Human impact and aeolian sand deposition during the last 1400 years - recorded in sediments of Lake Lyngsjön

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Introduction & Aims

Lake Lyngsjön, north-eastern Scania, situated on the Kristianstad Plain, reveals a long history of aeolian sand drift based on a 3 meter long sediment sequence. Human impact through intensified land use and decreased forest cover led to increased aeolian sand drift both locally and regionally.

The aims: Establish a chronology for the Lake Lyngsjön sediment record and quantify past changes in medium sand deposition. Evaluate past aeolian sand drift on the Kristianstad Plain based on changes in aeolian sand accumulation rate (ASAR), geochemical data, pollen data and historical documents.

Methods

Samples were wet-sieved (200µm sieve) to obtain mineral particles and plant fragments and further analysed for ignition residue (IR), to estimate the amount of minerogenic matter per unit volume. The aeolian sand content was estimated by:

ASAR (g cm^{-2} $year^{-1}$) = sedimentation rate (cm $year^{-1}$) x mineral matter concentration (g cm^{-3}) (Fig. 1). The sedimentation rate is based on 14 ^{14}C dates and 15 ^{210}Pb dates. Samples were analysed for carbon and nitrogen content and data obtained represents: C/N ratios, total organic carbon (TOC) and total inorganic carbon (TIC) (Fig. 1).

Results

The aeolian sand deposited during the last millennium can be summarized into five noticeable events with peaks representing ASAR values higher than 0,2 mg cm^{-2} $year^{-1}$.

1. AD 965: Relatively high forest cover during the 10th century coincides with high C/N ratios and an increase in TOC, which points towards increasing input of terrestrial organic matter due to human disturbance. Increased forest cover (mainly pine and birch, Fig. 1) had no effect on sand drift during this time, although the recorded aeolian sand deposition can be attributed to increased land use close to the lake.

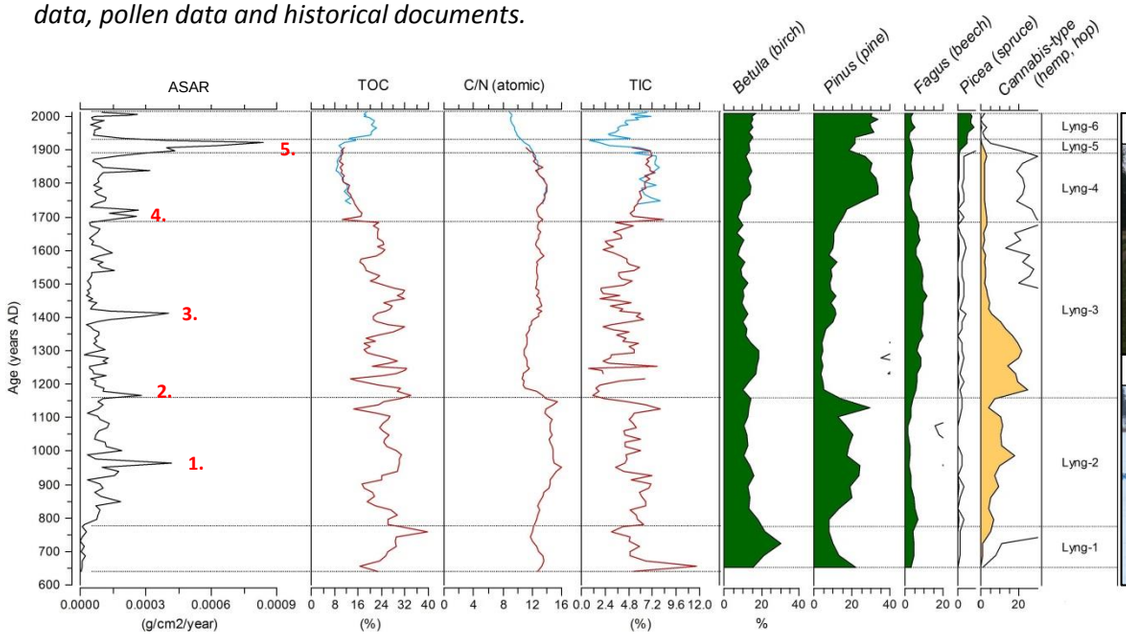

Fig. 1. Aeolian sand accumulation rate (ASAR, No. 1-5 represent peaks with medium sand deposited during increased aeolian sand drift), geochemical data (TOC, C/N ratios and TIC) and pollen data. Zones are based on changes in ASAR and the geochemical data.

