II

# Appendix II

## Land-use dynamics during 2000 years – a case study of agrarian outland use in a forest landscape, west-central Sweden

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# Land-use dynamics during 2000 years – a case study of agrarian outland use in a forest landscape, west-central Sweden

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## Abstract

The local dynamics of agrarian outland use in west-central Sweden during the last 2000 years are studied at a forest estate by using historic-geographical and palaeoecological methods. Depending on the method, different histories of agrarian outland use could be written. In contrast to the relatively short and simple history, as displayed by maps and a field inventory, the land-use history based on pollen analysis demonstrated intensive, multifaceted agrarian activities since the Migration Period. This illustrates the importance of using several methods, i.e., an interdisciplinary approach, for the study of the histories of the forest region. The local outland use is discussed from the perspective of two economic-historical theories, with a focus on economic cycles and replacement of resources and goods, respectively. Conjunctures of agrarian land use are demonstrated, but they are regularly out of phase compared with general conjunctures. During the course of the Viking Age and Middle Ages, agrarian and non-agrarian land use replaced each other, i.e., the agriculture declined when hides, antlers and iron were produced. Apparently, the surplus production of non-agrarian goods had an effect on agrarian land use and settlement structure, thus generating a distinct local economic development in the forest region.

# Introduction

Various histories about the settlement and land use of the forest region may be written, depending on the perspective of the writer. In this paper, the perspective is based on two commonly used theories, that are economic-historical in character (cf. Magnusson 1997).[1] The first theory refers to long-term history as alternating stages of expansion and recession, analogous to modern economic cycles. The second theory alludes to how the use of resources and the production of goods vary over time and replace each other in an economic system. However, the theories are not mutually exclusive; instead, they may be used complementarily. The overall aim of this paper is to discuss the local dynamics of agrarian outland use[2] in west-central Sweden during the last 2000 years from the perspective of the two theories.

The theory of alternating stages of expansion and recession – economic conjunctures – has been used to explain the historical development of settlement and land use. In Sweden as well as in much of northern Europe, the Roman Iron Age, the Viking Age – Early Middle Ages, the first part of Early Modern Times and Modern Times, are considered to be periods of colonisation, economic growth and intensified land use (Berglund *et al.* 1991; Magnusson 1997; Pedersen and Widgren 1998; Myrdal 1999).[3] The periods in-between – the Migration Period, the Late Middle Ages and the 17th century – are characterised by abandonment of settlement sites and decreasing land use. One of the suggested driving forces behind these stages of expansion are new complexes of technology, which consequently increase production and facilitate expansion into unoccupied areas or regions (Myrdal 1997; Myrdal 1999). The varying relationship between population and agrarian production, and subsequent changes in economic variables, such as cost and rate of interest, has also been proposed to force the conjuncture cycles (Magnusson 1997).

The second theory – replacement of resources and goods – is put forward in the context of regional change through time, especially from Early Modern Times and onwards. The predominant utilisation of resources and the subsequent production of goods shift, e.g., from slash-and-burn cultivation to farming and further to timber logging (Bladh 1995), or from tar to sawn timber to paper pulp (Layton 1981; Layton 1995). Alterations in external factors, like institutions and market forces, have been suggested to promote the replacement of resources and goods (Bladh 1995; Bylund 1996). Changes in the total intensity of utilisation or the sum of production value, i.e., conjunctures, are of minor interest in this model. Instead, a time-geographical perspective is often applied to the historical development, and in so doing, focusing on the geographical reorganisation of the economy (Bladh 1995; Layton 1995; Nilsson 1996).[4]

Elements of the two theories, i.e., conjuncture cycles and geographical relocation of the production from the infields to the outland, are integrated in the suggested transformation from an economy focused on cereal cultivation to an economy based more on animal husbandry during the Middle Ages (Magnusson 1997; Myrdal 1999) as well as during Early Modern Times (Egerbladh 1987). For northern Värmland in west-central Sweden, similar replacements of land-use practices and regional conjunctures have been demonstrated, although completely in association with outlands (Svensson 1998a; Svensson *et al.* in press). During a short period at the end of the Viking Period and in the beginning of the Middle Ages, the intensive use of pits for charcoal making at bloomery furnace sites as well as pit-falls for elk, most likely resulted in surplus goods for an external market. When these activities regressed in the High Middle Ages, animal husbandry connected with the use of shielings (in Swedish, *fäbodar, sätrar*) came to be the main form of outland use, above all during Early Modern Times and onwards. Hence, in addition to the physical reorganisation of the activities, the focus shifted from non-agrarian to agrarian land use (Svensson 1998b).

The two economic-historical theories, especially in combination with each other, have proved to be relevant for regional studies. But do they apply to local outland history? To answer this question, five outland sites within a single estate in northern Värmland, west-central Sweden were studied. By using historic-geographical and palaeoecological methods, the study aimed to

- describe the exploitation of the forests and the wetlands at the sites, both in terms of types of agrarian land use and the intensity of the land use;
- and compare the local land-use dynamics between the sites and in light of the historical development of the region.

From the results of this study, we discuss

- the importance of using several methods in the writing of a local land-use history;
- and the local land-use development in relation to the introduced economic-historical theories.

# The study area

Backa is located in Dalby parish, northern Värmland (Fig. 1). The estate stretches fully 13 km towards the east from the river Klarälven to the border of the province of Dalarna (Fig. 2). The main settlement – a small hamlet named Backa – and its infields are situated on the sediment soils along the meandering river. The rest of the estate consists of forests and mires on sandy and silty till, the latter dominating at higher elevations (Lundquist 1958). The most common forest trees are Scots pine (*Pinus sylvestris* L.) and Norway spruce (*Picea abies* (L.) Karst.), but deciduous trees, such as alder (*Alnus* spp.) and birch (*Betula* spp.), are also present. Historically, the large forest area – where the shieling Backasätern is located – was used as the outland of Backa.[5]

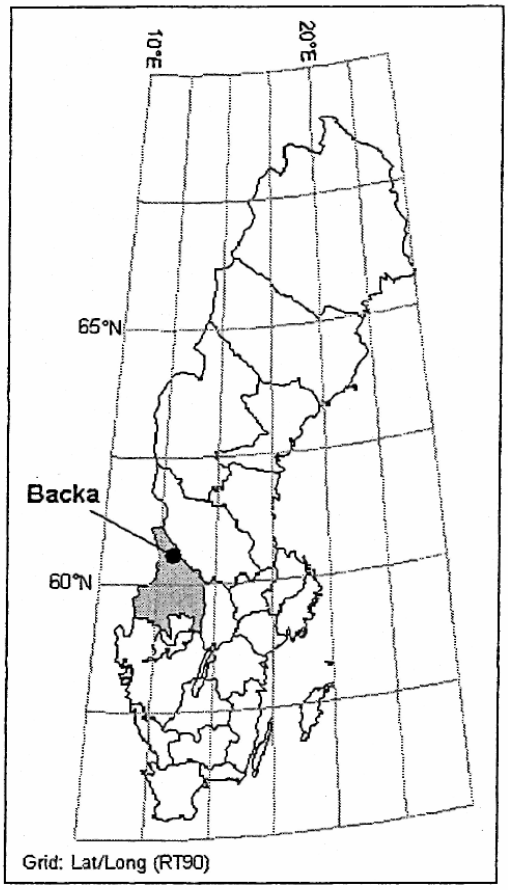

Fig. 1. Location of Backa in the northern part of the County of Värmland, Sweden.

## The settlement of Backa

Backa is mentioned for the first time in the taxation book from 1503 (Samuelsson and Kallstenius 1939). The number of farmsteads or households cannot be assessed from the older taxation documents due to the practice of registering only the name of one person per hamlet (cf. Nilsson 1950; Andersson Palm 1993). In 1730, the map from the geometrical survey (LMV R14-3:1) shows eight farmsteads and one croft (in Swedish, *torp*; small settlement on someone else's land) of a soldier. At the map from 1805 (LMV R14-3:2), the number of farmsteads has increased to nine; the croft of a soldier is also mentioned. The map from the enclosure process in 1843-1847 (in Swedish *laga skifte*; LMV R14-3:4) records eight farmsteads and three crofts. During the period from 1730 until the mid-1800's, the arable land expanded and the landscape around the hamlet became more open. The map from 1880-1895, on which the older economic map of the judicial districts is based (in Swedish *Hembygdskartan* or *Konceptkartan till häradskartan*; Folio 22; Folio 26), shows several crofts on the sediment terrace a few hundred metres to the north-east of the hamlet. The expansion of crofts during the 18th and 19th centuries was part of a general development, largely owing to an increase in population and local economic conditions, e.g., timber logging or iron works (Nilsson 1950).

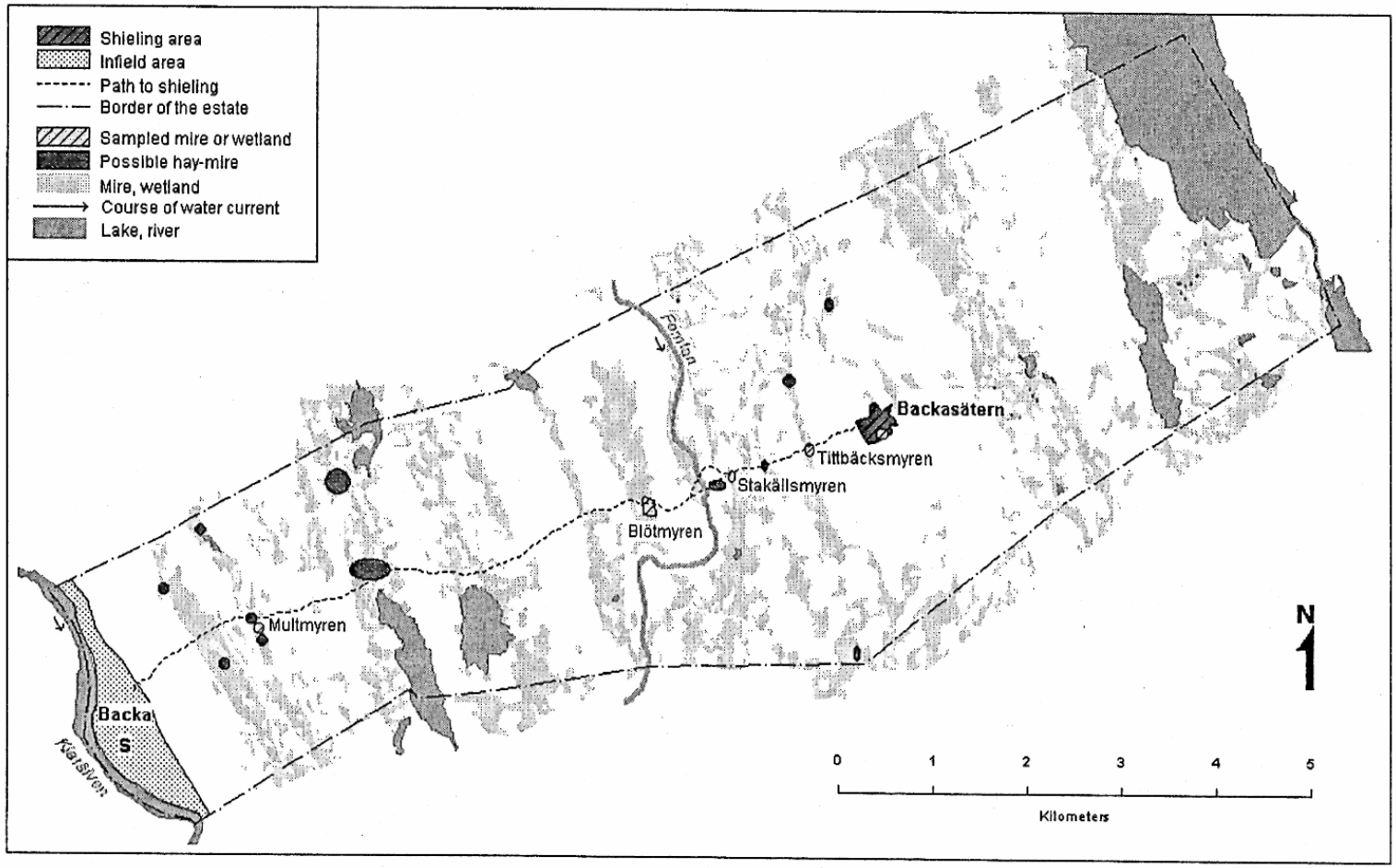


Fig. 2. Map of the estate of Backa. On the infield area of Backa, the location of the excavation at Skinnerud is indicated (S). The mires with grades 10, 24 and 50, according to the map of Backa from 1843-1847 (LMV R14-3:4), are marked, either as possible hay-mires or as sampled mire, if sampled for pollen analysis. The shieling area of Backasätern and the wetland cored for pollen analysis are also shown.

