Thinnig of forest stands

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Silviculture
Thinning of forest stands

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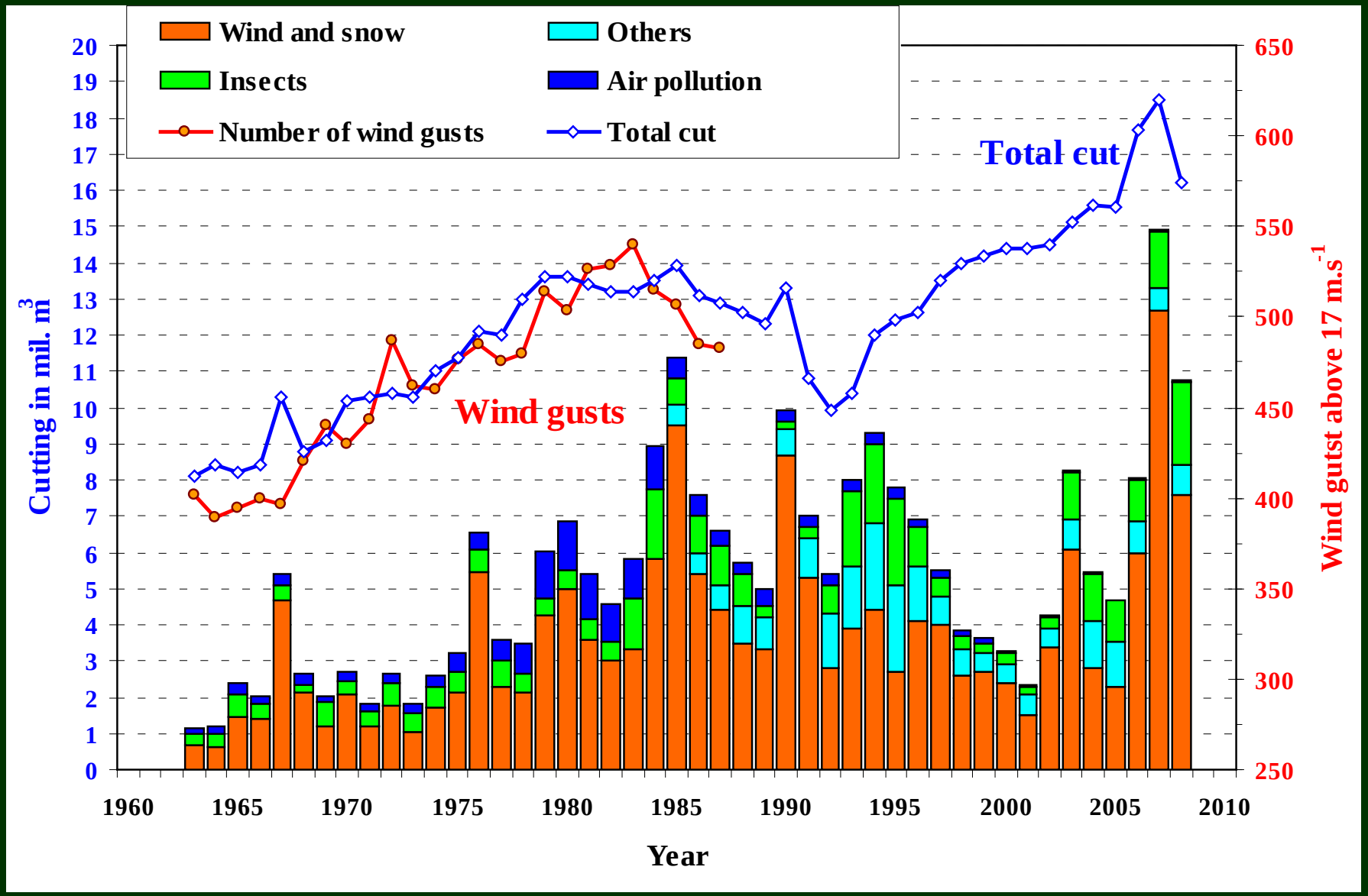
Scheme of presentation:

1. Introduction
2. Effect of thinning on forest stands
3. Principles of thinning for main forest tree species (Norway spruce, Scots pine, Beech, Oak, mixtures)
4. Thinning models for main forest tree species
5. Thinning of substitute tree species stands
6. Summary

The purpose of thinning is systematic regulation of growth and development of forest stands during the prevailing part of rotation as well as effect on individual quality of trees, forest stands and forest environment.

Main objectives of thinning of forest stands are:

- Improvement of **species composition** and **age structure**,
- Increment of **stability of forest stands** and their resistance to harmful factors,
- Increment of **biodiversity** of forest stands,
- Improvement of **wood-production role** of forests,
- Improvement of **other** non-wood-production **functions** of forests.


