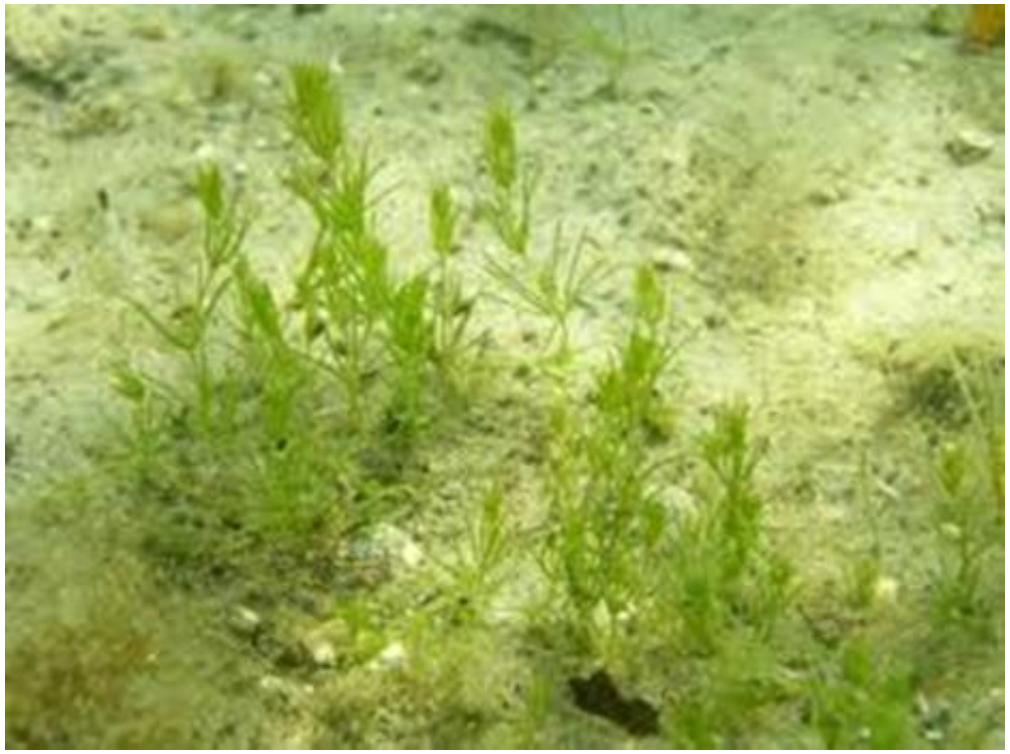
Recovery of *Chara aculeolata* Kütz. meadows in the Tendrivska Bay (Black Sea)



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Study area

The Black Sea Reserve is the largest (109256,8 ha) in Ukraine and the largest marine reserve in the Eastern Europe (aquatic area – 94435,8 ha).

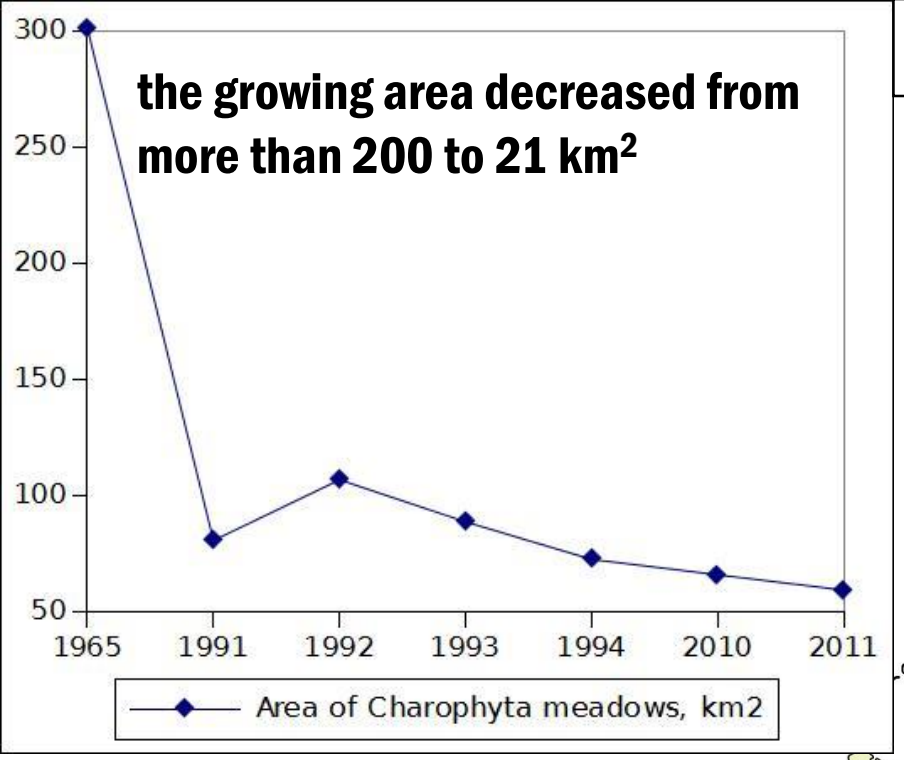
Tendrivska and Yagorlytska bays and their islands are the only aquatories of this region fully subjected to protection.