The south-western part of the infields of Backa comprises an abandoned settlement unit named Skinnerud (Fig. 2; RAÄ 776). It was known as a farm at the end of the 16th century (SOV 1938), but was reported as deserted already at c. 1600 (SOV and Ericksen 1950). Archaeological excavations at Skinnerud have revealed iron slag; iron artefacts, mainly a few scrapes and a piece of a knife; bronze artefacts; beads; burned bones; fire-cracked stones; remains of several buildings; and a fossil field. Taken together, the investigations and seven radiocarbon dates suggest a permanent agrarian settlement with connection to iron production and hide working during the Viking Age and the Early Middle Ages (Johansson *et al.* 1997; Johansson *et al.* 1998; Johansson *et al.* 1999). A single radiocarbon date from a possible cultural layer implies that Skinnerud is of an even older age, roughly from the Migration Period (Johansson *et al.* 1999). Although it is difficult to conclude what type of settlement or activity it was, due to the limited findings so far, it is assumed to represent a sedentary, agricultural economy in the Backa area (Svensson *et al.* in press; cf. Johansson *et al.* 1997). Thus, the archaeological investigations suggest that the activities at Backa predate the historical documents by roughly one millennium, i.e., to about AD 500.

## The outland

In the forest of Backa, numerous pits, either used as pit-falls for elk or as pits for charcoal making, and bloomery furnace sites are found (Johansson *et al.* 1997; Svensson *et al.* in press), but none of them have been excavated or dated. On the map from 1730 (LMV R14-3:1), the outland of Backa and its resources are sketchily referred to in terms of a shieling (not identified by name), outlying meadows, hay-mires near the river Femtan and the forest. According to the map, the outland meadows and mires yielded 12 $m^3$ hay yearly, of which two-thirds was produced at the shieling (Johansson *et al.* 1997). The infields of the shieling Backasätern is also recorded as a meadow on the map from 1843-1847, and a total number of 28 buildings are marked on the map (LMV R14-3:4).

Recently, Backasätern was surveyed and some of the remains of the older buildings were archaeologically investigated (Fig. 3). During the mapping, c. 60 buildings or remnants of buildings were registered; one-fifth of them were still standing or partly standing (Johansson *et al.* 1997; Johansson *et al.* 1999). The buildings and most of the foundations are found on the ridges around the infields, which still consist of almost treeless grassland. The north-eastern as well as the south-eastern parts are waterlogged, and sedges dominate the vegetation. House foundations with an older appearance were excavated. Part of one house foundation was radiocarbon dated to the Migration or early Vendel Period, but since another part of the same foundation was dated to the Late Middle Ages or Early Modern Times, it must be cautiously interpreted. The dates from two other foundations indicate that they were in use during the Middle Ages or Early Modern Times (Johansson *et al.* 1998; Johansson *et al.* 1999).

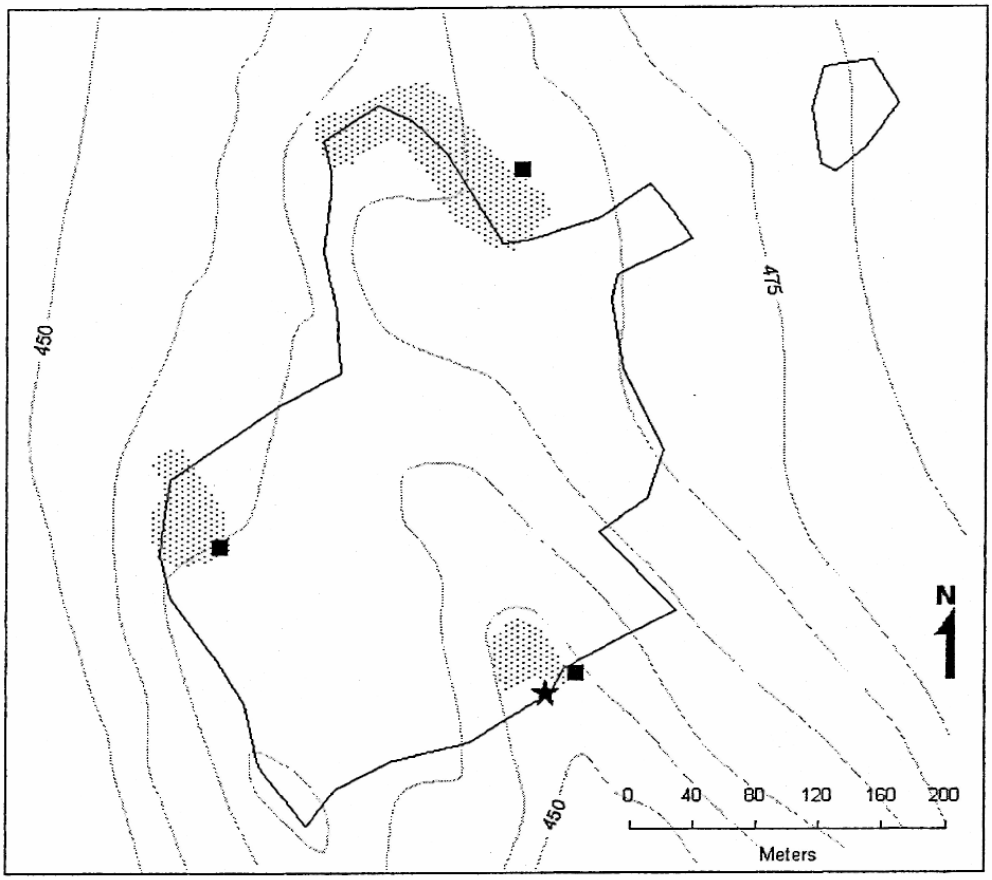


Fig. 3. Map of Backasätern, which shows the outline of the existing open area of the shieling and the contour lines (m asl). The sampling site of the peat core (★), the location of the large clearance cairns (■) and the possible extent of the former fields ( ▒ ), are indicated. Note that no buildings or house foundations are shown.

# Methods and material

To study the dynamics of agrarian outland use, pollen analysis of Backasätern and four mires was performed in combination with investigations of maps and a field inventory. At Backasätern, the wetland in the south-eastern part was cored for pollen analysis (Fig. 3; Table I); due to its small size and the location, the pollen accumulated in the peat is considered to largely reflect the vegetation and land use at the shieling and in the very nearby forest (Bradshaw 1988; Sugita 1994; Davis 2000). For the study of hay-making on mires and land use in the surrounding forest, four mires were chosen for pollen analysis: Multmyren, Blötmyren, Stakällmyren and Tittbäcksmyren (Fig. 2). Characteristics of the mires are presented in Table I.

Table I. Characteristics of the sites selected for sampling of peat cores, investigation of maps and field inventory.

| Site name | Mult-myren | Blöt-myren | Stakäll-myren | Tittbäcks-myren | Backa-sätern |
|---|---|---|---|---|---|
| Geographical position | 60°34'N; 13°07'E | 60°34'N; 13°12'E | 60°35'N; 13°13'E | 60°35'N; 13°14'E | 60°35'N; 13°15'E |
| Distance from Backa (km)[1] | 1.5 | 6.1 | 7.2 | 8.1 | 8.7 |
| Altitude (m asl) | 290 | 320 | 330 | 360 | 455[2] |
| Size of mire (ha) | 8.3 | 61.0 | 40.7 | 3.7 | 0.3 |
| Grade at the *laga skifte* map (graded area, ha) | 24 (1.2)[3] | 24 (2.3) | 10 (0.9) | 50 (1.1) | – |
| Dominating vegetation | Bog-moss | Bog-moss | Sedge | Sedge | Sedge |
| Depth interval used for pollen analysis (cm)[4] | 24-80 | 30-95 | 5-80 | 0-80 | 3-49 |
| Number of analysed samples | 15 | 26 | 22 | 28 | 30 |
| Possible dam construction | – | Yes | Yes | No | – |
| Cultivation area (maps) | No | No | No | No | No |
| Indications of cultivation (field inventory) | – | Possible area | – | Possible area | Yes |

[1] Measured along the shieling path on the map.
[2] The altitude of the sampling site; the altitude of the shieling area is varying between 455 and 480 m (Fig. 3).
[3] Areas, with grade 10 and estimated to 2.5 ha, are bordering the selected part of the mire (Fig. 2).
[4] The depth interval presents the upper values of the sub-sampled peat cores, e.g., at Multmyren the first sample was taken at the depth of 24-25 cm, while the last was from 80-81 cm.

## Selection of the sampling mires

The four mires were selected according to three criteria: the grading on the map from the mid-1800's; the suitability as sampling sites with regard to peat formation, evaluated after field control; and the location in relation to the path between Backa and Backasätern. In 1843-1847, the forest, including the mires, was divided into distinct areas or stands on the map of Backa (LMV R14-3:4). In the written description to the map, each area was given a grade based on the "quality" of the land. The grade 1 was equal to the "best" land, while 100 was considered "useless" land. Since all areas were described as forestland, the hay-mires, if any, cannot be identified directly today. However, the neighbouring hamlet Bänteby was also mapped in the 1840's (LMV R14-8:3), and in the description to the map of Bänteby, the hay-mires were specified. The grading

system, ranging from 1 to 100, was similar to the one used for Backa, and the hay-mires of Bänteby were given the grade 24. According to the description, the total area of hay-mires at Bänteby was 25 ha. On the map of Backa, only six mires, with an estimated area of about half of that of Bänteby, had the grade 24. Since the number and area of the 24-graded mires were small, we used the somewhat higher and lower grades, i.e., the grades between 5 and 50, for the identification of possible hay-mires at Backa. During the field inventory, the mires with grade 5 appeared to be wet forestland, with shallow peat deposits and therefore not suitable for further studies. The mires with the grades 10, 24 and 50 were regarded as possible hay-mires on the map of Backa (Fig. 2). The last criterion for the selection of sampling sites was that the mires had to be situated along the path between Backa and Backasätern. The reason for this is that the path presumably was important for the location of outland activities, i.e., people more likely used the forest or mires near the path due to improved transportation ability (cf. Stenqvist Millde in press).

## Analyses of the peat cores

For the pollen analysis, the mires and the wetland at Backasätern were sampled with a Russian peat corer (50 cm long; Moore *et al.* 1991). Sub-samples from the peat cores were prepared using standard methods, i.e., the 1-cm-thick samples were treated with KOH and acetolysis (Moore *et al.* 1991). The pollen material was mounted in safranine-stained glycerine on microscope slides. Between 600 and 850 pollen grains were counted from each sample. The number of microscopic charcoal particles (>50 µm and >150 µm respectively) on the pollen slides was also registered; the size limits were chosen to record charcoal particles of predominantly local origin (Patterson *et al.* 1987; Clark and Royall 1995; Tinner *et al.* 1998). The general keys of Beug (1961), Moore and Webb (1978) and Moore *et al.* (1991) were used for the identification of the pollen types, and a reference pollen collection was available for critical examinations. See the pollen diagrams (Figs. 4-8) for the Latin names of the pollen taxa.

