

ESF Exploratory Workshop on

**Long Term Socio-Ecological  
Research of a European Watershed**

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**Towards an Environmental History  
of the Danube's Riverine  
Landscapes (ENVIRDANUBE)**

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Convened by:

**Verena Winiwarter, Martin Schmid, Ortrun Veichtlbauer<sup>①</sup>,  
Gertrud Haidvogel<sup>②</sup> and Martin Knoll<sup>③</sup>**

<sup>①</sup> Klagenfurt University, Institute for Social Ecology and Centre for Environmental History, Vienna

<sup>②</sup> University of Natural Resources and Applied Life Sciences, Institute of Hydrobiology and Aquatic  
Ecosystem Management, Vienna

<sup>③</sup> Technische Universität Darmstadt, Institut für Geschichte, Darmstadt

## 1. Executive summary

The workshop brought together 21 European and US experts across various disciplines from sciences and humanities to discuss a common framework of research questions and approaches as well as methods for an interdisciplinary analysis of the Danube River Basin (DRB). It was aimed at initiating a multi-national scientific network to work towards an environmental history of the DRB. In their contributions, participants established that **ongoing social, economic and political changes along the river course give historically and ecologically informed planning a certain urgency**. Intriguingly, no such project has been attempted before, despite the importance of the Danube, the second largest European stream after the Volga. As several presentations made clear, the Danube riverine environment has been the site of human intervention into land-cover and hydrology for millennia. A conceptual basis for the necessarily interdisciplinary research to study it was suggested in the notion of “socio-natural sites” during the first day of the workshop.

Presentation topics covered methodological approaches like the concept of social metabolism, information sources like e.g. topographical literature or an analysis of different narratives for environmental history of rivers. Historical analyses focused on floodplain colonization, river channelisation, flood protection as well as hydropower use in the Upper Danube and highlighted the role of key actors and groups and social perception of human interventions into the river. Changing geographies, the influence of policy on river management and ecological degradation were studied in the Danube Delta. Geomorphological and archaeological studies were employed in recent research projects for the middle and lower Danube to inform about long term changes of socio-ecological interactions. It is clear that any study of the Danube has to be put into the context of existing river studies. Presentations about the Nile, the Seine, the Havel, the Neva and the Drome River integrated experiences from ongoing environmental history studies of rivers into the workshop and added expertise on river and fish ecology as well as on fisheries.

Participants worked in groups and facilitated plenary discussions towards a research plan for the Danube, which was presented and discussed at the last day of the workshop. Two contributions, a conceptual keynote, and a presentation by a representative of the ICPDR, The International Commission for the Protection of The Danube River, strengthened the history-policy link of the workshop. So far, efforts at managing the river and, to some degree, the basin as a socio-ecological realm have not taken the necessary historical depth into account, when making assumptions about a relatively recent past as representing the “natural” state. Not only is this assumption most often wrong, to the contrary, historical legacies continue to influence the present and future developments and options alongside the river.

### **Main results of the workshop are:**

Establishment of a **database of researchers** currently dealing with the DRB at the Institute of Social Ecology, University of Klagenfurt, Austria. It will become available via a website in the near future.

The draft of a research plan guiding further work in the DRB. The co-ordinators of the **three parts of the research plan** will publish the final document on the web and work towards a printed version of the plan.

The "**Danube Environmental History Initiative**" (DEHI) was founded after the meeting. A **steering committee** for this initiative was set up to follow up on the initiative and secure its continuation. The steering committee consists of Christoph Bernhardt, Julia Lajus, József Laszlovszky, Mark Graham Macklin, Mariyana Nikolova, Didier Pont and Verena Winiwarter. The steering group will bring the Danube River Basin in comparative perspective to the attention of the research and environmental policy communities and see to the initiation of new research in a co-ordinated way. The steering group will co-operate in issues of funding, public relations, support for young scholars and the further development of the content of the research plan. A steering group meeting shall be held later in 2008.

A **submission to COST's open call**, titled SUSTAINABLE RIVERS IN EUROPE: INTEGRATED RIVER BASIN MANAGEMENT BASED ON COMPARATIVE LONG-TERM SOCIO-ECOLOGICAL RESEARCH. Several attendees of the workshop signed the COST pre-proposal as participants.

A possible **proposal for a conference to discuss river basin histories in a comparative way** which will include the Danube as one major basin.

Both, the COST proposal or other funding to be obtained will in part be dedicated to fostering the **development of high-potential young scholars from the Danube Basin countries**, many of which do have only limited access to the international scholarly community. An **environmental history summer university course** will be organized for interested academics, scholars and graduate students to present and to disseminate aims and methods of an environmental history of the Danube River Basin. A proposal for this course to be held in 2009 at Central European University in Budapest will be submitted in May 2008.

For the **Upper Danube** selected case studies of the research plan feasible on a short and midterm perspective will be integrated into a national **research proposal to the Austrian Science Fund (FWF)** to be submitted later in 2008. The **support of the International Commission for the Protection of the Danube River** will enable us to develop a strong policy link.

Infrastructures for research funding are very unevenly developed in the DRB countries, and in many countries are currently not fit to adequately support the DEHI initiative.

The Danube Environmental History Initiative is confronted with national research communities which do not regularly publish in other languages than their national language, despite the quality of their work. Communities are hampered by the lack of support for projects. The link between the sciences and the humanities is often very weak. Environmental history is underdeveloped, many of the basin countries are not even represented in the European Society for Environmental History (ESEH). All these constraints will limit the involvement of these communities, unless funding infrastructures are further developed to support international, interdisciplinary work.

While all rivers share important characteristics, each has unique natural and social aspects. Long-Term Socio-Ecological Research in Europe has not been developed in case studies involving rivers, nor has comparative research across river basins been attempted. The Danube Environmental History Initiative aims at addressing these gaps in our knowledge. If the Danube Environmental History Initiative is successful, it will shape the future development of this type of

research and be a major cornerstone of the new and dynamic field of environmental history in Europe.

## 2. Scientific content of the event

The workshop was structured in two phases. The first phase of presentations was aimed at providing an overview of the state of knowledge about the environmental history of the Danube River Basin (DRB), the second, interactive phase should lead to the identification of research questions. The outline of a way forward was expected as a result.

Case study and conceptual presentations on the first day provided the input and laid the groundwork for the facilitated group and plenary discussions during days two and three. Two thirds of the workshop were dedicated to exchange in groups. The convenors took great care in designing and facilitating settings in which cross-disciplinary, cross-national communication towards an innovative research design could happen.

The convenors, by defining the workshop theme “Long Term Socio-Ecological Research (LTSER) of a European Watershed – Towards an Environmental History of the Danube’s Riverine Landscapes”, had made clear that the workshop would be interdisciplinary. Presentations and participants had been selected with respect to their capability to contribute to the larger framework of LTSER of a watershed as a whole. Individual paper contributions came from a broad range of disciplines from the humanities and sciences.

To facilitate comparative approaches to the Danube River Basin (DRB) and to learn from better studied areas, attendees also introduced the state of research on the Colorado, the Nile, the Mekong, the Seine, the Rhone (with the Drome as one of its tributaries), the Elbe (with the Havel as a tributary) as well as on the Neva River.

The spatial extent of the Danube River Basin is vast. The river itself has a length of more than 2.800 km and the river basin covers more than 800.000 km<sup>2</sup>, currently in the territories of 19 states. It was therefore clear from the outset that the task of developing an integrated research agenda would be challenging.

### Overview about the individual presentations (Day 1)

An introductory presentation and a keynote lecture discussed possible conceptual common ground for an integrated, interdisciplinary Environmental History of the DRB. The initial presentation by **Martin Schmid** and the first keynote lecture given later in the day by **Verena Winiwarter** focused on providing a conceptual basis for a sustainability-oriented long-term research linking biophysical processes to human actions, governance and communication and considering patterns and processes across several spatial and temporal scales. Both presentations used the concept of socio-natural sites, defined as nexuses of human practices and material arrangements. Martin Schmid showed how this concept can aid the interpretation of historical sources on the Danube. Verena Winiwarter put LTSER into the context of the current state of Integrated Watershed Management and its shortcomings. Both presentations emphasized the importance of investigating historical legacies influencing the current situation because of their importance for future decisions and options in integrated river management. They suggested overarching common research questions requiring contributions of various academic fields.

Examples of questions addressed in an LTSER of the Danube included how human practices and material arrangements shaped fish population distributions, changed sediment characteristics, influenced access to clean water for rural communities, led to social conflict between actors, and created long-lasting legacies (e.g. power plants).

**Eva Jakobsson** contributed an overview of river history narratives. Influential environmental (hi)stories of rivers can be differentiated into two broad categories: The older narratives present the river as an object of human domination, as degraded, even “killed” by humans through technical transformation and degradation, more recent co-evolutionary approaches such as Richard White’s “Organic Machine” take a less declensionist approach without denying the major changes induced by humans. **Martin Knoll**’s presentation dealt with Early Modern topographical literature as a source for the perception and cultural representation of rivers. Knoll emphasized that perception is the basis of all human action and hence a necessary part of any study of environmental history. **Ortrun Veichtlbauer** described the role of the Austrian state and that of private companies on the Upper Danube in Lower Austria as key actors in river regulation (for transportation) and hydropower use. This talk was presented by Verena Winiwarter. **Fridolin Krausmann** demonstrated how the concept of social metabolism can be utilized for examining river functions in urban development. He discussed long-distance connections of bulk commodities made possible by river transport and, more generally, rivers as modulators of the metabolism of the cities on their banks. **Sabine Barles**, who spoke later that day, offered a comparative opportunity, as she uses the concept of social metabolism in her studies within the project PIREN-Seine. She argued that material flows link society and biosphere, and showed that urban impact on the distribution of elements such as nitrogen or heavy metals changed markedly over time, and differs with different technologies. River-city-hinterland relationships are a main causal factor in elemental distribution patterns.

