

Carbon Binding Blue Black Sea BlueC BSB00020

# Blue Carbon in the Black Sea Basin

## Educational Guide

Programme priority:  
Blue and Smart Region

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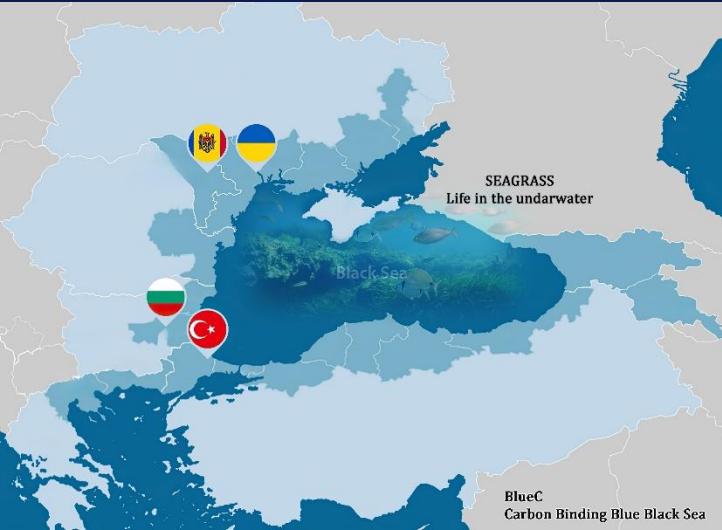
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## PART 01



# Introduction to aquatic ecosystems and the BlueC project

# Introduction to Aquatic Ecosystems

An overview of the Black Sea Basin's aquatic environments, their rich biodiversity, and critical ecological importance.



The Black Sea Basin hosts a remarkable range of interconnected aquatic ecosystems, which provide vital services but face significant threats from human activity and climate change.

## Diverse Ecosystems

From freshwater systems like the Danube River and its delta to the saline marine environment of the Black Sea, these ecosystems are deeply interconnected.

## Rich Biodiversity

These habitats support abundant life. The Danube Delta alone is a sanctuary for hundreds of bird, fish, and aquatic plant species, acting as a crucial natural filter.

## Key Pressures

Ecosystems face increasing stress from climate change (rising temperatures) and persistent pollution, where upstream contaminants heavily impact the marine environment.

## 1980s Ecological Crisis

- Massive nutrient input led to widespread eutrophication.
- Hypoxia created 'dead zones' across 12% of the sea.
- Significant loss of benthic life and predatory fish.
- Invasive species (\**Mnemiopsis leidyi*\*) disrupted the food web.

# The Concept of Blue Carbon

## ▪ Defining Blue Carbon

Carbon captured and stored by aquatic ecosystems, specifically vegetated coastal areas such as mangroves, salt marshes, and seagrass meadows.

## ▪ Climate Mitigation

These ecosystems fix atmospheric CO<sub>2</sub>, incorporating it into biomass and anaerobic sediments where it can remain isolated for millennia.

## ▪ Ecosystems' Role

Despite covering less than 0.5% of the seafloor, blue carbon ecosystems account for over 50% of organic carbon stored in all



## ▪ Sequestration Potential

A single hectare of seagrass can sequester tens of tons of carbon annually, making their protection a crucial nature-based

# Project BlueC: Goals and Importance

A summary of core objectives, stakeholder involvement, and regional collaboration for blue carbon conservation.

## Habitat Mapping

Develop GIS and remote sensing tools for precise mapping of blue carbon habitats.

## Community Awareness

Foster public engagement through participatory monitoring and educational programs.

## Impact Assessment

Create Ecosystem-Based Impact Assessment (EBIA) guides for informed decision-making.

## Policy Advocacy

Advocate for effective environmental policies that integrate ecosystem services.

## Crucial Stakeholder Involvement

Pupils & Students

Teachers

Local Authorities

NGOs

Fishing Communities

# Black Sea Ecological Crisis

The 1980s marked a historical ecological decline driven by **eutrophication**, **hypoxia**, and the devastating invasion of the ctenophore *Mnemiopsis leidyi*.

## Eutrophication & Hypoxia

Massive riverine nutrient runoff triggered widespread eutrophication, creating extensive hypoxic "dead zones".

**12% of Sea Surface**

## Benthic Ecosystem Collapse

The oxygen-deprived zones led to a catastrophic loss of bottom-dwelling organisms and the decline of predatory fish populations.

**60 Million Tons Lost**

## Invasive Species Dominance

The carnivorous ctenophore *Mnemiopsis leidyi* proliferated, reaching an unprecedented biomass by the end of the decade.

**800 Million Tons Biomass**

## Fisheries Devastation

*M. leidyi* consumed fish eggs and larvae, causing the complete collapse of commercial anchovy fisheries.

**Anchovy Fishery Collapse**

# Wetlands and Ramsar Sites

Exploring their dual role as critical biodiversity hotspots and vital blue carbon reservoirs.

## Biodiversity Hotspot

Provide crucial habitat for hundreds of bird, fish, and amphibian species, exemplified by sites like Moldova's Lake Beleu.

## Natural Water Purifier

Act as natural filters by absorbing nutrients and pollutants, thus significantly improving the water quality of the Black Sea.

## Blue Carbon Sink

Store significant carbon in organic matter (lacustrine peat) over long periods, mitigating climate change effects.

## The Ramsar Convention (1971)

This international treaty provides a framework for the conservation of globally important wetlands. It commits nations to protect these ecosystems, recognizing their roles in sustaining biodiversity, carbon stocks, and water quality.