The percentage frequencies of each pollen type were calculated based on the total terrestrial pollen sum, including sedges, for each sample; the percentages of the charcoal particles were calculated based on the sum of terrestrial pollen and the number of charcoal particles for each sample. The calculations and the pollen diagrams were made using the programs Tilia and Tilia-graph, made by EC Grimm. In the pollen diagrams, taxa that are regarded as being of minor importance for the interpretations are excluded. However, all taxa are included in the summary diagrams. Ribwort plantain is included in the sum of apophytic herbs, whereas the grass family is not. Apophytic species are considered to be favoured by anthropogenic activities, e.g., animal husbandry.

Bulk samples for radiocarbon dating were taken from the same peat cores as the samples for the pollen analysis. The AMS dating was carried out at the Radiocarbon Dating Laboratory at the University of Lund. The $^{14}$C-dates were calibrated using Calib 4.2 (revised version of Calib 3.0; Stuiver and Reimer 1993).

### Supplementary investigation of maps and field inventory

Additional investigations of maps and field inventories were made to complement the results of the pollen analysis (Table I). Various maps, both historical and contemporary, were examined to find areas formerly used for cultivation in the surroundings of the selected mires and at Backasätern. The maps used were: the map from the geometrical survey in 1730 (LMV R14-3:1); the *laga skifte* map from 1843-1847 (LMV R14-3:4); the map from 1880-1895, on which the older economic map of the judicial districts is based (Folio 22; Folio 26); the economic map from the 1960's and 1970's (13D 3a; 13D 4b); the topographical map from 1986 (13D SV); and the modern economic map from the 1980's (in Swedish *Gula kartan*; 13C 29; 13C 49). Taking the initial results of the pollen analysis into account, i.e., palynological indications of cereal cultivation, field inventories for identification of cultivated plots were carried out in the forest adjacent to the mires Blötmyren and Tittbäcksmyren and at Backasätern. Clearance cairns and field terraces or notches were regarded as positive indications of cultivation, while grassy, flat areas were considered to be possible plots. The surroundings of Stakällmyren were not surveyed, because the areas for cultivation are most likely found where some recent summer cottages are located, only 50-300 m from the sampling site. The mires Blötmyren, Stakällmyren and Tittbäcksmyren were also surveyed for possible dams, e.g., stone or wood constructions in the brooks connected to the wetland.

## Result and interpretation

The results of the pollen analysis, as assessed from the pollen diagrams (Figs. 4-8), and the field inventories are interpreted in terms of the local land-use history for each site. The land-use history comprises several phases, and the boundaries of the phases have been set on the basis of major vegetation changes, i.e., simultaneous changes in several taxa.

### Chronology

The chronologies of the pollen diagrams are based on calibrated $^{14}$C-dates, which are in correct relative order for each diagram (Table II). Due to the high standard deviations of the dates, the time intervals after calibration are predominantly between 300 and 400 years. To narrow down some of the intervals, the age ranges at 1$\sigma$ as well as the probability distribution (Table II) are taken into consideration. The age-depth diagrams (not shown), constructed from the calibrated $^{14}$C-dates , show no abrupt changes in the rate of peat accumulation, but the upper

Table II. The $^{14}C$-dates and calibrated ages from the peat profiles from the outland of Backa. The analyses were made on bulk peat samples, and were performed by the Radiocarbon Dating Laboratory at Lund University. The calibrations were made with the programme Calib 4.2 (revised version of Calib 3.0; Stuiver & Reimer 1993). The age ranges obtained from intercepts are given for all dates; the age ranges from probability distribution are specified in a few cases.

| Laboratory code | Mire, depth at peat profile (cm) | $^{14}C$ age BP | Calibrated age at 1σ | Calibrated age at 2σ |
|---|---|---|---|---|
| LuA-4967 | Multmyren, 55-56 | 535 ± 85 | AD 1313-1441 | AD 1288-1605 [1] |
| LuA-5122 | Multmyren, 67-68 | 1445 ± 90 | AD 539-663 | AD 422-770 |
| LuA-4968 | Multmyren, 69-70 | 1835 ± 85 | AD 78-320 | 17 BC-AD 406 |
| LuA-4956 | Blötmyren, 55-56 | 170 ± 90 | AD 1648-1951 | AD 1495-1955 [2] |
| LuA-4955 | Blötmyren, 75-76 | 1115 ± 90 | AD 781-1018 | AD 689-1154 |
| LuA-5123 | Blötmyren, 78-79 | 1220 ± 90 | AD 686-942 | AD 651-1015 |
| LuA-4954 | Stakällsmyren, 27-28 | 690 ± 85 | AD 1264-1392 | AD 1191-1417 |
| LuA-5124 | Stakällsmyren, 32-33 | 1225 ± 80 | AD 687-893 | AD 656-988 [3] |
| LuA-4953 | Stakällsmyren, 44-45 | 2015 ± 85 | 147 BC-AD 75 | 346 BC-AD 207 [4] |
| LuA-4686 | Tittbäcksmyren, 28-29 | 225 ± 95 | AD 1526-1948 | AD 1450-1953 |
| LuA-5125 | Tittbäcksmyren, 43-44 | 845 ± 80 | AD 1044-1276 | AD 1020-1295 |
| LuA-4687 | Tittbäcksmyren, 48-49 | 880 ± 110 | AD 1023-1273 | AD 904-1376 [5] |
| LuA-5126 | Tittbäcksmyren, 65-66 | 1375 ± 80 | AD 616-756 | AD 538-799 |
| LuA-4836 | Backasätern, 20-21 | 620 ± 80 | AD 1290-1409 | AD 1262-1439 |
| LuA-5127 | Backasätern, 27-28 | 965 ± 80 | AD 998-1162 | AD 897-1252 |
| LuA-4835 | Backasätern, 30-31 | 1135 ± 80 | AD 780-996 | AD 689-1027 |
| LuA-5128 | Backasätern, 40-41 | 1390 ± 85 | AD 601-688 | AD 474-780 [6] |
| LuA-4736 | Backasätern, 48-49 | 1630 ± 95 | AD 262-539 | AD 220-638 |

[1] AD 1283-1516 (relative area under probability distribution (r. a.): 0.982).
[2] AD 1626-1955 (r. a.: 0.949).
[3] AD 664-904 (r. a.: 0.872).
[4] 205 BC-AD 179 (r. a.: 0.965).
[5] AD 962-1300 (r. a.: 0.989).
[6] AD 527-782 (r. a.: 0.913).

parts of the peat stratigraphies from Multmyren (Fig. 4), Blötmyren (Fig. 5) and Tittbäcksmyren (Fig. 7) demonstrate high rates of accumulation due to low peat humification. Estimated dates have been derived from the age-depth diagrams when crucial for the discussion of changes in the land-use history. In general, the ages presented in the text are based on narrowed-down or estimated dates.

## Interpretation of Hordeum-type pollen

In all the pollen diagrams (Figs. 4-8), pollen grains identified as Hordeum type are present. The pollen type includes barley (*Hordeum vulgare* L.) as well as some wild grass species (Andersen 1979; cf. Wallin and Segerström 1994; Lagerås 1996a). At the present, these grasses do not grow in northern Värmland, with the exception of couch-grass (*Elytrigia repens* (L.) Nevski) and water manna-grass (*Glyceria fluitans* (L.) R. Br.) (Hultén 1971; Mossberg *et al.* 1992). These two species are usually found on lake shores or along rivers. Stakällmyren is the only study site that is close to this kind of habitat, i.e., the river Femtan is c. 200 m away (Fig. 2), and the presence of Hordeum-type pollen in the diagram (Fig. 6) will be discussed in more detail when interpreting the land-use history of that site. The Hordeum-type pollen in the peat profiles from the other mires is regarded as barley, due to the surroundings of the sites and the coexisting anthropogenic indicators in the diagrams (Figs. 4-5, 7-8). Concomitant apophytes and the restricted dispersal of cereal pollen, especially of barley (Vuorela 1973; Hall 1988; Segerström 1991; Hicks 1998), strongly suggest that cereal pollen originates from local – not distant – cultivations.

## Interpretation of pastures and meadows

In this study, the interpretation of different types of land use is based on an 'indicator-species' approach (cf. Behre 1981). In comparison with statistical procedures using modern pollen/land-use relationships, it has proved to be viable or even necessary when detecting small-scale, agricultural land use in forested landscapes (Gaillard *et al.* 1994; Hicks and Birks 1996; Lagerås 1996b). The presence of juniper and sorrels as well as slightly increasing frequencies of grasses and herbs are interpreted as forest grazing (Behre 1981; Hicks 1985; Vorren 1986). The total frequency of tree pollen remains high (usually >80%), but due to grazing and fire management of the pasture, the tree species composition is generally altered (e.g., Segerström and Emanuelsson 2001). Because of grazing during the flowering season, the frequency of grass pollen derived from pastures is expected to be low and relatively stable (usually <5%). In contrast, mowing of grass meadows later in the season results in distinctly higher frequencies of grasses (usually >5%), thus making the interpretation of hay-making possible (cf. Groenman-van Waateringe 1993; Hjelle 1998). Differentiating between grazing and hay-making on mires rests on the same assumption; mowing late in the season results in higher frequencies of sedge pollen than grazing on a mire during the flowering season. However, separating the two land-use practices from each other is hampered by the limited knowledge of the long-term effects of grazing and hay-making on the production of sedge pollen. Although mires used

for hay-making have been identified in recent studies (frequency of sedge pollen 10-60%; Segerström and Emanuelsson 2001), different effects, if any, of hay-making and grazing are virtually unknown, since grazing on mires has not been studied.

## Multmyren (Fig. 4)

*Phase A: Forest, prior to AD 400±200*

The forest around Multmyren consisted of alder, birch, pine and spruce. The field layer was mainly made up of dwarf-shrubs and ferns. The high frequency of charcoal suggests that the influence of fire was strong in the close vicinity of the mire (Pitkänen 1999; Tryterud 2000). The low proportions of grass and herbs, especially apophytic herbs, indicate that no agrarian land-use activities took place in the forest around Multmyren (cf. Hicks 1988).

*Phase B: Grazing and cultivation, AD 400±200 – 1550±100*

After an incident of fire, shown in the upper part of phase A, the presence of barley pollen and anthropogenically favoured species suggest that the forest was under some human influence. With the exception of plausibly one occasion of small-scale cultivation, the activity was probably forest grazing, as shown by the occurrence of sorrels and the rise in the pollen curves of grass and herbs (Behre 1981; Hicks 1985; Vorren 1986). At a depth of 58 cm, approximately AD 1100-1300, frequencies of species indicating grazing increase, thereby suggesting that the impact from grazing animals was stronger than before. The charcoal particles indicate that fire was used to improve the pasture (Frödin 1952; Segerström *et al.* 1996). The presence of rye pollen implies another short-term cultivation, dated to c. AD 1300-1500. The method of cultivation cannot be established for either of the two occasions due to the faint signal of anthropogenic impact.

*Phase C: Reduction of grazing, AD 1550±100 – 1700±100*

An increase in the spruce curve and a decrease in both grass and apophytic herbs suggest that the impact of grazing was reduced, or maybe even ceased during this period (Staaland *et al.* 1998).

*Phase D: Grazing, AD 1700±100 onwards*

In the upper part of the diagram, pollen types like juniper, grass and apophytic herbs, especially sorrels, are more common. Thus, the forest surrounding Multmyren was once again used as pasture for domesticated animals (Behre 1981; Hicks 1985; Vorren 1986). The increased proportion of sedge is difficult to interpret, owing to few analysed samples and only a slight rise in the curve; it may be the consequence of either natural vegetation changes or anthropogenic alterations related to hay-making or grazing on the mire (Moore *et al.* 1986).

