Impact of environmental changes on aquatic ecosystems in the Lower Danube River Basin

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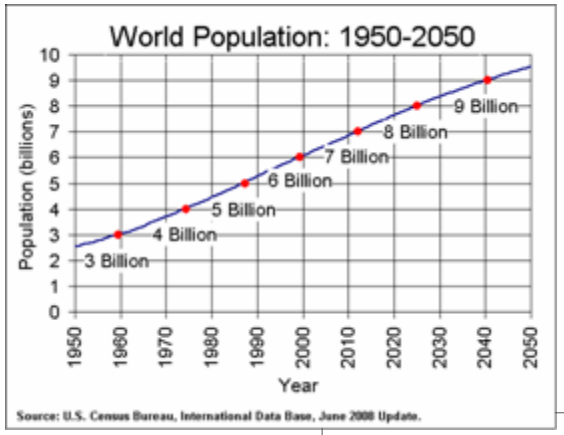
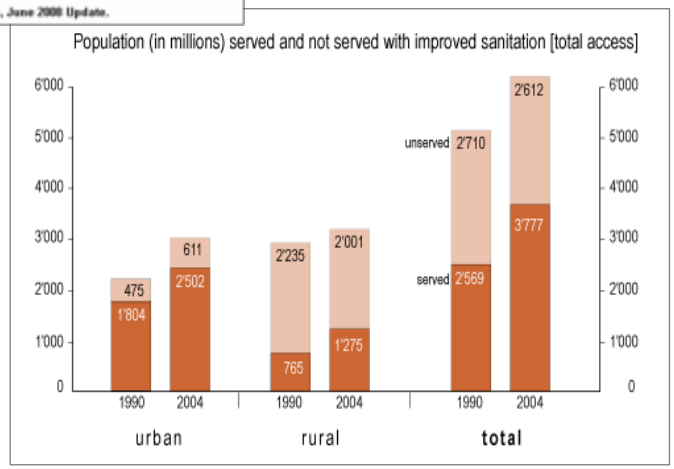
ENVIRONMENTAL CHANGES

Human population growth and increasing water usage are placing greater demands on the world's freshwater supplies (Postel, 2000).





Source: World Health Organisation

http://www.wssinfo.org/html_graphs/san_global_graph.html

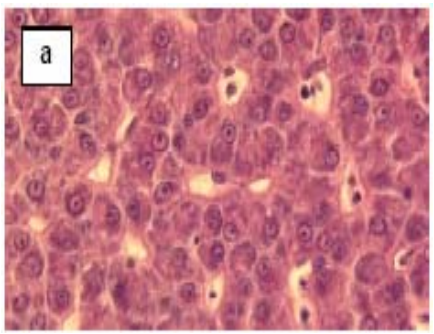
Increased pressure on aquatic ecosystems due to:

- **Extent agriculture and industry**
  - **modified land use**
  - **increased pollution + nutrient load**
- **Hydrotechnical constructions**
  - **river channelization**
  - **dams**
- **Global warming**

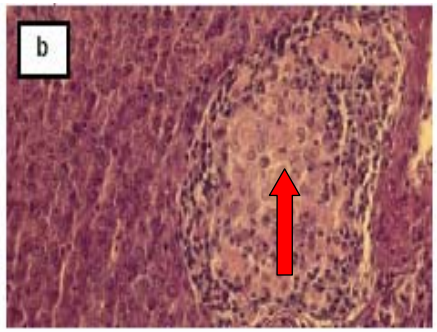
1. Chemical pollution

Lethal & sub-lethal effects (bioaccumulation, tissue damages)

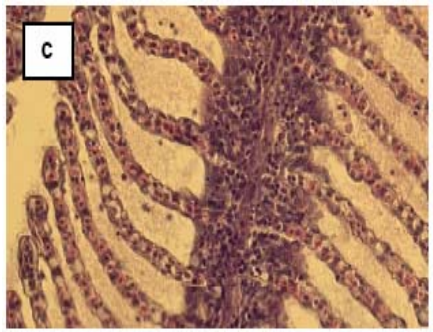
IAD pilot project:
MONITORING OF POLLUTION IN A DANUBE TRIBUTARY (MURES-TISZA SYSTEM) USING BIOMARKERS TECHNIQUES



