STANDARDIZED METHODS - COMPARABLE RESULTS: THE EEC - MANUAL ON AERIAL FOREST - CONDITION INVENTORIES

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ABSTRACT:

Since 1985 six study groups from six European countries have developed a method under the coordination of the Directorate Agriculture of the Commission of the European Communities to observe and monitor the state of forest health with aerial colour-infrared photographs. One result of this research is a practice oriented MANUAL *"Remote Sensing Applications for Forest Health Status Assessment"* (Commission of the European Communities, 1991) compiled under the supervision of Prof.Hildebrandt, Freiburg University. The MANUAL summarizes the experience gathered so far and documents the state of research in Europe.

KEY WORDS: Aerial Forest Damage Inventories, Color-Infrared Photographs, Interpretationkeys, Inventory Concepts, Statistics, Standards.

1. INTRODUCTION

The last decade saw a new type of forest decline in many forests in Europe. The damage is widespread and independent of site conditions or proximity to industrial centres. Symptoms vary but generally point to air pollution.

The main visible symptoms of such damage include progressive loss of needles or leaves, discoloration of sections or the entire crown, and even crown deformation. Decreasing vigour leaves the afflicted trees unprotected against biotic as well as climatic stress. Furthermore a remarkable decrease in timber increment can be observed.

Considering the progression of forest decline in Europe, inventories limited to individual countries are no longer adequate to monitor the scope of this pandemic process. The first measure taken by the Commission of the EEC was to establish a standardized terrestrial inventory at permanent sample plots in all member countries.

The assessment method is stipulated by the manual of the United Nations Economic Commission for Europe and equally applies to the annual UN-ECE coordinated forest damage inventory in European countries outside the community (UN-ECE, 1986)

2. AERIAL FOREST DAMAGE INVENTORIES IN THE EEC

In addition to inventories taken in fieldwork, remote sensing methods based on the interpretation of Color-Infrared (CIR) photographs have been widely applied since 1982.

In 1985 the EEC Council of Ministers decided to develop a method to observe and monitor the state of forests using CIR-assisted inventories which could be applied individually in the various regions of the Community. It was meant to draw on the experience gathered so far in select member countries. The General Directorates VI (Agriculture) and XI (Research) commissioned three study groups with the task: the Université Catholique Louvrain (Belgium), the INRA Télédétection in Cestas (France) and the Albert-Ludwigs-Universität in Freiburg (Germany). Other inventory groups in Denmark, Italy and Ireland have since then worked with the results of this pilot project and have successfully taken CIR-assisted forest inventories.

The application was paralleled by the improvement of the hitherto established methods in a number of follow-up-projects. For instance, research has been carried out to optimize photo scales, to test the usability of various infrared films for the purposes of forest damage inventories, to incorporate analytical photogrammetry into the assessment method, to develop standardized interpretation keys and to provide the basis for the statistical analysis of the interpretation results.

3. THE AIM OF THE EEC - MANUAL

Final reports fully document the results of the various projects (Constantini, 1990; Giot, 1989; Giot-Wirgot, 1986; Hildebrandt et al. 1986, Hildebrandt et al. 1989; Jensen et al. 1989; Riom et al. 1987; Walphot, 1990). It seemed useful however to summarize the cardinal results and dispersed individual information in such a way as to provide potential users with a transpicuous presentation of the experience gathered in the various projects. The result of this effort is the MANUAL Remote Sensing Applications for Forest Health Status Assessment which has been worked out by a team from the Abt. Luftbildmessung und Fernerkundung at Freiburg University and the Belgian company WALPHOT under the direction of Prof.G.Hildebrandt. It is primarily designed for use by foresters assigned with forest inventories who are obviously well-acquainted with the basics of forestry and biometry. These forest practicians should be supplied with all relevant information to enable them to plan and conduct aerial forest inventories on their own. Nevertheless the MANUAL is not conceived as a recipe-book which contains clear-cut solutions to all possible problems. Rather, it provides the technical, statistical and organisational basics, highlights potential snags and specifies research conditions and minimal standards which must be observed in successful inventories. As far as the concept of the inventory, its design and the analysis of its results are concerned the MANUAL provides a choice of possibilities which may be applied, combined or even modified independently and under the sole responsibility of the interpreters in accordance with environmetal, technical and personal conditions of the inventory. The authors of the

MANUAL thus had the difficult task to offer highly flexible concepts while maintaining standards designed to ensure the temporal and geographical comparability of the inventory results even across national borders.

4. SUMMARY OF CONTENTS

The MANUAL consists of six chapters. The first three (Introduction, Color-Infrared-Film, Flight Parameters) elaborate on the basics of the procedure. The brief characterization and comparison of the various methods to monitor forest damages in field-work and remote sensing is followed by a description of the photographic features and use of CIR-films, the planning and actual taking of aerial photographs, and a detailled call for tender.

The chapter "Inventory Concept" lists selection criteria and supplies inventory concepts along with sampling designs for inventory areas of various sizes, ranging from multistage sampling surveys to complete surveys of specific single stands. Furthermore methods are introduced which allow to locate identical trees in the photographs of follow-up-inventories.

The quality of interpretation results, especially their reproducibility and comparability, is mainly dependent on standardized assessment methods and carefully developed interpretation keys. Hence chapter five entitled "Photointerpretation" is particularly important. It contains the interpretation keys for the tree species spruce, pine, oak, beech and silver fir which have been developed by the international expert team "Arbeitsgruppe Forstlicher Luftbildinterpreten" (AFL) over a period of several years (Verein Deutscher Ingenieure, 1990). Meanwhile the keys have proved to be worthwhile in a number of inventories which have been carried out in various countries (Gross, 1990). They distinguish five classes of "crown condition" in accordance to damages classified in terrestrial inventories. Another important characteristic of theses interpretation keys is that shape characteristics are equivalent to, or even more important, than colour characteristics (Gross et al. 1990). Due to the fact that the present interpretation keys do not cover the whole spectrum of tree species in European forests, the MANUAL supplies all information which necessary to compile additional interpretation keys on the basis of the AFL-keys. Chapter five is completed by recommendations for the organisation of interpretations, technical equipment used in the analysis, the training of interpreters and means of control during the evaluation.

The final chapter six deals with the basics of the statistical data analysis. It emphasizes how important it is to handle information with utmost care which could only be obtained with great effort in the first place. In addition, this chapter draws attention to typical problems in forest damage inventories, outlines possible solutions and describes previously applied methods. It is a reminder that in all phases of the inventory, from the conception to data analysis and the presentation of the results, maximum care in the statistical planning and processing is indispensable to warrant the effectiveness and confidence of the inventory.

5. CONCLUSION

With the publication of the EEC-Manual standard preliminaries to monitor the state of forests in Europe with remote sensing methods have been established. Professional applicants have now access to current research in a form which is both concise and practice-oriented. Although the MANUAL does not give (legally) binding directions for application, future inventories on the basis of aerial photographs will undoubtedly have to conform with its minimal standards. Most importantly, the application of the interpretation keys improves the standardisation of evaluation methods and provides the basis for comparison between different inventories.

Yet the MANUAL does not settle inventory problems once and for all. Its "ring binding" underlines that further information from research or practical experience can be added at any time. For the present the MANUAL is available in English, French and German, but translations into other European languages will follow as the application becomes more widespread and the demand increases.

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