Long term effect of silviculture measures on forest-floor under Norway spruce stands

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MANAGING FORESTS FOR ECOSYSTEM SERVICES: CAN SPRUCE FORESTS SHOW THE WAY? **8-11 October 2012 – Edinburgh, Scotland**

In the Czech Republic - **Forest cover** represents one third of territory. Except of production function – forests provide **many other services**. One of the most important – **ecological stabilisation** of the land.

Contrary to intensively managed agricultural land (input of energy as fertilisers and pesticides, soil compaction by frequent transport etc,) – **forest are managed in long rotation regimes** generally without fertilisers and pesticides.

Forests in our conditions are consequently primarily based on **natural nutrient cycles** – it means decomposition of biomaterials (litter-fall etc.) in forest-floor.

Forest soil is one of the largest reservoirs of nutrients in the frame of forest ecosystems. Amount of dry-mass and consequently nutrients varies during the rotation. One factor may be **thinning** as a measure changing the density of stands.

Hypothesis:

Long-term above-ground biomass removal (thinning) leads to decreased litter-fall and lower content of dry-mass and nutrients in humus horizon with consequent possible negative effect on production.

Objectives:

Presented study is oriented on:

Long-term investigation of parameters of forest-floor in differently managed Norway spruce stands.

Methods




Forest-floor (L, F, H) and top-mineral-soil (A) were sampled using a square iron frame (625 cm^2) under stands (3–6 samples per plot) in period of 2001 – 2010.
All samples were analysed in a laboratory (dry-mass and main nutrients content).

In the presented study we used the results from horizon H as the main reservoir of mostly decomposed material with nutrients.

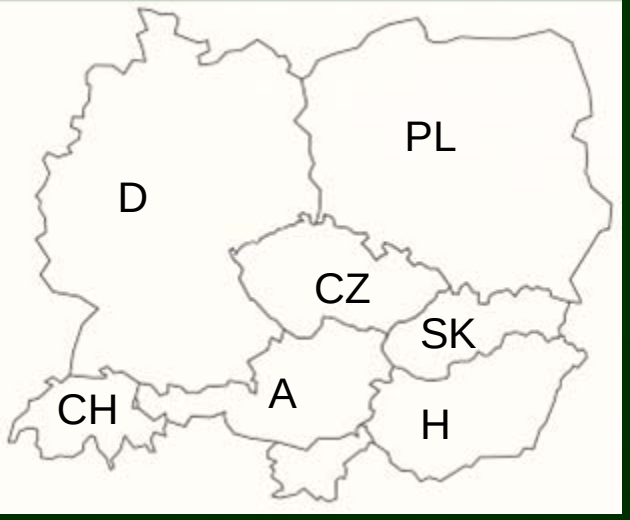
Study was performed of long-term thinning series established in Norway spruce stands since 1958 to 1986. We compare control variants without thinning with thinned variants.

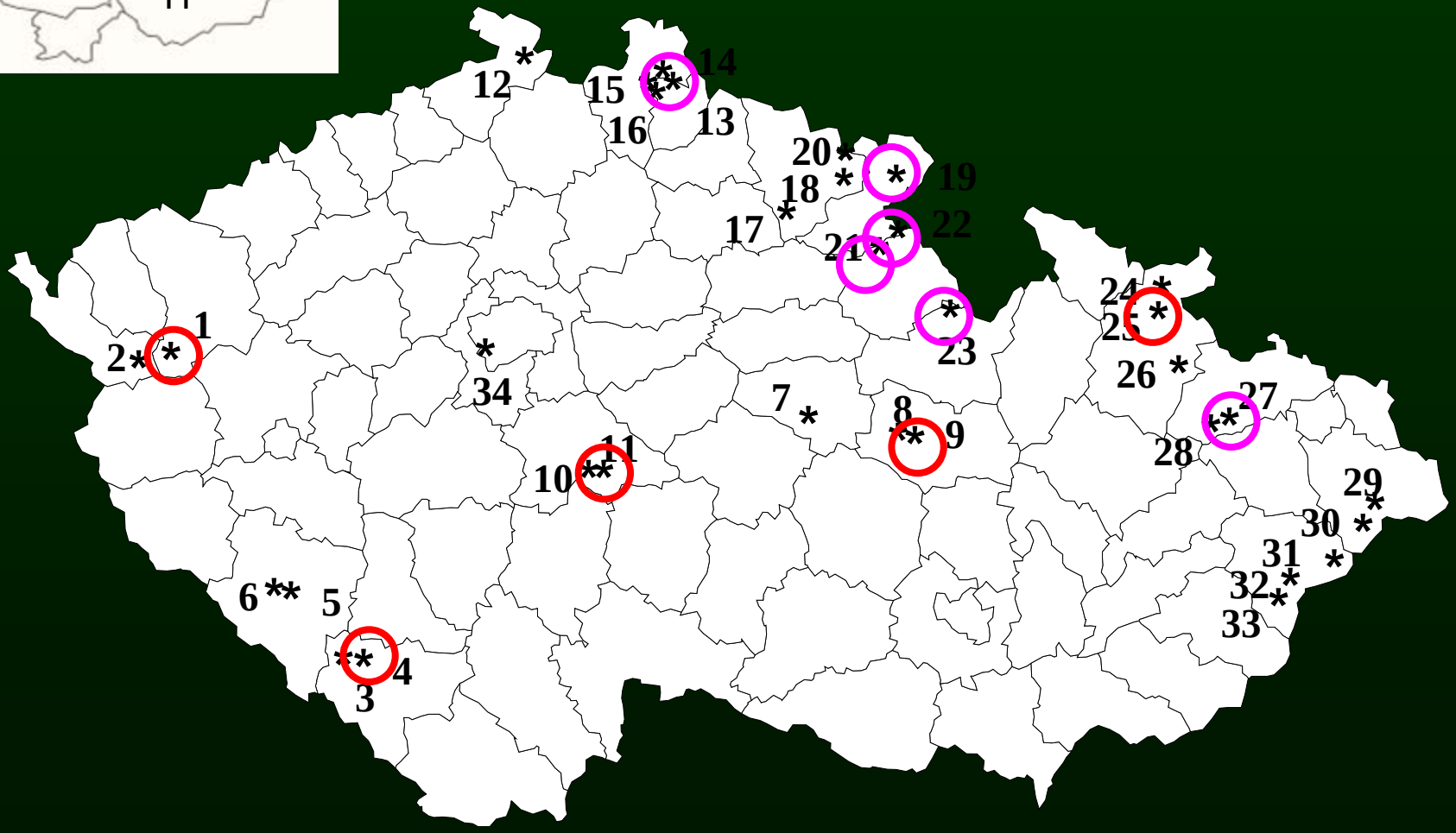
Experimental base can primarily divided into two groups:

1. **Younger stands** – thinning started before top height 10 m with removal of 50% individuals from below. Initial density was about 3-4 thousand trees per hectare (i.e. INITIAL LOW DENSITY, EARLY HEAVY THINNING).
2. **Older stands** - thinning started at top height about 15+ m with removal of 25% individuals from below. Initial density was about 10 thousand trees per hectare (i.e. INITIAL HIGH DENSITY, MEDIUM THINNING).

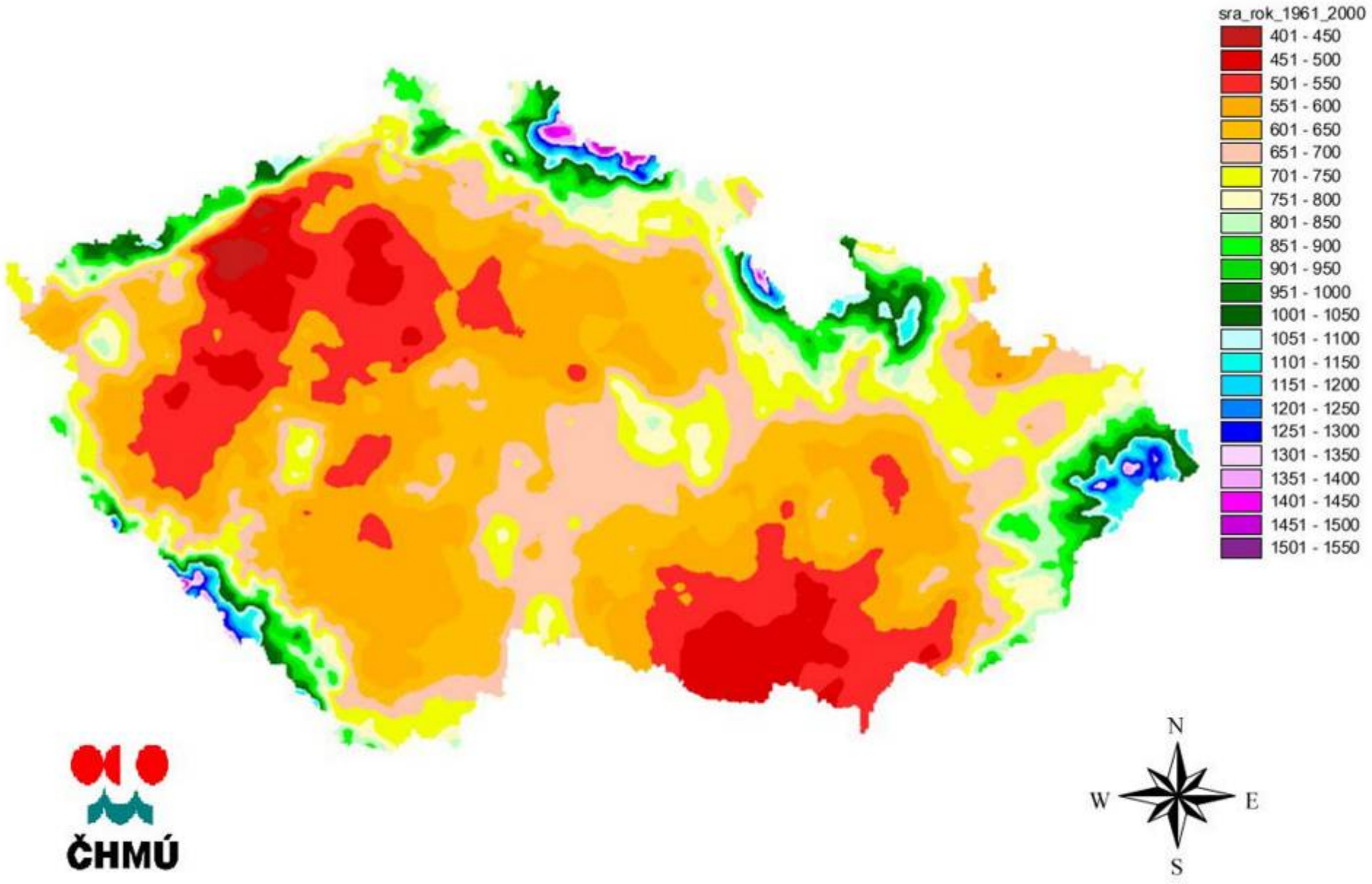
As the soil was sampled in 2001-2010, soil in younger stands was studied ca two decades after thinning while in older stands 3-4 decades after thinning.