## PART 02



# Beleu Lake and *Ceratophyllum demersum* – ecology and role in carbon capture

# Beleu Lake

Ecological significance, carbon sequestration, and conservation challenges of a unique freshwater ecosystem.

## Ecological Significance

A Ramsar site and Moldova's largest natural lake, vital for over 30 fish species, migratory birds, and amphibians. It acts as an "ecological kidney," filtering pollutants. The macrophyte provides crucial habitats and biofiltration.

## Blue Carbon Sequestration

Dense absorbs CO<sub>2</sub> from water for biomass. Upon decay, plant matter forms lacustrine peat in anaerobic sediments, creating a significant long-term blue carbon reservoir unique to freshwater systems.

## Conservation Challenges

Reduced floods from the regulated Prut River threaten the lake with silting and drying. Pollution from human activities and potential for excessive plant accumulation further endanger this fragile and valuable ecosystem.

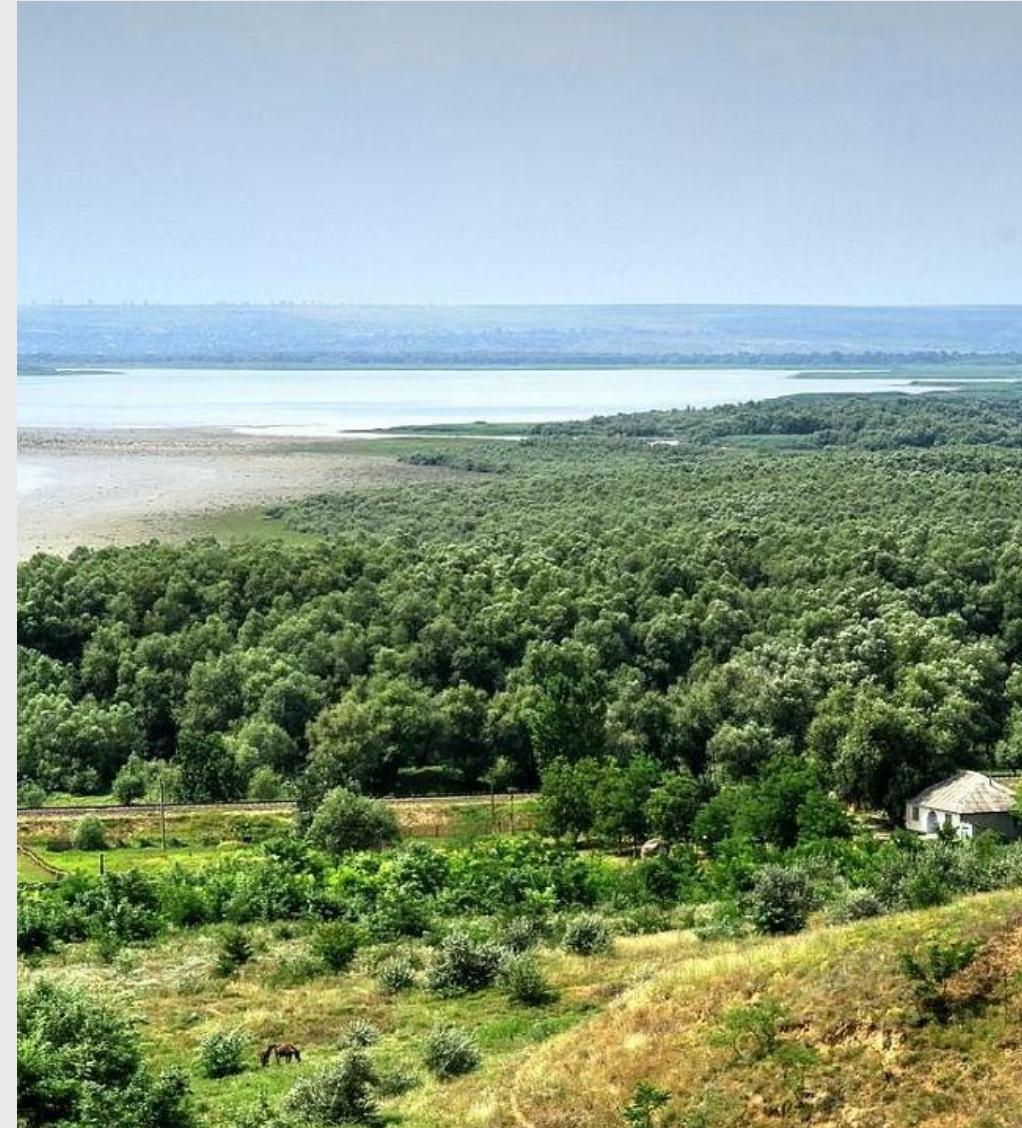
# Presentation of the Beleu Lake area

## Geographical and historical significance

Lake Beleu is the largest natural lake in Moldova, measuring approximately 5 km in length and 2 km in width, with an average depth of less than 1 meter. It dates back 5–6 thousand years and serves as a remnant of the ancient Danube lagoon.

## Biodiversity hotspot

The lake provides habitats for over 30 species of fish, a diverse array of birds such as herons, egrets, and cormorants, as well as migratory species like geese. Amphibians thrive in its wetlands, enhancing its ecological richness.



# Presentation of the Beleu Lake area

## Seasonal habitat dynamics

Water levels fluctuate seasonally; spring floods expand the lake across nearby floodplains, creating habitats with reeds and submerged vegetation, while hot summers may leave islands of silt and muddy zones.

## Ramsar recognition

Recognized in the year 2000 as the first Ramsar Wetland in Moldova, Lake Beleu is protected for its nearly pristine aquatic habitats and rare species, reflecting its international ecological importance.



