MEMORANDUM

TO: Charles Caramello
    Associate Provost and Dean, Graduate School

FROM: Phyllis Peres
      Associate Provost for Academic Planning and Programs

SUBJECT: Proposal to establish a Graduate Certificate in Professional Studies in Ecosystem Restoration (PCC log no. 07034)

On March 25, Chancellor Kirwan gave final approval to your proposal to establish a Graduate Certificate in Professional Studies in Ecosystem Restoration. A copy of the approved proposal is attached.

CWR/

Enclosure

cc: Carmen Balthrop, Chair, Senate PCC Committee
    Sarah Bauder, Office of Student Financial Aid
    Laura Slavin, University Senate
    Barbara Hope, Data Administration
    Denise Nadasen, Institutional Research & Planning
    Anne Turkos, Archives
    Linda Yokoi, Office of the Registrar
    Mary Ann Ottinger, Graduate School
    Norma Allewell, College of Chemical and Life Sciences
    Victoria Peterson, Office of Professional Studies
THE UNIVERSITY OF MARYLAND, COLLEGE PARK
PROGRAM/CURRICULUM PROPOSAL

DIRECTIONS:
- Provide one form with original approval signatures in lines 1 - 4 for each proposed action. Keep this form to one page in length.
- Early consultation with the Office of the Associate Provost for Academic Planning & Programs is strongly recommended if there are questions or concerns, particularly with new programs.
- Please submit the signed form to Claudia Rector, Office of the Associate Provost for Academic Planning and Programs, 1119 Main Administration Building, Campus.
- Please email the rest of the proposal as an MSWord attachment to pcc-submissions@umd.edu.

DATE SUBMITTED: December 10, 2007

COLLEGE/SCHOOL
Office of Professional Studies, Graduate School and College of Behavioral and Social Sciences

DEPARTMENT/PROGRAM University of Maryland Center for Environmental Science

PROPOSED ACTION (A separate form for each) ADD X DELETE ______ CHANGE_____

DESCRIPTION (Provide a succinct account of the proposed action. Details should be provided in an attachment. Provide old and new sample programs for curriculum changes.)

Attached is a program proposal for a Graduate Certificate in Professional Studies in Ecosystem Restoration

JUSTIFICATION/REASONS/RESOURCES (Briefly explain the reason for the proposed action. Identify the source of new resources that may be required. Details should be provided in an attachment.)

A new graduate certificate program designed for a professional audience. After conducting market research, the need for a graduate certificate program in ecosystem restoration is evident in the regional area. This program is self-support.

=================================================================================================

APPROVAL SIGNATURES

1. Department Committee Chair
2. Department Chair
3. College/School PCC Chair
4. Dean
5. Dean of the Graduate School (if required)
6. Chair, Senate PCC
7. Chair of Senate
8. Vice President for Academic Affairs & Provost

DATE
N/A
12/17/07
12/17/07
12/17/07
2/7/08
2/15/08
4/9/08

VPAAP 8-08
March 25, 2008

Dr. C. D. Mote
President
Main Administration Building
University of Maryland College Park
CAMPUS

Dear Dan:

Thank you for forwarding the request from University of Maryland College Park for a new iteration of the existing Graduate Certificate in Professional Studies award program.

I am delighted to approve this request. Please express my appreciation to departmental faculty and administrative committees for their careful work.

Sincerely,

William E. Kirwan
Chancellor

cc: Irwin Goldstein, Sr. Vice Chancellor for Academic Affairs
Theresa Hollander, Associate Vice Chancellor for Academic Affairs
Nariman Farvardin, Sr. Vice President for Academic Affairs and Provost

3300 Metzerott Road  •  Adelphi, MD 20783-1690  •  Phone: 301-445-1911  •  Fax: 301-445-1914  •  www.usmd.edu
March 11, 2008

Chancellor William E. Kirwan
University System of Maryland
3300 Metzerott Road
Adelphi, MD 20783

Dear Chancellor Kirwan:

I am writing to request final approval for a new iteration of the existing Graduate Certificate in Professional Studies award program. The new iteration of the award focuses on Ecosystem Restoration.

The proposal has been endorsed by the appropriate faculty and administrative committees. I have accepted this recommendation.

Yours sincerely,

[Signature]

C. D. Mote, Jr.
President

CWR/
Attachment

cc: Theresa Hollander, Associate Vice Chancellor for Academic Affairs
    Nariman Farvardin, Senior Vice President for Academic Affairs and Provost
    Charles Caramello, Dean, Graduate School
    Victoria Peterson, Assistant Dean and Director, Office of Professional Studies
PROPOSAL FOR

NEW INSTRUCTIONAL PROGRAM

UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND

Graduate Certificate in Professional Studies in Ecosystem Restoration

PROPOSED INITIATION DATE: Summer 2008
I. OVERVIEW and RATIONALE

A. Briefly describe the nature of the proposed program and explain why the institution should offer it.

The University of Maryland is committed to providing educational programs that meet the needs of a variety of potential students. As part of our graduate offerings, the Master of Professional Studies and the Graduate Certificate in Professional Studies are career-focused degrees designed for students who wish to increase their subject-matter knowledge as well as to prepare themselves for new challenges related to their professional areas. These programs are administered by the Office of Professional Studies (OPS), with academic oversight provided by the Graduate School.

