PRINCIPLES OF APPLIED FOREST ECOLOGY: THE PRACTICE OF SILVICULTURE
FES 659b (4 credits)

INSTRUCTOR: Prof. Mark S. Ashton
Office: 22 Marsh Hall - Office hours Tuesdays 9:00am-11:30am

TEACHING FELLOWS:  Aaron Lefland, FES MFS student;
Leonora Pepper, FES MFS student

TIME: 8.30-10.20 am Monday, Wednesday and two Fridays in January; Field trips - Fridays

SNACKS: Five-minute break at 9:30 am, coffee, hot chocolate & tea provided.
PLACE: Kroon Hall, Burke Auditorium.

This course will teach the scientific principles and techniques of controlling, protecting, and restoring the regeneration, composition, and growth of natural forest vegetation and their plantation and agroforestry analogs. Examples are from woodlands, forests, plantations, and agroforestry ecosystems worldwide. Analysis of biological and socio-economic problems affecting specific forest stands are discussed and design of silvicultural systems to solve these problems are suggested. Applications are discussed for management of wildlife habitat, water resources, agroforestry systems, urban green space, climate mitigation, timber and non-timber products, industrial management, and landscape design.

Desired but not required knowledge of subject areas for this course: Economics of natural resource management; Forest stand dynamics/forest ecology; Introduction to soil science; and Introduction to hydrology.

This course is a pre-requisite for: Management plans for protected areas; Rapid assessments in forest conservation; Analysis of silvicultural problems; Seminar in advanced silviculture; Seminar in Tropical Forest Restoration; Field trips in forest resource management and silviculture; Forest operations/Southern forest field trip.

REQUIREMENTS
-Mid-term exam - closed book 2 hr period, 30% of grade, 5:30-7:.30 pm, Wed 8th March.
-End-of-term exam - closed book, 3 hr period, 40% of grade, 1:00-3:00 pm, Fri. 5th May
-Silviculture prescription, 15% of grade, Wed. 3rd May
-Participation and attendance in lectures and field trips - 15% of grade.
Auditors: Auditors must take mid-term exam and attend first 2 field trips and the Yale-Myers field trip.

FIELD TRIPS (7 field days)
1. Stand exams and photographic interpretation of forested landscapes (All day 10th Feb.)
2. Methods of reproduction in southern New England (afternoon 3rd March)
3. Nursery, orchard pruning (afternoon 31st March)
4. Planting, pruning, and release (all day 7th April)
5. Yale-Myers – silvicultural prescriptions (2 all day field trips 14-15th April)
6. Quabbin Reservoir – watershed management/NIPF-private land ownership (all day 21st April)
7. New Haven, URI – urban renewal (afternoon 28th April)

READINGS
Available online on class server
COURSE OUTLINE

Wed. 18th Jan.
Introduction - What is silviculture? Historical development and place in resource management. What does this course include?

Readings:

SILVICS – PART 1
This part of the course provides an overview of the different site adaptations which tree and shrub species have to climatic, edaphic and biotic influences.

THE FOREST ENVIRONMENT
Fri. 20th Jan. (Kroon 321)
Lecture 1.1 Solar radiation - Macro and micro effects; the nature of light and temperature.
Readings:

Mon. 23rd Jan.
Lecture 1.2 Pattern in precipitation – Macro and micro effects across forested landscapes
Readings:

Wed. 25th Jan.
Lecture 1.3 The soil resource - Macro and micro effects of soil weathering pathways
Readings:

REPRODUCTIVE BIOLOGY OF TREES AND SHRUBS.
Fri. 27th Jan. (Marsh Hall)
Lecture 1.4 Flowering - Breeding systems, phenology and pollination.
Readings:
Mon. 30th Jan.
Lecture 1.5 **Fruiting** - Phenology, dispersal and germination.
Readings:

**ESTABLISHMENT AND GROWTH DYNAMICS OF TREES AND SHRUBS**

Wed. 1st Feb.
Lecture 1.6 **Disturbance and shade tolerance** - Disturbance pathways and regeneration guilds
Readings:

Mon. 6th Feb.
Lecture 1.7 **Soil nutrient and moisture status and tolerance adaptations** - Site interactions and the niche concept
Readings:

Wed. 8th Feb.
Lecture 1.8 **Diversity theory and floristics: Principles of regeneration ecology.**
Readings:

TUTORIAL Wed. 8th Feb. Noon-1:00 pm. (Marsh Rotunda) Silvics overview (TF).

**SILVICULTURE - REGENERATION ESTABLISHMENT - PART 2**

This part of the course describes the different methods of obtaining and establishing natural regeneration for a forest stand. It covers the techniques and practices used in nursery propagation of trees and shrubs, and in the methods of establishing different planting analogs to natural regeneration.

