BLUE MISSION BANOS

2nd MISSION ARENA
25-26 April 2024 | Riga, Latvia

Workshop: Innovative Strategies for Restoring Lakes and Rivers

Framing the restoration measures

Mikael Malmaeus, IVL Swedish Environmental Research Institute

THEME: Mission Ocean & Waters

#Arena2

EU MISSIONS RESTORE OUR OCEAN & WATERS

Funded by the European Union

This is LIFE IP Rich Waters

Rich Waters is Sweden's first integrated project (IP) within the EU's LIFE Programme. The project started in January 2017 and will be implemented for 7,5 years. The overall goal is to improve the aquatic environment in the Northern Baltic Sea River Basin District.

Rich Waters is a partnership between national authorities, municipalities, companies, researchers and water preservation associations.

The project aims to boost the full implementation of the River Basin Management Plan of the Northern Baltic Sea District.

https://www.richwaters.se/

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https://www.richwaters.se/

Themes

Eutrophication from agriculture, waste water and storm water

Eutrophication – internal loading

Connectivity

Environmental pollutants

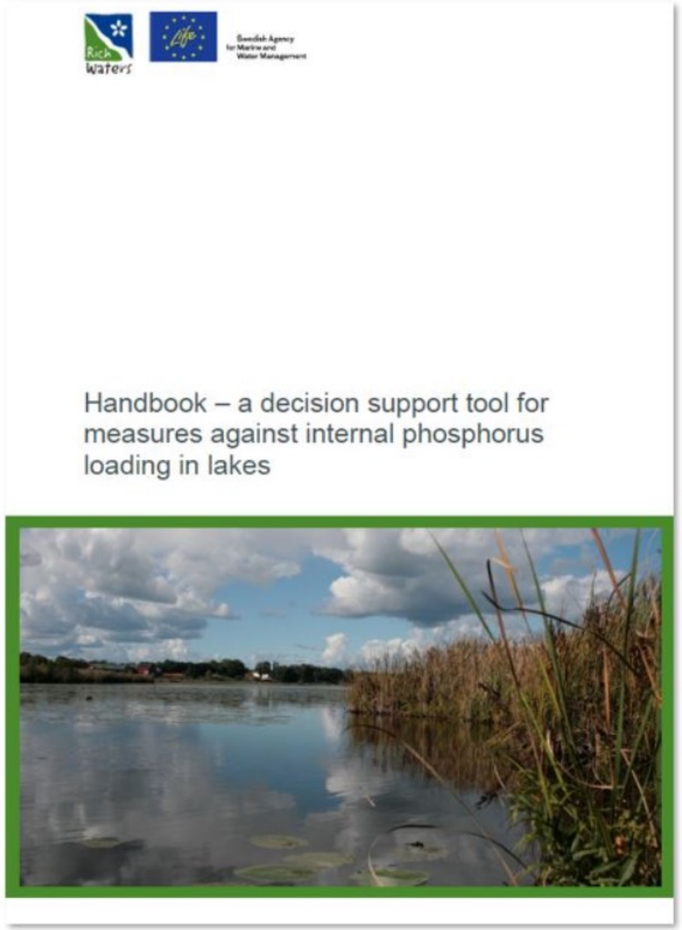
Water planning

Life

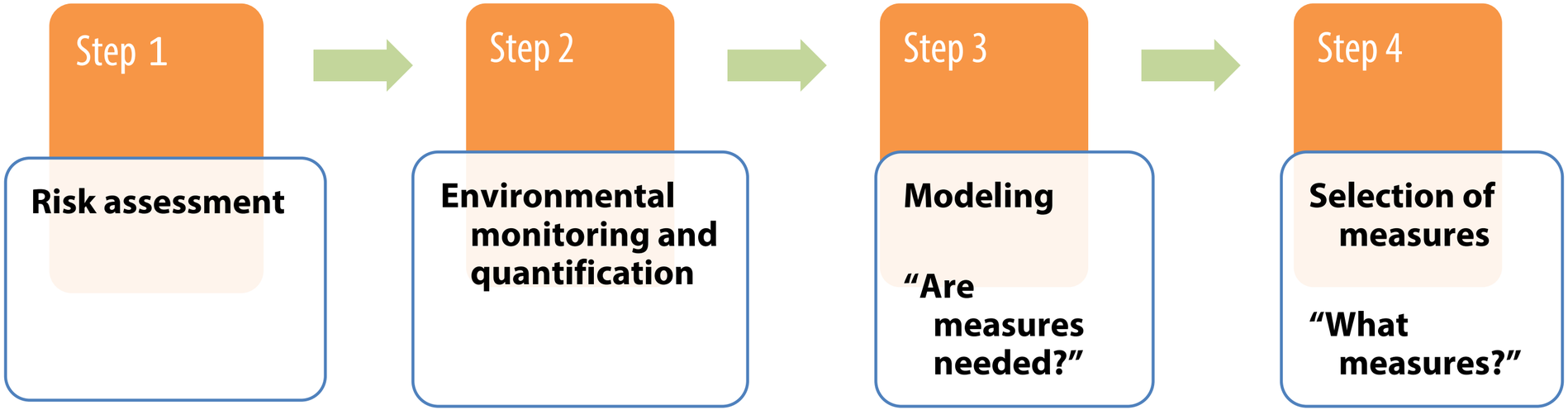
Rich Waters

Decision support tool for measures against internal loading – ”Handbook”

https://www.richwaters.se/handbook-a-decision-support-tool-for-measures-against-internal-phosphorus-loading-in-lakes/



Handbook for measures against internal loading – 4 steps



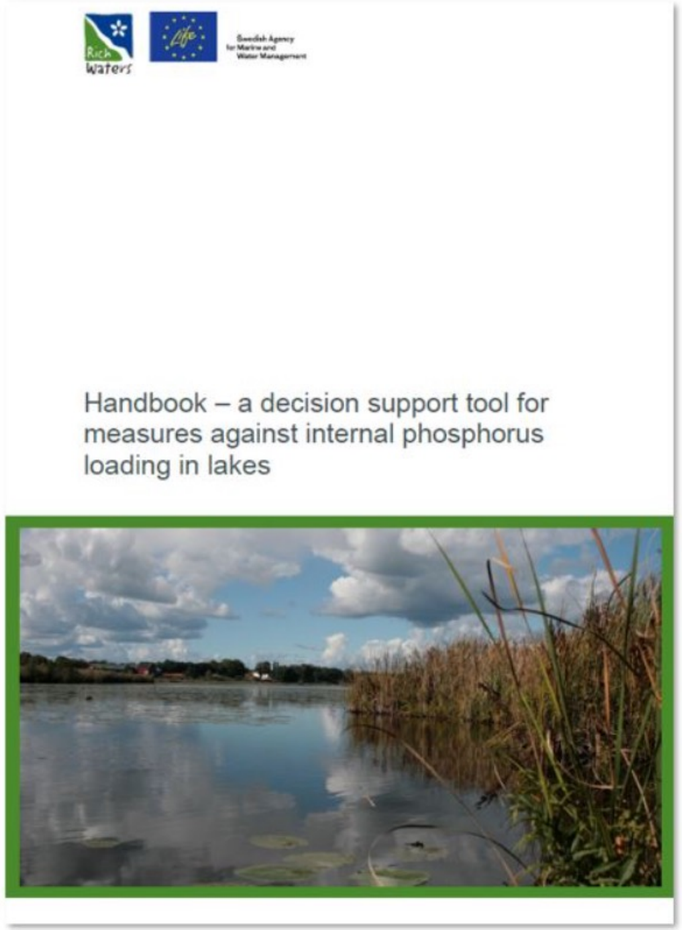
Step 4 – Selection of measures

Measure	Applicability	Drawbacks/ uncertainties	Potential positive secondary effects	Cost	CO2 footprint
Aluminum precipitation	General, well tested	Energy and resource intensive		Low	High
Conventional dredging	Small areas	Energy and resource intensive		Medium	High
Low flow dredging	Under development		Utilization of nutrients in agriculture or forestry	High	Medium
Hypolimnion draining	Stratified water		Utilization of nutrients on nearby fields or forest		
Oxygenation	Areas with low oxygen levels	Needs to take place over longer timespans	Beneficial for higher animal life	Low	Medium
Reduction fishing	Areas with dense populations of white fish		Beneficial for flora and fauna (bio-manipulation), utilization of food/feed resource	Medium	Low
Mussel cultivation	Under development		Utilization of food/feed resource		Low

Life Rich Waters

ivl SVENSKA MILJÖINSTITUTET

Decision support tool for measures against internal loading – ”Handbook”



https://www.richwaters.se/handbook-a-decision-support-tool-for-measures-against-internal-phosphorus-loading-in-lakes/

https://www.richwaters.se/

RESTORATION OF SMALL RIVERS IN LATVIA

Jānis Šīre
Project Manager
25.04.2024.

EU LIFE Programme integrated project
"Implementation of River Basin Management Plans of Latvia towards good surface water status"

THE OVERALL AIM

To **improve the status of water bodies at risk in Latvia** by implementing the measures laid down in all 4 river basin management plans

19 partner consortium, consisting from:

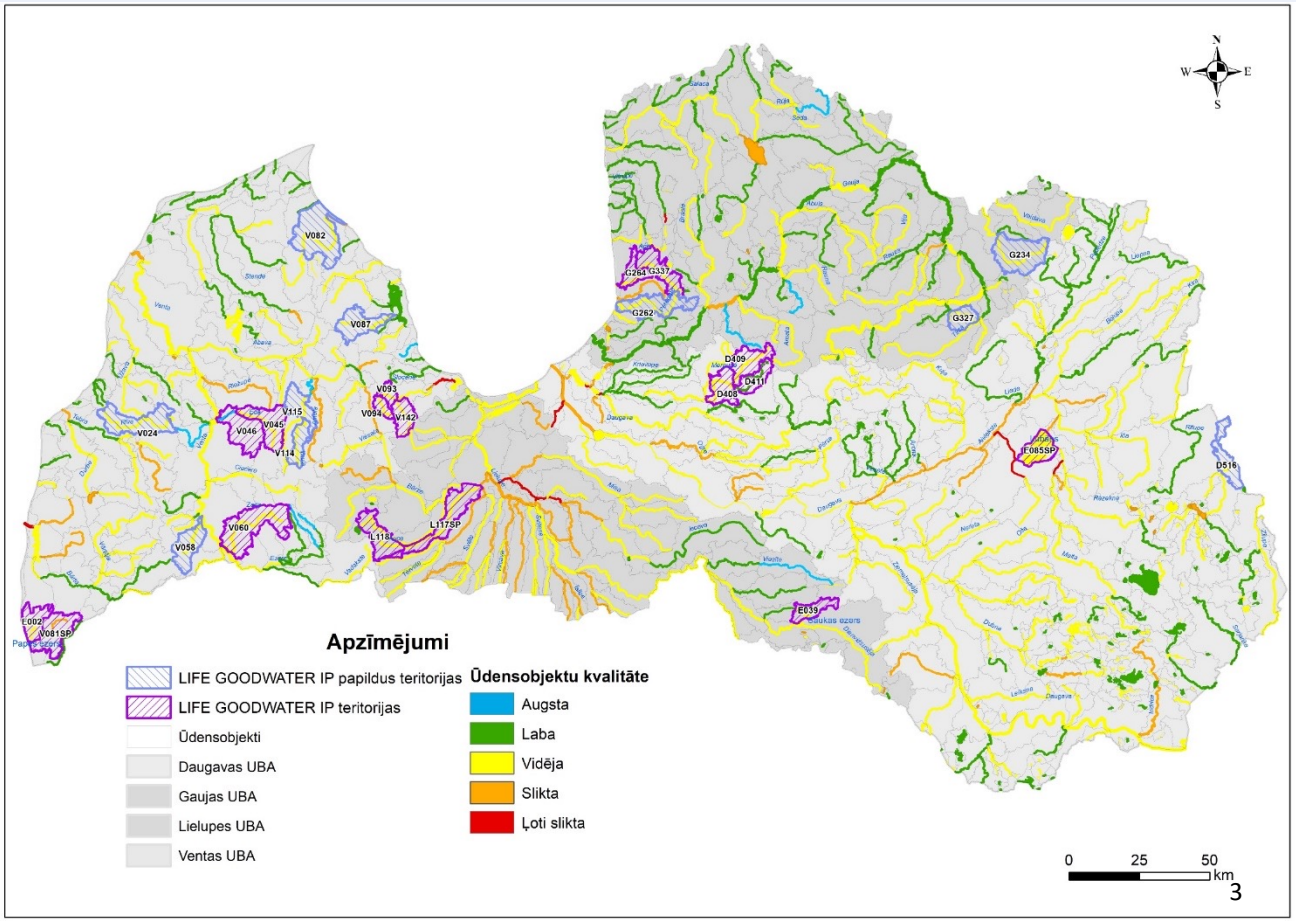
- public authorities;
- municipalities;
- scientific organizations;
- companies managing the State property;
- NGO`s (from farmers to environmental protection organizations)

EU LIFE Programme integrated project
"Implementation of River Basin Management Plans of Latvia towards good surface water status"

DURATION:
01.01.2020.–31.12.2027.

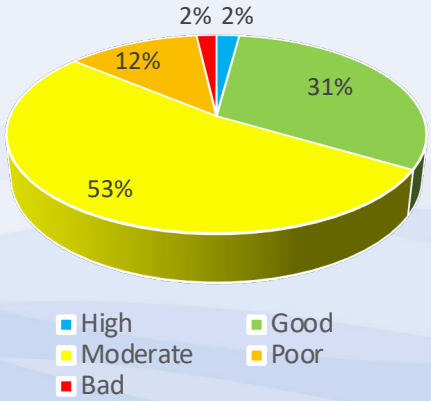
TOTAL BUDGET:
14 463 050 EUR

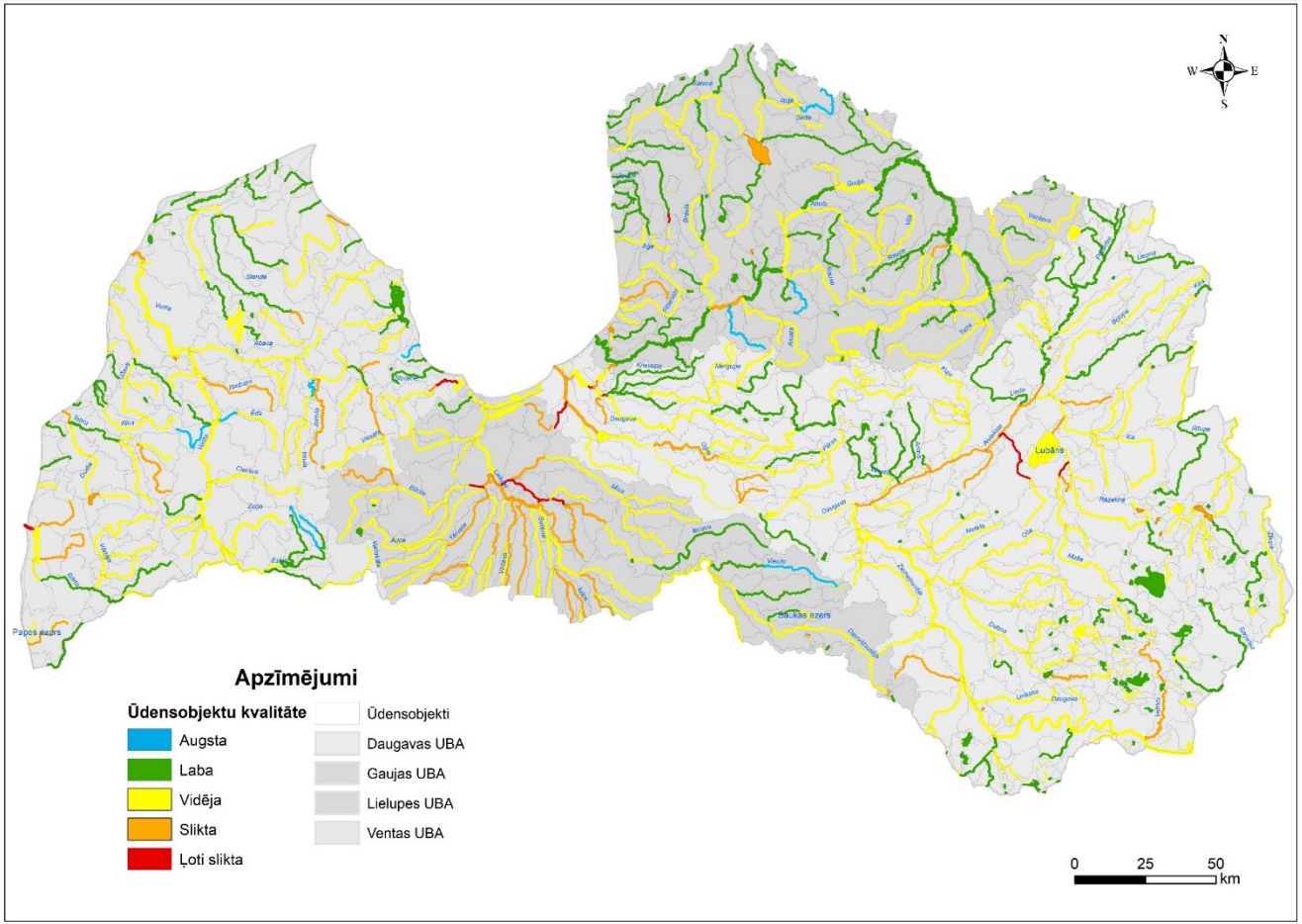
COMPLEMENTARY FUNDS:
101 890 569 EUR



ECOLOGICAL WATER QUALITY IN LATVIA

2022

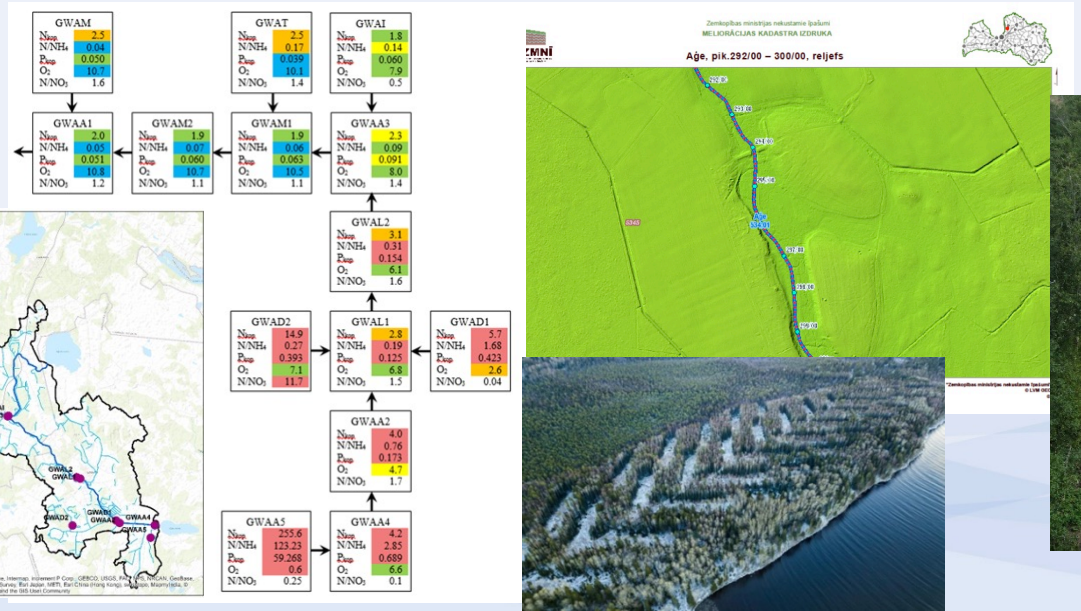




SPECIFIC OBJECTIVES

✓reduce the **diffuse pollution** from agricultural and forestry lands:

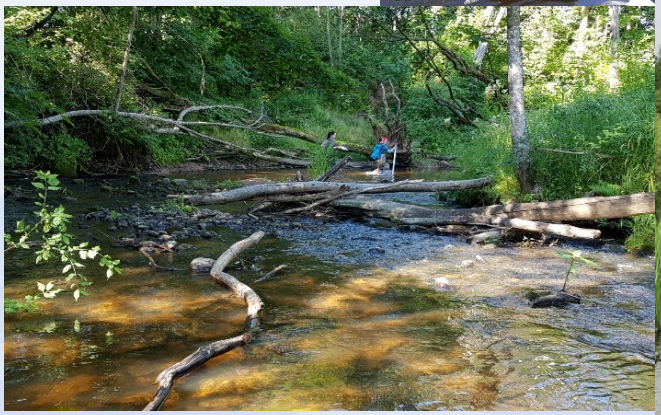
- **research** (monitoring) in Aģe, Slocene, Auce and Ēda river basins;
- **green infrastructure solutions** such as intelligent buffer strips, swales, constructed wetlands, controlled drainage, sedimentations ponds, wood chips bioreactors, …



SPECIFIC OBJECTIVES

✓mitigate effects of **hydrological and morphological alterations**, focusing not only on barriers, but also on drainage systems:

- **hydromorphological survey of 4 rivers (RHS & THS)** along their entire length (Aģe, Mergupe, Auce and Zaņa);
- **inspection of drainage systems** and construction of environmentally friendly elements, incl. culvert reconstruction
- **estimation of ecological flow regime** for 7 HPPs in 4 rivers
- **construction of a fish pass** (on HPP)