# The ecological importance of Lake Beleu

01

## Natural water filtration system

The abundant aquatic vegetation in Lake Beleu acts as a natural “kidney,” absorbing nutrients and filtering pollutants brought in by Prut River waters prior to entering the Black Sea.

02

## Carbon sink for climate regulation

Submerged and wetland vegetation, like reeds and water lilies, stores carbon in their biomass and sediments, contributing to global carbon mitigation.

03

## Critical habitat for species survival

The lake sustains diverse forms of life across trophic levels, from microorganisms to fish and large migratory birds, demonstrating its role as a balanced ecosystem.

04

## Flood control and soil enrichment

Seasonal floods deposit nutrient-rich sediments, improving soil quality in peripheral areas and reducing downstream flooding risks.

05

## Socio-economic contribution

Traditional small-scale fishing and pasture management by local villages showcase sustainable use of the lake's resources, promoting its long-term ecological and economic value.

# Anthropogenic pressures on habitat



## Flow regulation and habitat alteration

River damming and embankments have disrupted natural flooding cycles, reducing available habitat for wetland species and risking sediment overaccumulation.



## Climate change and water scarcity

Prolonged droughts and temperature increases have resulted in reduced inflows to the lake and in some extreme years, the lake has dried up significantly, exposing vulnerable ecosystems to collapse.



## Human-induced eutrophication

Farm runoff and nutrient-rich waste contribute to algal blooms in the lake, which compete with submerged plants for light and oxygen, damaging aquatic ecosystems.

# Anthropogenic pressures on habitat



## Illegal practices and pollution

Activities such as unsustainable fishing with destructive nets, agricultural pesticide runoff, and waste mismanagement put strain on native flora and fauna populations.

## Socio-economic impact and management challenges

The lake faces overuse and poorly managed exploitation by nearby communities, although local monitoring initiatives, like ranger programs, are helping to mitigate these pressures.



# *Ceratophyllum demersum*: Biology and adaptations

An overview of the morphology, growth habits, and unique adaptations of *Ceratophyllum demersum* (hornwort) in freshwater ecosystems.

## Rootless & Free-Floating

Lacks true roots, allowing it to float freely or be lightly anchored by modified leaves. Stems are flexible, often reaching 1-2 meters.

## Efficient Nutrient Uptake

Fine, highly branched leaves in whorls maximize surface area, enabling direct nutrient absorption from the water column, bypassing the need for roots.

## High Environmental Tolerance

Thrives in a wide range of conditions, including turbid, low-oxygen, and nutrient-rich (eutrophic) freshwater environments where other plants may fail.

## Vegetative Reproduction

Primarily reproduces asexually through stem fragmentation. Broken pieces can drift, settle, and grow into new, genetically identical plants.

## Winter Survival (Turions)

Forms specialized, dormant winter buds called turions. These dense buds sink to the sediment, ensuring survival through cold periods and regenerating in spring.

## Ecosystem Role

As a fast-growing macrophyte, it provides habitat for invertebrates and fish, influences nutrient cycles, and can form dense beds impacting water flow.

# *Ceratophyllum* d. in Carbon Sequestration



## Core Mechanism

- Understanding the carbon capture and storage process by *Ceratophyllum*, highlighting its critical role in sediment carbon burial.

01 •

### Absorption

As a photosynthetic plant, *Ceratophyllum* absorbs dissolved CO<sub>2</sub> from water, converting it into organic biomass.

02 •

### Biomass Storage

During its growth phase, significant carbon is temporarily stored within its flexible stems and leaves.

03 •

### Sedimentation

When the plant dies, its organic fragments sink and accumulate on the waterbed, forming a dense layer.

