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Tracing fire cultivation in Estonia

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Abstract. Fire cultivation is possibly the agricultural land-use method of the longest duration in Estonia; yet still it has attracted little attention from researchers. The aim of this paper is two-fold: firstly, to discuss the latest stage of historical bushland management via fire cultivation as it appears in historical sources, and secondly to look for ways in which the natural historical research methods can be combined with those of the humanities in search of more complex understanding of land-use dynamics. The material analysed are the 19th century agrarian laws and ethnographic data. These sources show that researchers have so far rather under- than overestimated the persistence and spread of fire use – a number of fire cultivation cases are reported even from the early 20th century from different parts of Estonia. Thus we suggest that bushland management with fire cultivation methods has continued longer than previously assumed. Analysis of the 19th century Livonian agrarian laws shows that legislation of the period directed the land-use pattern away from the earlier practice of a mosaic or scattered patchwork of wooded areas and cleared fields, towards bigger wooded areas and more compact cultivated areas, thus bringing about changes in the landscape.

Keywords: fire cultivation, bushland, slash-and-burn, historical land use, Estonia.

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Introduction

Fire cultivation is one of the oldest land-use methods, which persisted in Estonia up to the 20th century. It influenced the way people perceived forest and land use and has been a part of traditional culture in Estonia. Fire cultivation has left traces in the natural environment, culture and landscapes, although these traces have been studied very little so far.

The general term fire cultivation includes different land-use techniques. For swidden (also known as slash-and-burn) cultivation (in Estonian *ale, sõõrd*) a site was chosen, all trees and bushes were felled and burned and the ashes used as fertiliser for the field. After some years of cultivation, the plot was abandoned and vegetation left to regenerate. According to the historical data, two techniques of swidden cultivation have been practised in Estonia. In the first case the plot for cultivation was prepared

in an old-growth forest. Seeds were sown directly into the ash and ploughing was unnecessary because of the porous structure of the soil under an old-growth forest. Sometimes only the harrow was used to get the seeds deeper into the soil. The second method, swidden in a young secondary forest, meant that people returned to the once-cultivated plot after approximately 20 to 60 years, depending on the availability of suitable woodland. In addition to the different swidden techniques used in old-growth and young secondary forest, there were also differences in the methods used to prepare the area for winter and summer cereals (for more detail on the different techniques, see Ligi, 1963; Öpik, 1992; Myrdal, 1995). These two methods have been interpreted as steps of development historically following one another (Meikar & Uri, 2000), but it is more probable that they existed side by side for centuries, the last documented swidden fields being made in the old-growth forests of southern Estonia in the late 19th century (EA 22).

For burnbeating (in Estonian *kütis*) – another fire cultivation method – bundles of branches were covered with sods and burnt. The mixture of ash and burnt soil enhanced soil fertility.

The term bushland (*Buschland* in the Baltic-German sources, *võsamaa* in Estonian scientific usage) is described in the 19th century sources as a special land category – an area covered by young trees and bushes, where small plots were regularly chosen for fire cultivation. The prevailing tree species in these areas according to the historical sources were *Betula* (birch), *Alnus incana* (grey alder) and *Picea* (spruce) (Ligi, 1963). Parts of the bushland neighbouring the permanent arable could be used as a land reserve, cultivating parts of it only temporarily. Other more important uses of bushland were grazing and the collection of timber for fuel. Thus, bushland was a multifunctional and extensively used category of land.

Fire cultivation has remained a research topic of minor importance for historians in comparison to that of permanent arable in Estonia. Environmental scientists have focused more on semi-natural habitats like wooded meadows, alvars, *etc*. No in-depth research has been conducted on fire cultivation. The situation is considerably different in Finland, where fire cultivation has drawn ample attention since the beginning of agrarian history (see Raumolin, 1987 and the literature cited) and attention is paid to the influence of fire cultivation on forest formation (Heikinheimo, 1987). Historian Herbert Ligi (Ligi, 1963) can be marked as an exception among Estonian researchers, having produced a chapter on bushlands and fire cultivation in his treatise on agrarian land-use methods of the 16th and 17th centuries, which remains the most thoroughgoing study of fire cultivation in Estonia. More recently, Meikar and Uri (2000) have given a short overview of bushland and its development in Estonia.

