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Vegetation Response to a Floodplain Dynamisation Project along the upper Danube (Neuburg and Ingolstadt, Bavaria, Germany) from 2008 - 2012

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The project '*Dynamisation of the Danube Floodplain*' aims to bring dynamics back to the floodplain severely altered by human activities for 200 years (hydropower, straightening and bank stabilisation). Therefore, three measures (new floodplain river, ecological floodings and groundwater draw down) were implemented and were finished in 2010 (Fig. 1). Typical floodplain species and habitats should be promoted by a more dynamic water level and new sediment dynamics. We investigate the effects in different strata of the riparian forest before the start of the project (2008) and in two successive years afterwards (2011, 2012).

The main focus of the analysis is laid on plots that are situated close to the new floodplain river with a low relative height, being most frequently flooded or strongly influenced by an increased groundwater level (group 3, Fig. 2/3).

group	number (thereof flooded)	absolute height (median)
1	58 (11)	1.49
2	24 (12)	1.37
3	22 (16)	0.80
4	12 (4)	1.48

Fig. 2: number of plots and its median height above thalweg

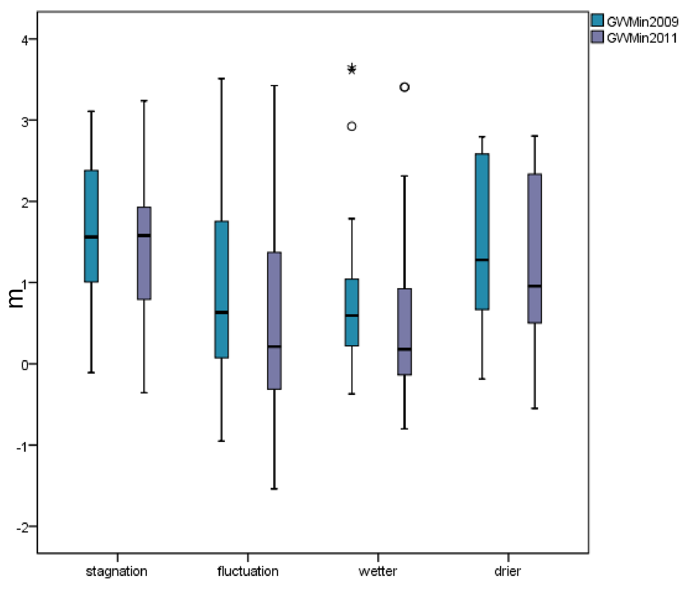

Fig. 3: change in mean groundwaterlevel (distance surface-groundwater)

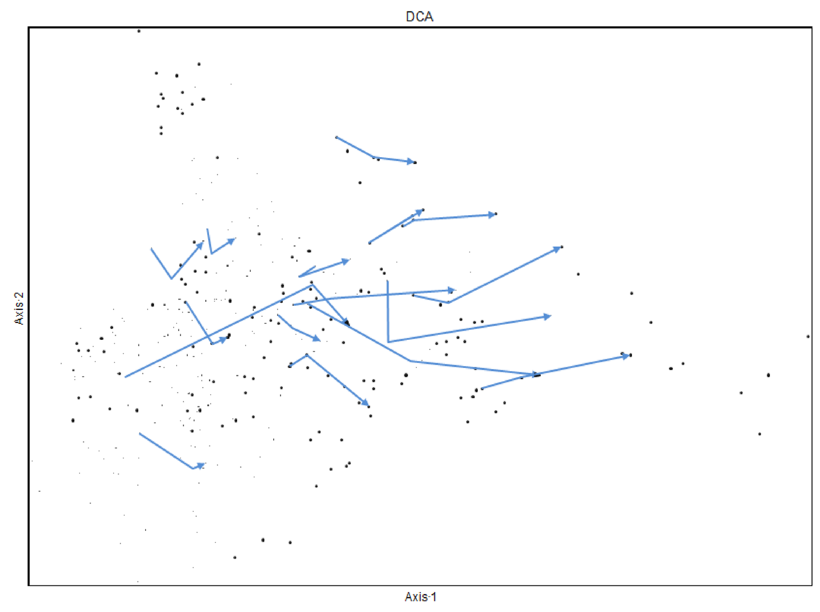

Fig. 4: Detrended Correspondence Analysis (total inertia = 2.5462); Relative change of species composition from 2008 to 2012; each permanent plot occurs three times; successive points in time are joined by arrows; for a better overview, only plots of group 3 are displayed

