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ESTONIAN MIRES AND THEIR UTILIZATION

Viron suot ja niiden käyttö

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In this paper, the mire classification system and its development in Estonia are reviewed. In addition the utilization of mires for peat harvesting, forestry, agriculture and conservation are outlined. There are two main groups of mires in Estonia — an eastern and a western type. Mire vegetation has been classified according to site conditions, community composition and structure. During the primary succession of mire communities, a number of fen communities converge to a smaller number of bog communities. The post-drainage succession is also convergent. Estonian mires are intensively utilized for peat harvesting. There is a clear need for a comprehensive mire protection and utilization plan.

Keywords: Classification, Estonia, nature conservation, succession, vegetation

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INTRODUCTION

Mires (ecosystems with peat layer more than 30 cm thick, or 20 cm in case of drained areas) cover approximately 25.8% of the total area of Estonia (Orru 1987, Kallas and Orru 1987, Fig. 1). Fen is the prevailing type of mire, occupying 515 000 ha (57%). Transitional mires cover 114 000 ha (12%) and bogs 278 000 ha (31%). There are 16 500 mires with an area of more than 1 ha in Estonia.

Estonia belongs to the Baltic geobotanical province of boreo-nemoral zone (Laasimer 1965). The border of western and eastern subprovinces of this province goes through Estonia. Western and eastern parts of the country differ in many respects — climate, geomorphology, soil conditions and history. Generally, the western part is geologically younger, soils are mainly calcareous, the climate is milder and the relief is flat. These factors cause marked differences in vegetation, including mires (Masing 1981). Western fens are frequently rich in species, while eastern fens are species-poor. Western bogs are relatively flat with an irregular pattern of compound microforms, while eastern bogs are convex with a well developed concentric pattern. On western mires, *Trichophorum caespitosum*, *Myrica gale* and *Sphagnum rubellum* are more frequent, while *Chamaedaphne calyculata* and *Sphagnum fuscum*

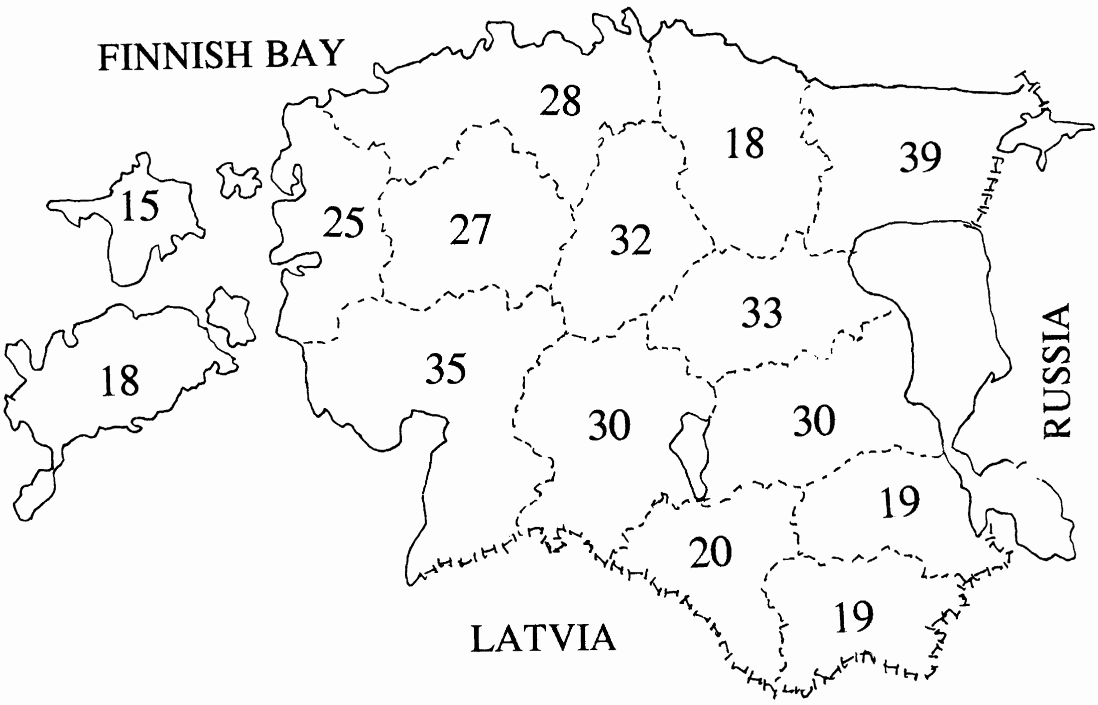

Fig.1. Percentage of mires from the total area in different counties in Estonia (data from Orru 1987).