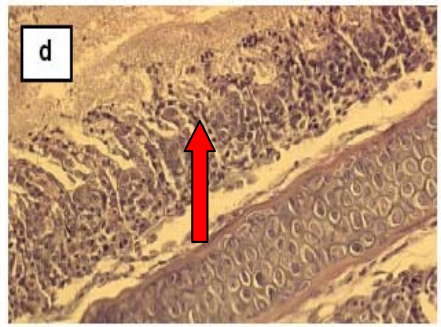
a. *Chondrostoma nasus*, site 4 – undamaged liver status



b. Chondrostoma nasus, site 1 - inflammatory changes in the liver



c. *Leuciscus cephalus*, site 4 – gills, almost undamaged;



d. Leuciscus cephallus, site 1 – gills with necrosis of epithelial cells

Histopathological results shows sub-lethal effects of pollution (Koehler et al, 2005).

Monitoring must include more sensitive analyses

EUTROPHICATION EFFECTS IN DANUBE DELTA

Started in 1977-1978 - intensified after the 1980s

main consequence - severe drop of aquatic biodiversity

- Phytoplankton ~600 species → ~100 species
- Zooplankton ~450 species → ~270 species
- Macrophytes 16 species → 11 species
- Benthic species decreased
  (e.g. Chironomidae to 3-5 species, Oligochaeta to 2-4 species)
- Ichthyofauna – economic valuable species 28 → 19

Source: Brezeanu et al 1991, Vadineanu et al 2001

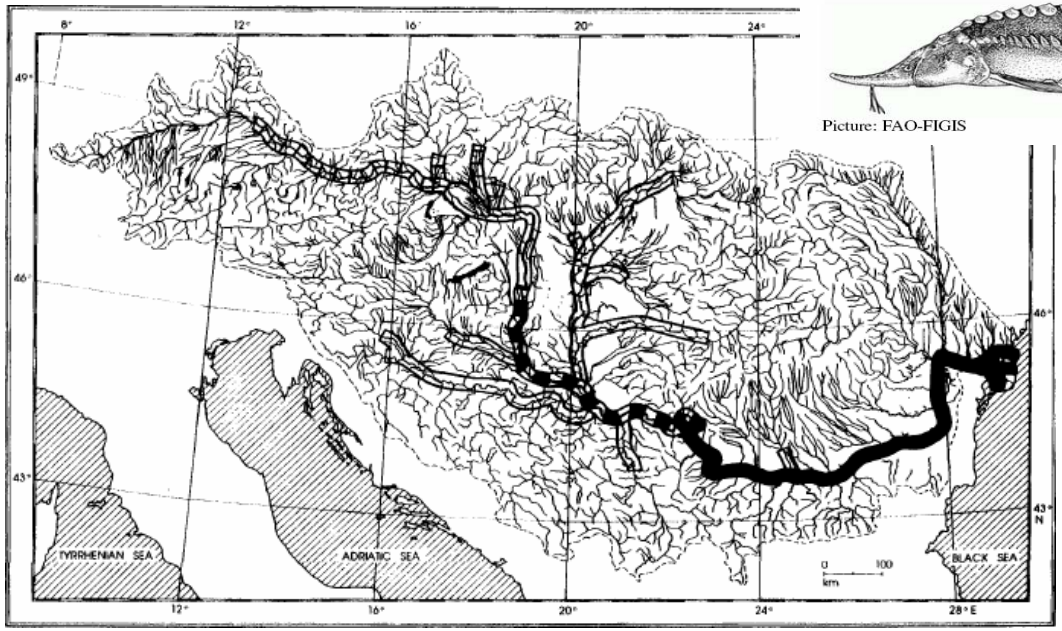
3. Effects of hydrotechnical constructions

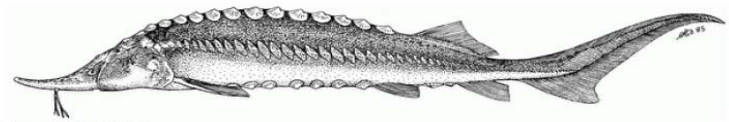
Hydrotechnical constructions (dams, river channelization, dikes, dredging, etc)

major cause of disruption in natural river flows:

- **changed hydrology (discharge, flow)**
- **habitat fragmentation,**
- **loss of floodplains and adjacent wetlands,**
- **changes of sediment flux - deterioration of river deltas and estuaries,**
- **decrease of water quality**

E.g.: Huso huso (Beluga or Great Sturgeon) – near to extinction





Picture: FAO-FIGIS

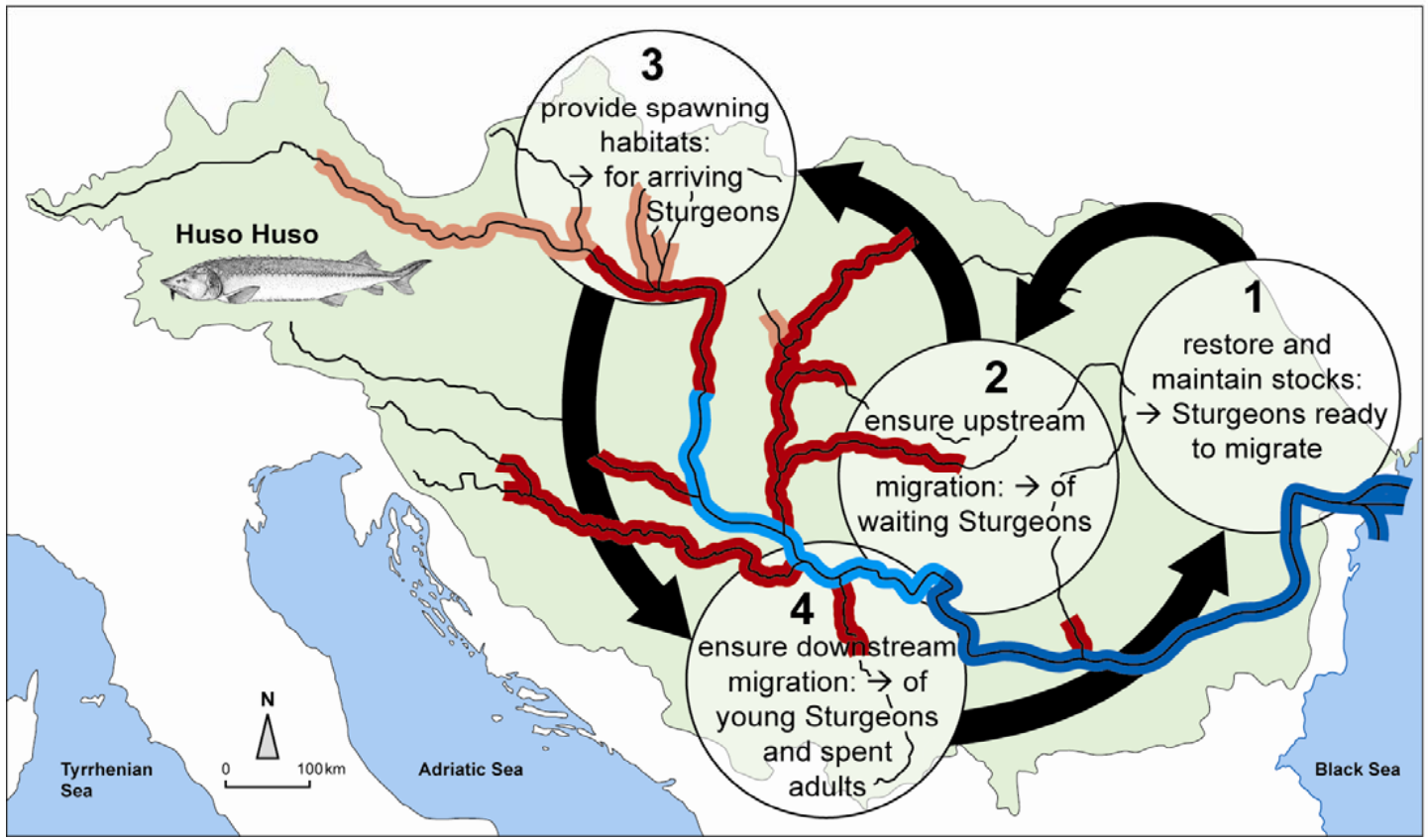
Distribution of *Huso huso in the Danube drainage system. Regular (continuous black) and occasional* (black and white area) occurrence at present; regular (continuous white) and occasional (striped white area) occurrence in the past. (from HENSEL & HOLČÍK 1997, Original figure by K. Hensel)