**Gertrud Haidvogel** presented the Machland Case Study, a Danube section along the border of Lower and Upper Austria discussing long-term land-use changes in areas governed by fluvial dynamics: Whereas earlier societal response was adaptive, later on regulation became the rule.

Two contributions came from a geomorphological perspective. A study of the influence of land use and population change on sedimentation processes in rivers on basin scale was presented by **Didier Pont** for the Drome river in France. This study of a gravel bed river, a tributary of the Rhone, took its starting point in the 19<sup>th</sup> century and followed aggradation and incision processes until the present. Rivers are very sensitive to climate fluctuation, one of their reactions are changes in floods, with ensuing changes of settlement patterns. **Mark Graham Macklin** showed this link as studied through long-term sediment analysis including <sup>14</sup>C-determination methods. These methods can also help to study historical legacies, particularly toxic pollution from past mining activities; a database covering a large number of sites from the Lower Danube is available. **Monica Georgescu** focused the Danube delta, giving an overview of important features of the geography and in particular discussing the various channel projects, old and new, which is a main political influence on river ecology.

Two presentations dealt with hydropower use in the Danube and its alpine tributaries. **Marc Landry** highlighted the role of individual personalities as key actors for propagating large scale projects in the Bavarian Alps in the late 19<sup>th</sup> century. As he could show, the dream of “White Coal” is to be considered as a major influence on river dynamics already in this period. **Viktor**

**Pal** described another aspect of dam projects; he discussed the Gabčíkovo-Nagyymaros dams in Slovakia and Hungary in terms of their social acceptance and rejection.

Archaeological approaches were presented for the Danube in Hungary. **Attila Toth** gave an overview of the potential of including archaeological investigations into the long-term study of the Danube basin. He pointed out that of the ca. 55.000 archaeological sites in Hungary, 140 confirmed underwater sites might be of special relevance to the project, as these sites allow reconstructions of trade, forest use and more general, the use and functions of the river for the riverbank communities. **József Laszlovszky** showed that the reconstruction of floods and reactions to them needs a multi-source approach, combining documentary, archaeological, and sedimentary records. Floods do show up in the archaeological data, in the past, they have not been of major interest to archaeologists, but the potential of archaeological investigations for reconstruction of river dynamics is high.

The workshop aimed at taking stock of the current situation of research into the long-term development of the Danube River Basin (DRB), but also to incorporate the experiences made in other river basins into the plans for further development of DRB research. One of these presentations, by Sabine Barles, was already mentioned. **Christian Wolter** contributed his research on the Havel river and discussed the biological concept of resilience for studying long term impacts of dams on fish communities. In particular, he stressed the disastrous effects of historical timber floating on fish communities. **Julia Lajus** highlighted the cultural meanings of fish and fisheries and focused on the role of migratory fish as a link between marine environments and riverine basins, using the case of Neva river and St. Petersburg, where the historical ecology of fish and fishing is already well studied. Finally, an entire research program was presented. **Tore Saetersdal** and **Terje Oestigaard** introduced the “Nile Basin Research Programme”. They introduced their approach for describing the role of water in history and development (“waterscapes”) in a long-term perspective.

### **Presentation and group discussion (Day 2)**

The second day started with a first phase of discussion in groups. Four interdisciplinary groups discussed “International River Policies”, „Sediments of Time“, “River in the Mind” and “Scales in time and space”. Group work aimed at developing a common understanding of group members and allowed a recapitulation of the breadth of the presentations of the first day. Their layout and results are described in detail below. The first group work phase was followed by the second conceptual keynote lecture, which focussed on the link between history and policy.

**Melinda Laituri** dealt with management of ‘water as a unique resource’. It is unique, so Laituri argued, because of its transboundary quality, both, physical and ecological as well as spatial, it is further unique because of its multiple uses and the ensuing complexity of policy aspects. Policies are also complex because water is often a means to another end, such as power, transportation, or general economic development. Laituri also presented an opportunity for co-operation: At Colorado State University, a project is in the making which uses dams to study management policy and practices in a comparative manner for the Nile, Mekong, Danube and Colorado river.

### **Results of Group Discussions and Plenaries**

Work in groups and plenaries on the second day aimed at laying the conceptual groundwork for a research plan to co-ordinate future activities by the network of researchers present at the workshop and by additional members identified by workshop participants. Steps towards this end were to identify common research interests as well as methods applicable and requirements for combining methods from the humanities and sciences.

In the first group phase, main research topics were discussed, with the following results: The “*International river policies*”-group suggested to identify different “political-ecological regimes” in the Danube River Basin’s past; the role of warfare in shaping socio-natural sites should be investigated and historical models of co-operation between up- and downstream abutters analysed; the group emphasized the potential of studying historical legacies to support current Danube River Basin Management.

The “*sediments of time*”- group suggested to investigate how environmental change manifests in bio- and geoarchives, archaeological and sedimentary records. Given the multi-national character of current research, no joint dating resource exists which would allow to join chronologies. Radiometric dating of sediments and archaeological methods should be improved and combined to allow conclusions across sites, in particular a long term perspective on environmental change since the Meso-Neolithic transition. Documentary sources and instrumental records are essential for research on a mid term scale (from antiquity and the 18<sup>th</sup> century onwards, respectively).

The working group on “*Scales in time and space*” concentrated on methodological questions and suggested to focus on the societal and ecological functions of rivers. For different time scales adequate approaches have to be contributed from both humanities and environmental sciences. Interdisciplinary pilot projects should start on specific sites where a LTSER can be based on existing knowledge and research. The group emphasized the different societal and ecological functions of rivers depending on the scale of research, e.g. for transport, energy use, food supply, river regulation and flood protection. Changes of river functions on different scales could be visualized on historical thematic maps.

The “*Rivers in mind*”-group emphasized the spatial distribution of different functional roles of the river e.g. for urban centres, recreation areas or fishing centres as research issue. Studies should address the Danube River as a separating and connecting force.

The second group phase was organised in three rather disciplinary coherent groups discussing methodological issues. Each group (*History, Archaeology/Paleosciences* and *(Social) Ecologies*), discussed sites, periods and methods, taking into account the research questions identified in the previous session and possible history-policy links.

The groups identified basic research issues and core questions of an environmental history of the DRB. Workshop participants agreed that an LTSER of the DRB shall contribute to current watershed management by highlighting historical legacies. History should be linked with current policy, therefore **research interests** were discussed in combination with **problem driven issues**.

The results were compiled and assessed through group reports to the plenary and discussed further by the entire group. This resulted in the compilation of the following overarching questions and themes:

- What are the lessons from studying historical legacies for nowadays DRB management?
- Which political-ecological regimes existed and exist in the DRB?

- What are the manifestations of environmental change (human + natural, including climate) in bio- and geoarchives, archaeological and sedimentary record?
- The river as boundary, border and frontier
- Transportation: the river as means of connection
- River regulation, flood protection and dams
- River cities and their hinterlands
- Spatial distribution of functions changes over time. The preparation of time-layered thematic maps was suggested to visualize these.

The last plenary phase of the day aimed at mapping these issues onto a room-size map of the Danube watershed (Fig. 1).

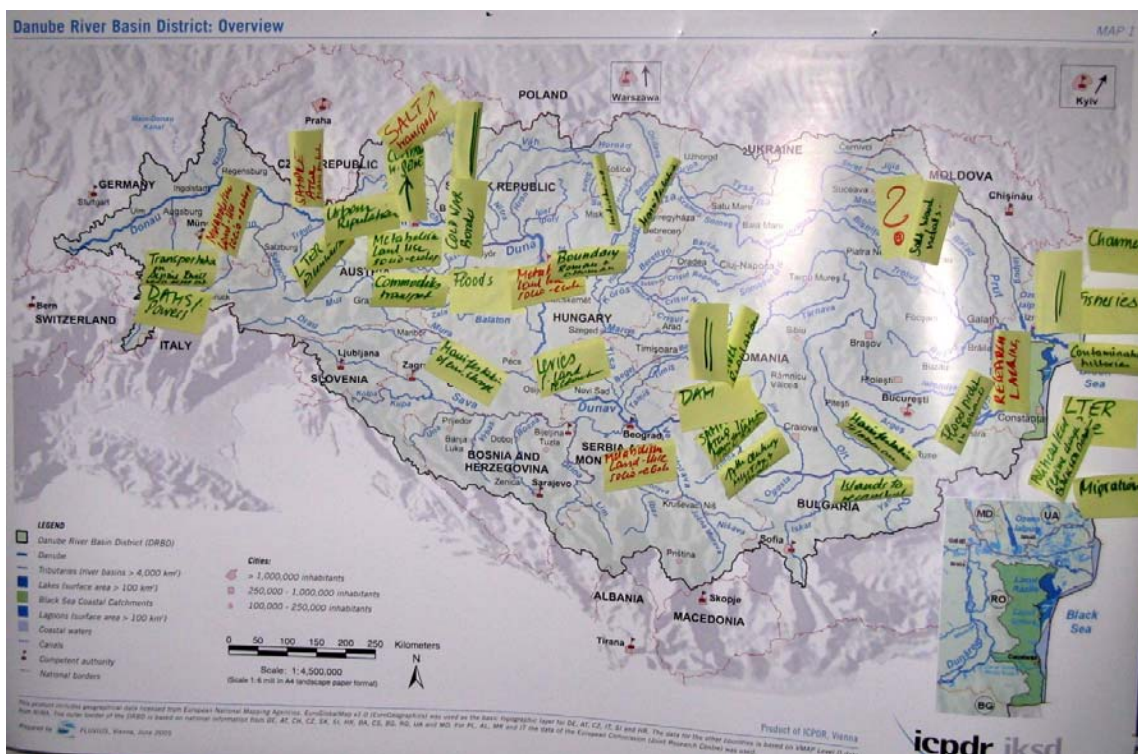


Figure 1: Map with research topics allocated to specific areas of the DRB as result of plenary discussion.

