

Climate ≈ water

**Bridging the gap between adaptation
strategies of climate change impacts
and European water policies**



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Progress Report 2

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Present state of benthic ecosystem in Razelm-Sinoie Lagoon Complex - RSLC

- Lying south of the Danube Delta (Sf. Gheorghe deltaic distributaries)
- Main component of the Danube Delta Biosphere Reserve;
- Total surface of 1015 km², out of which 863 km² – lakes area;
- Formed by four main lakes (the Great Razelm - 415 km², Golovița - 78 km², Zmeica - 60 km² and Sinoie - 110 km²)
- One of the most bioproductive paralic basins of the Romanian Coastal zone of the Black Sea, being doubly-connected with both the freshwater system of Danubian origin and, also, the seawaters of the Black Sea;
- Came into highlight more than 100 years ago as a result of its importance as commercial fisheries

At the end of the 19 Century

“the greatest fisheries on the Black Sea coasts and maybe, without exaggeration, the greatest ones in Europe” — (Antipa, 1884)

Anthropic intervention in the natural aquatic system

Fishery importance of the area imposed a permanent care to improve the conditions of biological productivity and fish production by technical works of cutting canals, by recalibration of some canals through widening and deepening their cross-sections for increasing the water discharge from Sf. Gheorghe distributor, or by building dams and closing the links with the Black Sea .

Human interventions consequences - severe and complex ecological changes including:

- *morphohydrographic* changes affecting the hydrologic regime,
- *hypsoetric* changes modifying bottom habitat parameters (depths and sediment structure),
- *water chemistry structure and regime* changes modifying mineralization, nutrient and pollutant loadings,
- *biological* changes marked by eutrophication, loss of biodiversity, decreased bioproductivity, impoverished fishery.

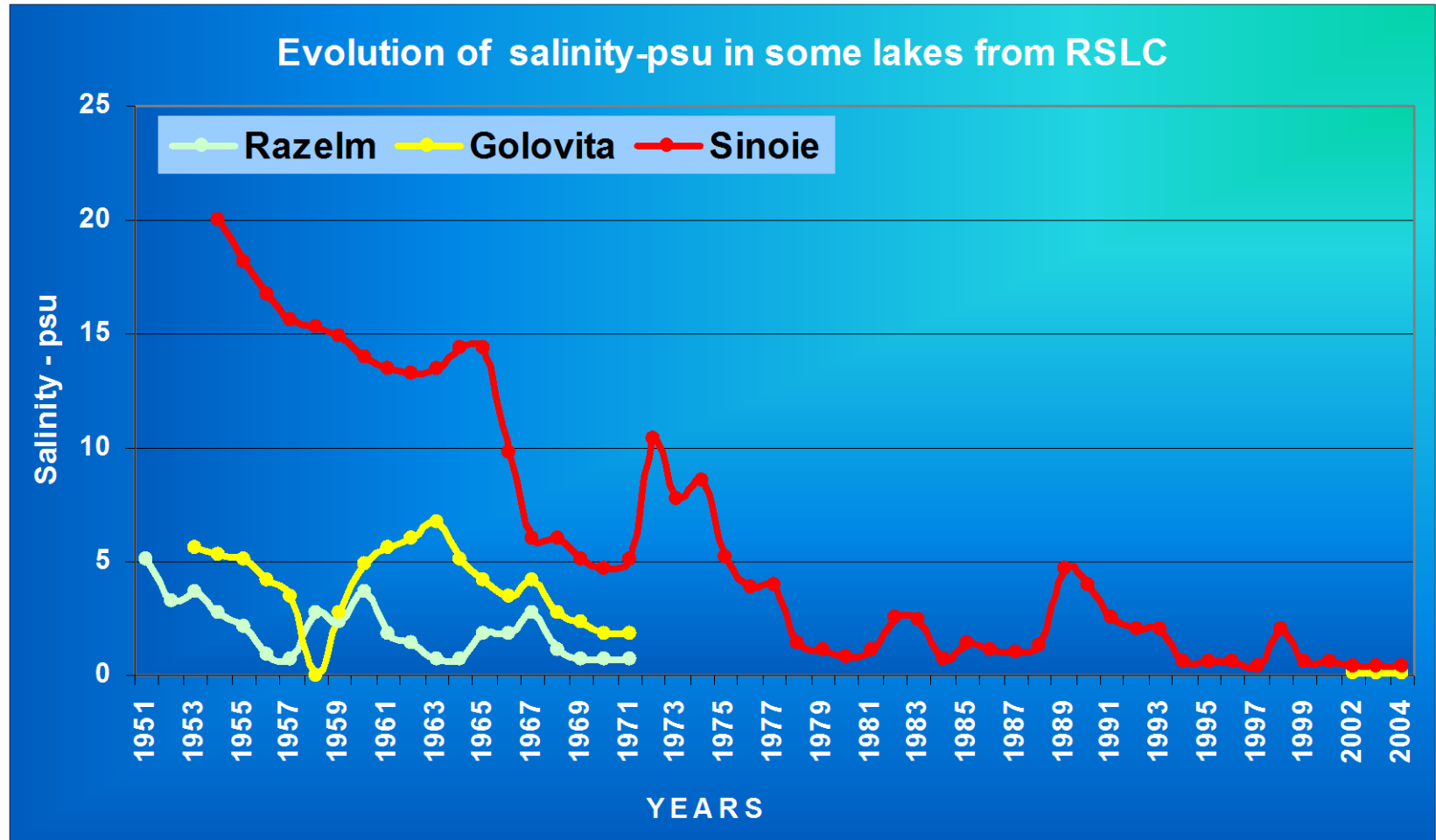
RSLC – freshwater reservoir for irrigations