Source: Bloesch, J., Jones, T., Reinartz, R., Striebel, B. (eds.), 2005: Action Plan for the Conservation of Sturgeons (Acipenseridae) in the Danube River Basin

3. Effects of hydrotechnical constructions

Action Plan for the Conservation of Sturgeons (Acipenseridae) in the Danube River Basin

Aim: to close the natural Sturgeon life-cycle
→ needs joint and simultaneous actions in the Upper, Middle and Lower Danube



Source: Bloesch J., IAD

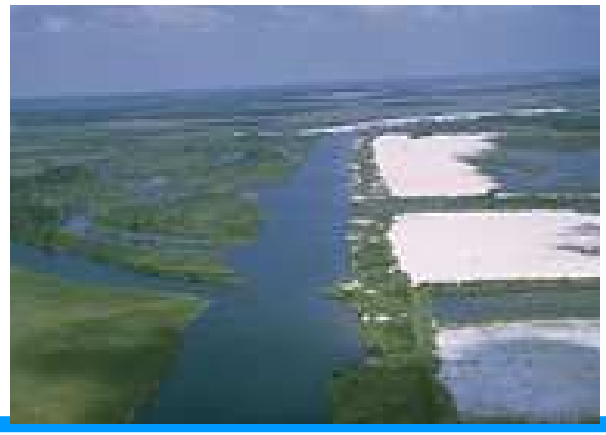
Kissimmee River

Before the channelization (1962)

Main consequences:
- fishes captures decline by 75%
- waterfowls utilization of floodplains decreased by 92%

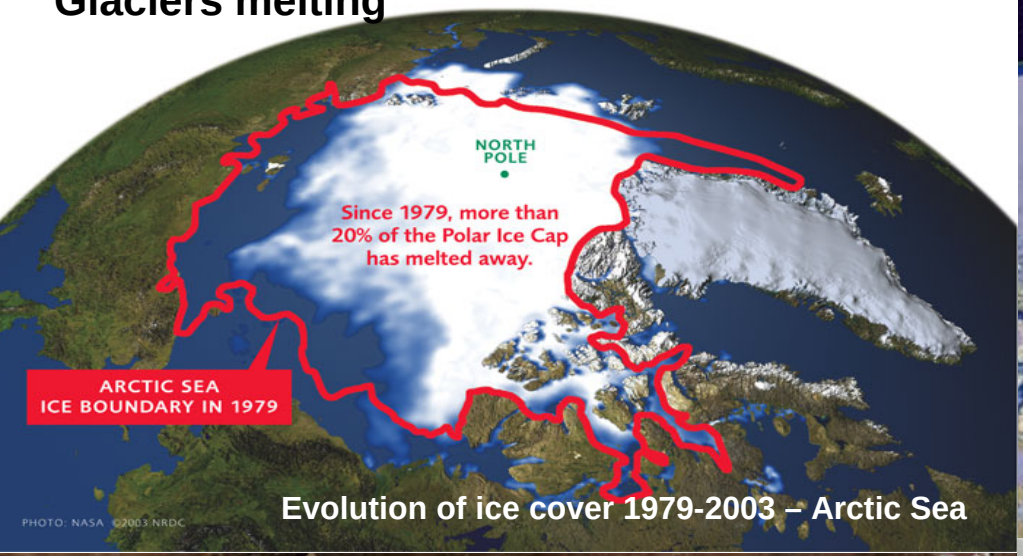
Based on 1997 estimates, the reconstruction costs - over 400 mil. USD

