UNIVERSITY OF RHODE ISLAND

The Graduate School

Curricular Report from the Graduate Council to the Faculty Senate

Report No. 2001-2002-4 C

Master of Environmental Science and Management (MESM)

As approved by the Faculty Senate on February 28, 2002

At Meeting No. 375 held on 7 December, 2001, the Graduate Council approved the following proposal that is now submitted to the Faculty Senate.

SECTION I

BACKGROUND INFORMATION

ABSTRACT

The Graduate Council approved a proposal from the College of the Environment and Life Sciences for a Master of Environmental Science and Management (MESM). The Master of Environmental Science and Management is proposed as an interdisciplinary, interdepartmental, non thesis professional degree with specializations in Conservation Biology; Earth and Hydrologic Science; Environmental Policy and Management; Remote Sensing and Spatial Analysis; Sustainable Systems; and Wetland, Watershed, and Ecosystem Science. The program requires no new resources, is deemed of significant merit, and is forwarded to the Faculty Senate at the Class A* level.

*Approved at Class C level.

BACKGROUND

The proposed degree would replace the non thesis option of the Master of Science in Environmental Sciences which currently serves students in the Departments of Geosciences, Natural Resources Science, and Plant Sciences. It also would serve students from four other CELS departments: Community Planning and Landscape Architecture; Environmental and Natural Resource Economics; Fisheries, Animal, and Veterinary Science; and Marine Affairs. Unlike the Master of Science in Environmental Sciences degree, which emphasizes research, the primary focus of MESM would be the application of scientific knowledge in environmental problem-solving and management. MESM features a blend of natural and social sciences, to better prepare students to deal with increasingly complex environmental management issues.

The proposal was reviewed under the process established by the Faculty Senate in which the Graduate Council serves as the Coordinating and Review Committee. Announcements of the receipt of the proposal were sent to the President and Joint Educational Policy Committee, the Provost and the Council of Deans, the Budget Office, and Department Chairs and Directors. Recommendations were sought from each of these, and the comments received are appended. Comments and recommendations have been kept on file in the Graduate School.

The Budget Office found that no additional resources would be required for implementation of the MESM degree program. The Council of Deans stated that the program will be "a valuable program for professional development for those already working in government agenciesŠ" and that "the proposal is a much needed professional degree." The JEPC also supports the program, but questioned whether the program "reverses actions taken to consolidate graduate programs in CELS in recent years." In meeting with the Graduate Council, Professor Frank Golet indicated that the proposal actually further consolidates existing programs, and in a single degree program provides opportunities that were not previously available to members of other groups.

SECTION II

RECOMMENDATION

The Graduate Council approved the proposal for the Master of Environmental Science and Management at its meeting number 375 on 7 December, 2001, and forwards it to the Faculty Senate at the Class A* level.

*Approved at Class C level.

Master of Environmental Science and Management (MESM)

A. PROGRAM INFORMATION

1. Name of institution: University of Rhode Island

2. Administrative units involved: College of the Environment and Life Sciences; Departments of Community Planning and Landscape Architecture; Environmental and Natural Resource Economics; Fisheries, Animal, and Veterinary Science; Geosciences; Marine Affairs; Natural Resources Science; and Plant Sciences.

3. Title of proposed program: Master of Environmental Science and Management (MESM).

4. Intended date of change: September 2002

5. Anticipated date for granting first degrees: May 2004

6. Intended location of proposed program: Kingston Campus

7. Institutional review and approval process:

Department of Community Planning and Landscape Architecture	8/16/01
Department of Environmental and Natural Resource Economics	9/14/01
Department of Fisheries, Animal, and Veterinary Science	8/15/01
Department of Geosciences	8/20/01
Department of Marine Affairs	8/30/01
Department of Natural Resources Science	9/14/01
Department of Plant Sciences	8/23/01
College of the Environment and Life Sciences	

Graduate Council **12/1/01**
Faculty Senate
President of the University
Board of Governors

8. Summary of proposed change: The Master of Environmental Science and Management (MESM), which would be offered through the College of the Environment and Life Sciences (CELS), is proposed as an interdisciplinary, interdepartmental, professional degree with specializations in Conservation Biology; Earth and Hydrologic Science; Environmental Policy and Management; Remote Sensing and Spatial Analysis; Sustainable Systems; and Wetland, Watershed, and Ecosystem Science. The new degree would replace the nonthesis option of the Master of Science in Environmental Sciences, which currently serves students in the Departments of Geosciences, Natural Resources Science, and Plant Sciences. At the same time, it would serve students from four other CELS departments: Community Planning and Landscape Architecture; Environmental and Natural Resource Economics; Fisheries, Animal, and Veterinary Science; and Marine Affairs. Unlike the Master of Science in Environmental Sciences degree, which emphasizes research, the primary focus of MESM would be the application of scientific knowledge in environmental problem-solving and management; it is designed for students seeking careers with state or federal regulatory or resource management agencies, nongovernmental organizations, or private industry. MESM features a blend of natural and social sciences, to better prepare students to grapple with increasingly complex environmental management issues.

9. Statement on resource needs: Implementation of the Master of Environmental Science and Management degree program will require no new or additional resources.

10. Signature of the President:

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11. Persons to be contacted during the review: Dean Jeffrey Seemann, College of the Environment and Life Sciences, 874-2957; Frank Golet, Professor, Natural Resources Science, 874-2916.

B. RATIONALE

Currently, students enrolled in the Master of Science in Environmental Sciences (MSES) degree program may pursue either of two options: thesis or nonthesis. Thesis students take 30 credits of coursework, including 6 credits of thesis research, and write and defend a thesis before a faculty committee; they are expected to conduct original research that is worthy of publication in scientific journals. Thesis students frequently are pursuing research careers, and many go on for the Ph.D. degree. Nonthesis students take 36 credits of coursework, including a 3-credit research project, and must pass a comprehensive exam on coursework; however, they are not required to write or defend a thesis. Nonthesis students typically enter the workplace immediately after graduation and settle in positions more closely related to environmental policy or management than research.

