

Diseases of trees I

Introduction



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Tento projekt je spolufinancován Evropským sociálním fondem a Státním rozpočtem ČR InoBio – CZ.1.07/2.2.00/28.0018

Schedule of subject Forest pathology

Lectures

- Introduction (1 hour)
- Diseases of trees and control (7 hours)
- Stress ecology, non biotic factors (Assoc. Prof. P. Cermak 8hours)
- Pests and pest control (Assoc. Prof. O. Holusa, 8 hours)

Practical courses

1. Diseases of woody plants (14 hours, T. Majek)
 1. Wood destroying fungi
 2. Nedlecasts
 3. Bark diseases
 4. Leaf diseases
2. Pests (14 hours) (14 hours, Assoc. Prof. Holusa, Dr. Foit)
3. Excursion and field trip (1 day)

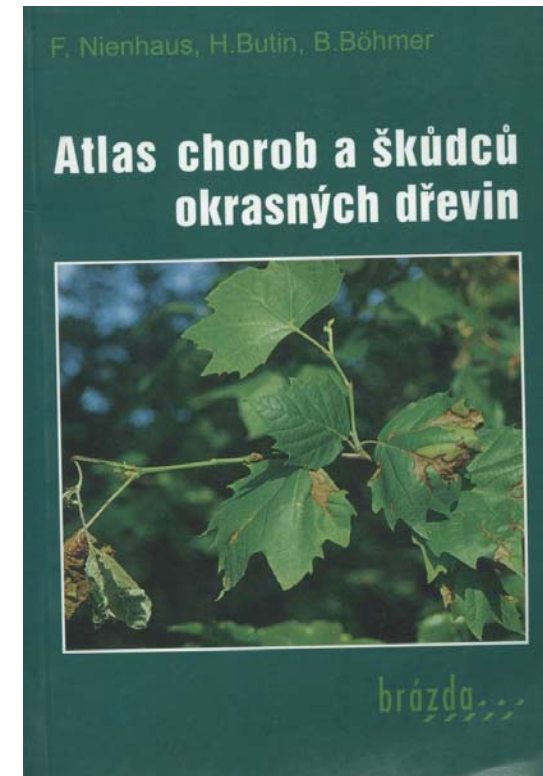
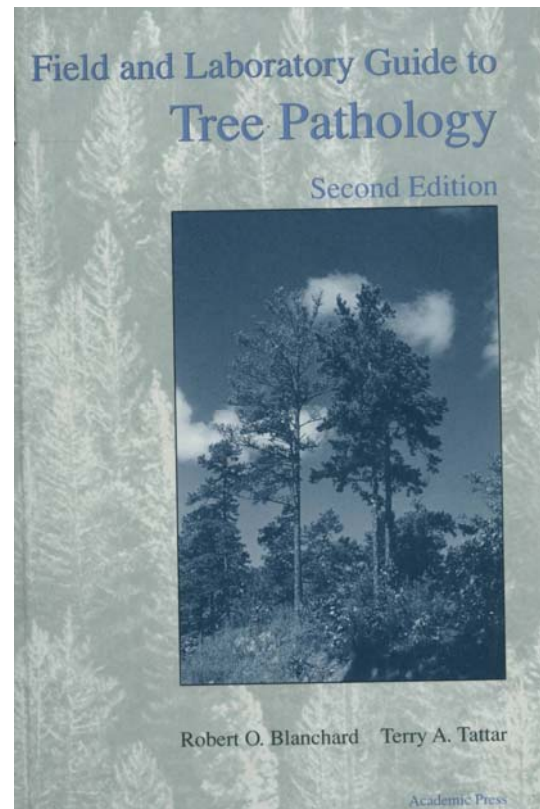
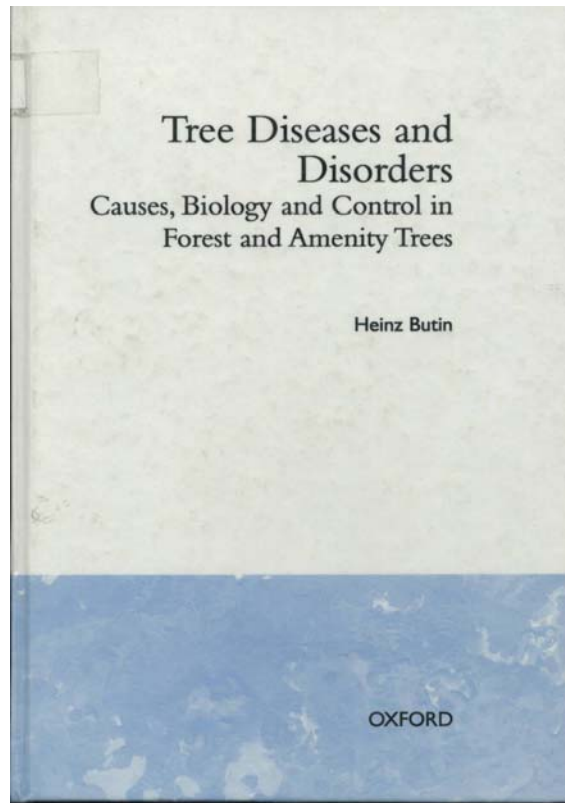
Requirements for final exam from Forest Pathology

