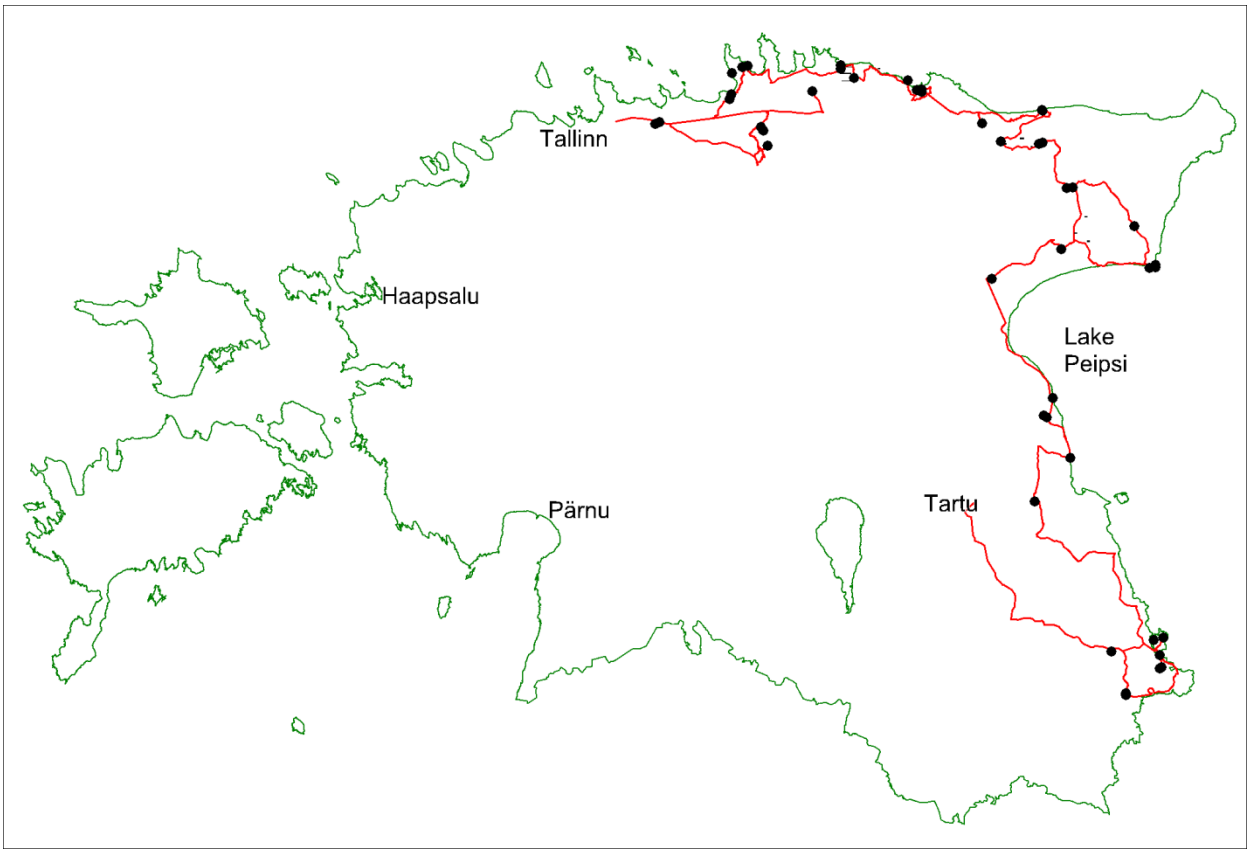
IAVS post-symposium tour

SE-, E-, NE- and N-Estonia



Hosted by

Jaan Liira

Kertu Lõhmus, Iti Jürjendal, Ave Suija

Rauno Kalda

1-6 July 2013

University of Tartu

Programme

July 1, Mon

9:00 Departure from Tartu, hotel Dorpat
10:30 - 11:15 Ilumetsa meteorite crater + Vacc.uliginosum pine forest; and various other boreal types (700m/45 min)
11:45 - 12:30 Floating (quaking) rich fen (Kragge, scragh, scraw) near Velna (or a swim in lake Saarõpää) (250m/30min)
12:45 Lunch at Tsäimaja of the Setu heritage museum in Värska
- 13:45 Dry sand grassland in museum of Setu (Värska)
14:00 - 15:30 Human disturbance initiated sand-dune habitats in Mustoja LR (2km/1.5h)
Detour through the "boot" of Saatse
16:30 - 17:30 Sand mining and plant resque planting in Piusa quarry (500m/ 1h)
18:00 Arrival at Värska Resort

July 2, Tue

9:00 Departure
10:45 - 11:00 Crossing Emajõgi river on cable ferry at Kavastu (30 min)
11:30 - 12:00 Villages of Russian old believers along shore of lake Peipsi (Varnja-Kasepää-Kolkja) (15min)
12:45 - 13:30 Lunch (Kivi pub in Alatskivi)
13:35 - 14:45 Boreo-nemoral forest near Alatskivi (the Oxalis and Aegopodium type) (1300m/1h)
15:00 - 15:30 Devonian sandstone cliff in Kallaste
16:00 - 16:30 Wood products in Avinurme village
17:00 - 18:30 Transitional mire and inland sand-dune forest of Rüütli mire near Iisaku (2400m/1.5h)
19:00 Arrival at hotel Mäetaguse SPA

July 3, Wen

9:00 Departure
9:15 - 10:15 Restored wooded grassland and Hepatica type nemoral forest near Mäetaguse (1100m/1h)
11:15 - 12:15 Riverside vegetation in Vasknarva (2000m/1h)
12:20 - 12:55 Sand-dune forest and beach vegetation of northern shore of lake Peipsi (or a swim) (30min)
13:00 - 13:45 Lunch –Suvi resort
Oli shale mining, and the nature restration/recovery
15:00 - 15:45 Kiviõli semi-coke and ash mountain (1700m)
16:00 - 17:00 Forest restoration in Aidu mining field (max 20min stop)
17:00 - 18:30 The oil shale mining museum of Kohtla-Nõmme
19:00 Arrival at hotel Saka Cliff manor

July 4, Thu

9:00 Start (pack, but do not leave, later, a walk first)
9:00 - 11:00 Baltic klint and nemoral forest of limestone escarpment (the clint-forest) at Saka (3000m/2h)
11:00 - 11:30 Packing and departure from Saka
12:15 - 13:00 wooded grassland of Arupealse at Rannu-Kestla (1900m)
13:30 - 14:15 Lunch at caffeteria Büchler in Lontova
14:15 - 15:30 Riverside forest vegetation of Kunda and old park (1200m/60min)
Alkaline pollution in Kunda
16:00 - 16:15 Sandstone cliff Kronkskallas (15min)
16:30 - 17:30 Coastal habitats and ruins of Toolse castle (800m/1h)
19:00 Arrival at hotel Vihula manor (800m)
22:00 Night walk? (depends)

July 5, Fri

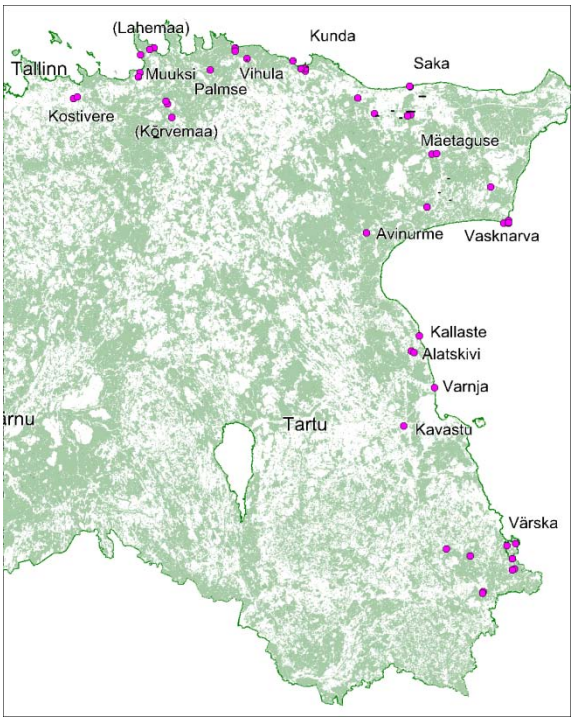
9:00 Departure
9:15 Old-growth boreal forest of Mustoja and Altja (Lahemaa NP)
- 10:00 Seashore vegetation in Altja (2500m/1.5h)
10:00 - 11:00 Disturbance by beaver on river valley vegetation (1000m/45min)
11:30 - 12:15 Hara bay- old submarine base
12:45 - 13:30 Lunch
13:45 - 14:15 Limestone grassland and historic land use at old settlement area of Muuksi and Hundikangru (750m/30min)
14:20 - 14:50 Limestone grassland and stone gist graves of Hundikangrud (300m/30min)
15:15 Rebala Heritage Museum of the late Bronze Age (20min)
- 18:00 Karst and calcareous grassland in Kostivere (2500m/1.5h)
19:00 Arrival at hotel Palmse
22:00 Night walk? (depends)

July 6, Sat

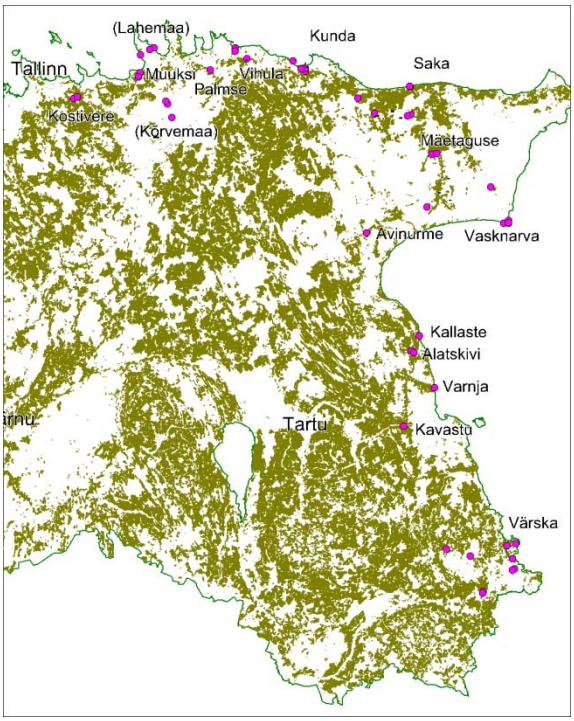
9:00 Departure
9:45 - 11:00 Raised bog of Kõnnu Suursoo (North-Kõrvemaa LR) (3000m) (+ a swim)
11:45 - 12:45 Lunch at Sportland Kõrvemaa Hike and Ski resort
13:00 - 16:00 Heath and alkaline hillock forest around Jussi lakes (North-Kõrvemaa LR) (5500m/3h)
Max 19:00 The End by the hotel Ülemiste

The background – land cover

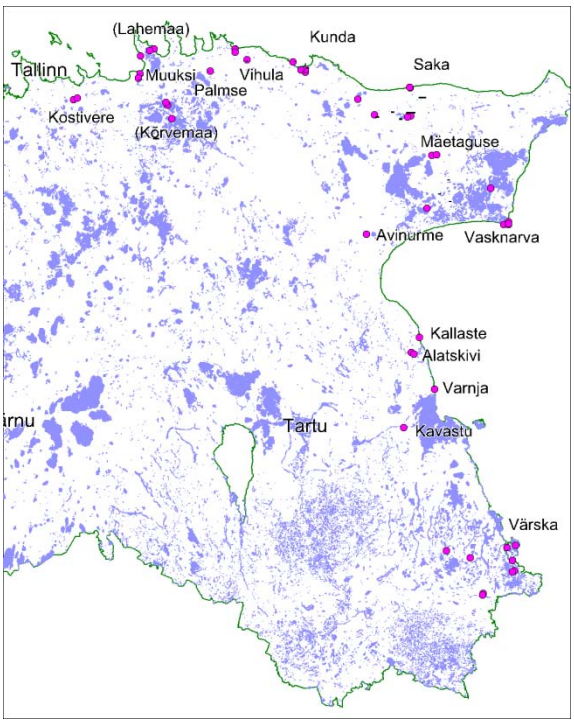
45-51% forest land



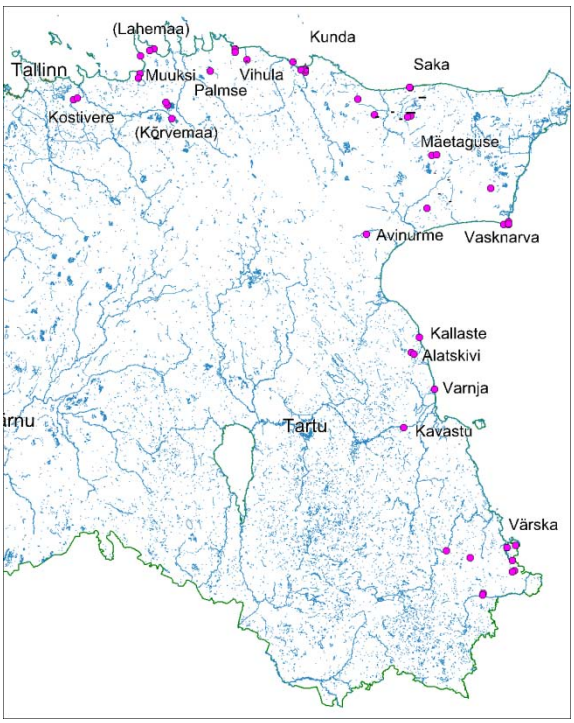
25% (only rotational)-31% (+all) agricultural land



5-6.5% open wetland (20% paludified)



2.5% (without Peipsi)-9% inland water



Plant species (natives, naturalized exotics) – ca 2300 species

Fungi ca 7300 species, therein 1100 lichens.

Bryophytes 590 species

Protected 18% of area, 570 species

Geological background

Raukas, A., Teedumäe, A. (eds). 1997. Geology and Mineral Resources of Estonia. Estonian Academy Publishers, Tallinn. 436 pp. ISBN 9985-50-185-3. (http://sarv.gi.ee/geology/)

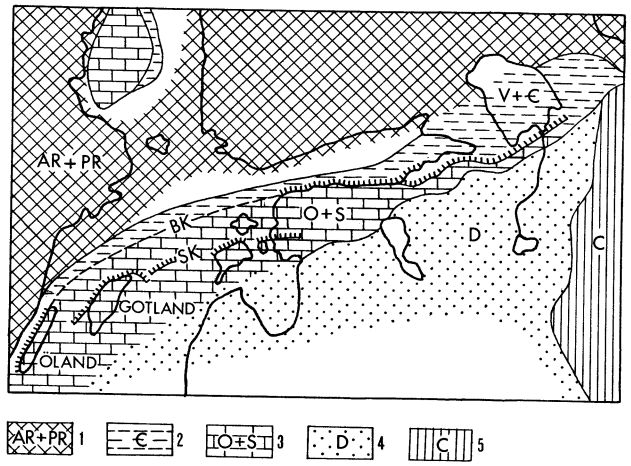


Fig. 253. Location of the Baltic (BK) and Silurian (SK) klints. Outcrops:
1 - crystalline Archaean and Proterozoic;
2 - Vendian and Cambrian;
3 - Ordovician and Silurian;
4 - Devonian;
5 - Carboniferous.

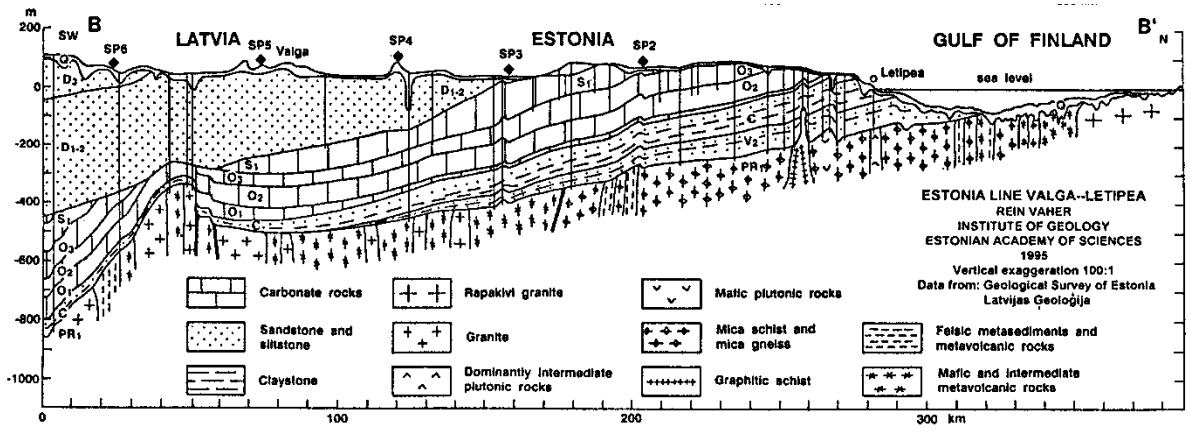


Fig. 115. Structure of Estonia and surrounding area; map (After Sildvee & Vaher 1995, improved)

Ice age / post-glacial

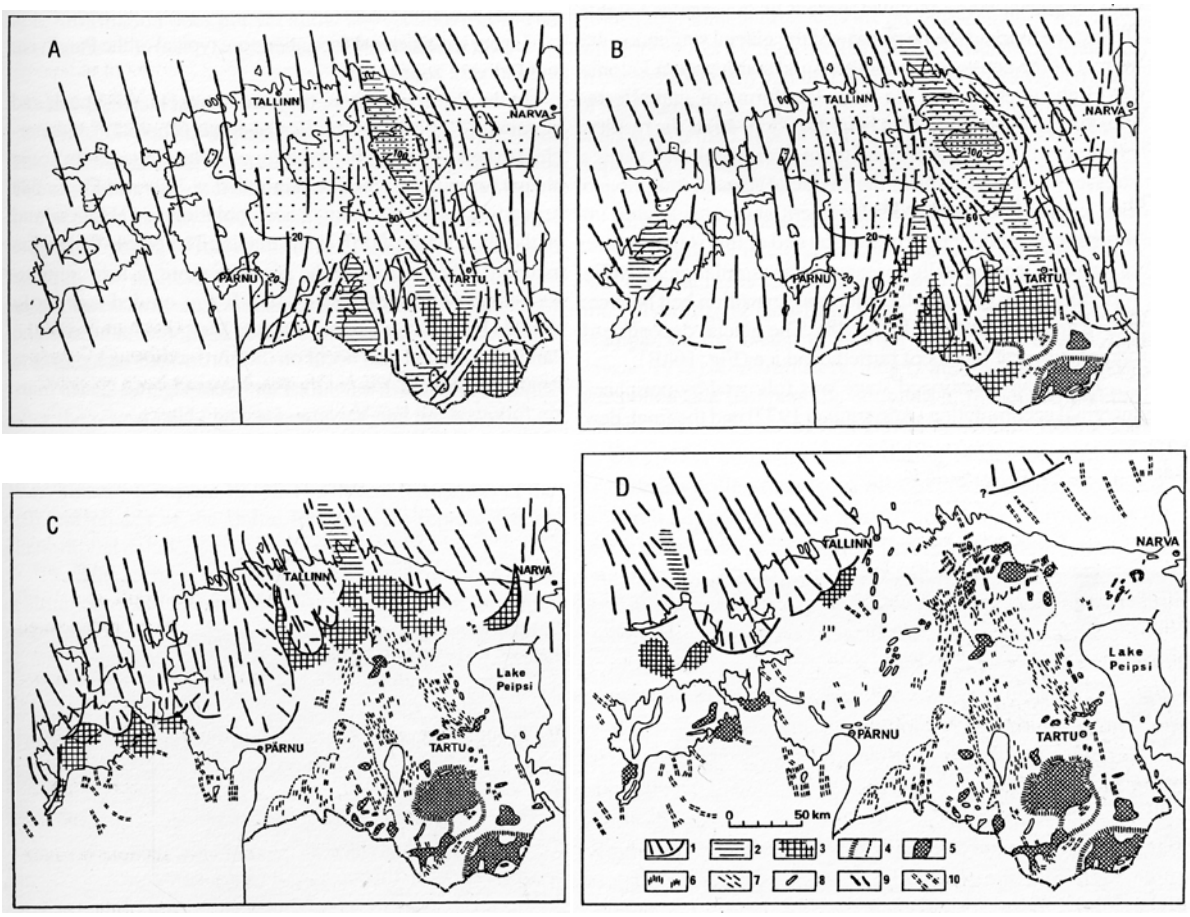


Fig. 164. Glacial dynamics and deglaciation of the Estonian territory (12500-9000 BP) against the background of the bedrock topography (dotted surfaces) with indications of its elevation above sea level (lines with numbers) after Raukas & Karukäpp 1979 with complements: A - stagnation of the glacier on the Haanja and Otepää heights; B - marginal formations of glacial lobes in southeastern Estonia; C - Pandivere Stadial of deglaciation; D - Palivere Stadial of deglaciation.

1 - margin of the active glacier and direction of the ice movement; 2 - ice-shed area; 3 - dead ice and formation of hummocky topography; 4 - foot lines of accumulative insular heights (a) and bedrock uplands (b); 5 - hummocky topography; 6 - marginal belts of hummocky topography; 7 - drumlins; 8 - end moraines and marginal eskers; 9 - radial eskers; 10 - orientation of elongated landforms.

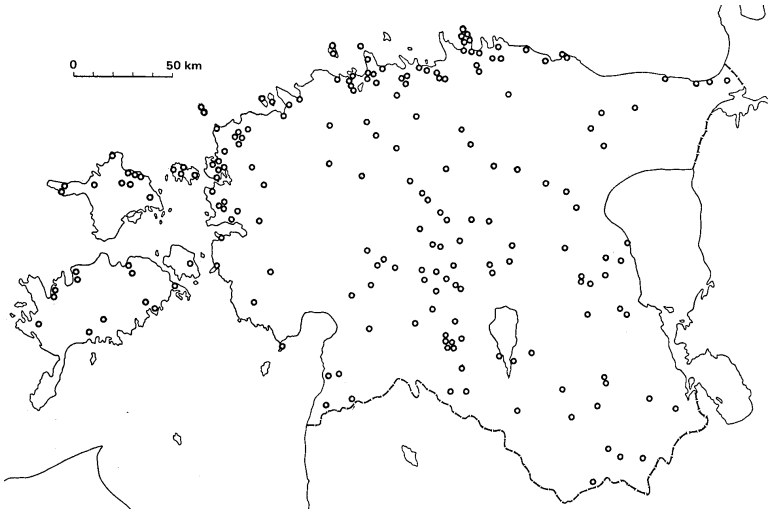


Fig. 250. Big boulders, boulder accumulations and boulder fields currently under the state nature protection (after Viiding 1960 with some modifications).

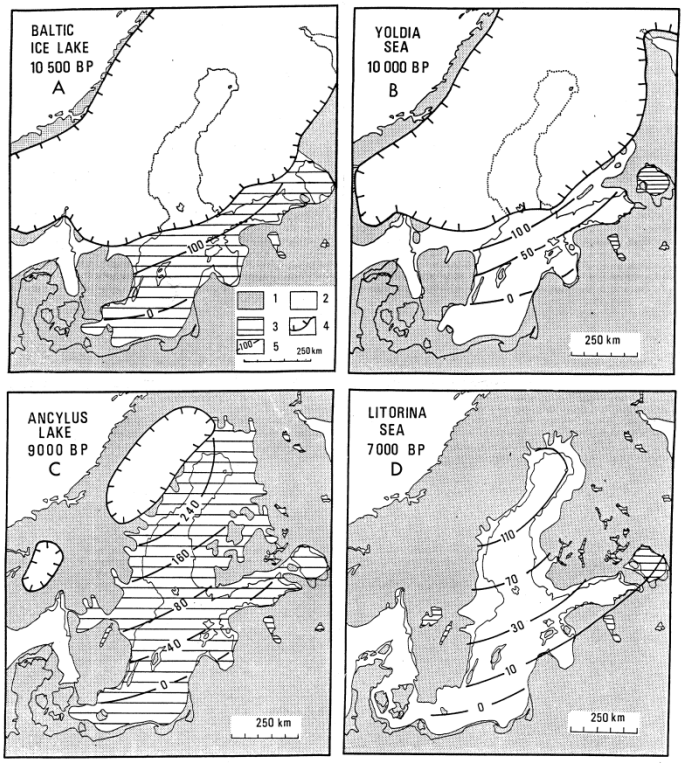


Fig. 165. Palaeogeographical reconstructions of the main stages of the Baltic Sea history after Hyvärinen (1991):
A - Baltic Ice Lake;
B - Yoldia Sea;
C - Ancylus Lake;
D - Litorina Sea.

