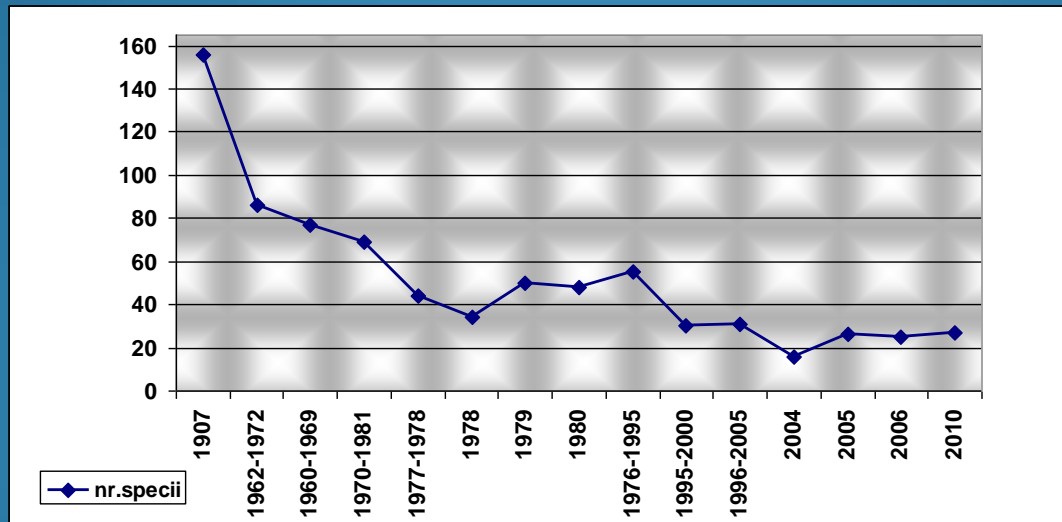


MACROPHYTES FROM THE ROMANIAN LITTORAL CURRENT STATE AND POSSIBLE USES

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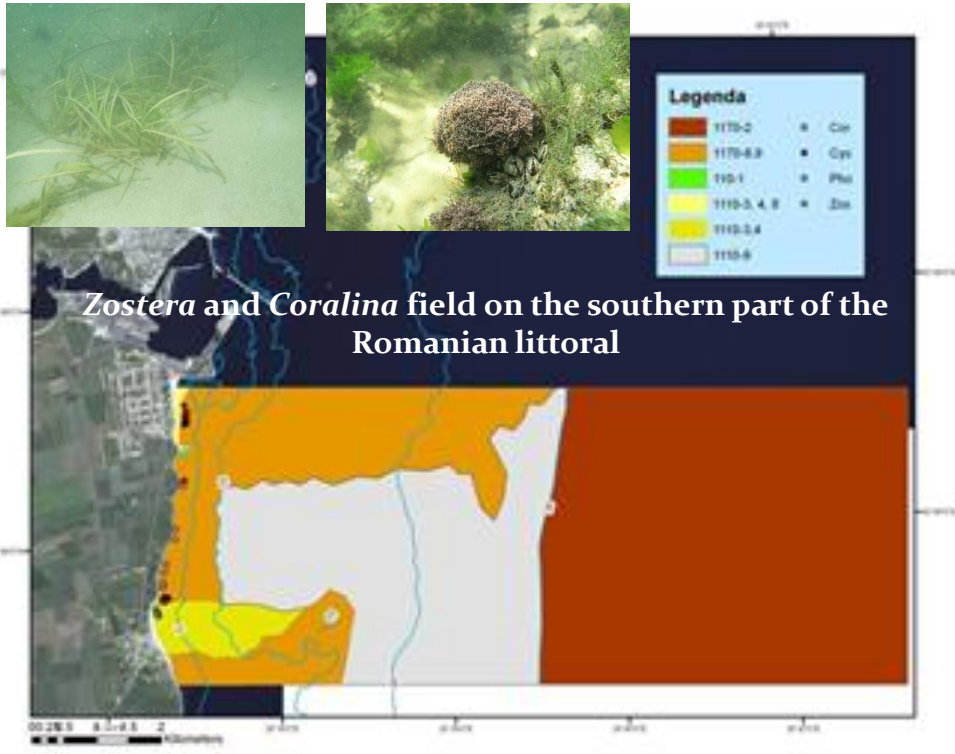
Macrophyte species list at the Romanian coast

- The number of macrophyte species from the Romanian coast has declined steadily since the early 60's, moment when only 85 taxa have been identified from a total of 162 described by then.
- The reduction trend has continued until today, when only 30 taxa have been identified. From this small number, only a few are important perennial and sensitive species, the rest being opportunistic species like the genera *Ulva*, *Cladophora* and *Ceramium*, fast-growing species and highly tolerant to the variability of enviromental conditions.



