THE IMPACT OF RIVER RESTORATION ON THE WATER QUALITY OF THE SURFACE WATER AND GROUNDWATER IN AN ALPINE CATCHMENT

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STUDY AREA – THE THUR CATCHMENT

- Thur river is in north eastern Switzerland, a tributary of the Rhine River, draining a catchment of **1696 km²**. The rainfall in the Thur catchment varies in the high lands from **2500 mm/year to 900-1000 mm/year** in the lowlands. (Fig.1)
- The land use in the Thur Catchment is predominantly **Agriculture (61%) with forest (30%) urban** areas forming the rest **(9%).**There **are 45 Waste Water Treatment Plants (WWTPs)** which contribute **22% waste water** in the low flow conditions. There are several meterological and hydrological measuring stations in the catchment. (Fig.1)

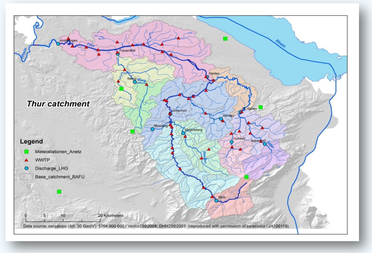


Fig. 1

RIVER RESTORATION - THE STORY SO FAR

- The meandering Thur river – **straightened to a narrow channel (45m wide)** with 50-100 m wide overbanks in **1890's**. The river reach at **Niederneunforn site – restored to mimic prechannelization** condition in 2002 -2003 resulted in a river bed width of 50-100m. (Fig. 2a and 2b). Detailed monitoring and water sampling been done at a **heavily instrumented site Niederneunforn** at the western end of the Thur valley as part of the **RECORD* project**. (Fig. 3)

  *http://www.cces.ethz.ch/projects/nature/Record

- Feedback mechanisms between **hydrological, ecological and morphological processes will be understood to an extent that allows for process-based prognostic modeling of key coupled processes at several scales.**

Fig. 2 a

Fig. 2 b

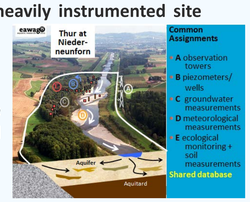


Fig. 3

IMPORTANCE OF THIS STUDY

- **60 million Swiss francs** are to be spent every year for river restoration in Switzerland in the different catchments over the next 80 years.
- There is an **urgent need for mechanistic understanding of processes** to evaluate the success of the river restoration project and to make proposals for future restoration projects.
- Assessment of water quality is a major step towards understanding the impact of restoration at the local and catchment scale.

RESEARCH QUESTIONS

- What are the **diurnal** and **seasonal** water quality changes in the Thur river upstream and downstream of the restored section ?
- Are there any **links** between the different water quality parameters and how do they influence each other ?

DISCUSSION OF INITIAL RESULTS

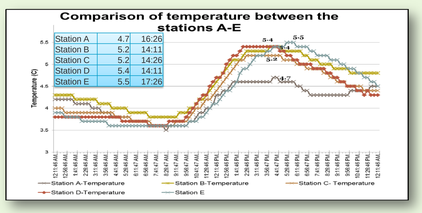


Fig. 5

- The temperature fluctuates from 3.5- 5.5 kelvin in the stations. The peak occurs between 14-17:30 in the various stations (Fig.5).
- It is observed that the temperature is getting warmer in the next night in comparison to the night when the observation was started.

- The 5 sampling stations located at the lower reach of the river Thur between Frauenfeld and Andelfingen. (Fig. 4)
- Distances between stations : A-B : 8 km, B-C : 4.2 km, C-D : 4.38 km , D-E : 7.2 km. Time of sampling/recording : 28-02-2012 -29-02-2012

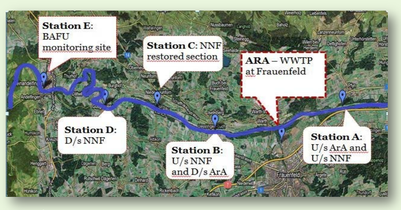


Fig. 4 (ArA WWTP- Waste Water Treatment Plant, NNF- Niederneunforn)

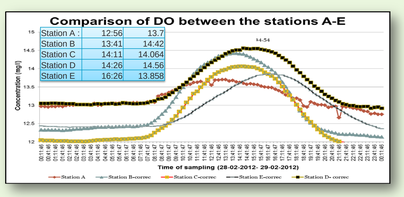


Fig. 6

- The diurnal oxygen fluctuations can be observed in each of the stations reaching the peak in the afternoon between 12-14:00.
- There is a time shift in the occurance of the peak which varies in each station as shown in the table enclosed in the graph.

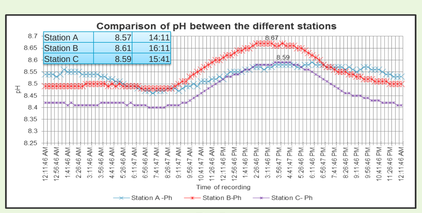


Fig. 7

- The pH in the different stations show pronounced diurnal trend also. The peak is observed between 14:00 to 16:00 in the different stations. (Fig. 7)

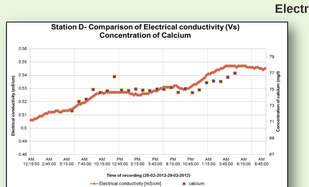


Fig. 8 a

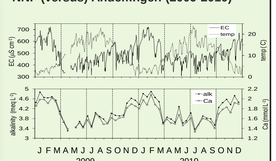


Fig. 8 b

Hayashi et al. 2012[1] (in Press)

- The yearly diurnal oscillations were observed in the river Thur in station C and station E for the year 2009-2010 and a strong correlation is observed between the EC signal and that of Ca concentrations and alkalinity for the whole year. (Fig. 8 b)
- The diurnal EC signal corresponds to Ca concentrations in a day as shown in station D (Fig.8 a) thus confirming that the lower reach of river Thur is a calcite dominated system.

RESEARCH PLAN

FIELD WORK

- 24 hour sampling campaigns in summer and winter for **pH, Temperature, Electrical conductivity and Dissolved Oxygen** at the sampling sites. (15 min intervals) using in situ probes
- Grab sampling at each location following the flow of a particular patch of water and auto samplers at each station collects **hourly samples for 24 hours**

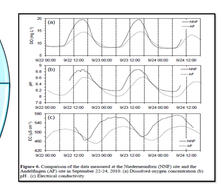
METHOD

- Lab analysis of water quality parameters (Cl, TOC, TIC, DOC, NH_4-N, NO_2-N, NO_3-N, SO_4, Ca, Total hardness, PO_4)
- Use of stable isotopes to trace the biogeochemical processes
- Development of a 1D HECRAS model to compute the velocity of the river between sampling stations

REVIEW

- Review of the results
- Establishment of long-term monitoring stations for both surface and groundwater
- Planning the next field campaigns
- Conceptualization of a Water quality model

EXPECTED RESULTS



Hayashi et al. 2012[1] (In press)

- Diurnal and seasonal change in the water quality parameters (Eg. Ph , DO and EC)
- Link between the different parameters
- Influence of the restored section on water quality parameters

[1]Hayashi.M, Vogt.T, Mächler.L, Schirmer.M., 2012. Diurnal fluctuations of electrical conductivity in a pre-alpine river: Effects of photosynthesis and groundwater exchange (In Press)

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