### Towards a research plan (Day 3)

The morning of the third day started with a summary by Verena Winiwarter, which comprised both all presentations of the first day and the results of the second day's work to enable participants to recollect important insights and contribute them to the last day's work.

Thereafter, **Birgit Vogel**, representative of the International Commission for the Protection of the Danube River (ICPDR) presented the work of the commission. Her assessment that current environmental problems are very different in the DRB's sections proved particularly important for the later work in structuring the planned research programme. While Birgit Vogel made clear that ongoing Danube River Basin Management would benefit from knowledge from a long-term



socio-ecological research on a sound empirical basis, it also became clear that such a perspective had not been integrated so far.

The European Science Foundation and its funding opportunities for research and networking were presented by ESF representative **Rüdiger Klein**.

### **Towards a research plan: regional groups**

The rest of the workshop was dedicated to the preparation of a research plan. Drafts were prepared in three groups focusing on upper, middle and lower Danube respectively. Each group defined “section-specific” and general “research issues”.

### **Long-Term Socio-Ecological Research in the Danube River Basin. A plan for action.**

In presentations and discussions during the workshop it had become clear that not only the state of development of research in the DRB countries is different, but the river itself changes its characteristics along its course fundamentally. An overarching LTSER has to address differences in current environmental problems in the upper, middle and lower DRB without losing sight of overarching issues and up-downstream connections. The three parts of the research plan were presented by the main responsible coordinators of each group towards the end of the workshop in a first draft version. The research plan is the most important outcome of the workshop and is presented hereafter in a version refined by group co-ordinators after the workshop, it is work in progress and the parts are at the moment unevenly developed. The plan will serve as a starting point and basis for future activities of the network (in particular for the steering committee, see chapter 3 for details). It allows further discussion aiming to integrate the approaches of the three parts.

### **Part I: Research plan for the upper DRB**

Coordinated and prepared by Gertrud Haidvogel, Martin Schmid (Aut); with contributions from Sabine Barles (F), Martin Knoll (Ger), Fridolin Krausmann (Aut), Marc Landry (US) and Didier Pont (F)

#### **Problem driven issues in the upper DRB**

*Hydromorphological change and pressures* are the major environmental challenges in today's management of the upper DRB. The Danube and its tributaries in the section from the headwaters downstream to the point where the stream crosses the former “Iron Curtain” at the Austro-Hungarian-Slovakian border can be characterized as alpine rivers. A series of *hydropower* plants tapping the water's energy transformed the aquatic socio-ecological riverine systems fundamentally and thoroughly. To give but one example, less than 50 km of the 321,5 km of the Danube in Austria are still free flowing. Hydropower plants are vivid examples of (almost) irreversible human interventions into the riverine socio-ecological systems. As their case shows, current management needs to be informed by the study of institutional, political, social, ecological and mental *legacies* from the past. Hydropower is a section-specific trajectory for hydrological change and, because of its side effects on the rivers' ecological systems, contested in the debate about the implementation of the *European Energy Directive*. In Austria, for example the conflicts about hydropower are considered the cradle of country's politically established

environmental movement. The implementation of the European Energy and other European directives, especially the *Water Framework*-, but also the *Flood*-, and the *Flora-Fauna-Habitat directive*, constitutes a major issue in the entire DRB. Because of the dominance of hydropower, flood protection and navigation and the contradictions between the different goals of these directives (e.g. biodiversity vs. energy generation), questions of *inter-resource transfer*, *substitution of resources and problem shifts* are of particular importance in the upper DRB.

The upper is the only part of the DRB being hydrologically connected to another major *European watershed*. The opening of the Rhine-Main-Danube channel was a crucial point in the long history of in most cases utopian and never realized plans to form trans-European networks crossing the continent's major watersheds. Environmental histories like these contribute to the current debate about (re-)constructing the Danube as a main *navigation route* in *Trans-European Networks (TEN)*.

### **Approaches to cross-cutting issues**

*Flood protection* is a cross-cutting issue which plays out in site-specific ways in the upper Danube basin. It is a cause of growing concern in German and Austrian public, in particular in connection to global *climate change* and its estimated effects on hydrological cycles. Living with and even from river floods was a major issue in the upper DRB's past and one could learn from historical practices in dealing with floods in the upstream regions to improve sustainable management of downstream floodplains today. The same is true for environmental problems like *pollution*, with a focus on the *contamination of soils* in floodplains and the *nutrient flows* between aquatic and terrestrial ecosystems through agriculture.

In an age of growing urbanisation, river-city dynamics gain importance. Munich at the Isar and Vienna are two big *cities* in the region which underwent a highly dynamic process of *urban agglomeration* between the 18<sup>th</sup> and early 20<sup>th</sup> century. Studying *river-city-hinterland relations* with the concept of *urban metabolism* for the case of Vienna (to be compared with Paris in the Seine watershed) and of smaller *power centres* in the region, wherever possible in a long-term perspective back to Roman times (like Regensburg and Carnuntum), shall serve as examples to understand similar present processes and their social and ecological effects on the riverine systems in the DRB's other parts.

Changes in *borders and demarcations* related to the course of the Danube and *migration* processes resulting out of these changes have been big issues in upper DRB's history and are currently big issues in other parts of the DRB. For centuries the Roman Limes along the Danube was a solid frontier, but also a zone of intercultural exchange. The Danube itself was a route for (military) navigation integrating large parts of the Roman Empire. In early modern times people were expelled from the upper DRB because of their religious denomination and migrated eastwards, taking with them practices of land- and water-use. People and knowledge moved downstream to other parts of the DRB.

The study group for the upper DRB emphasizes the *unique position of the humanities* within the larger framework of long-term socio-ecological studies. The retrospective approach in environmental history, trying to track back and identify the historical roots of current environmental problems, seems particularly fruitful in studying the socio-ecological transition about 1800 which resulted from the introduction of fossil fuels. But the current situation also has to be linked to historical, archaeological and geoscientific research for the times before industrialization. Research based on the concept of urban metabolism for example shall be,

wherever possible, enhanced, rethought and based on (proxy) data for earlier times. How societies faced and dealt with river-related sustainability problems has to be studied in *solar energy based regimes* and hence under fundamentally different socio-ecological conditions compared to the present. This enables to reflect and rethink current indicators and parameters for sustainable development. *Hopes and expectations surrounding natural resources* in the past, like the “white coal” in the late 19<sup>th</sup> and early 20<sup>th</sup> century, and their historical legacies, should be studied to contribute to the current debate on options for energy supply.

Focusing on the “*rivers of mind*”, the group for the upper DRB aims to contribute to a LTSER of the DRB by studying *cultural representations and human perceptions* of socio-ecological interactions related to the river in the past. The role of the river in a region’s *identity* – what a river means for the humans living on its course and how the stream is perceived by them – is deeply rooted in the common history of humans and rivers. Understanding this cultural side of human interactions with riverine systems is a prerequisite to design participative processes and therefore immediately linked to present river management.

### **Research topics for an LTSER of the upper DRB**

The research topics identified aim at investigating the long term dimension of the problem-driven research issues. They focus on the alteration of natural characteristics of rivers and riverine landscapes (e.g. influence of dams, embankments, dykes as well as of changing land use/cover on discharge, bed load and sedimentation processes), the development of social needs and resulting socio-ecological interactions (such as transportation, basin/floodplain colonisation, food supply or waste water management) as well as on changing cultural (perception and representation) and political aspects (property regimes, rivers as connection and frontiers/borders). Most research topics contribute to both, site specific (A) as well as cross cutting issues (B). An overview about the contribution of the different topics to site specific and cross cutting issues is shown in the matrix below.

Existing hydro-morphological pressures are a consequence of the construction of dams, embankments and dykes along the Danube and its tributaries as well as of changing land use/land cover in the basin. Human-induced alterations of *discharge and sedimentation processes* will be studied to consider in particular unintended side effects of interventions, requiring at present intense and complex sediment and bed load management. Similar processes can be analysed from the late Middle Ages onwards, when it was e.g. stated for the Salzach river that changes of land cover in the basin were a reason for increases in bed load transport. In contrast, river basin management practises in the 19<sup>th</sup> and 20<sup>th</sup> century frequently led to channel incision. In the 19<sup>th</sup> and 20<sup>th</sup> century the *colonization of floodplains and flood-protection measures* added to existing hydro-morphological pressures.

Against the background of conflicting objectives of European laws (such as the Water Framework, Energy and Flood directive) the construction of *dams and hydropower production* can illustrate how contradictory human resource needs were dealt with in the past. Hydropower use is also strongly linked to urbanisation/urban development and to the establishment of power centres and it can serve as a case study for analysing changing perceptions and meanings of nature and the establishment of “common histories” along rivers.

*River-City-Hinterland relations* and the *competition between urban centres* along rivers shall be studied based on the concept of urban metabolism to elucidate the river’s role for urbanization, inter-

resource transfer and the spatial transfer of problems caused by navigation or on hydro power production. The urban metabolism study will also allow to address causes for increasing negative environmental feed-back mechanisms created by up- and downstream connections (e.g. flood protection and floods or increasing water quality impacts and pollution).

