The Early Holocene Environment of North Fennoscandia and its Implications for Colonisation

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Abstract*

This paper uses the currently available data on the immediate post-glacial landscape of Fennoscandia, along with relevant palaeoenvionmental reconstructions for the Barents region, to paint a picture of the landscape and resources available to the early colonisers of this area. In addition, the aim is to provide a source of up to date references for those interested in integrating the archaeological and environmental evidence, towards an holistic model of the Early Holocene landscape.

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* Please note: this is not an official reprint, but a homemade reconstruction.

Introduction

The environmental and landscape changes which followed the retreating ice sheet in Northern Fennoscandia, are poorly understood, despite being important for the understanding of the human, plant and animal colonization of the area. Situated in the north-western corner of the Eurasian continent, two main immigration pathways, an eastern and a southern, are possible for arctic and boreal biota (Hewitt 1999). The complex deglaciation of the area, however, makes for an unpredictable colonisation history which needs considerably more research to understand.

The concept of ice free refugia within glaciated areas was proposed over a hundred years ago to explain the Quaternary distribution patterns (unicentric and bicentric) of some plant and animal species (see Abbott & Brochmann 2003; Dahl 1987 for a refugia positive, and Birks 1993; Mangerud 2004 for a more sceptical review). For over a century the issue has been debated, more recently expanding into the realms of molecular genetics and explanations of biodiversity (e.g. Abbott *et al.* 2000; Abbott & Brochmann 2003; Tollefsrud et al. 1998); although useful, much of the work still suffers from both underlying theoretical and statistical problems (*op. cit.* and Widmer & Lexer 2001). These preclude the drawing of significant conclusions without corroborating fossil evidence, and even then the interpretations can be fiercely discussed for both plants and animals (e.g. see the debate in Science: Tzedakis 2002 – Stewart 2003 – Tzedakis 2003 and Stewart & Lister 2001). There is however, no good geological evidence for such ice free areas within Northern Fennoscandia during the Last Glacial Maximum (LGM), and the more recent, more dynamic interpretations of Late Glacial deglaciation (e.g. Lundqvist & Saarnisto 1995) and related environments provide possibilities for other explanations of the origins of this region's biota.

Deglaciation

The Fennoscandian ice sheet began melting from all directions, including above, from ca.18000 BP (all dates are in ^{14}C years unless otherwise mentioned). The retreat of the ice was slow at first, with much regional rate variation, and numerous stand stills and readvances, including the more extreme Younger Dryas Stadial (Fig 2). Although it is not fully understood how long Northern Sweden was covered by ice, it is commonly accepted that it was the last area of Fennoscandia to be deglaciated (Lundqvist & Saarnisto 1995) and thus the most recently exposed for human habitation. By the beginning of the Mesolithic (10000 BP), South Scandinavia up to the Närke strait, the Atlantic coast of Norway, the Barents coast area and SE Finland were accessible to human immigration (Fig 1a), and rapid climatic amelioration at the start of the Holocene (Fig 2) lead not only to accelerated ice retreat (Walker 1995), but also rapid immigration of flora and fauna. By 9000 BP Northern Sweden and part of Southern Norway were ice covered (Fig 1b), and the remaining ice probably would have melted away by shortly after 8500 BP, perhaps leaving only the small icecaps which remain in Norway and Sweden.. Where reliable ice recession records are available, such as in the Central Sweden clay varve successions, a maximum retreat rate of 200-300m per year has been calculated for this period (Strömberg 1989, cited by Donner 1995), although much of the ice must have melted *in situ*.

At the LGM the central dome of the ice sheet, about 2.5 km thick, covered the eastern part of Northern Sweden and extended into the Gulf of Bothnia (Lundqvist & Saarnisto 1995). As the ice retreated towards this central dome, a chain of ice dammed lakes was formed between it and the Scandinavian mountains to the west, and along the eastern edge in Finland. Most of the western lakes initially drained into the Atlantic Ocean, only switching to the east when the ice was sufficiently reduced to allow either subglacial or surface drainage, often through old river valleys cut during former interglacials (Donner 1995). The largest of these lakes in Northern Sweden was the Central Jämtland ice-lake, to the west of Östersund (Lundqvist 1969), which broke through the ice dam to the east along the river Indalsälven, after having previously drained through the river Ljungan to the south. The drainage resulted in a very thick clay varve dated to 9238 BP (Cato 1987, cited by Donner 1995).

