Module No.	Module name
P 1	Global environmental changes

Module coordinators

Prof. Dr. J. Bauhus and Prof. Dr. H. Schanz Email: juergen.bauhus@waldbau.uni-freiburg.de, heiner.schanz@ifp.uni-freiburg.de

Additional teaching staff

Prof. Dr. Mayer, Prof. Dr. Storch, Prof. Dr. Hildebrand, Prof. Dr. Spiecker, Prof. Dr. H. Rennenberg

Syllabus

Students will be introduced to some of the globally most important environmental problems such as water and air pollution, acid rain and forest decline, the loss of forests and biodiversity, global warming and others. At the same time, this module is designed to familiarise students with the research process in the environmental and social sciences. Based on selected reading from the book “The sceptical environmentalist” and the responses from other scientists to the arguments by the author of that book, Bjørn Lomborg, students will be challenged by the difficulty to assess the magnitude of environmental problems. Against this background, research ethics, the quality and reliability of scientific information, and the role of science in the public discourse will be discussed.

Following the introduction of particular environmental problems by experts, students will work in groups to examine independently the extent of these problems in more depth and analyse the, sometimes contrasting, claims and arguments made by different scientists. These analyses will be presented to the whole group and an expert panel towards the end of the module.

Learning goals and qualifications

In this module students are expected:

- to gain an understanding of the most pressing environmental issues facing the globe
- to develop an understanding of important models and assumptions used to predict future environmental conditions
- to develop the capacity to assess scientific information critically
- to appreciate the social dimensions and context of information
- to reflect about the role of science in society, in particular in policy development
- to learn about research ethics

Development of the following qualifications is supported:

- literature research skills, reading of scientific documents
- teamwork
- presentation and report writing

Teaching and learning methods

Lectures, tutorials, discussion groups, independent research

Prerequisites

none

Requirements for registration

none

Distribution of work load

Contact hours	40 h (Lectures, tutorials, presentations)
Independent learning	85 h (group work, preparation, reading etc.)

Proposed assessment

Group presentation and final report

Link to some learning resources:

http://www.csicop.org/scienceandmedia/environmentalist/
http://www.grist.org/advice/books/2001/12/12/of/
http://www.ucsusa.org/global_environment/archive/page.cfm?pageID=533
http://www.wri.org/

Preliminary Reading

B. Lomborg (2001) The sceptical environmentalist – Measuring the real state of the world. Cambridge Univ. Press.

Comments

Module name

Tree Structure and Function

Module coordinator

Prof. Dr. Heinz Rennenberg Email: heinz.rennenberg@ctp.uni-freiburg.de

Additional teaching staff

Prof. Dr. Siegfried Fink, Dr. Jürgen Kreuzwieser

Syllabus

- Structure of roots, mechanisms of water and nutrient uptake by roots; significance of mycorrhizal symbiosis
- Structure of xylem and phloem; xylem and phloem transport and transpiration
- Leaf structure; CO_2-exchange and photosynthesis in woody plants; tree respiration
- Meristems and growth (cambium, shoot and root primordia, differentiation)
- Source/sink relations in trees and its seasonality
- Physiological basis of carbon fluxes in forest ecosystems
- nutrient requirements of trees, consequences of nutrient deficiency and excess
- regulation of tree nutrition
- nutrient storage and mobilization

Learning goals and qualifications

The students will:

- achieve an in depth understanding of carbon relations of trees from the molecular via the physiological, eco-physiological and tree to the stand level.
- learn the role of trees in water relations of forest and the mechanisms involved in water acquisition, water transport inside the tree and water vapour flux into the atmosphere.
- obtain a detailed understanding of nutrient requirements of trees, nutrient aquisition, the mechanisms involved and its regulation
- understand the relations between structural aspects at the cell, tissue and organ level and the respective physiological functions
- become competent in linking growth processes at the cell and tissue level to “classical” growth parameters used in forestry (annual rings, volume yield etc.)

Teaching and learning methods

Lectures, tutorials

Prerequisites

none

Requirements for registration

none

Distribution of work load

Contact hours 80 h (Lectures, pracs, excursion, exam)

Student learning 45 h (Preparation, reading etc.)

Proposed assessment

Link to learning resources

Preliminary Reading

Marschner H (1995) Mineral Nutrition of Higher Plants. Academic Press, London

Landsberg JJ and Gower ST (1997) Applications of Physiological Ecology to Forest Management. Academic Press, San Diego

Dickison, W.C. (2000): Integrative Plant Anatomy. Academic Press, San Diego

Tyree, M.T. and M.H. Zimmermann (2002): Xylem Structure and the Ascent of Sap. 2nd. Ed. Springer, Berlin

Comments

Module No.	Module name
P 4	Statistical Methods and GIS

Module coordinator

Prof. Dr. Dieter R. Pelz Email: pelz@biom.uni-freiburg.de

Additional teaching staff

Prof. Dr. Barbara Koch, Dr. K.P Gross

Syllabus

Introduction to statistical methods and GIS:

- statistical tests, analysis of variance, nonparametric statistics
- experimental design and analysis (completely randomized, randomized block, latin squares, split plot, factorial experiments etc.)
- regression analysis , simple linear regression, multiple regression, logistic regression

Introduction to Geographic Information Systems. Applications with ARC GIS

Learning goals and qualifications

At the completion of the course the students should be able to design experiments and analyse data from these experiments with standard statistical analysis programs. Major emphasis is placed on the prerequisites for using the methods and on the interpretation of the results.

In GIS students should be able to build a GIS model for specific areas and analyse the results.

Teaching and learning methods

Lectures, computer exercises, e-learning module on statistics

Prerequisites

Basic course in statistics, basic introduction to GIS

Requirements for registration

none

Distribution of work load

Contact hours	80 h (Lectures, pracs, excursion, exam)
Student learning	45 h (Preparation, reading etc.)

Proposed assessment

Written examination

Link to learning resources

Preliminary Reading

Comments

Course Managing Human-Environment Interactions			
Availability to other courses			
Module No.	**Module name** Managing Human-Environment Interactions		
ECTS-LP (Workload) 5 (125 h)	**Module length** 3 weeks	**Semester/return**	**No. of participants**
Contact hours	**Start date**	**Location**	**Instruction Language** English
Module coordinators			
Additional teaching staff			

Syllabus

All people live within an environmental context and all societies have developed ways of managing their interactions with their environment. This course explores the various ways in which societies organize and manage relationships with their environmental context and their use and appreciation of natural resources. Social institutions can take many forms: rituals, traditions, informal practices, and formalized procedures. The primary sources of social institutions for managing human-environment interactions include: family, community, religion, economic trade, law and politics. This course will focus primarily on five major institutions: property, community, social organizations, markets, and law.

