A reindeer track from a drill core, and lake basin development of the Late Glacial Lille Slotseng kettle-hole basin, South-East Jylland, Denmark

NANNA NOE-NYGAARD, JESPER MILÀN, MIKKEL ULFELDT HEDE & JØRGEN HOLM

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A subfossil reindeer track is found in lake shore sediments in a drill core through the Late Glacial and Holocene lacustrine succession from the Lille Slotseng kettle-hole basin, located in the south-eastern part of Jylland. The track is dated to 11,795 ± 80 ^{14}C yr BP or 13,635 cal. yr BP. This is the first vertebrate track recognized from a soft sediment drill core. Hitherto, convincing vertebrate trace fossils have only been described from boreholes through lithified Triassic sediments. During a previous excavation at the site, skeletal remains of at least ten reindeer were recovered from the Bølling succession and a vertebra was dated to approximately 14,100 cal. yr BP. The Lille Slotseng basin is semicircular with a maximum diameter of 23 m and the overall transgressive–regressive succession covers the time period from 16,000 to around 8,000 cal. yr BP. The oldest basin-fill sediments are melt-water deposits. They are overlain by a succession belonging to the Bølling Interstadial (GI 1-e), older Dryas (GI 1-d), Allerød, (GI 1-c, 1-b, 1-a), and Younger Dryas (GS 1), which terminates the Late Glacial succession. Then follows Preboreal algal gyttja and nearshore woody peat from the Boreal and Early Atlantic times, filling the basin.

Key-words: Lacustrine sedimentation, Late Glacial, Bølling / Allerød, drill core, footprint, artiodactyl track, slumped lake-margin.

Nanna Noe-Nygaard [*Nannan@geol.ku.dk*], *Jesper Milàn* [*milan@geol.ku.dk*] *and Mikkel Ulfeldt Hede* [*mikkeluh@geol.ku.dk*], *Department of Geography and Geology – Geology Section, University of Copenhagen, Øster Voldgade 10, DK-1350 Copenhagen K, Denmark. Jørgen Holm* [*fjordholm@gmail.com*], *Haderslev Museum, Dalgade7, DK-6100 Haderslev, Denmark.*

The Lille Slotseng lake basin was discovered during excavations of archaeological sites from the Late Palaeolithic Hamburgian and Federmesser cultures (Fig. 1), and archaeological excavation of the basin was later initiated by J. Holm (Holm *et al*. 2002). The lake basin is situated on a shoulder of the lower part of the sandy hill south-east of the excavated settlements in south-eastern Jylland, Denmark (Fig. 1). Archaeological excavation and systematic sedimentological and stratigraphical logging of the basinal succession took place in 1998–2002 (Figs 2, 3). Cultural remains of flint and bones from the contemporaneous fauna, including bones from ten reindeer, were retrieved from the basin. A cervical vertebra penetrated by a flint arrow head was radiocarbon dated to 14,100 ± 170 cal. yr BP (Holm *et al*. 2002), placing the find in the later part of the Bølling Interstadial GI -1e (s*ensu* Björck *et al.* 1998).

The Lille Slotseng lake was situated in an almost sub-circular depression with a maximum diameter of 23 m, formed as a kettle hole by melting of a dead-ice block, immediately west of the main Weichselian stationary ice border line in Jylland. The lacustrine succession shows rapid changes in sedimentary facies initiated by changes in water level. The melting of the ice block led to the formation of steep sides of the basin, which resulted in a series of Late Glacial slump and slide events. The rapid lake level changes resulted in marked lateral facies variations, and a complicated stratigraphy especially of the nearshore sediments. A similar type of kettle hole which contained a number of mammoth skeletons dated to

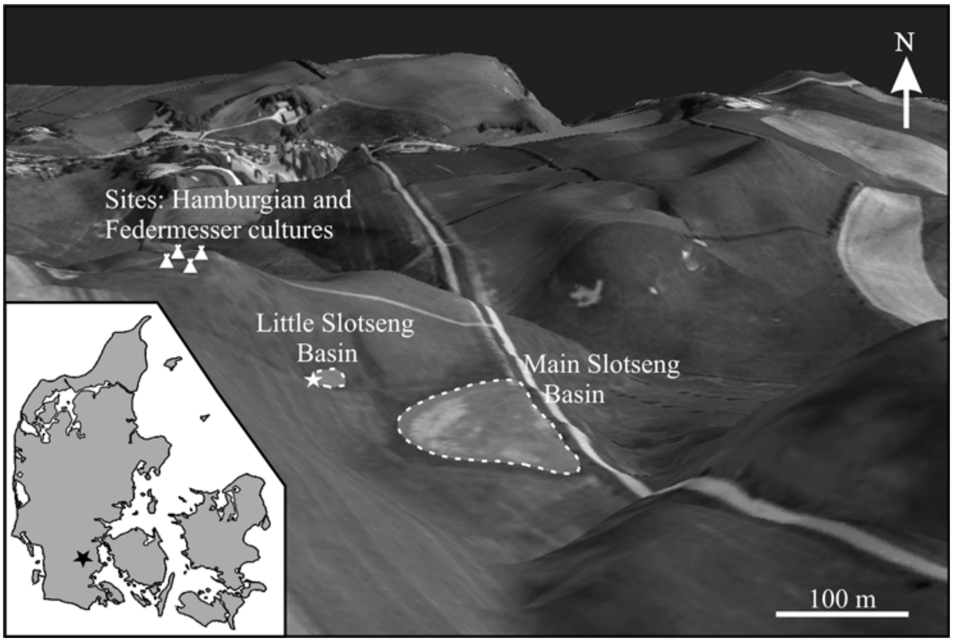

Fig. 1. Three-dimensional GIS model of the Lille Slotseng basin and the surrounding landscape. The basin is located on the shoulder of a sandy hill, in close proximity to excavated sites with Hamburgian and Federmesser cultures. The white * marks the location of the drill site. Landscape model by Niels Skytte Christensen. The topography is exaggerated × 10. Source © KMS G 15-03, COWI DD0 95.