Location of objects for forest thinning research in Norway spruce stands

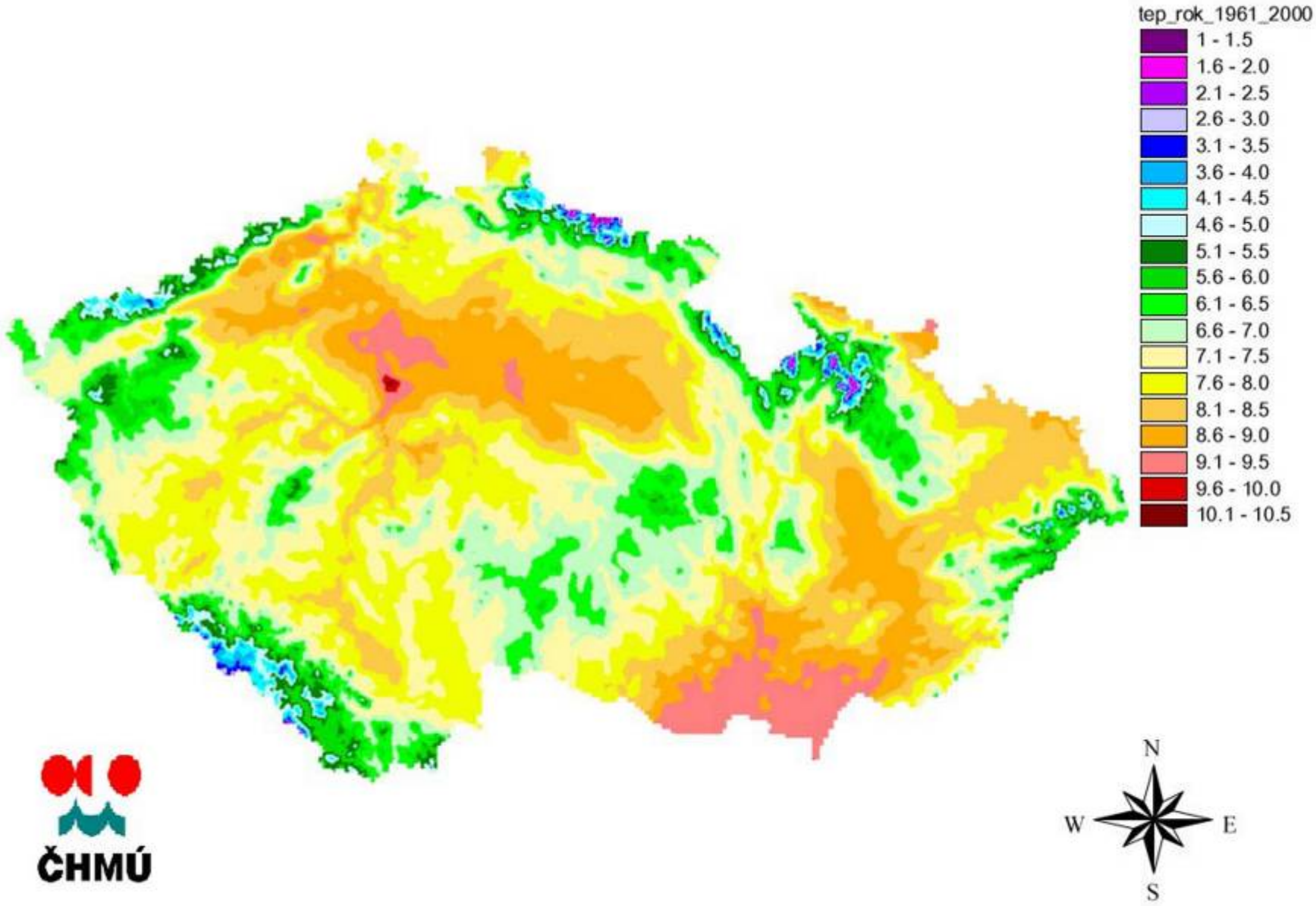