This course builds upon and applies the perspectives learned in the three modules on analyzing human-environment interactions. While the disciplines for understanding people, economies, and ecological processes tend not to consider the context of action, a management perspective requires contextual analysis and understanding. This module links analysis of people, politics, markets, and ecosystems by examining the institutions and ideas connecting them.

Students will have a core set of readings to introduce them to the main institutions for managing human environment interactions. Student teams will examine different institutions in more depth and give presentations to the class. Classes will be a mix of lecture and discussion where students have prepared the readings in advance.

In addition, this module will have two training workshops to give students an opportunity to learn practical ways of working with people in managing the environment.

Module No.	Module name
P 7	Methods in Ecosystem Analysis

Module coordinator

Prof. Dr. H. Rennenberg Email: heinz.rennenberg@ctp.uni-freiburg.de

Additional teaching staff

Prof. Bauhus, Prof. Boppré, Prof. Fink, Prof. Hildebrand, Prof. Mayer, Prof. Reif, Prof. Spiecker, Prof. Storch, Prof Pelz, Prof. Leibundgut

Syllabus

This module focuses on the theory of experimentation and the practical application of a set of different approaches and methods to address questions in ecosystem analysis. In this module students will be given the opportunity to learn methods required in their MSc research. In addition, students will be familiar with fundamental concepts in experimentation such as accuracy, replication, reproducibility, documentation etc. Following a general introduction to the principles of experimental design and analysis, students will work in small groups according to research areas in which they envisage to undertake their MSc research. These small groups will learn research methods in the following areas:

- Forests and Climate Change (Tree Physiology, Meteorology, Hydrology, Soil Science, a. o.)
- Forest Structure and Function (Silviculture, Forest Growth, Forest Botany, Tree Physiol. a. o.)
- Population and Community Ecology (Zoology, Wildlife Ecology, Vegetation Ecology, a. o.)

In each of these areas, students will collect samples or data using a range of methods, analyse samples were applicable (in the field or the laboratory), and compile, screen, analyse and interpret data, to allow a critical appraisal of the whole process.

Learning goals and qualifications

Students will learn:

- Principles of experimental design and how to translate a research question into an experimental approach incl. the choice of appropriate methodology
- Important steps in the research process from the formulation of hypotheses to the interpretation of data and the writing of a short research paper
- To evaluate critically the accuracy, different types of errors and reproducibility of ecological measurements, the issue of scaling up of results etc.
- To apply a range of methods confidently to particular areas of ecosystem research

Teaching and learning methods

Lectures, practical exercises, field and lab work, tutorials, peer review

Prerequisites

A basic course in statistics

Requirements for registration

Distribution of work load

Contact hours	80 h (Lectures, exercises, field and lab work)
Independent learning	65 h (data analysis and interpretation, writing of report)

Proposed assessment

Report on experimental work conducted

Link to learning resources

Preliminary Reading

Comments

Module No. (P/WP)	Module name
PX	Population and Community Ecology

Module coordinator

Prof. Dr. M. Boppré boppre@fzi.uni-freiburg.de

Additional teaching staff

Prof. Dr. I. Storch, Prof. Dr. A. Reif

Syllabus

In addition to individuals, populations and communities are important ecological entities. Plant species associating on certain sites form plant communities, which in turn, provide the basis for animal communities. Shifts in site conditions or successions result in a gradual turnover of species occurrences, both in plants and animals, that are linked in multiple and complex ways. Ecosystem management is based, in part, on population management by enhancement or suppression, respectively. Management goals include harvesting, conservation, and control of populations.

Basic principles of population dynamics (biotic as well as abiotic factors) are significant for the understanding of various types of population dynamics. Some contexts are particularly highlighted because different factors have different impact according to species or management context:

- Insect populations: examples for communities and their dynamics
- Wildlife Ecology: introduction to wildlife population ecology as a basis of wildlife management
- Neobiota: influences of alien species on their 'new' environment
- Relationships between sites and vegetation; indicator values of species
- Plant formations and communities: concepts, definitions, examples
- Ecological gradients

Learning goals and qualifications

In this module students learn and study biological basics of populations and communities such as structure, dynamics, and determining factors. Major objective is to understand relationships between pedology, climatology, species compositions; the formation of plant and animal communities and populations, their ecological function, the relations among animals and between plants and animals. Furthermore, cases are presented and analysed to understand complexity of biotic and abiotic influences.

Since every single problem of managing populations is unique; case studies are used to develop general principles and concepts that can be transferred to analyse any case for identifying biological factors crucial for management approaches. Students will be enabled to develop and implement adapted concepts and to consider and synthesize information from other sources (literature, modules).

Teaching and learning methods

Lectures, tutorials

Prerequisites

none,

recommended: propaedeutic self-study according to list of keywords

Requirements for registration

None

Distribution of workload

Contact hours	60 h (lectures, exam)
Independent learning	65 h (preparation, reading …)

Proposed assessment

written exam

protocol of 'take-home-messages'

Link to learning resources

http://www.fzi.uni-freiburg.de/lehre/.....