Wind and snow
Others
Insects
Air pollution
Number of wind gusts
Total cut
Total cut
Wind gusts
Cutting in mil. m3
Wind gutst above 17 m.s-1
Year
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
250
300
350
400
450
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650
1960
1965
1970
1975
1980
1985
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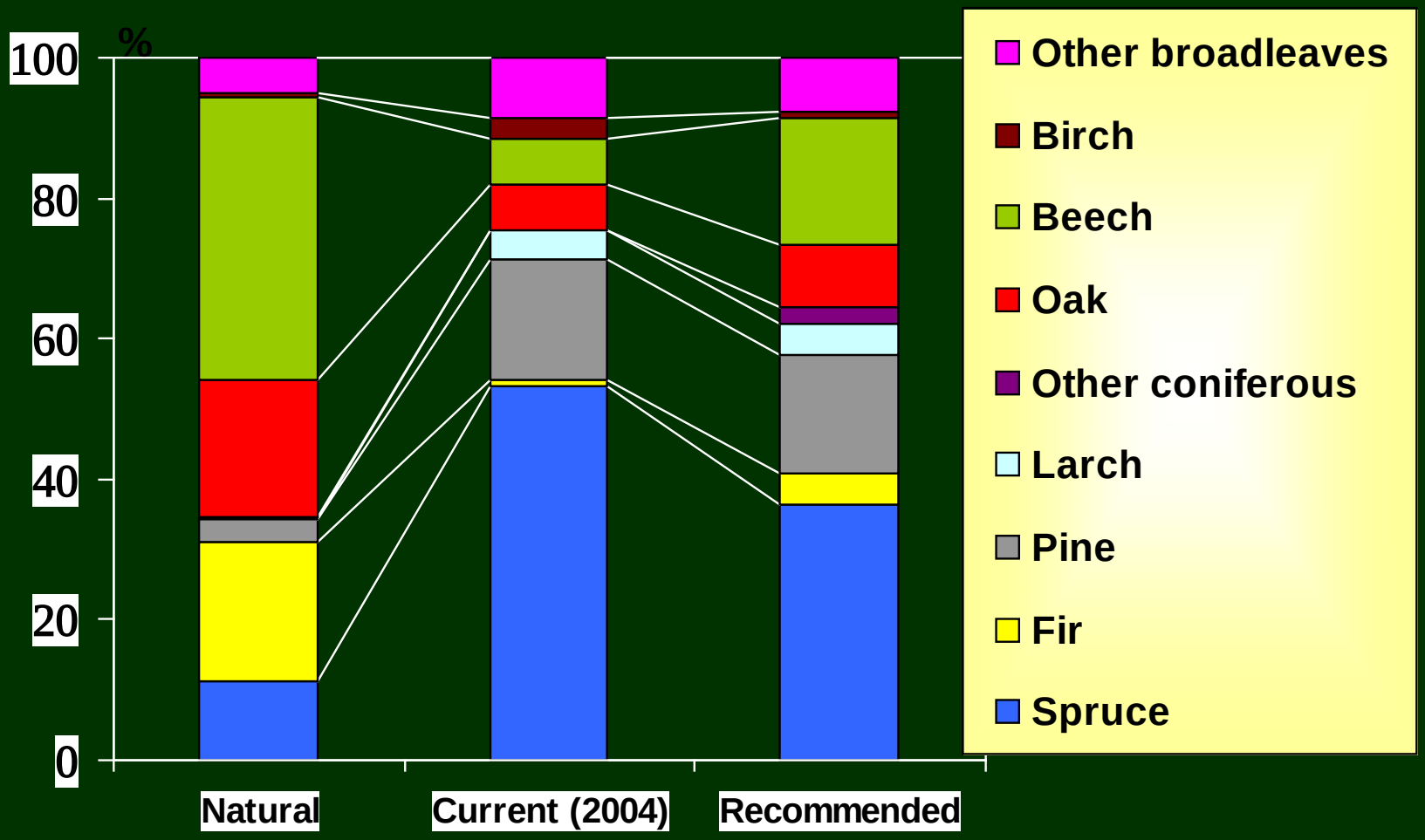
2010

Species composition in the Czech Republic



In forestry practice, thinning is divided into two specific silvicultural operations:

- thinning of young growth and thickets (**precommercial thinning**). It is silvicultural treatment oriented on the youngest forest stands, where mostly unmarketable thinned material is not removed from a stand. Precommercial thinning are planned and controlled on the basis of thinned stands area.

- thinning of older stands (**commercial thinning**). It is on the other hand the silvicultural treatment leading to some additional production of wood and therefore these treatments are planned and controlled on the amount of harvested wood or on the basis of removed basal area.

Thinning (both precommercial and commercial) effects the forest stands by two ways: by selection and by the changing of stand environment

Selection effect, based on individual selection, was formulated by famous Czech forester Konšel (1931) as removing of less appropriate stand components in favour of more desirable and appropriate components. In forestry practice, two main methods of selection were developed:

- **Negative selection** oriented on removing of under developing individuals of lower quality or individuals not appropriate from the viewpoint of forest management. Negative selection is mostly done by selection from below, though in young broad-leaved or mixed stands, the negative selection can be done in the main forest canopy (from above).
- **Positive selection** oriented on loosing and support of the most suitable stand components, as a rule, the target trees by removing of restraining individuals.

Effect of stand environment change (ecological principles of thinning formulated by Chroust 1997) consists in the **change of growing conditions in a forest stand after thinning**.

Removing a part of individuals from a stand by thinning results in decreased competition in crown layer and rhizosphere and due to decreased interception, more precipitation penetrates into the forest soil.

