

Interreg



Co-funded by
the European Union



NEXT Black Sea Basin

Assessing benthic habitat health in relation to environmental conditions and human impacts

EfxINNOs Partner Kick-off Meeting

Yelda AKTAN
Istanbul University

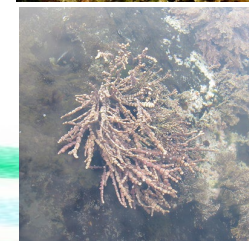


17 April 2026
Tbilisi, Georgia

Background

The Black Sea is a unique basin, rich in biodiversity, productivity and heritage, but also where an exceptional combination of natural and human stressors co-occurs (www.blacksea-cbc.net).

- Black Sea coasts comprise critical monospecific/mixed phytobenthic communities (seagrasses, macroalgal forests, coralligenous) (EU Habitat Directive, 92/43/EEC).
- Seagrass meadows, which are the primary producers of coastal ecosystems, are unique ecosystems with high capacity to store organic carbon «blue carbon» notably in the rhizomes, roots and sediment).
- Conservation of these ecosystems is an important tool for climate change limitation.



Objectives

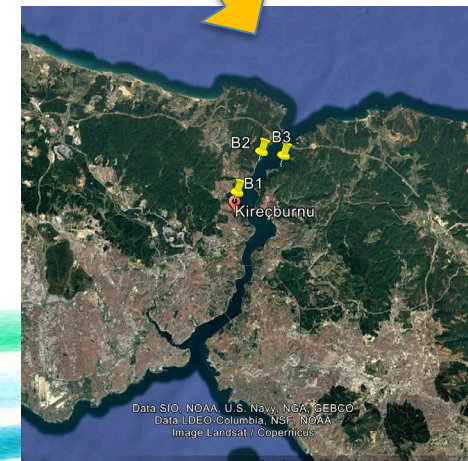
Activity 1.8

Assessing benthic habitats health in relation to environmental conditions and human impacts

- **Exploring the benefits of non-destructive technology** to quantify phytobenthic distribution and seagrass habitats.
- **Adapting the «coastal ecosystem monitoring» methods** used in the Mediterranean (in accordance with the Marine Strategy Framework Directive) to the Black Sea Basin.
- **Assessing the ecosystem status** using the marine data collected.
- **Evaluating the benthic habitat health** in relation to environmental conditions and human impacts

Methodology followed during the field study the Istanbul Strait – June 2025

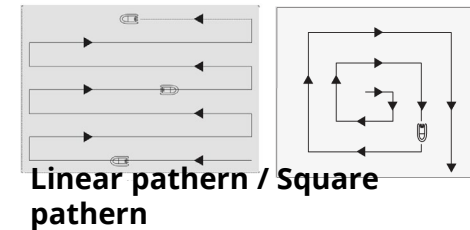
- **Monitoring** the macrophytic communities by ROV (non-destructive and no-time consuming) in the pilot sites.
- **Measurement** of the main physico-chemical parameters of seawater: temperature-salinity-pH-conductivity- dissolved oxygen-turbidity
- **Estimation** of macrophytic cover (%) through photoquadratic vertical projection (20x20 cm) in a standart depth.



Methodology followed during the data processing

- **Assessment** of the macrophytic composition by extracting the frame images from the ROV videos.

- Aerial imageries of Google Earth Pro
- Coordinates
- Photogrammetric images: upper&lower limit depth with habitat type