Strong disturbances of the hydrologic and biologic balance have been caused by the measures and works of forced freshening of the lagoon system, the state parameters being strongly affected and the former ecological system practically destroyed.

The continually increasing freshwater discharge by cutting canals and the closing of the breaches in the sandy beach ridges, which favored the penetration of marine waters, had multiple effects on state parameters, as follows:

1. increasing the quantities of nutrients and changing **Ntotal/P** ratio in water mass;
2. drastic reduction of the distribution areas of macrophytic vegetation;
3. releasing nutrients from mud deposits deprived of macrophytic vegetation;
4. increasing the volume of suspensions and turbidity;
5. decreasing water transparence and mineralization;
6. thriving of some opportunistic species in phytoplankton, zooplankton and benthos.

Evolution of water mineralization in RSLC



Indicators for benthic ecological state in 2002-2004

Conclusion: main process in the evolution of the paramarine lacustrine system consists in eutrophication and its consequences: organic silting, shifting of productivity importance from benthos to plankton and scarcity of adequate consumers ensuring the conversion of primary production.

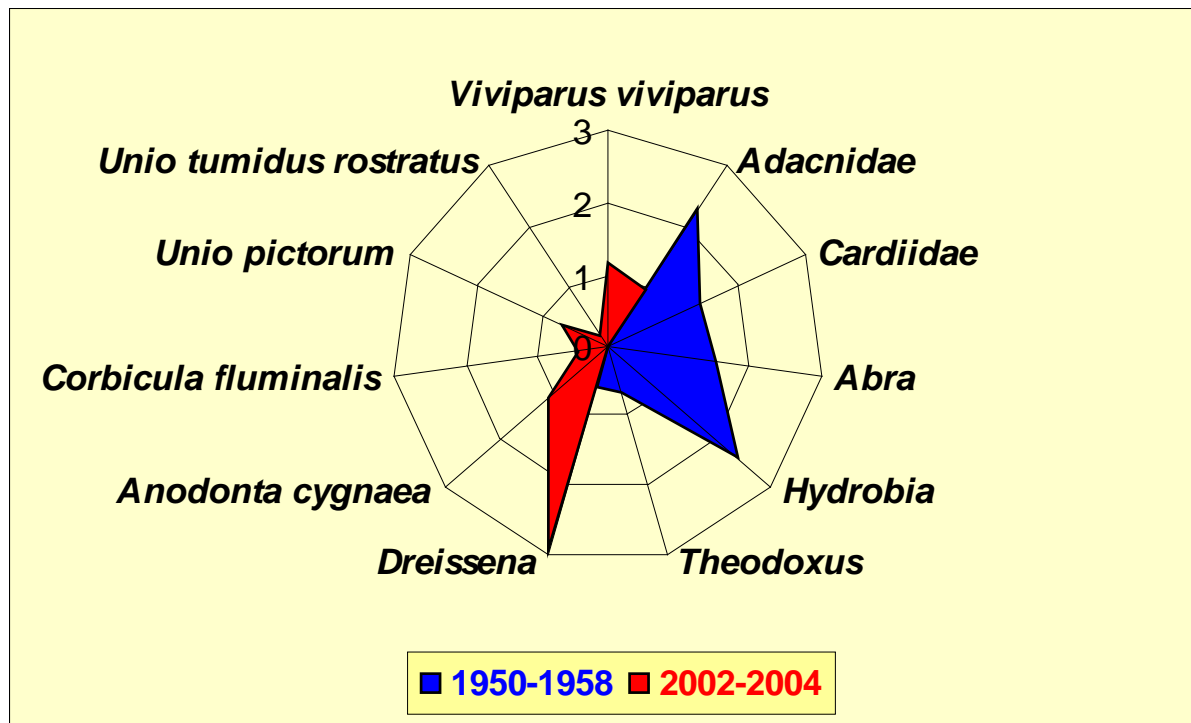
Lakes	Razelm	Golovița	Zmeica	Sinoe
Number of taxa – N.sp.	79	44	42	48
Density - D_{AVG} ex.m ⁻²	111,595.2	37,498.9	19,707.3	80,038.1
% Vermes	85.23	78.26	74.88	95.87
% Mollusca	0.77	0.13	0.14	0.07
% Crustacea	13.49	19.74	21.03	2.63
% Varia	0.51	1.87	3.95	1.44
Biomass - B_{AVG} g.m ⁻²	233.76	52.82	103.84	43.06
% Vermes	0.801	3.654	1.301	2.004
% Mollusca	92.526	80.299	97.879	20.297
% Crustacea	0.797	0.867	0.194	7.570
% Varia	5.875	15.180	0.626	70.130