1 - dry land;
2 - sea;
3 - lake;
4 - ice margin;
5 - isolines for shore level altitudes in metres above the present sea level.

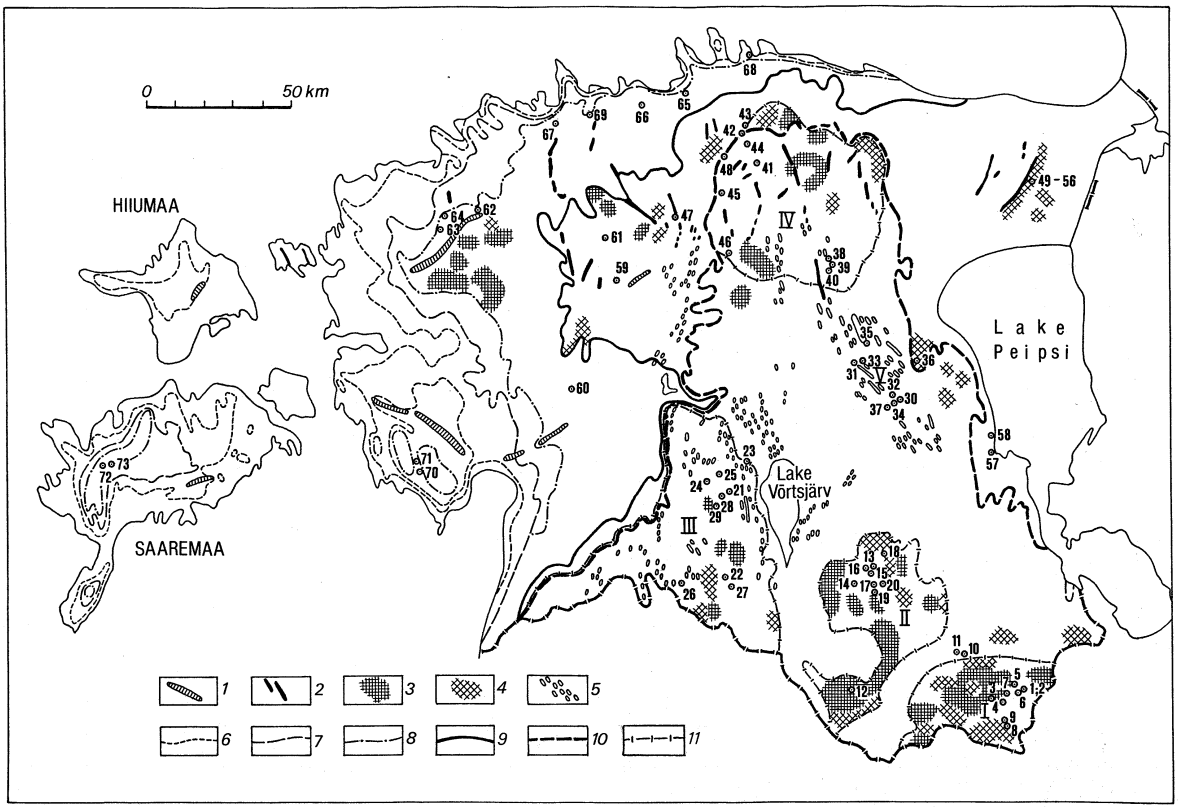


Fig. 184. 1 - end moraine and marginal esker; 2 - radial esker; 3 - morainic topography; 4 - kame field; 5 - drumlin field; 6 - limit of the Limnea Sea; 7 - limit of the Litorina Sea; 8 - limit of the Ancylus Lake; 9 - limit of the Baltic Ice Lake BIII; 10 - limit of the Baltic Ice Lake BI; 11 - boundary of heights and uplands.

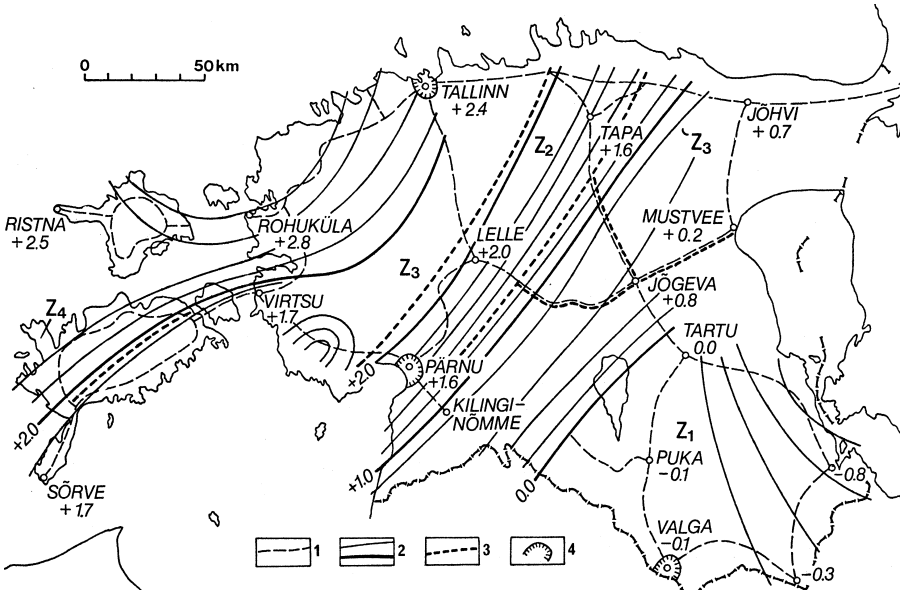


Fig. 130. Scheme of isobases and planes of annual velocities of recent vertical movements in Estonia (after Vallner et al. 1988):
1 - levelling network;
2 - isobases;
3 - boundaries of planes of annual velocities of recent vertical movements;
4 - local area of subsidence.

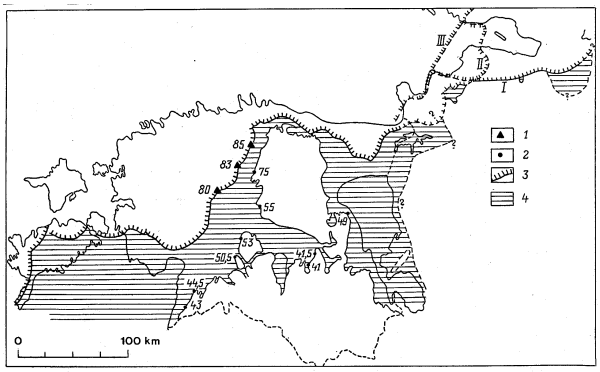


Fig. 167. The initial point of the formation of the Baltic Sea after the retreat of the glacier from the Pandivere Upland. Roman numbers show the location of the ice margin in the St. Petersburg Region according to different scientists: I - K. Markov; II - I. Krasnov and E. Zarrina; III - M. Spiridonov with co-authors.

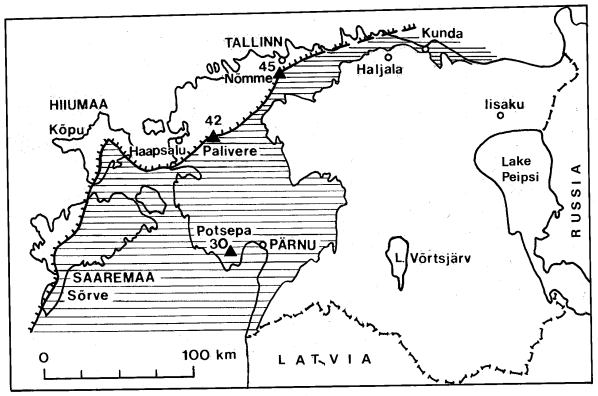


Fig. 168. Palaeogeographic scheme showing the maximum extent of the glaciers of the Palivere Stadial after Kessel and Raukas (Kessel & Raukas 1982) with complements. The hatching denotes the area under the Palivere Ice-Dammed Lake. For legend see Fig. 167.

Legend: 1 - elevation of aqueoglacial forms above the present sea level, m; 2 - elevation of coastal forms a.s.l.; 3 - ice margin; 4 - area occupied by ice-dammed lakes. Compiled by J. Vassiljev on the basis of data published by H. Kessel, E. Lõokene, K. Markov, K. Pärna, A. Raukas and E. Rähni.

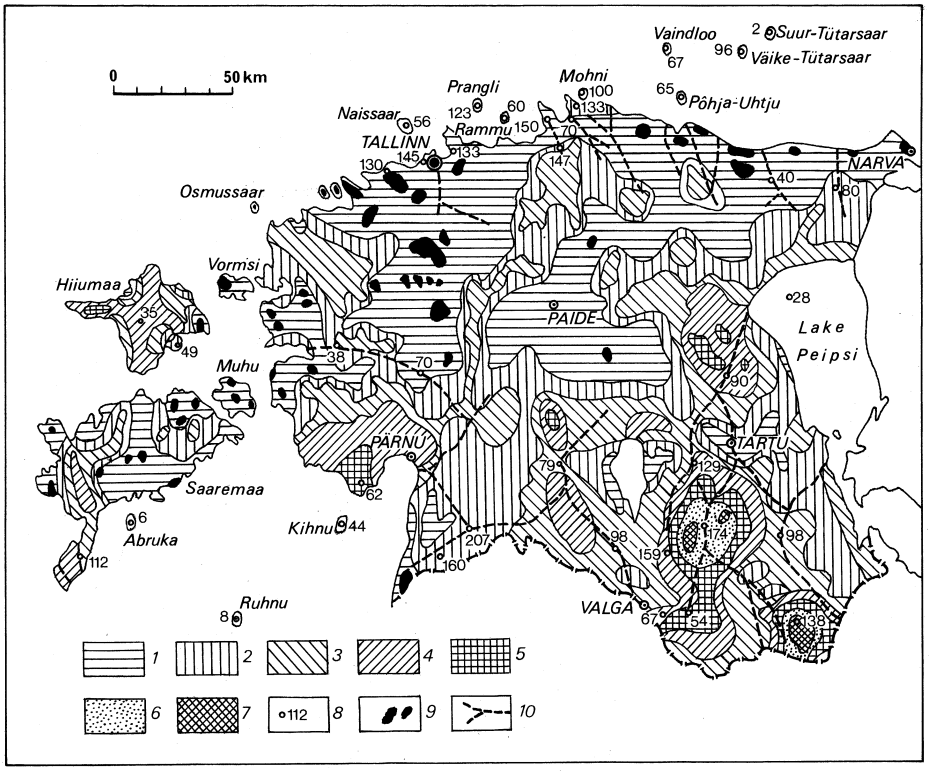


Fig. 91. Thickness of the Quaternary deposits:
1 - below 5 m;
2 - from 5 to 10 m;
3 - from 10 to 20 m;
4 - from 20 to 40 m;
5 - from 40 to 60 m;
6 - from 60 to 80 m;
7 - over 80 m;
8 - boreholes with the thickness of the Quaternary deposits;
9 - alvars;
10 - buried valleys.

Soil formation

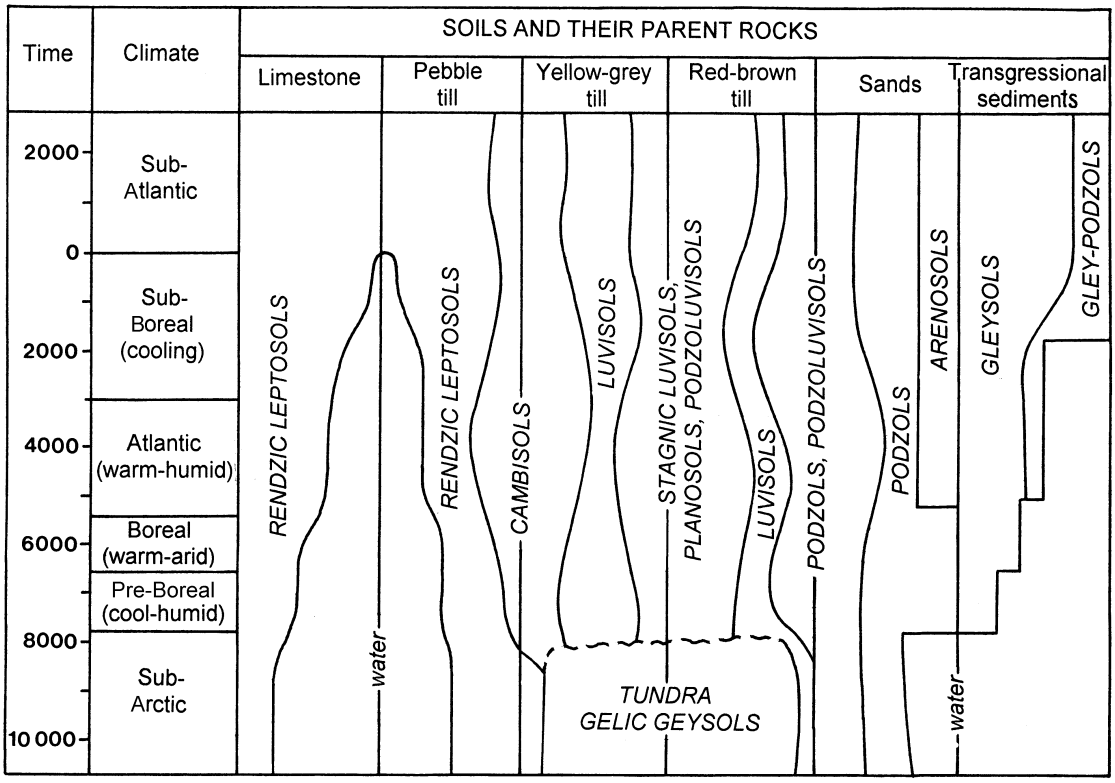


Fig. 198. Progress of soils in the postglacial period.

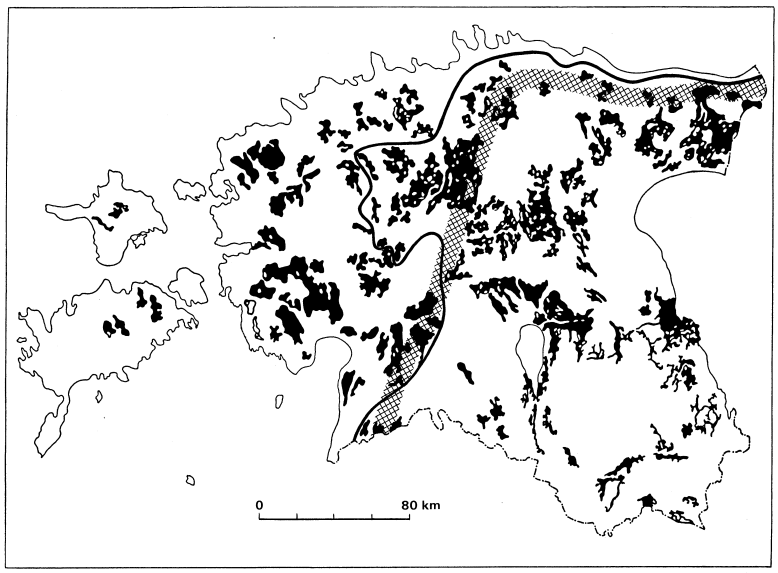


Fig. 192. Distribution pattern of mires larger than 1000 ha in Estonia (after Allikvee & Ilomets 1995, with complements). Solid line indicates the maximum distribution limit of the Baltic Ice Lake B3 and divides Estonia's territory into Lower and Upper Estonia. The cross-striped belt follows the approximate boundary between the East- and West-Estonian geobotanical provinces (after Laasimer 1965) and corresponds well with the distributional pattern of the West-Estonian type of plateau bogs and the East-Estonian type of convex bogs.

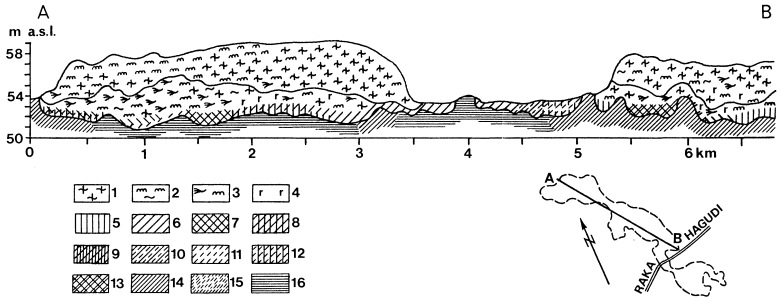


Fig. 225. Peat types profile of the Hagudi Mire, Rapla County: 1 - Fuscum peat; 2 - complex peat; 3 - cotton-grass - Sphagnum peat; 4 - heath peat; 5 - fen wood peat; 6 - fen sedge peat; 7 - transitional sedge peat; 8 - fen reed-sedge peat; 9 - fen wood-reed-sedge peat; 10 - fen sedge-Hypnum peat; 11 - fen Hypnum peat; 12 - fen wood-Hypnum peat; 13 - transitional grass peat; 14 - loam;
15 - sandy loam; 16 - clay.

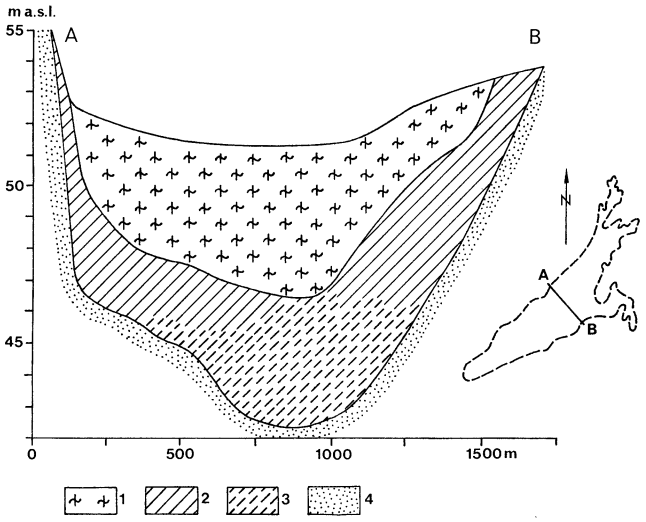


Fig. 227. Peat type profile of the Napsi Raised Bog, Viljandi County:
1 - Sphagnum-Fuscum peat;
2 - fen sedge peat;
3 - fen Hypnum peat;
4 - sand.

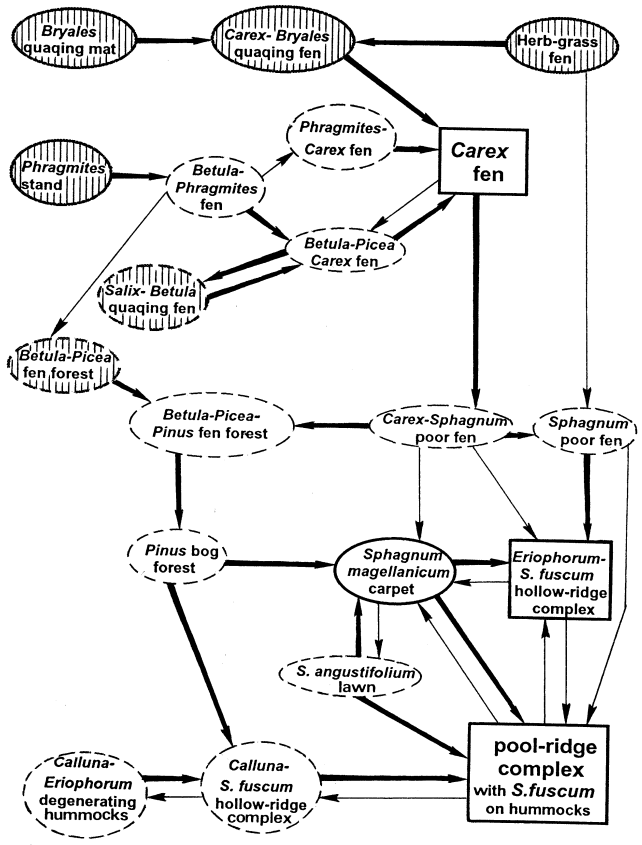


Fig. 196. Developmental pattern of limnogeneous mires in Estonia. Arrows: thick line - more common sequences, thin line - less common sequences. Ellipsoids: striped - initial states, white - serial states, continuous line - most common states, broken line - less common states. Rectangulas - climax states.

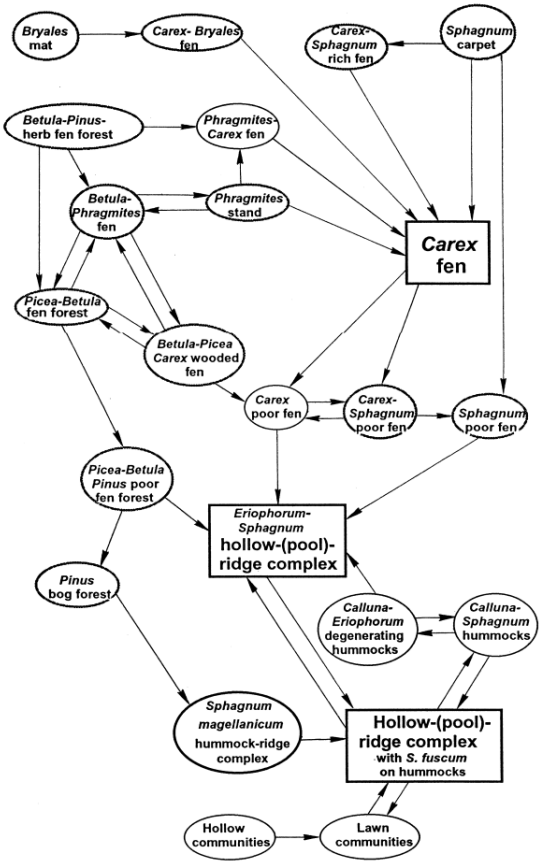


Fig. 197. Developmental pattern of topogeneous mires in Estonia. Symbols as in Fig. 196.

July 1

Postitee – Historic postal road

In ancient times and during the Middle Ages the most important means of travelling, besides roads, was waterways.

This road has already been used since the early-14th century for keeping the connection between Tartu-Vastseliina-Pskov, because Vastseliina was important destination of pilgrimage in the 14th century. At least, map issued in Swedish times, 1695, reflects almost the present day route. According to folk tales, both the Swedish King as well as the Russian imperator Peter the Great used this route to travel into local destinations or Europe.

Regular mail service in Estonia dates back to the mid-17. century, when Estonia belonged to the Swedish Crown and the management of post traffic in Estonia and Livonia became the responsibility of knighthoods and their peasants. Postal service stopped in 1700, because of the war between Sweden and Russia. Postal service was recovered in full only in the mid-19th century, in connection with the Crimean War. The speed of travelling at these times was low, travelling was possible only in daytime. Distance between post stations was 23 – 25 km, a 2-2.5 h journey. Therefore, the required facilities of postal stations were horses for change and to afford travellers with overnight lodging. The first post stations were roadside inns already in the 15th century. Initially wooden post stations were replaced in 19 century by stone buildings. The analogous buildings can be found also in Latvia and Poland.

The section of Postitee between Ihamaru and Puskaru is 7.5 km long, and it is a showcase of Norway spruce hedges, maple and birch alleys and poplars and apple trees planted during Soviet period to fence road from snow (snowdrift). Such richness of species is notable, but nobody knows, why, just happened so.

Ilumetsa meteorite craters

The biggest of Ilumetsa meteorite craters - Põrguhaud (The Hell's grave or hole) was formed 6600 years ago, it diameter is 80m and depth 12.5m. Crater's bottom is covered with 2.5m thick layer of turf. The diameter of the second crater Sügavhaud is 50m and depth 4.5m. The names assigned to them by people – Põrguhaud (Hell Grave), Tondihaud (Ghost Grave), Kuradihaud (Devils' Grave) and Sügavhaud (Deep Grave) – refer to dwellings of devil. The reasons they got such names remains secret. Near Põrguhaud people were afraid to say word "devil" because after that the servants of the devil take the lost person right to the devil himself.

To reach the Craters you have to first step over the still of the Gates of the Hell, where you will be greeted by funny wooden devils. Walking along the plank road you will arrive at Põrguhaud (Grave of Hell), which is the biggest of the Craters. Sügavhaud (Deep Grave) is situated 900 m further to south. The third is Kuradihaud (Grave of the Devil), which is usually filled with water.

