The second part of the event brought a vivid discussion in the „Danube Café“, which involved experts as well as the audience. DI Christian Steiner, Government of Lower Austria, Board Member of the European Land and Soil Alliance (ELSA), Elisabeth Wrbka, AVL Consultant for Landscape Planning and Urban Development, Kurt Weinberger, CEO of the Austrian Hail Insurance, Wilfried Hartl, Bioforschung Austria, Gottlieb Soriat, DV-Donau – Citizens´ Initiative for Sustainable Flood Protection, and IAD President Thomas Hein discussed about the practice of implementation of the goals for water management on local level. How can we reach water retention in the whole area of the catchment? Major topics had been: reduction of land sealing, optimising the retention in soils by supporting organic farming, and actively using the experience of green roofing for agricultural and commercial buildings.

Renowned and celebrated Bulgarian musicians, Alexander & Konstantin Wladigeroff and Magdalena & Dimitar Karamitev, and a Danubian buffet created by the agricultural school Ottenschlag, Lower Austria, and fine Hungarian specialities from Samos Bakery, Budapest brought the richness of the Danubian spirit into the event. IAD Secretary General Harald Kutzenberger lead through the program of the afternoon.

Figure 2: 'Green Roof': insulation against extreme temperature, retention of precipitation (Photo: H. Kutzenberger)

Finally a mobile exhibition and brochure on local measures for a sustainable development in the catchments of the Danube Basin were presented. This 'travelling' exhibition will be shown first in municipalities and schools all-around Austria, but there are concrete contacts already to extend the range of this 'travelling' exhibition to major cities in the Danube countries, in cooperation with the governmental and regional administration concerned.

JDS 3 from an environmental history and social science perspective – Part I: Danube research across disciplines and the selection of environmental problems

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Introduction

After the first and second Joint Danube Surveys (JDS) in 2001 and 2007, respectively, in August and September 2013 the third Joint Danube Survey (JDS 3) was the next, major step to document and to assess the biological, chemical and hydromorphological state of the Danube in a standardized way (e.g. recently in this journal Stanković et al. 2015; Frank and Schmidt 2015; Schwarz and Holubova 2015). Not only for natural sciences, these river expeditions and their results must be regarded as milestones in recent Danube research. The importance of JDS goes far beyond the sphere of natural sciences, and even beyond that of academia.

Both authors of this contribution have an academic background in history, have worked now for years on different topics of the environmental history of the Danube, often in close cooperation with natural scientists. In our contribution we reflect on the objectives and approaches of JDS in general, and we discuss selected results of JDS 3 in particular from a social sciences' and humanities' perspective – a perspective probably unusual for most readers of 'Danube News'.

We use JDS 3 to demonstrate and to discuss the potentials and limitations of closer cooperation between natural sciences, social sciences and humanities in future Danube research. To initiate and to support such broad interdisciplinary research is the explicit aim of the recently established IAD expert group "Long-Term Socio-Ecological Research (LTSER) and Environmental History" (Schmid and Haidvogl 2015).

Our contribution comes in two parts. This first part aims at a general characterization of JDS from a social science perspective. We ask what is specific about the JDS approach, which environmental problems are addressed and which methods are applied and further developed in JDS? Additionally, we are concerned with the benefit of research à la JDS for scholars from social sciences and humanities and vice versa.

The second part to be published in the next issue of 'Danube News' goes more into details and reflects selected results of JDS 3 from an environmental history perspective, namely hydromorphological alterations, fish diversity, and pollution. We argue that pertinent results from JDS can and should be interpreted as a body of information not only on the

current but also on past socio-natural states of the Danube River Basin (DRB). Environmental history can help to address the dynamics of the social, cultural, and economic sphere that have caused the state of the river at any one time, which the current state natural sciences observe and assess in important standardized monitoring programs like JDS.

JDS as 'boundary work' between science(s), management, and the public

For more than a decade, JDS have facilitated and necessitated cooperation and coordination between scientists and research institutions across the whole Danube river basin. Cleverly marketed as 'the world's biggest river research expedition' (cp. http://www.danubesurvey.org/), JDS have contributed to a higher awareness in media and the general public for some of the most pressing environmental issues the Danube River Basin faces today.