After

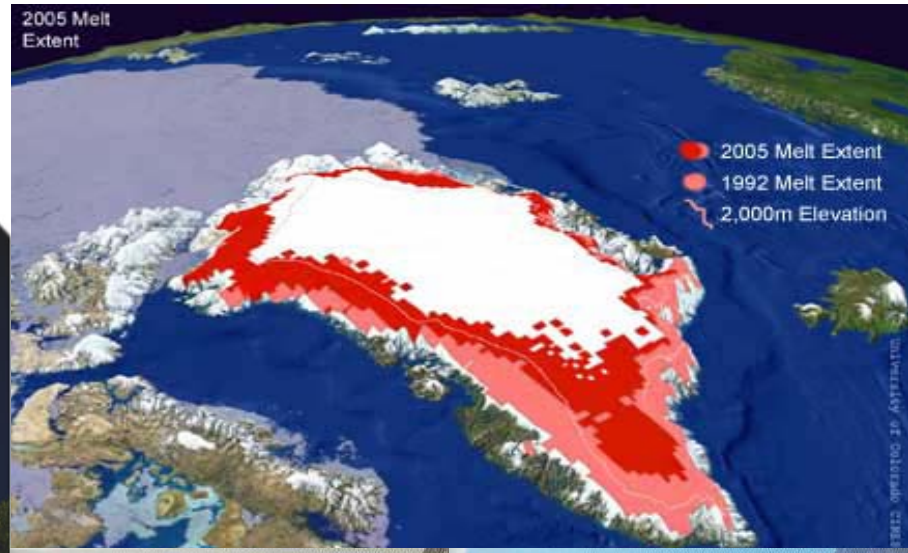


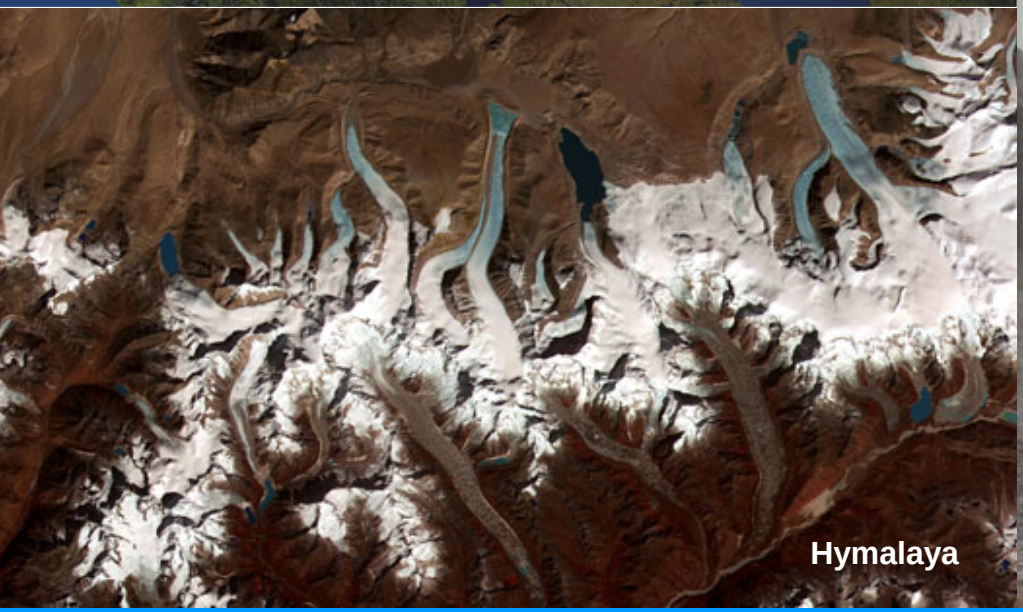
4. Global warming

Glaciers melting



Evolution of ice cover 1979-2003 – Arctic Sea



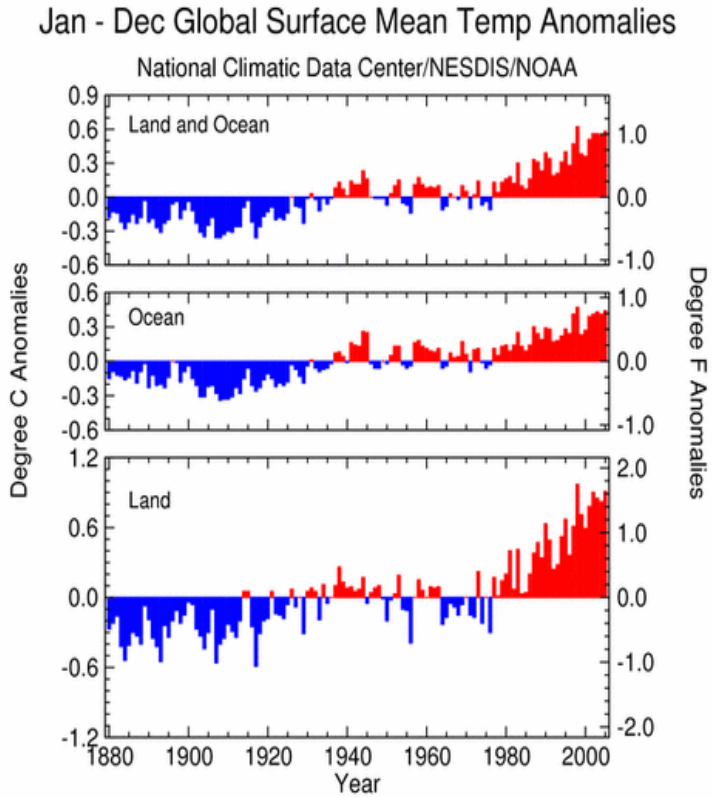


Hymalaya

Austria

Photo: courtesy of Kasimir, G. - IAD Austria

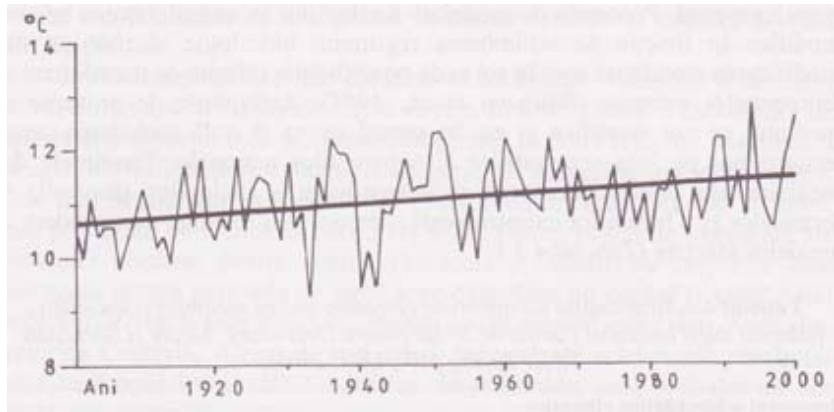
4. Global warming



http://www.ncdc.noaa.gov/oa/climate/research/2005/ann/global.html

Romania – Air temperature increase

