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Some Aspects of Interpretation of Forest Trees Defoliation Data

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Summary

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The state of defoliation with its changes on a subsample of the national 4 km grid, in the years 1987-1994 is presented in order to estimate their relevance and applicability.

Introduction

Evaluation of forest tree condition data collected on the national plotgrid has been a weak point of forest monitoring in Slovenia. The Slovenian evaluation model (ŠOLAR 1989) besides defoliation and discoloration (ANONYMUS 1987) uses other forest tree properties and can be supplemented by subtraction of defoliation explained by known damages (JURC 1988). Some additional data for the evaluation of forest condition are collected (KALAN 1987, BATIČ 1989) but determination of forest health condition is mostly based on the defoliation data.

Methods

National plotgrid has been assessed by two stage sampling with some exceptions yearly since 1985 at different intensity and by nearly the same metodology. The subsample of 26 tracts (e.g. 433 trees) on the 16 km grid is analysed which has been observed in last four inventories. The sample comprises 14 tree species and is dominated by beech (39%) and spruce (37%). Tree damages are recorded as (a) type of damage on stem base, trunk and crown, (b) characteristics presumably indicating disturbance of the normal development and functioning of a tree (secondary shoots, dry branches, etc.) and (c) estimation of tree defoliation. Defoliation is defined as the amount of needle or leaf loss. Quality of data is ensured by 3-5 day training seminar organised by Forestry Institute,

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reference photographs of main tree species and field control of 8-12% sampling plots. A tree is considered to be damaged (HOČEVAR & HLADNIK 1988, HOČEVAR 1990) when it is more than 25% defoliated. The defoliation values are recalculated to the tract value and presented as POS[1] and IND[2] (HOČEVAR 1990). Relative differences between time periods and geographical units are considered more important than absolute values.

Defoliation assessment in Slovenia and its quality control

Defoliation can not be used as a diagnostic tool unhesitatingly (INNES 1993b) but large scale inventory assessments of tree condition are mostly based on defoliation. Variation of foliage depends on geographic latitude, altitude, provenience, tree age, crown visibility and exposure, defoliation class, weather conditions and other factors (INNES 1988, 1993b, SCHADAUER 1991, KÖHL 1992, HORNVEDT 1993) so quality control of defoliation scores is urgent.

It has been rather neglected in Slovenia until the nineties (LEVANIČ 1990). Written reports about seminar results and inventory control were not available until 1991. SOČAN 1991 reports that more than half of the trees on three quarters of plots matched the scores of control team. In 1993 differences between average estimates for individual species exceeded the 5% tolerance limit only for silver fir *(Abies alba)* and beech (*Fagus sylvatica)* and were consistent for spruce *(Picea abies)* and oak *(Quercus sessiliflora).* In 1994 no significant differences were found ($p<0.05$). 92% of controlled trees remained within the 5% tolerance limit. The difference between inventory and control field estimates exceeded 20% for four trees (of 96) only. The standard deviation of differences corresponds to MAHRER 1989 (8%).

Results and Discussion

Defoliation of spruce *(Picea abies)* and beech *(Fagus sylvatica)* on the bioindication grid

The percentage of fully foliaged beech trees is declining[3]. On the contrary, the percentage of fully foliaged spruce trees varies, yet on a lower level than beech (Tab. 1, Fig. 1 a,b).

Tab. 1: The percentage of trees with no defoliation

	No tolerance(5%)		Tolerance accounted	
	Beech	Spruce	Beech	Spruce
1987			65.0	25.0
1991	13.7	4.3	35.3	12.4
1993	5.4	2.5	24.6	11.8
1994	3.6	4.3	21.6	17.4

Average defoliation of the tracts[4] show small variation, while the defoliation index shows more variability (Tab. 2). Its value of 1994 is surprisingly

[1]average defoliation on the tract

[2]defoliation index as the percentage of trees more than 25% defoliated

[3]In 1987, the defoliation was estimated in five damage classes (ANONYMUS 1987), which makes results hardly comparable. Nevertheless, the defoliation class 0 (0-10% defoliation) was analysed in comparisons including tolerance limits (5%).

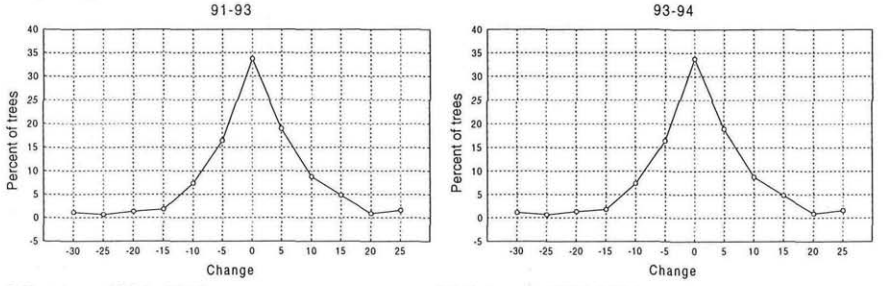
[4]All species are taken into account since changes are a relative measure.

low considered that the absolute standard was used in that year. Changes of IND in European countries for period 1993-1994 varies from -5.6 to +11 (ANONYMUS 1994).

Tab. 2. Changes in POS and IND values

Year	Ntracts	POS	IND	Change
1987	26	16	14.8	
1991	26	15	10.6	-4.2
1993	26	18	16.4	+5.8
1994	26	18	14.5	-1.9

Any differences might be a result of short interval between the observance periods or of the absolute standard introduced in 1994. The fact is that any changes in forest can only be observed over long-term periods, and by using the same methodology.



a) Between 1991- 1993 b) Between 1993-1994

Fig. 1. Changes in defoliation of single trees[5]

Conclusions

Inventories are primarily aimed at identifying spatial and temporal trends what demands a strong connection between methodology concept, field data collection, quality control and statistical evaluation and interpretation and last but not least a broad insight into the problem. This complexity has not always been guaranteed and could have been the reason for weak interpretation of slovenian forest decline data. Defoliation data presented in general do not differ from the one from the larger dataset (BOGATAJ 1995). Large number of species in relatively small sample observed is typical for the diverse site and stand conditions in Slovenia.

The data from the bioindication grid on tree and tract level in Slovenia are not changing to an extent that would allow conclusions about forest decline due to a relatively short observation period, small sample analysed, changes in methodology, possible estimation error and extreme diversity of site and stand

[5]Negative value presents increase of defoliation in the second year.

conditions on the plots. The most serious barrier for complex interpretation of forest condition, however, remains the ecosystem nature of forest.

In future geographical comparison should be better based on ecological units on different levels (for example climatic regions, landscape types, stand and site types, etc.) than on political units. Interpretation of forest condition data should bring together research efforts of different sciences (scientists) and last but not least should avoid to be hindered by the short termed political or research interests.

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