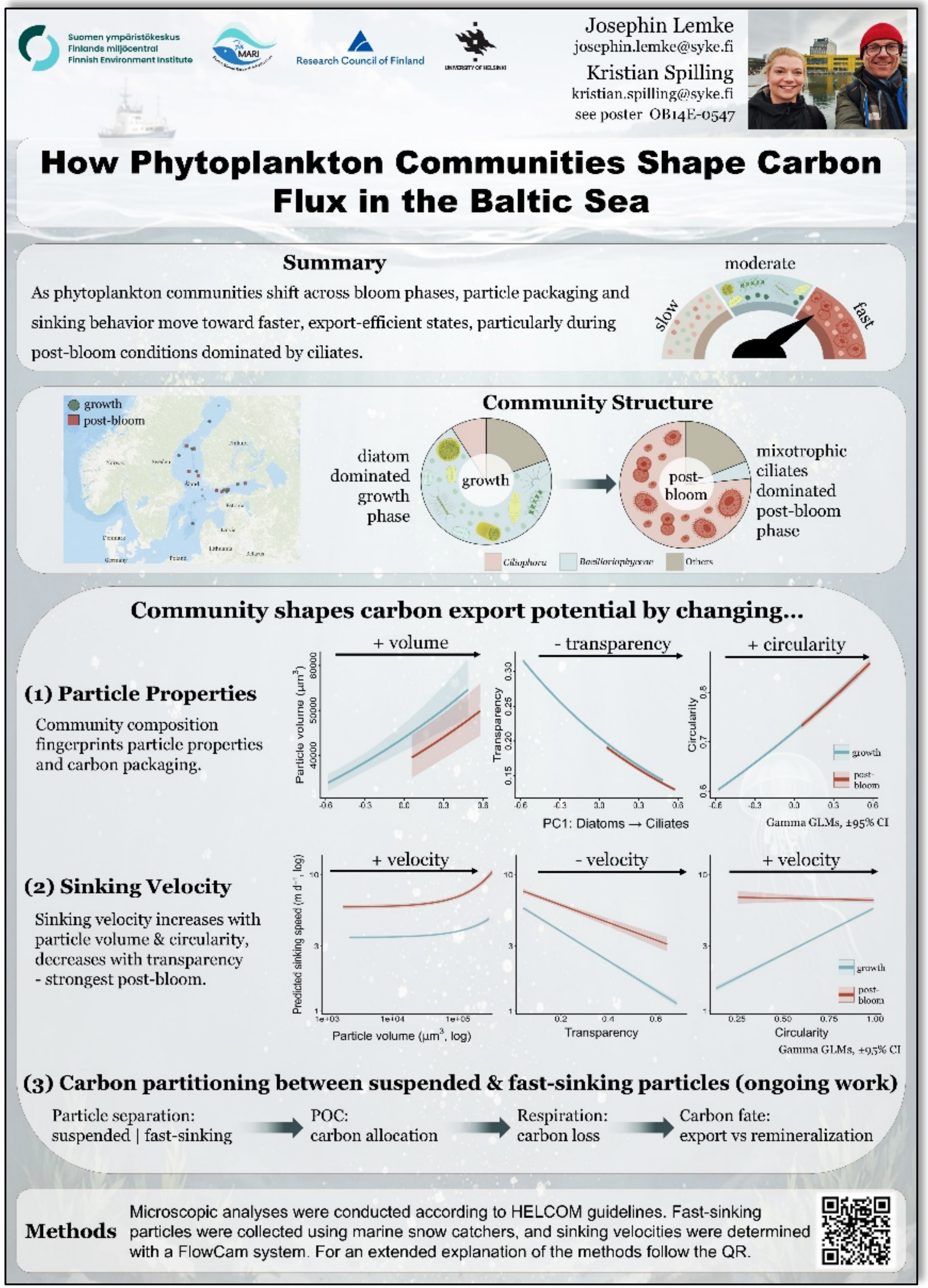
Josephin Lemke[1,2], Kristian Spilling[1]

[1]Finnish Environment Institute

[2] Tvärminne Zoological Station University of Helsinki

Finding: Community shifts affect particle packaging and sinking speed.

Implication: Post-bloom communities enhance carbon export efficiency.

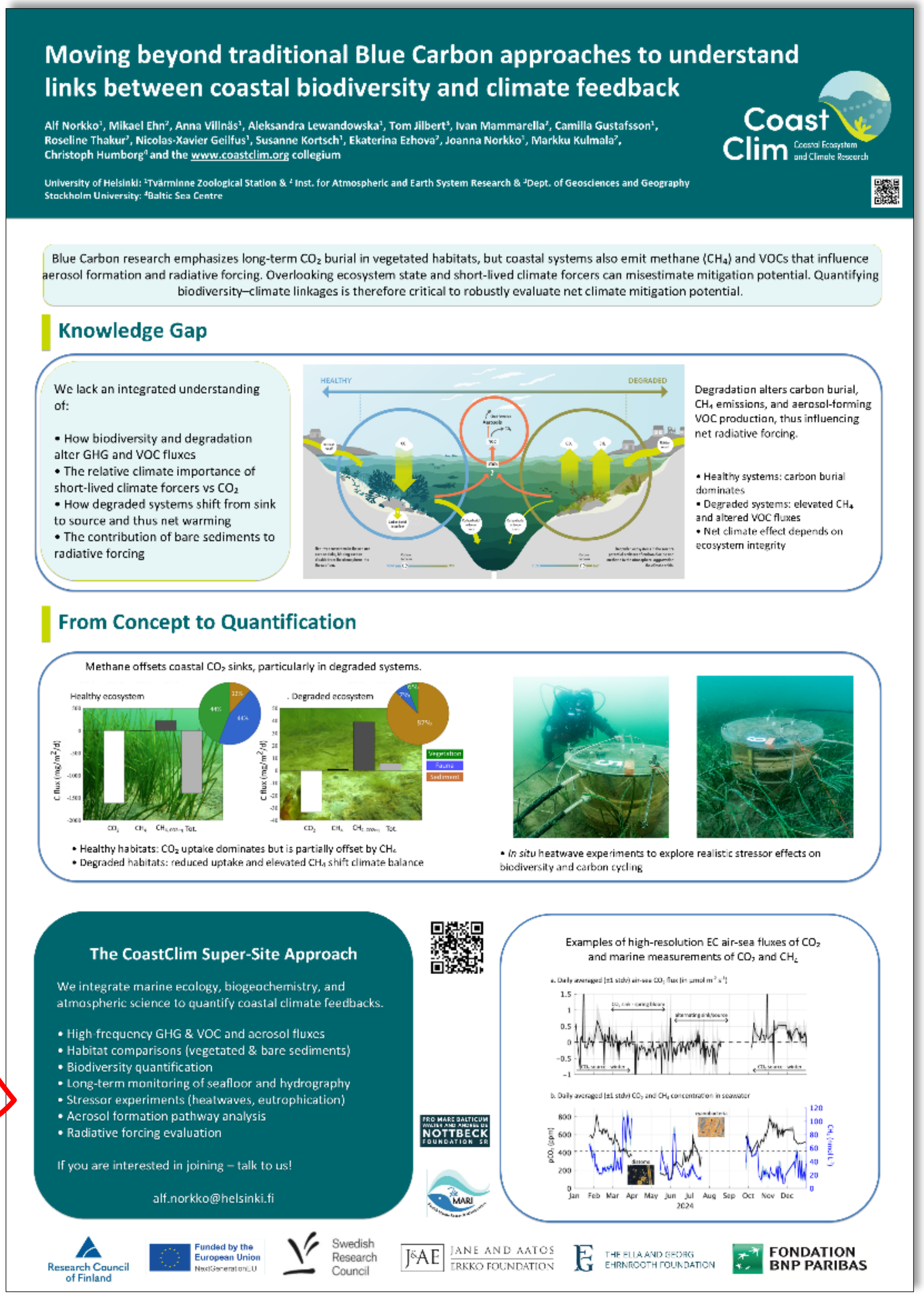


Moving beyond traditional Blue Carbon approaches to understand links between coastal biodiversity and climate feedback

Alf Norkko & the www.coastclim.org collegium
University of Helsinki & Stockholm University

- ✓ We integrate marine ecology, biogeochemistry, and atmospheric science to understand the role of healthy vs. degraded coastal habitats for climate
- ✓ Super-site approach; co-location of long-term monitoring, developing infra and field & lab studies at Tvärminne

Open call IRISCC TA!



Ferry-induced waves in the Archipelago Sea

Authors: Josten Mariah[1], Forsblom Louise[2], Kankare Ville[1], Alho Petteri[1]

Institutions: [1]University of Turku, [2]Finnish Environment Institute

Research questions

1. How far from the fairway are ferry-induced waves detectable?
2. Which factors most strongly influence ferry-induced wave amplitude?

Coastal environmental data – scattered and lost ?

