Interreg - IPA CBC
Bulgaria - Turkey
PARTNERSHIP

CB005.2.12.085 "Common Value Black sea - Let The World Breathe"

Contract No CB005.2.12.012/085-PP2-3 / LOT 2

Results from the implemented „Field and laboratory studies for the needs of the project

"Common Value Black Sea – Let The World Breathe"

CONTRACTING AUTHORITY	**"EUROPE AND WE" ASSOCIATION**
PROJECT	**"Common Value Black Sea – Let The World Breathe"**
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Prime Consulting

The project is co-funded by the European Union through the Interreg-IPA CBC Bulgaria–Turkey Programme
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METHODOLOGY FOR IMPLEMENTATION OF THE STUDY

Methodology for implementation of the study includes execution of the following consistent steps (fig. 1).

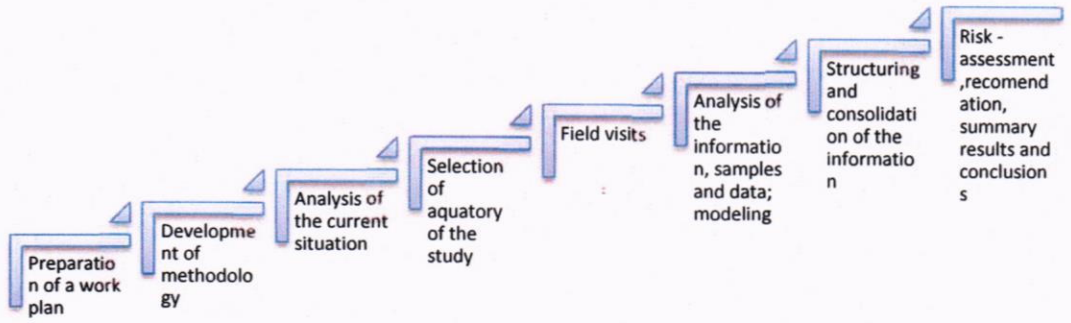

Figure 1 Consecutive steps of the study.

TEAM

The working team consists of scuba divers with the qualification "Scientific Diver", experts in seagrass ecology and GIS and an expert - technical maintenance (Table 1). A working moment of the study is shown in Fig. 2.

Table 1. The working team implemented the study

	Name	Position
1	Anton Krastev	Scuba diver, transport
2	Atanas Machev	Scuba diver
3	Valentin Panayotov	Scuba diver – support, GIS expert
4	Dimitar Yovchev	Technical maintenance
5	Elitsa Hineva	Specialist – sea grasses, GIS expert
6	Nikola Nietresta	Scuba diver – support, transport

Fig. 2. Sampling seagrasses in the area of Nessebar. Photo: Nikola Nietresta

DESCRIPTION OF THE CURRENT SITUATION AND SOURCES FOR ANTHROPOGENIC IMPACT

The selected study area covers parts of the aquatory of the Nessebar Bay, areas south of the Nessebar Peninsula to cape Akrotiria, from cape Akrotiria to cape Ravda and from cape Ravda to Pomorie salt pans. The area is entirely within the range of the Burgas Bay and falls within the zone for conservation of NATURA 2000 habitats - "Aheloy-Ravda-Nessebar" (http://natura2000.moew.government.bg/Home/Natura2000ProtectedSites).

The coastline in the different sections of the region changes its direction and orientation, which determines a different exposure to waves approaching from different azimuths and respectively a different vulnerability to sea-based sources of pollution. The catchment area of surface waters in the region is formed by the catchments of the rivers Kurudere, Hadjiyska, Aheloy. Larger rivers (Aheloy and Hadjiyska) has shown deviations in their water quality in terms of physico-chemical elements (both rivers), zoobenthos and fish (Hadjiyska) and all biological quality elements (Aheloy) (River Basin Management Plan 2016-2021). Near the surveyed area, two WWTPs discharged directly into the coastal waters - "Elenite" and "Ravda - Sl. Bryag – Nessebar - Aheloy ". The latter one has a step for removal of nitrogen and phosphorus, in addition to mechanical and biological treatment.