15,000 ± 100 cal. yr BP has been described from Condover, Shropshire in England (Coope & Lister 1987). The aim of this study is to describe and interpret a well-preserved mammal track encountered in a drill core section, and to link the drill-core succession to the unusually complete Late Glacial succession and development history of the of the Lille Slotseng lake basin described by Holm *et al.* (2002).

Material

The top of the lacustrine succession occurs 2–3 m below present day land surface and the base of the succession is situated about 6 m below present day surface and is marked by a transition from Late Glacial melt-water gravel, sand and clay to clay gyttja. The lowermost lacustrine clay gyttja with organic material is ^{14}C dated to the lower part of Bølling interstadial GI-1e (Holm *et al.* 2002). The Bølling succession is up to 80 cm thick, a unique thickness for safely identified and dated Bølling deposits in Denmark. The organic material mainly derives from windblown leaves from the adjacent terrestrial arctic vegetation. The overall transgressive Late Glacial and regressive Holocene succession thus covers the period from the melt-water deposits (16,000 cal. yr BP) below the Bølling Interstadial deposits, to Atlantic woody peat (9,000 cal. yr BP).

The excavations of the Lille Slotseng site lasted 6 years, and the senior author participated in the years 2001 and 2002, during which a number of sections were measured and samples were collected for geochemical analysis and ^{14}C dating. A monolith, measuring 30 × 30 × 200 cm, was cut out by Charlie Christensen (NNU at the National Museum) from the centre of the lacustrine succession for further studies, including high resolution sedimentology, geochemistry, macrofossils, pollen, and insect analysis.

A major part of the organic material from the Bølling succession is of terrestrial origin, including leaves from *Betula nana* and *Dryas* sp., which had blown into the basin from the sparsely vegetated surroundings. This allows ^{14}C dating of densely spaced samples through the Bølling succession up to and including the Allerød succession. Macrofossils and the pioneer flora and fauna, including the earliest direct traces of Man after the Last Glacial Maximum were also analysed (Dybdal 2001; Holm *et al.* 2002; N. Noe-Nygaard unpublished data).

The lacustrine succession is about 6 m thick in the centre of the basin and the nearshore Late Glacial deposits dip very steeply towards the centre (Fig. 2) (Holm *et al*. 2002). This is interpreted as resulting from continuous lake sedimentation with contemporaneous sliding of sand from the lake basin margin, which became unstable during melting of a residual buried ice block in the centre of the basin.

In 2003 a 10 m long core was drilled at the northwestern rim of the basin (Fig 4). The top of the core is situated at 2.5 m below present day land surface with strongly humified peat and it terminates downwards in melt-water sand and Tertiary clay 10 m below present day surface. The lake deposits cover the interval 2.5–6.0 m below present day land surface.

