

## SCIENTIFIC COMMUNICATION

### HAZELNUTS FROM A PEAT DEPOSIT AT EVIJÄRVI, WESTERN FINLAND

BRITA ERIKSSON, MARJATTA AALTO and TUOVI KANKAINEN

*Bull. Geol. Soc. Finland* 63, Part 2, 141—148.

Key words: macrofossils, *Corylus avellana*, peat, pollen diagrams, absolute age, Holocene, Evijärvi, Finland.

*Brita Eriksson, Tuovi Kankainen: Geological Survey of Finland, SF-02150 Espoo, Finland.*

*Marjatta Aalto: Department of Botany, University of Helsinki, Unioninkatu 44, SF-00170 Helsinki, Finland.*

#### Introduction

The more extensive range of the hazel (*Corylus avellana* L.) in Sweden and Finland in ancient times had already attracted interest among researchers at the turn of the century (Andersson 1896, 1902, 1907, 1909). Andersson catalogued all finds of subfossil hazelnuts and studied the palaeoecology of the shrub. Later, Salmi (1963) made comprehensive investigations on the ancient distribution of the hazel in Finland on the basis of nuts found in mires and pollen stratigraphy. More recently, Tallantire (1981) has provided new insight into the ancient northernmost habitats of the hazel in Fennoscandia.

In spring 1989 the Geological Survey of Finland received a peat sample (Fig. 1) from Evijärvi, western Finland, with eight well-preserved nuts of hazel attached to its surface. From information published to date (cf. Salmi 1963, Hultén 1971), Evijärvi is the northernmost site where subfossil hazelnuts have so far been found in Fin-

land. Also the other northernmost hazelnut finds in Finland have been in peat, although as far as is known hazel does not currently grow on mires anywhere in Europe.

#### Evijärvi site

The nuts at Evijärvi were found when a ditch was being dug in Kerttuankylä, Evijärvi (map sheet 2314 03, Kerttuankylä). The mires surrounding the northern end of the lake have been cleared as fields. The moraine hills in the area are drumlins trending NW-SE with strips of mire in between them. The sampling site, Perikytö ( $x = 7036.84$   $y = 2465.52$   $z = 63$ ), is located at lat.  $63^{\circ}25'35''$  N. The nuts were on the surface of woody peat (deciduous tree-*Equisetum-Carex* peat) with a layer composed almost exclusively of remnants of deciduous trees. The sample was taken from a depth of 1.0—1.12 m. The site of the find was visited in summer 1989, and more



Fig. 1. Subfossil hazelnuts on woody peat surface. The mean length of the nuts is 1.76 cm. Photo J. Väättäinen.

samples were taken for macrofossil studies. The stratigraphy of the mire is as follows:

- 0.00—0.50 m *Sphagnum* peat
- 0.50—0.70 m *Eriophorum* — *Carex* — *Sphagnum* peat
- 0.70—1.20 m deciduous tree — *Equisetum* — *Carex* peat
- 1.20 m— *Carex* peat

The peat sample was submitted to pollen analysis at the Geological Survey of Finland, and the nuts were dated with the radiocarbon method. The sizes and shapes of the nuts were studied, a macrofossil analysis was made, and the tree species were identified from the peat at the Department of Botany of the University of Helsinki.

### Pollen analysis

Pollen grains were analysed from the sample at intervals of two centimetres. The subsamples were boiled in 10% potassium hydroxide, and glycerine was used as a mounting medium. The pollen grains were well preserved.

The pollen spectra of the subsamples are very similar to each other (Fig. 2). The start of a continuous, low curve of spruce (*Picea*) from a depth

of 1.06 m upwards, the end of the continuous curve of elm (*Ulmus*) and the rise in the abundance of *Sphagnum* spores in the uppermost sample can be considered as weakly developed features of succession. Arboreal pollen accounts for >94% of the pollen at all levels, with birch (*Betula*) pollen clearly dominant. Alder (*Alnus*) pollen is fairly abundant, 9—24%. The pollen curve of pine (*Pinus*) is lower than that of alder, about 7% at its lowest. The pollen frequency of hazel fluctuates in the range 0.6—2.5%. The herb pollen values are low, consisting mainly of sedge (Cyperaceae).