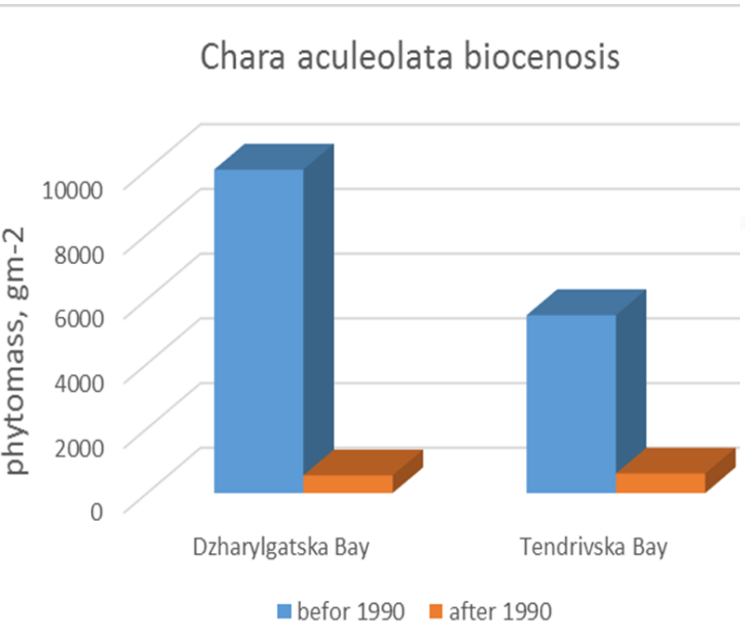
Total area is 940 km^2.

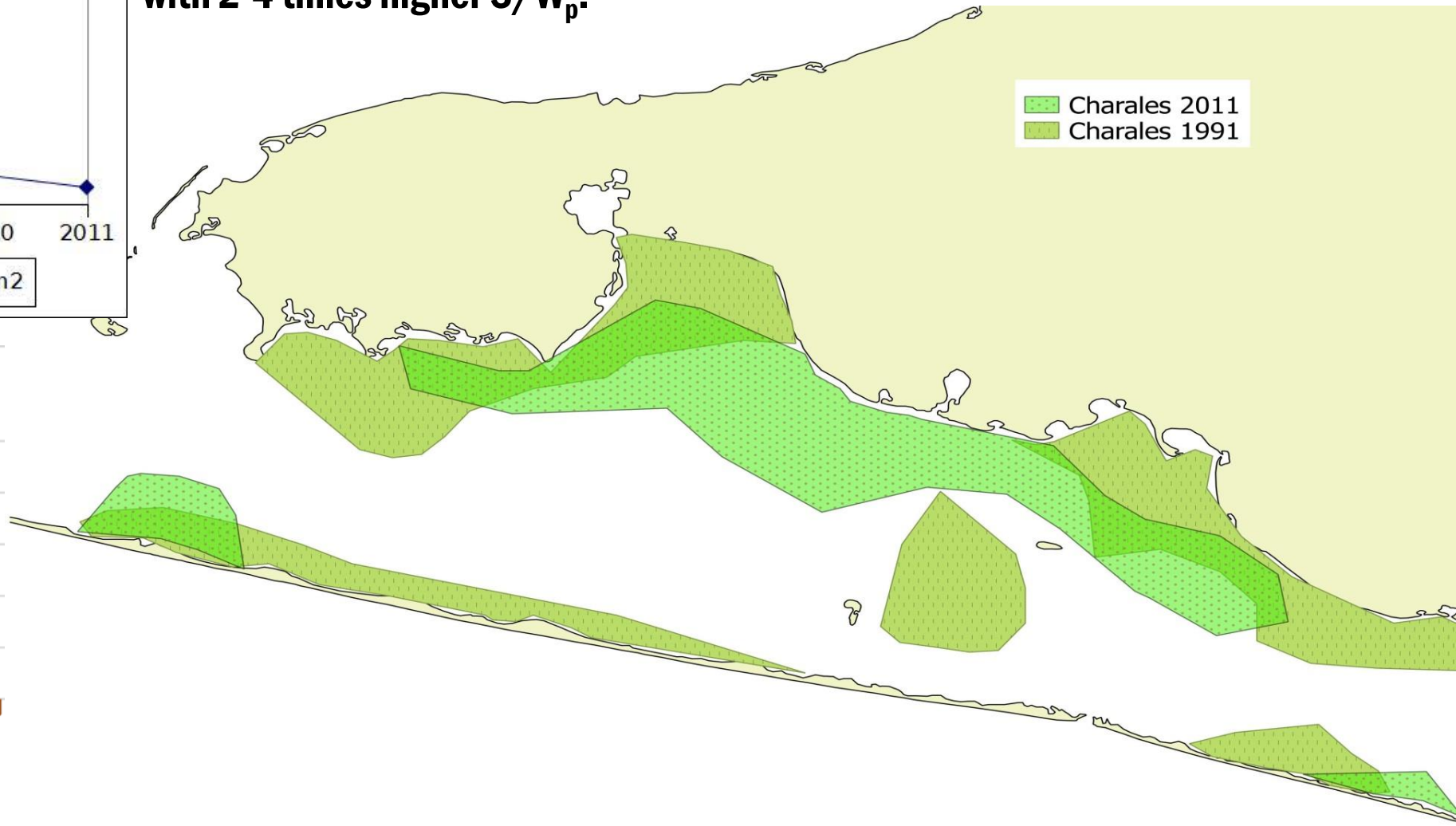
This is shallow brackish aquatory with average depth of 4 m and predominance of soft bottom habitats.

