

Management of Rivers and coastal waters under the aspect of Ecologically oriented Engineering

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Contents

1. The European Water Framework Directive

2. Ecological features

- Long-term development in species richness of the rivers Elbe and Rhine
- The influence of the current regime on the ecology of animals in large rivers
- Morphological structures
- Compensation and remedial actions
- Fish migration in anthropogenic altered rivers

3. Bedload management at the river Rhine

- Artificial bedload supply
- Bedload withdrawal
- Overall concept for the river Rhine

4. Directive for the Handling of Dredged Material in Federal Coastal Waterways (HABAK-WSV)

Contents

1. The European Water Framework Directive

2. Ecological features

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- Morphological structures
- Compensation and remedial actions
- Fish migration in anthropogenic altered rivers

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- Bedload withdrawal
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The European Water Framework Directive, an example for water management in national and international river basins

WATER

a resource of limited availability

a key element of the ecosystem

transcending national borders

The European Water Framework Directive, an example for water management in national and international river basins

- legislative actions since 1975 for
- drinking waters (Directive 80/778/ECE),
- ground-waters (Directive 80/68/EEC),
- fish waters (Directive 78/659/EEC),
- shellfish waters (Directive 79/923/EEC),
- bathing waters (Directive 76/160/EEC),
- different dangerous substances Directives,
-
- in total 30 !

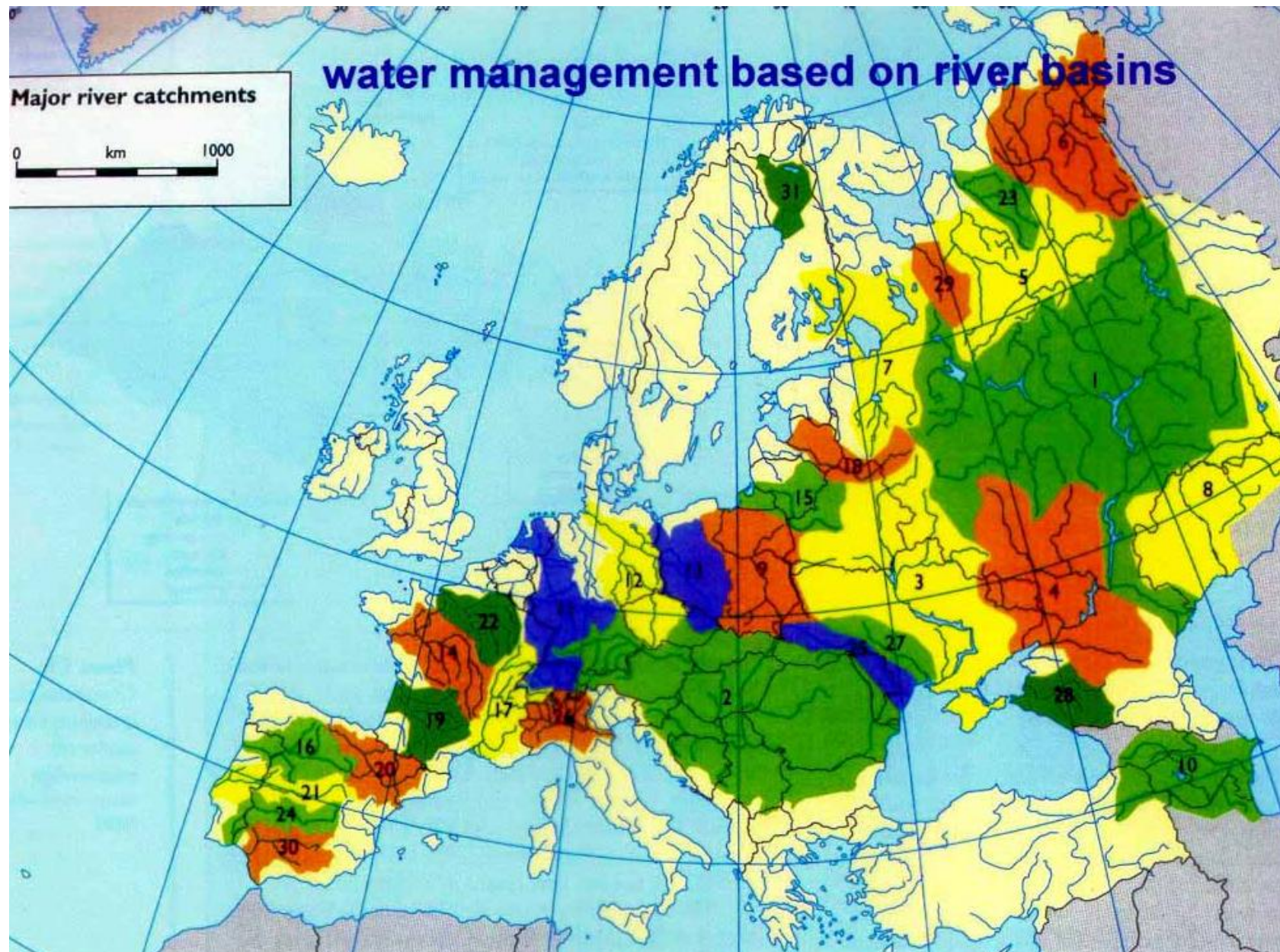
The European Water Framework Directive, an example for water management in national and international river basins

- expanding the scope of water protection to all waters
- achieving “good status” for all waters by a certain deadline
- “combined approach” of emission limit values and quality standards
- water quantity addressed
- getting the citizens involved more closely
- improved data and information management
- water management based on river basins

The European Water Framework Directive, an example for water management in national and international river basins

Expanding the scope of water protection

- to prevent further deterioration, and to protect and enhance the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;
- to promote sustainable water consumption based on the long term protection of available water resources;
- to contribute to the provision of a supply of water in the qualities and quantities needed for its sustainable use, and
- to aim at enhanced protection and improvement of aquatic environment through specific measures for the progressive reduction of discharges, emissions and losses of priority substances.



The European Water Framework Directive, an example for water management in national and international river basins

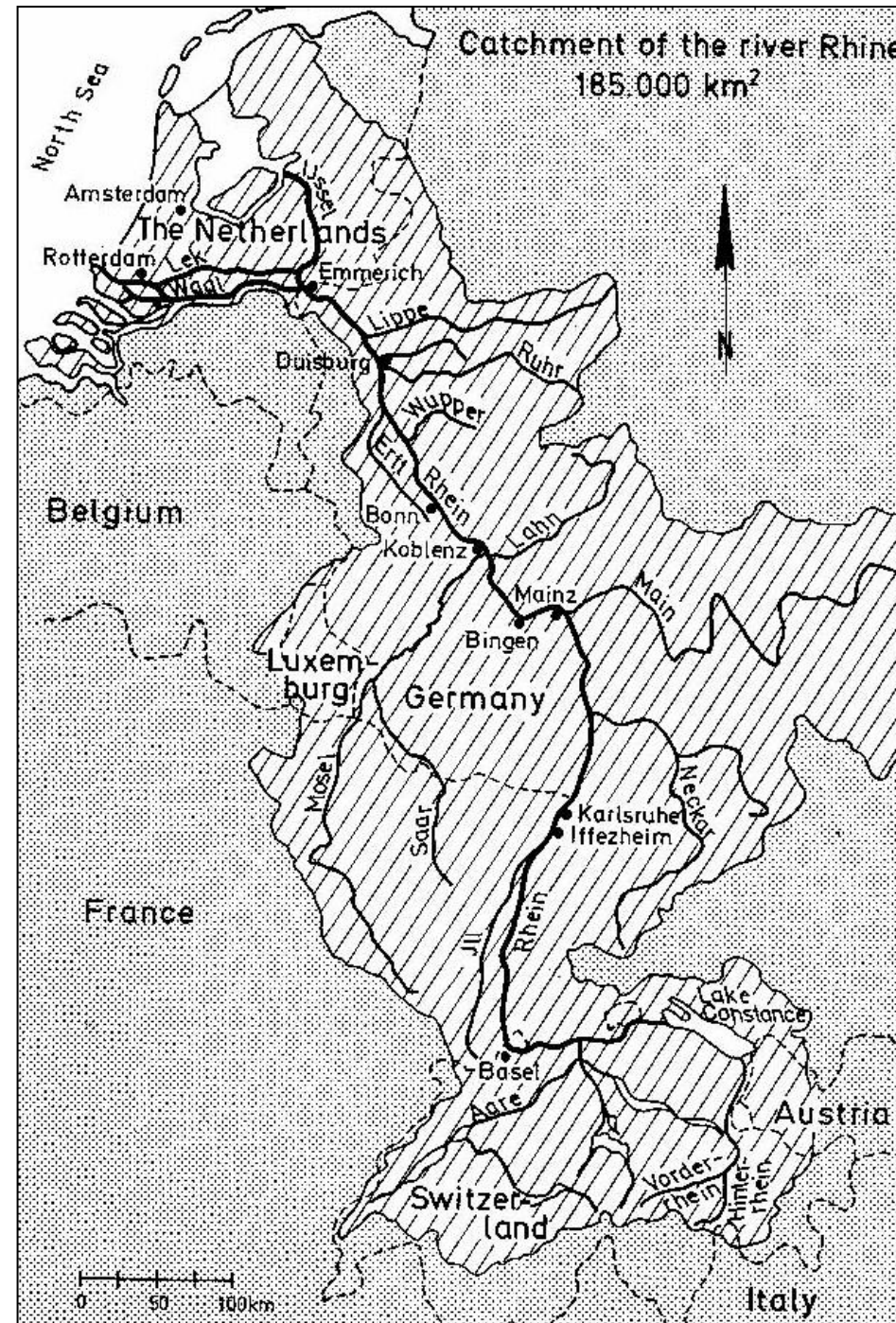
Water management based on river basins (1)

- One of the Framework Directive's innovations is that rivers and lakes will need to be managed by river basin – the natural geographical unit – instead of according only to administrative or political boundaries.
- Surface waters and groundwaters belonging to the same ecological, hydrological and hydrogeological system need to be treated as a unit and co-ordinated.
- It seems advisable to combine or join river basins with similar climatic, environmental and socio-economic conditions to form one individual river basin district.

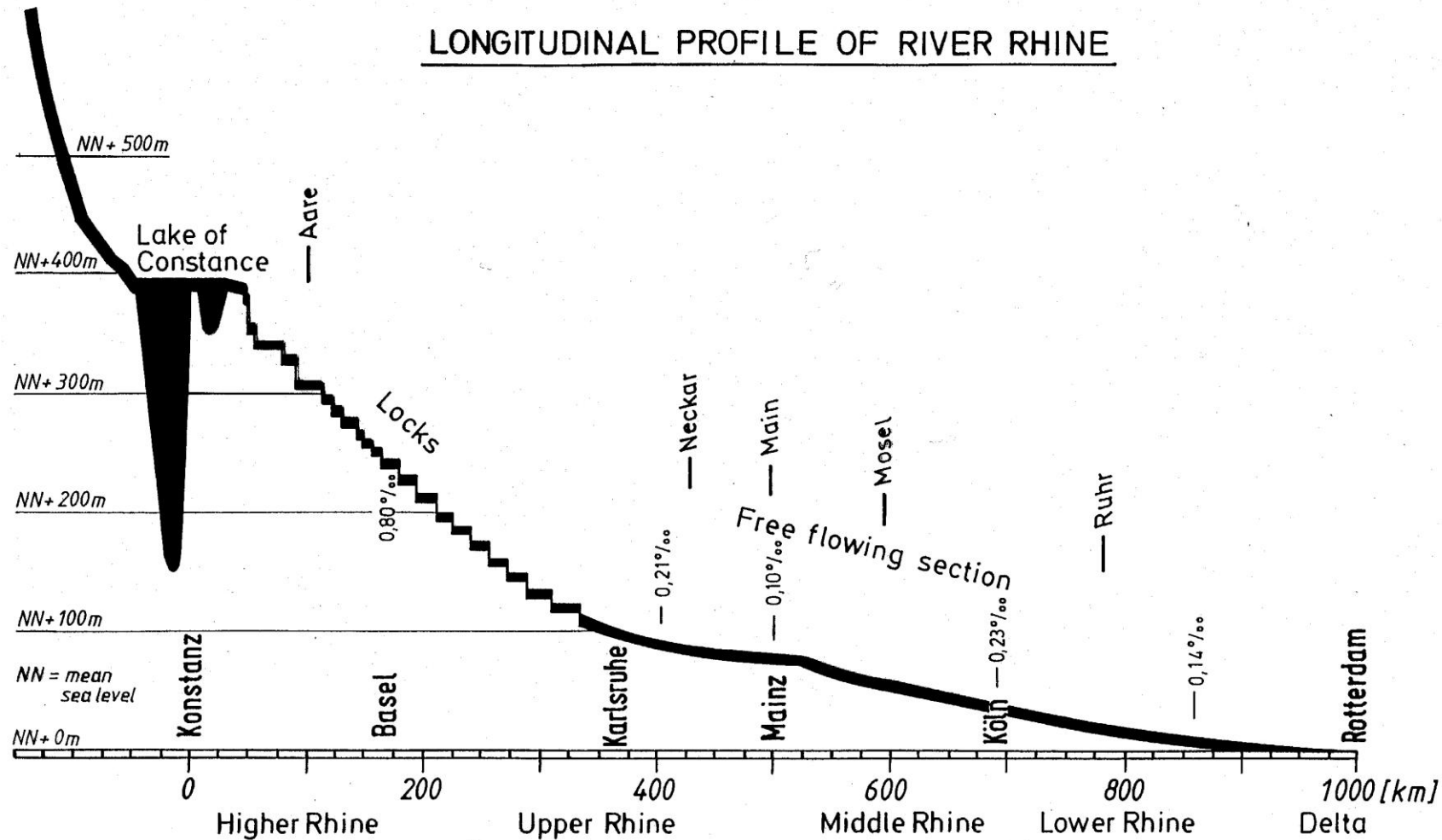
The European Water Framework Directive, an example for water management in national and international river basins