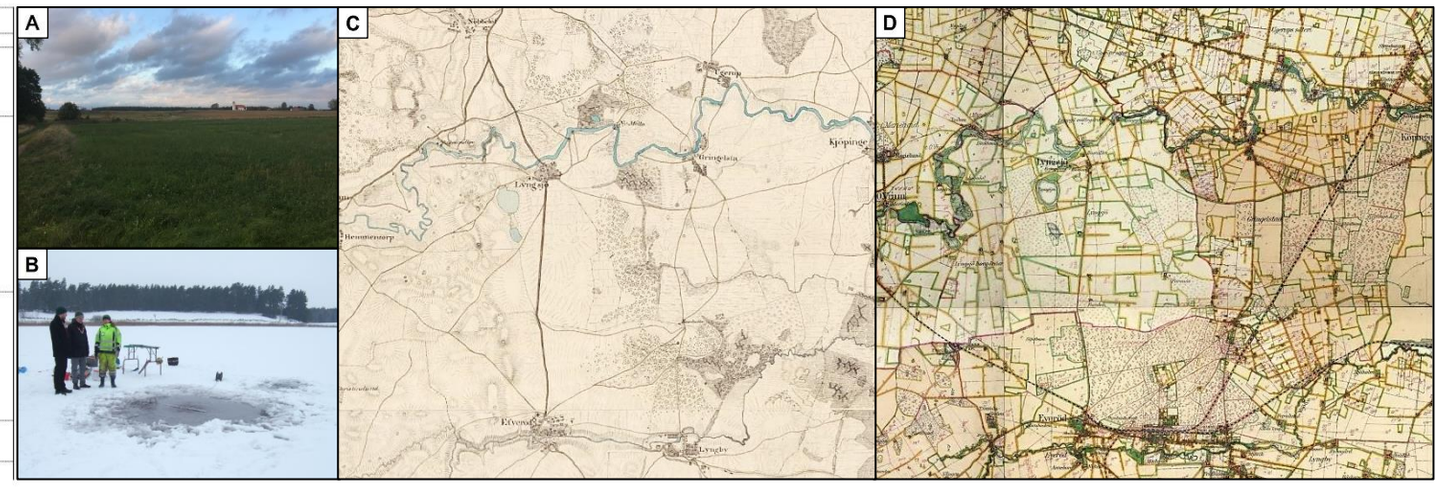

Fig. 2. Maps representing Lake Lyngsjön and surrounding areas. A) Present day semi-open landscape, east of the lake. B) Lake Lyngsjön in 2013. Pine forests located west of the lake margin. (Photo: Dan Hammarlund). C) Systematic map of Scania (1812-1820) displays a generally open landscape with forest cover present north-east, east and south-east of the lake. D) Hundred's map (1926-1934) depicts an increase in forest cover in the proximity of Lake Lyngsjön and further south and east of the lake as compared to the 1800s.

***2. AD 1170*:** Increased deposition of aeolian sand coincides with a deforestation event. The deforestation (decrease in pine pollen) is followed by low C/N ratios. Increased TOC suggests input of tree debris. A decline in TIC concurs with the ASAR peak. The decrease in pine pollen is followed by an increase in birch, beech and juniper. *Cannabis*-type pollen (20%) reflects hemp retting during this time, which could have suppressed the pine pollen percentages.

3. AD 1410: A small increase in C/N ratios concur with an increase in pine pollen and the recorded ASAR peak. The increased aeolian activity was a regional event caused by forest clearing and increased land use during the 14th century, based on historical documents.

***4. 1700s aeolian activity*:** Concurs with a documented regional increase in aeolian activity during the 18th century and the formation of sand dunes. The 1700s increase in aeolian activity cannot be solely confirmed based on increased ASAR due to limitations in the method.

***5. AD 1900-1920*:** Major deposition of aeolian sand, a consequence of intensified land use on a local to regional scale. Fig. 2A-B, depicts the modern day semi-open landscape with planted coniferous forests west of the lake. Fig. 2C depicts the Lyngsjö area (1800s) without forests close to the lake, which could have contributed to the recorded peak in ASAR a century later. Plantation of pine and spruce occurs after the major deposition of aeolian sand as seen in Fig. 2D.

Conclusions

- Aeolian activity is primarily governed by changes in agriculture and secondly by forest cover.
- Increased forest cover during the 10th and 20th centuries did not hinder the deposition of aeolian sand into the lake, indicating intensified land use locally and a more regional increase in forest cover.
- Elevated C/N ratios coinciding with increased tree pollen (pine and birch) suggest input of terrestrial organic matter from nearby trees.
- Lower C/N ratios concur with a suggested deforestation close to the lake.

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