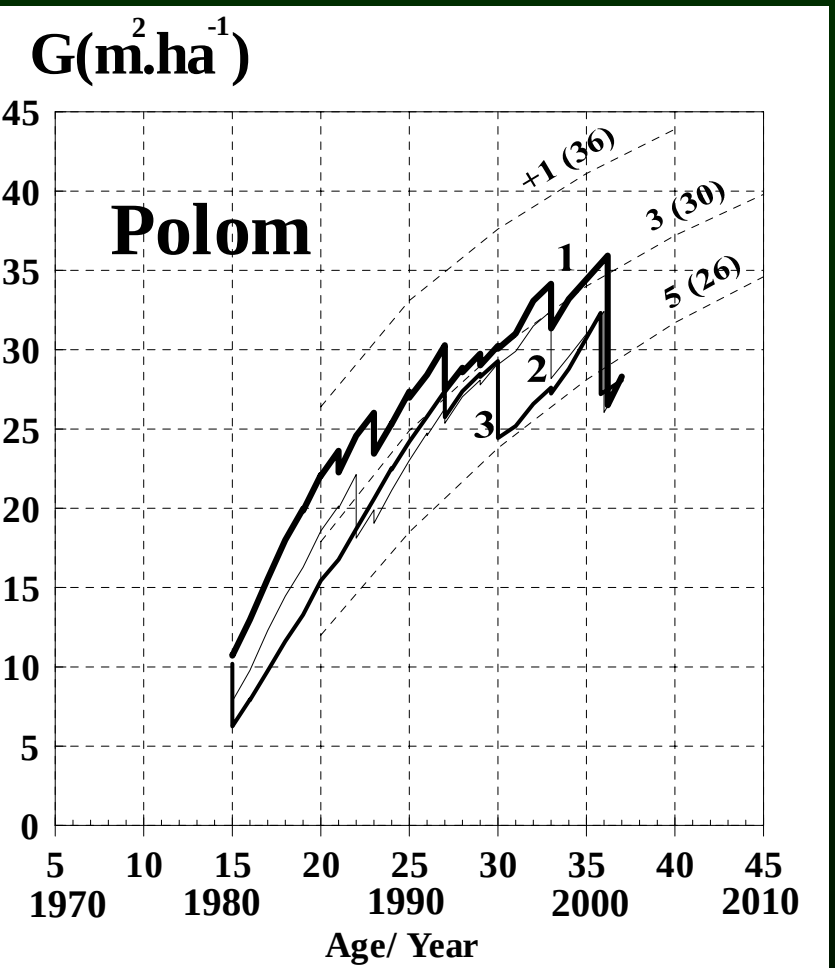


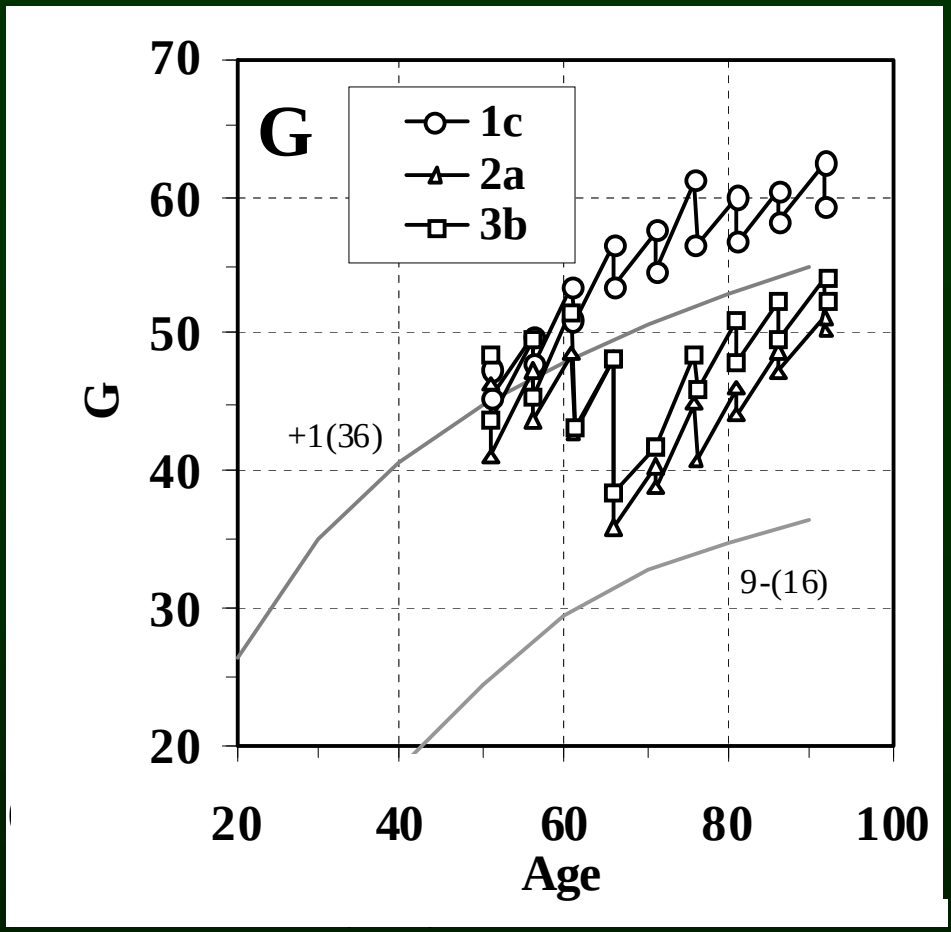
Mean annual sum of precipitations in mm (1961-2000)