SPECIFIC OBJECTIVES

✓**awareness raising** activities:

- 4 thematic training programs developed (wastewaters, agriculture, forestry, aquaculture) **https://macies.goodwater.lv/**;
- river clean-ups, exhibitions and landscape tours;
- a small grant program for local cooperation and involvement:
  - **8 initiatives** approved (implemented / in process)

KNOWLEDGE TRANSFER & INVOLVEMENT OF SOCIETY

Clean-up event in Zaņa river (2023)

KNOWLEDGE TRANSFER & INVOLVEMENT OF SOCIETY

Removing of barriers

EU LIFE Programme integrated project
"Implementation of River Basin Management Plans of Latvia towards good surface water status"

LET THE WATERS FLOW!

goodwater.lv LIFEGoodWaterIP LIFEGoodWaterIP LIFEGoodWaterIP LIFEGoodWaterIP LIFEGoodWaterIP

The integrated project "Implementation of River Basin Management Plans of Latvia towards good surface water status" (LIFE GOODWATER IP, LIFE18 IPE/LV/000014) has received funding from the LIFE Programme of the European Union and the State Regional Development Agency Republic of Latvia.

www.goodwater.lv

BLUE MISSION BANOS

2nd MISSION ARENA
25-26 April 2024 | Riga, Latvia

Innovative Strategies for Restoring Lakes and Rivers: Aligning with EU Mission “Restore Our Ocean and Waters”

Knowledge transfer and application
Inga Retike, LIAE

THEME: Mission Ocean & Waters

#Arena2

EU MISSIONS RESTORE OUR OCEAN & WATERS

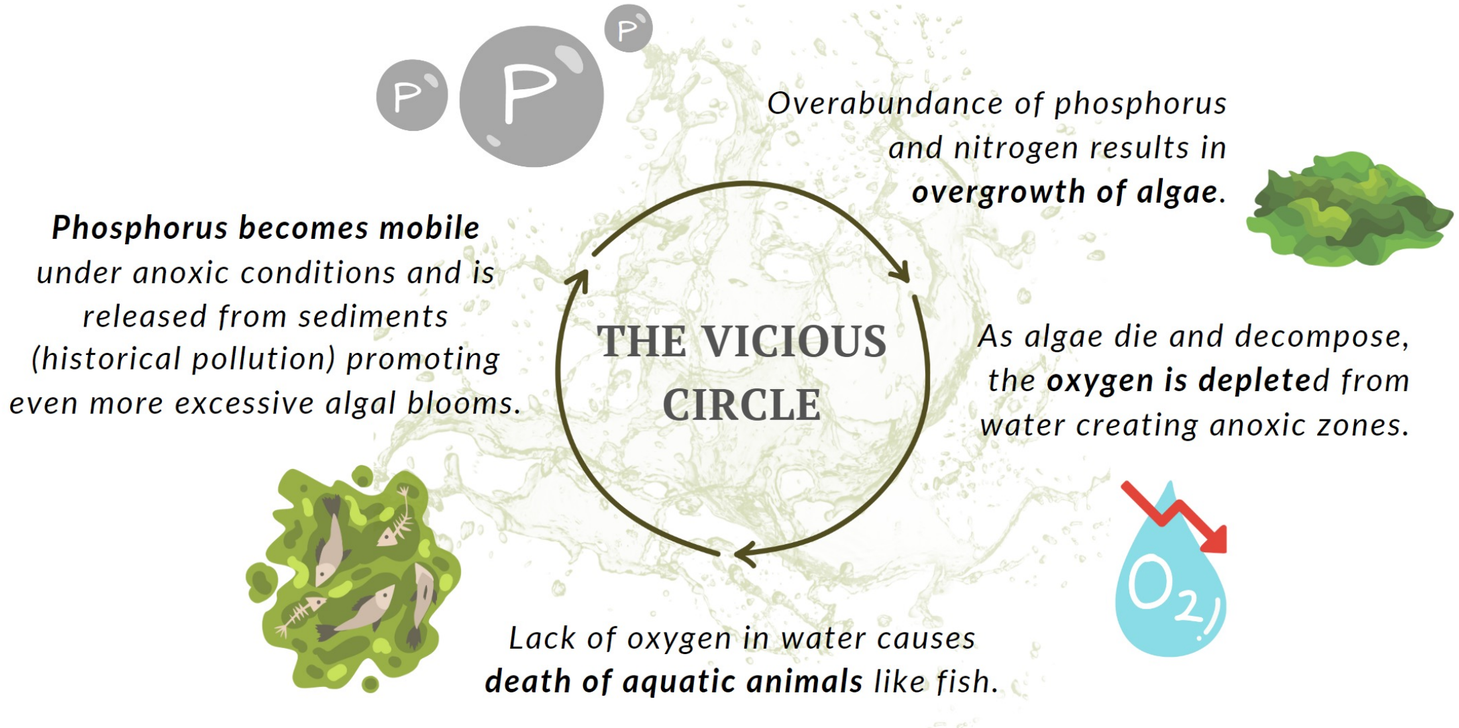
Funded by the European Union

Eutrophication is a joint challenge for the Baltic Sea Region

Up to 40% of Baltic lakes still polluted by phosphorous.

Historical legacy – pollution hotspots.

We need a fast and effective water treatment method.



ALUM method application

Basic treatments for water purification have been documented in Greek and Sanskrit writings, and Egyptians used alum for precipitation as early as 1500 BCE.

ALUM method is a commonly used chemical to treat drinking water, wastewaters and swimming pools.

ALUM method principle

gibbsite

ALUM water treatment method (PAC or polyaluminium chloride) precipitate phosphorous as an insoluble mineral.

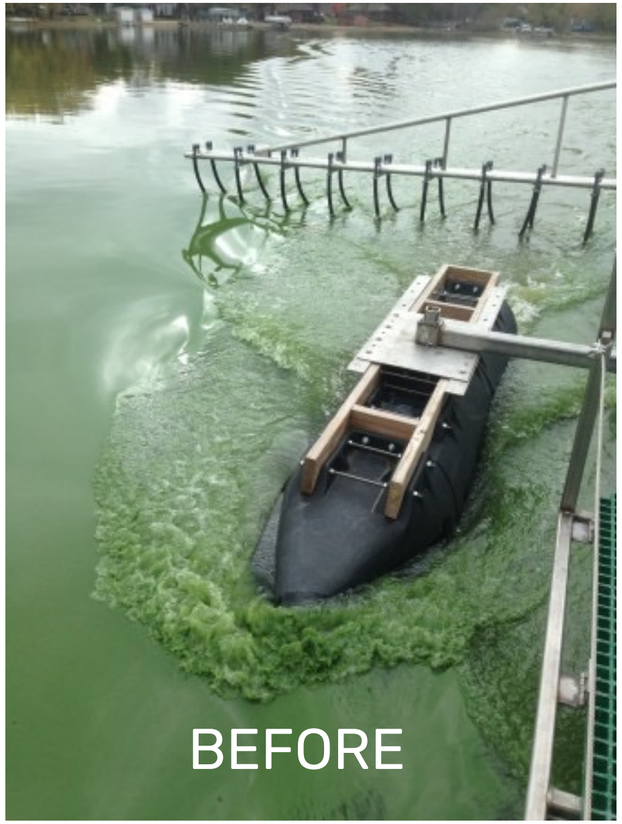
PAC injection into sediments

Automatization and control

Why ALUM water treatment?

ALUM method is fast!

Water clarity improves in several days.

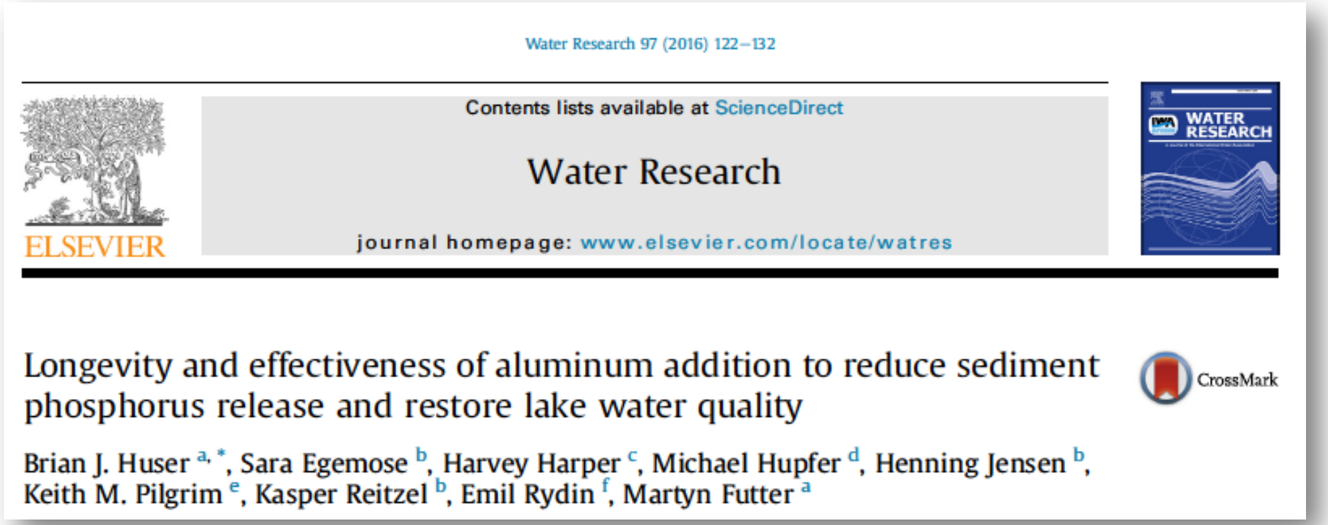


Why ALUM water treatment? (II)

ALUM treatment effect can last forever ∞

60 years of ALUM application on Swedish lakes with dozens of good examples.

Study of 114 lakes in Europe and North America with positive effects up to 45 years (average 11).



