

# **STAKEHOLDER GOALS AND THE UNESCO BIOSPHERE RESERVE LOBAU: How to make contrasting interests meet?**

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## **ABSTRACT**

The UNESCO Biosphere Reserve Lobau (Vienna, Austria) was established in 1973, covering one of the ecologically richest parts of the Danube River floodplain corridor, as it exists today, 130 years after river regulation. Stakeholder interests range from preserving the present conditions, with the effect of rapid wetland aging, to rehabilitating original flow conditions, which would result in a total change in floodplain water character. Recent investigations in special habitats revealed biodiversity hot spots. Further research of aquatic vegetation will enhance our understanding of the floodplain ecosystem, needed to bridge diverging stakeholder needs and to maintain the fundamental ecological qualities of the Lobau Biosphere Reserve.

**Key words:** floodplain, aquatic vegetation, biodiversity, ecosystem services, ecohydrology

## **1. INTRODUCCION**

### *1.1. History and location*

The UNESCO Biosphere Reserve Lobau was established in 1977 and declared part of the Danube National Park in 1996. It covers an ecologically most valuable part of the former floodplain in the Danube River corridor. It is located within the boundaries of Vienna, Austria's capital city, to the southeast of the central urban agglomeration. Today's situation is the result of river regulation finished in the last quarter of the 19<sup>th</sup> century, which resulted in a straightened main channel for the river, separation of most former side channels and floodplain waters, and an adjacent inundation area limited by a protective levee. By 1990 the latter was finally transformed into a flood discharge channel (New Danube) and an island, which separates the main channel from the New Danube. In the process of river regulation many separated smaller water bodies were filled in, but the former main course and some parts of secondary channels still exist (for more general information see Janauer, 2005 and the homepage of the Municipality of Vienna, Anonymous, 2007). The Lobau wetland is enclosed by levees as part of the flood defence system, but through a small opening in the main levee at the down-river end water of the main river channel can enter in cases of rising water levels (backflow flooding), and water flows out when the discharge in the main river channel decreases. Ground water connection with the main river channel contributes to water exchange processes in the floodplain waters, but long periods are characterised by negligible flow. Therefore, the aquatic vegetation, which secures good water quality by intensive competition with plankton algae, is abundant, and characterised by several rare and/or endangered species. The map (Fig. 1) shows the location of the Lobau wetland and the water bodies investigated as part of the 2006 UNESCO Demonstration Site Ecohydrology Study.

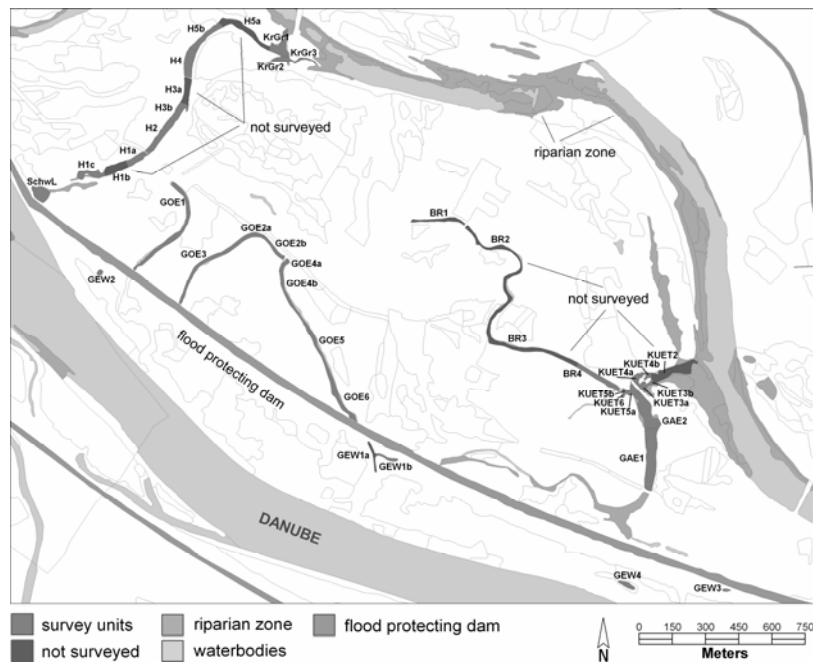


Figure 1: The study site of the Lower Lobau wetland. Water bodies investigated in 2006 are marked in dark grey; numbers mark the survey units. Abbreviations of the waterbody names: BR (Brunnader), GAE (Gänshaufenwasser), GEW (Gewässer = waterbody), GOE (Göthenwasser), H (Hanselgrund), KrGr (Kreuzgrund Traverse), KUET (Künigl Traverse), SchwL (Schwarzes Loch). Source: Janauer and Strausz (2006 b).