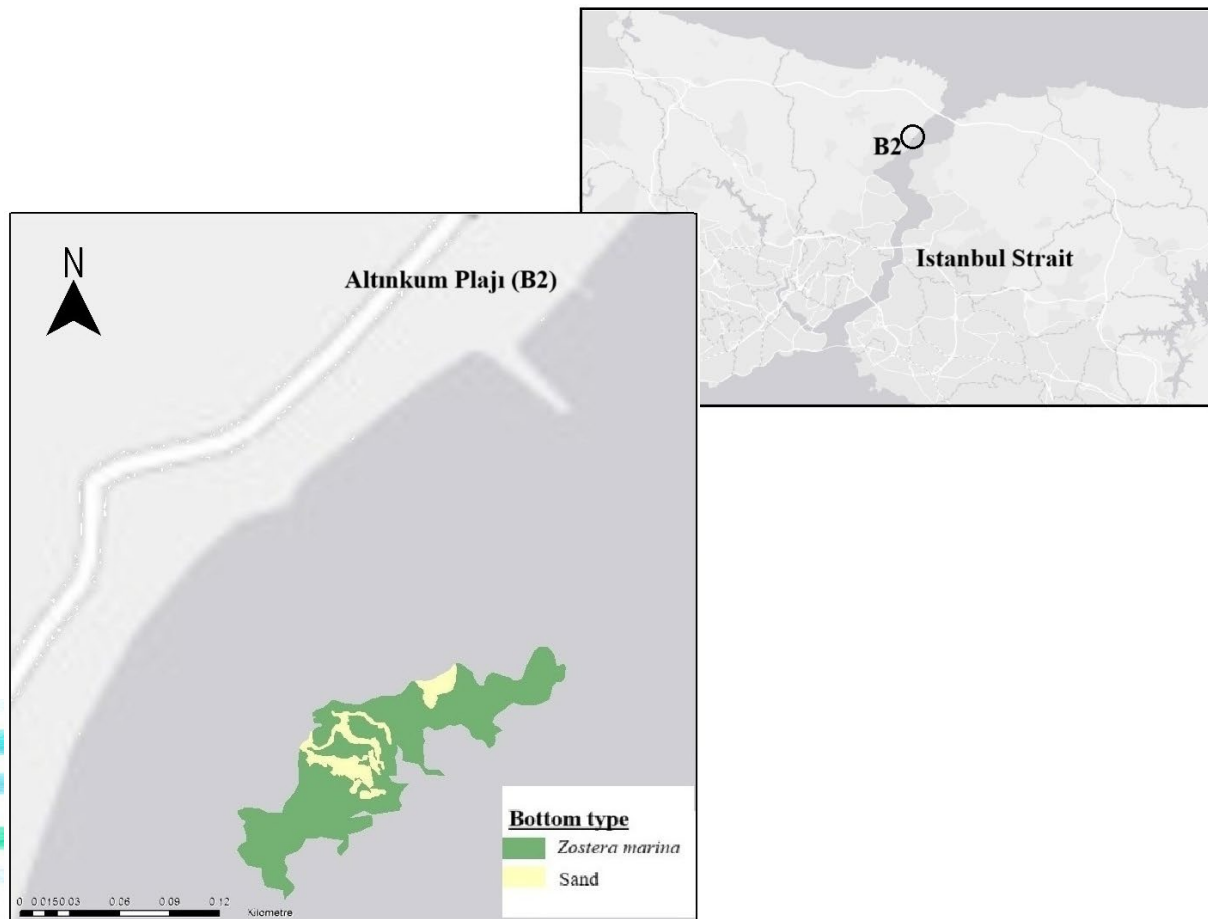


ROV Imagery & Data Labeling for Benthic Habitat Classification

- Coordinates
- Photogrammetric images: upper&lower limit depth
- Image labeling from videos for habitat type and marine litter

Pyrot 25.6.25/13-34-26 (lighthouse)							
Latitude	Longitude	Depth (m)	Habitat type	meadow upper limit depth	meadow lower limit depth	Litter	
41.1489334	29.0459796	8.0	<i>Ulva</i> - sand- mussels	4.2	6.2		
41.1488942	29.0459832	6.9	<i>Ulva</i> - sand- mussels				
41.1489309	29.0458121	5.4	<i>Ulva</i> - pebble -sand			Tire x1	
41.1490136	29.0457514	4.2	<i>Zostera</i> -broken mussel shells				
41.1490113	29.0457241	4.5	<i>Zostera</i> - <i>Ulva</i>				
41.1490802	29.0456895	4.9	<i>Zostera</i> - <i>Ulva</i>				
41.1490935	29.0457218	5.5	<i>Zostera</i> - <i>Ulva</i> -sand				
41.1490945	29.0456112	5.5	Continuous <i>Zostera</i>				
41.1491281	29.045629	6.5	<i>Ulva</i> - sand- mussels				
41.1491042	29.045591	5.9	<i>Zostera</i> - <i>Ulva</i> -sand				
41.1491099	29.0454644	5.6	<i>Ulva</i> facies				
41.1491503	29.0455085	6.0	Pebble -sand				
41.149196	29.0455767	7.8	Pebble -sand				
41.1491966	29.0455765	7.9	Pebble -sand				
41.1492306	29.0454523	5.2	<i>Ulva</i> - broken mussel shells				
41.1493082	29.0453957	5.3	<i>Ulva</i> facies				
41.1493097	29.0453916	5.2	<i>Ulva</i> facies				
41.1493215	29.045407	5.2	<i>Zostera</i> -mucilageous aggregates			Tire x3	
41.1493444	29.0454276	6.5	sand -pebble				
41.1494175	29.045353	6.0	<i>Zostera</i>				
41.1494215	29.0453592	6.0	<i>Zostera</i> -sand				
41.149449	29.0453502	5.6	<i>Zostera</i> -sand - <i>Ulva</i>				
41.1495225	29.0453516	5.5	<i>Zostera</i> -sand- <i>Ulva</i>				
41.1495628	29.0453432	5.1	<i>Zostera</i> - <i>Ulva</i> -mucilageous aggregates				
41.1496082	29.0453686	5.1	sand - <i>Zostera</i>				
41.149615	29.0453547	4.9	<i>Zostera</i> -mucilageous aggregates				

