



Swiss National Forest Inventory: Methods and Models of the Second Assessment

Edited by Peter Brassel and Heike Lischke



Published by
WSL Swiss Federal Research Institute, CH-8903 Birmensdorf, 2001

Swiss National Forest Inventory: Methods and Models of the Second Assessment

Edited by Peter Brassel and Heike Lischke

Published by

WSL Swiss Federal Research Institute, CH-8903 Birmensdorf, 2001

Responsible for this edition
PD Dr. Mario F. Broggi, Director WSL

Authors

Urs-Beat Brändli, Peter Brassel, Philippe Duc, Markus Keller,
Michael Köhl, Anne Herold, Edgar Kaufmann, Heike Lischke,
Ingrid Paschedag, Hans-Jörg Schnellbacher, Andreas Schwyzer,
Hans Rudolf Stierlin, Thomas Strobel, Berthold Traub, Ulrich Ulmer,
Jürg Zinggeler

Translation

Olaf Kuegler

Proof Reading

Eve Schaub

Layout

Margrit Wiederkehr

Recommended form of citation

Brassel, P.; Lischke, H. (eds) 2001: Swiss National Forest Inventory:
Methods and Models of the Second Assessment. Birmensdorf, Swiss
Federal Research Institute WSL. 336 pp.

ISBN 3-905620-99-5

Available from

Swiss Federal Research Institute WSL

Library

Zürcherstrasse 111

CH-8903 Birmensdorf

Fax: 01 739 22 15

E-mail: bibliothek@wsl.ch

Printed by

Gonzen Druck AG, Bad Ragaz

Abstract**Swiss National Forest Inventory: Methods and Models of the Second Assessment**

The goal of the National Forest Inventory (NFI) is to record the current state and recent development of the Swiss forest in a representative and reproducible manner, using various data sources. To this end, in the second inventory (1993–1995) a combination of methods was used. Sampling followed a double sampling design: In the first phase aerial photos on a 0.5 x 0.5 km grid were used to estimate strata sizes, to identify forest plots and stocks outside the forest and to provide reference points for the field survey. In the second phase terrestrial sample plots on a 1.4 x 1.4 km grid were surveyed to record a number of variables to do with the individual trees and stands, young growth and damage by game, as well as features of the surrounding areas. The work and costs involved in the different steps of the terrestrial survey were recorded and evaluated. Ongoing training of the survey teams and control surveys ensured the data was of a high quality. Further information was obtained from interviewing the local forest services, from external data sources and models describing the site conditions, and from specially designed studies of forest transportation systems and the effects of game browsing on tree growth. The data were stored in a relational database and evaluated using statistical software developed specifically for this purpose. Static models were used for the evaluation of the following complex forest characteristics: the volume of standing and cut timber, tree growth, the work and cost involved in timber felling and extraction, the sustainability of forest regeneration, the protection provided by the forest against avalanches and rockfall, its recreational value, and the biotope values of the stands and forest edges. Furthermore, a dynamic model was developed which yields prognoses of the future development of each single tree depending on management scenarios. The models were supplemented by studies of error and uncertainty propagation to ensure good quality output variables. The raw and derived variables were comprehensively documented.

Keywords: multipurpose forest inventory, double sampling, terrestrial survey, aerial photography, growing stock, increment, forest growth model, sustainable regeneration, game browsing, forest functions

Foreword

The first Swiss forest inventory was compiled in the years 1983 to 1985. Before it started there were long discussions about its significance and field of applications. The federal authorities finally agreed to invest a considerable amount of money in an information system to support sustainable forest management. Timber volume was, of course, the primary target variable. Ten years later, when the second field campaign was launched, the world had changed. The issue of dying forests had made people aware of ecological risks. The conference of Rio de Janeiro in 1991 resulted in “biodiversity” becoming a popular term. Consequently, the Swiss Forest Inventory became an important tool for environmental monitoring. Hence, the methods had to be adapted and the list of parameters extended. The methodological changes, especially the statistical ones, were substantial: While the time series had to be maintained, adjustments to accommodate new fields of interest had to be implemented. This is one of the reasons why it has taken two years longer to publish the methods volume than it did to produce the survey results.

While this volume presents the methods used in the second inventory, the preparations for the third inventory are in full swing. We are fully aware that the objectives and methods will have to shift again. Maintaining the qualities of the time series will be a major challenge: In particular, we aim to provide an unbiased estimate of the variables influencing the state of our forests, giving the standard error of these variables and using well-defined methods that will allow comparisons with future investigations. Furthermore, the inventory has become a model-based tool for prediction. It has to predict both the quantity of timber and the quality of the environmental ecosystem.

The aim of this book is to give as comprehensive an account as possible of the sampling design, the methods of measurement and the statistical analysis used, as method design is one of the major tasks of WSL’s research efforts. This is a must for any validation and proper use of the data. While the state of Swiss forests is of little importance to the overall sustainability of the world’s forests, the methodology used in the inventory may be a valuable contribution to reliable forest monitoring. That is why we decided to have the report translated into English. The German version is, of course, also available.

We would like to express our thanks to the many people who contributed to this work, including WSL colleagues, the federal authorities who provided the funds, the many cantonal forest services who cooperated with us and numerous practitioners who provided valuable input. And finally we are very grateful to the translators who had to do an immense amount of work.

December 2001

Otto Wildi

Table of contents

1	Introduction	9
1.1	The National Forest Inventory	9
1.2	Goals and Contents of the Method Report	9
1.3	Method Development in a Historic Overview	9
1.4	Summary	13
1.5	Using the Methods and NFI Information	
2	Methods	19
2.1	Inventory Concept NFI2	19
2.2	Aerial Photography	45
2.3	Terrestrial Inventory	65
2.4	Expenditure of the Terrestrial Inventory	88
2.5	Game Browsing Damage Survey	93
2.6	Forest Transportation System Survey	100
2.7	External Data Sources	105
2.8	Criteria and Provisions for Quality Assurance	109
2.9	Control Survey of the Terrestrial Inventory	114
2.10	Control Survey of the Aerial Photo Interpretation	125
2.11	Representativeness of the Sample Grid	132
3	Derived Variables and Models	151
3.1	Site	151
3.2	Estimation of Standing Timber, Growth and Cut	162
3.3	Prognosis and Management Scenarios	197
3.4	Sustainable Forest Regeneration	207
3.5	Expenditure for Timber Felling and Extraction	225
3.6	Protection against Natural Hazards	231
3.7	Recreational Function	254
3.8	Nature Protection Function	265
4	Data Analysis	283
4.1	Database	283
4.2	Analysis Software	288
4.3	Error Sources and Their Influence on the NFI Inventory Results	297
4.4	Propagation of Data Uncertainty through Models	306
5	Visions	321
6	Appendix	327