## 2. OBJECTIVES

This paper refers first to different stakeholder positions existing among responsible administrative units of the Municipality of Vienna, and other stakeholders like the Danube National Park Management, the Austrian UNESCO Commission, and the Austrian Academy of Sciences (UNESCO Program Commission for MaB/IHP). The second focus describes the situation of the aquatic and semi-terrestrial vegetation in water bodies separated from the main course of Lobau floodplain waters with respect to the most recent survey (Janauer and Strausz, 2006 b). Finally, ways of sustaining the present biodiversity and ecohydrological strategies preserving existing ecosystem services under changed hydrological conditions are discussed.

### 2.1. Stakeholder positions

The opinions and positions of stakeholders responsible for the Lobau area were noted during the 2006 Stakeholder Meeting 'Biosphere Lobau', organised by the Demonstration Site leader (Janauer and Strausz, 2006 a). Three main stakeholder positions were extracted from the contributions.

Stakeholder Position 1: Back-flow flooding entering the Lobau through the down-river opening in the levee (called "Schönauer Schlitz") deposits suspended solids in the floodplain waters at rates negatively correlated to the distance from the main river channel. Siltation reduces water depth and enhances growth of reed swamp and other helophytic vegetation, and wetland ageing (Reckendorfer *et al.*, 2000, Reckendorfer *et al.*, 2004).

Stakeholder Position 2: The Lobau groundwater resource is used for the collection of high quality potable water. Permanent direct river water inflow could negatively influence this quality source.

Stakeholder Position 3: 130 years of predominantly still water conditions following the river regulation supported the establishment of ecologically important aquatic vegetation types. The Biosphere Reserve is a last species refuge for water plants and their associated fauna and microorganisms: former habitats in the surrounding landscape do not exist any more.

## 2.2. The ecological and conservational value of small separated water bodies

In 2006, a field study was conducted in the small remaining sections of former secondary channels, meanders and oxbows originating from the web of branching and anastomosing channels of the river prior to regulation. Their ecological value *sensu* species refuge and biodiversity was assessed, as well as their value as a habitat for rare and endangered species.

Survey method: The aquatic vegetation was investigated by walking along the shoreline of the water bodies. Vegetation samples were taken by a rake. A 5-level estimator scale was used to assess the abundance of each aquatic and helophytic species (Kohler and Janauer, 1995, a short description is given in [www.midcc.at](http://www.midcc.at)). This method is also described in European Standard EN 14184 (Anonymous, 2003), which is used in several European countries for the assessment of the aquatic vegetation for EU-Water Framework directive purposes.

## 2.3. Biodiversity and ecosystem services under the influence of changed hydrological conditions

There are ecological (e.g. river rehabilitation) and social (e.g. drinking water resource) aims which lead to contradicting solution strategies. However, the present ecosystem services (e.g. prevention of algal blooms) and ecological values of the aquatic macrophyte vegetation (e.g. biodiversity, provision of structured habitats for other aquatic organisms) shall not be excluded from predictive scenarios and Decision Support System approaches. With respect to the reaction of the aquatic vegetation to hydrological changes our knowledge is still limited, and climate change-triggered impacts have not been accounted for at all.

## 3. RESULTS – FIELD STUDY 2006

During the field survey in 2006, the aquatic vegetation of eleven small disconnected water bodies was investigated in the UNESCO Biosphere Reserve Lobau. Comparing the field surveys in 1998 and 2006 (Pall and Kum, 2006, Janauer and Strausz, 2006 b), the total number of species showed a slight increase (1998: 73 species, 2006: 75 species), but the number of red list species distinctively decreased (1998: 49 species, 2006: 34 species, Niklfeld *et al.*, 1999, Schmidt *et al.*, 1996, Fig. 2).