In summary, forest grazing and occasional cereal cultivation constituted the agrarian land use at Multmyren (Fig. 9). The land use began at the end of the Roman Iron Age or during the Migration Period and continued until Modern Times, except for a period of a couple of hundred years in Early Modern Times, when the forest around Multmyren was left almost undisturbed. Although Multmyren is situated only 1.5 km from Backa, the human impact was surprisingly light during more than one thousand years. Forest grazing was resumed during Modern Times, when several crofts were founded on the sediment terrace above the hamlet (cf. Nilsson 1950), but the continuous effect of the settlement expansion has not been determined.

## Blötmyren (Fig. 5)

*Phase A: Forest, prior to AD 850±150*

The forest around Blötmyren consisted initially of alder, birch and pine and subsequently also spruce, which expanded 300 BC–AD 200 in the region (Fig. 6; Høeg 1996; Segerström *et al.* 1996; Segerström 1997). The field layer was mainly made up of dwarf-shrubs, and sedges were growing on the mire. The absence of apophytic herbs suggests that humans were not present in the forest around Blötmyren (cf. Hicks 1988).

*Phase B: Cultivation, grazing and hay-making, AD 850±150 – 1600±100*

High proportions of charcoal particles and the presence of the fungal spore *Gelasinospora* (type 1; van Geel 1978) indicate a major fire incident at the beginning of the phase; combustion of peat may have caused a hiatus, thus underestimating the age of the agricultural onset. Some pollen of rye and barley together with increasing occurrences of juniper, grass and apophytic herbs, such as aster species, mugwort and plantains, are evidence of agrarian land use (Behre 1981; Hicks 1985; Vorren 1986). Cereals were cultivated for some time, although the methods of cultivation are difficult to assess. The forest, which occasionally was burnt, was plausibly used as pasture for grazing animals (Frödin 1952; Segerström *et al.* 1996). Together, the burning and the grazing caused the proportion of spruce to fall in the longer term. The rise of the sedge curve also implies that the mire was under the influence of human activities, i.e., grazing or presumably hay-making, for some time during the phase (Levander 1943; Frödin 1952; Segerström and Emanuelsson 2001). The sharp rise of the proportion of birch pollen, estimated to c. AD 900-1150, is probably due to local re-growth of birch after an incident of intensive disturbance. A pollen diagram from a bloomery furnace site in central Sweden demonstrates a similar pointed appearance of the birch curve and the concurrence of charcoal particles (Ulf Segerström personal communication), suggesting that trees were cut down to make charcoal for the production of bloomery iron and subsequently birch reforested the logged area.

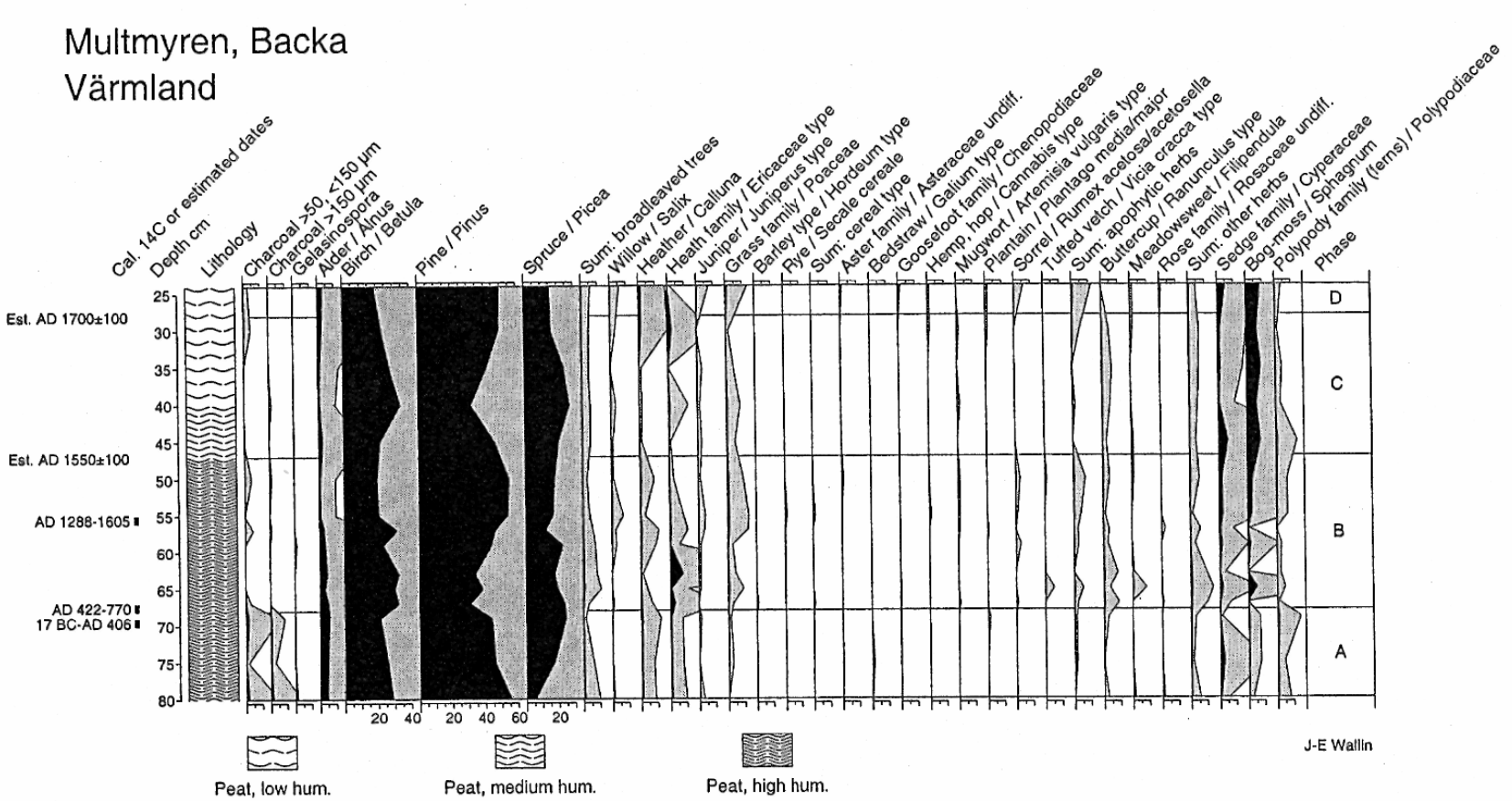


Fig. 4. Percentage pollen diagram from the peat core from Multmyren. From the left: calibrated $^{14}$C-dates (2 σ) or estimated dates (Est.); depth scale; lithology (key below the diagram; hum. = humification); charcoal particles >50, <150 µm and >150 µm, respectively; *Gelasinospora*, individual pollen types and sum curves of the major pollen and spore groups; the major land-use phases mentioned in the text. Black fields represent the percentage of each pollen type and grey fields the 10× exaggeration of the percentage values.

Although other sorts of disturbances, e.g., forest fires, cannot be excluded at Blötmyren, the interpretation is supported by the concurrence of the estimated date for the birch maximum and the dates of the bloomery furnace sites in the region (Svensson 1998a; cf. Myrdal-Runebjer 1998).

*Phase C: Grazing and field cultivation, AD 1600±100 – 1800±100*

Grazing affected the forest vegetation more than before, i.e., reducing spruce, and favouring juniper and apophytic herbs (Engelmark 1978; Kvamme 1988; Segerström *et al.* 1994; Segerström and Emanuelsson 2001). The recurring appearance of cereal pollen and the occurrence of goosefoot species imply that cereal cultivation took place on fields that were regularly tilled and manured (Engelmark 1995; Viklund 1998). Although no clear indications of fossil fields were found during the field inventory, a few small, flat plots with grassy vegetation were identified in the forest around Blötmyren (Table I).

*Phase D: Increased impact of grazing, field cultivation and hay-making, AD 1800±100 onwards*

Pollen types like juniper, grass and apophytic herbs, especially sorrels, are even more frequent than in phase C, thus suggesting that the effect of grazing animals was stronger around Blötmyren (Behre 1981; Hicks 1985; Vorren 1986). Charcoal particles indicate that the pasture was improved by using fire (Frödin 1952; Segerström *et al.* 1996). Cereal cultivation, probably on tilled and manured fields, continued; the raised proportion of cereal pollen is caused either by enlarged areas of cultivation or by enhanced dispersal of cereal pollen due to the increased impact of grazing. The high frequency of sedge pollen is likely due to hay-making on the mire (Segerström and Emanuelsson 2001). The vegetation and hydrology of the mire may have been deliberately altered by removing unwanted vegetation, e.g., dwarf-shrubs and bog-mosses, and by damming the mire (Levander 1943; Frödin 1952; Vasari 1988). During the field inventory, remnants of wooden constructions, which may have been used for damming, were found in the brook draining the mire (Table I; cf. Segerström *et al.* 1996).

In conclusion, Blötmyren and its vicinity have been used for agrarian land use since the end of the Vendel Period or the Viking Age (Fig. 9). The forest was used for extensive grazing, increasingly during Early Modern Times and Modern Times. Cereal cultivation also occurred in the forest, but the location of the cultivation plots is yet unknown. The first phase of cultivation took place at the end of the Vendel Period and during the Viking Age, while the second, more manifest phase began during Early Modern Times. The mire has most likely been used for hay-making, possibly during the Middle Ages, and more certainly in Modern Times. In addition, an episode of charcoal making for the production of bloomery iron possibly affected the forest alongside the agrarian land use during the Viking Period and Early Middle Ages.

