The role of slash and burn cultivation in the formation of southern Estonian landscapes and implications for nature conservation

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HIGHLIGHTS

- Fire cultivation played an important role in the formation of the patterns in rural landscapes in Southern Estonia.
- The former slash and burn areas have been the most changeable areas as shown in the study of Nineteenth Century maps.
- The former slash and burn areas identifiable in the present landscape are mainly transformed into forest.
- Knowledge of the historical significance of slash and burn is essential for the development of policies for nature conservation.
- The impacts of fire cultivation on the forest habitats need future study.

ARTICLE INFO

Article history:
Received 7 March 2014
Received in revised form 18 December 2014
Accepted 29 December 2014
Available online 23 January 2015

Keywords:
Fire cultivation
Cadastral maps
Changes in land cover
Landscape interpretation
Landscape management policy

ABSTRACT

Cultural landscapes result from the application of traditional management practices usually over centuries and are amongst the most valued in Europe. However, their composition is widely threatened by modern agriculture. It is therefore necessary to understand the historical factors involved in their formation, so that appropriate policies can be developed for maintaining their character. The present paper assesses for the first time the importance of slash and burn cultivation in the formation of current landscape patterns in Southern Estonia. Although generally associated with the tropics, this practice commenced in the Baltic region in the Bronze Age and persisted until the beginning of the Twentieth Century. The historical background to the practice is given and a detailed study is then described from Karula National Park in Southern Estonia. Parcels of different land covers were digitized from 51 farm maps for five dates from the 1860–1870’s to the present day in order to record the changes. In the mid Nineteenth Century slash and burn parcels covered 35% of the farms lands. Because of the hilly relief 79% of the parcels have returned to forest during the Twentieth Century. The comparable changes are characteristic of other upland areas in Southern Estonia. The management policy in the Park needs to take into account the role of slash and burn in the formation of these areas of forest and their contribution to the modern landscape structure. The contribution to biodiversity of the secondary forests in the former slash and burn areas needs future study.

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1. Introduction

Cultural landscapes involving traditional practices and a long history of management are amongst the most valuable in Europe, emphasized by Pedrol et al., 2007. The long-term durability of extensive agriculture has often created diverse patterns in these landscapes. In order to maintain and conserve this landscape heritage, it is necessary to understand their character and the changes that have taken place, so that appropriate management methods can be supported.

European rural landscapes have undergone major changes through historical times and the development of European landscapes can be divided into three periods, as described by Antrop (2005). Firstly, traditional landscapes were formed gradually by human labour, mainly in agriculture, until the end of Eighteenth Century. From the Nineteenth until the mid-Twentieth Century a second period can be identified, characterized by the major expansion of urbanized landscapes, development of new agricultural techniques and demographic growth. These processes caused rapid changes in landscape patterns. The third phase started after the Second World War and may be described as the post-modern period.
The transformation of many rural landscapes in the Twentieth Century was connected with increased urbanization but also with the mechanization and intensification of agriculture and the abandonment of remote and less productive land. The changes in Estonian cultural landscapes in the middle of the Twentieth Century were similar to the transition of modern landscapes elsewhere in Western Europe. However, in Eastern Europe it is also necessary to consider different political developments, which have also left their imprint on the landscape (Palang, Spek, & Stenske, 2011). The land reforms which changed the land use patterns, occurred three times in Estonia in the Twentieth Century. In Estonia therefore, the abandonment of isolated farmhouses and more remote agricultural land was more widespread than in the West, due to Soviet collectivization. As a result, during the Twentieth Century forest cover in Estonia increased from 14% to 42%, whereas agricultural land decreased from 65% to 30% (Palang, Mander, & Luid, 1998).

Landscape changes in the Nineteenth Century have not been the focus of studies in Estonia. There are some mostly methodological studies (Koppar, 2005, 2006; Raet, Sepp, & Kaasik, 2008Veski, Koppel, & Poska, 2005). These studies contain some information on Nineteenth Century land use and land cover, but this is not the main objective of these papers. The changing social and political processes of the Nineteenth Century are well described by historians (Kahk, 1992) but their impacts on landscapes have not received the same attention. Also, in this Century, land property rights changed. Historically, the land was the property of German speaking landlords from the Middle Ages until the Nineteenth Century, when the peasants were emancipated. Subsequently they rented the land, until land purchase started in the second part of the Nineteenth Century (Maandi, 2010).