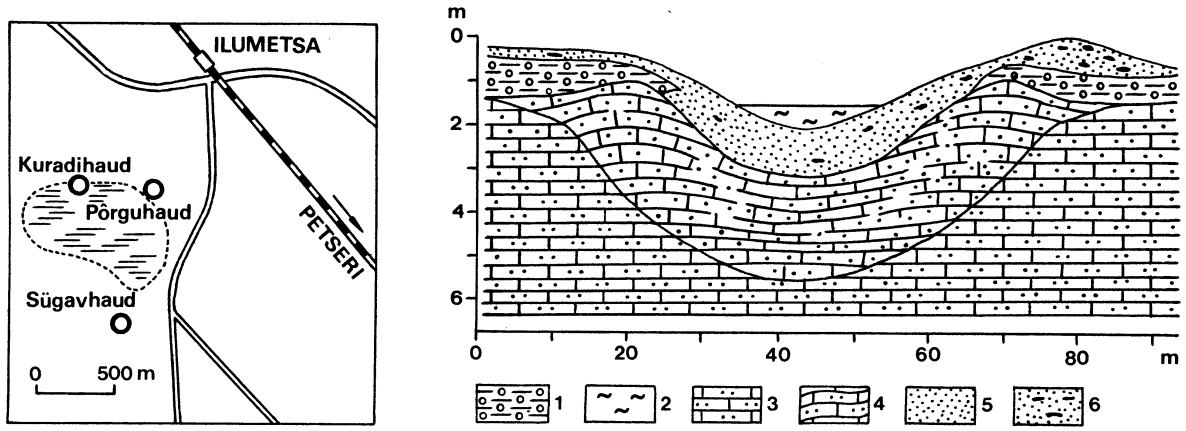
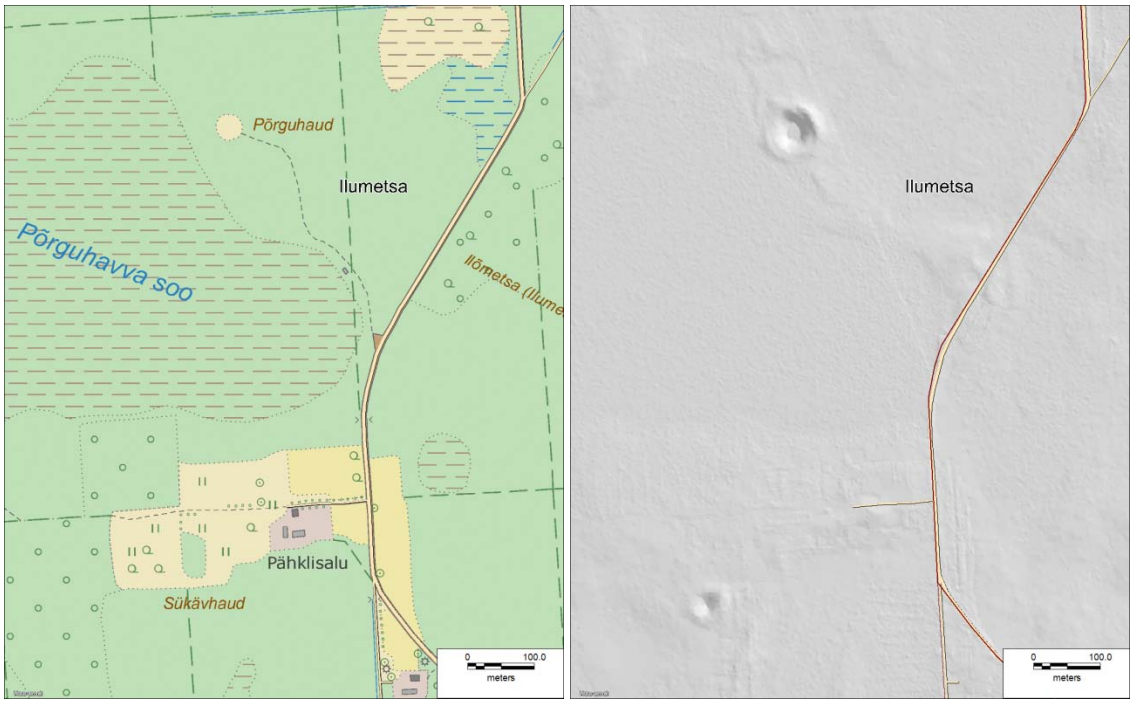


Fig. 247. Location of Ilumetsa craters and the cross section of the Põrguhaud Crater after Aaloe (1979): 1 till; 2 peat and sapropel; 3 Devonian sandstone; 4 disturbed sandstone; 5 glaciofluvial sand; 6 the same with till lenses.



Map and terrain NW from Rebasmäe. Two Ilumetsa craters can be recognized.

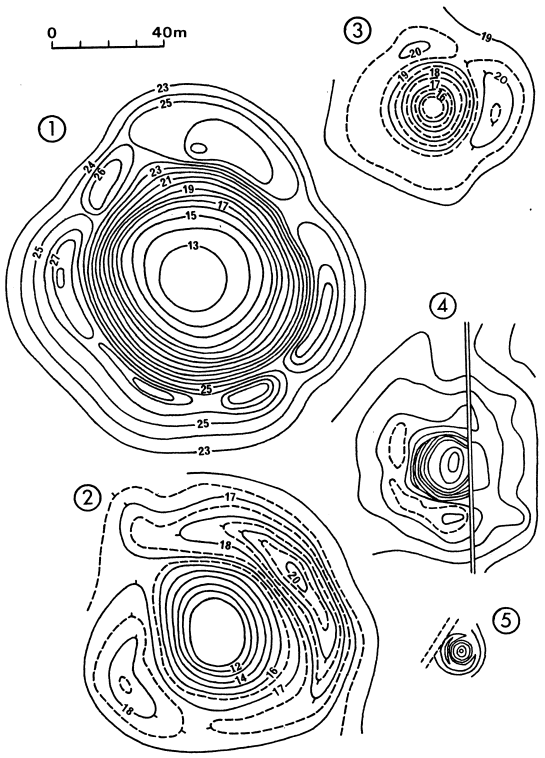


Fig. 244. Morphologically better preserved Holocene meteorite craters in Estonia (in comparable measure):
1 - Kaali main crater (100 m) in Saaremaa;
2 - Ilumetsa Põrguhaud (76 m);
3 - Ilumetsa Sügavhaud (47 m);
4 - Tsõõrikmägi (40 m);
5 - Simuna (9 m),
(after Pirrus 1995).

Vascular plants

Pinus sylvestris
Betula pendula
Picea abies

Wet forest

Calamagrostis arundinacea
Scorzonera humilis
Vaccinium myrtillus
Vaccinium uliginosum

Drained/dry

Anemone nemorosa
Luzula multiflora
Luzula pilosa
Melampyrum pratense
Platanthera bifolia
Pteridium aquilinum
Vaccinium vitis-idaea

Crater bottom

Calla palustris
Carex nigra
Menyanthes trifoliata
Potentilla palustris

Near-by Vacc.myrtillus type borea forest of Norway spruce (*Picea abies*)

Picea abies
Pinus sylvestris
Betula pendula
Sorbus aucuparia
Populus tremula
Corylus avellana

Calamagrostis arundinacea
Deschampsia flexuosa
Luzula pilosa
Lychnis flos-cuculi
Maianthemum bifolium
Melampyrum pratense
Melampyrum sylvaticum
Melica nutans
Orthilia secunda
Oxalis acetosella
Platanthera bifolia
Pteridium aquilinum
Pyrola rotundifolia
Quercus robur
Solidago virgaurea
Trientalis europaea
Vaccinium myrtillus
Vaccinium vitis-idaea

Bryophyte in the bottom of crater - Sphagnum flexuosum

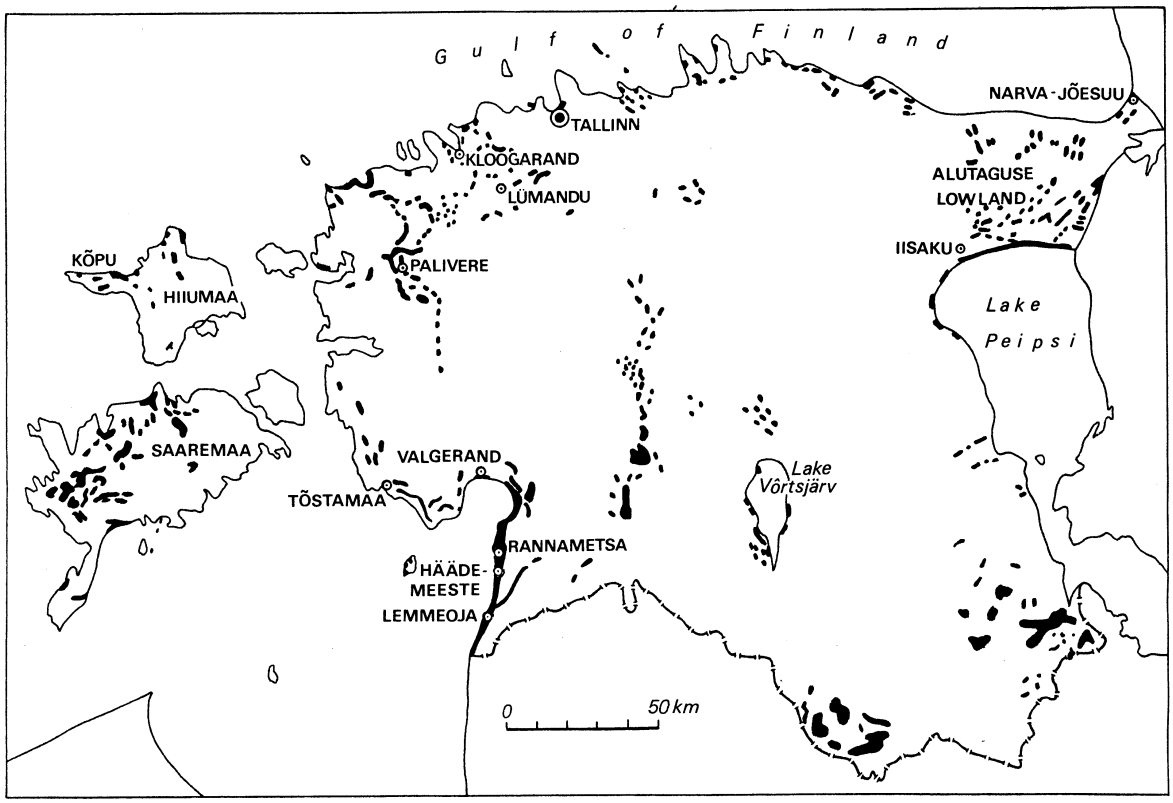


Fig. 189. The biggest sand dunes and main areas of aeolian sand.

Dry acidic sand sune grassland in Värska
– Velna (near lake Saarõpää, Pikalombi trail)
– Setu museum, Tsäimaja grassland

Achillea millefolium	Elymus repens	Plantago lanceolata
Amelanchier spicata	Euphrasia sp	Poa pratensis
Amelanchier spicata	Euphrasia sp.	Potentilla erecta
Amelanchier spicata	Festuca ovina	Prunella vulgaris
Anthoxanthum odoratum	Festuca rubra	Salix daphnoides
Carex hirta	Fragaria vesca	Scorzonera humilis
Carex leporina	Galium album	Stellaria graminea
Carum carvi	Galium verum	Trifolium repens
Cerastium fontanum	Knautia arvensis	Veronica chamaedrys
Deschampsia cespitosa	Linaria vulgaris	Veronica serpyllifolia
Dianthus deltoides	Pimpinella saxifraga	

Floating (quaking) fens and mires – Velna (Pikalombi trail)

Vascular plants

Andromeda polifolia	Carex lasiocarpa	Drosera rotundifolia
Betula nana	Carex limosa	Epilobium palustre
Calla palustris	Carex pauciflora	Equisetum palustre
Carex canescens	Carex rostrata	Eriophorum angustifolium
Carex diandra	Chamaedaphne calyculata	Eriophorum vaginatum
Carex dioica	Dactylorhiza incarnata	Lycopus europaeus

Menyanthes trifoliata
Molinia caerulea
Oxycoccus palustris
Phragmites australis
Potentilla palustris
Rumex hydrolapathum
Salix lapponum
Salix myrsinifolia
Salix phylicifolia
Scheuchzeria palustris
Stellaria palustris
Trichophorum alpinum

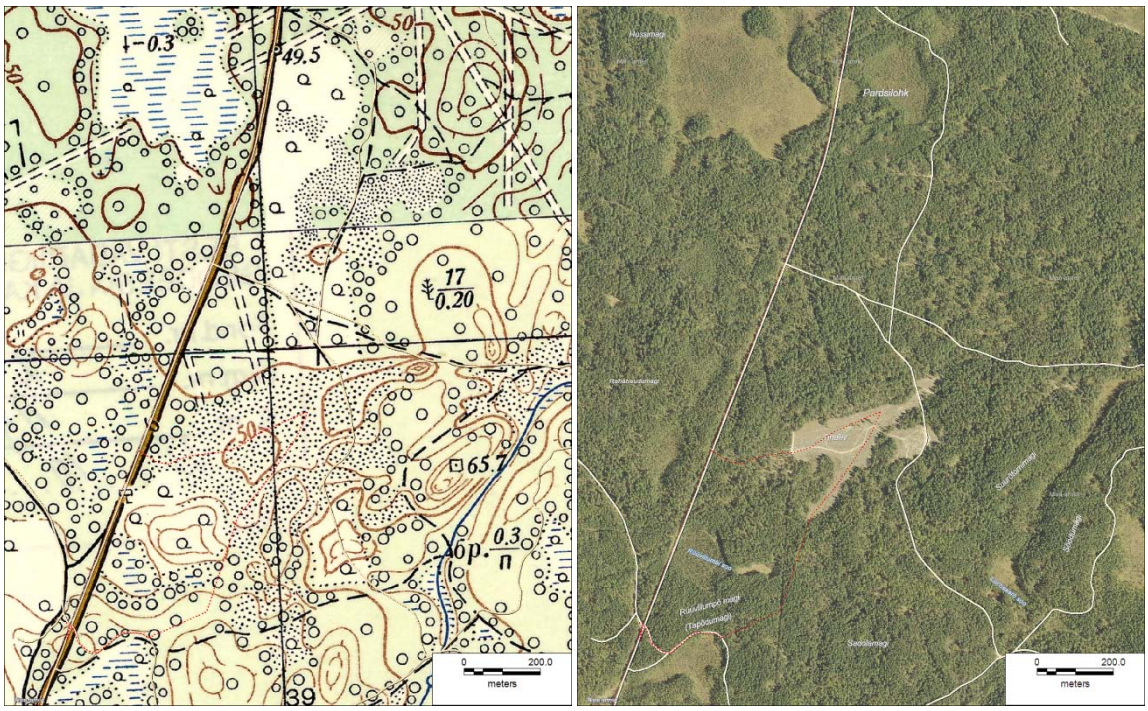
Bryophytes

Aulacomnium palustre
Marchantia polymorpha
Pleurozium schreberi
Polytrichum strictum
Sphagnum angustifolium
Sphagnum flexuosum
Sphagnum fuscum
Sphagnum magellanicum
Warnstorfia exannulatus

Small mires and bogs between hillocks

Carex acuta
Carex acutiformis
Carex canescens
Carex globularis
Carex lasiocarpa
Carex nigra
Chamaedaphne calyculata
Gymnadenia conopsea
Menyanthes trifoliata
Vaccinium oxycoccus
Vaccinium uliginosumu

Mustoja landscape reserve, Tinaliiv (translates as stannic-gray sand) sandy heath
Military practice area since 1920'ies (horses etc) until 1990 (tanks, armoured machines).



Map of 1950ies and present 2005. Large open areas have been decreased into a small fragment.

Vascular plants

Open sand heath	Calluna vulgaris	Solidago virgaurea
Betula pendula	Carex ericetorum	Thymus serpyllum
Frangula alnus	Festuca ovina	Vaccinium myrtillus
Juniperus communis	Hieracium umbellatum	Vaccinium uliginosum
Pinus sylvestris	Koeleria glauca	Vaccinium vitis-idaea
	Melampyrum pratense	
Arctostaphylos uva-ursi	Senecio viscosus	

Dry successional forest and road margins

Achyrophorus maculatus	Goodyera repens	Polygonatum odoratum
Antennaria dioica	Gypsophila fastigiata	Pulsatilla patens
Artemisia campestris	Helichrysum arenarium	Pulsatilla pratensis
Botrychium lunaria	Hypopitys monotropa	Quercus robur
Chimaphila umbellata	Koeleria grandis	Rosa canina
Deschampsia flexuosa	Leucanthemum vulgare	Scorzonera humilis
Dianthus arenarius	Libanotis montana	Sieglingia decumbens
Diphasiastrum complanatum	Lycopodium clavatum	Silene chlorantha
Diphasiastrum tristachyum	Onobrychis arenaria	Silene nutans
Epilobium angustifolium	Pilosella officinarum	Tilia cordata
Equisetum hyemale	Platanthera bifolia	

Bryopytes

Open sand habitat

Buxbaumia aphylla
Ceratodon purpureus
Dicranum polysetum
Dicranum scoparium
Pleurozium schreberi
Pogonatum urnigerum
Polytrichum juniperinum
Polytrichum piliferum
Ptilidium ciliare
Racomitrium canescens

Boreal forest

Brachythecium albicans
Ceratodon purpureus
Dicranum polysetum
Dicranum scoparium
Hylocomium splendens
Plagiochila asplenioides
Plagiomnium affine
Pleurozium schreberi
Pohlia nutans
Polytrichum commune
Polytrichum juniperinum
Polytrichum piliferum
Ptilium crista-castrensis
Rhytidiadelphus triquetrus

Lichens

Lichens on sand

Baeomyces carneus
Cetraria islandica
Cetraria muricata
Cladonia cariosa
Cladonia carneola
Cladonia cervicornis subsp. Verticillata
Cladonia coccifera
Cladonia cornuta
Cladonia crispata
Cladonia deformis
Cladonia furcata
Cladonia macilenta
Cladonia mitis
Cladonia pyxidata
Cladonia rangiferina
Cladonia uncialis
Dibaeis baeomyces – Red List NT
Placynthiella uliginosa
Pycnothelia papillaria – Red List NT
Stereocaulon condensatum – Red List NT
Stereocaulon paschale
Trapeliopsis granulose

Dry pine forest (The Cladonia type, Calluna type, Vacc.vitis-idaea type)

Bryoria capillaris – tree
Bryoria fuscescens – tree
Cetraria islandica – ground
Chaenotheca chrysocephala – spruce
Chaenotheca ferruginea – pine
Cladonia arbuscula – ground
Cladonia cenotea – pine (base)
Cladonia cornuta – ground
Cladonia crispata – ground
Cladonia digitata – pine (base)
Cladonia fimbriata – pine (base)
Cladonia mitis – ground
Cladonia rangiferina – ground
Cladonia stellaris – ground
Coenogonium pineti – pine (base)
Hypocenomyce scalaris – pine
Hypogymnia physodes – various trees
Imshaugia aleurites – pine
Lecidea nylanderi – pine
Parmeliopsis ambigua – pine
Peltigera aphthosa – ground
Peltigera neckeri – ground
Phlyctis argena – alder
Platismatia glauca – spruce
Pseudevernia furfuracea – various trees
Tuckermannopsis chlorophylla – spruce
Usnea dasypoga – pine
Usnea hirta – various trees
Vulpicida pinastri – pine

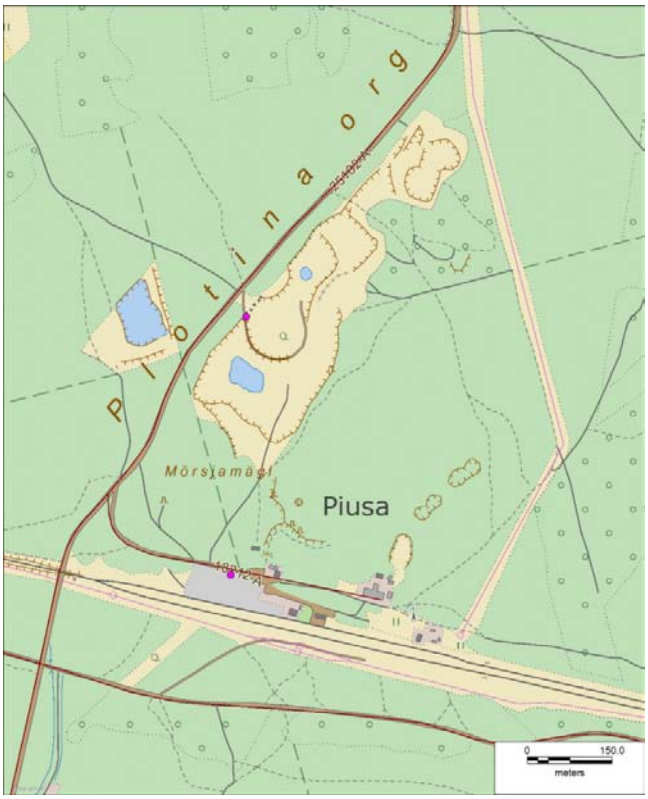
Piusa sand mine - the Nature reserve of the Piusa caves

Nature reserve concentrates mostly on the protection of the sandstone cave systems (6 of them) and the surrounding landscape. The caves of Piusa are galleries of a former quartz sand quarry, max cave height 10m and overall length ca 20km. Sand has mostly used for glass production. However, during the WW II, germans produced bomb shells from this sand. Discovered 1920, underground mining 1922-1966 (transport activity until 1976). Open ground quarry is more recent since 1966.

Cave system is the largest hibernating site for bats in the Baltics. All wintering seven bat species (out of 12 summer species of Estonia) use it. Bats come to hibernate in Piusa from distances of up to 100km, while their total number varies from 2500-3700 individuals in last years, but it was 7000-8000 in early 1980ies, when caves we not visited by a wide public.

On the western edge of the open mining site, resque planting of *Dianthus arenarius*, *Helichrysum arenarium*, *Jovibarba globifera* and (*Silene chlorantha*) was done in 2007/2008. Plants were brought from renovated railway line. This winter,the regrowth of pine was cut back to improve light conditions.

Other protected species are the sand lizard (*Lacerta agilis*), the common spadefoot (*Pelobates fuscus*) and the northern (great) crested newt (*Triturus cristatus*) inhabiting sand quarry ponds, located next to the caves. Specific plants of the site are: *Teesdalia nudicaulis*, *Veronica dillenii* and *Holcus mollis* . At the bottom of mine - *Lycopodiella inundata* and *Epipactis palustris*.



<u>Vascular plants</u>

<u>Dry sand</u>

Arenaria procera
Dianthus arenarius
Helichrysum arenarium
Hieracium umbellatum
Holcus mollis
Jasione montana
Jovibarba globifera
Koeleria glauca
Pilosella echioides
Pilosella officinarum
Silene chlorantha
Thymus serpyllum
Trifolium repens
Veronica spicata

<u>Bottom of the mine – wet sand</u>

Centaurium littorale
Dactylorhiza spp
Epipactis palustris
Equisetum scirpoides
Lycopodium inundatum

<u>Around</u>

Oxytropis pilosa
Melilotus albus
Melilotus officinalis
Dianthus deltoides

July 2

The river Great Emajõgi

Emajõgi is 100 km long, 145 m wide and up to 11 m deep. It unites two big lakes Lake Peipsi and Võrtsjärv. Historically the river has been an important trading route and the only navigable river in Estonia. The Emajõgi played a significant role in the development of the town of Tartu.

Kavastu raft

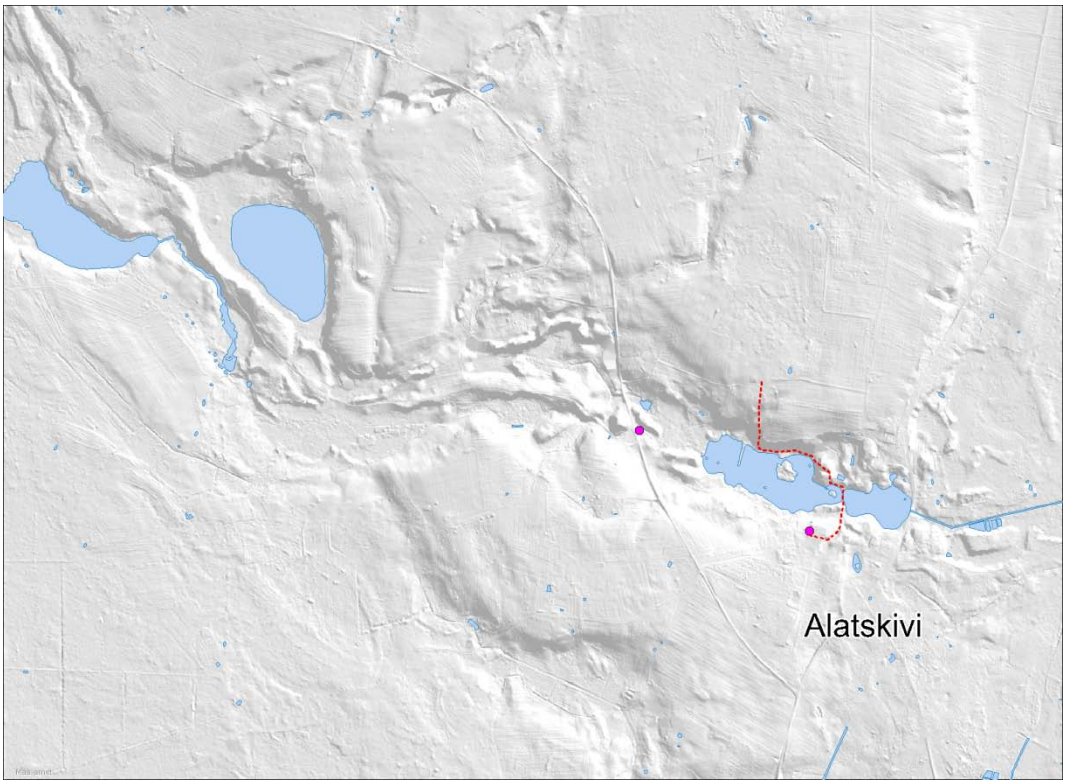
The only operating cable ferry in Estonia. More than hundred years ago, rafts were main means of transport to cross rivers. On Emajõgi from Tartu to Peipsi, the first bridge was built in early 1930ies. Raft in Kavastu functions since 1899, but it has not always been safe for humans or horses. E.g. in 1983 the chain of the raft broke and the raft went down the river and disappeared.