Last century – average annual temperature increased by 0.3 ºC



Average annual air temperature in Bucharest

Source: Busuioc (2002) quoted by Balteanu & Serban (2005)

Impact on aquatic ecosystems

Mures River Basin

Climate parameters:

-Air temperature increased by 0.4-0.7°C

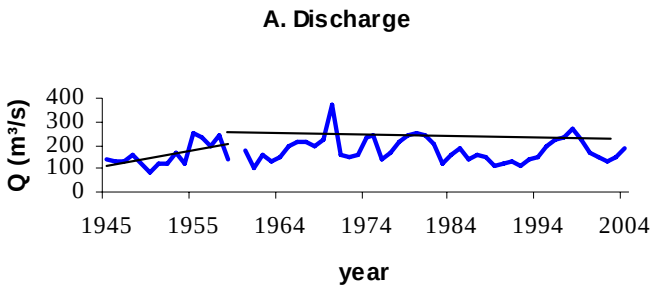
-No. of days with snow cover decreased

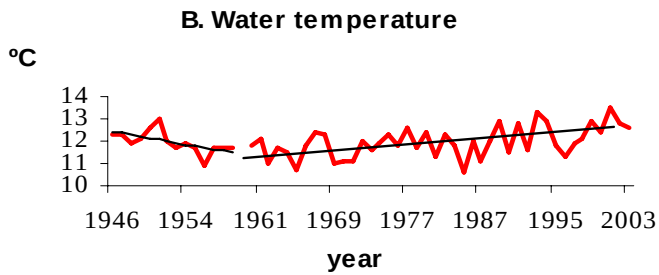
-No. of days with precipitations decreased

(-66 up to -79)