During the pre-industrial period, open fields formed the prevalent agricultural system in Estonia. The classic features of the open field system were individually owned strips of arable crops within the fields adjacent to the villages. The commonly owned multifunctional areas of land away from the village were used for activities such as communal grazing and the collecting of wood. They were often on poorer soils and were less intensively managed. In Estonia, some parts of the former commons were also used as temporary slash and burn fields (Ligi, 1963).

Fire has played an important role in traditional agriculture and landscape management in many regions of Europe. The use of fire in Britain on moorlands to promote game is still a widespread practice, as emphasized in a review by Grant, Mallord, Stephen, and Thompson (2012). The burning of heathlands has also been common practice in European countries such as Germany, The Netherlands (Goldhammer and Bruce, 2004), Norway (Hjelle, Halvorsen, & Overlandet, 2010) and Sweden (Hamilton, 1997).

Slash and burn is currently usually associated with tropical environments or, in Europe, with the Neolithic period. However, it is not widely known that the use of fire was also widespread throughout the Baltic region and also in the Black Forest in Southern Germany (Goldhammer and Bruce, 2004). The literature does show (Ligi, 1963; Kahk, 1992; Meikar & Utri, 2000) that fire cultivation was present in Estonia, but not how the practice has affected landscapes and habitats, hence the study described in the present paper.

Today prescribed fire is mainly used in nature conservation and landscape management, except in Britain where it is used for game management on moorlands. In Southern Europe, the methods of prescribed burning are discussed by Fernandes et al. (2013). In Finland and Sweden prescribed burning is recommended for forest restoration and as a method for nature conservation (Hekkala, Tarvainen, & Tolvanen, 2014; Lovén & Äänismaa, 2004; Niklasson and Drakenberg, 2001 etc.). Examples of the best practice of prescribed fire use are given by Montiel and Kraus (2010). In Estonia prescribed burning is not used as conservation tool.

The present paper poses the following hypotheses:

- Fire cultivation played an important role in the formation of the patterns in traditional cultural landscapes in Southern Estonia.
- Changes in the agricultural practices in the Nineteenth Century created a new structure of farmland connected with the decline of slash and burn cultivation.
- The former bushlands used in slash and burn are identifiable in present landscapes.
- Knowledge of the historical significance of slash and burn is essential for the development of policies for nature conservation in Southern Estonian landscapes.

1.1. Overview of the occurrence of fire cultivation and its impact on landscapes in the Baltic region

Throughout the Baltic countries slash and burn cultivation was a widespread practice. In the hilly, forested areas in Småland in Southern Sweden, slash and burn cultivation was common, even until the end of the Nineteenth Century. In central Sweden, the practice was connected with the Forest Finns, the Finnish migrants who colonized the Scandinavian Boreal region. Slash and burn in mature forests was prohibited by law in 1647 in all state land, due to lack of timber, and was therefore restricted to vegetation of young trees and scrub until the beginning of Twentieth Century (Hamilton, 1997).

In Finland fire cultivation and its impact on forests was studied at the beginning of the Twentieth Century (Heikinheimo, 1915). In the eastern regions of Finland—Karelia and Savo—slash and burn cultivation was still practiced until the 1930’s (Voionmaa, 1987). By the beginning of the Twentieth Century in some parishes in Eastern Finland up to 75% of the land had been used for slash and burn fields (Heikinheimo, 1915). The importance of large scale forestry increased in Finland, at the same time as in Sweden, and in 1929 burning was therefore restricted in the former country (Goldhammer & Bruce, 2004).

In Russia, fire cultivation was a common practice in the St Petersburg, Novgorod and Pskov regions, as well as in Russian Karelia (Heikinheimo, 1915). In the central part of European Russia, slash and burn was used up to the 1940’s and, in the north, even until the 1960’s (Bobrovskii, 2010).

In the Baltic region, therefore, slash and burn agriculture had an important role in rural landscapes over several hundred years. In Finland historical slash and burn cultivation has been taken into consideration in the process of designating Natura 2000 habitats (Eriksson, 2008). There is one Annex One Habitat in the Habitats Directive related to slash and burn—9070: Fennoscandian Woody Pastures. This habitat consists of woodlands with deciduous trees where the land was opened for grazing after slash and burn cultivation, and occurs in the eastern part of Finland (Eriksson, 2008).