04 •

### Sequestration

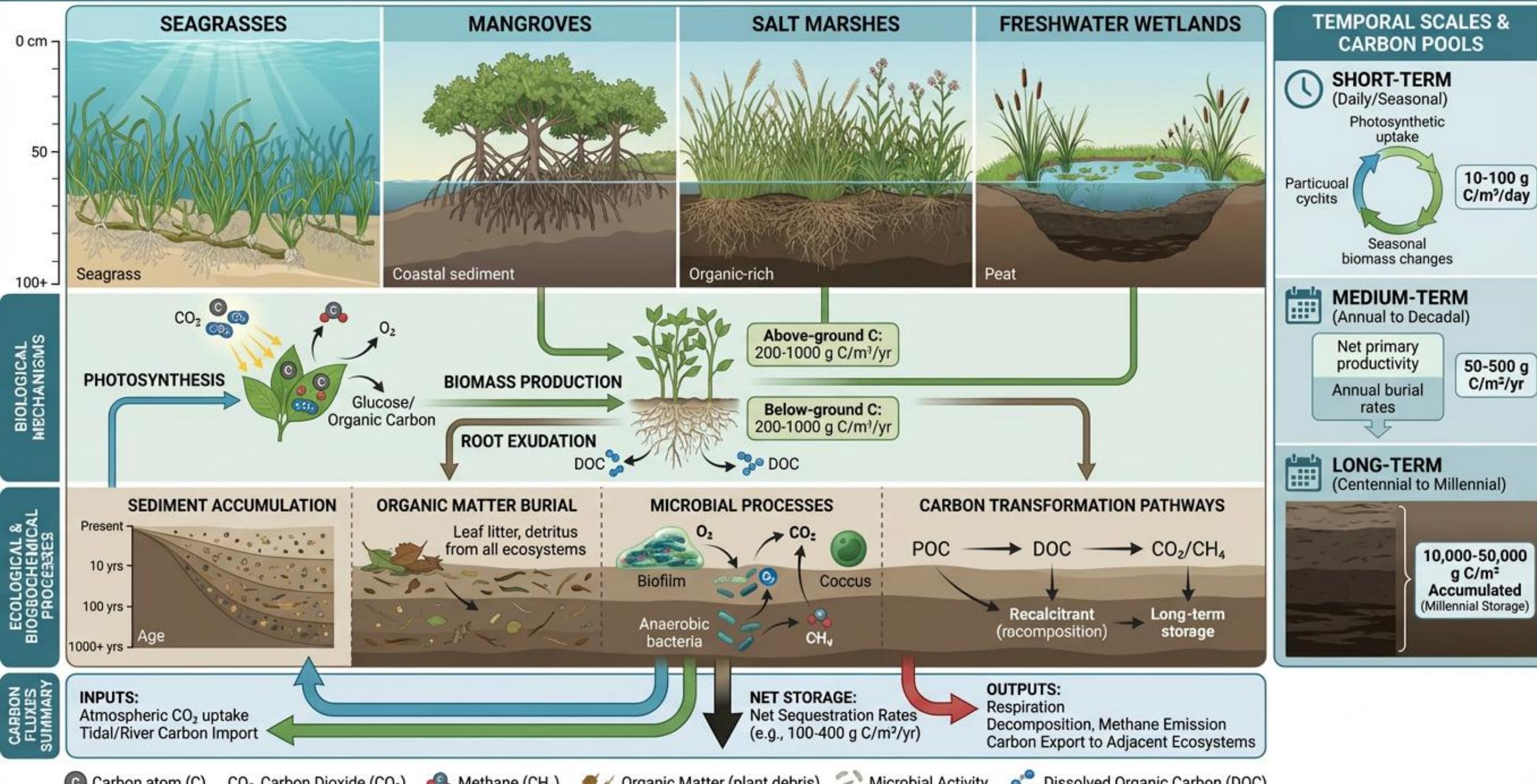
In anoxic sediment, slow decomposition buries carbon, isolating it from the atmosphere for long periods.

05 •

### Peat Formation

Repeated contributions facilitate lacustrine peat accumulation, establishing a crucial blue carbon sink.

# Carbon Sequestration by Macrophytes: Blue and Green Carbon Systems



# Water Purification by *Ceratophyllum*

## The Power of a Natural Filter

How Ceratophyllum filters nutrients, reduces eutrophication, and improves water quality in lakes.

### Natural Biofilter

Ceratophyllum demersum acts as an effective biological filter, cleansing the aquatic environment it inhabits.

### Nutrient Absorption

It actively absorbs excess dissolved nitrates and phosphates from water, which are vital for its own rapid growth.

### Combating Eutrophication

By outcompeting algae for nutrients, it significantly reduces algal blooms, leading to clearer lake water.

### Improved Transparency

Its dense foliage slows currents, allowing suspended particles to settle and thus increasing water transparency.

### Enhanced Water Quality

This natural process boosts biodiversity by improving light penetration and lowers water treatment costs for communities.

# Habitat and Biodiversity Support

This section explores how *Ceratophyllum demersum* functions as an ecosystem engineer, creating complex habitats that are foundational to aquatic biodiversity in freshwater basins.

## Core Role

- **Ceratophyllum** acts as a critical habitat for fish and invertebrates, significantly enhancing aquatic biodiversity.

## Underwater Forests

Forms intricate 3D structures that serve as a critical habitat and shelter for a multitude of aquatic organisms.

## Food Web Foundation

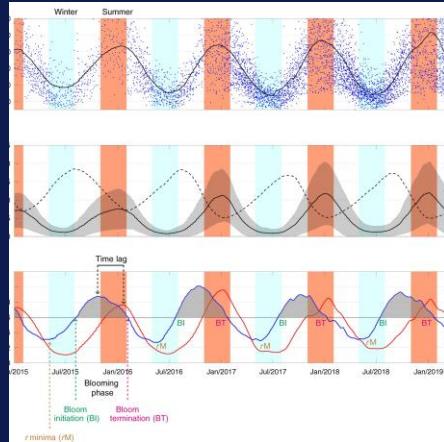
Its leaves support periphyton, feeding invertebrates like snails and larvae, which in turn become food for fish.

## Nursery & Refuge

Dense masses provide a safe refuge for juvenile fish (e.g., carp, perch), protecting them from predators.

## Biodiversity Hotspot

Functions as a "freshwater coral reef" with high invertebrate density, boosting overall aquatic biodiversity.



A study on submerged macrophytes and their environmental role.

# Seasonal Dynamics of Ceratophyllum

Exploring growth cycles, biomass peaks, and the critical challenges of decomposition and oxygen depletion.

## ▪ Growth Cycles

Growth resumes in spring from winter buds and fragments, accelerating as water temperatures exceed 15°C.

## ▪ Biomass Peaks

Maximum biomass is reached in early summer, forming dense, continuous underwater vegetation layers.

## ▪ Decomposition

Degradation begins late summer. Falling water levels can expose large masses, leading to rapid decay.

## ▪ Oxygen Depletion

Intensive decomposition consumes dissolved oxygen, creating hypoxic conditions and releasing toxic compounds.

# Human Impact on Ceratophyllum

Analysis of primary threats from human activities and essential community-led conservation responses.

## Key Threats

- 

### Pollution & Eutrophication

Fertilizers and wastewater cause excessive plant growth, leading to oxygen depletion and the release of toxic compounds.

### Physical Destruction

Dredging, habitat isolation, and mismanagement directly destroy vegetation and lead to detrimental organic matter accumulation.