Kuva 1. Soiden suhteellinen osuus Viron eri maakunnissa, Orrun (1987) mukaan.

are more common on eastern mires. *Cladium mariscus* and *Drosera intermedia* are found only in western mires.

CLASSIFICATION OF MIRE VEGETATION

Earlier attempts to classify the vegetation of Estonian mires have been reviewed by Laasimer (1965). These classifications have varied considerably, especially in case of paludifying and drained forested types. Lippmaa (1933, 1934) presented a theoretically oriented general classification system of the whole vegetation of Estonia, using one layer units (unions or synusia), and a system of vegetation mapping.

In the fifties, new vegetation classifications were elaborated for fens (Trass 1958) and bogs (Masing 1958). These classifications were based on ecological, structural and floristic characteristics. Simultaneously, forest site type classifications were elaborated by Ilves (1953), Karu (1957), Karu and Muiste (1958). These last two included forested mires, and also drained mires. Laasimer (1965) developed a classification scheme for the whole vegetation of Estonia.

Attempts to improve forest site type classification were made by Katus and Tappo (1965) and Masing (1969) and general schemes of vegetation classification for mapping were presented by Masing (1970) and Marvet (1970). All these works made changes in mire classification.

The most recent version of forest site type classification is described by Lõhmus (1974, 1984). According to this classification, mires are divided into four types: carr (swamp with *Alnus glutinosa*), swamp, transitional mire, and bog. There are also two types of drained sites: *Vaccinium myrtillus* and *Oxalis acetosella* sites. Compared to Karu and Muiste (1958), the drained *Dryopteris* site type is absent from Lõhmus' system.

A more detailed classification of mire vegetation is given by Masing (1975). There are four types of minerotrophic mire sites (soligenous, topogenous, limnogenous and transitional) and two types of ombrotrophic sites (moor and bog sites). These sites are further divided according to vegetation structure (e.g. treeless/treed) or according to site conditions (e.g. calcareous/noncalcareous substrate). Within each subdivision, plant communities are distinguished on the basis of floristic composition. In total, 36 plant community types are given. In raised bogs, different community types can form a regular pattern (Masing 1982). Among the latest attempts concerning classification of wetland vegetation, the description of the *Juncus subnodulosus* community (Roosaluste 1988) can be mentioned.

Drained forest sites have also been included in site type classifications since Karu and Muiste (1958), who distinguished *V. myrtillus* (oligotrophic), *Dryopteris* spp. (mesotrophic) and *Oxalis acetosella* (eutrophic) site types. A more detailed analysis of drained forest sites was carried out by Lõhmus (1981, 1982). He distinguished four mire sites (pine bog, transitional pine swamp, birch swamp and alder carr) and four drained sites, respectively (Fig. 2). After a long period of drainage, these sites converge into two site types — so-called 'decayed' *V. myrtillus* site type (mainly oligotrophic forests with pine) and 'decayed' *O. acetosella* site type (mainly eutrophic and meso-eutrophic forests with predominating spruce). The difference between drained and 'decayed' (kõdusoo, in Estonian) site types is made with the help of the understorey vegetation — in the community of 'decayed' site, mire plants cover less than 20%. In western Estonia, communities with predominating *Molinia caerulea* arise on calcareous fens and swamps after drainage (Roosaluste 1984). But *Molinia* site type, which has been distinguished in Latvia (Busch 1961, 1964), has not been described as a separate type in Estonia. The small number of drained site types is motivated by the post-drainage successional convergency — species composition of plant communities of drained sites gradually becomes more similar (Lõhmus 1981, 1982).