Urban development and the establishment of power centres shall be studied in a long term perspective by focusing on the importance of the Danube for the establishment of the *Roman Limes* and the foundation of Carnuntum.

Research on urbanisation in different areas along the Danube in the 20<sup>th</sup> century will highlight the effects of the *Iron Curtain*. The latter research topic should contribute to the cultural perspective and investigate the *representation of socio-ecological interactions* by studying the river's role as connection on the one hand and as border on the other hand. Policy perspectives shall be studied in terms of the interdependencies between resources use, human interventions and perceptions of rivers on the one hand and *property regimes and legal systems* (cp. research plan for the lower Danube) on the other hand.

Due to the construction of sewage treatment plants and reduced emission from pollutants water quality impacts - at least from point-sources - in the upper Danube are no longer a major environmental impact. However, accumulated contaminants in soils can be considered as historical legacy putting unpredictable risks to restoration projects. Long term historical analyses of *nutrient, hazardous and toxic substance input* can contribute to reduce these risks and help to make possible consequences better calculable.

Urban centres and urbanisation processes in pre-industrial societies depended heavily on sufficient wood supply from "Hinterland" areas. Prior to the construction of terrestrial connections rivers were main routes for *wood transport*. The decreasing importance of wood transport on rivers is also a consequence of the change from solar energy based to fossil energy based societies. Analysing the role of wood transport since the 14<sup>th</sup> century can thus highlight energy substitution and problem shifts possible due to this substitution.

Long term human impacts on river fish populations are strongly linked to timber floating. The decline of the importance of *fisheries* along the upper Danube in the 20<sup>th</sup> century is the effect of different factors. Fish stocks have been impacted by human interventions for centuries, fisheries were always conflicting with other resource functions of rivers. In addition to timber floating, hydropower production and channelisation were the most important impacts, and it has to be recognised that fishery itself was often performed in a non-sustainable manner and contributed itself to a decrease of fish stocks.

The Danube was a *main navigation route* and human interventions in terms of *regulation and channelisation* date back to the 13<sup>th</sup> century, especially in urban centres such as Vienna. Access to resources and upstream/downstream exchange will demonstrate the role of the river for the transfer of goods and people, resulting influences on urbanisation and competing development of urban centres. The *Rhein-Main-Donau channel* connects the Danube to the Rhine as one of the most important rivers for navigation in the world. The study of the history of this major feat of hydrological engineering is an excellent case study for the long term history of planning and constructing of inter-European navigation channels up to the recent establishment of the Trans-European Network for navigation.

### **Feasibility: Local and regional case studies in the upper DRB**

This part of the research plan distinguishes between possible **pilot projects**, where the study group has the necessary know how and has already conducted preliminary work for the sites and research topics (marked with “+++” in table 1 and 2), possible **case studies** that could be done in a **mid-term** perspective of 3-5 years, if national research grants are provided and additional competences are brought into the group (++) and **envisaged projects** that could be realized in the **long run** of more than 5 years (+). The classification of each proposed case study also depends on the specific case study’s temporal perspective, e.g. the proposed project investigating river city-hinterland relationships in the case of Vienna can be done as pilot project (+++) if it starts c. 1800; if it starts in early modern, medieval or even earlier times, its realization should be planned within a midterm perspective (++) .

### **Possible pilot projects (+++) in the upper DRB**

Due to the dominance of hydropower in the upper DRB and its hydromorphological, social and often irreversible ecological consequences at least one of two possible pilot projects related to this issue should be considered as highest priority. *Ybbs-Persenbeug* is one of the bigger run-of-river hydroplants in the upper Danube and, commissioned in 1959, the oldest in Austria. Plans for power generation at Ybbs-Persenbeug date back to 1938 when Austria became part of national-socialist Germany and the transformation of the Danube and Austria’s alpine landscapes gained importance in Third Reich’s energy politics. Located in the lower Austrian part of the Danube near the “Strudengau” its commissioning after WW II is just one, though crucial point, in the much longer history of river regulation for navigation from the first half of the 19<sup>th</sup> century onwards. The pilot project “*Walchenseewerk*” in upper Bavaria makes the importance of a watershed perspective for a LTSER on the DRB clear. Hopes surrounding the new resource “white coal” and contemporary enthusiasm for electrification in the early 20<sup>th</sup> century were in the beginning based on military and technological considerations. Completed by 1924, the implementation of Walchenseewerk resulted in fundamental changes of the land: The Isar river, one of the major Danube tributaries in the upper DRB with Munich on its course, was diverted for a stretch of 45 km and two lakes were transformed into reservoirs. The link between hydroelectric development and processes of urbanization and industrialization has not been investigated so far and should be a focus of the proposed pilot projects in combination.

The status of current research for the common environmental history of *Vienna* and the Danube is promising compared to other major conurbations along the rivers’ course. This pilot project suggests investigating the *urban metabolism* of Vienna related to the river, its local tributaries (like the urbanized river Wien) and its effects on the hinterland. In terms of amount, water currently has the largest share of material flows into and out of cities. Research on the wood supply of Vienna in the 1840s shows that Vienna drew a considerable amount of its material from regions as far as Bavaria. The river facilitated transport of bulk resources and therefore had an important supply function for the city. River-city-hinterland relations, the supply but also the sink function of the river could be studied in comparison with Paris in the Seine river basin, where the urban impact on biogeochemical cycles (in particular Nitrogen flows) and the consumption of heavy metal resulting in contamination of riverine soils has been investigated for several years already. An added value of this pilot project can be expected if similar projects could be initiated for other capitals in the DRB, in particular for Bratislava, Budapest or Belgrade (cp. research plan for the middle DRB).

### **Projects possible in a midterm perspective of 3-5 years (++) in the upper DRB**

River-city-hinterland relations in the case of Vienna cannot be understood without identifying its impact on the Danube's upstream tributaries. The *Traisen* river with its artificially changed lower section and dislocated confluence c. 40 km upstream of Vienna is one of the better investigated tributaries in the upper DRB. Research on the interaction between the increasing colonization of floodplains in the late 19<sup>th</sup> and during the 20<sup>th</sup> century and the planning and construction of flood protection measures exists. Historical sources from the late Middle Ages onwards would allow studying property regimes and legal systems adapted to the changing course and dynamics of the river.

The rivers *Möll and Drau/Drava* (cp. research plan for the middle DRB) as well as the rivers *Salzach and Inn* are case studies for the long term use of rivers for navigation and wood transport. In contrast to wood supply from "Hinterlands" to large cities like Vienna wood transport on these Danube tributaries was mainly linked to mining and metal processing industries. The example of the river Möll can highlight basic changes from the decentralized hydropower use of pre-industrial solar-energy based societies to modern centralized hydropower production characterised by relatively few, but massive dams and plants. The increasing colonisation of flood plains for the establishment of settlements and intense agriculture especially in the 20<sup>th</sup> century can be studied in a comparative way, highlighting the influence of different natural and socio-economic characteristics. The main human interventions such as dams for hydropower use and timber floating, embankments for navigation and dykes for flood protection can be studied on a long term perspective since the 14<sup>th</sup> century. Alterations of the natural characteristics of these case study rivers shall be analysed in terms of the fish fauna and changes of discharge and sedimentation processes. The Salzach river and in particular the city of Salzburg can in addition demonstrate changing cultural representation of rivers.

Representative for the smaller left side tributaries of the Danube the river *Aist* shall be analysed especially in terms of wood supply of larger cities and the influence of property regimes on resource use.

The city of *Regensburg* shall be a comparative case study site to the analysis of urban metabolism and river-city-hinterland relations in Vienna.

Located in the intersection of Lower Austria, Styria and Upper Austria the *Enns-Eisenwurzen* region is characterized by early industrialization due to metal processing. To date, research has focussed on the history of land use and land cover change from the 19<sup>th</sup> century onwards, in particular on reforestation. A project within the framework of a LTSER of the DRB should combine this research with questions of river- and water-use with respect to energy supply and the effects of land cover change on hydrology. All these research questions have not been investigated in linked form up to now. The project could gain added value from cooperation with ecologists working in the framework of one of the three long-term ecological (LTER) sites in the DRB located in the Eisenwurzen region. Because of the long history of industrialization an attempt to use a long-term, socio-ecological perspective for this project should be made to study developments and changes at least from the late Middle Ages onwards.

### **Projects possible in a long-term perspective (+) in the upper DRB**

The *Wachau*, a part of the river valley of the Austrian Danube was enlisted as UNESCO Cultural Heritage in 2000. It is therefore an ideal case study site especially for investigating changing meanings of rivers and representations of socio-ecological interactions.

The Danube along the *Lower Viennese Basin/Marchfeld* has undergone several changes from its time as power centre during the Roman period (Roman Limes and Carnuntum) up to “green” movements and protests against the construction of hydropower plants in the late 20<sup>th</sup> century. Due to the fact that the floodplains along this Danube section were never colonised for settlements and intensive agriculture, flood protection measures are limited and part of this area belongs nowadays to the Alluvial National Park Danube Floodplains (“Nationalpark Donau-Auen”). Here, competing interests and resulting interventions into the river and its floodplains can be studied.

*Munich* is today one of the biggest urban agglomerations in the DRB, located not on the Danube’s course but at the right side Isar tributary. Therefore a project on the river-related history of Munich as one of the power centres in the upper DRB from the 13<sup>th</sup> century onwards would allow comparisons with Danube capitals such as Vienna and Budapest. So far there are no researchers in or known by the study group acquainted with the environmental history of the Bavarian capital.