Water Research 97 (2016) 122–132

Contents lists available at ScienceDirect

Water Research

journal homepage: www.elsevier.com/locate/watres

Longevity and effectiveness of aluminum addition to reduce sediment phosphorus release and restore lake water quality

Brian J. Huser [a, *], Sara Egemose [b], Harvey Harper [c], Michael Hupfer [d], Henning Jensen [b], Keith M. Pilgrim [e], Kasper Reitzel [b], Emil Rydin [f], Martyn Futter [a]

ALUM limitations

ALUM cannot be used for:

- very shallow lakes (<2m)
- Lakes with low pH
- Lakes with low alkalinity

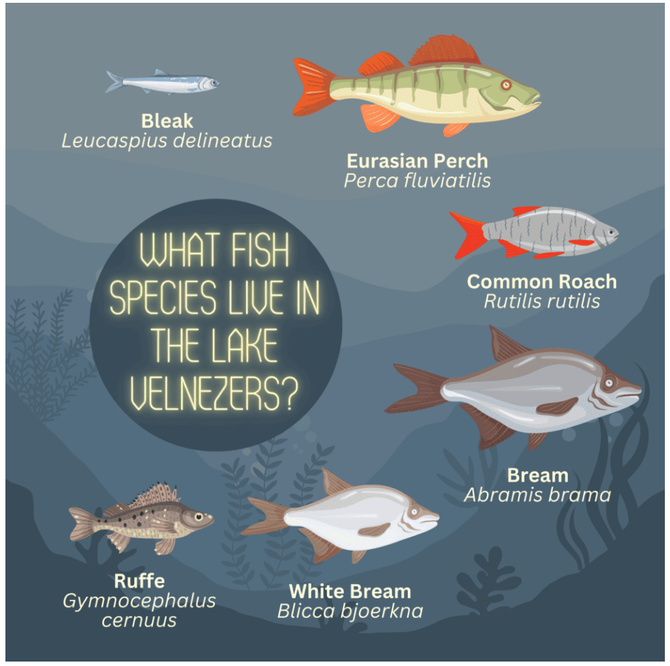
Success of the treatment depends on:

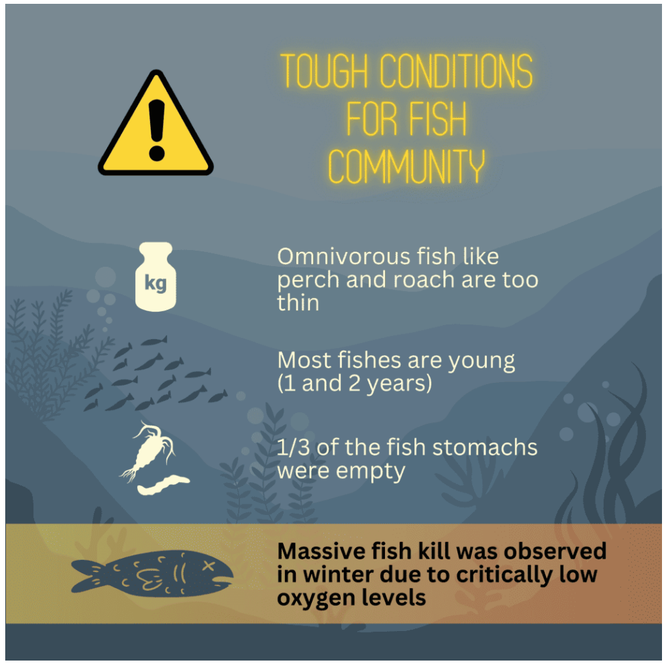
- Elimination phosphorus inputs
- Systematic and detailed lake monitoring (water quality and quantity, sediments, fishes etc.)
- Careful PAC dose modeling
- **Acceptance!!!**

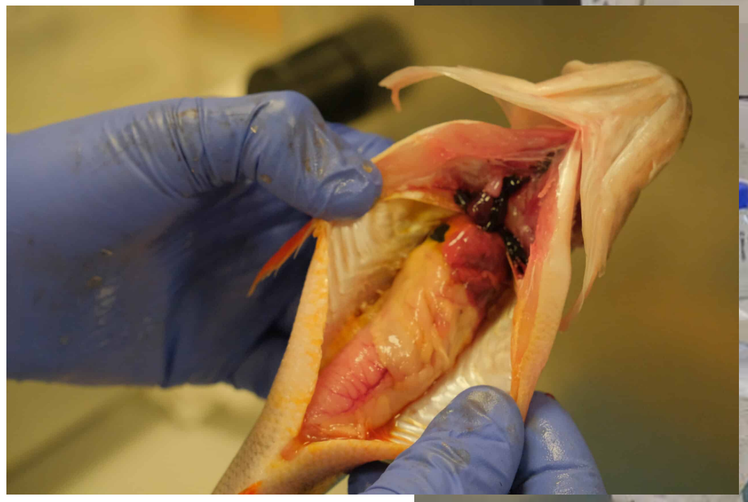
Public fish survey!

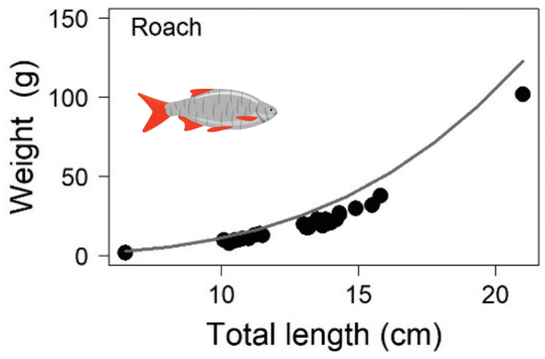
>80 locals and national media

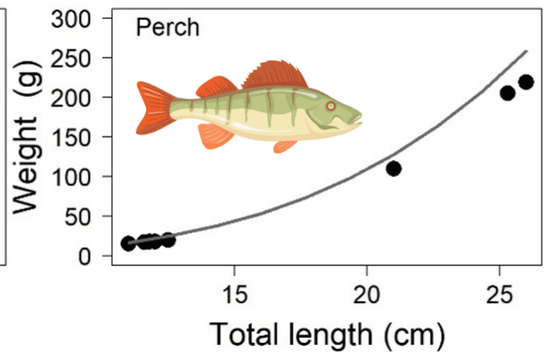
Science communication!