- Practical exam
 - identification of pests
 - identification of diseases
- Presentation of selected problem from Forest pathology
 - Power point presentation
- Oral exam
 - Teoretical bacgroud

Study literature

- Butin Heinz 1995. Tree Diseases and Disorders. Causes, Biology, and Control in Forest and Amenity Trees. Oxford University Press.
- Cermak: Stress ecology.

Literature



Introduction

- History
- Concepts
- Visions
- New technologies

Forest pathology and protection is a scientific discipline, synthesizing stress ecology, forest phytopathology, entomology, zoology, wildlife management with practical outcomes in forestry and environmental practices



Robert Hartig

30. května 1839 Braunschweig – 9. října 1901 Munich

http://en.wikipedia.org/wiki/Robert_Hartig

Terms

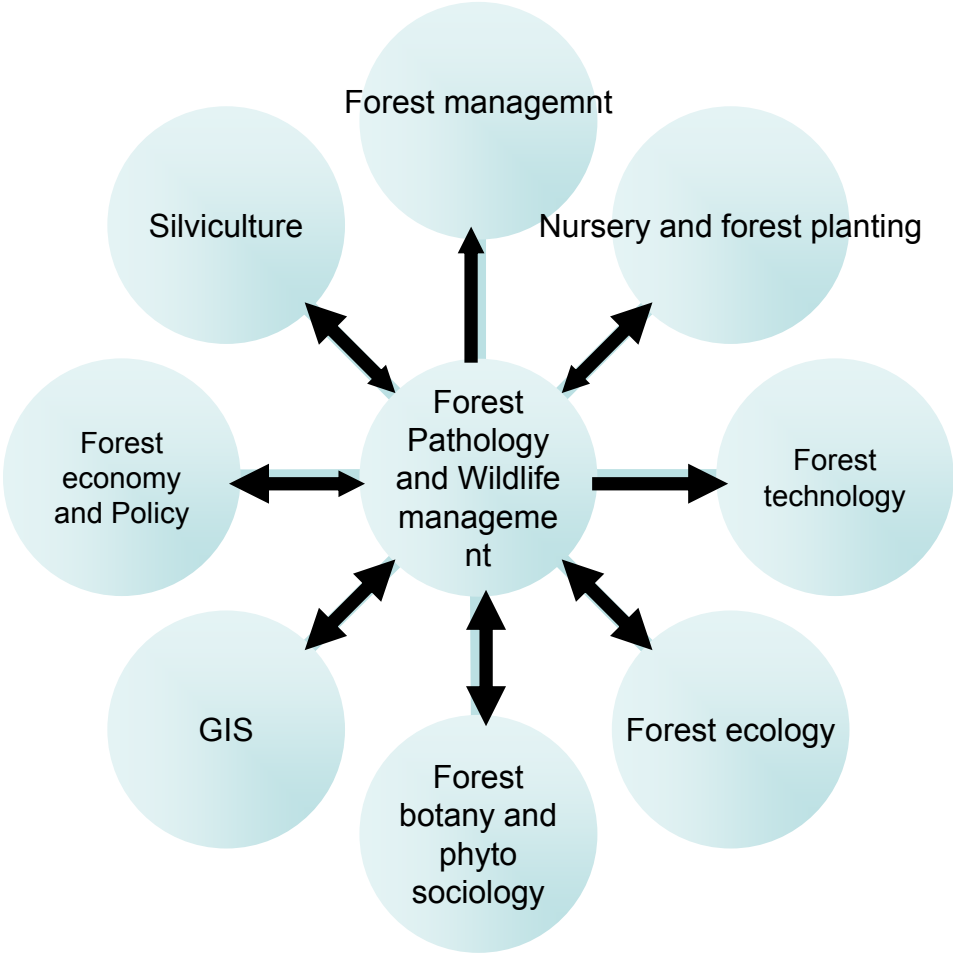
- Plant protection
- Phytosanitary
- Forest protection x Forest pathology)
- Tree pathology