**General
indicators
defining benthos
populations in
the four lakes of
RSLC**

Before 1956 over 70% of the zoobenthic species consisted of Ponto-Caspian relicts and only 30% of them were freshwater and brackishwater forms

At present: freshwater forms are dominant - 80% , Ponto-Caspian relicts - 7% and brackish and marine elements - 13%.

**The most important changes occurred in the populations of benthic mollusks:
from dominant brackishwater to freshwater species**



**Quantitative
changes of the
mollusk
populations in the
last 50 years in
RSLC**

Stock of benthic organisms and potential production in RSLC - assessment on the basis of 2002 – 2004 data

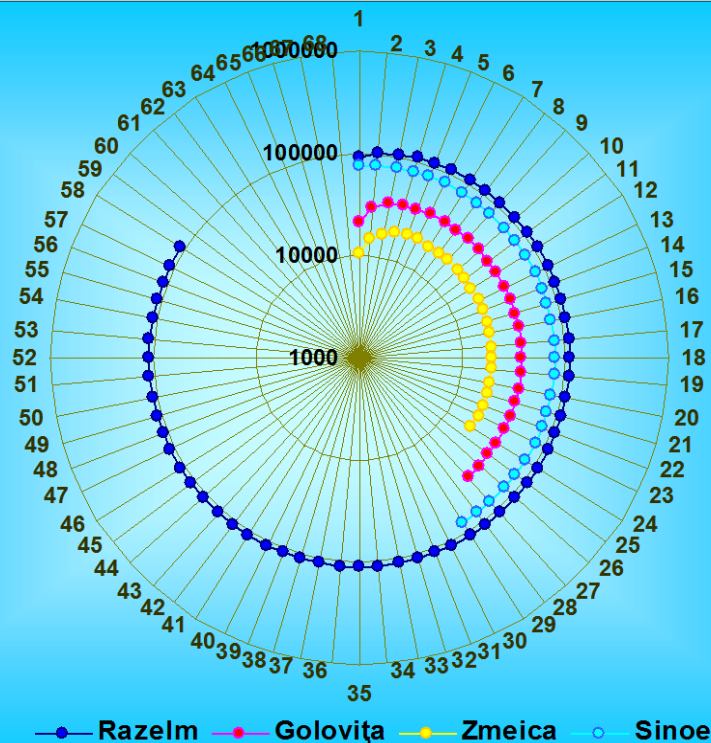
■ Total stock: ≈113,000 tons:

- worms 2.2%,
- mollusks 75.0%,
- crustaceans 3.1%
- other organisms 19.6 %

■ **Potential benthic production: ≈354,000 tons**, that is 3.15 times grater than the biomass (highest potential productivity can be achieved in Sinoie Lake by the brackishwater populations of crustaceans and other organisms).