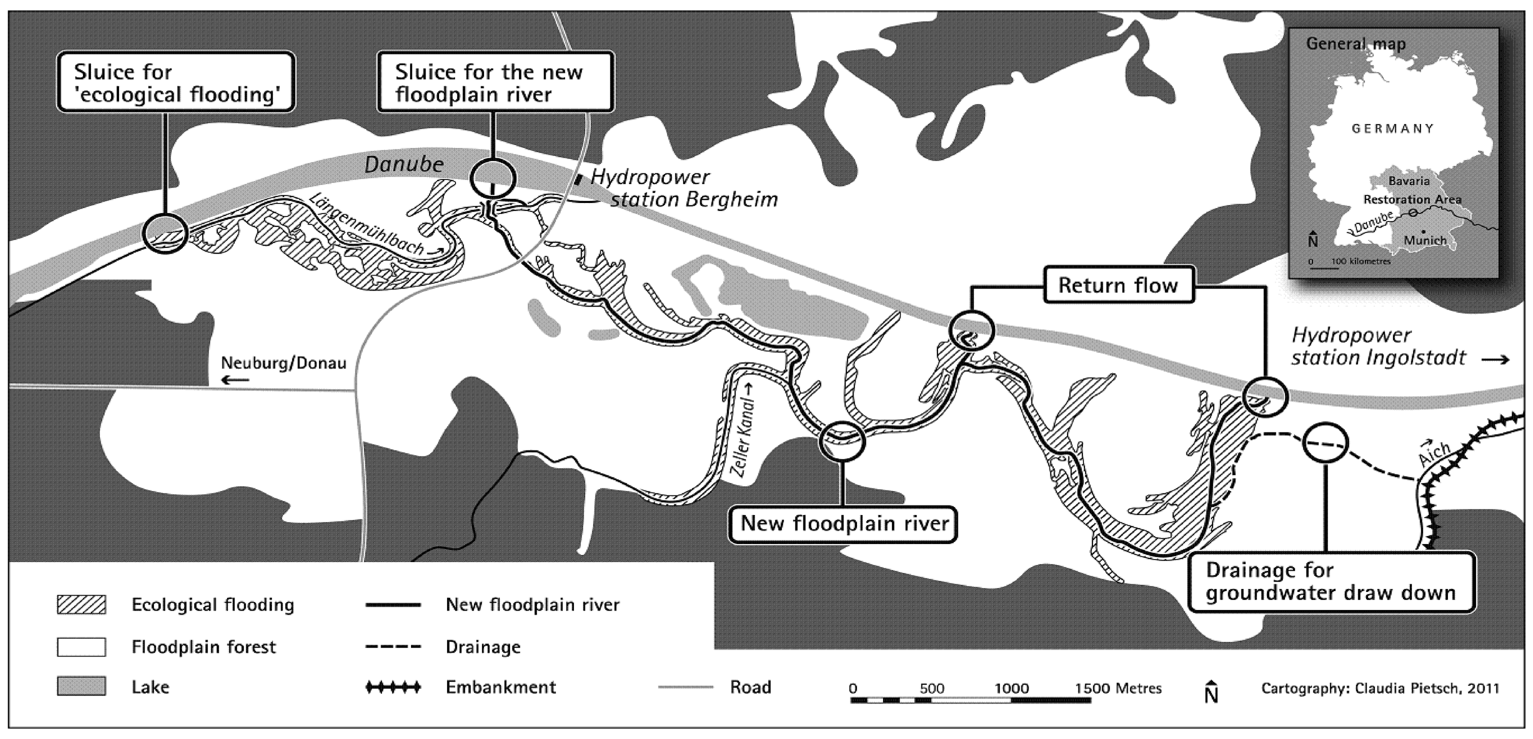

Fig. 1: study area and planned measures

Methods

117 vegetation relevées of 200 m² were repeated in 2008, 2011 and 2012. Plots were placed by a stratified random sampling design regarding different height, distance to the measures and flooding probability.

An analysis of the time-series (Fig. 4) was conducted by a DCA and the Sørensen-Index. Four groups according to their shift along axis 1 and to a Sørensen-Index higher than 0.8 could be identified.

1. Stagnation: no significant changes occur
2. Fluctuation: changes between the years, which turned opposite in the following year
3. Positive shift along axis 1 in both years towards wetter conditions
4. Negative shift along axis 1 in both years towards drier conditions

For these groups the distribution in the different strata and the species composition (indicator species according to Ellenberg et al. (2001), Red List species (LfU 2003), typical floodplain species) was analysed.