- Pests
- Diseases

Forest pathology vs. Agriculture phytosanitary

- long-living organisms like trees vs. short age crops
- specific requirements of trees to the environment as a prerequisite for long-term existence
- wood as a complex organism - mycorrhiza, wood mushrooms
- high genetic diversity of forest tree species vs. agricultural clones
- co-evolution of species - pathogen relationship as a partnership
relationship of pathogen - host (woody plants) determined primarily by the host predisposition - stress load.
- more frequent stressors synergy on trees and forest ecosystems - a complex disease

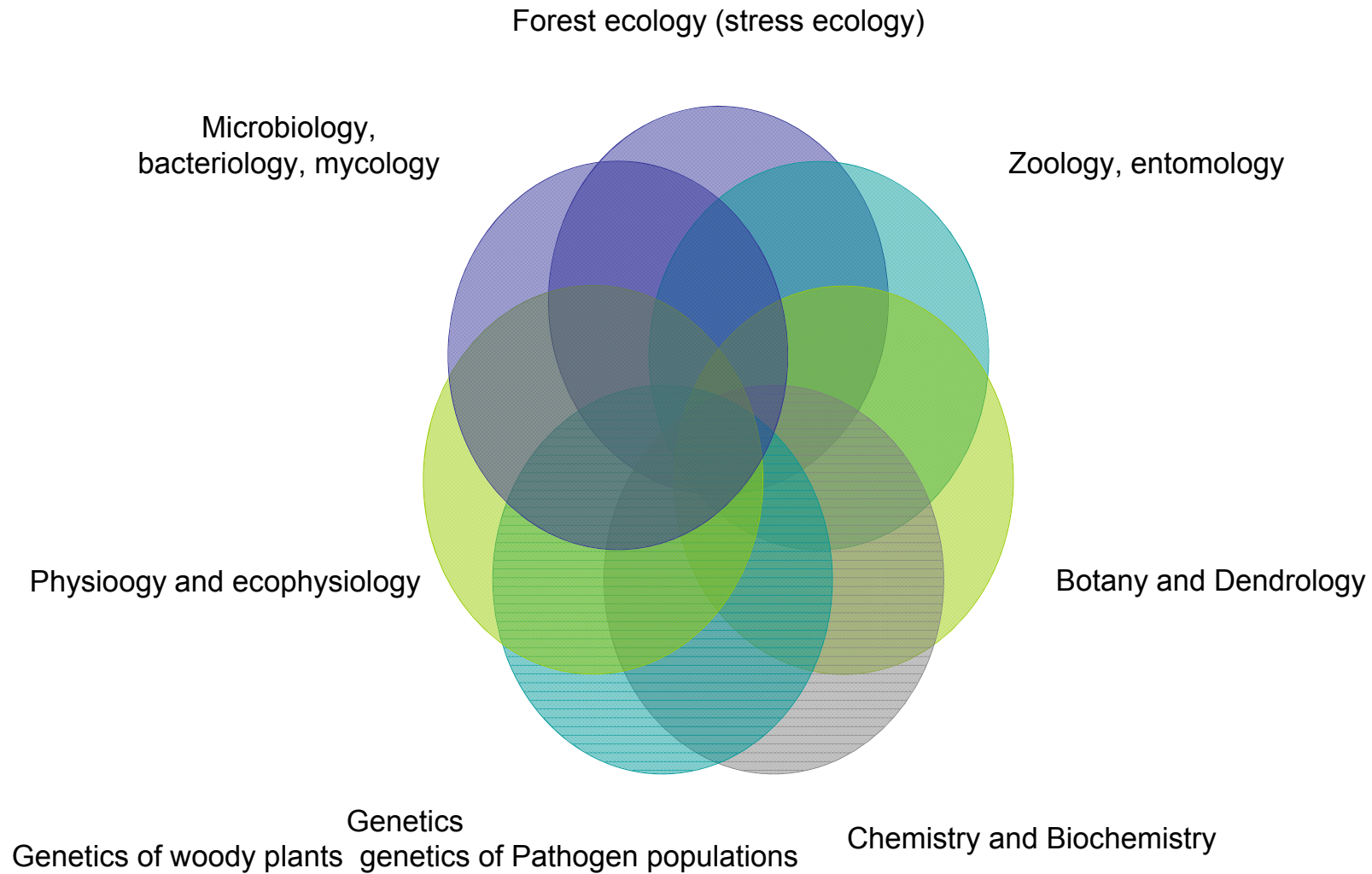
Forest pathology and Forest disciplines



Concept of Forest pathology

- Forest pathology
 - Diseases
 - Pests
- Forest protection
 - Forest fires

Biological background of Forest pathology



Concepts of Forest pathology and Forest Protection

Global Fires

- Forest fires (protection)
- Pests (pathology)
- Diseases (pathology)
- Injuries, air pollution



Concepts of Forest pathology and protection plantations- forest ecosystem .

- Control in plantations – close to phytosanitary problems of crops plantation
- Management of forest ecosystems – complex evaluation and regulation of ecosystems – forestry on the bases of systém ecosystem approach



Management of forest ecosystems

- Relation to natural forest ecosystems
 - generally high species diversity (but not the rule!)
 - high genetic diversity (generally required)
 - longevity and continuity
 - operation of feedback
 - mostly closed cycle elements
