

The global and local anthropogenic impacts on Danube Delta in the sustainable development perspective

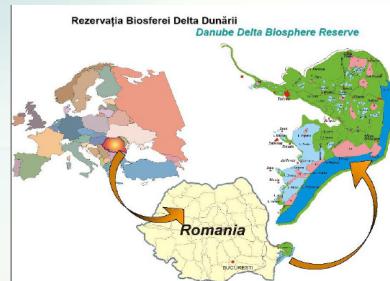
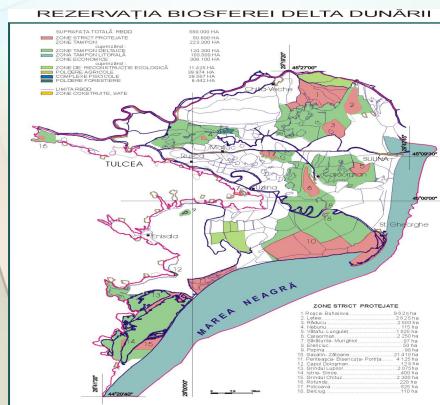
Roxana Bojariu

Outline

- Danube Delta – history and present state
- Climate dynamics and change
 - Observed
 - Future projections
- Non-climatic drivers of environmental changes in Danube Delta
- Environmental monitoring
- Coupling research and planning activities in the sustainable development perspective?
- Preliminary conclusions and follow-up

Danube Delta – history and present state

1. Present state configuration – no older than 4000-5000 yrs (Bondar et al., 1961)
2. Historic records: Herodot (describing Darius military expedition), Strabon, Plinius the Older, Ptolemeu, navigators from Venice and Genoa, Dimitrie Cantemir.
3. 1857 – the European Commission of Danube (Sulina Channel)
4. 1991 – Danube Delta reserve was declared UNESCO World Heritage



1.	Main Delta	383000 ha
2.	Lake like zone	86 000 ha
3.	Razelm-Sinoe complex	95 000 ha
4.	Maritime sector	

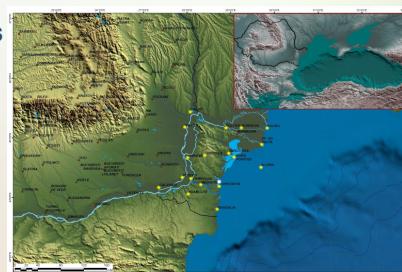
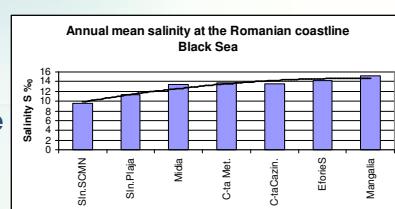
Rich biodiversity

- over 300 species of birds;
- 90 fish species, including sturgeons;
- the wildcat, European mink, the freshwater otter and the globally threatened monk seal.

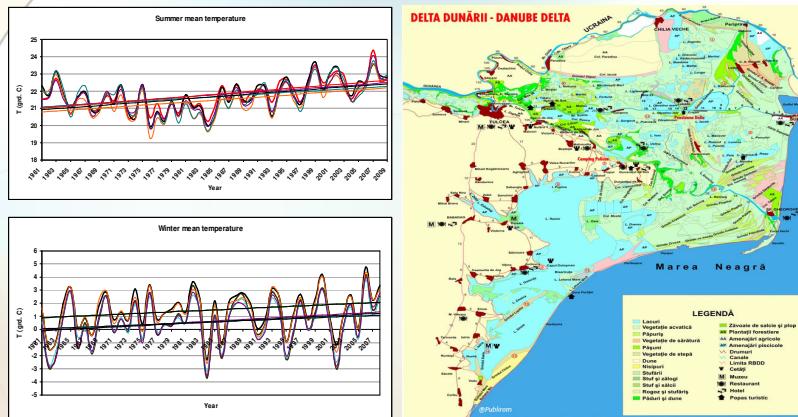
Danube Delta – history and present state

Favorable conditions for Danube Delta development:

- reduced tidal movement of the land-locked Black Sea;
- extended shelf area with shallow water depth;
- the high amount of sediments transported by Danube;
- dominant North-East/South-West direction of winds and currents in front of Danube flow into the Black Sea.