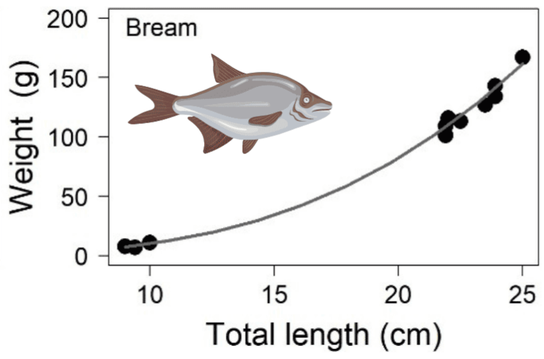


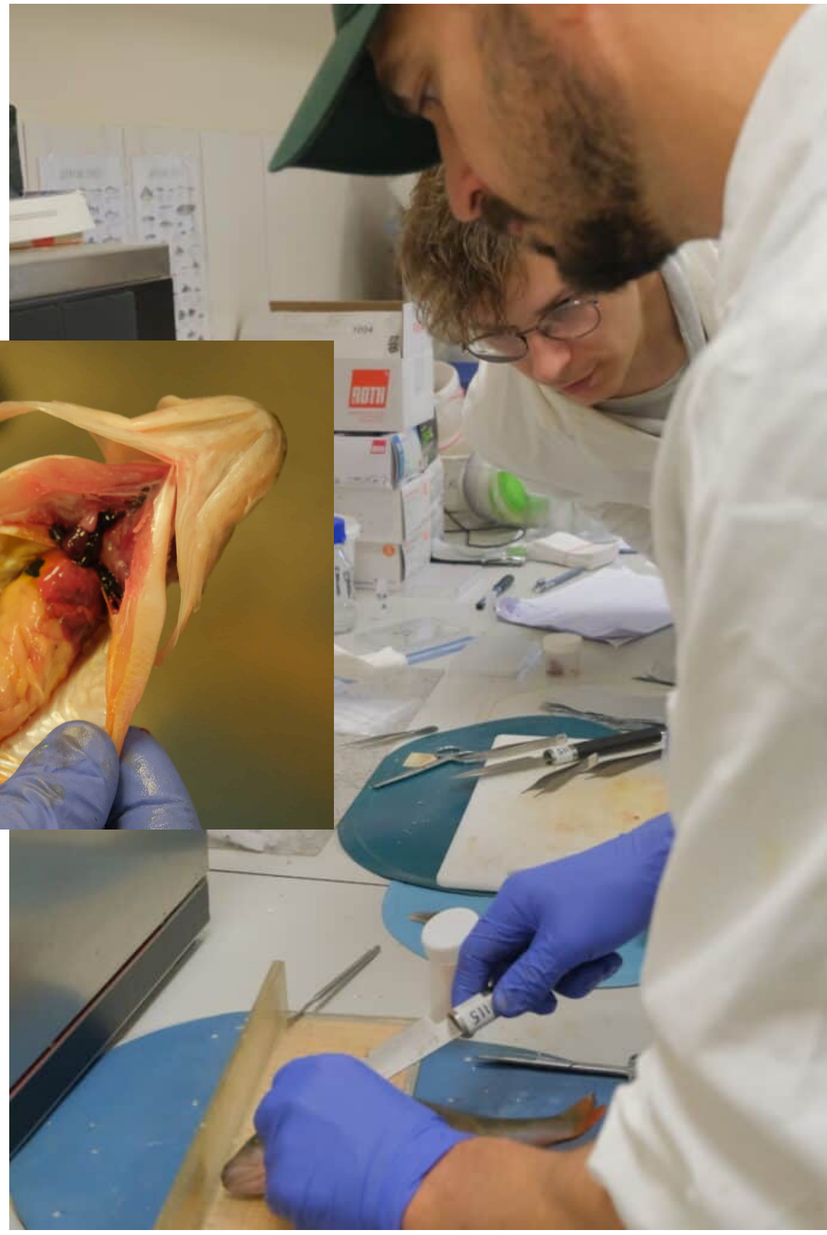




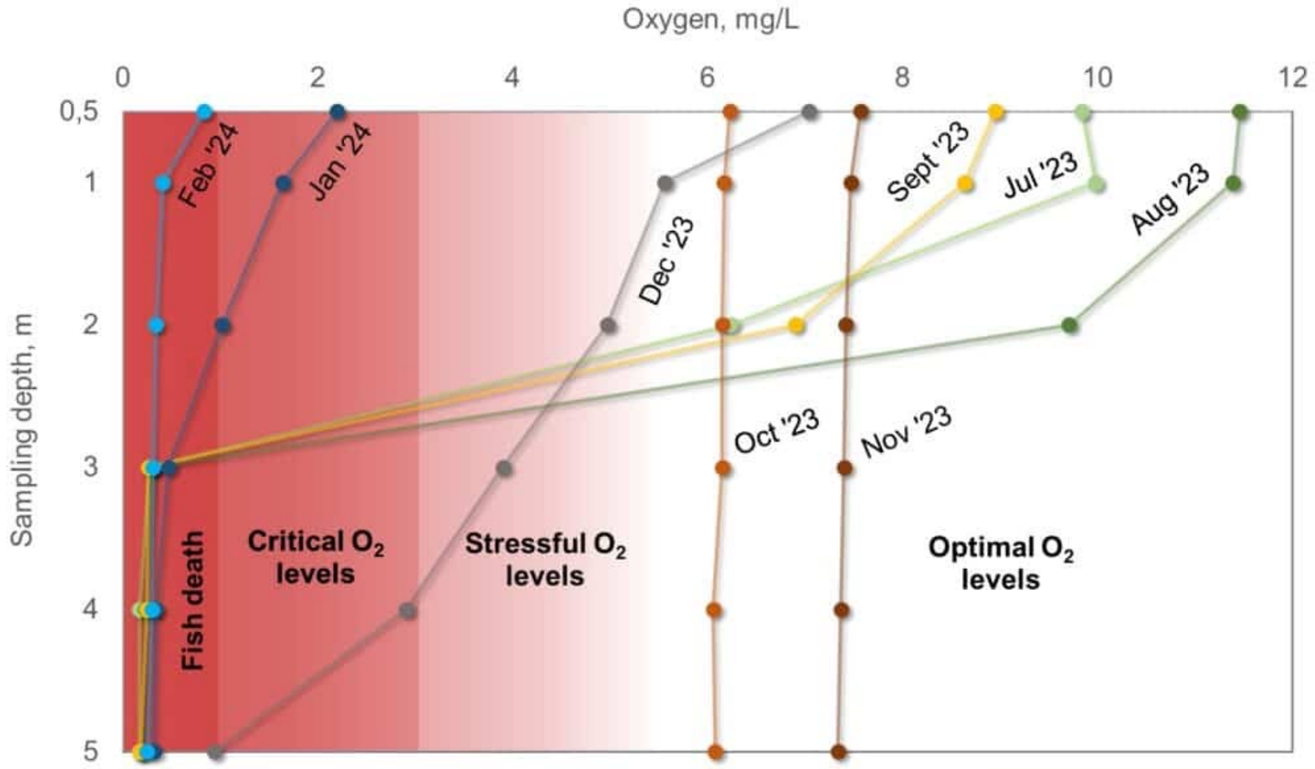








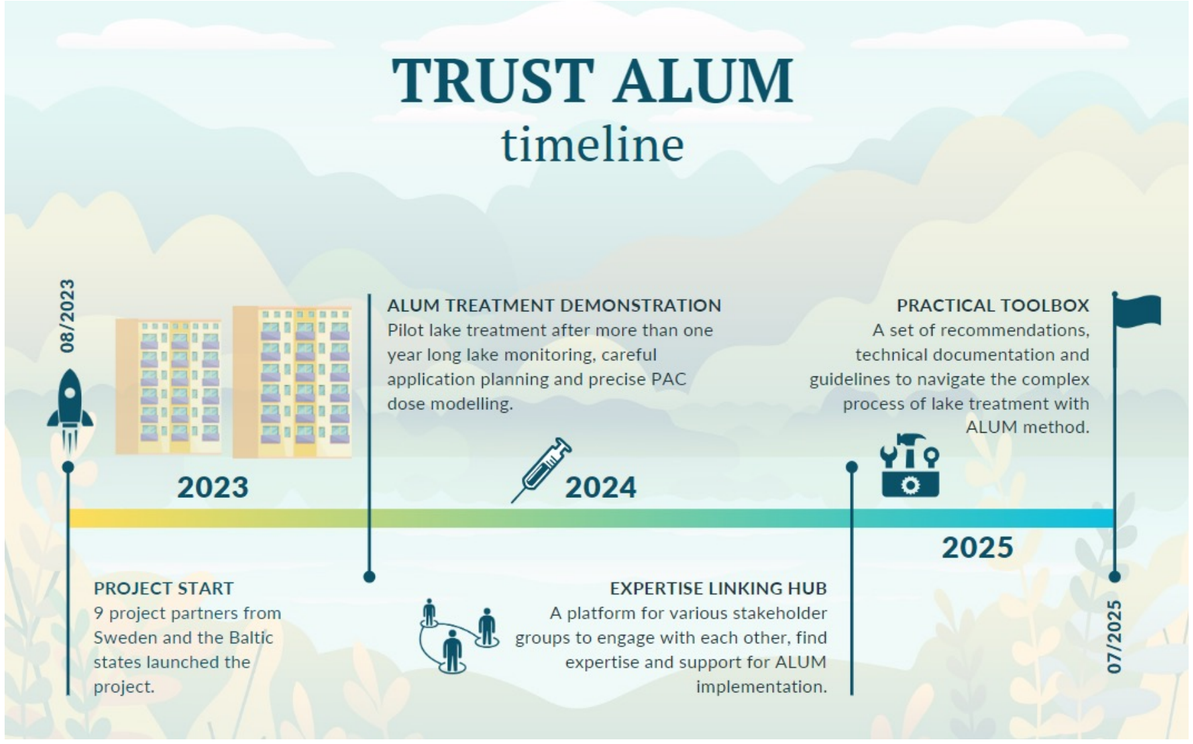
Crisis communication!



Massive fish death in pilot Lake Velnezers

First ALUM piloting in Lake Velnezers (Riga, Latvia)

Already in May 2024!



Community cleanup on 27th April!

TRUST ALUM

Interreg Baltic Sea Region
Co-funded by the European Union
SUSTAINABLE WATERS
TRUST ALUM

BUILDING TRUST IN TARGET GROUPS FOR ALUM TREATMENT - AN EFFECTIVE, YET MISUNDERSTOOD METHOD FOR WATER QUALITY IMPROVEMENT

LATVIJAS HIDROEKOLOĢIJAS INSTITŪTS
SEI Stockholm Environment Institute
RIGA
VATTENRESURS
LAKE RESTORATION
SLU SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCES
Ministry of Environmental Protection and Regional Development Republic of Latvia
State Environmental Service Republic of Latvia
ECAT

9 partners from LV, EE, LT, SE
August 2023 - July 2025

interreg-baltic.eu/project/trust-alum

BLUE MISSION BANOS

2nd MISSION ARENA
25-26 April 2024 | Riga, Latvia

Removing nutrients from lakes using closed-circuit hypolimnetic withdrawal

Laura Härkönen, Senior Research Scientist (Syke) &
Leena Nurminen, Assoc. Prof. (Univ. Helsinki)

Workshop: Innovative Strategies for Restoring Lakes and Rivers

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EU MISSIONS RESTORE OUR OCEAN & WATERS

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Traditional hypolimnetic withdrawal

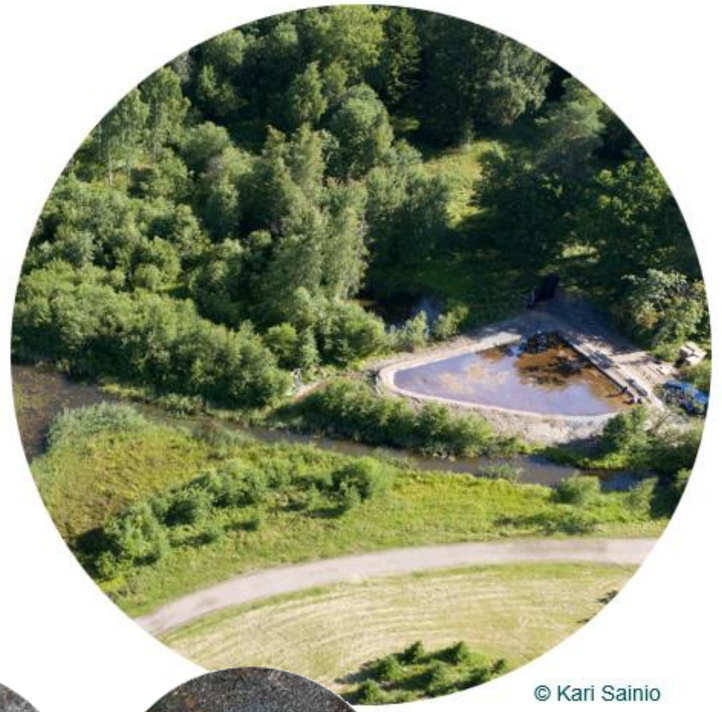
- Removes phosphorus and other nutrients from stratifying eutrophic lakes
  - Nutrient-rich near-bottom water extracted from the lake during stratification
  - Diversion downstream using passive siphoning by gravity or by pumping
- Reduces internal loading and can lead to long-term improvements in water quality
- Can cause eutrophication and nuisance problems in the receiving water bodies
- Additionally, water table level can be affected

Closed-circuit hypolimnetic withdrawal

- A recent, innovative modification by the University of Helsinki and City of Lahti
  - Nutrient-rich near-bottom water extracted from the lake during stratification, diversion to a treatment system on land
- Hypolimnetic water is first aerated, then filtered and returned back to the lake
  - Phosphorus precipitates by Fe oxides and is captured in a sand filter (See Silvonen et al. 2022)
- Prevents the negative downstream water quality impacts and does not affect water level

Lake Kymijärvi pilot, promising results

- Visible difference in incoming vs. outflowing water
  - ~67% retention of TP, ~71-91% of PO_4-P (Silvonen et al. 2022, Silvonen et al. 2023)
  - ~14% of TN retention (Silvonen et al. 2023)
  - Only minor increases (0-12%) in epilimnetic P concentration due to HWTS* effluent (Silvonen et al. 2023)
    - Values falling within the standard deviation of epilimnetic TP concentration
  - For nitrogen, increment slightly higher (1-17 %)