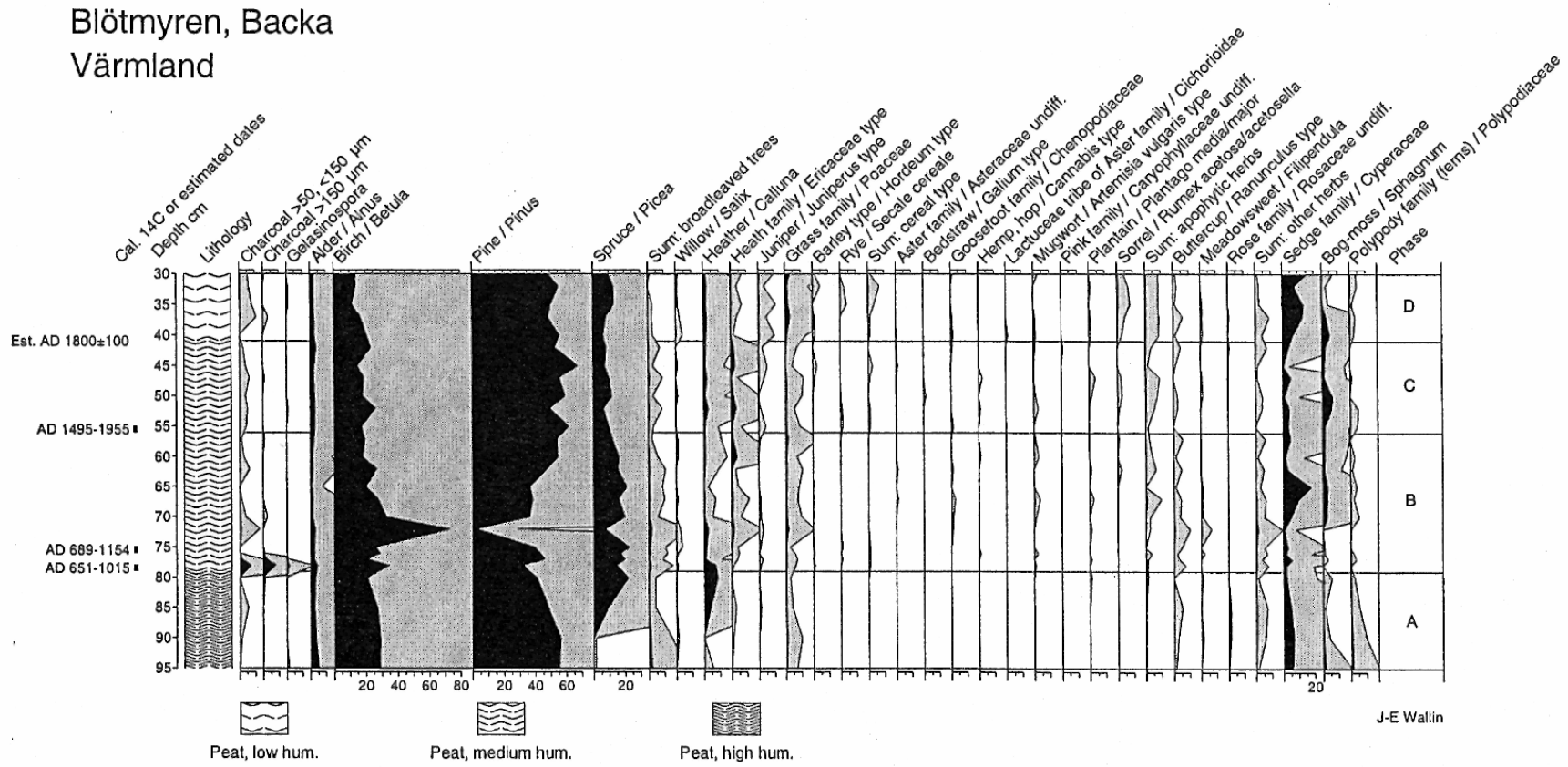


Fig. 5. Percentage pollen diagram from the peat core from Blötmyren. From the left: calibrated $^{14}$C-dates (2 σ) or estimated dates (Est.); depth scale; lithology (key below the diagram; hum. = humification); charcoal particles >50, <150 µm and >150 µm, respectively; *Gelasinospora*, individual pollen types and sum curves of the major pollen and spore groups; the major land-use phases mentioned in the text. Black fields represent the percentage of each pollen type and grey fields the 10× exaggeration of the percentage values.

## Stakällmyren (Fig. 6)

*Phase A: Forest, prior to AD 400±200*

The forest around Stakällmyren consisted initially of alder, birch and pine and subsequently also spruce. The expansion of spruce forest is dated to 300 BC–AD 200, which is consistent with other studies in the region (Høeg 1996; Segerström *et al.* 1996; Segerström 1997). The presence of charcoal particles suggests disturbance by wildfires. The dominating field-layer species were grasses and sedges. The absolute majority of the grass pollen most likely originated from the shores of the river Femtan only c. 200 m from the mire, and not from the forest. The low frequency of apophytic herbs indicates that the forest surrounding Stakällmyren was closed and not under the influence of any land-use practices (cf. Hicks 1988).

*Phase B: Possible cultivation, AD 400±200 – 750±150*

High proportions of charcoal particles and the presence of the fungal spore *Gelasinospora* (type 1; van Geel 1978) indicate a major fire incident at the beginning of the phase. Simultaneously, pollen of Hordeum type is found and is increasingly present. Although few other apophytic indicators are present and the Hordeum-type pollen may originate from grasses growing along the river, the possibility of cereal cultivation cannot be excluded. The appearance of Hordeum-type pollen at the same time as the forest fire, the expansion of birch as well as grasses, and the presence of humans at Backa (Figs. 4, 7-8; Johansson *et al.* 1999; Svensson *et al.* in press) suggest that the Hordeum-type pollen has an anthropogenic origin, i.e., cereal cultivation. However, there are no evident indications of other types of agrarian land use.

*Phase C: Cultivation and grazing, AD 750±150 – 1500±100*

Pollen of Hordeum type is present together with cultivation indicators like goosefoot species and bedstraw, hence suggesting cultivation of barley on tilled and manured fields (Behre 1981; Hicks 1985; Viklund 1998). Comparable with the previous phase, some of the pollen of Hordeum type could be derived from grasses growing along the river. Concomitantly, forest grazing was introduced in the area during this period, as indicated by the reduction of spruce and the occurrences of juniper, sorrels and other apophytic herbs (Behre 1981; Hicks 1985; Vorren 1986; Kvamme 1988). Thus, agrarian land use was well established in the vicinity of the mire. Changes in the grass curve, which usually are associated with grazing and the openness of the forest canopy (Hicks 1985; Hicks 1988), are difficult to interpret owing to the fact that they may reflect vegetation changes alongside the river as well as in the forest.

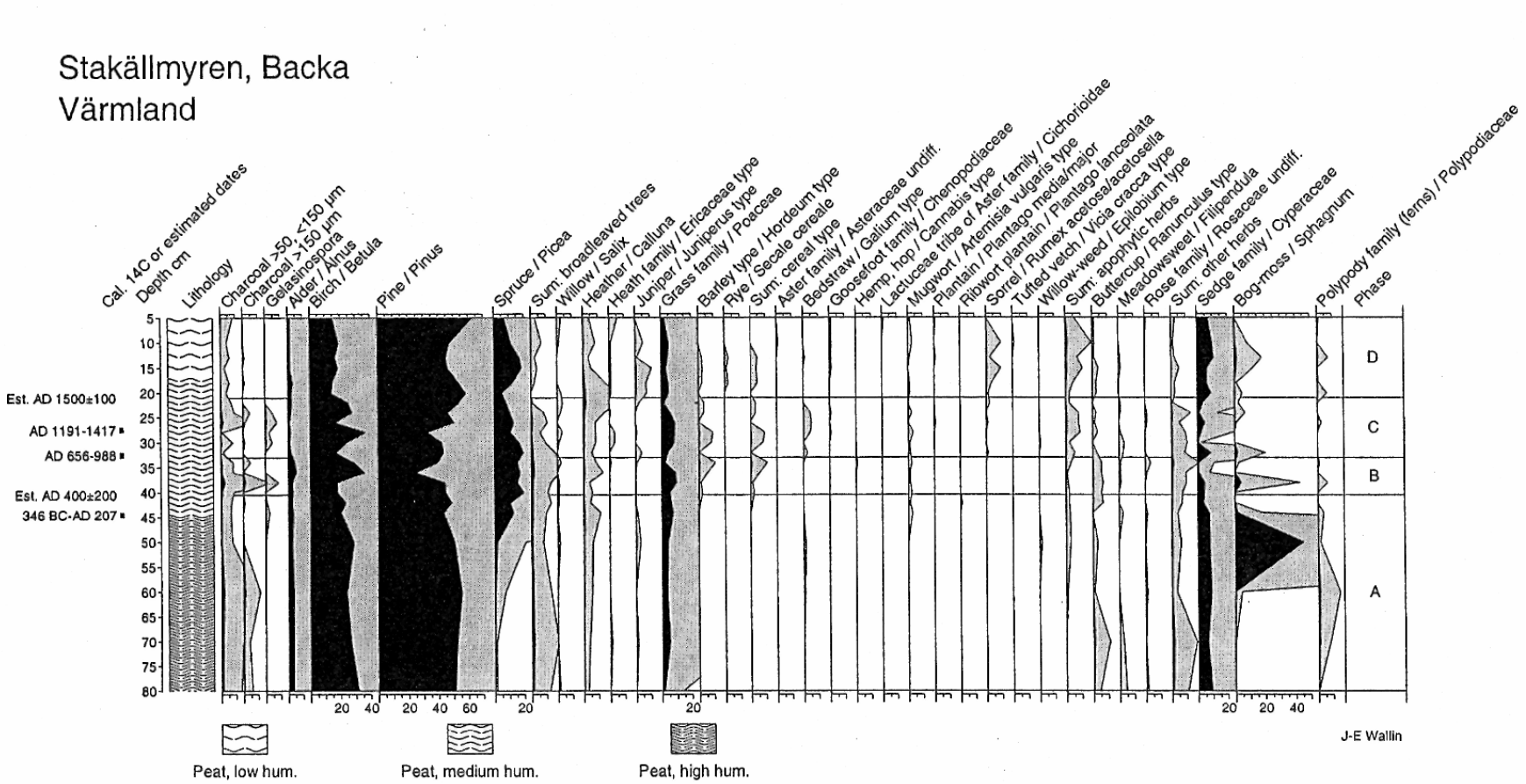


Fig. 6. Percentage pollen diagram from the peat core from Stakällmyren. From the left: calibrated $^{14}$C-dates (2 σ) or estimated dates (Est.); depth scale; lithology (key below the diagram; hum. = humification); charcoal particles >50, <150 µm and >150 µm, respectively; *Gelasinospora*, individual pollen types and sum curves of the major pollen and spore groups; the major land-use phases mentioned in the text. Black fields represent the percentage of each pollen type and grey fields the 10× exaggeration of the percentage values.

*Phase D: Intensive grazing, use of the mire and cultivation, AD 1500±100 onwards*

Grazing by domesticated animals became more pronounced during this phase, as interpreted from the increasing proportions of juniper, sorrels and other apophytic herbs (Behre 1981; Hicks 1985; Vorren 1986). The rising frequency of sedge pollen implies that the mire was used for either grazing or hay-making (Frödin 1952; Segerström and Emanuelsson 2001). This interpretation is supported by the decreasing frequencies of shrubs and dwarf-shrubs in the lower part of the phase; their frequencies are expected to diminish due to either grazing cattle or intentional removal before hay-making (Elveland 1979; Vasari and Väänänen 1986). In the brook along the western side of the mire, the field inventory revealed remnants of wooden constructions, possibly used for damming to improve the sedge production (Table I; cf. Segerström *et al.* 1996). Cereal pollen, both rye and Hordeum type, along with goosefoot species, indicate that cultivation on fields was performed in the surroundings of Stakällmyren until the 19th century (Engelmark 1995; Viklund 1998).

Summing up the land-use history at Stakällmyren, the forest was plausibly exploited for arable use at the end of the Roman Iron Age or during the Migration Period (Fig. 9). The agrarian land use was gradually diversified and intensified, first during the Vendel Period or early Viking Age, and later around the transition from the Middle Ages until Early Modern Times. The magnitude and the succession of the land-use practices at Stakällmyren are unusual, compared with the other sites within the estate of Backa and other outland sites in central Sweden. Firstly, the degree of cereal cultivation was high in relation to forest grazing at Stakällmyren. The relationship is usually the opposite at other outland sites, i.e., the signal of grazing is the major component of the total human impact (Figs. 4-5, 7; Segerström *et al.* 1994; Segerström 1997; Emanuelsson *et al.* in press). Secondly, the initial mode of land use was probably cultivation at Stakällmyren, and grazing was seemingly not established until a few hundred years later. Typically, the general succession of land-use practices is the opposite, more specifically, grazing is the first type of land use and cultivation follows (Figs. 7-8; Olsson 1998; Karlsson 2001; Nordström 2001; Emanuelsson *et al.* in press). Thus, the early agriculture at Stakällmyren has more in common with the land use at permanent settlements (cf. Wallin 1996; Lindbladh 1998). Even though the reasons behind the distinctive land-use history of Stakällmyren are intricate to determine, the river Femtan in the close vicinity of the mire may have played a fundamental role in locating the early agrarian activities. During most of the 20th century, a shieling – now summer cottages – was located at a place near the river (Styffe and Styffe 1989), but its earlier history is unknown from written documents or maps.

## Tittbäcksmyren (Fig. 7)

*Phase A: Forest, prior to AD 600±100*

The forest surrounding the mire consisted of alder, birch, pine and spruce; alder and willow were commonly growing in the wetter parts of the forest near the mire. The field layer was mainly made up of dwarf-shrubs and ferns. The low proportions of herbs, especially apophytic herbs, and grass indicate that the forest around Tittbäcksmyren was not in any substantial way exploited by humans (cf. Hicks 1988).