- regulation of pathosystem based mainly on indirect interventions using knowledge of ecosystem function, especially role of negative feedback: if necessary, the need for priority intervention to influence the interactions affecting the population of the pest and its success;
- possibility of defense against pathogens intervention are limited – precatution are based on prevention and with respect to environmental requirements of trees, respectively. comprehensively specific forest ecosystems
- Changing in behavior or pathogenws and pests – populations pf pathogen and pests under changed environmental conditions
- abandoning the traditional concept of harmful pest - Modern pathology based on knowledge of species ecophysiology and ecosystem relationships - stress pathology of trees;
- large diversity of potential pathogens - small impact on the ecosystem
minimal intervention = minimum cost vs. production relatively lower
difficult to determine the economic threshold of harmfulness - virtually impossible
- low cost on control contra lower efficiency of the process
generally stable production (up to a certain age)

Control in Plantations

- homogeneous plantation – the same age and homogenous structure, short rotation, quick growth
- clones, including genetic modified trees to the maximum distribution of primary production in the growth of raw material
- minimum genetic diversity (up to a one clone) as a prerequisite for susceptibility to pests a diseases
- need for direct intervention costs = high protection, high protection costs = reduction of the expected benefit to zero
- high risk of introduction of invasive quarantine pest or disease
- it is possible to determine the threshold of harmfulness
- high production, based on the additional power supply (increased costs) vs. high risk of loss of production