Faculty from those departments participating in the Environmental Sciences M.S. degree program--namely, Geosciences (GEO), Natural Resources Science (NRS), and Plant Sciences (PLS)--have felt for some time that the nonthesis Master's experience could be vastly improved if it were given more structure, in the form of standard course requirements and focused specializations. At the same time, many faculty and students alike have expressed the desire for a more interdisciplinary approach, given that such an approach is often the most successful way to attack complex environmental problems. Finally, many students and faculty have argued that the goals and aspirations of thesis and nonthesis students often are so dissimilar that separate degrees--not just separate options--are in order.

The Master of Environmental Sciences and Management degree program is being proposed to address all of the above issues and concerns. It is proposed as a professional degree with six specializations (see "E. Content" below), which represent both areas of great strength at URI and key focus areas for environmental management and policy specialists. The proposed program would replace the nonthesis option of the Master of Science in Environmental Sciences, which currently serves students in GEO, NRS, and PLS. But more significantly, the new program would join these three departments with four others--Community Planning and Landscape Architecture (CPLA);

Environmental and Natural Resource Economics (ENRE); Fisheries, Animal, and Veterinary Science (FAVS); and Marine Affairs (MAF)--to produce a truly outstanding, interdisciplinary blend of natural science and social science faculty and students with a common goal: more effective management of environmental resources.

Nationwide, there is a growing trend to elevate the nonthesis Master's experience to the degree level; prominent examples are Duke's Master of Environmental Management, Cornell's Master of Professional Studies, the University of Massachusetts' Master's in Wildlife and Fisheries Conservation, Yale's Master of Environmental Studies, and URI's own Master's of Oceanography. Given the popularity of professional environmental management degree programs at these and other schools, and the impressive array of top-notch environmental science, policy, planning, and economics faculty and courses at URI, the demand for such a program should be high. In fact, there would appear to be few institutions in the nation that can boast the depth and breadth that URI has to offer in environmental studies.

Faculty representatives from the above departments have met numerous times over a 2-year period to draft the various components of this proposal. They are convinced that a professional Master's degree in Environmental Science and Management is both timely and in keeping with URI's Land Grant, Sea Grant, and Urban Grant missions. They firmly believe that such a degree program, featuring a solid core of courses from the natural and social sciences; independent research on science, policy, or management topics; and professional internship opportunities, is the ideal approach for training environmental regulators, managers, policy specialists, and consultants. MESM should also be an attractive degree program for environmental professionals who seek to advance their careers, but who can attend school only on a part-time basis and whose work schedules might not permit the intensive field or laboratory research typical of the M.S. degree. Creation of the MESM degree program would have the added benefit of bolstering enrollment in undersubscribed graduate courses.

C. INSTITUTIONAL ROLE

The University of Rhode Island has one of the largest, most distinguished marine and environmental science faculties, and some of the most extensive environmental course offerings, in the nation. President Robert Carothers formally recognized this strength when he designated the Marine and Environmental Focus as one of a small number of core areas in which the University would be investing significant resources in future years. The Partnership for the Coastal Environment and the Coastal Fellows Program are shining examples of the University's commitment to environmental research, instruction, and outreach. Three years ago, URI's Departments of Fisheries, Animal, and Veterinary Science; Geology; Natural Resources Science; and Plant Sciences launched a new M.S. and Ph.D. umbrella program in Environmental Sciences. Creation of a professional Master's degree in Environmental Science and Management represents another step toward full realization of President Carothers' vision for the Marine and Environmental Focus.

As described below, MESM would require students to take a basic core of natural science and social science courses from the College of the Environment and Life Sciences, but students would be strongly encouraged to bolster those courses with selections from related units on the Kingston and Narragansett Bay campuses. The aim is to produce graduates who understand the principles of natural science and who know how to apply those principles to the solution of pressing environmental problems. By integrating subject matter from the diverse environmental science, natural resource management, policy, planning, law, and economics courses at URI with applied research projects, MESM stands to become a major contributor to the advancement of URI's already strong reputation in marine and environmental science.

D. INTERINSTITUTIONAL CONSIDERATIONS

None of the other institutions of higher education in Rhode Island offer graduate degree programs that are comparable to MESM. Brown University offers a Master of Arts in Environmental Studies, but the program is almost exclusively focused on environmental policy. There might be minor overlap between Brown's program and the proposed MESM specialization in Environmental Policy and Management; however, MESM would require students to take more coursework in the natural and quantitative sciences. Outside

of URI and Brown, there are no other Master's degree programs in environmental science fields in Rhode Island.

For these reasons, creation of MESM should have little or no adverse impact on other institutions of higher education in the State. On a more positive note, the MESM degree may be an attractive option for those graduates of other State institutions who desire to pursue graduate study and careers in environmental science and management.

E. CONTENT

1. Overview: The proposed Master of Environmental Science and Management (MESM) is an interdisciplinary, interdepartmental, professional degree program designed for students who are seeking professional environmental positions in areas other than research. It is considered to be a terminal degree; students who plan to go on for a Ph.D. should enroll in the Master of Science in Environmental Sciences degree program instead. The MESM degree program would serve graduate students from seven departments within URI's College of the Environment and Life Sciences: Community Planning and Landscape Architecture; Environmental and Natural Resource Economics; Fisheries, Animal, and Veterinary Science; Geosciences; Marine Affairs; Natural Resources Science; and Plant Sciences. It would replace the current nonthesis option within the Master of Science in Environmental Sciences degree program.

2. Admission requirements: GRE and Bachelor's degree in biological science, physical science, environmental science, natural resources, or engineering. Applicants with course deficiencies may be required to take appropriate undergraduate courses for no program credit and to demonstrate, by their performance in such coursework or through a qualifying exam, basic knowledge of the subject matter in the area(s) of deficiency.