Source: Romanian National Meteorological Administration

Extreme precipitation events are more frequent – increased flood risk

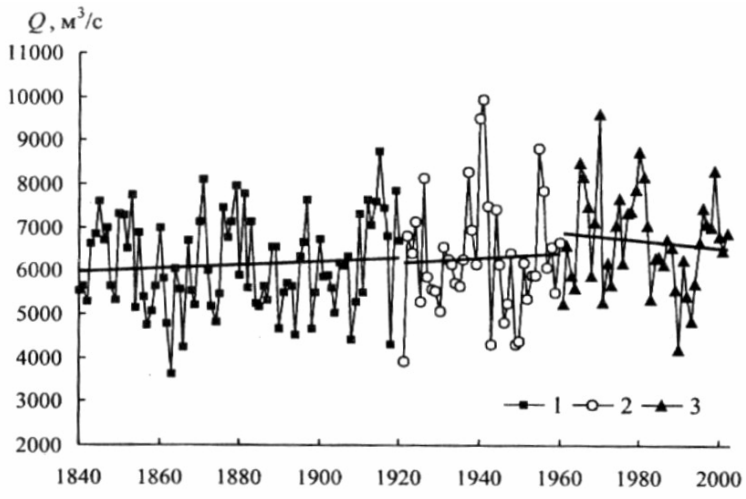




Decreasing water discharge (A) and increasing water temperature (B) of Mures River at Mako between 1960-2004 (VITUKI, H)

Impact on aquatic ecosystems

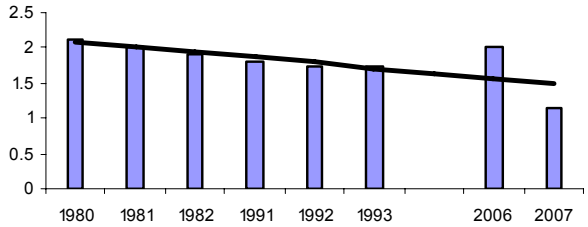
Danube River



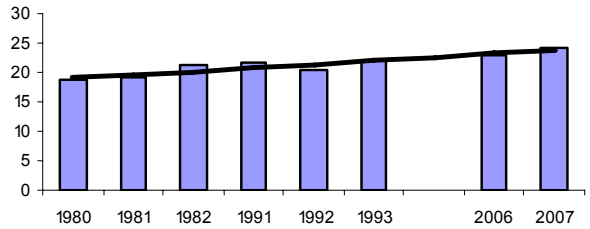
Danube discharge at Reni
- average 1840 – 2002 (source: Michaylova, 2004)

Danube Delta

Matita-Merhei average depth



Matita-Merhei water temperature



Decreasing water level and increasing temperature in Danube Delta lakes (SCOPES project 2005-2008 – Switzerland-Romania-Ukraine)

EXPECTED CONSEQUENCES ON AQUATIC COMMUNITIES

-Reduced oxygen concentration and self-purification capacity

-Shift towards species tolerant of high temperatures

- In rivers: migration upstream in colder regions

- Reduced duration of freezing in winter - earlier emergence of aquatic insects, loss of species needing a resting phase in their life-cycle

- Mild winters increase survival rate of birds, enhancing predation pressure on aquatic communities

WHY IS BIODIVERSITY IMPORTANT?

Biodiversity = "the variety of life" (Gaston & Spicer, 2005)

Intrinsic value – philosophical concept
Extrinsic value – utilitarian value

Direct-use values	Indirect use-values
Food	Regulating global processes, such as atmosphere and climate
Building Materials	Soil and water conservation
Fuel	Nutrient cycling
Paper Products	Pollination and seed dispersal
Fiber (clothing, textiles)	Control of agricultural pests
Industrial products (waxes, rubber, oils)	Genetic library
Medicine	Scientific and educational
	Tourism and recreation
	Cultural, spiritual, and aesthetic
	Water purification

Source: Laverty & Sterling, 2003

CONCLUSION

Environmental degradation

- Loss of biological diversity
- Extinction of species and populations
- Loss of ecosystems services

- Affects human well-being
- Affects users

Take Home Message

- The Danube River ecosystem is highly threatened by the environmental changes
- The legal framework demands „good ecological status“ (EU-WFD)
- Transdisciplinary collaboration between basic/applied scientists and managers offers useful tools for policy makers to mitigate negative effects of human development and foster sustainable solutions

Thank you for your attention

СПАСИБО ДЛЯ ВАШЕВО ВНИМАНИЕ