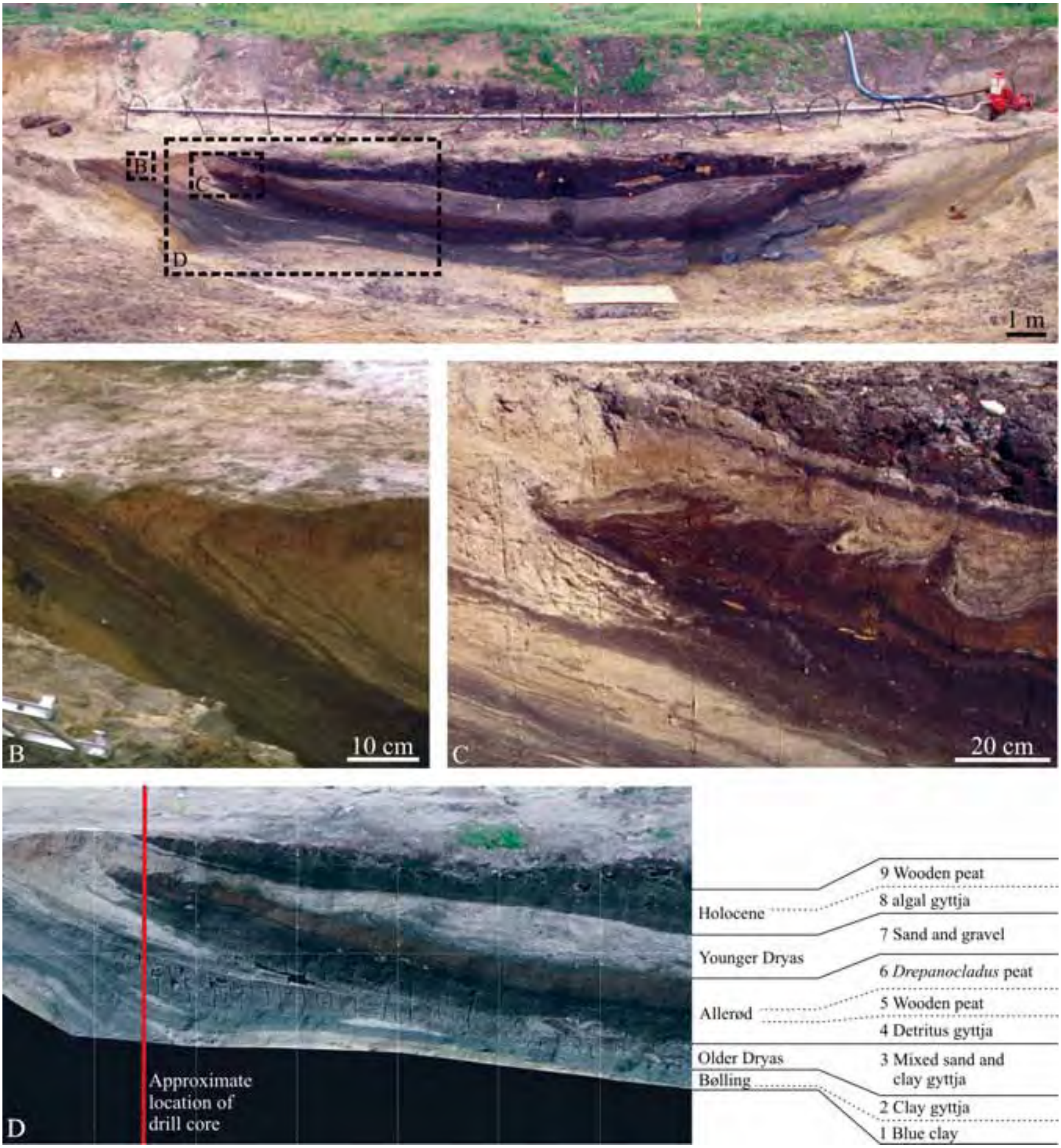

Fig. 2. A, NW–SE transect of the kettle hole Lille Slotseng basin. Note the sand slides along the rim of the basin intercalated with the organic deposits. B, detail of rim near overturned layers at the lake margin. C, enlargement of the NW lake margin, showing sand packages which have slumped into the basin. D, stratigraphic section of the Lille Slotseng basin showing the nine main sediment units. The lowermost units of Bølling age, dated to 15,000–13,800 cal. yr BP, consists of lower unit of blue clay overlain by a clay gyttja unit. Older Dryas (13,800–13,500 cal. yr BP) consists of mixed sand and clay gyttja. The Allerød succession (13,500–12,500 cal. yr BP) contains three units, a lowermost detritus gyttja, a middle wooden peat, and an upper *Drepanocladus* peat. Younger Dryas, 12,500–11,500 cal. yr BP is represented by a diamictic unit of mixed sand and gravel. The Holocene units comprise a lower algal gyttja and on top a wooden peat. All datings are from Holm *et al.* (2002). The drill core was taken at the north-western margin of the basin, and the approximate location of the core is indicated by the red line. Grid lines equal 1 m. Figure 2D is modified after Holm *et al.* 2002.

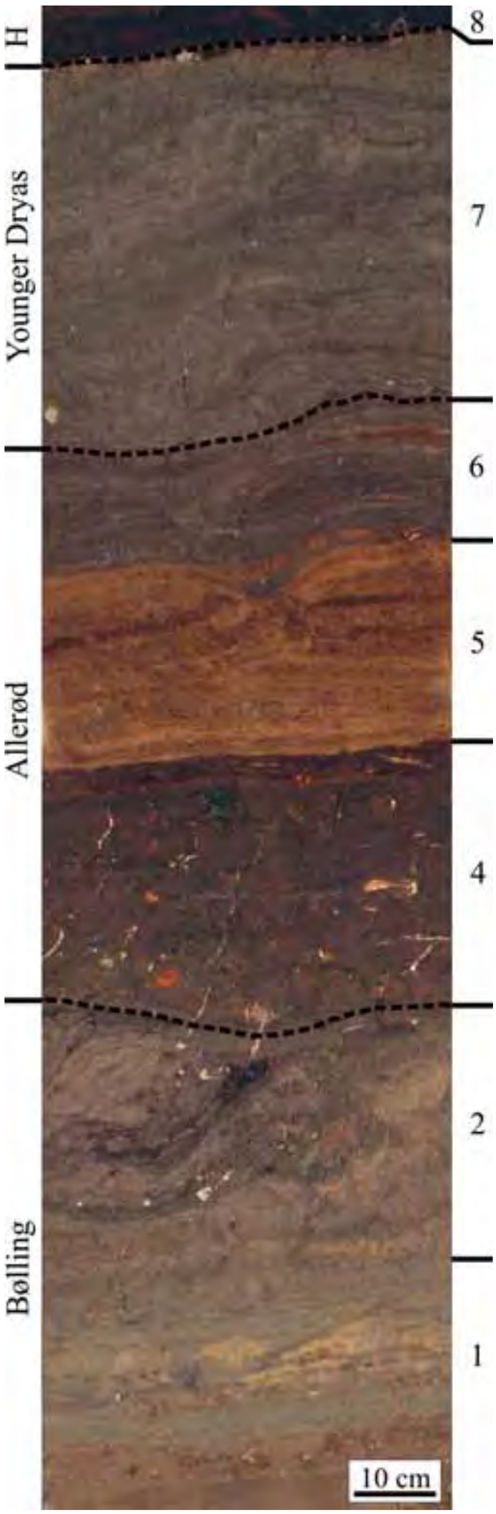

Fig. 3. Lacquer peel, 175 x 48 cm, from the central part of the Lille Slotseng basin. The main stratigraphic and sedimentary units from figure 2D recognized in the section are indicated. The peat clasts in the slump structure protruding down into the Bølling layers are dated to Allerød. Older Dryas cannot be identified in this section. Holocene is indicated by H. The peel was made by H. Breuning-Madsen.

The mammal footprint, described in this paper, was recognized in the nearshore Allerød succession of alternating sand, peat, clay and gyttja layers at 4.12 m below present day surface (Fig. 5).

General stratigraphy

In the central lake section (Fig. 2A, D), a total of nine distinct sediment units from Bølling to Holocene are distinguished based on the observations of the authors combined with data and dates presented by Holm *et al.* (2002). The units in the main excavated profile are in ascending stratigraphic order: Bølling (or older) age units consist of a lowermost blue clay overlain by an indistinctly laminated clay gyttja with macro-plant fossils. Older Dryas is represented by a unit of contorted sand streaks and lenses mixed with clay gyttja and thin layers of peaty material. The Allerød succession consists of three units, a lower detritus gyttja with sticks and branches, a middle wooden peat and an upper *Dreplanocladus* peat. Younger Dryas is developed as a coarse-grained diamictic unit, up to 30 cm thick, with pebble-sized clasts. The contact to the lower Allerød deposits are sharp and erosional. The top of the sedimentary successions is the two Holocene units, a lower algal gyttja with macro-plant remains, which is gradationally overlain by woody peat, representing final overgrowth in Late Atlantic time.

The sedimentary succession and stratigraphy of the Bølling, Allerød, Younger Dryas and early Holocene deposits of the lake basin are demonstrated by a lacquer peel, 175 × 48 cm, made by Henrik Breuning-Madsen (pers. comm. 2005) (Fig. 3). The different facies recognized in the lacquer peel can easily be correlated with the succession (Fig. 2D) presented by (Holm *et al.* 2002).