3. General program requirements:

a. Thirty-six (36) credits of coursework, consisting of:

1.) Core courses (21-25 credits), including:

- **Natural Sciences (at least 9 credits)**
- **Social Sciences (at least 6 credits)**
- **Numerical Methods (at least 3 credits)**

2.) Elective courses (6-10 credits), up to 3 credits of which might be an internship (EVS 597, Professional Internship in Environmental Science and Management) with an environmental agency, nongovernmental organization, or private firm.

3.) Independent study (3 credits: EVS 598, Professional Master's Research), an independent research project that culminates in a substantial, high-quality, written report.

4.) Graduate seminar (2 credits), including a terminal oral presentation.

b. Written comprehensive examination on coursework.

4. Specializations: Each MESM degree candidate shall enroll in one of the following six specializations. Each specialization has unique course requirements (see Appendix for possible course selections) and faculty advisors drawn from two or more CELS departments. Changes in course requirements may be effected by the MESM Steering Committee after consultation with program faculty from the specializations involved. The MESM Steering Committee shall include one member from each of the seven participating departments and be chaired by the CELS Graduate Programs Coordinator.

a. Conservation Biology Specialization: This specialization prepares students for professional positions in the science and management of the earth's biological diversity. Students may concentrate their studies in ecological aspects of applied conservation biology, in the management of biodiversity, or in the economics and policy aspects of conservation biology. Under this specialization, students take courses in plant and animal biology, ecology, and biodiversity analysis and management, as well as in numerical methods and social sciences. Graduates find employment with federal and state resource management and regulatory agencies, nongovernmental conservation organizations, and private environmental consulting firms.

1.) Core courses (21-25 credits), including:

- **Natural Sciences (12-16 credits)**
- **Plant & Animal Biology (at least 3 credits)**
- **Ecology (at least 3 credits)**
- **Biodiversity Analysis & Management (at least 3 credits)**
- **Social Sciences (6 credits)**
- **Numerical Methods (3 credits)**

2.) Electives (6-10 credits)

3.) Independent study (3 credits: EVS 598)

4) Graduate seminar (2 credits from NRS, PLS, or REN)

b. Earth and Hydrologic Science Specialization: This specialization is focused on the study of earth sciences at multiple scales. It gives students insight into the structure and process in earth systems, stresses the understanding of earth and hydrologic hazards and the application of earth science to management issues, and provides students with tools for effectively communicating how to live with the natural environment. Students concentrate their studies in one of the following: 1) earth surface processes, including coastal hazards and landscape development during and after deglaciation; 2) soil-landscape relationships and applied pedology; 3) hydrogeology, including groundwater and surface water processes, contaminant transport and cleanup, and modeling; 4) solid earth materials and processes, including natural hazards, mineral resources, and forensic science; 5) geoarcheology, including sources of lithic materials and paleoclimates; and 6) paleoenvironments of dinosaur-bearing rocks. Complementary background knowledge in spatial analysis (GIS) is strongly suggested. Required coursework comes from the areas of: earth surface processes; hydrology; earth materials; spatial analysis; numerical methods; and environmental economics, policy, planning, and law. Graduates find employment with federal and state resource management and regulatory agencies, private environmental consulting firms, academic laboratories, and nongovernmental conservation organizations.

1.) Core courses (21-25 credits), including:

- **Natural Sciences (12-16 credits from any or all of the following)**
- **Earth Surface Processes**
- **Hydrology**
- **Solid Earth Materials & Processes**
- **Spatial Analysis & Remote Sensing**
- **Social Sciences (6 credits)**
- **Numerical Methods (3 credits)**

2.) Elective courses (6-10 credits)

3.) Independent study (3 credits: EVS 598)

4.) Graduate seminar (2 credits from GEO, MAF, or NRS)

c. Environmental Policy and Management Specialization: This specialization prepares students for positions requiring an ability to integrate natural science into policy development and implementation affecting ecosystems, landscapes, land use and development, environmental regulation of industry, or conservation of biological diversity or environmental quality. Students concentrate their coursework in policy, planning, law, and economics, as well as taking a substantial share of courses in natural sciences including geology, hydrology, and soil science; ecology and management; or remote sensing and spatial analysis. Graduates are prepared for careers in federal, state, or municipal government; nonprofit organizations; and private consulting firms requiring professionals who can bring science to bear on policy and management solutions that succeed in a modern political and economic setting.

1.) Core courses (21-25 credits), including:

- **Social Sciences (12-16 credits)**
- **Policy, Planning & Law (at least 6 credits)**
- **Economic Theory & Methods (at least 6 credits; may include 3 credits from Numerical Methods)**
- **Natural Sciences (9 credits from any or all of the following or from Numerical Methods)**
- **Geology, Hydrology & Soil Science**
- **Ecology & Management**
- **Remote Sensing & Spatial Analysis**
- **Numerical Methods (3 credits)**

2.) Electives (6-10 credits)

3.) Independent study (3 credits: EVS 598)

4.) Graduate seminar (2 credits from CPL, GEO, MAF, NRS, or REN)

d. Remote Sensing and Spatial Analysis Specialization: This specialization provides students with the technical skills required to use state-of-the-art mapping technologies, such as geographic information systems (GIS), and cutting-edge data systems, such as those provided by satellite and aerial remote sensing and global positioning systems (GPS), for the analysis and presentation of environmental data. Students completing this specialization will have mastered a large and diverse suite of technical tools in geospatial data analysis. These tools can be used to solve practical problems in watershed modeling, ecosystem science, wildlife ecology, water resource management, landscape ecology, pollution control, conservation biology, and land use/land cover dynamics. Under this specialization, students take a core of basic and advanced courses in remote sensing and GIS, where they learn how to use modern mapping technologies. Additional coursework provides students with practical instruction in how GIS and remote sensing are applied in environmental analysis and basic research. Graduates of this program find employment with public- and private-sector agencies, firms, and organizations that use computerized mapping technologies for natural resource management and environmental protection.