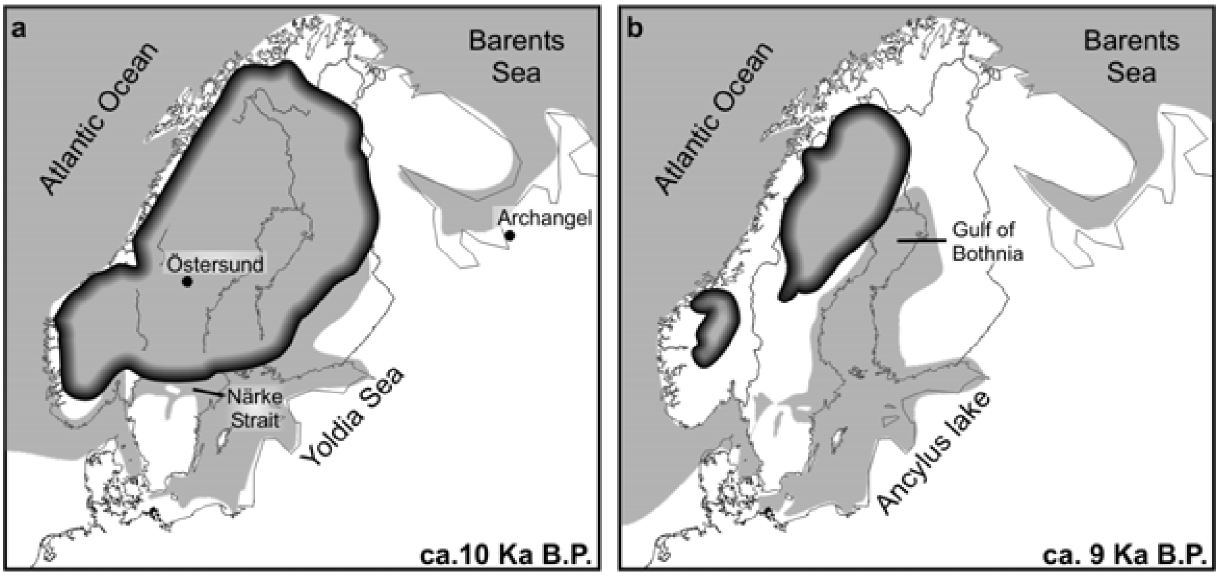

Fig 1. Aroximate reconstruction of the Fennoscandian Ice Sheet at a) 10 000 BP and b) 9000 BP, with places mentioned in the text marked. Redrawn from Lundqvist & Saarnisto 1995. Note that sea levels are extremely rough and included as a guide only.

The retreating eastern front of the ice was bounded by the Ancylus Lake until at least 9000 BP (Fig 1b), preventing the colonisation of Northern Sweden by sea. Where the land was not covered by ice, the combination of isostatic depression and high water level, about 250-300m above present, placed the shoreline about a hundred kilometres west of the present Swedish coast. A combination of isostatic rebound and ice retreat exposed the shores some hundred years later.

The last, mainly dead-ice remains of the ice sheet, melted from inland Lapland shortly after the middle of the Boreal period (ca. 8500 BP), although a small icecap may have remained in the Northern Scandinavian Mountains (Lundqvist & Saarnisto 1995).

Vegetation

The vegetation history of the Pleistocene-Holocene transition (Fig 2) has been primarily reconstructed from pollen analyses. From the early 1990's, however, plant macrofossils have been increasingly used as a complement to the pollen data. Improvements in ^{14}C dating, especially AMS, have increased the possibilities for reliably dating sediments with low organic contents. In addition, the use of multiple dates and statistical techniques such as 'wiggle-matching' have improved the chronologies and the possibilities for cross-correlation with high resolution climate records such as the Greenland ice cores, although accelerator dates are still not without problems (Wohlfarth *et al.* 1998).

