

Descriptor 1- Biodiversity

Pelagic habitats state

Zooplankton

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Background

- integral to aquatic productivity, serving as primary consumers of nutrient-driven primary producers, and as prey for fish;
- potential as indicators of environmental changes - fundamental role in the energy transfer and nutrient cycling in aquatic ecosystems
- zooplankton assemblages have not been widely used as indicators of ecosystem condition
- zooplankton is not included as a relevant quality element for the assessment of ecological status within Water Framework Directive

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Marine Strategy Framework Directive

- Descriptor 1 – Biodiversity

 - Habitat ecological level**

 - Criteria 1.6. Habitat condition*

 - Ecosystem level**

 - Criteria 1.7. Ecosystem structure*

- Descriptor 2 – Non native species

 - Criteria 2.1.1 Trends in abundance, temporal occurrence and spatial distribution in the wild of non-indigenous species.....*

 - Criteria 2.2.1 Ratio between invasive non-indigenous species and native species in some well-studied taxonomic groups.....*

- Descriptor 4 – Food web

 - Criteria 4.3. Abundance/distribution of key trophic groups/species - groups with fast turnover rates (e.g. phytoplankton, zooplankton, jellyfish, bivalve molluscs, short-living pelagic fish) that will respond quickly to ecosystem change and are useful as early warning indicators.*

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Proposed zooplankton indicators

Biomass of copepods (CB %) - contribution of copepods biomass to total mesozooplankton biomass

★ - key group, contribute significantly to the diet of planktivorous fish (sprat and anchovy, partly horse mackerel), reflects composition of zooplankton community and food availability for zooplanktivorous fish. State indicator relevant to two descriptors – D1 (1.6. Habitat condition, Indicator: 1.6.2. Relative abundance and/ or biomass) and D4.

Mesozooplankton biomass –

★ - reflects composition of zooplankton community, includes an information for major key groups (Copepoda, Cladocera, Meroplankton and species *O. dioica* and *S. setosa*), forming the structure of planktonic fauna.

Noctiluca scintillans biomass (N.sci%) - contribution of *N.scintillans* biomass to total mesozooplankton biomass

★ - wide feeding spectrum (phytoplankton, zooplankton and detritus), high blooming concentrations, "dead-end" in the food web. State indicator.

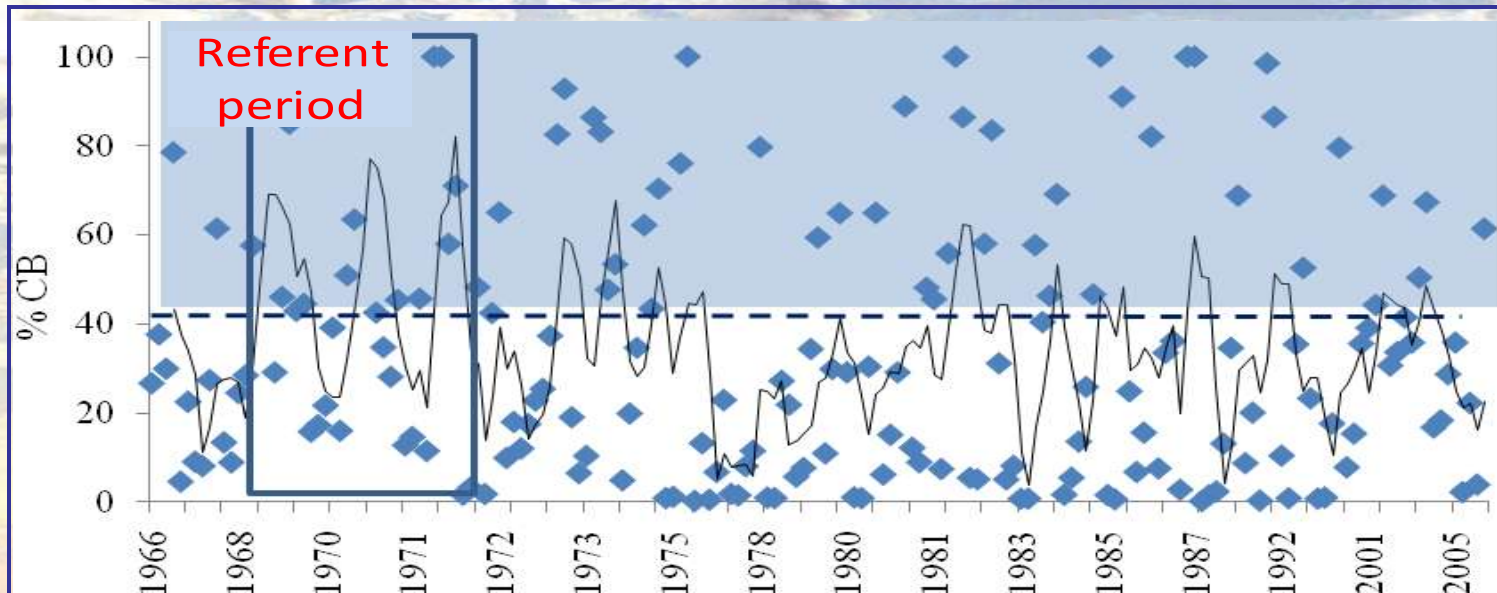
Shannon-Weaver index - reflects the number of species in a dataset, taking into account how evenly the basic entities (such as individuals) are distributed among species