1.) Core courses (21-25 credits), including:

- **Natural Sciences (12-16 credits)**
- **Remote Sensing & Spatial Analysis (at least 9 credits)**
- **Earth & Ecosystem Science (0-7 credits)**
- **Social Sciences (6 credits)**
- **Numerical Methods (3 credits)**

2.) Electives (6-10 credits)

3.) Independent study (3 credits: EVS 598)

4.) Graduate seminar (2 credits from GEO or NRS)

e. Sustainable Systems Specialization: This specialization focuses on the science and management of designed and domesticated ecosystems. A graduating student has a strong understanding of the functional dynamics of an ecosystem, comprehensive appreciation of ecosystem responses to manipulation, and the ability to link ecosystem processes to human and environmental health and economic output. Students may concentrate their efforts toward understanding terrestrial, aquacultural, or environmental impact and system function. The student develops expertise in the production of food, fiber, ornamental, and utility products from domesticated systems and the potential interactions with natural enemies and indigenous species. Required and optional coursework addresses natural ecosystem functions, management of designed ecosystems, numerical methods, environmental policy, land use planning, environmental law, and economics. Graduates find employment with private-sector firms in the production of food, fiber, ornamental, and utility products from domesticated systems and have ample opportunity with government advisory and regulatory agencies.

1.) Core courses (21-25 credits), including:

- **Natural Sciences (12-16 credits)**
- **Natural Ecosystems (at least 3 credits)**
- **Managed Ecosystems (at least 3 credits)**
- **Social Sciences (6 credits)**
- **Numerical Methods (3 credits)**

2.) Electives (6-10 credits)

3.) Independent study (3 credits: EVS 598)

4.) Graduate seminar (2 credits from ASP, NRS, PLS, or REN)

f. Wetland, Watershed, and Ecosystem Science Specialization: This specialization focuses on the science and management of ecosystems at all scales from landscape to interstitial. Students may concentrate their studies in the ecology, management, and conservation of inland or coastal wetlands; in watershed science and management, particularly land use-water quality interactions; in the ecology and management of forests for human use and biodiversity; or in soil ecology, including bioremediation of

organic pollutants. Under this specialization, students take courses from four key areas: ecosystem science and management; earth science, soils, and spatial analysis; statistics; and environmental planning, policy, law, and economics. Graduates find employment with federal and state resource management and regulatory agencies, municipal government, nongovernmental conservation organizations, and private environmental consulting firms.

1.) Core courses (21-25 credits), including:

- **Natural Sciences (12-16 credits)**
- **Ecosystem Science & Management (at least 6 credits)**
- **Earth Science, Soils & Spatial Analysis (at least 3 credits)**
- **Social Sciences (6 credits)**
- **Numerical Methods (3 credits)**

2.) Electives (6-10 credits)

3.) Independent study (3 credits: EVS 598)

4.) Graduate seminar (2 credits from GEO, MAF, NRS, or REN)

5. Existing program courses: Except for the proposed internship course (EVS 597; see below) course selections for the Master of Environmental Science and Management degree program will come primarily from existing course offerings from the participating departments: Community Planning and Landscape Architecture (CPL); Environmental and Natural Resource Economics (REN); Fisheries, Animal, and Veterinary Science (ASP, AVS, FST); Geosciences (GEO); Marine Affairs (MAF); Natural Resources Science (NRS); and Plant Sciences (ENT, PLS). These courses will be supplemented by selections from related departments such as Biological Sciences (BIO), Civil and Environmental Engineering (CVE), Oceanography (OCG), Political Science (PSC), and Statistics (STA). See the Appendix for a comprehensive listing of program courses.

6. New program courses: URI already offers a tremendous diversity of courses related to environmental science and management. For that reason, only one new course is proposed:

EVS 597 Professional Internship in Environmental Science and Management (I and II, 3 credits) Supervised work performed with an environmental agency, nongovernmental organization, or private firm as part of the requirements of the Master of Environmental Science and Management degree. (Practicum) S/U credit.

In addition, the title and description of EVS 598, Nonthesis Master's Research, will be changed to read as follows:

EVS 598 Professional Master's Research (I and II, 3 credits) Independent investigation to satisfy the research requirement for the Master of Environmental Science and Management degree. Substantial paper required. (Independent Study).

7. Program faculty: At the time of this proposal, the following faculty have expressed a desire to serve as major professor for students in the Master of Environmental Science and Management degree program. Additional program faculty may be added in the future, subject to approval by the MESM Steering Committee.