MIRE SUCCESSION

General trends in mire development during the postglacial period and the role of climatic factors in mire changes have been described by Laasimer (1965) and Valk (1988). An analysis of the autogenic succession of mires was carried out by Aaviksoo et al. (1984) and Masing et al. (1991). These authors used stratigraphic material to study the development of microcommunities on bog microforms. All microcommunities were classified to original community types, developed by Mati Ilomets. The main directions of successional transitions vary with the age of the peat layers (0–1500 vs. 1500–3000 BP). Consequently, microsuccessions are dependent on the development of the bog as a whole. In the margins of compound microforms, transitions between hummock and hollow communities occur (see also Karofeld 1986).

Succession at the macrocommunity level has been described with the help of stratigraphic material collected by the Estonian Geological Survey. Statigraphic data were generalized in the form of a

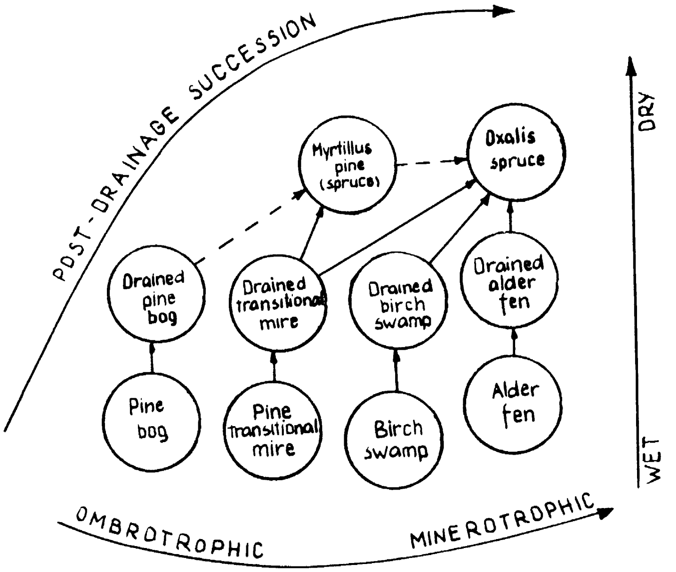

Fig.2. Post-drainage succession of forested mires (according to Lõhmus 1981).

Kuva 2. Puustoisten soiden ojituksenjälkeinen kasvillisuussukkessio (Lõhmus 1981).

transition probability matrix. In the case of macrosuccessions, plant community classification was derived from the peat classification system of Tyuremnov (1949), which was used by the Geological Survey. As a result, 17 plant community types were distinguished. The probabilities of the transition of each type into 16 other types during the time interval of c. 350 years i.e. 25 cm peat layer were then calculated (Masing et al. 1991).

The structure of the transitional probability matrix for community level, demonstrated the varying nature of community macrosuccession when the eutrophic and oligotrophic stages of mire development were compared. In early stages, transitions in different directions were possible and the general scheme of succession much resembled the T(tolerance)-model of Connell and Slatyer (1977). In the case of oligotrophic stages, the successional sequence of mire communities was much more fixed. In most of cases, there were only a few alternative successional pathways possible. The general scheme of the succession corresponded to F (facilitation-model) of Connell and Slatyer (1977). The succession that has taken place on raised bogs is probably one of the best examples of the so-called facilitation mechanism of succession in the world.

To characterize the nature of climax communities in mires, an eigenvector of the transition probability matrix was calculated (Masing et al. 1991). The eigenvector gives a so-called stable probability distribution, i.e. probabilities of finding certain community types after an infinitive number of time intervals. In case of five community types: *Sphagnum fuscum*, *S. magellanicum*, *Eriophorum vaginatum* — *Sphagna*, Ligneous — *Sphagna*, Ericacea — *Sphagna* — the probability of finding them in final stages was relatively high and these communities can be called climax communities. The situation in mires does not correspond to any of the climax theories. Bog succession is convergent (different initially eutrophic communities converge towards some oligotrophic final types). At the same time, multiple stable communities can occur in final stages, the spatial distribution of which is dependent on the surface pattern of a bog. An early successional community can develop towards a variety of final communities. Consequently, successional divergency and convergency are integrated in a complex manner on mires.