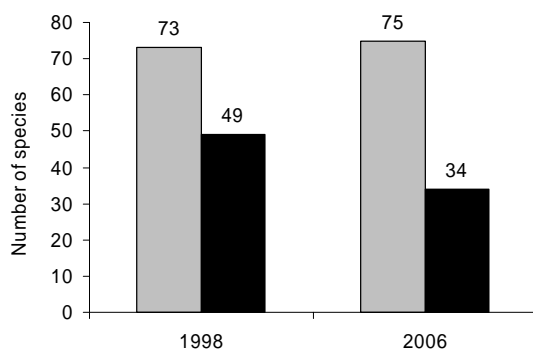


Figure 2: Species richness in isolated water bodies in the UNESCO Biosphere Reserve Lower Lobau, assessed in field surveys in 1998 and 2006. Grey bars: total number of aquatic species, black bars: number of Red List species.

In 1998 66 % of the recorded species belonged to one of the Red list categories, in 2006 Red list species represented only 45 %. Regarding red list categories, “endangered” (3) and “regionally endangered” (-r) made up the largest percentage in both years, 50 % in 1998 and 36 % in 2006 (Fig. 3).

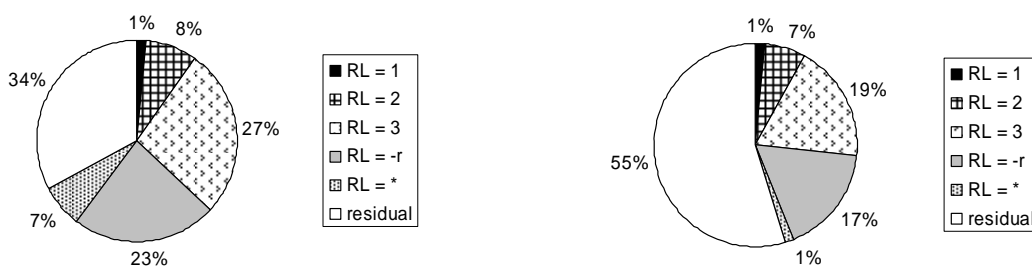


Figure 3: Red List species ratio of aquatic species split in Red List categories. Left: 1998, right: 2006.

Regarding the different growth forms, in the investigated Lobau water bodies the Hydrophytes represented the largest group of aquatic plants (37 species) in 1998, followed by Amphi- and Helophytes (22 and 14 species, respectively, Fig. 4 – left). However, in 2006, the growth form groups were subdivided more equally and the Helophytes represented the largest species group in this year.

Considering the species individually, this trend of Hydrophyte decrease and Helophyte increase is even more accentuated. 21 of the Hydrophyte species that still have been recorded in 1998 could not be found in 2006 any more (Fig. 4 – right). The same applies for a group of seven Amphiphytes and six Helophytes that were present in 1998 but not in 2006. In contrast, 18 Helophyte species that were not assessed in 1998 were detected in 2006, while only seven new Amphiphytes and four new Hydrophytes could be found in this year (Fig. 4 – right).

