

# Hydro-ecological criteria for sustainable utilization of the Middle Danube

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The background of the slide is a photograph of a wide, calm river, likely the Danube, with a forested bank visible in the distance. The water is still, reflecting the sky and the distant shore.

# **Content**

**Ecological importance and economic benefits of large rivers.**

**Degradation of ecological integrity of river-floodplain ecosystems**

**Management concepts of large European rivers – WFD**

**Problems of environmental assessment in the Danube**

**Need for development of hydro-ecological benchmarking**

**Restoration principles of large lowland rivers**

# River-floodplain systems – most diverse ecosystems



	Earth's water resource	%	Species richness – fish	%
<b>Global</b>	1 384 000 10 <sup>3</sup> km <sup>3</sup>		29 000 spp	
<b>Ocean, sea</b>	1 338 000 10 <sup>3</sup> km <sup>3</sup>	97,5	16 000 spp	55
<b>Freshwater</b>	177 10 <sup>3</sup> km <sup>3</sup>	0,01	13 000 spp	45
	<b>Freshwater resource</b>	<b>%</b>	<b>Species richness – fish</b>	<b>%</b>
<b>Lakes</b>	175 10 <sup>3</sup> km <sup>3</sup>	98,9	~ 5 200 spp	40
<b>Rivers</b>	2 10 <sup>3</sup> km <sup>3</sup>	1,1	~ 7 800 spp	60





# Social and economic benefits of large rivers

Land use in floodplain



Navigation way



Domestic water



Hydropower



Industrial water



Irrigation



# Human activity – decline ecological integrity of rivers

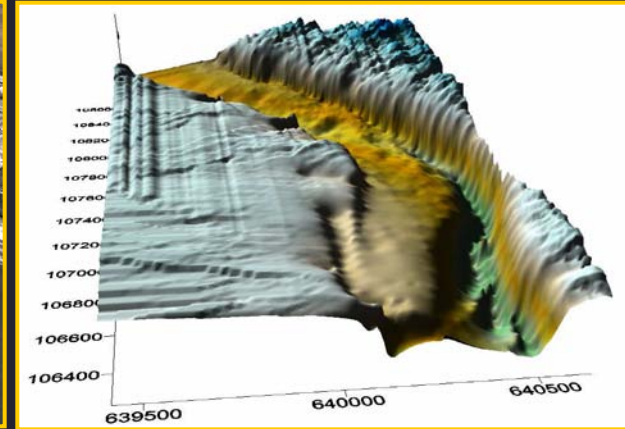
interruption of lateral  
connectivity – channelization



fragmentation of longitudinal  
connectivity – damming



river bed incision



increasing floodplain  
sedimentation



pollution (eutrophication,  
pesticides, heavy metals ...)