1.2. Overview of the status of fire cultivation in Estonia

In Estonia the duration and extension of slash and burn management has been underestimated by landscape and natural scientists for many years. Slash and burn cultivation has been studied primarily from an historical perspective. The Estonian historian Ligi (1963) is the main author cited in connection with the practice.

Slash and burn management is one of the oldest agricultural practices in Estonia. Evidence of the use of slash and burn cultivation has been dated to the Bronze Age (Lang, 2007). This cultivation practice lasted until the end of the Nineteenth Century. According to ethnographical data, there were cases of slash and burn used for clearing new fields even at the beginning of the Twentieth Century, as described by Jääts, Kihno, Tomson and Konsa (2010). In Northern and Western Estonia the importance of slash and burn
cultivation was already declining in the Middle Ages and fire was used more to prepare new fields or to get temporary extra crops. In Southern Estonia slash and burn cultivation remained significant as an independent cultivation practice for much longer. For example, in the Eighteenth Century as much as half of the annual crop was produced from slash and burn (Ligi, 1963). The data concerning Nineteenth Century agricultural history in Southern Estonia are relevant also to the northern part of contemporary Latvia because both these regions originally belonged to the former province of Livonia.

Ligi (1963) has described two different traditional agricultural management strategies in Estonia. One was typical of the west and north and the other of the south and east. This pattern results from the differences in bedrock. In Southern Estonia, the soils are acidic because they are derived from the Devonian Sandstone bedrock which is covered by variable depths of moraine deposits. The soils derived from this material are therefore acidic and low in nutrients. On such soils the ash from the burnt wood helps to modify the inherent acidity and increase fertility. Slash and burn was therefore an effective cultivation method in that period. In contrast, in Northern and Western Estonia, the bedrock is Silurian or Ordovician Limestone and soil acidity is not therefore a limiting factor for agriculture.

The term ‘fire cultivation’ includes several different agricultural practices. For slash and burn cultivation, an area was cleared of trees which were then burned to provide ash which subsequently served as fertiliser. After three to five years of cultivation, the plot was abandoned, because of the decline in nutrient levels, and the vegetation was left to regenerate. Two types of slash and burn cultivation have been described by historians. The first was the burning of mature forests and the second involved setting fire to land covered by relatively young trees and shrubs, which had colonised land which had previously been cultivated using the slash and burn practice (Meikar & Uri, 2000).

On Nineteenth Century maps a special land category was used for these regularly burned patches of land (Fig. 1). These were labelled as buschland in the local Baltic-German dialect. This land was used for growing temporary crops and was separated from the permanent fields in which crops were grown regularly and fertilized with manure: therefore buschland was often covered by young trees that had colonized the bare ground after cultivation.

There is no equivalent scientific term for buschland. The word scrub is used in the scientific literature for similar vegetation structures, as described by Barkmann (1990), but his definition is for ecological formations mainly of multi-stemmed bushes. This definition is therefore not suitable for describing buschlands because on the fallow of slash and burn fields the regenerated young trees mainly consist of single stems. Therefore, the term buschland is used throughout the present paper to cover land of this type.

Some patches of about 0.5–1.0 ha were chosen every year for fire cultivation from the buschland patches. The dominant tree species in these areas according to historical sources were silver birch (Betula pendula), grey alder (Alnus incana) and Norway spruce (Picea abies) (Ligi, 1963). These species also produce plentiful seed, as well being good colonizers of bare ground. Regular cycles of slash and burn management were carried out according to agrarian law (Lihwlandi-ma talloralhva Sesdus, 1820) as a minimum 21 year cycle.

Buschlands were also used for grazing in the first years following abandonment of crops as a type of long term fallow. After the trees had begun to colonize wood was collected for firewood (Fig. 2).

There has been some confusion as how to interpret the areas marked as buschland in the maps of the Nineteenth Century. Some non-historian authors have interpreted these as areas with an unclear land cover (Raet et al., 2008). As the practice of fire cultivation, and hence this special land category, does not exist in modern agriculture, it has sometimes been difficult to accept that there is no other explanation for these particular areas.

2. Materials and methods

The study areas are in the Karula National Park, in Southern Estonia, as shown in Fig. 3.

Karula National Park is designated as a Natura 2000 site (Estonian Government, 2004). The nature conservation objectives of Karula National Park are to protect rare species and habitats
which reach a maximum altitude of 137 m. Up to 86% of the Park is covered by natural landscapes such as forests, wetlands and lakes whilst managed land such as fields, semi-natural grasslands, farm buildings and roads cover the remaining 14%. The National Park is inhabited by 270 people. The land is owned mostly by the state (73%) and private land owners (27%) (Environment Board, 2007), but before World War II, the proportion of private farms was slightly higher. This paper considers only the former privately owned farmland because only the maps of these areas were available.

