Phyton (Horn, Austria) Special issue: "Bioindication ..."	Vol. 36	Fasc. 3	(167) -(170)	15.09.96

Ten Years of Forest Decline Inventory in Slovenia - an Overview

By

MARKO KOVAČ[1)]

Key words: forest decline, inventory, monitoring system, future development.

Summary

KOVAČ M. 1996. Ten years of forest decline inventory in Slovenia - an overview. - Phyton (Horn, Austria) 36 (3): (167) - (170).

The article presents an overview of forest decline inventories in Slovenia. The first part of the article deals with methodological and technological aspects of forest decline inventories, the second part describes some directions for further development of multiresource forest inventories.

Introduction

Similarly to the EEC and other countries, Slovenia has been monitoring forest decline since 1985. Besides assessing attributes such as description of sites and stands, dendrometric parameters, defoliation and some other tree-damage indicators, our attention has been lately directed towards monitoring several environmental characteristics. In comparison to the large-scaled inventorying, much less activity has been seen on the area of case studies. Few researchers really focused themselves on investigation of air pollution and forest growth and yield (FERLIN 1990, HOČEVAR 1990), but not a single one has attempted to study the forest and its processes as one entity, nor to connect rather diverse conclusions. Due to this reason Slovenian Forestry Institute launched a comprehensive research program which should help understand relations between forest ecosystems and forest health related problems.

Earlier development of forest decline inventories

The most significant characteristic of the former forest decline research (before 1985) was a lack of modern statistical knowledge and technologies. Investigation of forest decline was based mostly on temporary inventorying and on

[1)] Gozdarski inštitut Slovenije, Večna pot 2, 61001 Ljubljana, Slovenia

analysing visually perceived damages that were only occasionally supported by physiological, dendrometric or chemical statements. In addition, data acquisition was not organised according to the principles of continuous forest inventory (SCHMID-HAAS 1983), therefore it was not possible to assess chronological trends as well. Before organising the inventory in 1985 it was therefore necessary to assure comparability and quality of data, objectivity of assessed attributes and introduction of new technologies such as interpretation of colour infra red aerial photographs.

Tab. 1. Forest decline inventories in Slovenia

Year	Grid density / km	No. of tracts	No. of tress	Type of selection
1985	4 x 4	1207	24832	systematic
1987	4 x 4, 4 x 2	1151	25008	systematic
1988	16 x 16	64	1536	systematic
1990	-	97	2234	random
1991	4 x 4	549	13176	systematic
1993	16 x 16	34	816	systematic
1994	16 x 16	34	816	systematic
1995	4 x 4	723	17000	systematic

In order to assure the first item, the continuous forest inventory (based on double stage sampling) was accepted. Tracts, located on 4 x 4 km grid are remeasured every 3-5 years, and every year, if they are located on 16 x 16 km grid. Tracts are square-shaped (25 x 25 m) and have four secondary sampling units located at each angle. The selection of individual trees is performed by the M6 method (PRODAN 1968, cited by HOČEVAR 1993). Comparability and data quality are assured by preliminary training of the teams and by the exhaustive field control. Objectivity of assessed attributes also plays an important role in forest decline inventory. It is mostly assured by referenced photoguides and by comparison of estimates among different observers (Tab. 1.).

In order to provide relatively inexpensive and efficient supervision of forest decline, it was sometimes necessary to employ large-scaled colour infra red aerial photographs. Though they are not regularly used, such photographs are an excellent tool for assessing various types of forest damages and have been used world wide (HILDEBRANDT 1985, HLADNIK 1990, KOVAČ 1991).

Types and quality of data

Indicators, assessed through the monitoring process, are divided into the following groups (ANONYMUS 1995): 1) description of sites and stands, 2) dendrometric data, 3) degree of defoliation, crown and stem injuries, 4) description of groups of lichens on the trees and 5) environmental data.

Data describing sites and stands are permanent. Most of them come from the official Forestry information database, therefore some differences between Slovenian approach and recommendations of the ANONYMUS (1989) commission exist.

From the past experiences it has also been found out that some attributes should be assessed on considerably larger area. Due to this reason the new interpretation area "surroundings of tract" has been introduced this year and helps in acquiring information on attributes and facts that are hardly to be seen (found) within relatively short borders of the tract (e.g. stand structure, debris of the trees, etc.).

Attributes belonging to individual trees represent the basis for data interpretation and serve for chronological comparison of results. Acquisition of these data is performed on secondary sampling plots. This part of the database deals basically with data, referring to the whole inventory system (e.g. location) and with data, concerning forest damages such as defoliation and stem and crown damages. This part of the database is completely compatible to the proposed UN/ECE method. Even more, it is wider in the part which deals with the evident, well defined injuries. An important contribution to the comprehensive forest monitoring is the inventory of tree lichens. Their distribution on different parts of stems as well as the rough assessment of species diversity represent important inputs for assessing the index of atmospheric cleanness (BATIČ 1991). No information about causal connections between these and other attributes is available at the moment. Implementation of this methodology will be continued.