The pollen composition of the peat refers to an environment dominated by birch forests, in which elms, which had previously grown as single trees, were declining at the time of deposition of the surficial part of the peat sample. The site at which the nuts were found was a deciduous tree swamp, with hazel growing together with alder and birch.

Both the beginning of the continuous curve of spruce and the end of the continuous curve of elm demonstrate that the woody peat was deposited at about 5000—2500 yr BP. Spruce became common in the Evijärvi area at about 4000 yr BP (Aartolahti 1966, Tolonen 1983). According to Birks and Saarnisto (1975), the pollen fre-



EVIJÄRVI

63.0m a.s.l.

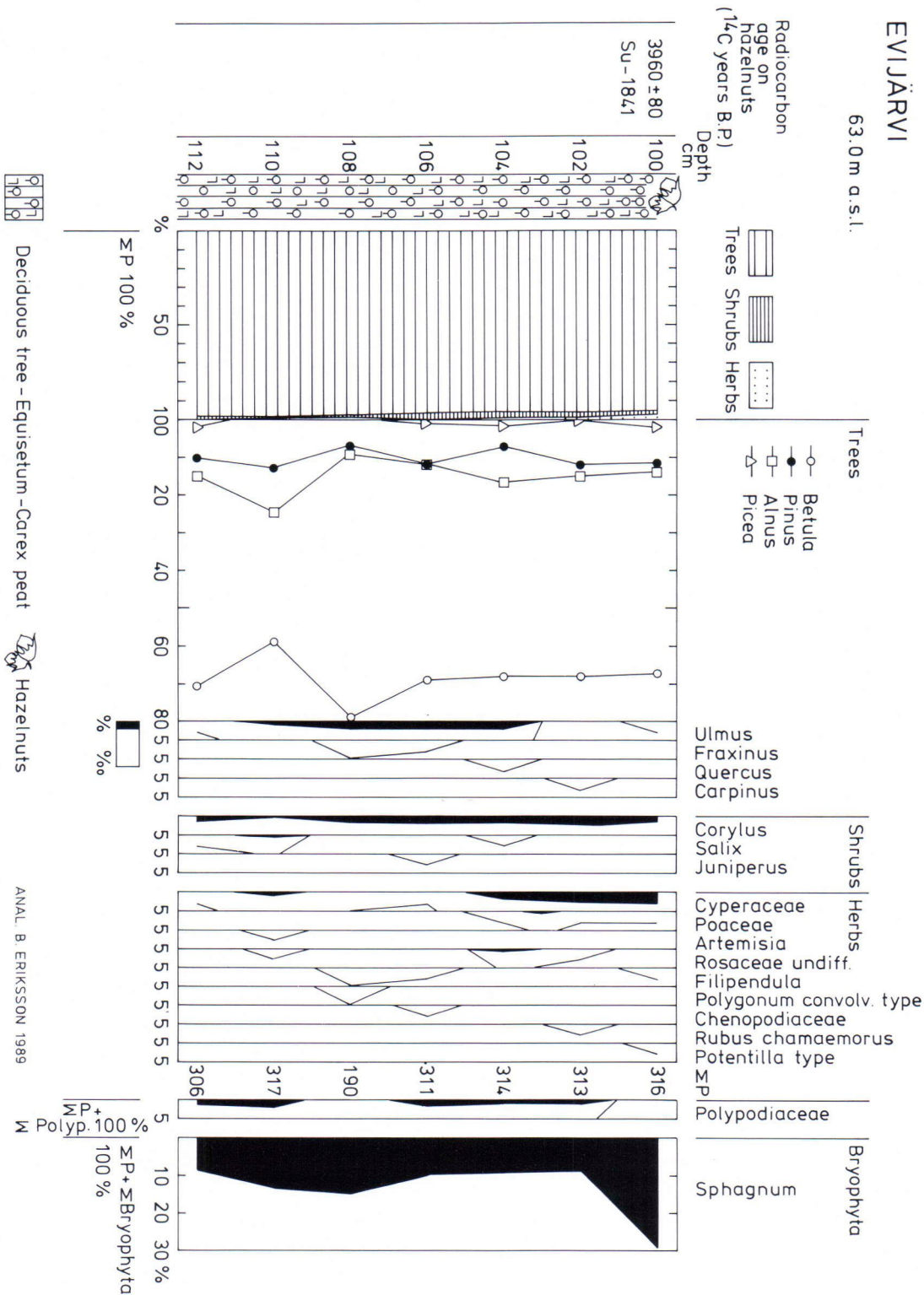


Fig. 2. Pollen diagram of peat sample from Evijärvi.

quency of spruce varied during that time in the range 2–10%. As shown by the pollen analysis, the peat was deposited about 4000 years ago.

A striking feature of the pollen assemblage in the Evijärvi sample is the low frequency of hazel pollen. The same feature is clearly evident in the pollen diagrams compiled by Salmi (1963) for the sites where hazelnuts were found in mires; even at the levels at which nuts had been discovered, the pollen values of hazel were often no more than 1–2%. The same holds for corresponding finds made in Sweden and Norway (Tallantire 1981). This would imply that hazel was not very common in these areas. However, at favourable sites it grew along with the regular vegetation on mineral soil and in deciduous tree swamps in which nuts have been preserved in peat.

### Macrofossil analysis

The nuts studied were of a fair size, well preserved and hard. They were slightly flattened ellipsoids with a more or less tapered end. The apex either had a sharp tip or was rather blunt (Fig. 1). Measuring  $1.76 \times 1.47 \times 1.21$  cm on the average, the nuts were bigger than present-day ones in southern Finland. The average