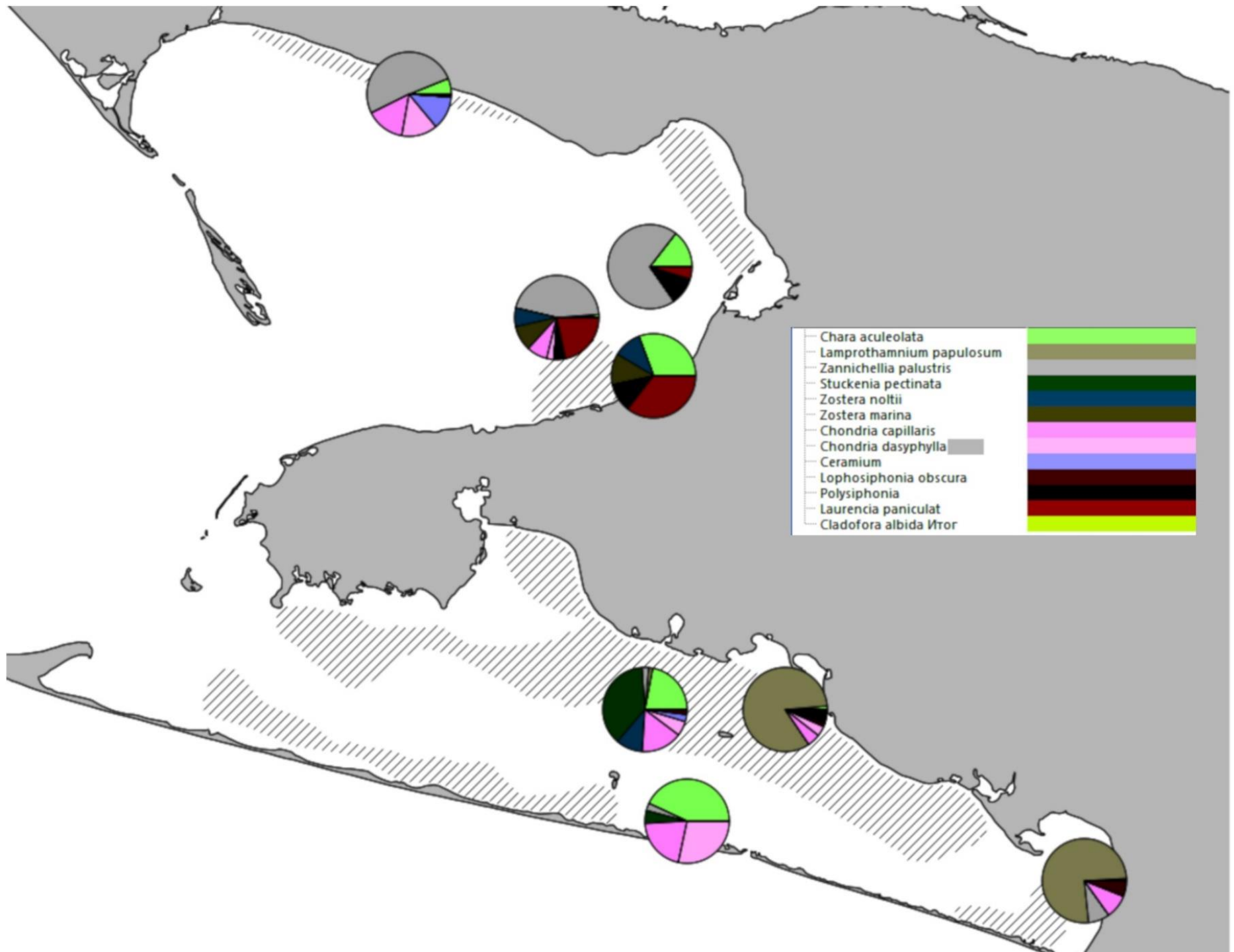
Degradation of the *C.aculeolata* monocenosis

Since the late 1980s there had been significant changes in the structural-functional organization of the bottom vegetation in Tendrivska Bay, *C.aculeolata* with Specific Surface of Population S/W_p-11.94 m^2kg^{-1} was replaced by species with 2-4 times higher S/W_p.