*Phase B: Grazing and possible use of the mire, AD 600±100 – 1150±150*

The occurrences of juniper and sorrels along with the rise in the pollen curves of both apophytic and other herbs suggest that the surrounding forest was affected by forest grazing (Behre 1981; Hicks 1985; Vorren 1986). At the same time, sedges grew more frequently on the mire; if it was due to deliberate changes of the mire vegetation or indirect effects of grazing is difficult to establish (cf. Amorosi *et al.* 1998). In the middle of the phase, the reduction of willow implies that the mire and wet areas adjacent to the mire were cleared of shrubs. The slightly higher frequencies of charcoal particles and grass pollen as well as the relative consistency of the curves of dwarf-shrubs suggest that an overall higher grazing pressure is the more probable explanation, rather than intentional clearance of woody plants on the mire to improve hay production (Frödin 1952; Elveland 1979). Although the vegetation changes are interpreted as effects of grazing, the anthropogenic signal, as a whole, is weak during this period.

*Phase C: Grazing, use of the mire and cultivation, AD 1150±150 – 1600±100*

Grazing and intentional burnings altered the forest tree composition around Tittbäcksmyren; spruce and to some extent also birch were held back (Engelmark 1978; Segerström *et al.* 1996; Segerström and Emanuelsson 2001). A substantial increase in grasses and the diminishing occurrence of dwarf-shrubs (apart from heather) changed the composition of the field layer. Together, these changes suggest that the forest was turned into a forest pasture, rich in grasses and herbs (cf. Frödin 1952). Most likely, the mire was continually used for fodder production, i.e., grazing or hay-making, but determining which of the two land-use practices that was performed is not possible due to the indistinct increase of sedges. Somewhere in the vicinity of the mire, short-term cultivation of cereals apparently took place on tilled and manured fields, as indicated by the presence of barley and goosefoot species (Engelmark 1995; Viklund 1998). Although a few areas – very small, flat, grassy plateaus on the slope to the east of the mire – were considered to be potential cultivation plots, no clear indications of cultivation, such as clearance cairns or field terraces, were found during the field inventory (Table I).

*Phase D: Increased impact of grazing, cultivation and hay-making, AD 1600±100 – 1850±50*

For a period of a few hundred years, the agrarian land use around and on the mire was intensive. The impact of forest grazing, cereal cultivation and hay-making is clearly expressed in the pollen diagram. Similar to the previous phase, the cultivation almost certainly took place on tilled and manured fields. The high proportion of sedge pollen indicates that the mire was used for hay-making (Segerström and Emanuelsson 2001). The production of hay was most likely improved by deliberately damming the mire, thus increasing the growth of sedge (Levander 1943; Frödin 1952; Emanuelsson and Möller 1990). However, during the field inventory, no possible dam construction was found in the brook draining the mire (Table I). On the other hand, simple wooden constructions, as described for northern Sweden (Levander 1943; Campbell 1948; Frödin 1952), could have been degraded, destroyed or even deliberately removed.

*Phase E: Cessation of agrarian land use, AD 1850±50 until present*

During the 19th century, the agrarian impact declined and the anthropogenically favoured vegetation has successively vanished from the forest and the mire.

To summarise the land-use history at Tittbäcksmyren, forest grazing and possible use of the mire was initiated during the Migration Period or at the beginning of the Vendel Period (Fig. 9). At the beginning of the Middle Ages, land use was intensified and later on, temporary cultivation was also performed. In Early Modern Times, agrarian land use, including extensive forest grazing, hay-making on the deliberately flooded mire and field cultivation, was reinforced even more.

## Land-use history at Backasätern (Fig. 8)

*Phase A: Forested carr, prior to AD 650±100*

The sampling site was a carr, dominated by alder and birch; pieces of wood, which were found in the peat at the depth of 50 cm, indicate that the shallow wetland was forested. The signal from the forest growing on the mineral soil is concealed by local birches, due to the fact that birches usually produce large amounts of pollen, compared with most other tree species, and the character of the carr as a closed-canopy site (Birks and Birks 1980; Jacobson and Bradshaw 1981; Bradshaw 1988). The forest around the carr was probably dominated by spruce, since the proportion of pine pollen is too low to derive from a pine forest in the vicinity of the carr. The field layer of the carr consisted of herbs, e.g., buttercup and meadowsweet, and ferns. Although apophytic herbs like aster species were present, the vegetation was probably not influenced by agrarian land-use activities; instead the herbs were likely to grow naturally in the carr.

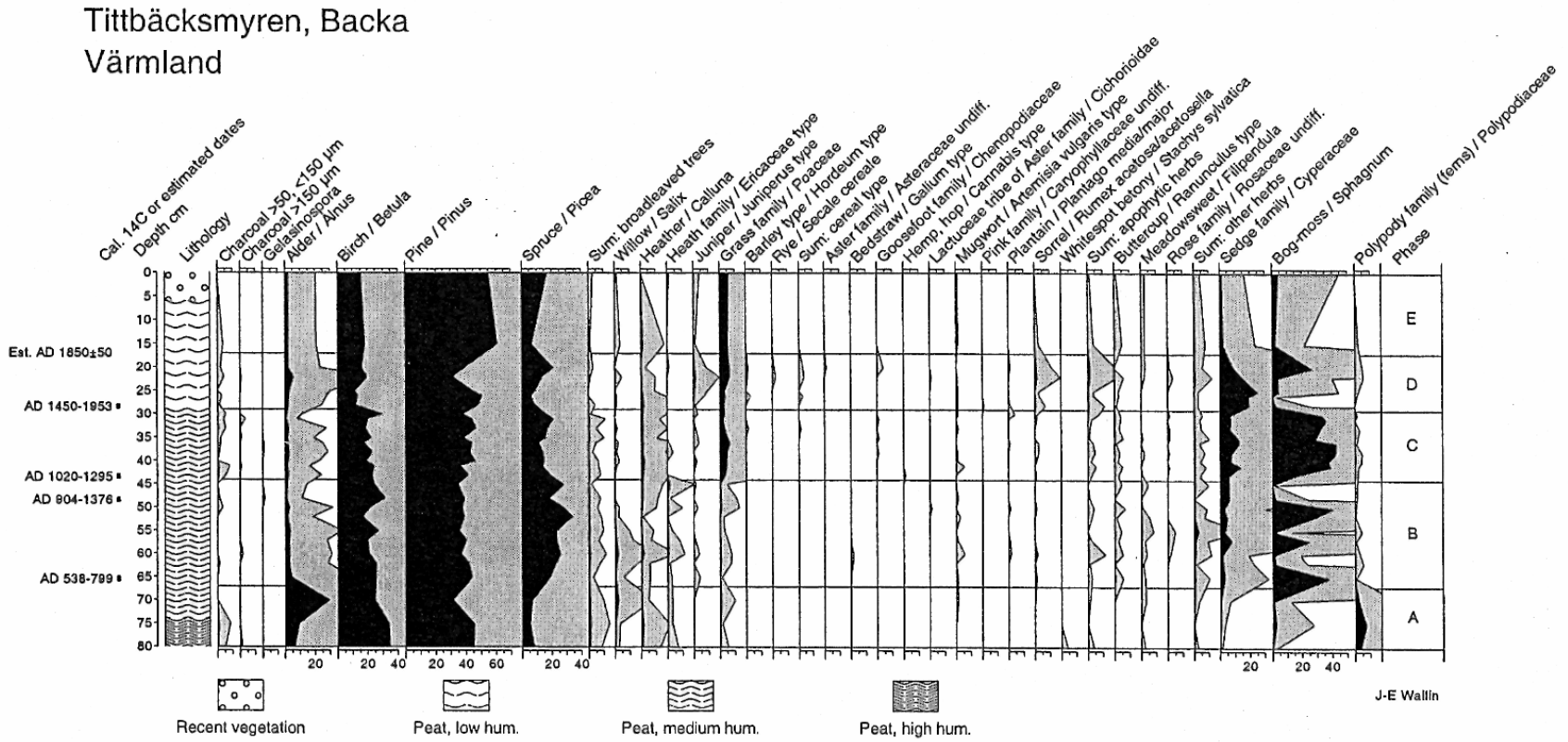


Fig. 7. Percentage pollen diagram from the peat core from Tittbäcksmyren. From the left: calibrated $^{14}$C-dates (2 σ) or estimated dates (Est.); depth scale; lithology (key below the diagram; hum. = humification); charcoal particles >50, <150 µm and >150 µm, respectively; *Gelasinospora*, individual pollen types and sum curves of the major pollen and spore groups; the major land-use phases mentioned in the text. Black fields represent the percentage of each pollen type and grey fields the 10× exaggeration of the percentage values.

*Phase B: Hay-making and grazing at the shieling, AD 650±100 – 1050±150*

In the pollen diagram, the proportions of tree species change considerably in concert with alterations of the field-layer vegetation. These changes are most likely the consequence of clearing the carr. When the birch was cut down, the ferns growing in the carr almost disappeared and grasses increased in abundance (cf. Segerström *et al.* 1994). The abrupt increase in the frequency of spruce pollen is not necessarily the result of the expansion of spruce nearby, but the likely effect of improved dispersal of spruce pollen to the sampling site when the birch canopy was removed (cf. Jacobson and Bradshaw 1981; Davis 2000). It is not obvious from the pollen diagram if some parts of the dry land were also cleared for the establishment of the shieling area. However, the overall vegetation changes and the contemporaneous radiocarbon date beneath an excavated house foundation (Johansson *et al.* 1998) suggest that the shieling was established during the Vendel Period. At first, the high frequency of grass pollen shows that hay-making plausibly was performed somewhere at the shieling (Segerström *et al.* 1994; Segerström and Emanuelsson 2001). At the depth of 36 cm, changes in the pollen assemblage indicate that the land use changed and the grass meadow turned into grazing land; consequently, species associated with grazing increased (Behre 1981; Hicks 1985; Vorren 1986). Later on, c. AD 750-950, hay-making appears to have been carried out on the wet area near the sampling site, as indicated by an increased proportion of sedge. At the same time, part of the spruce forest was cut down, presumably to enlarge the shieling area. Possible alteration of the surrounding forest – still spruce dominated – is largely overshadowed by the vegetation changes at the shieling area, and therefore, the land use in the forest, e.g., grazing, if any, is not feasible to deduce. Although the local vegetation changes are noticeably expressed in the diagram, the anthropogenic impact is vague, in particular as cultivated plants are absent. Still, the vegetation changes are more directly comprehended as the consequence of human impacts rather than as the result of natural disturbances.

*Phase C: Abandonment of the shieling, AD 1050±150 – 1400±100*

The declining frequencies of grass and apophytic herbs indicate that the shieling area became less open, hence suggesting that the agrarian land use at the shieling ceased (Cousins and Eriksson 2001; Dupré and Diekmann 2001). The influence of fire also diminished, as indicated by the few occurrences of charcoal particles in the peat. Although the curve of spruce steadily declines and some anthropogenic indicators still are present, it is difficult to determine whether any land use, e.g., marginal grazing, was maintained, or if the pollen assemblage is the result of the slow re-growth of forest on the shieling.