Giannina Hattich, Sarah Rühmkorff, Lucinda Kraufvelin, Sebastien Lafond, Tesfay Tesfay, Christian Pansch
Åbo Akademi University

- ✓ Frequency, intensity, & duration of marine heatwaves are increasing → biodiversity impacts
- ✓ Thermal stress does not occur uniformly across time and space → microclimates
- ✓ Coastal (temperature) data are needed, and are frequently collected, yet not centrally available
- ✓ ***CoastSense*** aims to provide easy and effective workflows for the scientific community to store and share coastal temperature data across Finland and the Baltic Sea

→ PROVIDE YOUR INPUT

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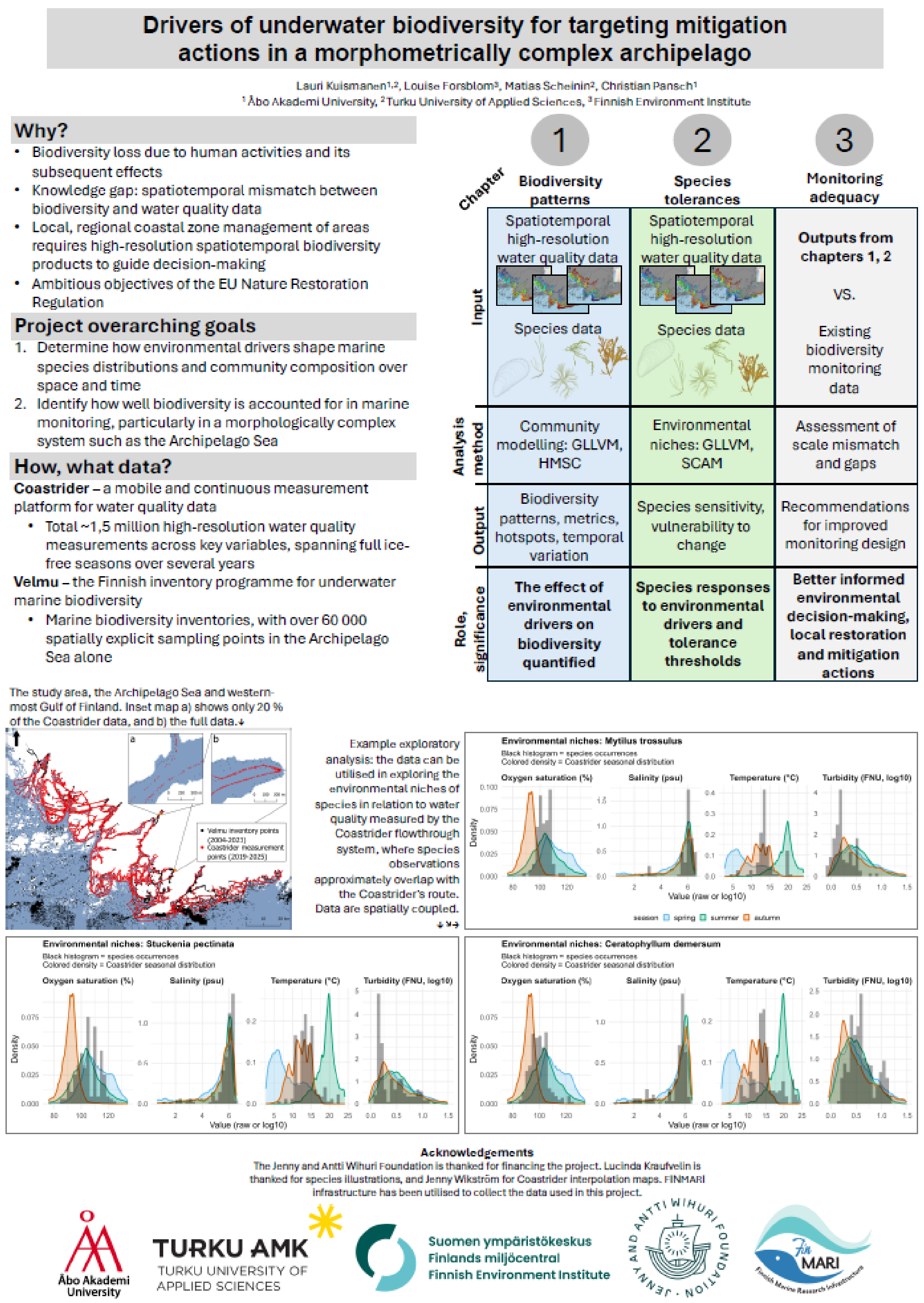
Drivers of underwater biodiversity for targeting mitigation actions in a morphometrically complex archipelago

Lauri Kuismanen[1,2], Louise Forsblom[3], Matias Scheinin[2], Christian Pansch[1]
[1]Åbo Akademi University, [2]Turku University of Applies Sciences, [3]Finnish Environment Institute

- ✓ **Poster:** Introduction, project plan, early exploratory analyses
- ✓ **Goal:** Environmental drivers of underwater biodiversity
- ✓ **Goal:** Evaluate monitoring adequacy
- ✓ **Utilising:** Velmu & Coastrider data



Responses of brackish-water plankton communities to Ocean Alkalinity Enhancement using mesocosms

Henna Yliluikki[1,2], Nicolas-Xavier Geilfus[3] and Jonna Engström-Öst[1,3]

[1]Novia University of Applied Sciences

[2]University of Turku

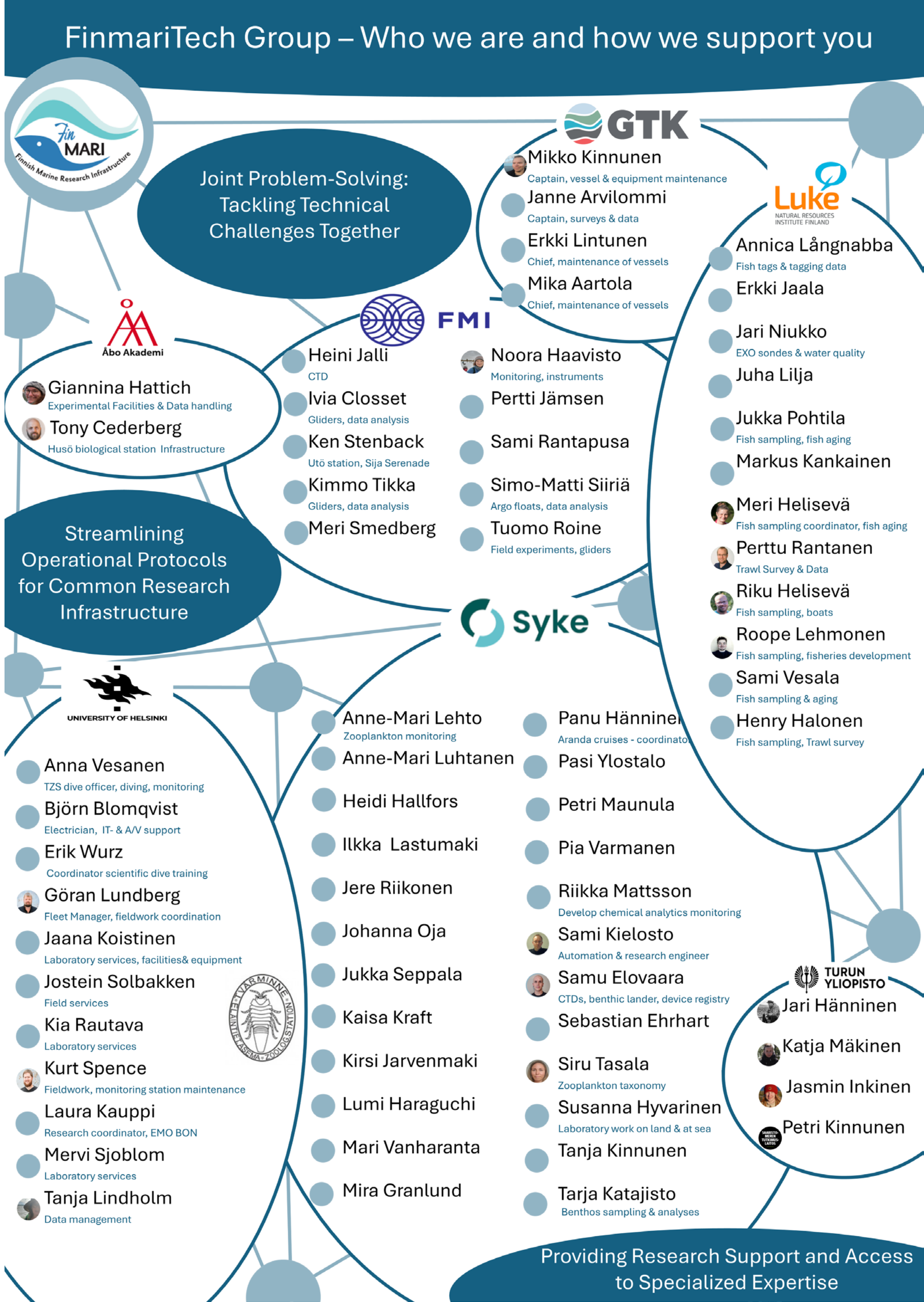
[3]Tvärminne Zoological Station

- ✓ Ocean alkalinity enhancement (OAE)
  - ✓ A method to mitigate climate change and counteract acidification
- ✓ Eco-physiological responses of plankton community to OAE
  - ✓ Fatty acids of zooplankton and seston