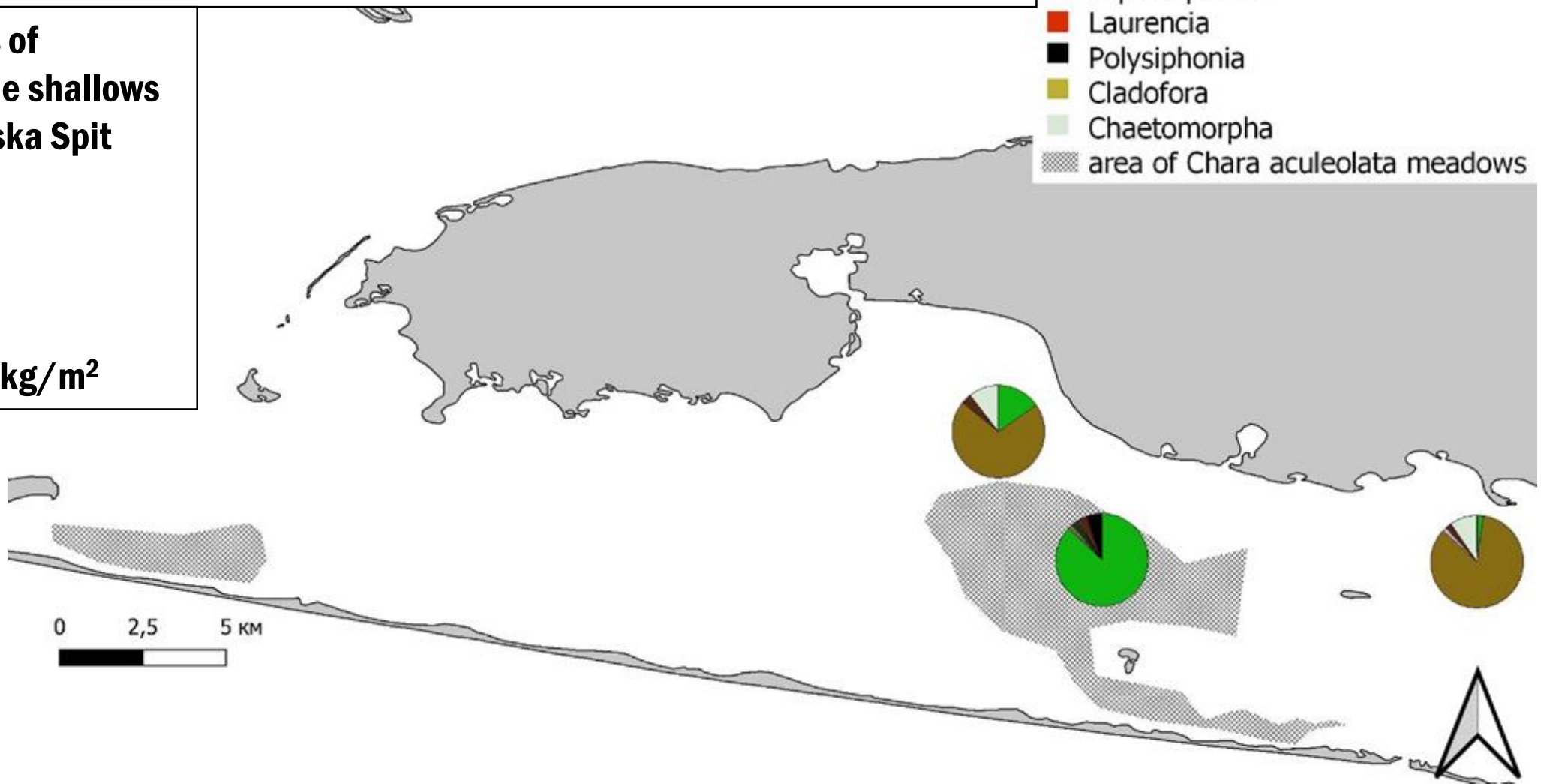
Between 2005 and 2016, C.aculeolata was found as a minor component in phytocenoses of higher aquatic plants and Lamprothamnium papulosum

