

Heavily Modified Waters in Europe

Case Study Wienfluss

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PART I

3 Introduction

3.1 Choice of Case Study

Beside flood protection urbanisation is the main use in the case study river section of the Wienfluss. The focus of the case study is concentrating on alterations of flood protection which have the main impact on the Wienfluss river system in terms of channelisation and impoundment.

Another aspect for the choice of this part of the Wienfluss as heavily modified case study was the fact that a variety of rehabilitation measures have been done showing improvements of the ecological conditions within this river section.

Several investigations have been performed in this area before and after the establishment of rehabilitation measures and therefore a large amount of information, for example surveys on macroinvertebrates and fish are available.

3.2 General Remarks

The case study focuses on the Wienfluss within the city of Vienna. This river section has a length of about 34 km with a catchment area of 94 km² and is characterised by flood protection, bank reinforcement and hydrologically altered areas.

4 Description of Case Study Area

4.1 Geology, Topography and Hydrology

The Wienfluss in Vienna is a 5th order stream with a catchment area of about 94 km² (Wimmer & Moog, 1994) and a pluvionival regime.

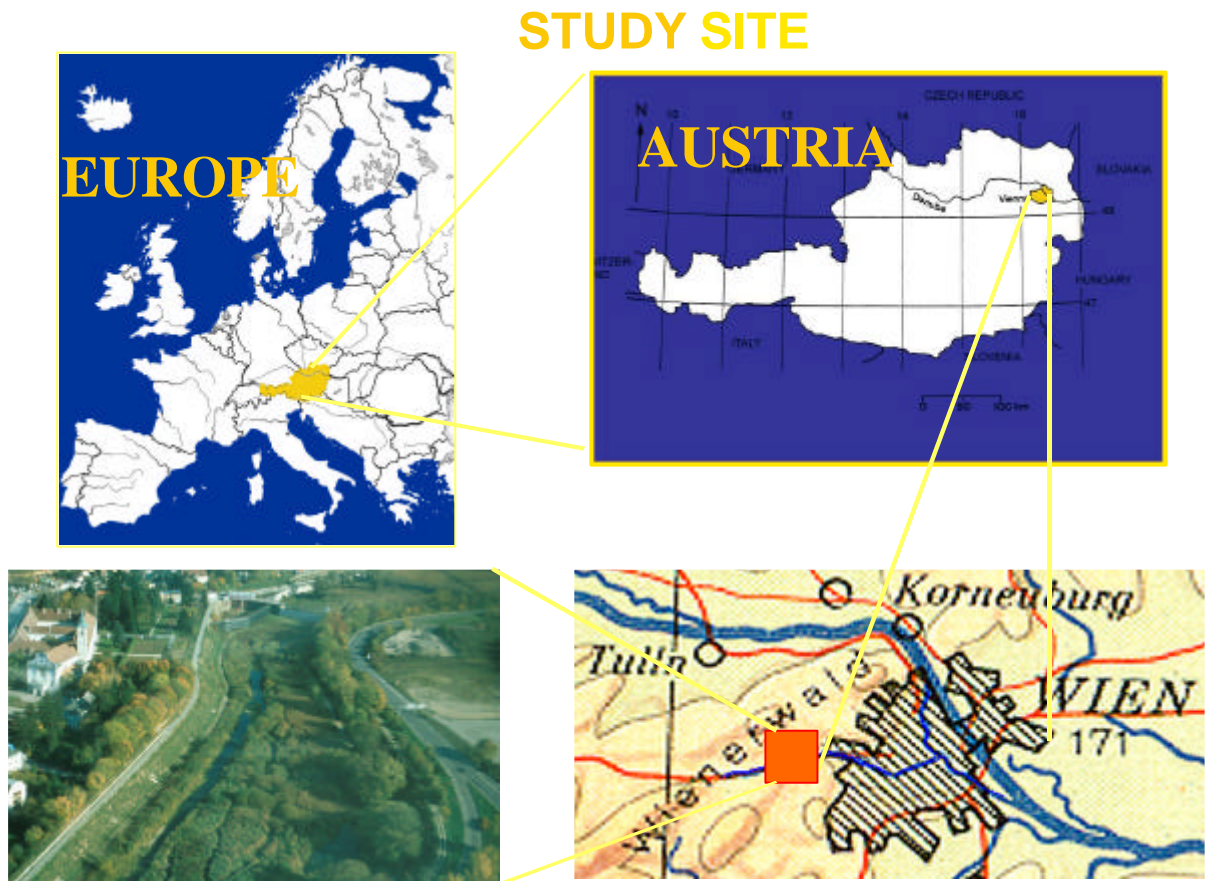


Figure 1 Study area

4.2 Socio-Economic Geography and Human Activities in the Catchment

The population in the catchment is about 490000 people with a population density of 5000 persons per km². The Wienfluss runs through the city of Vienna with a population of about 2 million inhabitants.