Table 1: Contribution of the case studies to research topics and their feasibility in the Upper DRB

Local & regional case study /research topics	Discharge and sedimentation processes (1)	Property regimes/legal systems (cp.LD) (2, 10, 11)	Competition of urban centres (3, 5)	Nutrient inputs, river as sink (4)	Wood transport, mining, salt (5, 3)	Floods, colonization of floodplains, flood-protection (1, 6)	Navigation and transport, regulation, channelization (5, 7, 8)	Rhein-Main-Donau-Channel (8, 9)	Representations of socio-ecological interactions (10)	River-City-Hinterland; Urban Metabolism (3, 4, 5, 6)	Fish fauna and fisheries (esp. impact of logging) (1, 6, 2)	Hydropower and Dams (1, 2, 3, 10)	Iron Curtain, Roman Limes (3, 10, 11)
period from	from 1350	from 1200	from 0	from 0	from 1350	from 1200	from 0	from 800	from 0	from 1350	from 1350	from 1850	from 0
A = Aist		++											
E = Enns (LTER Eisenwurzen)	+				++	++				+	++		
M = Munich			+		+								
MD = Mül/Drau					++	++					++	++	
R = Regensburg			+++		++	++		++		++	++		+++
SI = Salzach/Inn (Salzburg, Passau)	+	+++			++	++	++		+++		++		
T = Traisen		+++			++	+++			+++	+++	+++		
V = Vienna		++	+++	++	++	+++	+++				+++	+++	+++
W = Walchenseewerk												+++	
WA = Wachau							+		+				
WM = Viennese basin/Marchfeld	+		+	+									+
Y = Ybbs-Persenbeug	++										+++	+++	



Table 2: Problem driven issues (the section-specific are highlighted in blue) related to research topics as well as to contributing case studies

period from	research topics	Problem driven issues										
		(1) Hydro-morphological pressures	(2) Implementation of WFD, Energy-Flood-Directive, FFHabitat Directive	(3) Urbanization, urban development, power centres	(4) Pollution	(5) Inter-resource transfer, substitutions and problem-shifts	(6) Floods and flood protection	(7) Navigation	(8) Trans-European Transport Networks (TEN-T)	(9) Connection of European Watersheds	(10) Meanings and perceptions of the river	(11) River as frontier, boundary, border
from 1350	Discharge and sedimentation processes (1)	V++ SI+ E? Y++ WM++										
from 1200	Property regimes/legal systems (cp.LD) (2, 10, 11)		V++ T++ A++							V++ T++ A++	V++ T++ A++	
from 0	Competition of urban centres (3, 5)			V+++ M? R+++ WM (Carn.)++		V+++ M? R+++ WM (Carn.)++						
from 0	Nutrient inputs, river as sink (4)				V++ WM+							
from 1350	Wood transport, mining, salt (5, 3)			V++ R++ M? E++ SI++ MD++		V++ R++ M? E++ SI++ MD++						
from 1200	Floods, colonization of floodplains, flood-protection (1, 6)	V+++ E+ SI++ MD++ WM++ T++				V+++ E+ SI++ MD++ WM++ T++						
from 0	Navigation and transport, regulation, channelization (5, 7, 8)					V+++ WA++ SI++	V+++ WA++ SI++	V+++ WA++ SI++				
from 800	Rhein-Main-Donau-Channel (8, 9)							R++	R++			
from 0	Representations of socio-ecological interactions (10)									V+++ R++ WA++ SI (Sb., P)++ T++		
from 1350	River-City-Hinterland; Urban Metabolism (3, 4, 5, 6)			V+++ (cp paris) R++ M ?	V+++ (cp paris) R++ M ?	V+++ (cp paris) R++ M ?	V+++ (cp paris) R++ M ?					
from 1350	Fish fauna and fisheries (esp. impact of logging) (1, 6, 2)	V+++ E++ SI++ MD++ Y+++	V+++ E++ SI++ MD++ Y+++			V+++ E++ SI++ MD++ Y+++						
from 1850	Hydropower and Dams (1, 2, 3, 10)	W+++ Y+++ MD++	W+++ Y+++ MD++	W+++ Y+++ MD++						W+++ Y+++ MD++		
from 0	Iron Courtain, Roman Limes (3, 10, 11)			V+++ R+++ WM++						V+++ R+++ WM++	V+++ R+++ WM++	

## **Part II: Research plan for the middle DRB**

Coordinated and prepared by József Laszlovszky (Hun); with contributions from Terje Oestigaard (Nor), Victor Pal (Fin), Tore Saeterdal (Nor), Attila Toth (Hun), Birgit Vogel (ICPDR)

### **Problem driven issues and research topics for an LTSER of the middle DRB**

*Flood-risk, environmental pollution and species extinction* are among the major environmental challenges in today's management of the middle DRB. These challenges are the results of historical socio-ecological processes unfolding over extended time. Their present importance can only be understood with the help of studies of their environmental history. Some of the major transformations in this part of the DRB happened during the modern period. Other aspects, however, have a much longer history. Recent environmental-historical studies have indicated that some transformations can be traced to human activities such as farming, forest clearance, mining, and pollution caused by human settlements in the prehistoric period. Major transformations in these processes continued and intensified during the Roman Period and in the Middle Ages.

Compared to the upper and the lower DRB sections the middle DRB region is the largest, the most complex and the most international. It has a very large, variable and complex basin area comprising large tributaries and the diverse natural and social entities of several geographical regions. Topographically, the basin area contains high mountains, hilly zones, marshlands, floodplains and the western most extension of the Eurasian steppe, the Great Hungarian Plain.

This topographic diversity has had both positive and negative consequences for both the human population and the natural environment. On the one hand the fact that the Danube and its intricate tributary system crosscut so many environmental zones has had a positive effect on the movement of goods, people and information across broad swathes of territory. The rivers itself offered natural routes of communication and sources of raw materials. On the other hand, the interaction of these multiple zones has often resulted in accumulation of negative effects of various kinds of environmental degradation, including erosion, extreme flooding events and leaching of heavy metals and other pollutants.

Another characteristic of the middle DRB is the *concentration of military, economic and political centres* along this section of the Danube compared to the lower and upper stretches. A concomitant aspect of this concentration of major settlements is a greater density of population along certain points on the Danube and its tributaries. The topographic development of these central settlements was fundamentally driven by possibilities and limitations of living in close proximity to the Danube. In the Roman period, Vindobona, Carnuntum, Brigetio and Aquincum, being the administrative and military centres of the *limes* system, represent the military and defensive aspect of human-river interactions. The river in this case acted as a boundary, a protective zone and a communication route for moving troops and goods rapidly and securely over wide territories. The military aspect of the Danube reappears as a dominant force during the expansion of the Ottoman Turkish Empire into the heart of Central Europe.

In the Middle Ages, Vienna, Esztergom, Visegrád and Buda were at one time or another *major urban centres and residences of rulers*. As centres they developed as "*Medium Regni*" ("heart of the realm"), and acted as focal points of a larger zone of interaction, which was in a very real sense

synonymous with the basin area of the middle DRB itself. Thus, this zone of interaction was not only the town and its immediate hinterland but the system of a complex settlement networks and their natural hinterlands. Modern capitals of the region are also clustered along the Danube. The emergence of Vienna, Bratislava, Budapest and Belgrade as modern capitals represents a continuation of past developments and at the same time the creation of new political entities. In this respect, the Danube in this region may be seen as force for both cohesion and division in human interaction in different periods.

The middle DRB section has been known historically as a major producer of *fish* based on a very high level of species diversity. It has offered a secure, if seasonal source of protein to a large human population living near the banks of the river and its tributaries. At the same time, a surplus in the supply of fish permitted export, particularly in sturgeon, which had significant economic consequences. The fish economy represented one part of a complex *flood-plain economy*, which was to be fundamentally transformed by the largest ever European water *regulations* in the nineteenth and twentieth centuries. The goal of these regulations was to create predictable water levels for shipping routes and even more important, to claim large tracts of land for agriculture. The long-term ecological repercussions of this massive human intervention into the natural flood cycle of the rivers represents the most pressing challenge for river basin management today.

### **Feasibility: Pilot projects in the middle DRB**

(1) *Long-term water level changes and historical floods in the middle DRB region*: Data collection and interdisciplinary data-analysis based on fluvial deposit, geological, palaeo-environmental, archaeological and historical sources. The framework of co-operation of these research areas will be discussed on an international conference on historical floods, September 2008. Some aspects of the research agenda are included in a research program currently supported by the Hungarian National Research Fund (OTKA).

(2) *Archaeological and historical approaches to the impact of historical water level changes on settlements in the middle DRB*: This pilot project will focus on three historical periods. The Roman period is discussed mainly on the basis of recent interpretations of the Aquincum stratigraphy, a project developed by the Aquincum Museum in Budapest. The medieval period is investigated in case studies on water usage and water management connected to four major medieval settlements and to the topographical changes. Bratislava, Esztergom, Visegrád and Buda will be presented with the same type of topographical maps. The pilot project is coordinated by scholars contributing to the “European Historical Town Atlases” project, representing Slovak and Hungarian research teams.

(3) *Dráva pilot project* (cp. research plan for the upper DRB): The complex tributary system of the middle DRB will be researched in a number of reference areas and case study projects. The most complex is the interdisciplinary investigation of the Dráva river basin. It focuses on the palaeo-environmental aspects combined with the underwater archaeological investigations of the area. The co-ordination of the pilot project is based in the Hungarian Cultural Heritage Office (KÖH), where an underwater archaeological data-base is also developed. The pilot project will provide the DEHI-framework with important data on water course changes of a tributary, with information on historical transport systems and with complex environmental data-sets for a frontier region. These data can be confronted with similar datasets from other tributaries in the DRB.

