FORESTRY 272 **Spring 2007**

Sustainable Management of Forest Ecosystems

"If 20th century forestry was about simplifying systems, producing wood, and managing at the stand-level, 21st century forestry will be defined by understanding and managing complexity, providing a wide range of ecological goods and services, and managing across broad landscapes." – Kathryn Kohm and Jerry Franklin, in "Creating a Forestry for the 21st Century"

INSTRUCTOR

Bill Keeton
Office: Aiken 343
Phone: 656-2518
Email: william.keeton@uvm.edu
Office Hours: By appointment

GENERAL

This is a course about *forest stewardship* and *sustainable forest ecosystems* from a planning, decision analysis, and implementation perspective. It provides a structured review of alternative approaches to *planning and decision analysis* that can be used to restore, enhance, and sustain a full range of forest ecological, social and economic values. An experiential approach to the fundamental principles of adaptive management and stewardship for biodiversity and long-term ecosystem integrity will be recurrent themes for the course.

When we talk about sustainable forestry from a *planning and decision analysis* perspective, it is imperative that we acknowledge the challenges that are associated with assessment, planning, and decision analysis at different spatial and temporal scales. There are also fundamental challenges associated with different categories of ownerships.

Forest Management has traditionally referred to managing timber resources, with thought given to minimizing negative environmental impacts and providing non-timber forest uses as a secondary objective. This course will take a different approach. We will define "forest management" very broadly as encompassing the full suite of ecosystem goods and services provided by forests, including wildlife and other forms of biodiversity, recreation, carbon sequestration, clean air, clean water, soil regeneration, and, yes, timber.

Adaptive forest management acknowledges that management approaches need to continuously evolve in response to dynamic ecosystems, changing societal expectations, and improved scientific understanding and management experience. The cornerstone of this management philosophy is the ability to explicitly anticipate outcomes, and then to continually monitor and evaluate the ecosystem in light of these expectations, making adjustments in our management as we go along.

COURSE OBJECTIVES

- Comprehend alternative methods and approaches to forest land use planning;
- Comprehend the diverse definitions of, and alternative criteria for assessing, sustainable forestry;
- Comprehend the planning process and implementation strategies for long-term, adaptive forest management at the land unit and landscape levels;
- Comprehend the steps involved in the quantitative development, evaluation, and application of prescriptions for a variety of management objectives (primarily) at the land unit and landscape levels; and
- Apply quantitative analyses to the planning of forest activities (strategically, operationally, and tactically) from a diversity of planning frameworks.

PREREQUISITES

Prior enrollment in NR 205 (Ecosystem Management: Integrating Science, Society, and Policy), and concurrent or prior enrollment in FOR 223 (Multi-Resource Silviculture). Concurrent enrollment in NR 205 accepted.

EVALUATION AND GRADING

Lab Assignments and Free Writes Based on Readings	15 %
Attendance and Participation	10 %
Management Plan	25 %
Mid-term Exam	25 %
Final Exam	25 %

COURSE ORGANIZATION

The class meets MWF from 10:10-11:00, with labs on Friday afternoon from 1:20 to 5:25. Lectures are held in Dewey 212. Labs are held in Aiken 222, except when assembling for field trips, in which case we will meet at the Aiken Center's loading dock.

Lectures are intended to provide an overview of alternative planning methods, data collection and estimation techniques, and implementation considerations that you would likely encounter in long-term, parcel-specific, planning for sustainable forestry. While most of the labs will entail a field visit with a practicing professional, some labs will be devoted to class group discussions and computer laboratory exercises.

In this course you will work in groups to produce a forest management plan, of professional quality, for the Jericho Research Forest. You are expected to produce short, weekly free-writes on reading assignments, and period short reports based on laboratory (primarily computer modeling) and field assignments.

The final exam is scheduled for Monday, May 8th at 8:00 AM in Dewey, RM 212.

NO CLASS!

There will be no class/lab on Friday, February 2n. Other "no class" days will be announced later in the semester.

In addition, there will be no class/lab on University holidays, which include President's Day (Monday, February 19th) and spring break (March 12-16).