invasion of  
non-native species



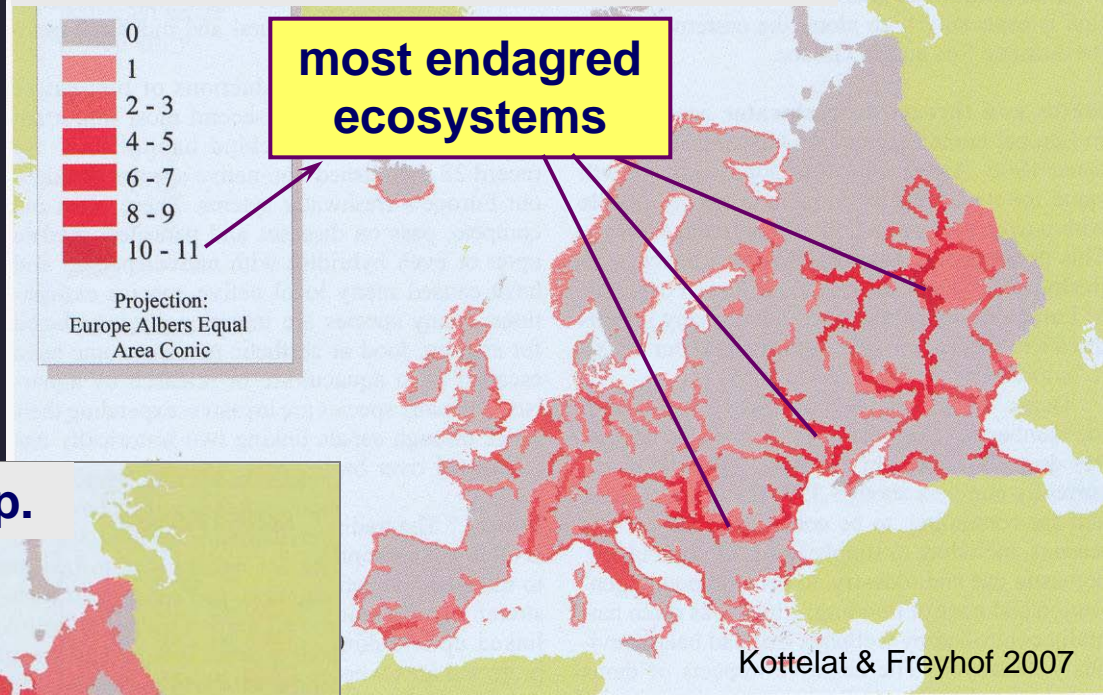


# Fish fauna – indicator of environmental changes

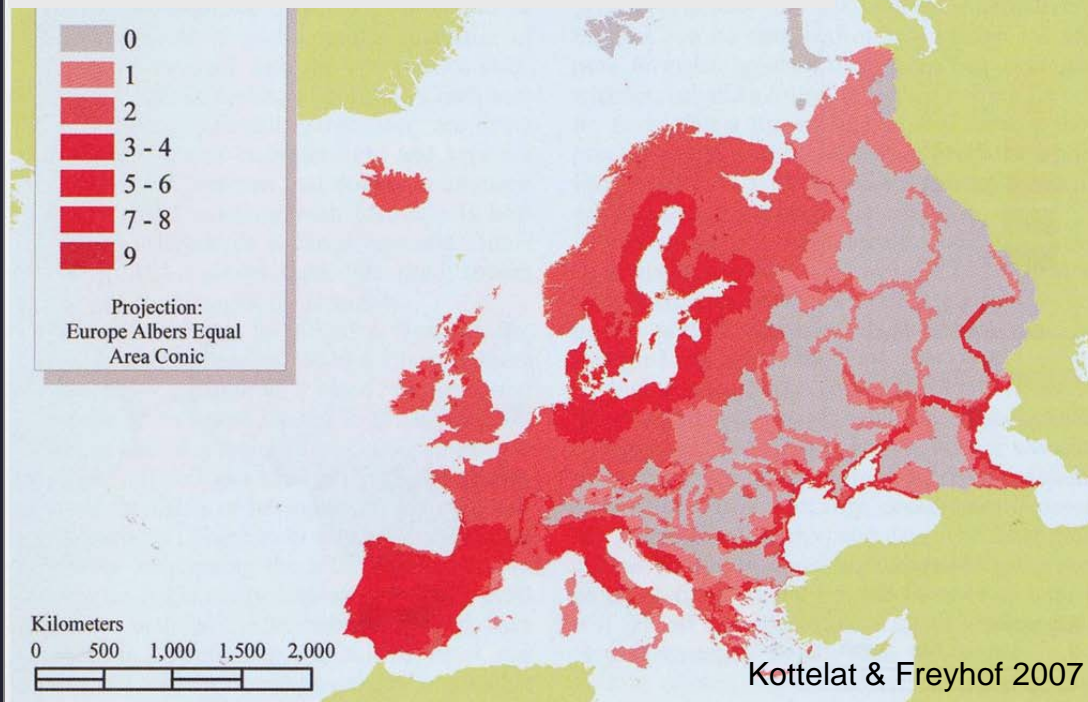
200 out of 522 of Europe's freshwater fish species are at risk for extinction

**60% of riverine species are endangered**

## Frequency of extirpated fish sp.



## Frequency of endangered fish sp.

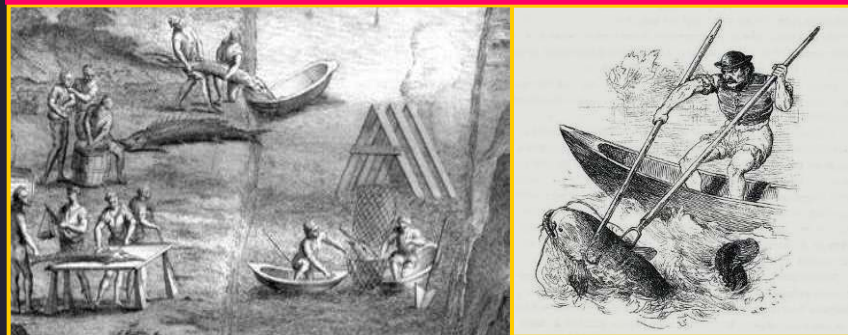
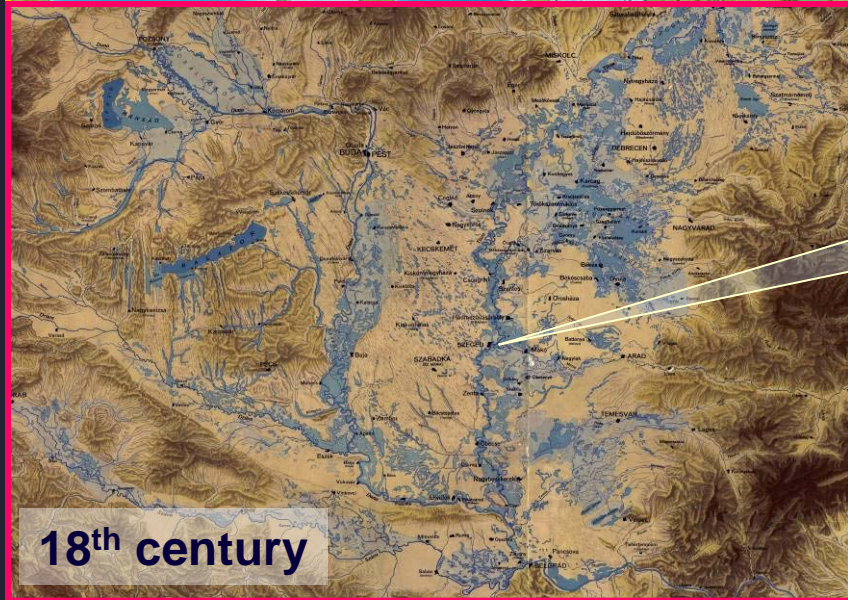


frequency of endangered fish species is positively related to indicators of “human activity”