FinmariTech Group

Many Authors
across all FinMARI Institution

- ✓ Come and meet us



FinmariTech Group

Many Authors
across all FinMARI Institution

- ✓ Unique scientific expertise of each partner
- ✓ Specialized equipment& facilities
- ✓ Shared research themes
- ✓ Complementary methodoligies

Effects of Abiotic Factors and Diversity on the Ecosystem Functioning of Plankton Communities in the Baltic Sea

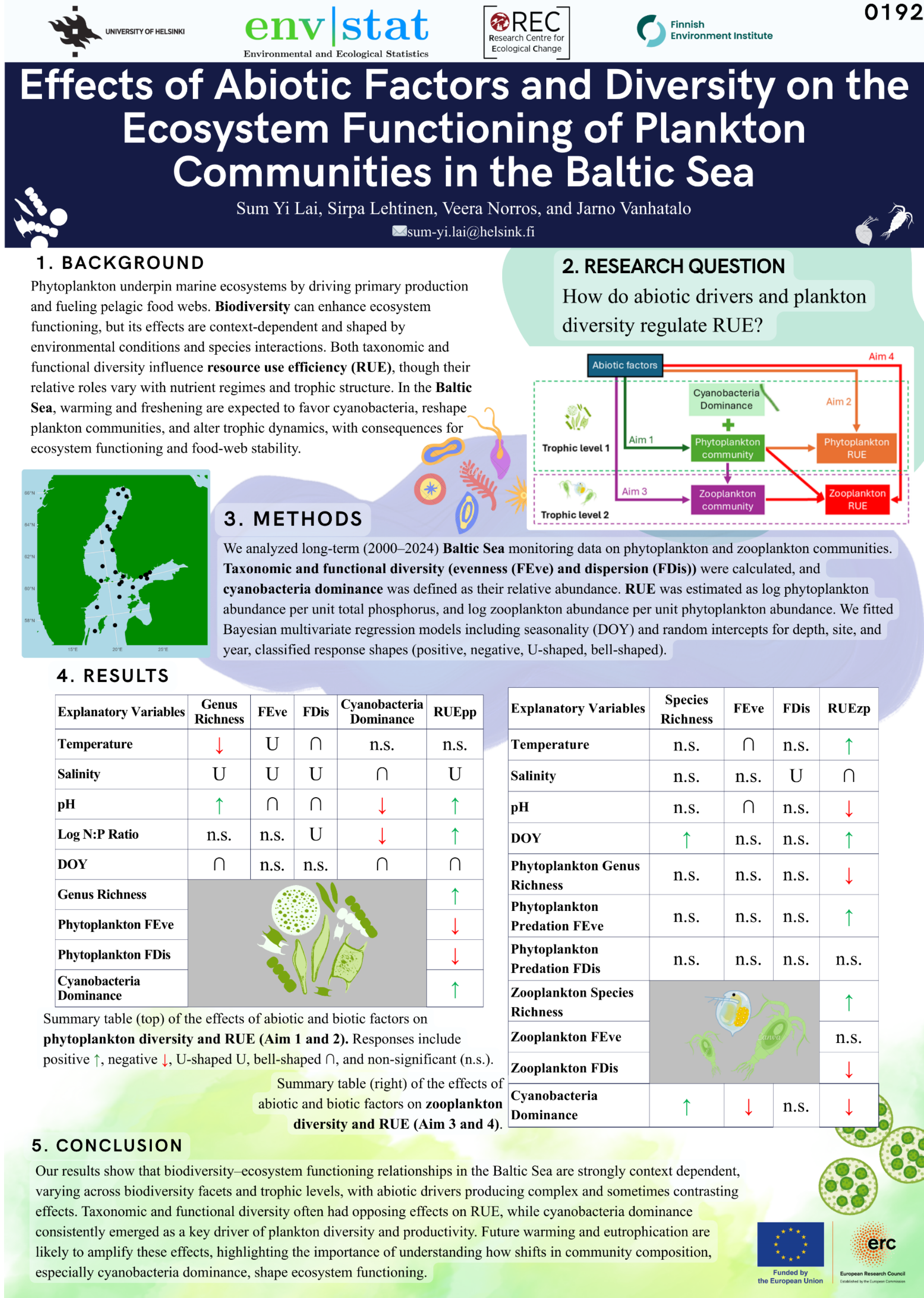
Authors: Sum Yi Lai[1], Sirpa Lehtinen[2], Veera Norros[2], and Jarno Vanhatalo[1]

1. University of Helsinki
2. Finnish Environment Institute Syke

- ✓ How do abiotic factors and plankton taxonomic and functional diversity influence plankton resource use efficiency (RUE)?

	RUEpp	RUEzp
Taxonomic diversity pp	↑	↓
Functional diversity pp	↓	↑
Taxonomic diversity zp		↑
Functional diversity zp		↓
Cyanobacteria dominance	↑	↓

- ✓ Cyanobacteria dominance is a key driver of plankton productivity
- ✓ Need to consider the context-dependency of biodiversity-ecosystem functioning relationships



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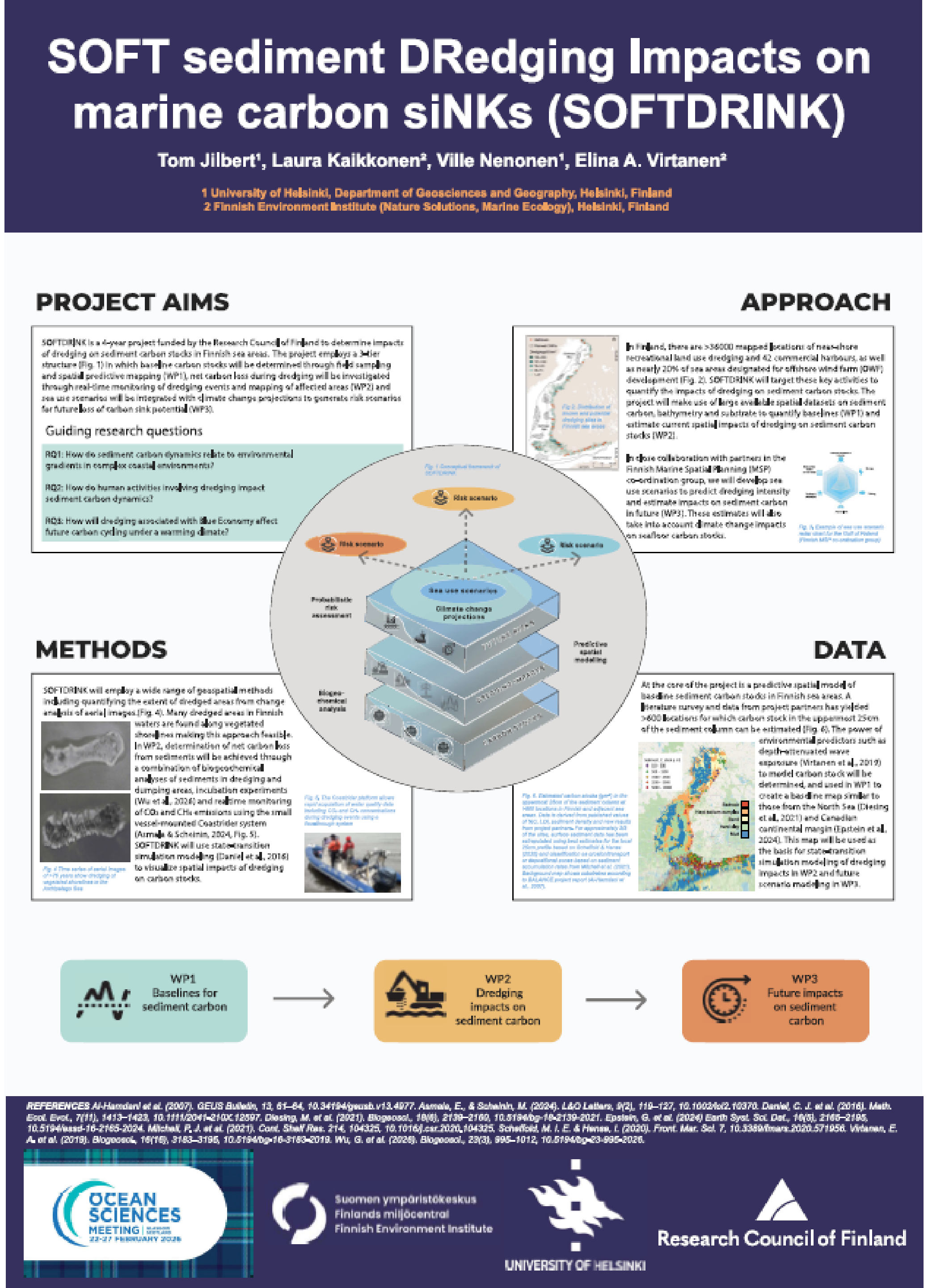
SOFT sediment DRedging Impacts on marine carbon sINKs (SOFTDRINK)