Concepts of Forest pathology and protection

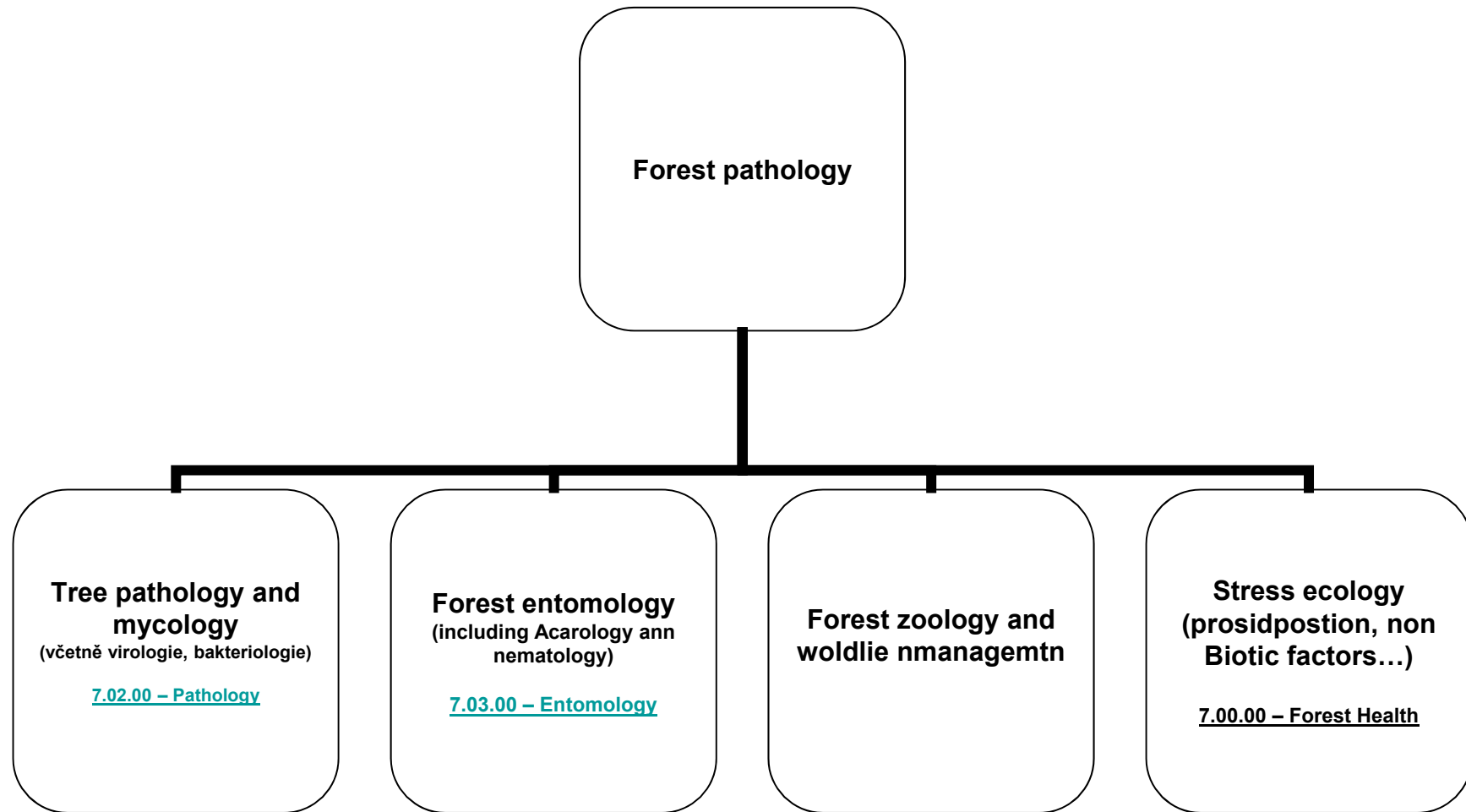
- Management of forest stands (Europe)
- Plantations
- Control in nurseries