- GDP,
- population density,
- percentage of urban area



# Fish abundance – indicator of river ecosystem functions



Pre-regulation period

**Extensive river-floodplain system**

(original floodplain area: 38.500 km<sup>2</sup>)

→ **high fish abundance**

↓  
**Fishery** – important role  
in nutrition of human population

14<sup>th</sup> century

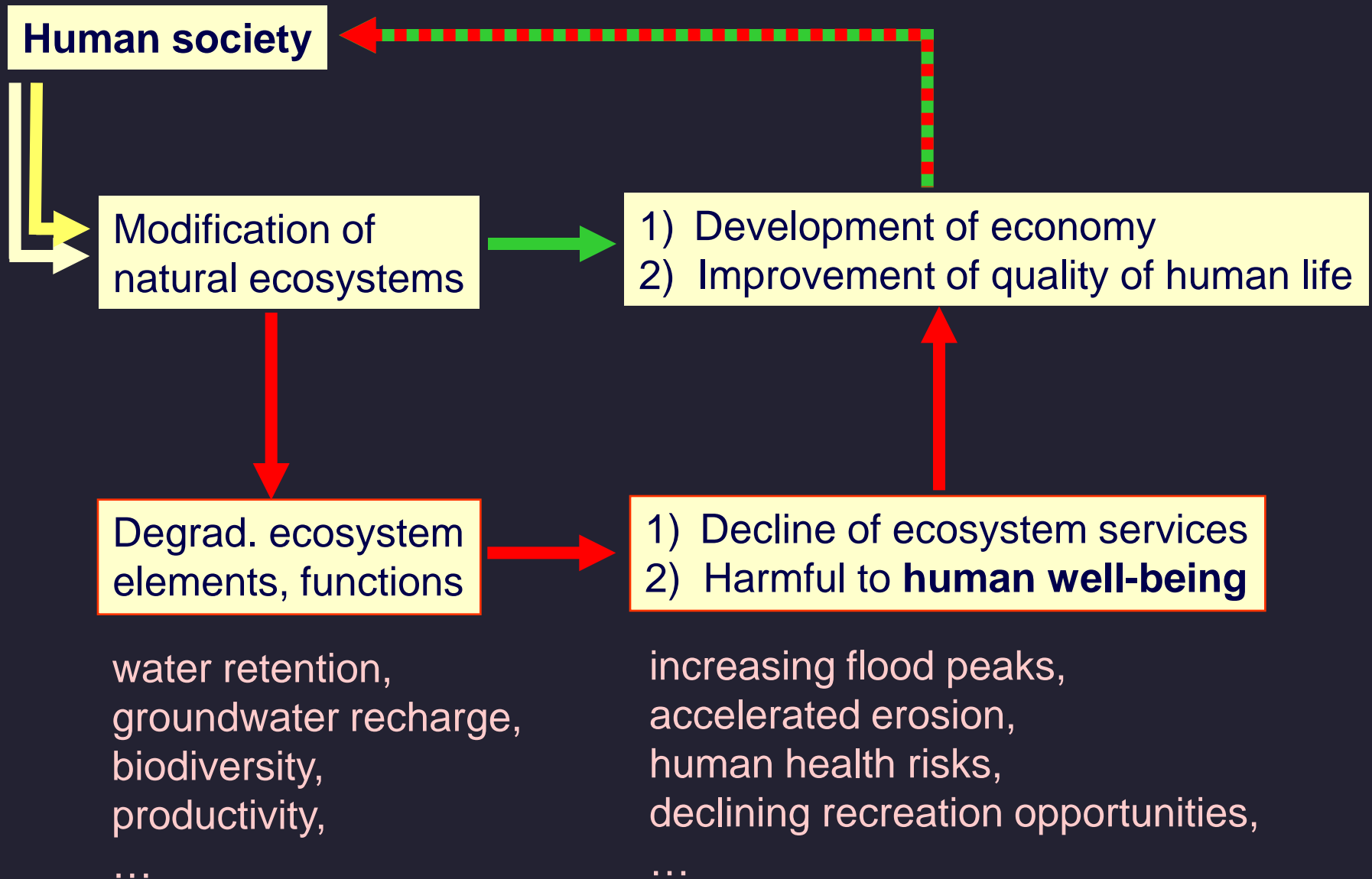
4000 registered fishermen only in Szeged



**active floodplains were reduced by >90%**  
(IUCN 1995)

↓  
**Catch of river fishery declined – 99%**  
(Répássy 1914)

# Statements of Millennium Ecosystem Assessment (2005)





# Sustaining of ecosystem integrity

Recognition of human dependence on ecosystems



Restoring ecological integrity  
policy goal

Human population density  
– restoring pristine state is impossible

Integrative policy is needed with consideration:

- Degradation of ecosystems
- Economic needs of growing human population
- Social needs of human population

What types of measures can provide sustainable ecosystem integrity, in the context of balancing social, economic and environmental needs?

# Restoration strategy of large rivers – (according to Jungwirth et al. 2002)

**EU WFD**

## Status quo assessment

### Water management

Flood protection  
Navigability improvement  
River engineering, ...

### Ecology

Hydro-morphology  
Landscape, habitats  
Flora, fauna, ...