Introduction

Restoration ecology is a relatively new academic and research frontier that is also the intellectual basis for the rapidly growing business practice of environmental restoration. Environmental consulting firms are now specializing in various types of ecosystem restoration (e.g., stream restoration, submersed aquatic vegetation restoration, wetlands restoration, and fishery management and restoration). Natural resource managers of government agencies such as state and county departments of environmental protection and federal agencies such as the U.S. Fish & Wildlife Service and the Army Corps of Engineers are also looking to hire employees with training in restoration and management of populations or ecosystems.

Nature of proposed program

This 12-credit Graduate Certificate in Professional Studies in Ecosystem Restoration has been developed to accommodate working professionals. Students will take two core courses and may choose two of three elective courses. The core courses will cover ecosystem restoration, including principles of ecosystem restoration and applications of these principles to ecosystem restoration. The three elective courses, including one on hydrologic effects of land use change as well as two lecture-and-field courses (restoration of streams; restoration of submersed aquatic vegetation), are designed to provide students with practical, hands-on experience in ecosystem restoration. It is anticipated that additional electives and field courses will be added in the future to span a broader range of restoration ecology topics. The program draws upon the considerable expertise of faculty within the University of Maryland Center for Environmental Science (UMCES). The Faculty teach within the Marine, Estuarine, and Environmental Sciences Graduate Program within the University of Maryland College of Chemical and Life Sciences.
Market for Graduates

Market research undertaken by the research firm Diagnostics Plus demonstrates that occupational trends are positive for a Graduate Certificate in Ecosystem Restoration. Based on interviews with opinion leaders, government and industry experts, and participants of past restoration workshop programs, as well as secondary research, Diagnostics Plus found that the issue of restoration and protecting and improving the Chesapeake Bay Watershed and nearby coastal waters is a very visible issue, which is positive toward the development of the certificate. Overall, Diagnostics Plus interviewed fifteen opinion leaders, including environmental leaders, consultants, government officials, engineers, and others. Some of the firms and organizations they represented included EPA, NOAA, the U.S. Fish and Wildlife Service, the Maryland Department of Natural Resources, Chesapeake Bay Trust and Smithsonian Environmental Research Center. In addition, Diagnostics Plus conducted industry and secondary research and interviewed twenty-one individuals who participated in a related University of Maryland ecological education workshop. Secondary research indicated that there is a strong regional market for the ecosystem restoration certificate program.

Currently, there are very few restoration ecology certification programs in the country that are based in academic settings (e.g., University of Washington, University of Idaho). In our region, Johns Hopkins University offers an M.S. degree in Environmental Sciences and Policy, but that program is very different from the proposed Graduate Certificate in Ecosystem Restoration in that the Hopkins program “occupies a broad position centered at the juncture between science and policy.” Their program has four areas of concentration: Environmental Monitoring and Analysis, Ecological Management, Environmental Management, and Environmental Planning. While aspects of those areas feature in our proposed certification program, our emphasis is on understanding and applying principles of ecosystem ecology in restoration actions that solve contemporary and emerging problems in the environment. Non-credit short courses and course sequences are also offered by individuals, through institutes, and within a few agencies. However, restoration practitioners and students of restoration increasingly are asking for programs that are based in accredited universities.

B. How big is the program expected to be? From what other programs serving current students, or from what new populations of potential students, onsite or offsite, are you expecting to draw?

The program will draw a professional audience. Initial enrollment is anticipated at 7 students in Year 1. Expected growth is to reach 10 students in Year 2.
II. CURRICULUM

A. Provide a full catalog description of the proposed program, including educational objectives and any areas of concentration.

The Graduate Certificate in Professional Studies in Ecosystem Restoration is a 12-credit graduate program comprised of courses from the University of Maryland Center for Environmental Science. The program emphasizes ecosystem restoration, including principles of ecosystem restoration and applications of these principles to ecosystem restoration. Three elective courses will be offered including one on hydrologic effects of land use change as well as two lecture-and-field courses (restoration of streams; restoration of submersed aquatic vegetation). The program draws upon the considerable expertise of faculty within the University of Maryland Center for Environmental Science (UMCES).

B. List the courses (number, title, semester credit hours) that would constitute the requirements and other components of the proposed program. Provide a catalog description for any courses that will be newly developed or substantially modified for the program.

The program will consist of the following courses. These courses have temporary course numbers and are awaiting permanent course numbers from the College of Chemical and Life Sciences.