length of nuts from a collection (1980) of Karjalohja, South Finland is 1.5 cm. In shape the nuts resemble forma *oblonga* in the classification of G. Andersson, although some smaller specimens are closer to f. *ovata* (Andersson 1896, Fig. 54; 1902, Fig. 17), the average difference between length and width being 2.89 mm (range 1.4–5.2 mm).

The peat on the surface of which the nuts were found was highly humified, black and mull-like. Macrofossil analysis gave few indications of the local vegetation, as seeds and other recognizable parts of the plants were very scanty. Instead, pieces of wood and debris were abundant. Apart from wood, the abundance of cell remnants was low in the sample. However, some remnants of the seeds of magnocaricetum (*Carex vesicaria*,

7 nutlets), bogbean (*Menyanthes trifoliata*, 1 seed) and meadowsweet (*Filipendula ulmaria*, 1 seed) were recorded. The sample contained only some leaves of thread mosses (*Mnium* sp.) and one capsule, but no remnants of leaves typical of *Sphagnum* mosses (cf. pollen diagram, Fig. 2) or other leafy mosses. The sample contained only a few nutlets of birch (*Betula pendula*, B. sp.) and grey alder (*Alnus incana*).

The nut layer (Fig. 1) has abundant wood remains, thin branches and sticks. Dendrological analysis showed that at least one of them, a piece of shoot about 1.5 cm thick, was hazel. The sample contained at least three pieces of birch and two pieces of alder. The outcome is compatible with the pollen analysis (Fig. 2) and demonstrates that hazel really did grow at the Evijärvi site. All in all, the results of the analysis delineate a local alder woodland fen, a dense deciduous tree-predominant vegetation in which undergrowth is present only in openings. The field layer is composed of some leafy mosses; otherwise the soil is barren. Such conditions prevail in dense hazel and alder groves which, due to the scarcity of light, are almost free from undergrowth.