Approach for defining GES

- to establish baselines and acceptable variability for specific indicators, trends and reference periods were evaluated.



- for CB% mean values and 95% confidence intervals (CI) the upper and lower 95% limits were used (HELCOM, 2012). In the context of GES for CB (CB%), upper limit is not relevant, or GES boundary for CB (CB%) is the lower 95% CI limit. CB (CB%) should not decline below its GES boundary. The GES boundary was estimated to be **42%** based on the reference period 1968-1973, when anchovy and sprat stocks were relatively stable and had high weight-age and body condition. The threshold is relevant for coastal, shelf and open sea.



Long-term changes in copepod contribution to the total mesozooplankton biomass (CB%) in c.Galata transect (1966-2006). According to the trend observed, CB% >42% indicate good conditions (blue area).

Mesozooplankton biomass

Baseline condition, trends and reference period (summer 1967-1972) were assessed using the 75 percentile for obtaining upper and lower (25 percentile) range of values to determine good environmental status. It is fact that high mesozooplankton biomass suggest higher trophic environment (Helcom, 2012) and increasing concentrations of the planktonic fauna is an indirect indicator of the food ability in the water column. On the other hand mesozooplankton biomass reduction indicates enhanced predator pressure in the food chain (jellyfish, ctenophores and small pelagic fish). Therefore, neither high nor low values of biomass would affect the GES.

Thresholds	Coastal	Shelf	Open sea
mg.m ⁻³	550-280	300-130	150-40

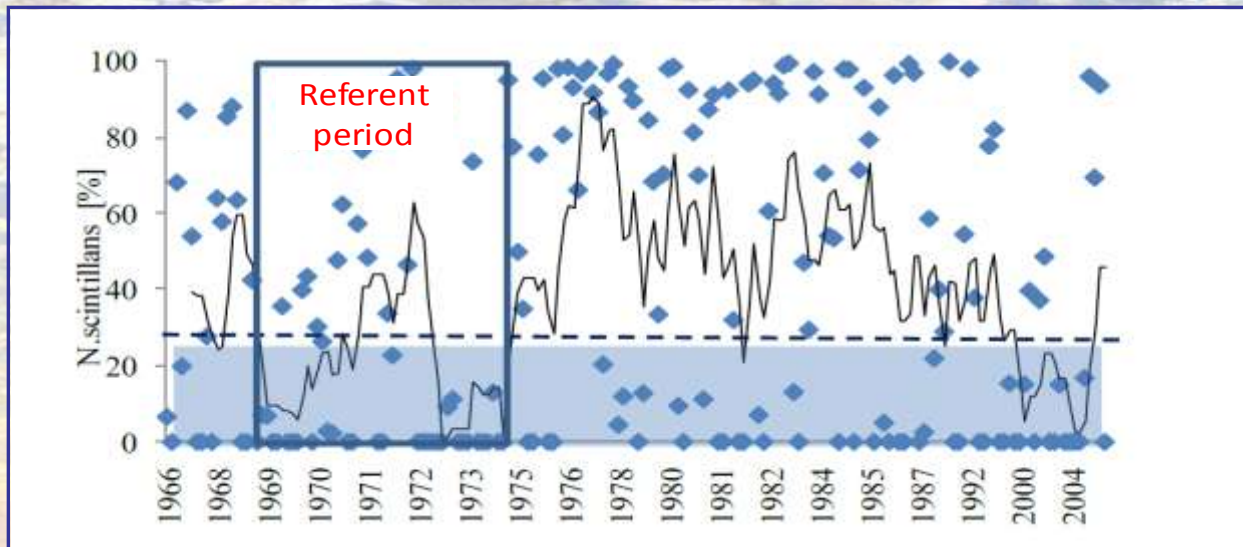
>4	High	GES
4-3	Very good	
3-2	Moderate	Not Good
2-1	Poor	
< 1	Bad	