Number of Macrophyte species evolution during 1907 - 2010

Macrophyta specie list at the Romanian coast



Zostera and *Cystoseira* field on the southern part of the Romanian littoral



Limitative and stimulative factors

Substrate

- Macrophytes are organisms that live attached to the hard substrate (natural and artificial). The substrate is one of the main ecological requirements necessary for their normal development and for the whole development cycle.

Waves, currents

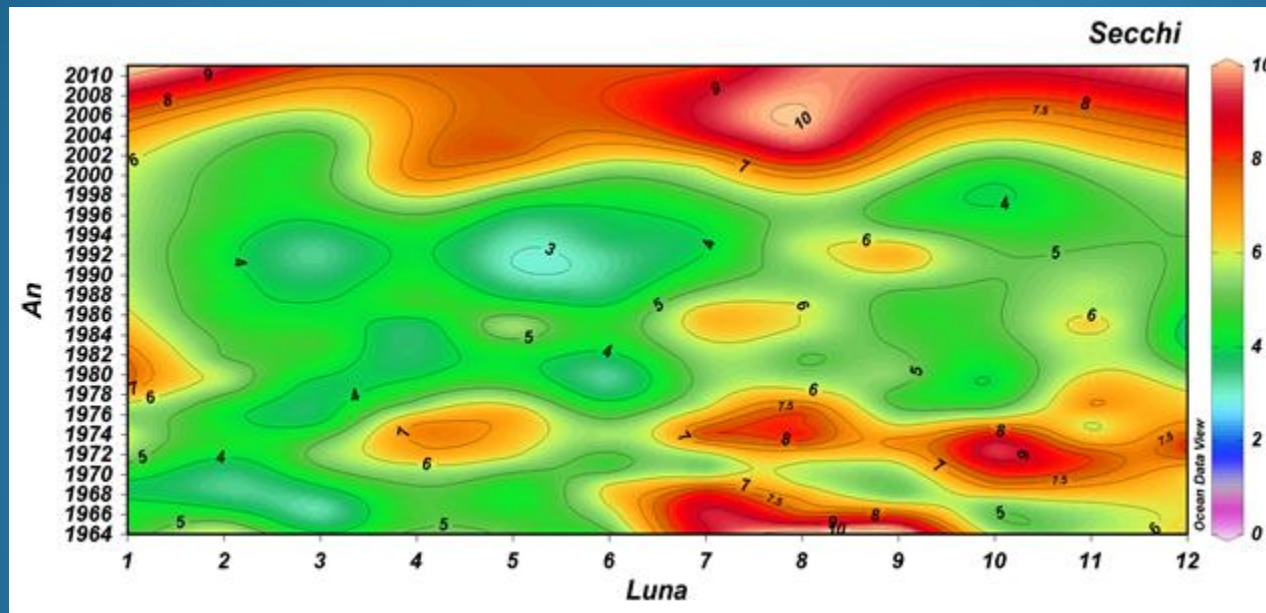
- Water movement is also an important factor, making diffusion of nutrients and acting as a thermal regulator by reducing sudden variations of environmental conditions. On our coast, free from tidal water movement, these oscillations due to waves are felt up to 6-7 meters deep, affecting, in different ways, the macrophytes. These adaptations for attachment and resistance to movement of water masses are not sufficient in case of storms, in which case the macrophytes end up on the beach or bottom areas without strong currents and movements of water masses.



Limitative and stimulative factors

Light

- Being photosynthesizing organisms, light is essential for their existence. The amount of light that enters the sea decreases significantly with depth, so the light acts as a limiting factor where water transparency is low.
- Currently, at the Romanian coast, transparency presents a general upward trend, which results in increasing bottom surface that macrophytes can grow on.