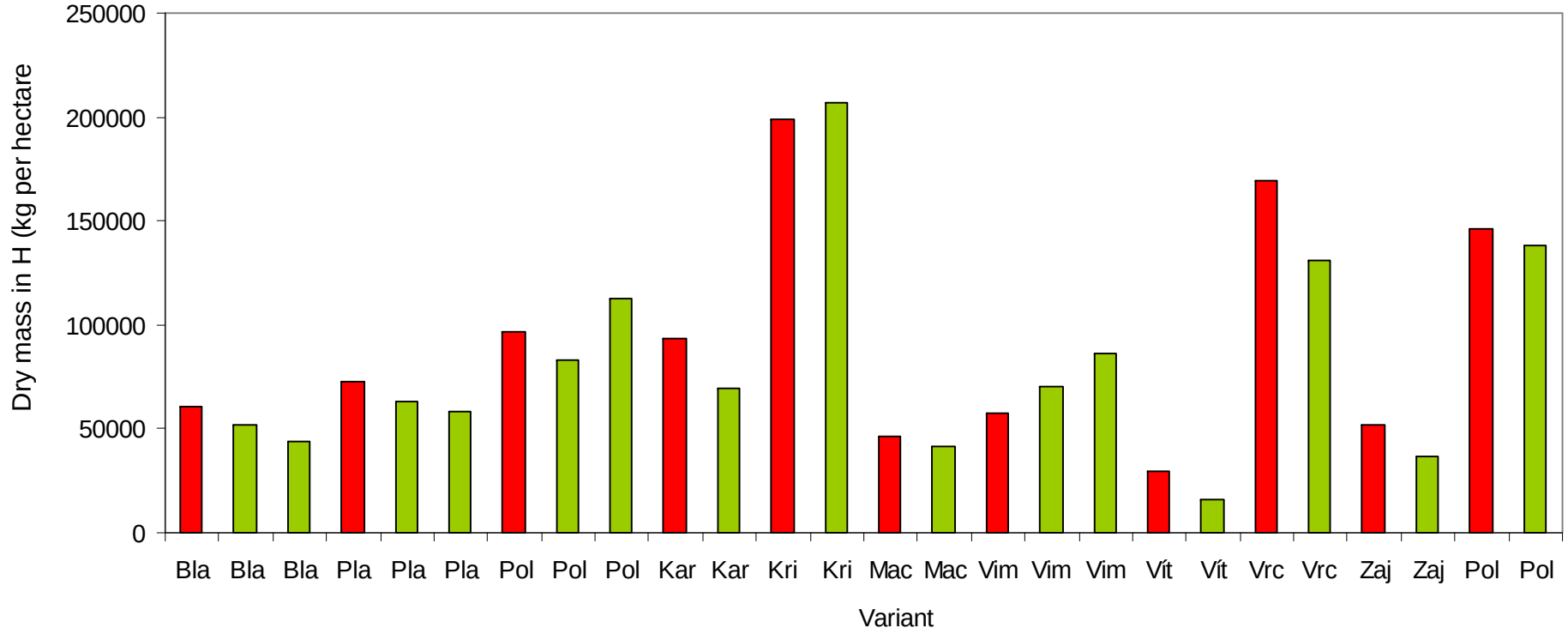
Mean annual air temperature in °C (1961-2000)




G(m².ha⁻¹)
Polom
+1 (36)
3 (30)
5 (26)
1
2
3
0
5
10
15
20
25
30
35
40
45
5
10
15
20
25
30
35
40
45
1970
1980
1990
2000
2010
Age/ Year