Tom Jilbert[1], Laura Kaikkonen[2], Ville Nenonen[1], Elina A. Virtanen[2]
[1]University of Helsinki, [2]Finnish Environment Institute

- ✓ Dredging is widespread in Finnish waters: >36,000 recreational sites, 42 commercial harbors, and ~20% of sea areas designated for wind farms
- ✓ Soft marine sediments store large amounts of organic carbon, but dredging can release it back to the water column
- ✓ SOFTDRINK is a 4-year Research Council of Finland project quantifying these dredging impacts on sediment carbon stocks
- ✓ WP1: Baseline carbon maps using predictive spatial modelling with data from >600 field locations across Finnish sea areas
- ✓ WP2: Net carbon loss quantified via biogeochemical analyses, incubation experiments, and vessel-mounted real-time CO_2 / CH_4 monitoring
- ✓ WP3: Future risk scenarios combining sea-use planning, state-transition simulation modelling, and climate change projections



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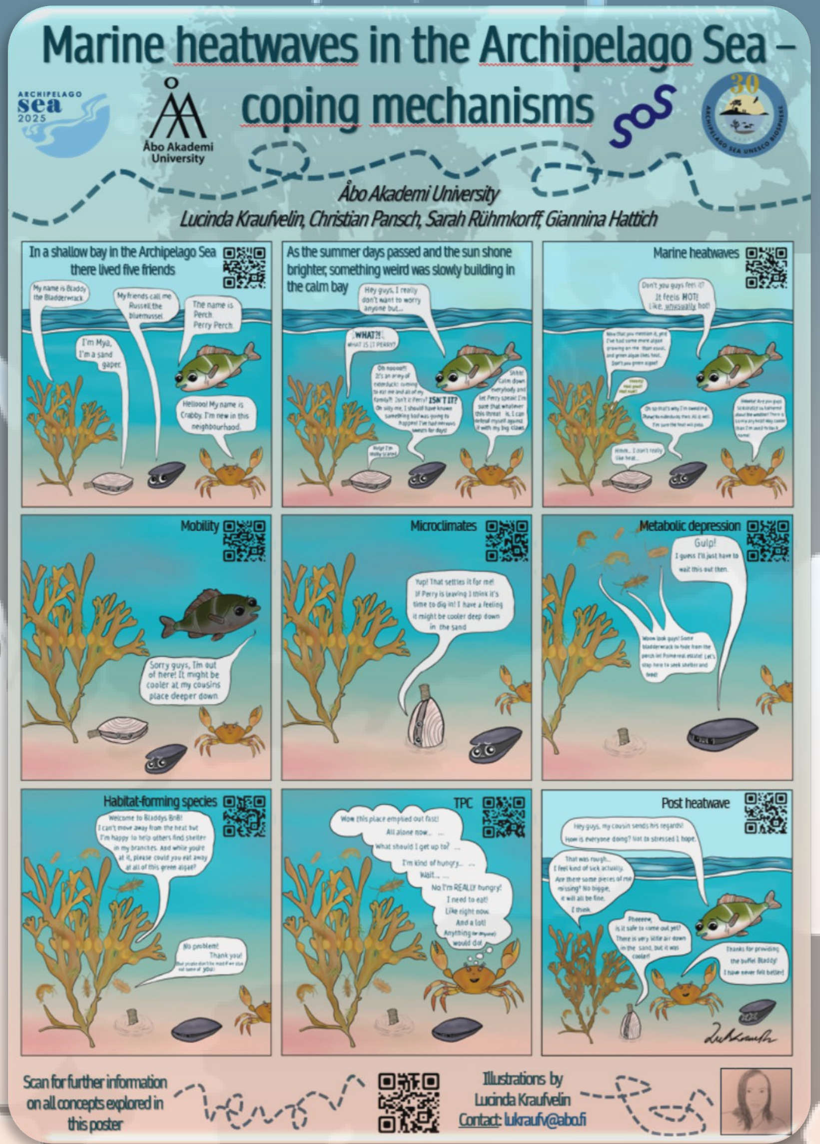
Marine heatwaves in the Archipelago Sea

Coping mechanisms

Lucinda Kraufvelin, Christian Pansch, Sarah Rühmkorff, Giannina Hattich
Åbo Akademi University

How do Baltic Sea species cope with extreme temperatures?

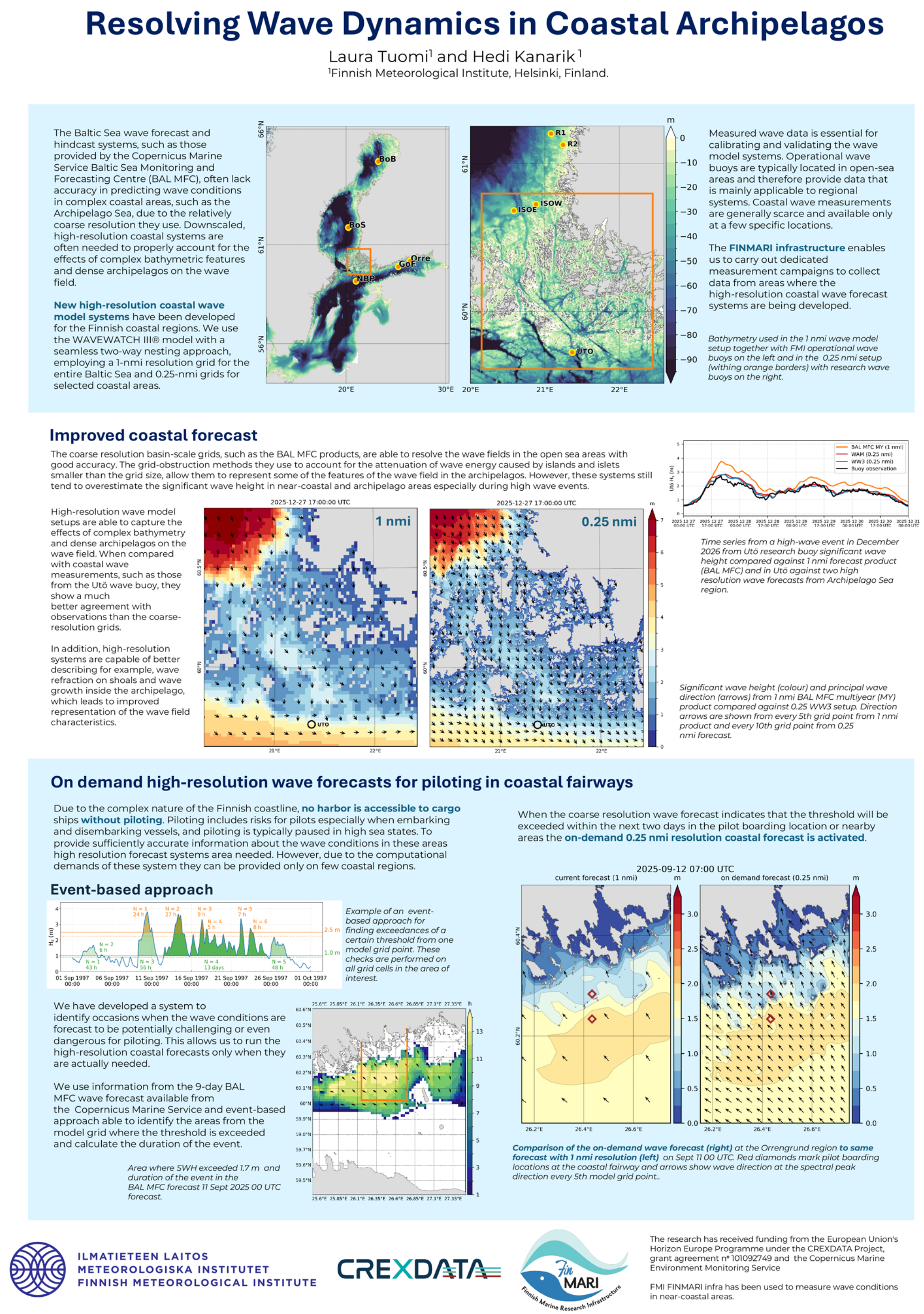
Microclimates in the Archipelago Sea?