Russian settlement along the western coast of Lake Peipsi

Western coastal area of Lake Peipsi is an example of coexistence of different cultures and denominations for centuries. Compact Estonian and Russian settlement is located intermittently. Russian orthodox, Russian Old Believer (Raskolnik) and Estonian Lutherian areas.
The russian settlement on the western coast of Lake Peipsi dates back to the end of the 17th and 18th century, mostly in the 1730-s. Migration trigger was the schism (Raskol in Russian) in 1666 in old Russia, because the church reforms in Russia draw the Russian orthodox Church toward Greek Catholic church. Among other aspects, the Church service was shortened, liturgy books were improved, crossing oneself with two fingers was replaced with crossing oneself with three fingers, and the floorlength obeisance was replaced with the knee-high obeisance. Also, the old believers' church has 8-branch cross and larger onion-dome. They protested against the western influence, particularly against the secular education and insisted respecting of old Russian traditions. The raskolniks were proclaimed outlaws and their only escape was the marginal areas of the Russian Empire. Peipsi shores were outskirts even in Estonia and local luterians regarded indifferently the inner problems of the Russian Church. The land there by the lake was unproductive. Old believers lived and still live in isolation per village group (about four). The main activities are fishing and vegetable oriented agriculture – particularly famous is local onion. The villages here have an easy to recognize structure - the households are lined along one street passing through the village and the households are located very closely side by side.

Alatskivi landscape reserve and mixed boreo-nemoral forest

The first mention about Alatskivi Manor dates back to the year 1601. In 1628, King Gustav II Adolf of Sweden gave the manor to his secretary Johan Adler Salvius.
Alatskivi Castle Park (85 ha) was established in the end of the 18th century as regular park. In the end of 19th century, park was redesigned into English type landscape garden together with building a new manor house in a style of Balmorali castle in Scotland.
On the northern shore of the lake are situated mount of Alatskivi stronghold and sacred spring, called Red spring, and the oak of faithfulness.



Terrain around Alatskivi – the structure of ancient valley and esker in it can be recognized.

<u>Mixed boreo-nemoral forest</u>

Vascular plants

Acer platanoides
Alnus glutinosa
Alnus incana
Fraxinus excelsior
Populus tremula
Quercus robur
Tilia cordata

Acer platanoides
Actaea spicata
Aegopodium podagraria
Alliaria petiolata
Alnus incana
Anemone nemorosa
Anthriscus sylvestris
Asarum europaeum
Athyrium filix-femina
Betula pendula
Brachypodium pinnatum
Bromopsis inermis
Calamagrostis arundinacea
Calamagrostis canescens
Campanula latifolia
Campanula rapunculoides
Campanula trachelium
Carex canescens
Carex digitata
Carex elongata
Carex spicata
Chelidonium majus
Convallaria majalis
Corylus avellana
Crepis paludosa
Dactylis glomerata
Deschampsia cespitosa
Dryopteris carthusiana
Dryopteris expansa
Dryopteris filix-mas
Elymus caninus

Epilobium montanum
Equisetum hyemale
Equisetum pratense
Equisetum sylvaticum
Festuca gigantea
Filipendula ulmaria
Fragaria vesca
Fraxinus excelsior
Galeobdolon luteum
Galeopsis tetrahit
Galium uliginosum
Geranium palustre
Geum rivale
Geum urbanum
Glechoma hederacea
Gymnocarpium dryopteris
Hepatica nobilis
Impatiens noli-tangere
Impatiens parviflora
Lamium album
Lapsana communis
Lathyrus pratensis
Lonicera xylosteum
Luzula pilosa
Lysimachia vulgaris
Maianthemum bifolium
Melampyrum nemorosum
Melampyrum pratense
Melica nutans
Mercurialis perennis
Moehringia trinervia
Mycelis muralis
Myosotis sylvatica
Oxalis acetosella
Padus avium
Paris quadrifolia
Phegopteris connectilis
Picea abies
Poa compressa
Poa nemoralis
Poa trivialis
Populus tremula
Prunella vulgaris
Pteridium aquilinum
Quercus robur
Ranunculus cassubicus
Ranunculus repens
Ribes rubrum
Rubus idaeus
Rubus saxatilis
Sambucus racemosa
Scrophularia nodosa
Solidago virgaurea
Sorbus aucuparia
Sparganium sp.
Stachys sylvatica
Stellaria holostea
Stellaria media
Stellaria nemorum
Taraxacum officinale
Thelypteris phegopteris
Tilia cordata
Trientalis europaea
Ulmus glabra
Urtica dioica
Vaccinium myrtillus
Valeriana officinalis
Veronica chamaedrys
Veronica teucrium
Viburnum opulus
Vicia sepium
Viola mirabilis
Viola riviniana

Lake shores and grasslands

Butomus umbellatus
Carex acuta
Carex acutiformis
Carex appropinquata
Carex cespitosa
Cicuta virosa
Cirsium oleraceum
Elymus repens
Filipendula ulmaria
Geranium palustre
Glyceria fluitans
Glyceria maxima
Lemna minor
Leonurus cardiaca
Nuphar lutea
Nymphaea alba
Phalaris arundinacea
Phragmites australis
Scirpus sylvaticus
Sparganium sp.
Stachys palustris
Veronica anagallis-aquatica
Veronica beccabunga

Bryophytes

Forest epiphytes and ground

Anomodon attenuatus
Brachythecium rutabulum
Eurhynchium hians
Homalia trichomanoides
Hypnum cupressiforme
Leucodon sciuroides
Orthotrichum speciosum
Plagiomnium cuspidatum
Pseudoleskeella nervosa
Pylaisia polyantha
Radula complanata
Atrichum undulatum
Plagiomnium undulatum
Plagiomnium cuspidatum

Kallaste sandstone escarpment / outcrop

Outcrop – max height 9m, lensh 1.2km. Mid-Devonian sandstone with age ca 390-380 My, when Balctica continent was located on equator. Paleontological findings of lobe-finned fishes, lung fishes , jaw less fishes and armoured fishes, inhabiting low-water river deltas. In outcrop wall, there is large colony of the sand martins (*Riparia riparia*).

Vascular plants

Chelidonium majus
Cystopteris fragilis
Elymus repens
Phalaris arundinacea
Phragmites australis
Stachys palustris
Stellaria nemorum

Bryophytes

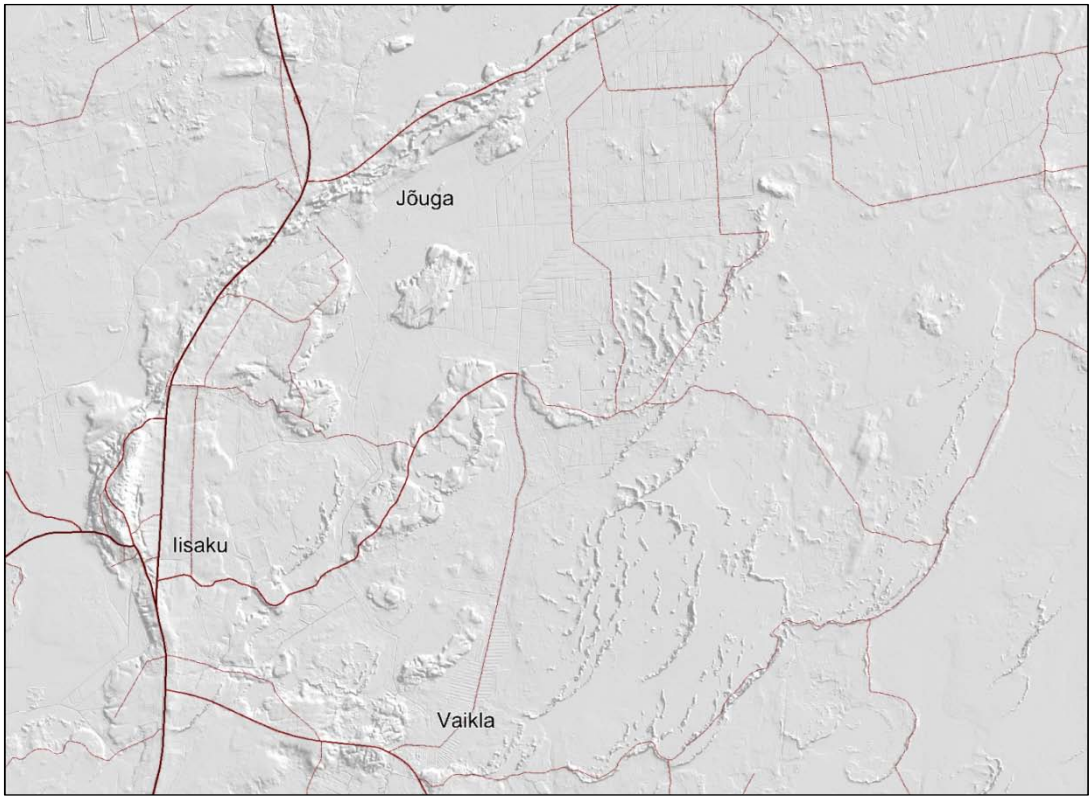
Sandstone

Funaria hygrometrica
Amblystegium serpens
Brachythecium albicans
Brachythecium rutabulum
Brachythecium salebrosum
Bryum argenteum
Ceratodon purpureus
Funaria hygrometrica
Hypnum cupressiforme
Leptobryum pyriforme
Plagiomnium cuspidatum
Pogonatum urnigerum
Pohlia nutans
Pohlia proligera
Polytrichum juniperinum
Tortula muralis
Tortula ruralis

Lichens on sandstone

Bacidia bagliettoana
Bilimbia sabuletorum
Caloplaca citrina
Cladonia fimbriata
Cladonia ochrochlora
Lecania sylvestris
Lecanora albescens
Lecanora hagenii
Lecanora perpruinosa
Lepraria incana
Lepraria lobificans
Peltigera didactyla
Phaeophyscia orbicularis
Physcia tenella
Protoparmeliopsis muralis
Trapelia placodioides
Verrucaria muralis

Eskers and inland dunes “kriiva”s

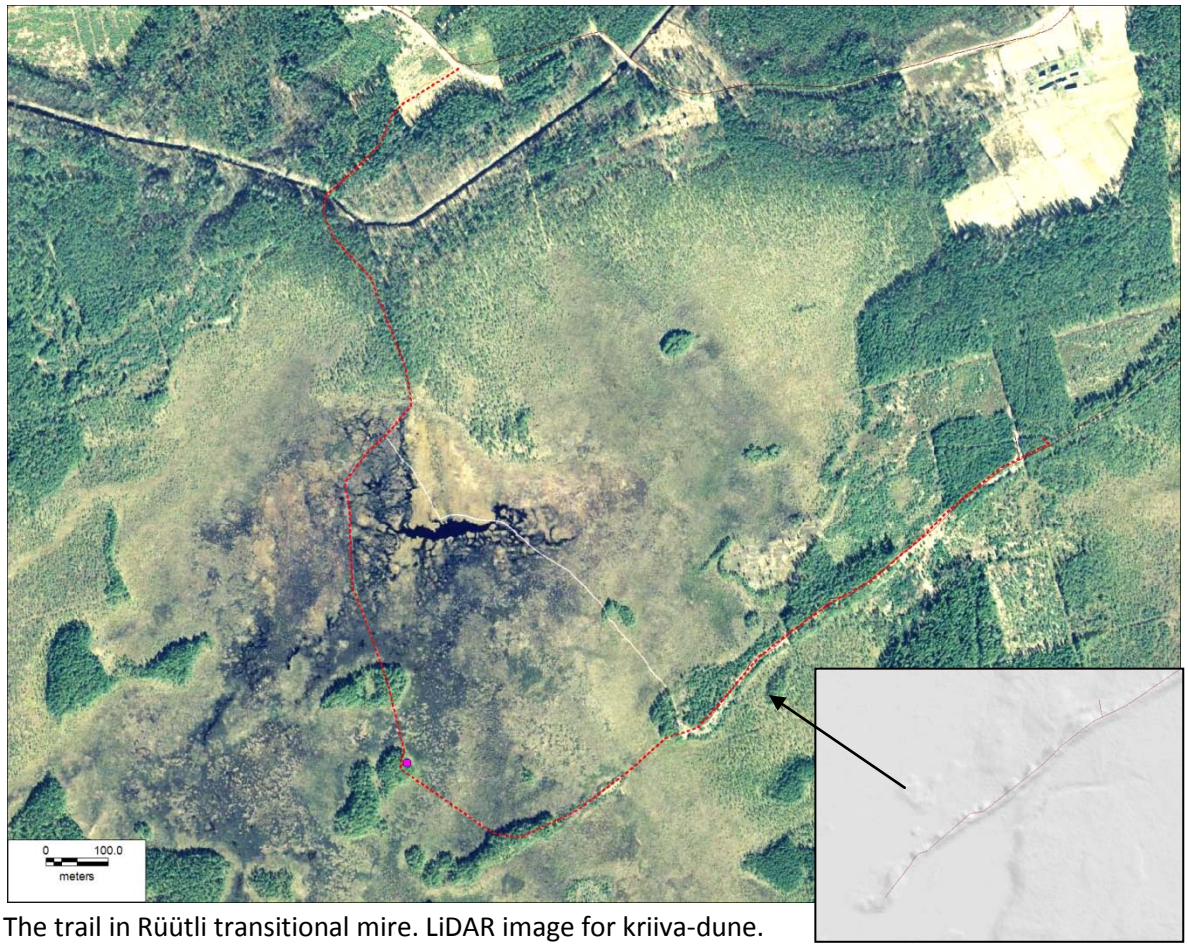


Terrain east from Iisaku. From left diagonally up - esker from Iisaku over Jõuga to Illuka; centre and right – inland dunes “kriivas”.

Three types of dunes exist in Estonia – active shore dunes (e.g. Hiiuma or north coast of Lake Peipsi), historic seashore dunes (e.g. near Pärnu) and inland dunes – kriivas only in Alutaguse. Therefore kriivas are landscape symbol of the region.

“Kriiva” comes from Russian word meaning ‘curved’. The formation of inland dunes is usually related to sandy deserts, but presently kiivas are located in the most forest and bog rich region of Estonia. There are ca 200 inland dunes counrd in NE-Estonia. They formed during the existence of cold desert at the end of Glacial period by the wind about time of late-Dryas ja Pre-Boreal (i.e. ca 9000 – 11 000 BP). Their present heigt varies between 3 to 18m, the longest 3.3 km, width only 20-30m. (Pae et al 2010 EL).

Rüütli transitional mire and inland sand dune



The trail in Rüütli transitional mire. LiDAR image for kriiva-dune.

Kotka Hiking Trail near Iisaku (3 km) passes through the Bog of Rüütli – from N – E – fen forest V.uliginosum; trasitional mire, residual bog lake, bog island (grazed), inland dune vegetation, distorted trees for resin collection and “gold hole”. There has been historic winter road. Name Rüütli, comes from Estonian word knight, the last Swedish knght who staid behind to stop Russians ,while other troops fled through the bog (probably in the 17th or early 18-hundred).

Vascular plants

<u>Iisaku river</u>

Alisma plantago-aquatica
Carex pseudocyperus
Carex riparia
Filipendula ulmaria
Glyceria fluitans
Scirpus sylvaticus
Valeriana officinalis

<u>Vacc.uliginosum type fen forest</u>

Carex brunnescens
Carex canescens
Carex globularis
Carex pauciflora
Empetrum nigrum
Eriophorum angustifolium
Eriophorum vaginatum
Ledum palustre
Pedicularis palustris
Peucedanum palustre
Phragmites australis
Potentilla palustris
Vaccinium myrtillus
Vaccinium uliginosum

<u>Transitional mire</u>

Andromeda polifolia
Betula nana
Carex acuta
Carex canescens
Carex lasiocarpa
Carex limosa
Carex nigra
Carex pauciflora
Carex rostrata
Carex vesicaria
Drosera anglica
Drosera rotundifolia
Eriophorum vaginatum
Menyanthes trifoliata
Phragmites australis
Rhynchospora alba
Trichophorum alpinum
Utricularia vulgaris

Vaccinium oxycoccus

Semi-open community on inland dune (kriiva)
Arctostaphylos uva-ursi
Calamagrostis epigeios
Calluna vulgaris
Carex caryophyllea
Carex ericetorum
Carex globularis
Deschampsia flexuosa
Dianthus arenarius
Hieracium umbellatum
Melampyrum pratense
Pinus sylvestris
Scleranthus perennis
Solidago virgaurea
Thymus serpyllum
Vaccinium vitis-idaea
Veronica officinalis

Bryophytes

Fen forest
Dicranum polysetum
Dicranum scoparium
Pleurozium schreberi
Polytrichum commune
Polytrichum strictum
Sphagnum angustifolium
Sphagnum capillifolium
Sphagnum fallax
Sphagnum flexuosum
Sphagnum magellanicum
Sphagnum obtusum
Sphagnum russowii

Forests
Aulacomnium palustre
Brachythecium albicans
Ceratodon purpureus
Dicranum polysetum
Dicranum scoparium
Hylocomium splendens
Plagiochila asplenioides
Plagiomnium affine
Pleurozium schreberi
Pohlia nutans
Polytrichum commune
Polytrichum juniperinum
Polytrichum piliferum
Ptilium crista-castrensis

Lichens (mostly in forest area)

Bryoria capillaris – pine
Bryoria fuscescens – pine
Cetraria islandica – ground
Cetraria sepincola – pine
Cladonia arbuscula – ground
Cladonia botrytes – stumps
Cladonia cenotea – pine (base)
Cladonia cornuta – ground
Cladonia crispata – ground
Cladonia deformis – ground
Cladonia digitata – pine (base)
Cladonia floerkeana – ground
Cladonia furcata – ground
Cladonia gracilis subsp. elongata – ground
Cladonia gracilis subsp. gracilis – ground
Cladonia macilenta – ground
Cladonia ochrochlora – pine
Cladonia pyxidata – ground
Cladonia rangiferina – ground
Cladonia stellaris – ground
Cladonia uncialis – ground
Hypocenomyce scalaris – pine
Hypogymnia physodes – pine
Imshaugia aleurites – pine
Lecidea nylanderi – pine
Parmeliopsis ambigua – pine
Peltigera rufescens – ground
Placynthiella icmalea – ground
Placynthiella uliginosa – ground
Platismatia glauca – pine
Pseudevernia furfuracea – pine
Pycnora sorophora – pine
Trapeliopsis granulosa – ground
Usnea hirta – pine
Vulpicida pinastri – pine

Mäetaguse
Manor and park

The first owner of the manor was Peter von Tiesenhausen in 1542. The present-day main building was established in 1796 by the rule of the family von Rosens (owner since 1919), but it was renovated in 1890. Hotel and SPA is historic stable and carriage shed. Park was first designed as regular in complex with new main building, but redesigned as free style English park in the 19th century. Redesign was organized by Eugen von Rosen, who ordered every peasant and worker to come for celebration, but to bring and plant a tree as well. House lady and children watched in distance, but the herr itself enjoyed dancing with slave girls (according to memories Daniel Reisberg, recorded E. Tensmann in 1931). The same land lord and his father educated locals by letting to translate sermons of Ignatiusel Schubert into Estonian and organized public readings near chapel. However, a generation before that, O.F.Rosen complied agricultural law in 1739, which declared the special status and right to Baltic land lords and put slavery bondage on peasants i.e. only manor's rule (later called Ronen declaration).

Some selected vascular plants from park

Aegopodium podagraria
Athyrium filix-femina
Carex spicata
Carex sylvatica
Chaerophyllum aromaticum
Festuca gigantea
Lapsana communis
Moehringia trinervia
Mycelis muralis
Myosotis sylvatica
Poa nemoralis
Ranunculus cassubicus

Bryophytes

Epiphytes

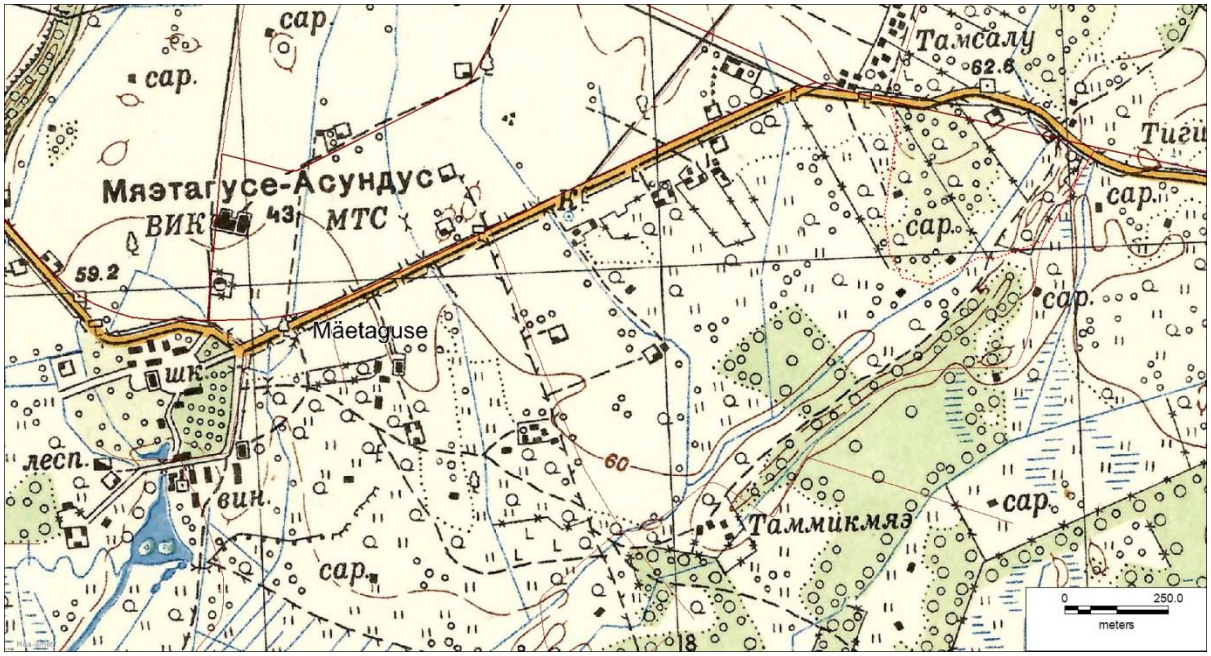
Amblystegium serpens
Brachythecium populeum
Hypnum cupressiforme
Leucodon sciuroides
Neckera pennata
Orthotrichum speciuosum
Otrhotrichum obtusifolium
Plagiomnium cuspidatum
Pseudoleskeella nervosa
Pylaisia polyantha
Radula complanata
Tortula ruralis

Epilithic

Amblystegium subtile
Brachythecium populeum
Homalia trichomanoides
Pseudoleskeella nervosa
Racomitrium heterostichum

July 3
Mäetaguse wooded meadow

Oak woodland and wooded grassland mosaic, where local lord used to go for a drive with a hansom in early mornings. The area of wooded meadow has been overgrown with secondary tree species or transformed into rotational agricultural land. The restoration of woodland pasture started 2012.



Left - Mäetaguse manor (park), Right – wooded meadow with different densities of stand (Map of 1950'ies).

Present day orthophoto (Estonian Land-Board). Note the increased density of trees in the grassland, while the landscape structure has been retained.