One particular question, connected with the 'facilitation' mechanism of succession, is the role and dynamics of soil aeration conditions. The soil of paludifying coniferous forests, representing different stages of mire succession, was studied by Zobel (1990). The lowest aeration level was measured during the first stages of paludification, where the peaty layer was not more than 10 cm thick. In later stages, when the peat layer is of 30 cm or more, the levels of aeration were higher. The suppression of the decomposition process in later stages was probably not induced by the low levels of aeration only, but by a variety of factors, including decreasing soil pH and a lack of nutrients.

PEATLAND UTILIZATION

The amount of economically valuable peat (weight is calculated for peat containing 40% of moisture) in Estonia is estimated to be $1720 \cdot 10^6$ t. Within this supply, the amount of slightly decomposed peat constitutes $350 \cdot 10^6$ t. Other peat resources, the use of which is considered to be economically unreasonable or which occur in nature reserves, is $684 \cdot 10^6$ t, so the total supply is approximately $2\,400 \cdot 10^6$ t (Kallas 1990). The area of peatlands, consisting of economically valuable peat resources (with peat layer of 0.9, 1.1 and 1.2 m thickness in bogs, transitional mires and fens respectively) is 700 000 ha.

In 1990, 80 different mires, with a combined area of 14 200 ha, were used for peat mining. The amount of peat harvesting in 1990 was $2.08 \cdot 10^6$ t, while the rest supply of peat (i.e. peat resources not used yet) in these mires under harvestig) constituted $60 \cdot 10^6$ t (Turvas 1990). From the total 1990 production, $0.94 \cdot 10^6$ t was slightly decomposed peat and used as litter in the keeping of farm animals. Of the $1.14 \cdot 10^6$ t of intermediately decomposed peat, $0.64 \cdot 10^6$ t was used for household heating (briquettes) and $0.50 \cdot 10^6$ t in gardening and agriculture. Besides these official figures, it was estimated that c. $1.00 \cdot 10^6$ t per year is produced by collective farms and state farms, but precise data about this production are absent.

The annual peat increment in Estonia is estimated to be $0.80 \cdot 10^6$ t (Kallas and Orru 1987). Consequently, the industrial peat production is almost three times more than natural increment. The use of peat is wasteful (Noodla 1991). For example, most of the slightly decomposed peat that is harvested is used as litter in state animal farms, while little use is made of the straw, produced by agriculture (c. $300–500 \cdot 10^6$ t per year). Also, 33 000 t of peat is exported each year. Peat producing companies have planned to increase this figure to 200 000 t by 1995 and to 400 000 t by 2010. The production of treated raw peat (e.g. fertilized peat for gardening) has not been planned. The regulation of the Estonian peat industry has been weak. This is partly because of the very low price of oil until 1991, which has enabled cheap peat milling. Due to the changing economical relationships with the former Soviet Union, which includes also the increase of the price for oil, however, the structure of peat use will probably change in the near future. At the present time, peat and peatland utilization in Estonia can be characterized as not being effective.

After drainage, peatlands are also used for agriculture and forestry. Approximately 84 000 ha of peatlands have been drained for agricultural purposes — mainly for cultivated hayfields, but also as pastures and cropping (Annuk and Hirmo 1988). There are 158 000 ha of drained forested peatlands — 144 000 ha represent eutrophic sites (swamps and transitional mires) and 14 000 ha represent oligotrophic sites (bogs) (Kollist 1988). Both strongly eutrophic and oligotrophic sites have been shown to be unsuited for drainage. 45 000 ha of drained peatlands has been used for forest cultivation, some 72% has been planted with Norway spruce (*Picea abies*). On the remainder, the existing forest has been managed for forestry purposes.

CONSERVATION OF MIRES

One of the first nature reserves in Estonia, established in 1938, was Ratva bog (1109 ha) in North-East Estonia. Five other mires were declared to be under protection in 1957, and two of them (Nigula bog and Viidumäe spring fen) received State Nature Reserve status (Masing 1988). In the end of the sixties, drainage of peatlands was carried out on rather large areas, which included several raised bogs. These works were financially supported from Moscow and ditches were dug in places where it was not economically effective. Subsequently, several papers, advocating the protection of mires, were published in the local journal 'Eesti Loodus'. It was probably the first time during the soviet period, when public opinion had a certain influence on nature protection. As a result, a list of mires which needed protection was compiled (Kask and Masing 1974). In 1981, 28 mires were protected by law, occupying 122 190 ha, which is approximately 13% of the total area of mires (Herman et al. 1987).