Resolving Wave Dynamics in Coastal Archipelagos

Laura Tuomi and Hedi Kanarik
Finnish Meteorological Institute

- FMI is developing coastal wave forecasting systems to better support safety of the maritime traffic in the coastal fairways.
- FINMARI infrastructure is important in getting measured data to calibrate and validate the forecast system.
- Demonstration of coastal wave forecast service available at marine.fmi.fi/aallokko



Resolving Wave Dynamics in Coastal Archipelagos

Laura Tuomi[1] and Hedi Kanarik[1]
[1]Finnish Meteorological Institute, Helsinki, Finland.

The Baltic Sea wave forecast and hindcast systems, such as those provided by the Copernicus Marine Service Baltic Sea Monitoring and Forecasting Centre (BAL MFC), often lack accuracy in predicting wave conditions in complex coastal areas, such as the Archipelago Sea, due to the relatively coarse resolution they use. Downscaled, high-resolution coastal systems are often needed to properly account for the effects of complex bathymetric features and dense archipelagos on the wave field.

New high-resolution coastal wave model systems have been developed for the Finnish coastal regions. We use the WAVEWATCH III® model with a seamless two-way nesting approach, employing a 1-nmi resolution grid for the entire Baltic Sea and 0.25-nmi grids for selected coastal areas.

Measured wave data is essential for calibrating and validating the wave model systems. Operational wave buoys are typically located in open-sea areas and therefore provide data that is mainly applicable to regional systems. Coastal wave measurements are generally scarce and available only at a few specific locations.

The **FINMARI infrastructure** enables us to carry out dedicated measurement campaigns to collect data from areas where the high-resolution coastal wave forecast systems are being developed.

Bathymetry used in the 1 nmi wave model setup together with FMI operational wave buoys on the left and in the 0.25 nmi setup (withing orange borders) with research wave buoys on the right.

Improved coastal forecast

The coarse resolution basin-scale grids, such as the BAL MFC products, are able to resolve the wave fields in the open sea areas with good accuracy. The grid-obstruction methods they use to account for the attenuation of wave energy caused by islands and islets smaller than the grid size, allow them to represent some of the features of the wave field in the archipelagos. However, these systems still tend to overestimate the significant wave height in near-coastal and archipelago areas especially during high wave events.

High-resolution wave model setups are able to capture the effects of complex bathymetry and dense archipelagos on the wave field. When compared with coastal wave measurements, such as those from the Utö wave buoy, they show a much better agreement with observations than the coarse-resolution grids.

In addition, high-resolution systems are capable of better describing for example, wave refraction on shoals and wave growth inside the archipelago, which leads to improved representation of the wave field characteristics.

Time series from a high-wave event in December 2026 from Utö research buoy significant wave height compared against 1 nmi forecast product (BAL MFC) and in Utö against two high resolution wave forecasts from Archipelago Sea region.

Significant wave height (colour) and principal wave direction (arrows) from 1 nmi BAL MFC multiyear (MY) product compared against 0.25 WW3 setup. Direction arrows are shown from every 5th grid point from 1 nmi product and every 10th grid point from 0.25 nmi forecast.

On demand high-resolution wave forecasts for piloting in coastal fairways

Due to the complex nature of the Finnish coastline, **no harbor is accessible to cargo ships without piloting**. Piloting includes risks for pilots especially when embarking and disembarking vessels, and piloting is typically paused in high sea states. To provide sufficiently accurate information about the wave conditions in these areas high resolution forecast systems area needed. However, due to the computational demands of these system they can be provided only on few coastal regions.

Event-based approach

Example of an event-based approach for finding exceedances of a certain threshold from one model grid point. These checks are performed on all grid cells in the area of interest.

We have developed a system to identify occasions when the wave conditions are forecast to be potentially challenging or even dangerous for piloting. This allows us to run the high-resolution coastal forecasts only when they are actually needed.

We use information from the 9-day BAL MFC wave forecast available from the Copernicus Marine Service and event-based approach able to identify the areas from the model grid where the threshold is exceeded and calculate the duration of the event.

Area where SWH exceeded 1.7 m and duration of the event in the BAL MFC forecast 11 Sept 2025 00 UTC forecast.

When the coarse resolution wave forecast indicates that the threshold will be exceeded within the next two days in the pilot boarding location or nearby areas the **on-demand 0.25 nmi resolution coastal forecast is activated**.

Comparison of the on-demand wave forecast (right) *at the Orrengrund region* ***to same forecast with 1 nmi resolution (left)*** *on Sept 11 00 UTC. Red diamonds mark pilot boarding locations at the coastal fairway and arrows show wave direction at the spectral peak direction every 5th model grid point..*

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

CREXDATA

FinMARI Finnish Marine Research Infrastructure

The research has received funding from the European Union's Horizon Europe Programme under the CREXDATA Project, grant agreement nº 101092749 and the Copernicus Marine Environment Monitoring Service

FMI FINMARI infra has been used to measure wave conditions in near-coastal areas.

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(Bio)geochemical Dynamics of Seawater-Aquifer Interactions: Impacts on Coastal Sediments and Ecosystem

Ronja Lanndér[1], Conny Sjöqvist[2], Joonas Virtasalo[3], Peter Österholm[1]

[1]Department of Geology and Mineralogy, Åbo Akademi University
[2]Department of Environmental and Marine Biology, Åbo Akademi University
[3]Geological Survey of Finland, Marine Geology

Coastal **groundwater-seawater mixing** zones are important but poorly understood biogeochemical **hotspots**.

- Coastal mixing of groundwater and seawater drives **physical and biogeochemical** changes in sediments and aquifers.

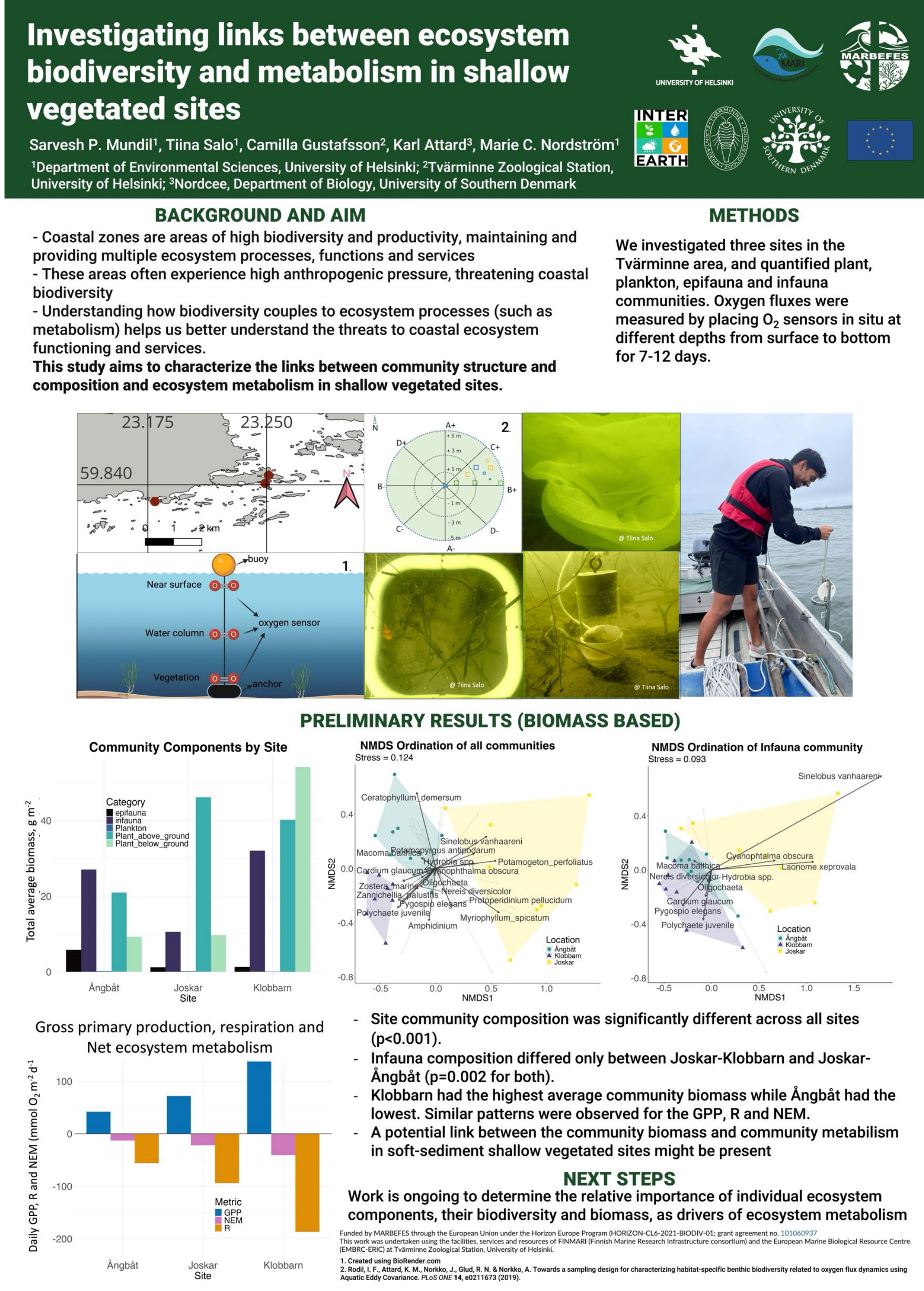
- This project provides and interdisciplinary view of these dynamics along the SW Finnish coast.
  - How do these interactions shape **coastal aquifers**?
  - How do they influence **solute cycling** and **availability** in the marine environment?
  - What **responses** occur in benthic and pelagic communities?