Drill core stratigraphy

The core was drilled from a truck-transported drilling rig close to the western lake margin in order to unravel the sedimentary succession below the Lille

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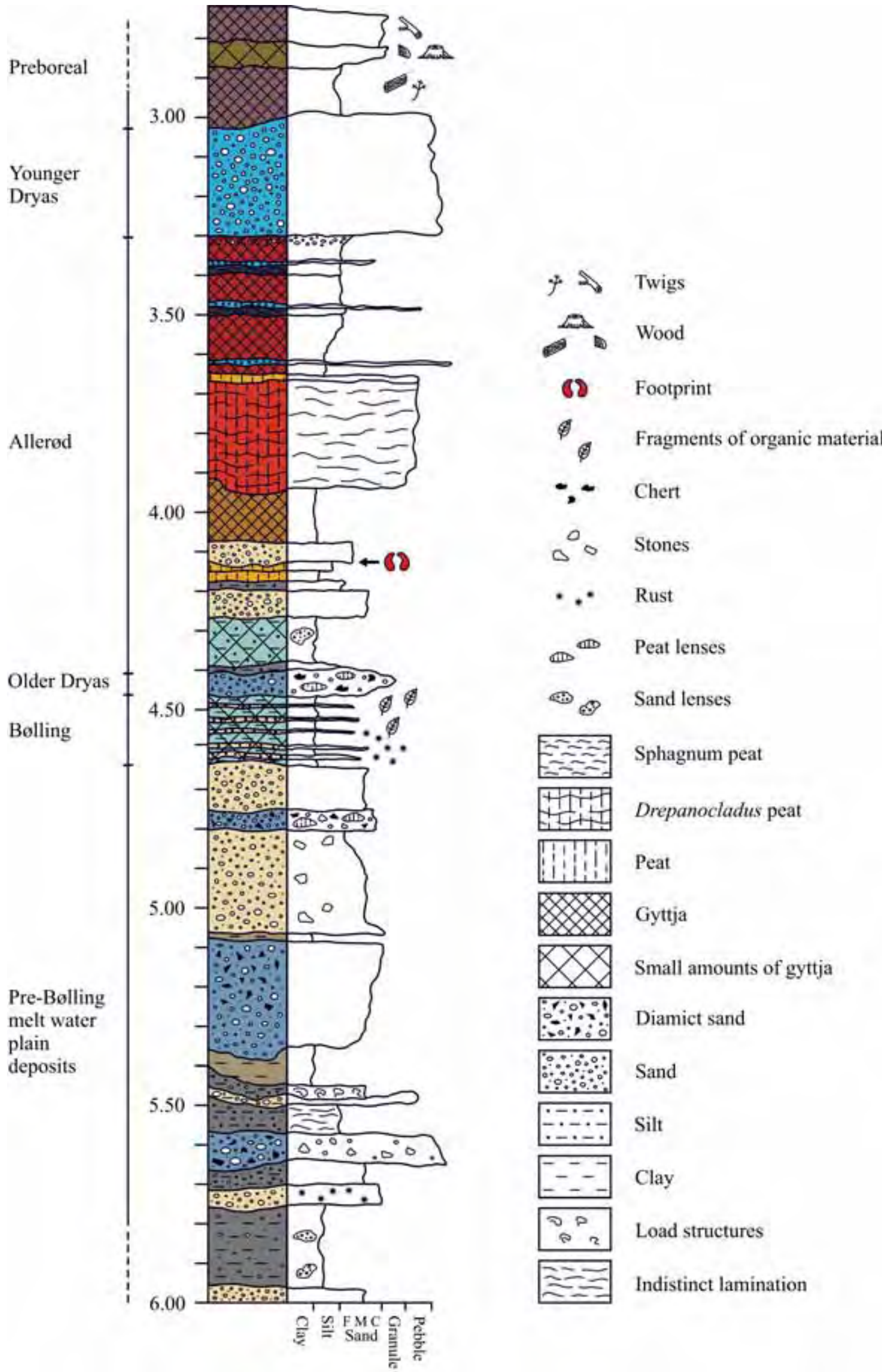
Fig. 4. Sedimentological log of the drill core. The ages of the level with the reindeer track are precise and ^{14}C dated, whereas the other ages are based on lithological and visual correlation with the excavated exposure shown in Holm *et al.* (2002) and on figures 2 and 3. The core was taken from the nearshore successions of the basin (Fig. 2D).


Preboreal
Younger Dryas
Allerød
Older Dryas
Bølling
Pre-Bølling melt water plain deposits
3.00
3.50
4.00
4.50
5.00
5.50
6.00
Clay
Silt
F M C Sand
Granule
Pebble
Twigs
Wood
Footprint
Fragments of organic material
Chert
Stones
Rust
Peat lenses
Sand lenses
Sphagnum peat
Drepanocladus peat
Peat
Gyttja
Small amounts of gyttja
Diamict sand
Sand
Silt
Clay
Load structures
Indistinct lamination