From the very beginning, one of the outstanding features of JDS was that it is situated on the interface of river research and management. JDS have provided results that have the potential to identify main environmental issues and their causes; results shall assist decision-makers to take the right measures for managing water bodies all over the Danube Basin (Joint Danube Survey Public Report, p.3). In fact, results of JDS 3 feed directly into the next, updated version of the Danube River Basin Management Plan (DRBMP).

All three JDS were motivated by legal requirements, first and foremost by the EU-wide 'Water Framework Directive (WFD)'. With a special website, a news blog, public events, and a public report, JDS works also publicly and visibly across the boundaries of science and non-science. JDS help to raise public awareness for the work of its coordinating institution, the International Commission for the Protection of the Danube River (ICPDR).

In line with Science and Technology Studies (STS), JDS can be termed as 'boundary work' (Gieryn, 1983) between three societal spheres: (1) scientific field monitoring and research (including the development of new methods for scientific observation), (2) river basin management and environmental policy, and (3) science communications and public relations. In this respect, JDS can be compared to other - and admittedly much more prominent - activities like the Intergovernmental Panel on Climate Change (IPCC). However, there is one important difference between JDS and IPCC: JDS results are solely the product of scientific research while the regular IPCC reports are the outcome of a consensus process between researchers on one side and representatives of political governments on the other. The Danube of JDS 3 is not a 'boundary object' in the strict sense of the technical term, as it was recently argued for 'ecosystem services' (Abson et al. 2014). However, the Danube we encounter in the recent reports from JDS 3, can and shall be used by different communities (in and outside academia) in different ways.

With a clear focus on ecology, chemistry and hydromorphology, JDS approaches the Danube mainly as an ecosystem. Such a focus allows studying and assessing what ecologists call the changing 'human impact' or 'human imprint' on riverine ecosystems. But what drives this 'human impact'? One way to address the societal, cultural, and economic side of environmental change is to take a long-term perspective like interdisciplinary environmental history.

Why history matters

Environmental historians take a perspective that is informed not only by natural sciences but rather by humanities and social sciences. Environmental history is, to cite one of the most concise definitions, 'the history of the mutual relations between humankind and the rest of nature' (McNeill 2003). 'Mutual relations' means that an environmental history of the Danube not only shares the natural sciences' interest in the 'human imprint' on the river, but is also interested in 'impacts' the other way round, as it asks how the changed riverine ecosystem affected human societies. 'Long Term Socio-Ecological Research (LTSER)' is an alternative name for such an approach. With environmental history LTSER shares the interest in studying the interactions between society and nature on larger temporal scales (from decades, up to centuries and few millennia), but the latter takes a more system-oriented approach focusing on 'coupled socio-ecological systems (SES)' to facilitate cooperation particularly with ecologists.

From our own research experiences, we are convinced that interdisciplinary dialogues between historians and natural scientists are rewarding for both sides. From an environmental history perspective, natural scientific enterprises like JDS 3 offer highly relevant information not only on the current state of the river but also on its long history in which societal and natural processes have been entangled in many ways. Data collected by JDS represent information from biological and geological archives, which store residues from the long common history of nature and society that resulted in the river we encounter today.

On the other hand, environmental history can help to identify and better understand past societal processes that caused the situation natural sciences observe today. This includes the identification and chronology of past societal interventions into the riverine landscapes (like river regulation measures, land use and land cover change, technical arrangements in the riverine landscape) as well as their intended and unintended consequences and long-term legacies for both ecology and society.

With environmental history a high awareness for temporal processes on different scales comes into our conception of the Danube as an object of interdisciplinary investigations. The reasons for a specific state we observe in the river today can lie in the recent or in a – in historical terms – rather deep past. Earth scientists have shown that long before modern

industrialization, intensification of land use in the Danube River Basin over the last two millennia significantly increased sediment loads delivered by the Danube to the Black Sea (Giosan et al 2012). The same study also argued that increased deforestation in the lower Danube basin over the last five to six centuries resulted in a pulse of river-borne nutrients 'that radically transformed the food web structure in the Black Sea'. In other words: The shape, extent and species composition of today's Danube Delta is the unintended consequence of human activities that started two thousand years ago and far away from the site itself. Water pollution is another case in point. Its source can be a very recent spill somewhere close to a water body in the basin (like in the case of Baia Mare in 2000). But the Danube has a memory; it stores in its sediments the remnants of societal activities. Then one day during a flood, sediments from past spills or dumps are spread again, and only with historical methods we at least have a chance to clarify where the original point of that pollution was, or where and when these pollutants came into the river.