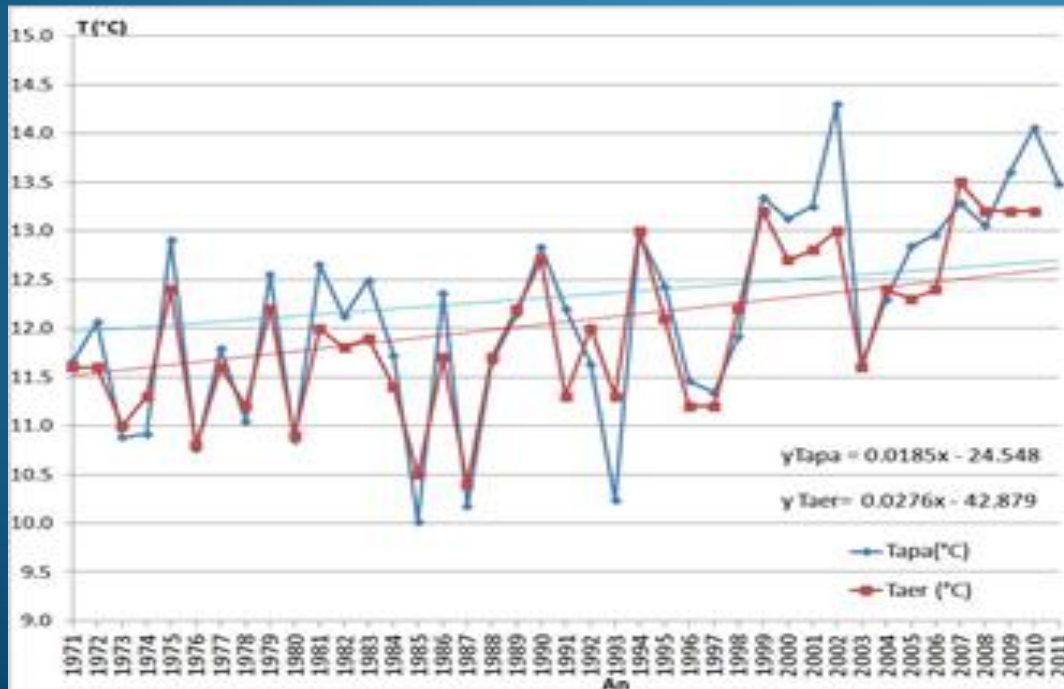


Water transparency (Secchi disk; m) along East Constanta transect during 1964-2010

Limitative and stimulative factors

Temperature

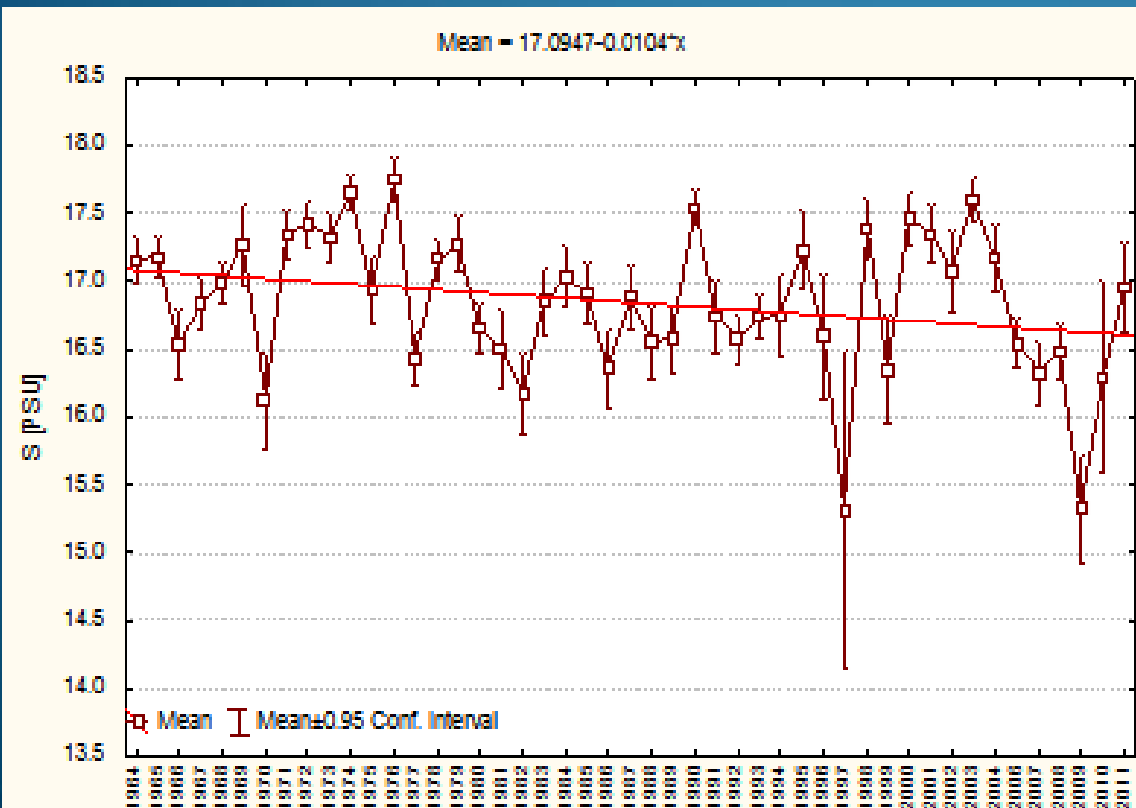
- Temperature is one of the factors that controls geographical and vertical distribution of macrophytes. On the upper part of the water column, on the coast, macrophytes are influenced by annual variations in temperature, and monthly or even daily variations that are manifested continuously or periodically, due to sea currents and the phenomenon of “up-welling”.
- There are eurithermal macrophytes, able to withstand high summer temperatures and low winter temperatures (such as *Ulva* or *Ceramium*) located at shallow depths.
- This kind of species are able to carry out metabolic activity and reproduce in a wide temperature range.