Shannon-Weaver index

High and very good conditions in WFD correspond to GES in MSFD, while moderate, poor and bad are considered as not good state

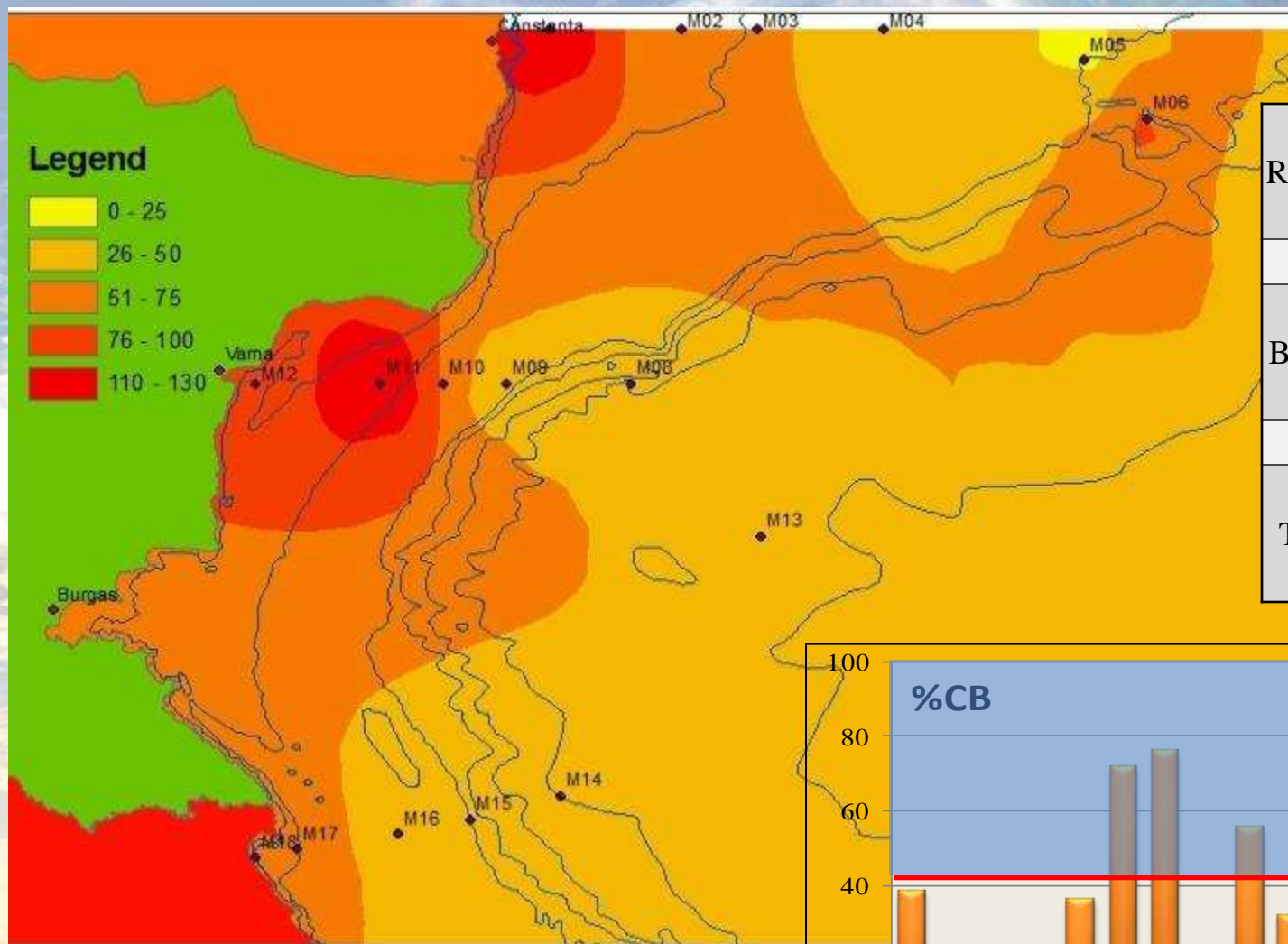
N.sci %

To establish a baseline condition and acceptable variability of the indicator, trends and the reference period (1968-1973) were assessed using the mean and 95% confidence interval (CI). In the context of achieving good ecological status for N.sci% upper limit of 95% confidence interval is taken as the limit of good. N.sci% should not be over the boundary for the good environmental status. Established threshold for good environmental status is <30%. Eutrophication