Core Courses:

MEES 698E Principles and Practices of Ecosystem Restoration; (3 credits) This course will provide an overview of critical ecosystem functions across biomes as well as general considerations and tradeoffs in restoration designs for enhancing function in biotic communities. Through quantitative examination of current “real world” applications and evaluation of alternatives, students will examine both how and when structure and function can be considered in the principles and practices of ecosystem restoration. Specific case studies regarding physical processes will include: strategies to regulate the hydrologic cycle and thermal energy; discussion of specific biogeochemical processes to regulate the accumulation and transport of C, N, P, organic contaminants and heavy metals; and strategies to increase habitat extent and quality and food web structure for protecting target species. All topics will be discussed with an emphasis on how underlying principles in ecosystem ecology can be used in restoration science to solve contemporary and emerging problems in the environment. Students should have taken an introductory course in ecology or related field or have the consent of the course instructor. This course is taught at the Chesapeake Biological Laboratory and on the Interactive Video Network.
MEES 698G Ecosystem Restoration Applications; (3 credits) The practice of ecosystem restoration requires making difficult decisions in the face of uncertainty, measuring progress toward objectives, and being able to understand and work within existing policy frameworks. This course will introduce students to tools needed to apply and evaluate restoration activities and provide a background on restoration-related policy. This course includes homework projects, lectures and discussions of philosophical and technical aspects of successful restoration, and field work. One focus of the course will be to provide students with an introduction to such topics as decision analysis, adaptive management, and developing monitoring programs. A second focus will be on policy issues involved in restoring ecosystems. Additionally, there will be consideration of project management, communication, and conflict management skills. This course is taught at the Chesapeake Biological Laboratory and on the Interactive Video Network.

Electives courses: Select at least two of the following courses:

MEES 698S Foundations of Stream Restoration; (3 credits)
This course presents the ecological and geomorphologic foundations of stream restoration, emphasizing their application in restoration practice. The course focuses on understanding and measurement of ecological and geomorphic processes and their application within an integrated approach to stream restoration. The course is designed for engineers, geologists, biologists, planners, land managers, landscape architects, government officials - anyone who deals with rivers and streams and who can benefit from a more in-depth understanding of how they work. The course includes intensive field experiences taught at Cromwell Valley Park in Baltimore, Maryland. The lectures are taught at the Chesapeake Biological Laboratory and on the Interactive Video Network.

MEES 698V Restoration Ecology of Submersed Aquatic Vegetation; (3 credits)
This course presents the ecology of submersed grasses in the context of applying this ecological information to the restoration of these underwater plants. Background information focuses on their habitat requirements, their ecological importance in the aquatic environment, and best management practices for their survival. Emphasis is placed on the restoration ecology and practices for several species ranging from freshwater through estuaries to the sea. The course is designed for people interested in restoring submersed aquatic plants and includes intensive and practical field work. The lectures are taught at the Horn Point Laboratory and on the Interactive Video Network.

MEES 698O Hydrological Effects of Land Use Change; (3 credits)
This course examines the catchment-scale hydrological effects attributable to major land use and land cover alterations, including both anthropic and non-anthropic disturbances. First part of the course will focus on the quantitative measurement and mathematical description of those physical hydrological processes that can be affected by land use and land cover changes. Second part of the course reviews how both deterministic and empirical/statistical models can be applied to analyze and predict
observed catchment-scale hydrological and hydrochemical responses to land alterations and disturbances. This course is taught at the Appalachian Laboratory and on the Interactive Video Network.

C. Describe any selective admissions policy or special criteria for students selecting this field of study.

The admissions policy will reflect current standards established by the Graduate School, including the prerequisite bachelor's degree and a cumulative 3.0 GPA. Official undergraduate transcripts from all colleges attended must be provided. A current resume is required.

Prospective students should have taken an introductory course in ecology or related field or have the consent of the Program Director. All students must meet the prerequisites specified in each course or receive special permission from the course instructor.
III. STUDENT LEARNING OUTCOMES AND ASSESSMENT

The purpose of this plan is to set clear guidelines, identify articulated outcomes, and ensure avenues for continuous improvement. It is the mission of the Office of Professional Studies to provide programs that meet UMD’s institutional goals and objectives for educational activities.

<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Assessment Measures and Criteria</th>
<th>Assessment Schedule</th>
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</thead>
<tbody>
<tr>
<td>1. Students will illustrate comprehension of issues related to Ecosystem Restoration.</td>
<td>Measurement A: Successful completion of paper and/or special project focusing on issues related to Ecosystem Restoration. Criterion A: 80% of students will attain a 2 or better on Comprehension Scale Measurement B: OPS Pre and Post-Test Assessment. Criterion B: 80% of students will show gains between Pre and Post-Test questions #2, #3, #4, #5 and #6 (see attachment).</td>
<td>Comprehension Scale will be scored by faculty, and data collected annually by OPS. All Pre-Test data will be collected by OPS prior to first class attendance by annual cohort. All Post-Test data will collected by OPS after conclusion of last class by annual cohort.</td>
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<td>2. Students will assess the relevance of program content as it applies to their professional and educational needs</td>
<td>Measurement A: An exit interview will be conducted with a random sample of graduates (80%) to assess their overall satisfaction with the certificate. Criterion A: 80% of respondents will correlate academic program offerings to needs Measurement B: OPS Pre and Post-Test Assessment. Criterion B: 80% of students will show gains between Pre and Post-Test questions #7, #8, #9, and #10 (see attachment).</td>
<td>Responses will be collected and discussed with the Academic Oversight committee for retention purposes. All Pre-Test data will be collected by OPS prior to first class attendance by annual cohort. All Post-Test data will collected by OPS after conclusion of last class by annual cohort.</td>
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IV. FACULTY AND ORGANIZATION

A. Who will provide academic direction and oversight for the program? [This might be a department, a departmental subgroup, a list of faculty members, or some other defined group.]

