BIOWETMAN

A science based approach to understand biodiversity driven functions and services for improving wetland management

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Project Coordinator: Dr. Thomas Hein, A

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Partners:

1. Wasserkluster Lunz biologische Station GmbH, Austria
2. Institute of Zoology Sofia, BAS, Bulgaria
3. Department of Biology, Strossmayer University Osijek, Croatia
4. Institute of Biology Bucharest, Romanian Academy
5. Faculty of Sciences, University of Novi Sad, Serbia

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State-of-the-art

Wetlands - link terrestrial - aquatic ecosystems → high biodiversity, productivity, intense processing of matter.

- reduce influences from the land, provide migration corridors, support biodiversity and water quality in both adjacent environments (Naiman & Decamps, 1997, McClain et al. 2003, Verhoeven et al. 2006) – buffer areas.

Their ecological significance was acknowledged during the last decades - countermeasure to increasing anthropogenic impacts.

Wetlands restoration schemes designed – aims: protect, conserve and restore

- integration of different disciplines and link with management organizations is only partially operative;

- mainly hydrological measures, the interaction of other factors being less known.

Future steps: integrated efforts to improve our knowledge about wetlands biodiversity, functions, services and concerted measures implementation at DRB scale

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Danube River Basin

- About 80 % of the former floodplains have been lost or are functionally extinct.
- Anthropogenic impacts have led to habitat destruction, system fragmentation - disrupted structures and functions in the aquatic and terrestrial ecosystems.
- The idea of biodiversity integrates the structural diversity of the ecosystem with the diversity of processes and the diversity of species - these interactions occur across different scales.
- Eco-hydrology is the suggested approach to link environmental driving forces, water quality and biodiversity.

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Aim and objectives:

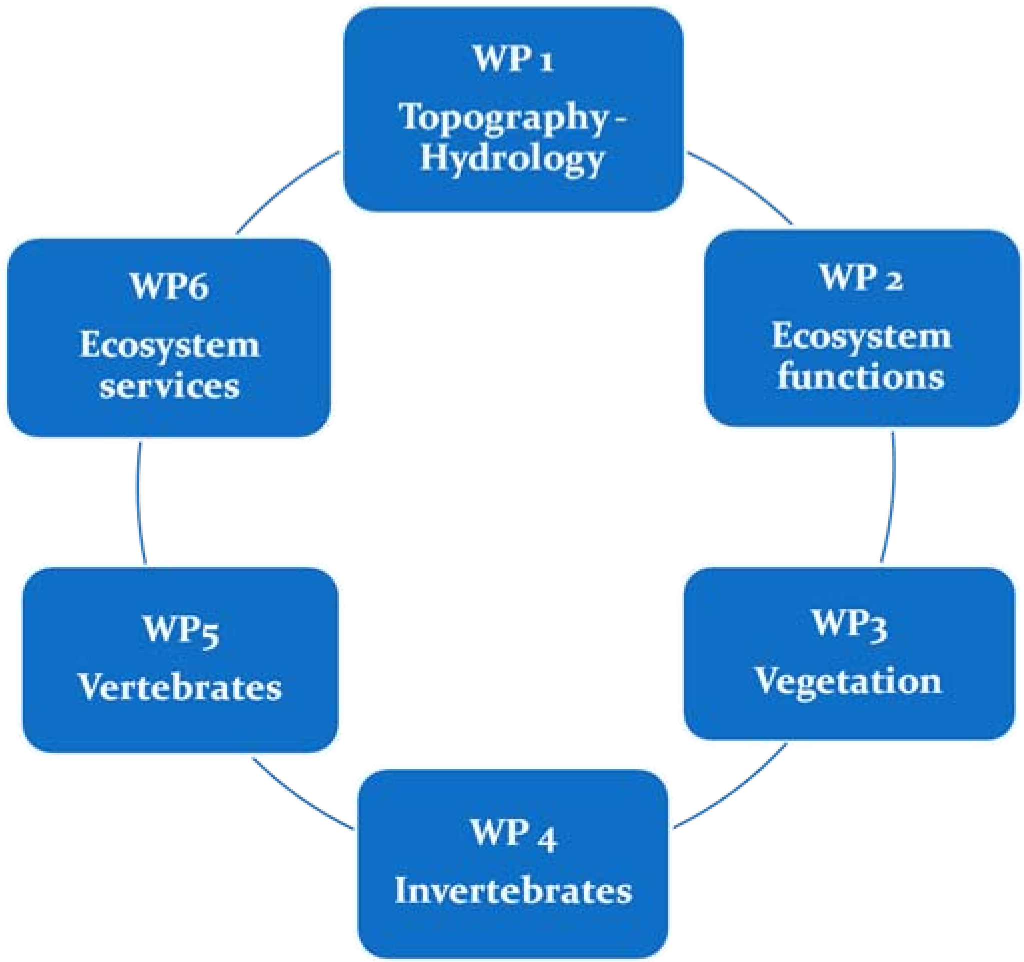
- **To investigate the role of biodiversity in water quality improvement and other ecosystem services, thus, leading to potential answers how wetlands functions can support the implementation of WFD and human needs**