Higher insolation together with higher moisture supply improve conditions for primary production, accelerate the nutrient cycling, positively influences of forest soil and results in better function of all forest ecosystem.

Principles of thinning for main forest tree species

Biological characteristics of the forest tree species require the different approach in thinning with consequent differentiation on site conditions.


Spruce stands

Norway Spruce

- Most important forest tree species.
- Cultivated on nearly all site conditions (from floodplain to Mts.)
- Diversified natural conditions require the differentiation of silvicultural methods and management goals.

Biological feature:

- Very good growth reaction on loosing during nearly all period of rotation.
- Even outside of canopy it keeps upright stem and symmetric crown.
- In artificially regenerated stands, pioneer growth strategy prevails, i.e. the tendency of very quick growth in young age with culmination of diameter increment at the age of 10 – 15 years and height increment at the age of 20 – 30 years.
- In this period of quick growth, Norway spruce trees need sufficient growing space to form symmetric and stable stems and powerful root system. For this reason, spruce trees need vigorous mass of assimilation organs – developed crowns.

Even aged Norway spruce stand originated from planting or sowing is highly artificial structure, which cannot survive without proper silvicultural care.

Thinning principles in such stands consist in keeping them in open canopy in young age. It can be achieved by different way:

- by lower planting density,
- by early and frequently repeated medium thinning or
- by one very heavy thinning in the period of canopy closure.

Lower initial density is not necessary in regions not endangered by snow and wind damage and is not recommended in air polluted areas.


Pine stands

Scots pine

- Flexible to growing conditions and undemanding to nutrients and moisture.
- Comparing to spruce stands, thinning principles for pine stands are different because of dissimilar biological characteristics (different crown structure, sunny needles, etc.).
- Reaction of pine stands on thinning is slower than in spruce stands and generally weak.
- Heavy thinning in pine stands can result in production losses and therefore the main objective of thinning is increased of production quality.

The first thinning in pine stands is not oriented on density reduction as in spruce stands, but on removing of minimal number of undesirable individuals of low quality (wolf trees).


Beech stands

Beech

- Typical shade-tolerant tree species with later culmination of growth, i.e. with climax growth strategy.
- Relatively resistant to snow and wind damage.
- Ability of increased growth after releasing in the second half of rotation (+).
- Disposition to broaden of crowns after heavier thinning and the tendency to fork growth of a stem (–).

The first treatments in beech stands are not oriented on density reduction in young age - The main goal is **increasing of production quality**, i.e. removing of undesirable stand components (wolf trees).


Oak stands

Oak

- Light demanding forest tree species with early growth culmination (similarly like Scots pine), but decrease of growth after culmination is slower.
- Oak reacts on releasing by widening of crown and by forming of epicormic shoots.
- Very resistant to wind damage, but oak stands suffer from tracheomycosis last period.
- The time of the firs thinning depends on amount of admixed species. As soon as possible (to the age of 10 years), quickly growing species (birch, maple, alder and ash) which may overtop the oak, should be removed.
- Thinning in the young age is based as a rule on negative selection in the main canopy, later, when the top height reaches 15 m, positive selection from above should be used.


Mixed stands

Mixtures

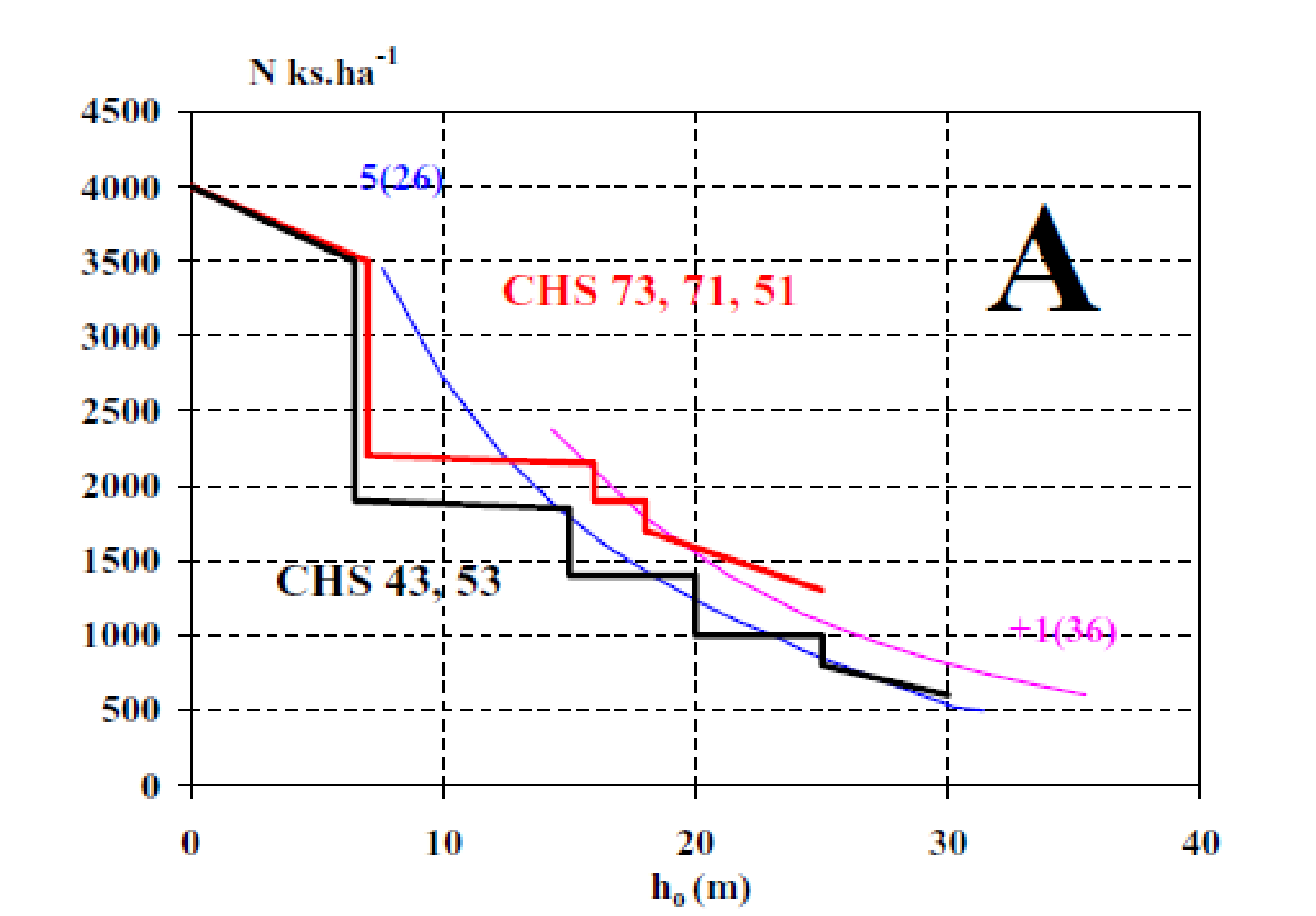
Similarly like in single tree species stands, thinning of mixed stands must respect the characteristics of particular forest tree species and site conditions.

