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Reed for Bioenergy and Construction

SMALL SCALE STUDIES OF THATCHED ROOFS IN ESTONIA

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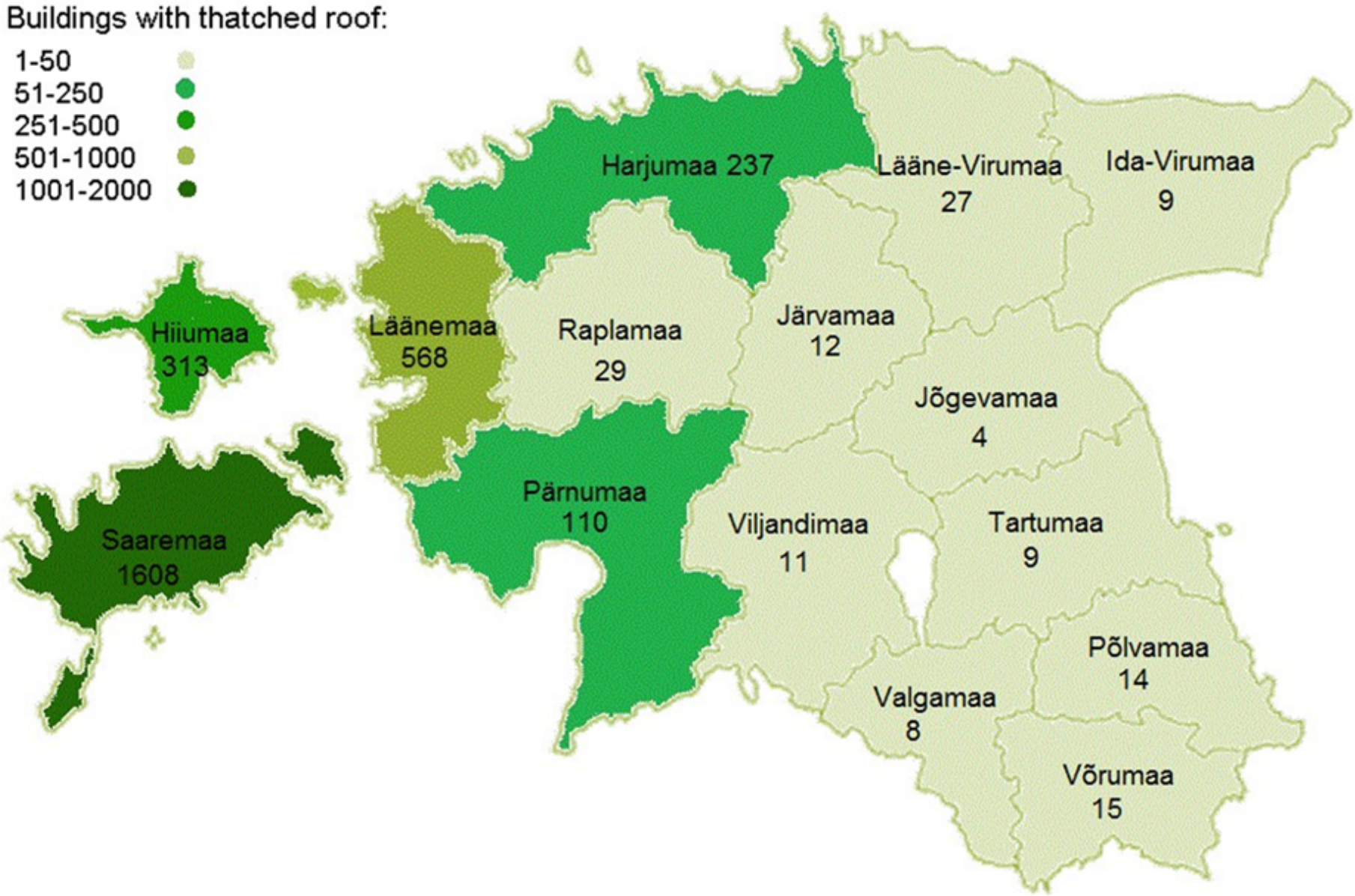
- Using common reed as roofing material is a centuries old tradition in Estonia, especially in Western-Estonia.
- Large and steep thatched roofs, sometimes covered with moss are characteristics to Estonian vernacular architecture.