From concept pests and harmful agents to complex health assessment

- concept based on the identification of the pest organism regardless of other factors
- concept of harmful agents operating in the forests
- ecosystem approach - assessment of the synergistic effect of stressors, to assess the synergistic interactions - first comprehensive assessment of the status and role of plant pathogenic and non-pathogenic organisms in the pathogenesis, including synergies; spiral of stress, predisposition, initiation and death rates stressor
- primary object to protect the forest (wood) is wood, respectively. forest ecosystem, not a pest or pathogen
- study of pest or pathogen and interactions in the ecosystem is a means of understanding relationships and causes of ecosystem destabilization or worsening health condition of trees rather than to
- identifying the cause and effect, thtreatment at the causes rather than symptoms removal

The ecosystem approach is valid for forests, it can not be universally applied for the plantations, respectively. restrictions apply in some types of plantations

Disciplines of Forest pathology



IUFRO – Forest health

- **7.00.00 – Forest Health**
 - 7.01.00 – Impacts of air pollution and climate change on forest ecosystems
 - 7.01.01 – Impacts of air pollution and climate change on forests – **Detection, monitoring and evaluation**
 - 7.01.02 – Impacts of air pollution and climate change on forests – Mechanisms of action and indicator development
 - 7.01.03 – Impacts of air pollution and climate change on forests – Atmospheric deposition, soils and nutrient cycles
 - 7.01.04 – Impacts of air pollution and climate change on forests – **Genetic aspects**
 - 7.01.05 – Impacts of air pollution and climate change on forests – Modelling and risk assessment
 - 7.01.06 – Impacts of air pollution and climate change on forests – **Social and political aspects**
 - 7.01.07 – Impacts of air pollution and climate change on forests – **Multiple stressors on ecosystems**
 - 7.01.08 – Impacts of air pollution and climate change on forests – Hydroecology
- **7.02.00 – Pathology**
 - **7.02.01 – Root and butt rots**
 - **7.02.02 – Foliage, shoot and stem diseases**
 - 7.02.03 – Vascular wilt diseases
 - 7.02.04 – Phytoplasma and virus diseases of forest trees
 - 7.02.05 – Rusts of forest trees
 - **7.02.06 – Disease/environment interactions in forest decline**
 - 7.02.07 – Diseases and insects of tropical forest trees
 - **7.02.09 – Phytophthora diseases on forest trees**
 - 7.02.10 – Pine wilt disease
 - 7.02.11 – Parasitic flowering plants in forests
- **7.03.00 – Entomology**
 - 7.03.01 – Cone and seed insects
 - 7.03.02 – Gall-forming insects
 - **7.03.04 – Diseases and insects in forest nurseries**
 - 7.03.05 – Ecology and Management of Bark and Wood Boring Insects
 - 7.03.06 – Integrated management of forest defoliating insects
 - 7.03.07 – Population dynamics of forest insects
 - 7.03.08 – Forest protection in Northeast Asia
 - 7.03.10 – Methodology of forest insect and disease survey
 - 7.03.11 – Resistance to insects
 - **7.03.12 – Alien invasive species and international trade**
 - **7.03.13 – Biological control of forest insects and pathogens**
 - 7.03.14 – Entomological Research in Mediterranean Forest Ecosystems

Concepts and challenges for Forest Pathology

- **identification and quantification of tree/forest predisposition - stress load (!?) - water deficit , secondary metabolism**
- **determining risk of forest pathology and protection in the changed environmental conditions, forest decline in terms of climate change, the synergy effect of stressors**
- **Reasons of forest decline - a comprehensive assessment of the ecosystem approach principles, identification of the synergical effects of stressors on trees/forests**
- **relationship of host - pathogen - pest – ecosystem**
- **optimization of the relationship of animals, forest and economic needs of man**
- **application of friendly methods in forest protection**
- **economic evaluation of the impact of the destabilizing factors on forests**
- **modeling the impact of stressors on forests**
- **Plant quarantine and disease in the EPPO (European and Mediterranean Plant Protection Organisation)**