G
1c
2a
3b
+1(36)
9-(16)
G
20
30
40
50
60
70
20
40
60
80
100
Age

Results

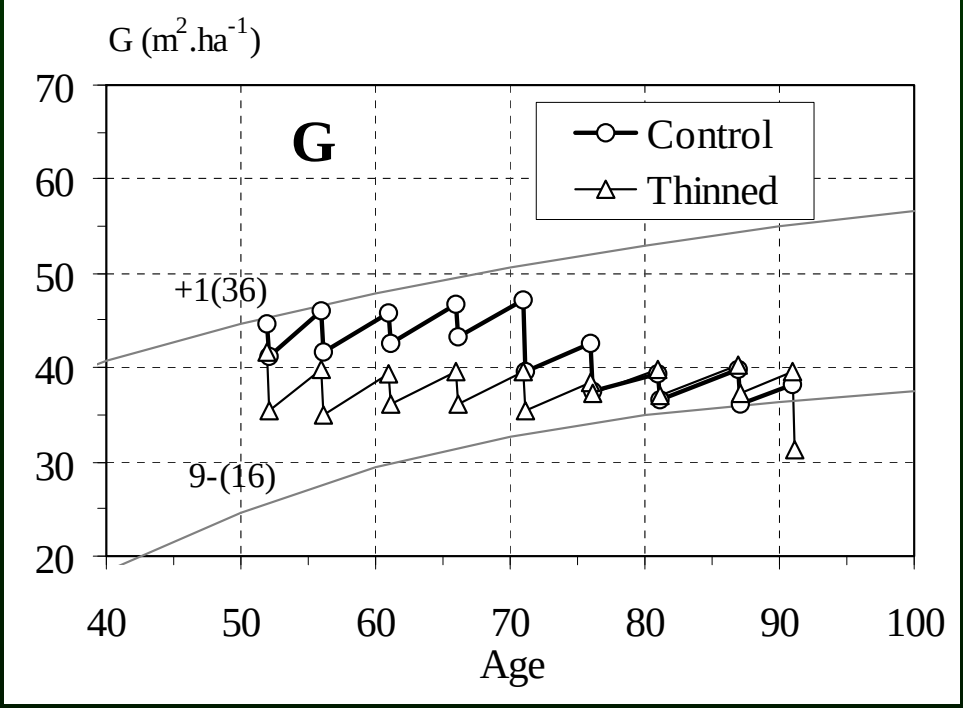


Results showed:

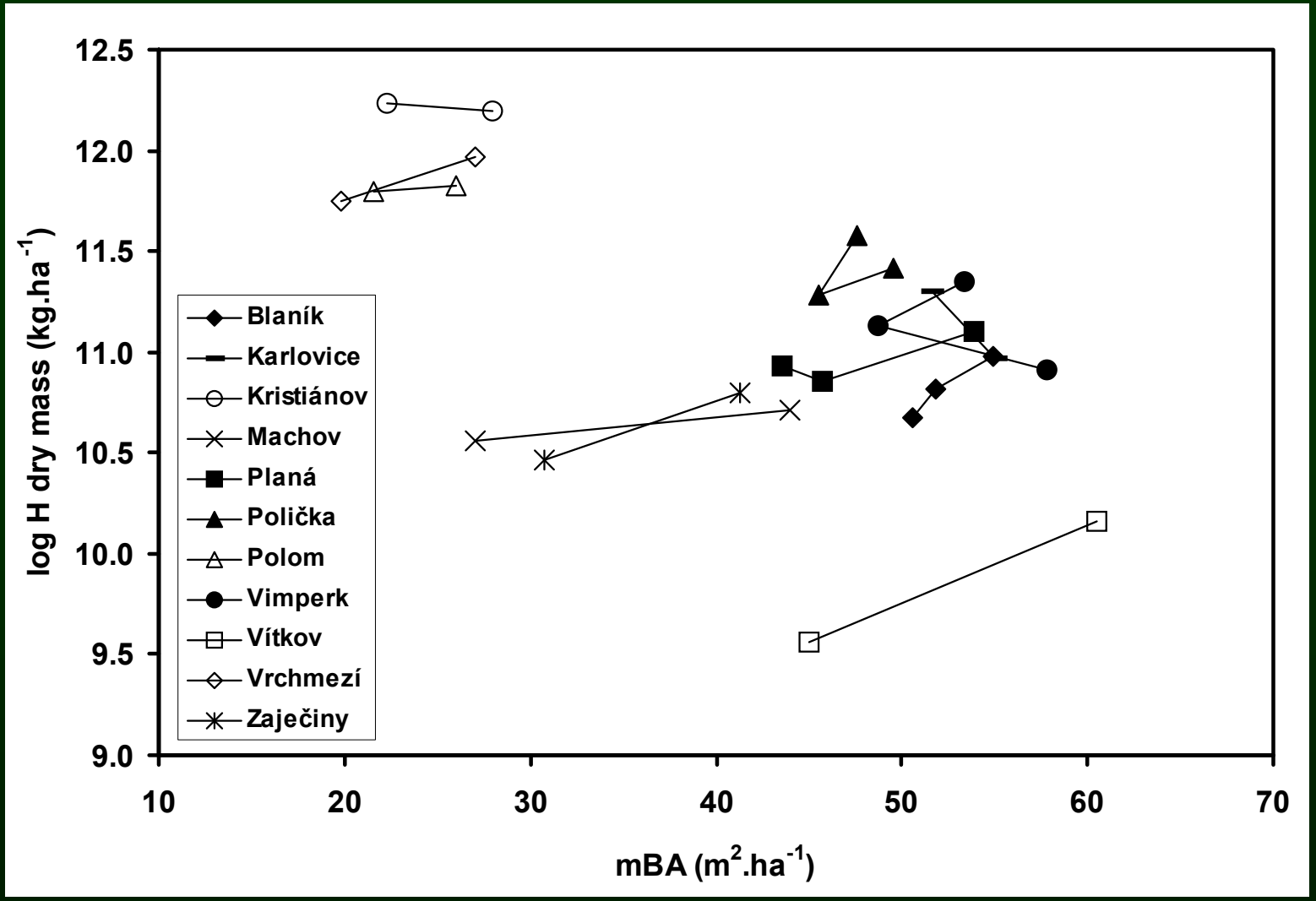
From 11 series, 9 series showed higher amount of humus in control variants.