## Status quo evaluation

Assessment of ecosystem deficits

## Target vision

Delineation environmental objectives  
Consideration existing constraints

## Restoration program

## Monitoring program

Evaluation of restoration or rehabilitation measures

## Historical reference conditions

Pre-regulation system, ecology

## Framework conditions

**Land use**

**Water utilization**

**Urban areas**

**Legal aspects**

Water Framework Directive,  
FFH Directive, ...



# Problems of evaluation of ecological status

ecol.status one of the focal points of the WFD

implementation of assessment methods on the Danube

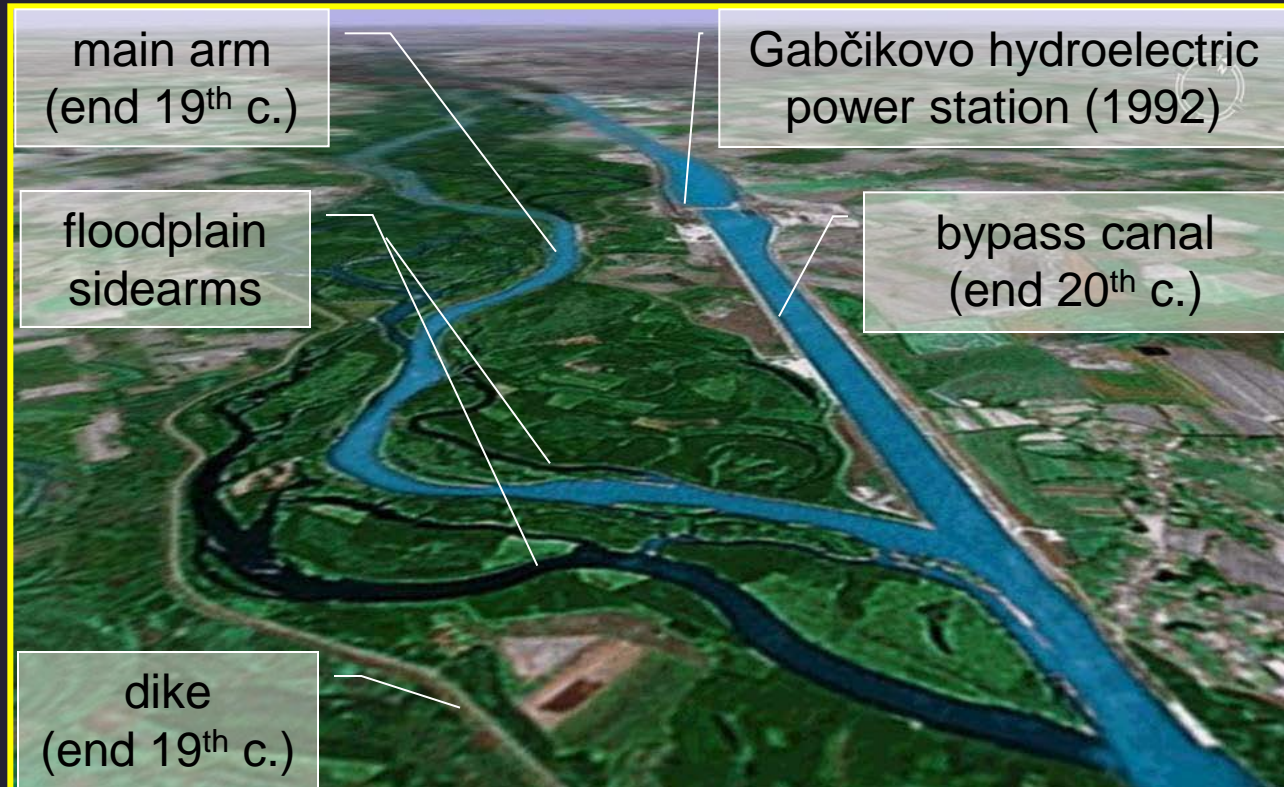
**19<sup>th</sup> century:**

**River engineering**  
navigation way,  
flood protection works

**1992**

**Discharge diversion**  
(85%),  
Hydrower station

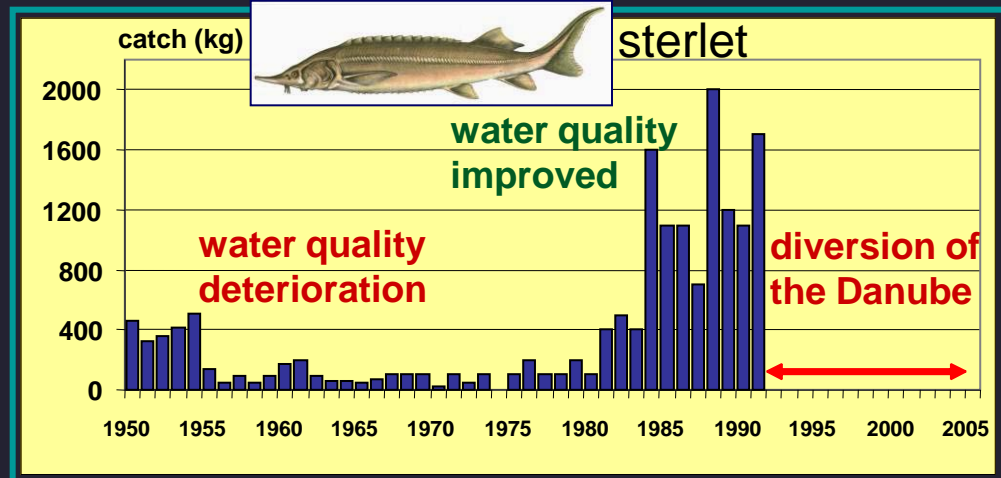
**Intense human  
modifications**





# Problems of evaluation of ecological status

Ecological degradation  