Water management based on river basins (2) River Basin Management Plan

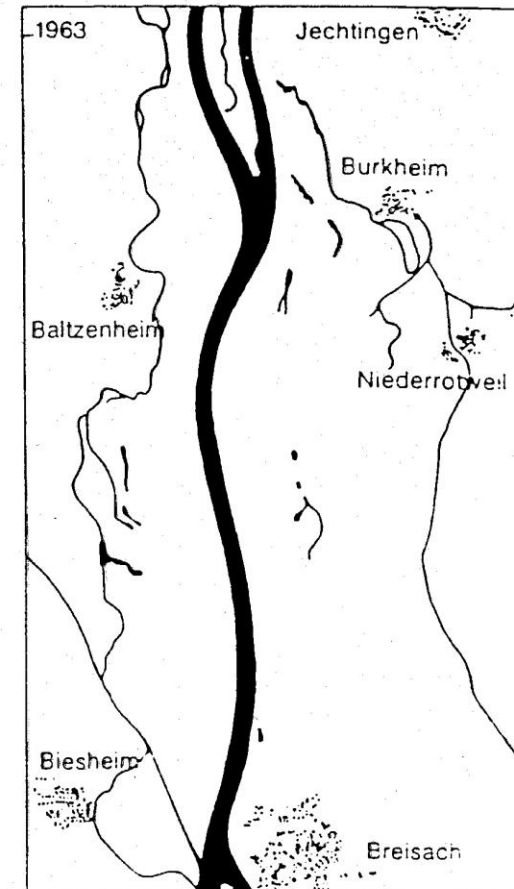
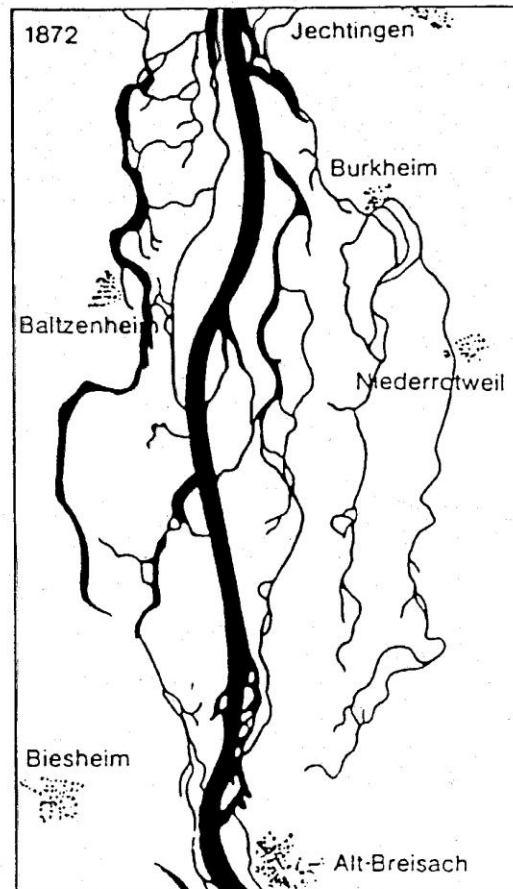
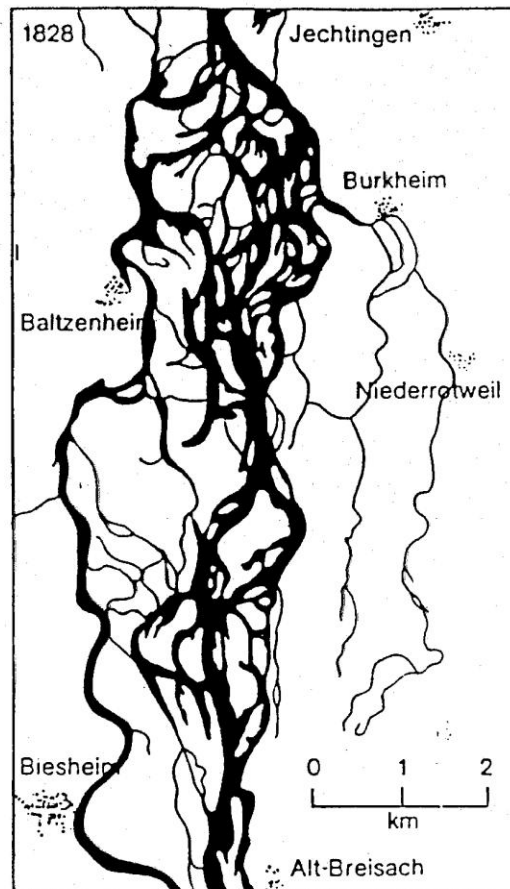
- For each river basin district, some of which transcend national frontiers, a “river basin management plan” is needed to be established.
- This plan will have to include an analysis of the river basin’s characteristics, a view of the impact of human activity on the status of waters in the basin, and an economic analysis of water use in the basin district.
- Within a river basin where use of water may have transboundary effects, the requirements for the achievement of environmental objectives should be co-ordinated for the whole of the river basin district.



LONGITUDINAL PROFILE OF RIVER RHINE



	4200		4550	5600		7000	11000	11000		12000	12000	m ³ /s	maximum discharge
	1020		1240	1380		1590	1960	2050		2250	2300	m ³ /s	mean discharge
	267		335	370		482	560	481		570	600	m ³ /s	lowest discharge



Upper Rhine River
1828 before regulation, 1872 after regulation,
1963 after regulation and canalisation

Contents

1. The European Water Framework Directive

2. Ecological features

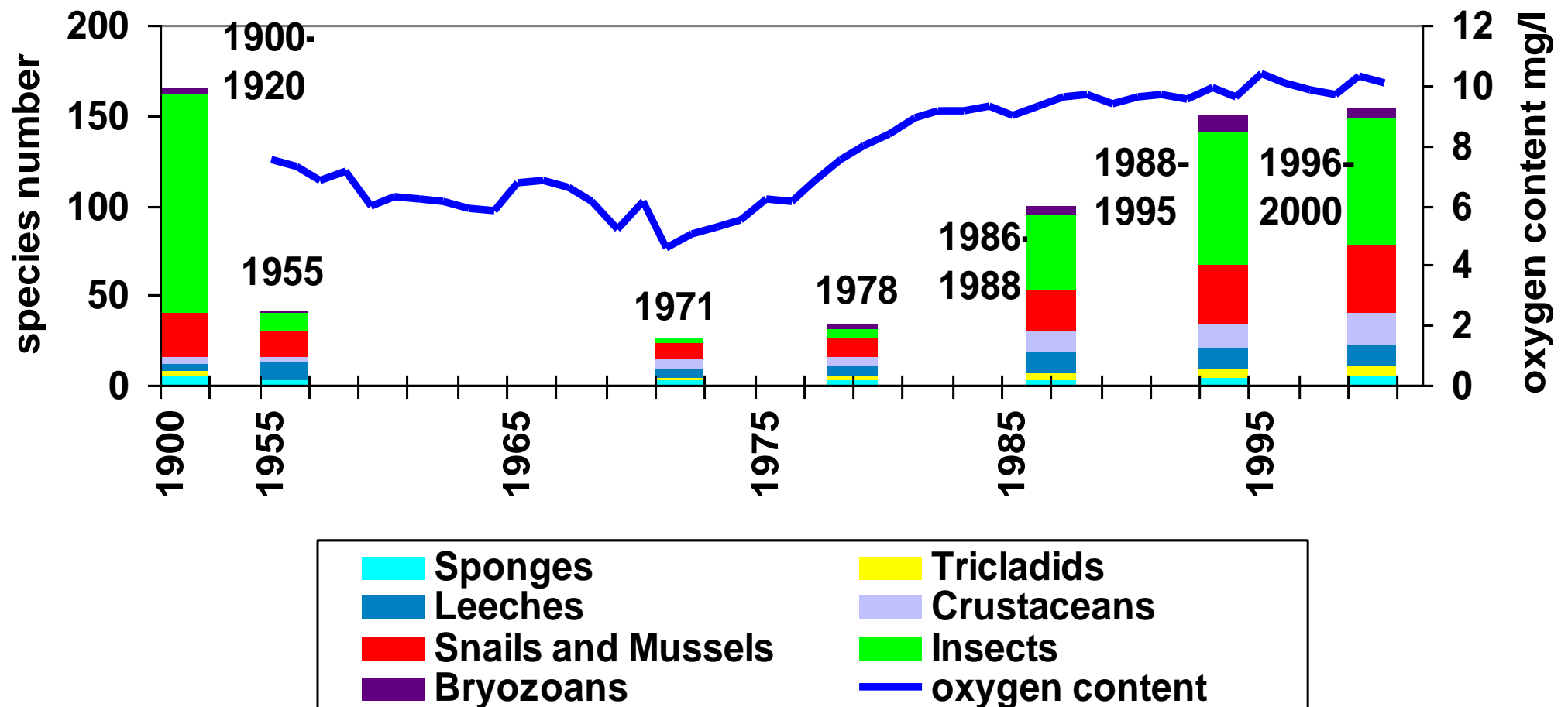
- Long-term development in species richness of the rivers Elbe and Rhine
- The influence of the current regime on the ecology of animals in large rivers
- Morphological structures
- Compensation and remedial actions
- Fish migration in anthropogenic altered rivers

3. Bedload management at the river Rhine

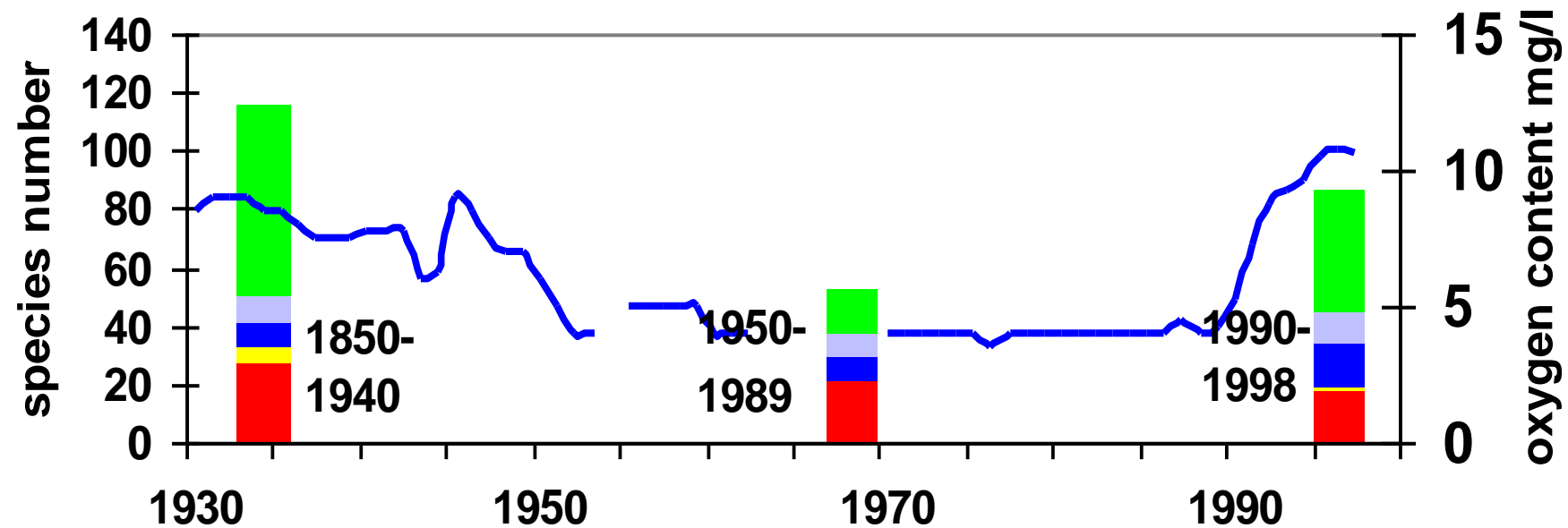
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- Bedload withdrawal
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Species number of the macrozoobenthos in the german stretch of the Rhine and annual averages of oxygen content of the Rhine



Species number of the macrozoobenthos in the german stretch of the Elbe and annual averages of oxygen content of the Elbe



