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CONTRIBUTIONS TO THE EUROPEAN POLLEN DATABASE

61. A pollen record from Lake Öagöl (south-Swedish Uplands): 1500 years of land-use history

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Site details

Lake Öagöl (57° 12′ 34″; 14° 48′ 03″) is situated in the central part of the province of Småland, southern Sweden, a region characterised by mixed woodlands and small-scale agriculture. The investigated lake has a circular to squarish shape and covers 1.8 ha. A minor road runs through the catchment area (which is 22 ha) on the western side of the lake (approximately 100 m from the lake shore). The nearest village is situated about 2 km away. Historical maps from the nineteenth century show that cultivated fields and hay meadows were situated close to the village. The maps also show that the immediate area around the lake was part of the land, which was mainly used for grazing and wood resources, and that the nearest hay meadow was approximately 500 m away. Today, the land-cover around the lake is mixed woodland, dominated by spruce plantations. On the western side of the lake catchment is a local nature reserve (Kråketorpsskogen, 200 ha), which is protected from modern forestry.

Sediment description

The lake was sampled during fieldwork in 2010 using a freeze corer (Renberg & Hansson 2010). The sediment consisted of dark brown gyttja, of which the uppermost 86.5 cm were retrieved and kept frozen until further sampling in laboratory. The water depth was 10.8 m at the coring location.

Dating

Eleven macrofossil samples were dated using accelerator mass spectroscopy (AMS) at the Radiocarbon Dating Laboratory at Lund University (Table I). A chronology for the uppermost 18 cm was established at the Environmental Radiometric Facility, University College London, by using lead-210 dating method and the Constant Rate of Supply (CRS) model (Appleby 2001). The OxCal program (v.4.2.4) was used for calibration of radiocarbon dates and to construct an age-depth model for the entire sediment sequence based on the IntCal13 calibration curve (Bronk Ramsey 2009; Reimer et al. 2013). Based on the established chronology (spanning from AD 480 to AD 2010), samples were extracted (0.5 cm intervals), prepared and analysed for pollen composition, with a time interval of 50 years (or as close as possible).

Interpretation

The vegetation and land-use development inferred from this study is comparable to previously published pollen records from the region (e.g. Lageräs et al. 2016; Fredh et al. 2019). Despite being situated outside a village and at some distance from managed hay meadows (at least during the nineteenth century), the pollen diagram shows clear indications of human activity during periods commonly associated with relatively high agricultural intensity in the region, although woodland cover dominates the lake surroundings throughout the last *c.* 1500 years. Based on stratigraphically constrained cluster

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Table I. Information about radiocarbon dates on macroscopic remains from Lake Öagöl. Sample weights are from the laboratory report (after pre-treatment).

Lab-ID	Depth (cm)	Radiocarbon age BP ± 1σ	Calibrated age AD (1σ interval)	Weight (mg C)	Pre-treatment	Type of material
LuS10226	22.75	170 ± 45	1665–1950	3.6	HCl, NaOH	*Alnus* bark
LuS10227[a]	31.25	340 ± 60	1482–1635	0.41	—	*Pinus* bark
LuS10228	37.25	300 ± 50	1513–1650	2.6	HCl, NaOH	*Pinus* bark + *Pinus* needles
LuS10229	45.25	290 ± 50	1515–1658	1.9	HCl, NaOH	*Pinus* bark
LuS10230[b]	48.75	525 ± 50	1325–1440	2.6	HCl, NaOH	*Pinus* bark + *Pinus* needle
LuS10231	52.25	645 ± 50	1286–1391	2.2	—	*Pinus* needle
LuS10232	59.25	800 ± 50	1192–1273	2.6	HCl, NaOH	*Pinus* bark
LuS10233	64.25	995 ± 50	989–1150	3.6	HCl, NaOH	*Pinus* bark
LuS10234	71.75	1135 ± 60	778–984	0.4	—	*Betula* leaf
LuS10235	82.25	1515 ± 50	433–605	2.4	HCl, NaOH	*Pinus* bark + *Pinus* needle
LuS10236	84.75	1630 ± 50	354–534	2	HCl, NaOH	*Betula* leaf + brown moss stem

[a]Not included in the age-depth model used in this article.
[b]Two samples combined (i.e. sediment interval 1.5 cm instead of 0.5 cm).

analysis (CONISS), the pollen diagram was divided into seven local pollen assemblage zones (LPAZs 1–7), which are described in detail (Figure 1).

LPAZ 1 (AD 480–825, 86–73 cm)

The vegetation during this period was dominated by trees (up to 97%), mainly *Alnus*, *Betula*, *Corylus*, *Pinus* and *Quercus*. The relatively large number of light-demanding trees indicates some human activity, for example by deliberate removal of shade-tolerant trees. There are no other clear signs of human impact during this period, except a few scattered pollen grains from e.g. *Hordeum* type and *Cannabis* type. However, the two oldest samples have a slightly larger proportion of grazing indicators, including *Juniperus*, *Calluna vulgaris* (L.) Hull., Cyperaceae, *Plantago lanceolata* L. and Poaceae. The amount of microscopic charcoal is also slightly larger in these two samples. Possibly, this lower part of the pollen diagram shows the remains of an earlier agricultural expansion in the area.