in the Szigetköz



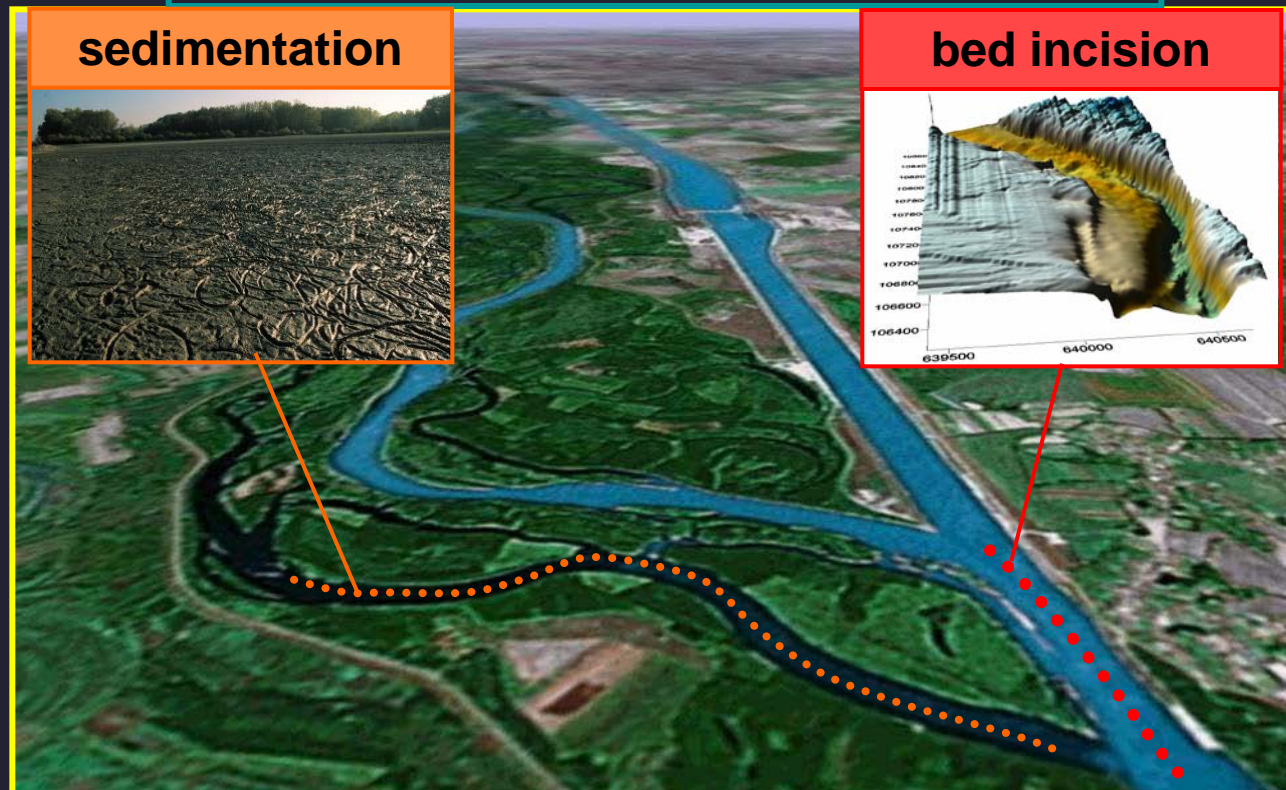
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(85%),  
Hydrower station

**Intense human  
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# Problems of evaluation of ecological status

Morphological, ecological changes indicate alterations

Evaluation of ecological status by biotic metrics – WFD

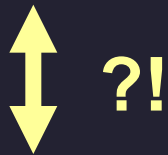
vt-VOR NAME	AEP443 Rajka - Gönyü
average of phytobenthos grade	3,9
phytobenthos grade by expert judgement	4,0
confidence of the phytobenthos grade	3,0
average of phytoplankton grade	5,0
confidence of the phytoplankton grade	2,2
average of macroinvertebrate grade	3,6
maximum of macroinvertebrate grade	5,0
confidence of the macroinvertebrate grade	2,0
average of fish grade	3,2
maximum of fish grade	4,0
confidence of the fish grade	3,0
physico-chemical grade	4
confidence of the physico-chemical grade	3
<b>Integrated grade (weighted average)</b>	<b>3,9</b>