The present study is based on analysis of cadastral maps of 51 farms dating from the 1860–1870’s, which were geo-referenced and digitized. These maps were drawn up for land purchase and are now maintained in National Archives (EAA 2469). These maps (scale 1:4200) cover an area of 3574.9 ha, but actually, 3557.7 ha inside the National Park were analysed in the present study because some farms had land outside the Park. Only maps which could be geo-referenced accurately were used. Even then, some patches or borders might have been moved a little, because of the insufficient accuracy of the Nineteenth Century maps. On these maps, permanent fields, buschlands, hay meadows, pastures and other less important land-use units of the Nineteenth Century are delineated. Some pastures contained trees in the Nineteenth Century. Many farms had a few separately located hay meadows at some distance from the main farm unit, often by the banks of rivers or lakes. These meadows are not included in the analysis because there are no recognisable landmarks available on the maps to provide exact locations. Therefore, only the meadows used for hay in the main parcels of farmland were analysed. Probably the maps reflect a slightly earlier situation than the date shown. It is also possible that some of the buschlands were in use as permanent fields at the time the map was drawn. Nevertheless, by using these maps it is possible for general analysis to identify the plots regularly used for

<table>
<thead>
<tr>
<th>Time interval</th>
<th>Status</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 year</td>
<td>clear cutting, drying wood and burning</td>
<td>tree clearance</td>
</tr>
<tr>
<td>3-5 years</td>
<td>managed crops</td>
<td>growing crop</td>
</tr>
<tr>
<td>4-6 years</td>
<td>fallow, few tree seedlings</td>
<td>grazing</td>
</tr>
<tr>
<td>6-10 years</td>
<td>colonisation by young trees</td>
<td>light grazing</td>
</tr>
<tr>
<td>10-21 years</td>
<td>complete tree cover</td>
<td>extraction of wood for firewood/ fences</td>
</tr>
</tbody>
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**Fig. 2.** Management cycle of a buschland plot.

listed in EU directives, maintain the landforms and landscapes which are typical to Southern Estonia, to protect nature values, maintain the cultural heritage and provide the balanced usage of environment (Estonian and Government, 2006). Estonian National parks are not exactly in accordance with the IUCN definition of category II National Park: “Large natural or near-natural areas protecting large-scale ecological processes with characteristic species and ecosystems, which also have environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities” (Dudley, 2008). The conservation aims of Karula National Park also contain the elements of IUCN category V “Protected landscapes” and VI “Protected areas with sustainable use of natural resources”.

Karula National Park (12,300 ha) is an area with a complex relief and variable landscapes, located in the southern uplands

**Fig. 3.** Location of the study area.
fire cultivation with reasonable precision. To analyse the land cover changes classes were adopted: arable fields (which includes also the small areas of gardens, farmyards and roads), grasslands (hay meadows and pastures), forest (coniferous and deciduous forests and wetlands) and water.

The distribution of buschlands was also checked by analysing Nineteenth Century land cover in the Haanja uplands in Southern Estonia by digitising the map of Saaluse manor (EAA 2072.4.164 sheet 1). The map from 1886 was used, which divided the land into plots before it was sold, with 27 farms being included covering 1036.4 ha. This map is similar in its features to the Karula farmland maps and it was manipulated in the same way.

Land cover changes in Karula were analysed by comparison of the digitised topographical maps from the successive dates. The Russian map was termed One-Verst and was completed in 1894–1915 at the scale 1:42000. This map was used to examine the situation at the beginning of the Twentieth Century. Land cover data of the middle of the Twentieth Century, at the start of the period of Soviet collectivization was obtained from the topographical map at the scale 1:50,000 completed in 1950’s. Cadastral Map from 1985–1987 (1:10,000) was used to characterise the Soviet period. All these maps are electronically available (Land Board, 2014). The Estonian Digital Basic Map (1:10,000) was used to provide recent coverage. To unify the information, four categories of land cover were distinguished based on local landscape features and the tasks of study: the category “field” (arable fields, bare areas, buildings and roads are aggregated), “grasslands” (wet and dry semi-natural grasslands), forests and wetlands (forest, scrub, felled areas, bogs and fens) and “waters”. This classification resulted from what land cover types were differentiated on the used maps and reflects the maximum number of common units.