JDS – a selection of specific types of environmental problems

From the beginning, JDS were based on indicators to identify and assess environmental problems in the Danube River basin. The already mentioned legal background (particularly the EU-WFD) that motivates JDS and its explicit aim to have an impact on river basin management (via the DRBMP) effects not only the types of indicators which are surveyed, but also which types of environmental problems are considered in JDS in general (and which not).

Besides indicators, there are many other ways to distinguish what is harmless (or even 'good') for the environment and what is harmful and thus regarded as an environmental problem. These different conceptions of environmental problems vary according to scientific disciplines, but also according to different broader socio-cultural (e.g. political or ethical) understandings of how human societies relate to nature. Four basic paradigms help to order this wide variety of what is regarded as an environmental problem and by whom (Fischer-Kowalski et al 1994; Winiwarter 2003; both based on Korab 1992) *(Figure 1):*

1. the toxicological or pollution paradigm
2. the paradigm of 'ecological equilibrium' or 'natural balance'
3. the paradigm of resource economy or entropy, and
4. the paradigm of conviviality.

We shortly illustrate these paradigms and their effects with examples from the current environmental debate about the Danube, topics that are also addressed in JDS.

Two paradigms dominate: 'Pollution' and 'equilibrium'

An example for the first, the toxicological paradigm is water pollution e.g. from industrial activities. If the accepted environmental problem is the release of substances which are harmful to humans, animals or plants in the riverine landscape, the main political response will be to set thresholds and to define critical values that must not be exceeded. The latter requires first adequate scientific monitoring, sampling and analysis, but thereafter it needs a political process of negotiations. The societal value of the industrial activity that releases the harmful substance has to be brought into balance with an evaluation of the damage the very same substance causes. In almost all cases, dealing with toxic substances is not a question of yes or no, but of quantities, society finds acceptable (i.e. critical values). In the toxicological paradigm, scientific research (chemistry in particular together with other natural sciences), has the role to provide knowledge necessary to define these critical values and then to observe and assess the current state of water quality by comparing measured concentrations with the standards set by politics. This exactly is done by JDS, particularly with the chemical, but also in the biological assessment (e.g. when it comes to N- and P-concentrations and related water quality).

Conservationists and ecologists mainly use the second paradigm of 'ecological equilibrium', although it was recently more and more replaced in ecology by related concepts like 'resilience' or 'no-analogue communities'. Nevertheless, the idea of an endangered 'balance in nature' is still prominent in public environmental debates. At the Danube, a case in point would be the discussion about 'natural reference conditions' in general or invasive alien species (IAS) more specifically. The latter topic gets more and more attention in environmental sciences, not only along the Danube. In JDS, IAS became an important issue in JDS 3 for the first time.

Another example that fits well into this paradigm of 'ecological equilibrium' is the hydromorphological assessment of Danube sections in five classes from 'near-natural' to 'severely modified'. Human interventions like river regulation or dams are seen as causes for disturbances that endanger the integrity of the riverine system. The grade of disturbance is assessed based on habitat types and their spatial extension, by sediment balances and several other indicators. If 'disturbance' is the main environmental problem, the solution is protection or restoration of the natural system (conservation, restoration of the longitudinal continuum with fish facilities, prohibition of uses, so called 're-naturalisation'). Scientific research then is in charge of assessing the grade of disturbance, and of controlling the effectiveness of such measures.

JDS are disciplinary dominated by biology, chemistry, and meanwhile also hydromorphology. This might explain to a large extent why the overall majority of environmental problems in focus of JDS belong either to the paradigm of 'pollution' or to that of 'equilibrium'. The third and fourth paradigms play a minor role in JDS. The third paradigm of 'entropy' might even have an opposing role to the conceptualisation of environmental problems in JDS; this paradigm is favoured e.g. by physicists and environmental economics.