The general outline of the vegetational history, as well as the chronology and climatic oscillations, during the Pleistocene-Holocene transition are well documented for the deglaciated areas of South Scandinavia (e.g. Birks 1994;Birks 2000). The ice free areas of Northern Fennoscandia followed a similar pattern, although the vegetation developed more of an Arctic character, with stee elements such as Artemisia and Chenopodiaceae, during the cold phases (Birks et al 1994). The timing of climatic change events, such as the Younger Dryas, was also delayed to variable extents due to the inertial cooling effects of the remaining ice sheet, although the northern coast was significantly influenced by changes in the North Atlantic ocean currents (Hald & Aspeli 1997).

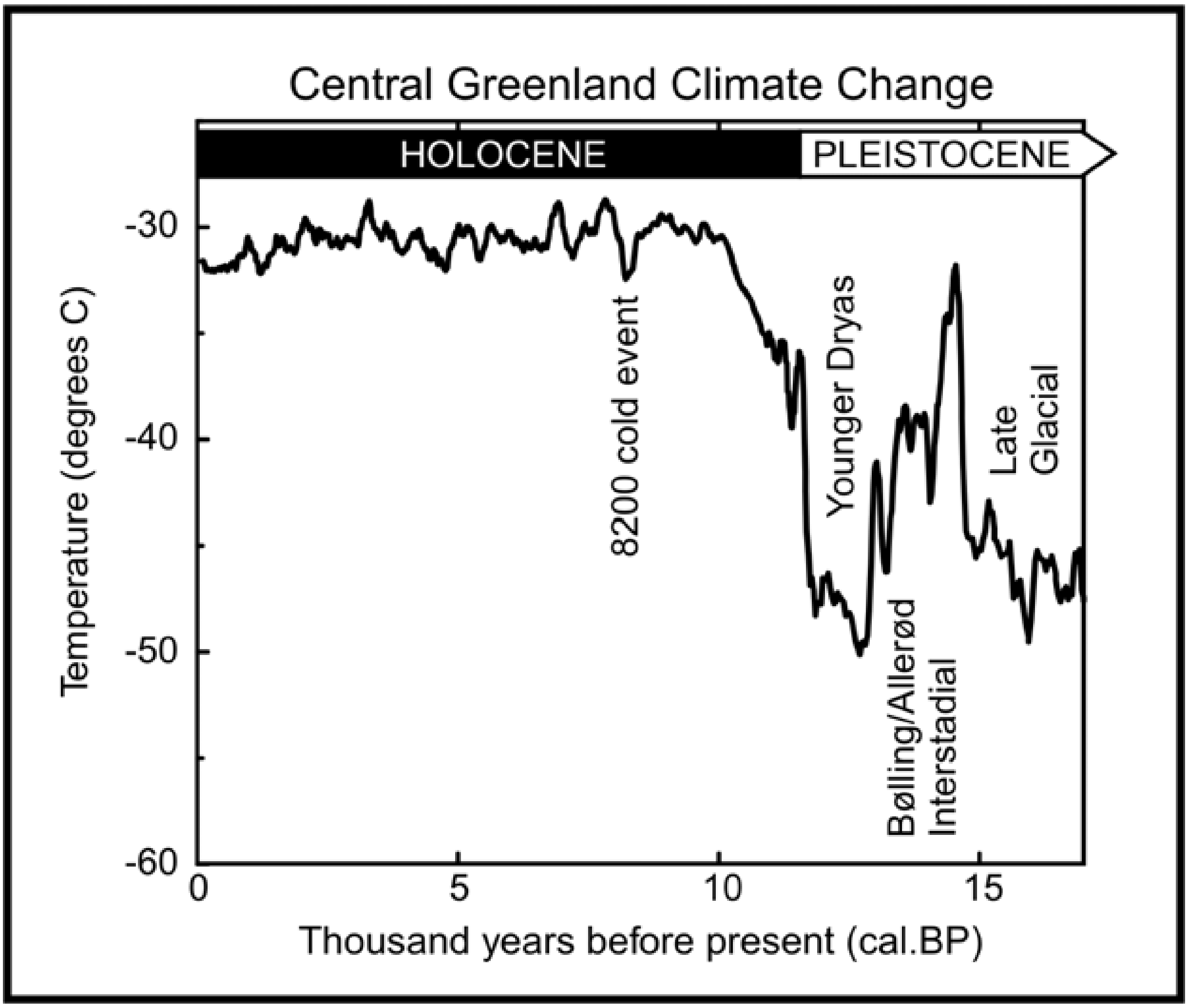

Fig 2. Late glacial and Holocene climatic curve, showing temperature changes over the past 18 thousand calendar years as reconstructed from Central Greenland snow accumulation rates. Modified from Alley et al (1993) using the downloadable version from the PAGES website (2003).

The vegetation development seen is a response to a dramatic climatic amelioration, with a rapid spread of birch and pine over the ice free areas. The warming also increased the rate of ice recession, and consequently, it can be questioned as to whether forest colonisation could keep up with the rate of exposure of land. Initially the soils were unstable and saturated, due to the huge quantities of water released by the melting ice, and rich in minerals but low in nitrogen, thus favouring nitrogen–fixing plants such as Hiophae (sea buckthorn).

All pollen diagrams from Northern Sweden have a substantial percentage of birch and pine in the early Boreal period, which is certainly a heavy over-representation of the actual vegetation. In an open landscape, the local non-arboreal pollen production is small, with only a few wind pollinated shrubs (Hippophae, Fig.3) and graminoids (Poacae and Cyperaceae). The pollen proportion of shade intolerant plants is high enough to indicate an open environment in the newly