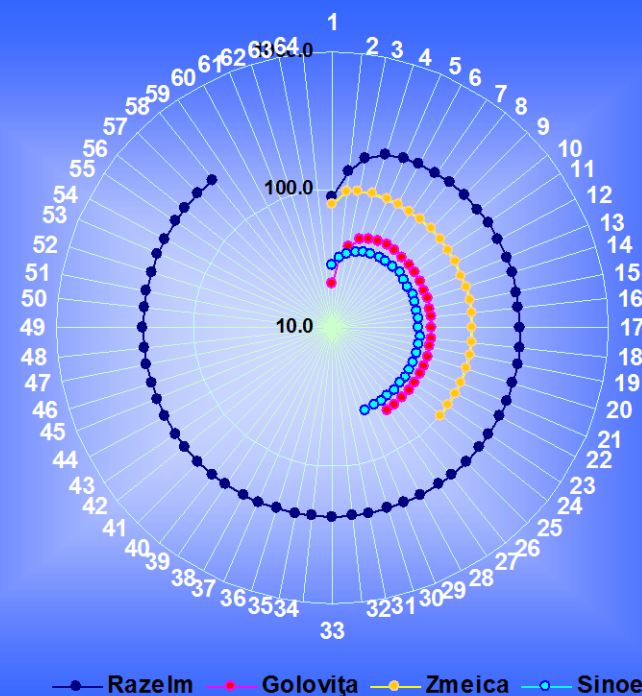
Lake	Tons Total benthic organisms	Tons Benthos potential production
Razelm	97,008	286,950
Golovița	4,120	15,070
Zmeica	6,230	16,217
Sinoe	4,736	35,710