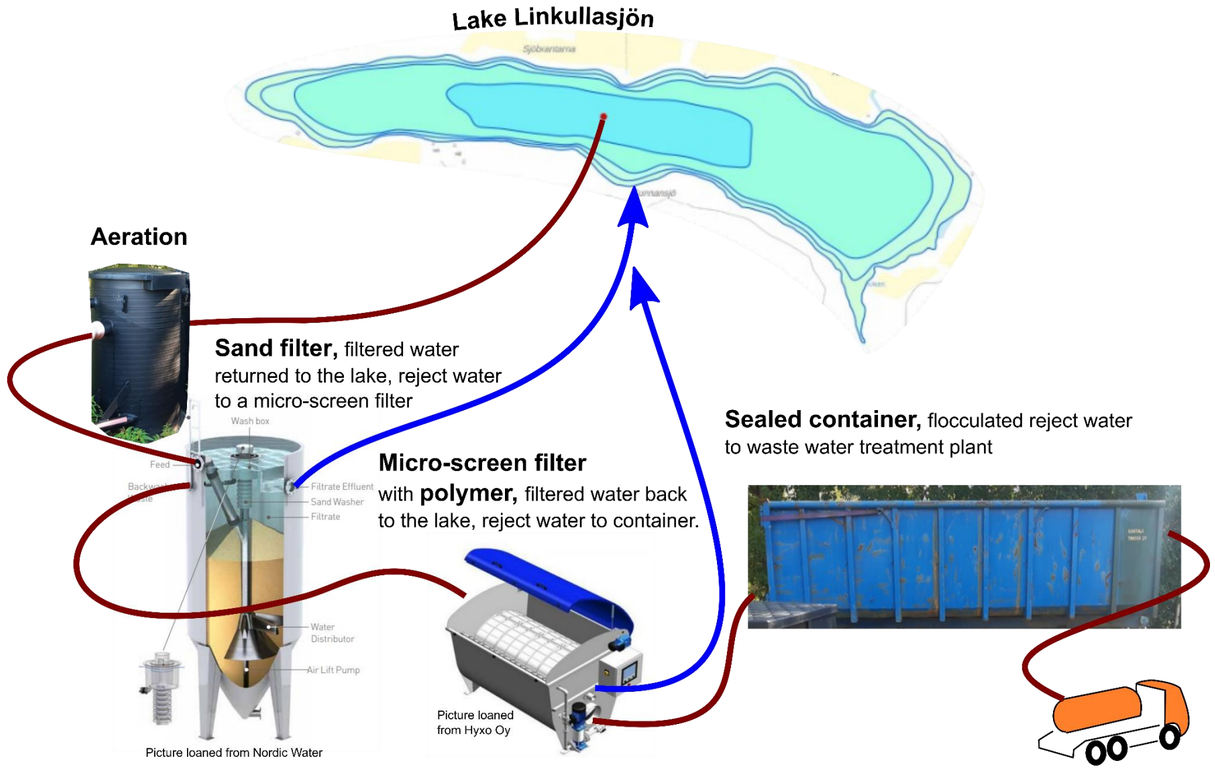

© Kari Sainio


Inflow Outflow

* Hypolimnetic withdrawal and treatment system

RaPo-project to develop method's feasibility

- Aims to develop method's replicability and produce guidance to expand applicability
- Takes advantage of movable filtering technology, co-operation with water treatment sector
  - Funded by the Ministry of the Environment, conducted by Finnish Environment Institute (Syke) and University of Helsinki
  - Prior studies for water quality and sediment chemistry in 2023
  - Piloting, result reporting and guidance in 2024



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2nd MISSION ARENA
25-26 April 2024 | Riga, Latvia

Thank you!

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leena.nurminen(at)helsinki.fi

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

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RESTORE OUR OCEAN & WATERS

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BLUE MISSION BANOS

2nd MISSION ARENA
25-26 April 2024 | Riga, Latvia

Workshop: Innovative Strategies for Restoring Lakes and Rivers: Aligning with EU Mission "Restore Our Ocean and Waters"

Subtitle: **Low flow dredging- Action against internal phosphorus loading in lakes and coastal waters**

THEME:

#Arena2

EU MISSIONS RESTORE OUR OCEAN & WATERS

Funded by the European Union

Katrineholm

Low Flow dredging Lake Öljaren

LIFE IP Rich Waters

Jenny Herbertsson, Environmental strategist and water coordinator

Rich Waters

Five thematic areas LIFE IP Rich Waters

External loading

- policyinstrument, horsefarms, stormwater

Internal loading

- Lake Öljaren, mussel farming, aluminiumtreatment

The natural connections of water

- Fish migration barriers (conductivity), hydroelectric power

Pollutants

- Coordinated measurements and measurement data, boat bottom cleaning

Waterplanning

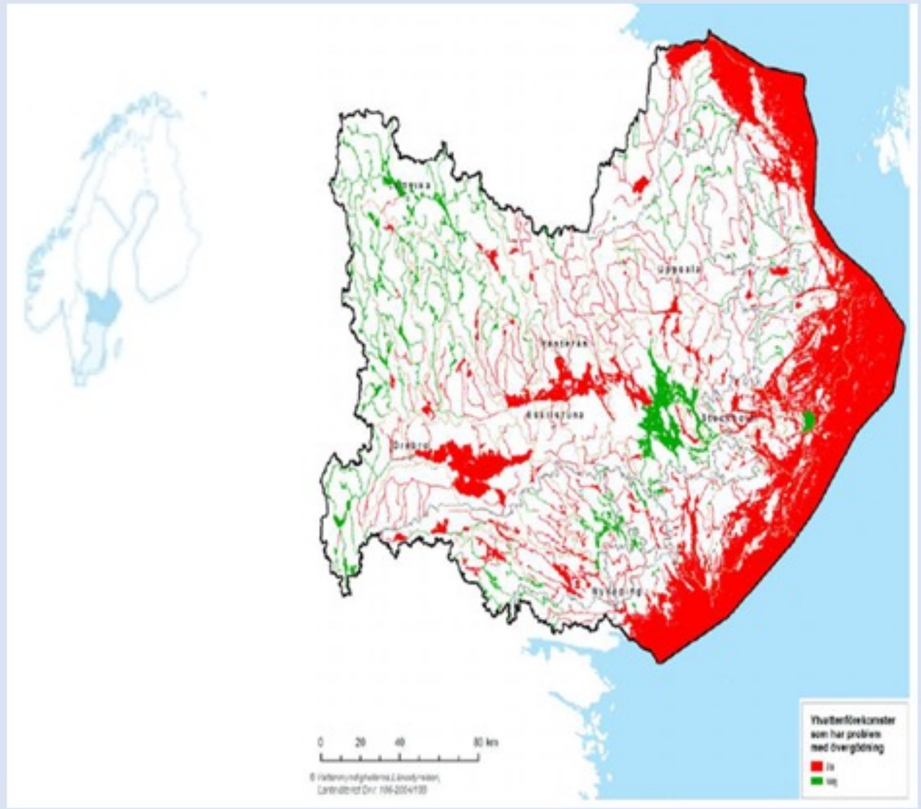
- Policies and guidelines for the water district

Katrineholm

Rich Waters

Status Lake Öljaren and catchment area

- Northern Baltic Sea
- Poor status
- Runn of to lake Hjälmaren



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Low flow dredging Lake Öljaren

- Subproject internal loading" Actions against internal phosphorus loading in lakes and coastal waters"

Rich Waters

Life

Havs och Vattenmyndigheten

LOVA LOKALA VATTENVÅRDSPROJEKT

NEFCO

Katrineholm

Purpose of the project

- **Test of the method low flow dredging**
  - Reduced internal loading?
  - Function of the technology?
  - Sediment a substitute for imported fertilizer?
    Economi? LCA? Climatefactor?
  - Reduced occurrence of algal blooms?
  - Positive impact on benthic fauna?
  - Recommended method for others??

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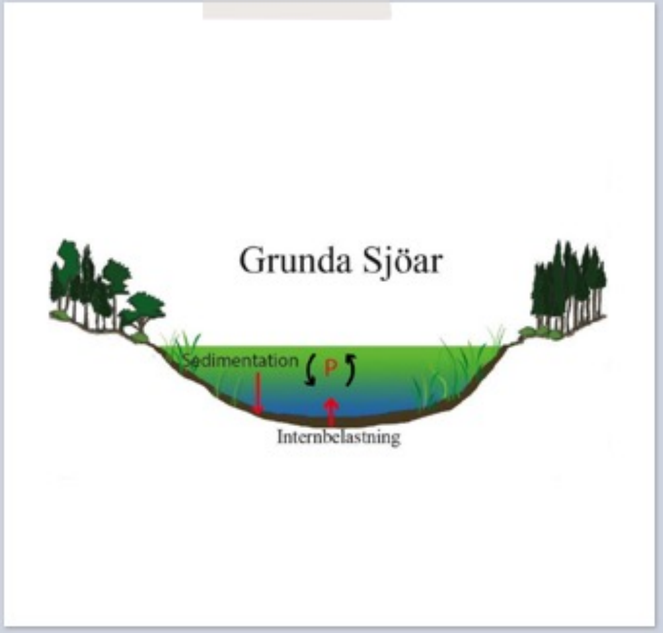
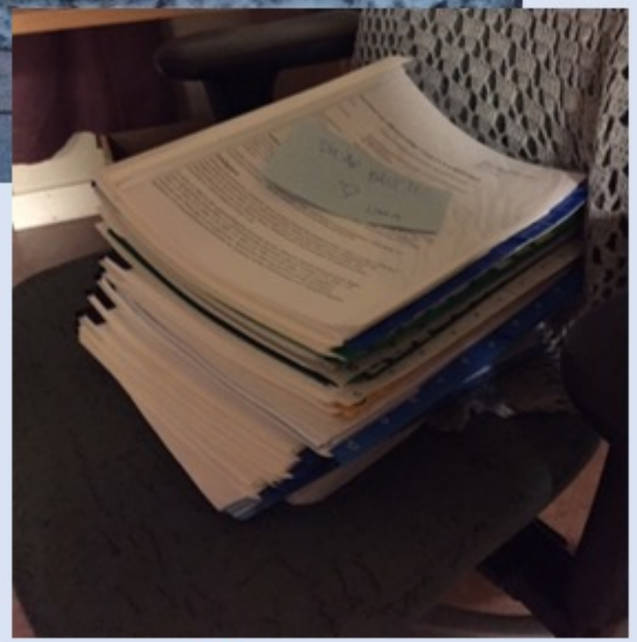
Rich Waters



Background

Katrineholm

Preparations



- Water sampling once a month for 18 months
- Sediment investigations three times
- Bottom mapping and benthic fauna in 2017-2018

- Notification of water operations
- Four procurements.
- Permit for dredging and dewatering, sediment spreading and return of reject water May 2020.

