Water Framework Directive implementation

Capacity Building Workshop

Toward River Basin Characterisation

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Content

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2. Monitoring strategies
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1. Report from last workshop

General WFD issues

- The bird and fish perspectives
  - Good status for water bodies
  - Sustainable development of the basin
- Robust science and citizens' engagement for developing new solutions

EU experiences

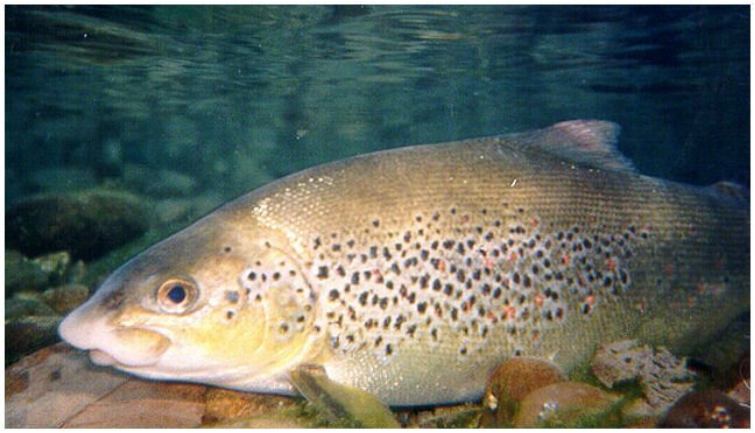
- Half of all water is not managed sustainable
- New water management issues are
  - Availability of sufficient space and water to ensure functioning aquatic ecosystems
  - Uncertainty of integrated environmental assessments
- "Old issues" of chemical and organic pollution remain important
- *Countries with natural rivers left are on the way to loose them, countries who lost them already try to restore them….*

Your situation

- Challenge to implement WFD based water management
  - Lack of capacities and missing data
  - Permitting and licensing procedures lacking
  - Difficult cooperation between regions
- Different starting point then “old” EU countries
  - Favourable environmental conditions and rather good water quality
  - Low level of general deterioration of ecosystems
- Similar starting point then “old” EU countries 30 years ago
  - Intensive hydropower
    - serious degradation and natural river character lost similar to the old European centres of industrialisation.
    - endemic fish species threatened
  - Insufficient waste water management
    - Bathing in the river is not safe, but saprobic index seems still ok

Key Species at risk?

Neretvanska Mekousna



Glavatica

Zubatak

2. Monitoring

- Principles of monitoring strategies
  - *You cant manage what you don't measure*
  - *But data alone do not produce knowledge*
  - Therefore
    - *Define objectives first:*
      - *protection and restoring the good status*
      - *Achieving sustainable water management*
    - *Apply risk based approach*
      - *Use existing information to identify water bodies at risk of failing good status*

➢ *River Basin Characterisation comes before designing monitoring programmes*

- Three types of monitoring
  - Surveillance – to validate the characterisation, pressure and impact assessments, detect long-term trends;
  - Operational – to help classify those water bodies which are at risk of failing to meet ‘good status’
  - Investigative – to ascertain the cause and effects of a failure to meet ‘good status’ where it is not clear.

Surveillance – the bird's view

- Once for each management cycle (6 years)
- For parameters indicative for all
  - Biological quality elements;
  - Hydromorphological quality elements;
  - Physico-chemical (including organic pollutants) quality elements;
  - Priority and priority-hazardous substances.
- Site selection:
  - Are sufficient sites being monitored to:
    - 1) Represent all pressures in the River Basin District?
    - 2) Assess long term trends at reference sites?
    - 3) Assess long term trends from wide-spread anthropogenic activities?
  - Minimum criteria for site selection
    - Significant water flow (catchment is greater than 2 500 km2)
    - Significant volume (Large lakes and reservoirs)
    - Significant water bodies cross state boundary
    - Pollutant transfers across state boundaries and into the marine environment

Operational – the fish perspective

- To be done for water bodies at risk
  - When is a water body at risk? E.g. current information indicates the possibility of
    - a significant negative impact on a quality element (e.g. oxygen, fish)
    - A significant pressures expected to have a significant negative impact (dam, untreated waste water)
- Assess parameters indicative of the quality elements most sensitive to the identified pressures
  - One out - all out principle