deglaciated areas, and the rate and character of forest colonisation has still to be investigated. This vegetation community has no true modern analogues, with the closest possibly being the narrow zone of recently uplifted land along the Bothnian shore, although the rate of land upheaval is very slow, and the vegetation under saline influence. Pollen alone cannot solve the problem; plant macrofossils, insects and snails could contribute to a more comprehensive reconstruction of the earliest environments post deglaciation (c.f. Lemdahl 1997; Vandenberghe *et al.* 1998).

Fig 3. *Hippophae rhamnoides*; Sea Buckthawn (Eng.); Havtorn (Sve.), a typical early coloniser of postglacial landscapes. (Digitally remastered from Lagerberg, 1957, pl.599)

Animals

The full Glacial mammoth stee fauna was successively reduced in the early part of Late Glacial, but managed to survive long enough to reach South Sweden and SE Finland (Stuart *et al.* 2002). The European Russian mainland was probably not glaciated east of about 100km east of Archangel (Fig 1a) during the LGM (Larsen et al 1999), and part of Northern Norway was deglaciated very early, leaving a northern zone open for megafauna colonization as well as a route for the immigration of Siberian arctic plants and animals. The early forest colonization of the Pechora region (ca. 500km east of Archangel; Khotinsky 1984; Väliranta *et al.* 2003) may subsequently have cut off the immigation route for eastern arctic tundra biota. The acid soils prevailing in most of Fennoscandia are most unfavourable for the preservation of bone, nevertheless, there are bones of mammoth and musk-ox from sites in central Fennoscandia, the majority of which are radiocarbon or geologically dated to the mid-Weichselian interstadial. The few dates on mammoth from southern Sweden and Denmark belong to the Late Glacial and pre LGM (Stuart *et al.* 2002). Other megafauna which could have lived close to the retreating ice front, such as the giant deer (*Megaloceros giganteus* Blumenbach) probably became extinct during the early Younger Dryas (Aaris-Sørensen 2004).