The recovery of the C.aculeolata population

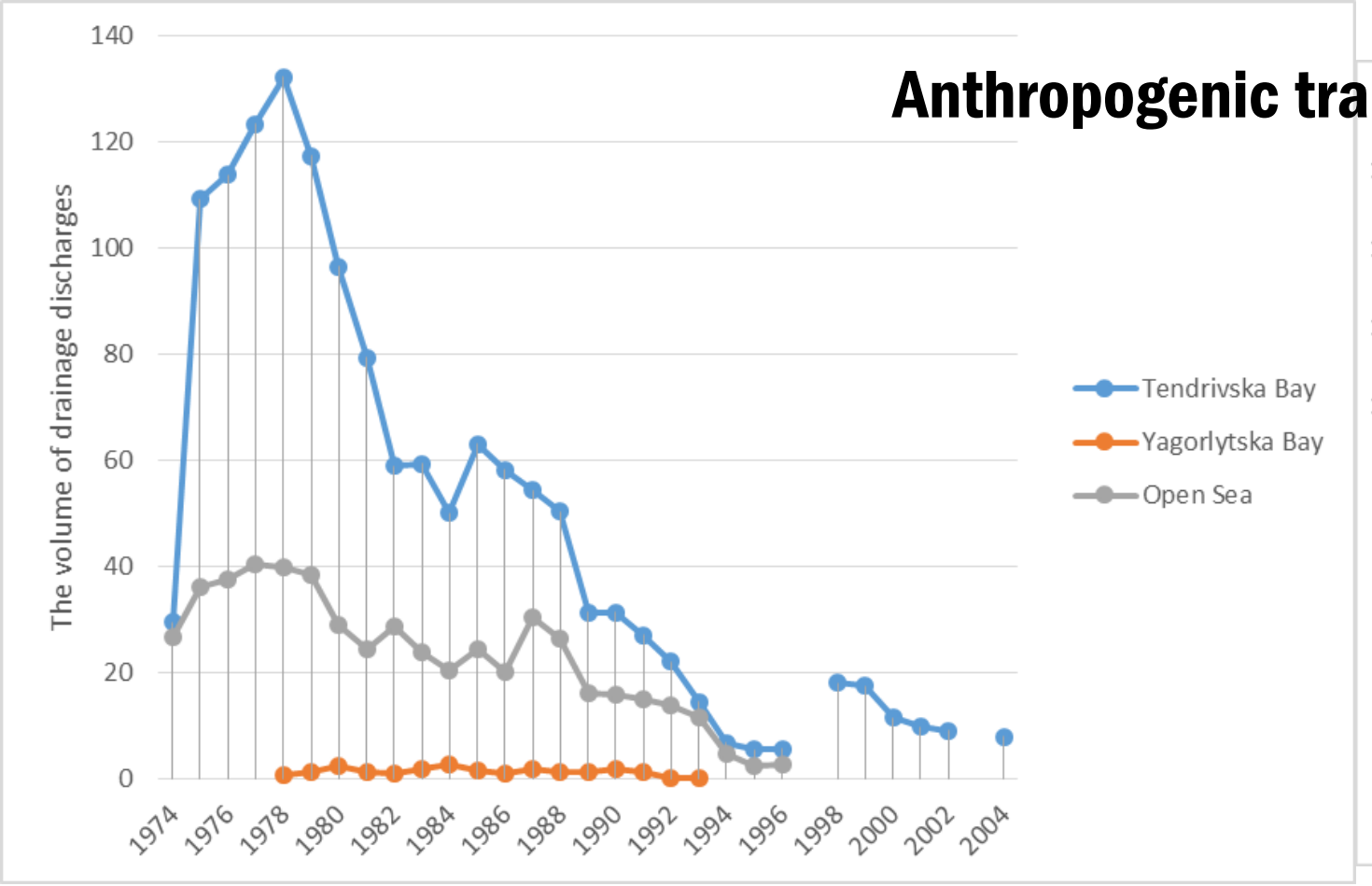
In 2021 meadows of C.aculeolata in the shallows along the Tendrivska Spit were found.