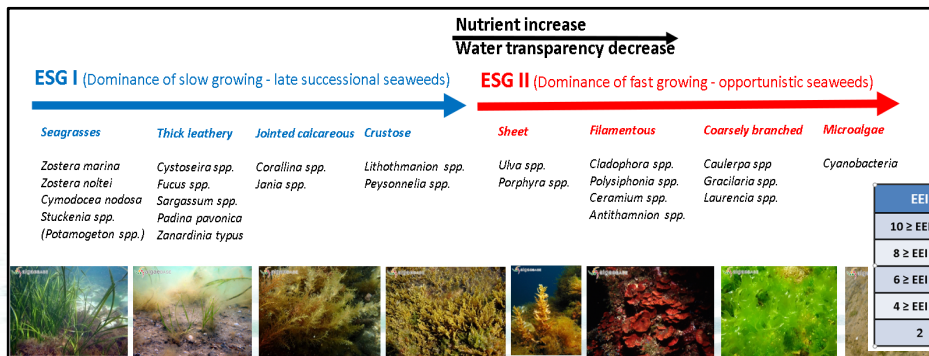
➤ **Integration** of collected data to ArcGIS for **Mapping**.



Methodology followed during the data processing

- **Calculation** of the Ecological Evaluation Index (EEI) after sorting and estimating the cover of ecological status groups (ESGs).

Ground-truthing step
Quadrat-based field observations



Genus	ESG	Cover on quadrat (%)
Acetabularia	I	
Acanthophora	II	
Amphiroa	I	
Anadyomene	I	
Antithamnion	II	
Bryopsis	II	
Calithamnion	II	
Caulerpa	II	
Ceramium	II	
Chaetomorpha	II	
Champia	II	
Chondria	II	
Cladophora	II	
Codium	II	
Colpomenia	II	
Corallina	I	
Cystoseira	I	
Dasya	II	
Dermatolithon	I	
Dictyopteris	II	
Dictyota	II	
Ectocarpus	II	
Enteromorpha	II	
Erithrotrichia	II	
Flabellia	I	

EEI	EQR EEI	Status
$10 \geq EEI > 8$	$1 \geq EQR > 0.75$	High
$8 \geq EEI > 6$	$0.75 \geq EQR > 0.5$	Good
$6 \geq EEI > 4$	$0.5 \geq EQR > 0.25$	Moderate
$4 \geq EEI > 2$	$0.25 \geq EQR > 0$	Low
2	0	Bad

Preliminary Approach:

ROV-Based Seagrass Status Index (ROV-SSI)

Methodological Basis:

- Adapts diver-based ecological indices into an ROV-based operational monitoring framework
- Depth gradient & lower depth limit as primary reference
- Transect-based habitat labeling (*Zostera* meadows / foliose algae / filamentous algae)
- Video-derived semi-quantitative scoring

	0	1	2	3
Meadow cover	0-25%	26-50%	51-75%	76-100%
Meadow Continuity	Absent	Patchy	Semi-continuous	Continuous/dense
Lower Limit	Clear regression	Fragmented/unstable boundary	Stable and continuous	Expanding
Epiphytes / Opportunistic	Dense filamentous leafy dominance	High	Moderate	Low
Sediment Stability	Highly unstable -Extensive rhizome exposure -Strong mat erosion -Disturbed sediment	Unstable -Clear rhizome exposure -Moderate erosion -Partially disturbed sediment	Moderately stable -Limited rhizome exposure -Low erosion -Mostly stable sediment	Stable -Rhizomes buried -No erosion -Compact sediment

ROV-Based Sediment Stability Index (0-3)

Semi-quantitative visual assessment



Preliminary Approach: Calculation ROV-Based Seagrass Status Index (ROV-SSI)

Total Score (0–15)

SSI % = Total Score x 15/100

- $SSI = \sum (Score_i \times Weight_i)$ -- weight 1 aldım??
- $SSI_{\%} = (Toplam\ Skor / Max\ skor) \times 100$

Quality scores	SSI	Ecological Status Classification
0-3	Sayı	Bad
3-6	Sayı	Poor
6-9	Sayı	Moderate
9-12	Sayı	Good
12-15	Sayı	High

Interreg



Co-funded by
the European Union



NEXT Black Sea Basin

Thank you



Methodology followed during the data processing

- **Evaluation** of the relations between the ecological status of phytobenthic communities (EEI) & the anthropization level (LUSI).

Urban (% landuse)	Agricultural (% landuse)	Industrial (% landuse)	Riverine (mean salinity)	Score	Coastline morphology	Correction factor
	< 10 %	< 10 %	> 37.5	0	Concave	1,25
< 33 %	10 – 40 %	> 10 %	34.5 - 37.5	1	Convex	0,75
33 - 66 %	> 40 %		< 34.5	2	Straight	1
> 66 %				3		

LUSI = (urban score + agricultural score + industrial score + riverine score) × coastline correction factor

A	B	C	D	E	F	G
ID	Site	Urban (% landuse)	Agricultural (% landuse)	Industrial (% landuse)	Riverine (mean salinity)	Coastline morphology
1	Name	80	20	0	36.0	Straight