SUBJECT OF THE SEA SURVEY AND CONSERVATION STATUS

Seagrasses, unlike algae, are higher plants (angiosperms, flowering plants). Their habitats are protected because of the high ecological value they represent (Table 2).

Table 2. Conservation status of the identified habitats and macrophytic species

	Species	Condition according the Red list of IUCN	Habitats Directive 92/43/EU and BDA	Red Data Book of Bulgaria (Todorova V., 2011; Todorova V. and Panayotova M., 2011)
1	*Zostera marina L.*	Least concern	Habitat 1110	vol. III Habitats - endangered

2	*Z. noltei, Hornemann*	Least concern	Habitat 1110	vol. III Habitats – endangered
3	*Zannichellia palustris L.*	Least concern	Habitat 1110	vol. III Habitats – endangered
4	*Stuckenia pectinata (L.) Borner*	Least concern	Habitat 1110	vol. III Habitats – endangered
5	*Cystoseira spp. (Agardh)*	-	Habitat 1170	vol. III Habitats - endangered

At present, the identified macrophyte species are not endangered (IUCN Red list), but their habitats are subject to protection under both the European and the Bulgarian legislation. The available scientific information on the Bulgarian coast indicates that at least 29 fish species inhabit, feed or spawn in coastal vegetation (macroalgae and seagrass). Of these, one species - the straightnose pipefish (N. ophidion (Linneus, 1758), family Syngnathidae) is endangered and one species is vulnerable grass goby (Z. ophiocephalus (Pallas, 1814)) is endangered Sivkov et al., 2011).

DETERMINING THE AREA OF MEADOWS, GPS COORDINATES, DIMENSIONS, LOCATION

In the studied water area 4 fields of seagrass were identified and mapped: one to the north of the Nessebar peninsula and 3 to the south of it: 2 – between cape Akrotiria and cape Ravda (Aurelia 1 and Aurelia 2) and one - between cape Radva and the estuary of the Aheloy River. The fields have a total area of 0.7 km^2. The largest one is Nessebar - north with an area of 0.253 km^2 (Fig. 3).

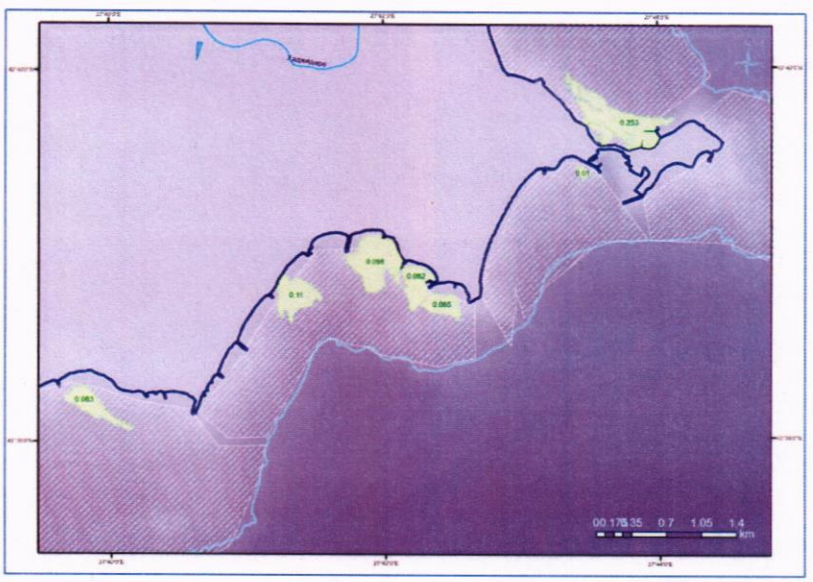

Fig. 3 Location of mapped seagrass habitats

TRACKING SEASONAL DYNAMICS WITHIN THE IDENTIFIED UNDERWATER SEAGRASS MEADOWS

Mapping the boundaries of seagrass fields has shown a lack of pronounced seasonal dynamics. The study has shown the upper boundary can be limited by both the wind waves (in the sandy stretches) and bottom substrate. Mapping the boundaries of seagrass fields has shown a lack of pronounced seasonal dynamics. The study has shown the upper boundary can be limited by both the wind waves (in the sandy stretches) and bottom substrate. The lack

of a seasonal change of the upper boundary position on the soft bottom should be sought in the high recurrence of moderate breeze from north-east, east and south-east, which was observed almost continuously during the studies and in-between. The lower meadow limit has also not shown a change, the reason for which can be found in approximately the same water transparency during the study period.