Vascular plants

Restored wooded grassland

Aegopodium podagraria
Allium oleraceum
Anthoxanthum odoratum
Anthriscus sylvestris
Brachypodium pinnatum
Briza media
Campanula glomerata
Campanula patula
Campanula persicifolia
Carex hirta
Centaurea jacea
Centaurea scabiosa
Cichorium intybus
Cirsium heterophyllum
Dactylis glomerata
Deschampsia cespitosa
Festuca rubra
Filipendula ulmaria
Filipendula vulgaris
Galium album
Galium boreale
Galium verum
Geranium palustre
Geranium pratense
Geranium sylvaticum
Geum rivale
Helianthemum nummularium
Helictotrichon pratense
Helictotrichon pubescens
Heracleum sibiricum
Hypericum maculatum
Hypericum perforatum
Knautia arvensis
Leucanthemum vulgare
Melampyrum nemorosum
Phleum pratense
Plantago lanceolata
Plantago media
Poa angustifolia
Poa trivialis
Polygonum viviparum
Potentilla erecta
Ranunculus auricomus
Rubus idaeus
Scorzonera humilis
Trifolium montanum
Trollius europaeus
Veronica chamaedrys
Vicia cracca

Mixed nemoral forest

Alnus glutinosa
Betula spp
Corylus avellana
Lonicera xylosteum
Padus avium
Populus tremula
Quercus robur

Actaea spicata
Aegopodium podagraria
Anemone nemorosa
Asarum europaeum
Carex digitata
Carex sylvatica
Convallaria majalis
Geum urbanum
Hepatica nobilis
Lathyrus palustris
Lathyrus vernus
Melampyrum nemorosum
Melica nutans
Mercurialis perennis
Neottia nidus-avis
Paris quadrifolia
Pteridium aquilinum
Pulmonaria obscura
Ranunculus cassubicus
Rubus saxatilis
Stellaria holostea
Vicia sylvatica
Viola mirabilis

Moist oak woodland

Quercus robur

Athyrium filix-femina
Calamagrostis canescens
Calamagrostis purpurea
Cirsium oleraceum
Crepis paludosa
Deschampsia cespitosa
Filipendula ulmaria
Iris pseudacorus
Mercurialis perennis
Pulmonaria obscura
Urtica dioica

Bryophytes

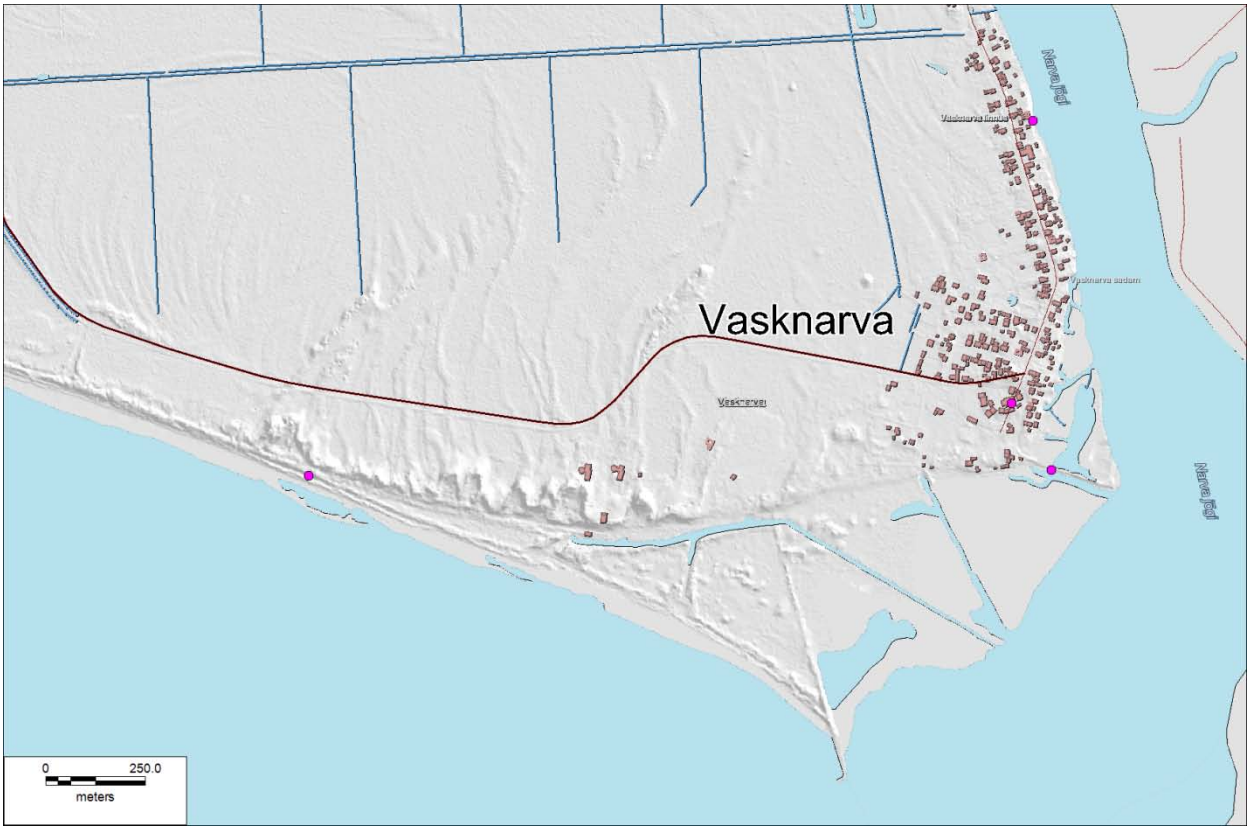
Amblystegium subtile
Brachythecium populeum
Brachythecium rutabulum
Eurhynchium hians
Hypnum cupressiforme
Leucodon sciuroides
Orthotrichum speciuosum
Plagiomnium affine
Plagiomnium cuspidatum
Pseudoleskeella nervosa
Radula complanata
Sanionia uncinata
Thuidium philibertii

Northern coast of Lake Peipsi

Vasknarva moles and active sand dunes with forest – the NE-coast of lake Peipsi.

Pine forests full of light border sandy beach. The mires and forests go in parallel with the shoreline. The permanent population is rather negligible but the number of people multiplies in summer time. The 40 km long shore section of the Lake Peipsi lying west of Vasknarva can be considered ideal for swimming and recreation. Natural beach areas (e.g. Järvevälja dunes) alternate with camping and other recreation sites (e.g. Raadna, Kauksi) on the northern shore of Lake Peipsi. The sandy beach between Kuru and Kauksi is well known for the sand´s ability to sing or whistle, this can be explained by mutual impact of specific form of sand grains and winter.

Usually, the singing sands are smoother and silkier than the sands in general. It has also been stated that the singing sand is an indicator of the water´s good quality.



LiDAR image of the terrain west from Narva river and north from lake Peipsi. Left – coastal sand dunes. Right village Vasknarva and moles in the start of Narva river.

Vascular plants

Shores

Butomus umbellatus
Carex acuta
Glyceria fluitans
Glyceria maxima
Iris pseudacorus
Phalaris arundinacea
Sium latifolium
Solanum dulcamara
Stratiotes aloides
Typha angustifolia

Trampled sites

Dianthus deltoides
Sedum acre

Dunes and wet valleys (fen)

Artemisia campestris
Carex acuta
Dactylorhiza baltica
Deschampsia flexuosa
Festuca ovina
Leymus arenarius
Lycopodium clavatum
Melampyrum nemorosum
Melampyrum pratense
Petasites spurius
Pilosella officinarum
Pinus sylvestris
Platanthera bifolia
Platanthera chlorantha
Pulsatilla patens
Pulsatilla pratensis
Ranunculus flammula
Salix acutifolia
Solidago virgaurea

Bryophytes

Castle and mole

Amblystegium serpens
Brachythecium albicans
Brachythecium rutabulum
Ceratodon purpureus
Thuidium abietinum

Sandy habitats

Brachythecium albicans
Brachythecium salebrosum
Ceratodon purpureus
Climacium dendroides
Dicranum polysetum
Dicranum scoparium
Plagiomnium cuspidatum
Pohlia nutans
Racomitrium canescens
Thuidium abietinum
Thuidium philibertii
Tortula ruralis

Sand dune lichens

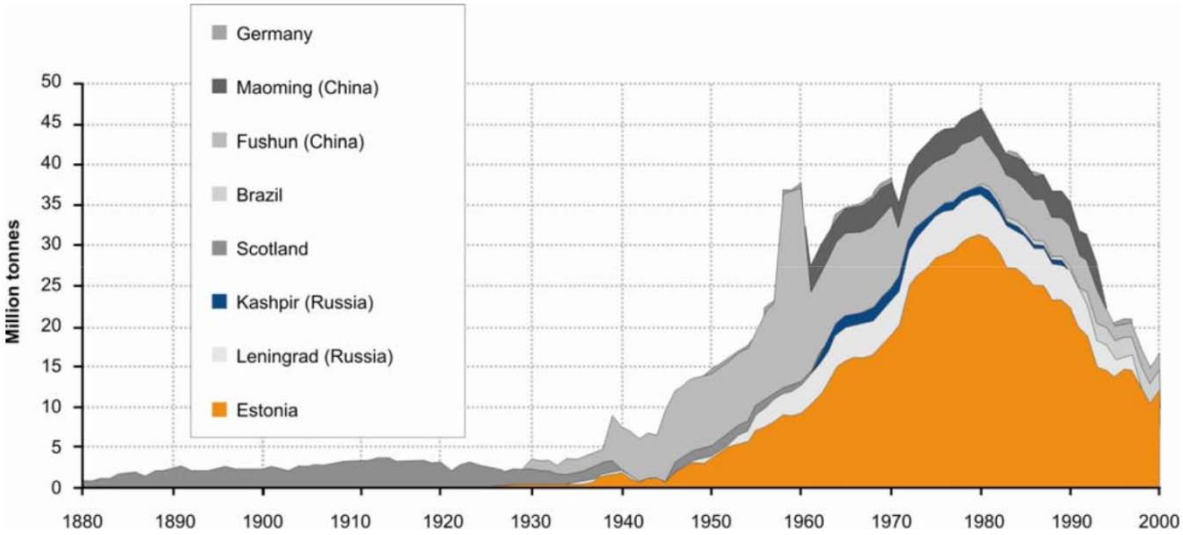
Cetraria islandica
Cladonia arbuscula
Cladonia chlorophaea
Cladonia gracilis
Cladonia mitis
Cladonia rangiferina
Cladonia subulata
Peltigera polydactylon

Oil shale

Oil shales are fine-grained sedimentary rocks containing relatively large amounts of organic matter (known as 'kerogen'). Shale means metamorphosed clay. Oil shales were deposited in a wide variety of environments, including freshwater to saline ponds and lakes, epicontinental marine basins and subtidal shelves. Low wave activity has induced well-laminated bedding of oil shale.

Because of these higher costs, only a few deposits of oil shale are currently being exploited – in Brazil, China, Estonia, Germany and Israel. Estonia produces two-thirds of the world's oli shale. Most of the present day decline is due to the gradual downsizing of the Estonian oil shale industry.

Figure 3-2 Oil shale mined from deposits in Brazil, China, Estonia, Germany, Russia and Scotland, 1880-2000
Source: USGS



The Baltic Oil Shale Basin is situated near the north-western boundary of the East European Platform. There are two kinds of oil shale in Estonia – Dictyonema argillite (claystone) and kukersite (derived from the name of the locality Kukruse). Both are shallow marine-type, from Ordovician period. The principal organic component of kukersite is derived from the fossil green alga, *Gloeocapsomorpha prisca*, which has affinities with the modern cyanobacterium *Entophysalis major*, a species that forms algal mats in inter-tidal to very shallow subtidal waters. Estonian kukersite deposits are one of the world's highest-grade deposits with more than 40% organic content and 66% conversion ratio into shale oil and oil shale gas, therefore Kukersite has higher energy value. Kukersite is also easily mined and therefore can be used directly as a combustible fuel in the industrial sectors and power plants or for oil distillation. Additionally kukersite ash could be used in the cement and brick-making industries. The spent shale (semi-coke) is used for portland cement production at the Kunda Nordic Cement factory.
Dictyonema argillite has lower energy quality (25% of organic content), but it contains pyrite and rare heavy metals, such as uranium, thesium, molybdenum, and vanadium. The shale was mined and uranium processed in 1947–1959 at Sillamäe.

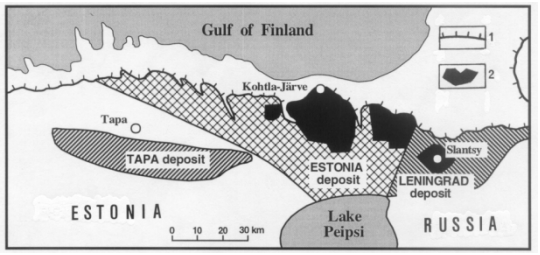


Fig. 203. Location of oil shale deposits in the Baltic Oil Shale Basin:
1 - Recent erosional boundary of kukersite oil shale;
2 - mined out areas and fields of active mines.

Oil shale was first scientifically researched in the 18th century. In 1838 work was undertaken to establish an open-cast pit. Modern production began in 1918, because of the fuel shortages created by World War I.

Oil shale is mined both underground mining and open-cast. The opencast mines use surface mining technology of stripping with relatively big bucket (10–35 cubic meters) excavators. Both the overburden and the bed are at first broken up by blasting. Stripping is done with smaller excavators in opencasts with thin overburden using front end loaders and hydraulic excavators. Underground mines exploit room and pillar method. Longwall mining, used earlier, was abandoned in 1990s. The historical ratio of underground mining to open-cast (approximately 50:50) is tending to move away from open-cast production as the bed depths increase – the exhausted open-cast areas are gradually being re-cultivated and reforested.

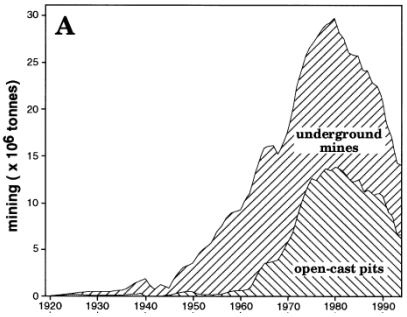


Fig. 207. Output of kukersite oil-shale in Estonia since 1919 (A), including list of all present and past open-cast pits and underground mines.

Kohtla-Nõmme mining museum

<u>Bryophytes</u>

Amblystegium serpens Fissidens adianthoides Leptobryum pyriforme

Reforestation of Aidu quarry

Aidu open mine is in the left-to-centre and above-ground refection of underground mining system in the right. Museum of mining is in the upper-right corner. Planted tree species: *Pinus sylvestris, Betula pendula, Picea abies, Larix sp, Acer platanoides, Acer negundo, Populus tremula or hybrids, Hippophae rhamnoides, Physocarpus sp, Caragana sp, Alnus glutinosa*. Over 70-80% of plantings and sowings have been successful.

Restoration and reforestation area – open site and surrounding forest (since 1960-ies)

Vascular plants

Betula pendula
Lonicera xylosteum
Malus domestica
Physocarpus opulifolius
Picea abies
Pinus sylvestris
Populus tremula
Rhamnus catharticus

Achillea millefolium
Aegopodium podagraria
Agrostis tenuis
Alchemilla sp.
Alopecurus pratensis
Anthoxanthum odoratum
Anthriscus sylvestris
Aquilegia vulgaris
Artemisia vulgaris
Briza media
Calamagrostis arundinacea
Calamagrostis epigeios
Campanula patula
Campanula rapunculoides
Carex flava
Carex hirta
Carex nigra
Carex panicea
Carex spicata
Carum carvi
Cerastium fontanum
Cirsium arvense
Dactylis glomerata
Deschampsia cespitosa
Epilobium angustifolium
Equisetum arvense
Equisetum pratense
Festuca arundinacea
Festuca ovina
Festuca pratensis
Festuca rubra
Filipendula ulmaria
Fragaria vesca
Galium album
Galium boreale
Geum rivale
Helictotrichon pratense
Hieracium umbellatum
Knautia arvensis

Lathyrus pratensis
Leontodon hispidus
Leucanthemum vulgare
Linaria vulgaris
Listera ovata
Lotus corniculatus
Luzula multiflora
Luzula pilosa
Medicago lupulina
Medicago sativa
Myosotis sylvatica
Ophioglossum vulgatum
Orchis militaris
Phalaris arundinacea
Pilosella officinarum
Pimpinella major
Plantago lanceolata
Plantago media
Poa angustifolia
Poa compressa
Poa nemoralis
Poa pratensis
Potentilla erecta
Prunella vulgaris
Pyrola rotundifolia
Ranunculus acris
Ranunculus auricomus
Ranunculus repens
Rumex crispus
Solidago virgaurea
Stellaria graminea
Stellaria graminea
Tragopogon pratensis
Trifolium hybridum
Trifolium repens
Tussilago farfara
Verbascum nigrum
Veronica chamaedrys
Vicia cracca
Vicia sepium

Mostly forest or semi-open areas

Acer negundo
Acer platanoides
Betula pendula
Caragana arborescens
Physocarpus opulifolius
Pinus sylvestris
Ribes alpinum
Rosa canina
Salix caprea
Salix spp.
Sorbus aucuparia

Achillea millefolium
Actaea spicata
Aegopodium podagraria
Anemone nemorosa
Angelica sylvestris
Anthriscus sylvestris
Artemisia vulgaris
Athyrium filix-femina
Brachypodium pinnatum
Calamagrostis arundinacea
Calamagrostis epigeios
Campanula persicifolia
Carex cespitosa
Carex digitata
Carex ornithopoda
Carum carvi
Centaurea jacea
Cerastium fontanum
Cirsium oleraceum
Convallaria majalis
Dactylis glomerata
Deschampsia cespitosa
Dryopteris filix-mas
Elymus caninus
Epilobium angustifolium
Epilobium montanum
Equisetum pratense
Erigeron acer
Festuca ovina
Festuca rubra
Filipendula ulmaria
Fragaria vesca
Galium boreale
Geranium sylvaticum
Geum rivale
Hieracium umbellatum
Hypericum maculatum
Knautia arvensis
Leontodon autumnalis
Leucanthemum vulgare
Linum catharticum
Lotus corniculatus
Medicago sativa
Mycelis muralis
Origanum vulgare
Orthilia secunda
Paris quadrifolia
Phragmites australis
Pilosella officinarum
Pilosella praealta
Poa trivialis
Pyrola rotundifolia
Ranunculus acris
Ranunculus cassubicus
Ranunculus repens
Rubus saxatilis
Scrophularia nodosa
Senecio viscosus
Silene dioica
Taraxacum officinale
Tragopogon pratensis
Trifolium medium
Trifolium pratense
Tussilago farfara
Veronica chamaedrys
Vicia cracca
Vicia sepium
Vicia tetrasperma

Bryophytes

Amblystegium serpens
Cirriphyllum piliferum
Hylocomium splendens
Plagiochila asplenioides
Plagiomnium undulatum
Pleurozium schreberi
Pylaisia polyantha
Sanionia uncinata

Artficial hills in NE Estonia

Along with the start of enrichment of oil-shale in Ida-Viru County the artificial hills started to shape the landscape already in 1930s. According to the composition the hills of waste piles of the oil-shale industry are classified into spoil heaps, ash dumps and heaps of semi-coke.

In **Kiviõli**, For instance, there are two heaps known as an old and a new mountain. The disposal of semi-coke and ash was launched there in 1922 and 1951, respectively. The relative height of the old heap is 96m and that of the new one is 116 metres. Their absolute height is greater than largest natural hills.The old semi-coke / ash hill has become a popular recreation site. The view from the hilltop embraces a wide panorama of the area of oil-shale mining. When the weather is sunny the Tütarsaared Islands and Suursaar Island, the chimneys of the electric power stations in Narva as well as several church towers can be seen from the hilltop.

Kukruse spoil heap is touristic viewpoint, but has problem of self-combusition for decades.

<u>Vascular plants</u>

Acer pseudoplatanus
Betula pendula
Caragana arborescens
Hippophae rhamnoides
Pinus sylvestris
Populus tremula
Salix spp.

Achillea millefolium
Aegopodium podagraria
Agrimonia eupatoria
Agrostis capillaris
Alopecurus pratensis
Anthemis tinctoria
Anthriscus sylvestris
Arctium tomentosum
Artemisia vulgaris
Bromopsis inermis
Bunias orientalis
Calamagrostis epigeios
Campanula rapunculoides
Capsella bursa-pastoris
Carum carvi
Centaurea jacea
Cirsium arvense
Cirsium vulgare
Conyza canadensis
Conyza canadensis / Erigeron canadensis
Crepis praemorsa
Crepis tectorum
Dactylis glomerata
Dactylorhiza incarnata
Echium vulgare
Elymus repens
Erigeron acer
Festuca pratensis
Festuca rubra
Galium album
Galium boreale
Galium verum
Helictotrichon pratense
Heracleum sosnowskyi
Hieracium umbellatum
Hieracium vulgatum
Hypericum perforatum
Lapsana communis
Lathyrus sylvestris
Leucanthemum vulgare
Lotus corniculatus
Matricaria perforata
Medicago lupulina
Medicago sativa
Melilotus albus
Pastinaca sativa
Pastinaca sylvestris
Phalaris arundinacea
Phleum pratense
Pilosella praealta
Pimpinella major
Poa angustifolia
Poa compressa
Poa pratensis
Potentilla norvegica
Ranunculus acris
Ranunculus repens
Rosa canina
Rumex crispus
Sagina nodosa
Scutellaria hastifolia
Silene alba
Solidago virgaurea
Taraxacum officinale
Tragopogon pratensis
Trifolium montanum

Trifolium pratense
Trifolium repens
Tussilago farfara
Urtica dioica
Verbascum nigrum
Vicia cracca
Vicia sepium

Bryophytes

Brachythecium salebrosum
Bryum argenteum
Bryum caespiticium
Ceratodon purpureus
Eurhynchium hians
Plagiomnium cuspidatum

Nearby park of Kukruse as comparison

Acer platanoides
Fraxinus excelsior
Larix spp.
Ribes uva-crispa
Tilia cordata
Ulmus glabra

Achillea millefolium
Aegopodium podagraria
Anthriscus sylvestris
Arctium tomentosum
Artemisia vulgaris
Carex spicata
Dactylis glomerata
Deschampsia cespitosa
Epilobium montanum
Galium album
Geum rivale
Geum urbanum
Impatiens parviflora
Lamium album
Lapsana communis
Luzula pallidula
Lycopodium annotinum
Moehringia trinervia
Mycelis muralis
Myosotis caespitosa
Myosotis sylvatica
Poa nemoralis
Poa trivialis
Ranunculus cassubicus
Ranunculus repens
Stellaria media
Taraxacum officinale
Urtica dioica
Veronica chamaedrys
Vicia sepium
Viola odorata

Other threats to environment

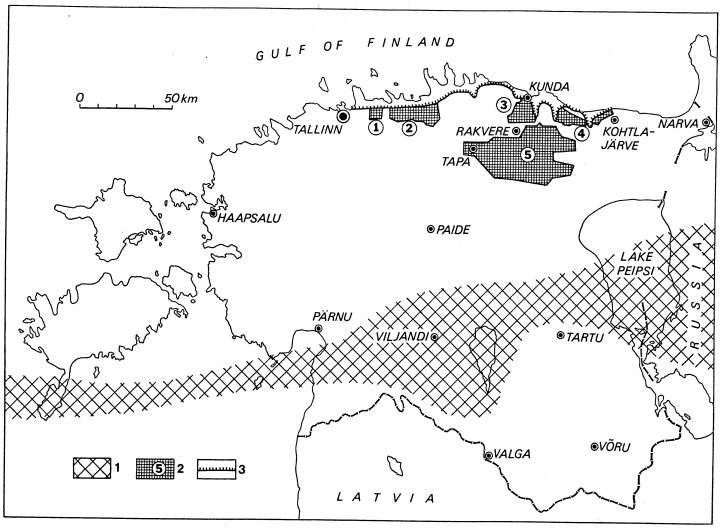


Fig. 218. Phosphorite deposits of Estonia:
1 - area where Obolus sandstone is lacking;
2 - phosphorite deposits (1 - Maardu, 2 - Tsitre, 3 - Toolse, 4 - Aseri, 5 – Rakvere);
3 - klint.

In 1987–88, when ministries of the USSR were planning the establishment of gigantic phosphorite mines in Northeast Estonia together with massive import of foreign labour, which was jeopardizing both the Estonian national identity and natural environment, nature conservation movement united the Estonian society and initiated an overall protest movement against phosphorite mining. These events, known as the Phosphorite War, triggered a rise in Estonians' national self-consciousness, which later (1991) led to restitution of the national independence of Estonia and indirectly also to the fall of the Soviet imperium.