Table 4. Quality elements sensitive to the pressures affecting rivers

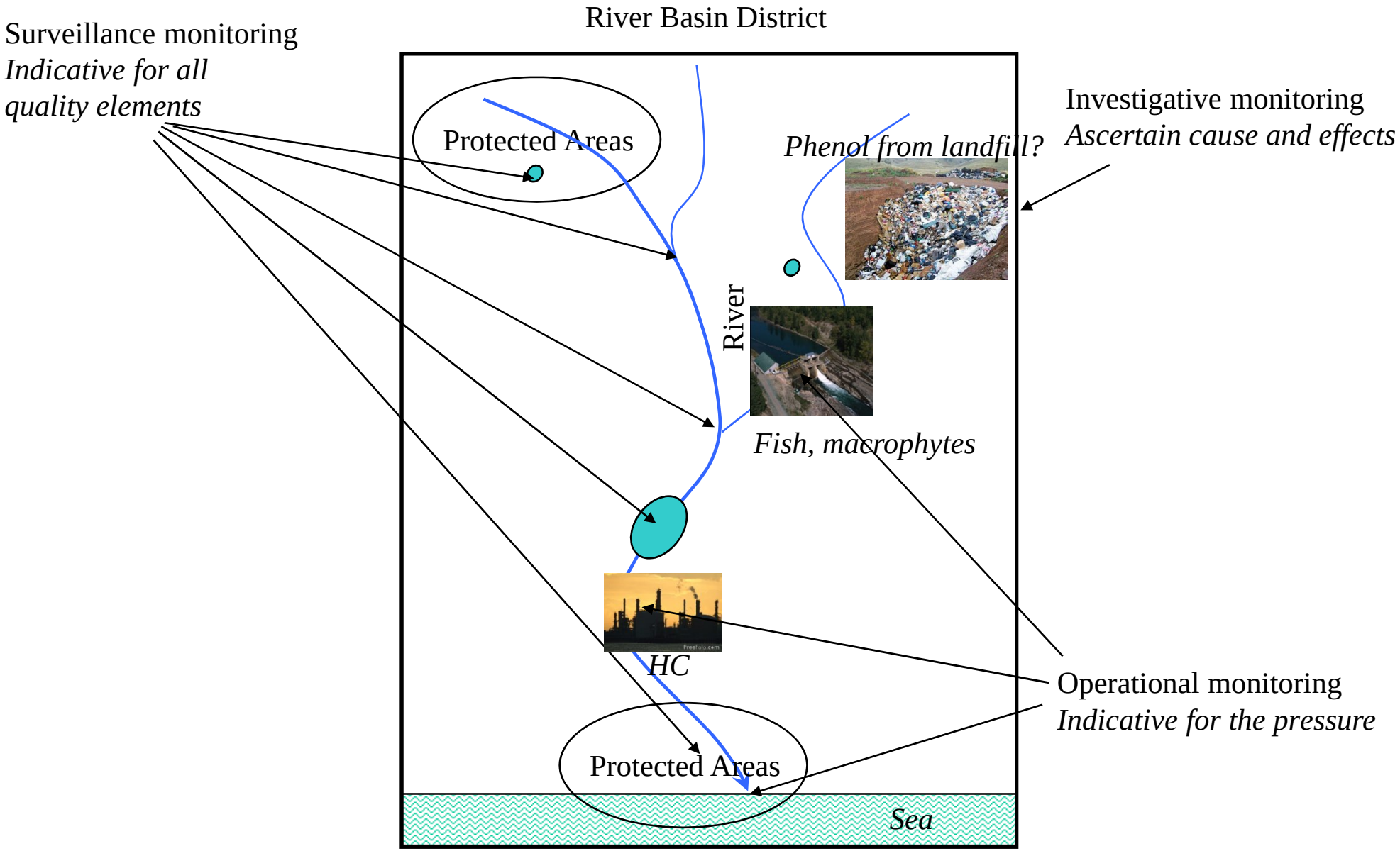
SOURCE PRESSURE	CATEGORY OF EFFECT	EXPOSURE PRESSURE	MACROPHYTE	PHYTOBENTHOS	MACRO-INVERTEBRATES	FISH	MORPHOLOGY	HYDROLOGY	GENERAL PHYSICO-CHEMICAL	SPECIFIC POLLUTANTS	PRIORITY SUBSTANCES	PRIORITY HAZARDOUS SUBSTANCES
NUTRIENT ENRICHMENT	Primary effect on biology	Change in nutrient concentration in defined water body. Enhanced biomass, changes to other primary producers	X	X				X	Nutrient suite			
ORGANIC ENRICHMENT	Primary effect on biology	Increased organic enrichment; change in biological community structure			X			X	Organic suite			
ANNEX 8 AND ANNEX 10 POLLUTANTS	Primary effects on sediment and water quality	Increased concentrations of contaminants (water column and sediments)			X			X	General suite	X	X	X
HYDROLOGICAL	Primary effect on biology	Changed water levels from abstraction; altered flow regime impacting biology	X	X	X	X	X	X	General suite			
MORPHOLOGICAL	Primary effect on biology	Riparian and channel modification, Altered sediment characteristics (e.g. size), smothering and damage to river bed	X		X	X	X	X				
ACIDIFICATION	Primary effect on biology	Change in ANC & Ph; change in biological community & toxicity synergies		X	X	X			Acidification suite			