Annual average sea surface temperature in Constanta, between 1971-2011

Salinity

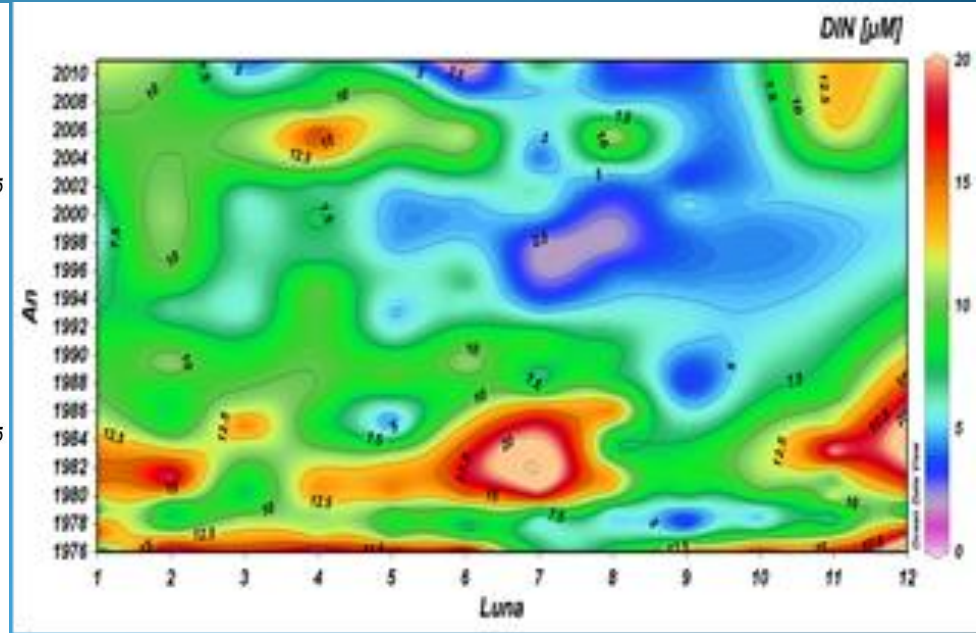
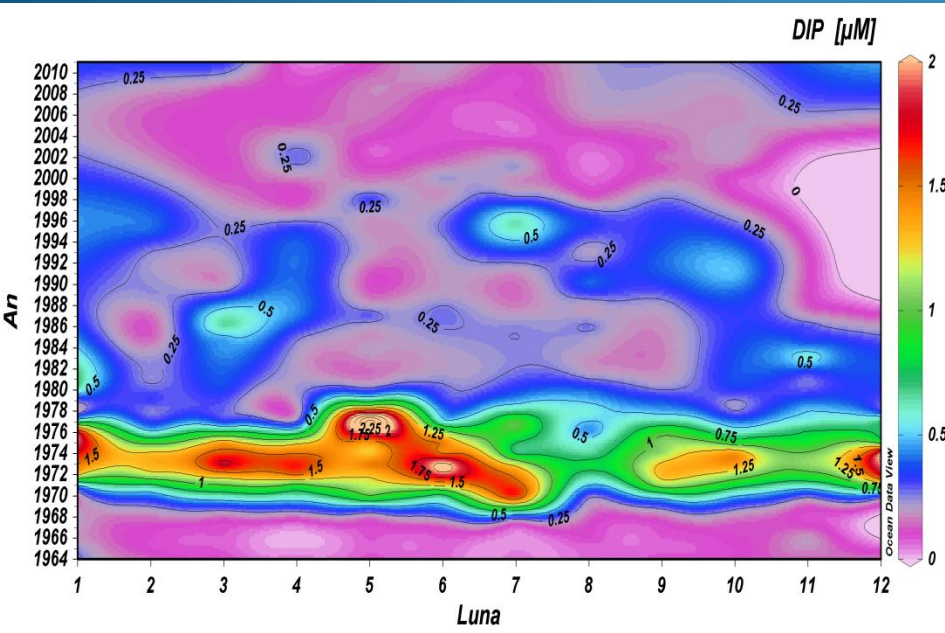
- Low salinity of the Black Sea waters is one of the main selection criteria for the adaptation of macrophytes from the Mediterranean or Atlantic, and is one of the main factors that control the development of local populations.
- Large variations of salinity that are recorded at the Romanian coast and especially with larger amplitudes in the last decade lead to the development of opportunistic species with short life cycle like *Ulva*, *Cladophora* and *Ceramium*.