The Graduate Certificate will be housed in the Graduate School.

Continuing academic and program direction will be provided by the Program Oversight Committee while the project itself will be managed by the Office of Professional Studies. Members of the Program Oversight Committee include:

Academic Representatives:
Victor S. Kennedy  
Professor, Horn Point Laboratory  
University of Maryland Center for Environmental Science

Margaret A. Palmer  
Professor, College of Chemical and Life Sciences  
Laboratory Director, Chesapeake Biological Laboratory

Ken Paynter  
MEES Program Director  
UMCP

Graduate School Representative:  
Charles Caramello  
Dean, Graduate School

OPS Program Representative (program management chair):  
Ken Carter  
Program Manager, Office of Professional Studies

B. If the program is not to be housed and administered within a single academic unit, provide details of its administrative structure.

The Graduate Certificate in Professional Studies in Ecosystem Restoration will be housed in the Graduate School and managed by the Office of Professional Studies. A Graduate Faculty member from the University of Maryland Center for Environmental Science will serve as Graduate Director and will provide the academic leadership for the team. OPS will manage and coordinate the Program Oversight Committee as well as all other components of the program.

Faculty selection and appointments will be made by the University of Maryland Center for Environmental Science. All faculty, including adjunct faculty, will be members of the Graduate Faculty and approved by the Dean of the Graduate School to teach.
V. OFF-CAMPUS PROGRAMS (if necessary)

A. If at Shady Grove – indicate how students will access student services

   Not applicable

B. If on-line – describe the concerns in “Principles and Guidelines for Online Programs” are to be addressed.

   This program does not offer on-line courses.

VI. OTHER ISSUES

A. Describe any cooperative arrangements with other institutions or organizations that will be important for the success of this program.

   Not applicable

B. Will the program require or seek accreditation? Is it intended to provide certification or licensure for its graduates? Are there academic or administrative constraints as a consequence?

   No

VII. COMMITMENT TO DIVERSITY

The University of Maryland is an equal opportunity institution with respect to both education and employment. The University does not discriminate on the basis of race, color, national origin, sex, age, or handicap in admission or access to, or treatment or employment in, its programs and activities as required by federal (Title VI, Title IX, Section 504) and state laws and regulations.

Through its actions and statements of policy the University of Maryland has demonstrated a commitment to diversity by creating programs of study which explore the experiences, perspectives, and contributions of a wide variety of cultures, groups, and individuals; and has sought to create a campus environment which encourages tolerance and respect for individuals regardless of differences in age, race, ethnicity, sex, religion, disability, sexual orientation, class, political affiliation, and national origin.
VIII. REQUIRED PHYSICAL RESOURCES

A. Additional library and other information resources required to support the proposed program. You must include a formal evaluation by Library staff.

It is not anticipated that additional library resources will be necessary. A formal evaluation will be performed by University of Maryland Library staff. The University of Maryland Center for Environmental Science also has extensive library resources available to certificate program students at the Appalachian Laboratory in Frostburg, Chesapeake Biological Laboratory in Solomons, and Horn Point Laboratory in Cambridge.

B. Additional facilities, facility modifications, and equipment that will be required. This is to include faculty and staff office space, laboratories, special classrooms, computers, etc.

This program does not require additional resources.

C. Impact, if any, on the use of existing facilities and equipment. Examples are laboratories, computer labs, specially equipped classrooms, and access to computer servers.

This program does not require additional resources.

IX. RESOURCE NEEDS AND SOURCES

A. List new courses to be taught and needed additional sections of existing courses. Describe the anticipated advising and administrative loads. Indicate the personnel resources (faculty, staff, and teaching assistants) that will be needed to cover all these responsibilities.

Two new courses developed by the University of Maryland Center for Environmental Science will be offered in this program:

1. Principles and Practices of Ecosystem Restoration; (3 credits)
2. Ecosystem Restoration Applications; (3 credits)

These courses are currently awaiting the assignment of permanent course numbers from the College of Chemical and Life Sciences.

B. List new faculty, staff, and teaching assistants needed for the responsibilities in A, and indicate the source of the resources for hiring them

MEES Program Faculty will teach the courses in this program. University of Maryland faculty who teach in the program will be compensated using overloads paid from course tuition.
C. Some of these teaching, advising, and administrative duties may be covered by existing faculty and staff. Describe your expectations for this, and indicate how the current duties of these individuals will be covered, and the source of any needed resources.

   Approval of all faculty overloads for teaching and advising will be in accordance with University of Maryland policy and procedures. OPS is responsible for the overall administrative management of the program.