HONOR CODE

I strongly support the University's academic honesty polices. It is your responsibility to be fully knowledgeable of these policies. If you have not had occasion to read the academic honesty policies, I encourage you to do so as soon as possible. The web site for the Division of Student Affairs presents the policies as well as a list of some, but not all, offenses of academic dishonesty; the site is found at

<http://www.uvm.edu/~dosa/handbook/?Page=Academic.html>.

STUDENT FEEDBACK

Any student suggestions for improvement, either as the course progresses or at the end, would be greatly appreciated.

TRANSPORTATION

The lab for this course will largely field-based. Throughout the term I will need to know in advance (i.e., no later than the previous Wednesday noon) if you will not be relying on university provided transportation for a particular lab. Unless otherwise notified, assume that all labs are outdoors. We will leave promptly from the Aiken loading dock at the beginning of the lab period and we will try to be back at Aiken no later than the end of the lab period.

FOR 272 SPRING 2007
COURSE SCHEDULE

Lectures and Exams

January 16Th – March 28th

1. Defining Sustainable Forestry
    a. Implications of globalization
    b. Definitions
    c. Montreal Process Criteria and Indicators
    d. Grey Towers Forest Stewardship Protocol
    e. Sustainable forestry in the context of globalization

2. Holistic Forest Management
    a. Managing for multiple resources and values
        i. Traditional view of forest management
            1. focused on timber
        ii. Current view
            1. Managing for all ecosystem goods and services
    b. The Triad Model of landscape conservation and management
        i. reserves
        ii. multiple use areas/buffer areas/ forest stewardship areas
        iii. intensively managed areas/developed areas
    c. Understanding forest landscape change
        i. History of forest ecosystem change in New England
        ii. Historic Range of Variability as a guide for sustainable forestry
    d. Matrix management approaches → integrating all of the above
        i. Reasons why the matrix is important
        ii. Management approaches
            1. private lands
            2. public lands
            3. both
    e. Multi-Resource Management Decision Methods
        i. Benefit-cost analysis
        ii. Marginal analysis
        iii. Optimization
        iv. Linear programming
        vi. Tools:
            1. NED-2
            2. Ecosystem Management Decision System
            3. ASSISI

3. Management Planning
    a. Setting goals and objective
    b. Land Classification: pros and cons of different approaches

i. Natural communities
ii. Potential vegetation
iii. Current vegetation
iv. Historic vegetation
v. Ecological Land Types (USFS),
vi. Landscape Diversity Units, etc.

c. Zonation approaches
    i. Bioregional examples
    ii. Small ownership examples: e.g. Jericho Research Forests
    iii. Compartments and stands
d. Desired Future Condition
e. Standards and guidelines tied to individual stands
f. Planning Tools
    i. NED software
    ii. Stewplan: software for creating forest stewardship plans
    "Planning for Forest Stewardship: a Desk Guide"

4. Timber harvest planning
    a. Timber harvest layout (from lab and lecture)
        i. Harvest unit layout
        ii. Boundaries
        iii. Timber marking
        iv. Road layout
        v. Buffering harvest units
        vi. Managing recreation and trails: e.g. "beauty strips"
    b. Growth and Yield Modeling
        i. Mean annual increment vs. periodic annual increment
        ii. Net vs Gross volume production
        iii. Growth vs. yield
        iv. Required inputs
            1. Site index
                a. Height correlated with site productivity
                b. Site Index integrates all edaphic factors
            2. Relative density or stand density index
                a. Basal area and density correlate with competition and bole growth → the indexes integrate BA and stem density
        v. Modeling using NED-SIPS
            1. Calculating periodic annual increment
            2. Estimating yield
            3. Specifying alternate treatment scenarios