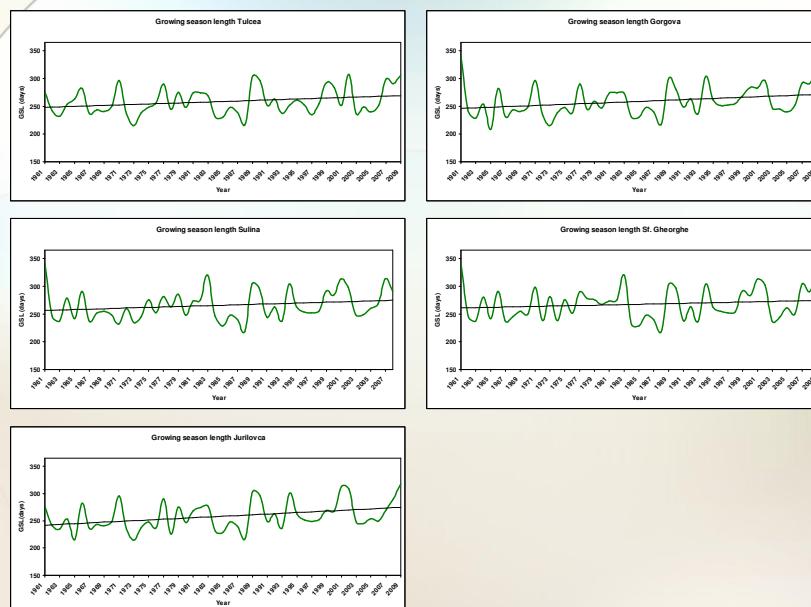


Observed climate – seasonal temperature



	Tulcea	Sulina	Sf. Gheor.	Jurilovca
1921-1958	-0.37	0.4	0.7	-0.03
1961-1998	0.47	1.33	1.18	0.43
1981-2008	0.8	1.62	1.42	0.68

Observed climate – Growing season length



Observed climate - seasonal precipitation

Summer



	Tulcea	Sulina	St. Gheor.	Jurilovca
1921-1958	144	105	102	144
1961-1998	135	83	99	101
1981-2008	146	80	97	107

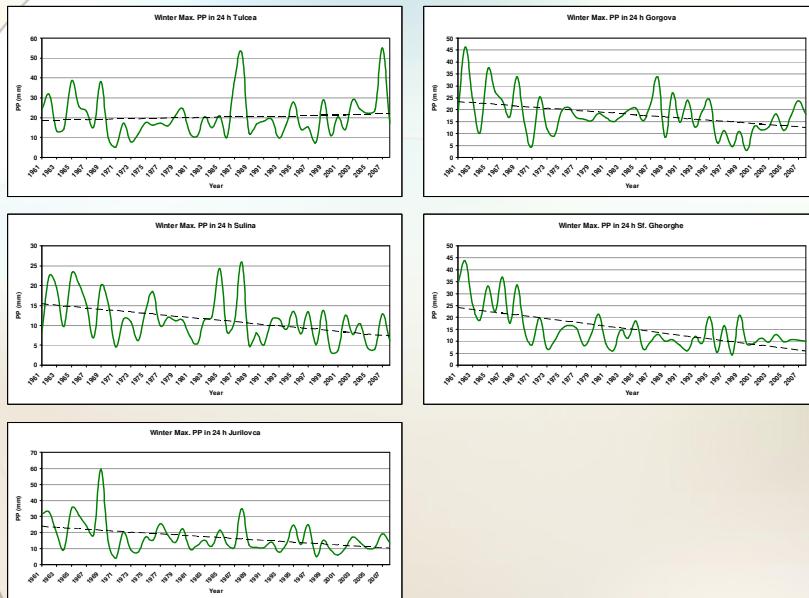
Winter



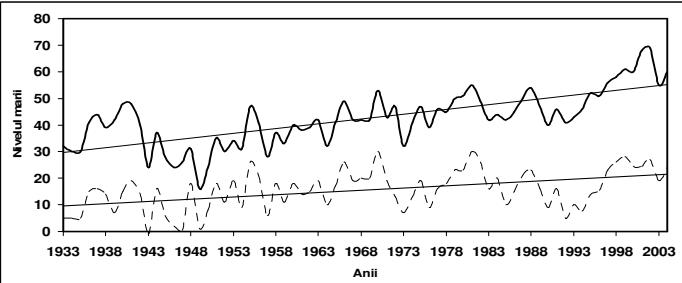
	Tulcea	Sulina	St. Gheor.	Jurilovca
1921-1958	89	80	82	77
1961-1998	100	60	82	91
1981-2008	84	45	57	64

Observed climate – Extremes

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Sea level rise



- in the last millennia the sea level had a couple of oscillations of an order of 4-5 m; from sec. X A.D. there is a slight upward trend;
- the present upward trend (1.7-3.6 mm/yr) is superimposed on a pronounced interdecadal variability (~10 cm/decade) and it is due mainly to thermosteric component (Stanev and Peneva, 2002; (Oguz et al, 2006) and Danube run off (accounting for 70% of the fresh water contribution of rivers in the Black Sea) (Bondar, 1973);
- Danube run-off is strongly affected by precipitation regime (Rimbu et al., 2004) over Danube watershed (affected by atmospheric circulation in the Atlantic-European sector).