Digitization of the One-Verst and topographical map from the 1950’s may have caused some errors because of their smaller scale, but more detailed maps from this period were not available. In addition, in the process of digitization it was sometimes difficult to decide the borders of the patches, because only symbols without definite contours are used on the maps in some places. These errors might be misleading if the interest is in the history of a certain land patch or small area. These maps were therefore used to characterize the general trends in land cover, which is the aim of the present study.

The MapInfo Professional 10.0 programme was used for manipulating and comparing the maps. For each map, the areas of land cover classes were calculated. To follow the changes in land cover classes, each class of the earlier map was overlaid with the later map and changes were analysed. In order to reduce random errors, areas smaller than 0.1 ha were eliminated at every step during the comparison of time periods. The results were analysed in Microsoft Excel 2010.

The Forest Management database and the database of Natura Habitats were also used to characterize the forest stands that had regenerated on former agricultural land.

During preliminary fieldwork, 20 former buschland sites were visited in Karula and photographed to obtain an impression of their current appearance.

2.1. Importance of fire cultivation in traditional landscapes in Southern Estonia

The results of the map analyses indicate that buschlands occupied an important position in the Karula upland landscape in the Nineteenth Century and accounted for the largest proportion (35%) of the total area of the farms in the study area, followed by land covered by grassland (28%) and permanent fields (25%). The remainder of the land surface was covered by fens, bogs, small woodlands and water bodies, as shown in Table 1. As the separated hay meadows were not included in the analysis, their proportion is underestimated in the landscape: but this does not significantly alter the results because of their small area.

In the Saaluse farmlands in Haanja upland the buschlands were even more common, covering 45% of the farmland, while permanent fields covered 20%, pastures and hay meadows 24% and residual land such as wetlands 8%. The large proportion of buschlands was not therefore only characteristic in Karula and the study can be considered to reflect the overall situation in Southern Estonia in the Nineteenth Century.

The slash and burn parcels were located mostly on the slopes and tops of hills, as shown in Fig. 4, because ploughing and transportation of dung for annual cultivation was difficult and involved much labour. The permanent arable fields were located on flatter land.

| Table 1 | Land cover changes from the Nineteenth Century to 1900, 1950, 1980 and 2000 (approximately). Areas of land cover categories are in hectares. |
|---|---|---|---|---|---|
| Land cover in Nineteenth Century | Land cover | ~1900 | >1950 | ~1980 | >2000 |
| Arable fields 875.0 | Arable fields | 791.8 | 780.8 | 458.0 | 377.5 |
| | Grasslands | 56.4 | 56.0 | 17.3 | 205.6 |
| | Forest | 10.5 | 13.6 | 159.2 | 209.8 |
| | Water | 0.0 | 0.0 | 0.8 | 0.8 |
| Buschlands 1261.7 | Arable fields | 866.4 | 753.0 | 198.4 | 140.4 |
| | Grasslands | 112.2 | 86.5 | 120.7 | 134.7 |
| | Forest | 265.8 | 402.5 | 899.2 | 960.1 |
| | Water | 0.0 | 0.0 | 0.7 | 0.8 |
| Hay meadows and pastures 984.6 (grasslands) | Arable fields | 363.1 | 331.4 | 92.8 | 54.8 |
| | Grasslands | 392.2 | 367.6 | 156.1 | 87.1 |
| | Forest | 199.2 | 253.5 | 668.4 | 786.9 |
| | Water | 1.5 | 1.1 | 6.0 | 11.5 |
| Forest 388.4 | Arable fields | 81.9 | 63.3 | 10.1 | 2.2 |
| | Grasslands | 54.4 | 40.2 | 14.1 | 12.4 |
| | Forest | 241.1 | 271.7 | 348.6 | 311.9 |
| | Water | 0.3 | 0.3 | 0.3 | 4.9 |
| Water 48.0 | Arable fields | 5.3 | 3.8 | 0.2 | 0.0 |
| | Grasslands | 7.3 | 10.4 | 0.8 | 0.2 |
| | Forest | 4.9 | 2.2 | 16.7 | 15.9 |
| | Water | 35.0 | 31.4 | 33.7 | 35.1 |
The maps show that, by the beginning of the Twentieth Century, crucial changes had occurred in the land cover and landscape appearance. The buschlands had declined, with 72% being converted into arable land, 19% into forest and 9% into meadows. During the Twentieth Century, the buschlands underwent further major changes. By the present time, 78% of buschlands had become forest, whereas 72% of the former permanent fields have remained as open land, as shown in Fig. 5.