- 

### Harmful Practices

Destructive fishing techniques and the dumping of litter further degrade and disrupt the delicate aquatic ecosystem.

## Conservation & Monitoring

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### Community Monitoring

Locals and rangers actively track water quality and vegetation health, forming the first line of defense for the ecosystem.

- 

### Proactive Conservation

Targeted conservation efforts are crucial to protect existing populations and restore damaged *\*Ceratophyllum\** habitats.

- 

### Early Stress Detection

Consistent monitoring enables the early detection of ecosystem stress, allowing for timely and effective interventions.



# Ceratophyllum in Phytoremediation

A natural solution for heavy metal contamination, leveraging the plant's absorption capabilities for wastewater treatment.



## Heavy Metal Absorption

*Ceratophyllum demersum* demonstrates a significant capacity for absorbing heavy metals like lead (Pb) and cadmium (Cd) directly into its tissues, making it a valuable agent for purifying polluted waters.



## Treatment Efficacy

Lab experiments on industrially contaminated water (50 ppm) show remarkable removal efficiency by fragmented *Ceratophyllum*.

Lead (Pb) Removal **>75%**

Cadmium (Cd) Removal **~60%**



## Cost-Effective Biofilter

This natural ability positions the plant as a low-cost, effective biomaterial for wastewater treatment, acting as a natural filter to mitigate pollution and indicate past contamination.

## PART 03



# Seagrass meadows and marine ecosystems in the Black Sea basin

# Seagrass Ecosystems in the Black Sea

A look at key species like *Zostera marina*, their historical decline due to eutrophication, and encouraging signs of recent recovery.



## System Under Stress

Once extensive, meadows faced a dramatic decline in the 1980s. Intense eutrophication and pollution created turbid waters, blocking sunlight essential for photosynthesis and leading to widespread loss.



## Glimmers of Hope

Recent studies show species like *Zostera noltei* recolonizing bays along the Bulgarian and Romanian coasts, a positive trend linked to improved water transparency in shallow areas.



## The Current Challenge

Despite positive developments, existing seagrass meadows in the Black Sea remain highly fragmented. These vital ecosystems are still considered critically endangered, requiring continued conservation efforts.





# Seagrass Carbon Storage Potential

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**>50%**

of oceanic carbon is stored by seagrass, despite covering less than 0.5% of the seafloor.

- 

**27-44 Tg**

of organic carbon buried annually, accounting for 10-18% of total oceanic carbon burial.

- 

**24.2 tons**

of organic carbon stored per hectare in the top 30cm of soil within an average *Zostera* meadow.

## Sequestration Stability: A Comparative View



### Seagrass Meadows

Organic matter is deposited in anaerobic sediments, ensuring stable carbon isolation for centuries to millennia.

### Terrestrial Forests

Carbon is stored in biomass and soils where it is more susceptible to release through decomposition or fire.

# Coastal Protection by Seagrasses

Seagrass meadows act as natural "green dikes," providing both ecological stability and economic value for coastal communities.

## Wave Attenuation

Act as natural breakwaters, significantly reducing wave energy and calming coastal waters, which protects shorelines from erosion.

## Sediment Stabilization

Their dense root and rhizome networks bind and stabilize seabed sediments, preventing erosion and maintaining water clarity.

## Socio-Economic Support

Sustain coastal fisheries by providing vital nursery grounds. They also enhance tourism by ensuring clear waters and protected beaches.

## Future Economic Value

Significant blue carbon storage capacity offers incentives for conservation through carbon market integration and direct financial stimulus.

# Blue Carbon in the Black Sea Basin

EDUCATIONAL GUIDE

## Seagrass as Fish Nurseries

Critical for marine biodiversity, commercial fish species, and the sustainability of fisheries.

- **A Safe Haven**

Seagrass meadows provide essential shelter from predators and abundant food for juvenile commercial fish like turbot, mullet, and sea bass.

- **Economic & Ecological Link**

Protecting this habitat is vital for sustainable fisheries. Its loss reduces fish stocks, harming both marine ecosystems and economic well-being.

# 70%

### Global Significance

An estimated 70% of commercial fish and crustacean species globally rely on these estuarine ecosystems for feeding and reproduction.

Interreg  Co-funded by the European Union

NEXT Black Sea Basin



# Connectivity: Rivers to Sea



## The Unbroken Lifeline

Ecological linkages between freshwater systems, like the Danube River, and the Black Sea are crucial. These corridors deliver vital nutrients and create unique habitats in transition zones such as estuaries and deltas, forming the foundation of the region's health.

### Vital Corridors

Rivers act as essential conduits, transporting nutrients, sediments, and life, bridging distant ecosystems and fueling marine productivity.

### Migratory Species

Species like sturgeons depend on these integrated corridors for their complex life cycles, moving between freshwater and marine environments.

### Biodiversity Health

Maintaining this connectivity is paramount for the rich biodiversity and the overall ecological stability of the entire Black Sea Basin.

# Economic Benefits of Seagrass

- Seagrass value extends beyond ecology, driving key economic sectors like tourism and fisheries, and opening new avenues in blue carbon markets that provide direct community incentives for conservation.

## Coastal Fisheries

Seagrass meadows are vital nurseries for commercial fish and crustaceans, forming the backbone of coastal fishing industries.

**~68%**

of commercial catches are supported by estuarine habitats like seagrass.

## Tourism & Recreation

By ensuring clear waters and protecting beaches from erosion, seagrass enhances coastal appeal and unlocks ecotourism potential.