Mixtures of tree species with different demands (e.g. the most frequent mixture of beech and spruce) should be preferably founded by group admixing.

Thinning of stand mixtures consisting of spruce and beech depends therefore on the pattern of stand foundation. In the most suitable group mixtures, groups of spruce and groups of beech can be thinned by adequate specific way, i.e. spruce groups heavily in the young age and mildly later and beech groups mildly in the young age with individual release of the best trees later.

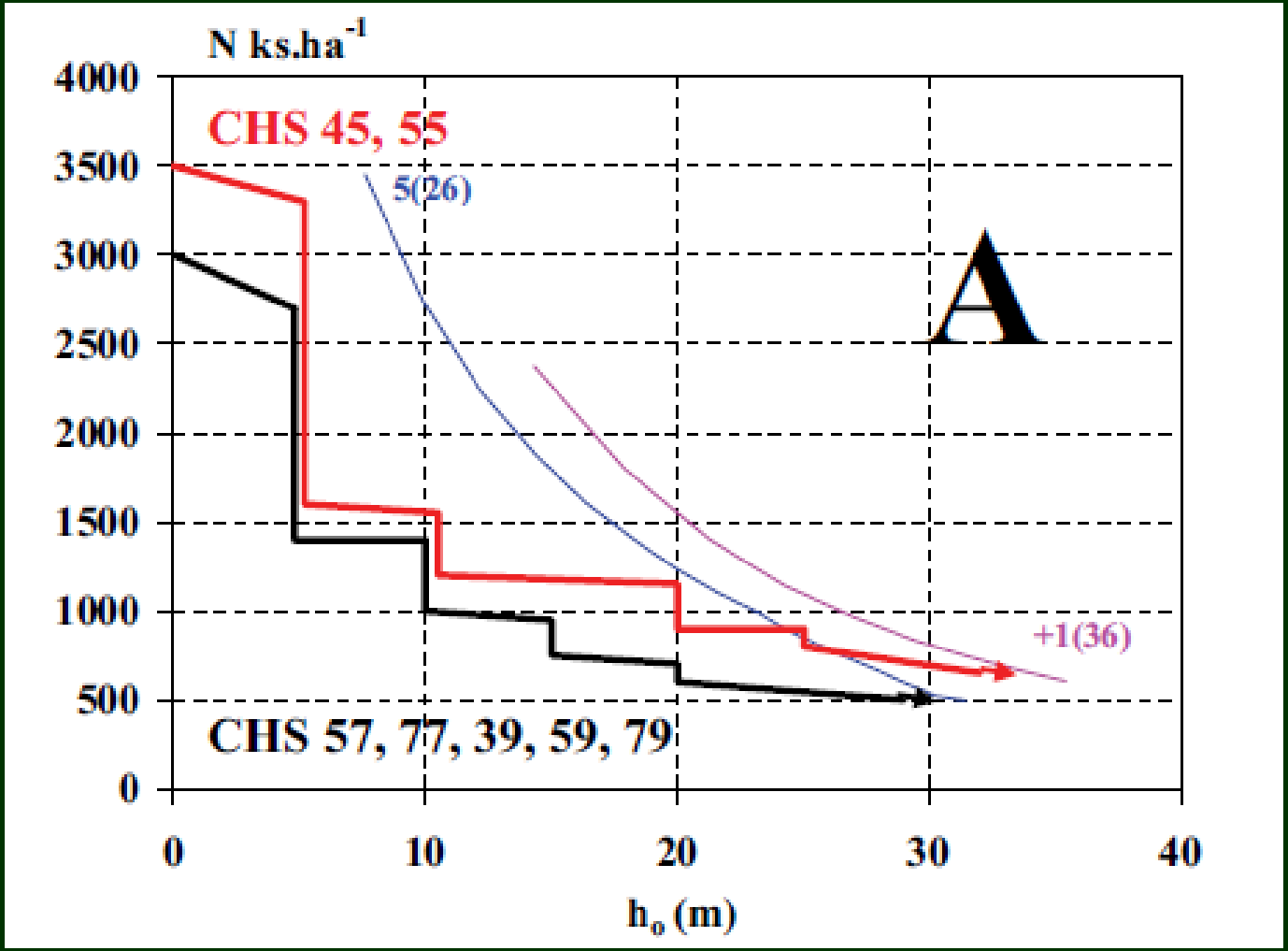

Thinning models
(Slodičák, Novák 2007)

Spruce – basic model



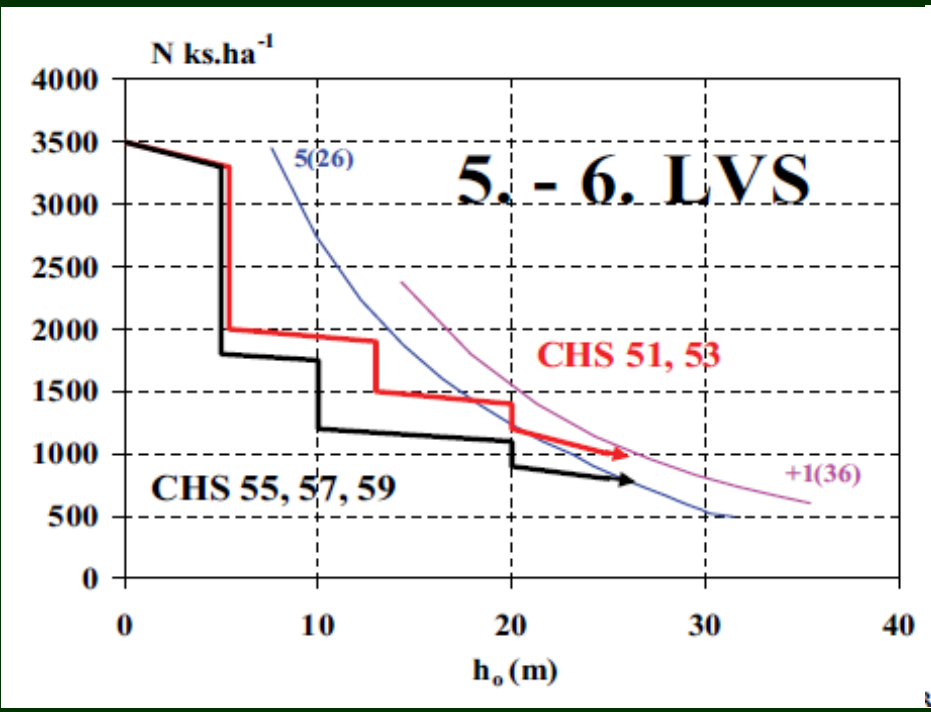
Thinning programs for spruce stands less threatened by abiotic harmful agents with data on tree number (N) and basal area (G) from the Growth table (Černý et al. 1996) for +1 (36) and 5 (26) yield classes

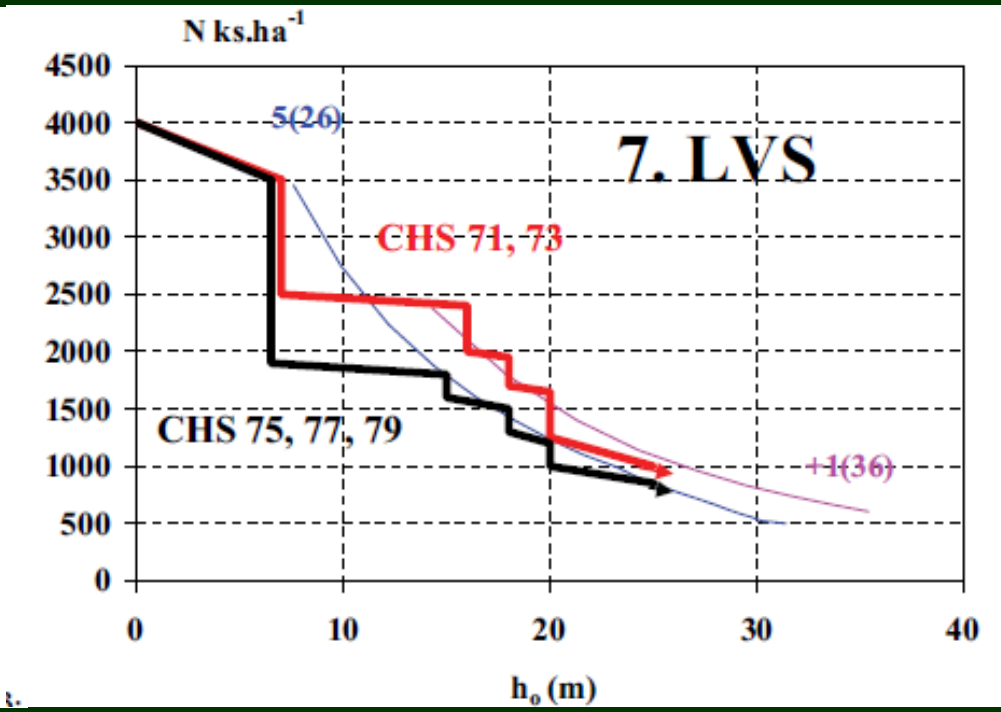
Spruce – model for stands threatened by abiotic harmful agents