*Phase D: Cultivation and grazing, AD 1400±100 – 1750±100*

Open-land species increase, demonstrating that the shieling area was used again. Higher proportions of charcoal particles, presence of the fungal spore *Gelasinospora* (type 1; van Geel 1978) and a sharp fall in the spruce curve suggest that the

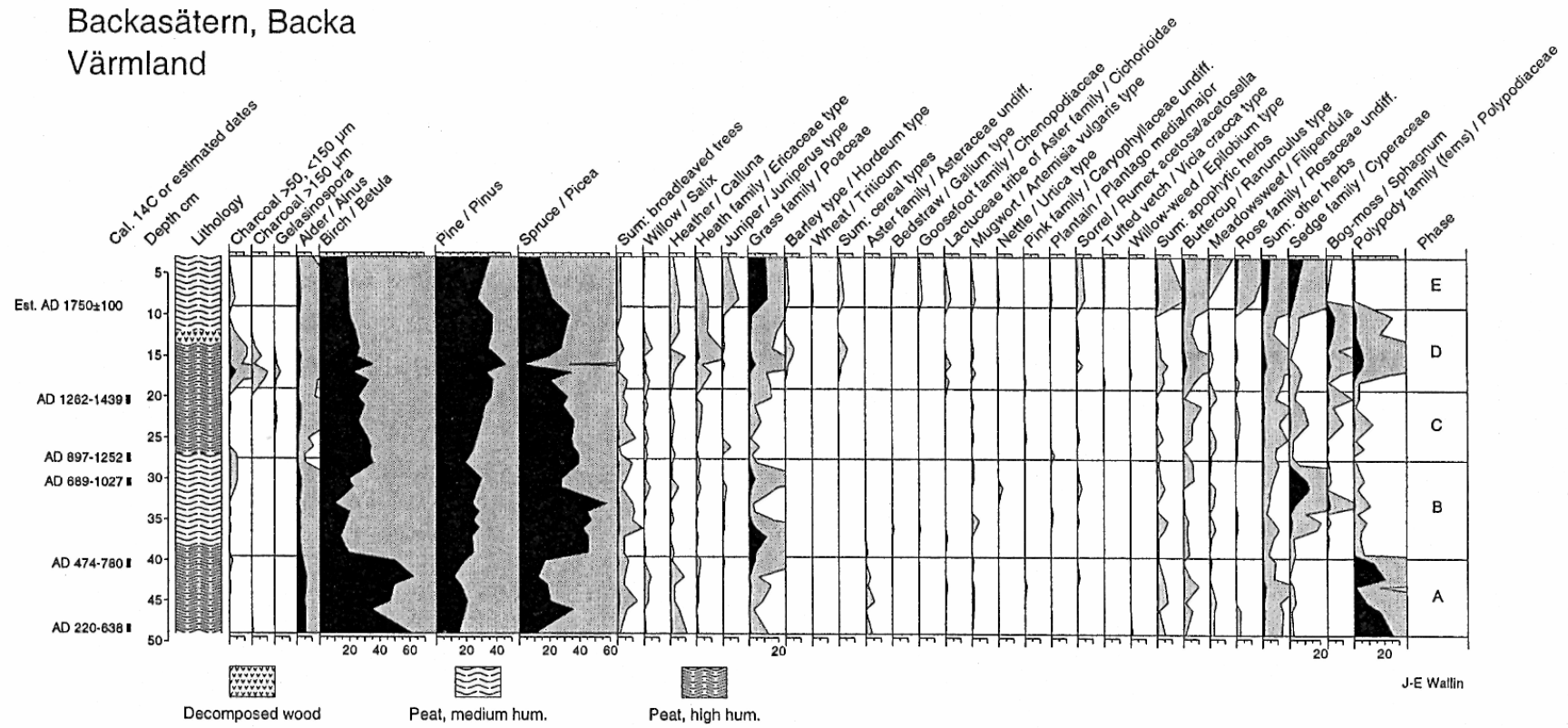


Fig. 8. Percentage pollen diagram from the peat core from Backasätern. From the left: calibrated $^{14}$C-dates (2 σ) or estimated dates (Est.); depth scale; lithology (key below the diagram; hum. = humification); charcoal particles >50, <150 µm and >150 µm, respectively; *Gelasinospora*, individual pollen types and sum curves of the major pollen and spore groups; the major land-use phases mentioned in the text. Black fields represent the percentage of each pollen type and grey fields the 10× exaggeration of the percentage values.

area was opened up by fire and logging. This occasion is seemingly contemporary with the suggested establishment of buildings at the shieling (Johansson *et al.* 1999). The shieling was used for cereal cultivation, presumably performed as temporary small-scale cultivation in the grassland (in Swedish known as, e.g., *lindbruk* or *koppelbruk*; Myrdal 1999; Gadd 2000). The basis for this method of cultivation was the long-term fallowed grassland, which was normally used as meadow or pasture; the fallow was broken by tilling and maybe burning a small area, and after one or a few years of cereal cultivation, the plot returned to grassland. The positive effect of clearance on the availability of nutrients made manuring unnecessary (Ekstam *et al.* 1988); no nitrophilous annuals, e.g., goosefoot species, appear during this phase. The small clearance cairns that are scattered all over the open shieling area may be the result of this type of cultivation. The grassland is assumed to have been grazed most of the time, since the frequency of grass pollen is not high enough to suggest that the whole shieling area was used for hay-making (Groenman-van Waateringe 1993). Due to the proposed land use at the open shieling area, species like dwarf-shrubs and juniper are not likely to be found at the shieling (Odgaard 1994; Lagerås 1996a); they grew rather in the forest, thus suggesting that the surroundings of the shieling were used for extensive grazing.

### *Phase E: Intensive grazing, cultivation and hay-making, AD 1750±100 onwards*

The forest around the shieling was under pressure from grazing animals, as suggested by the increased proportions of juniper and apophytic herbs (Behre 1981; Hicks 1985; Vorren 1986). On the open shieling area, grazing was almost certainly restricted. Instead the area was used as a meadow to produce hay, as indicated by the high frequencies of grass and sedge pollen (Segerström *et al.* 1994; Segerström and Emanuelsson 2001). Grazing was usually allowed on the shieling area, but only after hay-making in the late summer (Levander 1943; Nyman 1963). Cereal cultivation was probably carried out on permanent fields; this interpretation is supported by the presence of goosefoot species (Engelmark 1995; Viklund 1998) and the field inventory. The use of the shieling came to an end in the 1930's (Syffe and Styffe 1989), but the open area is still maintained.

During the field inventory of the shieling, a few large heaps of stones and three former fields, which indicate intense cultivation of the ground, were identified (Fig. 3). Two of the fields are located in the wetter parts of the shieling area. Since cultivation of wetland was made possible with extensive ditching and modern ploughs during the 19$^{th}$ century (cf. Myrdal 1999; Gadd 2000), these two fields are assumed to be from the 19$^{th}$ or 20$^{th}$ centuries. This assumption is further supported by the carved name initials and dating to the end of the 19$^{th}$ century on one of the stones in a large clearance cairn only c. 20 m distant from the peat sampling site. The third field is situated in the western part of the shieling, where the ground is dry and sandy. Low field notches and terrace formations along with some smaller clearance cairns and the absence of plough furrows suggest that an

ard has been used; even so, manuring and cultivation was probably intense. Since the ard has been used for a long time, and still was used at the end of the 19th century (Kritz 1997), it is very difficult to determine the age of the field. As put forward by the pollen analysis, it was possibly used during the 19th or the beginning of the 20th century.

In conclusion, the land-use history at Backasätern began during the Vendel Period when the shieling was established (Fig. 9). The agrarian land use consisted of grazing and hay-making, and principally continued in that way until the very end of the Middle Ages when cultivation of cereals was added. However, the shieling area was most likely abandoned for a period during the Early Middle Ages. At the end of the Middle Ages and during Early Modern Times, the shieling was reoccupied, and the land use at the shieling was gradually intensified. According to historical maps from the 18th and 19th centuries, the open grassland at the shieling was used as a meadow for hay-making. The information on the maps is only partially consistent with the results of the pollen analysis and the field inventory, since both cereal cultivation and hay-making are demonstrated to have taken place at the shieling.

# Discussion

## Different methods – different histories

The study of the outland of Backa displays a complex picture of agrarian land-use history. Part of the complexity lies in the differences of the methods and material used for the investigation. The land-use history obtained from the historical maps and the field inventory is presented in Table I, while the pollen analysis is summarised in Table III. Based on the comparison between the maps of Backa and Bänteby from the 1840's (LMV R14-3:4; R14-8:3), mires with grade 24 – Multmyren and Blötmyren – were expected to have been the primary hay-mires. But according to the pollen analysis, Blötmyren and Tittbäcksmyren were used as hay-mires, likely dammed for deliberate flooding. The improved production of fodder due to flooding is most clearly expressed in the pollen diagram from Tittbäcksmyren during Early Modern Times and Modern Times (Fig. 7). However, this is opposite both to the presumption derived from the historical map and to the inventory of dam constructions, since the grading of the mire – 50 in this case – and the absence of dams suggest that Tittbäcksmyren was not likely to have been used as a hay-mire. The inconsistency of the results also points at the difficulty to study hay-making on mires, irrespective of methods.

Also regarding the cultivation of cereals, discrepancies related to the methods used in this study are demonstrated. According to the maps from the 18th and 19th centuries, no cultivation has taken place in the forest around the mires. In contrast to this, cereal cultivation during Modern Times, sometimes on tilled and

manured fields, is suggested based on the pollen analyses at four of the sites. The palynological results are only just supported by the field inventory; first after the initial results of the pollen analysis, possible areas of cultivation were identified in the forests around Blötmyren and Tittbäcksmyren. Although the physical structure of these plots do not meet the criteria for fossil fields (Gren 1997), identification of cultivated areas could have been ascertained with soil pollen analysis (cf. Segerström 1991; Hörnberg *et al.* 1999; Emanuelsson and Segerström 2001).

Quite the opposite to the investigations of the mires, the results from the different methods are more concordant for the land-use history at Backasätern. The pollen analysis and the field inventory demonstrate cereal cultivation, while both the pollen analysis and the maps display hay-making on the grassland of the shieling. Still, the traditional, ethnographical picture of the shieling area as a hay-producing grass-meadow (Levander 1943; Frödin 1948; Nyman 1963; Eles 1975) – often supported by the historical maps – is only confirmed by the pollen analysis for some hundreds of years during the Vendel Period and Modern Times. The shieling area has rather been used for other types of land use than hay-making during most of the time, something that also has been demonstrated at other shielings (Olsson 1998; Karlsson 2001; Emanuelsson *et al.* in press). Pasturing, either in terms of grazing on the shieling area or extensive forest grazing around the shieling, is demonstrated in the pollen analysis. Conversely, the other methods used in this study did not identify grazing, no matter where or when. Despite this and the fact that the production of winter fodder apparently is difficult to assess, animal husbandry is often referred to as the principal subsistence of the forest region of central and northern Sweden (Frödin 1933; Myrdal and Söderberg 1991; Segerström 1996).

The history of agrarian outland use at Backa, as written after the study of historical maps, would be relatively short and simple: hay-making on a few mires and at the shieling during Modern Times. In addition, the field inventory adds a bit of cultivation on the shieling for the 19$^{th}$ century. In contrast, the land-use history as displayed by the pollen analysis is a history of multifaceted agrarian activities extending over large areas during at least 1500 years. Nevertheless, the interpretation of the palynological results is sometimes ambiguous, especially when apophytes are few and strong anthropogenic indicators, i.e., cereals, are absent. This is regularly the case in the boreal forests during the Iron Age (cf. Figs. 7-8; Olsson 1998; Karlsson 2001; Henrik von Stedingk personal communication), and consequently pre-historical outland use is challenging to study. Thus, the historic land use linked directly to a settlement, e.g., a shieling, is more easily considered when archaeological, historic-geographical and palaeoecological methods are possible to use in combination, in comparison to the study of the long-term, non-manifest land use of forests, e.g., forest grazing or small-scale cultivation. This illustrates the importance of using several methods, i.e., an interdisciplinary approach, for the study of the histories of the forest region (Lagerås *et al.* 1995; Svensson 1998b).