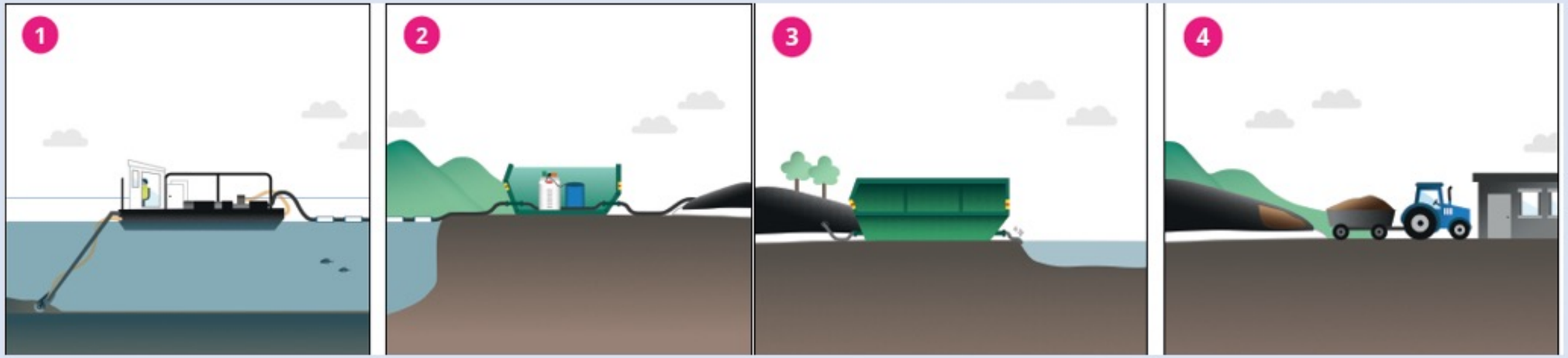
Katrineholm

Low Flow Dredging Öljaren

Foto: Johan Hammar

Katrineholm

Low Flow Dredging Öljaren



Rich Waters

Life

och Havs Vatten myndigheten

NEFCO

LOVA
LOKALA VATTENVÅRDSPROJEKT

Katrineholm

The dredging device

Foto: Johan Hammar

Katrineholm

Dredging device

Katrineholm

Polymerstation

Katrineholm

Dewatering geobag

Katrineholm

Reject water and sediments

Katrineholm

Emptying of the geobag

Katrineholm

Analysis of sediments

Katrineholm

Sediment dispersion

Katrineholm

Funding of the project

- EU- contribution and municipality of Katrineholm ~ 4,8 millions sek
- LOVA contribution 765 000 sek + 3,3 millions sek
- Swedish Agency for Marine and Water Management, funding 5 millions sek
- BASAP Fund, foundation €200 000

Rich Waters
Life
Havs och Vattenmyndigheten
NEFCO
LOVA LOKALA VATTENVÅRDSPROJEKT
Katrineholm

Katrineholm

Thank you for listening

Jenny Herbertsson

jenny.herbertsson@katrineholm.se

BLUE MISSION BANOS

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Innovative Strategies for Restoring Lakes and Rivers: Aligning with EU Mission “Restore Our Ocean and Waters”

Floating islands: How to improve an urban lake

THEME: Mission Ocean & Waters

#Arena2

EU MISSIONS RESTORE OUR OCEAN & WATERS

Funded by the European Union

Freshwater waterbodies suffer from complex pollution

Many of our beloved freshwater lakes and ponds, especially the shallow ones, are facing some big challenges. From cities expanding to farms growing, various activities are causing pollution to end up in our waters.

Excess nutrients, heavy metals, pharmaceuticals, microplastics, PFAs etc. This all in combination with climate change makes call for action!

Summer blooms of cyanobacteria
Photo T. Pedusaar

Floating islands (wetlands, gardens, ecosystems)

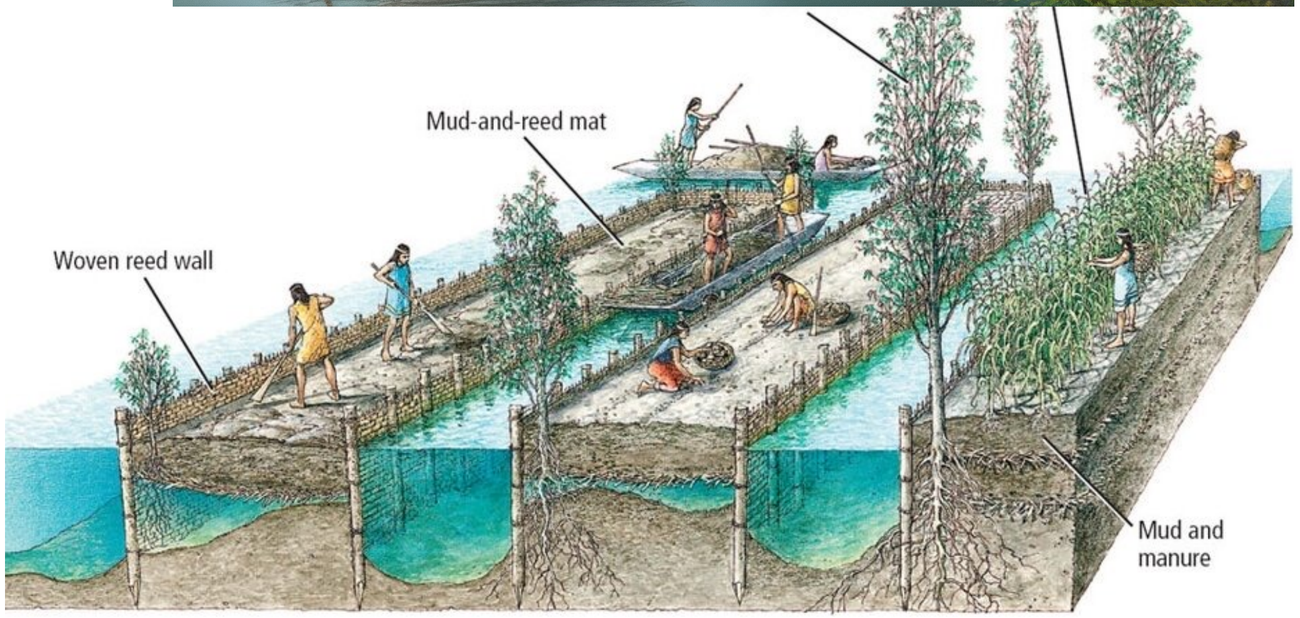
Amazing artificial platforms that use the superpowers of plants and microbes (a process called bioremediation) improve the water quality and break down contaminants, as well as provide a shelter for various species.

https://www.flora-float.com/biodiversity/

Floating gardens

The chinampas developed by the Aztecs around the 14th century in the Valley of Mexico.

The chinampas were created by building small, rectangular plots of land on shallow lake beds, made from layers of mud, decaying vegetation, and other organic matter.



https://www.thearchaeologist.org/

Benefits

Water purification

A microbial biofilm forms on these roots, serving as a natural biofilter that consumes algae, carbon, and nutrients. Plant roots that grow into the water column also absorb excess nutrients and pollutants.

Additionally, oxygen is transferred through the plant roots into the water, enhancing dissolved oxygen levels.

Plant roots and microbial biofilm purifies water

Efficiency assessment

Internation Institute for Sustainable Development and their bioplatforms

Plant harvesting

Floating ecosystems with designated nesting areas for swans throughout the United Kingdom!

https://www.biomatrixwater.com/

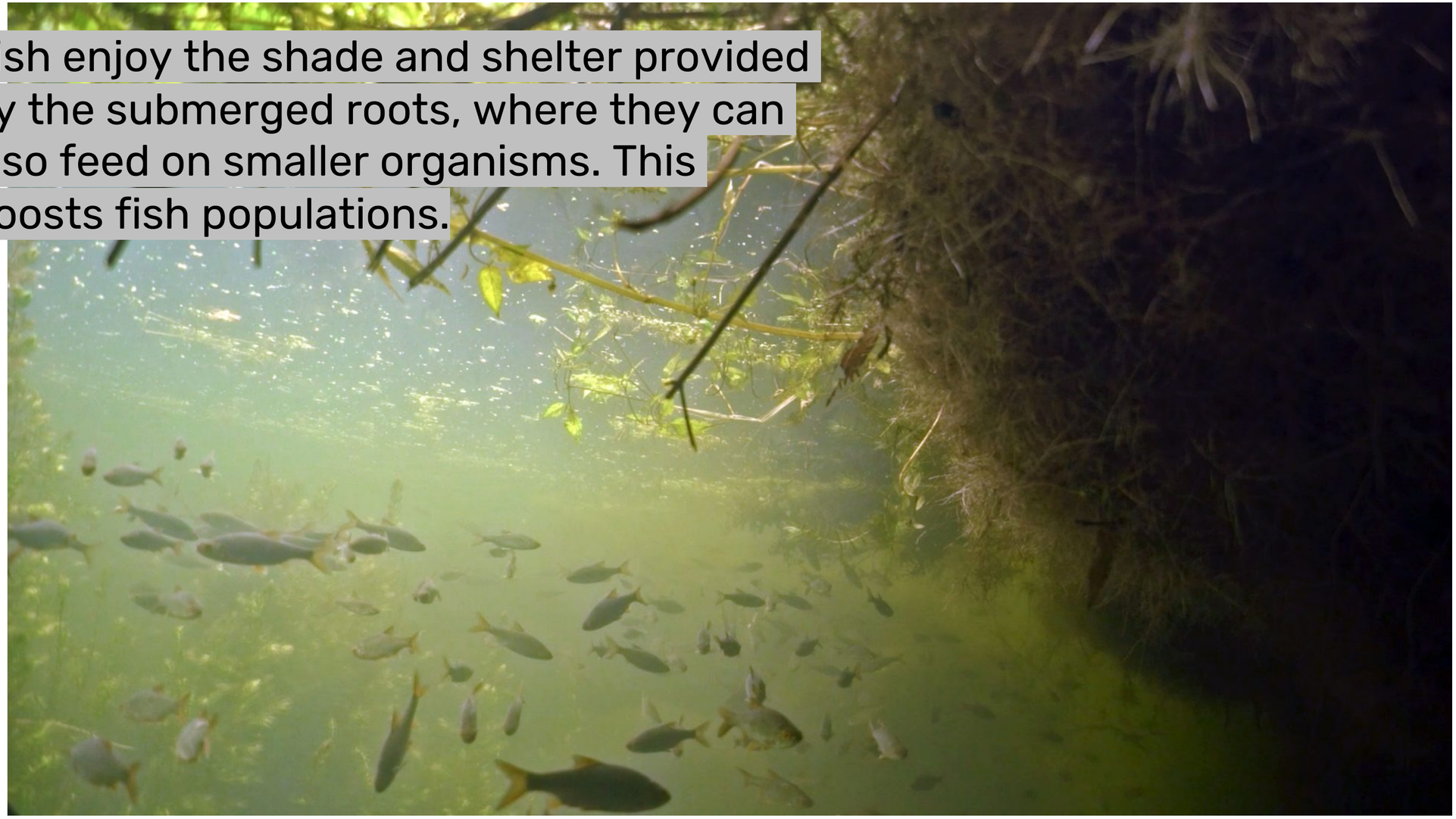
Habitats above the water

In urban settings, these islands act as biodiversity refuges, offering habitats for birds, insects, and pollinators. The plants on the islands serve as a living seed bank, with seeds distributed by birds and water currents, enhancing native flora.