THERE ARE 3 BASIC SHAPES OF THATCHED ROOFS IN ESTONIA:

HALF-HIPPED ROOF

HIPPED ROOF

GABLED ROOF



Source: Estonian Building Registry

AIM OF THE STUDY:

- To find a new ways to use attic in old thatched houses, which are being renovated
- To study the possibility of reducing thermal loss of the building by using the existing thatched roof as additional insulation
- To monitor air temperature and the relative humidity in the attic after closing ventilations holes and eaves in order to determine the danger of biodegradation of thatched roof.
- Also the moisture content of reed were determined.

OBJECTIVES OF THE RESEARCH:

- 3 buildings in Hiiumaa

METHODS:

- The gaps under the eaves were filled with chopped reed, the gable ends were insulated with reed plates and the ventilation-holes on hipped roofs were covered with wind barrier
- Sensors for measuring temperature and relative humidity were fixed to attic, interior room and outside.
- The measuring took place before as well as after the closing of the ventilation holes.

SIMPLIFIED METHOD TO DETERMINE THE THERMAL RESISTANCE OF THATCHED ROOF:

- The thermal loss from inside to the attic trough the attic ceiling was calculated (Q_1)
- Thermal loss from the inside to the outside through the attic ceiling (Q_2) was calculated
- The difference between thermal loss (Q_1-Q_2) provided the saving due to the fact that the thatched roof acts as an additional insulation layer.

$$Q = \frac{F(t_s - t_v)}{R_0} A$$

- Q is thermal loss through the enclosure (Wh),
- F is area (m^2),
- A is time in hours (h),
- t_s is internal air temperature (^0C),
- t_v is external air temperature (^0C),
- R_0 is heat transfer ($m^2\ ^0C/W$).

RESULTS

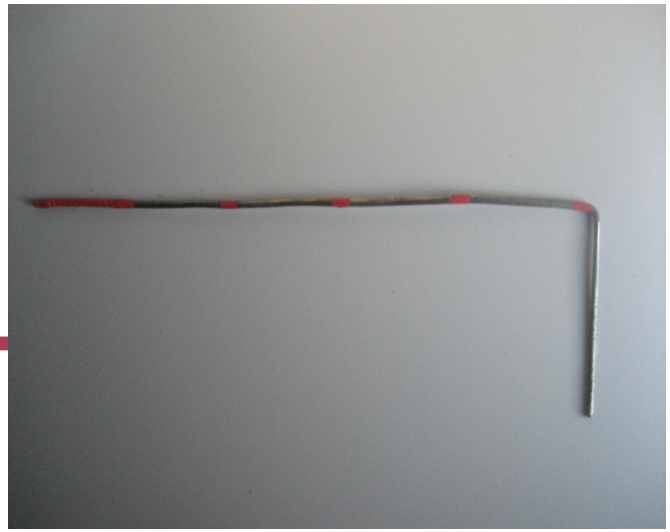
- The decrease of thermal loss through the ceilings after the closing the ventilation holes was 20% to 26% .
- The danger of biodegradation of thatched roof was not found during the test period

Building	Average air moisture content inside [g/m^3]		Average air moisture content in attic [g/m^3]		Average air moisture content outside [g/m^3]	
	before	after	before	after	before	after
Malmi	7.3	6.55	4.28	4.79	4,16	4,47
Uibo	5.77	4.60	5.34	4.34	5,39	3,96
Kupitsa	5.41	5.12	4.33	4.93	4,17	4,61

ESTIMATED DETERIORATION OF THATCHED

- Thatched roof is very durable and longevous, its lifespan is approximately 50 years up to 100 years.
- The lifespan of a thatched roof is dependent on the roof pitch, quality of the reed and expertise of the thatcher, as well as the orientation of the roof and thickness of reed layer.
- Deterioration by weathering of exposed surface of roof was investigated in order to assess the lifespan of thatched roofs.

METHODS:



To study the deterioration of thatched:

- the age of the roof was estimated
- orientation of the roof and original thickness of a reed layer was investigated
- and thickness of present reed layer was measured with a special metal rod
- the estimated average annual deterioration of the roof was calculated to compare the deterioration of the different sides of the roof.
- all together 13 buildings in Hiiumaa and Saaremaa were studied.