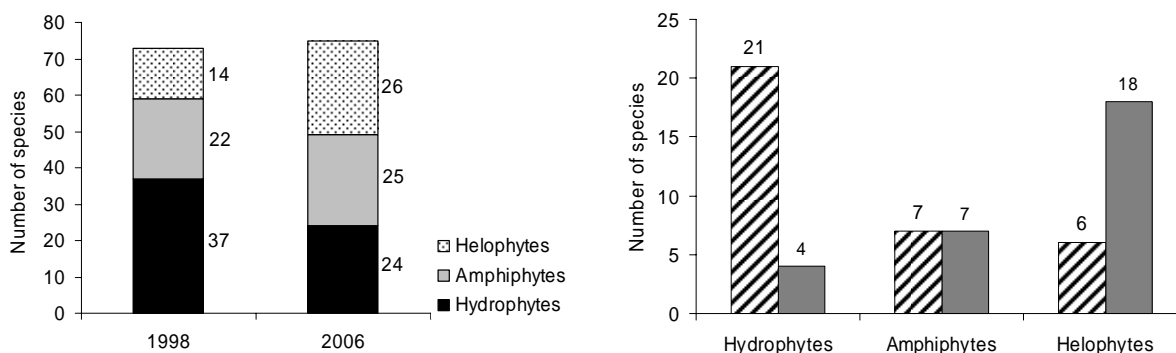


Figure 4 – Left: Growth form distribution of aquatic plant species in isolated water bodies in the UNESCO Biosphere Reserve Lower Lobau in 1998 and 2006. – Right: Aquatic plant species fluctuation in named water bodies, subdivided into growth forms. Streaked bars: species that were not found in 2006 any more, dark grey bars: species that were present in 2006 but not in 1998.

A large part of the aquatic species group that disappeared between 1998 and 2006 was formed by Red List species. Amongst them, repeatedly the Hydrophytes represented the most affected species group. 12 hydrophytic Red List species still present in 1998 could not be recorded in 2006 any more. Similarly, six Amphiphytes and four Helophytes mentioned in the Red List were not found in 2006 (Fig. 5).

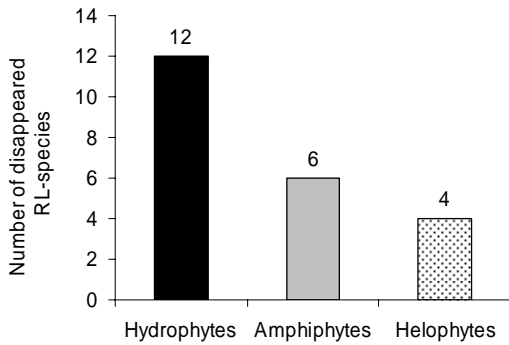


Figure 5: Number of aquatic Red List species that were recorded in isolated water bodies in the Biosphere Reserve Lobau in 1998 but could not be found in 2006 any more.

#### 4. DISCUSSION

The ecological value of the UNESCO Biosphere Reserve Lobau is represented to a great extent by its wetland biodiversity. But since its implementation in 1977 conditions have changed and new stakeholder interests will shape its future. Our macrophyte study in the Lobau wetland showed that small, isolated water bodies serve as refuge for aquatic plant species and represent biodiversity hot spots. A comparison with data from 1998 revealed that total aquatic species richness scarcely changed. When specifying the growth forms of the plants Hydrophytes, especially annual species, decreased in number from 1998 to 2006 while Helophytes increased. Amphiphytes hardly changed in number. This indicates progress in the conversion of aquatic into terrestrial habitats. It is proof that the whole Lobau Biosphere Reserve is a slowly ageing wetland, with water bodies filling up with suspended solids introduced by river floods or with autochthonous organic material.

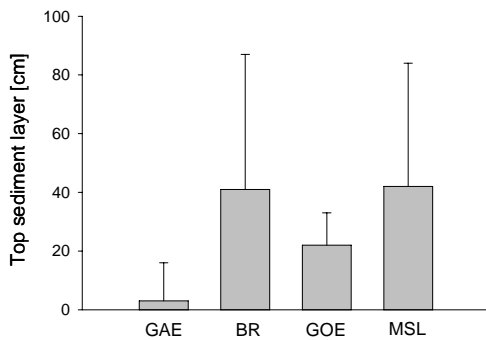


Figure 6: Mean top sediment layer thickness in selected water bodies in the Demo Site Lower Lobau. Abbreviations of waterbody names see Figure 1. The abbreviation 'MSL' indicates the mean thickness of the top sediment layer of all side arms and isolated water bodies located in the Lower Lobau (data: Reckendorfer *et al.*, 2000).

The small water bodies in the Lobau distinctly differ from each other in their top sediment layer thickness (Fig. 6). Reckendorfer *et al.* (2004) found no significant link with hydrological parameters such as groundwater connectivity and the effect of back-flow floods. According to these authors, sediment accumulation is primarily a result of autochthonous production of organic material in the isolated water bodies. Danube water percolating through the levees results in higher phosphorus concentrations in the water bodies located near the dam than in those more distant to the main river channel (Reckendorfer *et al.*, 2004) and may enhance primary production, despite shading impact.