Mushrooms growing in the 5D planting media

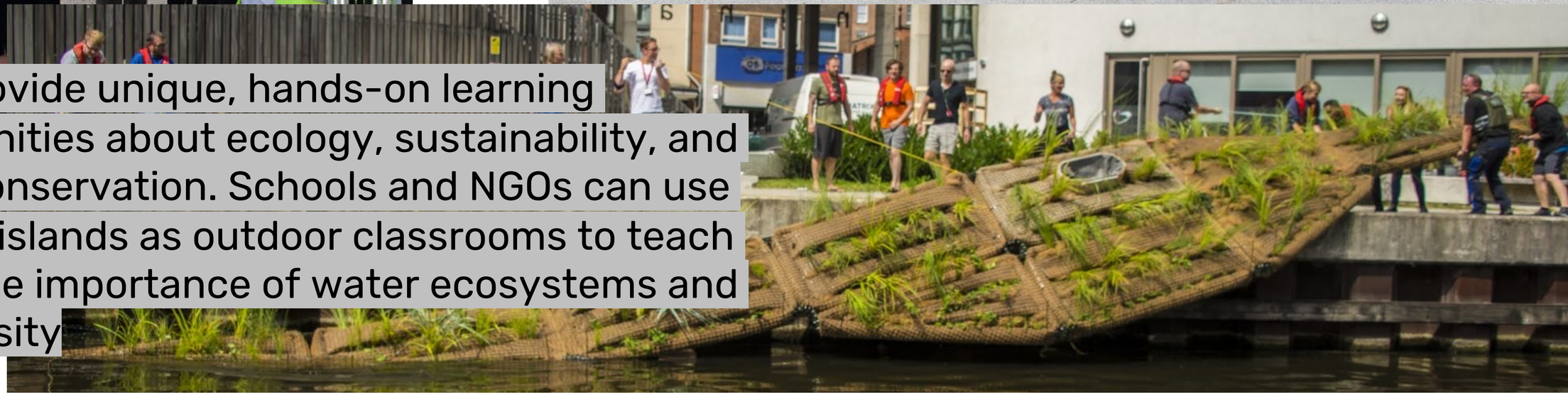
Example of a Eurasian Water Shrew

Habitats below the water



Fish enjoy the shade and shelter provided by the submerged roots, where they can also feed on smaller organisms. This boosts fish populations.

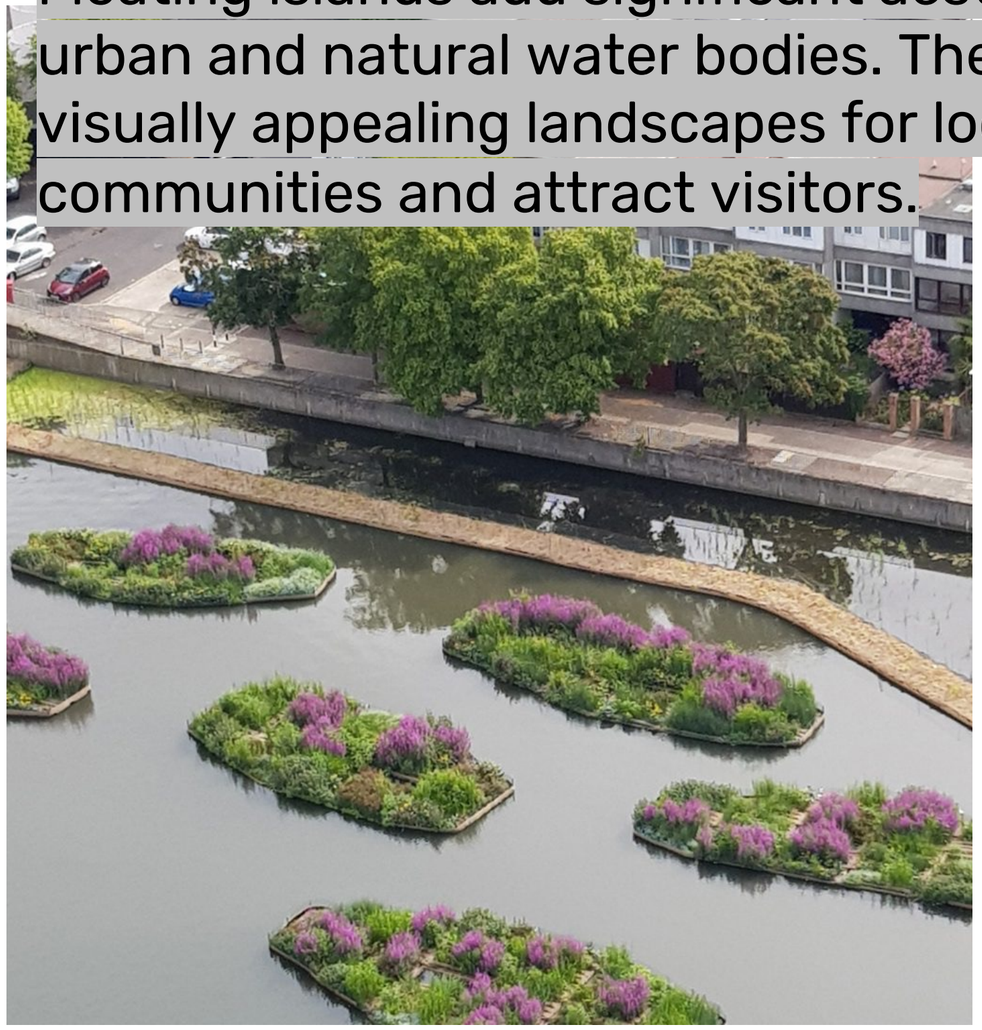
Awareness raising

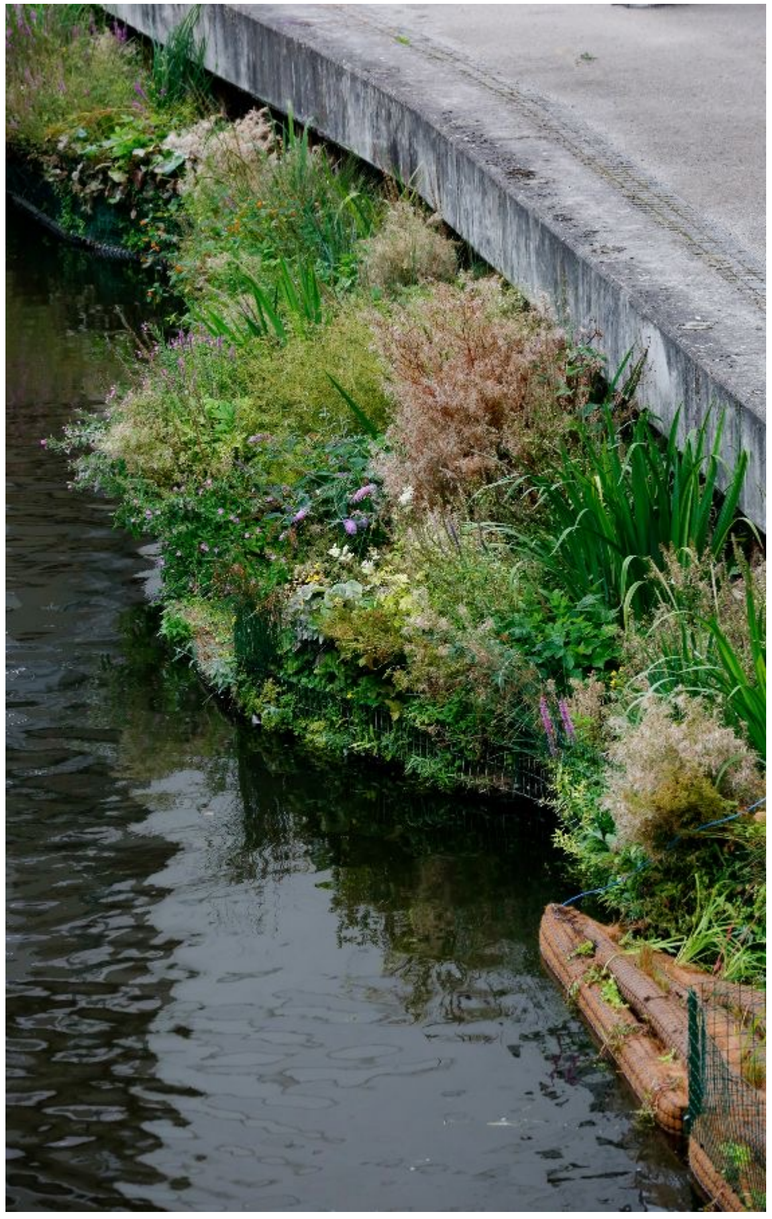


They provide unique, hands-on learning opportunities about ecology, sustainability, and water conservation. Schools and NGOs can use floating islands as outdoor classrooms to teach about the importance of water ecosystems and biodiversity

Aesthetic value

Floating islands add significant aesthetic value to urban and natural water bodies. They create visually appealing landscapes for local communities and attract visitors.





Climate regulation

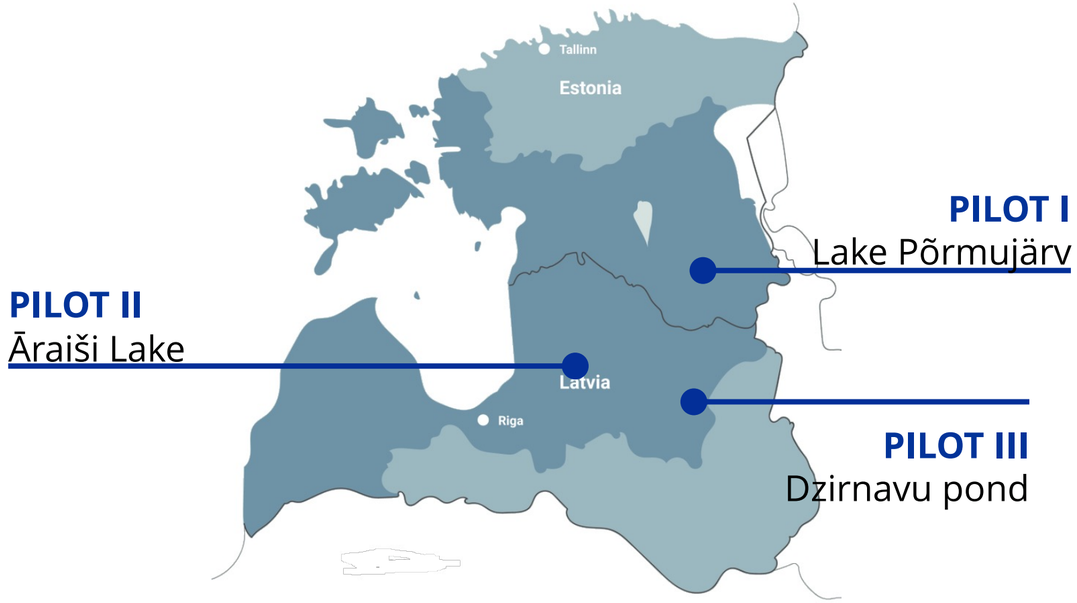
The plants absorb carbon dioxide, a greenhouse gas, through photosynthesis.

Reduce erosion

Floating islands can help to reduce erosion along shorelines and riverbanks. The roots of the plants grown on these islands can stabilize the water’s edge, protecting against the erosive action of waves and currents.

Floating islands as biodiversity pit stops and pollution cut outs towards more resilient cities

#BioFloat



PILOT I
Lake Põrmujärv

PILOT II
Āraiši Lake

PILOT III
Dzirnavu pond

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