Written sources cover only some hundreds of years, long-term landscape changes are documented in so-called biological archives, or stratified sediments. Archaeological and natural historical data are often combined to give wider picture of land-use history (e.g. Berglund 1991). When this is done, information is obtained through analyses of fossil pollen and spores, and charcoal particles found in sediments, as well as in the settlement pattern and comparisons with later periods. In Nordic countries study of slash-and-burn cultivation has been a part of interdisciplinary research projects, as land-use method strongly associated with the region (Vuorela, 1986; Sarmaja-Korjonen, 1992; Lagerås, 1996; Pitkänen & Huttunen, 1999; Alenius, 2007). Poska's 2004 overview of the pre- and early agrarian human impact reflected in pollen diagrams of Estonia (Poska *et al*., 2004) did not discuss slash-and-burn. Anyhow there are some references to the fire cultivation practices of the pre-

historic period in Estonia (e.g. Laul & Kihno, 1999; Niinemets, 2008; Poska *et al*., 2008; Saarse *et al*., 2010).

In archaeological research on different phases of land use, some data are also provided on fire cultivation (e.g. Lang, 1995, 2007). The historical perspective of fire cultivation in Estonia is introduced in more detail in Jääts *et al*. (in press).

The aim of the present paper is to discuss the traces of fire cultivation in written historical sources and the natural environment. We will attempt to circumscribe its geographic distribution and persistence in time. We aim to demonstrate that the impact of fire cultivation has lasted longer, and been geographically more varied, than shown by earlier research.

Material and Methods

The evidence of fire cultivation in earlier periods in history is provided by palynology and archaeology, the data on the later phases in the 18th and 19th centuries by written historical sources and ethnographic sources.

19th century legislation

In the given context, important written sources are the so-called agrarian laws, issued repeatedly during the 19th century, e.g. 1804, 1820, 1849, e.g. Lihwlandi-ma tallorahva Seadus (Agrarian Law of the Livonian Governorate) published in 1820, defining the rights and duties of the peasantry in the Governorate. Some of the paragraphs describe the regulations governing fire cultivation, thereby serving firstly as evidence that the practice was still widely spread enough to be mentioned in a law, and secondly to give the details of this land-use system.

Ethnographic data

In addition to agrarian laws, information on fire cultivation during the 19th and 20th centuries is provided by ethnographic sources. The archives of the Estonian National Museum (ENM) include contributions from members of the museum's nationwide correspondents network – responses to questionnaires on different topics compiled by the museum since early years of 20th century. The questionnaire relevant for the topic at hand was "Agriculture", issued in 1939, which included questions on slash-and-burn as well as burnbeating techniques. The majority of the responses to this questionnaire have been written during 1940s.

The study method used concerning the different archival sources has been that of complementary source analysis. No single source type can give us an exhaustive insight into the practice of fire cultivation. Comparative analysis of different types of sources can however bring us closer to understanding past land use and environments.

Palynological approach

The indicator species approach is often used since Behre (1981) published paper on the interpretation of anthropogenic indicators in pollen diagrams. The method relies on the modern ecology of species, that is, on the indicator value of species in terms of environmental characteristics such as soil properties, climate and human-induced factors (Gillard 2007).

Results

A Livonian agrarian law dating to 1820 laments the quick rate at which forests were being destroyed, and the lack of control over cutting and burning practices. The law blames such developments on peasants who cut the forests for burnbeating without any regulations. The law declares that to end such a damaging practice a quarter of the bushland area was to be set aside unused to let the forest recover. The rest of the bushland areas were to be divided into 24 parts and only one part (1/24th) was to be

Table 1. Estonian National Museum correspondents' responses on swidden cultivation. Notations: NE – northern Estonia, WE – western Estonia, CE – central Estonia, SE – southern Estonia, EE – eastern Estonia.

Tabel 1. Ülevaade aletamist käsitlevatest Eesti Rahva Muuseumi korrespondentide vastustest. Lühendid: NE – Põhja-Eesti, WE – Lääne-Eesti, CE – Kesk-Eesti, SE – Lõuna-Eesti, EE – Ida-Eesti.