The history of river regulation in the Vienna section of the Wienfluss is closely related to urban development and was started in the 19th century in a large scale.



Figure 2 Downstream section of the Wienfluss at low water level and during the flood event of 1992. Due to the geological situation in the catchment area (Viennese sandstone, Flysch) there are great differences between low and high water levels.

4.3 Identification of Water Bodies

The section of the Wienfluss in the city of Vienna was divided into two different sections. Classification of both sections was made according to system A and B, according Annex II of the WFD.

Table 1 Result of classification according to system A and B (See Water Framework Directive (WFD, Annex II, 1.2 "Ecoregions and Surface Water Body Types), European Commission, 2000).

Descriptors	Classification
Ecoregion	Alps
Altitude	200–500 lowland
Size typology	River, stream order 5
Geology	Flysch

4.4 Discussion and Conclusions

The study area was divided into two sections. The upper one is characterised by minor

flood protection measures with minor anthropogenic impacts and a restructured subsection, the downstream section is heavily impacted by flood protection and urbanisation.

PART II

5 Physical Alterations

5.1 Pressures and Uses

The main human impacts on the Wienfluss river system in the case study area are caused by flood protection and urbanisation.

For the assessment of physical alterations the case study focused on flood protection as the most important use.

List of pressures and uses for the Wienfluss within the city of Vienna in order of importance

- Flood protection
- Urbanisation

5.2 Physical Alterations

The following physical alterations can be identified as the dominant impacts in this river system:

- Change in river profile
- Disruption of the river continuum
- Disruption of the sediment transport
- Channelisation / longitudinal straightening
- Bank reinforcement
- Detached ox-bow lakes / wetlands
- Change in river profile
- Change in the flow regime
- Reduced flow in the river bed

5.3 Changes in the Hydromorphological Characteristics of the Water Bodies and Assessment of Resulting Impacts

The main effects of the hydromorphological changes can be summarised as follows:

- Reduced fluvial dynamics
- Reduced longitudinal and lateral connectivity
- Large deviation from a type-specific reference condition

5.4 Discussion and Conclusions

The major influences on the morphology of the Wienfluss are alterations due to flood protection and urbanisation. For this case study report mainly data for the assessment of alterations due to flood protection have been evaluated.

Figure 3 Wienfluss upper section



Figure 4 Wienfluss downstream section



6 Ecological Status

6.1 Biological Quality Elements

Macroinvertebrates

Methods

The assessment of the macrozoobenthic coenosis of the Wienfluss within the city of Vienna is based on studies by Keckeis & Winterberger (1992), Katzmann & Forster (1996), Gattringer (2001) and Raudaschl (2001).

Due to the lack of a section of high ecological status as reference condition a section of a tributary system of the same river type was selected as reference (Mauerbach).

Results

59 species were found in the Wienfluss.

99 percent of all taxa belong to chironomids (25 taxa) and oligochaetes (14 taxa).

Ephemeroptera and Trichoptera show only small abundances in the whole river-stretch.

In the upper reach groups such as ostracods, nematods, trichoptera, other diptera and isopods could be found besides the dominant chironomids and oligochaetes.

The number of species decreases from the upper to the lower part of the river.

On the other hand the few species in the low structured lower reach show higher abundances than the species in the upper reach.

Hence the mean species number decreases from the heterogenous upper reach to the homogenous and monotonous lower reach.

Conclusions

In accordance to the WFD (Annex V, 1.2), following conclusions can be drawn:

- Upper section:
 - There are slight changes in the composition, abundance and diversity of invertebrate taxa from the type-specific communities of the Mauerbach
- Downstream section:
 - The composition and abundance of invertebrate taxa differ significantly from the type-specific communities
 - Major taxonomic groups of the type-specific community are absent
 - The level of diversity is substantially lower than the type-specific level and significantly lower than for good status

Summarising these results, the ecological status for the upper section can be classified as good (II) and for the downstream section as poor (IV).