D. Identify the source to pay for the required physical resources identified in Section VIII. above.

   Tuition revenue will be used to cover the program expenses.

E. List any other required resources and the anticipated source for them

   Not applicable

F. Complete the additional proposal and financial tables as required by MHEC.

   Not applicable for MPST/GCPS programs.

Additional Approvals (see PCC coversheet for other required signatures)

Judith K. Broida  Associate Provost and Dean, Office of Professional Studies
GCPS Ecosystem Restoration

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**tuition charge ($1950)**

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**instruction**

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**overhead (4.5%)**

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**OPS mgmt (20% tuition)**

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**revenue to participating dept.**

|               | $3,708 | $3,708 | $2,038 | $1,618 |

**NOTES:**

- Year 1: Marketing covered by Provost -- $25,000
- $1950 per student per course (In-state and out of state)
- Contingent instructor contracts
- Revenue is returned to dept that participated that semester

**SIGNATURES:**

Judith K. Broida, Associate Provost and Dean
Office of Professional Studies

Norma Allerwell, Dean
College of Chemical and Life Sciences

Donald F. Boesch, President
UMCES
MEES 698E Principles and Practices of Ecosystem Restoration
Fall 2008, 3 Credits

Instructors: Dr. Sujay Kaushal and Dr. Michael Kemp
Office: University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory and Horn Point Laboratory
Phone: (301) 689-7201 (Kaushal) and (410) 221-8436 (Kemp)
E-mail: skaushal@al.umces.edu and kemp@hpl.umces.edu
Website: www.al.umces.edu and www.hpl.umces.edu

Lecture and Discussion: Thursdays, 4 – 7 pm

Required texts: Course packet with selected readings from the primary literature.

Recommended Prerequisites: Principles and Practices of Ecosystem Restoration (MEES), Restoration Ecology (NRMT 489F), Land Margin Interactions (MEES698I)

Course Description:
Overview of critical ecosystem functions across biomes, and general considerations and tradeoffs in restoration designs for enhancing function and biotic communities. Specific cases studies and discussions will be aimed at understanding how structure can influence biophysical and biogeochemical processes supporting ecosystems, and then describes how rates, timing, and location of physical and chemical processes can be altered by different restoration strategies to enhance ecosystem services and improve habitat quality. Through quantitative examination of current “real world” applications and evaluation of alternatives, this course will examine both how and when structure and function can be considered in the principles and practices of ecosystem restoration.

Topics covered:
The initial overview will illustrate how key processes across terrestrial, freshwater, and marine environments can present challenges to restoration across these biomes. Specific case studies regarding physical processes will include: current strategies to regulate the hydrologic cycle and thermal energy; discussion of specific biogeochemical processes to regulate the accumulation and transport of C, N, P, organic contaminants and heavy metals; current strategies to increase habitat extent and quality and food web structure for protecting target species. All topics will be discussed with an emphasis on how underlying principles in ecosystem ecology can be used in restoration science to solve contemporary and emerging problems in the environment.

Course Structure and Objectives:
Lecture (4 pm – 5:30 pm) – A primary goal of the initial lectures are to provide a general overview of important ecosystem considerations in restoration across biomes and then further explore the use of ecosystem concepts in restoration related to a select group of current and emerging environmental problems. The basic format of lectures regarding more specific topic areas will cover a brief review of how key processes and reactions of
cycles (e.g. hydrologic, material, energy and/or habitat extent and foodweb structure) have been altered by human activities to understand the nature and scope of the environmental problem. The lectures on specific topics will then describe the broad spectrum of ecosystem level approaches/methods used in restoration with examples from case studies.

**Discussion** (5:30 pm – 7pm) – The objective of the following discussion after lecture is to discuss cases studies from the primary literature and stimulate critical thinking regarding how much, when, where, and why restoration applications of ecosystem ecology can work in problem solving in a particular ecosystem and identify potential application and limitations in application across different biomes. The discussion will also propose and critique alternative strategies and designs. A student will be assigned to summarize 2 papers, and then 2 other students will provide questions for analysis and discussion.

**Group Projects** – Group projects will be coordinated outside of lecture and discussion sessions. A team of 2-3 students will pick one of the problem topics covered in a lecture and synthesize a review of studies in the literature describing the efficacy of restoration applications of ecosystem ecology to an environmental problem. The project will quantify and review our state of knowledge on restoration science in a given area and discuss new developing technologies and/or strategies across different biomes.