In three cases this trend was not observed – localities on extreme mountains locations with very slow decomposition and possible high content of humus from previous generation.

With respect of the fact that the investigation of thinning is very long process (many decades), there are situations where basal area of thinned variant is lower, the same or higher compared to control in the frame of one series.



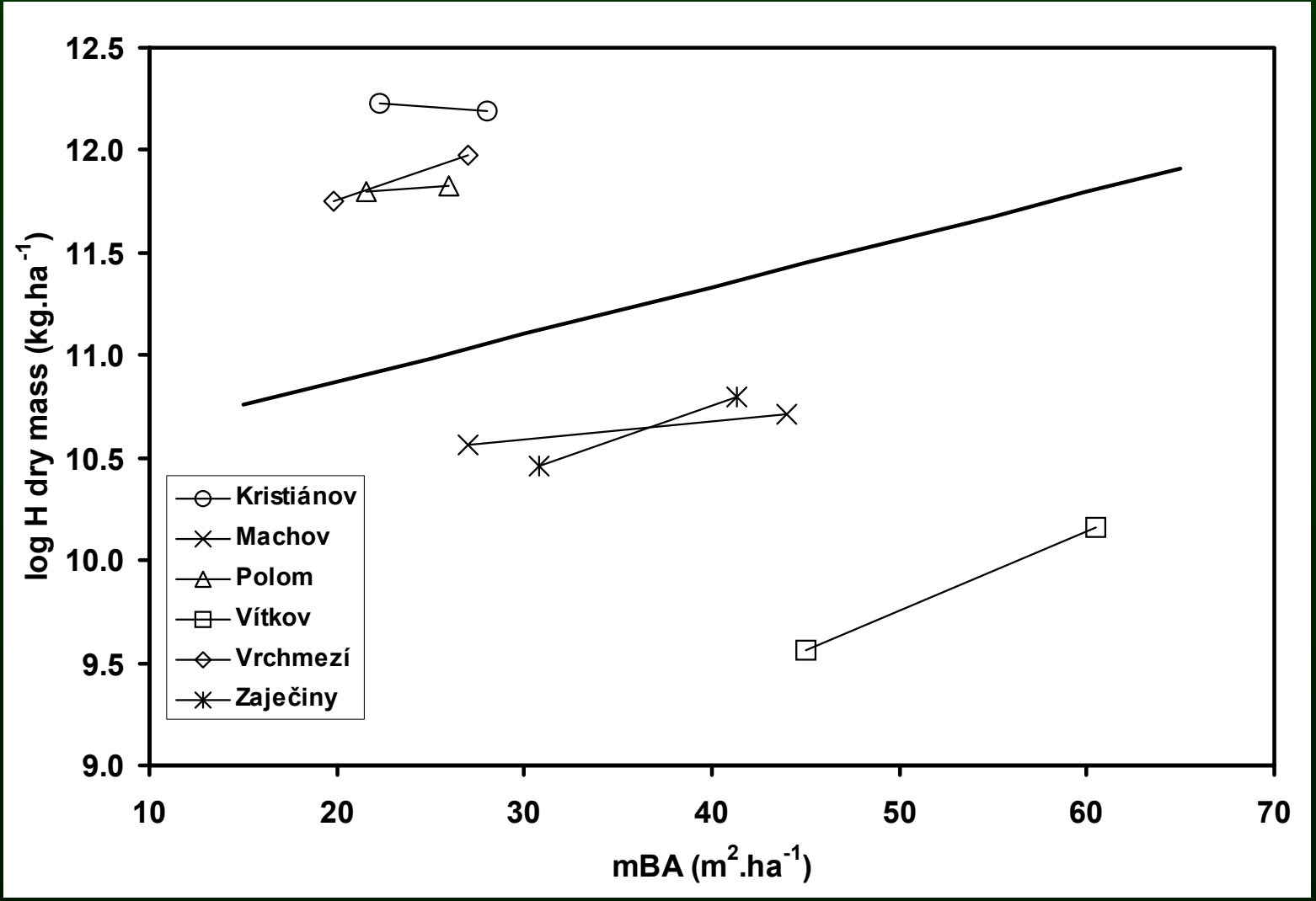
For more detailed evaluation of effect of stand density on humus formation we used the parameter of mean basal area (mBA, according to Pretzsch 2009) for period of last 20 years.