Remains from archaeological excavations show a fauna following the Early Holocene ice recession similar to the boreal fauna of today with reindeer, elk, beaver and brown bear. These bone assemblages, however, are biased by human preferences and cultural treatment, and as such probably do not represent the true nature of the fauna. In particular, the past distribution of smaller mammals, birds and herpetiles is extremely poorly understood, and that of invertebrates hardly touched upon. Since the ice receded from all directions, the same species could have immigrated by different routes and thus be of separate genetic lineages, which has been proven for several boreal species (Aaris-Sørensen 2000; Hewitt 1999).

In terms of aquatic species, it is believed that ringed seal was to be found in the Bothnian Sea as early as the Ancylus Lake stage (ca. 9000 BP). With the transition to the Littorina Sea (ca. 7500 BP) the harp seal became common, probably due to the increased biological diversity which followed increasing salinity (*op. cit.*).

Climate, ice and human expansion

It has been suggested that human populations may experience enhanced phases of rapid expansion and colonisation after cold/harsh weather phases (Adams & Otte 1999). As yet, this idea is entirely theoretical, having been suggested in the context of linguistic spread in more temperate zones, and lacking any conclusive dating. There is always a great danger in the correlation of climatic and cultural events, especially when the latter are both sparsely evidenced and poorly dated. Indeed, Bennett (2002) has pointed out the dangers of even geographically correlating specific climatic or geological events, in this case the '8200 cal. yr BP cold event' (Fig 2, and see Alley *et al.*1997) in Norway. Whether human expansion was accelerated by the population depression resulting from the last glaciation or not, there is mounting evidence for an early colonisation of Northern Sweden (e.g. Olofsson 2003), the more recent ice recession curves lending their suort to this possibility. It is also probable that colonisation occurred from the east/north and the south simultaneously, as it did with the other animal populations, and our present understanding of colonisation may be more a reflection of site visibility than theoretical possibility. That is to say that pioneer settlements, whatever form they take, may be so small that the probability of finding them in Norrland is extremely small. Forsberg (1996) describes pioneer sites with an area of <50m^2, and Bang-Andersen (2003), for example, describes pioneer settlements in SW Norway with site areas from 15-20m^2, leaving horizontal artefact scatterings of only 8-50m^2 for repeated occupation over a period of up to 500 years. Hicks (1993) has looked at the pollen signal of a small scale, seasonal, low impact hunter-gatherer (Saami) site in Finnish Lapland and shown that the human impact is only visible within a distance of 20-50m from the site, which may serve to illustrate just how difficult Early Mesolithic sites may be to find. Lake tilting may be a key to locating these small sites in Northern Sweden (Bergman *et al.*2003), as peat covered sites have a far greater preservation potential, and a significant increase in the number of well (AMS) dated sites is needed before we can draw any further conclusions.

Conclusions

The sparsity of evidence of the environment followingdeglaciation makes a reconstruction of the landscape available to the pioneer human immigrants difficult and patchy. For Northern

Sweden in particular, this period of time is poorly understood, although we may be able to extrapolate that which is known for Northern Norway and Southern Fennoscandia. The pollen records of shade intolerant species indicate a broad zone of open vegetation with thickets of willow and sea buckthorn. Birch and pine stands, as well as deciduous trees under-represented in the pollen records, such as aspen, rowan and bird-cherry, may have occurred, but a closed canopy forest is not probable until the end of the Boreal period (7000 BP). The former vegetation type would be favourable to browsing animals and suorts the assumption of a rapid immigration and establishment of dense populations of elk, beaver and hare. Thus we can reasonably confidently assume that inland resources and ecological conditions laid no restrictions on the immigration of people adapted to a boreal way of life. The availability of coastal resources during the Ancylus Lake stage are poorly understood, but what evidence that exists suggests that they most probably increased from the beginning of the Littorina sea stage (ca. 7500 BP), and facilitated a more extensive exploitation of the Bothnian coasts.

As mentioned above, tilted lakes may give us possibility of finding well preserved Early Mesolithic sites, but these are not the only areas that should be examined. The mounting evidence for early colonisation, although the idea itself is not a new one (see Forsberg 1996 for sources), demands a rearaisal of research strategies for finding and understanding the early sites, with specific attention being paid to the more recent ice recession chronologies.

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