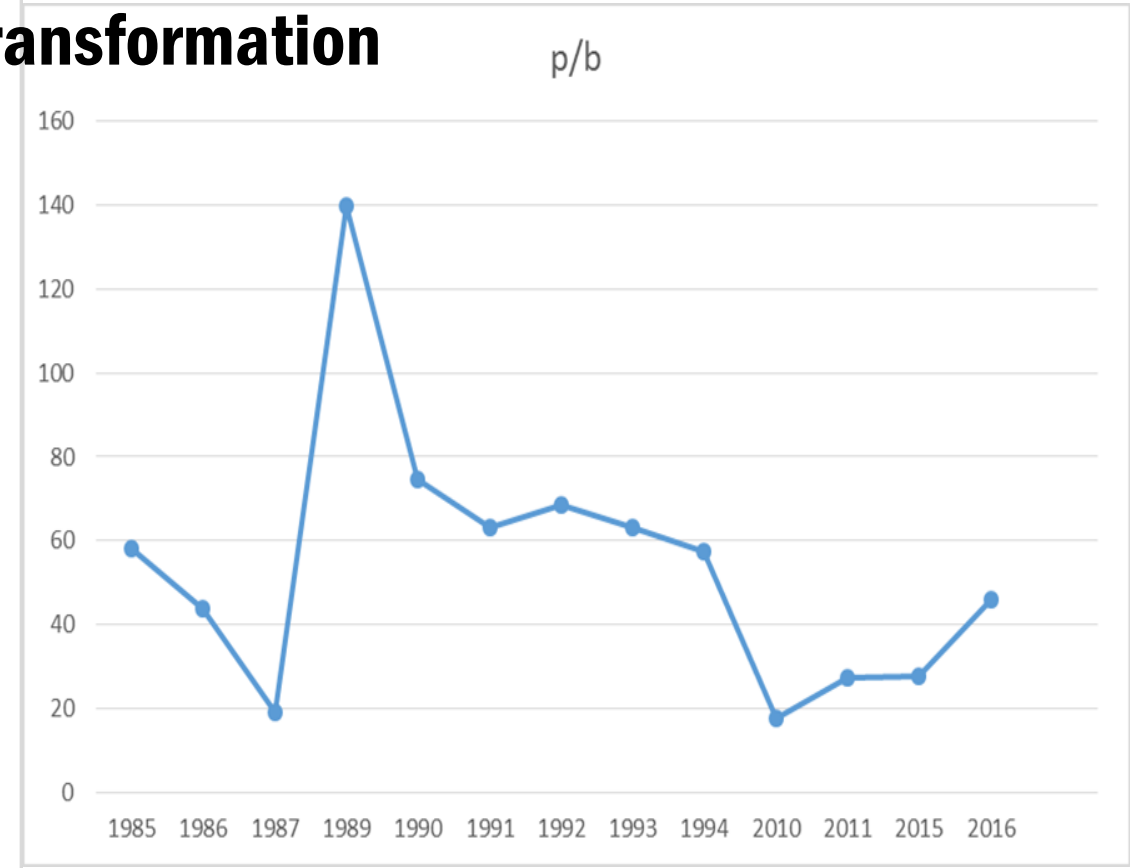
Area – 30 km^2.

Biomass – near 1 kg/m^2



Anthropogenic transformation

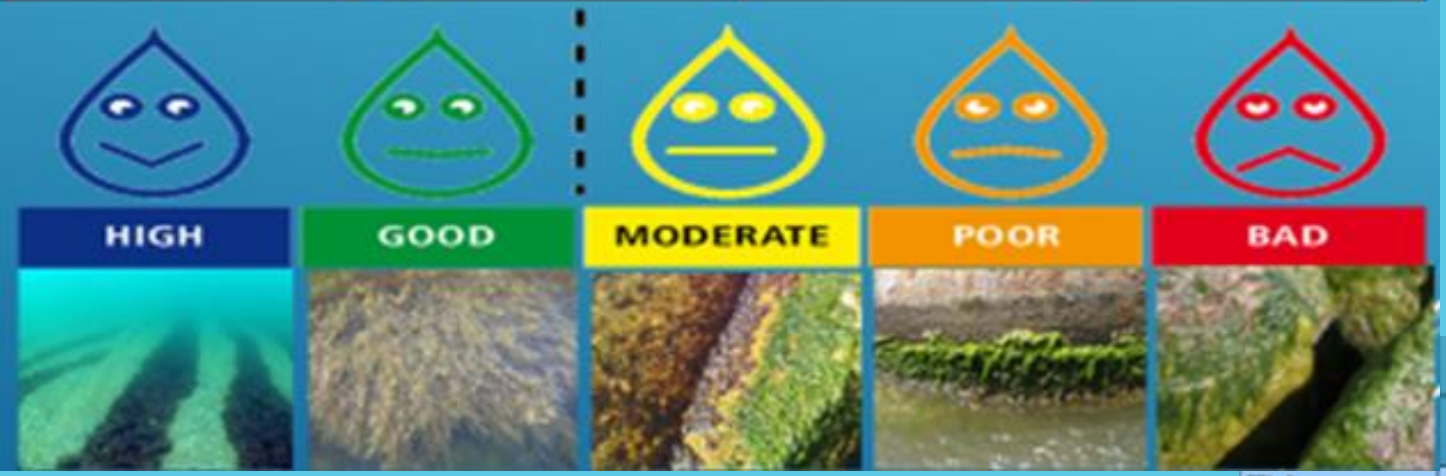




	Cu	Ni	Zn	Cr	Pb	Mn
			in sediments			
1987	24,8	43,2	57,3	89,5	17	256,4
2003	0,91-54,94	9,69-16,15	4,45-26,8	15,15-148,5	9,14-33,2	no data
			in water			
1987	4,3-16,9	4,2-14,7	7,7-13,6	no data	no data	no data
2003	2,99-3,25	1,56-16,42	1,32-19,9	0,51-0,98	<0,9	0,48-1,5