- **To select case studies and their pressures – evaluate impact situation and the urgent needs related to ecosystem services, especially in the context of climate change**

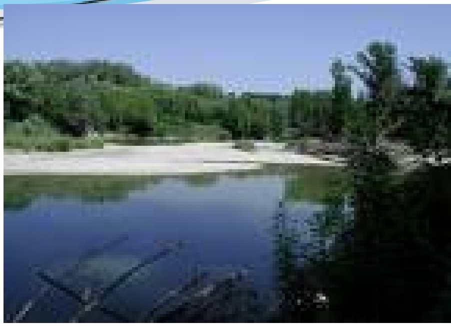
- **To initiate a network of scientists and wetland managers for improving wetland management on a larger scale by using an integrated scientific approach**

- **To increase knowledge and know-how exchange within this network in order to provide useful scientific tools to the decision makers for a sustainable management of Danubian wetlands**

Project structure



Case studies
Austria: Donau-Auen National Park



Founded : 1996

Surface: 9,300 ha

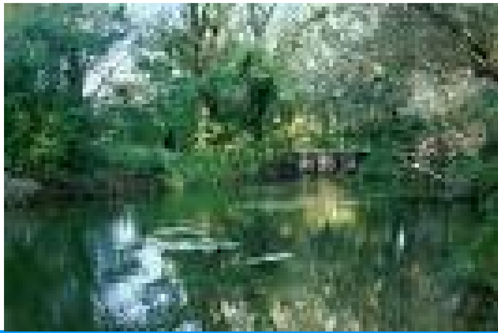
- 800 vascular plants
- 30 mammals
- 100 breeding birds
- 8 reptiles and 13 amphibians
- about 60 fish species

The Donau-Auen National Park extends from Vienna to the mouth of the Morava River, on the border to Slovakia.

The park protects the last remaining major wetland environment in Central Europe.

For 36 km, the Danube flows freely

The dynamic rise and fall of water levels - up to 7m - mean that the wetlands landscape is constantly reshaped - creates habitats for a large number of plants and animals.



Case studies
Croatia – Nature Park Kopacki Rit

Kopački rit is a floodplain area of the Danube River, situated in northeast Croatia at the confluence of the Drava and Danube rivers.
One of the largest alluvial plains in Europe that extends to the north all the way to Szekszard in Hungary.

Founded: 1967
Surface: 23.894 ha
International protection: IBA

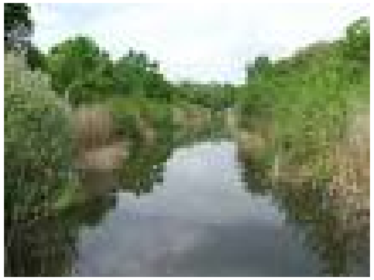
Algae: 746 species
Vascular flora: 425 species
Invertebrates: 632 species
Birds: 289 species
Amphibians: 11
Reptiles: 10
Mammals: 55
Fish: 44

Case studies
Serbia: Koviljsko-petrovaradinski marshes

Special Nature Reserve – 1998

International status: IBA site(1989)
ICPDR area (2004)
Candidate for Ramsar Site

Surface: 4840,60 ha



-backwaters, ponds, swamps;
-forests, meadows, reeds, rushes;
-172 species of birds
- 46 species of fish