Thinning programs for spruce stands very threatened by abiotic harmful agents with data on tree number (N) and basal area (G) from the Growth table (Černý et al. 1996) for +1 (36) and 5 (26) yield classes

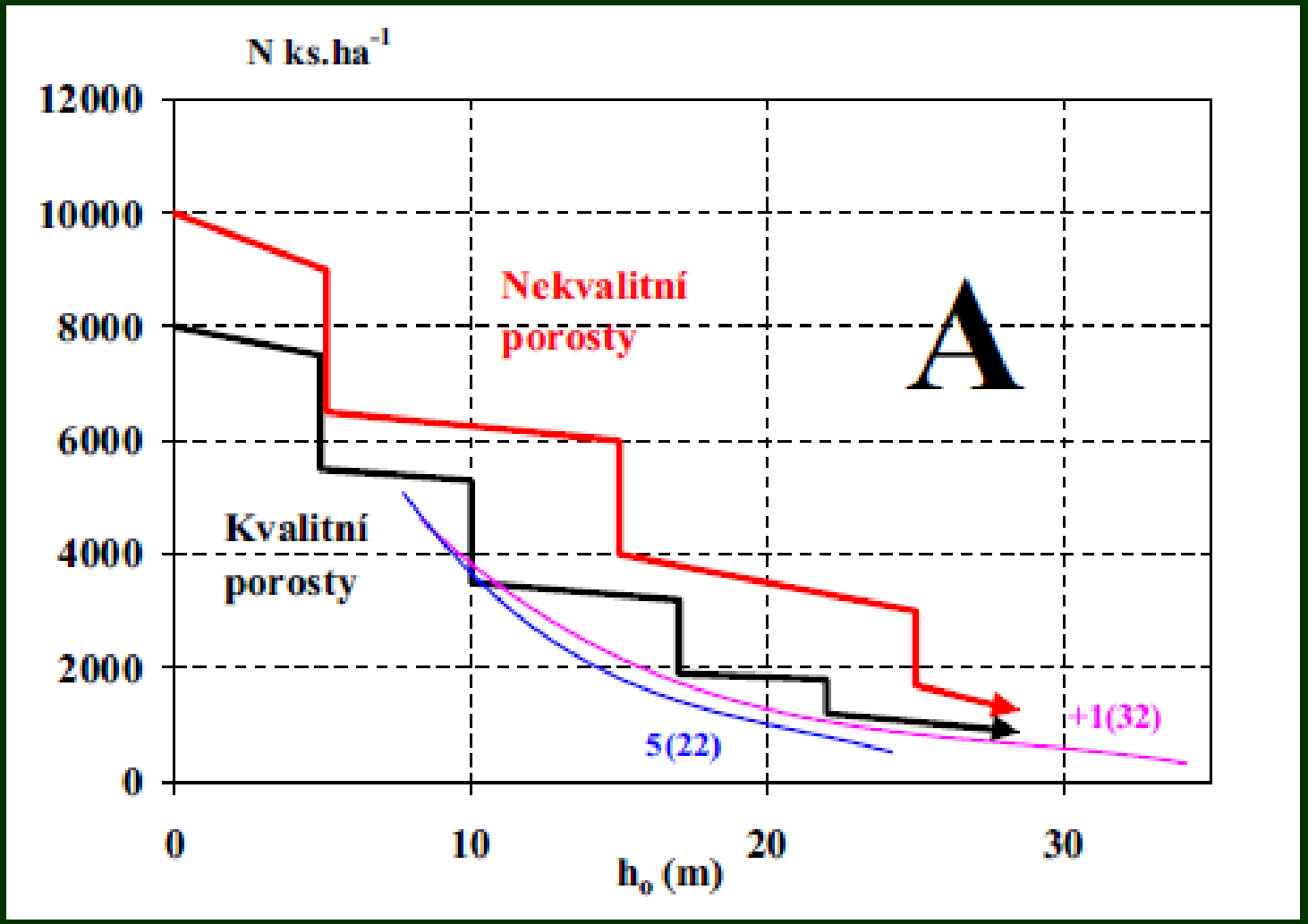
Spruce – model for stands on localities with higher acid deposition