a. Conservation Biology Specialization

*Peter V. August, Professor, NRS**

Kimberley D. Brosofske, Assistant Professor, NRS

Howard S. Ginsberg, Resident Professor, PLS

Francis C. Golet, Professor, NRS

Thomas D. Husband, Professor, NRS

Roger A. LeBrun, Professor, PLS

Patrick A. Logan, Professor, PLS

Scott R. McWilliams, Assistant Professor, NRS

James J. Opaluch, Professor, ENRE

Peter W.C. Paton, Associate Professor, NRS

Jon G. Sutinen, Professor, ENRE

Stephen K. Swallow, Professor, ENRE

b. Earth and Hydrologic Science Specialization

Jon C. Boothroyd, Professor, GEO

Thomas B. Boving, Assistant Professor, GEO

J. Allen Cain, Professor, GEO

David E. Fastovsky, Professor, GEO

Reinhard K. Frohlich, Associate Professor, GEO

Arthur J. Gold, Professor, NRS

William R. Gordon, Associate Professor, MAF

O. Don Hermes, Professor, GEO

Daniel P. Murray, Professor, GEO

Mark H. Stolt, Assistant Professor, NRS

Anne I. Veeger, Associate Professor, GEO

c. Environmental Policy and Management Specialization

James L. Anderson, Professor, ENRE

Jon C. Boothroyd, Professor, GEO

Thomas B. Boving, Assistant Professor, GEO

Paul A. Buckley, Resident Professor, NRS

Richard Burroughs, Professor, MAF

J. Allen Cain, Professor, GEO

Reinhard K. Frohlich, Associate Professor, GEO

John M. Gates, Professor, ENRE

Francis C. Golet, Professor, NRS

Thomas A. Grigalunas, Professor, ENRE

Timothy M. Hennessey, Professor, MAF

O. Don Hermes, Professor, GEO

Lawrence Juda, Professor, MAF

Bruce E. Marti, Professor, MAF

Dennis W. Nixon, Professor, MAF

James J. Opaluch, Professor, ENRE

Richard B. Pollnac, Professor, MAF

Jon G. Sutinen, Professor, ENRE

Stephen K. Swallow, Professor, ENRE

Robert H. Thompson, Assistant Professor, CPLA

Timothy J. Tyrrell, Professor, ENRE

Cathy R. Wessells, Professor, ENRE

d. Remote Sensing and Spatial Analysis Specialization

Peter V. August, Professor, NRS

Jon C. Boothroyd, Professor, GEO

Reinhard K. Frohlich, Associate Professor, GEO

O. Don Hermes, Professor, GEO

Daniel P. Murray, Professor, GEO

Yeqiao Wang, Associate Professor, NRS

e. Sustainable Systems Specialization

Steven R. Alm, Professor, PLS

James L. Anderson, Professor, ENRE

David A. Bengtson, Professor, FAVS

Kimberley D. Brosofske, Assistant Professor, NRS

Richard A. Casagrande, Professor, PLS

John M. Gates, Professor, ENRE

Howard S. Ginsberg, Research Associate Professor, PLS

Marta Gomez-Chiarri, Assistant Professor, FAVS

Roger A. LeBrun, Professor, PLS

Thomas N. Mather, Professor, PLS

Nathaniel A. Mitkowski, Assistant Professor, PLS

Brian K. Maynard, Associate Professor, PLS

Michael A. Rice, Professor, FAVS

Cathy R. Wessells, Professor, ENRE

f. Wetland, Watershed, and Ecosystem Science Specialization

Jose A. Amador, Professor, NRS

Peter V. August, Professor, NRS

Jon C. Boothroyd, Professor, GEO

Thomas B. Boving, Assistant Professor, GEO

Kimberley D. Brosofske, Assistant Professor, NRS

Richard Burroughs, Professor, MAF

David E. Fastovsky, Professor, GEO

Arthur J. Gold, Professor, NRS

Francis C. Golet, Professor, NRS

James J. Opaluch, Professor, ENRE

Mark H. Stolt, Assistant Professor, NRS

Jon G. Sutinen, Professor, ENRE

Stephen K. Swallow, Professor, ENRE

Anne I. Veeger, Associate Professor, GEO

8. Target enrollment: With existing faculty, courses, and facilities, as many as 50 MESM candidates could be easily accommodated.

F. PROGRAM EVALUATION

The MESM Steering Committee will compile annual statistics on the number and demographic characteristics of applicants, the number of enrollees, and the number of graduates by specialization. These data and other pertinent information will be forwarded to the College of the Environment and Life Sciences (CELS) Graduate Programs Committee for review. At the time of graduation, each student will be asked to complete an exit questionnaire. The results of the questionnaires will be reviewed by the MESM Steering Committee to identify any issues of concern. If enrollments are lower than desired, more vigorous recruitment efforts will be undertaken. If any other issues of concern are identified, the MESM Steering Committee will appoint subcommittees to study the issues in detail and to propose remedies to the parent Committee and to the CELS Graduate Programs Committee.

APPENDIX

Course Selections for MESM Specializations

Master of Environmental Science and Management

CONSERVATION BIOLOGY SPECIALIZATION

(Total credits = 36)

1. Core Courses (21-25 credits)-

Natural Sciences (12-16 credits)

- Plant & Animal Biology (at least 3 credits):

BIO 418 Marine Botany	BIO 437 Fund. Molecular Biology
BIO 454 Genetics Lab	BIO 460 Adv. Population Biology
BIO 464 Invert. Zoology	BIO 465 Biology of Algae
BIO 466 Vertebrate Biology	BIO 467 Animal Behavior
BIO 522 Plant Molec. Biology	BIO 551 Sem. Aquatic Botany
BIO 563 Ichthyology	BIO 566 Herpetology
BIO 568 Ornithology	

- Ecology (at least 3 credits):

BIO 455 Marine Ecology	BIO 457 Marine Ecology Lab
BIO 458 Limnology	BIO 524 Methods Plant Ecology
BIO 560 Sem. Plant Ecology	BIO 561 Behavioral Ecology
BIO 562 Sem. Behav. Ecology	BIO 570 Field Biology Fishes
ENT 544 Insect Ecology	ENT 561 Aquatic Entomology
NRS 423 Wetland Ecology	NRS 525 Wetland Field Invest.
NRS 534 Ecol. Fragm. Landsc.	NRS 538 Physiol. Ecol. Verts.

NRS 555 Appl. Coast. Ecology	PLS 576 Envir. Plant Physiol.