Literatur

Alcock, J (1993) Animal Behavior. Sunderland/Mass.: Sinauer

Begon M, Thompson M, Mortimer M (eds) (1990) Population Ecology. Blackwell Science

Campbell NA, Reece JB (2004) Biology. Heidelberg: Spektrum

Gullan PJ, Cranston PS (1994) The Insects: An outline of entomology. London: Chapman & Hall

Krebs JR, Davis NB (1993) An introduction to behavioural ecology. Oxford: Blackwell

Krausman PR (2002) The basics of habitat. Chapter 16 (pp 292-302) *in* Krausman PR (2002) (ed.) Introduction of Wildlife management. Upper Saddle River, New Jersey: Prentice Hall

Bolen EG & Robinson WL (1999) Population Ecology. Chapter 5 (pp 45-66) *in* Bolen EG & Robinson WL (eds) (1999) Wildlife ecology & management. 4th ed. Upper Saddle River/NJ: Prentice Hall

Van der Maarel E (ed.) (2005) Vegetation Ecology. Oxford: Blackwell

Bemerkungen

Module No.	Module name
P	Soil ecology and management

Module coordinator

Prof. Dr. Hildebrand Email: Ernst.Hildebrand@bodenkunde.uni-freiburg.de

Additional teaching staff

Prof. Dr. P. Trüby, Dr. H. Schack-Kirchner, Prof. Dr. J. Bauhus

Syllabus

Soil assessment and mapping

Excursion: Introduction to soils and geomorphology
Soil classification and theory of soil mapping
Field methods of soil assessment (practical training)
Soil and site Mapping (field training)
Self-study

Soil hazards and soil protection

Introduction and mechanical impacts of harvesting operations
Soil Erosion, Salination and Irrigation
Eutrophication and acidification, Soil contamination and remediation

Plant/Soil Relations

Concepts and theory of tree nutrition
Diagnosis and therapy of nutrient deficiencies
Field trip: Nutrient cycling
Interactions between vegetation and soils

Learning goals and qualifications

- Ability to assess soil and site quality in the field
- Ability to use and interpret soil maps
- Knowledge of soil hazards especially in forests
- Ability to select adequate management options
- Ability to understand scientific and technical publications concerning soil ressources
- Ability to use computer resources and the WWW to obtain soil information
- Ability to assess and to manage the nutrient status of forests

Teaching and learning methods

Lectures (field and lecture hall), computer based training, field training

Prerequisites

Basics of ecology, chemistry and soil science

Requirements for registration

None

Distribution of work load

Contact hours	60 h (Lectures, pracs, excursion, exam)
Student learning	65 h (Preparation, reading etc.)

Proposed assessment

Written Examination

Field exam

Link to learning resources

Forest Ecology Online

Preliminary Reading

Comments

Module No.	Module name
P 7	Ecosystem Management

Module coordinators

Prof. Dr. J. Bauhus Email: juergen.bauhus@waldbau.uni-freiburg.de

Additional teaching staff

PD Dr. Peter Pechacek (Pechacek@t-online.de), Dr. Benno Pokorny

Syllabus

The concept of Ecosystem Management has emerged as a new paradigm for the management of natural resources. It is based on the objectives of sustainable use and conservation of natural resources as well as fair and equitable sharing of benefits from ecosystem goods and services. Underpinning this approach are explicit objectives for the management of natural resources. These can be translated into measurable goals, which lend themselves to monitoring. Ecosystem management recognises that ecosystems are complex and interconnected systems, which function on a range of spatial and temporal scales. While management should be based on sound science and ecological models to maintain ecosystem integrity, the approach acknowledges that the current knowledge is limited and the paradigms provisional and likely to change in future. Consequently management approaches are being viewed as hypothesis that require testing through systematic research and monitoring resulting in adaptive management.

In this module, students will be introduced to the concepts underpinning Ecosystem Management to enable them to critically evaluate the strengths and limitations of the approach. The module comprises an excursion of ca. 1 week duration to visit the Bavarian-Bohemian Forest region, which serves as a case study to examine the Ecosystem Management approach. In the last phase of the module students will have to write a report about an analysis of the feasibility to apply the approach to a different setting.

Learning goals and qualifications

Students:

- apply the concepts of ecosystem management to a particular setting (landscape)
- evaluate the strengths and limitations of the ecosystem management approach based on practical experience from a case study
- plan and prepare for an excursion to facilitate discussions with local experts and ensure the most effective format of gathering information
- develop the ability to communicate the analysis of a complex issue in a report.

Teaching and learning methods

Lectures, excursions, tutorials, independent learning

Prerequisites

Students should have skills to:

- review and synthesize information from the literature and other sources
- work in small teams and make presentations to a larger audience
- understand landscape considerations for the protection of biodiversity
- basic understanding of silviculture and the dynamics of vegetation and animal populations

Requirements for registration

Students need to bring their passports on the excursion.

Distribution of work load

Contact hours	60 h (Lectures, pracs, excursion, exam)
Independent learning	65 h (Preparation, research, report writing etc.)

Proposed assessment

Portfolio including: Information about the excursion area, short presentation, documented preparation of the excursion (including catalogue of questions for excursion guides), protocol of the excursion, final report assessing the feasibility of the ecosystem approach

Link to learning resources

http://www.nationalpark-bayerischer-wald.de/

http://www.npsumava.cz/

Preliminary Reading

http://www.iucn.org/themes/cem/

http://www.esa.org/pao/esaPositions/Papers/ReportOfSBEM.php

Comments

Module No.	Module name
P8	Ecoinformatics and Environmental Monitoring

Module coordinator

Prof. Dr. Barbara Koch Email: Barbara.Koch@felis.uni-freiburg.de

Additional teaching staff

Prof. Dr. G. Becker, Prof. Dr. E. Hildebrand, Prof. Dr. L. Jaeger, Prof. Dr. H. Mayer, Prof. Dr. D. Pelz, Prof. Dr. A. Reif, Prof. Dr. H. Spiecker

Syllabus

General:

Introduction into different ecological monitoring systems comprising remote sensing and inventories, vegetation monitoring, meteorological monitoring, forest growth monitoring and assessment as well as soil monitoring. Introduction into management of spatial data for forestry and environmental management applications.

Specific Modules:

Remote sensing theory and applications for assessment of landcover features in different scales and with different instruments. Basics in evaluation of image data.

Meteorological and hydrometeorological monitoring will be studied using the forest experimental site Hartheim as an example for long term monitoring.

Monitoring forest conditions. Growth assessment in long term permanent plots. Stem analysis. Continuous growth monitoring based on diameter tapes and dendrometer measurements.

Vegetation mapping, monitoring of biodiversity.

Documentation and monitoring of harvesting activities. Monitoring of resource development (timber dimension, wood quality, etc)

Environmental monitoring: Introduction to german and europeaen forest-related monitoring networks. Aspects of implementation of monitoring networks. Management and processing of monitoring data.

Learning goals and qualifications

Overview on monitoring systems and instruments. Ability to plan and process basic monitoring concepts and measurements. Overview on spatial data types and database management systems. Information on GIS Systems for logistic planning. Ability to chose tools to sample, manage and explore environmental monitoring. Ability to discuss regonalization problems of point data

Specific learning goals

The students should learn how to design forest meteorological/hydrometeorological monitoring with respect to specific objectives.

