Correcting the mistakes from the past – remediation of riparian areas on the Danube floodplain between Neuburg and Ingolstadt (Bavaria/Germany)

Bernd Cyffka[1]

Keywords: Floodplain, remediation, interconnection floodplain/river

Introduction

It is common knowledge that man contributes to landscape changes. But, often, the extension of this change is not clear – not even the consequences. Especially significant are the changes of our floodplains. In Germany it started at the beginning of the 19th century. People did not want to accept the "restrictions" by the river, and so began the embankment of rivers such as the Rhine and the Danube. "Restrictions" were the frequent flooding that made it impossible to use this land for settlements and agriculture. This was (and is) the classical concurrence of space: nature vs. man. At the beginning man was victorious. Embankment and straightening showed positive effects, and rivers and floodplains were separated as far as the hydraulic and ecologic connections were concerned. During those times people ignored the effects of the changes because other priorities existed. But times have changed and now it is necessary to correct the mistakes made in the past. The coping with nature is shown in figure 1 as the example of the area between Neuburg and Ingolstadt in Germany.

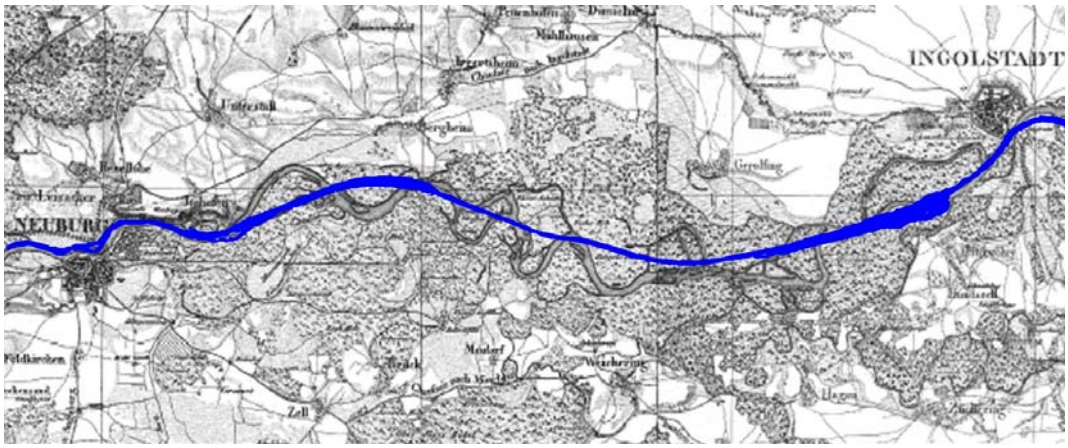

Fig. 1: Historic map of the Danube floodplain from 1830. The modern change of the river course is shown in blue.

The corrections of the Danube River are visible as a blue band in figure 1. Today, the former meanders are nearly invisible. In the early 1970s two barrages (Bergheim in the west and Ingolstadt in the east of fig. 1) were built. Up to that time the Danube gushed through its river bed, with virtually no hydraulic contact to the floodplain and the riparian areas. No water was left for this terrestric-aquatic biotope. The barrages did not change this impression.

There are 2.100 ha riparian forest in this area – one of the largest coherent riparian forests in Europe. It is owned and managed by the Duke of Bavaria, and also suffers from the changes. The lack of water in the floodplain made forestry more lucrative. Non-riparian tree species were planted, but luckily the forest management kept some natural areas as well. Therefore, the riparian forest between Neuburg and Ingolstadt did not completely change from a natural to a cultural landscape.

[1] Floodplain Institute Neuburg / University of Eichstaett-Ingolstadt, Platz der Deutschen Einheit 1, D-86633 Neuburg a.d. Donau, Germany

The question is how to remedy the floodplains of today (fig. 2), as well as determining the final goal of the remediation (DISTER 1992; HÜGIN & HENRICHFREISE 1992). Is it sensible to achieve the noble goal of the former natural floodplain? It may be sensible, but in most of the cases it is not possible because of the aforementioned reasons.