**Grading:**

Midterm exam (covering both lecture and discussion material) .......................30%

Final exam (covering both lecture and discussion material) .........................30%

Group research project
  Proposal .................................................................5%
  Presentation ............................................................10%
  Project Report .......................................................10%
  Work distribution ...................................................5%

Individual participation (in discussion and group project) .........................10%
## Class Topic and Discussion

<table>
<thead>
<tr>
<th>Class</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Course Intro, Handouts, IVN, Discussion of Group Projects</td>
</tr>
<tr>
<td>2</td>
<td>An Overview of Critical Ecosystem Functions Across Biomes</td>
</tr>
<tr>
<td>3</td>
<td>Advantages and Tradeoffs in Targeting Ecosystem Functions versus Species</td>
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<tr>
<td>4</td>
<td>Restoration Strategies for Regulating Water Flow</td>
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<tr>
<td>5</td>
<td>Restoration for Critical Temperature: U.S. Streams and Watersheds in Hot Water</td>
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<tr>
<td>6</td>
<td>Restoration Strategies for Acidification: Offsetting Air Pollution and Mining</td>
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<tr>
<td>7</td>
<td>Midterm Exam</td>
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<tr>
<td>8</td>
<td>Proposals Due and Meet to Discuss Progress on Group Research Projects</td>
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<tr>
<td>9</td>
<td>Restoration Strategies for Reducing Nitrogen and Phosphorus in Surface Waters</td>
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<td>10</td>
<td>Bioremediation of Heavy Metals and Organic Contaminants</td>
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<td>11</td>
<td>Restoration of Habitat Quality, Coastal Food webs, and Protected Species</td>
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<tr>
<td>12</td>
<td>Restoration Strategies for Carbon Sequestration: Approaches Across Scales</td>
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<td>Group projects and presentations</td>
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<tr>
<td>15</td>
<td>Final Exam</td>
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MEES 698G Ecosystem Restoration Applications (3 credits)

Spring 2009, 3 Credits

Instructors:
Dr. Bill Dennison, UMCES, dennison@ca.umces.edu
Dr. Donald Boesch, UMCES, boesch@ca.umces.edu
Additional lecturer to be decided

Course Description

Many ecosystems around the world have become substantially impaired or degraded, and ecosystem restoration is a growing area of ecosystem management. The practice of ecosystem restoration requires integration of science, planning, and policy. This includes making difficult decisions in the face of uncertainty, defining and measuring progress toward objectives, and understanding and working within existing policy frameworks. This course will introduce students to tools needed to apply and evaluate restoration activities and provide a background on restoration-related policy. It will consist of lectures, assignments, discussions of philosophical and technical aspects of successful restoration, and a final project.

The course will provide students with an introduction to such topics as decision analysis, adaptive management, developing monitoring programs, policy issues involved in restoring ecosystems. Additionally, there will be consideration of project management, communication, and conflict management skills.

Week Topics

1. Role of uncertainty in ecosystem restoration
2. Steps to success: Planning, implementation, and monitoring
3. Defining goals and quantifiable objectives.
4. Simple models of resource recovery to guide expectations
5. Using restoration activities as an experiment: Adaptive management
6. Designing monitoring programs to measure progress
7. Decision analysis and maximizing expected benefits to guide restoration decisions
8. Integrating new science, technology, and modeling into planning and implementation
9. Integrating humanity and nature in the restored ecosystem
10. Achieving environmental sustainability in restoration programs
11. Consideration of local, regional and national policies that guide restoration.
12. Effectively integrating policy, planning, and science
13. Project management to ensure continuity and completion of large-scale, multiyear, and multi-partner restoration projects
14. Scientific communication skills
15. Conflict management

Readings

There is not a specific text book for the course. Readings will be assigned from book chapters and journal articles.
**Evaluation**

In-class assignments and a final project will comprise two-thirds of the grade. However, success of the course will rely considerably on active, constructive, and substantive participation by all students. Therefore class participation forms one-third of the overall grade.

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Assignments and exams</td>
<td>34%</td>
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<tr>
<td>Final Project</td>
<td>33%</td>
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<tr>
<td>Class Participation</td>
<td>33%</td>
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</table>
This course presents the ecological and geomorphologic foundations of stream restoration, emphasizing their application in restoration practice. The course focuses on understanding and measurement of ecological and geomorphic processes and their application within an integrated approach to stream restoration. The course is designed for students interested in restoration, conservation, ecological theory, or most fields of environmental science.