### Radiocarbon dating

Radiocarbon dating was carried out on seven nuts. When wet, the nuts weighed a total of 11.2 g and when dry, after acid-alkali-acid treatment, 3.2 g, which was just enough to obtain sufficient carbon dioxide for  $^{14}\text{C}$  dating. The ideal number of nuts would have been 20, as this would have guaranteed a more precise result. The shells of the water chestnut (*Trapa natans*) weigh approximately the same as those of the nuts (*Corylus*). Even so, these figures, whether in grams or number of specimens, cannot be taken as simple guides for dating nuts; when wet and less well preserved, a ten times greater quantity of water chestnuts has sometimes been needed to obtain sufficient gas for dating.

The conventional  $^{14}\text{C}$  age of the Evijärvi nuts,

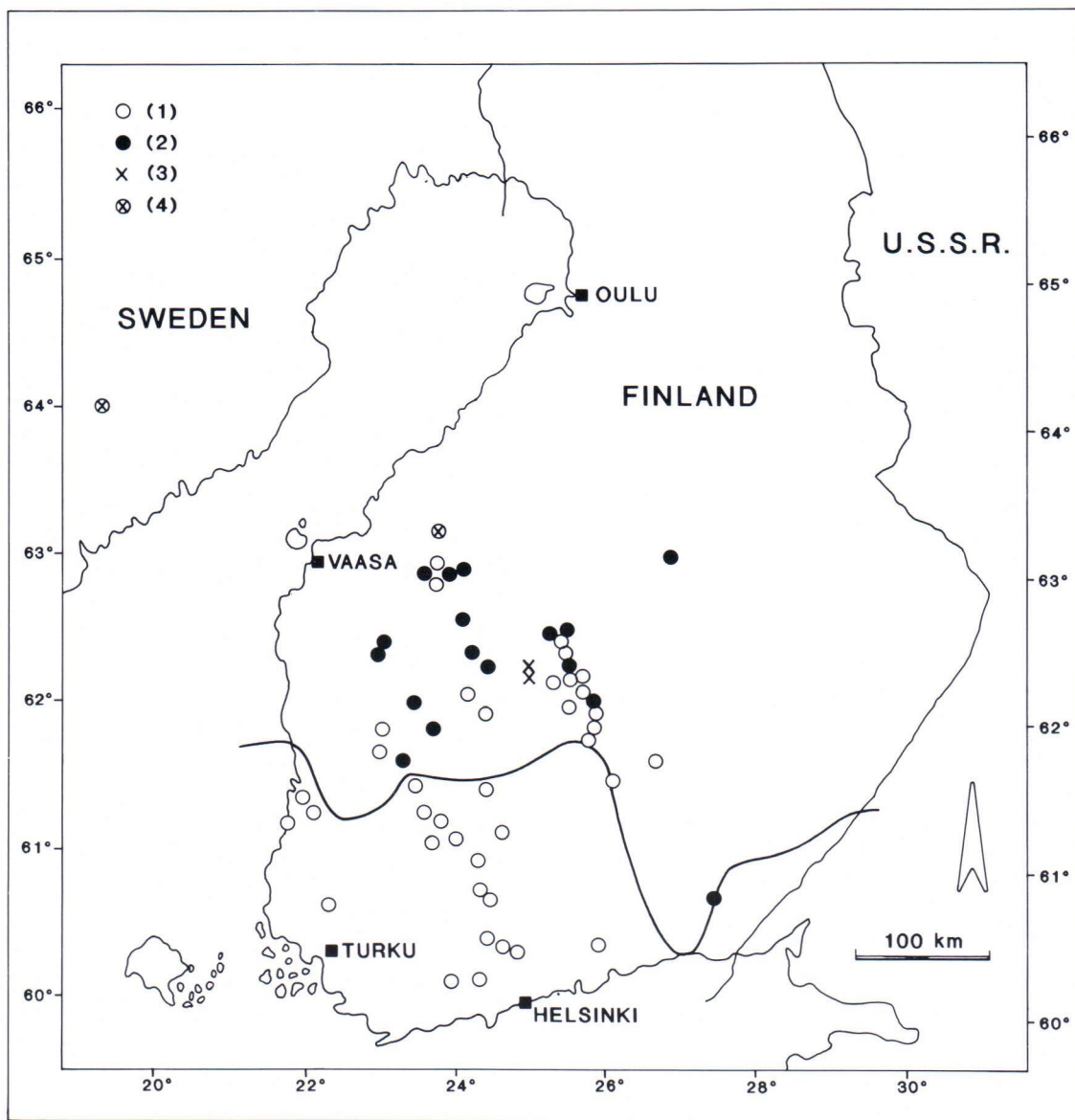


Fig. 3. The thick line indicates the present northern range limit of *Corylus* (Hämet-Ahti 1988, after Fig. 1b) in Finland. (1) Sites of subfossil hazelnut finds in Finland from the literature compiled by Salmi (1963, after Fig. 1), (2) Sites of subfossil hazelnut finds in peat deposits in Finland (Valovirta 1959, Tolonen 1960, Salmi 1963, Alhonen 1971), (3) Hazelnut finds in peat deposits at Multia ( $^{14}\text{C}$  dates: Heikkinen & Äikää 1977), (4) Northernmost sites of hazelnut finds (both peat deposits): Evijärvi in Finland and Bjurholm in Sweden (Andersson 1907).

$3960 \pm 80$  yr BP (Su-1841) ( $\delta^{13}\text{C} = -24.3$  ‰) is compatible with the pollen analysis, and proves that hazel was growing at Evijärvi, producing nuts at the time spruce spread to the region.

Only two  $^{14}\text{C}$  dates of subfossil nuts in Finland have been reported (Heikkinen & Äikää 1977), both on nuts found at Multia by Dr L.O. Ervi and his team (University of Jyväskylä). Ervi



also provided the Geological Survey of Finland with the data on the site where the find was made (archives of GSF radiocarbon laboratory). The age of the nuts found in a mire south of Lake Hepolampi in the village of Isojärvi, Multia, ( $x = 6914.73$   $y = 2549.23$   $z = 180.6$ ) is  $5060 \pm 100$  yr BP (Su-316). The nuts discovered at Sahrajärvi, Multia, were dated to  $4985 \pm 100$  yr BP (Su-317). According to Ervi, nuts have also been found at several other sites in Multia.

