

## Theme issues to FSE of Forestry, Water and Landscape Management

### **Forest Ecosystems** (Advance Forest Ecology, Forest Protection, Silviculture, Forest Genetics)

#### *Advance Forest Ecology*

1. Forest ecology, forest ecosystem, biomes, main biomes on the Earth
2. Natural forest dynamics, disturbance regimes, forest development cycles, forest dynamics in vegetation zones, post-glacial forest development
3. Water cycles and forest ecosystem, forest ecosystem and atmosphere, forest ecosystem and environment
4. Primary and secondary production in forest ecosystems, biomass production in Forest Ecosystem
5. Main nutrient cycles in forest ecosystems, forest ecosystems and soils

#### *Forest Protection*

6. Abiotic factors in forest protection. The main global and central European threats, their effect on forests, causes and consequences, preventive and curative solutions.
7. Weeds in forest protection. The most important species and groups regarding propagule dispersal, their effect on forests, causes and consequences, preventive and curative solutions.
8. Bark- and wood-boring insects in forest protection. The most important global groups, damaging species in the northern hemisphere, their effect on forests, causes and consequences, preventive and curative solutions.
9. Insect defoliators in forest protection. The most important global groups, damaging species in the northern hemisphere, their effect on forests, causes and consequences, preventive and curative solutions.
10. Fungi in forest protection. The most important northern hemisphere species and groups regarding the tree species, their organs and wood damage, their effect on forests, causes and consequences, preventive and curative solutions.
11. Vertebrates in forest protection. The most important taxonomic groups and species globally, their effect on forests, causes and consequences, preventive and curative solutions.

#### *Silviculture*

12. Structure and development of forest stands, selection of tree species, formation and modification of stand mixtures, and differentiation according to the functional orientation of stands
13. Thinning of forest stands – concepts and methods for the main commercial tree species
14. Silvicultural measures increasing the stability and resilience of forest stands
15. Forest regeneration – main techniques and applications
16. Forest management systems – standard classification, characteristics and use
17. Silvicultural options for forest adaptation to climate changes.
18. Close to nature silviculture - definition, principles and procedures.

## *Forest Genetics*

19. Forest genetics – concepts, scope and importance
  - Concepts and sources of variation in Forests
  - The role of plantations as forest ecosystems
20. Molecular basis of inheritance
  - Genome organization
  - Gene structure and regulation
21. Transmission genetics – Mendelian genetics, chromosomes, recombination
  - Mendelian genetics
  - Cell cycle, mitosis, meiosis
22. Genetic markers
  - Characteristics of genetic markers
  - Polymerase chain reaction
  - Molecular markers (SSRs, SNPs)
23. Population genetics
  - Genotype and allele frequencies, Hardy-Weinberg law
  - Forces of evolution – mutation, migration, selection, genetic drift
24. Quantitative genetics
  - Nature of polygenic traits
  - Genetic variances and heritabilities
  - Genetic correlations
  - Genotype x environment interaction
25. Tree improvement programs
  - Tree breeding cycle of forest tree improvement programs
  - Genetic gains
  - Seed orchards

## **Forest Management** (Forest Inventory and Remote Sensing, Forest Management Planning, Perspectives to Forestry Bio-economy)

1. Data gathering and mensuration
2. Methods of determination of tree volume
3. Methods of determination of stand volume
4. Sampling methods and their application in inventory
5. Methods of forest inventory, national forest inventory
6. Utilization of Remote Sensing for acquisition of data about forests
7. Utilization of drones in forestry
8. Active and passive remote sensing sensors for forest data acquisition
9. Lidar data, their processing and information extraction
10. Growth, increment principals of forest growth models
11. Description of structural forest characteristics and functional characteristics
12. Normal forest and forest management types.
13. Legislative rules for forest management
14. Temporal arrangement of the forest
15. Spatial arrangement of the forest
16. Cutting control and allowable cut
17. Forest Management Plan and its parts
18. Forest Management Guidelines in Czech Republic
19. Optimization in forest management: general frameworks and background theory
20. Application of optimization in forest management: practical cases and examples
21. The importance of sustainable development for the forest bioeconomy.
22. Relationship between forest bioeconomy and energy.
23. Main goals of forest bioeconomy.

## **Water and Landscape Management** (Global Changes and Water Resources, Landscape Planning, Water Resources Management, Application of GIS in Forest Management)

### *Global Changes and Water Resources*

1. Natural variability of climate: Give an example of a driver (external or internal process) of natural climate variations and describe its influence on climate on Earth.
2. Natural variability of climate: Describe how the volcanic activity may influence the climate.
3. Anthropogenic climate change: Describe the principle of greenhouse effect, its importance for the life on Earth and how it is influenced by human activity.
4. Anthropogenic climate change: name the most important greenhouse gases, describe their natural and anthropogenic sources.
5. Climate change and water: Give examples of observed and/or projected changes in climate that are related to water and describe their impacts on water.
6. Climate change and water: What are the possible consequences of the climate change in the ecosystem of tropical rain forest?
7. What are the possible consequences of air temperature above 0 °C in winter in mid-latitudes regarding the groundwater recharge?

### *Application of GIS in Forest Management*

8. Introduction to GIS in Forestry:
  - What is Geographic Information System (GIS) and how is it used in forestry management?
  - Explain the key components of a GIS system (description of geodata, types of geodata).
9. Spatial Referencing and non-spatial data:
  - Spatial referencing in raster and vector data in GIS, differences. How does it ensure accurate location representation?
  - How are vector and raster data associated with attribute information. Provide an example.
10. Raster Data:
  - Raster data model in GIS, its represent spatial information.
  - Concept of pixels in raster data. How are pixel values used to convey information?
  - Give examples of continuous data that are commonly represented using raster models (e.g., satellite imagery, elevation maps, temperature data).
11. Vector Data:
  - Define the vector data model and its key components (points, lines, polygons).
  - How do vector points differ from raster pixels? Provide specific examples.
  - The significance of topological connectivity in vector networks (e.g., road networks, river networks).
12. Data Acquisition and Integration:
  - Spatial data collected for forest mapping using GIS techniques.
  - Various data sources (e.g., satellite imagery, LiDAR, field surveys) into a GIS database.
13. Forest Inventory and Mapping:
  - GIS in mapping forest cover types, tree species distribution, and stand density.
  - Role of GIS in monitoring forest health, deforestation, and land-use changes.
14. Forest Planning and Decision Support:
  - How does GIS assist in forest management planning? Provide examples.
  - Explain how GIS can be utilized for risk (wildfire, wind damage) assessment in forested areas.

### *Water Resources Management*

15. Floods. Explain how deforestation, overgrazing, mining, industrialisation, global warming, etc. have contributed to the incidence of floods. How to protect land against inundation.
16. Water Logging. Explain principles of sustainable management in water logging. Special attention should be paid in arid and semi-arid regions, why?
17. Watershed Management. Water cycle, watershed, precipitation-runoff relations. How to manage it for sustained and increased productivity in the regions.
18. Rainwater Harvesting. Traditional ways and new technologies. How to use them in conditions of climatic changes.
19. Irrigation. Principles, main role in sustainable agriculture and forestry.
20. Drainage. Principles, main role in sustainable agriculture and forestry.