Study of macroscopic markers of Norway spruce damage in the Krušné Hory Mts.
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Introduction
In past, natural development of Central European forests has been heavily affected by human activities. In the Krušné Hory Mts. the situation gradated in the beginning of 1980 and led to the exhaustion of 70% of Norway spruce forests older than 60 years. Terminology extracts the name forest decline for phenomenon when the exhaustion is not caused just by one factor, but by combination of chronic and acute natural and anthropogenic stress factors. Buds with apical meristems are organs reflecting the actual tree condition, because they determine crown architecture, amount of new shoot increments, assimilative and reproduction organs. On the basis of the detailed anatomical study, a macroscopic criterion of identification of vegetative bud developmental types (growing, aborted, and malformed buds, and buds with growing potential (GP): dormant, latent and regenerated buds) was developed allowing a fast evaluation of bud developmental potential [1]. We used the above criterion for determination of bud developmental types as a macroscopic marker of actual tree condition.

Material and methods
Mature 60-year-old Norway spruce (Picea abies) trees were investigated in 1998 and 2000 from four homogenous sites in the Krušné Hory Mts. Different levels of damage determined by defoliation characterized the sites. One branch was sampled from each of the five representative trees inside each site. Individual bud developmental types [1] were determined for each of the branch and transformed into percentage of total screened buds on the branch. Other macroscopic characteristic such as needle retention, chlorosis, and occurrence of aphid galls and percentage of the secondary shoots were measured.

Results and discussion
The branches were sorted by PCA (Principal Component Analysis) to four groups. Branches with (i) colonizing growth potential (high ratio of growing/aborted buds - G/A, low GP), (ii) declining growth potential (low G/A, low GP), (iii) stable growth potential (high G/A, high GP) and (iv) opportunistic growth potential (low G/A, high GP). Several factors have been known to influence individual bud developmental types, for example, localization of the branch along a crown, tree age, interaction of external environmental factors. The influence of all these factors has not been intensively investigated and fully understood yet. When the specific site factors are known then their effects on the ratios of individual bud developmental types can be assessed. Evaluation of bud vitality can be very useful tool to specify a current stage of tree reaction to the stress loads. The results from Krušné Hory Mts. show that strongly damaged Norway spruce trees in the past (according to their defoliation degree) are in the stage of recovering and, on the other hand, damage of healthy trees (determined by estimation of their defoliation) increases likely because of influence of chronic stress impact. Other results show that the needle retention decreased as environmental damage increased and the percentage of secondary shoots increased as the needle retention decreased.

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References