No *Nr*	Rural municipality *Vald*	Geographical region *Piirkond*	Swidden practices ended *Aletamine lõppes*
1	Aaspere	NE	1865
2	Avanduse	NE	1890–1900
3	Juuru	NE	1870–1880
4	Keila	NE	
5	Kohtla	NE	1875
6	Kunda	NE	1880
7	Kõue	NE	continuing in / *jätkus* 1940
8	Lelle	NE	1875
9	Lüganuse	NE	1880
10	Raasiku	NE	
11	Vohnja	NE	before / *enne* 1850
12	Kaarma	WE	
13	Laimjala	WE	1830
14	Märjamaa	WE	1910-1920
15	Pärsamaa	WE	
16	Pühalepa	WE	
17	Rajangu	WE	1890
18	Varbola	WE	continuing in / *jätkus* 1940
19	Orajõe	WE	1864–1895
20	Kodavere	EE	1900
21	Käru	CE	1880–1890
22	Pajusi	CE	1870
23	Salla ja Rakke	CE	before / *enne* 1860
24	Aakre	SE	1900
25	Kaagjärve	SE	1860–1870
26	Kasaritsa	SE	1936
27	Kuigatsi	SE	1870–1890
28	Laheda	SE	1740–1790
29	Lasva	SE	1890
30	Lasva	SE	1900
31	Leevi	SE	1895
32	Lõuna	SE	
33	Põdrala	SE	1875–1880
34	Sangaste	SE	1875
35	Sangaste, Urvaste	SE	1895
36	Taevere	SE	1890–1895
37	Taevere	SE	1910–1915
38	Taheva	SE	1890
39	Tori	SE	before / *enne* 1860
40	Tori	SE	1870–1880
41	Valgjärve	SE	1890–1910
42	Varstu	SE	1860–1870
43	Vilo	SE	1880

Table 2. Estonian National Museum correspondents' responses on burnbeating. Notations: NE – northern Estonia, WE – western Estonia, CE – central Estonia, SE – southern Estonia, EE – eastern Estonia.

Tabel 2. Ülevaade kütisepõletamist käsitlevatest Eesti Rahva Muuseumi korrespondentide vastustest. NE – Põhja-Eesti, WE – Lääne-Eesti, CE – Kesk-Eesti, SE – Lõuna-Eesti, EE – Ida-Eesti.

No *Nr*	Rural municipality *Vald*	Geographical area *Piirkond*	Burnbeating ended *Kütisepõletamine lõppes*
1	Albu	NE	continuing in / jätkus 1940
2	Avanduse	NE	1910
3	Hageri	NE	
4	Keila	NE	continuing in / jätkus 1939
5	Kohtla	NE	1885
6	Kunda	NE	1880
7	Kõue	NE	continuing in / jätkus 1940
8	Lüganuse	NE	
9	Raasiku	NE	
10	Salla	NE	1890
11	Saue	NE	
12	Juuru	WE	1900
13	Kaarma	WE	1900
14	Kullamaa	WE	continuing in / jätkus 1940
15	Kärla	WE	continuing in / jätkus 1940
16	Leisi	WE	
17	Märjamaa	WE	
18	Padise	WE	1905
19	Pärsamaa	WE	continuing in / jätkus 1940
20	Pärsamaa	WE	1920
21	Pühalepa	WE	
22	Rajangu	WE	1900
23	Ridala, Haeska	WE	1905
24	Varbola	WE	continuing in / jätkus 1900
25	Vigala	WE	1910
26	Kodavere	EE	1890–1900
27	Koigi	CE	1880–1890
28	Käru	CE	1900–1910
29	Lelle	CE	1890
30	Pajusi	CE	1880–1885
31	Rapla	CE	1900
32	Rapla	CE	1935
33	Salla ja Rakke	CE	1906
34	Särevere	CE	1900
35	Taevere	CE	1890–1895
36	Aakre	SE	1880
37	Elva	SE	1880
38	Järvesuu	SE	1940
39	Kaagjärve	SE	1860–1870
40	Kuigatsi	SE	continuing in / jätkus 1940
41	Laheda	SE	1865–1870
42	Lasva	SE	1900
43	Leevi	SE	1895
44	Orajõe	SE	1890–1910
45	Sangaste	SE	1860
46	Sangaste, Urvaste	SE	1900–1910
47	Seliste	SE	
48	Taevere	SE	1890–1895
	Taevere	SE	1919–1915
49	Taheva	SE	1890
50	Tori	SE	1900
51	Valgjärve	SE	1880
52	Varstu	SE	1870–1880
53	Vilo	SE	1900–1910