Case studies
Bulgaria: Srebarna Biosphere Reserve

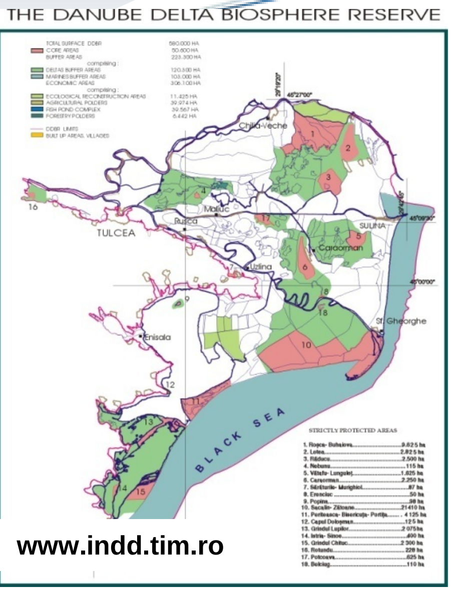
Surface: 902.1 ha; 600 ha - BR

Designated as :
- **Monument of World Cultural and Natural Heritage (1983)**
- **UNESCO biosphere reserve (1977)**
- **RAMSAR site (1975)**
- **Important Bird Area (1990)**

A dyke built in 1948, together with intensive use of groundwater and land use change lead to accelerated eutrophication
Restoration activities (1993-1994) especially a canal which re-connected the lake with the Danube, lead to the beginning of lake's recovery.

-139 vascular plant species
-19 fish species until 1948
-21 reptile and amphibian species
-41 mammal species
-230 bird species

Case studies
Romania: Danube Delta Biosphere Reserve



Surface: 580,000 ha

Danube Delta – Biosphere Reserve –

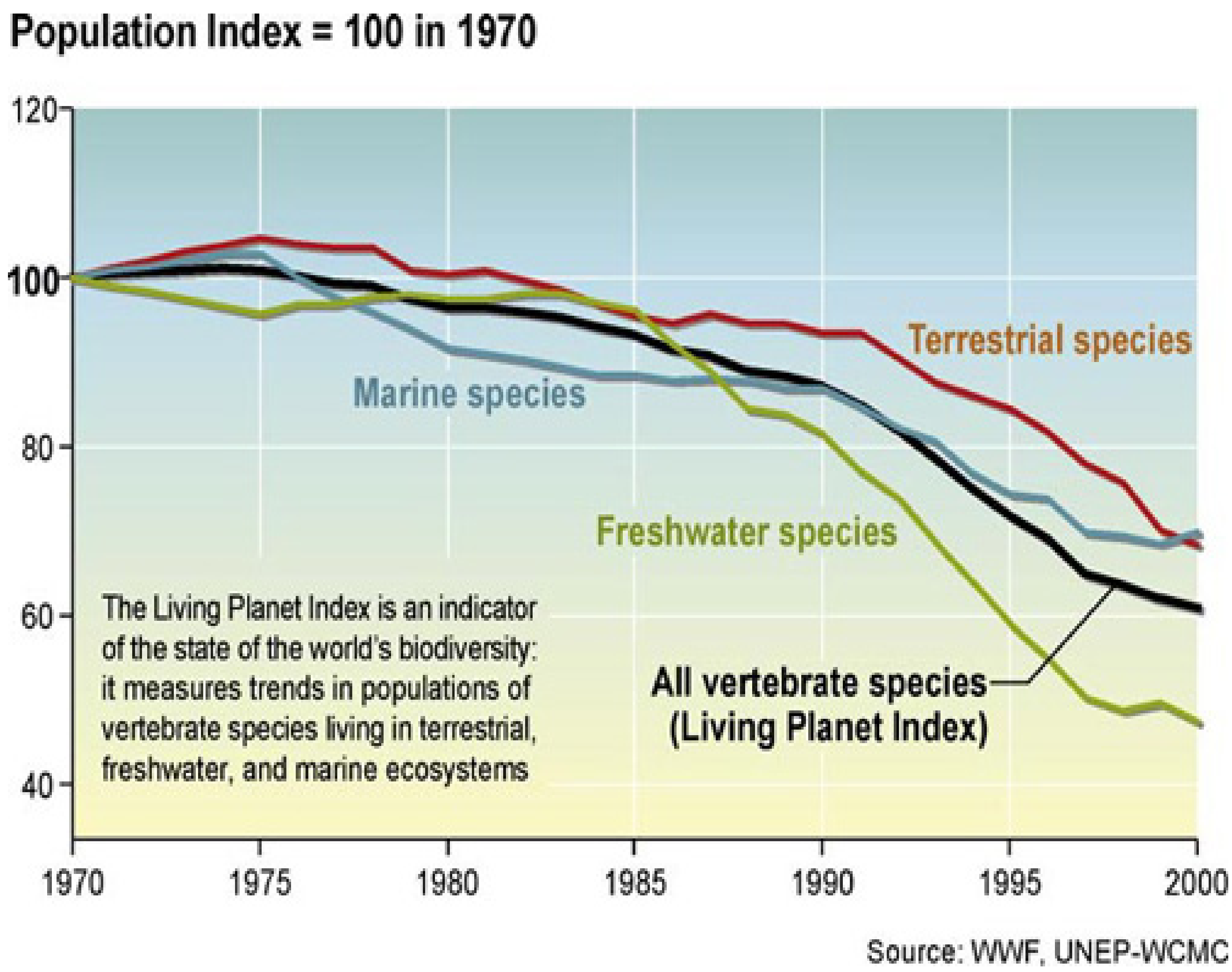
Included in: - World Natural Heritage List

