



# Effects of hydrologic variations on the dynamics of reed belts and their habitat suitability for reed breeding birds of Lake Constance, Germany

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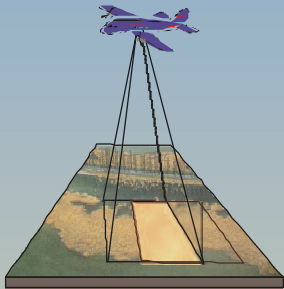


## Background

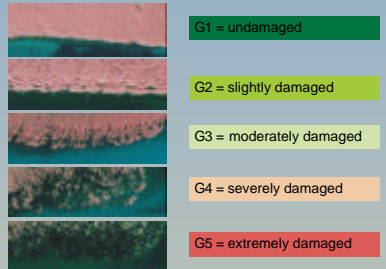
In consequence of the extreme flood at Lake Constance in 1999 the reed belts showed a severe loss in vitality so that a permanent damage could be expected. The monitoring project presented here focused on the documentation of the damage following the disturbance event, the identification of co-factors, and the assessment of its consequences to breeding habitats of the Great Reed Warbler (*Acrocephalus arundinaceus* L.).



## Material and Methods

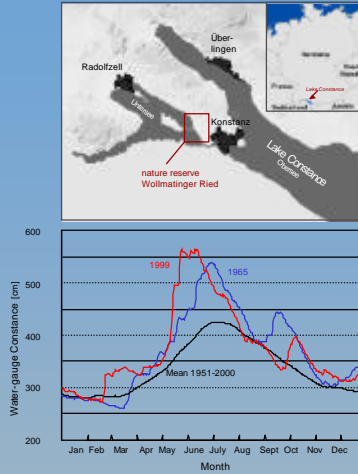


The monitoring was based on CIR aerial photo interpretation, quantitative GIS-analyses and field data. The design of the study implied the definition of five degrees of damage using the interpretation of CIR aerial photo series from July 2000. Using a photogrammetric plotter (Plancomp P 33, Zeiss, Germany), the aquatic reed beds were digitized and spatial changes compared to corresponding data from 1998 and 1993 were calculated by GIS techniques (ArcGIS, Redlands USA). Correspondence of damage patterns to stand elevation was revealed by spatial overlay of digital elevation model with reed data.



## Study area

Lake Constance is situated between the countries of Austria, Switzerland and Germany. With a surface area of approximately 535 km<sup>2</sup>, it ranks among the largest lakes in Europe. The littoral area occupies about 13% of this surface area, which is relatively high as is its shore length of 273 km. Lake Constance is one of the few large alpine and prealpine lakes with an unregulated water level. Due to its alpine drainage area, maximum water level, approximately 2 m above the annual minimum in winter, normally occurs in the summer season. In extreme cases, such as in 1965 and 1999, the difference can be a lot higher. The extreme flood in 1999, the third highest since the regular water level registration in 1816, was not only exceptionally high but occurred very early in the season, affecting reed stands in an early growth stage.



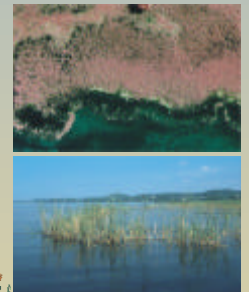
## Results

Water level fluctuations play a major role in reed dynamics at Lake Constance. The extreme flood in 1999 caused damage of 30 ha (-24%) of aquatic reed stands on the shore of Baden-Württemberg. This corresponds to a die-back of the aquatic reed border of 8 m. During the favorable time period 1993 – 1998 the aquatic reeds extended by 9 ha, which corresponds to a lakeward progress of 2 m. Assuming this yearly progress of 0.4 m, recovery period will last at least two decades.

Reed area 1993	115 ha
Reed area 1998	124,2 ha
Reed area 2000	94 ha
Changes 1993 - 1998	+ 9,3 ha (+ 8,1 %)
Changes 1998 - 2000	- 30,3 ha (- 24 %)
Shore line covered by reed	44 km

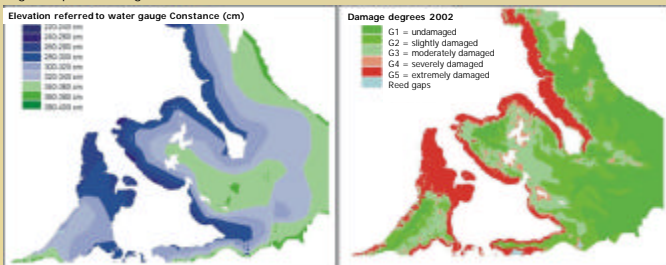
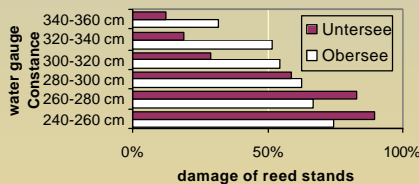


Damages occurred in lakeside reed stands mainly.



## Correlation of damage to stand elevation

Damage patterns showed a high correlation to the elevation level of the stands supporting the hypothesis of flood induced damage. In particular in the lower situated stands, the reed shoots were flooded in early growth stage for several weeks and large proportions of the stands died off. Gently inclined shores, as the example of Wollmatinger Ried revealed the highest spatial damages.



Damage degrees correspond to the elevation model

## Consequences for breeding habitats

The Great Reed Warbler requires specific breeding habitat conditions and can be used as an indicator to assess the habitat quality of aquatic reed stands. Based on multispectral scanner data classification and GIS-techniques breeding habitat factors were parametrized in a breeding habitat suitability model. Modeled habitat suitability correlated highly with occupied nesting sites in the nature reserve of the Wollmatinger Ried.