used annually for fire cultivation, with not more than 3 crop yields taken from one field (Lihwlandi-ma tallorahva Seadus l820, §44). § 484 further emphasises that a tenant was only allowed to "cut forest for swiddening" or to take more than 3 crop yields from one swidden field with the landlord's special permission. This section also prohibits the use of fully grown trees for burnbeating, stipulating that brush was to be used instead (ibid.). §33 specifies that, by the termination of a tenancy contract, there ought to be as much rye sown in the permanent field as in the swidden field (ibid.).

The next of the Livonian Governorate's agrarian laws, dating to 1850, repeats the regulation that bushland be divided into 24 parts, with one part used for fire cultivation annually and a maximum three-crop yield taken from any field in consecutive years (Liiwlandima Tallorahwa Säeduse-ramat, 1850, §170). In addition, this law specifies that a tenant is allowed to clear forest in order to make fields, but not as scattered patches in the forest. Tenants had to keep the forest and the field as two separate entities and proceed gradually in clearing the forest. The law sets the minimum limit to the size of such field plots (about 1 ha) (§166-167, ibid.).

Ethnographic data report a number of fire cultivation cases from late 19th and early 20th centuries. In the Estonian National Museum ethnographic archives, 66 questionnaire responses report fire cultivation in different parts of Estonia. The survey of data on fire cultivation is presented in tables (Table 1 and Table 2). Both tables list the ENM correspondents' responses about fire cultivation in their home rural municipality and, if presented in the source material, data on when these practices ended in a given municipality. A number of responses have been written in 1939 and 1940, therefore the rural municipalities in the table reflect the administrative division of the period.

It is claimed in 30 questionnaire responses that some fire cultivation methods (mainly burnbeating) were still in use at the turn of the 20th century or later, even up to the 1940s (KV 53, 74). The geographical distribution of these data covers most of Estonia, including parts of western and northern Estonia where, according to earlier agrarian historical research, fire cultivation practices had ceased much earlier.

Discussion

Agrarian historians have claimed that, at least up to the late 17th century, fire cultivation was in widespread use in the bushlands of southern Estonia, not only as a means to expand the permanent arable, but also as an independent land-use technique in its own right (Ligi, 1963). Estonia's comparatively large, extensively managed, wooded areas probably served as one precondition for this.

The repeated legislation on the matter of bushlands and fire cultivation in the early 19th century shows that these topics were continuously relevant, demanding attention at the government level. Developments were similar in Finland (Vuorela, 1981). In Estonia, there was a rather rapid decrease in woodland during the 18th and 19th centuries. Shortage of forest and timber was severe in certain areas of Estonia and at least some authors linked the problem to extensive fire cultivation (Kelch, 2004; Friebe, 1794). These were probably the centuries of a rather rapid decline in fire cultivation.

The agrarian laws of the 19th century probably had an impact on the land-use system, regulating the size and location of the swidden fields in the bushland and directing the land-use pattern away from the earlier practice of scattered patchworks of wooded areas and cleared fields, towards larger wooded areas and more compact

cultivated areas (see summary of § 166–167 of Liiwlandima Tallorahva Säeduseramat, 1850 in the Results section). One-quarter of the bushland previously used for regular fire cultivation was set aside for forest management. In these areas forest communities instead of short-lived brush could start developing.

Historian Herbert Ligi has studied the bushland management of the 16th and 17th centuries and claimed that the economic importance of fire cultivation in bushland was higher in the Livonian Governorate than in the Estonian Governorate. He claims that the importance of swidden technique "came close to zero" in the Estonian Governorate, but that burnbeating was practised instead. According to Ligi, swidden technique was still widespread in the Livonian Governorate in the 16th and 17th centuries, but was gradually replaced by burnbeating during the late 18th and 19th centuries (Ligi, 1963).