Name of the object	Estimated age of the roof	Original thickness of the roof (mm)	Present thickness of the roof (mm) and orientation of pitch			
			N	S	E	W
1	55	300	200	210		
2	37	250	170	150		
3	38	300	220	190		
4	100	300	60	eternit		
5	27	350	220	190		
6	70	300	190	170	150	eternit
7	13	300	-	-	290	260
8	17	250	220	210	-	-
9	14	300	-	-	270	250
10	19	250	220	190	-	-
11	26	250	-	-	180	170
12	22	250	200	170	-	-
13	3	300	300	290	300	295

RESULTS:

- The reserach indicated that the deterioration by weathering occurs fastest on the south- and west- facing sides of the roof compared to north -and east- facing sides.
- The roof side facing south has higher exposure to the sun. This means a fluctuating temperature and higher exposure of uv- radiation resulting in cracking and peeling of the reed cells.

ESTIMATED AVERAGE OF ANNUAL DETERIRATION OF THE THATCHED ROOFS (mm)	
NORTH SIDE / SOUTH SIDE	WEST SIDE / EAST SIDE
2,05 / 3,05	2,84/1,55

- The roof side facing west is affected by prevailing Westerlies winds, which damages roof.

A NUMBER OF THE OLD THATCHED ROOFS ARE COVERED WITH MOSS

IMPACT OF OVERGROWING WITH MOSS

To determine the impact of overgrowing with moss:

- the thickness of the thatched roof was measured,
- the thickness and the range of moss layer on the roof was determined,
- the orientation of the roof pitch was detected,
- some samples of moss were taken from roof to determine different species of moss growing on the roof.

THE THICKNESS AND THE RANGE OF MOSS LAYER ON THE ROOF WAS DETERMINED USING 4-POINT SCALE

0	No moss or the roof is covered with different roofing material (e.g eternit)
1	A few light spots of moss on the roof (thickness of the moss layer ~ 0...5 mm)
2	Heavy spots of moss on the roof (thickness of moss layer ~ 5...10 mm)
3	„moss carpet“ on the roof (thickness of moss layer 10... 20 mm)
4	Thick and heavy „moss carpet“ on the roof (thickness of moss layer > 20 mm)

Object number	Estimated range of moss layer (%)	Thickness of the moss layer in 4-point scale	Age of the roof	Comments
1	S~0% N~75%	S - 1 N - 4	55 years	
2	S - 5% N - 15%	S - 1 N - 1	37 years	
3	S -10% N - 75%	S - 1 N - 3	38 years	
4	S - 0% (eternit) N - 50%	S - 0 N - 2	80 years	
5	S - 0% N - 90%	S - 1 N - 4	27 years	Trees near the north side of the house
6	W- 0% (eternit) E- 20% N/S-10%	W - 0 E - 2 N/S - 1	70 years	
7	W- 5% E- 5%	W - 1 E - 1	13 years	
8	S -30% N - 50%	S – 1…2 (E) N – 1…3 (E)	17 years	Trees near the east side of the house
9	W- 20% E- 60%	W - 1 E – 1…4 (S)	14 years	Trees near the south side of the house
10	S -5% N - 40%	S – 1 N – 3	19 years	
11	W- 80% E- 90%	W - 4 E – 4	26 years	Trees near the house
12	S - 10% N - 20%	S – 1 N – 1	22 years	
13	W/E/N/S-0%	W/E/N/S-0	3 years	

- The study showed that moss prefers to grow on the damp surfaces facing north.
- North sides of roofs were covered with moss ranging 15-75% compared to south side of roofs, which were covered with moss only 0-10 %.
- There was no significant difference in the representation of moss on east- and west-facing roof sides.

- It was found that shading trees magnify the growth of moss.