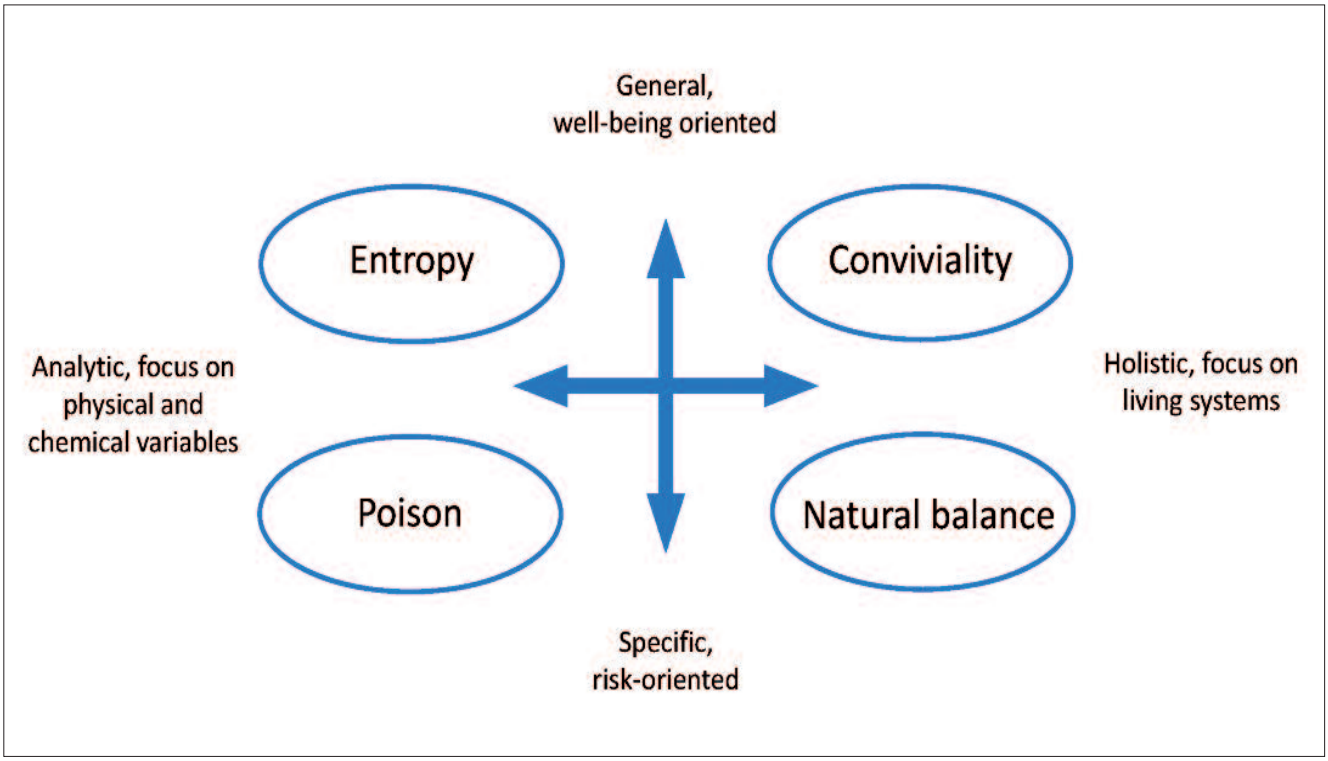

Figure 1: Four basic paradigms to identify 'environmental problems', and the epistemological qualities of these four paradigms (from Fischer-Kowalski et al. 1994)

It mainly asks where society (over)exploits energy and resources above rates of regeneration. Thus, within this paradigm a societal activity like hydropower exploitation can be seen as a solution, whereas another paradigm like equilibrium sees the same activity as a reason for an environmental problem. Implicitly and more in the public than in the scientific debate, the present notions of biodiversity, IAS along with habitat destruction might refer to the fourth paradigm of 'conviviality'. Mainly used by philosophers, moralists and preservationists, this paradigm asks where humans unnecessarily destroy, harm or dominate the living conditions of other species, consequently the aim of this paradigm's followers is to reduce the degree of human dominance over other species.