Table 3.1 Key features of each biological quality element (QE) for rivers

Aspect/feature	Benthic invertebrates	Macrophytes	Benthic Algae	Fish	
Measured parameters indicative of QE	Composition, abundance diversity, and presence of sensitive taxa.	Composition and abundance , and presence of sensitive taxa	Composition and abundance, , and presence of sensitive taxa	Composition and abundance, sensitive species diversity, age structure,	Compo plankto of sens
Supportive/interpretative parameters measured or sampled at the same time	Morphology, physico-chemical parameters (e.g. Temp/DO, nutrients, pH etc), river flow, substrate/habitat sampled	Morphology, river flow, depth, transparency	Substrate/habitat sampled, morphology, nutrients (N, P, Si), TOC, pH, hydrological regime, light conditions	Substrate/habitat sampled, river size (depth/width), river flow, temp, oxygen	Chloroc chemio DO, N,
Pressures to which QE responds	Mainly developed to detect organic pollution or acidity, can be modified to detect full range of impacts.	Mainly used to detect eutrophication, river dynamics including hydropower effects.	Mainly used as an indicator of productivity. Can be used to detect eutrophication, acidification, river dynamics.	Can be used to detect habitat and morphological changes, acidification and eutrophication.	Used a produc
Mobility of QE	Low, although unfavourable conditions may cause drift	Low. Generally fixed position.	Low	High. Tendency to avoid undesirable conditions (e.g. low oxygen conditions).	High. D
Level and sources of variability of QE	High seasonal variation in community structure. Influenced	High seasonal variation in community structure and	High seasonal variation in community structure. Limited by	High seasonal variation in community structure (e.g.	High in variatio
	• Presence of exotic species in some EU rivers.				
Conclusions/ Recommendations	This QE is best developed in EU and hence it is recommended as one of the key elements for monitoring especially for organic pollution.	Under certain hydrological conditions this QE is not suitable. However, in good conditions it can give a robust assessment.	Recommended, particularly for assessment of trophic status.	It is recommended as one of the key elements for monitoring for habitat and morphological changes. Further work required for assessing the impact of pollution on fish populations.	On slo