Spruce spread to Multia at about 4500 yr BP. The dates of the nuts refer to a time preceding this by 500 years. However, as the nuts were collected from a 30-cm-thick hazel nut layer their radiocarbon age indicates only the mid-point of the period during which hazel was growing on the mire.

### Present and past distribution of hazel

The present northern boundary of the hazel in Finland runs from Merikarvia to Korpilahti, turning there to Kymenlaakso (Fig. 3). The shrub is most abundant in the Åland archipelago, on the coast of southwestern Finland and on the south coast up to Kotka. It thrives close to the coast and on the shores of lakes and rivers. The scattered northernmost present occurrences represent exceptionally favourable habitats, and can be considered as relicts. The present northernmost site of growth is at Vaarunvuori, Korpilahti at about lat.  $62^\circ\text{N}$ .

In Denmark and southern Sweden hazel is common, as it is on the south coast of the Baltic Sea up to the Karelian Isthmus. In Sweden, separate occurrences are encountered at latitude  $60^\circ$ – $63^\circ\text{N}$ . On the west coast of Norway the species is permanent up to lat.  $62^\circ\text{N}$  and continues to grow sporadically up to the Arctic Circle.

The pollen maps of hazel referring to different millenia (Birks & Saarnisto 1975, Huntley & Birks 1983) demonstrate that the species has occurred in southern and western Finland throughout the postglacial period. On the scale of the

whole of Europe, hazel has been a western species. Its range had its maximum in Fennoscandia in the middle and closing stages of the postglacial thermal maximum, at about 6000–4000 yr BP, after which it gradually withdrew to its present habitats. In the northernmost growing sites hazel is not usually able to produce mature nuts, and hence its propagation is vegetative.