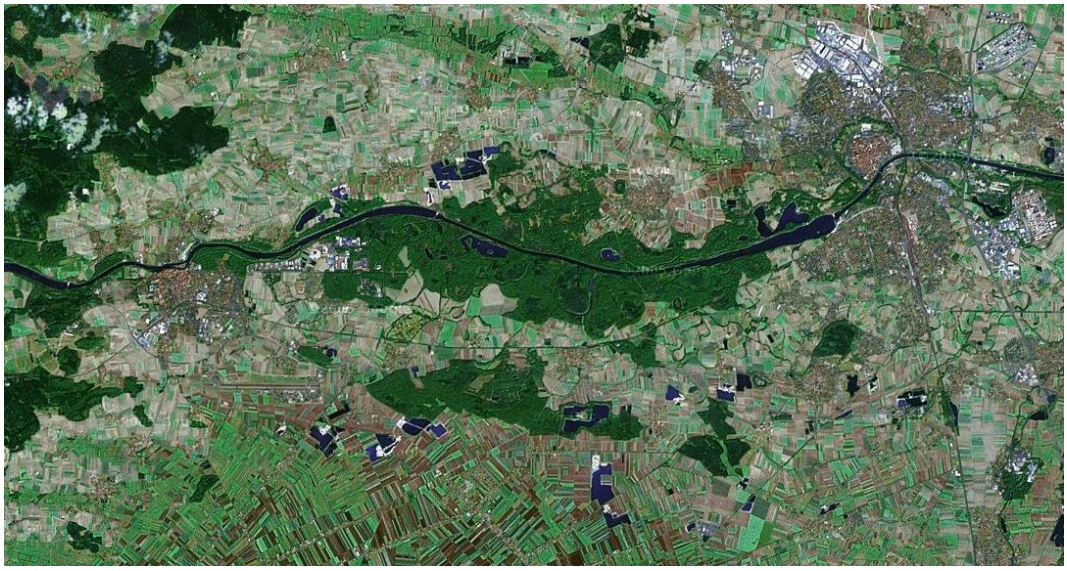

Fig. 2: The floodplain between Neuburg and Ingolstadt of today (large green area in the middle). Satellite image from MRSid data base. Orthorectified Landsat ETM+ mosaics, band combination 7-4-2, sharpened with panchromatic band, pixel size 14.25 m.

The main goal of the restoration in this case is to bring more dynamics to the existing floodplain. Dynamics to the groundwater level, to the water surface and water courses, and to the morphological features as sand and gravel banks and the watersides itself. Therefore the hydrological processes are targeted as the most importance ones. Nearly everything in a natural floodplain has a relation to hydrological processes and is connected hydraulically. If one is able to use water as an adjusting screw many other related features (e.g. vegetation) will adjust itself after a certain period.

Measurements

On November 21, 2005, the Bavarian Minister for the Environment, Health, and Consumer Protection dug the first turf for the 11 million Euro project named *"Remediation of riparian areas on the Danube floodplain between Neuburg and Ingolstadt."*

The riparian forests in this area will experience a significant change during the next several years. The plan is to install two weirs in the Danube dikes (see fig. 3 and 4). The first one will discharge permanently 0.5-5.0 m^3/sec into a former riverbed of the Danube. The riverbed is not continuous over its complete length, so the scientific exiting situation is to determine the path for the water. The question is which role erosion and accumulation will play. Of course there will be some initial diggings to pre-determine the main course of this new river from former ox-bow to ox-bow, but that is all. Nature will direct the details.

This is not only the reactivation of a former Danube River course; it is simultaneously a bypass of the Bergheim barrage (fig. 4).