            Linking to the Stand Visualization System

5. Forest Management Economics
    a. Economic forestry context
        i. Economic perspective conducts analyses with the purpose of maximizing the forest's net benefit to humankind
            1. Benefit as measured by employment levels and income
            2. Macroeconomic perspective
            3. Finding 'efficient' solutions to forestry problems
                a. Select the alternative that maximizes the net benefit … NOTE net benefit vs financial return … economics teaches the methods for selection/allocation irrespective of the units used to 'value' the alternatives
                b. Private owners are often trying to maximize the profit associated with the forest whereas the National Forests are charged with being efficient in attaining multiple use alternatives
        ii. Finding the least costly solution to attain our forestry goals is hard to challenge
            1. Inefficient solutions tends to produce conflicts, particularly relative to trade-offs or costs associated with an alternative solution
            2. The higher the cost of attaining a goal, the less likely that society will choose high levels for that goal.
            3. Provides a good starting point for political or organizational debate
    b. Basics
        i. Valuation of the tree
        ii. Value development in a log
        iii. Valuation of timberland
    c. Net Present Value
        i. Why do we use this?
        ii. Calculation under different treatment scenarios
    d. Operational Expenses
    e. Valuation of non-timber goods and services
        i. Market values
        ii. Non-market values
            1. Direct valuation approaches
            2. Indirect valuation approaches
    f. Harvest scheduling
        i. Scheduling and Rotations
            1. Classical regulation
            2. Volume control
            3. Allowable cut approach
            4. Scheduling using multiple, different rotation lengths
        ii. Spatial configuration of harvest units
        iii. Incorporating reserves
        iv. Extended rotations
            1. implications for culmination of mean annual increment
            2. economic disadvantages: e.g. lower net fiber production
            3. economic advantages: e.g. high quality products

4. ecological advantages: e.g. carbon, wildlife, other ecological functions, etc.

6. Sustainable forest management on public lands
    a. Statutory requirements
        i. National Forest Management Act
        ii. National Environmental Policy Act
        iii. Endangered Species Act
    b. Paradigm shifts
        i. Classical sustained yield model
            1. Derivation of sustained yield models in Europe
            2. What is sustained yield?
            3. Quantifying sustained yield
        ii. Multiple-use model
        iii. Ecosystem management model
    c. Wilderness management
        i. What is wilderness?
        ii. History of wilderness laws and management
        iii. Roadless areas
        iv. Current wilderness proposals
            1. Pros
            2. Cons
    d. Forest recreation management
        i. historic approaches
        ii. emerging issues
        iii. managing competing uses
        iv. incorporation into planning

7. Forest stewardship on private lands
    a. Green Certification
        i. Alternate certification systems
            1. Forest Stewardship Council
            2. Sustainable Forestry Initiative
        ii. Chain of custody issues
        iii. Advantages and limitations of market-based incentive approaches
    b. Conservation Easement Approaches
        i. Former Industrial Timberlands (examples)
            1. Former Champion Lands
            2. Former International Paper Lands
            3. Atlas Lands
        ii. Small Private Ownerships
            1. New England Forestry Foundation example
            2. Sustainable forestry guides and consulting
            3. Incentive-based approaches
    c. Other approaches
        i. Habitat Conservation Plans (negotiated by USFWS)

ii. Community-based forestry, etc.

8. Disturbance-based forest management
    a. Landscape level
        i. Metrics of landscape level structure
        ii. Mimicking natural disturbance patterns, scales, and frequencies
        iii. Managing for age class distributions
        iv. Benchmarks for landscape level management'
            1. Historic Range of Variability
                a. What is HRV?
                b. Scale dependency
                c. Practical applications and limitations
            2. Putting current conditions in the context of historic land-use change
            3. Future development, climate change, and uncertainty
            4. Landscape Management System (LMS)
                a. Dynamic landscape modeling
                b. Modeling multiple compartment or stands
                c. Predicting future outputs: timber, carbon, wildlife, water, etc.
        v. Prioritizing fire restoration projects across entire landscapes
            1. Bush Administration initiative (Healthy Forests Initiative)
            2. Approaches advocated by environmental groups
            3. In short, do we start with the back-country or the urban-wildland interface?
            4. Examples: Lake Tahoe Basin, southern California, etc.
    b. Stand level
        i. Metrics of stand structure
            1. Vertical structure
            2. Horizontal structure
            3. Other key structural elements
        ii. Stand development over time
            1. Role of biological legacies
            2. Alternate models of stand development
            3. Simulating stand development
                a. Forest Vegetation Simulator
                b. Stand Visualization System
        iii. Disturbance-based stand level management
            1. Even-aged approaches
                a. Variable Harvest Retention System
                b. Experimental demonstrations across North America
            2. Uneven-aged approaches
                a. Diameter distributions
                    i. Balanced vs. unbalanced distributions
                    ii. Conventional approaches
                    iii. Unconventional approaches based on natural disturbance effects on stand development

iv. Gap-based approaches: U. Maine's "expanding gap" study

b. Multi-aged forestry → Managing multiple age cohorts similar to discrete recruitment events