Methods, technologies and approaches in forest pathology

- **Identification of pathogens and pests**
- (ELISA)
 - (ELISA)
 - PCR
 - Real-time PCR (quantification)
 - sequencing
- **Study population structure**
Mating types
 - AFLP
 - microsatellites
 - Bioinformatics
 - Biostatistics
- **Relationships between organisms in the pathosystem, quantification of infection**
 - Real time PCR
- **Reaction wood to infection, predisposing trees**
 - Sap flow
 - Secondary metabolism of nitrogen
 - The attractiveness of trees to insects outbreak – olfactometry
- **Biological control of forest**
 - ds RNA virus transformation into strains of pathogens
 - Implementation of GIS
 - Damage to forests - Remote sensing
 - Mapping calamities, pests gradations, mapping the occurrence
- **Modeling**
 - forest ecosystem behavior under stress
 - forecast the behavior of the pathogen

The main problems and challenges for forest pathology


- global change
- changes in silvoiculture and forest management
- Control of trees in plantations,
- introduced and invasive species
- methods of control based on the application of biological agents and knowledge of the system operation - reducing costs, improving stability of production

Global changes

- climate change
- globalization movement of persons, animal, plants material and goods
- globalization of trade, including trade in plant material - the movement of plant material as a potential pathway for introduction of pathogens, packaging material based on wood as a source of pest introduction
- globalization processing of wood products, the pressure on standardization of raw materials - push to expand the tree plantations for timber production
- invasive organisms, including pests, the risk of introduction of new organisms from other areas and their adaptation to new hosts spectrum outside their natural range expansion - change of pest and disease strategies of species in new areas
- changes in the composition of forests and their management
- reducing the area of natural forests – remains of natural forests are strictly protected in some areas – local lack of timber

http://www.youtube.com/watch?v=G1L4GUA8arY&feature=player_detailpage

Globalization and forests pathology and protection

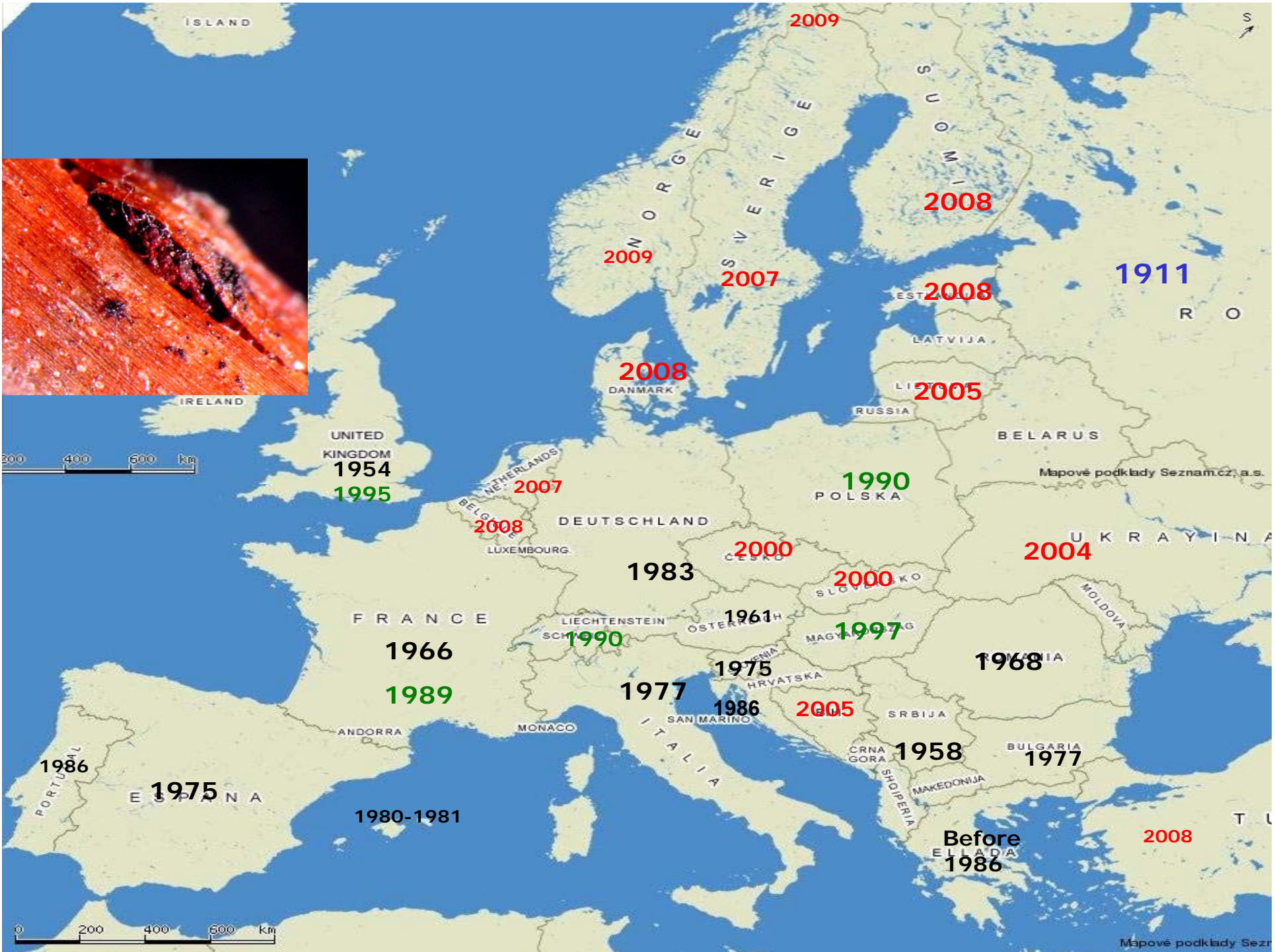
- Reaction of existing forests to climate change
 - changes in predisposition of trees / forest ecosystem
 - risk of spreading harmful organisms and pathogens
 - changing of the behavior of pathogens and pests
- What precautions do to improve the adaptation potential of contemporary forest ecosystems?
- Changes in the structure of forest ecosystems.
- Precautions to minimize the impact of the stressors, design of adaptive management with regard to anticipated problems, recommendations for the silviculture and forest management
- Investments - investments pressure technology to change the structure of forests
- The pressure to intensify production, intensive forest plantations - plantations - new problems and challenges; protection in plantations - clones
- Changing the behavior of organisms - hosts and pathogens - in different climatic conditions.
- The spread of invasive organisms - plant trade in commodities, packaging materials, tourism 