The maps showing the sites where subfossil hazelnuts have been found give the clearest picture of the maximum fertile distribution of the hazel (Sweden: e.g. Andersson 1902, 1909, Finland: Salmi 1963, Fig. 3 in this paper). Nuts have been found in gyttja, mud and sedge or woody peat. Tallantire (1981) points out that most of the nuts discovered north of the present range of hazel are probably contemporaneous with the »Sub-boreal» period (5000–2500 yr BP). As shown by pollen stratigraphy and radiocarbon dating, hazel grew on mires in Finland at about 5000–4000 yr BP.

### Discussion

A number of authors (Auer 1924, Sauramo 1940, Salmi 1963) have shown that during the thermal maximum hazel grew in Finland on deciduous tree and alder woodland fens. However, the subfossil nuts found in mire deposits are enigmatic, as in present-day Finland hazel thrives best on light, calcareous mineral soils. Did hazel really grow on peat substrate, or were the nuts transported to the mires?

As shown by pollen statistics, at its northernmost growing sites hazel was no more abundant during the subboreal period than it had been in the preceding time. At that time the shrub was a persistent, if not common, member of the vegetation. The nuts found in mires therefore prompt several questions. Did hazel produce nuts while growing on mineral soils at the time before the deposition of the nuts in mires? If so, why is it that nuts have not been found in gyttja or peat deposits formed at that time? Tallantire (1981)



concludes that in these areas hazel did not produce nuts until the early subboreal period. According to him, the climate of these areas reached the postglacial thermal maximum only at that time, and hazel had grown on mineral soils. The nuts had then been transported to mire deposits by external factors (animals, water).

However, Salmi (1963), who studied 13 sites of hazelnuts found in mires in Finland, maintained that hazel grew on mires at that time and that the migration of the species to the margins of the mires was due to competition with spruce spreading to the area. Later, the deteriorating climate resulted in the disappearance of hazel. Salmi did not discuss whether or not the hazel produced nuts before it started to grow on mires.

A favourable microclimate, moisture and the availability of nutrients were the key factors controlling the growth of the hazel in its northernmost habitats. It should be mentioned that Evijärvi is also the northernmost site in Finland where subfossil water chestnut (*Trapa natans* L.) has been found (Valovirta 1960). Both at Evijärvi and Pielavesi (the second northernmost site of hazel; Salmi 1963) hazel obviously grew primarily on the lower slopes of hills, obtaining nutrients from downflowing water. The current habitats of the species are often in areas of mafic bedrock. The lowermost peat layers at the sites where the nuts studied by Salmi were found indicate a nutrient-rich soil. The schist belt east of Evijärvi may have had a favourable effect on the area as a habitat. The peat deposits where the nuts were found refer to a dry period, as demonstrat-

ed by the high degree of humification of the peat (Salmi 1963).

The mystery of the mire nuts cannot be solved without supplementary studies, comprehensive documentation of the sites, pollen and macrofossil analyses and, above all, radiocarbon dates on the nuts. The present study demonstrates that the hazel shrubs at Evijärvi grew on sedge peat in a deciduous tree swamp. As suggested by the peat type, the site was, at least for a time, dry enough for hazel to grow. Some other hazelnut finds (Andersson 1896, 1902, 1907, 1909 and Salmi 1963) indicate similar desiccation surfaces. They may be due to a dryer and warmer interval of the macroclimate and/or the lowering of the groundwater table. Competition caused by the spread of spruce may have contributed to the migration of hazel to drained mires. According to Linnman (1981), hazel is able to invade new, open habitat faster than other forest taxa. When considering the ancient occurrences of the hazelnuts in mires an interesting alternative should be kept in mind, i.e. active planting by man. A habitat with plenty of light, such as a mire, would have been able to produce abundant hazelnuts.

*Acknowledgements.* The Evijärvi site was discovered by Matti Laide and Seppo Laide of Evijärvi. They kindly sent a sample to the Geological Survey of Finland. Prof. Matti Saarnisto visited the site and took the additional samples for macrofossil studies. Juha Karhu made the  $\delta^{13}\text{C}$  determination. Satu Moberg drew the figures, and Gillian Häkli translated the manuscript into English. We are grateful to all these persons for their cooperation and help.

