Preface

This volume contains a selection of 14 articles dealing with different aspects of biomonitoring and their relation to questions of global change. During the last 10 - 15 years, vegetation changes due to various causes have been more intensively studied in biological and environmental sciences. Especially aspects of global warming lead to a great variety of tasks for vegetation science (see e.g. the articles by Grabherr, Gottfried & Pauli; Carraro, Gianoni, Mossi, Klötzli & Walther; Walther; Defila; Stampfli & Zeiter; Röthlisberger; Burga & Perret and Möller, Wüthrich & Thannheiser).

The different aspects of applied biomonitoring related to (possible) environmental changes concern various ecosystems, e.g. Central European beechwoods, Insubrian evergreen broad-leaved forests, thermophilous lowland deciduous forests, dry grasslands of the lower montane belt of the Ticino Alps, alpine mountain peaks of Switzerland and Austria, Swiss alpine timberline ecotones, and high arctic tundra vegetation.

The volume is divided into three parts: A. General aspects of biomonitoring (contributions by Klötzli; Wildi and Labasch & Otte), B. Examples of applied biomonitoring in Germany and Switzerland (articles by Hakes; Herpin, Siewers, Kreimes & Markert; Defila; Stampfli & Zeiter; Röthlisberger and Ruoss, Burga & Eschmann), and C. Aspects of global change in the Alps and in the high arctic tundra (Grabherr, Gottfried & Pauli; Burga & Perret; Carraro, Gianoni, Mossi, Klötzli & Walther; Walther and Möller, Wüthrich & Thannheiser).

The first article by Klötzli concerns general aspects of biomonitoring. Indeed, biomonitoring in the form of vegetation mapping and observation of permanent plots is a traditional field of vegetation science. Different ways of biomonitoring are presented, its aims and tasks, its methods and its possibilities of statistical evaluation of data sets.

The second contribution by Wildi deals with statistical design and analysis in long-term vegetation monitoring, i.e. succession theories and related methods for time series analysis. Succession, understood as any directional change of vegetation, can be distinguished at three different levels of perception: pattern, process and mechanism. The author describes different methods and gives examples.

Labasch's and Otte's contribution deals with administration levels and tasks of nature conservation efficiency control. Different methods and application possibilities are discussed, the methodology of nature conservation efficiency control on various administrative levels is outlined.

Six contributions give examples of applied biomonitoring in Germany and Switzerland: Recent changes in the vegetation structure and site conditions of nutrient-rich beech forests in central Germany were studied by Hakes. Within a nine-year observation period, remarkable temporal variation in vegetation structure reflecting significant environmental changes could be ascertained.

In the framework of two national monitoring programmes in Germany Herpin, Siewers, Kreimes & Markert investigated changes in heavy metal concentrations in moss (lead was used as an example). This contribution describes mainly methods available to evaluate bioindication data.

Defila's paper deals with phytophenological series as a possible contribution to vegetation monitoring. Based on a remarkable tradition of phenological observations in

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Switzerland, climate-related trends for the regions Ticino and Engadine were calculated with the national data from 1951 – 1998.

Aspects of species responses to climatic variation and land-use change in grasslands of southern Switzerland have been investigated by Stampfli & Zeiter. For 10 years they monitored the species composition in dry grasslands of high species diversity at experimental sites in the southern Alps. Responses of the abundant herb species to stochastic factors, abandonment and mowing after abandonment of man's influence were examined. Only slow shifts of species composition could be recognized.

Röthlisberger's phytophenological case study in central Switzerland (Canton of Zug) of the time of flowering during the last mild winters shows a clear shifting from the early spring to the winter season. These shifting effects could be recognized on the levels of species diversity and distribution (i.e. colonization of new ecological niches).

The contribution by Ruoss, Burga & Eschmann contains a case study with a technical approach of vegetation monitoring on a restoration site of Pilatus Mountain in central Switzerland. Plant recolonization, induced in two steps by planting first seedlings of herbs and afterwards of alpine grass species, has been monitored for 8 years. Considerable fluctuations of both plant species and cover abundance led to average plant cover values between 60 and 95 %.

The third part of this volume deals with climate-related monitoring studies of arctic-alpine and temperate regions of the northern hemisphere. Grabherr, Gottfried & Pauli summarize a long-term monitoring project of mountain peaks in the Alps. Based on historical and recent records of nival summit floras, the authors detected a general trend towards increased species diversity and abundance, i.e. an upward migration of alpine biota during the last decades.

The contribution by Burga & Perret discusses general features of the upper limit of the Swiss Alpine forest and tree limits, with special emphasis on historical, present and future vegetation dynamics within the timberline ecotone. Complex interactions of climatic, physico-geographical, geological, biological and anthropozoogenic factors are influencing the present timberline ecotone. Six sites were studied for a long-term monitoring project, focusing on different models of climatically induced changes within the timberline ecotone.

Carraro, Gianoni, Mossi, Klötzli & Walther detected changes in forest vegetation in the northern and southern Swiss Alps by comparing 300 vegetation relevés of the last decades. One of the crucial factors of the changes in species composition and vegetation structure are mild winters during the last 30 years. These changes concern also formerly introduced exotic evergreen trees and shrubs, which show at present marked semi-natural spread into the indigenous broad-leaved forests of the southern Alps.

This phenomenon of the so-called "laurophyllisation" has been intensively studied by Walther, whose contribution to this volume summarizes the main features. Although evergreen broad-leaved plants have been cultivated in Switzerland for more than 200 years, only in the last decades a dozen of these species succeeded in escaping from the gardens and in spreading into the forests where they have become naturalized. As temperature can be considered as one of the major climatic determinants of plant distribution, the possible link between the observed vegetation shifts and climatic change is discussed.

Möller, Wüthrich & Thannheiser investigated plant community patterns, phytomass and carbon balance in a high arctic tundra ecosystem and the changes under a climate of increasing cloudiness during the last 4 – 5 decades. The measurements and calculations showed that an alteration of the vegetation pattern is much less effective in changing the carbon balance of the tundra vegetation than a change of light or length of the snow-free period.

Most of these contributions are a first attempt at the high complexity of global change, especially global warming. The articles show different assessments and ways for future research in this field, which will be of increasing importance for environmental aspects, especially the biosphere, including administration levels.

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