Invasive and alien disease and pests

- Invasive species - the non native species in a geographically limited area, with an uncontrolled spread and impacts on native populations of organisms that directly displaces competition for natural resources, or damages directly pathogenic effects.
- Introduced species - the species, distributed in an area outside its natural range, will not necessarily cause problems indigenous populations and ecosystems
- Quarantine species - the alien species in certain areas, which are applied to the official measures, usually by phytosanitary authority

Reasons of introduction and invasion

- The introduction of the pathogen into new areas and adaptation to new host (*Ophiostoma ulmi*, *O. novo-ulmi*)
- The introduction of the pathogen with their host introduction (*Rhabdocline pseudotsugae*, *Phaeocryptopus gauemanii*, *Apiognomonina veneta*)
- Introduction of the new tree species and the adaptation of native species of the pathogen (*Cronartium ribicola*)
- Changed environmental conditions such disturbing ecological barriers (*Dothistroma septosporum*)
- Trade with plant material (powdery mildews, *D. septosporum*, insect-Anaplophora, *Bursaphelenchus xylophilus*)
- Wood as a packaging material (*Anaplophora glabripennis*)
- Scientific Research (*Cameraria ohridella*, *Lymantria dispar*)



Disease of trees - schedule

Group of main pathogns

- Root rots
- But rots
- Cancers
- Vascular mycoses
- Foliage and shoot diseasa
- Diseases of young trees, diseases in nurseries

Main diseases of different forests stands in Europe

- Boreal forests
- Secondary spruce stands
- Mixed Central European forests
- Mountain forests
- Beech stands
- Oak stands
- Floodplain forest
- Coppices
- Mediterranean forests
- Pine plantations
- South European stands and plantations

Phytosanitary precautions and control

- Phytosanitary regulation in the World
- EPPO and Phytosanotary regulations in EU
- Allien, invasive and Quarrantine pests