Investigating links between ecosystem biodiversity and metabolism in shallow vegetated sites

Sarvesh P. Mundil[1], Tiina Salo[1], Camilla Gustafsson[2], Karl Attard[3], Marie C. Nordström[1]

[1]Department of Environmental Sciences, University of Helsinki; [2]Tvärminne Zoological Station, University of Helsinki; [3]Nordcee, Department of Biology, University of Southern Denmark

- ✓ Coastal areas are regions with important ecosystem services and functioning, but they are facing several anthropogenic threats.
- ✓ Understanding the link between ecosystem processes and biodiversity helps us better understand these threats to these ecosystems
- ✓ Hence, this study aims to characterise links between ecosystem biodiversity and metabolism in shallow vegetated sites

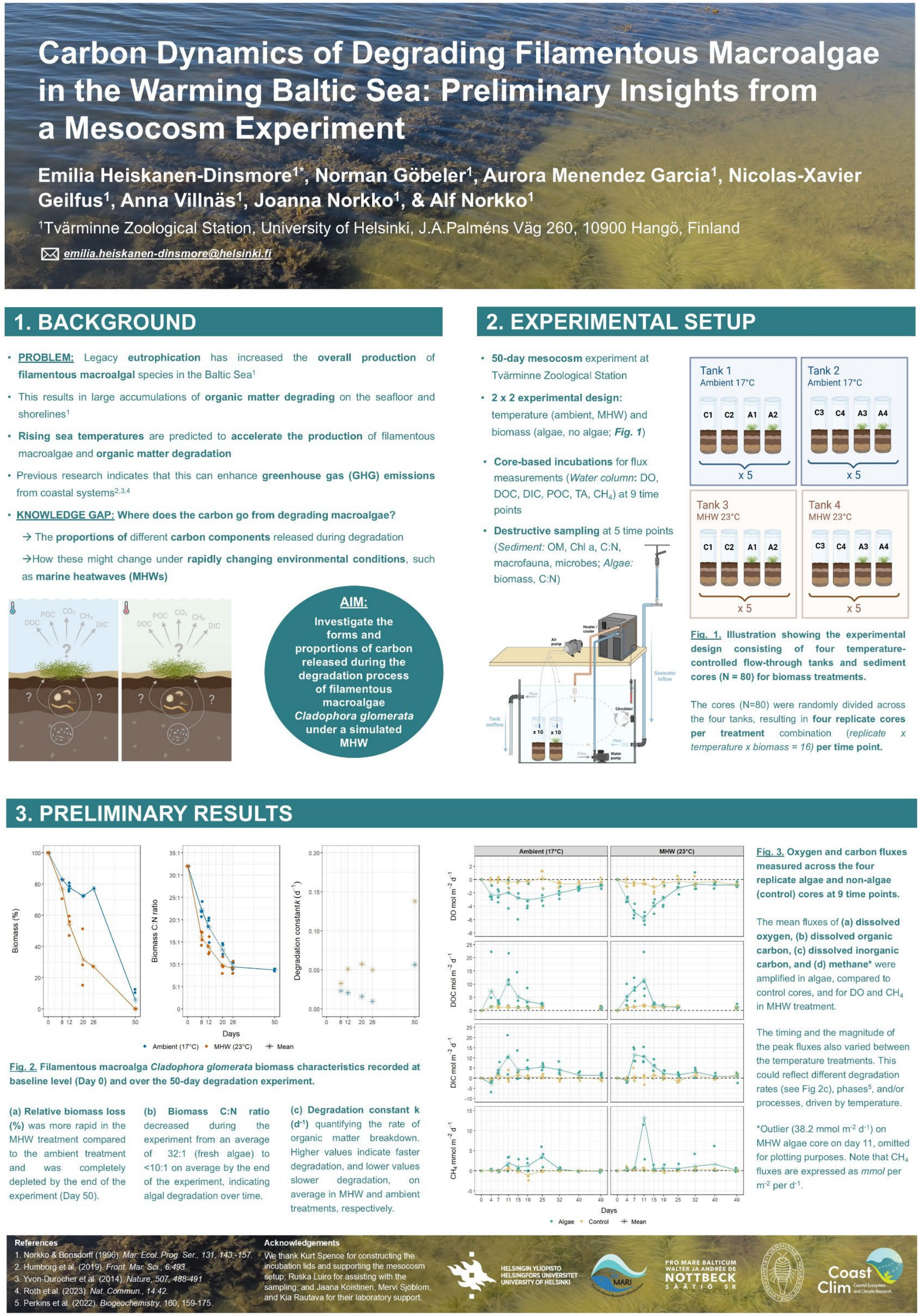


Carbon Dynamics of Degrading Filamentous Macroalgae in the Warming Baltic Sea: Preliminary Insights from a Mesocosm Experiment

Emilia Heiskanen-Dinsmore[1], Norman Göbeler[1], Aurora Menendez Garcia[1], Nicolas-Xavier Geilfus[1], Anna Villnäs[1], Joanna Norkko[1], & Alf Norkko[1]

[1]Tvärminne Zoological Station, University of Helsinki

- ✓ Filamentous macroalgae degradation
- ✓ Where does the carbon go?
- ✓ Mesocosm experiment
- ✓ Temperature linked to degradation rates and carbon fluxes (preliminary)



Evaluating fish farms impact to a-chlorophyl

- Nea Matinlauri et all.
- In this research campaign we evaluated baltic sea fish farms impact to waterquality parameters such as a-chlorophyl
- We did not detected change in a-chlorophyl near farms, but more detailed data analysis are needed especially from debth.

Ship wakes reduce *Fucus* recruitment

[1]Petra Saari, [1]Dimitrios Kampantais, [2]Veijo Jormalainen,
[3]Saija Saarni, [3]Petteri Alho, [1]Christoffer Boström
[1]Åbo Akademi University, Environmental and Marine Biology
[2]University of Turku, Department of Biology
[3]University of Turku, Department of Geography and Geology

- Impacts of ship wakes on reproduction of *Fucus vesiculosus*
- Investment in reproductive structures and gamete production were not affected by ship wakes
- Recruitment success was reduced near the fairway
- Impact sites experienced more frequent large waves, higher sedimentation rates, and lower light levels, which likely explain the reduced recruitment.

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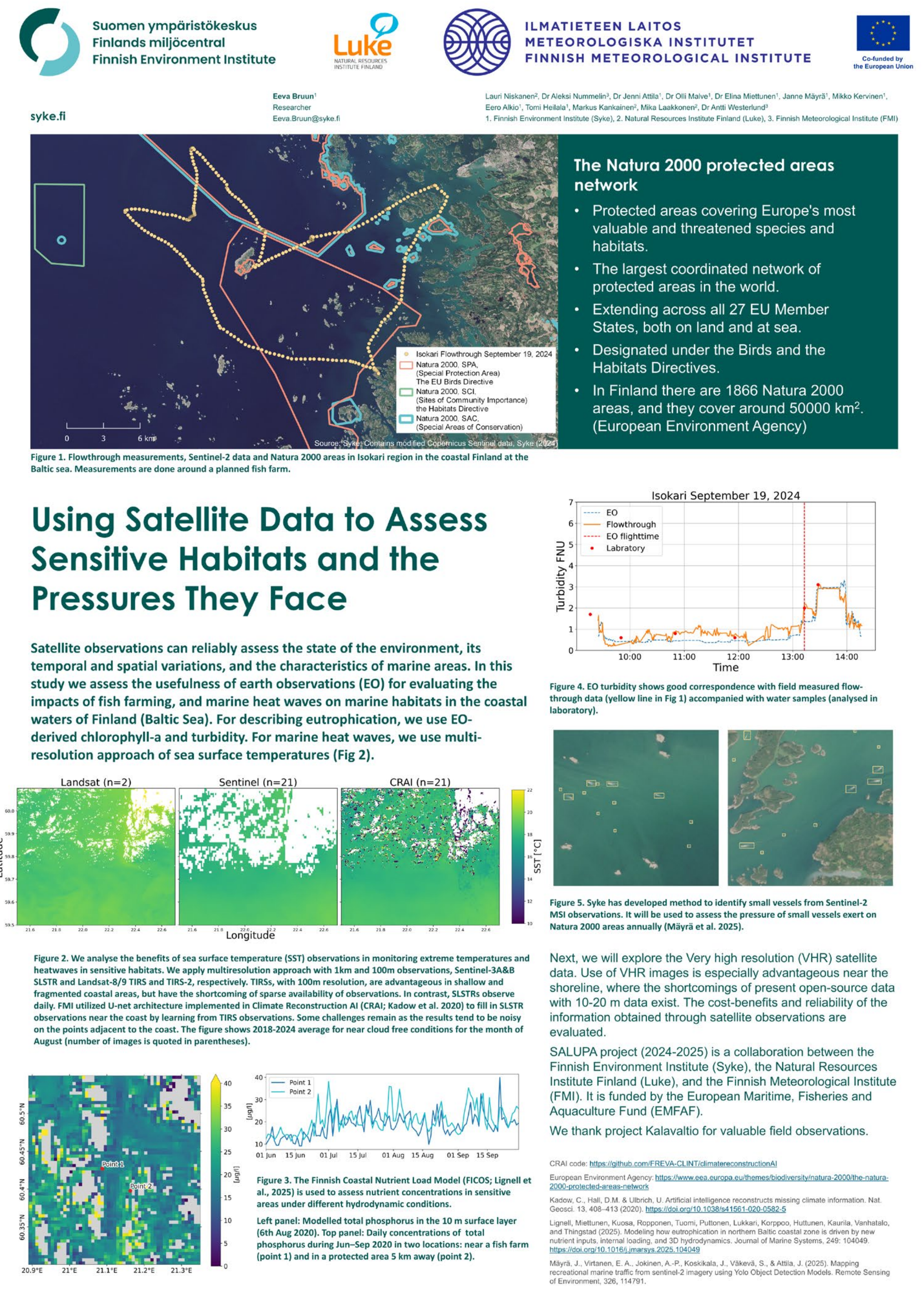
Using Satellite Data to Assess Sensitive Habitats and the Pressure They Face