Table 5. Quality elements sensitive to the pressures affecting lakes

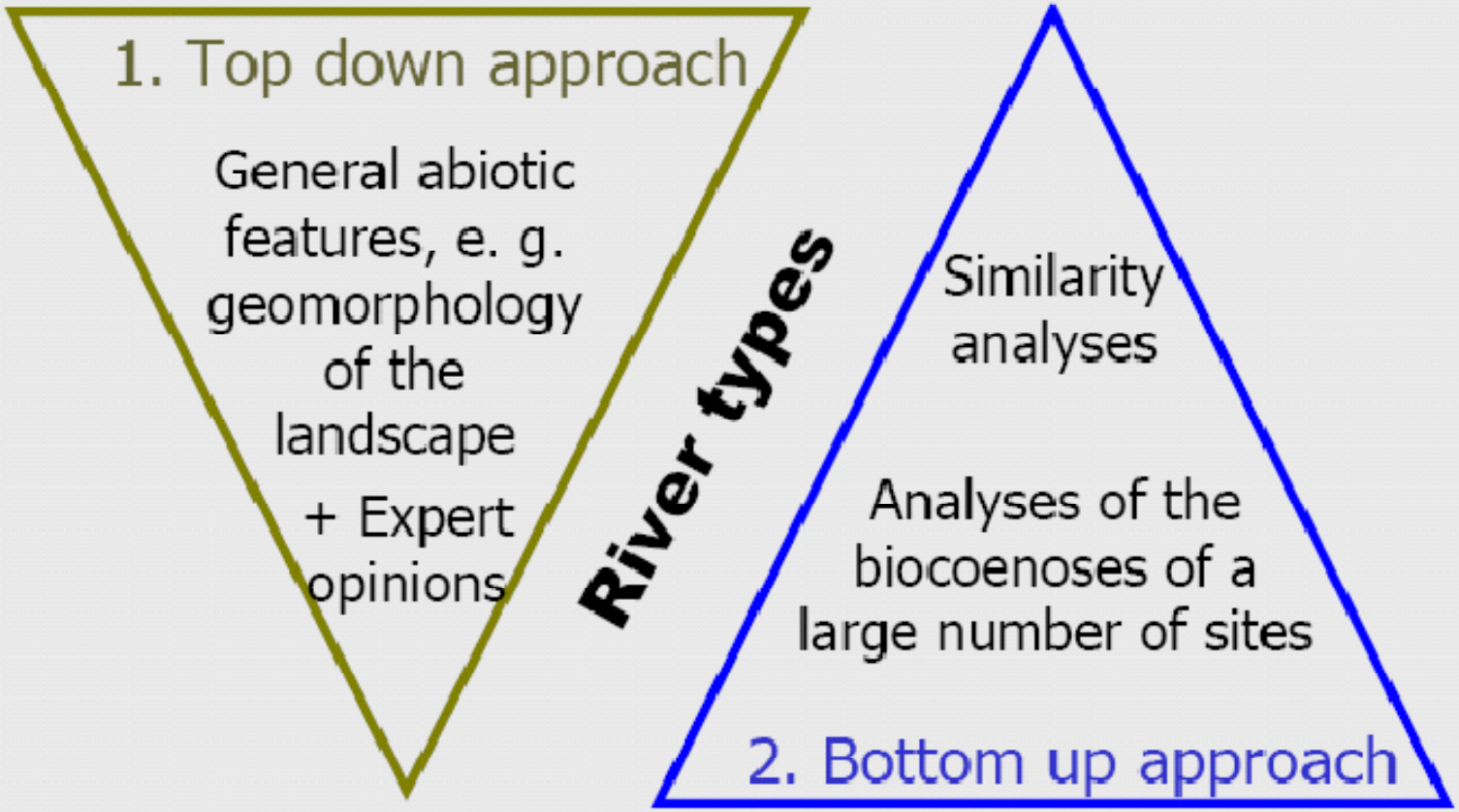
SOURCE PRESSURE	CATEGORY OF EFFECT	EXPOSURE PRESSURE	PHYTOPLANKTON	MACROPHYTE	PHYTOBENTHOS	MACRO-INVERTEBRATES	FISH	MORPHOLOGY	HYDROLOGY	GENERAL PHYSICO-CHEMICAL	SPECIFIC POLLUTANTS	PRIORITY SUBSTANCES	PRIORITY HAZARDOUS SUBSTANCES
NUTRIENT (& ORGANIC) ENRICHMENT	Primary effect on biology	Change in nutrient concentration in defined water body. Enhanced biomass, changes to other primary producers	X	X	X				X	Nutrient suite			
ANNEX 8 AND ANNEX 10 POLLUTANTS	Primary effects on sediment and water quality	Increased concentrations of contaminants (water column and sediments)				X			X	General suite	X	X	X
HYDROLOGICAL	Primary effect on biology	Changed water levels from abstraction; altered flow regimes impacting biology; concentration of nutrients	X	X		X		X	X				
MORPHOLOGICAL	Primary effect on biology	Shoreline and channel modification, altered sediment characteristics (e.g. size), smothering and damage to river bed		X		X		X	X				
ACIDIFICATION	Primary effect on biology	Change in ANC & pH; change in biological community & toxicity synergies			X	X	X		X	Acidification suite			