Knowledge of major principles and concepts of vegetation monitoring. After attending this course the students will be able to develop and evaluate vegetation monitoring studies. Basic knowledge of environmental monitoring with respect to existing monitoring networks and their conceptual aspects.

Teaching and learning methods

Lecture, practical work

Prerequisites

none

Requirements for registration

None

Distribution of work load

Contact hours	90h (Lectures, pracs, excursion, exam)
Independent learning	35h (Preparation, reading etc.)

Proposed assessment

Written exam

Link to learning resources

http://www.felis.uni-freiburg.de, : http://www.ffu.uni-freiburg.de/Waldwachstum/lehre.htm

Preliminary Reading

Remote Sensing and Image Interpretation. Thomas Lillesand and Ralph Kiefer, 4th edition

Comments

Module No.	Module name
P 7	Natural Hazards and Risk Management

Module coordinator

PD Dr. M. Hanewinkel Email: Marc.Hanewinkel@forst.bwl.de

Additional teaching staff

Prof. Dr. J. Bauhus, Prof. Dr. H Mayer, Prof. Dr. M. Boppré, Prof. Dr. Fink N.N.

Syllabus

Almost every day we are confronted with news of natural catastrophes, the spread of diseases and other disturbances, which are all events that affect both natural and managed ecosystems. To manage ecosystems sustainably, these risk factors need to be considered.

This module will introduce students to a range of biotic and abiotic risk factors and the way in which these may affect ecosystems and the enterprises depending on them. In addition, students will learn about the components of ecosystem resistance and resilience and how these can be managed to stabilise forest ecosystems and reduce the impact of risks. Particular emphasis will be placed on the following ecosystem risks/disturbance agents: storms, drought, fire, flooding, and biotic factors such as animals.

Students will learn that disturbances are a normal phenomenon in ecosystems and responsible for the dynamics of stands and landscapes. The importance of managing ecosystems within the variation of a natural disturbance regime will be discussed, and approaches to assess disturbance regimes will be examined. Examples of ecosystem risks and disturbances and how they can be considered in natural resource management will be drawn from around the world. Risk management and particularly risk assessment and risk modelling will be a focus of the module.

Learning goals and qualifications

Students will learn:

- that disturbances are a natural phenomenon and responsible for ecosystem dynamics
- reasons and features of disturbances and the consequences of disturbances in forest ecosystems
- how to reconstruct disturbance regimes of forest ecosystems and how to develop management systems that increase ecosystem resistance and resilience.
- principle processes of risk management including risk analysis (identification and evaluation of risks), risk handling and control
- assessment, modelling and application of risk probabilities (including expert systems, basic statistical and mechanistic models and advanced technologies of risk modelling)

Teaching and learning methods

Lectures, tutorials, pracs, excursions

Prerequisites

Requirements for registration

Distribution of work load

Contact hours	60 h (Lectures, pracs, excursion, exam)
Independent learning	65 h (Preparation, reading etc.)

Proposed assessment

Written exam

Link to learning resources

Preliminary Reading

Attiwill PM (1994) The disturbance of forest ecosystems; the ecological basis for conservative management. Forest Ecology & Management 63, 247-300.

Oliver CD and Larson BC (1996) Forest Stand Dynamics. Update edition. John Wiley & Sons, NY.

Comments

Module No.	Module name
P 10	Forest Resources and Wood Production

Module coordinator

Prof. Dr. Heinrich Spiecker, Email: instww@uni-freiburg.de

Additional teaching staff

Prof. Dr. G. Becker, Prof. Dr. E. Hildebrand, Prof. Dr. H. Mayer, Prof. Dr. A. Reif

Syllabus

1. Forest Resources World Wide (3 days) (Spiecker):
- Definitions
- State of the forest resources
- Changes of the forest resources
- Causes of changes in forest resources
- Production potentials of forests
- Use of forest resources (Becker)

2. Wood Production (3 days) (Spiecker):
- Forest growth
- Growing stock
- Past and actual trends

3. Management Scenarios (5 days) (Spiecker):
- Management concepts
- Management changes in the past
- Future scenarios: natural forests, semi-natural forests, devastated secondary forests, man-made forests
- Quality criteria of timber (Becker)
- Impacts of management scenarios on timber volume and quality

4. Forest Utilization (4 days) (Becker):
- Interactions and impacts of management scenarios on harvesting systems
- Accessibility of timber resources
- Transport and logistics
- Future trends.

Learning goals and qualifications

Students will gain knowledge

- on the extent and structure of forest resources at regional, national and the global scales
- on the climatological, pedological, and phyto-sociological conditions of the forest resources
- on relevant growth-determining environmental factors
- on the wood production potential of forests in the present, past and future
- on the effect of management options on forest resources and wood production potentials
- on the interactions between management options and harvesting systems

Students will acquire competence:

- to analyse the structure of forest resources
- to estimate wood production potential
- to analyse changes in wood production potential
- to define and formulate integrated management scenarios
- to evaluate management scenarios and their impacts on forest resources.

Teaching and learning methods

Lectures, tutorials, panel discussions, group works

Prerequisites

none

Requirements for registration

Distribution of work load

Contact hours	60 h (Lectures, pracs, exam)
Student learning	65 h (Preparation, reading etc.)

Proposed assessment

Written exam

Link to learning resources

SoftTutor: http://www.ffu.uni-freiburg.de/Waldwachstum/lehre.htm

Preliminary Reading

Comments

Elective 1:
Forests and Water
Agroforestry and Farm Forestry

Module No.	**Module name**
WP 1	Forests and Water

Module coordinator

Prof. Dr. H. Mayer

Email: helmut.mayer@meteo.uni-freiburg.de

Additional teaching staff

Dr. J. Lange, Prof. Dr. L. Jaeger

Syllabus

The module consists of three units.

"Forest microclimatology" deals with micrometeorological processes and phenomena, which are relevant to investigate the components of the water balance of forests by use of experiments and simulations.

"Water balance of forest stands" deals with the specific characteristics of the water balance of forests compared to other land use types. Differences caused by different tree species or climate conditions will be discussed. Key elements are: (a) different components of precipitation (gross precipitation, interception, throughfall, stemflow), (b) evapotranspiration of forests, (c) infiltration and groundwater recharge. At the end a simple water balance model is introduced.