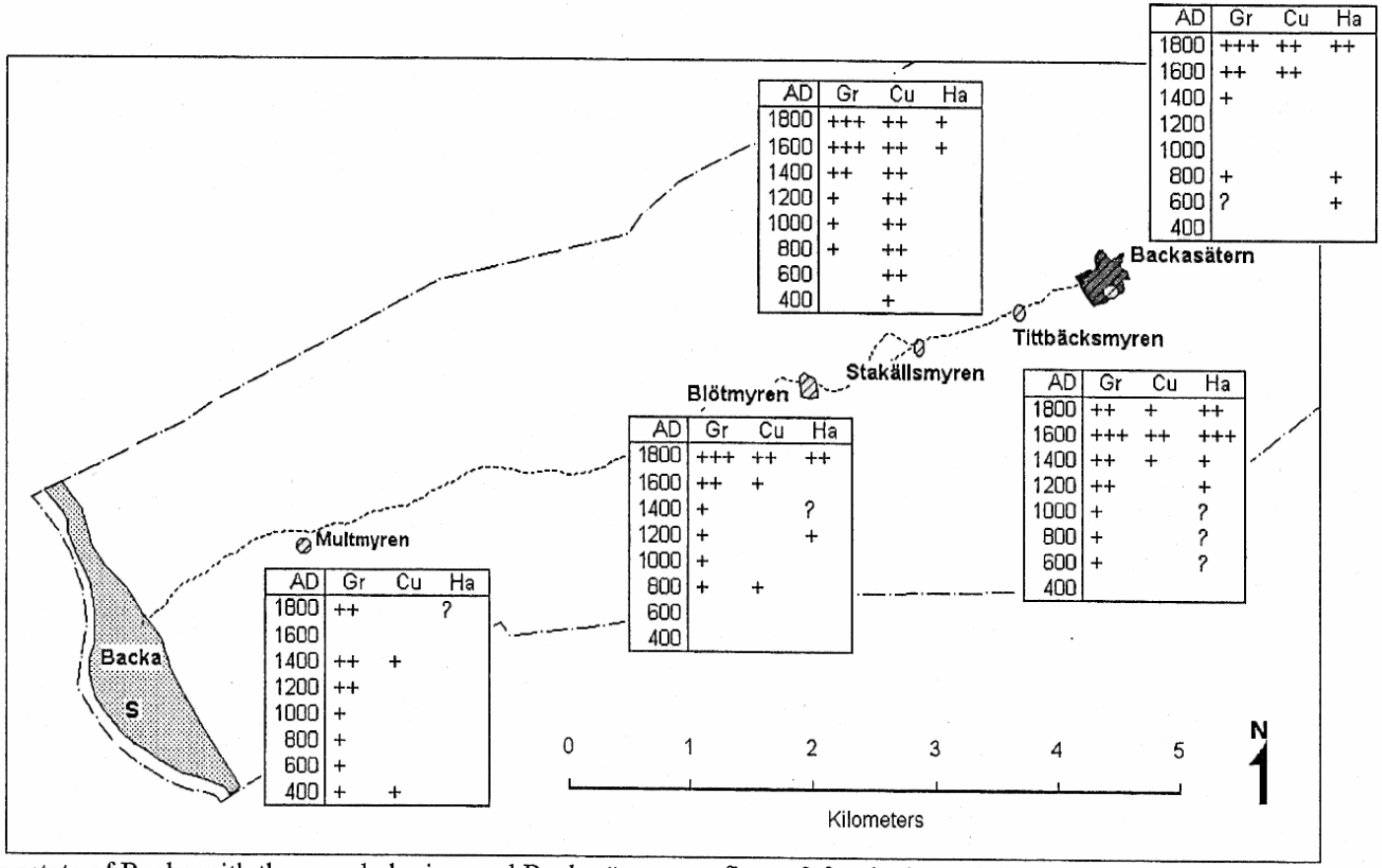


Fig. 9. Map of the estate of Backa with the sampled mires and Backasätern; see figure 2 for the legend. The agrarian land-use history of each site is summarized in the tables; Gr = grazing; Cu = cereal cultivation; Ha = hay-making. Observe that the impact of land use (+ = minor; ++ = medium; +++ = major; ? = ambiguous or indistinct) is related to changes at each site and that the chronologies are simplified.

## The local dynamics of agrarian outland use

The history of the outland use of Backa may be written as follows (Table III): The agrarian land use – grazing and cereal cultivation – was initiated at the end of Roman Iron Age or during the Migration Period, assumingly by the people at Backa (cf. Johansson *et al.* 1999; Svensson *et al.* in press). The areas closest to the settlement and in the vicinity of the river Femtan were first exploited. Shortly after, Backasätern was established and the forest grazing expanded into new forest areas. By the time of the transition from the Vendel Period to the Viking Age, most of the forest along the path from Backa to Backasätern was used for animal grazing, but only the shieling and its neighbourhood was used for production of winter fodder. At the end of the Viking Age or during the Early Middle Ages, Backasätern was abandoned, and the shieling was not reoccupied until the end of the Middle Ages. Although a slight increase in animal husbandry occurred during the High Middle Ages, an overall intensification of agrarian land use started off during the Late Middle Ages and carried on gradually during Early Modern Times and Modern Times. Especially cereal cultivation and the production of hay increased during the last two time periods.

Seeing the history of Backa in the perspective of the first theory of economic-historical development – the theory of conjunctures – it is evident that agrarian outland use changed in relation to periods of expansion and regression. The initial establishment and the first phase of expansion at the outland of Backa occurred during the Migration and Vendel Periods, which are generally regarded as a period of regression (Berglund *et al.* 1991; Myrdal 1997; Pedersen and Widgren 1998). However, the time of the formation of a sedentary, agricultural economy is in agreement with the results of some recent studies of the settlement history of the forest region (Ersgård 1997; Svensson 1998a; Andersson and Svensson in press; Emanuelsson *et al.* in press; Svensson *et al.* in press). The relationship between the local and wide-ranging conjunctures was also inverted at the end of the Viking Age and the Early Middle Ages; at Backa, it was a period of agrarian regression while much of the farming regions of Sweden experienced a time of settlement and land-use expansion (Berglund *et al.* 1991; Myrdal 1999). During the Late Medieval Crisis, agriculture intensified at the outland of Backa, and Backasätern was once again occupied; expansion during the Late Middle Ages is also demonstrated at other outland sites in central Sweden (Olsson 1998; Segerström and Emanuelsson 2001; Emanuelsson *et al.* in press). After that, Backa principally followed the general conjuncture of expansion. Taken together, the local agrarian outland use of Backa displayed stages of expansion and recession, but they are out of phase compared with the general conjunctures during most of the last 2000 years.

Compared with the second perspective, i.e., the replacement of resources and goods, the history of local agrarian outland use shows no correspondence with the theory at first glance. Indeed, land use, in particular cereal cultivation and hay-making, was geographically variable, but no tendency in location is

Table III. Summary of the agrarian land-use history at the outland of Backa. M = Multmyren, B = Blötmyren, S = Stakäll-myren, T = Tittbäcksmyren, Bs = Backasätern. Observe that the impact of land use (+ = minor; ++ = medium; +++ = major; ? = ambiguous or indistinct) is primarily related to changes at each site and that the chronology is simplified. The period of pronounced iron-production in Dalby parish is high-lighted (Svensson 1998a).

| | Grazing | | | | | Cultivation | | | | | Hay-making | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AD | M | B | S | T | Bs | M | B | S | T | Bs | M | B | S | T | Bs |
| 1800 | ++ | +++ | +++ | ++ | +++ | | ++ | ++ | + | ++ | ? | ++ | + | ++ | ++ |
| 1600 | | ++ | +++ | +++ | ++ | | + | ++ | ++ | ++ | | | + | +++ | |
| 1400 | ++ | + | ++ | ++ | + | + | | ++ | + | | | ? | | + | |
| 1200 | ++ | + | + | ++ | | | | ++ | | | | + | | + | |
| 1000 | + | + | + | + | | | | ++ | | | | | | ? | |
| 800 | + | + | + | + | + | | + | ++ | | | | | | ? | + |
| 600 | + | | | + | ? | | | ++ | | | | | | ? | + |
| 400 | + | | | | | + | | + | | | | | | | |

observed. But when the outland history of Backa is put into a larger perspective of settlement and land use, a clear pattern of economic conjunctures, replacement of production and geographical relocation appears. At the end of the Viking Age and during the Early Middle Ages, the use of pit-falls for elk as well as the production of charcoal and iron suggest surplus production of non-agrarian goods in Dalby parish, in which Backa is located (Svensson 1998a; Svensson *et al.* in press). The excess of hides, antlers and iron was probably intended for an external market, and gave rise to economic wealth. At the same time, the settlement Skinnerud was occupied on the arable infields of Backa (Johansson *et al.* 1997; Johansson *et al.* 1998: Johansson *et al.* 1999); considering Backa as an agrarian entity, this would presumably result in a higher pressure of agrarian utilisation of the outland. But on the contrary, the agrarian land use declined, most obviously at Backasätern. The outland agriculture increased slowly again in High Middle Ages, concurrently with the regression of the non-agrarian land use. Seemingly, the agrarian and the non-agrarian production replaced each other during the course of the Viking Age and the Middle Ages. And in so doing, Backasätern was successively abandoned and reoccupied, while the focus of the outland use shifted from the shieling to mires with iron ore, and back again.

From the combined perspective of the two economic-historical theories, the study of the outland of Backa illustrates a complex history of local land-use dynamics in the Swedish forest region. The surplus production of non-agrarian goods is demonstrated to have a regressive effect on the agrarian land use and the settlement structure of a forest estate; consequently, a distinct, local economic development is generated. Thus, the exploitation of a variety of outland resources plays a fundamental role in the alternative histories of forest regions.

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# Notes

[1] This study is part of the interdisciplinary research project "Settlement, shielings and landscape". The main objective of the project is to study the history of a forest settlement, with focus on changes in land use and resource utilisation. Besides the economic-historical perspective of this paper, social and cultural aspects of the history will be elaborated on in the future, final publication of the project (cf. Svensson *et al.* in press).
[2] In this paper, *agrarian* is used for all activities connected to agriculture, i.e., cereal cultivation, hay-making on meadows or mires and grazing animals. The term *outland* is used for the part of an estate that is not regarded as the infields, generally meaning the forestland, including the mires. The expression is often used for the forest regions of central and northern Sweden, implying that activities other than the traditional infield agriculture, played an important, and even decisive, role in the economy of a settlement (Andersson 1998; Svensson 1998a).
[3] The chronological periods are used as follows: Roman Iron Age AD 1–400; Migration Period AD 400–600; Vendel Period AD 600–800; Viking Age AD 800–1050; Middle Ages AD 1050–1520; Early Middle Ages AD 1050-1200; High Middle Ages AD 1200-1350; Late Middle Ages AD 1350–1520; Early Modern Times AD 1520–1700; Modern Times AD 1700–1900.
[4] A central feature of the time-geographical perspective is the observation of events and activities, described in terms of time and space. Important concepts of analysis are, e.g., actors, projects and pockets of local order. For further reading, see, e.g., Hoppe and Langton (1986), Hägerstrand (1991), Ellegård (1998), and Lenntorp (1998).
[5] In accordance to the discussion by Emanuelsson *et al.* (in press), a shieling is identified as an agrarian, seasonal settlement, related to permanent farms. Small buildings, grass-meadows and cultivated plots are normally found on the open shieling area, which are regarded as infields, similar to those found at the permanent farms. Nonetheless, the use of shielings is primarily associated with animal husbandry. Historically, Backasätern is known as a shieling (e.g., LMV R14-3:4), and for that reason, it is considered to be a shieling in this paper. However, the seasonality and the linkage between the shieling and the permanent farms are difficult to determine for the pre-historic times. A more thorough discussion of whether Backasätern was established as a shieling or if it has been used permanently during some periods of time, will be presented in the future, final publication of the project.

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The Research Archive at the National Land Survey of Sweden (LMV)

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