The Lobau Biosphere Reserve's groundwater connection with the river is as good as possible with respect to the existence of lateral, but permeable levees. Water level changes still support the riparian

forest (but not as much as in natural conditions), and the floodplain waters are a species refuge for numerous aquatic organisms whose habitats were lost more than a century ago in the surrounding landscape. In social context and with respect to the sustainability of the wetland proactive strategies must be developed, as urgent stakeholder needs ask for solutions.

River ecologists want to rehabilitate, at least in part, flow conditions (“wetland flushing”) in the existing floodplain channel system (Janauer and Dokulil, 2006, Janauer *et al.*, 2006). This coincides with flood protection strategies for the urban area of Vienna. Both interests would be met by diverting water from the regulated main Danube River channel to the wetland, at flood periods as well as in a permanent regime. Negative side effects would be the transport of suspended solids into water bodies so far less prone to conversion into semi-terrestrial environments. Helophytes could take advantage of the changing conditions and gradually displace hydrophytic species. Our results described above are a strong indicator for this process. Additionally the plant nutrient pool (especially phosphorus) would increase and make algal blooms more likely (Wolfram *et al.*, 2006), and permanent flow would exterminate flow-sensitive aquatic plants (Chambers *et al.*, 1991, Henry *et al.*, 1994, Bornette and Amoros, 1996, Janauer and Pall, 1999, Preiner *et al.*, 2006, Strausz *et al.*, 2006).

Stakeholders responsible for the quality of potable water drawn from the Lobau horizontal filter wells object to any changes as, at present, no further treatment except mild chlorination is necessary (Anonymous, 2007). During flood periods wells are shut down today, to avoid a decrease in drinking water quality. Similarly, an all too static position on how to conserve the rich ecological status and species refuge service of especially aquatic habitats would prevent any rehabilitation of former flow conditions (Janauer and Strausz, 2006 b) and would accept rapid wetland ageing processes (Reckendorfer *et al.*, 2000, Reckendorfer *et al.*, 2004, Remy, 1993). These examples show how difficult it is to find a strategy simultaneously suitable for preserving existing ecological values and at the same time rehabilitating river flow conditions and suiting necessary planning for flood protection and drinking water supply (Table 1).

Table 1: Listing of some problems to solve in the Lobau Biosphere Reserve, possible measures, and benefits vs. potential threats upon implementation of such measures.

PROBLEM	MEASURE	BENEFIT / THREAT
Siltation & organic deposition in water bodies	Diversion of regular flow and floods into the wetland	<i>Siltation reduced</i> <b>Aquatic vegetation reduced</b>
Saving drinking water quality	No change of the present situation	<i>Still water plants saved</i> <b>Wetland turns terrestrial</b>
Saving aquatic vegetation values	Save and reconstruct diversified aquatic vegetation and habitats by application of ecohydrological principles	<i>Prevention of algal blooms</i> <i>Sustaining structure for aquatic organisms, species refuges, biodiversity, ecosystem services</i>

## 5. CONCLUSION

Two types of conclusions are apparent: those with ecological relevance and those with socio-economic relevance, with both closely interrelated. In ecological context, the importance of the small disconnected water bodies is paramount as species refuges dependent on special habitat conditions. They contribute essentially to the diversity not only of species but also of habitats, and their loss would be ultimate as outside the floodplain they are extinct today. Diverting floods into the wetland as a measure to slow wetland ageing may endanger the small valuable habitats unless measures are taken against their loss. In socio-economic context the need to have full flood protection for the city is a

prime aim, but should be reached not without saving, and recreating, the biodiversity hot spots in the small separated habitats. Preserving drinking water sources without preventing anti-siltation strategies may need technical solutions. Controlled floodwater diversion into the upstream part of the wetland could serve ecological rehabilitation interests as well as those of flood protection managers, and economic solutions for then needed water purification facilities may not be too expensive to become part of planners' and stakeholders' strategies. The development of a balanced set of ecological and socio-economic solutions must be supported by ecohydrological strategies (Zalewski, 2002), which keep ecosystem services as well as biodiversity intact in the UNESCO Biosphere Reserve Lobau.

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