"Hydrological processes in forests" enlarges the focus from single forest stands to larger scales of forested slopes or headwater catchments. It introduces different concepts of lateral water flows and runoff generation (e.g. saturation excess, quick interflow, piston flow effects, etc.). Examples from several research catchments around the world are given. These include semi arid, temperate and tropical forests.

Learning goals and qualifications

This module imparts knowledge on the importance of water being essential for forest ecosystems throughout the world. At its end students will be able to

- realise meteorological and climatic processes and phenomena significant to the water balance of forests
- understand the basic differences of the water balance in forests compared to other land use types
- apply relevant techniques to measure water balance components in forests
- give quantitative estimates for water balance components in forests of different climatic regimes
- Identify relevant water pathways in forests, dependent on the climatic regime
- apply simulation tools (mathematical models) to describe water balance components in forests

Teaching and learning methods

Lectures, tutorials, pracs

Prerequisites

none

Requirements for registration

none

Distribution of work load

Contact hours 65 h (Lectures, pracs, exam)

Student learning 60 h (Preparation, reading etc.)

Proposed assessment

Written exam

Link to learning resources

http://www.mif.uni-freiburg.de/index1.htm

http://www.hydrology.uni-freiburg.de/

Preliminary Reading

Bonell, M. Barnes, C. J., Grant, C.R., Howard, A. and Burns J. (1998): High Rainfall, Response-Dominated Catchments: A Comparative Study of Experiments in Tropical Northeast Queensland with Temperate New Zealand, in: Isotope Tracers in Catchment Hydrology (1998), C. Kendall and J. J. McDonnell (Eds.) Elsevier Science B.V., Amsterdam, pp. 347-390.

Geiger, R., Aron, R.H. and Todhunter, P. (1995): The climate near the ground, Harvard Univ. Press, Cambridge, Mass.

MacDonald, L.H. and Stednick, J. D. (2003): Forests and Water: A State-of-the-Art Review for Colorado, Colorado Water Resources Research Institute, Completion Report No.196.

McGlynn, B. L.; McDonnel, J. J.; Brammer, D. D. (2002): A review of the evolving perceptual model of hillslope flowpaths at the Maimai catchments, New Zealand. In: Journal of Hydrology 257, 1-26.

Post D.A. and Jones J. A. (2001) : Hydrologic regimes of forested, mountainous, headwater basins in New Hampshire, North Carolina, Oregon, and Puerto Rico, Advances in Water Resources 24, 1195 – 1210.

Comments

Module No.	Module name
WP 7	Agroforestry and Farm Forestry

Module coordinator

PD Dr. G. Kapp Email: <gerald.kapp@waldbau.uni-freiburg.de>

Additional teaching staff

Prof. Dr. A. Reif, Dr. B. Bösch (FVA)

Syllabus

Introduction to agroforestry and farm forestry. Production characteristics of farmsteads, ecological interactions in subsystems, co-generation of agricultural, pastoral and silvicultural products, including non-wood forest products and carbon sequestration

Overview of land use types of farm forestry and agroforestry in the tropics and temperate climates

Field visits to farm forestry and agroforestry sites

Case studies of selected examples of farm forestry and agroforestry

Analysis of systems of farm forestry and agroforestry through modelling: system concept and model. Interaction diagrams, modelling of dynamic systems (pasture models)

Computer exercise: development of different type of models, including spreadsheet programming, systems optimisation, theory of linear optimisation

Computer exercise: modelling of (agro-)forestry CO_2-sinks

Computer exercise: optimisation of tree pasture systems and management simulation of an agroforestry farmstead in a developing country

Conclusions regarding the development of farm forestry and agroforestry projects

Learning goals and qualifications

Knowledge of farm forestry and agroforestry systems with main emphasis on the tropics. Understanding of historic developments, ecological, technical and economic interactions, and development perspectives. Skills in analysis, modelling, simulation and evaluation of agroforestry systems with emphasis on plant production, economic optimisation, carbon sequestration, and project development.

Teaching and learning methods

Lectures, excursions, case studies, computer exercises

Relevance/use of the module

Professional development cooperation in rural areas requires an in-depth understanding of farm forestry and agroforestry systems, based on practical experiences and modelling. Moreover, the acquired knowledge, e.g. on model formulation, linear optimisation, or CO_2 sequestration are useful in many jobs.

Prerequisites

Basic computer literacy and basic English language skills

Requirements for registration

Distribution of work load

Contact hours	80 h (Lectures, practices, excursion, exam)
Independent learning	45 h (Preparation, reading, etc.)

Proposed assessment

Exam (partly using computer programmes)

Presentation of an excursion protocol

Link to learning resources

Preliminary Reading

Bösch, B.; Kapp, G. (2004): Modellbildung und Simulation agroforstlicher Systeme. Skript zum Blockkurs WS 2004/2005. 70 S. + Annex

Gordon, A.M; Newman, S.M. (eds.) (1997): Temperate Agroforestry Systems. CAB International, Wallingford, UK and New York, USA, 269 pp.

Kapp, G. B. (1998): Bäuerliche Forst- und Agroforstwirtschaft in Zentralamerika. Untersuchungen über forst- und agroforstliche Produktionssysteme unter besonderer Berücksichtigung des feuchten Tieflands von Costa Rica und Panama. Margraf Verlag, Weikersheim, 303 S. (Forstbibliothek)

Mac Dicken, K.G.; Vergara, N.T. (ed.) (1990): Agroforestry: Classification and management. John Wiley & Sons, New York, 382 p. (Forstbibl. LA 600/3)

Nair, P. K. R. (1993): An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, Boston, London in Cooperation with ICRAF, Nairobi, 499 pp. (Forstbibl. LA 600/14)

Further bibliographical references will be provided during the course.

Comments

Number of participants restricted by the number of computers available in the CIP room.