According to Meikar and Uri (2000), swidden technique had lost its economic importance in western and northern Estonia by the 13th century and even burnbeating was used very little in 17th and 18th centuries. They claim that both techniques declined in southern Estonia in the late 18th century.

The data presented here in tables (Table 1 and Table 2 above) show that both techniques still existed at the turn of 20th century, particularly burnbeating, even during the first decades of the 20th century.

A total of 46% of the responses concerning swidden cultivation come from southern Estonia with 18% coming from western Estonia and about 25% from northern Estonia. Central Estonia is represented with 7% and eastern Estonia with only 1 response.

For to correctly interpret the data provided by the responses to the ethnographic questionnaires we need to consider the way these sources have come to be. A correspondent's task in answering the open-ended questions in the museum's questionnaire was to write down his or her own memories, or the contribution could be based on his or her informants' memories (usually approximately 2–4 people). Due to this method of information gathering there are comparatively detailed descriptions of work process (e.g. different fire cultivation practices, tools, work cycles and crop yields), although the data on the geographical distribution of this phenomenon are not as representative. A museum correspondent's report from parish N may provide data showing that his informants have personal experience of fire cultivation, but which does not give a statistical overview of how many farmers in the given parish engaged in this land-use method.

Although the ENM has striven for its correspondents network to equally cover all parts of Estonia, some regions are represented by a more abundant and active network than others. In addition, responding to the annual questionnaires has always been a voluntary task for the correspondents. Because of this, the results of the questionnaires have to be interpreted carefully. The geographical distribution of the questionnaire results cannot be mixed up with the geographical distribution of the phenomenon under study.

Thus, the fact that eastern Estonia is underrepresented in the results may simply mean that there were fewer correspondents in this region.

The geographical distribution of responses concerning burnbeating is more evenly divided, with over 34% of the responses from southern Estonia, around 26% from western Estonia, 21% from northern Estonia and 17% from central Estonia. As stated above, these ethnographic data are not representative of all Estonia and do not give us information about the economic relevance of fire cultivation in this late period.

However, these data show that fire cultivation techniques were still present in 20th century Estonia, which raises new questions about the dynamics and spread of this land-use method and bushland management in the 19th century.

These data support the view that Estonia was part of a wider Northern European slash-and-burn region, including Scandinavia, Latvia and North-West Russia, where the practice has continued longer than in other parts of Europe. In North-West Russia, swidden cultivation persisted among the Finno-Ugric peoples – the Carelians and Vepsians – until the 1930s, the South Vepsians until the 1950s (Vinokurova, 2003; Klementjev, 2003) and among the Komi until the 1920s (Peterson, 1981). Swiddening was reportedly widespread in Novgorod oblast during the early decades of the 20th century and the Soviet kolkhoz period (Gromov, 1958).

Any given land-use method is not a rigid complex of elements but a flexible system, adapting to the changing natural and social situation (Raintree, 1991). This holds true for fire cultivation techniques in 19th century Estonia. The decline of fire cultivation was a long process with a change in function and work process. Interest in rearranging the management of bushland and investment in forestry gradually grew throughout the 19th century (Meikar & Uri, 2000). During the agricultural intensification process the land category of bushland was divided into permanent arable and forests, e.g. in the Karula region, south-eastern Estonia 70% of farmers' bushland was turned into arable and about 20% became forest (Tomson, 2007).

It is obvious that the role of fire cultivation has not been uniform throughout all periods and regions. There are some differences between inland and coastal areas. All the presently known ancient permanent fields in Estonia were discovered on the thin rendzina soils found on the limestone bedrock in coastal Estonia, whereas they are absent in the inland regions (Lang, 2007). Pollen analyses support the view of fire cultivation prevailing in southern Estonia during the same period (Laul & Kihno, 1999). It has been suggested that in Estonia the inland soil type was more suitable for swidden cultivation (Moora, 1966). In western Estonia the woodland regenerates very slowly on the thin alvar soil of the coastal areas (Ligi, 1963) where the cycle of fire cultivation thus becomes too long and unpractical.