- Biodiversity Analysis & Management (at least 3 credits):

ENT 519 Insect Biol. Control	ENT 555 Insect Pest Mgt.
NRS 406 Wetland Wildlife	NRS 407 Nongame/Endang. Spp
NRS 410 Fundamentals	GIS NRS 415 Remote Sens. Envmt.
NRS 424 Wetlands/Land Use	NRS 509 GIS Concepts/Applic.
NRS 516 Adv. Remote Sensing	NRS 522 Adv. GIS Analysis
NRS 524 Appl. Adv. Spat. Anal.	NRS 532 Consv. Biol./Res. Econ.
NRS 533 Landsc. Pattern/Change	

Social Sciences (6 credits)

CPL 511 Plann./Nat. Env. Syst.	CPL 539 Environmental Law
CPL 545 Land Devel. Seminar	MAF 461 Coastal Zone Mgt.
MAF 521 Coastal Zone Law	MAF 544 Water Resources Law
MAF 582 Estuarine Mgt.	REN 410 Fish/Wildl. Economics
REN 432 Envir. Econ./Policy	REN 440 Benefit-Cost Analysis
REN 514 Econ. Marine Resour.	REN 535 Envir. Economics

Numerical Methods (3 credits)

ENT 529 Systems Sci. Ecol.	NRS 520 Quant. Techn. NRS
STA 412 Stat. Meth. Res. II	STA 550 Ecological Statistics

2. Electives (6-10 credits)

Selections may come from the above lists or from other approved graduate-level courses. Enrollment in a 3-credit internship (EVS

597) with a professional environmental agency, organization, or firm is optional.

3. Independent Study (3 credits)

EVS 598 Professional Master's Research

4. Graduate Seminar (2 credits)

Graduate Seminar in NRS or PLS.

Environmental Science and Management

EARTH AND HYDROLOGIC SCIENCE SPECIALIZATION

(Total credits = 36)

1. Core Courses (21-25 credits)

Natural Sciences (12-16 credits)

- Earth Surface Processes:

GEO 450 Intro. Sed. Geology	GEO 515 Glacial Geology
GEO 550 Sed. Processes/Envmts.	GEO 577 Coastal Geol. Hazards
NRS 412 Soil-Water Chem.	NRS 423 Wetland Ecology
NRS 424 Wetlands/Land Use	NRS 440 Ecosystem Processes
NRS 441 Meth. Ecosys. Anal.	NRS 450 Capstone Soil./Water
NRS 452 Soil, Water Invest.	NRS 471 Soil Morphol./Mapp.
NRS 525 Wetland Field Invest.	NRS 555 Appl. Coast. Ecology
NRS 567 Soil Genesis/Classif.	

- Hydrology:

CVE 475 Water in Environment	CVE 588 Groundwater Hydrol.
GEO 468 Ground-Water Chem.	GEO 483 Hydrogeology
GEO 485 Envir. Engin. Geophys	GEO 568 Isotopes Hydrogeol.
GEO 582 Innov. Remed.	GEO 583 Ground-Water

Technol	Modeling
GEO 584 Envir. Hydrogeology	GEO 587 Contam. Transpt. Model
NRS 510 Soil-Water Relations	

- Solid Earth Materials & Processes:

GEO 401 Ore Deposits	GEO 421 High Temp. Geochem.
GEO 465 Intro. Geophysics	GEO 488 Geol. Evol. N. Amer.
GEO 530 Petrogenic Ign. Proc.	GEO 554 Sediment. Petrology
GEO 565 Geophys. Models	GEO 580 New England Geology
GEO 581 Topics Tectonic Geol.	

- Spatial Analysis & Remote Sensing:

NRS 410 Fundamentals GIS	NRS 415 Remote Sens. Envmt.
NRS 509 GIS Concepts/Applic.	NRS 516 Adv. Remote Sensing
NRS 522 Adv. GIS Analysis	NRS 524 Appl. Adv. Spat. Anal.

Social Sciences (6 credits)

CPL 539 Environmental Law	CPL 549 Seminar Ecol. Planning
MAF 461 Coastal Zone Mgt.	MAF 521 Coastal Zone Law
MAF 544 Water Resource Law	REN 432 Envir. Econ./Policy
REN 440 Benefit-Cost Analysis	REN 514 Econ. Marine Resour.
REN 528 Microeconomic Theory	

Numerical Methods (3 credits)

ENT 529 Systems Sci. Ecol.	NRS 520 Quant. Techn. NRS
STA 412 Stat. Meth. Res. II	STA 413 Data Analysis

2. Electives (6-10 credits)

Selections may come from the above lists or from other approved graduate-level courses. Enrollment in a 3-credit internship (EVS 597) with a professional environmental agency, organization, or firm is optional.

3. Independent Study (3 credits)

EVS 598 Professional Master's Research

4. Graduate Seminar (2 credits)

Graduate Seminar in GEO or NRS.

Master of Environmental Science and Management

ENVIRONMENTAL POLICY AND MANAGEMENT SPECIALIZATION

(Total credits = 36)

1. Core Courses (21-25 credits)

Social Sciences (12-16 credits)

- Policy, Planning & Law (at least 6 credits):

CPL 501 Comm. Plann. Practice	CPL 510 Comm. Plann. Pol./Soc. Change
CPL 511 Plann./Nat. Env. Syst.	CPL 522 Planning Law
CPL 538 Site Planning	CPL 539 Environmental Law
CPL 543 Meth. Soc. Policy Anal.	CPL 545 Land Devel. Seminar
CPL 546 Urb/Rural Transp. Plann.	CPL 549 Seminar Ecol. Planning
MAF 456 Polar Resources/Policy	MAF 461 Coastal Zone Mgt.