(4) *Long-term environmental changes in the DRB - the woodland coverage of the middle DRB*: The middle DRB as the largest tributary system of the Danube is influenced by two major ecological factors and by their historical changes. One of them is the land management and land use system of the flood-plain zones, the other is the size and character of woodland areas in the basin. This pilot project will focus on the long-term historical changes of the woodland coverage of the Carpathian Basin. Recently a complex methodology has been worked out for these questions and two major publications focused on the issue of forests have been published. The aim of this pilot project is to connect the historical data-sets with the palaeo-environmental data-bases.

### **Part III: Research plan for the lower DRB**

Coordinated and prepared by Mark Graham Macklin (UK); with contributions from Monica Ina Georgescu (Rom), Eva Jacobsson (Nor), Melinda Laituri (USA), Julia Lajus (Rus), Verena Winiwarter (Aut)

#### **Section specific issues**

The lower DRB (defined as the Danube River and its tributaries downstream from the Iron Gates dams to coastal margin of the Danube Delta in the Black Sea) uniquely integrates and records anthropogenic and environmental signals generated upstream from the upper and middle parts of the DRB. Tributary basins within the lower DRB, which drain Romania, Bulgaria, Moldova and Ukraine, also have a major impact on water, sediment and pollutant delivery to Danube River. However, these have been less intensively studied and the degree to which they modify and de-couple material fluxes from upper and middle DRB is not presently known. The Danube Delta and the former Lunca Brăila alluvial wetland (south of the city of Galati) both play a critical role in controlling material flows and fluxes to the Black Sea. They have variably functioned as buffers between basin and coastal systems acting as sinks for sediment and pollutants (heavy metals, radionuclides, nutrients, PCBs). At other times, primarily as a result of river channel avulsions during large floods or channel engineering that have increased the connectivity between the lower Danube River and the Black Sea, they have operated as efficient conduits or even secondary sources of contamination to the coastal zone.

In comparison to the more densely populated and urbanised upper and middle Danube valley, the longer-term environmental history of the lower DRB is under-researched despite the fact that from the perspective of the fluvial sedimentary archive it is likely to have the most complete and temporally resolved record of environmental change in the entire Danube basin. Furthermore, although channel engineering and land drainage have had a significant negative impact on the hydromorphology and biodiversity of the lower Danube River and its tributaries, the lower DRB still contains some of the least modified river channels, floodplains and alluvial wetlands in the entire Danube basin. These include the Bulgarian and Romanian Danube islands that contain some of the most important floodplain forests in Europe, the lower Prut floodplains and Liman lakes in Moldova, which together with the Danube Delta in Romania and Ukraine makes this area one of the world's most important regions for biodiversity.

#### **Main study areas and research topics in the lower DRB**

To address the key issues and themes that were identified for the lower DRB during the ENVIRDANUBE workshop held at Vienna in February 2008 (Table 3), four main study areas

have been selected as starting points from which to build an interdisciplinary research platform. It is expected that these will enable human-river environment interactions to be evaluated over a wide range of temporal and spatial scales, as well as facilitating links to research undertaken in the upper and middle DRB, leading to the development of an environmental history for the entire Danube basin. These areas in downstream sequence are:

(1) *the Danube Valley between the Iron Gates gorge (IGG) dams 1 and 2* that includes the Schela Cladovei and a number of other important archaeological sites. These contain some of the best dated records of the Meso-Neolithic transition in the Danube Valley and are key sites for studying the adoption of farming in south-eastern Europe (Bonsall *et al.*, 2002). Additionally, climate-related flooding can be shown to have had a significant impact on human settlement and use of riverine environments in this area during the middle Holocene, and may even have been an important stimulus of cultural change.

(2) *The Teleorman River (TR) and basin, southern Romania*. The Teleorman River rises in the Carpathian Mountains, has a drainage area of approximately 830km<sup>2</sup> and flows into the Vedea River, a major north bank tributary of the lower Danube. Since 1998 human-river environment interactions in the Teleorman basin have been investigated as part of the Southern Romania Archaeological Project (SRAP), a major integrated landscape history study (Bailey *et al.*, 2002) initiated to investigate land-use and settlement in the Teleorman Valley from the Neolithic (ca. 4500 BC) to the medieval period. This has been done in conjunction with detailed geomorphological investigations of valley floor sedimentary sequences combined with radiocarbon and luminescence dating of alluvial deposits, and constitutes one of the best constrained Holocene alluvial chronologies in the southern Romanian Plain (Howard *et al.*, 2004). The Teleorman River provides a representative basin in the lower DRB in which to investigate tributary river response to environmental change that can be compared to those found in the main Danube River immediately downstream. This spatially and functionally nested approach will allow notions of synchronous and non-synchronous basin responses to climate and land-use change to be tested and modelled, as well providing information on how and at what speed are environmental signals propagated down and up river basins, and the degree to which material fluxes in tributary and trunk rivers in the DRB are connected and coupled.

(3) *The Bulgarian and Romanian lower Danube Islands (BRLDI)*. One of the distinctive features of the lower Danube River is the considerable number of large semi-permanent islands. The best known of which are Belene (the biggest island in Bulgarian waters, 14.5 km long and 6 km wide, and part of the internationally important Persina Natural Park) and the Great Brăila Island and wetland (formerly Balta Mare a Brăilei, the "Great Brăila Pond", 60 km long and 20 km wide) in the Brăila County, Romania that was drained for agriculture during the communist regime. The geomorphological development of the lower Danube Islands, particularly the influence of longer-term changes in flooding and sediment transport, has not been studied but research on river islands elsewhere in the world (e.g. Mississippi) suggest that these sites should preserve exceptionally high quality sedimentary records of environmental change and human impact in the Danube basin.

(4) *The Danube Delta (DD)* is Europe's largest remaining natural wetland and is one of the continent's most valuable habitats for wetland wildlife and biodiversity. Consisting of a labyrinthine network of river channels, shallow bays and hundreds of lakes, interspersed with extensive marshes, reed-beds, islands and floodplains, it forms a natural buffer zone filtering out

pollutants from the River Danube, protecting water quality in the north-western Black Sea. Its ecosystems are affected by changes upstream, such as pollution and the manipulation of water and sediment discharges in the DRB, as well as by deliberate and inadvertent changes by river engineering and regulation in the delta itself. Wetland areas and biodiversity have been significantly reduced by the building of agricultural polders and fishponds that have altered natural flow and sedimentation patterns. There is also considerable concern that the construction of the Bystroe Canal in Ukrainian part of the delta will have an impact on the water level dynamics and result in a loss of floodplain habitats, which are used by fish for spawning and nurseries, and by birds for nesting and feeding.

These four study areas have been carefully selected because, with the exception of the Bulgarian and Romanian lower Danube Islands, they have all been the focus of research by one or more members of DEHI (or by the institutions they represent) and have a significant body of existing data from which to explore all of key research issues identified at the Vienna workshop. Equally important is that these areas are also likely to contain a very wide range of environmental archives including instrumental, documentary, archaeological, geomorphological and geological that, if linked to long term socio-ecological archives in the upper and middle DRB will allow basin-wide reconstructions of human-river environment interactions.

#### **Feasibility: Possible Case Studies in the lower DRB**

Historical and modern contaminant metal fluxes in the *Danube basin & delta (DD)*: the principal aim of this project would be to determine the changing sources and delivery over the last 200 years or so of contaminant (heavy) metal (e.g. Pb, Cd, Hg, Zn, Cu) to the Danube Delta region. This would be achieved by coring of the delta, geochemical analysis of sediments using XRF and Pb isotope techniques (the former to establish changing metal loadings, the later technique to determine contributory source areas & types) and radiometric dating (Cs 137, Pb 210) of the cores to provide a chronology. This would also require sediment sampling the various Danube sub-basins to identify source areas & types of contaminating material.

Holocene, historical and modern flood histories in the lower Danube River Basin based on investigations of *islands in the lower Danube Valley Islands (BRLDI)* are a very important geomorphological feature of the Danube River especially in the lower Danube Valley. This project would reconstruct long-term changes in flooding through the sedimentological, radiometric and hydraulic analysis of landforms and sedimentary sequences on the major islands of the lower Danube that include Potelu (RO), Suhaia (RO), Belene (BG), Kalimok (BG), Calarasi-Raul (RO) and the Great Island of Braila (RO). It would also benefit from cartographic and documentary analysis of floods and their impacts. The primary aim of this project would be to establish possible links between climate, basin land-use change and flooding in the Danube basin.

Long-term human river environment interactions in the *Teleorman River Basin (TR)* lower Danube valley, Romania: this project will continue work by Doug Bailey and Mark Graham Macklin examining human settlement patterns and its controls since the Neolithic. The importance of this project is, that it will evaluate how a tributary of the Danube has responded to environmental change, resulting from both human and climate effects.