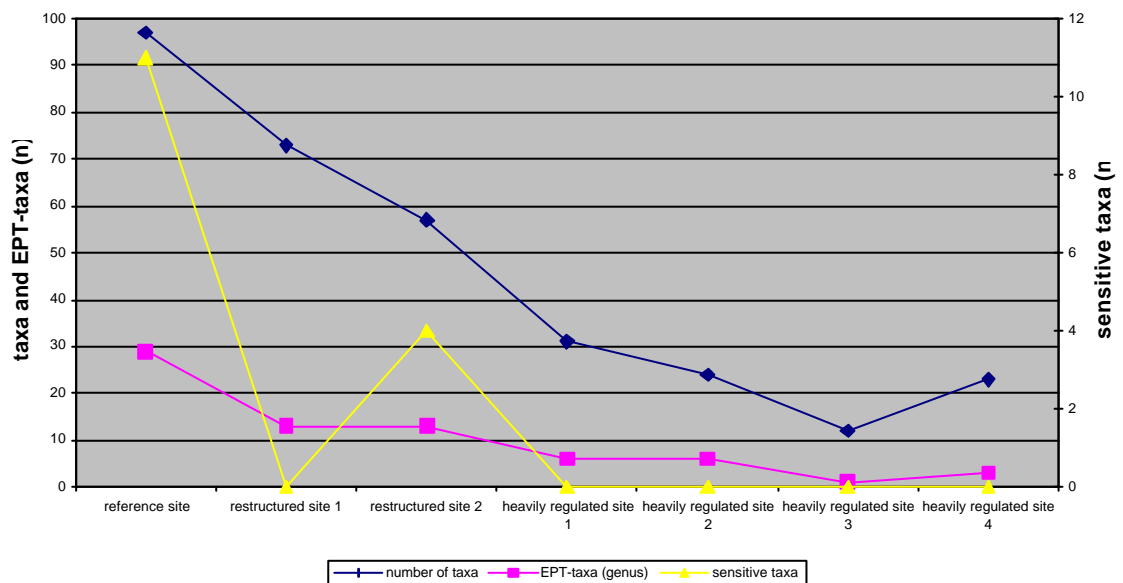


Figure 5 Comparison of a nature-like site (Mauerbach), two restructured sites (upper section Wienfluss) and four strongly impaired sites (downstream section Wienfluss; data from Gattringer, 2002)

Fish fauna

Methods

The assessment of the fish fauna of the Wienfluss within the city of Vienna is based on studies Keckeis & Winterberger (1992), Keckeis (2001), Schmutz et al. (2001) and expert judgment.

Assessment method

In principle, the assessment method used follows the procedure proposed by Schmutz et al. (2000) using 7 biological criteria according to the normative classification of the ecological status as described by the WFD (Tab. 2). For of the case study Wienfluss the parameters abundance and diversity were mainly used for the fish ecological assessment.

Table 2 Criteria and verbal definition of 5 levels of ecological integrity (Schmutz et al., 2000)

Criteria	Ecological integrity levels				
	1 high	2 good	3 moderate	4 poor	5 bad
(1) Type-specific species	none or nearly none missing	some species missing	several species missing	many species missing	most species missing
(2) Self-sustaining species	none or some missing	several species missing	many species missing	most species missing	nearly all species missing
(3) Fish region	no shift	no shift	shift	shift	shift
(4) Number of guilds	no guild missing	no guild missing	single guilds missing	many guilds missing	most guilds missing
(5) Guild composition	no alteration	slight alteration	substantial alteration	complete alteration	complete alteration
(6) Biomass and density	no or nearly no changes	slight changes	substantial changes	heavy changes	extremely changed
(7) Population age structure	no or nearly no changes	slight changes	substantial changes	heavy changes	extremely changed

Results

In the Mauerbach stream 19 fish species and in the upper section of the Wienfluss 17 fish species were found. The upper section of the river is dominated by the omnivorous cyprinid species chub (*Leuciscus cephalus* L.)

At the downstream section of the Wienfluss only 4 species of fish showing very low abundance could be observed.

The increased connectivity with a flood plain area is responsible for the additional occurrence of at least 10 fish species in the system.

Within a period of 3 years, a distinct sequence of different ecological guilds similar to

natural flood plains was observed along the longitudinal course of the newly created river system.

Different habitat configurations which correlate significantly with species number, fish abundance and fish species diversity could be distinguished.

The size structure of the fish communities indicate a deficit when compared to similar rivers.