RESULTS- SPECIES OF THE MOSS

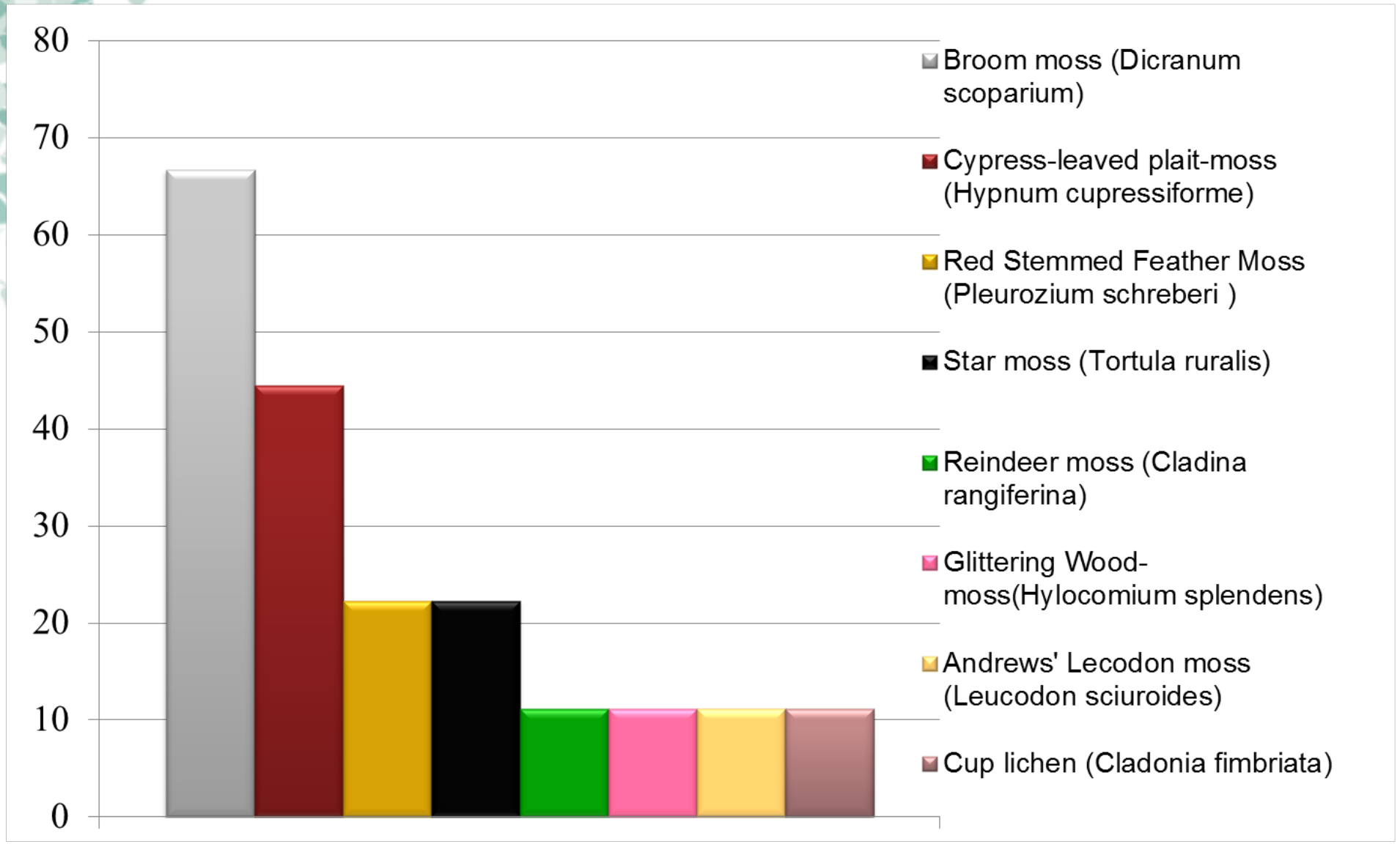
- The samples of moss were taken from 9 different roofs and the species of the moss were classified in a laboratory.

Hypnum cupressiforme (left) and Dicranum scoparium (right)

Dicranum scoparium, Cladina rangiferina, Pleurozium schreberi

- It was common that varoius species of moss grew mixed on the same roof.

Species of moss (%) found on studied roofs



CONCLUSIONS:

- As the result of this experiment, we can conclude that overgrowing with moss is generally bad for roof but it slows down the deterioration speed of south and west sides of roof.
- Deterioration of thatched roofs and impact of overgrowing with moss need further study and more records.
- It will be necessary to continue experiments to get more veritable results.

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