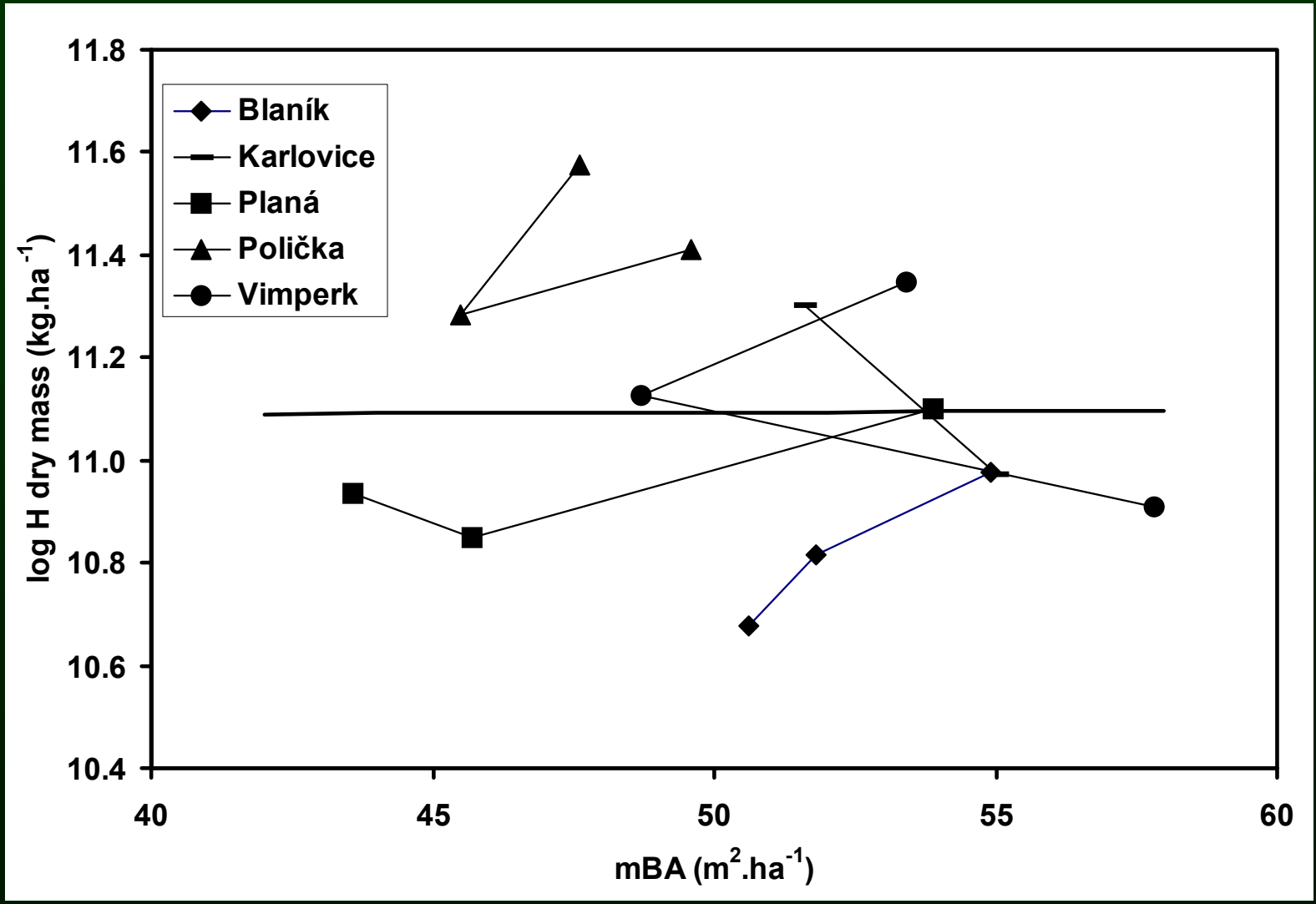
Higher mBA(20) resulted in higher dry-mass of humus.

Two different (decreased trend) events were observed in series, where during the last 20 years basal area ratio between C and T reversed.

When we evaluated data from younger and older stands separately – we found that in younger stands the trend of increased mBA resulted in increased humus mass was clear and significant.



In older stands the relation between mBA and dry humus mass was insignificant.



Conclusion 1/2

Lower stand density resulted in significantly **lower dry-mass of humus** in younger spruce stands.

In **older stands** this trend was **not confirmed**. The main reason is very long period between first thinning and soil sampling and rather low amount of studied series (5).

As the content of nutrient in dry humus mass was found relatively similar, **lower humus mass means lower content of nutrient.**

Conclusion 2/2

With respect of working hypothesis we confirmed the **possible risk for natural nutrient cycles caused by above-ground biomass removal** (thinning), which is frequent practice in European forestry.

On the other hand, basal area development of experimental series confirmed, that control stands **without thinning** are most susceptible to stand disintegration (BA decrease) than thinned stands. It means, thinning is important measure for stabilisation of Norway spruce stands.

According to presented results, the **best practice is early thinning**, because of their stabilisation effect and relatively small biomass removal.


Thank you for your attention!