leads to an increase in the number and productivity of phytoplankton, which provoked *N.scintillans* development simultaneously with favorable hydrological factors. relevant to D1 **Habitat level** Criteria 1.6. Habitat condition, Indicator: 1.6.2. Relative abundance and/or biomass and indirectly to Descriptor 5 (Eutrophication) as a consequence of eutrophic conditions and phytoplankton density



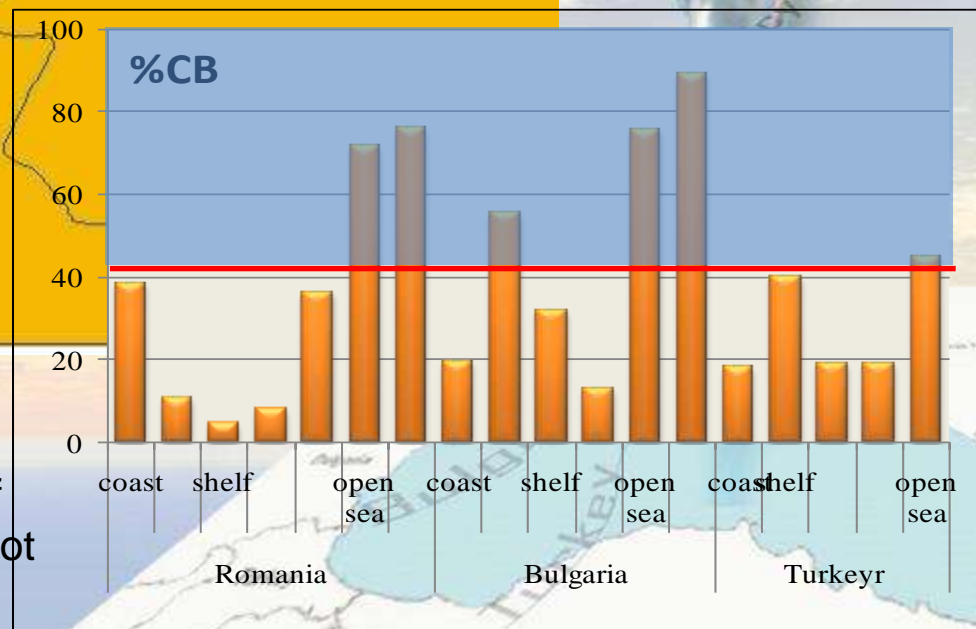
Long-term changes in *N.scintillans* contribution to the total mesozooplankton biomass (%N.sci) in c.Galata transect (1966-2006). According to the trend observed, N.sci%<30% indicate good conditions (blue area)

