FORESTRY 272 **Spring 2011**

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

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GENERAL

This is a course about *forest stewardship* and *sustainable forest ecosystems* from a planning 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. 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* perspective, it is important that we acknowledge the challenges associated with 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 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

Free Writes Based on Readings	15 %
Lab Assignments	15%
Attendance and Participation	10 %
Mid-term Exam	30 %
Final Exam	30 %

COURSE ORGANIZATION

The class meets MWF 9:35-10:25 am in Old Mill 523. Labs will be held Monday afternoons, 12:50-4:55 pm in Hills 228, except when assembling for field trips, in which case we will meet at the Hill's loading dock on the north side of the building. On most lab weeks, there will be no lecture Monday morning; the opposite is true for weeks with no lab.

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.

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 10th from 9:00-11:00 AM in Old Mill 523.

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

With the exception of three computer labs at the beginning of the term, the lab for this course will largely field-based. Travel separate from the group is discouraged as this creates logistical complications. 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 by the end of the lab period. Occassionally we may need to return by 6:00 if the lab site is far afield.

ATTENDANCE

You are allowed 2 unexcused absences. Each absence thereafter will lower your final grade by 0.5 points.

READINGS

There will be required readings each week and these will be posted on the class Blackboard.

FOR 272 SPRING 2010

COURSE SCHEDULE

Lectures and Exams

January 29Th – March 19th

1. Globalization and Sustainable Forestry
    a. Global trends in the forest products industry
    b. Defining Sustainable Forestry
        i. Definitions
        ii. Montreal and Helsinki Processes, Criteria and Indicators
        iii. Paradigm shifts
            1. Classical sustained yield model
                a. Derivation of sustained yield models in Europe
                b. What is sustained yield?
                c. Quantifying sustained yield
            2. Multiple-use model
            3. Ecosystem management model
        iv. The Triad Model of landscape conservation and management
            1. reserves
            2. multiple use areas/buffer areas/ forest stewardship areas
            3. intensively managed areas/developed areas

2. Management Planning
    a. Critiquing management plans
    b. Setting goals and objective
    c. 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.
    d. Zonation approaches
        i. Bioregional examples
        ii. Small ownership examples: e.g. Jericho Research Forest
        iii. Compartments and stands
    e. Effective use of maps
    f. Desired Future Condition
    g. Standards and guidelines tied to individual stands
    h. Planning Tools
        i. NED software
        ii. Stewplan: software for creating forest stewardship plans
        "Planning for Forest Stewardship: a Desk Guide"

3. 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. Culmination of mean annual increment
        iii. Extended rotations
        iv. Net vs Gross volume production
        v. Growth vs. yield
        vi. 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
        vii. Modeling using NED2 and the Forest Vegetation Simulator
            1. Calculating periodic annual increment
            2. Estimating yield
            3. Specifying alternate treatment scenarios
    c. Determining Economic Value of Harvests
        i. Value development in a log
        ii. Net Present Value
            1. Why do we use this?
            2. Calculation under different treatment scenarios
        iii. Operational Expenses
        iv. Valuation of non-timber goods and services
            1. Market values
            2. Non-market values
                a. Direct valuation approaches
                b. Indirect valuation approaches
    d. 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. Managing Forest Carbon **(Special guest speakers Feb 28 – March 4)**
    a. The role of forests in global carbon cycles
        i. Flux rates versus storage
        ii. Sinks and sources
        iii. carbon allocation within forest ecosystems
    b. Developing cap and trade carbon markets
        i. CAR
        ii. CDM
        iii. CCX
        iv. VCS
        v. RGGI
    c. Mechanisms
        i. Reforestation
        ii. Avoided deforestation
        iii. Improved forest management
    d. Carbon accounting
        i. Additionality and permanence
        ii. Leakage and substitution effects
        iii. Baselines and business-as-usual scenarios
    e. Field measurement of forest carbon
    f. Growth and yield projections of carbon uptake and storage
    g. Options for carbon management at the stand and management unit levels
    h. The next frontier: biomass energy
        i. Types of biomass harvesting
        ii. Economic implications
        iii. Predicting net carbon effects
        iv. Effects on stand structure
        v. Procurement standards/harvesting guidelines
        vi. Global demand

5. Sustainable forest management on public lands
    a. National Forest Planning Process
        i. Green Mountain National Forest plan revisions
        ii. On-going adaptive management
    b. Planning on VT state lands
        i. ANR mandate
        ii. Use of spatial analysis
        iii. Harvest planning
    c. Wilderness management
        i. What is wilderness?
        ii. History of wilderness laws and management
        iii. Roadless areas

iv. Recent wilderness proposals
    1. Pros
    2. Cons

d. Forest recreation management
    i. historic approaches
    ii. emerging issues
    iii. managing competing uses
    iv. incorporation into planning

6. 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.