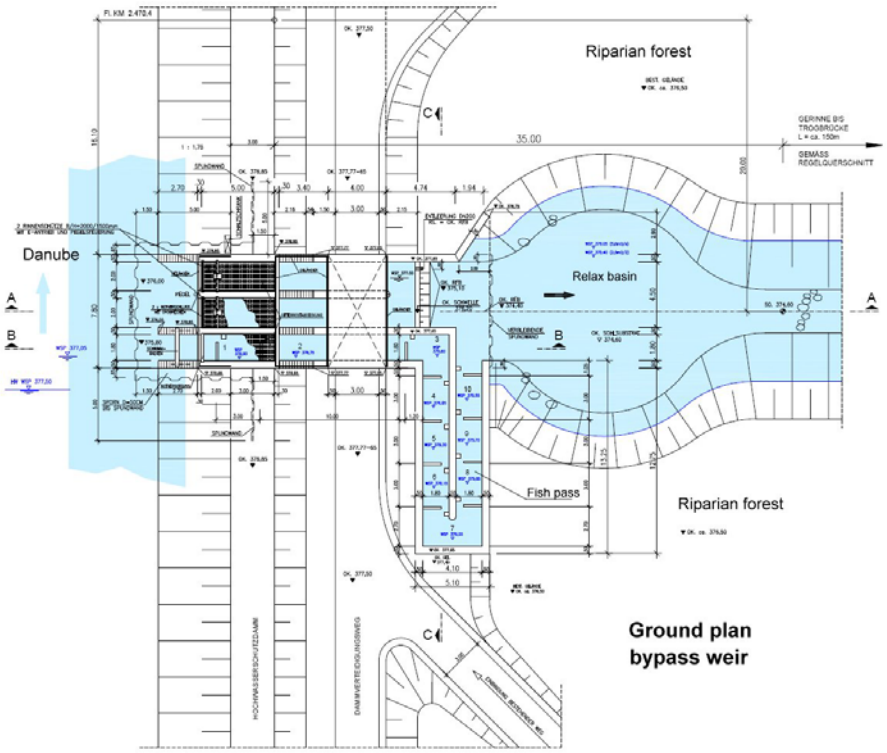

Fig. 3: Technical sketch of the Danube bypass weir.

In this part the Danube River will be open again for migrating fish. It is only a first step because there are the barrages of Bittenbrunn, Ingolstadt, and so on that are still impermeable, but it is a step in the right direction. The bypass is controllable, so it is possible to imitate natural conditions – e.g. during summer at low water there will be a water emission of only 0.5 m^3/sec. This will give back dynamics to the new side river, and fauna and flora will have to adapt to this. But 0.5 m^3/sec is the minimum discharge, and of course, there will be no complete drain so that fish can migrate throughout the year.