Fig. 4. A close view of a fragment of the study area. The comparison of the map of farms with relief, showing that the buschlands location was mostly on the hills.

Fig. 5. Changes of land cover in the farmed land of Karula. The columns in the chart show the distribution of land cover over time whereas the arrows show the transition of the land covers into the next period. The different shading patterns inside the columns shows the proportion of Nineteenth Century land cover categories in different periods. Transitions of less than 5% are not shown.
Arable land declined steadily through the time sequence, matched by increases in grasslands and forest, as shown in Table 1. Almost the same area of grasslands became arable as remained unchanged. Some grasslands became forest at first. However, subsequently the forest cover also increased elsewhere. The forest and wetlands increased at the expense of former agricultural land, while water remained nearly stable.

The forest cover showed a major increase between the 1950’s and 1980’s in Karula, as elsewhere in Estonia (Palang et al., 1998). The new forests mainly replaced the former buschlands and wet meadows.

These results show that 35% of the farmland was covered by buschlands. It is likely that the whole management cycle of slash and burn was about 21 years, with an individual plot being cultivated for three years on average, as enacted by the imperial law (Lihwaldi-ma tallorahva Seädus, 1820). The regeneration of patches of trees took a minimum of six years, therefore it was possible for the young trees to grow up for a minimum of 15 years before the next burning and cultivation cycle. These calculations show, that in pre-industrial landscapes in Karula 63% of the slash and burn areas and 20% of the whole farmed area was covered by young trees forming scrub, although the location of the tree cover patches changed in time. The term young trees is used because, as stated above, they consisted of birch, spruce and alder which are not shrubs. A similar pattern can also be considered to be typical of other hilly areas in Southern Estonia. Consequently, these areas of scrub were an important feature of pre-industrial farmland and the appearance of the landscapes was more variable and significantly different from the period before the Second World War or the contemporary situation.

Throughout the Twentieth Century, the former buschlands underwent new major changes, with 79% becoming forest. The main proportion of the secondary forests in the region are therefore derived from former buschlands. The majority of forests in the former buschlands are associated with hilly land in Karula because the terrain was unsuitable for mechanized agriculture. The slopes were initially colonized by young trees, forming scrub which eventually became forest. The permanent arable fields are on the more flat and fertile areas. The former slash and burn patches have therefore changed the most in the landscape, whereas the arable fields have remained stable.

Within the forests now growing on the former buschland plots identified during preliminary fieldwork, traces of the original agricultural remain with features such as relict field margins and pits in the bottom of slopes, which were excavated to store turnips over the winter. There are also individual large relict trees, which originated from the end of fire cultivation when the former buschlands were used for grazing. More detailed studies of the traces of slash and burn cultivation in the forests are needed in future.

The changes in land use did not only affect the buschlands, since the pastures and hay meadows also began to change at the end of the Nineteenth Century. Thus, the parts of the unproductive meadows that were very wet were abandoned, probably because the farmers started to cultivate clover on the fields to improve the quality of the hay (Kahk, 1992). In addition, approximately 30% of the land analysed on the maps as pastures and hay meadows were converted into arable land, as shown in Fig. 5. Only 39% were mapped as grasslands at the beginning of the Twentieth Century, whereas by that time the original wet pastures, mostly woodland pastures, had been mapped as forests. These numbers do not cover all the changes of grasslands because the separately located hay meadows are excluded, as mentioned before.

2.2. Discussion of the role of fire cultivation in development of cultural landscapes and their associated values

The appearance of the buschlands changed during the cycle of fire cultivation. At first, they had the appearance of arable fields, but then became fallow land with regenerating trees, leading to scrub and eventually young forests, depending on the stage of the management cycle. The buschlands were therefore unique in their usage and appearance and there is therefore no comparable category of land in contemporary landscapes.

At the end of the Nineteenth Century the patches of scrub that originally formed the buschlands finally disappeared from rural landscapes. As slash and burn agriculture only occupied such an important position in Southern Estonia, the distinct period characterized by the ending of slash and burn management is restricted to this region of the country. In Northern and Western Estonia, fire cultivation had declined much earlier and this break point cannot therefore be so easily defined.