Table 3: Study areas in the lower Danube Basin and potential time periods of research

Topics	Study areas	Time periods
Floods	IGG +++ TR +++ BRLDI +++ DD +++	IGG: prehistory - present TR: prehistory - present BRLDI: prehistory - present DD: prehistory - present
Migration/minority	IGG ++ TR + BRLDI ++ DD ++	IGG: prehistory TR: prehistory BRLDI: prehistory - present DD: prehistory – present
Material flows and pollution	IGG +++ TR + BRLDI +++ DD +++	IGG: prehistory - present TR: prehistory - present BRLDI: prehistory - present DD: prehistory – present
Marine-fluvial connections & interactions	IGG + TR + BRLDI ++ DD +++	IGG: prehistory - present TR: prehistory - present BRLDI: prehistory - present DD: prehistory – present
Landscape/environmental change	IGG +++ TR +++ BRLDI +++ DD +++	IGG: prehistory - present TR: prehistory - present BRLDI: prehistory - present DD: prehistory – present
Dams	IGG +++ TR BRLDI + DD +	IGG: 19 <sup>th</sup> – 20 <sup>th</sup> C - present TR BRLDI: 19 <sup>th</sup> – 20 <sup>th</sup> C - present DD: 19 <sup>th</sup> – 20 <sup>th</sup> C – present
Communist legacy (water management, river regulation, land drainage, pollution) and interventions	IGG +++ TR++ BRLDI +++ DD +++	IGG: 20 <sup>th</sup> C - present TR: 20 <sup>th</sup> C - present BRLDI: 20 <sup>th</sup> C - present DD: 20 <sup>th</sup> C – present
Transportation	IGG +++ TR++ BRLDI +++ DD +++	IGG: prehistory - present TR: prehistory - present BRLDI: prehistory - present DD: prehistory – present
Traditional resource use	IGG TR BRLDI ++ DD +++	IGG TR BRLDI: 19 <sup>th</sup> – 20 <sup>th</sup> C DD: 19 <sup>th</sup> – 20 <sup>th</sup> C
Frontiers	IGG +++ TR BRLDI +++ DD +++	IGG: prehistory - present TR BRLDI: prehistory - present DD: prehistory – present

### 3. Assessment of the results, contribution to the future direction of the field

The workshop ended with the agreement of all participants that a co-ordinated, multi-national initiative to study the long-term socio-ecological evolution of the Danube river basin was both desirable and feasible, albeit both conceptual and organisational challenges.

At the workshop, the convenors agreed to collect a **database of researchers** currently dealing with the DRB and could be contacted in further research. It was established at the Institute of Social Ecology, University of Klagenfurt, Austria. This database currently contains the names, addresses and affiliations of about 45 people, and will become available via a website in the near future.

The co-ordinators of the **three parts of the research plan** agreed to further develop their work in time to be integrated into the ESF report. The research plan is detailed above. The plan will be published on the web and eventually also in printed form.

The "**Danube Environmental History Initiative**" (DEHI) was founded after the meeting. A **steering committee** for this initiative was set up to follow up on the initiative and secure its continuation. The steering committee consists of Christoph Bernhardt, Julia Lajus, József Laszlovszky, Mark Graham Macklin, Mariyana Nikolova, Didier Pont and Verena Winiwarter. The steering group will bring the Danube River Basin in comparative perspective to the attention of the research and environmental policy communities and see to the initiation of new research in a co-ordinated way. The steering group will

- (1) Oversee the second phase of the COST proposal plus a satellite proposal to bring the Neva and Russia into the network, if the proposal is accepted into a second phase; if the COST application proves unsuccessful, the group will co-operate in identifying alternative sources of funding, e.g. develop parts of the COST idea independent of it and co-operate in writing of the respective grants.
- (2) The steering group will consult on the production of a **folder** prepared by the ESF workshop convenors to be able to distribute material about the initiative at conferences, etc. and distribute the folder in existing networks.
- (3) An **environmental history summer university course** to be held in 2009 for interested academics, scholars and graduate students will be organized to present and to disseminate aims and methods of an environmental history of the DRB. This summer university course can be organized in the framework of SUN, a major annual summer university program at Central European University in Budapest. The proposal for the course will be worked out with the support of the steering group and will be submitted in May 2008 after the preparatory meeting of the project contributors of the middle DRB region. The course can built on previous experiences of a similar course on "People and Nature in Historical Perspective" with the participation of a wide range of specialists from environmental-historical fields.
- (4) Members of the steering group will actively seek to publicize the idea and recruit members for the network.
- (5) The steering group will also bring new ideas into the network. Among these new ideas is the development of a "Danube Environmental History Wiki" to make existing research known to the wider community.



Gertrud Haidvogel and Martin Schmid, who have been instrumental in convening the workshop, will continue to work for the network, but can only devote limited time to this task. They will be supported by the strongly committed steering group to being able to develop the Danube research network further. A meeting of the steering group is planned for late 2008, if funding can be obtained.

The most immediate and consequential result of the workshop is the **submission of a proposal to COST's open call**, titled SUSTAINABLE RIVERS IN EUROPE: INTEGRATED RIVER BASIN MANAGEMENT BASED ON COMPARATIVE LONG-TERM SOCIO-ECOLOGICAL RESEARCH, submitted on March 27<sup>th</sup>. Several attendees of the workshop signed the COST pre-proposal as participants.

The colleagues from Norway wish to submit a **proposal for a conference to discuss river basin histories in a comparative way** and will include the Danube as one major basin.

Taken together, these results are encouraging and show that the group is interested and willing to develop the Long Term Socio-Ecological Research of the Danube's Riverine Landscapes, eventually leading to a synthetic Environmental History of this important part of Europe.

Both, the COST proposal or other funding to be obtained will in part be dedicated to fostering the **development of high-potential young scholars from the Danube Basin countries**, many of which do have only limited access to the international scholarly community. Such an interdisciplinary initiative is an excellent opportunity for high potentials in many fields. In this context it must be remarked that the infrastructures for research funding are very unevenly developed in the DRB countries, and in many countries are currently not fit to adequately support such an initiative.

The Danube Environmental History Initiative is confronted with national research communities which do not regularly publish in other languages than their national language, despite the quality of their work. Communities are hampered by the lack of reliable, long-term support for projects and ensuing huge financial problems. The link between the sciences and the humanities is often very weak. Environmental history is underdeveloped, many of the basin countries are not even represented in the European Society for Environmental History. All these constraints will limit the involvement of these communities, unless national and international funding infrastructures are further developed to support international, interdisciplinary work.

For the **Upper Danube** selected case studies of the research plan feasible on a short and midterm perspective will be integrated into a national **research proposal to the Austrian Science Fund** to be submitted later in 2008. The output of the workshop has the potential to enhance long term socio-ecological research on rivers and river basins in terms of methods and approaches in particular by matching sciences and humanities. The **support of the International Commission for the Protection of the Danube River** will enable us to improve the debate about the impact of historical studies on current river basin management and to integrate studies on historical legacies.

As has become clear during the workshop, river basins have been changed by mankind for millennia and hence must be studied in a long-term perspective. They are ecologically integrated by the flow of water and home to the most dynamic ecosystems. Their current situation cannot be understood if the common past of nature and humans is studied apart.

While all rivers share important characteristics, each has unique natural and social aspects. Long-Term Socio-Ecological Research in Europe has not been developed in case studies involving rivers, nor has comparative research across river basins been attempted. The Danube Environmental History Initiative aims at addressing these gaps in our knowledge. If the Danube Environmental History Initiative is successful, it will shape the future development of this type of research and be a major cornerstone of the new and dynamic field of environmental history in Europe.

## 4. Final programme

### Wednesday 20 February 2008

afternoon                      Arrival

### Thursday 21 February 2008

09:00-09:30                      Welcome Coffee

*Chair: Gertrud Haidvogel*

09:30-10:00                      **Welcome and Introduction to the Workshop by the convenors**

10:00-12:00                      **Case study reports CONCEPTUAL**

*(15 minutes each)*

**Martin Schmid**, The river as a socio-natural site - Conceptual considerations for an environmental history of the Danube

**Eva Jakobsson**, Modern and post-modern rivers - a discussion of river histories

**Martin Knoll**, Cities, rivers, environment. What does early modern topographical literature tell us about the interrelations between human settlements, rivers and regions in the Danube river basin?

**Ortrun Veichtlbauer (presented by Verena Winiwarter)**, A neverending quest for power: An environmental history of the Danube River in Austria (18th-20th century)

**Fridolin Krausmann**, The river and the city: Urban metabolism and its role for the social-ecology of a watershed

**Didier Pont**, An interdisciplinary approach for the sustainable development of gravel bed river in the Alps (Drome River, France)

12:00-13:30                      *Lunch break*

*Chair: Martin Knoll*

13:30-15:00                      **Case study reports LOCAL/REGIONAL**

*(15 minutes each)*

**Gertrud Haidvogel**, Land use and fluvial dynamics – society-nature interactions along the Austrian Danube

**Mark Graham Macklin**, A geomorphological perspective on the changing nature of human-river environment interactions in the lower Danube river and watershed over the last 10,000 years

**Monica Georgescu**, Lower Danube and Danube Delta. Common History. Environmental interdependencies. New Geography?

**Mark Landry**, “White Coal” in the Upper Danube Watershed: Hydroelectric Development in Alpine Bavaria 1891 – 1924

**Viktor Pal**, The social acceptance and rejection of the Gabčíkovo-Nagymaros barrage system on the River Danube

- 15:00-15:30 **Conceptual keynote presentation 1:**  
**Verena Winiwarter**, Towards a framework for long-term socio-ecological studies
- 15:30-16:00 *Coffee/tea break*  
**Chair: Martin Schmid**
- 16:00-17:45 **Case study reports LOCAL/REGIONAL**  
*(15 minutes each)*
- Attila Toth**, From the archaeology of the river to River Archaeology - a new field of research?
- József Laszlovszky**, Historical floods and water level changes of the Danube in the Late Middle Ages: Archaeological approaches for the study of the environmental-historical investigations
- Sabine Barles**, Long-term interactions between societies and river systems: lessons for the Seine basin and the PIREN-Seine
- Tore Saetersdal and Terje Oestigaard**, Comparative Studies on River Basins
- Christian Wolter**, Using historical information to assess the resilience of river fish assemblages
- Julia Lajus**, Fish, river and the city: Approaches towards history of fisheries in the urban environment, case of St. Petersburg
- 17:45-18:30 First collection of ideas in interdisciplinary, international groups selected by common research interests (using Mind Mapping technique)
- 19:30 *Dinner* (Buschenschank Pötzleinsdorf, Pötzleinsdorfer Strasse 97, 1180 Wien)