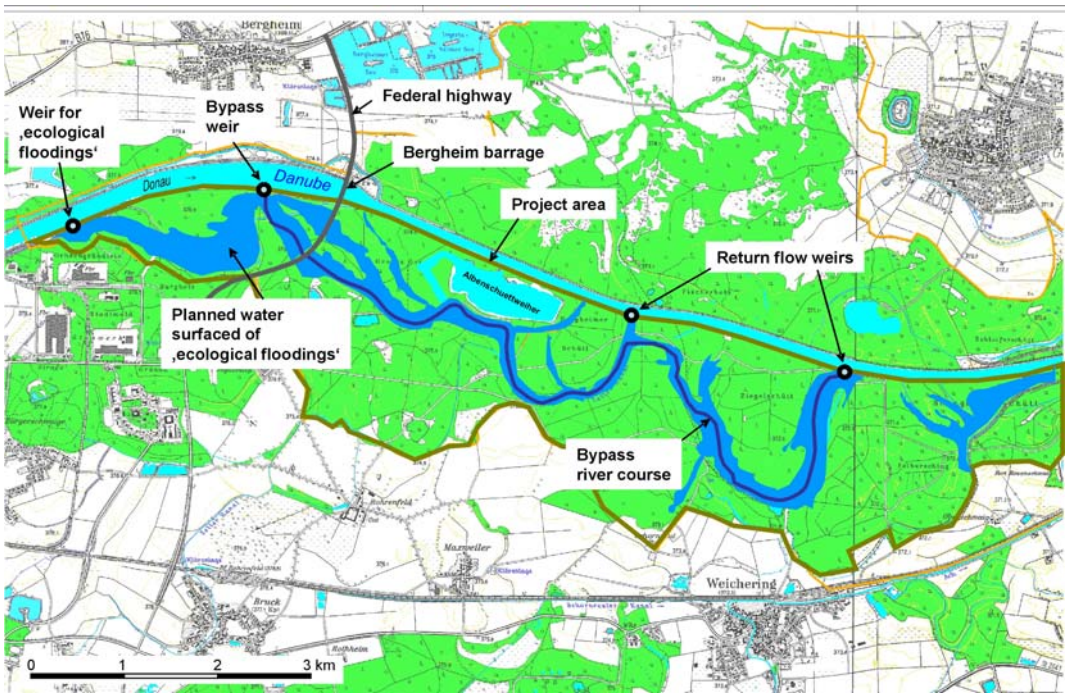

Fig. 4: Project area and location of the planned weirs, the bypass and the area of "ecological floodings".

But the bypass will not cause conditions that are characteristic for a dynamic floodplain. To generate this, it is necessary to have frequent floods. This will be possible by the second weir (fig. 4), and "ecological floodings" (some people like the expression "controlled floodings" better) will be the result. If the water level in the Danube is high enough (more than 600 m^3/sec), statistically 2-3 times a year, about 30.0 m^3/sec can be let out from the Danube into the floodplain, and especially into the riparian forests. The "ecological floodings" will cause a band of water that accompanies the bypass and brings more water as well as more groundwater dynamics to the floodplain. The floods will last 5 to 10 days, depending on the conditions (soil moisture) in the preceding weeks. It is important not to dam the water, but to have flowing conditions. The water will be led through the riparian area and the part that is not able to seep away will be fed back into the Danube by two extra weirs. After the flooding, the water will saturate the soil in the riparian forest for several weeks, and will contribute to the groundwater and so the groundwater table will rise. And with this, it might be possible to re-establish corresponding biotopes.

But the way to nature-like softwood forests along the bypass, which were characterized by poplars, willows, and alders, is long. The construction will continue up to 2008 and the hope of all participants involved in the project (Water Management Authority Ingolstadt (in charge), district of Neuburg-Schrobenhausen, cities of Ingolstadt and Neuburg, University of Eichstaett-Ingolstadt and the newly founded Floodplain Institute Neuburg) is to have the first water as well in 2008 on the floodplain. During this time the restoration protocol will be set up by the Floodplain Institute Neuburg. This protocol will follow certain guidelines from the planning approval procedure but has several possibilities to be extended in direction of scientific research. During the next two years the Floodplain Institute Neuburg is looking for project partners to install sophisticated research projects. As incentive it offers one of the largest outdoor tests with outstanding research possibilities.

The advantages and scientific benefits of the "ecological floodings" and the bypass in this project are that the weirs work as an adjusting screw. This makes the project really to one of the largest field experiments in Germany. Depending on frequency, duration, and quantity, the water is let into the floodplain it is possible to influence the conditions of moisture. However, this will cause partly anaerobe conditions in the soil and at the roots of the trees at least for several days, and the delicate ones will soon die. Conservationists will say: "Okay, so what?", but the forests are owned by the "Wittelsbacher Ausgleichfonds" (a public corporation to support the former Bavarian Royal House) and is managed by its Forest Management Department. They have a vivid economical interest to keep the trees upright and growing. And that is the crux of the matter. On the one hand, wonderful conditions for a long-term scientific experiment for nature conservation and re-establishment of riparian forests and floodplain meadows, on the other hand a forest company that wants to benefit.