Snails

Mussels

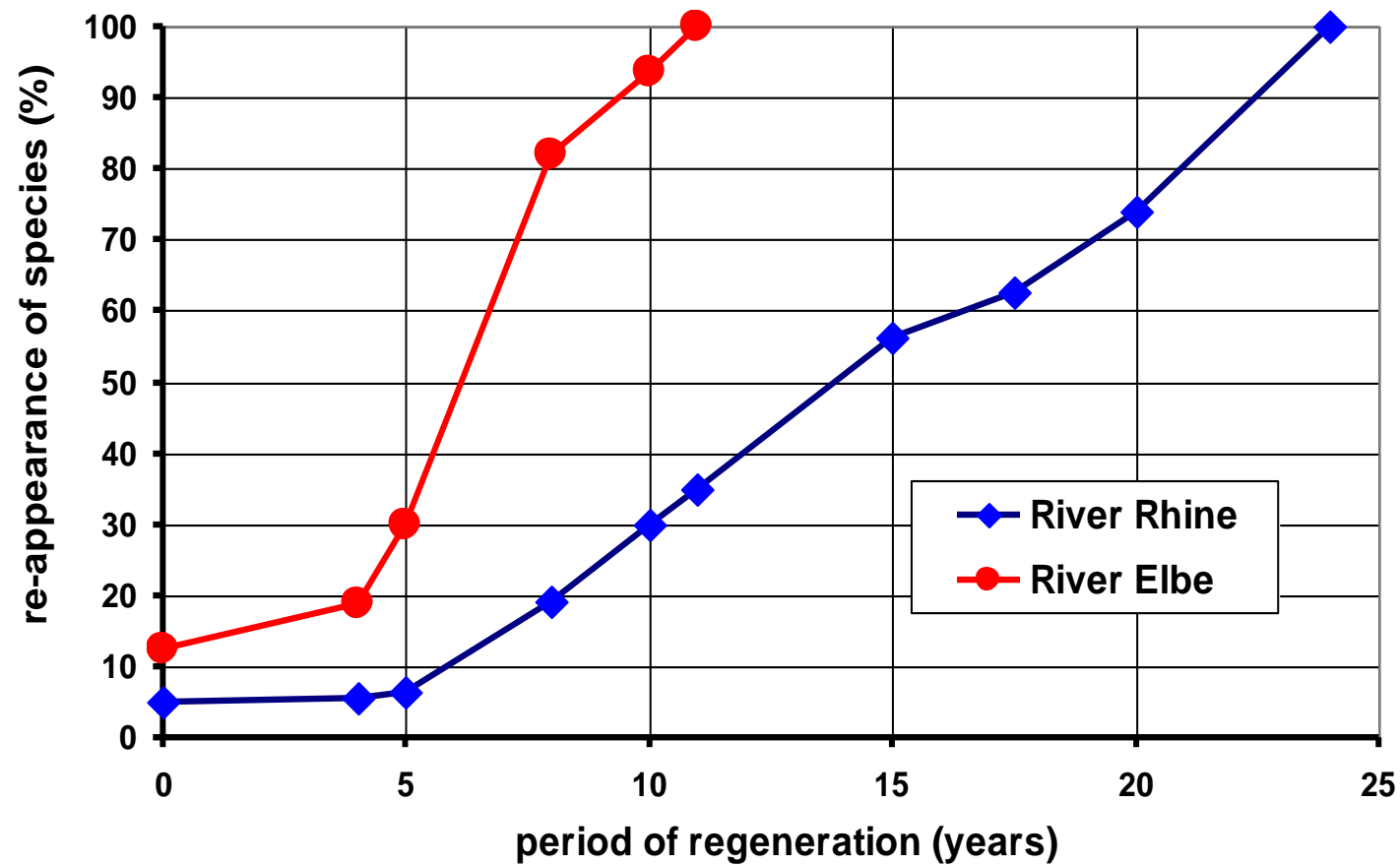
Leeches

Crustaceans

Insects

Oxygen content

Time response of ecological Regeneration



Reasons for this accelerated recovery process:

1. The reduction in organic pollutants from industrial and municipal sources was much quicker in the Elbe due to the fast (a few years) construction of new sewage treatment plants
2. In the Elbe the new sewage treatment plants were equipped with the newest techniques which had been developed and implemented over years along the river Rhine
3. The river Elbe was preconditioned for a fast recolonization due to its higher structural variety compare to the Rhine



Mayfly *Ephoron virgo*



Mating flight of
Ephoron virgo



Newspaper headline:

“Millions of flies; alert in Bonn; scenes like in a horror movie”

Contents

1. The European Water Framework Directive

2. Ecological features

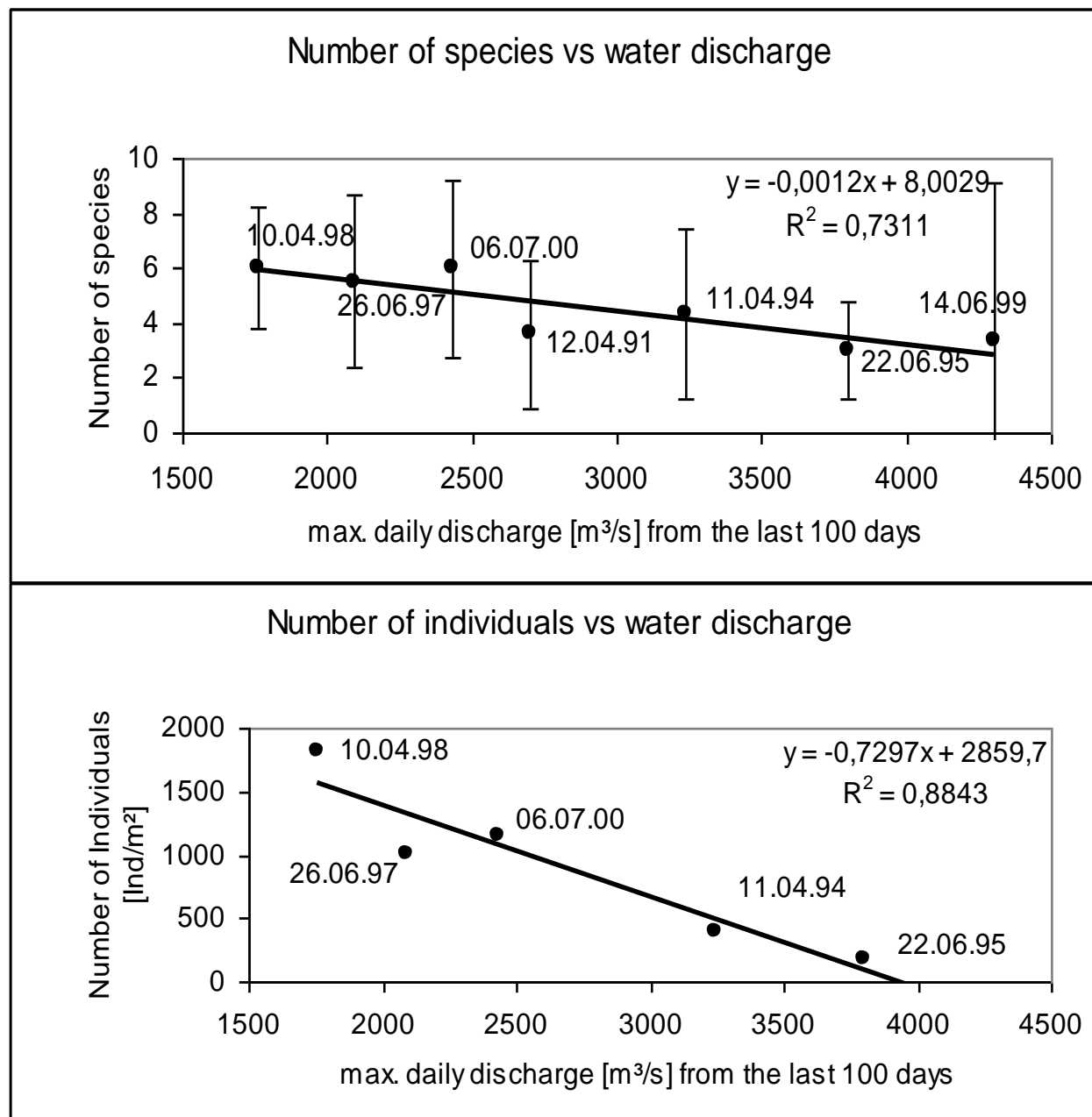
- Long-term development in species richness of the rivers Elbe and Rhine
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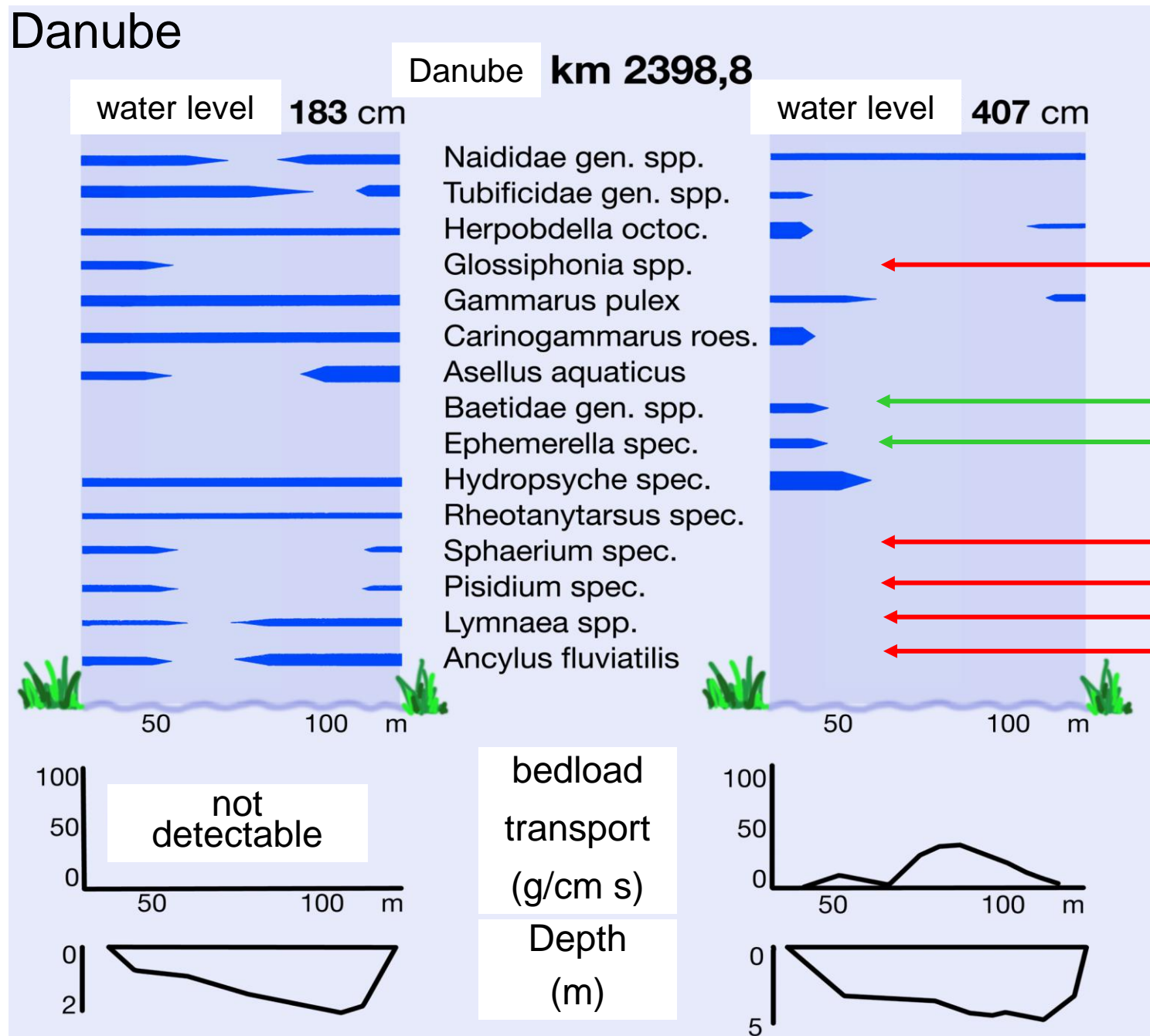
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Influence of water discharge (Q_{\max} of the last 100 days) on abundance and species numbers



High current velocities and species occurrence in the river Danube



species are:

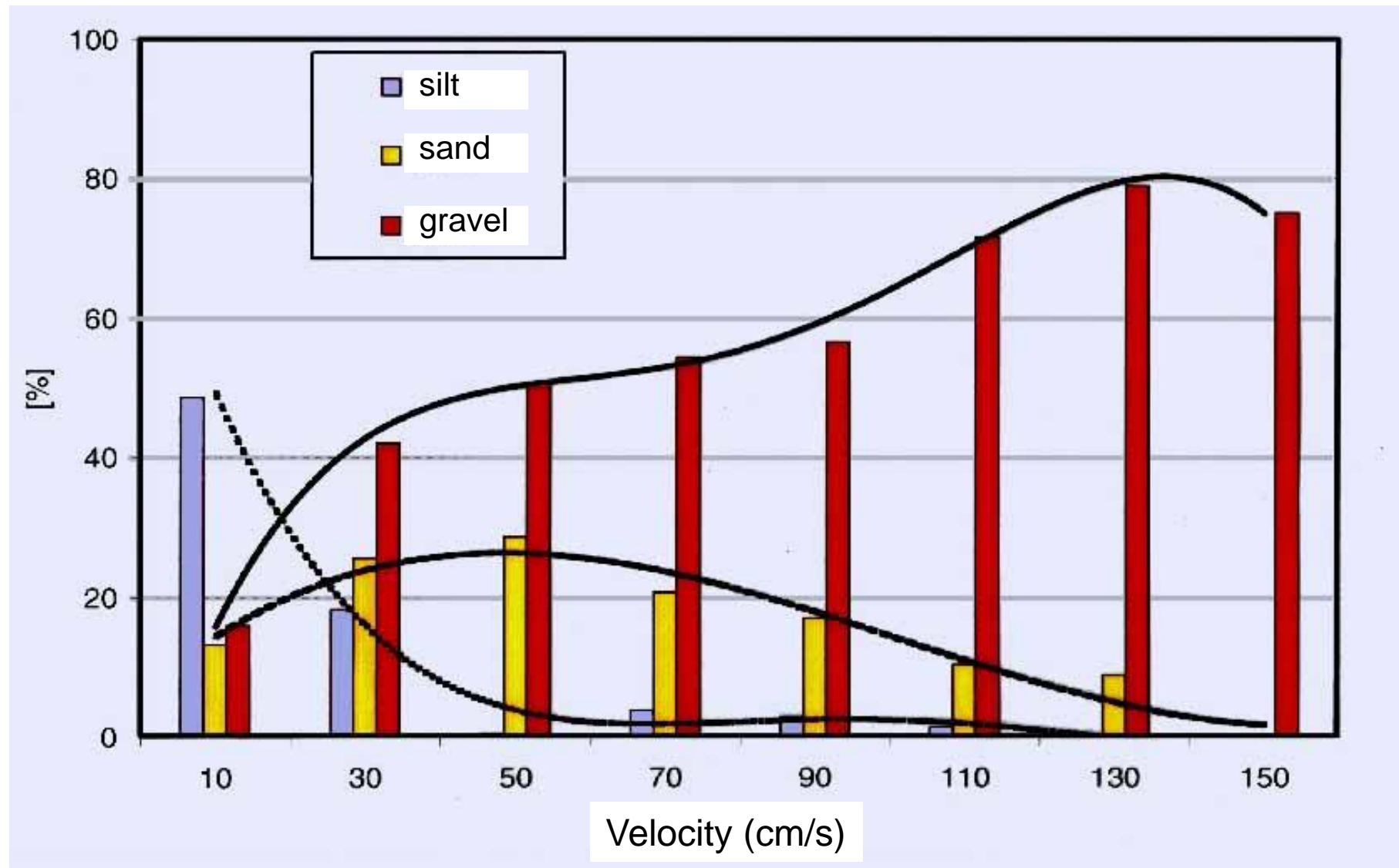
handicapped

favored

handicapped

by high current velocities

Flow velocity vs grain size distribution



Contents

1. The European Water Framework Directive

2. Ecological features

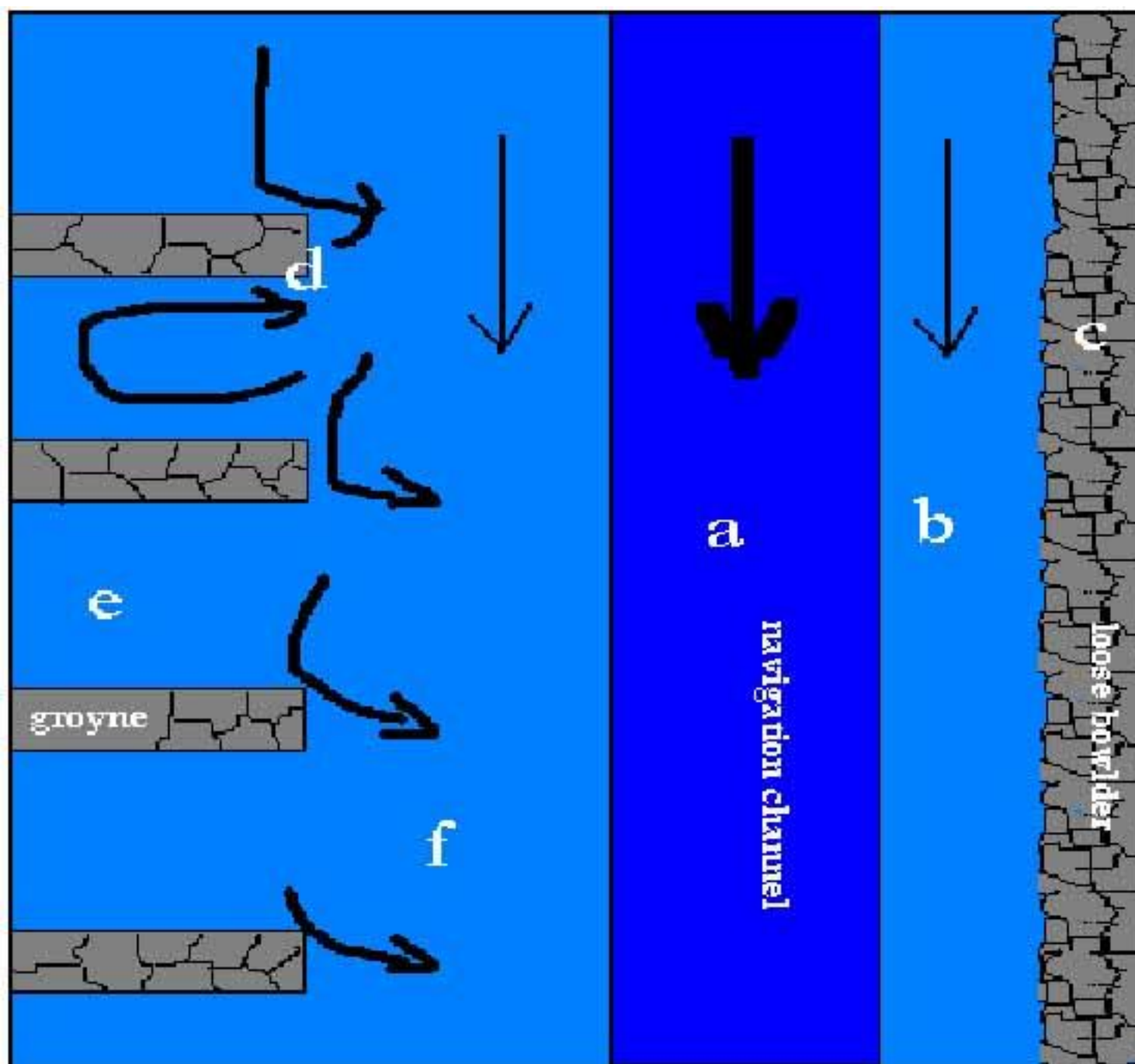
- Long-term development in species richness of the rivers Elbe and Rhine
- The influence of the current regime on the ecology of animals in large rivers
- **Morphological structures**
- Compensation and remedial actions
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Common constructions along shipping routes



Scheme of a typical regulated river with its main habitats (a-f).

Main difference between habitats is mainly the grain size distribution and the current velocity.

Groins and longitudinal groins in the river Elbe **bfg** Bundesanstalt für Gewässerkunde






Since 1880 groins were used to establish the the shipping route in the river Elbe

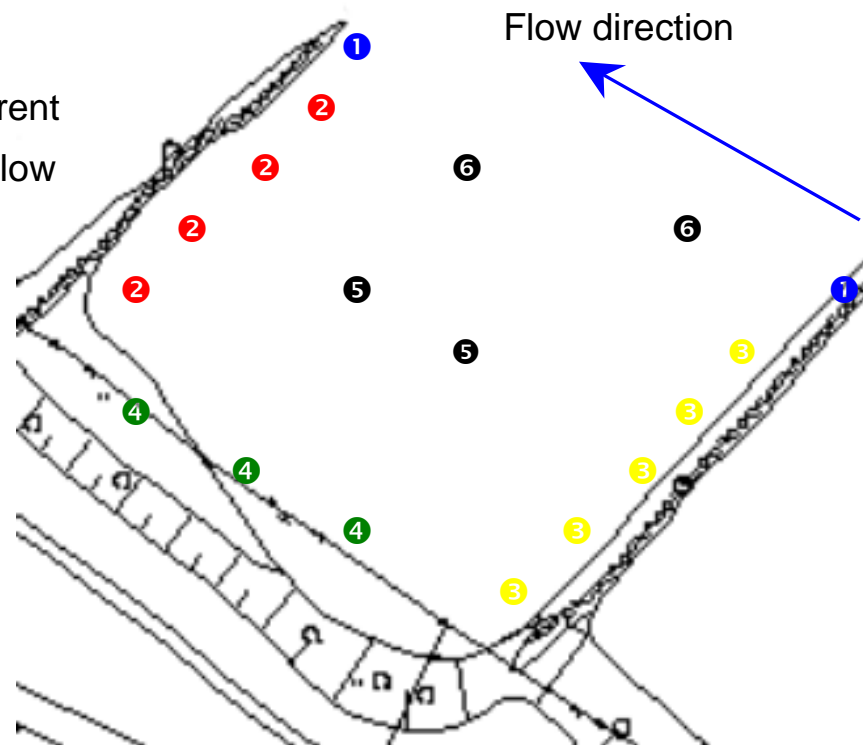
Today approximately 6900 groins border the river Elbe



Groin fields as habitats

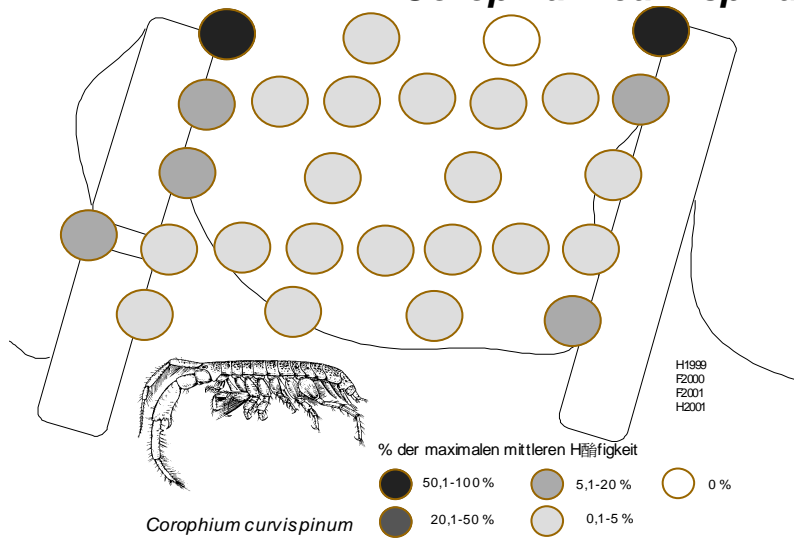
1. Groin head
2. Groin saddle exposed to current
3. Groin saddle not exposed to flow
4. Aggregation zone
5. Sedimentation zone
6. Navigationchannel

-  stone, high flow velocity
-  stone, medium flow velocity
-  mud, low flow velocity
-  sand, low flow velocity
-  free-water, variable flow conditions