Copepods biomass

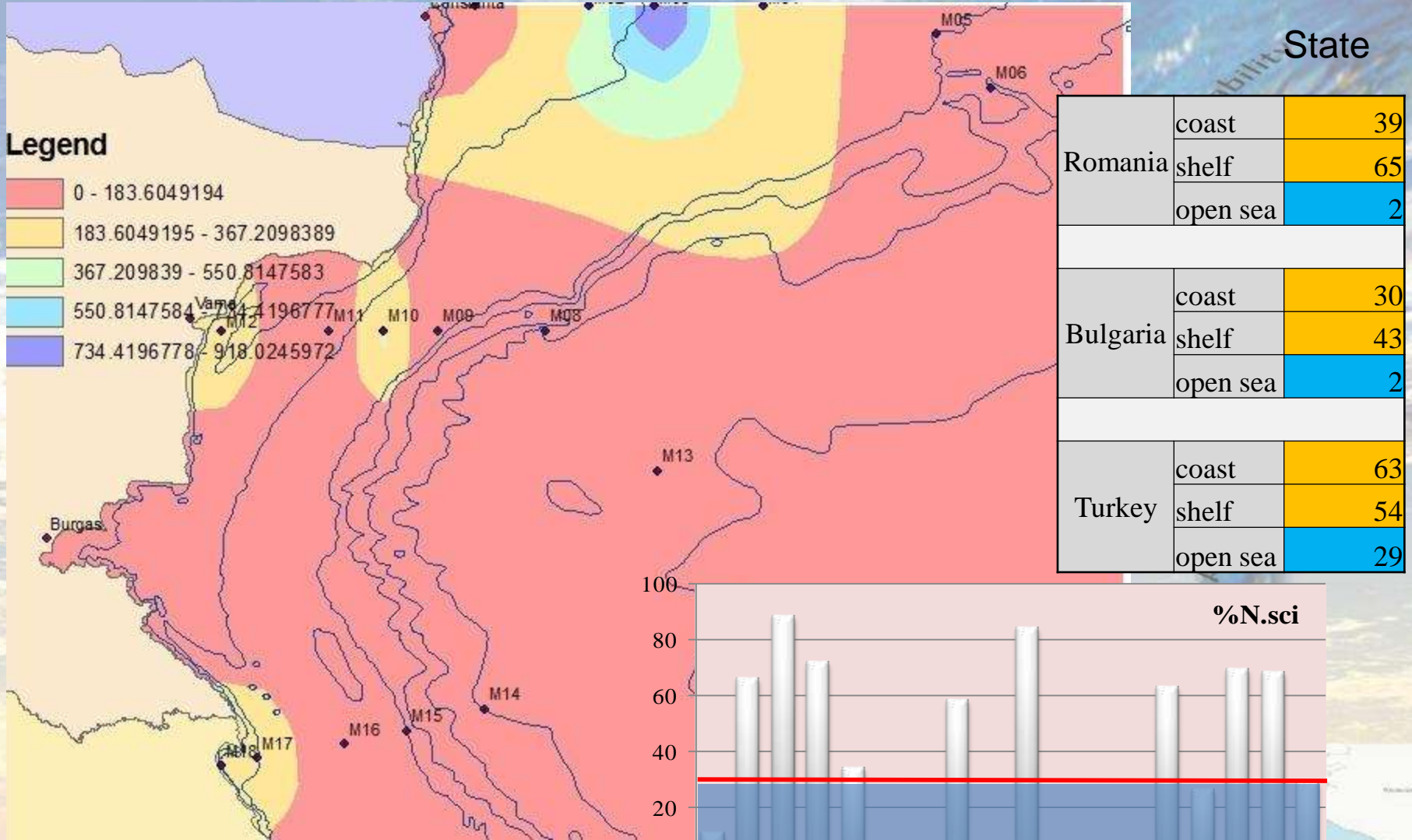


		State
Romania	coast	25
	shelf	16
	open sea	74
Bulgaria	coast	37
	shelf	22
	open sea	82
Turkey	coast	18
	shelf	26
	open sea	45