Fire cultivation declined during the same period as other major social changes were taking place in Estonian land holdings. The common lands were parcelled out and landlords sold the farms as property to the former peasants. The new landowners were committed to use their land more intensively and therefore at first transformed the majority of the buschlands into arable fields. The industrialisation and modernisation of society changed the attitudes of rural people. The availability of up to date knowledge improved due to newspapers and magazines. New agricultural techniques were adopted and the ancient three field system was abandoned and replaced by crop rotations to maintain fertility. New crops, such as potatoes and clover, were introduced by farmers. This process was more pronounced in Southern Estonia than elsewhere in the country (Viires, 1998).

The main regions covered in most Estonian landscape history studies have been the west and north. The majority of studies are focused on the landscape changes in the Twentieth Century because of the readily accessible maps available for such texts, for example the original One-Verst Map from 1894–1913 which covers almost all Estonia. Many Nineteenth Century estate and farm maps are preserved in the archives but have only been relatively easy to find in public databases in recent years. These maps do not cover large areas and it is often complicated to geo-reference them. The landscape history of Southern Estonia, including the importance of slash and burn agriculture and the changes at the end of the Nineteenth Century, have therefore been neglected in the landscape literature before the present study. Southern Estonia fits well into the periods described by Antrop (2005). Well defined break points can be distinguished between the periods and the traditional landscapes belonging to the period before the Twentieth Century are clear, as described in the present paper. By contrast, in Northern and Western Estonia traditional and modern landscapes merge imperceptibly.

Identification of former buschlands within present landscapes is straightforward once their origin is understood. During the Twentieth Century, most of them have developed into forest patches located on the hills and with surrounding fields and hay meadows currently still in agricultural use (Fig. 6). This landscape pattern is considered to be specific to the Karula National Park and reflects land use history and needs “translation” from the original pre-modern structure. Land use history provides the key to understanding the contemporary landscape. The current study has demonstrated conclusively that the described landscape pattern is not very old or traditional but does have a distinctive cultural value because, once it is understood, the contemporary landscape pattern expresses land use history. The aesthetic value of this landscape is connected with the observed variability and is a result of
interactions between geology and land use history. The appearance of the landscape is picturesque and has been highly valued in the context of nature conservation objectives (Environment Board, 2007).

In the Karula National Park 29% of buschlands, which were mapped as forests at the beginning of the Twentieth Century, are designated as Natura 2000 habitats in the Natura Habitats database, mostly as the Western Taiga type. Also, 52% of the former buschlands, where the forests are 100 years or older, are designated as Natura 2000 habitats in this database. The first number is smaller because some of the forests, developed before the One-Verst Map was drawn up, had already been felled during the Twentieth Century. The land use history was not known at the time of designation of the Natura habitats and the possible impacts of former fire cultivation on some landscape patches was not taken into account.

In the text of the Interpretation Manual of European Union Habitats (European Commission, 2013) Western Taiga is considered to qualify within the Annex One list if it is natural old forest as well as young forests naturally developed after fire.

The oldest forests derived from the former slash and burn patches are 170 years old in Karula and are the product of natural regeneration. Many of the stands have remained undisturbed for several decades and have the comparable appearance of Old Growth forests, as shown in Fig. 7. These forests have a relatively natural structure with many rotten logs and dead trees and therefore are likely to have a rich flora of fungi living on the dead wood, as well as saprophytic insects. These trees have died firstly from self-thinning and secondly from being senescent old individual, large, relic trees. As the buschlands were used for grazing after cultivation, the old trees have wide crowns, because they were formed in open landscapes. Recently the literature has references to forests with natural structure being considered as old growth (Hilbert & Wienscyk, 2007: Mosseler, Thompson, & Pendrel, 2003), although in the past the definition was much stricter. However, whether these forests contain Ancient Woodland Indicators (Hermy, Honnay, Firbank, Grashof-Bokdam, & Lawesson, 1999) and, therefore, how they can be interpreted in terms of Natura 2000 requires further work to define the resources of biodiversity.