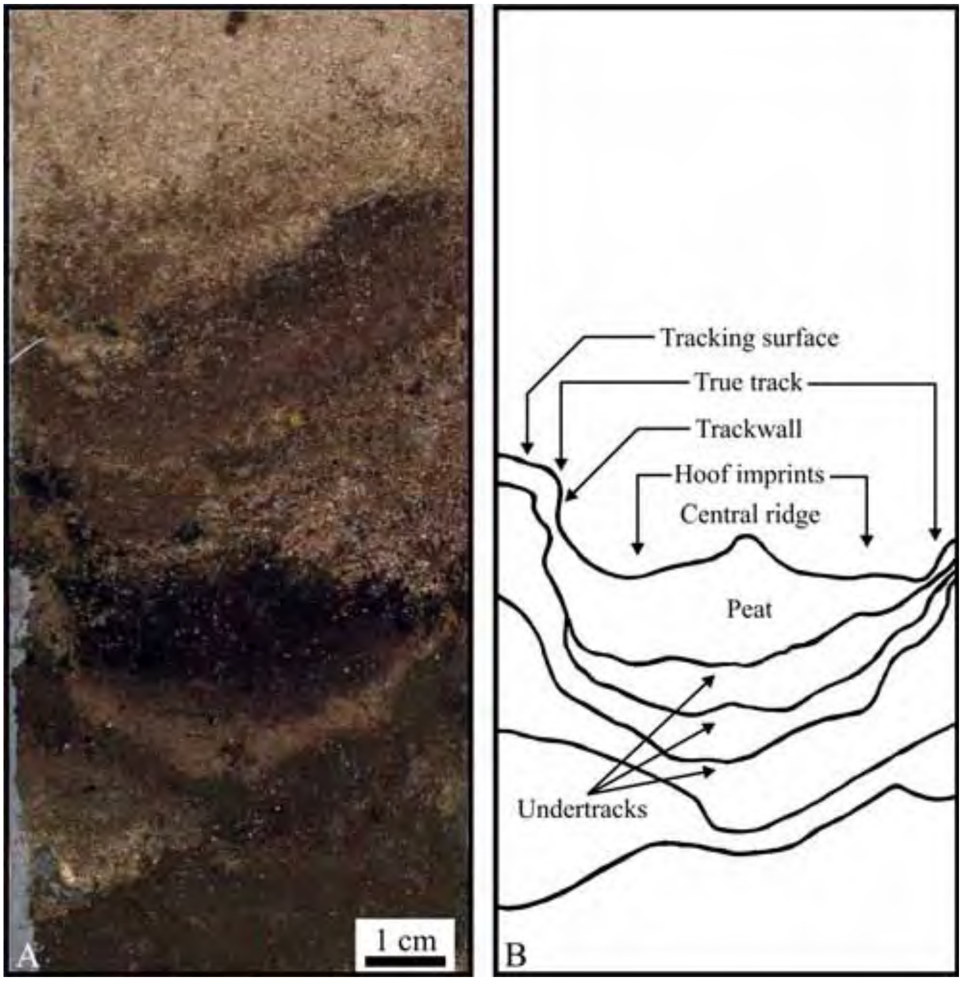


Fig. 5. Core section from the Lille Slotseng basin containing the track. The section was split longitudinally for sedimentological study. A, in the core section the track occurs as a bilobed depression, with a central ridge in the surface of a peat layer. The peat layer has been pressed down into the subjacent gyttja to form an undertrack in this and the underlying layers. B, interpretative drawing of the true track and undertracks.

Slotseng lake basin (Figs 1, 2, 4). As the excavated section (Fig. 2A) covers the entire basin, the stratigraphy of the drilled core can be easily matched with the more complete succession in the basin centre (Fig. 2D). The stratigraphy and sedimentology of the core is described below with reference to figure 4.

Pre-Bølling deposits (6.00–4.65 m). The lowermost 135 cm of the core, from 6.00–4.65 m below present day surface, consists of mixed coarse sand, silty clay and clay, alternating with well-sorted sand and clay. The grain size, the erosional base of the bed, and the diamictic nature of the sediments indicate deposition by mass flows into the incipient glacial lake. The unit was presumably originally deposited on a meltwater plain with lakes formed around dead-ice blocks. The rapidly changing sedimentary facies indicate deposition under changing energy from fine clay deposited from suspension probably under lake ice cover to processes initiated on a tilting slope during thawing of frozen sediments. The cored section clearly reflects the repeated sliding events of sand and clay interpreted to result from rapid lake-level changes (Figs 2 and 4). The lowermost laminated sandy clay in the core from 5.45–5.55 m shows some resemblance with the blue clay of facies l (Fig. 2D) in the excavated profile dated to 16,000 cal. yr BP.

Bølling deposits (4.65–4.45 m). The laminated lower clay and sand deposits in the core succession was most likely deposited in a standing body of water into which siliciclastic material was transported under variable energy (Fig. 4). Terrestrial macro-plant fossils, such as leaves of *Salix* and *Dryas* have been found in these deposits, which are probably of Bølling age based on correlation to the excavated main profile (Fig 2A, D), but further confirmation by ^{14}C dating or by microtephra correlation is desirable.

In the excavated profile (Fig. 2A) the well-dated Bølling succession is mainly located in the central part of the basin, where it reaches a thickness of up to 40–60 cm (Fig. 2D). Here it consists of a lower bed of yellowish thin layers of fine to medium-grained sand and an upper bed of silty clay gyttja with abun-