At the present time, there are four main problems in mire protection:

1. The law of nature protection is not followed in reality, and protected mires are used for economical purposes. For example,peat harvesting has been going on in Viru bog, Lahemaa National Park.

2. Construction of drainage systems in the vicinity of protected mires has strong influence on mire ecosystems. Many protected mires have suffered for this reason, including a rare *Juncus subnodulosus* community in Viidumäe Nature Reserve (Roosaluste 1984).

3. Air pollution (alkaline oil-shale ash with many heavy metals) is changing the vegetation of mires in North-East Estonia. There has been a strong accumulation of polluting substances in wetlands of the North-East (Punning et al. 1987). This has resulted in rapid changes in mire vegetation, including the degeneration of *Sphagna* and invasion of some new species such as *Gymnadenia conopsea*, *Prunella vulgaris*, *Hieracium pilosella* (Karofeld 1987).

4. Seminatural fen grasslands are overgrown by shrubs and trees. By 1980 the total area of seminatural grasslands has decreased to a fifth of it's area in 1939 and the overgrowing is still in progress (Aug and Kokk 1983). The result is that some communities (e.g. *Carex davalliana* association) become gradually rarer.

Thus, there is a clear need for a comprehensive mire protection and utilization plan.

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REFERENCES

Aaviksoo, K., Masing, V.& Zobel, M. 1984: Autogenic succession of mires: a Markovian approach. — In: Estonia. Nature, man, economy: 56–67. Tallinn.

Annuk, K. & Hirmo, E. 1988: Soode põllumajanduslik kasutamine. — In: Valk, U. (ed.), Eesti sood: 192–198. Valgus, Tallinn.

Aug, H. & Kokk, R. 1983: Eesti NSV looduslike rohumetsade levik ja saagikus. — 100 pp. Tallinn.

Busch, K. 1962: Läti NSV hydromelioratsioonifondi metsa kasvukohatüüpidekarakteersed tunnused. — In: Kollist, P.(ed.), Soometsa tüpoloogia küsimusi: 32–52. Tartu.

Busch, K. 1964: Latvijas PSR meza angsanas apstaklu un purvu tipu noteicejs. — Jaunakais mezsaimnieciba 6/7:72–92.

Connell, J. & Slatyer, R.O. 1977: Mechanisms of succession in natural communities and their role in community stability and organization. — Am. Nat. 111:1119–1144.

Herman, M., Loopmann, A. & Ranniku, V. 1982: Sookaitsealad — milleks ja kuhu. — Eesti Loodus 10/1982:626–632.

Ilomets, M. 1982: The productivity of Sphagnum communities and the rate of peat accumulation in Estonian bogs. — In: Masing, V. (ed.), Peatland Ecosystems: 102–116. Valgus, Tallinn.

Ilves, A. 1953: Eesti NSV arumetsatüübid. — Loodusuurijate Seltsi Aastaraamat 46:11-49.

Kallas, R. 1990: Päästkem turvas. — Eesti Loodus 9/1990:567–569.

Kallas, R. & Orru, M. 1987: Kas meie turbavarud on ikka ammendamatud? — Sotsialistlik põllumajandus 42:20.

Karofeld, E. 1986: Temporal variation of hummock-hollow complexes in raised bogs in Estonia. — Botanicheskii Zhurnal 7:535–1542 (in Russian).

Karofeld, E. 1987: Kurtna järvestiku rabade looduslike tingimuste ja taimkatte dünaamikast viimastel aastakümnetel. — In: Ilomets, M. (ed.), Kurtna järvestiku loodslik seisund ja selle areng: 133–139. Valgus, Tallinn.

Karu, A. 1975: Eesti NSV soometsatyybid. — In: Kabala metskonnas 2.–3.nov. 1956. toimunud metsakuivendusalase teadusliku nõupidamise materjalid: 35–41. Tartu.

Karu, A. & Muiste, L. 1958: Eesti metsakasvukohatüübid. — 36 pp.Tallinn.

Kask,E. & Masing,V. 1974: Mida on tehtud soode säilitamiseks? — Eesti Loodus 4/1974: 1–8.