Fire has been a significant presence in these landscapes for many centuries. Forest fires have also played an important role in boreal forest ecology, changing the succession and composition of the tree cover. How the slash and burn cultivation has affected the soil conditions, and therefore the biological condition of forest biotopes, is not yet clear. Many Finnish researchers consider the forests in the former slash and burn land to be semi-natural biotopes (Uotila & Kouki, 2005; Vanha-Majamaa et al., 2007). There is some evidence that former slash and burn patches are characterized as having higher vegetation diversity than natural forests (Hokkanen, 2006). Myllyntaus and Mattila (2002) have emphasized that there is no agreement in Finland if slash and burn cultivation has caused any permanent impact on the characteristics of forests. There are data suggesting that fire affects the soil (Delgado-Matas, 2004; Viro, 1974) but how long these impacts last in boreal forests is not so clear. The modelling dynamics of soil organic matter show that the impact of slash and burn management on the soil may persist even up to 120 years in the Boreal region (Bobrovsky, Komarov, Mikhailov, & Khanina, 2010). As the impacts of former fire cultivation on the boreal forest are not well understood, it is not possible to give specific guidelines for their management.

The role of secondary forests in protected areas needs further attention, because many European protected sites are located in remote areas where traditional extensive farming is declining significantly. The maintained remnants of traditional forms of land use have to coexist with new dynamic wild areas. Both parts of the landscape need appropriate, well defined management goals and techniques suited to local conditions (Höchtl, Lehringer, & Konold, 2005). In most cases there is not sufficient information to predict the future value of the new biotopes and therefore to plan appropriate management. Historical information can be used to estimate the potential value of such new forests, and to set up targets for restoration or development of biodiversity linked to such sites once such resources have been assessed. Old slash and burn forests could form a “model” to predict the potential natural value of the younger secondary forests in the former slash and burn cultivation sites, which
were transformed into arable fields at the beginning of Twentieth Century.

As shown by Antrop (2005) and Marucci (2000), landscape history is a valuable tool to help make valid planning decisions. An understanding of landscape history is essential in the design of appropriate policies for maintenance of valuable landscapes, otherwise important elements will not be protected. As elsewhere in Europe, traditional rural landscapes are valued in Estonia for their high cultural values and specific biodiversity. Land use history provides the basic information to determine conservation objectives, as initially described by Hoskins (1970). If nature conservation planners take the model from the Northern and Western Estonia where the slash and burn management declined earlier than in Southern Estonia, then the targets for nature conservation management will not be appropriate. Karula and other protected areas in the South Estonia therefore need well defined objectives related to their individual history.

Over time, some new landscapes and habitats are formed and some disappear, mainly as a result of human activities. However, the determination of which habitats and landscape elements are most valuable remains problematic, as does the period when a given landscape was in an “ideal” state. Although to the general observer the Karula farmed landscape appears natural, the present paper shows that it is necessary to explain its evolution, so that the public can appreciate the history of its development. It is also necessary to emphasise that change is an integral part of the development of valued landscapes.

Traditional landscapes in Southern Estonia have been formed gradually in pre-modern times and have changed not only in the Twentieth Century but also previously in the Nineteenth Century. It might not therefore be realistic to plan to restore any particular historical pattern but rather to accept the maintenance of the contemporary landscape with its modern aesthetic and cultural values.

3. Conclusions

The historical analysis has demonstrated that slash and burn was an important agricultural management practice from the Bronze Age until the mid-Nineteenth Century. This cultivation method then began to decline and had ceased by the beginning of the Twentieth Century. Slash and burn cultivation is surprisingly little studied in Europe but evidence of its impact on the current landscape pattern exists even today.

The Nineteenth Century maps allowed the examination of the parcels of traditional farm landscapes and the location of the former slash and burn cultivation areas. In farmlands in Karula National Park, most of the former slash and burn areas were transformed into arable fields by the beginning of Twentieth Century. In the second half of the Twentieth Century these fields gradually turned into forest because they were too steep for mechanized tillage. About 20% of slash and burn parcels had already regenerated into forest by the end of Nineteenth Century and are now covered by mature stands of trees.

The paper has therefore shown for the first time that in rural Estonia, slash and burn has played an important role in the formation of landscapes. The former fire cultivation sites are now mainly forest and occur in specific locations on the tops and slopes of hills.

This study has therefore shown that the forests on the former slash and burn sites have an important status in Karula National Park, because of their large area and high proportion of old grown forest. The forests formed on the previous slash and burn land need further study to investigate their differences in terms of biodiversity from other forests.

Estonian National Archives

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Acknowledgements

This research has been financed by the Estonian Research Agency, project “Non-additive impact of border-richness to biota” (IUT21-1) and by the European Union through the European Regional Development Fund (program 3.2.0802.11-0043) project ÖKOMAA.

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