Elective 2
Plantation Forestry
Forests and Climate Change

Module No.	**Module name**
P 1	Plantation Forestry

Module coordinator

Prof. Dr. Dr.h.c. G. Becker Email: institut@fobawi.uni-freiburg.de

Additional teaching staff

Prof. Dr. Bauhus, Dr. B. Pokorny, Dr. L. Nutto, (Prof. Dr. Oesten – ist noch abzuklären)

Syllabus

Students learn objectives, strategies, concepts and management of large scale plantation forestry and pulp production as a case study. Based on the example of southamerican integrated forest/pulp company,

including

- The ecological, legal and social framework of forest management and pulp-production;
- Soil and site conditions, climate, selection of species including clones, soil preparation and fertilizing, planting
- Risks and pest management
- Stand management for pulp and sawnwood as an value added by product
- Harvesting strategies and transportation logistics
- Short, middle and long term planning based on forest inventory
- Products of pulp and other wood products, bio-energy
- Business plan
- markets and marketing, certification and future role of CO_2-certificates

Based upon this data tasks (groups of 5 persons each) of specific topics will be done by the students under supervision of experts in the corresponding subject. The aim is to analyse data critically and to find solutions for specific problems or tasks.
The students will present and discuss the outcomes with all participants of the module and write a final report .

Learning goals and qualifications

The overall learning goal is that the students learn to make a critical science and knowledge based evaluation of an enterprise based on plantation forestry and pulp production in order to optimise the management of natural resources, wood harvesting, transportation logistics and production processes. The students include into their assessment and decision making legal, social and natural restrictions in their decision taking.

The candidates will be qualified in elaborating and / or optimising management and business plans under realistic and practical conditions, considering existing and future socio-economical and socio-ecological circumstances of specific countries or regions.

The students will learn to work in a team, to discuss different point of views and at least to find compromises for future activities. They also will be trained in presenting results in an convincing and professional way and how to write detailed reports with essential information for further decision taking.

Teaching and learning methods

Case study, comprising; lecture, didactic discussion, groupwork, oral presentation, report writing;

Relevance/use of the module

The module enables the students how to apply theoretical knowledge in management practice of an enterprise and to solve related economical, ecological and social problems. The training includes how to work in teams, to present results in an oral and written way to a specific audience is essential for the professional integration in companies.

Prerequisites

None

Requirements for registration

Basic knowledge in forest ecology, forest management, forest utilization and forest economy;

Distribution of work load

Contact hours	43 h (Lectures, groupwork, oral presentation of the results)
Student learning	82 h (Preparation and structuring of groupwork, oral presentations, reading, calculations and report writing)

Proposed assessment

Assessment of the (final) oral presentation and of the written report of defined tasks, which are elaborated by groups of 5 to 6 students.

Link to learning resources

http://www.forst.uni-freiburg.de/fobawi/institut/

Preliminary Reading

Brown,C.. The global outlook for future wood supply from forest plantations. No. GFPOS/WP/03, 1-145. 2000. Rome, FAO. Working Papers. (WEB)

Cossalter,C., Pye-Smith,C.. Fast-Wood Forestry. -50. 2003. Indonesia, CIFOR. (WEB)

FAO. The Eucalypt Dilema. FAO Working papers , 26. 1985. Rome, FAO. (WEB)

FAO. Afforestation and plantation forestry. Kanowski, P. J. Volume 3, Topic 12, -84. 1997. Rome, FAO. XI World Forestry Congress, Antalya, Turkey. 13-10-1997. (WEB)

FAO, 2001. State of the World´s Forest. FAO, Rome. (WEB)

Stape,J.L.. Production ecology of clonal Eucalyptus plantations in northeastern Brazil. -225. 2002. Colorado State University, Fort Collins, Colorado. (WEB)

Comments

Module No.	Module name
P 2	Forests and Climate Change

Module coordinator

Prof. Dr. Helmut Mayer Email: helmut.mayer@meteo.uni-freiburg.de

Additional teaching staff

Prof. Dr. E.E. Hildebrand, Prof. Dr. H. Rennenberg, Prof. Dr. H. Spiecker, Prof. Dr. K.-R. Volz

Syllabus

1. Climate Change (4 days) (Mayer/Rennenberg)

1.1 Atmospheric processes significant to climate change (1 day) (Mayer)

1.2 Atmospheric features of climate change (1 day) (Mayer)

1.3 Effects of climate change on processes in trees (1 day) (Rennenberg)

1.4 Effects of climate change on forests and biogeochemical cycles (1 day) (Rennenberg)

2. Climate Change Policy (1 day) (Volz)

Background, state of affairs and problems of the actual national and international policies and processes on climate change

3. Soil-Atmosphere Interactions (5 days) (Hildebrand)

3.1 The importance of soils in the global carbon cycle

3.2 Key parameters of carbon storage and dynamics in soils

3.3 Change of the “chemical climate” and forest soil drift

3.4 Soils as sources and sinks of gases

3.5 Land use change and soil carbon

4. Impacts of Climate Change on Forest Growth (5 days) (Spiecker)

4.1 Growth parameters as indicators for climate change (1 day)

4.2 Growth – climate relations (1 day)

4.3 Forest management and climate change (1 day)

4.4 Selected case studies (2 days)

Learning goals and qualifications

The students will

- realise the atmospheric fundamentals of climate change,

- understand the interaction of increasing atmospheric CO_2, increasing surface temperature, and enhanced UV radiation with physiological processes in trees,

- learn the consequences of these interactions for ecosystem processes and biogeochemical cycles, in particular of carbon,

- understand the actual climate change policies concerning the main actors and institutions, political processes and instruments,

- understand the principles of soil-atmosphere interactions and the effects of land use change,

- learn fundamentals of forest growth impacted by climate change.

Teaching and learning methods

Lectures, tutorials, pracs, excursions

Prerequisites

none

Requirements for registration

none

Distribution of work load

Contact hours	80 h (Lectures, pracs, excursion, exam)
Independent learning	45 h (Preparation, reading etc.)

Proposed assessment

Written exam

Link to learning resources

Preliminary Reading

IPCC (2001): Climate Change 2001 – The scientific basis. Cambridge: Cambridge University Press. 881 S.

Oberthür, Sebastian; Ott, Hermann (2002): Das Kyoto-Protokoll: internationale Klimapolitik im 21. Jahrhundert. Opladen: Leske + Budrich. 440 S.