ESTIMATION OF THE ECOLOGICAL STATUS CORRESPONDS TO REQUIREMENTS OF THE WFD AND MFSD WITH USE MORPHOFUNCTIONAL APPROACH

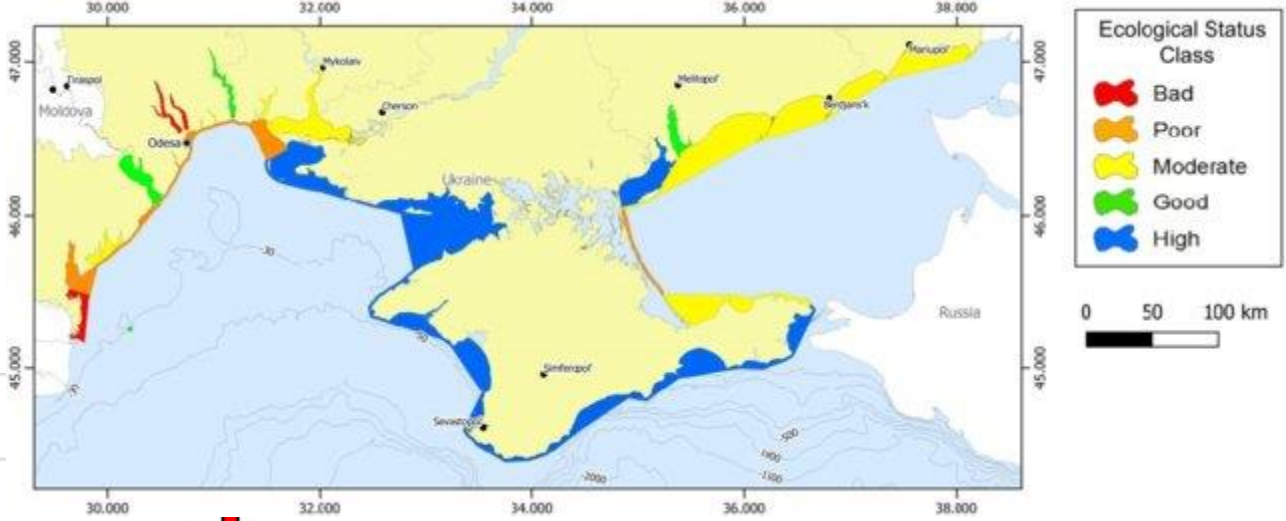
Ecological Status Class	Ecological Quality Ratio
High	1
Good	0.75
Moderate	0.5
Poor	0.25
Bad	0