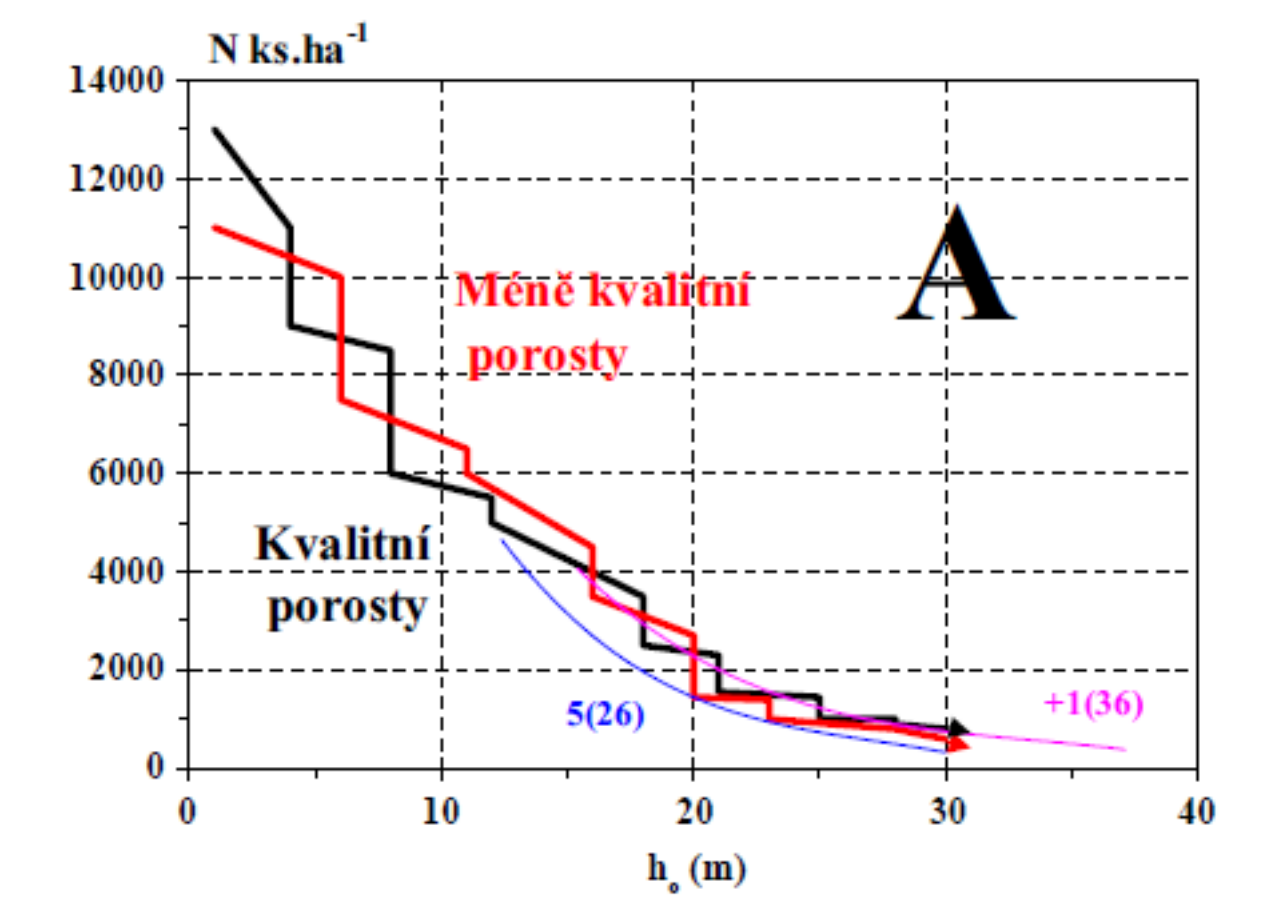
Thinning programs for spruce stands on localities with acid deposition higher than double critical amount, i. e. higher than 3.2 kmol H^+ ha^{-1} $year^{-1}$ with data on tree number (N) and basal area (G) from the Growth table (Černý et al. 1996) for +1 (36) and 5 (26) yield classes