## Friday 22 February 2008

*Moderators/Facilitators: Martin Schmid, Verena Winiwarter*

- 09:00-10:00 **Group discussions** – common research interests (4 groups)
- 10:00-10:45 **Reports of groups** (5-10 min each, presumably 4 groups) and short discussions
- 10:45-11:15 *Coffee/tea break*
- 11:15-11:45 **Conceptual keynote presentation 2:**  
**Melinda Laituri**, The Watershed as a Unit of Analysis: Relationships between Environmental History and Policy
- 11:45-12:30 **Group discussions:** Methodologically coherent research teams - changing the group structure of day 1, discussing methodological issues
- 12:30-14:00 *Lunch break*
- 14:00-15:20 **Reports of groups** and discussion

15:20-16:20	<b>Plenary discussion</b> to connect results from the morning reports (LOCAL/REGIONAL vs. CONCEPTUAL) with the METHODOLOGICAL reports of the afternoon (Mind Mapping technique)
16:20-16:50	<i>Coffee/tea break</i>
16:50-17:50	The Danube revisited: Alongside a room-size map of the Danube watershed, we will post issues, approaches and the respective regions to identify missing regions/locales, missing periods of interest; missing themes or questions
17:50-18:20	<b>Plenary Discussion</b> of the visualized result
19:30	<i>Dinner</i> (Ephesos Kebap Haus, Gymnasiumstrasse 58, 1190 Wien)

### Saturday 23 February 2008

*Moderator/Facilitator: Verena Winiwarter*

09:00-09:30	How far have we come? An overview of the results of day 1+2 (Verena Winiwarter)
09:30-09:50	<b>Birgit Vogel</b> , The Danube River Basin – Outlining the Basin's Characteristics and Current River Basin Management Activities
9:50-10:20	<b>Presentation of the European Science Foundation (ESF)</b> <b>Dr. Rüdiger Klein</b> (Standing Committee for the Humanities)
10:20-12:30	Individual group work on a research agenda (3 p paper, containing issues, themes, methods) and a timeline and to-do-list for the practicalities of a research proposal <i>(coffee/tea served during individual group working session)</i>
12:30-13:30	<i>Lunch break</i>
13:30-14:00	Group phase II
14:00–15:10	Presentations of the groups, discussion of framework structure, way forward
15:10-15:30	<i>Coffee/tea break</i>
15:30-16:00	Feedback
16:00	Farewell and End of Workshop

### Sunday 24 February 2008

Departure

## 5. Statistical information on participants (age structure, gender repartition, countries of origin, etc.)

Country	Age structure		Number male	Number female	Total number of participants
	Senior	Young			
Austria	1	3	2	2	4
Germany	1	1	2		2
France	2		1	1	2
Finland		1	1		1
Norway	2	1	2	1	3
Hungary	1	1	2		2
Romania		1		1	1
Russia	1			1	1
UK	1		1		1
USA	1	1	1	1	2
International Organisation (ICPDR; ESF)	n.a.*	n.a.	1	1	2
<b>Total (%)</b>	<b>10 (53 %)</b>	<b>9 (47 %)</b>	<b>13 (62 %)</b>	<b>8 (38 %)</b>	<b>21</b>

\* n.a. = not applicable;

## 6. Final list of participants (full name and affiliation)

### **Barles Sabine, Dr.**

Laboratoire Théorie des Mutations Urbaines - UMR CNRS 7136 AUS  
 Université de Paris 8 - Institut Français d'Urbanisme  
 4 rue Alfred Nobel - Cité Descartes  
 77420 Champs-sur-Marne, France  
[sabine.barles@univ-paris8.fr](mailto:sabine.barles@univ-paris8.fr)

### **Georgescu I. Monica**

European Center of Excellence for the Environment (ECEE)  
 University "Lower Danube" of Galati  
 47 Domneasca street  
 800008 Galati, Romania  
[georgescuimonica@yahoo.com](mailto:georgescuimonica@yahoo.com)

### **Haidvogl Gertrud**

Institute of Hydrobiology and Aquatic Ecosystem Management  
 Univ. of Natural Resources and Applied Life Sciences  
 Max Emanuelstr. 17  
 1180 Vienna, Austria  
[gertrud.haidvogl@boku.ac.at](mailto:gertrud.haidvogl@boku.ac.at)

**Jakobsson Eva, Dr.**

Risk Management and Societal Safety  
Department of Media, Culture and Social Science  
University of Stavanger  
4036 Stavanger, Norway  
[eva.jakobsson@uis.no](mailto:eva.jakobsson@uis.no)

**Klein Ruediger, Dr.**

Dep Head Humanities  
European Science Foundation (ESF)  
1, quai Lezay Marnesia  
67080 Strasbourg, France

**Knoll Martin, Dr.**

Institut fuer Geschichte  
Technische Universitaet Darmstadt  
Residenzschloss, Zi. S 313/230  
64283 Darmstadt, Germany  
[knoll@pg.tu-darmstadt.de](mailto:knoll@pg.tu-darmstadt.de)

**Krausmann Fridolin, Prof.**

IFF/Institute for Social Ecology; Centre for Environmental History  
University of Klagenfurt  
Schottenfeldgasse 29  
1070 Vienna, Austria  
[fridolin.krausmann@uni-klu.ac.at](mailto:fridolin.krausmann@uni-klu.ac.at)

**Laituri Melinda J., Prof.**

Dept. of Forest, Rangeland, and Watershed Stewardship; Warner College of Natural Resources  
Colorado State University  
80523 Fort Collins, USA  
[mell@warnercnr.colostate.edu](mailto:mell@warnercnr.colostate.edu)

**Lajus Julia, Dr.**

Center for Environmental and Technological History  
European University at St. Petersburg  
3 Gagarinskaia str.  
191187 St. Petersburg, Russia  
[jlajus@eu.spb.ru](mailto:jlajus@eu.spb.ru)

**Landry Marc**

Dep. of History  
Georgetown University Washington, DC  
Box 571305  
20057-1305 Washington, DC; USA  
[mdl42@georgetown.edu](mailto:mdl42@georgetown.edu)

**Laszlovsky József, Prof.**

Department of Medieval Studies  
Central European University  
Nádor u. 9.  
1051 Budapest, Hungary  
[laszlovj@gmail.com](mailto:laszlovj@gmail.com)

**Macklin Mark Graham, Prof.**

Centre for Catchment & Coastal Research  
River Basin Dynamics & Hydrology Research Group  
Institute of Geography & Earth Sciences  
Aberystwyth University  
King Street  
SY23 2AX Aberystwyth, UK  
[mvm@aber.ac.uk](mailto:mvm@aber.ac.uk)

**Oestigaard Terje, Dr.**

UNIFOB Global  
University of Bergen  
Nygårdsgt.5  
5020 Bergen, Norway  
[Terje.Ostigard@ark.uib.no](mailto:Terje.Ostigard@ark.uib.no)

**Pal Viktor**

Department of History  
University of Tampere  
Nasilinnankat 11 B 17  
33210 Tampere, Finland  
[Viktor.pal@uta.fi](mailto:Viktor.pal@uta.fi)

**Pont Didier, Dr.**

Hydrological Unit HYAX  
Cemagref  
3275 Route de Cezanne  
13182 Aix-en-Provence Cedex 5, France  
[didier.pont@cemagref.fr](mailto:didier.pont@cemagref.fr)

**Saetersdal Tore, Dr.**

UNIFOB Global  
University of Bergen  
Nygårdsgt.5  
5020 Bergen, Norway  
[Tore.Saetersdal@global.uib.no](mailto:Tore.Saetersdal@global.uib.no)

**Schmid Martin, Dr.**

IFF/Institute for Social Ecology; Centre for Environmental History  
University of Klagenfurt  
Schottenfeldgasse 29  
1070 Vienna, Austria  
[martin.schmid@uni-klu.ac.at](mailto:martin.schmid@uni-klu.ac.at)

**Toth Attila, Dr.**

National Office of Cultural Heritage and Hungarian Archaeological and Art-historian Society  
Táncsics u. 1  
1014 Budapest, Hungary  
[Attila.Toth@koh.hu](mailto:Attila.Toth@koh.hu)

**Vogel Birgit**

International Commission for the Protection of the Danube River



Vienna International Center  
Wagramer Strasse 5  
1220 Vienna, Austria  
[birgit.vogel@unvienna.org](mailto:birgit.vogel@unvienna.org)

**Winiwarter Verena, Prof.**

IFF/Institute for Social Ecology, Centre for Environmental History  
University of Klagenfurt  
Schottenfeldgasse 29  
1070 Vienna; Austria  
[verena.winiwarter@uni-klu.ac.at](mailto:verena.winiwarter@uni-klu.ac.at)

**Wolter Christian, Dr.**

Dep. Biology and Ecology of Fishes  
Leibnitz-Institute of Freshwater Ecology and Inland Fisheries  
Müggelseedamm 310  
12587 Berlin, Germany  
[wolter@igb-berlin.de](mailto:wolter@igb-berlin.de)