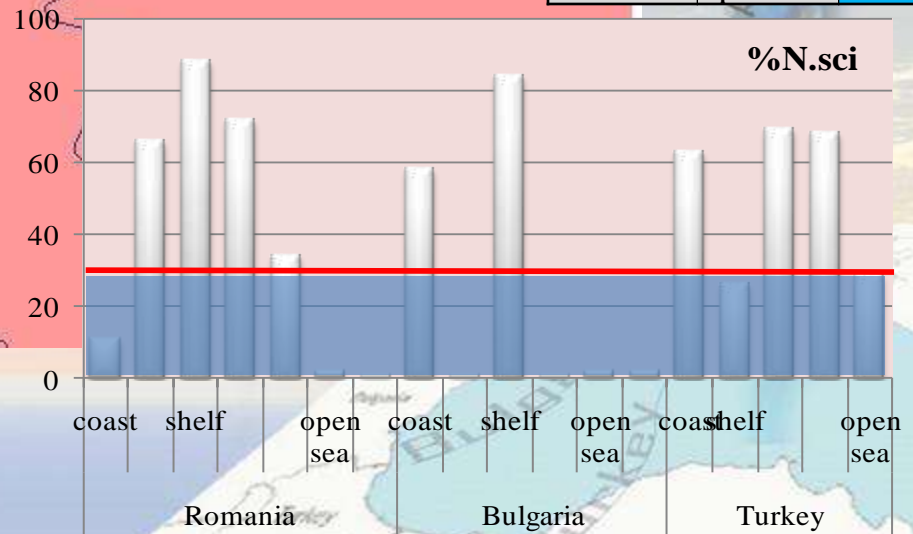
Copepods presented the same distribution pattern as mesozooplankton biomass decreasing to the offshore. In coastal and shelf stations percentage of copepod biomass has not reached GES boundary (> 42%).