For the implementation of a monitoring under scientific conditions the Floodplain Institute Neuburg/Danube was founded in January 2006. A co-operative contract with the Catholic University of Eichstaett-Ingolstadt ensures scientific linkage and personal security. The topics of research are multifarious. Starting from the top there are the main fields of vegetation, soil, and water. Most exciting will be to see the change in all these fields. Therefore, the status quo was taken up during the last year, and theses works will last until 2007. Finally, there will be detailed information on the trees next to the new water course, the morphologic basis of this water course, as well as on the soil and sediments in and next to it.

A selection of the main research, restoration and monitoring questions is:

- What species of trees are able to tolerate the future moister environment?
- Will it be young or old trees that die first or that will survive (MARGRAF 2004)?

- What is the detailed course of the new river? Will it follow old lineaments, old ox-bow structures, or is erosion the main factor and the river will form a really new bed?
- What is the amount of sediment transported in this situation by about ±2.5 m^3/sec discharge?
- What will happen if a hidden ancient gravel bank is eroded? Will the water start to diminish into the ground?
- What about groundwater dynamics (KIENER 1984)? One goal of the project is to foster groundwater dynamics. Will this come true and to what extent?
- Will the beaver – not rare in this area – use the new environmental conditions to spread more and more?
- What about the mosquitoes? Will they rise to a plague in the vicinity?

These questions show only a part of what is to do after the flooding has started. The milestones to evaluate the success of the operation will be both the technical creation of the bypass and the "ecological floodings" but also the measurable groundwater dynamics. The gauging stations will show whether there is a major improvement. If there is a development in direction to morphological dynamics, sand and gravel banks, several floodings a year nature will benefit and follow the new conditions step by step. To what extent nobody is really able to say yet. Nature-like conditions are the goal to strive for.

Several people ask whether it is sensible to "let just nature do it". But what is the alternative? There is the unique chance to let nature overtake the steering wheel again. Shall we intervene or restrict and start to shape the landscape like the decades before? Of course it is not possible to "let nature do it" in each area of our cultural landscape, but in this case it is, and we will see to what extent nature is able to come back.

Of course the author is a scientist and curious about the outcome of this outdoor test. So there are already some modelling approaches especially in direction of the river course and the water surface of the ecological floodings (fig. 5).