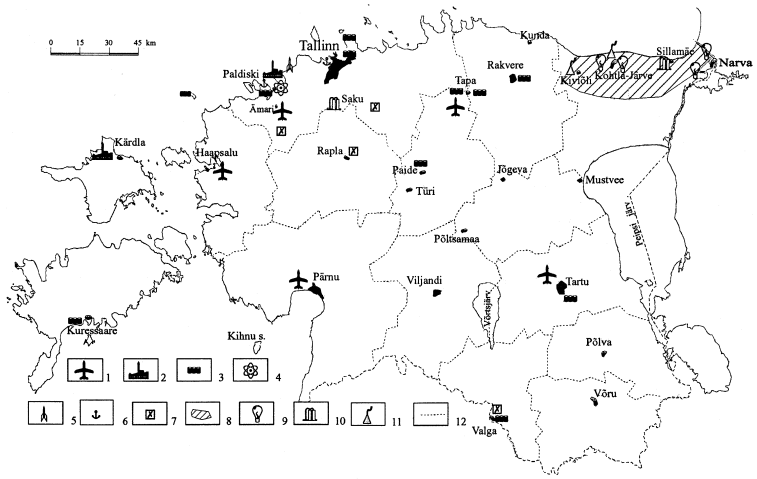


Fig. 105. Significant point-pollution sources: 1- airfield; 2 - boiler house; 3 - fuel depository; 4 - nuclear reactor, liquidated; 5 - missile base, liquidated; 6 - harbour; 7 - asphalt concrete works; 8 - industrial region of North-East Estonia; 9 - power station; 10 - radioactive waste depository; 11 - oil shale processing enterprise; 12 - boundary of the county. Compiled by the joint-stock company MAVES.

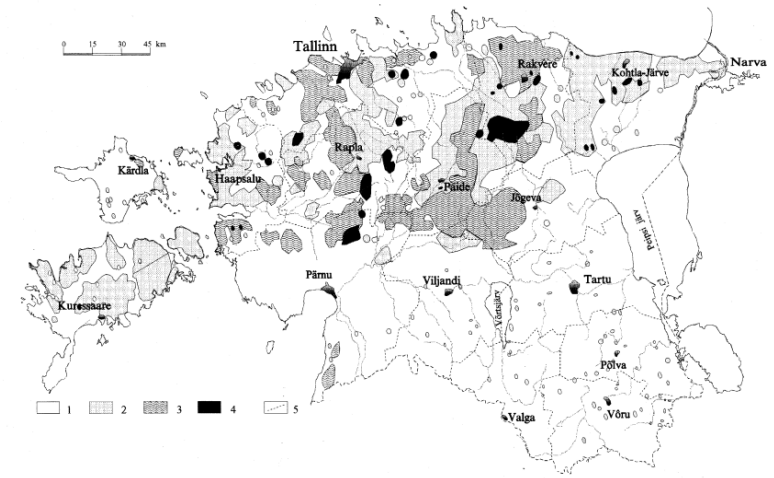


Fig. 106. Distribution of nitrates in groundwater to a depth of 30...100 m from the ground in 1990. 1-4 - concentration of nitrates in groundwater, mg/l:
1 - <4;
2 - 4...20;
3 - 20...45;
4 - >45;
5 - boundary of the county.
Compiled by L. Savitskaja.

July 4

The Baltic Klint

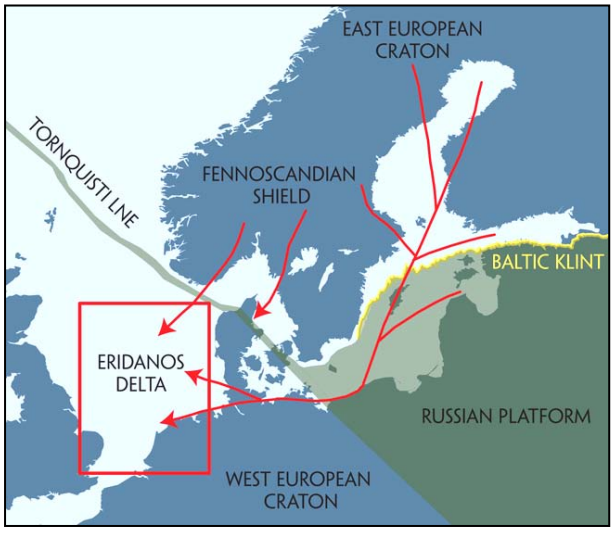
The Baltic Klint is a nature monument with a symbolic meaning for Estonia.

The Baltic Klint is an app. 1200-km-long system of erosional escarpments in Lower Palaeozoic (Cambrian to Ordovician) sedimentary rocks between the southern end of Öland Island in Sweden and Lake Ladoga (the estuary of the Syass River) in Russia. The klint follows more or less the boundary between the Fennoscandian (Baltic) Shield and the East European Platform.

The North Estonia Klint is an app. 300-km-long section of the Baltic Klint in North Estonia, between Osmussaar Island and the Narva River.

It has a number of lower limestone escarpments on the limestone plateau, to the south of the main escarpment (klint) abraded into Ordovician limestones. Although the limestone escarpment is often the most conspicuous part of the North Estonian Klint, it is by far not always the only one: for instance, of the 56-m-high klint escarpment at Ontika, only the upper 15 m are composed of limestone and the lower 40 m are composed of both Ordovician and Cambrian sandstones and clays. The steep escarpment abraded into Cambrian sandstones and blue clay between Kunda and Toolse is 35 m high, while the gentle-sloping, hardly noticeable limestone escarpment on top of the plateau is only 10 m high.

The hypotheses about the formation of the Baltic Klint associates it with the erosive action of water. Namely, the Pra-Neva River emanated from the area of the White Sea and flew west along the boundary between hard crystalline rocks of the Baltic (Fennoscandian) Shield and the softer sedimentary rocks covering the Russian Plate (Greisler et al. 1980). The Pra-Neva, flowing on a hard, more wear resistant crystalline basement (granites etc., exposed in Finland) with a slight southward dip (2–3 m per km), was denuding its southern bank consisting of softer sedimentary rocks more intensively and therefore shifted itself, too, gradually southward. The eroded material was transported into the location of the present day North Sea, an area called the Eridanos Delta. The hypothetic up to 2700-m-long giant river Eridanos, which began somewhere in the area of Lapland and ran across the eastern part of the Gulf of Bothnia and the western part of the Baltic Sea down to the Polish coast and from there across Denmark and German north coast into the North Sea. Pra-Neva played merely the role of one of the few eastern tributaries of this giant river. The Eridanos River ceased to exist about a million years ago due to the invasion of a continental glacier.



The Eridanos River and the Baltic Klint.

The Eridanos River got its name from an Old Greek legend according to which Phaeton (Faeton), son of Helios, was pushed down from the Vault of Heaven by Zeus with a lightning bolt and fell into this very river invisible to human eye. The Heliades (daughters of Helios, God of the Sun) came to the banks of this river to bevail their slain brother. Their bodies turned into poplars and their tears into amber. In the legends, the Eridanos River has been most often associated with the River Daugava (or Gauja).

Saka

Saka-Ontika-Toila Limestone Clint is the most important tourist sight of Ida-Virumaa County. From the edge of the highest Estonian limestone terrace (up to 56 metres above the sea level) a beautiful view opens to the sea. Also the three highest waterfalls of the Baltic Klint and also of the Baltic States are situated on Saka–Ontika Klint (ca 54m).

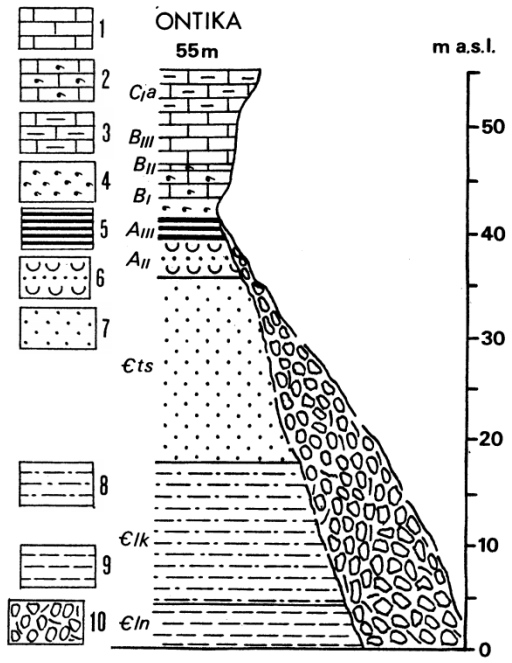


Fig. 254. Section of the North-Estonian Klint at Ontika near Saka (after Einasto & Saadre 1991). Legend:
1 - limestone;
2 - glauconitic limestone;
3 - oolitic limestone;
4 - glauconitic sand and sandstone;
5 - graptolitic argillite (Dictyonema shale);
6 - Obolus sandstone;
7 - fine-grained quartzose sandstone;
8 - siltstone;
9 - Cambrian blue clay;
10 - talus.

Klint forest (http://www.klint.envir.ee)

Forest is what adds expression to the foot of the North Estonian Klint. Forest spreads only there, where man with saw and agricultural acticity have not reached because the talus is too steep and narrow. Being a pristine and one of the best preserved ecosystems and relatively untouched by human impact , klint forest provides plenty of subjects worth investigating.

Estonian prime ecologist prof Theodor Lippmaa (1882–1943) was the first to differentiate klint forest as a separate plant geographical unit – forests of the sub-region of limestone coast (Estonia clivosa). By present classification (Paal 1997), it is classified as the Lunaria-site type of the type group of fresh boreo-nemoral forests. Standard version of klint forest is found only as a rather narrow strip (50–100 m on an average) at the foot of the high klint escarpment. Growth substratum of specific composition combined with a specific water regime and climatic conditions have created the preconditions for the development of klint forest – a plant community rather exceptional in northern conditions. Klint forests grow on Dictyonema shale, Obolus sandstone (phosphorite) and Cambrian sandstone and blue clay rich in micro- and macro-elements favourable for plant growth. The narrow strip and the neighbourhood of sea created specific climatic conditions that differ significantly from inland forests. Raised humidity, smaller temperature deviations, shelteredness from winds – all this is part of the microclimate of klint forest. Klint forest is rooted in water – this is the main specificity of its water regime - because groundwater is trickling out from above the clayey strata at the foot of the Cambrian-Ordovician escarpment.

Klint forest is one of the oldest-growth types of forest in Estonia, as the complicated access and unfavourable species composition (broadleaved trees) have not allowed the development of

commercial forestry in this area. The dominating tree species here are grey and black alder, aspen, elm, ash, lime, maple, birch, willow, less often oak. Conifers (mainly spruce) are very rare. The excessive lushness of broad-leaved forest, the head-high fern and honesty thickets, hops crawling on tree trunks like lianas, the heady flavour of moist decay, the clay-doughy soil of spring fens – there is something jungle-like in all of this.

Nemoral forest on talus (fits also for Kunda)

Vascular plants

Acer platanoides
Alnus incana
Fraxinus excelsior
Humulus lupulus
Padus avium
Quercus robur
Tilia cordata
Ulmus glabra
Ulmus laevis

Actaea spicata
Aegopodium podagraria
Allium ursinum
Anemone nemorosa
Anemone ranunculoides
Anemone ranunculoides
Athyrium filix-femina
Campanula latifolia
Campanula trachelium
Carex digitata
Carex pallescens
Carex spicata
Carex sylvatica
Chrysosplenium alternifolium
Convallaria majalis
Cystopteris fragilis
Dactylorhiza fuchsii
Dryopteris carthusiana
Dryopteris filix-mas
Elymus caninus
Epipactis helleborine
Equisetum pratense
Equisetum sylvaticum
Festuca altissima
Festuca gigantea
Filipendula ulmaria
Fragaria moschata
Fragaria vesca
Galeobdolon luteum
Galium aparine
Geranium sylvaticum
Geum rivale
Geum urbanum
Hepatica nobilis
Heracleum sosnowskyi
Impatiens noli-tangere
Lamium album
Lapsana communis
Lathyrus vernus
Listera ovata
Lunaria rediviva
Matteuccia struthiopteris
Mercurialis perennis
Milium effusum
Mycelis muralis
Myosotis sylvatica
Neottia nidus-avis
Oxalis acetosella
Paris quadrifolia
Platanthera chlorantha
Poa nemoralis
Polygonatum multiflorum
Primula veris
Ranunculus cassubicus
Rubus idaeus
Rubus saxatilis
Scrophularia nodosa
Silene dioica
Stachys sylvatica
Stellaria holostea
Stellaria nemorum
Urtica dioica
Valeriana officinalis
Veronica chamaedrys
Vicia sepium
Vicia sylvatica
Viola mirabilis
Viola riviniana

Bryophytes

Amblystegium serpens
Anomodon longifolius
Anomodon viticulosus
Atrichum undulatum
Brachythecium populeum
Brachythecium rutabulum
Brachythecium salebrosum
Campylium sommerfeltii
Cirriphyllum piliferum
Distichum capillaceum
Encalypta streptocarpa
Eurhynchium hians
Eurhynchium pulchellum
Fissidens adianthoides
Homalia trichomanoides
Homalothecium sericeum
Leucodon sciuroides
Lophocolea heterophyllea
Mnium stellare
Neckera complanata
Pellia epiphylla
Plagiomnium affine
Plagiomnium cusidatum
Plagiomnium cuspidatum
Plagiomnium undulatum
Pseudoleskeella nervosa
Radula complanata

Sanionia uncinata
Schistidium apocarpum
Thuidium philibertii

Conocephalum conicum

<u>On clay at beach</u>
Blastia pusilla

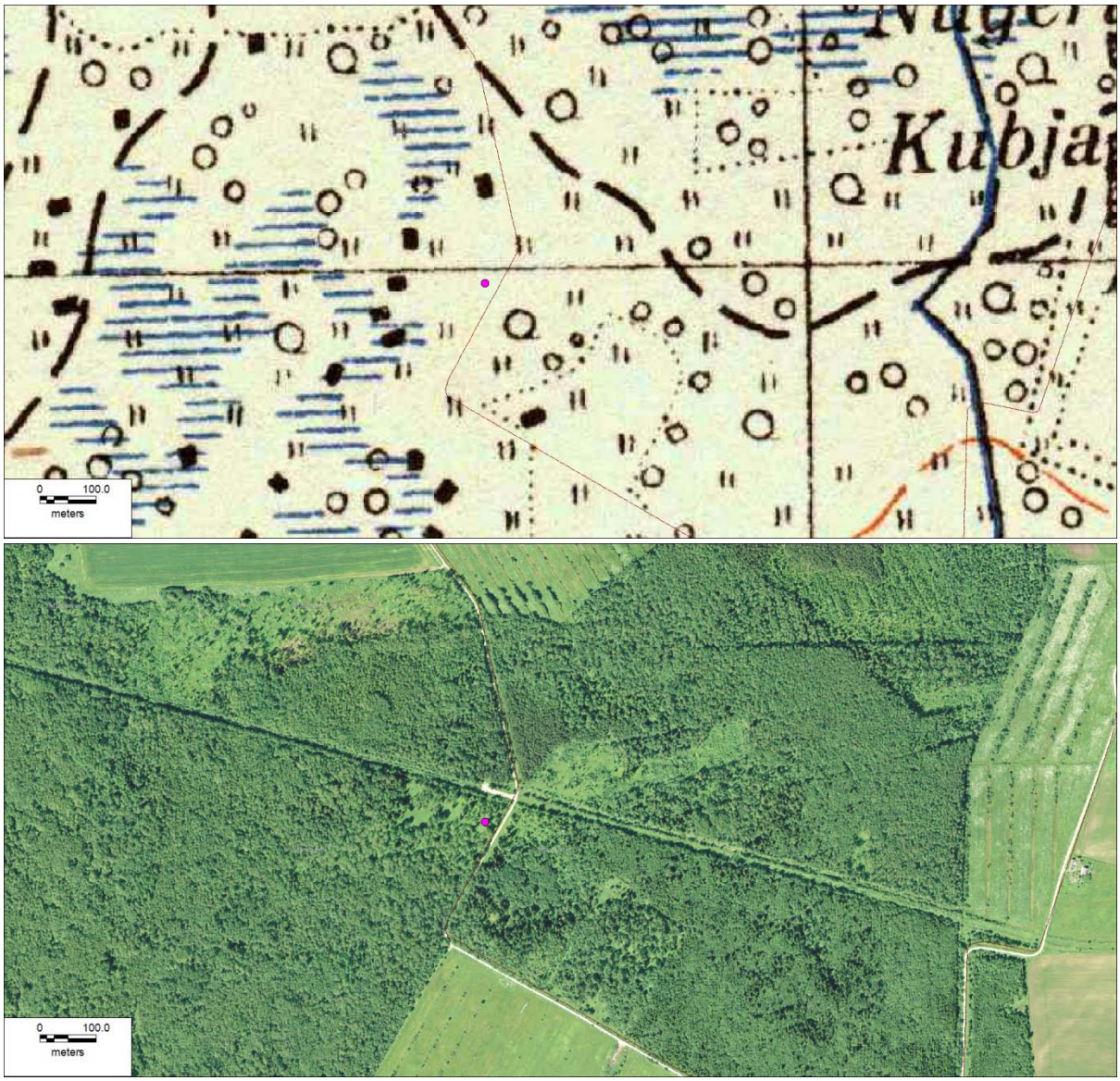
<u>Lichens</u>

Acrocordia sp. – various trees
Arthonia radiata – various trees
Bilimbia sabuletorum – ash
Graphis scripta – various trees
Lecidella elaeochroma – various trees
Lepraria sp. – various trees
Leptogium lichenoides – various trees
Opegrapha atra – black alder
Opegrapha ochrocheila – ash
Opegrapha rufescens – elm
Opegrapha varia – various trees
Opegrapha vulgata – maple
Peltigera praetextata – various trees
Phlyctis argena – various trees

Aa village **-** The first written record of Aa dates back to a 1241. Historic manor of Hazä or Haakhof is from 1698. In the vicinity is regionally the most poular beach.

Purtse Vassal Fortress (tower fortress) in Late Gothic style was established in 1553 by the notorious vassal Jacob Taube (said to have acted as a pirate). The building is a mixture of a fortification and a residential manor. During its long history the manor has also burnt down several times, the last restoration finished 1990, being abandoned since 1940.

Arupealse wooded meadow



Arupealse wooded meadow in 1930ies and present day encroachment. Only a minor central part has preserved stand structure of semi-open woodland.

Vascular plants

Betula pendula
Betula pubescens
Corylus avellana
Daphne mezereum
Picea abies
Populus tremula
Populus tremula
Rhamnus catharticus
Ribes alpinum
Ribes rubrum

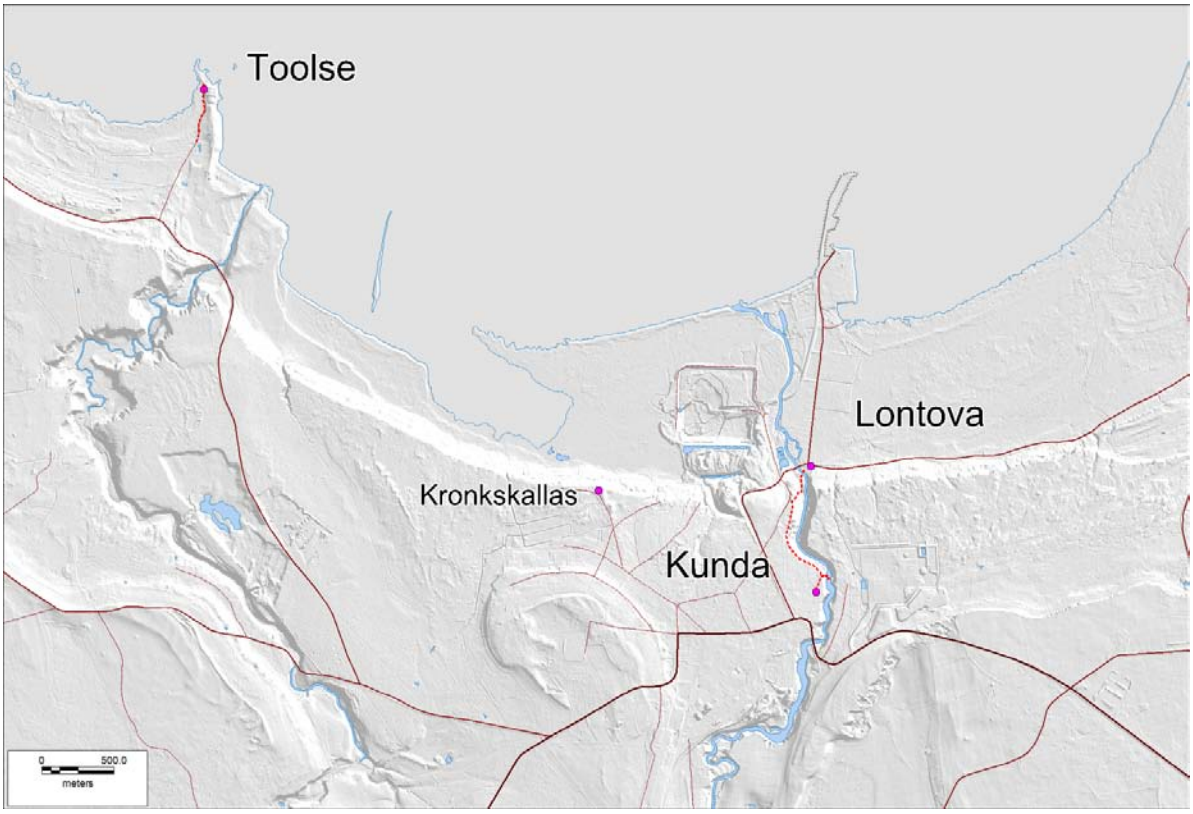
Aegopodium podagraria
Anemone nemorosa
Brachypodium pinnatum
Briza media
Calamagrostis arundinacea
Calamagrostis canescens
Calamagrostis epigeios
Campanula glomerata
Campanula persicifolia
Carex cespitosa
Carex flacca

Carex vaginata
Centaurea jacea
Convallaria majalis
Daphne mezereum
Deschampsia cespitosa
Dryopteris carthusiana
Festuca rubra
Filipendula vulgaris
Fragaria vesca
Galium boreale
Geranium palustre

Geranium sylvaticum
Hepatica nobilis
Heracleum sibiricum
Hieracium umbellatum
Hypericum maculatum
Inula salicina
Lathyrus pratensis
Lathyrus vernus
Leucanthemum vulgare
Melampyrum nemorosum
Paris quadrifolia
Peucedanum palustre
Poa angustifolia
Poa trivialis
Primula veris
Prunella vulgaris
Ranunculus auricomus
Ranunculus polyanthemos
Ranunculus repens
Rhinanthus serotinus
Ribes alpinum
Rubus saxatilis
Scorzonera humilis
Solidago virgaurea
Stellaria graminea
Stellaria holostea
Trifolium medium
Trollius europaeus
Valeriana officinalis
Veronica chamaedrys
Vicia cracca
Vicia sepium
Viola mirabilis
Viola palustris

Lichens

Anaptychia ciliaris – aspen
Caloplaca flavorubescens – aspen
Cladonia cenotea – birch (base)
Cladonia coniocraea – birch (base)
Cladonia fimbriata – birch
Evernia prunastri – decidous trees
Hypogymnia physodes – aspen
Lecanora allophana – aspen
Lecanora pulicaris – birch
Lecidea nylanderi – birch
Lecidella elaeochroma – rowan
Melanelia olivacea – birch
Opegrapha rufescens – aspen
Parmelia sulcata – decidous trees
Parmeliopsis ambigua – birch
Peltigera praetextata – aspen (base)
Pertusaria albescens – birch
Pertusaria coccodes – aspen
Phlyctis argena – decidous trees
Physcia adscendens – aspen
Physcia aipolia – aspen
Physconia distorta – aspen
Ramalina farinacea – decidous trees
Ramalina pollinaria – aspen
Xanthoria parietina – aspen



Terrain around Kunda.

Kunda

The present-day Kunda River cuts into the Cambrian terrace with a 35-m-deep and 3-km-long canyon between Linnuse Village and Hiiemägi. The canyon accommodates the oldest (built in 1893) hydropower plant in Estonia and the Baltic States.

Linnuse Village contains the production buildings of the former Kunda Manor (watermill, sawmill, distillery, dairy, etc.) – some of the best examples of Estonian industrial limestone architecture.

On a small hill named Lammasmägi ("Sheep Hill"), formerly an app. 100-m-diameter island in Lake Kunda, lies the place where the oldest known traces of human activity on the Baltic Klint (from about 9000 years BP!) were discovered.