Comments

Elective 3:
Analysis & Mgmt of Tree & Stand Growth
Conservation Biology

Module No.	**Module name**
	Analysis & Mgmt of Tree & Stand Growth (Forest growth & Silviculture)
Module coordinators	
Prof. Dr. J. Bauhus, Prof. Dr. H. Spiecker	
Additional teaching staff	
Prof. Dr. K. Püttmann, ,Dr. H.-P. Kahle, Dr. C. Kühne	
Syllabus	
In this module students will learn how to analyse and interpret the growth of individual trees and the dynamics of forest stands in order to develop decision tools and design silvicultural prescriptions for their management. Based on an introduction to tree growth and its environmental control and an introduction to forest dynamics, regeneration methods and stand density management will be explored in the context of traditional silvicultural systems as well as in the context of ecosystem management and close to nature silviculture. Students will be introduced into various methods of sampling trees and stands in the field and analysis of trees and their parts. The participants will learn how to assess and interpret data and parameters of trees and stands for controlling tree and stand growth and will be able to apply methods of forest site productivity assessment. Students will be introduced to models of tree and stand growth and their critical application. Based on the understanding of the environmental and spatial determinants of tree growth and wood quality development, students will learn approaches to control tree and stand growth and apply their analytical and planning skills to a number of case studies incl. mixed-species and uneven-aged forests and stands undergoing conversion. Students will also learn the ecological implications of controlling tree and stand growth as well as silvicultural approaches to manage and restore forest structure for forest conservation goals.	

Learning goals and qualifications

Students:

- will be able to understand silvicultural and growth and yield techniques and terminology.
- will gain an appreciation for various management approaches and their implications on growth and yield and ecosystem functions and processes.
- will be able to discuss principles of natural and artificial regeneration, intermediate stand treatments, and silvicultural systems in the context of growth and yield relationships and other ecosystem functions and processes.
- will be able to predict short- and long-term ecosystem responses to common silvicultural practices, based on fundamental ecological concepts, such as succession, stand dynamics, growth and yield relationships.
- will be able to apply silvicultural and growth and yield concepts to case studies.

Teaching and learning methods

Lectures will provide an overview over basic silvicultural and growth and yield concepts and highlight the scientific basis for silvicultural practices. They also aim at putting the readings into perspective and link silvicultural, ecological, and quantitative analysis concepts. The instructors assumes students have read the assigned material and the lecture will not just duplicate material covered in the readings.

Field trips: Field trips will provide real world experiences. They will help visualize basic ecological and silvicultural concepts. Students are expected to read assigned readings before the field trip.

Laboratory and computer excercises:

Prerequisites

Students should:

- have skills to review and synthesize information from the literature and other sources
- be able to work in small teams and make presentations to a larger audience
- have a basic understanding of forest mensuration
- have a basic understanding of tree physiology
- have a basic understanding of vegetation dynamics of and animal populations
- understand landscape considerations for the protection of biodiversity

Requirements for registration

Distribution of work load

Contact hours	60 h (Lectures, pracs, excursion, exam)
Independent learning	65 h (Preparation, research, report writing etc.)

Proposed assessment

Assignment: Students will be assigned a stand and are expected to develop management prescriptions in two stages. Stage 1 is to be completed at the beginning of the course, by the beginning of the 3rd day. This provides the student with a quick overview of concepts and challenges of managing forest ecosystems. The prescription developed in stage 1 can be modified throughout the 3 week period and the revised prescription is due at the end of the course, including a write-up and an oral presentation. Aim of the two stage assignment is to put the various lecture, field trips, and discussions into context. Grading of the assignment will reflect the write-up (for both stages, with a higher emphasis on the final product) and the oral presentation.

Written exam

Link to learning resources

https://campusonline.uni-freiburg.de

Module No.	Module name
P	Conservation Biology

Module coordinator

Prof. Dr. A. Reif

Additional teaching staff

Prof. Dr. I. Storch, N.N.

Syllabus

Introduction: Conservation goals; Conservation Biology as discipline between fundamental and applied research

Ecological concepts I - Patterns and consequences of landscape change: Stability/disturbance; Succession/climax; Ecosystem processes, Habitat degradation and loss; Ecological thresholds

Ecological concepts II - Dynamics of small populations: Habitat concept; Fragmentation, Metapopulation concept; Minimum Viable Popoulations; Genetic diversity and extinction vortex

Conservation instruments - **Legal framework and major players:** International conventions (Ramsar, Rio 92, IUCN, Natura 2000), Organisations (GOs, NGOs; IUCN, WWF, UNEP

Setting conservation priorities: Diversity, rarity and endangerment (incl. Red lists of threatened species), naturalness/originality, restorability; Biodiversity hotspots; Protected areas; Surrogate species concepts: indicators, umbrellas, flagships

Restoration ecology – aims and principles; Restoration of environment (site) conditions (physical and chemical environment, landscape scale)

Techniques in ecosystem restoration and habitat management: Topsoil removal, rising of water level, nutrient depletion, Grazing, mowing, burning, "mulching", etc.

Animal species recovery programmes (Restocking and re-introduction)

Restoration in practice - proiect work: Species compositions, structures, dynamics (field work; sampling plots; interviews; Land use, land use history; site); Evaluation (diversity, endangerment, naturalness, restorability, …), economy: Yields and costs; Planning options

Learning goals and qualifications

Course participants will get acquainted with aims and methods of conservation biology, and an introduction into use: (1) Nature conservation goals; (2) Conservation biology and ecology in the landscape scale, the habitat scale, and the species scale; (3) conservation instruments; (4) restoration goals and methods; and (5) application in practice (project work).

Teaching and learning methods Lectures, excursions, group work, project work
Relevance/use of the module
Prerequisites
Requirements for registration
Distribution of work load *Contact hours* *Independent learning*
Proposed assessment
Link to learning resources
Preliminary Reading
Comments

Elective 4:
Ecological Modelling
Non Timber Forest Products and Bioresources

Module No.	**Module name** Ecological Modelling

Module coordinator

Dr. Helmer Schack-Kirchner Email: Helmer.Schack-Kirchner@bodenkunde.uni-freiburg.de

Additional teaching staff

Prof. Dr. Hildebrand, Dr. Gerald Kändler (FVA), Dr. Felix Knauer

Syllabus

What is modelling?
Introduction to theoretical ecology
Modelling Tools
System Analysis and algorithmic thinking, basics principles of cybernetics
Differential equations
Introduction to computer programming with modelling examples
Implementation of simple ecological models
- humus dynamics ,- carbonate weathering
- temperature regime in soils, transport of water and matter in soils
- population models
- cellular automats
- point processes
- Markov processes
- brief introduction to related topics: fuzzy logic, fractal geometry, deterministic chaos

Model evaluation

Learning goals and qualifications

Ability to assess and critically evaluate existing models

Understanding systems and their components

Ability to translate rules and statistical relationships into algorithms

Ability to analyse (dynamic) processes and recognize essential functional and structural relationships and interdependencies as well as dynamics

Ability to implement and use simple models to test hypothesis

Teaching and learning methods

Lecture (10%), CBT + Lecture (40%), CBT Exercises 40%

Prerequisites

Requirements for registration

Distribution of work load

Contact hours 80 h (Lectures, pracs, excursion, exam)

Student learning 45 h (Preparation, reading etc.)