Abundance of benthic populations in RSLC

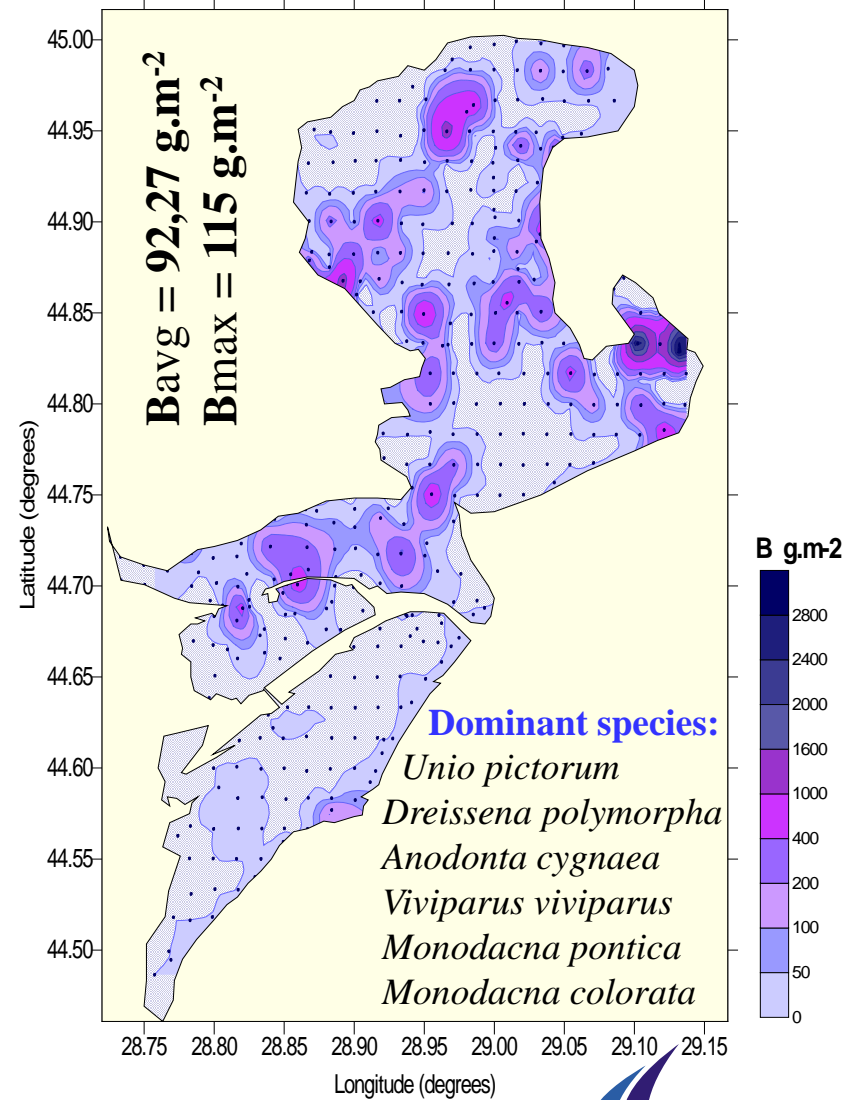
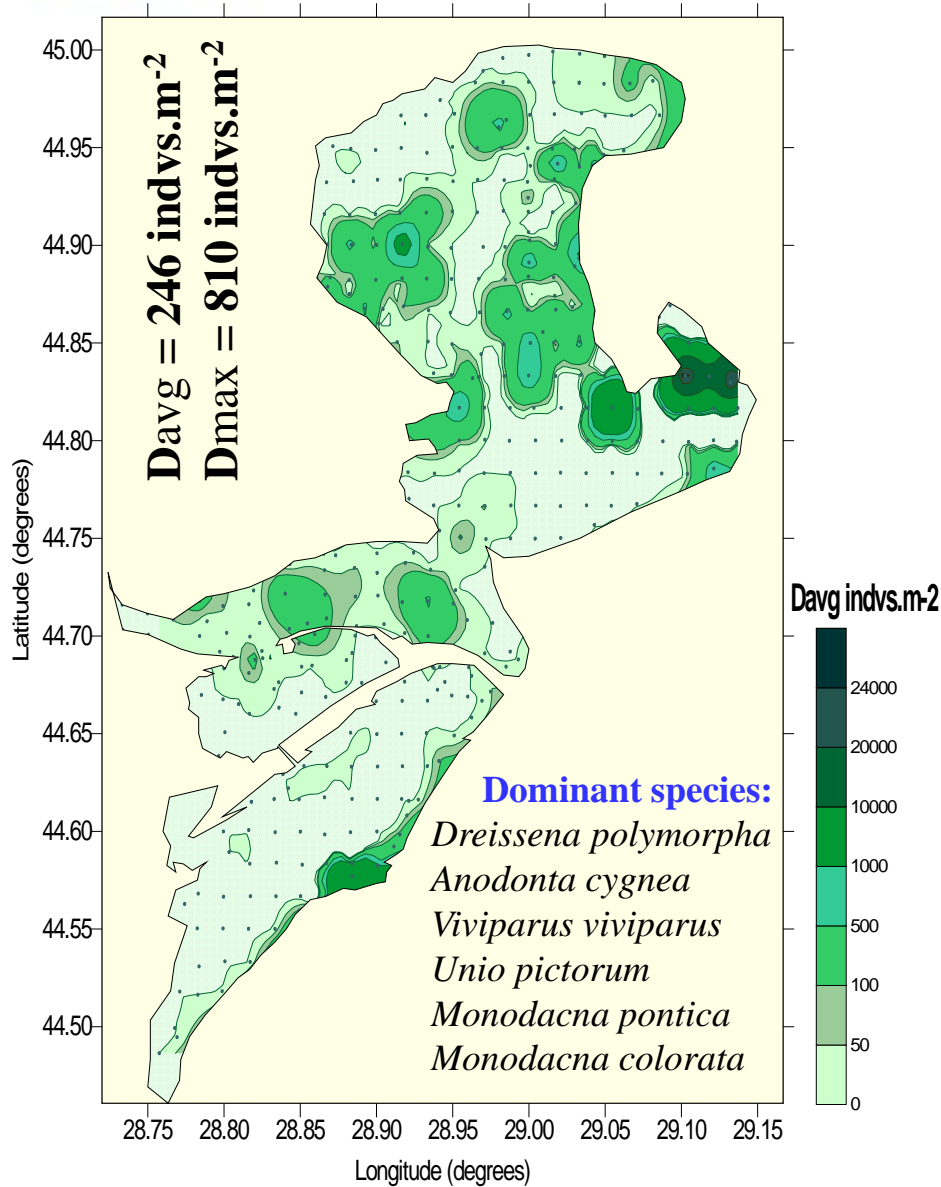