With 'poison' and 'natural balance', JDS is dominated by those two paradigms that focus mainly on specific risks and their reduction (instead of an orientation towards general well-being); this also has positive implications for the political acceptability of JDS and its recommendations *(Fig. 1)*. According to the authors of the original idea of the four paradigms (Fischer-Kowalski et al 1994), it is easier to argue for measures against specific risks than for ones aiming for long-term well-being; the latter are often seen as unrealistic, utopian, and at least in the case of 'conviviality' more preachy than rational. This might partly explain why JDS is so successful in influencing river basin management in practice. On the horizontal dimension of epistemological qualities, JDS is well balanced with the poison paradigm closely related to established ways of analytical thinking on one side, and the natural balance paradigm presenting more holistic views referring to living systems on the other.

Conclusions and Outlook

From a general social science perspective, we have characterized JDS as successful 'boundary work' on the interface of three spheres: scientific research, river basin management and science communication and public relations. The importance of JDS goes far beyond the natural sciences. From an environmental history perspective, i.e. a perspective informed by social sciences and humanities and interested in the mutual relations between humans and nature over time, scientific results of JDS represent valuable data from geological and living biological archives that shall be re-read and interpreted as traces of past states of the environment in the Danube River Basin (DRB). We have emphasized that with environmental history and 'Long Term Socio-Ecological Research (LTSER)' a higher awareness for temporal processes comes into interdisciplinary Danube research. Such advertence for chronology and timing is decisive also to identify the social, economic and cultural dynamics that have caused the present situation observed and assessed with natural scientific me-thods in schemes like JDS. We have argued that JDS so far have shown a strong tendency to concentrate on those types of environmental problems that are based on either a 'toxicological' paradigm or a paradigm that focuses on 'ecological equilibrium' in the riverine systems; other types of environmental problems (related to 'entropy' or 'conviviality') are not in the focus of JDS.

The second and final part of this contribution will be published in the next issue of 'Danube News' and will discuss selected main results of JDS – namely hydromorphological alterations, fish diversity and pollution – against the back-

ground of the long common history of nature and society in the Danube River Basin.

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News and Notes

Innovative development

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In the frame of the EU FP7 project DANCERS – DANube macroregion: Capacity building and Excellence in River Systems (basin, delta and sea) – a set of articles have been accepted for publication in the journal Science of the Total Environment.

River basin management – new strategies?

The Danube, one of the many regulated rivers in Europe, is affected by the impact of flood protection measures, hydropower installations and navigation, which exert pressure on sediment transport and river morphology (Habersack et al 2015, article in press). Sediment deposition, and re-mobilisation confined to fine grain-size fractions during floods are recorded in impoundments, whereas in other river reaches river bed incision is a continuing process since regulation had been implemented. Several other negative effects related to the natural structures in the channel and regarding the floodplain areas followed the taming of the river and affect the ecological status today. Causes and effects of this negative development are demonstrated and attention is drawn to the lack of comprehensive knowledge, including the whole basin, as to find solutions of sustainable character for an integrated approach of management.

Sustainable development, education, and the Danube river basin

Knowledge as well as certain skills are needed for organising river basin management in a sustainable way. What needs to be added today is the propagation of focused education, which is the prime aim of the DANCERS FP7 project (see: http://www.eip-water.eu/projects/dancers-project-romania, Irvine et al 2015, article in press), leading to broader education and the development of economic aspects. What is needed is a new kind of networking for training in water management and the future development within the region. On one hand DANCERS project addresses environmental challenges and on the other hand tries to advance academic training and education as part of the Bologna Process, especially at the Masters and PhD level. New education networks need to be started, including public and private organisations. This needs, among other aspects, the establishment of research infrastructure on a standardised basis and programmes on water management and development reaching out to the whole Danube basin.

Floodplain restoration

As part of the process of river training throughout the whole world floodplains were reduced tremendously, e.g. by 68% at the Danube. In two case studies strategies for river restoration are presented, taking into consideration present drivers and pressures, but also realistic opportunities in the respective regions (Hein et al 2015, article in press). Despite Upper and Lower Danube showing differences in the context mentioned, common options apply regarding e.g. stakeholders and societal needs. While acting within these boundaries relevant at present, emerging constraints like climate change and invasive alien species, the latter already covered by a Regulation of the European Union, will be integrated in future strategies and recommendations for sustainable floodplain restoration.