- Ramsar Convention List

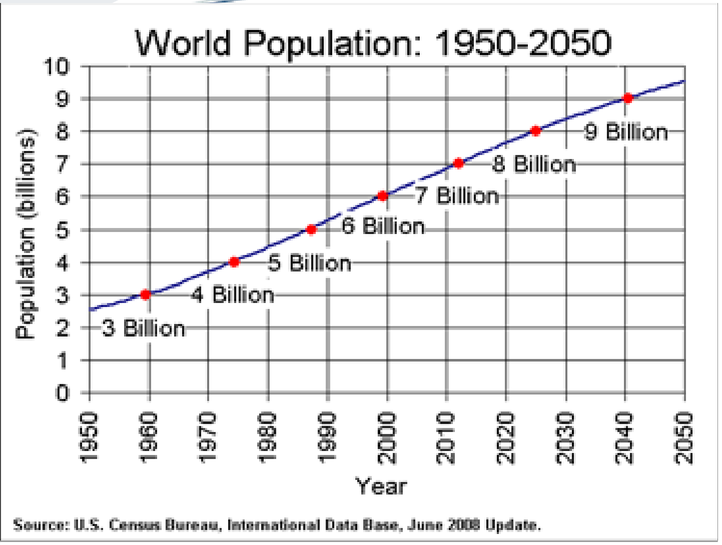
- UNESCO program Man and

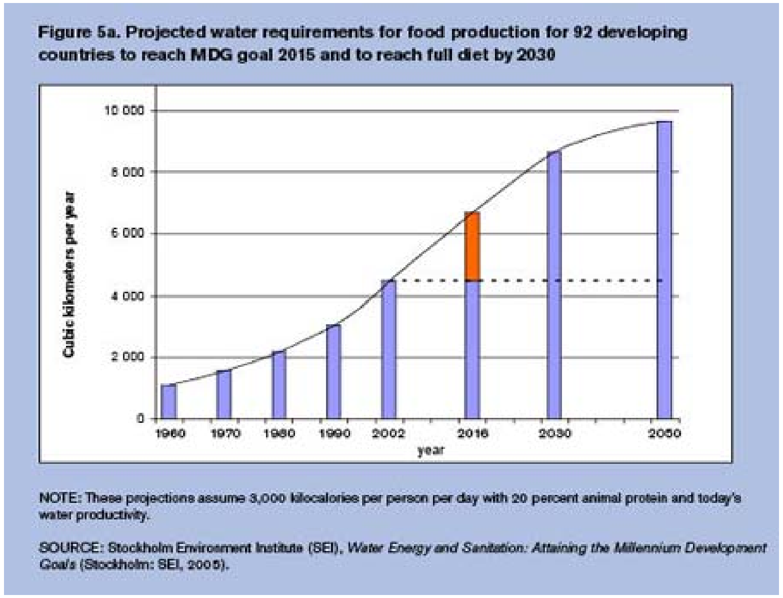
Biosphere Inventory 1991 – 1997: 1615 plant species and 3491 invertebrate and vertebrate species (Oosterberg et al, 2000)

Worldwide decline of biodiversity



Major cause: environmental changes





Increased environmental pressure:

- Extent agriculture and industry
    - modified land use
    - increased pollution + nutrient load
- Hydromorphological alterations
    - river channelization, dams, dikes
    - drying wetlands for agriculture
- Global warming

Wetlands importance

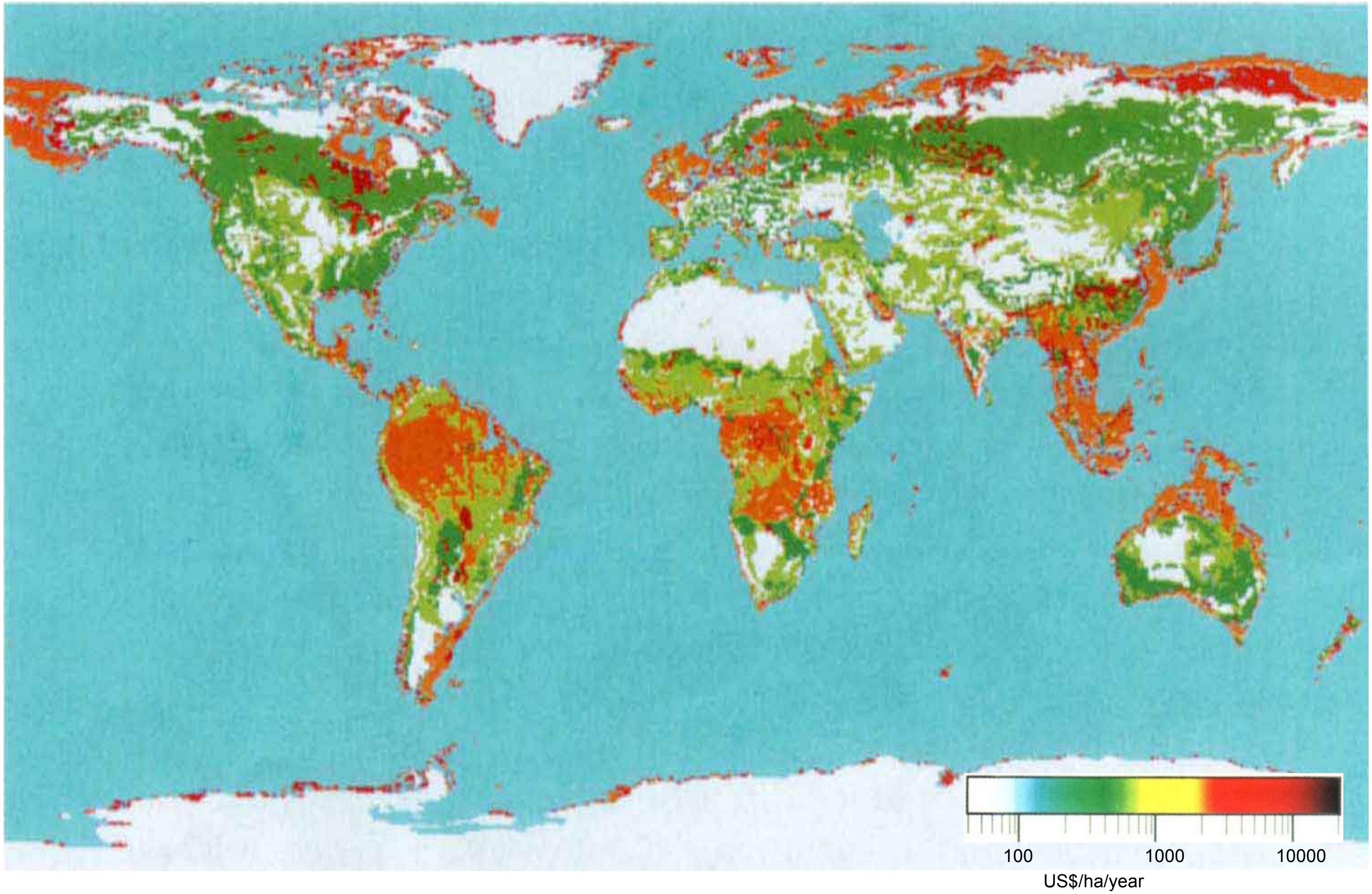
Through their conversion to agricultural and construction lands, through diking, filling and draining – over 53% of US wetlands were lost between the 1780s and 1980s (Meyer 1995).