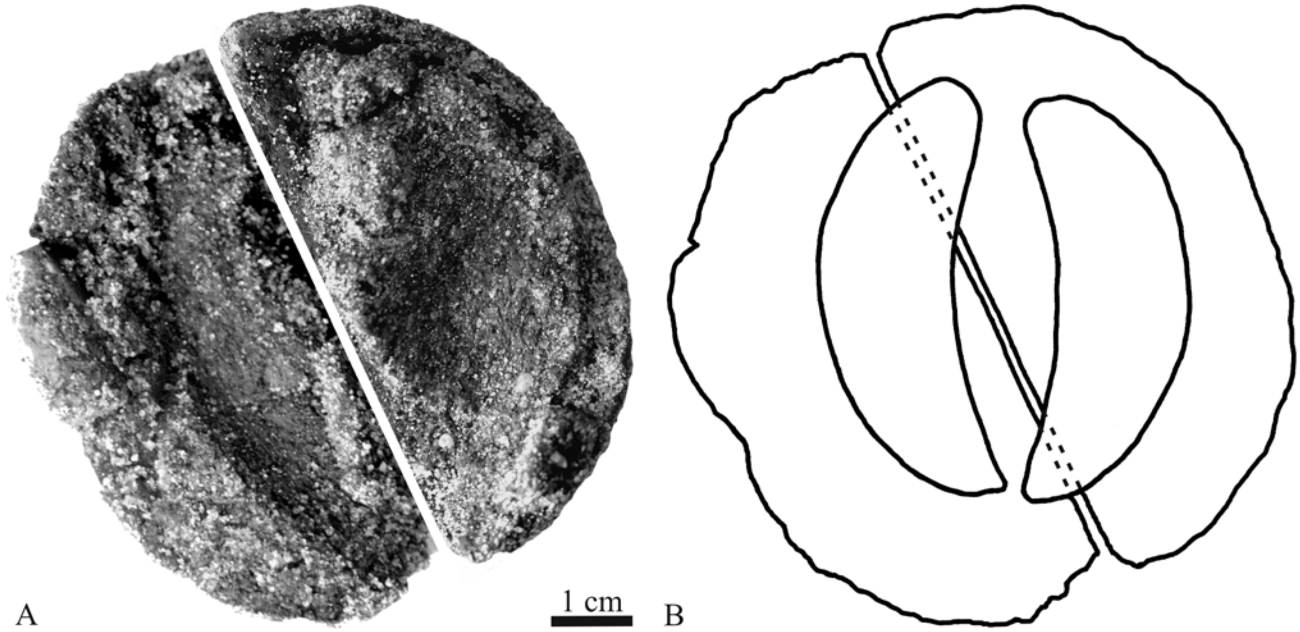


Fig. 6. Composite picture of the two halves of the core together to show the true track as it appeared on the original tracking surface. A, the two hoof imprints are crescent-shaped and the outline of the track almost circular. The left side of the core is stored in the collection of the Geological Museum, University of Copenhagen (MGUH 28424). B, interpretative drawing of the track.

dant terrestrial macro-plant remains. Skeletal remains from at least ten reindeer individuals were found in the lower part of the silty clay gyttja in the central part of the basin (Holm *et al.* 2002). Scattered charcoal and numerous fragments of terrestrial macrofossils occur, including insects and plant remains, leaves, twigs and fruits from *Betula nana* and leaves from *Dryas* sp. Both thickness and sediment types vary strongly across the basin due to rapid sedimentation and lake-level changes accompanied by slide and slump events.

Older Dryas? deposits (4.5–4.4 m). This unit comprises coarse-grained sand with pebbles and clasts of peaty material. The base is erosional and comparison with the excavated profile (Fig. 2A, D) indicates that the sand forms lenses and streaks intercalated with the Bølling clay gyttja deposits in the centre of the basin. The sandy erosionally-based beds are overlain by organic deposits of Allerød age (Figs 2 D, 3). At several places along the top of the Older Dryas lake deposits, basin margin sand layers were deposited by sliding into already deposited unconsolidated sediment in the basin (Fig. 2 A, D).

Allerød deposits (4.4–3.3 m). The Allerød deposits in the core are dominated by peat, gyttja, gyttja alternating with peat, peat of *Drepanocladus*, clay gyttja and sand (Fig. 2). The content of organic matter generally increases upwards, although the succession is locally interrupted by coarse, erosionally-based sand beds (at 4.10 and 4.25 m depth). At 4.05 m, the sediment changes to an organic-rich gyttja coarsening upwards into a coarse drift gyttja with tree roots. The succession in the core continues upwards into a fine detritus gyttja (4.07–3.90 m), indicating renewed rise of lake level. The Allerød deposits are covered by peat made of *Drepanocladus* moss (3.90–3.65 m). The peat is overlain by a coarsening-upwards detritus gyttja interbedded with thin, upward coarsening, indistinctly laminated layers of clay gyttja and sand (3.65–3.30 m). The Allerød succession is topped by an upward coarsening sand bed (3.34–3.30 m), overlain at 3.30 m by erosionally based, clastic-dominated Younger Dryas deposits. This sedimentary development indicates increasing vegetation cover, stabilisation of the sediments along the lake margin, and a shallowing of the lake during a warmer climate.

Younger Dryas deposits (3.30–3.00 m). Younger Dryas in the core is characterized by a coarse-grained, structureless mixture of fine pebbles, sand, silt and clay. The sediment is light-grey with white clasts of chalk (Fig. 4). The base and top of the unit are sharp and erosional and the base shows load structures into the underlying peat and gyttja deposits as is also seen in the central part of the basin (Figs 2A, C, D, 3).

The coarse grain size and the indistinct flow structures suggest deposition from debris flows initiated at the lake margin by sliding and slumping. There is very little plant material, indicating a cold environment, supporting the assumption of a Younger Dryas age for the deposits and in accordance with the ^{14}C dating from the main section (Fig. 2D).

Preboreal deposits (3.00–2.70 m). The Younger Dryas deposits are in the core overlain by fine detritus / algal gyttja. At 2.85–2.80 m depth, the gyttja is intercalated with woody peat, indicating that the basin was almost filled in by vegetation growing from the rim of the lake towards the centre. Both branches and roots from *Betula* have been recovered in the section (Figs 2D, 4). This overgrowth probably represents the termination of the Preboreal and Boreal drying, which was later followed by lake-level rise during the more humid Atlantic period.

A track in the drill core

During sedimentological logging of the drill core, each 0.5 m long core segment was split into two along the length axis. During this process a strange bi-lobed deformation structure was observed at 4.12 m in the upper part of the assumed Allerød succession of alternating layers of gyttja, peat, clay and sand lenses, and later ^{14}C dated to the Allerød interstadial (Fig. 4). A layer of humified peat was deformed and pressed down into the subjacent layer of gyttja that further was deformed downward. A bi-lobed deformation structure, 5.5 cm wide and 1.5 cm deep, was found on top of the peat layer. A prominent central ridge divides the two lobes constituting the deformation structure (Fig. 5). The bi-lobed deformation structure is filled in by sandy clay. This morphology bears a close resemblance to cross sections through tracks from even-toed animals (Loope 1986; Lea 1996; Allen 1997; Fornós *et al.* 2002).

The interbedding of sand and peat allowed splitting of the core along the original tracking surface to examine the structure in horizontal view. By careful cleaning of the peat horizon on both of the two halves of the drill core, and afterwards refitting the two halves of the core together, a complete true track was revealed. The track is subcircular in outline and consists of two crescent-shaped hoof impressions, divided by a lens-shaped, central ridge. The termination of each hoof impression is blunt and directed inwards (Fig. 6). It was clearly made by a didactyl, cloven-hoofed mammal.