MAF 471 Island Ecosystem Mgt.	**MAF 475 Human Respons. Coast. Hazards**
MAF 484 Envir. Anal./Policy Coast.	**MAF 511 Ocean Uses/Marine Sci.**
MAF 515 Marine Pollution Policy	**MAF 521 Coastal Zone Law**
MAF 523 Fisheries Law & Mgt.	**MAF 530 Coastal Areas Mgt. Sem.**
MAF 544 Water Resource Law	**MAF 577 International Ocean Law**
MAF 578 Intern. Ocean Organiz.	**MAF 582 Estuarine Mgt.**

- Economic Theory & Methods (at least 6 credits; may include 3 credits from Numerical Methods):

REN 410 Fish/Wildl. Economics	**REN 415 Envir. Harms/Sanctions**
REN 432 Envir. Econ./Policy	**REN 440 Benefit-Cost Analysis**
REN 456 Tourism Economics	**REN 528 Microeconomic Theory**
REN 529 Game Theory	**REN 534 Econ. Natural Resources**
REN 570 Experim. Economics	

Natural Sciences (9 credits; may include 3 credits from Numerical Methods)

- Geology, Hydrology & Soil Science:

GEO 450 Intro. Sed. Geology	**GEO 483 Hydrogeology**
GEO 484 Envir. Hydrogeology	**GEO 515 Glacial Geology**
GEO 550 Sed. Processes/Envmts.	**GEO 577 Coastal Geol. Hazards**
NRS 412 Soil-Water Chemistry	**NRS 426 Soil Microbiology**
NRS 450 Capstone Soil/Water	**NRS 452 Soil, Water Invest.**
NRS 471 Soil Morphol./Mapp.	**NRS 510 Soil-Water Relations**
NRS 567 Soil Genesis/Classif.	

- Ecology and Management

NRS 406 Wetland Wildlife	NRS 423 Wetland Ecology
NRS 424 Wetlands/Land Use	NRS 440 Ecosystem Processes
NRS 441 Meth. Ecosys. Anal.	NRS 525 Wetland Field Invest.
NRS 526 Microbial Ecology	NRS 532 Consv. Biol./Res. Econ.
NRS 534 Ecol. Fragm. Landsc.	NRS 555 Appl. Coast. Ecology

- Remote Sensing & Spatial Analysis:

MAF 465 GIS Appl. Coast. Mgt.	NRS 410 Fundamentals GIS
NRS 415 Remote Sens. Envmt.	NRS 509 GIS Concepts/Applic.
NRS 516 Adv. Remote Sensing	NRS 522 Adv. GIS Analysis
NRS 524 Appl. Adv. Spat. Anal.	NRS 533 Landsc. Pattern/Change

Numerical Methods (3 credits)

ENT 529 Systems Sci. Ecol. *NRS 520 Quant. Techn. NRS*
STA 412 Stat. Meth. Res. II STA 550 Ecological Statistics*
REN 576 Econometrics**

2. Electives (6-10 credits)

Selections may come from the above lists or from other approved graduate-level courses. Enrollment in a 3-credit internship (EVS 597) with a professional environmental agency, organization, or firm is optional.

3. Independent Study (3 credits)

EVS 598 Professional Master's Research

4. Graduate Seminar (2 credits)

Graduate Seminar in CPL, MAF, or REN.

*May be counted as Natural Sciences.

**May be counted as Economic Theory & Methods.

Master of Environmental Science and Management

REMOTE SENSING AND SPATIAL ANALYSIS SPECIALIZATION

(Total credits = 36)

1. Core Courses (21-25 credits)

Natural Sciences (12-16 credits)

- Remote Sensing & Spatial Analysis (at least 9 credits):

NRS 410 Fundamentals of GIS*	NRS 415 Remote Sens. Envmt.*
NRS 509 GIS Concepts/Applic.*	NRS 516 Adv. Remote Sensing*
NRS 522 Adv. GIS Analysis*	NRS 524 Appl. Adv. Spat. Anal.
NRS 533 Landsc. Pattern/Change	OCG 665 Marine Remote Sens.

- Earth & Ecosystem Science (0-7 credits):

GEO 483 Hydrogeology	GEO 484 Envir. Hydrology
GEO 515 Glacial Geology	GEO 550 Sed. Processes/Envmts.
GEO 577 Coastal Geol. Hazards	GEO 580 New England Geology
NRS 423 Wetland Ecology	NRS 424 Wetlands/Land Use
NRS 440 Ecosystem Processes	NRS 441 Meth. Ecosys. Anal.
NRS 450 Capstone Soil/Water	NRS 452 Soil, Water Invest.
NRS 471 Soil Morphol./Mapp.	NRS 510 Soil-Water Relations
NRS 525 Wetland Field Invest.	NRS 532 Consv. Biol./Res. Econ.
NRS 534 Ecol. Fragm. Landsc.	NRS 555 Appl. Coast. Ecology
NRS 567 Soil Genesis/Classif.	

Social Sciences (6 credits)

CPL 511 Plann./Nat. Env. Syst.	**CPL 545 Land Devel. Seminar**
CPL 549 Seminar Ecol. Planning	**MAF 461 Coastal Zone Mgt.**
MAF 465 GIS Appl. Coast. Mgt.	**MAF 484 Envir. Anal./Policy Coast.**
MAF 582 Estuarine Mgt.	**REN 410 Fish/Wildl. Economics**
REN 432 Envir. Econ./Policy	**REN 440 Benefit-Cost Analysis**
REN 514 Econ. Marine Resour.	**REN 535 Envir. Economics**

Numerical Methods (3 credits)

ENT 529 Systems Sci. Ecol.	**NRS 520 Quant. Techn. NRS**
STA 412 Stat. Meth. Res. II	**STA 413 Data Analysis**

2. Electives (6-10 credits)

Selections may come from the above lists or from other approved graduate-level courses. Enrollment in a 3-credit internship (EVS 597) with a professional environmental agency, organization, or firm is optional.

3. Independent Study (3 credits)

EVS 598 Professional Master's Research

4. Graduate Seminar (2 credits)

Graduate Seminar in GEO or NRS.

***This course or an equivalent is required, unless it was taken prior to matriculation in this degree program.**

Master of Environmental Science and Management

SUSTAINABLE SYSTEMS SPECIALIZATION

(Total credits = 36)

1. Core Courses (21-25 credits)

Natural Sciences (12-16 credits)

- Natural Ecosystems (at least 3 credits):

ASP 401 Pathobiology	ASP 476 Genetics of Fish
BIO 524 Methods Plant Ecology	BIO 560 Sem. Plant Ecology
ENT 519 Insect Biol. Control	ENT 529 Systems Sci. Ecol.
ENT 544 Insect Ecology	ENT 561 Aquatic Entomology
FST 415 Fishery Science	FST 416 Fishery Science Lab
FST 510 Prob. Marine Fish. Ecol.	NRS 406 Wetland Wildlife
NRS 440 Ecosystem Processes	NRS 534 Ecol. Fragm. Landsc.
PLS 511 Nature Plant Disease	PLS 576 Envir. Plant Physiol.