Nowadays, the concept of "mitigation" was promoted by law — if wetlands are to be altered for other uses, compensation must be provided, often in the form of physical improvements, for those benefits that would be diminished as a result of alteration of system function.

Knowledge of wetlands resource values allows us to recognize the costs (i.e., lost resource values) associated with wetlands development and the long term benefits of wetlands protection (Leschine et al, 1997).

Value of ecosystem services (Constanza et al, 1997): 33,3 x 10^9 US$/an

Wetlands - 4,9 x 10^9 US$/an (15%)



ECOSYSTEM SERVICES (De Groot et al, 2002)

	Functions	Ecosystem processes and components	Goods and services (examples)
A	***Regulation Functions***	***Maintenance of essential ecological processes and life support systems***	
1	Gas regulation	Role of ecosystems in bio-geochemical cycles	1.1 UVb-protection by O3 (preventing disease) (e.g. CO2/O2 balance, ozone layer) 1.2 Maintenance of air quality. 1.3 Influence on climate
2	Climate regulation	Influence of land cover and biologically mediated processes on climate	Maintenance of a favorable climate (temp., precipitation, etc) for example, for human habitation, health, cultivation
3	Disturbance prevention	Influence of ecosystem structure on dampening environmental disturbances	3.1 Storm protection (e.g. by coral reefs) 3.2 Flood prevention (e.g. by wetlands and forests)
4	Water regulation	Role of land cover in regulating runoff & river discharge	4.1 Drainage and natural irrigation. 4.2 Medium for transport
5	Water supply	Filtering, retention and storage of fresh water (e.g. in aquifers)	Provision of water for consumption (drinking, irrigation, industrial use)
6	Soil retention	Role of vegetation root matrix and soil biota in soil retention	6.1 Maintenance of arable land. 6.2 Prevention of damage from erosion/siltation
7	Soil formation	Weathering of rock, accumulation of organic matter	7.1 Maintenance of productivity on arable land. 7.2 Maintenance of natural productive soils
8	Nutrient regulation	Role of biota in storage and re-cycling of nutrients (N, P, S)	Maintenance of healthy soils and productive ecosystems

ECOSYSTEM SERVICES (De Groot et al, 2002)

	Functions	Ecosystem processes and components	Goods and services (examples)
9	Waste treatment	Role of vegetation & biota in removal or breakdown of xeniobiotic nutrients and compounds	9.1 Pollution control/detoxification. 9.2 Filtering of dust particles. 9.3 Abatement of noise pollution
10	Pollination	Role of biota in movement of floral gametes	10.1 Pollination of wild plants 10.2 Pollination of crops
11	Biological control	Population control through trophic-dynamic relations	11.1 Control of pests and diseases. 11.2 Reduction of herbivory (crop damage)
B	***Habitat Functions***	***Providing habitat for wild plant and animal species***	***Maintenance of biological & genetic diversity (and thus the basis for other functions)***
12	Refugium function	Suitable living space for wild plants and animals	Maintenance of commercially harvested species
13	Nursery function	Suitable reproduction habitat	13.1 Hunting, gathering of fish, fruits 13.2 Small-scale subsistence farming & aquaculture
C	***Production Functions***	***Provision of natural resources***	
14	Food	Conversion of solar energy into edible plants and animals	Provision of plants, vegetables fish, meat from natural and semi-natural ecosystems
15	Raw materials	Conversion of solar energy into biomass for human construction and other uses	15.1 Building & manufacturing (e.g. wood, animals skins). 15.2 Fuel and energy (e.g. oil, fossil fuel, organic matter). 15.3 Fertilizer (e.g. leaves,, litter, manure).

ECOSYSTEM SERVICES (De Groot et al, 2002)