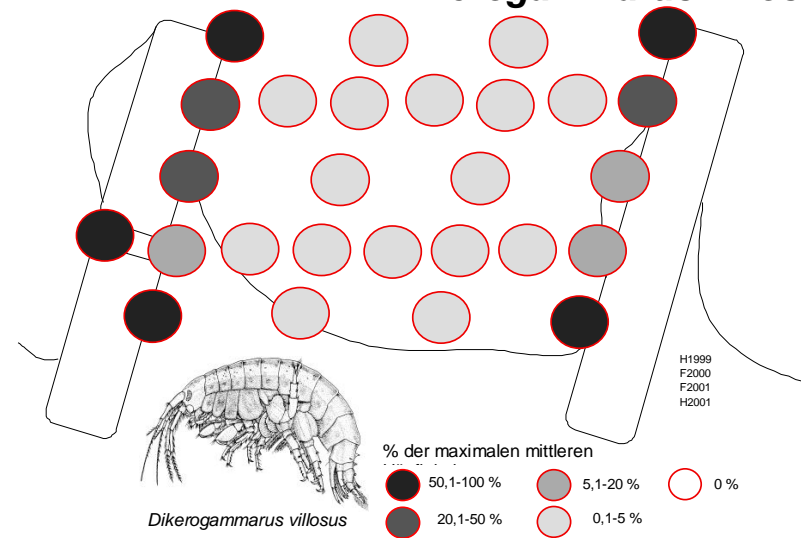


Macrozoobenthos associated with groins

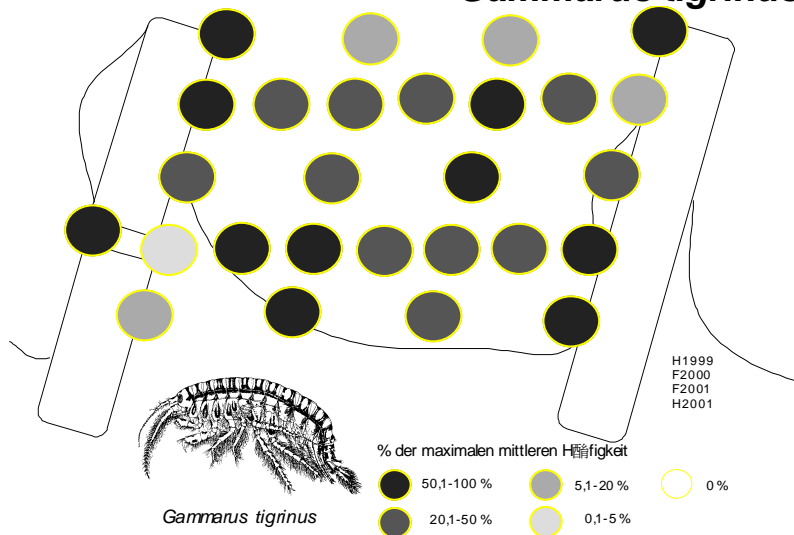
Corophium curvispinum



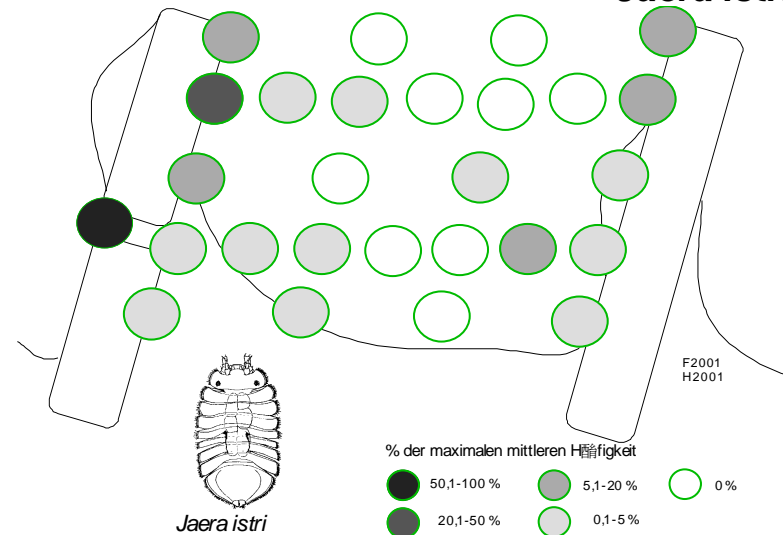
Dikerogammarus villosus

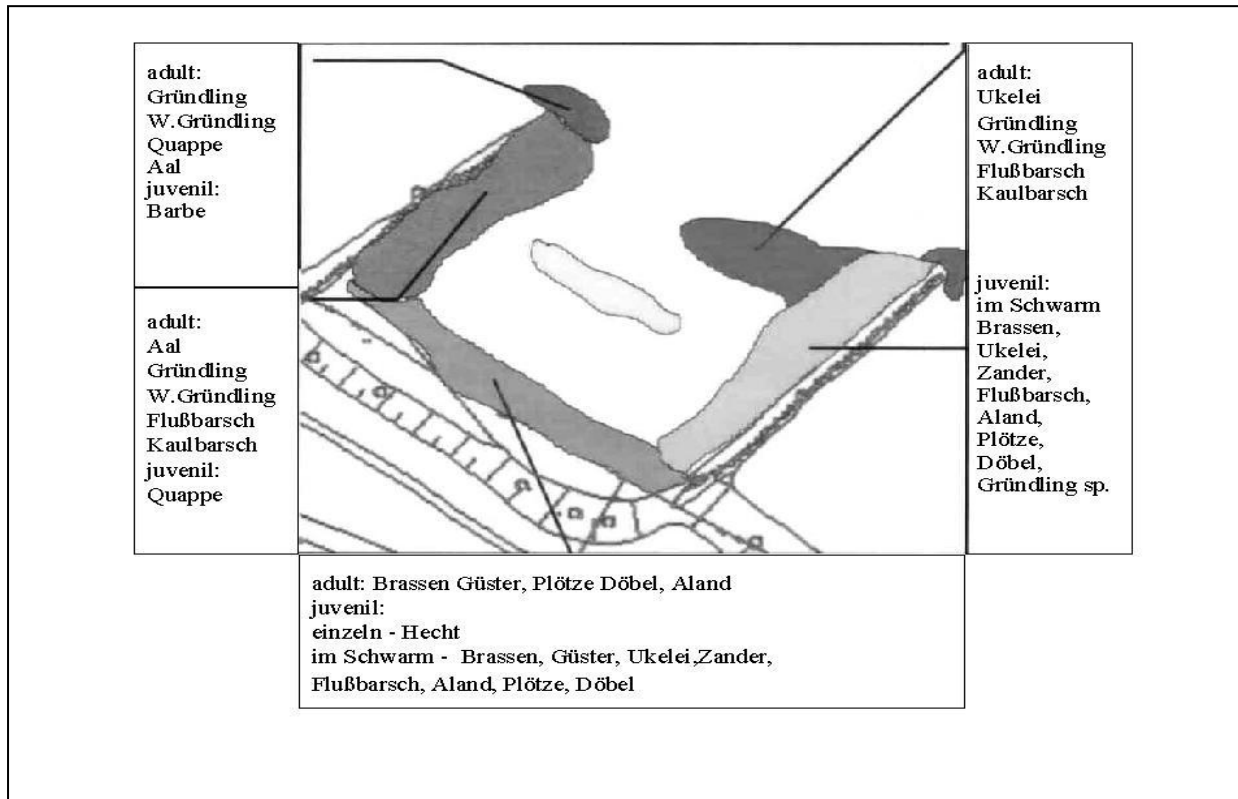


Gammarus tigrinus



Jaera istri





Fish fauna of groin fields

Ukelei - bleak

Flußbarsch - perch

Gründling - gudgeon

Kaulbarsch - ruff

Hecht - pike

Quappe - burbot

Barbe - barbel

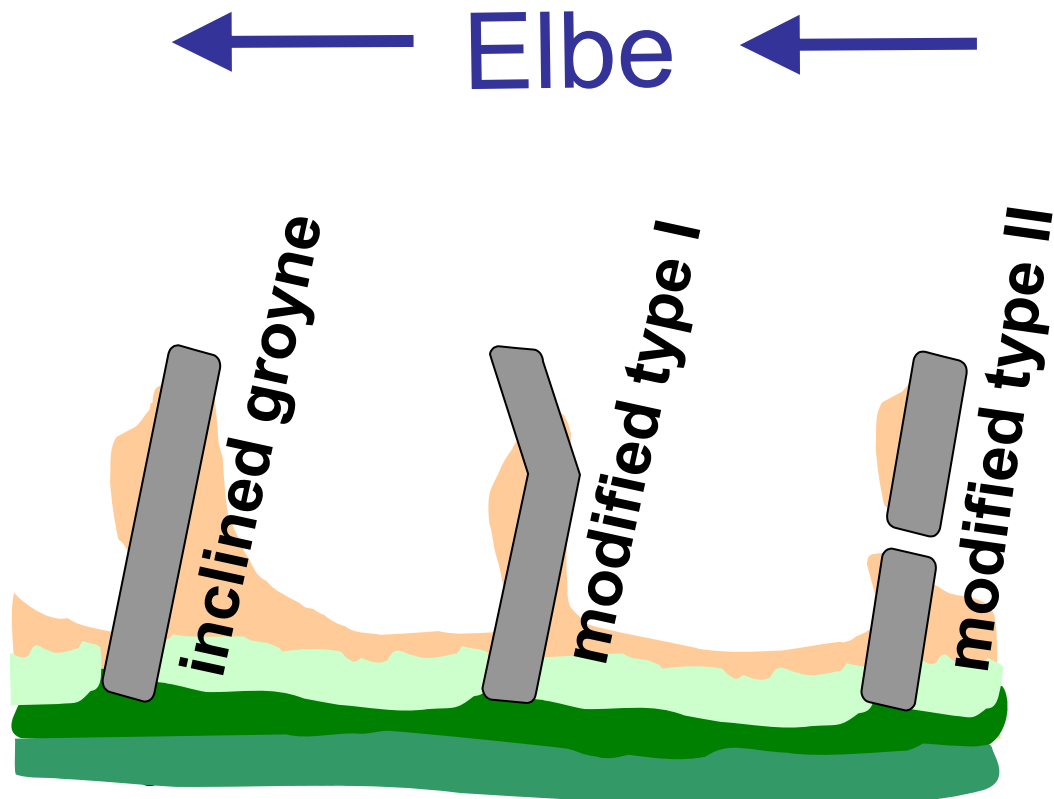
Moderlieschen - sunbleak

Plötze - roach

Brasse - bream

Zander - green pike

Different groin types



Contents

1. The European Water Framework Directive

2. Ecological features

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- **Compensation and remedial actions**
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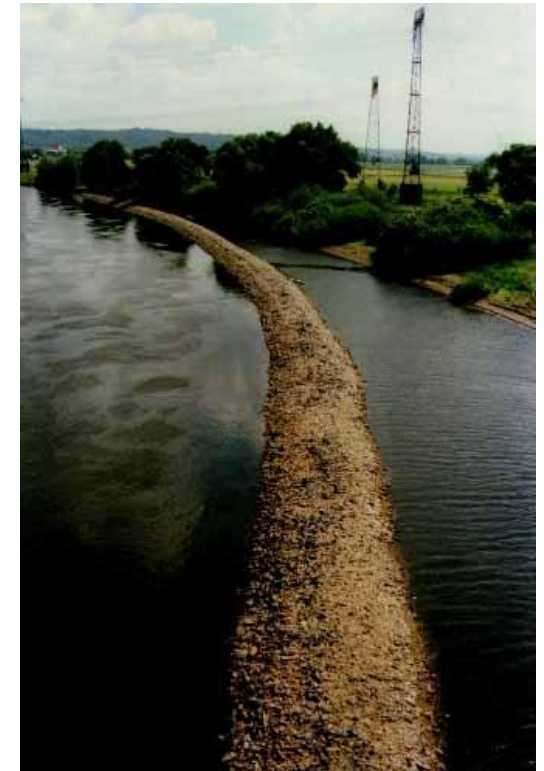
- Artificial bedload supply
- Bedload withdrawal
- Overall concept for the river Rhine

4. Directive for the Handling of Dredged Material in Federal Coastal Waterways (HABAK-WSV)



New constructed shallow waters
and areas with reduced wave impact

Guided dykes



Contents

1. The European Water Framework Directive

2. Ecological features

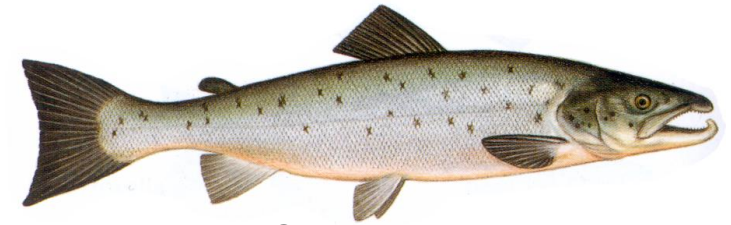
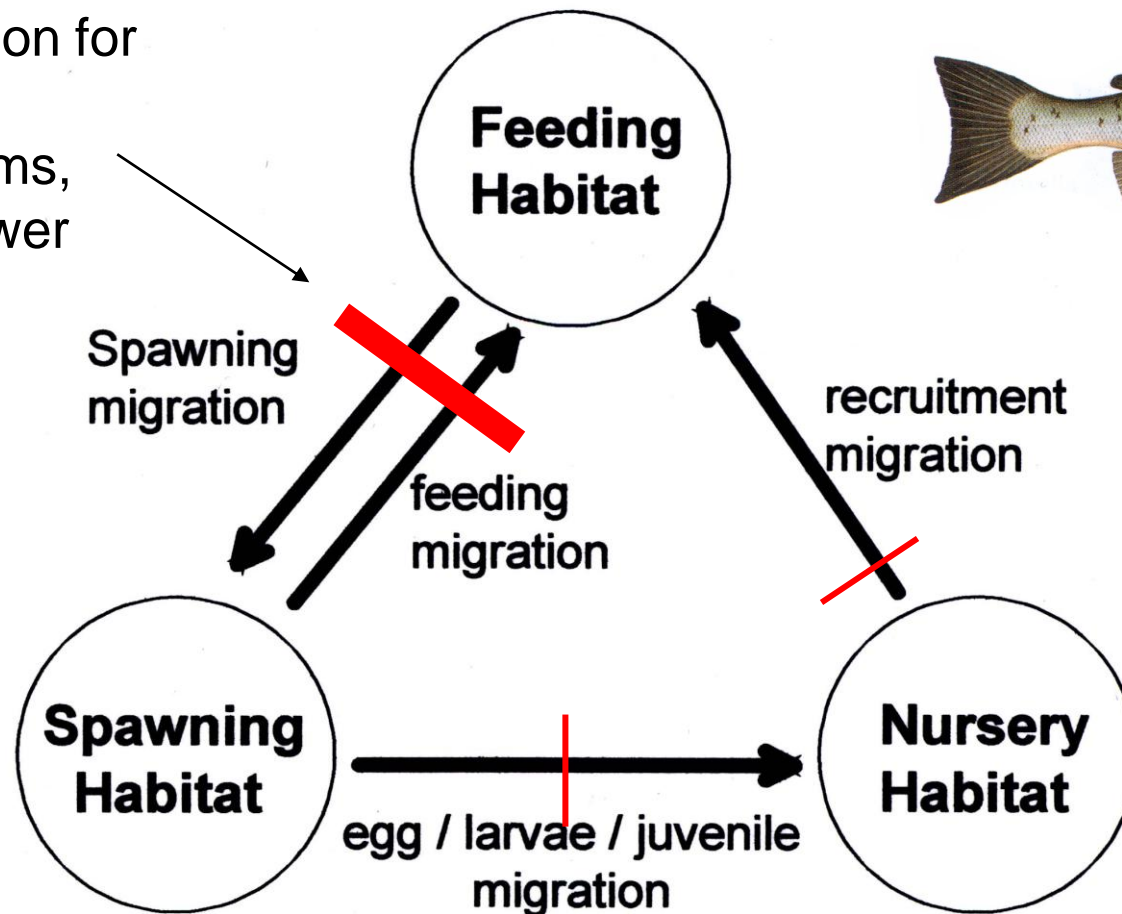
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- The influence of the current regime on the ecology of animals in large rivers
- Morphological structures
- Compensation and remedial actions
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3. Bedload management at the river Rhine

- Artificial bedload supply
- Bedload withdrawal
- Overall concept for the river Rhine