**+80%**

of recreational fish catches rely on these healthy ecosystems.

## Blue Carbon Markets

Quantifying CO<sub>2</sub> storage in seagrass can create financial incentives and compensation schemes for local conservation efforts.

**10%**

of ocean's carbon is buried annually in seagrass, despite covering <0.2% of the seafloor.

# Challenges in Seagrass Restoration

## Major Threats

### Severe Pollution

Eutrophication from agricultural runoff and industrial discharge degrades water quality, hindering seagrass growth.

### Coastal Development

Extensive construction, dredging, and shoreline alteration lead to direct habitat loss and destruction.

## Critical Solutions

### Active Restoration

Transplanting seagrass from robust donor beds to degraded areas to kickstart recovery processes.

### Policy & Protection

Implementing pollution controls, rigorous impact assessments, and establishing Marine Protected Areas (MPAs).

### Public Awareness

Educating communities and stakeholders on the importance of seagrass ecosystems to foster support for conservation.

## PART 04



# Marine seagrass vs. freshwater macrophytes and ecosystem connectivity

# Comparative Analysis: Freshwater vs. Marine Plants

Exploring the key differences between **Ceratophyllum** and **Zostera** in adaptation, carbon storage, and ecosystem services.

## Ceratophyllum

FRESHWATER

### Adaptation

- Thrives in still freshwater; rootless and buoyant.
- Absorbs nutrients directly from the water column.

### Carbon Storage

- Sequesters carbon through photosynthesis into biomass.
- Contributes to carbon accumulation in lake sediments.

### Ecosystem Services

- Purifies lake water by absorbing excess nutrients.

## Seagrass meadows

MARINE

### Adaptation

- Adapts to saline environments and wave energy.
- Firmly rooted in sediment with extensive rhizomes.

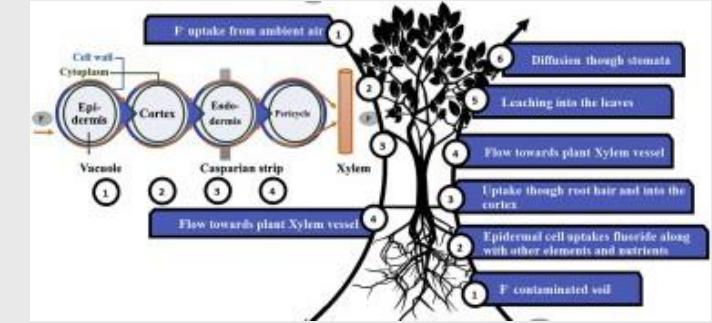
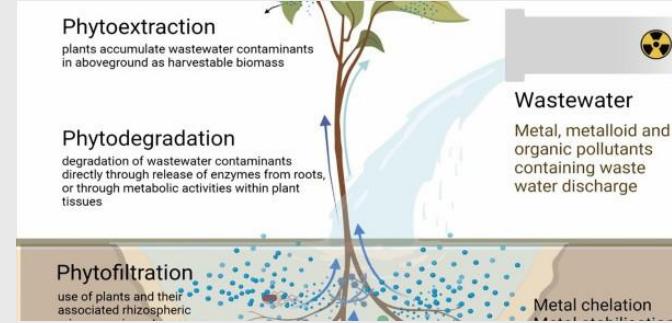
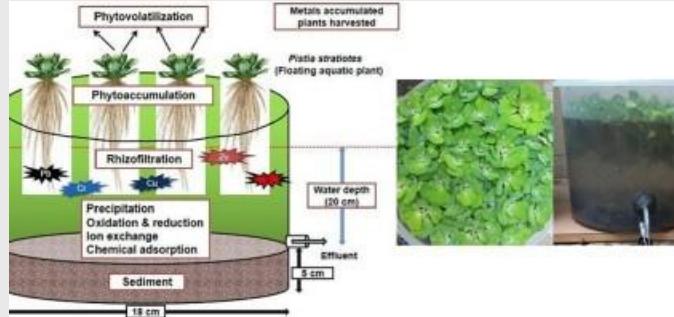
### Carbon Storage

- Stores carbon durably in anoxic marine sediments.
- Forms significant "blue carbon" reserves vital for climate mitigation.

### Ecosystem Services

- Provides critical coastal protection and stabilizes sediments.

# Practical Exercises for Students



## ■ Field Observation Journals

Document aquatic flora (like *Ceratophyllum*) and fauna during site visits. Advanced students can measure water parameters in vegetated vs. non-vegetated areas to analyze the plant's impact on water quality.

## ■ Food Web Modeling

Construct simplified food webs for Lake Beleu, centering on *Ceratophyllum*. Identify trophic links to insects, fish, and birds to understand its crucial role in sustaining the ecosystem.

## ■ Phytoremediation Experiments

Conduct small-scale jar experiments with *Ceratophyllum*. Monitor water clarity and nutrient absorption against a control to demonstrate its powerful phytoremediation capabilities.

## PART 05



# Policy and Conservation Recommendations

# Community Engagement and Education

Strategies for raising awareness: local atlases, citizen science, and stakeholder workshops.