Spring break **March 7th-11th**

Mid-Term Exam **March 25th** **12:50, Hills 228**

March 23th – May 4th

7. Sustaining Forest Biodiversity
    a. Understanding forest landscape change
        i. History of forest ecosystem change in New England
        ii. Biodiversity trends
    b. Managing Forest Fragmentation
        i. What is ecological fragmentation?
        ii. Types of fragmentation effects
            1. Edge effects
            2. Loss of interior habitats

iii. Connectivity issues, etc.
iv. Indirect effects: roads, fire hazards, recreational management issues, etc.
v. Variable penetration of edge effects
vi. Alternate management approaches
    1. Dispersed clearcut harvesting approach → created huge problems
    2. Aggregated patch cut harvesting approach
        a. Advantages
        b. Disadvantages
    3. New approaches based on natural disturbance dynamics and Historic Range of Variability (HRV)

c. Matrix Management
    i. Principles of matrix management
    ii. Five critical roles of the matrix
        1. Five implementation principles
    iii. Disturbance-based management: landscape level
        1. Metrics of landscape level structure
        2. Mimicking natural disturbance patterns, scales, and frequencies
        3. Managing for age class distributions
        4. Benchmarks for landscape level management'
            a. Historic Range of Variability
                i. What is HRV?
                ii. Scale dependency
                iii. Practical applications and limitations
            b. Putting current conditions in the context of historic land-use change
            c. Future development, climate change, and uncertainty
            d. Landscape Management System (LMS)
                i. Dynamic landscape modeling
                ii. Modeling multiple compartment or stands
                iii. Predicting future outputs: timber, carbon, wildlife, water, etc.
    iv. Disturbance-based management: stand level
        1. Metrics of stand structure
            a. Vertical structure
            b. Horizontal structure
            c. Other key structural elements
        2. Stand development over time
            a. Role of biological legacies
            b. Alternate models of stand development
            c. Simulating stand development
                i. Forest Vegetation Simulator
                ii. Stand Visualization System
        3. Disturbance-based stand level management
            a. Even-aged approaches
                i. Variable Harvest Retention System
                ii. Experimental demonstrations across North America

b. Uneven-aged approaches
    i. Diameter distributions
        1. Balanced vs. unbalanced distributions
        2. Conventional approaches
        3. Unconventional approaches based on natural disturbance effects on stand development
        4. Gap-based approaches: U. Maine's "expanding gap" study
    ii. Multi-aged forestry → Managing multiple age cohorts similar to discrete recruitment events

8. Fire Management
    a. Fire suppression and 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
            1. Fuels treatment methods
            2. Slash treatment methods
            3. Prescribed burning methods
    c. Salvage Logging
        i. Management issues
            1. Biscuit fire debate
            2. Alternative views
        ii. "Healthy Forests Initiative:" pros and cons

9. Water Resources Management
    a. Forested Watershed Management
        i. Watershed analysis
            1. Data collection and watershed description
            2. Setting TMDLS
        ii. Cumulative effects analysis
            1. Types of CEA
            2. Principles and steps involved
            3. Examples: Cedar River watershed; Catskills State Park, NY.
        iii. Watershed Management Tools
            1. Dynamic Landscape Simulator software
            2. Federal and State watershed analysis manuals
        iv. Logging road management:
            1. Managing densities
            2. Decommissioning options
            3. Roadless areas issues
    b. Riparian Forest Management

i. Defining the area of riparian influence
ii. Riparian functions
iii. Setting riparian buffer widths
iv. Delineating unstable slopes
v. Alternate management approaches inside riparian buffers
vi. Examples of regional and state riparian protection standards

10. 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.

11. Course wrap-up and synthesis

Final Exam Friday, May 6th from 10:30 AM - 1:15 PM Old Mill 521