Results

Only a few plots showed a significant shift in the desired direction towards typical floodplain species, mainly in group 3.

Group 3 represents the plots which changed to wetter conditions. The índicator value for moisture constantly increased between 2008 and 2012 (Fig. 6). Besides this, the number of red list species (Fig. 7) and indicator species for an intact floodplain were promoted, e.g. *Oenanthe aquatica* and *Senecio paludosus* (Fig. 8/9). A species turn-over can be observed on these plots (Fig. 10)

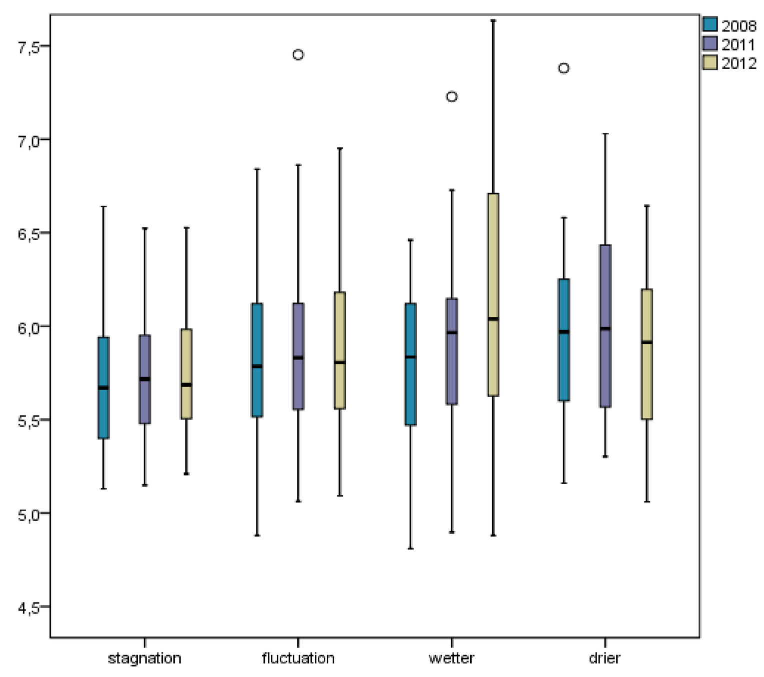

Fig. 6: Ellenberg moisture value in 2008, 2011 and 2012

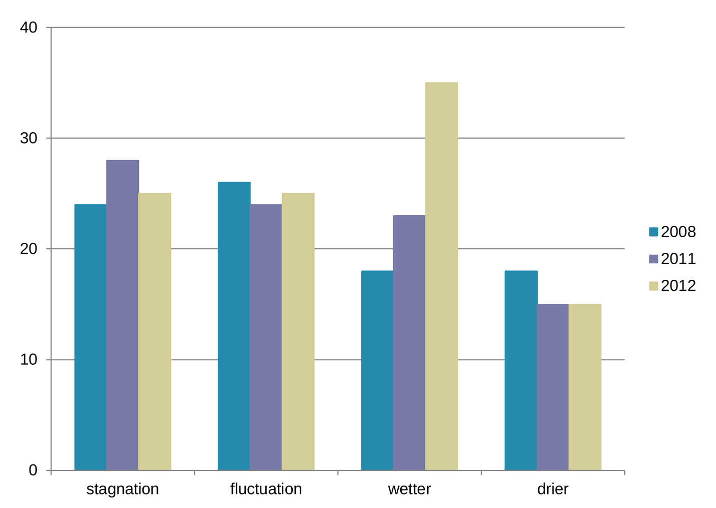

Fig. 7: Number of red list species ranked endangered (2), vulnerable (3) and near threatened (V)

Fig. 8: *Oenanthe aquatica*

Fig. 9: *Senecio paludosus*

2008 2012

Fig. 10: An example of a plot directly influenced by the measures and frequently flooded since 2010 (left, 2008 before the beginning of the restoration project and right, 2012 afterwards)

Conclusions

- Vegetation quickly responded to changed hydrological conditions
- Changes are restricted to a few plots mostly situated on deep sites close to the measures
- At larger distances (altitudunal and longitudinal) effects cannot (yet) be observed
- Thus, the measures taken are only effective in a small strip on both sides of the new floodplain river →the measures create a new floodplain along the new river but it is not a dynamisation of the whole Danube floodplain!

Literature:
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