The analysis of the samples showed a clear difference in the abundance and quality of the epiphytes. The epiphytic cover during the actual summer season is weak and without the development of large algal species. During the autumn period, the algal epiphyte cover of the older leaves of Zostera is almost 100%: the red and blue-green species form a dense cover on the older leaves. Representatives of Polisiphonia and Hondria have well-developed thallus, with tetrasporangia and gametangia, which indicates an intensive process of asexual and sexual reproduction. The differences in the values of the number and biomass of seagrass in seasonal terms (Table 3) can be related to the natural spatial heterogeneity in the vegetation, rather than to a pronounced seasonality.

Table 3. Summary results from the analysis of seagrass samples. Average values and confidence interval (95 %) are presented

No	Expedition	n	Species	Number, No/m²	Aboveground mass, g./m²	Belowground mass, g./m²
1	18.07.2020-22.07.2020	10	*Z. noltei*	1780 ± 804,61	53,38 ± 17,53	10,426± 30,80
	Aurelia - 1	10	*Z. marina*	547,5±201,36	67,843±30,087	207,556±99,659
		3	*Z.palustris*		16,067±22,129	
		6	*S. pectinata*		25,467±16,55	
2	*23.09.2020–27.09.2020*	*10*	*Z. noltei*	1655±624,25	80,4±27,518	143,9±46,904
	Aurelia - 1		*Z. marina*	-	-	-
		6	*Z.palustris*		22,033±16,02	
		10	*S. pectinata*		75,938±28,06	
3	*23.09.2020–27.09.2020*	*1*	*Z. noltei*	-	-	-
	Nessebar - north	*9*	*Z. marina*	611,11±94,685	101,471±19,75	361,058±70,79

ASSESSMENT OF THE SEAGRASS HABITATS THREATS

The approach adopted under the MarLIN project https://www.marlin.ac.uk/ was chosen for the evaluation. The most relevant sources are summarized in the Table 4.

Table 4. Assessment of the risks for the identified fields

	Field	Priority risks	Assessment	Motives
1	**1. Nessebar - south** **2. Aurelia 1 and 2**	Enrichment with nutrients (nitrogen and phosphorus)	1. Moderately high 2. Low-moderate-high	Nessebar-north: There are no nearby point sources of nitrogen and phosphorus in the area. Wastewater from the settlements is covered by a sewerage network and is treated. The WWTP

	3. Ravda south		3. Low-moderate-high	discharges (Ravda - Sunny Beach - Nessebar - Aheloy and Elenite) are far from the field. The area is relatively protected from the waves, which favors the accumulation of pollutants. Potential risk factors: Hadjiyska River if its nutrient load increases; aquaculture facilities located near the field; development of livestock farms near the coast, etc. Aurelia 1 and 2, Ravda - south: a potential source of stress is the Aheloy River (if its load increases), an accident on the WWTP pipeline Ravda - Sunny Beach - Nessebar - Aheloy, excessive saturation of the area with aquaculture facilities. The areas are relatively open to the action of waves, which implies a lower risk of accumulation of pollutants.
2	**1. Nessebar - south** **2. Aurelia 1 and 2** **3. Ravda south**	Enrichment with easily degradable organic substances	1. Moderately high 2. Low-moderate-high 3. Low-moderate-high	Nessebar-north: There are no nearby point sources of nitrogen and phosphorus in the area. Wastewater from the settlements is covered by a sewerage network and is treated. The discharges of the WWTP (Ravda - Sunny Beach – Nessebar - Aheloy and Elenite) are far from the field. The area is relatively protected from the waves, which favors the accumulation of pollutants. Potential risk factors: Hadjiyska River if its nutrient load increases; aquaculture facilities located near the field; development of livestock farms near the coast, etc. Aurelia 1 and 2, Ravda - south: a potential source of stress is the river Aheloy (if its load increases), accident of the pipeline of WWTP Ravda - Sunny Beach – Nessebar - Aheloy, excessive saturation of the area with aquaculture facilities. The areas are relatively open to the action of the waves, which implies a lower risk of accumulation of pollutants.
3	**Nessebar north** **Aurelia 1 and 2** **Ravda south**	Change of the type of the bottom substrate	High, if realized	Potential risk factors: hydrotechnical engineering construction on the water area occupied by the field
4	**Nessebar –**	"Sealing" of the habitat	High, if realized	Potential risk factors: hydrotechnical construction