Finnish Environment Institute (Syke), Ms Eeva Bruun, , Dr Jenni Attila , Dr Olli Malve , Dr Elina Miettunen Mr Janne Mäyrä, Mr Mikko Kervinen, Mr Eero Alkio , Mr Tomi Heilala
Natural Resources Institute Finland (Luke), Mr Lauri Niskanen, Mr Markus Kankainen , Mr Mika Laakkonen, Mr Jari Niukko
Finnish Meteorological Institute (FMI). Dr Aleksi Nummelin , Dr Antti Westerlund

- ✓ Satellite data provides efficient monitoring of sensitive marine habitats across large areas.
- ✓ Fish farming impacts can be detected using EO-based turbidity and chlorophyll indicators.
- ✓ Marine heatwaves are mapped reliably by combining high-resolution Landsat temperatures with daily SLSTR data.
- ✓ Small vessel detection from Sentinel-2 offers a new way to quantify human pressure on Natura 2000 sites.
- ✓ Field data and models support validation, using flow-through measurements, lab samples, and the FICOS nutrient model to understand changes under varying conditions.



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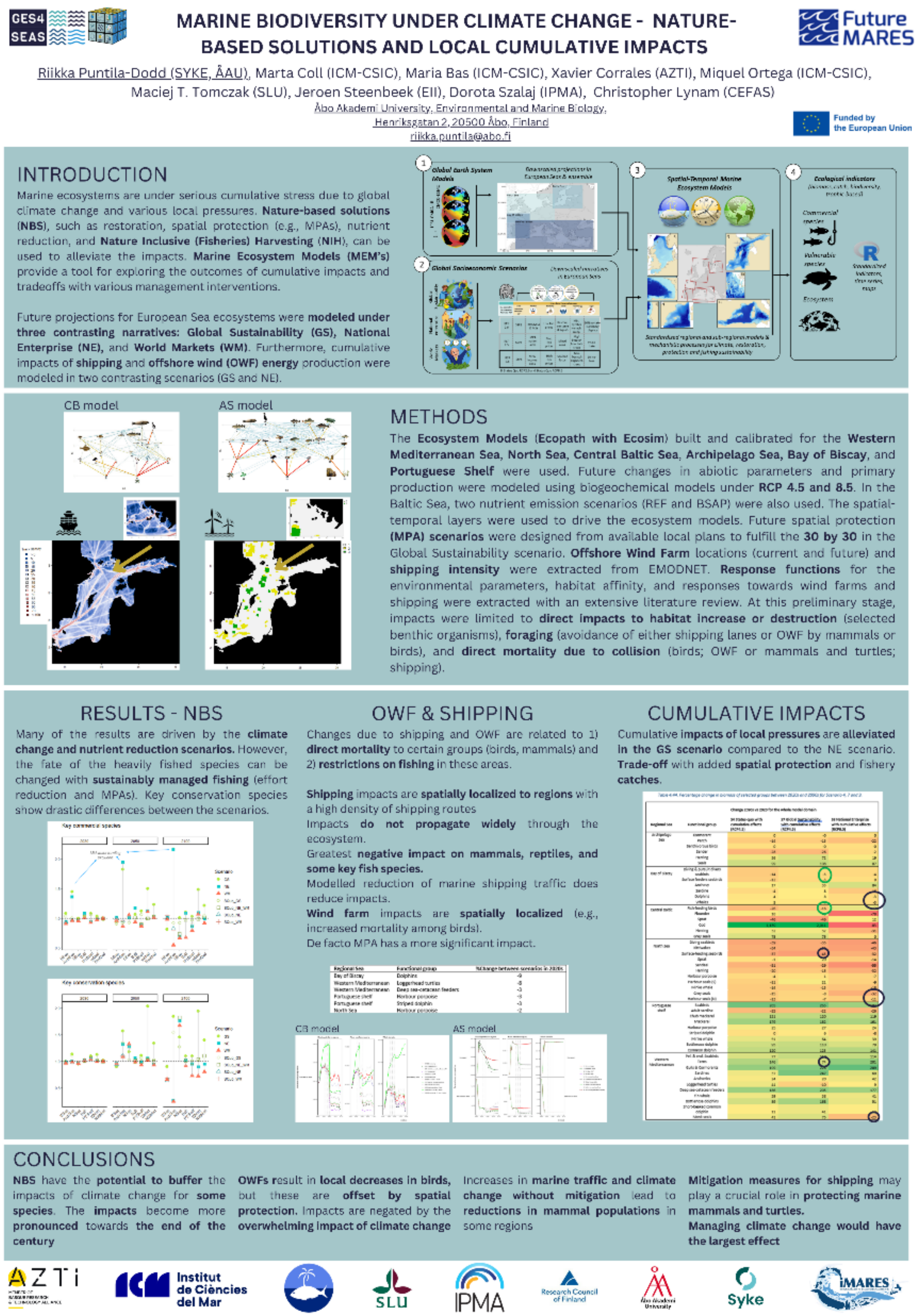
MARINE BIODIVERSITY UNDER CLIMATE CHANGE - NATURE-BASED SOLUTIONS AND LOCAL CUMULATIVE IMPACTS

Riikka Puntila-Dodd et al.
Åbo Akademi/Syke

- ✓ The marine environment experiences multiple, often cumulative pressures
- ✓ NBS have potential for alleviation of impacts
- ✓ Modelling tools have been limited
- ✓ Ecosystem modelling provides opportunities for evaluating the impacts of individual and cumulative pressures
- ✓ NBS can be effective in protecting some species, but curbing CC is the key



Marine Research Laboratory

Anne-Mari Luhtanen
Finnish Environment Institute (Syke)

- ✓ Information about Syke's Marine Research Laboratory in Viikki
- ✓ Expertise and facilities
- ✓ Analyses
- ✓ Equipment for field work

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

syke.fi | ymparisto.fi

Photo: Ilkka Lastumäki, Syke

Baltic Sea monitoring and marine research

The Marine Research Laboratory at Syke produces analyses and measurements for the Baltic Sea monitoring programme. The monitoring programme is part of the European Union's common maritime policy.

Laboratory also provides expert personnel, facilities, and equipment for marine research needs.

Marine Research Laboratory

Viikki, Helsinki

ilac-MRA

FINAS Finnish Accreditation Service
T003 (EN ISO/IEC 17025)

Syke's Marine Research Laboratory is a FINAS-accredited laboratory. The operations meet the requirements of the standard SFS-EN ISO/IEC 17025. FINAS T003.

The Marine Research Laboratory of the Finnish Environment Institute (Syke) is part of the national marine research infrastructure FINMARI. The laboratory offers analysis and research services to Syke researchers and partners. Through national and international research infrastructure projects, other entities can also apply for laboratory time for research.

Expertise and facilities

The skilled and experienced staff of the Marine Research Laboratory are the foundation of all operations.