The right side of the core section containing the track was preserved by slowly drying it and subse-

Fig. 7. Cross section of the track (see fig 5) which was dated by three ^{14}C datings, one from the gyttja 2.5 cm below the track, one from the peat at the bottom of the track, and one from the gyttja 2.5 cm above the track.

quently stabilizing it with Diacon CMG 302 Clear 011 (Plexigum) dissolved in acetone. This side is stored in the collection of the Geological Museum, University of Copenhagen (MGUH 28424). The core section containing the left side of the track crumbled during the process and could not be preserved.

Three samples were ^{14}C dated to determine the age of the track. A sample 2.5 cm below the track has an age of 11,720 ± 100 ^{14}C yr BP (AAR-9613), the peat in the bottom of the track has an age of 11,795 ± 80 ^{14}C yr BP (AAR-9182), and the sample 2.5 cm above the track has an age of 11,760 ± 80 ^{14}C yr BP (AAR-9614). The ages are calibrated using OxCal 3.10 to13,565 ± 215 cal. yr BP for the sample below the track, 13,625 ± 185 cal. yr BP for the peat, and 13,600 ± 200 cal. yr BP for the sample above the track (Fig. 7). The age differences between the three samples fall within the uncertainty range of the radiocarbon dating, giving a reliable age for the track, well within the Allerød Interstadial as defined by Iversen (1954, 1973) or GI1-c of Björck *et al.* (1998).

The animal that makes a track is the "trackmaker", and the surface the animal walks upon and in which the track is made is termed the "tracking surface" following Fornós *et al.* (2002). The track formed directly on the tracking surface by the trackmaker´s foot is the "true track" (Lockley 1991). In soft sediments, the trackmaker's foot can sink to considerable depth into the substrate, thus adding vertical or inclining walls from the true track to the tracking surface; these vertical parts of the track are termed "shaft" (Allen 1997) or "trackwalls" (Brown 1999). If the track is emplaced on a layered substrate consisting of different lithologies, the trackmaker will not only produce a track in the tracking surface. The weight of the trackmakers foot will be transferred radially outward into the subjacent substrate and form a stacked succession of "undertracks" in the sediment layers below the tracking surface (Allen 1989, 1997; Milàn & Bromley 2006). Undertracks differ from the true track in that they are always less detailed than the true tracks, and in cases where undertracks are formed along several subjacent horizons, they become successively shallower, wider and less detailed downward (Milàn & Bromley, 2006).

Data from trace fossils, in this case tracks, are important in palaeoecological reconstructions, as the tracks in some cases are not only the sole indicator of the former vertebrate fauna (e.g. Lockley 1991; Lockley & Meyer 2000), but traces found on vertebrate bones can also provide evidence of the various activities of the tracemaker (Noe-Nygaard 1989, 1995). Fossil and subfossil animal tracks are most easily recognized when exposed on bedding planes representing the original tracking surface. But as tracks are three-dimensional structures deforming the original sedimentary layering, it is possible to recognize tracks exposed under less than optimal conditions, as in vertical sections or as random erosional cuts through the layers (Loope 1986). Vertebrate tracks *per se* in cross section are common (e.g. Loope 1986; Lea 1996; Allen, 1997; Fornos *et al*. 2002), but very few convincing tracks have hitherto been recognized in drill cores. Purported reptilian tracks from a drill core through Triassic sediments (Wills & Sarjeant 1970), were later reinterpreted as inorganic structures (King & Benton 1996), but a few undeniable tracks have been found in Triassic sediments from borehole cores in England (Tresise & Sarjeant 1997). Invertebrate trace fossils, on the other hand, are common in cores and are important palaeoenvironmental indicators (e.g. Bromley 1996; Pemberton *et al.* 2001).

The skeletal record of cloven-hoofed animals from Allerød deposits of Denmark comprises moose *(Alces alces)*, Irish giant deer *(Megaloceros giganteus)*, and reindeer *(Rangifer tarandus)* (Aaris-Sørensen 1998). Moose tracks are typically 10–15 cm long with sharp terminations of the hoof tips (Rezendes 1999). Reindeer have the widest and roundest feet of all deer animals. The male forefoot measures typically up to 8.5 x 10 cm and the hindfoot 8.5 x 9.5 cm. The tracks from the female are smaller and more pointed (Bang & Dahlstrøm 1972). The hooves have a characteristic shape, in that the impressions look like two widely separated crescents facing each other (Rezendes 1999). This particular shape makes them easily distinguishable from the tracks of other deer, which have straighter hoofs (Fig. 8).

Tracks of Irish giant deer have not been described in the literature, but the size and shape of their hooves can be estimated by comparing the distal phalanges with those of the moose and reindeer. The distal phalanges of the reindeer are short and broad and curve inward, reflecting the curved and almost circular shape of their track. The distal phalanges of the moose are straight and have pointed tips, reflected by the drop-like shape of the moose tracks with the sharp terminations of the hoof tips. For the Irish giant deer, the distal phalanges are broad with a rounded, inwardly curved outer edge. The phalanges are not as inwardly curved as for the reindeer, but from the morphology of the phalanges, the shape of the hooves must have been elongated with a drop-shaped to oval outline and they are in addition significantly larger than the tracks of a moose and more than double the dimensions of reindeer tracks (Fig. 8).

The track described here from the drill core is subcircular in outline; the hooves are well-separated from each other by a broad lens-shaped gap. The shape of the track, being almost circular in outline, with the impressions of the blunt hoof tips facing each other. It is thus interpreted as made by a reindeer. The size of the track is rather small for a reindeer, being only 5 cm long. Reindeer tracks from the German, Late Quaternary, Bottrup-Welheim tracksite are 6–11.5 cm long (Koenigswald 1995), so small-sized tracks are not unusual, and it is likely that the track from Lille Slotseng was made by a female or subadult individual. Deers with a body size smaller than reindeer were absent in Denmark at that time (Aaris-Sørensen 1998).

Conclusions

A reindeer track is described from Early Allerød age lake shore sediments in a drill core from the Lille Slotseng kettle-hole basin. The track in the core is unique, in that it is the first vertebrate track to be recognized and identified in a soft-sediment core section.

