Holocene climate, fire and vegetation dynamics at the treeline in the Northwestern Swiss Alps

Christoph Schwörer^{1,2} & Willy Tinner^{1,2}

¹Institute of Plant Sciences & ²Oeschger Centre for Climate Change Research, University of Bern

UNIVERSITÄT BERN

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—Introduction –

With Climate Change today's treeline is expected to shift to higher elevations, but the rate and extent of change are largely unknown [1]. Paleoecological methods can assess the impact of past climatic changes and human disturbance on treeline vegetation. This will help to develop sustainable ecosystem management practices and identify threats for alpine biodiversity [2].

-----Study Site

Iffigsee is a small lake (10ha) at 2065m a.s.l. in the Bernese Alps, Switzerland. The lake is located ca. 150m above the present treeline. Archaeological finds at Schnidejoch, a high alpine mountain pass nearby, show that humans have been present in the area at the latest since the Neolithic (Fig. 3) [3,4].





Figure 1: Tree- and timberline in the Swiss Alps. Timberline is defined as the limit of closed forest, treeline as the limit of tree growth. Both are expected to move upwards with warmer temperatures.



Figure 2: (A) Map of the study site with the coring location (red dot) and the mountain pass Schnidejoch (red brackets). The inset shows the location of the study region in Switzerland. (B) Picture of the small lake Iffigsee (2065m a.s.l.), surrounded by scree slopes and alpine meadows.



Figure 3: Combined pollen and macrofossil diagram of Iffigsee (2065m a.s.l.), showing selected taxa only. Only terrestrial pollen types were used to calculate pollen percentages. Macrofossils and stomata are represented as histograms. The white pollen curves show 10x exaggeration of the percentage values. LOI 550°C is an estimate of the organic content in the sediment. N = needles. IFFP 1-4 = Local pollen assemblage zones 1 to 4. The pink horizontal bands show the age of archeological finds from Schnidejoch, indicating human presence in the area. 1 = wooden bowl, 2 = leather shoe, 3 = bow, 4 = loop for fence posts (made of twigs), 5 bronze needle, 6 = roman shoe nails, 7 = textile fragment (roman tunica), 8 = roman coin [3,4]



—Conclusions

- Tree- and timberline were mostly above the study site during the Holocene
- Afforestation at the lake started rather late at ca. 9500 BP with *Larix decidua* and *Pinus cembra*
- The study area was used as pasture by Neolithic farmers, possibly as early as 6300 BP
- Agriculture intensified during the Bronze Age and Roman times, with local clearing of the forest around the lake
 Widespread forest clearings and intensive agriculture during the middle ages led to a lowering of the treeline below the lake

Lakes and mires are natural archives, that store the environmental history of their surroundings for millenia. We analyzed pollen, plant macrofossils and charcoal in a 8m sediment core from Iffigsee to reconstruct the local vegetation and fire history.



Figure 5: Light microscope and scanning electron microscope pictures of *Plantago lanceolata* (left) and *Abies alba* pollen (right).

-Acknowledgements

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• *Larix decidua, Pinus cembra* and *Abies alba* are part of the natural vegetation at the treeline in the Bernese Mountains

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