Proposed assessment

Link to learning resources

Preliminary Reading

Comments

Module No. (P/WP)	Module name
WP 6	Non Timber Forest Products and Bioresources

Module coordinator

Prof. Dr. M. Boppré <boppre@fzi.uni-freiburg.de>

Additional teaching staff

Prof. Dr. I. Storch, Prof. Dr. G. Becker, Prof. Dr. H. Schanz, Prof. Dr. S. Fink, Prof. Dr. U. Schmidt

Syllabus

"Bioresources" are the products and benefits from ecosystems and their plant and animal populations - to be used sustainably by people, including "non-timber forest products" in the well established meaning.

Bioresources can be classified as usable, useful or hazardous, which can directly (e.g. meat; fruits; pathogens) or indirectly (e.g. pollinators; pests) affect human needs and interests. The spectrum reaches from protozoa as pathogens to hunting and ecotourism.

Animals, plants and fungi do have numerous impacts on man; basic understanding of ecological principles in the light of management goals treated to help harnessing bioresources. Therefore, markets of bioresources as well as to historic and ethical aspects will be considered.

Learning goals and qualifications

Different types of NTFPs and bioresources will be characterised, and their management will be studied. Drawing attention to new and innovative ways of generating income by using NTFPs and bioresources is the main goal of the course.

Analysing case studies will lead to the identification of new products from ecosystems.

Students will appreciate the difficulty in marketing some NTFPs and bioresources.

Teaching and learning methods

Lectures, self-study, seminars, groupwork

Prerequisites

none,

recommended: propaedeutic self-study according to list of keywords

Requirements for registration

None

Distribution of workload

Contact hours 50 h (lectures, exam)

Self-stuy 75 h (preparation, reading)

Proposed assessment

Written exam

Link zu Modulunterlagen

http://www.fzi.uni-freiburg.de/lehre/.....

Literatur

Berenbaum MR (1996) Bugs in the System: Insects and Their Impact on Human Affairs. Helix Books

Freese CH (1998) Wild Species as Commodities. Washington DC: Island Press UBFR NA 99/392

Lewington A (1990) Plants for People. London: The Natural History Museum London

Bemerkungen

Elective 5:
Forest and Resource Inventory
Forest-Atmosphere Interactions

Module No.	**Module name**
	Forest Inventory

Module co ordinator

Prof. Dr. Dieter R. Pelz Email: pelz@biom.uni-freiburg.de

Additional teaching staff

Prof. Dr. B. Koch Dr. Gerald Kändler (FVA)

Syllabus

Statistical methods, sampling designs

National forest inventory systems

Management inventory systems

Global Forest resources assessment of FAO

NTFP in inventories

Tropical inventories

Remote sensing in forest inventories

Learning goals and qualifications

Students will gain the:

- Ability to assess inventory designs and procedures
- Ability to design and implement forest inventories

Teaching and learning methods

Lecture (30%), Exercises (30%), field work (20%), literature study 20%

Prerequisites

Forest mensuration, statistics

Requirements for registration

Distribution of work load

Contact hours	80 h (Lectures, pracs, excursion, exam)
Independent learning	45 h (Preparation, reading etc.)

Proposed assessment

Home work

Link to learning resources

Preliminary Reading

Comments

Module No.	Module name
WP 3	Forest-Atmosphere Interactions

Module coordinator

Prof. Dr. Heinz Rennenberg Email: heinz.rennenberg@ctp.uni-freiburg.de

Additional teaching staff

Prof. Helmut Mayer, Dr. Jürgen Kreuzwieser, PD Dr. Hans Papen, PD Dr. Klaus Butterbach-Bahl

Syllabus

The unit "Meteorology of trace gas exchange" (3 days) deals with the characteristics of atmospheric processes and phenomena significant for the trace gas exchange between forests and the atmosphere at different spacio-temporal scales.

The unit "Forest vegetation and trace gas exchange" (6 days) will introduce the role of plants as sources and sinks of atmospheric trace constituents and the plant processes involved in this exchange of C, N, and S.

The unit "Forest soils and trace gas exchange" (4 days) will provide information on the exchange of N and S trace gases between forest soils and the atmosphere and the processes involved in the production and consumption of these compounds by microbial processes.

The unit "Modelling forest – atmosphere interactions" (2 days) will communicate knowledge how to use mechanistic models to simulate carbon and nitrogen turnover processes in forest ecosystems and associated C and N gas exchange between forest ecosystems and the atmosphere.

Learning goals and qualifications

The student will

- obtain physical knowledge on features of the atmosphere and its influence on trace gas exchange
- obtain a quantitative view about the exchange of C, N, and S trace gases between forest vegetation and the atmosphere
- obtain a quantitative view about the exchange of C, N, and S trace gases between forest soils and the atmosphere
- understand plant and microbial proccesses involved in the production and consumption of atmospheric trace constitutents
- understand how biological and physico-chemical processes can be implemented in numerical models and how these models can be used to understand, proof and simulate ecosystem processes

Teaching and learning methods

Lectures, tutorials, pracs

Prerequisites

none

Requirements for registration

Distribution of work load

Contact hours	80 h (Lectures, pracs, excursion, exam)
Student learning	45 h (Preparation, reading etc.)

Proposed assessment

Link to learning resources

Preliminary Reading

- Stull RB (1991) An introduction to boundary layer meteorology. Kluwer Acad Publ., Dordrecht

- Gasche R et al. (2002) Trace gas exchange in forest ecosystems. Kluwer Acad. Publ., Dordrecht

Comments