	Functions	Ecosystem processes and components	Goods and services (examples)
16	Genetic resources	Genetic material and evolution in wild plants and animals	16.1 Improve crop resistance to pathogens & pests 16.2 Other applications (e.g. health care)
17	Medicinal resources	Variety in (bio)chemical substances and other medicinal uses of natural biota	17.1 Drugs and pharmaceuticals 17.2 Chemical models & tools. 17.3 Test- and essay organisms
18	Ornamental resources	Variety of biota in natural ecosystems with (potential) ornamental use	Resources for fashion, jewelry, pets, decoration & souvenirs (furs, feathers, ivory, orchids, butterflies, aquarium fish)
D	***Information Functions***	***Providing opportunities for cognitive development***	
19	Aesthetic information	Attractive landscape features	Enjoyment of scenery (scenic roads, housing)
20	Recreation	Variety in landscapes with (potential) recreational uses	Travel to natural ecosystems for eco-tourism, outdoor sports, etc.
21	Cultural and artistic information	Variety in natural features with cultural and artistic value	Use of nature as motive in books, film, folklore, national symbols, architecture, advertising
22	Spiritual and historic information	Variety in natural features with spiritual and historic value	Use of nature for religious or historic purposes (heritage value of natural ecosystems, features)
23	Science and education	Variety in nature with scientific and educational value	Use of natural systems for school excursions, scientific research

Selected wetlands - BIOWETMAN

Wetlands	***Regulation Functions***	***Habitat Functions***	***Production Functions***	***Information Functions***
Austria	yes	yes	yes	yes
Bulgaria	yes	yes	yes	yes
Croatia	yes	yes	yes	yes
Romania	yes	yes	yes	yes
Serbia	yes	yes	yes	yes

Case study 1 – New York City
(Turner & Daily, 2008)

1991 - EPA ordered New York City to build a water filtration plant.
Estimated budget: 8 billion US$ plus 300 million in annual operating costs

Revolutionary approach – city officials invested in restoring the watershed.

Since 1997, nearly 2 billion US$ were invested in land management changes
- land purchased around reservoirs to preserve forests and wetlands,
- landowners paid to restore forest along streams,
- technical aid and infrastructure offered to farmers and foresters.

Triple-win situation (Daily and Ellison 2002):
urban people get pure-water at lower cost;
rural people are rewarded for the land;
visitors and rural residents enjoy the spectacular landscape.

Case study 2 – Napa River

(Turner and Daily, 2008)

Worldwide – floods costs approx. 40,000 deaths and 29 billion US$ (1999 – 2000) - (Daily and Ellison 2002).

Floods in US – damages of 4 billion US$.

After 28 major floods and over 500 million US$ in damages, Napa County adopted a "living river" approach to flooding.

The ecosystem approach - more expensive (by 50 million US$) – accepted in view of the many benefits not explicitly valued.

The town - revitalized by major increases in private investment after the approval of the flood plan – construction, boating, hiking, fine dining etc. (Brauman 2006).

Napa's plan mitigates flooding over 6 of the 55miles of the Napa River – now the efforts are focused on the improvement of upstream management of the river – stressing the dependence of local efforts on support at larger scales.

Case study 3 - China

(Turner and Daily, 2008)

Studies have shown that flood peaks may be 80 percent higher in watersheds without wetlands than in similar basins with large wetland areas (U.S. ACOE 1976, quoted by Leschine et al, 1997)

- **Due to the massive flooding in 1998 (damages of 20 billion US$) the Chinese government promoted a new land-use policy entitled the National Forest Conservation Program (NFCP).**

- **The policy is intended to regulate water flow and promote soil retention, primarily by conserving and restoring natural forests while increasing timber production in plantations.**