River Basin District
Surveillance monitoring
Indicative for all quality elements
Protected Areas
Phenol from landfill?
Investigative monitoring
Ascertain cause and effects
River
Fish, macrophytes
HC
Operational monitoring
Indicative for the pressure
Protected Areas
Sea

3. Reference conditions

- No clear tested method available
- Availability of natural sites, data and expertise decides what is the best approach
- Note
  - Reference conditions have to be established for each water type separately

Two methodological approaches to develop a typology



Advantages and disadvantages of Top down / Bottom up approaches

Top down approach...

- Only a few abiotic data needed for the development of typologies
- Easily and fast to develop (weeks – months)
- BUT: Types not necessarily biological meaningful

Bottom up approach ...

- Requires large biotic and abiotic data sets from reference sites
- Typology depends on availability of data and quality of sites
- Types biologically meaningful
- BUT: Development time-consuming (up to several years...)

- Step wise approach to establishing reference conditions

1. Investigate pristine water bodies (apply a pressure screening to select sites – see check list below; and cross check with saprobic index map or other parameters, i.e. BOD, and morphological classification)
   - *If no pristine water body or sufficient data are available (which is often the case for large, low-land rivers)*
2. Use data of neighbouring regions, i.e. from Croatia or Slovenia
   - *If not available*
3. Use historical data or models, as last resort only (presumably sufficient sites with reference conditions should be available on the Balkan)
   - *If not available and in addition to 1-3*
4. Use expert judgment

Pressure screening criteria for selecting potential reference sites or values

	High ecological status
General statement	•High status or reference conditions is a state in the present or in the past corresponding to very low pressure, without the effects of major industrialisation, urbanisation and intensification of agriculture, and with only very minor modification of physico-chemistry, hydromorpology and biology.
Diffuse source pollution	
Land-use intensification: Agriculture, forestry	•Pre-intensive agriculture or impacts compatible with pressures pre-dating any recent land-use intensification.
	•Pressures pre-dating any recent intensification in airborne inputs that could lead to water acidification.
Point source pollution	
Specific synthetic pollutants	•Pressures resulting in concentrations close to zero or at least below the limits of detection of the most advanced analytical techniques in general use (A Selection process for relevant pollutants in a river basin is presented as an example of best practice in section 6 of the guidance document from Working Group 2.1, IMPRESS).
Spec. non-synthetic pollutants	•Natural background level/load (see reference above)
Other effluents/discharges	•No or very local discharges with only very minor ecological effects.

Morphological alterations	
River morphology	• Level of direct morphological alteration, e.g. artificial instream and bank structures, river profiles, and lateral connectivity compatible with ecosystem adaptation and recovery to a level of biodiversity and ecological functioning equivalent to unmodified, natural water bodies
Lake morphology	• Level of direct morphological alteration, eg. structural modifications that hinder fluctuations of the water surface, compatible with ecosystem adaptation and recovery to a level of biodiversity and ecological functioning equivalent to unmodified, natural water bodies
Water abstraction	
River and lake water abstraction	• Levels of abstraction resulting in only very minor reductions in flow levels or lake level changes having no more than very minor effects on the quality elements.
Flow regulation	
River flow regulation	• Levels of regulation resulting in only very minor reductions in flow levels or lake level changes having no more than very minor effects on the quality elements.
Riparian zone vegetation	
	• Having adjacent natural vegetation appropriate to the type and geographical location of the river.
Biological pressures	
Introductions of alien species	• Introcuctions compatible with very minor impairment of the indigenous biota by introduction of fish, crustacea, mussels or any other kind of plants and animals. • No impairment by invasive plant or animal species.
Fisheries and aquaculture	• Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends • Stocking of non indigenous fish should not significantly affect the structure and functioning of the ecosystem.. • No impact from fish farming.
Biomanipulation	• No biomanipulation.
Other pressures	
Recreation uses	• No intensive use of reference sites for recreation purposes (no intensive camping, swimming, boating, etc.)