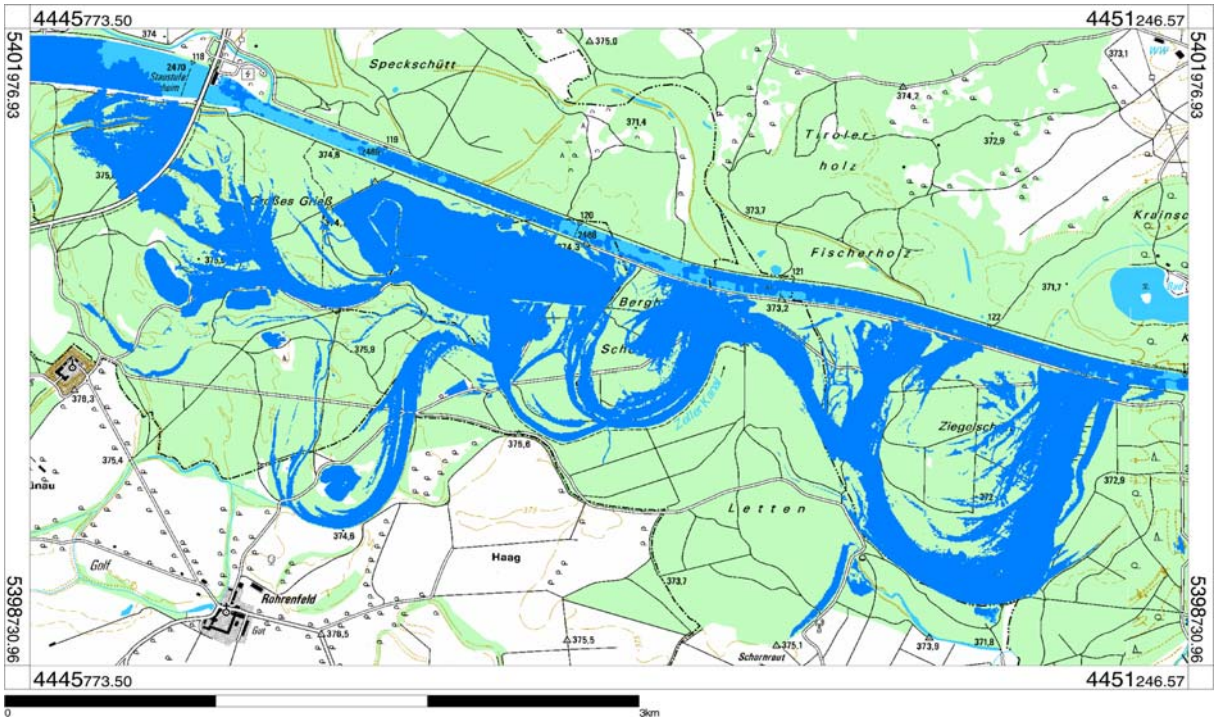

Fig. 5: Modelled "ecological flooding" water surface 2.5 m above the channel line. Western part of the project area. The flooded area is shown in blue. Laser scanning data © LVG Bayern.

The results differ clearly from that what is given in the planning approval procedure. But there are several superimposing processes – erosion and accumulation in the bypass river course, "ecological floodings", natural floodings – from which the particular effects can not be modelled. So each modelling approach is just an "approach". The final results will be determined by nature.

Furthermore, there is the old conflict between economy and ecology. Will it be possible to keep a modern forest upright in the area of the hardwood riparian forests (KOOP 1986)? It will not be possible to pay for compensation for the entire area owned by the "Wittelsbacher Ausgleichsfonds." So the steering of discharge of the bypass and the "ecological floodings" has to happen carefully and must take both sides into consideration, ecology and economy. At least in this area, but probably in the whole of Europe and most other parts of the world, it is not possible to roll back the centuries. Mankind is active in many areas and we have to balance out the interests.

Summary

Nature conversation and flooding makes it necessary to start remediation of our rivers in Europe, even of dammed rivers as the Danube. The article shows foreseen measurements in between Neuburg and Ingolstadt (Bavaria/Germany) which make it possible to give the floodplain the former hydro-, morpho- and bio-dynamics back. The measurements are a bypass and "ecological floodings".

References

DISTER, E. (1992): Wissenschaftliche Erfahrungen aus Renaturierungsprojekten.– Ber. Akademie Natur- und Umweltschutz Baden-Württemberg **13b**: 20-36.

HÜGIN, G. & HENRICHFREISE, A. (1992): Naturschutzbewertung der badischen Oberrheinaue. Vegetation und Wasserhaushalt des rheinnahen Waldes. – Schr. Vegetationskunde **24**.

KIENER, J. (1984): Veränderungen der Auenvegetation durch die Anhebung des Grundwasserspiegels im Bereich der Staustufe Ingolstadt. Ber. Akad. Nat. Landschaftspflege **8**: 104-129.

KOOP, H.G.J.M. (1986): Ecological monitoring of natural and semi-natural forests. In: Fanta, J. (eds.): Forest dynamics research in western and central europe. Proceedings of the IUFRO workshop of subject group S1.01-00 ecosystems, Wageningen, The Netherlands, pp 257-262.

MARGRAF, C. (2004): Die Vegetationsentwicklung der Donauauen zwischen Ingolstadt und Neuburg: Vegetationskundliche Studie über den Wandel einer Auenlandschaft 30 Jahre nach Staustufenbau. Hoppea **65**.