Expertise (Baltic Sea):
- Phytoplankton (also cultivation)
- Zooplankton
- Benthic animals
- Nutrient analyses (NO2, NO2+3, TOTN, NH4, PO4, TOTP, SiO4)
- Hydrographic analyses (pH, alkalinity, oxygen, hydrogen sulfide)
- Chl-*a*
- Carbon cycling + nitrogen (DIC, DOC/N, TOC/N, POC/N, TPC)
- Microplastics
- Bio-optics, particle analysis and imaging

Facilities
- Molecular biology laboratory
- Isotope laboratory
- Microplastics laboratory
- Indoor mesocosm facilities
- Temperature and light controlled cold rooms for experimental research
- Microscopy facilities

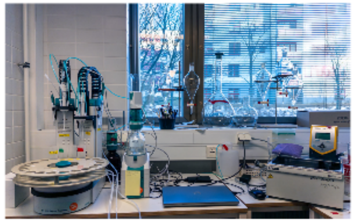
Field work

Marine Research Laboratory has up-to-date equipment for marine field work, e.g.:

- Benthic lander
- Various in-situ sensors especially for biogeochemical and optical studies
- Imaging Flow Cytobot, CytoSense and FlowCam imaging instruments for plankton research
- AquaBox automated multichannel and multiparameter sampling and measurement unit
- Sediment traps
- Octonaut transportable outdoor cabin for instruments
- Bredel large volume hose pump (10512 L/h)
- Laboratory and sampling marine containers

Other resources

- Microalgae culture collection
- Sampling requests from Aranda monitoring cruises and Alg@line Ferryboxes



Automatic titrator for alkalinity and oxygen. Photo: Ilkka Lastumäki

CytoSense scanning and imaging flow cytometer . Photo: Ilkka Lastumäki

QR code: more information about Marine Research Laboratory in Syke

Contact: Anne-Mari Luhtanen, anne-mari.luhtanen@syke.fi

User agreement to work in FINMARI facilities

FINMARI Management Group

- ✓ You must fill in new form before using any FINMARI facilities.
- ✓ The form helps us organize access to labs, instruments, and technical support so everything runs smoothly.
- ✓ We also need this information for reporting to the Research Council of Finland and European research infrastructures.
- ✓ All FINMARI partners will start using similar form in 2026 except Tvärminne and Seili

Access application / user agreement: FINMARI Marine Research Infrastructure facilities

Syke Marine research laboratory, RV Aranda, Utö research station & field equipment

Please, complete this booking form to ensure the availability of services and facilities for your project.

Liity skannaamalla QR-koodi tai käyttämällä linkkiä

https://forms.office.com/e/PGUxvE6W6w

Kopioi linkki

FINMARI at GTK

Aarno Kotilainen & Joonas Virtasalo
Geological Survey of Finland (GTK)

- ✓ In our poster, we present GTK's main marine geological research infra
- ✓ Do get in contact for access and collaboration

Services for Marine research

Authors: Jari Hänninen & Katja Mäkinen
Institution: Archipelago Research Institute, Seili

- ✓ Please, check options Seili field station can offer for your marine research. Come to see our poster for details and connections.

SERVICES FOR MARINE RESEARCH

UNIVERSITY OF TURKU | ARCHIPELAGO RESEARCH INSTITUTE | TURKU ARCHIPELAGO - SEILI | RESTAT | INAR | EMBRC | FinMARI

ARI The *Archipelago Research Institute* of Turku University, located at the Seili island, has been established in a former 18th century asylum, which has been converted into a modern state-of-the-art international marine research facility. The neoclassically built environment provides an ideal, inspiring and unique framework for conducting high quality marine research. SITES.UTU.FI/SEILI/

EMBRC Besides FINMARI, the services offered at ARI are also part of the *European Marine Biological Resource Centre*, which provides access to marine ecosystems and experimental platforms, and related services, to researchers from both academia and industry. WWW.EMBRC.EU

ENVIRONMENTAL MONITORING
- As a part of global ODAS network, ARI provide sixty-year-long environmental time series of seawater temperature (°C) and salinity (PSU), and meso-zooplankton community composition from 0-45 deep water column from institute's fixed monitoring station north of Seili island.
- Since the early 1980s, ARI has also monitored the characteristics of the spawning herring population in the Archipelago Sea as part of a long-term project on herring reproductive biology.
- Downloadable automatic seawater measurements from Seili automatic profiling buoy, with weather station and eutrophication predictions for the next 10 days, to complement the manual measurements for higher sampling frequency and real-time data acquisition (SAARISTOMERI.UTU.FI/ODAS_FI/)

VESSELS, equipped a range of samplers/probes for field studies (e.g. Nets, Grabbers, Sonars, ROVs, etc.)
r/v Aurelia
- Max. capacity 40 persons (+ 2 crew; the vessel is hired only with crew)
- Overall length 18.1m, beam 5m, draft 1.5m, max. speed 15 knots, gross tonnage 5.8 t.
- Outdoor working space (16.4 m²), Lowered sampling deck (15.5m², small laboratory/wet lab space (2.9 m²)

Minor Range 7600 & Faster 515 motor boats, available for transportations and sampling trips in the Archipelago Sea
- Max. 6-8 passengers
- Lengths 5.1-7.5 m
- Powers 60-160 hp

EXPERIMENTAL FACILITIES
- Three drylabs and four wetlabs, classrooms, cold facilities, superfreezers (-80°C), etc.
- Ten indoor experimental racks with nine 10-30 litre aquaria tanks each with temperature-controlled flow-through seawater and adjustable light periods and spectra
- Outdoor flow-thru mesocosms with 16 units tanks (120 litre), equipped with wave machines if needed

For more information of our possibilities, see SITES.UTU.FI/SEILI/

Services for Marine Research at Tvärminne – where to next?

- ✓ The "Tvärminne Hub" to integrate research, scientific diving, science education and outreach
- ✓ Come and check out the current "architect's vision". What would you like to see in there?

SERVICES FOR MARINE RESEARCH

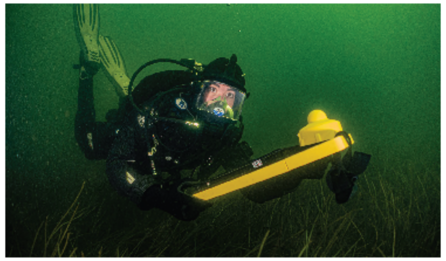
UNIVERSITY OF HELSINKI

TVÄRMINNE ZOOLOGICAL STATION

Over 120 years of Baltic Sea research, now focusing on the links between coastal biodiversity, ecosystem functioning and climate change. Our competent staff has experience on various instrument deployments and experimental setups both in the field and in the laboratory. We are happy to help you from the planning to the execution. TZS offers in-house lodging and catering facilities for visiting researchers. The sauna is very popular!

EMBRC The services offered at TZS are part of the European Marine Biological Resource Centre, which provides access to marine ecosystems and experimental platforms, and related services, to researchers from both academia and industry.
WWW.EMBRC.EU

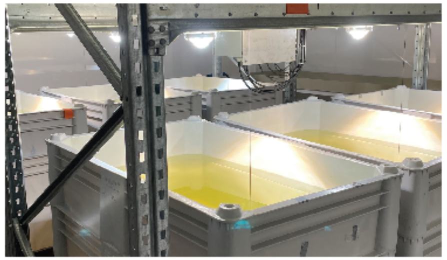
SCIENTIFIC DIVING
Sampling and instrument deployment; supported by the Finnish Scientific Diving Academy specialising in advanced training and support for underwater research.



ENVIRONMENTAL MONITORING
- Unique, over hundred-year-long datasets of biological and hydrographical parameters
- Automatic measurements to complement the manual measurements for higher sampling frequency and real-time data acquisition (www.helsinki.fi/monicoast)
- Part of the European Marine Omics Biodiversity Observation Network (EMOBON), sampling water column, soft substrates, and hard substrates
- ICOS station for atmospheric and oceanic greenhouse gas measurements

EXPERIMENTAL FACILITIES
- Experimental tanks in temperature-controlled rooms from 10 litre aquaria to 12 x 600 litre tanks, with flow-through seawater and adjustable light spectra
- Can be fitted with automated sensors (temp, cond, oxygen)
- Outdoor mesocosms of up to 5 m3 volume, with 12 units (flexible plastic bags) attached to a floating raft

ECOSYSTEM ACCESS AND FIELD EXPERIMENTS
- Access to a range of habitats from inner to outer archipelago and outer sea within an MPA managed by the station
- Research vessels of different sizes: R/V Augusta (18 m catamaran), hovercraft for winter sampling, and a range of smaller boats for coastal sampling also suitable for diving operations
- Standard sampling equipment such as water samplers, plankton nets, sediment corers and grabs, and handheld probes (CTD, oxygen)



LABORATORY SERVICES
- Water chemistry (e.g., nutrients, chlorophyll, carbonate system) and sediment analyses
- Molecular biology laboratory facilities
- Stereomicroscopes, upright and inverted microscopes fitted with cameras, some with fluorescence capability

FINMARI PHYTOPLANKTON CULTURE COLLECTION
- Approx. 100 species strains of Baltic Sea phytoplankton, cultivated at +4 °C and +16 °C, salinity 6
- For ecological and applied research, instrument testing, harmonization of methods and education

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