	north Aurelia 1 and 2 Ravda south			on the water area occupied by the field
5	**Nessebar – north Aurelia 1 and 2 Ravda south**	"Burial" of the habitat with unpolluted sediment, siltation	High, if realized	Potential risk factors are: deposition of sediment masses, poorly calculated hydrotechnical construction, which crosses longshore drift and causes the formation of sandy spits, large scale-hydrotechnical construction which leads to extremely calm conditions and siltation (Corg in sediment > 15 - 20%).
6	**Nessebar – north Aurelia 1 and 2 Ravda south**	Abrasion / disturbance on the sediment surface (Sediment extraction)	High, if realized	Potential risk factors are: direct sediment extraction from the area, poorly calculated hydrotechnical construction, which leads to sediment erosion and impacts the rhizomatous system of seagrasses; bottom trawling, dredging in the field area, bottomnets for growing white mussels, etc.
7	**Nessebar - north Aurelia 1 and 2 Ravda south**	Physical damage to the bottom - disturbance in the subsurface sedimentary layer	High, if realized	Potential risk factors: hydrotechnical construction works and maintenance, which would lead to deepening in the area greater than 6 m (i.e. 7, 8, etc. meters).
8	**Nessebar - north Aurelia 1 and 2 Ravda south**	Decrease in water transparency	Moderately high	Potential risk factors: intense phytoplankton blooms, increase in inorganic suspended matter, including strong and frequent river floods, pollution with optically active substances that block light.
9	**Nessebar - north Aurelia 1 and 2 Ravda south**	Non-targeted extraction of species	High, if realized	Potential risk factors: dredging, bottom trawling, breeding of molluscs in bottom nets, etc. The presence of large stones and rocky areas in the grass fields reduces the risk of trawling and dredging.
10	**Nessebar - north Aurelia 1 and 2 Ravda south**	Maritime accidents (oil spills)	High-moderate-high	Nessebar - north is a relatively sheltered area. If the spill occurs in the area of Nessebar Bay - the risk to the field is high. If the spill occurs to the south of the peninsula, the risk is moderate - high.

				Arelia 1 and 2 and Ravda south - if the spill occurs in the area opposite to the fields, the risk is high. If the spill occurs in the Nessebar Bay - the risk is lower. For all fields, the risk is lower if the spill occurs to the north of the cape Emine and under calm weather. Seagrasses are relatively tolerant to oil polution and respond with a rapid recovery (<1 year) after the cessation of exposure (Dean et al., 1998).

RECOMMENDATIONS

It is possible to formulate the following recommendations for protection of the mapped meadows considering the available information on anthropogenic pressure sources:

- ✔ Further increase of the nutrient levels above the ecological limits of seagrasses and Cystoseira spp. not to be allowed. Further increase of the loads (e.g. enlargement of the tourist accommodation capacity) should be allowed only if adequate treatment is assured;
- ✔ Further reduction of the transparency not to be allowed;
- ✔ Hydrotechnical construction on the fields and direct impacts on the bottom harming the seagrasses within the field not to be allowed;
- ✔ Hydrotechnical engineering construction(s) that may affect the fields to be accompanied by an environmental impact assessment of the expected impacts on seagrasses and Cystoseira spp.;
- ✔ Increase of the loads of the discharging rivers above the limits that sensitive species can tolerate not to be allowed;
- ✔ Both ecosystem services of the meadows and possibilities for alternative for ecological local business - development of sustainable scuba diving tourism among the local communities and the tourists to be promoted.