Conclusions

In accordance to the WFD (Annex V, 1.2), following conclusions can be stated:

- Upper section:
 - There are slight changes in the composition, diversity and abundance of the fish fauna from the type-specific communities

- Downstream section:
 - The composition and abundance of fish fauna differ significantly from the type-specific communities
 - Major taxonomic groups of the type-specific fish community are absent
 - The level of diversity is substantially lower than the type-specific level and significantly lower than for good status

Summarising these results, the fish ecological status for the upper section can be classified as good (II) and for the downstream section as poor (IV).

6.2 Physico-Chemical Elements

A detailed information on the physico-chemical characterisation of the Wienfluss is provided by the national water quality monitoring system (WWK/UBA 2000).

6.3 Definition of Current Ecological Status

The definition of the ecological status for the Wienfluss within the city of Vienna was made by using the worst case from the classification with macroinvertebrates and fishes.

Table 3 Summary of the classifications for the Wienfluss in Vienna

	Macroinvertebrates	Fish	Ecological assessment
Upper section	2	2	2 - good
Downstream section	4	4	4 – poor

6.4 Discussion and Conclusions

The assessment of the ecological status quo is discussed in terms of two indicator groups, macroinvertebrates and fish, which are considered to be the most relevant groups for the assessment of flood protection.

The assessment for each indicator group was performed by using a type-specific approach.

The ecological status of the downstream section of the Wienfluss within the city of Vienna is characterised by a poor ecological status.

7 Identification and Designation of Water Bodies as Heavily Modified

7.1 Provisional Identification of Water Bodies as Heavily Modified

The case study area of the Wienfluss impacted mainly by flood protection, shows a variety of physical alterations and changes in the hydromorphological characteristics of the river.

The ecological status of the downstream section for this water body is classified as poor (4).

This section of the river could be provisionally identified as heavily modified due to the physical alterations, hydromorphological changes and the poor ecological status.

Aspects of necessary remediation measures to achieve good ecological status as well as the assessment of other environmental options and economic factors will be discussed in chapter 8.

Fig. 6 Downstream section of the Wienfluss



8 Definition of the Maximum and Good Ecological Potential

The ecological monitoring at the Wienfluss and the Mauerbach stream provides an essential basis of discussion on the natural reference condition and ecological potentials.

The following goals and measures have been set in consideration of the elaboration made by the entire monitoring team:

The general target of ecologically oriented measures taken at the Wienfluss is an increase in the structural diversity and dynamics of numerous physical, river-morphology, hydrological and biological processes. The reason is that the reference conditions of the Wienfluss - deduced from historic sources - must be described as follows: the Wienfluss was a dynamic system with a more or less constantly flowing main arm and several more or less well linked side arms, which were stocked with riparian vegetation. Floods often led to substrate shifts, creating new structures and pioneer sites, which could be populated by specialised species.

8.1 Measures for achieving the Good Ecological Potential:

- ensuring the continuous flow along the entire Wienfluss course enabling fish migration
- placing of water-type-specific substrates in the entire course of the Wienfluss (by way of cover fillings or opening of the bed). Attention is to be paid to the fact that substrate from the side streams can be transported into the main stream;
- complying with a weir code ensuring that all the weirs of the retention basis are kept open permanently and completely till the two-year flood water (HQ2 = 30 m³/sec);
- structuring measures to be carried out in the currently paved Wienfluss channel in order to obtain a higher heterogeneity of the current and substrate conditions (increasing the width and depth variance, the creation of shallow-water zones, promoting the riverside vegetation); creating refuge for fish and macrozoobenthos in the Wienfluss channel;
- extending the river-bank line, varying slope inclinations, and improvement of the river-bank structures through specific biology-engineering measures.

8.2 Measures for achieving the Maximum Ecological Potential:

The following additional measures are required to reach the maximum ecological potential as a state of reference for the Wienfluss – in the case of the designation of the Wienfluss as a "heavily modified water body":

- restitution of a far-reaching run-off dynamics, corresponding to the natural discharge regime. The hydrological dynamics of the Wienfluss is currently adversely affected by the Wienerwald water reservoir situated upstream of the study area

- improvement of the connectivity between Danube, Donaukanal ("Danube Channel" and Wienfluss in the sense of a macroscale river system approach.

8.3 Discussion and Conclusions

The rehabilitation measures so far taken in Wienfluss show that it would be possible to attain the target "good ecological potential", set by the EU WFD, provided that these measures are extended to the entire Wienfluss stretch.

Fig. 7 Rehabilitation measures increasing habitat diversity in upper section of the Wienfluss



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