Annual average salinity in Constanta, between 1964-2011

Nutrients

- Nutrients are compounds such as phosphates, nitrates, nitrites and are essential for the life of organisms that use photosynthesis.
- Macrophytes' nutrients requirements (type, amount) vary widely from species to species.
- The alteration of the ratio between nutrients determines the qualitative and quantitative changes in the composition of macrophyte populations.
- Nutrient availability is one of the most important factors that regulate growth and reproduction of macrophytes. Studies have shown that an excess of nitrogen (in various forms) generates an excessive growth of biomass.



Past situation



Macrophytes (*Ceramium sp.*) deposits on Agigea beach, June 1974



Ulva and *Ceramium* deposits on the Agigea beach, June 1976



Ulva and *Ceramium* deposits on the Eforie Sud beach, June 1976

Current status



2 Mai, June 2004



Saturn, June 2004



Costinesti, June 2004



Eforie Sud, June 2006



Costinesti, June 2006



Vama Veche, September 2007



Navodari, July 2009

Current status



Future trends of evolution

- In the future, given the current variability of environmental conditions and comparing this with the past situation, we can consider that the phenomenon will still occur and the amplitude will be directly proportional to environmental factors variability.
- This situation is very difficult to control or even impossible, thus being directly related largely to current climate conditions and human activities.
- Another situation that should be considered in the future is the increasing number of hydrotechnical constructions and coastal defences, that will lead to increased surfaces on which the macrophytes can grow.
- As a negative example, we can take the bridge build in Mamaia in 2012.



Utilisation of macroalgae

Taking in to consideration EU directive forbidding biodegradable waste going to landfill sites (1999/31/EC) and EU Directive concerning the quality of bathing water (2006/7/EC), that obliges the authorities responsible for beach management to organize the removal of macroalgae accumulating on the shore, we have to consider the possible utilization of macroalgae deposits from the beach.

Main direction in which macroalgae can be used are:

- Food for livestock and humans;
- Pharmaceutical and cosmetics industry;
- Energy production;
- Industry CO₂ reduction;
- Production of bio-fertilizers, etc.

The algae accumulating on the beach during summer in Romania is different from the one occurring in Atlantic or North Sea. It is heterogeneous and in different stages of decomposition, and its abundance and location of appearance is hard to predict. That is why the use of this material by the food, pharmaceutical or cosmetics industries is improbable and unprofitable.

One realistic way of utilizing algal material at present is as a natural biofertiliser. Macroalgae and the products derived from them are valuable biofertilisers, rich in nitrogen , phosphate and potassium.

Chemical and biochemical composition of algal powder made from green, red and brown macroalgae, from the Romanian littoral



Parameter	<i>Cystoseira barbata</i> n* = 3	<i>Ceramium spp.</i> n = 3	<i>Cladophora spp.</i> n = 3	<i>Enteomorpha spp.</i> n = 6	<i>Ulva spp.</i> n = 3
Moisture %	9,27 ± 0,42	11,01 ± 0,13	5,71 ± 0,22	9,14 ± 2,93	12,86 ± 1,01
Ash %	17,63 ± 1,73	13,83 ± 1,68	26,38 ± 0,31	30,28 ± 9,01	18,38 ± 3,08
OS%	73,25 ± 2,14	75,16 ± 1,56	67,92 ± 0,53	60,57 ± 6,12	68,86 ± 1,99
Total nitrogen %	2,26 ± 0,34	3,19 ± 0,41	2,45 ± 0,02	1,94 ± 0,14	2,32 ± 0,20
Protein %	14,13 ± 2,11	19,94 ± 2,56	15,43 ± 0,36	12,10 ± 0,89	14,58 ± 1,30
Lipids %	1,03 ± 0,54	3,43 ± 0,25	3,85 ± 0,47	1,69 ± 0,47	0,69 ± 0,06
Carbohydrates %	58,05 ± 0,72	51,90 ± 4,35	48,45 ± 0,5	46,57 ± 5,19	54,95 ± 1,43

•Number of samples