The spread of bushland has differed in different parts of Estonia, as well. It has been claimed that the bushlands formed about 25% of all farmland in 19th century southern Estonia, making it a very widely spread landscape type (Meikar & Uri, 2000). In Tartu county the relationship of permanent arable, to bushland, to meadows was 1:1:1, in Vooremaa in the early 19th century 1:1,2:1,3 (Liitoja-Tarkiainen, 2006). In some regions the proportion of bushland could have been even higher: in the Karula area bushland accounted for the largest proportion (33%) of 19th century farmland, followed by the areas used as grasslands (26%) and permanent fields (22%), with fen, bog, heath and small woodlands representing the remainder (19%) (Tomson, 2007).

The distribution of bushlands also has a relationship with landscape features and usage. Being a less intensively used category of land, bushland was usually situated further away from the house and garden than the permanent arable. The distance of bushland from the garden varied much more than that of permanent arable. Moora has stressed the relationship between fire cultivation and relief – a field established in an old-growth forest has to be well exposed, otherwise part of the crop remains in shadow and ripens unevenly (Moora, 1974, 1976). Koppel (2005) has concluded, concerning the Kasaritsa study area, that a much greater proportion of fields established in bushland are situated on steep slopes in comparison to permanent fields. For fire cultivation, fields slopes of 3–4° were preferred, on slopes of 5° the proportion

of fire cultivation fields drops sharply. Tomson has shown that on hilly landscape the bushlands were located on steep slopes (Tomson, 2007). In the Karula study area the peripheral location of bushland in relation to settlement has not been as pronounced as in Vooremaa (Liitoja-Tarkiainen, 2006) and Kasaritsa (Koppel, 2005).

It seems logical to assume that a land-use method as long-lasting and widespread as fire cultivation should have shaped our landscapes and influenced the natural environment. The data from the historical sources cannot, however, be related to the exact locations in nature where the influence of fire cultivation could be studied in more detail.

Swidden is one of the land-use methods that may have had an impact on soils, although in Estonia there is almost no research on this topic. Data from Finland imply that the impact depends on the previous conditions of the site and the burning process itself. The extent of soil changes depend on the quality of the burning, which, in turn, depends on the weather, soil humidity and depth of humus layer, and the amount of burnt timber and its humidity (Matas, 2004). Thus, only the correct amount of burned biomass and intensity of fire has an effect on the quantity of available nutrients, organic matter contents and increases the pH of the humus layer. According to several authors (Viro, 1974; Matas, 2004) the average increase in pH immediately after burning is about 2 units. Later the pH value decreases, doing so faster in the first 7 years after the burn. After 30 years the pH values become similar to the situation before the burn (Viro, 1974). Concerning podzolisation, the published data of Estonian authors are contradictory, e.g. Reintam and Moora (1983) claim that podzolisation may intensify as a result of fire cultivation; Rõuk (1995) too has suggested that podzolisation of soil intensifies in areas of fire cultivation; while Ligi (1963) has expressed the opinion that repeated fire cultivation inhibits the podzolisation process. The impact of fire cultivation on soil has not been studied in Estonia and it is difficult to study the influence of historical fire cultivation because, as stated above, the historical swidden fields have not been localised in nature.

Burning results in changed light conditions and in changed pedological conditions, factors that may affect the composition and regeneration of vegetation, although changes in vegetation caused by each individual slash-and-burn case are restricted to a small area. Natural forest effectively obstructs the dispersal of slash-and-burn markers, i.e. the charcoal fragments from the burning phase and the resulting *Cerealea* pollen, lessening the pollen's possibility of being deposited in the lakes and mires of the region (Vuorela, 1999).

According to former research, the most wide-spread tree species in former slash-and-burn fields is birch (Ligi, 1963; Öpik, 1992). Koppel (2005) has mentioned deciduous species, particularly birch as the pioneer species on burnt soils; followed by the increase in the number of pines (*Pinus*) in 50–100 years and finally spruce, the latter mainly on fertile soils rich in humus.