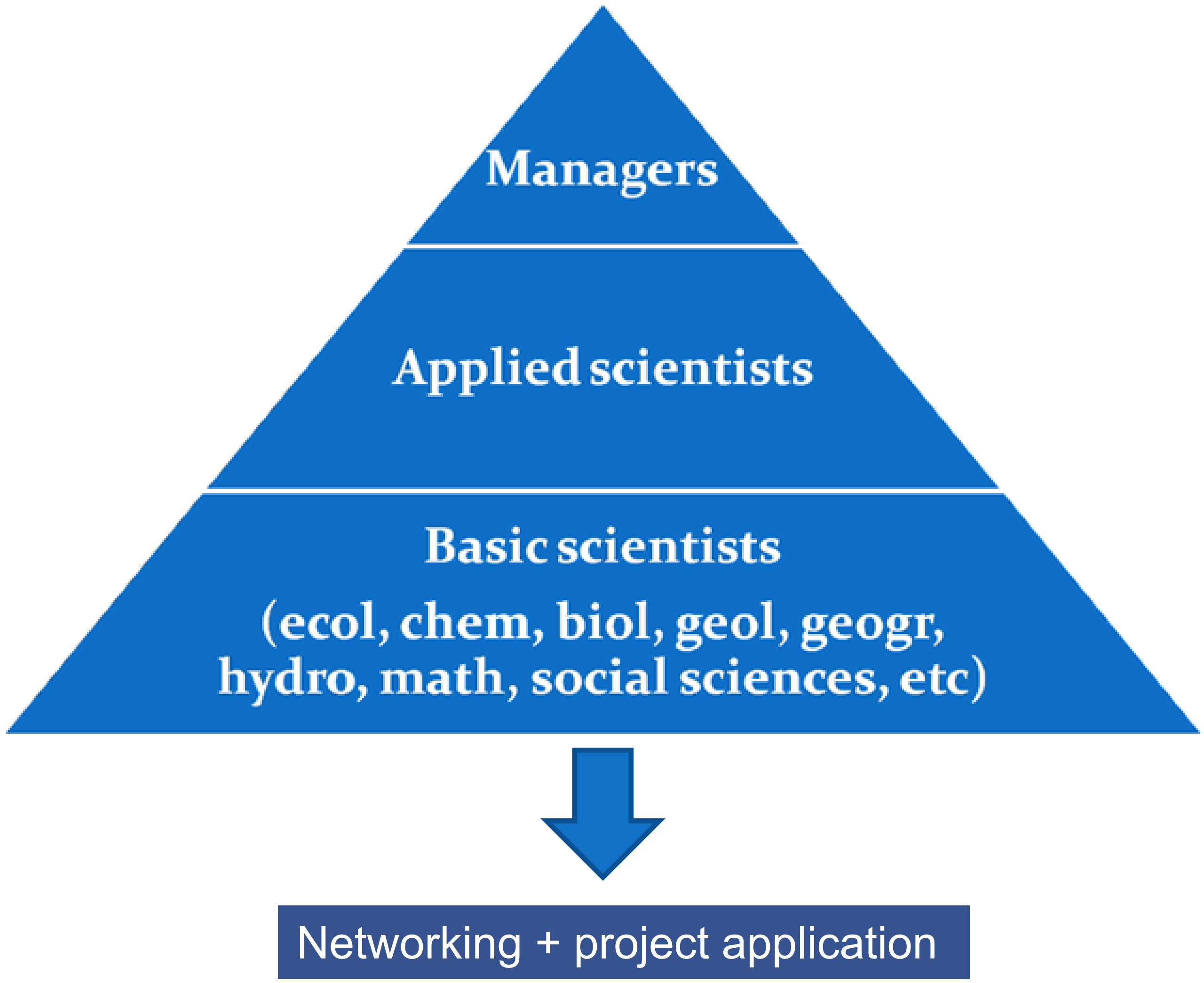
- **Preserve 30million ha of natural forests in the upper reaches of the Yangtze River and upper and middle reaches of the Yellow River (SFB 2005).**

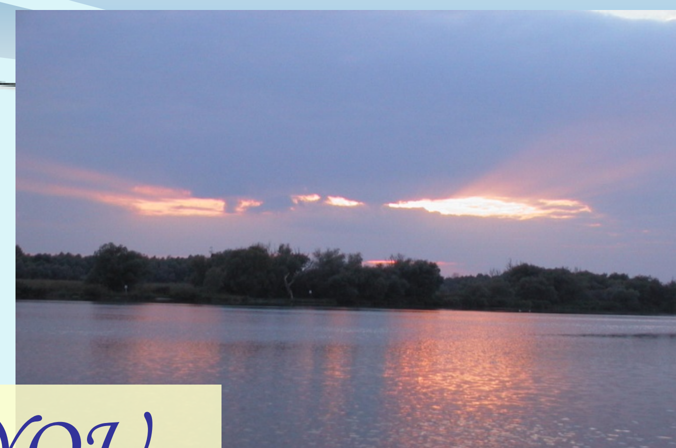
- **The government has invested billions US$ into the programme - trainings, resettlements, direct compensation of forest dwellers, mandatory conversion of marginal farmlands to forest lands (Zhang et al. 2000).**

Take Home Message

- The wetlands along Danube River are highly threatened by the environmental changes
- The legal framework demands „good ecological status“ (EU-WFD)
- Protecting wetlands biodiversity and functions means protecting human well-being
- Integrative restoration measures of wetlands along the Danube River are needed

AIM OF THE WORKSHOP





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