**THE SOCIO-ECONOMIC AND BIOLOGICAL MANAGEMENT UNIT**

Fri. 10th Feb. 8.30-10.20 am (in Bowers Hall)
Lecture 2.1 **The working units of silviculture: The concept of site and stand.**
Reading:

Field Trip - Stand exams and photographic interpretation of forest landscapes
Mon. 13th Feb.
Lecture 2.2 Site treatments: Restoration, protection, and preparation.
Readings:

**METHODS OF NATURAL REPRODUCTION**

Wed. 15th Feb.
Lecture 2.3 The clear-cut and seed-tree methods of reproduction
Readings:

Mon. 20th Feb.
Lecture 2.4 The shelterwood method of reproduction
Readings:

Wed. 22nd Feb.
Lecture 2.5 Methods based on vegetative reproduction - Coppice
Reading:

Mon. 27th Feb.
Lecture 2.6 The selection method of reproduction
Reading:

TUTORIAL Mon. 27th Feb., Noon-1 pm. (Marsh Rotunda) Methods of natural reproduction (TF).

**ANALOGS TO NATURAL REPRODUCTION - PROPAGATION AND PLANTING**

Wed. 1st March.
Lecture 2.7 Propagule collection, improvement, storage and germination
Reading:

**Field Trip - Methods of reproduction in southern New England.**
Fri. 3rd March 12:30pm-4:00 pm

Mon. 6th March
Lecture 2.8 Nursery operations
Reading:

TUTORIAL Mon. 6th March Noon-1 pm. (Marsh Rotunda). Preparation for silviculture exam (TF).

Wed. 8th March
Lecture 2.9 Methods and classification of planting systems

Wed. 8th March - SILVICS EXAM. 5:30-7:30 pm. Burke Auditorium.

SILVICULTURE - POST ESTABLISHMENT TREATMENTS - PART 3
This part of the course examines methods used in silviculture to tend the development of a stand after regeneration establishment. It discusses the methods used for harvesting various goods and services from a forest.

Mon. 27th March
Lecture 3.1 The concept of growing space and competition

Wed. 29th March
Lecture 3.2 Treatments to the individual – Pruning.

Field Trip – Nursery operations; treatments to the individual - pruning.
Fri. March 31st 12:30 – 5:00 pm

Mon. 3rd April
Lecture 3.3 Early Treatments of the Stand - Methods of release; herbicides.

Wed. 5th April
Lecture 3.4 Methods of thinning - High, low, selection, and mechanical; improvement, salvage and protection treatments.

Field Trip – Methods of planting, release treatments, and pruning
Fri. April 7th 10:00am – 5:00 pm

Mon. 10th April
Lecture 3.5 Quantitative thinning and spacing guidelines
Reading:

TUTORIAL Wed. 12th April - Noon-1 pm (Marsh Rotunda), Post establishment tending (TF).

SILVICULTURAL CONSIDERATIONS AND APPLICATIONS – PART 4
This part of the course examines silvicultural applications for restoration, forest health and climate change, wildlife, watersheds, agricultural systems, industrial and public lands and urban environments.

Wed. 12th April
Lecture 4.1 Methods of harvesting and forest operations
Reading:

Field Trip - Yale-Myers Forest – stand development and thinning exercise; silvicultural prescriptions for regeneration; wildlife habitat prescriptions.
Fri. 14th April 8:00 am - Sat. 15th April 6:30 pm

Mon. 17th April
Lecture 4.2 Methods of managing for wildlife habitat.
Reading:

Wed. 19th April
Lecture 4.3 Forest watershed management
Reading:

Optional readings on restoration, health and climate change:

Field Trip - Non-industrial private landowners; Quabbin Reservoir – watershed management.
Fri. 21st April 7:00 am – 6:30 pm.

Mon. 24th April
Lecture 4.4 Agroforestry Systems – Succession versus structure; Alley cropping, silvo-pasture, tree gardens
Reading:
Wed. 26th April.
Lecture 4.5 **Trees and woodlands in urban landscapes** – Aesthetics, polluants, and storm water runoff.

**Reading:**

Optional readings on industrial forest and public land management:

Lecture 4.6 **Summary remarks.**

**Field Trip – The practice of silviculture in urban environments**
Fri. 28th April 12:30 pm – 4 pm.

Field prescription exercise – Wed. 3rd May 1-4 pm

TUTORIAL Thurs. 4th May Noon-1 pm, (Marsh Rotunda). Silviculture overview (TA).

Fri. 5th May - **SILVICULTURE EXAM** 1:00 pm - 3:00 pm Burke Auditorium.

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**TUTORIALS**

Tutorials are optional for those students who desire background information on certain topics or who require clarification of topics and concepts talked about in lectures.

**Teaching Fellows:**
Aaron Lefland, aaron.lefland@yale.edu - FES MFS student – Marsh Hall.
Leonora Pepper, leonora.pepper@yale.edu - FES MF student – Marsh Hall.