## Local Atlases & Citizen Science

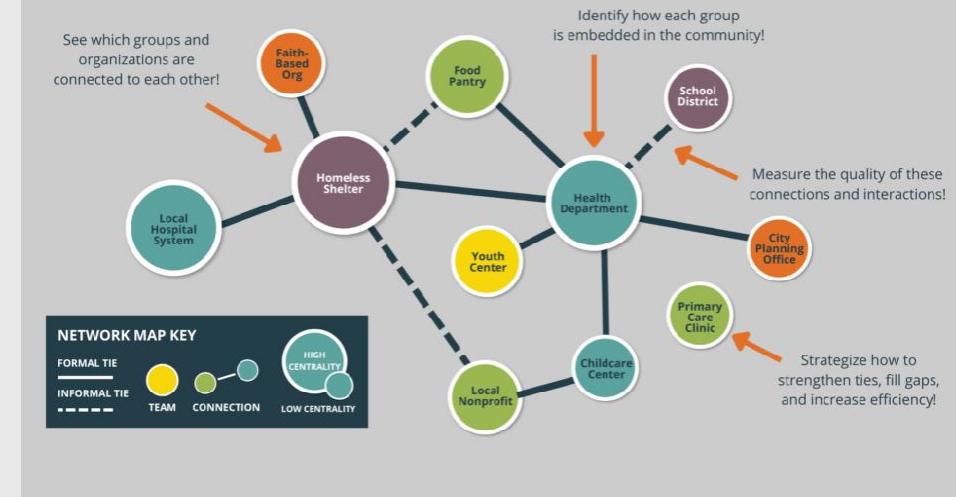
Empower individuals to document aquatic macrophytes via platforms like iNaturalist, mapping species and their vital ecological roles.

## Volunteer Monitoring

Engage volunteers in initiatives such as Marine Litter Watch to actively monitor coastal zones and contribute to pollution reduction efforts.

## Stakeholder Workshops

Facilitate collaboration among pupils, students, NGOs, and authorities through simulations for integrated decision-making.



## Core Mission

Raising awareness is vital for Blue Carbon conservation in the Black Sea Basin. These community-focused efforts ensure the sustained protection and understanding of critical marine ecosystems.

# Policy and Conservation Recommendations



## Integrated Management

Implement holistic strategies linking freshwater and marine ecosystems. Managing upstream pollution is crucial for downstream marine health and blue carbon habitats.



## Ecosystem-Based Impact Assessment

Mandate EBIA for all development projects. This comprehensive approach considers ecosystem services, cumulative effects, and ensures active stakeholder involvement.



## Regional Cooperation

Foster robust collaboration among Black Sea nations. Synchronize conservation, establish transboundary protected areas, and share data for long-term ecosystem resilience.

# Water quality monitoring and the use of GIS

1

## Continuous monitoring

Effective water quality management requires real-time data collection via sensors, laboratories, and sampling programs, ensuring precise and timely deployment of conservation strategies.

2

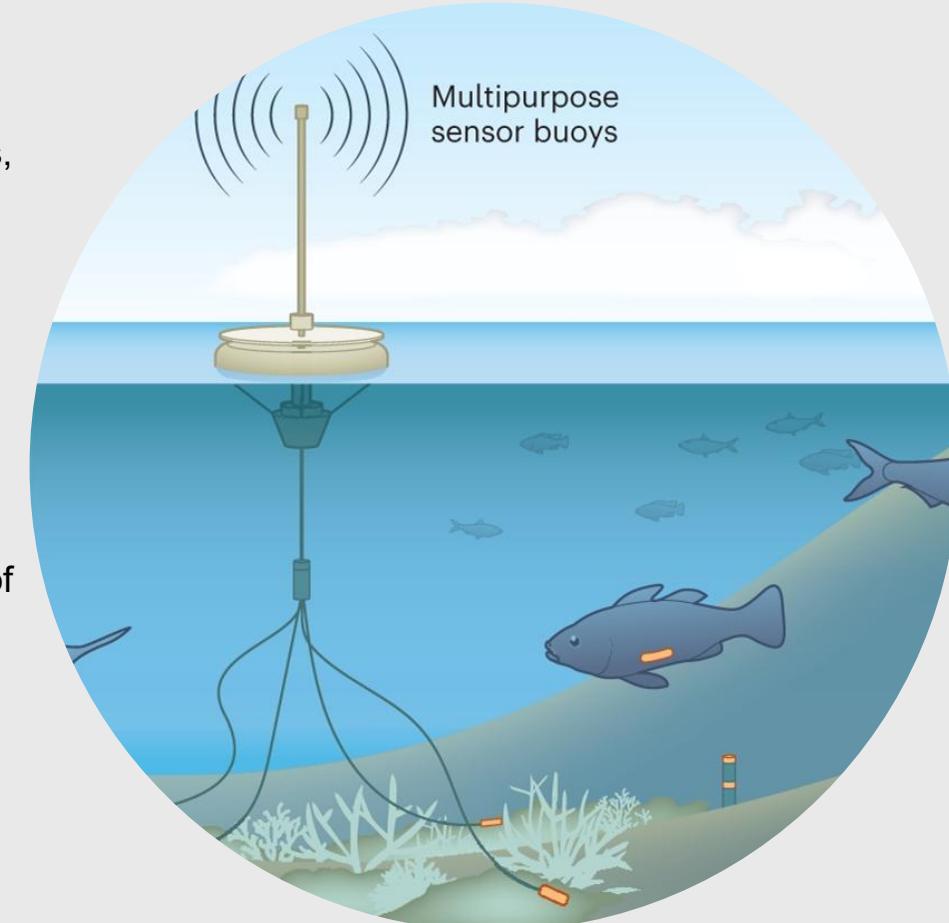
## GIS for habitat mapping

Geographic Information Systems (GIS) are instrumental in identifying pollution hotspots and monitoring aquatic ecosystem health, aiding in the spatial planning of blue carbon habitats.