## References

- Aartolahti, T., 1966. Über die Einwanderung und die Verhäufung der Fichte in Finnland. *Annales Botanici Fennici* 3, 368—379.
- Alhonen, P., 1971. Subfossiilisia pähkinäpensaana (*Corylus avellana*) pähkinöitä Ikaalisissa. Summary: Subfossil nuts of *Corylus avellana* at Ikaalinen, SW-Finland. *Geologi* 5—6, 72—73.
- Andersson, G., 1896. Svenska växtvärldens historia. Stockholm. 136 pp.
- , 1902. Hasseln i Sverige fordom och nu. *Sveriges Geologiska Undersökning, Ser. C*, 3, 168 pp.
- , 1907. Nordligaste kända lokalen för fossil hassel i Sverige. Ymer, Svenska Sällskapet för Antropologi och geografi, tjugondesjätte årgången, 1906, Stockholm, 119—120.
- , 1909. The climate of Sweden in the Late-Quaternary period. *Sveriges Geologiska Undersökning, Ser. C*, 218, Årsbok 3(1909):1, 88 pp.
- Auer, V., 1924. Die postglaziale Geschichte des Vanajavesisees. *Bulletin de la Commission géologique de Finlande* 69, 132 pp.

- Birks, H.J.B. & Saarnisto, M.*, 1975. Isopollen maps and principal components analysis of Finnish pollen data for 4000, 6000, and 8000 years ago. *Boreas* 4, 77—96.
- Hämet-Ahti, L.*, 1988. Metsäkasvillisuus, pp. 1—2. In: *Atlas of Finland* 141—143. Vegetation and flora (Ed. Pentti Alalammi). National Board of Survey. Geographical Society of Finland.
- Heikkinen, A. & Äikää, O.*, 1977. *Radiocarbon* 19, 263—279.
- Hultén, E.*, 1971. *Atlas över växternas utbredning i Norden*. Atlas of the distribution of vascular plants in northwestern Europe. Stockholm. 531 pp.
- Huntley, B. & Birks, H.J.B.*, 1983. *An Atlas of Past and Present Pollen Maps for Europe: 0—13 000 years ago*. Cambridge University Press. Cambridge. 667 pp.
- Linnman, G.*, 1981. Some aspects of the colonization of *Corylus avellana* L. in North West Europe during Early Flandrian times. In: *Florilegium Florinis Dedicatum*. (Ed. L.-K. Königsson and K. Paabo). *Striae* 14, 72—75.
- Salmi, M.*, 1963. On the Late-Quaternary distribution in Finland of the filbert (*Corylus avellana* L.). *Bulletin de la Commission géologique de Finlande* 207, 67 pp.
- Sauramo, M.*, 1940. Suomen luonnon kehitys jääkaudesta nykyaikaan. WSOY Porvoo/Helsinki. 286 pp.
- Tallantire, P. A.*, 1981. Some reflections on hazel (*Corylus avellana* L.) on its boundary in Fennoscandia during the postglacial. *Acta Palaeobotanica* XXI(2), 161—171.
- Tolonen, K.*, 1960. Uusia pähkinälöytöjä. *Luonnontutkija* 64, p. 90.
- , 1983. Kuusen levinneisyshistoriaa Suomessa. Summary: The history of Norway spruce, *Picea abies*, in Finland. *Sorbifolia* 14, 53—59.
- Valovirta, V.*, 1959. Subfossiilisia pähkinöitä Muuramesta. Summary: Subfossil nuts at Muurame. *Suo* 10, 83—85.
- , 1960. Paläobotanische Untersuchung über einen nördlichen Fundort subfossiler *Trapa natans* L. in Südpohjanmaa. *Comptes Rendus de la Société géologique de Finlande* N:o XXXII, 41—65.

Received May 13, 1991

Revision accepted October 2, 1991