Lontova Formation - blue clay layer of Lontova Stage (outcropping in Lontiva). It is the thickest (max 75m) component of the North Estonian klint. Blue clay contains in abundance of white flattened siliceous tubelets of the genus *Platysolenites* (the earliest foraminifers) and pyritized crawling tracks.

Kronkskallas - one of the most significant nature monuments of Kunda – an up to 35-m-high sandstone escarpment with outcropping sandstones. The seaside lowland in front of Kronkskallas is the location of the blue clay quarry of Kunda.

A culture ofmesolithic hunter-gatherer communities of the Baltic forest zone extending eastwards through Latvia into northern Russia and dates to the period 8000–5000 BC got its name from first findings near Kunda (Lammasmäe "hill ofsheeps") and therefore called **Kunda Culture**. Settlements of Kunda culture were located near edges of forests, rivers, lakes, or marshes. They perhaps used hunting-dogs. Inland they hunted on elk, on the coast on seals, also pike was main fishing product. Tools were decorated with simple geometric designs. Kunda culture was proceeded by Narva culture, which used pottey and started use agriculture.

Alkaline dust and ash emissions since 1882 and the long-termdeposition have caused changes in the soil pH and bark pH of pines in the influence zone of the cement and power plants in Northeast Estonia as compared with the control (Reisner & Ots 2002, Paal et al. 2013). The sample plots were stands of 70–85-year-old Scots pine (*Pinus sylvestris* L.). Atmospheric emissions from the industrial enterprises have decreased several times during the last ten years, but in the immediate vicinity of the Kunda cement plant the bark is still alkaline (pH = 7.4).

Bryophytes (epiphytes)

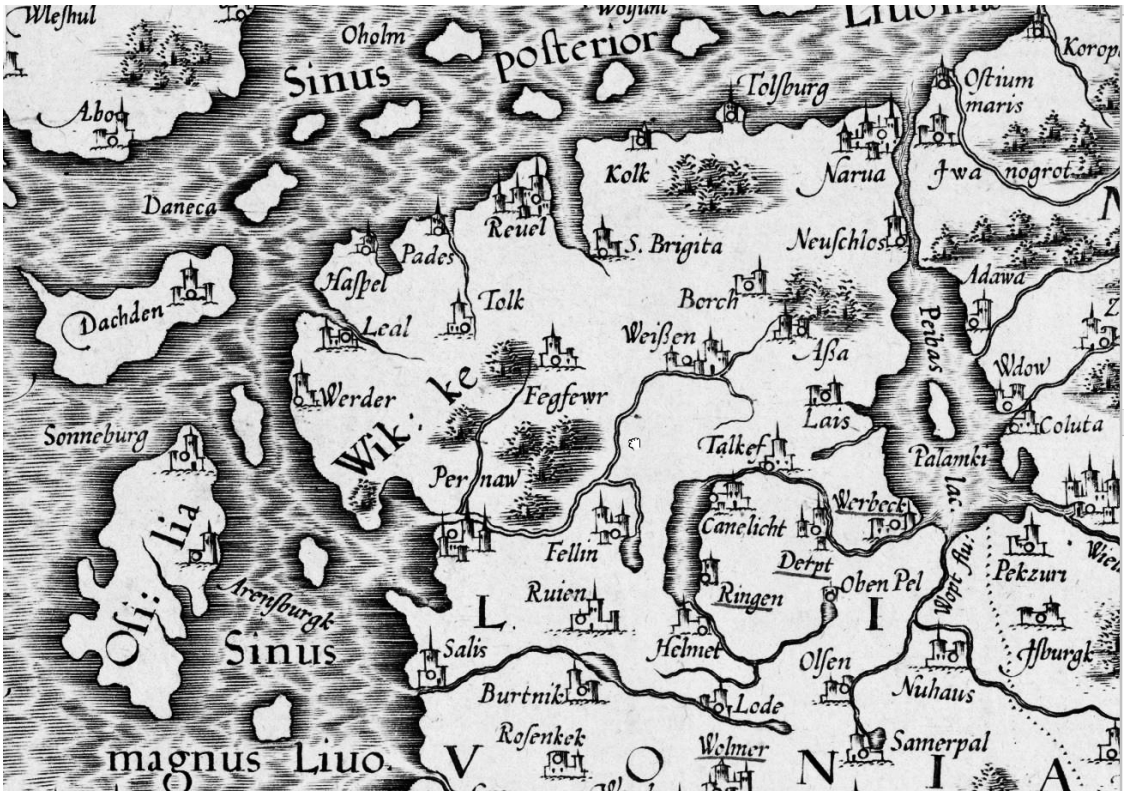
Amblystegium serpens	Encalypta streptocarpa	Pseudoleskeella nervosa
Anomodon longifolius	Eurhynchium hians	Pylaisia polyantha
Anomodon viticulosus	Homalia trichomanoides	Radula complanata
Atrichum undulatum	Hypnum cupressiforme	Tortula ruralis
Brachythecium salebrosum	Leucodon sciuroides	
Bryoerythrophyllum recurvirostrum	Neckera pennata	
	Orthotrichum obtusifolium	

Lichens

Biatora globulosa	oak	
Mycobilimbia tetramera	oak	
Bilimbia sabuletorum	pine	
Lepraria lobificans	pine	
Mycobilimbia tetramera	pine	
Opegrapha rufescens	pine	typical species for broad-leaved trees
Opegrapha varia	pine	typical species for broad-leaved trees
Acrocordia cavata	pine	typical species for broad-leaved trees
Caloplaca decipiens	pine	typical species for limestone wall
Candelariella aurella	pine	typical species for limestone
Lecanora albescens	pine	typical species for limestone
Opegrapha varia	pine	typical species for broad-leaved trees
Phaeophyscia nigricans	pine	
Phaeophyscia orbicularis	pine	
Verrucaria xyloxena	pine	usually on soil bryophytes
Xanthoria parietina	pine	
Rinodina colobina	pine, maple, oak	
Caloplaca citrina	pine, oak, maple	

Toolse

Toolse castle was built in 1471 to defend local historic harbour of the inland city Rakvere frm pirates. The golden time for Toolse was in 15-16th century. It was demolished during the Swedish-Russian war (ca 170X). Actually, two ancient-Estonian strongholds were located earlier in the same neighbourhood, more close to estuary of Toolse river.



Map from the 16th century. Please find castles of Toolse (Tolburg), Vasknarva (Neusschlos), but also Tartu (Derpt) and Tallinn (Revel).

Species list is pooled with Altja (see below)

Lahemaa National Park

The Lahemaa National Park, founded in 1971, is the oldest one in Estonia. The area has high landscape diversity. The wide northeast-southwest directional forest zone splitting Estonia into two major landscape regions arrives at the sea in Lahemaa. The coastline is very curvilinear with peninsulas switching over to bays. Stony forelands are stretched far toward the sea. In the direction of inland the former coastal cliff adds diversity to the landscape. The coastal cliff has been crucial in the formation of waterfalls and rapids on North Estonian rivers. In many places the former coastal landforms, huge erratic boulders having witnessed the power of the last glacier, and semi-natural alvar communities can be seen. The settlement pattern of Lahemaa is closely linked with the natural environment. The households in coastal villages face the sea and follow the coastline, forming lane-type villages. Villages positioned at some distance from the sea in the North Estonian plateau form more compact settlements. The visitor and information centre of the national park is located in Palmse.

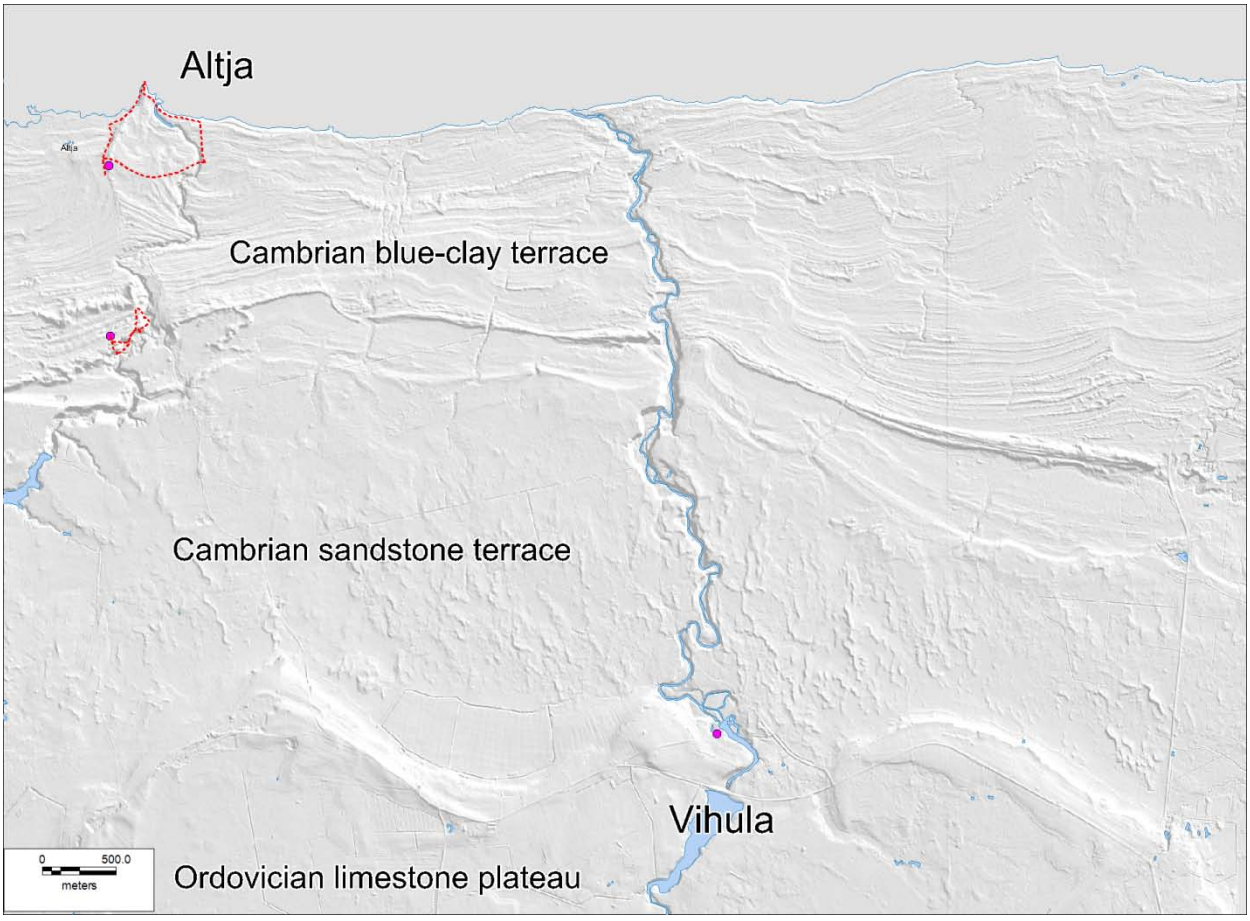
Vihula Manor

The earliest preserved document about Vihula dates back to 1501, when it was owned by H. von Lode. From 1810 to 1939 it was in hand of family von Schubert. Old main building is from 1760-1780, new (present) main building from 1880. Manor park is from the 19th century, planted in several stages.

When the manor was rented to J. von Knorring ca 1696, then he was active as “false signal light using pirate”, but the tradition was continued by baron Elbrecht ja Schubert.

Altja village got its name from voices, which were heared from the coast and sounded like fairies (in Estonian Haldjas) would have been there, but probably they were originated from those victims of the pirates.

July 5
From Vihula to Altja



Three types of coastal landscape zones can be distinguished –limestone until Vihula with more alkaline soil, sandstone trerrace with fresh or paludified forest and coastal sand dune “wave lines” above blue clay flatland. Lines are developed with land uplift and presently they are covered by the Vacc. *** type boreal forest. The most intensively visible dune lines marks the location of shoreline of the post-glacial Ancylus lake.

Altja-Toolse seashore communities (from forests to sea-shore grassland)

Vascular plants

Boreal forest (the Calluna, Vacc.v-i and V.myrt types)

Betula pendula	Carex globularis	Oxalis acetosella
Juniperus communis	Carex leporina	Platanthera bifolia
Picea abies	Convallaria majalis	Pteridium aquilinum
Pinus sylvestris	Deschampsia flexuosa	Thymus serpyllum
Sorbus aucuparia	Empetrum nigrum	Trientalis europaea
	Festuca ovina	Turritis glabra
Calamagrostis arundinacea	Luzula pilosa	Vaccinium myrtillus
Calluna vulgaris	Maianthemum bifolium	Vaccinium uliginosum
Carex canescens	Melampyrum pratense	Vaccinium vitis-idaea
Carex echinata	Orthilia secunda	Veronica officinalis

Bryophytes in boreal forest

Aulacomnium palustre	Hylocomium splendens	Polytrichum commune
Brachythecium albicans	Plagiochila asplenioides	Polytrichum juniperinum
Ceratodon purpureus	Plagiomnium affine	Polytrichum piliferum
Dicranum polysetum	Pleurozium schreberi	Ptilium crista-castrensis
Dicranum scoparium	Pohlia nutans	

Vascular plants

Algnus glutinosa paludifying forest

Alnus glutinosa	Galium aparine	Phalaris arundinacea
Padus avium	Geranium pratense	Phragmites australis
	Geranium robertianum	Poa trivialis
Anthriscus sylvestris	Geum urbanum	Ranunculus acris
Caltha palustris	Impatiens parviflora	Ranunculus polyanthemos
Carex pallescens	Lycopus europaeus	Rubus idaeus
Crepis paludosa	Lysimachia vulgaris	Stellaria nemorum
Deschampsia cespitosa	Moehringia trinervia	Taraxacum officinale
Epilobium angustifolium	Myosotis scorpioides	Urtica dioica
Filipendula ulmaria	Paris quadrifolia	Valeriana officinalis

Bryophytes in paludifying forest

Dicranum majus	Sphagnum palustre
Sphagnum girgesohnii	Sphagnum squarrosum

Open seashore and wet hollows

Agrostis capillaris	Carum carvi	Festuca ovina
Anthriscus sylvestris	Cirsium arvense	Fragaria vesca
Atriplex glabriuscula	Elymus repens	Fragaria viridis
Atriplex littoralis	Epilobium angustifolium	Geranium pratense
Atriplex prostrata	Equisetum pratense	Helictotrichon pratense
Carex disticha	Festuca arundinacea	Juncus filiformis

Juncus gerardii
Lathyrus maritimus
Lathyrus pratensis
Leymus arenarius
Lotus corniculatus
Phragmites australis
Plantago maritima
Potentilla anserina
Rumex crispus
Schoenoplectus tabernaemontanii
Stellaria nemorum
Tanacetum vulgare
Trifolium repens
Triglochin maritimum
Tussilago farfara
Vicia cracca

Bryophyes in sea shore habitats

Amblystegium serpens
Atrichum undulatum
Blasia pusilla
Brachythecium albicans
Brachythecium rutabulum
Campylium polygamum
Ceratodon purpureus
Conocephalum conicum
Desmatodon heimii
Dicranum scoparium
Homalothecium sericeum
Mnium hornum
Plagiomnium cuspidatum
Plagiomnium ellipticum
Plagiomnium undulatum
Racomitrium canescens
Schistidium apocarpum

Rivers in clay and sand:

Altja-Oandu Beaver trail

Vascular plants (non-boreal part)

Alnus glutinosa
Alnus incana
Betula pendula
Corylus avellana
Picea abies
Pinus sylvestris
Ribes alpinum

Aegopodium podagraria
Anemone nemorosa
Anthriscus sylvestris
Athyrium filix-femina
Calamagrostis stricta
Caltha palustris
Campanula persicifolia
Carex digitata
Cirsium oleraceum
Convallaria majalis
Dryopteris carthusiana
Dryopteris expansa
Equisetum pratense
Equisetum sylvaticum
Filipendula ulmaria
Fragaria vesca
Galeobdolon luteum
Geranium pratense
Geranium sylvaticum
Gymnocarpium dryopteris
Hepatica nobilis
Hypericum maculatum
Maianthemum bifolium
Matteuccia struthiopteris
Milium effusum
Oxalis acetosella
Pilosella officinarum
Poa nemoralis
Prunella vulgaris
Pteridium aquilinum
Rubus idaeus
Rubus saxatilis
Rumex acetosella
Silene dioica
Solidago virgaurea
Solidago virgaurea
Stellaria holostea
Stellaria nemorum
Thelypteris phegopteris
Trollius europaeus
Urtica dioica
Vaccinium myrtillus
Veronica chamaedrys
Veronica officinalis
Vicia sepium
Viola canina

Klint Plateau and alvars (www.klint.envir.ee)

Just like klint forest belongs inseparably with the foot of klint scarps, alvars belong with the klint plateau. Alvar is an area of low but species-rich xero- and calciphilous vegetation on a limestone plateau covered with a thin (less than 0.5 m) layer of earth or gravel.

1. **Open alvar** – a treeless and shrubless area with a low but species-rich groundlayer vegetation – is widespread on the North Estonian Klint Plateau. Open alvar is a secondary plant community developed from an alvar forest or alvar shrubland as a result of human use. When an alvar is left to develop on its own, every open alvar soon becomes an alvar shrubland and that, in turn, an alvar forest.

2. **Alvar shrubland or alvar scrub** is the first stage of the overgrowing of alvars. The most widespread type of alvar shrubland is juniper alvar – alvar shrubland dominated by juniper. In addition to juniper, the shrub layer may include dog roses, common and alder buckthorns, fly honeysuckles, hazels, etc. Juniper alvar is more common than alvar shrubland dominated by hazel.

3. **Alvar forest** is usually a low and slow-growing spruce or pine mixed forest. In addition to spruce and pine, it may contain also birch, ash, elm and in places even oak. The bush layer is dominated by hazel, rowan and dog rose. Alvar forest is a primary and natural plant community, while the other types of alvar have been shaped by human impact.

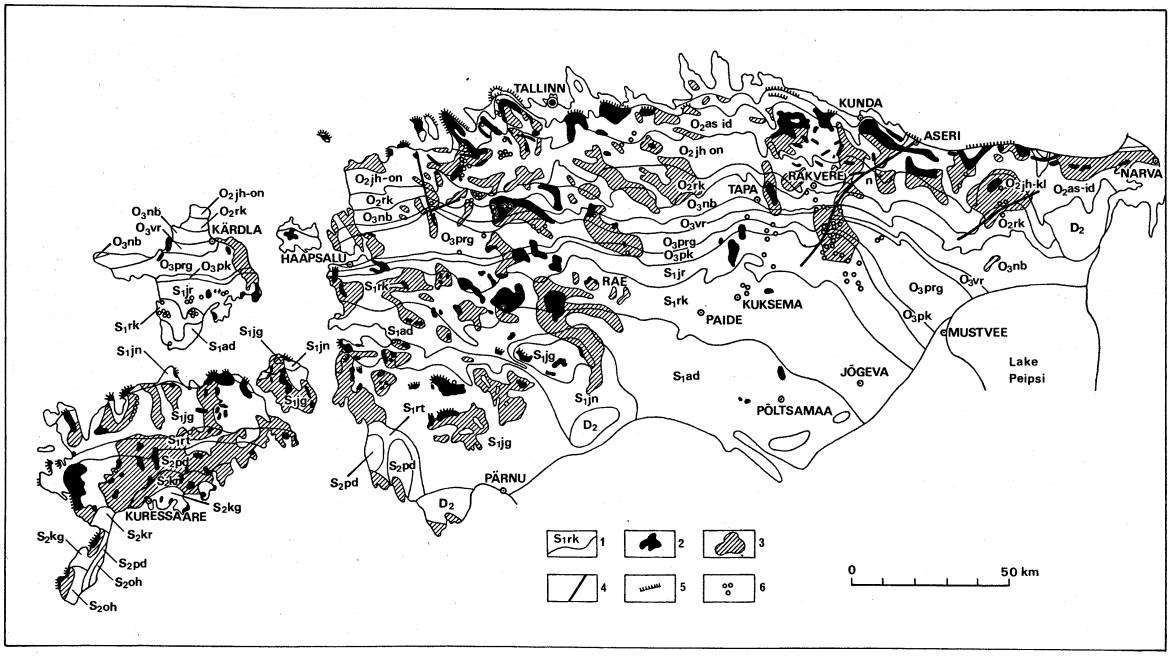
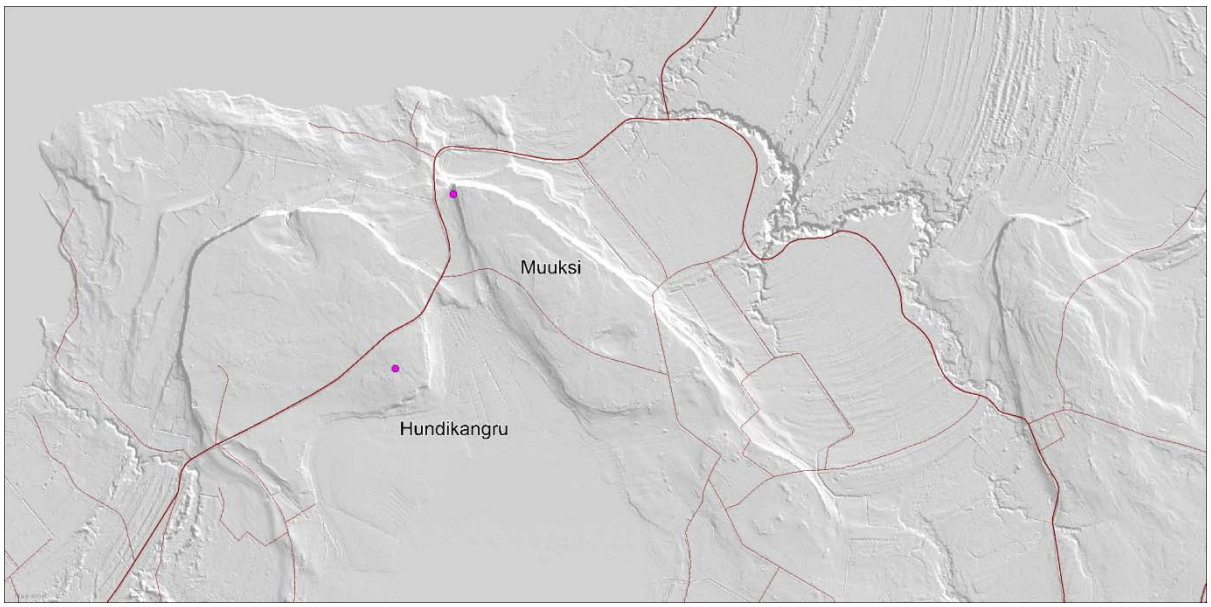


Fig. 158. Distribution of alvars (after Jürgenson & Tavast 1986, with complements): 1 - boundaries between outcrops of bedrock stages with stratigraphical indices of the stages (see Ch. IV 3.4); 2 - alvars; 3 - outcrops of the bedrock covered with a thin (up to 30 cm) layer of Quaternary deposits; 4 - zones of tectonical disturbances; 5-cliffs; 6 - karst forms.

Alvar grassland. Muuksi bronze age settlement and ancient burial grounds.

Located on residual section of the Baltic klint, called Tsistre klint.



LiDAR image of treeain at Muuksi and Hundikangru.

The remnants of Muuksi stronghold and stone gist graves (Hundikangrud) date back the earliest to 8th-9th century BC.