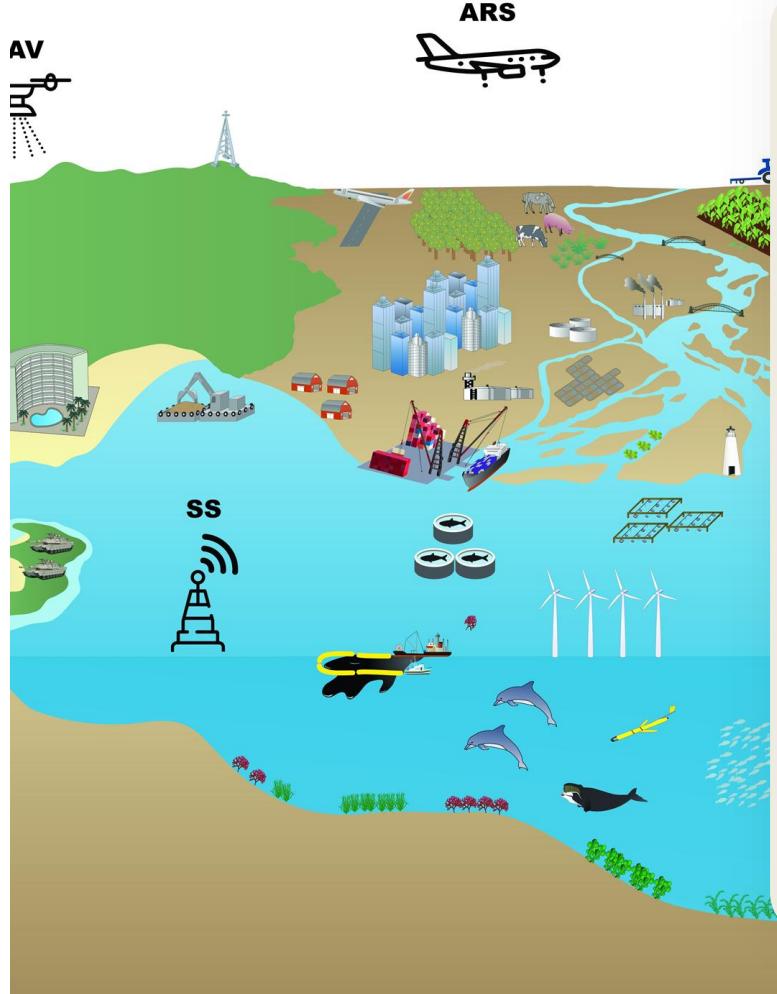
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## Community participation in data collection

Programs such as Marine Litter Watch empower citizens to collect and report information on aquatic pollution, strengthening local engagement in conservation efforts.



# Water quality monitoring and the use of GIS



## Predictive analytics

Advanced GIS modeling allows for the prediction of areas prone to environmental degradation and helps direct targeted interventions to preserve blue carbon biomass.

## Integrated management platforms

Combining GIS data with remote sensing tools enables a holistic approach to tracking habitat changes and evaluating conservation outcomes.

# Nature-based solutions and the application of the EBIA concept

01

## Carbon sequestration habitats

Nature-based solutions include protecting coastal wetlands and seagrasses, which act as carbon sinks and mitigate climate change impacts.

04

## Flood management with ecology

Integrating stufas and grasslands into flood-prone regions reduces disaster risks while enhancing ecological resilience.

02

## Conservation frameworks

Ecosystem-Based Impact Assessment (EBIA) broadens the scope of environmental evaluations to consider ecosystem services and cumulative impacts, promoting sustainable development.

05

## EBIA as a collaborative tool

Encouraging stakeholder involvement through EBIA ensures that all impacts and benefits associated with ecosystem services are holistically considered in developmental projects.

03

## Habitat restoration

Restoring degraded wetlands and coastal vegetation demonstrates the implementation of natural processes as solutions to improve biodiversity and ecosystem health.

# Education and awareness through the BlueC program

## Intergenerational learning

The program targets diverse groups, including high school students, university students, NGOs, and local policymakers, providing tailored educational materials about blue carbon.

## Visual storytelling

Resources such as ecosystem posters and infographics simplify complex processes like CO<sub>2</sub> capture by aquatic vegetation, inspiring conservation actions among young learners.

## Practical engagement

Encouraging hands-on activities such as field visits, water testing, and plant sampling brings students closer to understanding ecosystem connectivity and threats.

## Community-led initiatives

Workshops and educational campaigns hosted by local NGOs serve as platforms for integrating traditional knowledge and scientific approaches to conservation.

## Global partnerships

Collaborative projects under BlueC unite countries like Bulgaria, Ukraine, and Turkey, fostering shared expertise and cross-border strategies for protecting the Black Sea's blue carbon reservoirs.

# Conclusion and Call to Action

Synthesizing our findings  
on the Black Sea's blue  
carbon ecosystems and  
outlining the path forward.



# Conclusion and Call to Action

Synthesizing our findings on the Black Sea's blue carbon ecosystems and outlining the path forward.

## Key Takeaways



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### Critical Ecosystems

Protecting seagrass meadows and *\*Ceratophyllum\** beds is vital for climate mitigation, clean water, and rich biodiversity.

- 

### Immense Value

These ecosystems act as 'natural filters' and 'nurseries,' providing significant ecological and economic benefits.

## Call to Action

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### Unite Stakeholders

Engage pupils, students, NGOs, and teachers through education and participatory actions for sustainable conservation.

- 

### Adopt Integrated Management

Implement ecosystem-based approaches, reduce pollution, and actively restore degraded marine habitats.

- 

### Foster Cooperation

Strengthen international partnerships to safeguard the Black Sea's critical blue carbon resources for future generations.



**THANK YOU!**