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Topics</th>
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<tbody>
<tr>
<td>1</td>
<td>Welcome. Linking restoration objectives to actions, tradeoffs, uncertainty, and considering options</td>
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<tr>
<td></td>
<td>Ecosystem services: the ecological context of restoration</td>
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<tr>
<td>2</td>
<td>Ecological theory and restoration</td>
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<td></td>
<td>What constitutes success in restoration? When is a stream ‘broken’?</td>
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<tr>
<td>3 (lab/field)</td>
<td>Evaluating restoration options: evaluating pristine to degraded to restored streams [Baisman’s Run – Goodwin Run – Stony Run]</td>
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<td>4</td>
<td>The geomorphic context of stream restoration (river behavior and channel change in watershed and geologic context)</td>
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<td></td>
<td>Hydraulics, open-channel flow, Mannings’ N, flood flows, flood frequency &amp; recurrence, bankfull/effective discharge</td>
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<tr>
<td>5</td>
<td>Composition, Distribution, and Dynamics of Alluvial Sediment</td>
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<td></td>
<td>Grain to facies to subreach scale; Alluvial sediment - types of sediment problems, grain entrainment</td>
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<tr>
<td>6 (lab/field)</td>
<td>Watershed context, discharge measurements, mapping &amp; measuring facies; estimating roughness [Paint Branch or Mine Bank Run]</td>
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<tr>
<td>7</td>
<td>Mid-Term Case Study assignments</td>
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<td>8</td>
<td>Near-bed flows, shear, &amp; aquatic habitats 10 (lab/field)</td>
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<td></td>
<td>The benthic environment, adaptations to life in flow, dispersal, metapopulations, refugia</td>
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<td>9</td>
<td>Riparian restoration &amp; ecological principles</td>
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<td></td>
<td>Ecological Functions – primary production</td>
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<tr>
<td>10 (lab/field)</td>
<td>Aquatic insect ID; combine field maps &amp; sediment/invertebrate samples in composite description</td>
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<tr>
<td>11</td>
<td>Nutrient processing and restoration to reduce N flux</td>
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<td>Decomposition &amp; carbon sequestration</td>
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<tr>
<td>12 (lab/field)</td>
<td>Water quality benefits of stream restoration – approaches &amp; assessments</td>
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<tr>
<td>13</td>
<td>Restoration of structure or function?</td>
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<td></td>
<td>Mitigation vs. restoration - -- ephemeral&gt;intermittent&gt;wetland restoration; Assessments methods – compliance vs. design vs. mitigation</td>
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<tr>
<td>14 (lab/field)</td>
<td>Field assessment – structural, functional – multi-objective</td>
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<tr>
<td>15</td>
<td>FINAL EXAM</td>
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MEES 698V  Restoration Ecology of Submersed Aquatic Vegetation (3 credits)
Summer 2009

Instructor:
Dr. Laura Murray
http://www.hpl.umces.edu/faculty/murray.html

This course presents the overall ecology of submersed grasses in the context of the restoration ecology of these underwater plants. Background information focuses on habitat requirements of these plants, their ecological importance in the aquatic environment, and best management practices for their survival. Emphasis is placed on the restoration ecology and practices for several species from freshwater to the saline environment. The course is designed for people interested in restoration ecology, and the general field of environmental science.

Prerequisites: A general ecology course, or relevant professional experience.

<table>
<thead>
<tr>
<th>Weeks</th>
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<tbody>
<tr>
<td>1</td>
<td>Course Orientation. Restoration ecology, purpose, general practices, success vs. failure</td>
</tr>
<tr>
<td>2</td>
<td>Ecology of SAV, Global and Local</td>
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<tr>
<td>3 (lab/field)</td>
<td>Ecology of SAV beds; field techniques for evaluating ecosystem health of grass beds</td>
</tr>
<tr>
<td>4</td>
<td>Habitat Requirements of SAV</td>
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<tr>
<td>5</td>
<td>Water quality. Sediment composition, Sediment porewater nutrients</td>
</tr>
<tr>
<td>6 (lab/field)</td>
<td>Sampling techniques for SAV habitat requirements; Data Analysis and discussion</td>
</tr>
<tr>
<td>7</td>
<td>Mid-Term Case Study assignments</td>
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<tr>
<td>8</td>
<td>Seagrass and Policy; Tipping Point of Seagrass Meadows</td>
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<td>9</td>
<td>Site Selection for SAV restoration; How to select suitable sites</td>
</tr>
<tr>
<td>10 (lab/field)</td>
<td>Field Analysis for site selection; Models and Web-quests for SAV Site Selection</td>
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<tr>
<td>11</td>
<td>Restoration of SAV I: Propagation methods/techniques for various species</td>
</tr>
<tr>
<td>12 (lab/field)</td>
<td>Restoration of SAV II: Planting methods/techniques for various species</td>
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<tr>
<td>13</td>
<td>Monitoring SAV Restoration, Why, What, and How; Demonstration of monitoring techniques</td>
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<tr>
<td>14 (lab/field)</td>
<td>Field analysis of successful SAV restoration</td>
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<tr>
<td>15</td>
<td>FINAL EXAM</td>
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</tbody>
</table>
MEES 698O  Special Topics: Hydrological Effects of Land Use Change (co-listed as BIOL-650-001 at FSU)

Spring 2006  3 credits; M/W (1030-1145); AL Room 109 (also via IVN at CBL, HPL, UMCP, UMBC, and UMES)

Instructor  Keith N. Eshleman AL Room 308 (office); (301) 689-7170 (phone); (301) 689-7200 (FAX); eshleman@al.umces.edu; http://www.al.umces.edu/cvKeithEshleman.htm Office hours: W (1330-1600)

Course Description  This course will examine in detail the catchment-scale hydrological effects attributable to major land use and land cover alterations, including both anthropic and non-anthropic disturbances. The first part of the course will focus primarily on the quantitative measurement and mathematical description of those physical hydrological processes that can be affected by land use and land cover changes, including: precipitation; evapotranspiration; interception; snow accumulation and melt; infiltration; groundwater recharge; and all components of surface runoff. The second part of the course will review how both deterministic and empirical/statistical models can be applied to analyze and predict observed catchment-scale hydrological and hydrochemical responses to land alterations and disturbances. In addition, effects of land use changes on surface- and ground-water quality will also be addressed. Prerequisite: one course in hydrology and one course in statistics or permission of instructor.