Vacular plants

Limestone grassland and juniper shrubland

Betula pendula
Corylus avellana
Juniperus communis
Lonicera xylosteum
Quercus robur
Rhamnus catharticus
Ribes alpinum
Viburnum opulus

Achillea millefolium
Acinos arvensis
Agrimonia eupatoria
Agrostis capillaris
Alchemilla sp.
Anemone sylvestris
Campanula glomerata
Campanula persicifolia
Campanula rotundifolia
Carex caryophyllea
Carex muricata
Carex spicata
Centaurea jacea
Dactylis glomerata
Daucus carota
Echium vulgare
Festuca ovina
Festuca rubra
Filipendula vulgaris
Fragaria vesca
Fragaria viridis
Galeobdolon luteum
Galium boreale
Galium verum
Helianthemum nummularium
Helictotrichon pratense
Hepatica nobilis
Hieracium umbellatum
Inula salicina
Knautia arvensis
Linum catharticum
Listera ovata
Lotus corniculatus
Medicago lupulina
Melampyrum nemorosum
Phleum phleoides
Phleum pratense
Pimpinella saxifraga
Plantago lanceolata
Plantago media
Poa angustifolia
Polygala amarella
Primula veris
Ranunculus polyanthemos
Sagina nodosa
Sedum acre
Sesleria caerulea
Silene nutans
Solidago virgaurea
Thymus serpyllum
Trifolium hybridum
Trifolium medium
Trifolium repens

Veronica chamaedrys	Veronica spicata	Vicia cracca

<u>For comparison – nearby grassland</u>

Alopecurus pratensis	Galium album	Melampyrum nemorosum
Campanula glomerata	Geranium pratense	Rubus caesius
Campanula persicifolia	Lamium maculatum	
Centaurea scabiosa	Libanotis montana	

<u>And escarpment forest</u>

Acer platanoides	Convallaria majalis	Oxalis acetosella
Alnus glutinosa	Crepis paludosa	Paris quadrifolia
Fraxinus excelsior	Dryopteris carthusiana	Poa nemoralis
Padus avium	Dryopteris filix-mas	Polygonatum multiflorum
	Filipendula ulmaria	Primula veris
Actaea spicata	Galeobdolon luteum	Pulmonaria obscura
Aegopodium podagraria	Geum urbanum	Stachys sylvatica
Anemone nemorosa	Hepatica nobilis	Stellaria nemorum
Anemone sylvestris	Impatiens noli-tangere	Veronica beccabunga
Asarum europaeum	Lunaria rediviva	
Campanula latifolia	Mercurialis perennis	

<u>Bryophytes</u>

Bryum argenteum	Homalothecium sericeum	Schistidium apocarpum
Dicranum scoparium	Hypnum cupressiforme	Thuidium abietinum
Ditrichum flexicaule	Rhytidiadelphus squarrosus	Tortula ruralis
Homalothecium lutescens	Rhytidiadelphus triquetrus	

Rebala and Kostivere

Rebala Heritage Reserve and Museum (http://www.rebala.ee)

Rebala Heritage Reserve is an ancient cultural landscape, where within a mere 74 sq km are at least 300 archaeological remains from the early Stone Age. The oldest and most representative shrine mounds have been established in the late Bronze Age – VIII-VII century BC.

An abundant number of ancient burial grounds - referred to as “kangur” (cairn-grave by the local people - have been preserved intact throughout history. There is usually only one, or several in a group, but they can always be identified by a hump on the ground. The dead have been buried in centrally-placed sarcophagi with their heads pointing to the north and their eyes gazing at the life giving Sun. The sarcophagi were encircled in limestone walls as if embodying the world model of the man of that time : the man is the centre of the circle, able only to seize the unattainable horizon of the world with his gaze. The burial site is quite unique in Europe. It dates back to the Bronze Age (8th-7th century BC). The Tallinn-Narva road was being constructed when the builders stumbled upon 36 stone-cist graves which later, after having been explored, were so to say "lifted" to the side of the new road in accordance with the original plan. There were few finds from the coffins. Objects like a bronze shaving knife and pincers put into coffins were most typical to Jutland toward the end of the Bronze Age. Evidently also the spindles found from the barrows originate from Danish territories.

Kostivere karst region

Kostivere karst is the best-known Karst region in Estonia. Its total area is 125 hectares.A large region with the total area of 16 hectares is under state protection. Near the river's underground course interesting limestone Karst formations are open cracks, Karst ditches, funnels, and valleys up to 5 meters deep. Also caves, the largest of them is Karjakelder that is 6 meters long, 4 meters wide and 2.5 meters high. The bottom of the grotto is always covered with water. Here is also one Karst bridge and peculiar residual rock known as "stone mushroom" in the Karst region.
In the Karst field there are 2 - 3 flood periods per year - early in the spring, in the autumn, and sometimes also during a rainy summer. Ditches have been dug above the secret river to facilitate the drainage of the floodwater. In the dry periods the water runs along the flow courses of the secret river that form a complicated underground network.
In Kostivere, the alpine meadow grass (*Poa alpina* L.) can be found. The species is of arcto-alpine origin, very rare in Estonia, as here it has the southernmost border of its area.

Vascular plants

Productive limestone grassland

Achillea millefolium
Alopecurus geniculatus
Alopecurus pratensis
Anthyllis vulneraria
Briza media
Bromopsis inermis
Bunias orientalis
Carex hirta
Centaurea scabiosa
Dactylis glomerata
Equisetum pratense
Festuca rubra
Filipendula vulgaris
Fragaria vesca
Geranium pratense
Geranium sanguineum
Helictotrichon pratense
Helictotrichon pubescens
Medicago sativa
Ranunculus polyanthemos
Trifolium medium
Veronica chamaedrys
Vicia cracca

Limestone trench, stream

Agrostis tenuis
Artemisia vulgaris
Campanula glomerata
Carex acuta
Carex cespitosa
Elymus repens
Erysimum cheiranthoides
Festuca rubra
Filipendula ulmaria
Glyceria fluitans
Lamium album
Lysimachia vulgaris
Medicago lupulina
Phalaris arundinacea
Poa pratensis
Poa trivialis
Rubus caesius
Scrophularia nodosa
Sedum maximum
Tanacetum vulgare
Thalictrum flavum
Urtica dioica
Valeriana officinalis
Veronica longifolia

Dry alvar, rocks

Achillea millefolium
Campanula patula
Campanula rotundifolia
Galium verum
Lathyrus pratensis
Linaria vulgaris
Phleum phleoides
Plantago media
Poa alpina
Poa angustifolia
Potentilla argentea
Potentilla tabernaemontani
Rosa spp.
Sedum acre
Sedum album
Sedum telephium
Seseli libanotis
Silene nutans
Silene vulgaris
Thymus serpyllum
Trifolium montanum
Veronica spicata

Bryophytes

Limestone graves, walls, ganite boulders, ground, wet sites

Amblystegium serpens
Brachythecium populeum
Brachythecium rutabulum
Bryum argenteum
Bryum caespiticium
Ceratodon purpureus
Climacium dendroides
Drepanocladus aduncus
Encalypta streptocarpa
Grimmia ovalis
Hedwigia ciliata
Homalothecium lutescens
Hypnum cupressiforme
Leskea polycarpa
Pseudoleskeella nervosa
Rhytidiadelphus squarrosus
Sanionia uncinata
Schistidium apocarpum
Schistidium trichodon
Thuidium abietinum
Thuidium philibertii
Tortula ruralis

Macro-Lichens

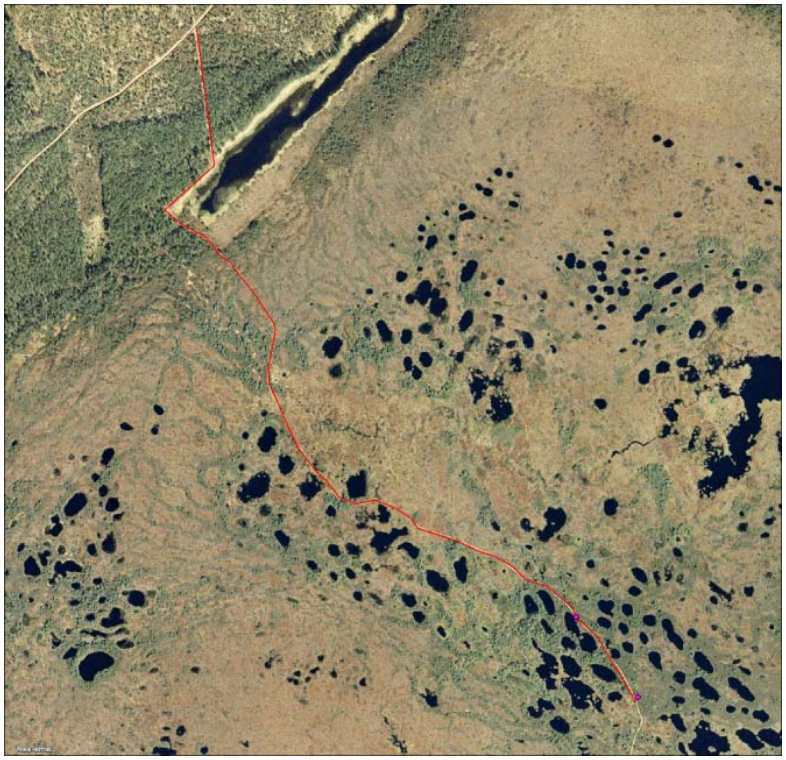
Dermatocarpon miniatum

Endocarpon psorodeum – the only locality in Estonia, Red list - endangered

July 6
North-Kõrvemaa Landscape Reserve

Kõrvemaa – it is ancient bogs, forests stretching until the horizon, uninhabited landscapes, where there are altogether 60 km of ski trails and other hiking and riding trails.
Põhja-Kõrvemaa Landscape Reserve (area 11, 283 ha) was created in 1991 to preserve relatively untouched landscapes and ecosystems. The region, also called Estonian Switzerland, is extremely diverse: steep-sided eskers and plateaus formed by the withdrawal of the glacier sheet some 12, 000 years ago, and in concaves between them, some 50 forest lakes and different types of bogs and forests can be found.

Kõnnu Suursoo raised bog



Track line within raised bog microtopographic mosaic.

<u>Vascular plants</u>
<u>Bog-forest edge</u>

Carex acuta	Deschampsia flexuosa	Vaccinium uliginosum
Carex globularis	Juncus filiformis	Vaccinium vitis-idaea
Carex nigra	Vaccinium myrtillus	

<u>Raised bog</u>

Andromeda polifolia	Empetrum nigrum	Vaccinium oxycoccus
Betula nana	Eriophorum vaginatum	Vaccinium uliginosum
Calluna vulgaris	Ledum palustre	Trichophorum alpinum
Carex canescens	Melampyrum pratense	Carex limosa
Drosera anglica	Rhynchospora alba	
Drosera rotundifolia	Rubus chamaemorus	

Bryophytes

Forest margin and bog

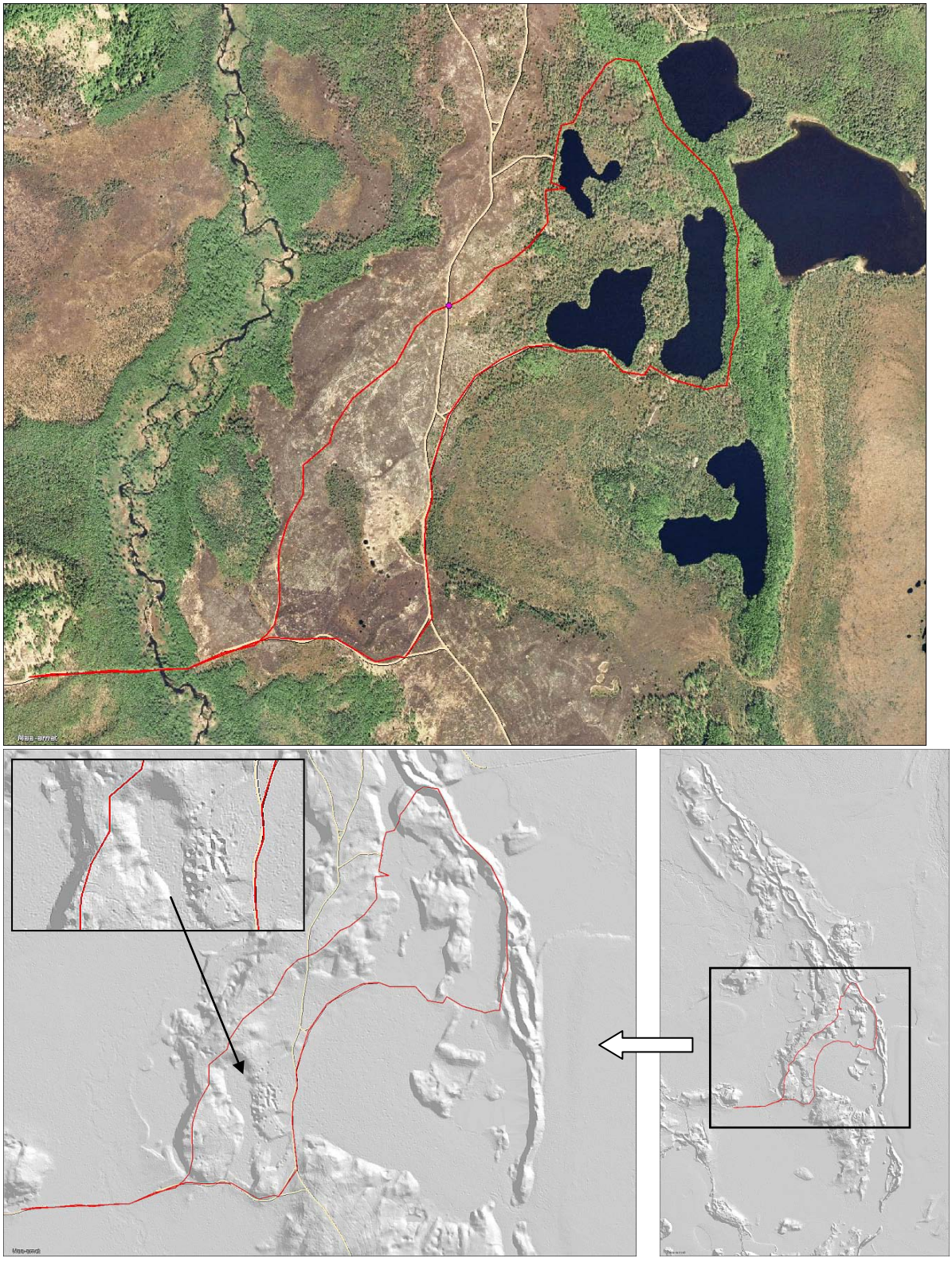
Aulacomnium palustre
Brachythecium albicans
Ceratodon purpureus
Dicranum bergerii
Dicranum heteromalla
Dicranum polysetum
Dicranum scoparium
Hylocomium splendens
Pleurozium schreberi
Pohlia nutans
Polytrichum commune
Polytrichum strictum
Ptilium crista-castrensis
Racomitrium canescens
Rhizomnium punctatum
Rhytidiadelphus squarrosus
Sphagnum angustifoilum
Sphagnum angustifolium
Sphagnum balticum
Sphagnum capillifolium
Sphagnum cuspidatum
Sphagnum fallax
Sphagnum fuscum
Sphagnum girgesohnii
Sphagnum magellanicum
Sphagnum rubellum
Sphagnum tenellum

Lichens of raised bog

Cladonia arbuscula – ground
Cladonia cenotea – pine (base)
Cladonia chlorophaea – ground
Cladonia cornuta – ground
Cladonia deformis – ground
Cladonia fimbriata – ground
Cladonia furcata – ground
Cladonia mitis – ground
Cladonia ochrochlora – pine (base)
Cladonia stygia – ground
Hypocenomyce scalaris – pine
Imshaugia aleurites – pine
Ochrolechia alboflavescens – pine
Parmeliopsis ambigua – pine
Placynthiella icmalea – ground
Placynthiella oligotropha – ground
Pseudevernia furfuracea – pine
Usnea hirta – pine

Calluna heath of Jussi with hillock forest on esker

Jussi (and N-Kõrvemaa in more large scale) was used as practice area of Soviet army. Jussi heath was formed by intensive bombing practice. Before that, there was forest and any settlements. Presently it is artificially maintained for nature conservation.



Map of the region and LiDAR terrain around Jussi lakes. Line notes the planned walk route. In the centre – sand deposit with bomb-craters, on the right – esker.

Vascular plants

Wer/floodplain forest of Alnud glutinosa

Alnus glutinosa	Crepis paludosa	Melampyrum sylvaticum
Picea abies	Dactylorhiza fuchsii	Myosotis palustris
Salix spp.	Deschampsia cespitosa	Peucedanum palustre
Sorbus aucuparia	Dryopteris carthusiana	Phragmites australis
	Dryopteris filix-mas	Platanthera bifolia
Aegopodium podagraria	Equisetum fluviatile	Poa palustris
Angelica sylvestris	Equisetum palustre	Poa trivialis
Anthriscus sylvestris	Equisetum sylvaticum	Potentilla palustris
Astragalus glycyphyllos	Festuca gigantea	Prunella vulgaris
Athyrium filix-femina	Filipendula ulmaria	Ranunculus repens
Calla palustris	Galium palustre	Rubus idaeus
Carex canescens	Geum rivale	Scirpus sylvaticus
Carex cespitosa	Glyceria fluitans	Silene dioica
Carex elata	Hierochloe odorata	Stellaria nemorum
Carex elongata	Impatiens noli-tangere	Urtica dioica
Carex nigra	Iris pseudacorus	Valeriana officinalis
Carex pallescens	Juncus effusus	Veronica beccabunga
Cirsium oleraceum	Lychnis flos-cuculi	Viola palustris
Cirsium palustre	Lysimachia vulgaris	

Heath

Betula pendula	Deschampsia flexuosa	Lychnis viscaria
Pinus sylvestris	Dianthus deltoides	Lycopodium clavatum
	Diphasiastrum complanatum	Melampyrum pratense
Achyrophorus maculatus	Diphasiastrum tristachyum	Pilosella officinarum
Anthyllis vulneraria	Erigeron acer	Pulsatilla pratensis
Arctostaphylos uva-ursi	Festuca ovina	Rumex acetosella
Artemisia campestris	Hieracium umbellatum	Scleranthus perennis
Calamagrostis canescens	Hypericum perforatum	Scorzonera humilis
Calamagrostis epigeios	Jasione montana	Solidago virgaurea
Calluna vulgaris	Koeleria grandis	Thymus serpyllum
Carex ericetorum	Leucanthemum vulgare	Trifolium arvense
Convallaria majalis	Luzula multiflora	Vaccinium myrtillus
Crepis praemorsa	Luzula pilosa	Vaccinium vitis-idaea

Paludified shore of lake Mustjärv

Betula nana	Carex vesicaria	Rubus chamaemorus
Carex canescens	Eriophorum vaginatum	Utricularia sp
Carex globularis	Ledum palustre	Vaccinium myrtillus
Carex nigra	Molinia caerulea	Vaccinium uliginosum

Hillock forest (alkaline, but sand, moraine)

Pinus sylvestris	Betula pendula	Picea abies

Tilia cordata
Corylus avellana
Lonicera xylosteum
Ribes alpinum
Daphne mezereum

Actaea spicata
Aegopodium podagraria
Anemone nemorosa
Astragalus glycyphyllos
Athyrium filix-femina
Calamagrostis arundinacea
Campanula persicifolia
Carex digitata
Crepis praemorsa
Equisetum pratense
Festuca ovina
Fragaria vesca
Galeobdolon luteum
Galium odoratum
Geranium sylvaticum
Gymnocarpium dryopteris
Hepatica nobilis
Lapsana communis
Lathyrus pratensis
Lathyrus vernus
Maianthemum bifolium
Melampyrum pratense
Melampyrum sylvaticum
Melica nutans
Milium effusum
Oxalis acetosella
Paris quadrifolia
Poa angustifolia
Poa nemoralis
Polygonatum odoratum
Pulmonaria obscura
Pyrola rotundifolia
Rubus saxatilis
Solidago virgaurea
Stellaria holostea
Vaccinium vitis-idaea
Veronica chamaedrys
Vicia sepium
Vicia sylvatica
Viola mirabilis

Bryophytes

Heath and boreal forest
Brachythecium albicans
Ceratodon purpureus
Climacium dendroides
Dicranum flagellare
Dicranum polysetum
Dicranum scoparium
Hylocomium splendens
Plagiothecium curvifolium
Pleurozium schreberi
Pohlia nutans
Polytrichum commune
Polytrichum juniperinum
Polytrichum piliferum
Ptilidium ciliare
Ptilium crista-castrensis
Racomitrium canescens

Lake floating fen/mire
Aulacomnium palustre
Climacium dendroides
Dicranum flagellare
Dicranum polysetum
Hylocomium splendens
Odontoschisma denudatum
Pleurozium schreberi
Pohlia nutans
Polytrichum commune
Sphagnum angusifolia
Sphagnum capillifolium
Sphagnum fallax
Sphagnum magellanicum
Tetraphis pellucid

Hillock forest
Brachythecium velutinum
Cirriphyllum piliferum
Dicranum polysetum
Dicranum scoparium
Eurhynchium angustirete
Eurhynchium pulchellum
Hylocomium splendens
Plagiomnium affine
Plagiomnium cuspidatum
Plagiothecium curvifolium
Pleurozium schreberi
Rhytidiadelphus triquetrus

Lichens in heath
Cetraria islandica
Cladonia arbuscula
Cladonia crispata
Cladonia gracilis
Cladonia rangiferina
Cladonia stellaris
Cladonia subulata
Cladonia uncialis
Peltigera rufescens
Placynthiella uliginosa
Stereocaulon condensatum – III-category sp
Stereocaulon paschale
Trapeliopsis granulosa

Programme

July 1, Mon

9:00 Departure from Tartu, hotel Dorpat
10:30 - 11:15 Ilumetsa meteorite crater + Vacc.uliginosum pine forest (700m/45 min)
11:45 - 12:30 Floating (quaking) rich fen (Kragge, scragh, scraw) near Velna (or a swim in lake Saarõpää) (250m/30min)
12:45 Lunch at Tsäimaja of the Setu heritage museum in Värska
- 13:45 Dry sand grassland in museum of Setu (Värska)
14:00 - 15:30 Human disturbance initiated sand-dune habitats in Mustoja LR (2km/1.5h)
Detour through the "boot" of Saatse
16:30 - 17:30 Sand mining and plant resque planting in Piusa quarry (500m/ 1h)
18:00 Arrival at Värska Resort

July 2, Tue

9:00 Departure
10:45 - 11:00 Crossing Emajõgi river on cable ferry at Kavastu (30 min)
11:30 - 12:00 Villages of Russian old believers along shore of lake Peipsi (Varnja-Kasepää-Kolkja) (15min)
12:45 - 13:30 Lunch (Kivi pub in Alatskivi)
13:35 - 14:45 Boreo-nemoral forest near Alatskivi (1300m/1h)
15:00 - 15:30 Devonian sandstone cliff in Kallaste
16:00 - 16:30 Wood products in Avinurme village
17:00 - 18:30 Transitional mire of Rüütli mire near Iisaku (2400m/1.5h)
19:00 Arrival at hotel Mäetaguse SPA

July 3, Wen

9:00 Departure
9:15 - 10:15 Restored wooded grassland and Hepatica type nemoral forest near Mäetaguse (1100m/1h)
11:15 - 12:15 Riverside vegetation in Vasknarva (2000m/1h)
12:20 - 12:55 Sand-dune forest and beach vegetation of northern shore of lake Peipsi (or a swim) (30min)
13:00 - 13:45 Lunch –Suvi resort
Oli shale mining, and the nature restration/recovery
15:00 - 15:45 Kiviõli semi-coke and ash mountain (1700m)
16:00 - 17:00 Forest restoration in Aidu mining field (max 20 min stop)
17:00 - 18:30 The oil shale mining museum of Kohtla-Nõmme
19:00 Arrival at hotel Saka Cliff manor

July 4, Thu

9:00 Start (pack, but do not leave, later, a walk first)
9:00 - 11:00 Baltic klint and nemoral forest of limestone escarpment (the clint-forest) at Saka (3000m/2h)
11:00 - 11:30 Packing and departure from Saka
12:15 - 13:00 wooded grassland of Arupealse at Rannu-Kestla (1900m)
13:30 - 14:15 Lunch at caffeteria Büchler in Lontova
14:15 - 15:30 Riverside forest vegetation of Kunda and old park (1200m/60min)
Alkaline pollution in Kunda
16:00 - 16:15 Sandstone cliff Kronkskallas (15min)
16:30 - 17:30 Coastal habitats and ruins of Toolse castle (800m/1h)
19:00 Arrival at hotel Vihula manor (800m)

July 5, Fri

9:00 Departure
9:15 Old-growth boreal forest of Mustoja and Altja (Lahemaa NP)
- 10:00 Seashore vegetation in Altja (2500m/1.5h)
10:00 - 11:00 Disturbance by beaver on river valley vegetation (1000m/45min)
11:30 - 12:15 Hara bay- old submarine base
12:45 - 13:30 Lunch
13:45 - 14:15 Limestone grassland and historic land use at old settlement area of Muuksi and Hundikangru (750m/30min)
14:20 - 14:50 Limestone grassland and stone gist graves of Hundikangrud (300m/30min)
15:15 Rebala Heritage Museum of the late Bronze Age (20min)
- 18:00 Karst and calcareous grassland in Kostivere (2500m/1.5h)
19:00 Arrival at hotel Palmse
22:00 Night walk? (depends)

July 6, Sat

9:00 Departure
9:45 - 11:00 Raised bog of Kõnnu Suursoo (North-Kõrvemaa LR) (3000m) (+ a swim)
11:45 - 12:45 Lunch at Sportland Kõrvemaa resort
13:00 - 16:00 Heath and alkaline hillock forest around Jussi lakes (North-Kõrvemaa LR) (5500m/3h)
Max 19:00 The End by the hotel Ülemiste