4. Preliminary pressures and impacts screening

- Clear indication that a number of pressures are having a significant negative impact
- But inconclusive to determine level of risk and certainties
  - Impact information missing to judge exact level of impact
    - Untreated sewage water but saprobic index indicates good condition
      - Is this now a a slight or a moderate deviation from reference condition? How is the reference condition defined?
    - Hydropower presents a significant loss of habitat and prevents migration of endemic trout species
      - How far are endemic species endangered?
  - Pressure information missing due to lack of inventories and licensing
    - Phenol concentrations in in surface water above EQS
      - But source not clearly identified?

Categories	Drivers	Pressure			Impact	Information sources	Preliminary risk assessment	Next steps
		Significant?						
		Basin	*WB*	*explain*				
1. Hydrology								
abstractions	domestic water supply	unlikely	likely	12 mill m3/year. Less then 0.1% of annual discharge	NA	WWF, InterSus 2008	some water bodies likely to fail	MEDIUM PRIORITY: Need inventory of abstractions and to investigate impact of abstraction on small tributaries during low flow
	industry water supply	unlikely	likely	3 mill m3/year. Less then 0.035% of annual discharge	NA	WWF, InterSus 2008		
	Agriculture irrigation	unlikely	likely	17 mill m3/year. Around 0.13% of annual discharge	NA	WWF, InterSus 2008		
	Power production	unlikely	likely	1 Thermal Power plant	NA	WWF, InterSus 2008		
flow regulations	Energy production	likely	Very likely	10 hydropower (1.5 GW). Lost connectivity, change of water flow, water category and sediment structure	NA	WWF, InterSus 2008	Many water bodies very likely to fail	HIGH PRIORITY: Need to gather pressure data, design operational monitoring
	domestic water supply	NA	NA	NA	NA	NA	no judgmenent possible	MEDIUM PRIORITY: Establish inventory of flow regulations
	industry water supply	NA	NA	NA	NA	NA		
	Agriculture irrigation	NA	NA	NA	NA	NA		

Categories	Drivers	Pressure			Impact	Information sources	Preliminary risk assessment	Next steps
		Significant?						
		Basin	*WB*	*explain*				
2. Morphology								
embankments, dykes and dams	Flood protection / land take for settlements and agriculture	NA	NA	Several cities and villages along the River Neretva	NA	Own observation	no judgmenent possible	MEDIUM PRIORITY: Inventory using GIS land use data
	Energy production	likely	Very likely	10 hydropower (1.5 GW). Lost connectivity, change of water flow, water category and sediment structure	NA	WWF, InterSus 2008	Many water bodies very likely to fail	HIGH PRIORITY: Need to gather pressure data, design operational monitoring
	Transport	NA	NA	NA	NA	NA	no judgmenent possible	MEDIUM PRIORITY: Inventory using GIS land use data
river maintenance / dredging	Flood protection and transport	NA	NA	NA	NA	NA	no judgmenent possible	MEDIUM PRIORITY: Inventory using GIS land use data
drainage	Land take for agriculture	NA	NA	NA	NA	NA	no judgmenent possible	MEDIUM PRIORITY: Inventory using GIS land use data