Mid-Term Exam **March 23rd** **1:20 – 3:30, Aiken 222**

March 26th – May 2nd

9. Managing Forest Fragmentation
    a. What is ecological fragmentation?
    b. Types of fragmentation effects
        i. Edge effects
        ii. Loss of interior habitats
        iii. Connectivity issues, etc.
        iv. Indirect effects: roads, fire hazards, recreational management issues, etc.
    c. Variable penetration of edge effects
    d. Alternate management approaches
        i. Dispersed clearcut harvesting approach → created huge problems
        ii. Aggregated patch cut harvesting approach
            1. Advantages
            2. Disadvantages
        iii. New approaches based on natural disturbance dynamics and Historic Range of Variability (HRV)
        iv. Uneven-aged vs. even-aged approaches: which work better to reduce fragmentation in northern hardwood forests?

10. Fire Management
    a. Fire control
    b. Fire restoration
        i. Landscape scale
            1. Problem: Fire suppression/High Grading effects on landscape structure
            2. fire management approaches
        ii. Stand scale
            1. Problem: Fire suppression/high grading effects on stand structure
        iii. Restoration silviculture
    c. Salvage Logging
        i. Management issues
        ii. "Healthy Forests Initiative:" pros and cons

11. Forested Watershed Management
    a. Watershed analysis
        i. Data collection and watershed description
        ii. Setting TMDLS
    b. Cumulative effects analysis
        i. Types of CEA

ii. Principles and steps involved
iii. Examples: Cedar River watershed; Catskills State Park, NY.

c. Watershed Management Tools
    i. Dynamic Landscape Simulator software
    ii. Federal and State watershed analysis manuals
d. Logging road management:
    i. Managing densities
    ii. Decommissioning options
    iii. Roadless areas issues

12. Riparian Forest Management
    a. Defining the area of riparian influence
    b. Riparian functions
    c. Setting riparian buffer widths
    d. Delineating unstable slopes
    e. Alternate management approaches inside riparian buffers
    f. Examples of regional and state riparian protection standards

13. Managing Forest Carbon
    a. Basics of climate change science
    b. The role of forests in global carbon cycles
    c. Quantifying forest carbon sequestration
    d. Carbon sequestration credit trading under Kyoto
    e. Stand management approaches
    f. Uncertainties in carbon credit trading systems

14. Old-growth forest management
    a. Defining "old-growth"
    b. Characteristics of old-growth forests
        i. Structure
        ii. Differences among forest types
    c. Management options
        i. Conservation and reserves
        ii. Restoration
            1. Passive approaches
            2. Active approaches
                a. Western U.S.
                b. Eastern U.S.

15. Course wrap-up and synthesis

April 16th -- Draft Management Plans due in class

May 2rd – Final Management Plans due in class

May 10th (Thursday) – Final Exam, 8:00 AM in Dewey 212

FOR 272 – SPRING 2007
Professor Bill Keeton

LABORATORY/FIELD TRIP SCHEDULE
(Subject to Change)

Date	Meeting Place	Guest	Destination/Purpose
Jan. 26	Aiken 222	NED-2 forest inventory and management software	
Feb. 8	Aiken 222	Introduction to StewPlan software	Software-aided forest management planning
Feb 15	Aiken Loading Dock	Jericho Research Forest	Stand assessments for management planning
Feb 23	Aiken Loading Dock	Diane Frederick, VT Dept. of Forests, Parks, and Recreation	Harvesting operations on State lands
March 2	Aiken Loading Dock	Richard Donovan, Executive Director	Smartwood, Richmond, VT Certified forestry on private lands
March 23	Aiken 222	Mid-term Exam	
March 30	Aiken Loading Dock	Erhardt Frost, Vermont Forest Guild	Sustainable forestry on private lands
April 6	Aiken Loading Dock	Jericho Research Forest – follow-up field work for management planning	
April 13	Aiken 222	Work time for group management plans	
April 20	Aiken Loading Dock	VT Forest Ecosystem Management Demonstration Project, Mt. Mansfield State Forest	
April 27	Aiken 222	Work time for group management plans	