Future projections of climate of Danube delta

Results from an ensemble of 9 regional climate runs (Busuioc et al., 2010)

- Temperature change (relative to 1961-1990) in
 - 2021-2050
 - winter average increase: 1.7-1.8 C
 - summer average increase: 1.6-1.8
 - 2071-2100
 - winter average increase: 3.2- 3.3 C
 - summer average increase: 3.8- 4 C
- Precipitation change (relative to 1961-1990) in
 - 2021-2050
 - winter average reduction: 0-2 %
 - summer average reduction: 6-10%
 - 2071-2100
 - winter average increase: 4-8 %
 - summer average reduction: 25-35 %

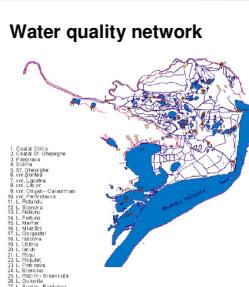
Results from one regional climate run:

- Extreme precipitation change – maximum precipitation in 24h (relative to 1961-1990) in
 - 2021-2050
 - winter average increase: 0-1 mm/day
 - summer average reduction: 0-2 mm/day
 - 2071-2100
 - winter average increase: 4-8 mm/day
 - summer average reduction: 4-8 mm/day

Environmental monitoring

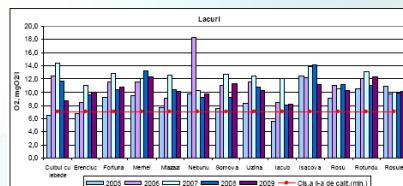
Annual reports of Danube Delta National Reserve (from 2005 – present)

- Climate
- Air quality
- Water
 - Surface water (e.g. water quality, acidification, oxygen concentration, nutrients, salinity, Zn, Cd, Fe, Ca, nitrates, sulfates)
 - Ground water (e.g. pollution)
- Soil
- Biodiversity
- Radioactivity
- Waste
- Urban area
- Environmental challenges
- Energy
- Transportation
- Policies/sustainable development planning

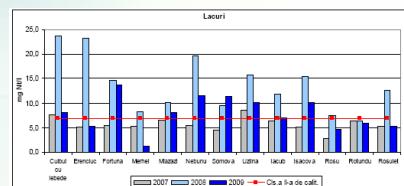


Environmental monitoring

Annual evolution of oxygen in lakes



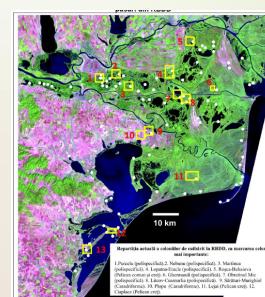
Annual evolution of total nitrogen in lakes



Biodiversity in Danube Delta

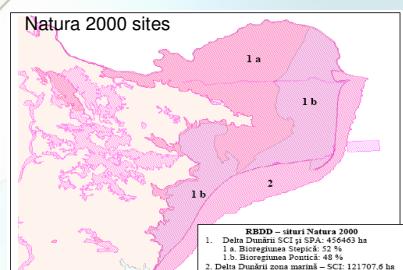


Birds colony locations



Environmental monitoring

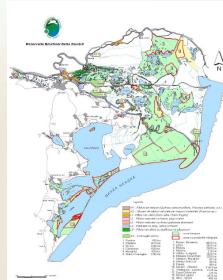
Natura 2000 sites



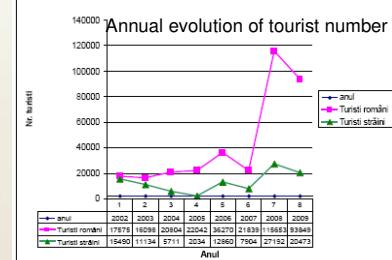
Approved hunting areas



Forrest areas in Danube Delta



Dinamica turism în Rezervație Biosferei Delta Dunării în perioada 2002-2009



Regional and local anthropogenic impacts on Danube Delta

- upstream regularizations of Danube
 - dams - for instance, after building of Iron Gate I and II dams for the hydropower plant the sediment mass carried by the Danube has been reduced with ~ 40-50% (Bondar et al., 1991; Panin, 1996);
- navigation related activities
 - modifications of Sulina and Chilia channels;
 - Danube-Black Sea channel;
 - Bistroe channel.
- Socio-economic activities (e.g. fishing, tourism)

Preliminary conclusions and follow up

Research	Planning
Hydrological balance due to climate/extremes/floods & how are they changing under future climate	Navigation, agriculture, fishing, infrastructure, life quality of people and tourism
Sediment transport/coastal erosion	Infrastructure, tourism
Wave height fluctuations at Danube outlet/mixing of fresh and marine water & how are they changing under future climate	Navigation, avoidable biodiversity threats, fishing
Winds and marine currents in front of Danube outlet/coastal erosion & how are they changing under future climate	Navigation, infrastructure, tourism
Regional and local socio-economic changes (upstream river regularizations & irrigations, demographical dynamics, socio-economic behaviour patterns)	Navigation, agriculture, fishing, infrastructure, life quality of people and tourism

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