LPAZ 2 (AD 825–1175, 73–60 cm)

This zone shows a similar pollen composition as LPAZ 1, but with slightly lower percentages of *Alnus* and *Corylus*. In the upper part of this zone, a slightly more open landscape and a low amount of agricultural activity seem to have been present, indicated by a larger proportion of dwarf shrubs and herbs, such as *Calluna vulgaris*, *Artemisia*,

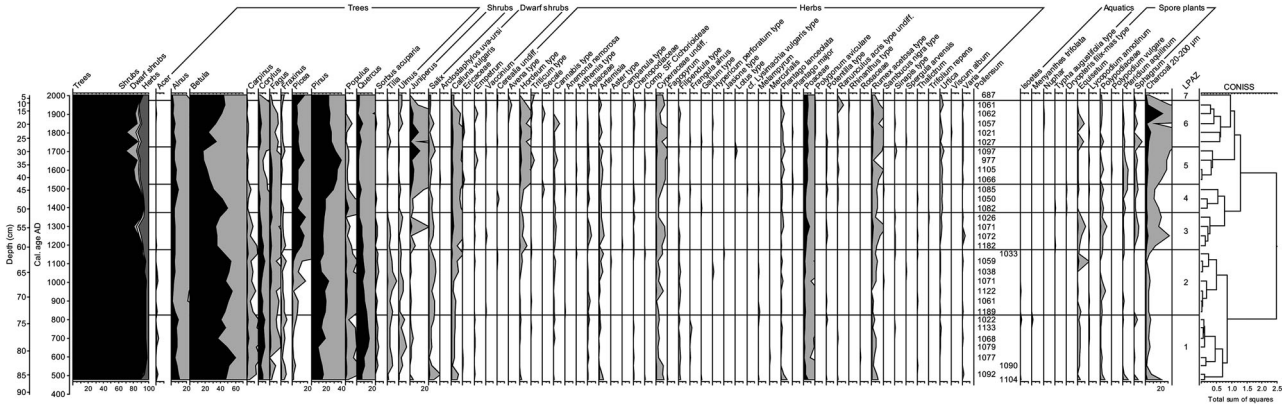

Figure 1. Pollen percentage diagram from Lake Öagöl. Black graphs show percentages and grey graphs show exaggeration (× 10). Constrained cluster analysis (CONISS) in Tilia (v.2.0.41) was used to identify local pollen assemblage zones (LPAZs). The pollen sum includes all terrestrial pollen taxa.

Cyperaceae, *Plantago lanceolata* and *Rumex acetosa* type, at the expense of the tree *Pinus*. In addition, the cultivated plants *Hordeum* type and *Cannabis* type, were identified continuously from this time. The upper part of LPAZ 2 probably represents the first phase of a more permanent agricultural settlement nearby.

LPAZ 3 (AD 1175–1375, 60–51 cm)

The transition into this zone marks the most distinct change in the pollen diagram, characterised by the establishment of *Picea* and an agricultural expansion. When *Picea* arrived at the lake (shown by increased pollen percentage) it became one of the dominant trees, which is in agreement with the regional trend (Bradshaw & Lindbladh 2005). Crop cultivation and grassland continued to expand, suggested by increased pollen composition of *Juniperus*, *Hordeum* type, Poaceae and *Urtica*, and an increased amount of microscopic charcoal (that remained on a higher level from this time onwards). Simultaneously, several trees declined during this period, indicated by a reduced pollen percentage of *Betula*, *Corylus*, *Quercus* and *Tilia*. Farming based on permanent fields became widespread in the uplands of southern Sweden around the eleventh century (Lagerås 2007), which is possibly reflected by the agricultural expansion indicated also in the present study.

LPAZ 4 (AD 1375–1525, 51–43 cm)

This zone is characterised by a temporary reduction in human activity, indicated by reduced percentages of *Juniperus*, *Calluna vulgaris*, *Hordeum* type, Cyperaceae undiff., Poaceae and microscopic charcoal (although these indicators are still present in low numbers). Meanwhile, the pollen composition suggests woodland regrowth, through two phases of succession: first, light-demanding trees (*Betula* and *Populus*) which were later replaced by more shade-tolerant trees (*Alnus*, *Pinus* and *Quercus*). The changes recorded in this time interval are probably a consequence of the regression after the Black Death pandemic (*c.* AD 1350) (Lagerås et al. 2016).

LPAZ 5 (AD 1525–1725, 43–28 cm)

During this period, the pollen composition suggests an expansion of agricultural activities. Several taxa indicating cultivation and grazing increased, mainly *Juniperus*, *Calluna vulgaris*, *Hordeum* type, Cyperaceae and *Plantago lanceolata*, at the expense of mainly *Alnus*, *Betula* and *Quercus*. The amount of microscopic charcoal also increased. This expansion is consistent with the commonly inferred re-establishment of farms in the region during the sixteenth century, when the population increased again after the regression following the Black Death pandemic, shown in LPAZ 4.

LPAZ 6 (AD 1725–1975, 28–8 cm)

The inferred vegetation during this period is similar to LPAZ 5, except for a shift to more short-lived trees, mainly *Betula* and *Corylus*, at the expense of the more long-lived tree *Pinus*. These changes suggest a different use of the land at further distance from the village, possibly increased grazing. In addition, *Tilia* and *Ulmus* seem to be re-established locally in low numbers during this period, probably allowed to expand on temporary, newly opened land. This period is contemporary with the agricultural revolution and early phases of modern agriculture, which include agricultural improvements, such as land-divisions and crop rotation, which might be reflected in some of the changes seen during this period.

LPAZ 7 (AD 1975–2010, 8–0 cm)

This uppermost zone shows reduced human activity, suggested by the decreased presence of *Juniperus*, *Hordeum* type, *Plantago lanceolata*, *Rumex acetosa* type and microscopic charcoal, while the tree cover expanded, indicated by the increased percentage of *Picea* pollen. These changes probably reflect modern land use, which commonly includes areas for either cultivation or tree plantations, with almost no semi-open vegetation and permanent grassland remaining.

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Disclosure statement

No potential conflict of interest was reported by the author.

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