Syllabus

<table>
<thead>
<tr>
<th>Week no.</th>
<th>Dates (approx.)</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/24</td>
<td>Course introduction: description, syllabus, requirements; hydrological science; history of hydrology.</td>
</tr>
<tr>
<td>2</td>
<td>1/30, 2/1</td>
<td>Introduction to the catchment: hydrological processes and the hydrological cycle; the continuity equation; rainfall-runoff relationships</td>
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<tr>
<td>3</td>
<td>2/6, 2/8</td>
<td>Precipitation: temporal and spatial variability; interception; throughfall and stemflow</td>
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<tr>
<td>4</td>
<td>2/13, 2/15</td>
<td>Evaporation and transpiration: meteorological, physiological, and soil moisture controls; liquid-vapor phase changes; energy budget and aerodynamic equations; potential evapotranspiration</td>
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<tr>
<td>5</td>
<td>2/20, 2/22</td>
<td>Groundwater: water movement and distribution in the saturated zone; Darcy's law; unconfined aquifer flow; groundwater recharge and discharge</td>
</tr>
<tr>
<td>6</td>
<td>2/27, 3/01</td>
<td>Soil moisture: water movement and distribution in the unsaturated zone; infiltration</td>
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<td>7</td>
<td>3/6, 3/8</td>
<td>Streamflow generation mechanisms: concepts of infiltration-excess overland flow, saturation overland flow, and subsurface stormflow</td>
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<tr>
<td>8</td>
<td>3/13, 3/15</td>
<td>Snow accumulation and snowmelt</td>
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<tr>
<td>9</td>
<td>3/20, 3/22</td>
<td>SPRING BREAK—NO CLASSES SCHEDULED</td>
</tr>
</tbody>
</table>
Analyzing and predicting responses to land disturbances: introduction and application of empirical models and statistical approaches

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<tr>
<th>Week No.</th>
<th>Dates (approx.)</th>
<th>Topic</th>
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<tbody>
<tr>
<td>11</td>
<td>4/03, 4/05</td>
<td>Analyzing and predicting responses to land disturbances: introduction and application of deterministic models</td>
</tr>
<tr>
<td>12</td>
<td>4/10, 4/12</td>
<td>Forest hydrology and forest management practices: hydrological and hydrochemical effects; natural disturbances; riparian forests</td>
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<tr>
<td>13</td>
<td>4/17, 4/19</td>
<td>Hydrological effects of conversions of forests to alternate uses</td>
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<tr>
<td>14</td>
<td>4/24, 4/26</td>
<td>Agricultural hydrology and agricultural management practices: hydrological and hydrochemical effects; conversions to alternate uses</td>
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<tr>
<td>15</td>
<td>5/01, 5/03</td>
<td>Urban hydrology and management: hydrological and hydrochemical effects; stormwater management practices; conversions to alternate uses</td>
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<tr>
<td>16</td>
<td>5/08, 5/10</td>
<td>Wetlands hydrology and management: hydrological effects and conversions to alternate uses; surface mining and reclamation: hydrological effects; water resources development: hydrological effects</td>
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<tr>
<td></td>
<td>5/18</td>
<td>Final exam due</td>
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**Textbook and Reading Assignments**

Readings pertaining to the following week's lectures will be assigned each Thursday. A basic textbook in hydrology—*Elements of Physical Hydrology* (1998) by G.M. Hornberger *et al.*—contains about half of the assigned readings; students are encouraged to work the *Example Problems* at the end of each chapter and study the *Review Questions* (and *Answers*) provided with the HTML (Netseape Navigator® version 2.0 or later required) version of the textbook on the accompanying CD-ROM. Supplemental readings will be assigned regularly from scientific periodicals, reports, and other books. Individual reprints or on-line access to these readings through *Blackboard 6* will be provided to students for their personal use only free-of-charge. *Readings should be completed prior to class!*
Course Requirements

(1) Examinations. One mid-term and one final examination will be given as take-home assignments. It is intended that each examination will require approximately equal amounts of analytical, quantitative, and writing skills.

(2) Other assignments. Five take-home assignments will be given during the semester (approximately bi-weekly). Most of these will require access to a PC equipped with an e-mail utility, electronic spreadsheet and basic graphics/statistics software (e.g., MS-Excel), and a web-browser.

(3) Grading policy. The course grade will be computed from a weighted-average of the two examination scores, the take-home assignment scores, and a class-participation score as follows:

(4) Blackboard 6. Course materials, important announcements, and last-minute messages will be distributed to students on-line via a web-based course management system (http://blackboard.cbl.umces.edu/).

Class participation: 15%
Mid-term examination: 25%
Final examination: 35%
Take-home assignments: 25%

Teaching Assistant

A teaching assistant may be available at AL to help with distribution of reading materials, class notes and visuals, take-home assignments, and exams; all questions regarding course content, assignments, grading, etc. must be addressed to the course instructor, however.