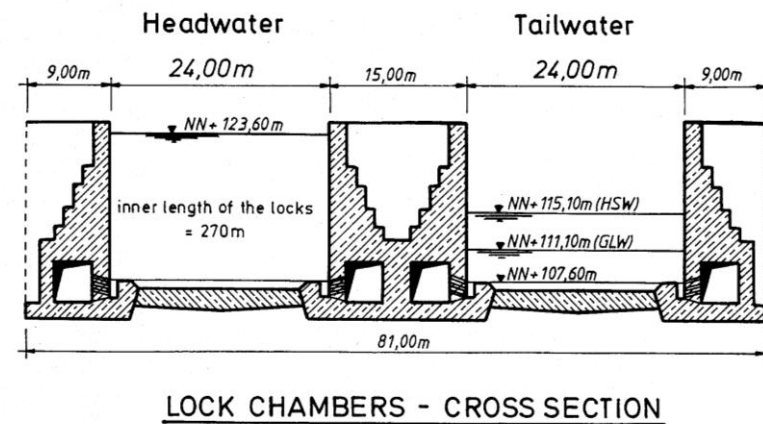
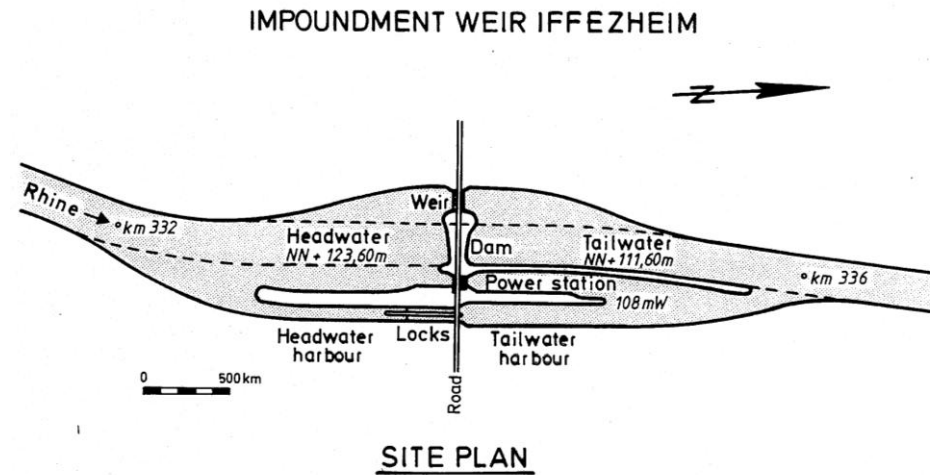
4. Directive for the Handling of Dredged Material in Federal Coastal Waterways (HABAK-WSV)

main obstruction for
fish passage
caused by dams,
locks, and power
plants



Basic Pattern of Fish Migration

Case Study 1: The modified vertical slot fish pass at Iffezheim (Rhine). A German-French joint project

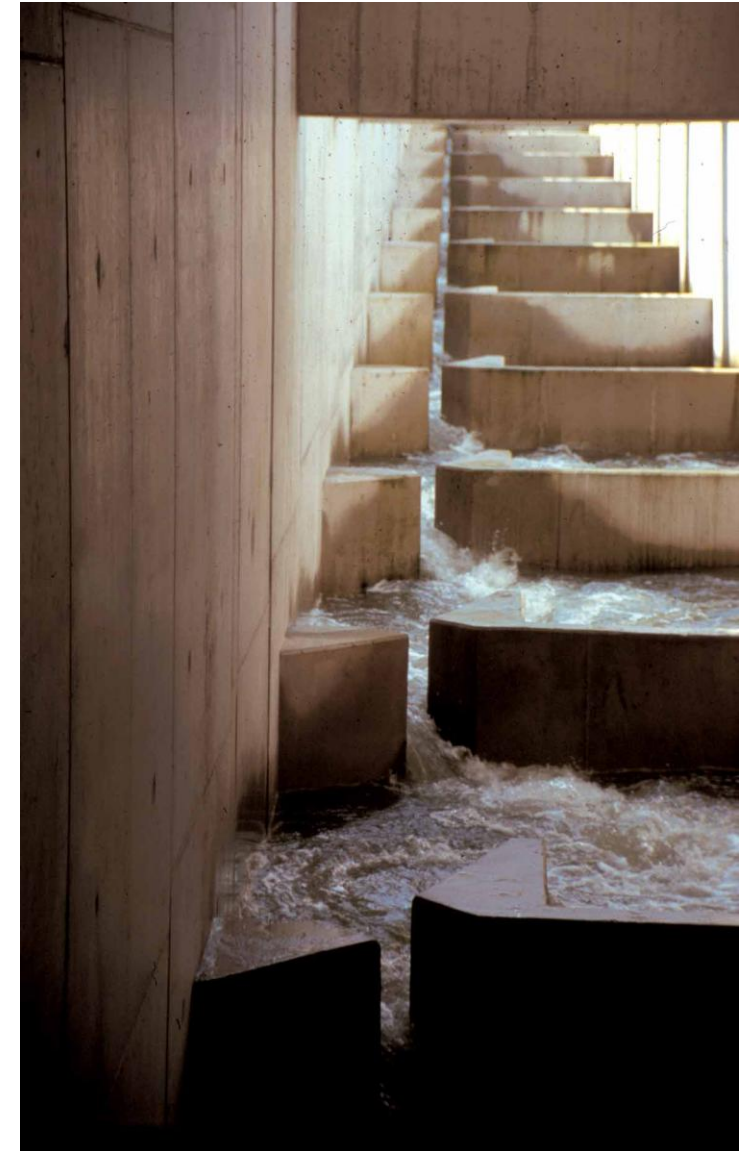
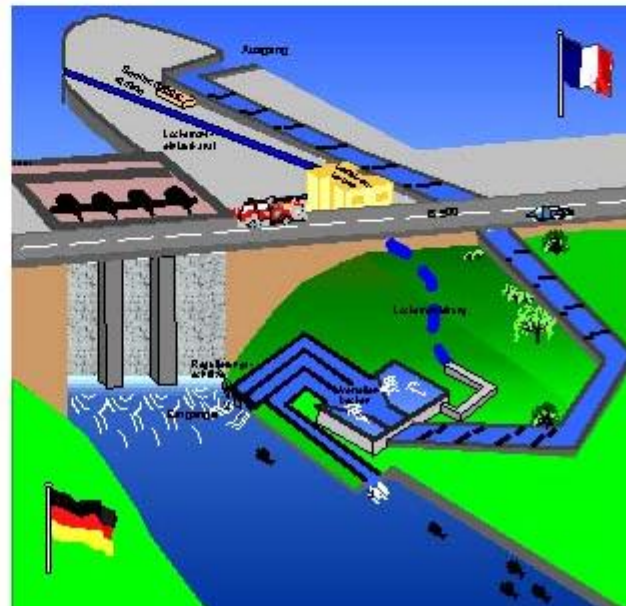


Case Study 1: The modified vertical slot fish pass at Iffezheim (Rhine). A German-French joint project

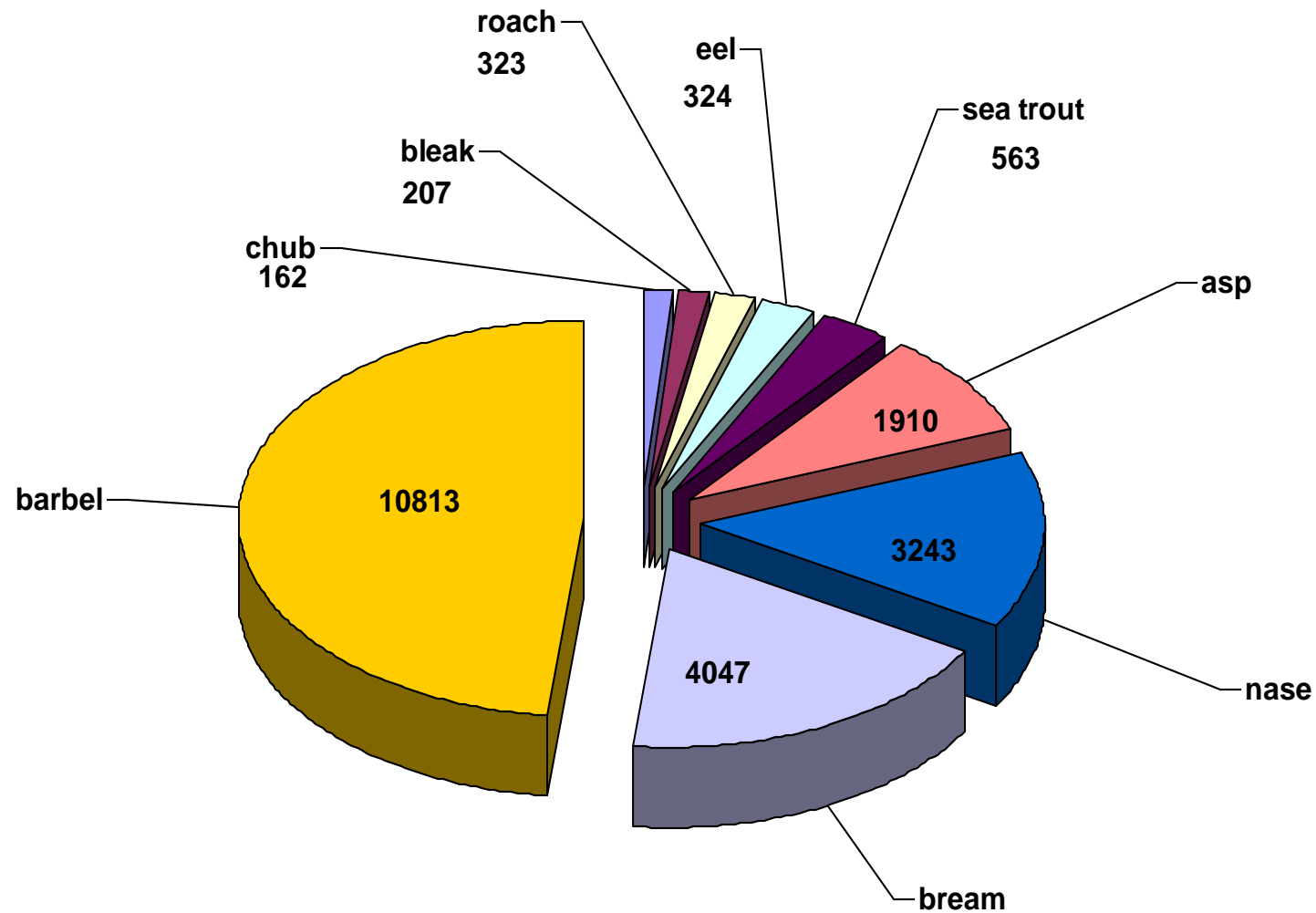


The fish passage construction, the largest (300 m length) of Europe, was under way since April 1998. Migratory fishes, particular salmon and sea trout, now reach their spawning areas of tributaries such as Breusch, Ille, Acher and Rhench.

The fish passage structure was in operation on 10 th of July 2000. Ascending fish were registered by a video detecting system and, for determining Taxonomy, body weight and length of each mounting fish. All fishes are caught by a special trap. Scientific evaluation of the results indicate a well operating fish passage structure.



Number of migrating fish*



* only abundant species (relative abundance >1%) shown

Case Study 2: River Elbe, the migratory device at the weir Geesthacht



Iffezheim fish pass and Geesthacht bypass channel. A comparison

	Rhine: Fish migratory device at the Iffezheim Hydropower Station	Elbe: Fish migratory device at Geesthacht weir
Fish passage type	<p>Modified vertical slot fish pass</p> <p>37 basins (4.5m x 3.5 m) connected through 45cm slits</p> <p>continuous discharge ($Q = 1.2 \text{ m}^3/\text{s}$)</p> <p>Fish attraction current at the entrance of the fish pass ($10 \text{ m}^3/\text{s}$)</p>	<p>Natural designed fish bypass</p> <p>continuous discharge ($Q = 6.3 \text{ m}^3/\text{s}$)</p>
Start of construction	1998	September 1997
On line since	June 2000	July 1998
Mean height difference	approx. 12 m	approx. 6 m
Total Length	300 m	216 m
Costs	7.5 Mio €	1.3 Mio €

Contents

1. The European Water Framework Directive

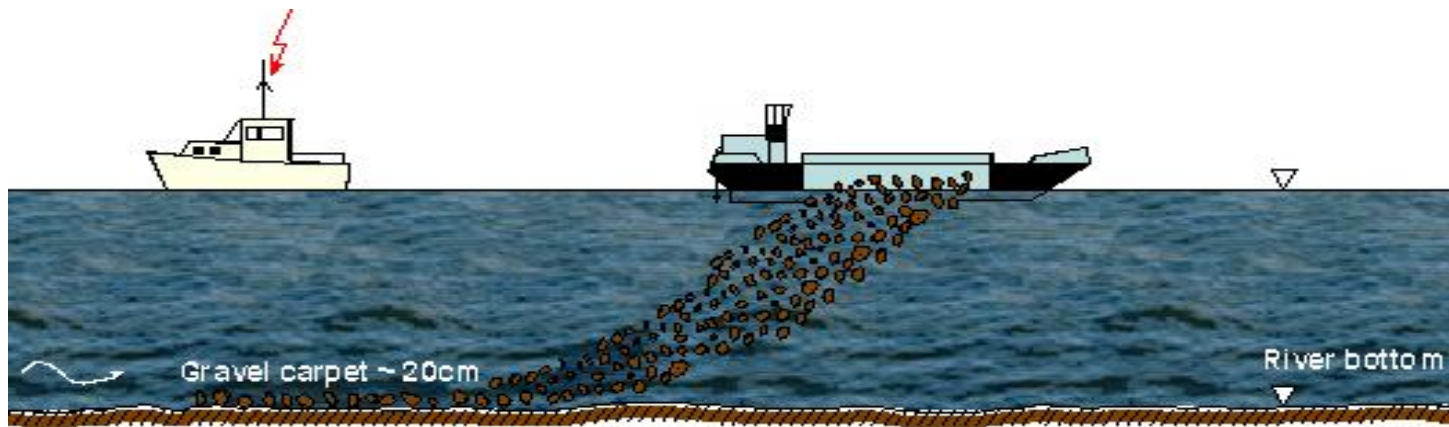
2. Ecological features

- Long-term development in species richness of the rivers Elbe and Rhine
- The influence of the current regime on the ecology of animals in large rivers
- Morphological structures
- Compensation and remedial actions
- Fish migration in anthropogenic altered rivers