Katus, A. & Tappo, E. 1965: Eesti metsakasvukohatüübid. — 46 pp. Tallinn.

Kollist, P. 1988: Soode metsamajanduslik kasutamine. — In: Valk, U. (ed.), Eesti sood: 198–209. Valgus, Tallinn.

Laasimer, L. 1965: Eesti NSV taimkate. — 397 pp. Valgus, Tallinn.

Lippmaa, T. 1933: Taimeühingute uurimise metoodika ja Eesti taimeühingute klassifikatsiooni põhijooni. — Loodusuurijate Seltsi Aruanded 40:1–169.

Lõhmus, E. 1970: Eesti arumetsaraiestike klassifitseerimisest — Metsanduslikud uurimused 8:190–245.

Lõhmus, E. 1974: Eesti metsade ordineerimisest ja klassifitseerimisest. — Metsanduslikud uurimused 11:81–90.

Lõhmus, E. 1981: Anthropogenous forest site types on drained peatlands. — In: Laasimer, L. (ed.), Anthropogenous changes in the plant cover of Estonia: 77-90. Tartu.

Lõhmus, E. 1982: Kõdusoometsade geneesist, klassifitseerimisest ja diagnostikast. — In: Metsamajandus. Metsade majandamine, kaitse ja rekreatiivne kasutamine: 3–25. Tartu.

Lõhmus, E. 1984: Eesti metsakasvukohatüübid. — 88 pp. Tallinn.

Marvet, A. 1970: Eesti taimekoosluste määraja. — 61 pp. Tartu.

Masing, V. 1958: Rabataimkatte klassifitseerimise printsiibid ja ühikud. — Tartu Riikliku Ülikooli Toimetised 64:63–101.

Masing, V. 1969: Metsatüpoloogia probleeme. — Loodusurijate Seltsi Aastaraamat 59:150-167.

Masing, V. 1970: Rakendusliku tüpoloogia ja taimkatte kaardistamise ühikud. — In: Kalda, A. (ed.), Välibotaanika: 138–155. Tartu.

Masing, V. 1975: Mire typology of the Estonian SSR. -In: Laasimer, L. (ed.), Some aspects of botanical research in the Estonian SSR: 123–136. Tartu.

Masing, V. 1982: The plant cover of Estonian bogs. A structural analysis. — In: Masing, V. (ed.), Peatland Ecosystems: 50-92. Tallinn.

Masing, V. 1988: Eesti soode kaitse. — In: Valk, U. (ed.), Eesti sood: 224–227. Valgus, Tallinn.

Masing,V. & Allikvee,H. 1988: Eesti soode valdkonnad. — In: Valk,U. (ed.), Eesti sood: 247-275. Valgus, Tallinn.

Masing, V., Zobel, M., Ilomets, M. & Aaviksoo, K. 1992: Dynamics of mire communities in Estonia: a markovian approach. — In: Patten, B.C. (ed.), Wetlands and Shallow Water

Bodies 2. SPB Acad. Publ., The Hague (in press).
Noodla, A. 1991: Turba kasutamisest Eestis. — 10 pp. (manuscript).
Orru, M. 1987: Kui palju on Eestis soid? — Eesti Loodus 10/1987:646–652.
Punning, J.–M., Ilomets, M., Karofeld, E., Toots, M., Kozlova, M., Pelekis, L. & Taure, I. 1987: Mõningate keemiliste elementide sisaldus Liivjärve raba turbalasundis ning Räätsma järve põhjasetteis. — In: Ilomets, M. (ed.), Kurtna järvestiku looduslik seisund ja selle areng: 62–67. Valgus, Tallinn.
Roosaluste, E. 1984: Influence of drainage on spring fen vegetation in Viidumäe Nature Reserve. — Proc. Univ. Tartu 662:54–58 (in Russian).
Roosaluste, E. 1988: Estonian Juncus subnodulosus communities. — Proc. Univ. of Tartu 812:186-192.
Trass, H. 1958: Geobotaanika teooria probleeme seoses madalsoode taimkonna klassifitseerimisega. — Tartu Riikliku Ülikooli toimetised 64:38-62.
Turvas 1990: A report of the Ministery of Environmental Protection (manuscript).
Tyuremnov, S.N. 1949: Peatlands and their recognition. — 464 pp. Gos. Energ. Izdat., Moscow (in Russian).
Valk, U. 1988: Soode teke ja areng. — In: Valk, U. (ed.), Eesti sood: 22-42. Valgus, Tallinn.
Zobel, M. 1990: Soil oxygen conditions in paludifying boreal forest sites. — Suo 41: 81–89.
Zobel, M. & Masing, V. 1987: Bogs changing in time and space. — Arch. Hydrobiol. Beih., Ergebn. Limnol. 27:41–45.