According to pollen diagrams, the most prominent changes occur in tree pollen composition, which shows a decline in spruce pollen that often coincides with an increase in heliophilous birch pollen. This brief decrease of spruce pollen, together with the high charcoal concentration values, is often the only indicator of forest clearance in earlier periods. Later on, the shortened rotation periods harmed the regeneration of spruce, causing its pollen curve to no longer be informative. Frequencies of other tree pollen, spores from light-demanding bracken (*Pteridium*) and the human-activity indicator herb pollen, became more important, for example sorrel/sheep`s sorrel (*Rumex acetosa* and *Rumex acetosella*), which appears abundantly for a short

period after harvest (Huttunen, 1980; Vuorela, 1986). This phenomenon was also demonstrated by an experiment to find changes in pollen composition after slash-and-burn cultivation carried out on the Saadjärv drumlin field, eastern Estonia (Kihno & Mäemets, 2007).

Fire cultivation makes the nutrients accessible to plants, so the regeneration via underground parts and survived seeds is fast during a certain period. E.g. bracken establishes itself quickly after fire thanks to the rhizomes deep in the ground. There are also data showing that bracken depends directly on the availability of burnt ground for to reproduce by spores (Oinonen, 1967). Increase of ash in the soil is favoured by rosebay willowherb (*Epilobium angustifolium*), increased light conditions by cow wheat (*Melampyrum*) and heather (*Calluna vulgaris*), also the development of the heather seeds is stimulated by high temperatures. There are no direct pollen indicators of swidden cultivation, however, periodicity in the tree pollen succession, finds of cereals and other anthropogenic pollen types, combined with layers of microscopic charcoal in the sediment profiles, may reflect the practice of swidden (Vuorela, 1986; Lagerås, 1996).

Conclusions

The analysis of the historical sources shows that the impact of fire cultivation has lasted longer, and also been more widespread, than previously assumed. We do not claim that fire cultivation was in widespread usage in the 20th or even late 19th century, but these data give us reason to suggest that fire cultivation did not end by the 19th century. Some practices of fire cultivation (burnbeating) seem to have existed even longer than the land category of bushland. It seems that researchers have rather under- than overestimated the persistence of fire cultivation; thus this is an area of research that calls for further systematic analysis. If fire cultivation has been used later and more widely than suggested before, further research on its impact and consequences in our environment and landscapes is required, as is closer cooperation between historians and natural scientists in this sphere. Different information obtained from written and natural historical sources must be combined to reconstruct the use of fire cultivation in greater detail, covering a larger span of time and space.

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Tuleviljeluse jäljed Eestis

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Kokkuvõte

Tuleviljelus kui üks põllumajanduslikke tegureid peab olema mõjutanud eesti maastike kujunemist nagu on mõjutanud seda loomakasvatus ja künnipõllundus. Käesoleva artikli eesmärk on näidata, et tuleviljeluse mõju on olnud pikemaajalisem ja ruumiliselt varieeruvam, kui senised käsitlused seda on näidanud.

Kirjalikud allikad, mis võimaldavad täpsustada tuleviljeluse ajalist levikut, on 19. sajandi Liivimaa talurahvaseadused ja Eesti Rahva Muuseumi korrespondentide kaastööd. 19. sajandi esimesel poolel oli tuleviljelus Lõuna-Eestis laialt levinud põllumajandustegevus. Seaduste tulemusel muutus senine põllumajandusmaastike mosaiikne muster ja neljandikul seni võsamaadena kasutataud aladel hakasid taastuma mestakooslused. Töös analüüsitud etnograafilised allikad näitavad, et tuleviljelust kasutati põllumajanduses veel 20. sajandil, isegi kuni 1940ndate aastateni. Etnograafiliste allikate analüüs näitab, et erinevalt seni arvatust esines tuleviljelust 19. sajandi teisel poolel veel kõikjal Eestis.

Käesolevas artiklis toodud etnograafilise ja ajaloolise materjali analüüs näitab, et uurijad on seni tuleviljeluse kestvust ja levikut Eestis pigem ala- kui üle hinnanud. Sellise alahindamise tõttu ei ole ka aleviljeluse mõju eesti maastikule ja looduskeskkonnale piisavalt tähelepanu pööratud, erinevalt näiteks Soomest. Tuleviljeluse seni arvatust hilisem ja geograafiliselt laialdasem levik eeldab täiendavaid uuringuid selle inimõjulise teguri mõjude ja tagajärgede selgitamiseks meie keskkonnas ja maastikel ning ajaloolaste ja loodusteadlaste tihedamat koostööd selles valdkonnas.

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