Limitations of the recent

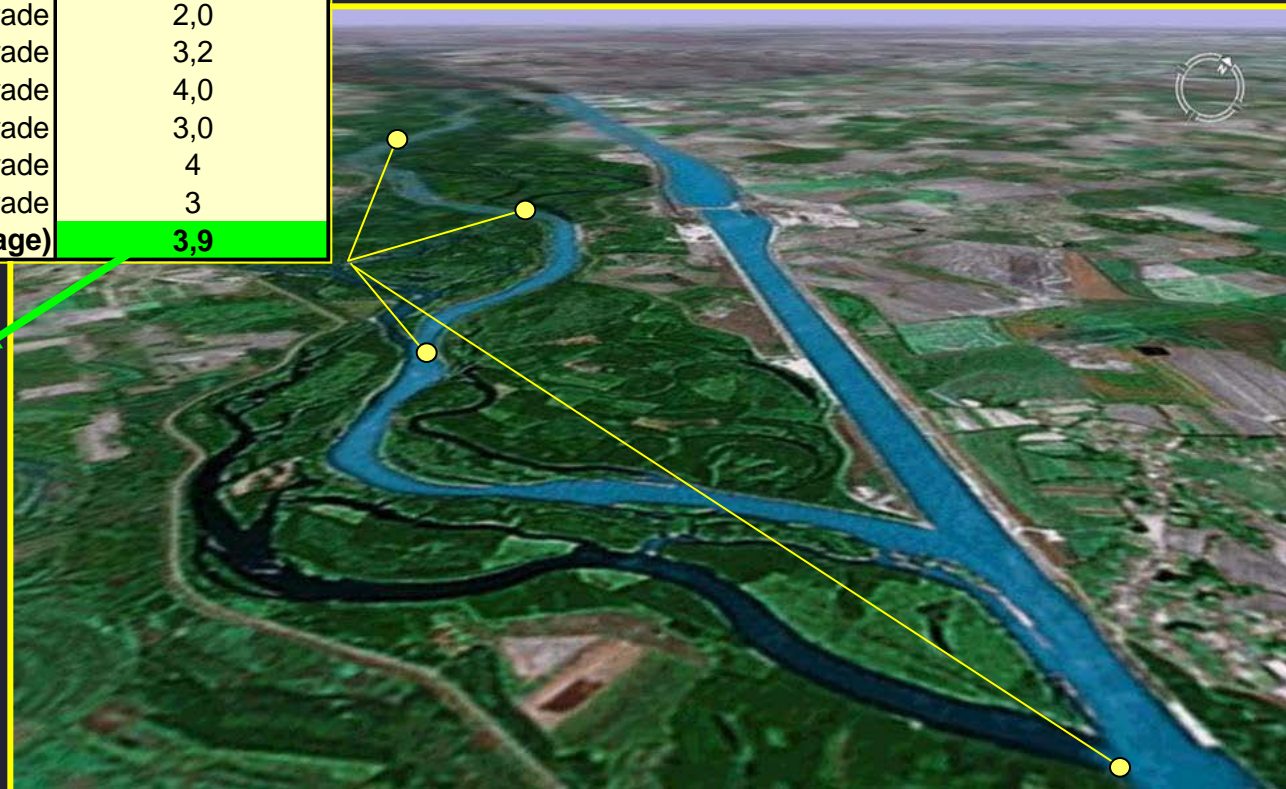
WFD assessment on the Danube:

- **Historical reference data neglected**
- **Lateral connectivity is ignored**

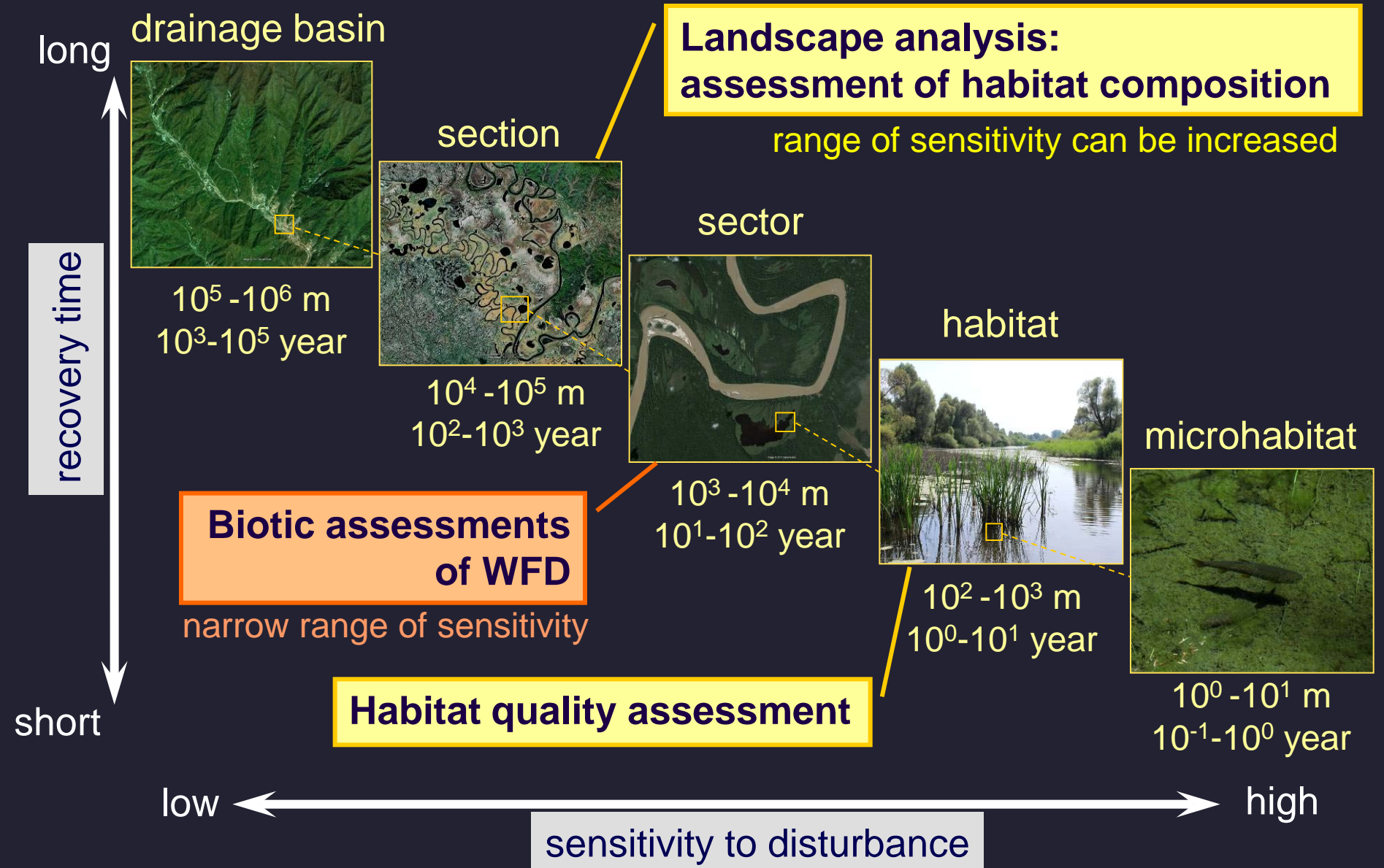
ecological status:  
**good**



**Intense human  
modifications**



# Preliminary benchmarking for large lowland rivers:



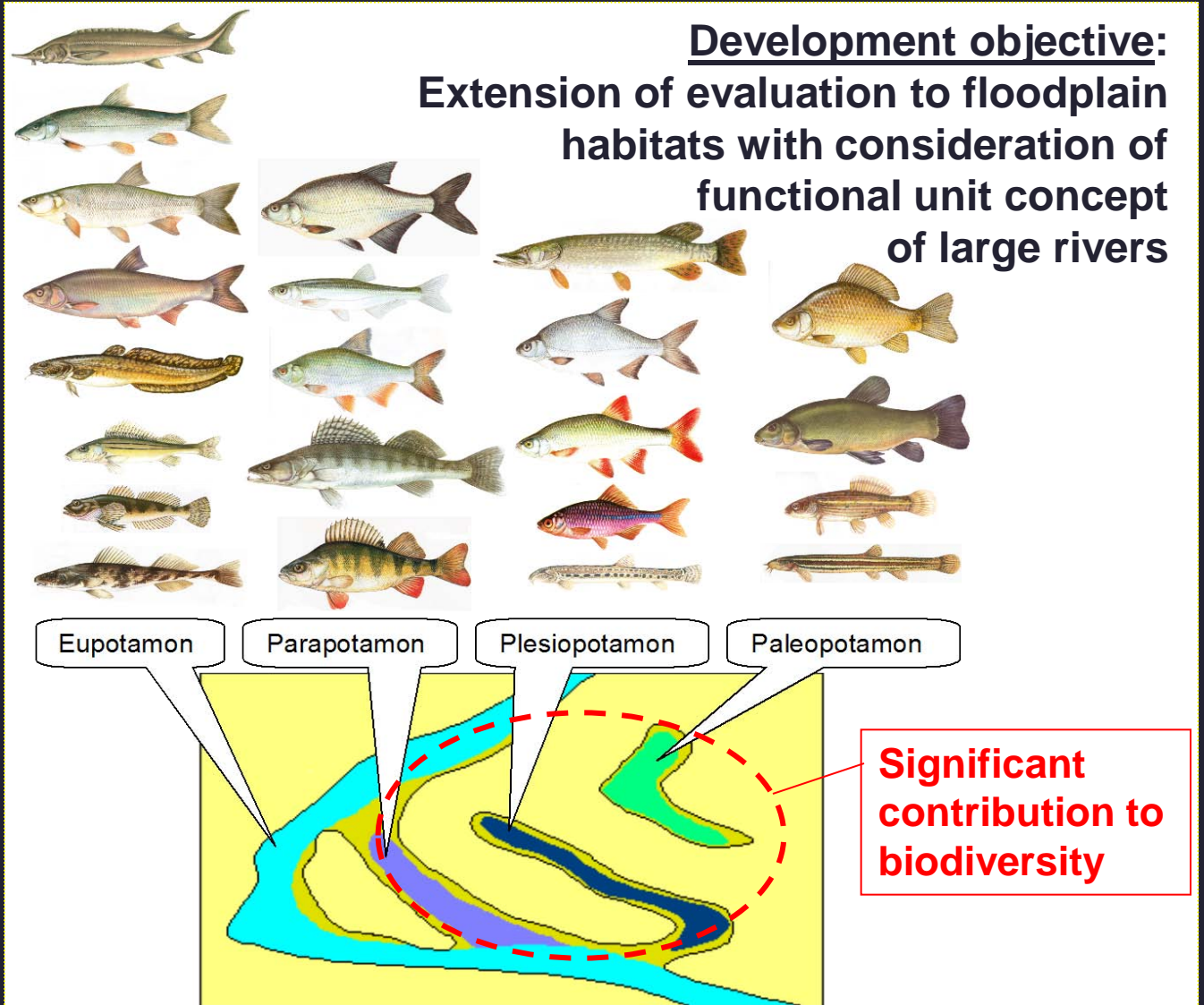
Hierarchical organization of river system in relation to sensitivity and recovery time