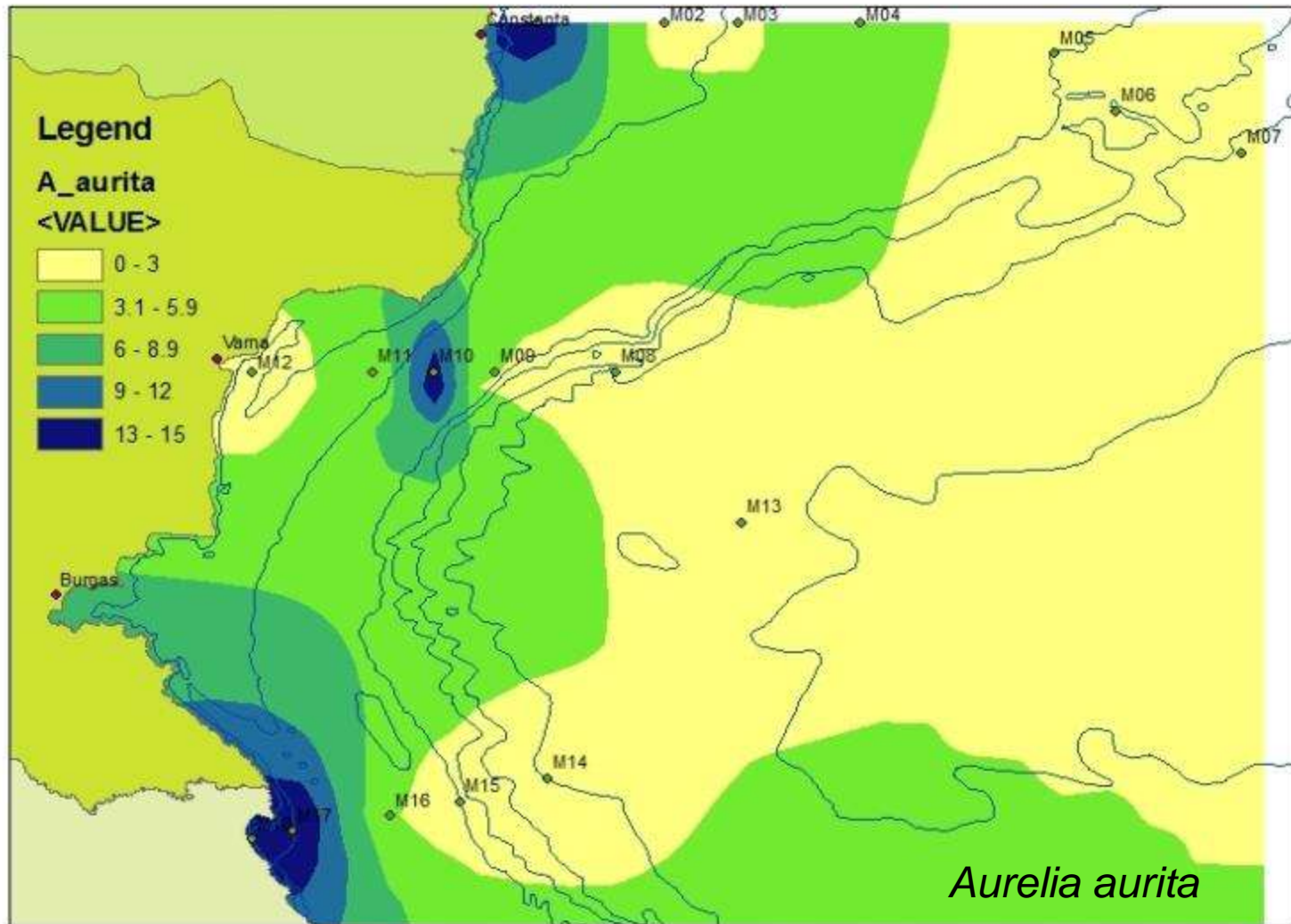
Noctiluca scintillans biomass



Threshold *N.sci* % - < 30%



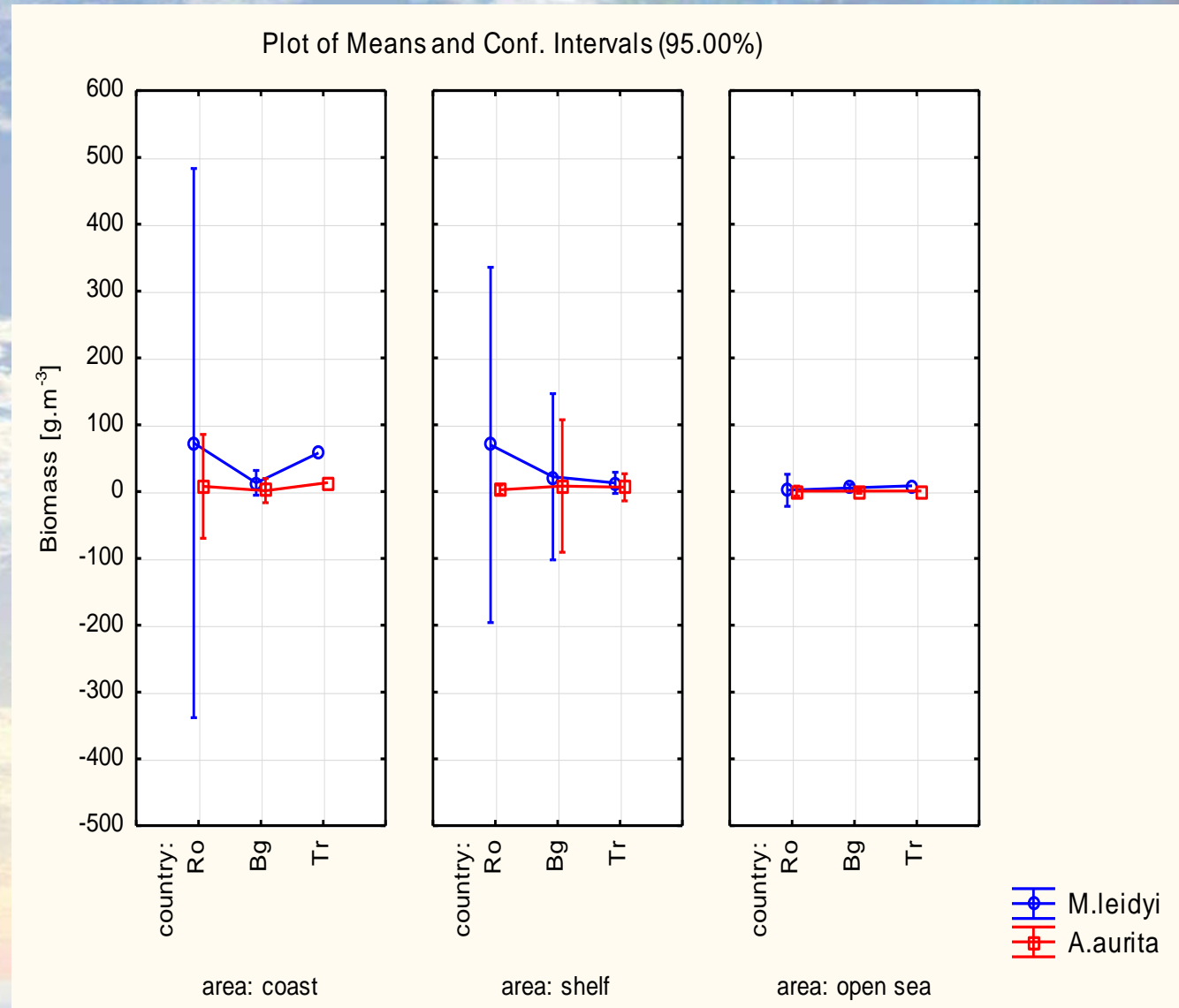
Jellyfish



Jellyfish association includes ctenophors *P. pileus*, *M. leidyi* and *B. ovata* and medusa *A. aurita*. Mnemiopsis and Aurelia are registered in higher concentrations. Coastal and shelf area are under the influence of *M.leidyi* predator pressure. Only at offshore stations the impact is insignificant. Aurelia presented patchiness in its distribution with hot spot in coastal area.

Comparing transects according the M.leidy and A.aurita distribution Mnemiopsis was dominated coastal area in Romania and Bulgaria transects with decreasing trends from north to south. The amount of *M.leidy* increases when the temperature is above >22 °C and the salinity is about 15 ‰. Favorable environmental factors were recorded during the cruise especially in the north.

The quantity of *A. aurita* drops drastically with *M. leidy* biomass increase above 300 g.m^{-2} (Mihneva, 2012).



Zooplankton community state

Mesozooplankton biomass

CB %

N.sci %

Shennon index

Romania	coast	233.059
	shelf	92.115
	open sea	82.477
Bulgaria	coast	218.11
	shelf	136.008
	open sea	44.250
Turkey	coast	104.07
	shelf	77.62
	open sea	56.107

Romania	coast	25
	shelf	16
	open sea	74
Bulgaria	coast	37
	shelf	22
	open sea	82
Turkey	coast	18
	shelf	26
	open sea	45

Romania	coast	25
	shelf	16
	open sea	74
Bulgaria	coast	37
	shelf	22
	open sea	82
Turkey	coast	18
	shelf	26
	open sea	45

Romania	coast	2.3
	shelf	2.14
	open sea	2.5
Bulgaria	coast	2.7
	shelf	2.4
	open sea	2.2
Turkey	coast	2.5
	shelf	2.7
	open sea	2.9

On the base of proposed indicators and their thresholds

- Coastal and shelf area are not in good status due to dominance of non trophic species *N.scinitllans* and *M.leidy* predator pressure.
- Open sea is considered in good state according to all indicators

???? – approach for GES determination (in case indicators shown different results which approach to follow)

???? - indicator validation (indicators are still under development)

???? – need of complex and integrated indicator

Thank you for your attention!