Categories	Drivers	Pressure: Significant? Basin	Pressure: Significant? WB	Pressure: explain	Impact	Information sources	Preliminary risk assessment	Next steps
3. Pollution of surface water								
Industry	Aluminium, Electroplating	unlikely	likely	Discharge of Chromium, Zn, Ni	below EQS	AVP Jadr.mora Mostar	few water bodies likely to fail	LOW PRIORITY
	Energy production	unlikely	likely	1 Thermal Power plant	NA	WWF, InterSus 2008	few water bodies likely to fail	LOW PRIORITY: check temp changes
Urban	waste water	likely	very likely	only 43% of population connected, low level treatment	Phenol and microbiological pollution	AVP Jadr.mora Mostar	many water bodies likely to fail	HIGH PRIORITY: Describe waste water collection+ treatment and apply model
Agriculture		unlikely	likely	3% of land is farmed. No significant findings of copper, pesticides, nitrates pollution. But growth potential	below EQS	WWF, InterSus 2008 / AVP Jadr.mora Mostar	increasing number water bodies likely to fail	MEDIUM PRIORITY: Inventory of pesticide and fertiliser use
Fisheries	trout farms	very likely	very likely	several trout farms in stream. Use of antibiotics, introduction of alien species	NA	Own observation	many water bodies likely to fail	HIGH PRIORITY: Inventory of fish farms
diffuse sources	NA	NA	likely	for example landfill and uncontrolled small industrial activities	Phenol above EQS	Own observation	No information - need investigation	HIGH PRIORITY: Investigate source of phenol, check for other possible pollutants

Categories	Drivers	Pressure			Impact	Information sources	Preliminary risk assessment	Next steps
		Significant?						
		Basin	*WB*	*explain*				
4. Pollution of groundwater								
Industry	NA	NA	very likely	NA	phenols above EQS	NA	some water bodies likely to fail	HIGH PRIORITY: Investigate source of phenol and check for other possible pollutants
Urban	landfill	NA	very likely	NA	phenols above EQS	NA	some water bodies likely to fail	HIGH PRIORITY: Investigate source of phenol and check for other possible pollutants
Agriculture		unlikely	likely	3% of land is farmed, significant development potential	NA	WWF, InterSus 2008	increasing number of bodies likely to fail	MODERATE PRIORITY: Inventory of pesticide and fertilisers use, apply model
5. Groundwater abstraction&recharges	domestic water supply	unlikely	likely	Over 90% of total water abstracted in Neretva basin are groundwater resources	NA	WWF, InterSus 2008	increasin number water bodies likely to fail	MEDIUM PRIORITY: Need to develop inventory of groundwater abstractions
	industry water supply	unlikely	likely		NA	WWF, InterSus 2008		
	Agriculture irrigation	unlikely	likely		NA	WWF, InterSus 2008		

General findings

- Hydropower and fish farms
  - significant negative impact at river basin scale is likely
- Hydropower and urban waste water
  - Significant negative impact on several water bodies is very likely
- Industrial and urban activities (incl landfills)
  - Significant negative impact and several water bodies is very likely

Next steps

- High priority
  - Developing operational monitoring
    - Fish / macrophytes for hydropower and aquaculture impact
  - Intensive information gathering
    - To describe hydropower, waste water and fish farming pressures
    - To assess further impacts of land uses (mainly floodplain uses: for settlement, transport and agriculture)
  - Establish inventories of
    - Significant abstractions and flow regulations
    - Chemical uses, incl agri use of pesticides and fertilisers
    - ➢ *Model nutrients and pesticides flows*

Observations of the representatives of the Agency for Adriatic Sea watershed:

Pressures:

1. *unsolved problem of the sewerage system in all cities on river Neretva – there is a need of construction of sewerage system and WWTP; at the present time, all wastewater is discharges directly into the river;*

2. *industry and wastewater discharges without treatment;*

3. *uncontrolled usage of pesticides in agriculture;*

4. *excessive abstraction of groundwater on private properties in downstream of the river Neretva;*

5. *Illegal gravel extraction from the river;*

6. *salt water entering deep into the river (amount of chloride is twice as much then permitted);*

7. *hydro power plants have interrupted the natural water regime;*

8. *fish farms on the river are also the polluters;*

9. *illegal dumpsites of solid waste on the river banks;*

Observations of the representatives of the Agency for Adriatic Sea watershed:

Impacts:

1. *water-level oscillations have caused changes in morphology of the riverbed, it effects the existing water intakes and influences groundwater streams in karst area;*

2. *Unsanitary landfills have negative effects on the quality of groundwaters.*

5. Outline of guidance (to come)

4. Situation in the Neretva

4.1. Typology and reference conditions

To be done urgently,

4.2. Water body designation

4.2. Results of pressures and impacts screening

5. Strategies toward a robust characterisation

5.1. Typology and water body designation

5.2. Pressures and impacts assessment

6. Conclusion and recommendations

7. References