Average density – indvs.m⁻²

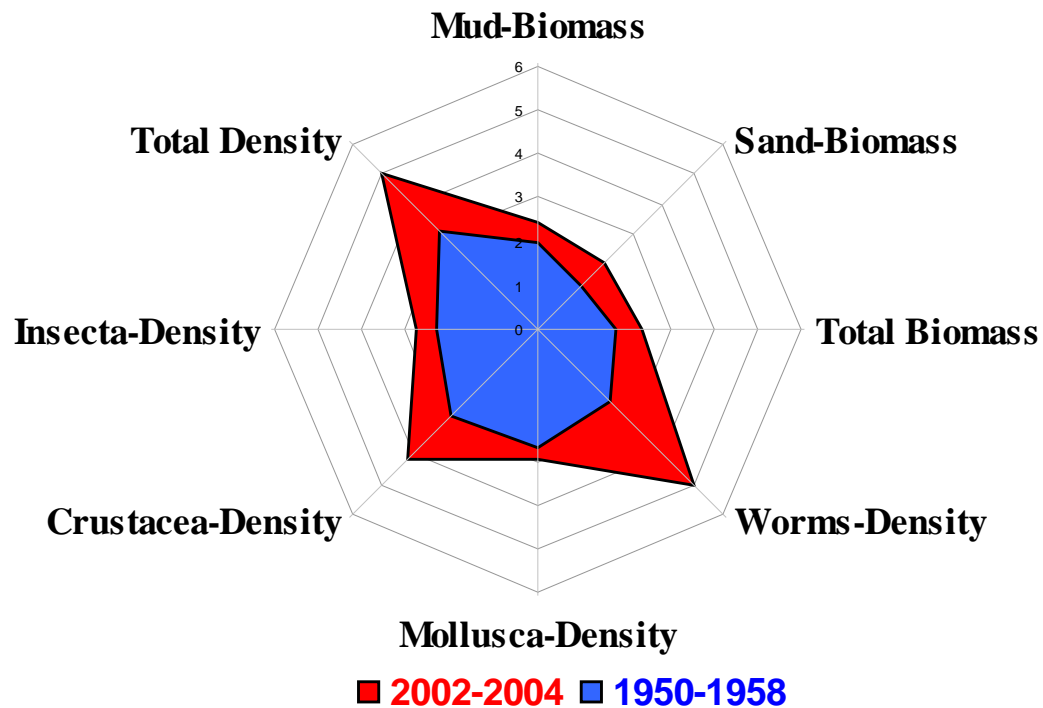
Average biomass – g.m⁻²



Mollusca – Density & Biomass in RSLC



Benthic populations in Razelm Lake : 1950 vs. 2003



CONCLUSIONS

1. Biodiversity :

- 153 taxa → 33 groups
- Zooplankton: 48 taxa → 5 groups
- Benthos: 105 taxa → 28 groups
- Highest biodiversity – Lake Razelm – 102 taxa

2. Density of benthic populations :

- 112,000 indvs.m⁻² - Razelm Lake
- 37,000 indvs.m⁻² - Golovița Lake
- 20,000 indvs.m⁻² - Zmeica Lake
- 80,000 indvs.m⁻² – Sinoie Lake

3. Benthic Biomass:

- Highest values (over 100 g.m⁻²) → Razelm and Zmeica,
- Non-homogeneous, “in patches” distribution of the populations
- Heterogeneous size-class structure of molluscs populations (*Unio*, *Dreissena* și *Anodonta*)

Comparing the present state of Lake Razelm benthic fauna with the data published before -

- Qualitative and quantitative changes in the structure of communities in comparison with the 1960s;
- Extinction of a series of species, mostly euryhaline forms (*Cardiidae*, *Syndesmia*, *Hydrobia*) and freshwater forms, the most vulnerable ones (*Theodoxus*);
- Occurrence of new species or new forms, missing previously in the perimarine lacustrine system under analysis (*Anodonta cygnaea*, *Corbicola fluminea*, *Unio pictorum* etc.);
- Increase in benthos abundance, both as number and weight, by the development of the freshwater-stenobiotic forms, more resistant in the new environmental conditions.
- The quantitative changes taking place in the past years are characterized, as a rule, by the increase in benthos abundance both as numerical density and weight.

RSLC main threats:

- Threat of biodiversity - the potential loss of global diversity is high
- Reduction/loss of some commercial fish stocks, including mullet, flatfish
- Coastal erosion and degradation of landscape, destruction of habitats
- Pollution/contamination from agricultural, industrial and domestic sources
- Sand extraction
- Eutrophication
- Introduction of new species

Uncertainties:

- Insufficient knowledge concerning the consequences of global changes in western Black Sea;
- Scarcity of long series of data concerning RSLC;
- The evolution of RSLC regulations and legal aspects within the Danube Delta Biosphere Reserve (DDBR);
- Provisions referring to the RSLC aspects from the Management Plan of the DDBR Authority;
- Future use of Lake Razelm waters in irrigations;
- Perspectives in the development of aquaculture in RSLC.

Professor Marian-Traian Gomoiu – GeoEcoMar Constanta Branch

mtg@cier.ro

Fish catch in RSLC