Environmental data such as faunal and floristic richness, presence and type of erosion, presence of debris of the trees, number of hollows, presence of illegal garbage dumps, number of anthills, etc., are newly introduced into the monitoring system. Most of them will serve for statistical purposes.

Accuracy of data

Up to this year only partial results on data accuracy are available. According to some reports, field-checking has been performed only for the most important group of attributes. The comprehensive analysis of already existing forestry databases showed (KOVAČ 1992) that the attention should be focused towards supervising nearly all elements of the inventory. A completely new approach to field control has been launched in 1995. More than 5% of all plots were remeasured by the independent control teams and every investigated plot actually represented an informational flow between teams on the field and the team running the inventory.

The most important results of the Slovenian 1995 forest decline inventory

As shown in Table 1, Slovenia carried out its fourth inventory on 4 x 4 km grid. Totally more than 700 tracts were sampled, only 649 of them were completely measured (e.g. 4 secondary sampling plots each having 6 trees). The most important preliminary results are shown in Tab. 2.

Tab. 2. Results of the 1995 forest decline inventory

Indicator	No. of complete tracts	Average value	Standard error
Index* broadleaves	649	14.8	0.67
Index* conifers	649	26.3	1.11
Average index*	649	22.4	0.66
Average defoliation	649	21.1	0.55

* Index: number of trees, defoliated more than 25% / 24

A rough comparison with the previous inventories show, that the forest condition in 1995 is slightly worsened. The average defoliation is estimated to 21%. More than 22% (26.3% conifers, 26.3% broadleaves) of all sampled trees have severe damages and are defoliated for more than 25%. The most damaged species from the temporal point of view are pine (*Pinus sp.*), oak (*Quercus sp.*) and beech (*Fagus sylvatica*) while a less significant worsening has been noticed for spruce (*Picea abies*) and fir (*Abies alba*).

Conclusions

Besides the system for monitoring forest decline, the forestry of Slovenia runs additional inventory systems such as the Forestry information system (based on ocular, full areal surveying; non-sampling technique) which is primarily used for forest management planning and Forest inventory, based on Swiss permanent sampling plots (SCHMID-HAAS & al. 1993). Conceptually different systems are hardly comparable, significantly large are also the differences between observational methods and between measurements of various attributes. In order to assure the lower costs of inventories, to approach these data to several users and to raise an efficiency of the data, it is therefore necessary to achieve the compatibility of the systems as soon as possible.

References

ANONYMUS 1989. Manual on methodologies and criteria for harmonized sampling, assessment, monitoring and anlysis of the effects of air pollution on forests. - UNEP/UN-ECE, 93 s.

ANONYMUS 1995. Monitoring propadanja gozdov in gozdnih ekosistemov. Priročnik za terensko snemanje podatkov. - Gozdarski inštitut Slovenije, Ljubljana, 64 s.

BATIČ F. 1991. Bioindikacija onesnaženosti zraka z epifitskimi lišaji. - Gozdarski vestnik 49: 5, s. 248-254.

FERLIN F. 1990. Vpliv onesnaženega ozračja na rastno obnašanje in rastno zmogljivost odraslih smrekovih sestojev. - Magistrsko delo. Ljubljana. VDO Biotehniška fakulteta,VTOZD za gozdarstvo, 142 s.

HILDEBRANDT G. 1985. Pilotinventur fuer eine europaeische Waldschadensinventur. - In: Inventorying and monitoring endangered forests. Birmensdorf. Proceedings IUFRO conference, August 19-24, 1985, Zürich, Switzerland, s. 237-242.

HLADNIK D. 1990. Spremljanje razvoja sestojev in časovna dinamika propadanja dreves v jelovo-bukovem gozdu. - Magistrsko delo. Ljubljana. Univerza v Ljubljani, VDO Biotehniška fakulteta, VTOZD za gozdarstvo, 112 s.

HOČEVAR M. 1990. Poškodovanost in rast gorskega smrekovega gozda na pokljuško - jeloviški planoti. - Ljubljana. Zbornik gozdarstva in lesarstva 36, s. 27-68.

-- 1993. Dendrometrija - gozdna inventura. Ljubljana. - Univerza v Ljubljani, BF/oddelek za gozdarstvo, 274 s.

KOVAČ M. 1991. Zasnova prostorskega informacijskega sistema za spremljanje stanja in gospodarjenja z gozdnato krajino - primer na velikoprostorski ravni. - Magistrsko delo. Ljubljana. Univerza v Ljubljani, VDO Biotehniška fakulteta, VTOZD za gozdarstvo, 152 s.

-- 1992. Poizkus kritične razčlembe gozdarskega informacijskega sistema. - Zbornik gozdarstva in lesarstva t. 40, s. 123-160

SCHMID-HAAS P. 1983. Swiss continuous forest inventory, 20 years experiences. - Proceedings. Corvallis. IUFRO conference, s. 133-140.

--, BAUMANN E. & WERNER J. 1993. Forest inventories by unmarked permanent sample plots: instructions. - Birmensdorf. Berichte WSL, 135 s.