Previous finds of skeletal remains from at least ten

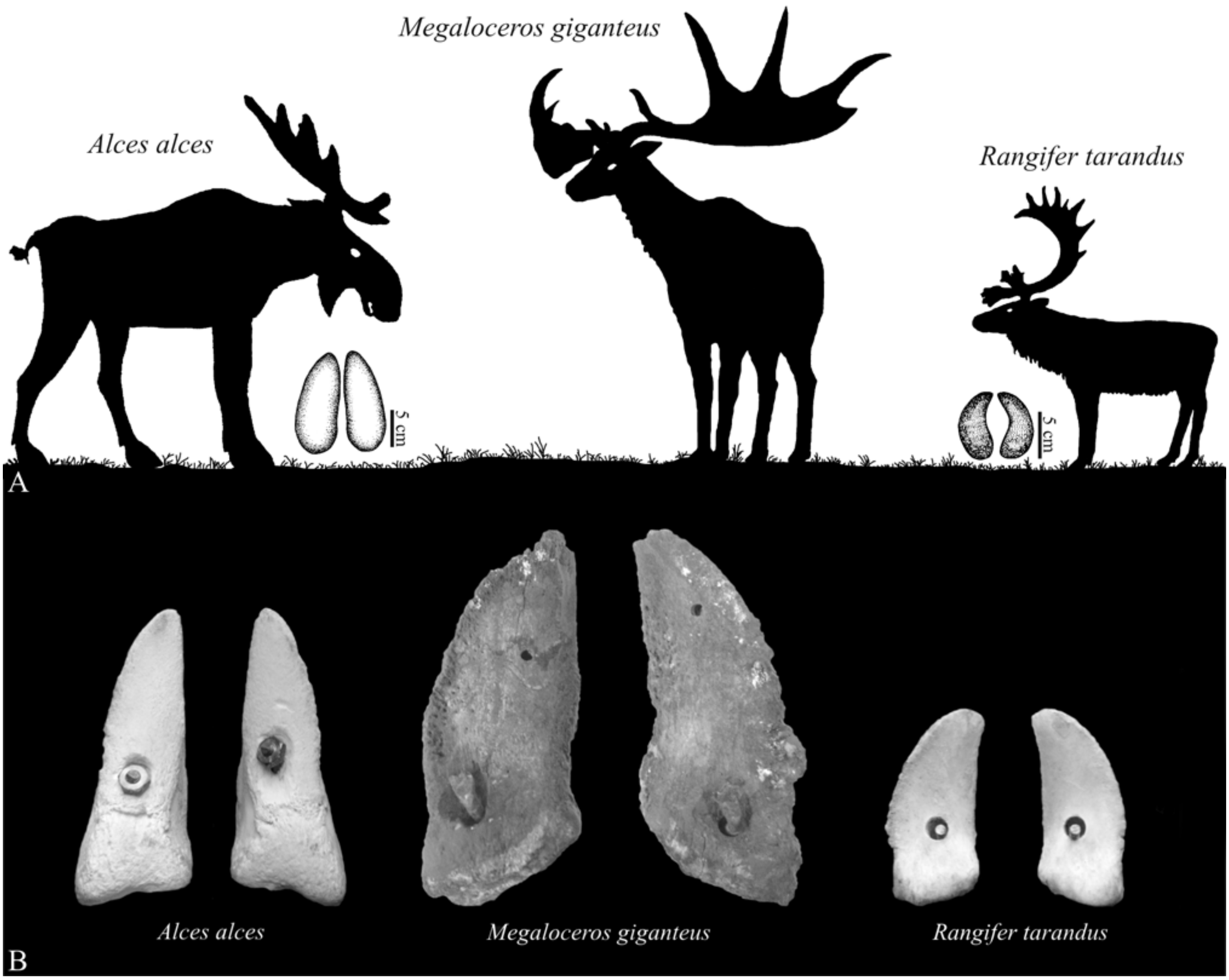


Fig. 8. A, The potential even-toed track makers known from Allerød of Denmark comprise moose (*Alces alces*), Irish giant deer (*Megaloceros giganteus*), and reindeer (*Rangifer tarandus*). The tracks from a moose are too large to fit the track from the core and have impressions of straight sharp hoofs. The reindeer tracks are almost circular in outline and the hoofs are strongly curved contrary to the moose track. Tracks redrawn from Rezendes (1999). B, distal phalanges of Irish giant deer, moose, and reindeer, all in ventral view and reproduced to the same scale.

reindeer from the underlying Bølling succession in the central part of the basin, demonstrate that reindeer were present, at least intermittently in the area for thousands of years.

The sediments of the Lille Slotseng basin represent a complete Late Glacial succession, including a Bølling unit, 20 cm thick at the rim of the basin and more than 40 cm thick in the centre. It was deposited in a kettle hole during progressive melting of a large block of dead ice. Wind-blown terrestrial leaves from *Betula nana* secure a firm ^{14}C dating of the Bølling unit to between 14,700–13,900 cal. yr BP.

The marginal layers of the lake basin dip steeply, up to about 40°, much higher than what should be expected from quiet deposition of generally fine-grained, organic-rich sediments in a small lake or bog. The steep dips were caused by gradual melting of a residual block of dead ice, and progressive tilting of the layers. During Allerød time, the basin was covered almost exclusively with *Drepanocladus* peat.

The Younger Dryas succession is chaotic and coarsens upward, showing a highly disturbed or disrupted layering, and is in parts almost completely homogenized. Along the eastern margin of the basin, the upper part shows irregular overfolding and loading into the underlying Allerød moss peat. The basal load structures show that the Allerød moss peat still was soft, wet and unconsolidated during onset of Younger Dryas sedimentation.

The nearshore location of the described drill core makes it difficult to perform a direct layer for layer correlation with the excavated central part of the basin. Overfolding of the upper part of the basin margin succession is caused by the drag exerted by the Younger Dryas density flows. The axial planes of the folds dip down-slope by about 10° and the stratigraphy is thus repeated upside-down along the margins. This demonstrate that great care should be taken in avoiding basin margins for sampling purposes and especially drill cores where the limited width of the core sections, makes it hard to recognize inverted stratigraphy. The find of a reindeer track in the drill core further demonstrates that disturbed basin margin sediments can be the result of trampling by animals.

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