TIIVISTELMÄ:

VIRON SUOT JA NIIDEN KÄYTTÖ

Suolla täytyy virolaisen määritelmän mukaan olla turvetta vähintään 30 cm; ojitusalueilla riittää suoksi 20 cm:n turvekerros. Näin määritettyjä soita on Virossa n. 907 000 ha, mikä on neljännes valtion pinta-alasta (Kuva 1). Erilaiset nevat ovat soiden vallitseva päätyyppi (57%). Viron itä- ja länsiosat eroavat toisistaan myös suokasvillisuuden perusteella. Länsiosan kalkkikivialueilla on runsaslajisia nevoja ja lettoja kun taas itäosan suot ovat pääosiltaan karuja kilpikeitaita.

Soiden luokittelussa on kaksi yksityiskohtaisuudessaan erilaista järjestelmää. Masingin (1975) esittämässä järjestelmässä suot jaetaan ensin minerotrofisiin ja ombrotrofisiin soihin alaluokkineen. Nämä jaetaan edelleen kasvillisuuden rakenteen (esim. puuton/avoin) ja kasvualustan (esim. kalkkipitoinen/hapan) mukaan, jolloin lopputuloksena on 36 kasviyhdyskuntatyyppiä. Lõhmuksen (Kuva 2) järjestelmässä on soiden kasvupaikkatyyppejä erotettu selvästi vähemmän, joista ojitettuina kehittyy mustikka- ja oravanmarjaturvekankaita vastaavia kasvillisuustyyppejä. Tällöin suokasvien peittävyys on alle 20%.

Taloudellisesti korjattavan turpeen määräksi Viron soissa on arvioitu 1 720 miljoonaa tonnia 700 000 ha:n alalla. Vuonna 1990 nostettiin turvetta 80 suoalueelta 14 200 ha:n alalta. Nostetun turpeen määrä oli n. 2 miljoonaa tonnia (40%:n kosteus). Tilastoitujen lukujen lisäksi arvioidaan, että osuustoimintatilat ja valtion tilat olisivat nostaneet jopa 100 miljoonaa tonnia turvetta. Turvetta myös viedään raaka-aineeksi ulkomaille. Tällä hetkellä vienti on ollut n. 33 000 tonnia vuodessa, mutta sitä on suunniteltu nostettavaksi 400 000 tonniin vuoteen 2010 mennessä.

Soita on ojitettu maatalouskäyttöön n. 84 000 ha, joista suurinta osaa käytetään laitumina ja heinän kasvatukseen. Suometsätaloudessa on n. 158 000 ha, joista 45 000 ha on istutettu pääasiassa kuuselle.

Eräs Viron ensimmäisiä suojelualueita

oli v. 1938 rauhoitettu Ratvan suoalue (1109 ha) Koillis-Virossa. 1960-luvulla käytiin kiivastakin keskustelua soiden suojelun tarpeellisuudesta Eesti Loodus-lehden palstoilla, jonka seurauksena kirjattiin suojeltavien soiden luettelo. Vuonna 1981 oli lailla suojeltu 28 suoaluetta (122 190 ha). Tämä vastaa 13% maan suopinta-alasta. Soiden suojelussa on kuitenkin useita käytännön ongelmia. Turpeen nosto, kuivatus, ilmansaasteet ja joidenkin harvinaisten kasviyhdyskuntien häviäminen suojelualueilta ovat näistä esimerkkeinä. Virossa tarvittaisiinkin selkeämpää soiden suojelun ja kaikenlaisen hyödyntämisen kattavaa suunnitelmaa.

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