- Managed Ecosystems (at least 3 credits):

ASP 400 Diseases Cult. Fishes	ASP 421 Aquaculture/Envir
ASP 432 Mar. Finfish & Aquacult.	ASP 481 Shellfish Aquacult. Lab
ASP 483 Salmonid Aquaculture	ASP 486 Appl. Physiology Fish
ASP 581 Topics Mollusc. Aquacult.	ASP 584 Adv. Aquacult. Systems
ASP 586 Fish Nutrition	AVS 412 Animal Nutrition
AVS 420 Animal Breed. Genetics	ENT 555 Insect Pest Mgt.
ENT 571 Insect Microbiology	ENT 586 Med./Vet. Entomology
FST 421 Design Fish Capture Syst.	FST 516 Life Hist. Aquat. Animals
FST 521 Eval. Fish Capture Syst.	FST 531 Fish Stock Assessment
PLS 405 Propag. Plant Materials	PLS 440 Diseases Turf/Trees/Shrubs

PLS 463 Prin. Plant Disease Control	PLS 471 Plant Improvement I
PLS 472 Plant Improvement II	PLS 475 Plant Nutrit./Soil Fertil.

Social Sciences (6 credits)

CPL 511 Plann./Nat. Env. Syst.	CPL 539 Environmental Law
CPL 545 Land Devel. Seminar	MAF 523 Fisheries Law/Mgt.
MAF 544 Water Resources Law	MAF 582 Estuarine Mgt.
PSC 402 Envir. Policy/Politics	REN 410 Fish/Wildl. Economics
REN 432 Envir. Econ./Poli	REN 440 Benefit-Cost Analysis
REN 528 Microeconomic Theory	REN 535 Envir. Economics

Numerical Methods (3 credits)

ENT 529 Systems Sci. Ecol.	STA 412 Stat. Meth. Res. II
STA 500 Nonparam. Statist. Meth.	STA 520 Fund. Sampl./Applic.
STA 532 Experimental Design	STA 550 Ecological Statistics

2. Electives (6-10 credits)

Selections may come from the above lists or from other approved graduate-level courses. Enrollment in a 3-credit internship (EVS 597) with a professional environmental agency, organization, or firm is optional.

3. Independent Study (3 credits)

EVS 598 Professional Master's Research

4. Graduate Seminar (2 credits)

Graduate Seminar in ASP, NRS, PLS, or REN.

Master of Environmental Science and Management

WETLAND, WATERSHED, AND ECOSYSTEM SCIENCE SPECIALIZATION

(Total credits = 36)

1. Core Courses (21-25 credits)

Natural Sciences (12-16 credits)

- Ecosystem Science & Management (at least 6 credits):

NRS 406 Wetland Wildlife	NRS 423 Wetland Ecology
NRS 424 Wetlands/Land Use	NRS 440 Ecosystem Processes
NRS 441 Meth. Ecosys. Anal.	NRS 525 Wetland Field Invest.
NRS 526 Microbial Ecology	NRS 532 Consv. Biol./Res. Econ.
NRS 534 Ecol. Fragm. Landsc.	NRS 555 Appl. Coast. Ecology
NRS 582 Sem. Soil Ecol./Biochem.	

- Earth Science, Soils & Spatial Analysis (at least 3 credits):

GEO 450 Intro. Sed. Geology	GEO 482 Innov. Remed. Technol.
GEO 483 Hydrogeology	GEO 484 Envir. Hydrology
GEO 515 Glacial Geology	GEO 550 Sed. Processes/Envmts.
GEO 577 Coastal Geol. Hazards	GEO 583 Ground-Water Modeling
GEO 585 Org. Contam. Hydrochem.	MAF 465 GIS Appl. Coast. Mgt.
NRS 410 Fundamentals GIS	NRS 412 Soil-Water Chemistry
NRS 415 Remote Sens. Envmt.	NRS 426 Soil Microbiology
NRS 450 Capstone Soil/Water	NRS 452 Soil, Water Invest.
NRS 471 Soil Morphol./Mapp.	NRS 509 GIS Concepts/Applic.
NRS 510 Soil-Water Relations	NRS 516 Adv. Remote Sensing
NRS 533 Landsc. Pattern/Change	NRS 567 Soil Genesis/Classif.

Social Sciences (6 credits)

CPL 511 Plann./Nat. Env. Syst.	CPL 539 Environmental Law
CPL 545 Land Devel. Seminar	CPL 549 Seminar Ecol. Planning
MAF 461 Coastal Zone Mgt.	MAF 484 Envir. Anal./Policy Coast.
MAF 521 Coastal Zone Law	MAF 544 Water Resource Law
MAF 582 Estuarine Mgt.	PSC 402 Envir. Policy/Politics
REN 410 Fish/Wildl. Economics	REN 432 Envir. Econ./Policy
REN 440 Benefit-Cost Analysis	REN 514 Econ. Marine Resour.
REN 535 Envir. Economics	

Numerical Methods (3 credits)

ENT 529 Systems Sci. Ecol.	NRS 520 Quant. Techn. NRS
STA 412 Stat. Meth. Res. II	STA 550 Ecological Statistics

2. Electives (6-10 credits)

Selections may come from the above lists or from other approved graduate-level courses. Enrollment in a 3-credit internship (EVS 597) with a professional environmental agency, organization, or firm is optional.

3. Independent Study (3 credits)

EVS 598 Professional Master's Research

4. Graduate Seminar (2 credits)

Graduate Seminar in NRS.