# Assessment of habitat composition



Lateral interactions – key element of ecol. integrity  
Recent assessment is focused on the main stream  
Functions of lateral connectivity are not evaluated

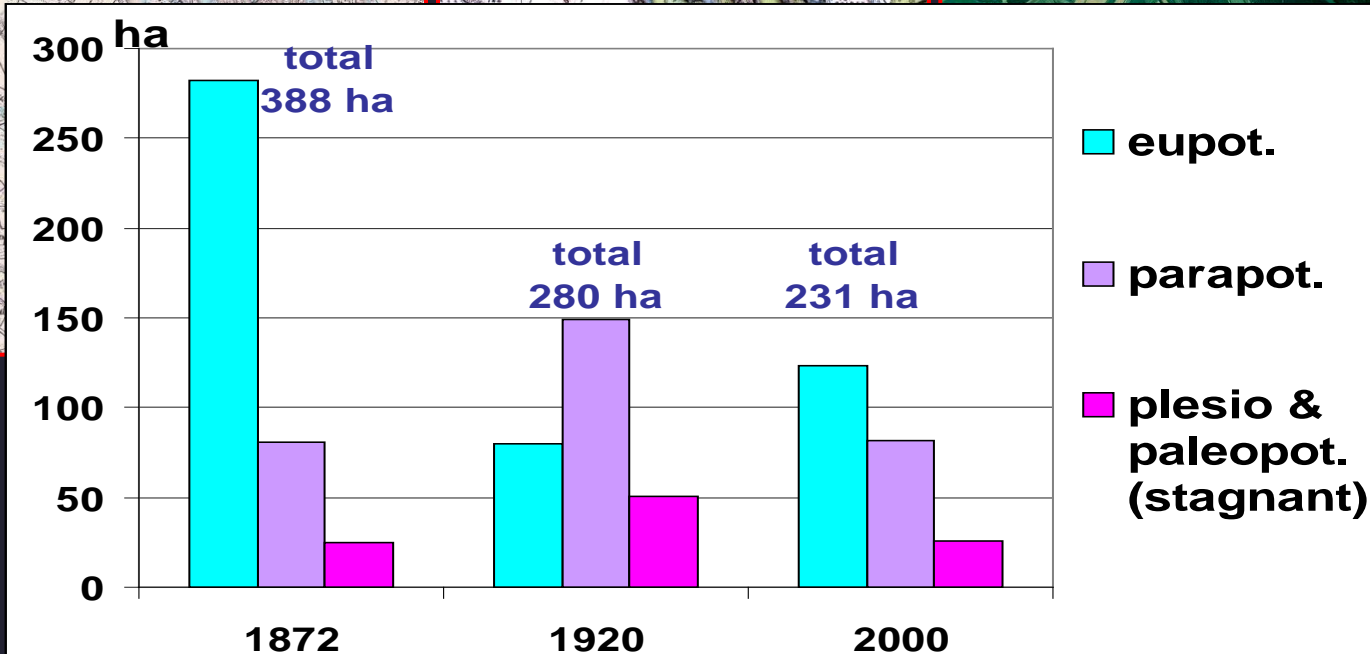
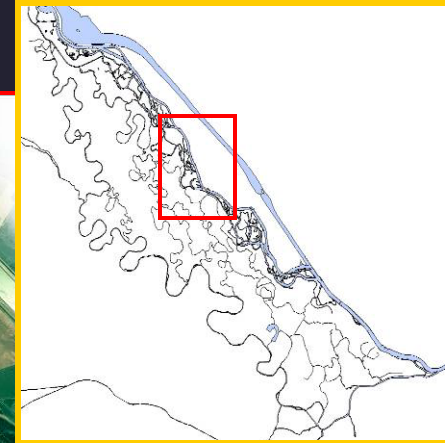
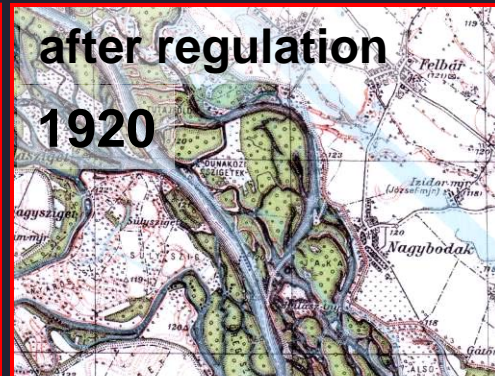


# Analysis of historical habitat changes

Description of reference conditions for evaluation is central question of EA

Natural reference sections are not available

- Historical habitat analysis has growing importance



study reach:  
15 km



# EU Danube Region Strategy

Improvement of hydro-ecological benchmarking relevant to EDRS

**EU – Danube – Black Sea – Central Asia**  
**New opportunities for**  
**development of sectoral policies**

**socio-economic development**  
**competitiveness**  
**environmental management**  
**modernisation of transport corridor**



**Decline of biodiversity**  
**Alteration of natural ecosystem**

**Environmental protection**  
**Sustainable utilization approach**

**Investment in environmental research**  
**to identify and develop new tools for**

- improvement ecosystem integrity
- reduce human pressure

**Management of sustainable utilization**  
**requires effective measures:**  
**Management tools are currently at**  
**various stages of development**

**Goal of sustainable utilization**



Thank you for your attention!