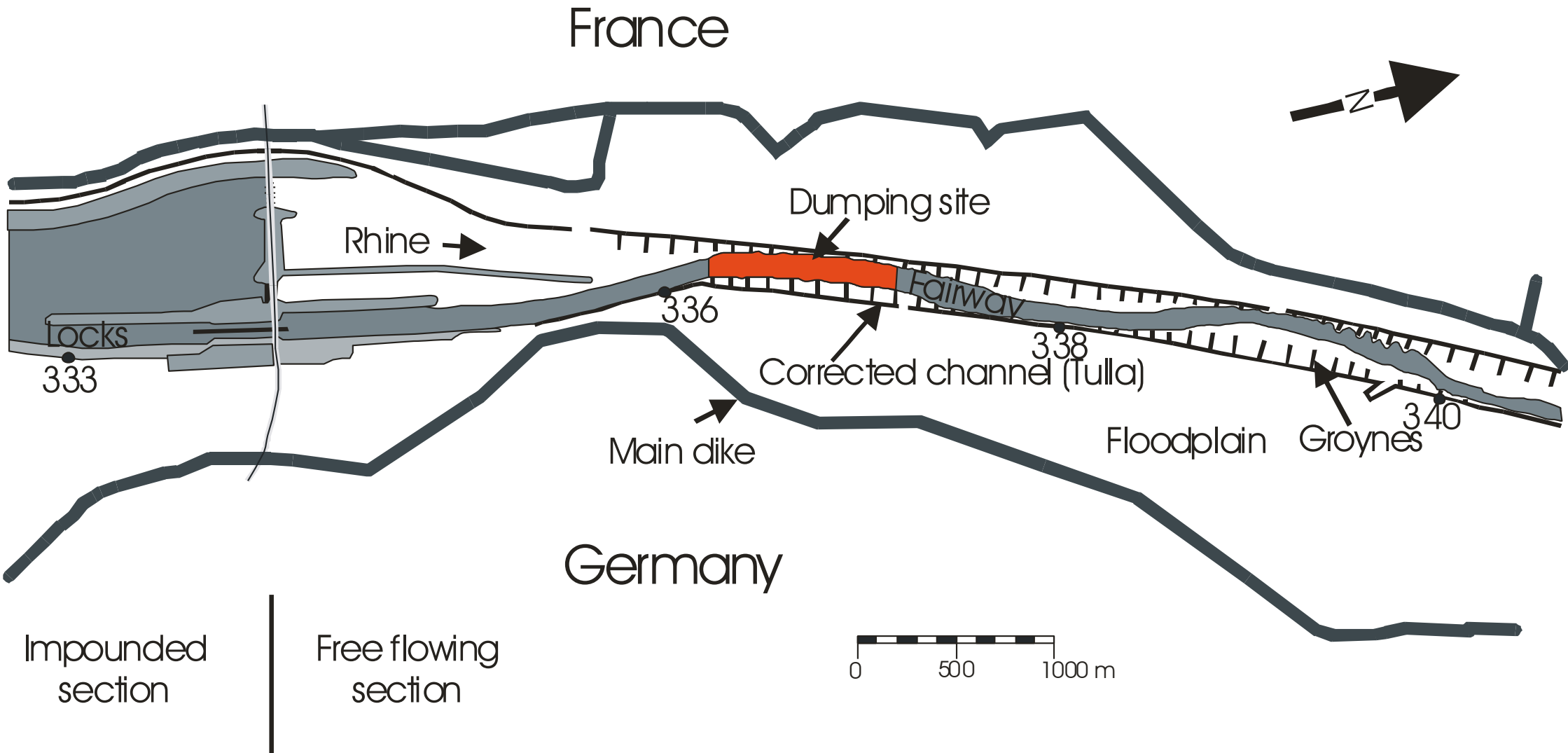
3. Bedload management at the river Rhine

- Artificial bedload supply
- Bedload withdrawal
- Overall concept for the river Rhine

4. Directive for the Handling of Dredged Material in Federal Coastal Waterways (HABAK-WSV)



The Upper Rhine near the Iffezheim barrage



Contents

1. The European Water Framework Directive

2. Ecological features

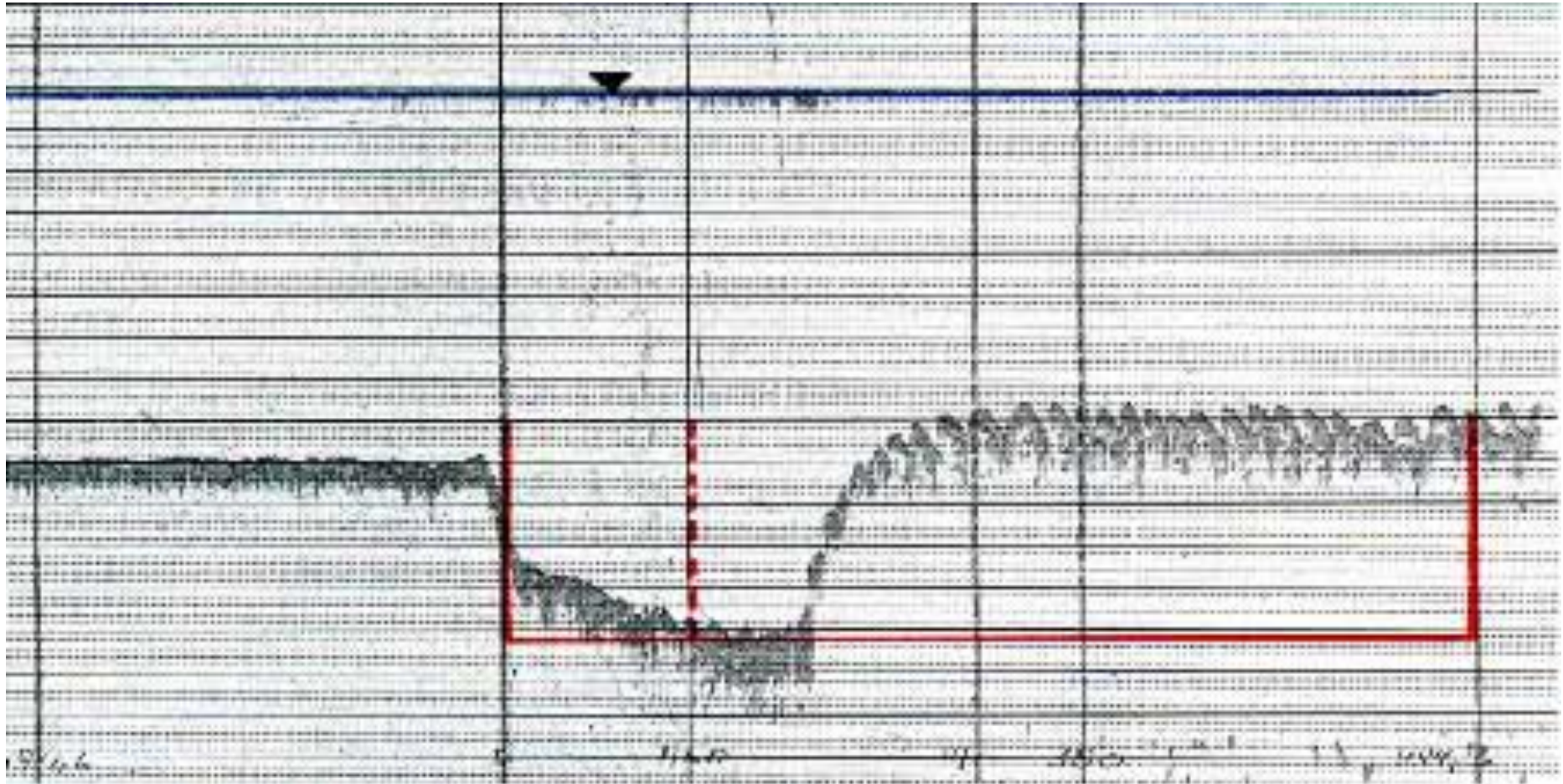
- Long-term development in species richness of the rivers Elbe and Rhine
- The influence of the current regime on the ecology of animals in large rivers
- Morphological structures
- Compensation and remedial actions
- Fish migration in anthropogenic altered rivers

3. Bedload management at the river Rhine

- Artificial bedload supply
- **Bedload withdrawal**
- Overall concept for the river Rhine

4. Directive for the Handling of Dredged Material in Federal Coastal Waterways (HABAK-WSV)

Bedload trap near Mainz (longitudinal section)



Contents

1. The European Water Framework Directive

2. Ecological features

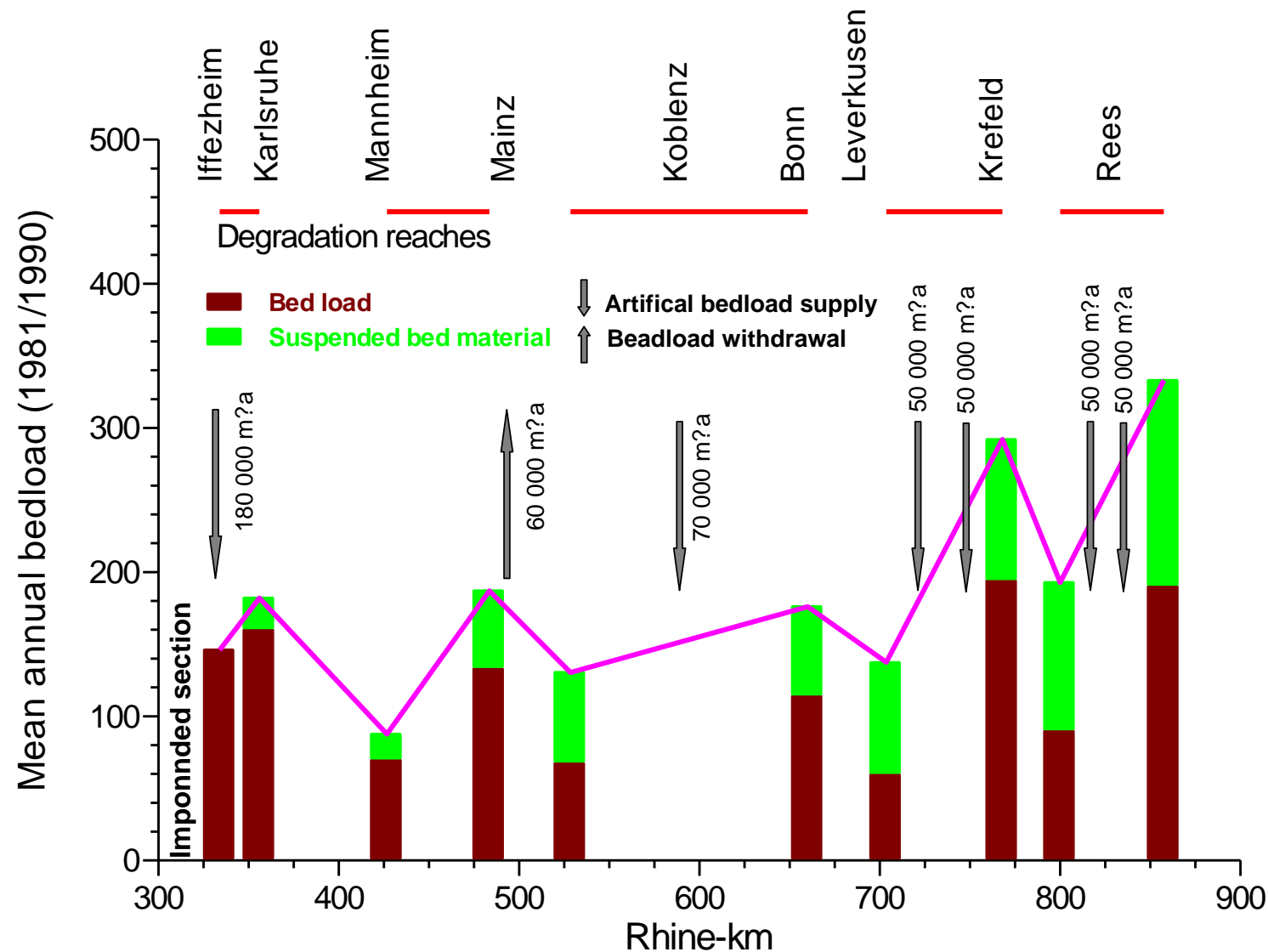
- Long-term development in species richness of the rivers Elbe and Rhine
- The influence of the current regime on the ecology of animals in large rivers
- Morphological structures
- Compensation and remedial actions
- Fish migration in anthropogenic altered rivers

3. Bedload management at the river Rhine

- Artificial bedload supply
- Bedload withdrawal
- Overall concept for the river Rhine

4. Directive for the Handling of Dredged Material in Federal Coastal Waterways (HABAK-WSV)

Bedload distribution and bedload management measures at the Rhine between Iffezheim and the Dutch-German border