Pine



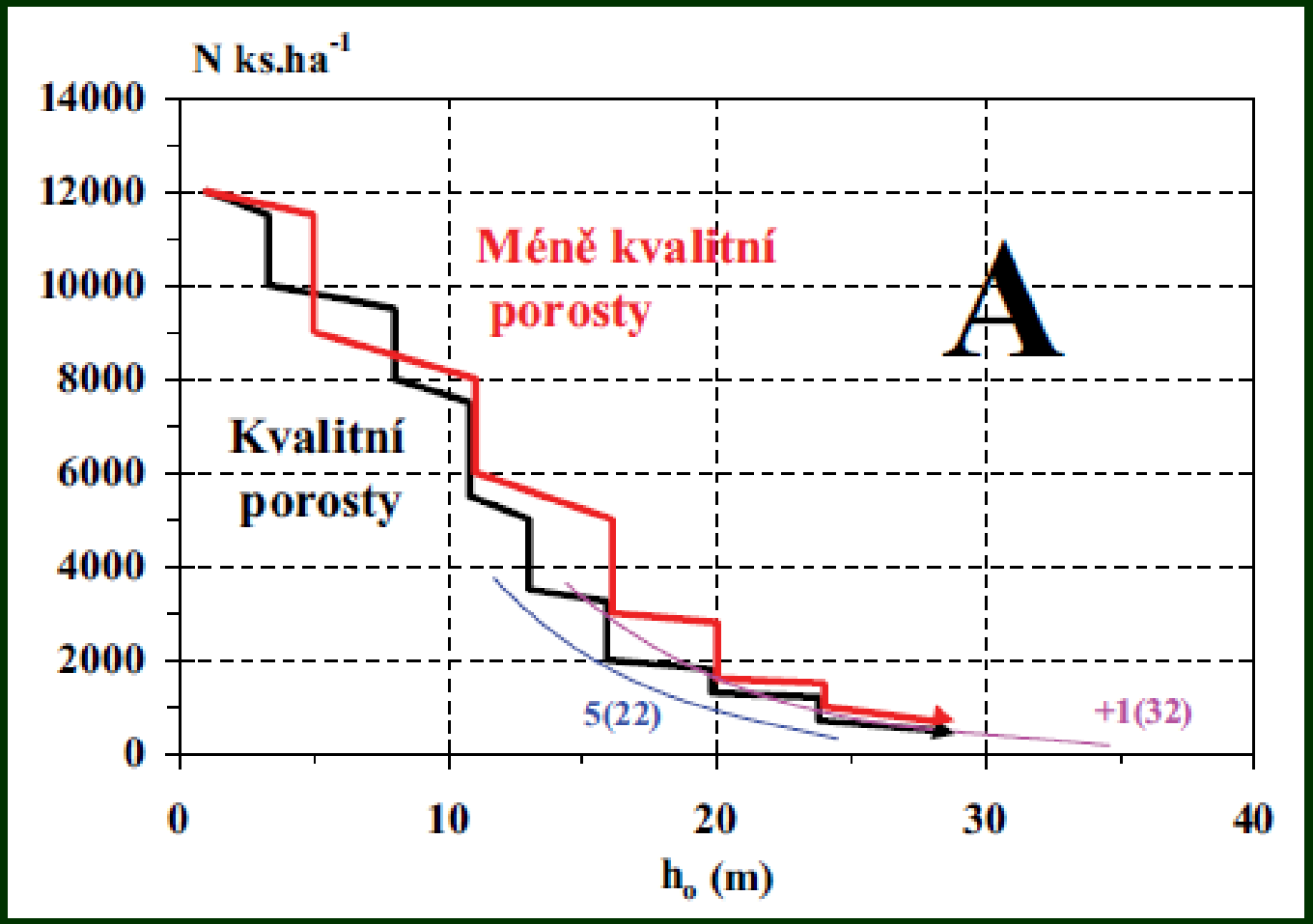
Thinning programs for high quality and low quality pine stands with data on tree number (N) and basal area (G) from the Growth table (Černý et al. 1996) for +1 (32) and 5 (22) yield classes

Beech



Thinning programs for beech stands with data on tree number (N) and basal area (G) from the Growth table (Černý et al. 1996) for +1 (36) and 5 (26) yield classes

Oak



Thinning programs for high quality and low quality oak stands with data on tree number (N) and basal area (G) from the Growth table (Černý et al. 1996) for +1 (32) and 5 (22) yield classes


Substitute
tree species
stands

Substitute tree species stands

Forest stands of substitute tree species (STS) were established in the 70´s and the 80´s in the heavily air polluted areas of the Ore Mts., especially on the sites where the declining spruce monocultures could not be replaced by ecologically suitable tree species.

At present, STS occupy 33 thousands hectares of forest land and it represents of 52 % of forest land of eastern Ore Mts. ridge. The largest percentage (ca 61%) of this area is covered by birch (Betula sp.) and blue spruce (*Picea pungens* Engelm.) or mixtures of these two species.

Next important species in STS with ca 14% of the area is European larch (*Larix decidua* Mill.), which is in the 6th vegetation zone considered as target tree species. Other tree species as European mountain ash (*Sorbus aucuparia* L.), European aspen (*Populus tremula* L.) and conifers (e.g., pines such as *Pinus rotundata* Link. and *Pinus contorta* Loudon) occur to a lesser extent.

The main **objectives of thinning of substitute tree species stands** in air-polluted areas are following:

- Sustaining and improvement of fulfilment of forest functions.
- Maintaining vitality of dominant trees, i.e. to increase vitality of whole stands.
- Reduction of acid throughfall deposition from the continued air pollution load.
- Reduction of interception and improvement of water regime in the root layer.
- Creation of microclimate favourable to continual decomposition of litter (improvement of soil conditions, prevention of raw humus accumulation).
- Changing of species composition and stand structure in favour of target tree species.
- Increasing quality and safety of production (resistance to snow, rime and wind damage in the substitute stands with production function).

Summary

Present thinning methods are differentiated on biological characteristics of forest tree species, on **natural conditions**, on expected **silvicultural goals** and on the **level of hazard**.

Differentiation on biological characteristics respects the different specific requirements of forest tree species and their growth dynamics (e.g. quicker growth in young age).

Differentiation natural conditions consists in respecting of differences of forest vegetation zones, edafic categories, silvicultural regions, level of air-pollution and danger of snow and wind damage.


Thank you for
your attention!