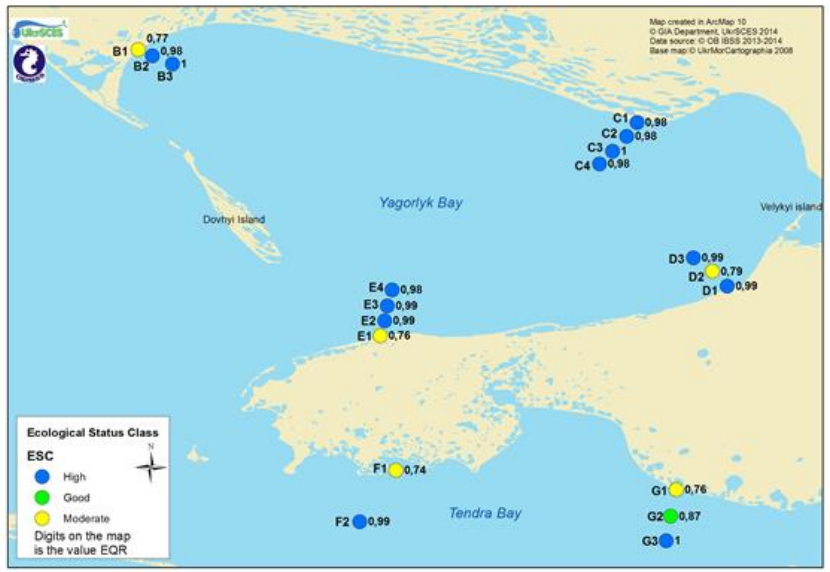


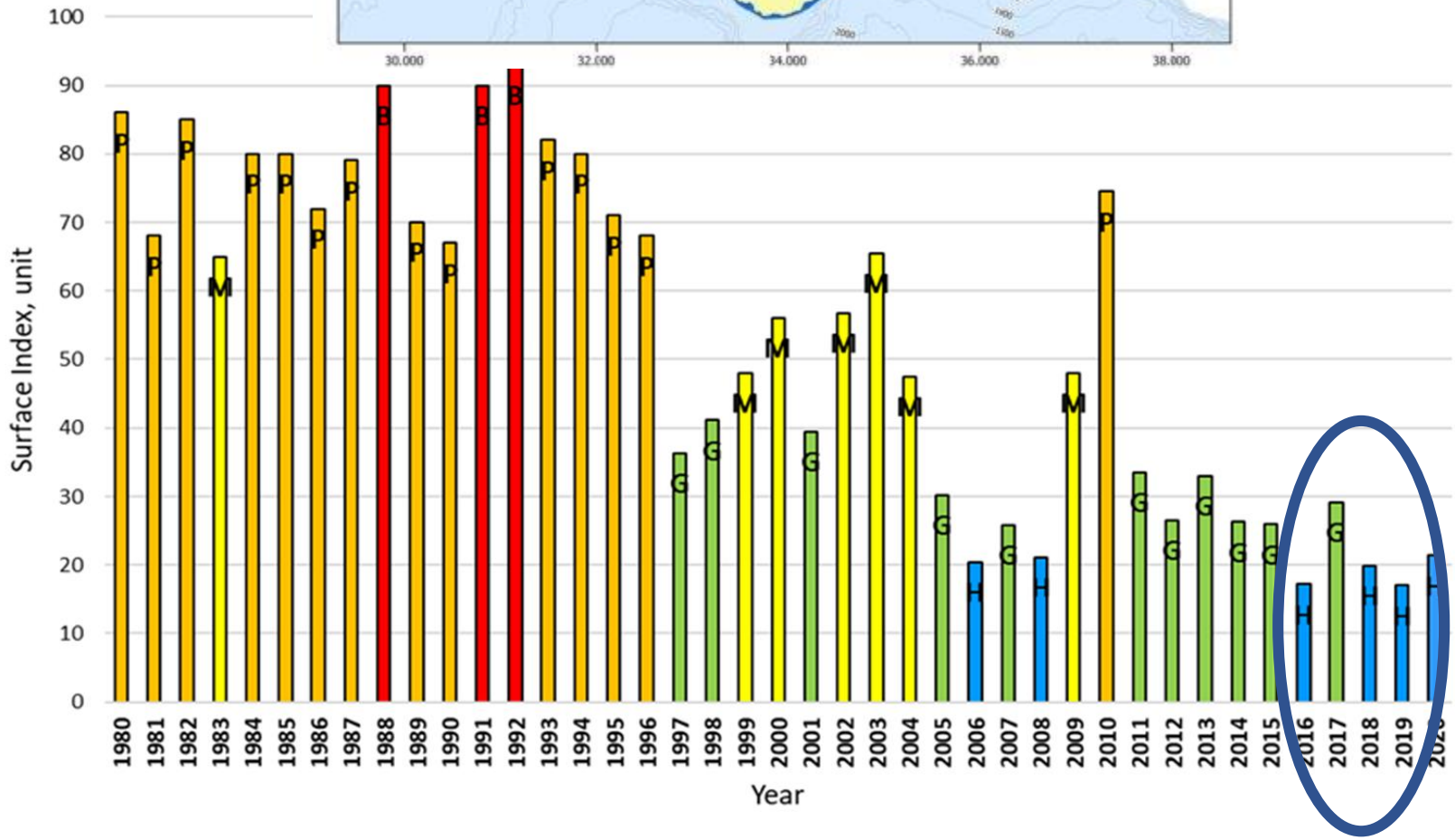
Using this approach it became possible to assess the current ecological state of coastal water bodies and largest limans in the ESC categories based on morphological and functional indicators of benthic vegetation and estimate trends in long-term dynamics

	EEI range					
	$(S/W)_{3Dp}$, $m^2.kg^{-1}$	EQR	$(S/W)_x$, $m^2.kg^{-1}$	EQR	SI_{ph}, units	EQR
High	$(S/W)_{3Dp} < 15$	≥ 0.82	$(S/W)_x < 60$	≥ 0.98	$SI_{ph} < 25$	≥ 0.93
Good	$15 \leq (S/W)_{3Dp} \leq 30$	0.54	$60 \leq (S/W)_x \leq 80$	0.79	$25 \leq SI_{ph} \leq 40$	0.61
Moderate	$31 \leq (S/W)_{3Dp} \leq 45$	0.37	$81 \leq (S/W)_x \leq 120$	0.58	$41 \leq SI_{ph} \leq 55$	0.41
Poor	$46 \leq (S/W)_{3Dp} \leq 60$	0.25	$121 \leq (S/W)_x \leq 200$	0.17	$56 \leq SI_{ph} \leq 90$	0.22
Bad	$(S/W)_{3Dp} > 60$	≥ 0	$(S/W)_x > 200$	≥ 0	$SI_{ph} > 90$	≥ 0

The decrease of anthropogenic pressure in the late 1990s led to the improvement of the regional ESC







Conclusions

- The recovery of the *Chara aculeolata* meadows has been observed since 2021 in Tendrivska Bay of the Black Sea Biosphere Reserve

- The recovery of the *C.aculeolata* population correlates with results of the assessment of ESC long-term dynamics, which demonstrate the shift from the category of “Good” to “High”, occurred 6 or 7 years ago for most of the region.

- The recovery of sensitive species with low ecological activity became possible with the improvement of the region ESC.


Thank you for your attention !