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Contents

1. The European Water Framework Directive

2. Ecological features

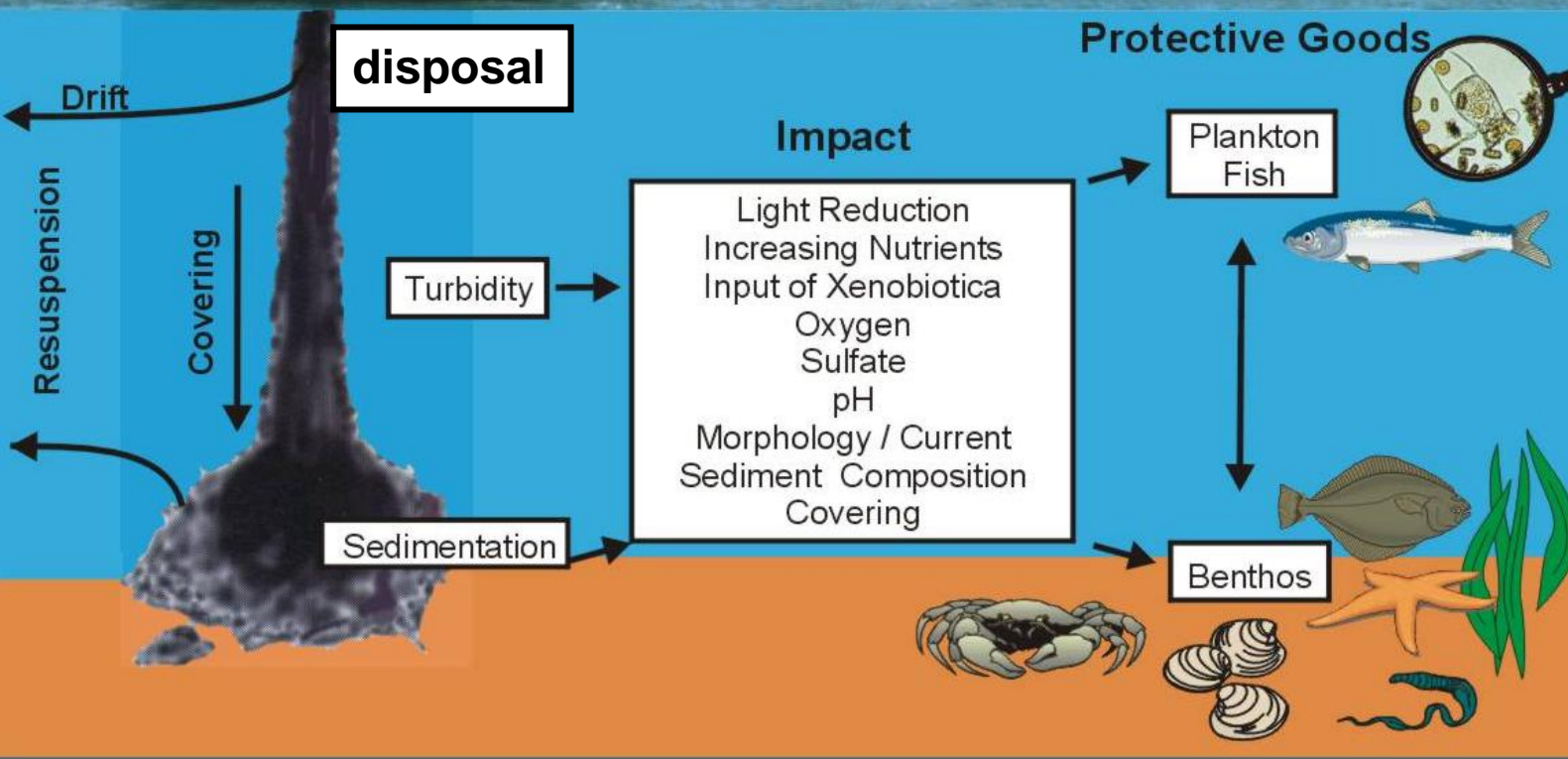
- Long-term development in species richness of the rivers Elbe and Rhine
- The influence of the current regime on the ecology of animals in large rivers
- Morphological structures
- Compensation and remedial actions
- Fish migration in anthropogenic altered rivers

3. Bedload management at the river Rhine

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- Overall concept for the river Rhine

4. Directive for the Handling of Dredged Material in Federal Coastal Waterways (HABAK-WSV)

Disposal of dredged material



Procedural steps according to HABAK

Chapter

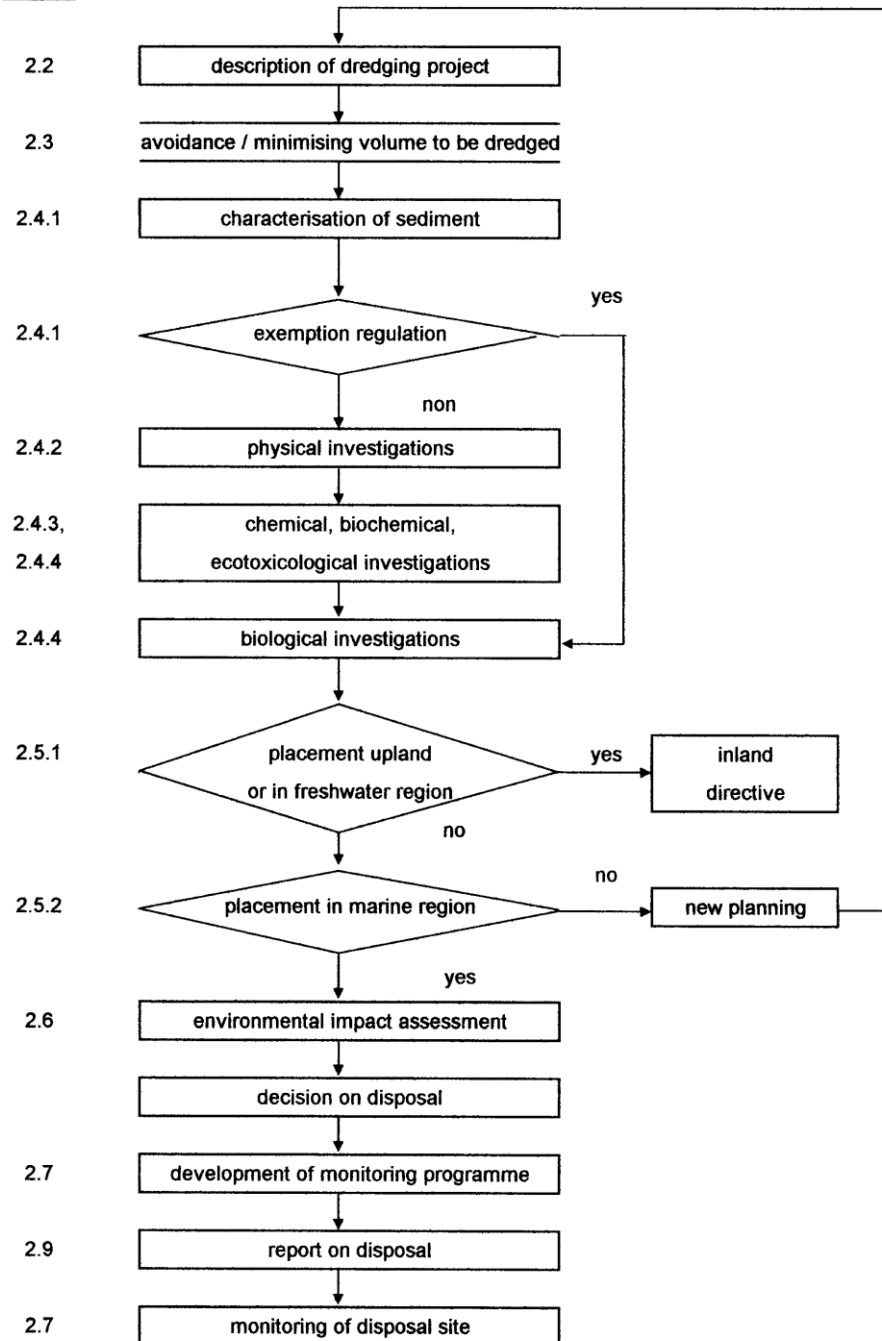
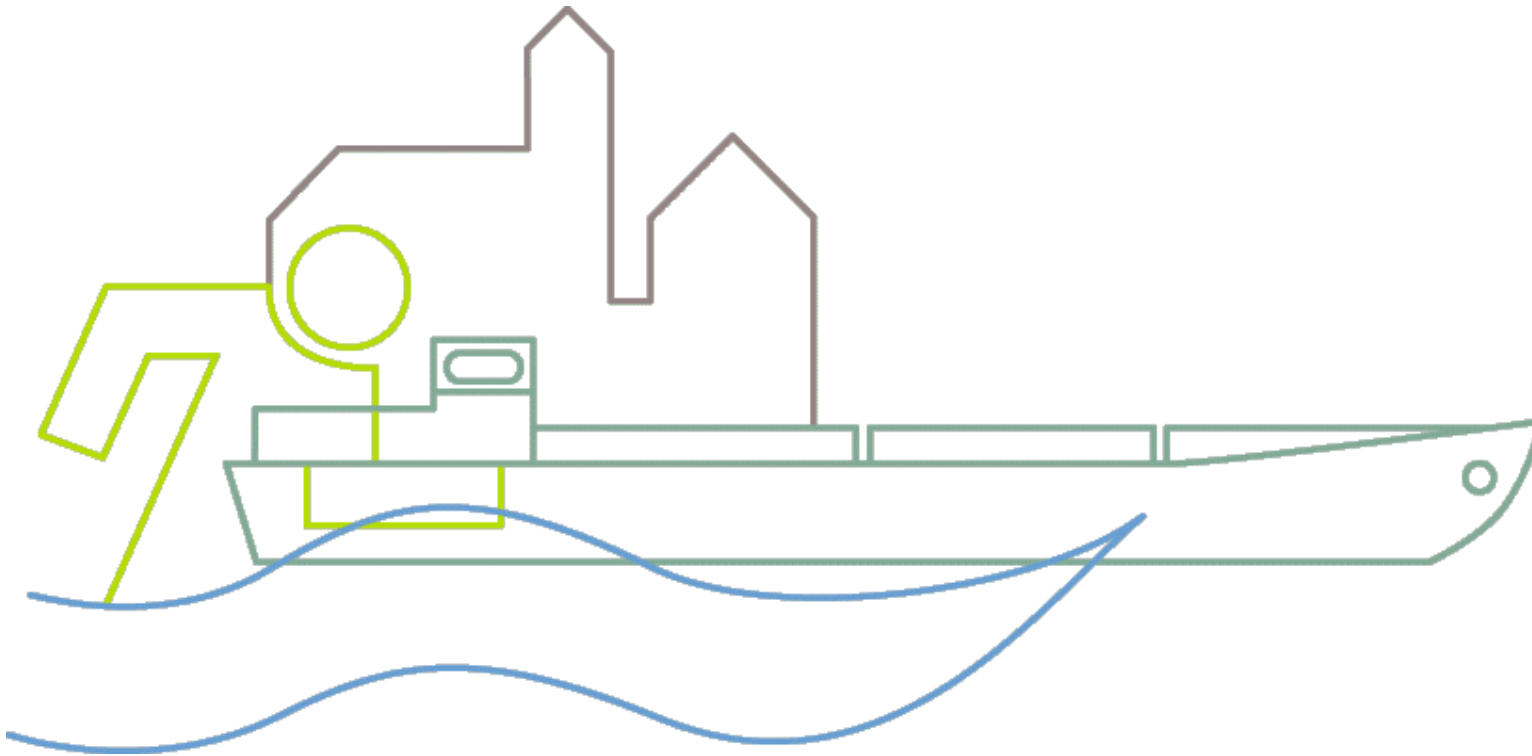


Table of Contents

	<u>Page</u>
1 Introduction	3
1.1 Reason, Objective and Application	3
1.2 Scope and Applicability of HABAK	4
1.3 Additional Directives	7
2 Procedures	7
2.1 Introduction and overview	7
2.2 Description of the dredging project	9
2.3 Avoidance and minimisation of dredged material	9
2.4 Characterisation of dredged material and site of disposal	9
2.4.1 Exemption regulations	10
2.4.2 Sedimentological testing	10
2.4.3 Chemical testing	11
2.4.3.1 Extent and methods of analysis	11
2.4.3.2 Reference values for assessment of contamination in dredged material	11
2.4.4 Biological testing	11
2.4.4.1 Ecotoxicity	12
2.4.4.1.1 Extent and methods of testing	12
2.4.4.1.2 Evaluation of test results	13
2.4.4.2 Balance of substance	13
2.4.4.2.1 Extent and methods of testing	13
2.4.4.2.2 Evaluation of test results	14
2.4.4.3 Flora and fauna	14
2.4.5 Sampling	15
2.4.5.1 Representativeness of sampling	15
2.4.5.2 Frequency of testing	16
2.5 Selection of possible placement sites	17
2.5.1 Beneficial use and recycling	17
2.5.2 Disposal of dredged material in a water body	18
2.5.2.1 Possible impacts	18
2.5.2.2 Required testing	18
2.5.3 Deciding on an appropriate disposal site	19
2.5.4 Reducing negative impacts of dredged material at disposal site	21
2.6 Impact Hypothesis	21
2.6.1 Allocation of tasks	21
2.6.2 Assessment of the extent of impacts	22
2.7 Monitoring programme for the site of disposal	23
2.8 Identification of contaminant sources	23
2.9 Obligatory reporting of dredged material disposal	24
List of Sources	25
Appendices	26



Thank you very much for your attention

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