

Aquaculture and Fisheries Ecology **(AFS)**

AFS 415: Fishery Ecology (Fall) (NS)

LEC: (3 crs.) Ecological characteristics of fishes and shellfishes in capture fisheries worldwide. Relationship between aspects of fishing, habitats, and community structure along with assessment methods. (Lec. 3) Pre: AFS 215 and MTH131 or MTH141; concurrent registration in 416.

AFS 416: Fishery Ecology Laboratory (Fall) (NS)

LAB: (1 cr.) Practices and techniques of fisheries ecology. Field exercises in local model estuary and coastal zone on sampling methods, enumerating and documenting collections, measuring and reporting environmental attributes, estimating population parameters. (Lab. 2) Pre: concurrent registration in AFS 415.

AFS 421: Design of Fish Capture Systems

LEC: (3 crs.) Detailed study of the design considerations and methods of construction of specific representative commercial and scientific sampling fish capture gear. Full-scale and model nets are designed, constructed, and tested. (Lec. 2, Lab. 3) Pre: AFS 321 or permission of instructor.

AFS 425: Aquaculture and the Environment (Spring) (NS)

LEC: (3 crs.) Impacts of aquaculture practices on the environment, including habitat alteration, release of drugs and chemicals, and interaction of cultured and wild organisms. Methods to reduce or eliminate those impacts: modeling, siting and monitoring of aquaculture facilities; use of polyculture and water reuse systems. (Lec. 3) Pre: AFS 102.

AFS 432: Marine Finfish Aquaculture (Spring) (NS)

LEC: (3 crs.) Culture of non-salmonid marine fish worldwide, with emphasis on the hatchery phase. Broodstock, larval rearing, live and formulated feeds, grow-out systems, stock enhancement. Requires student project on facility design. Pre: AFS 102.

AFS 433: Research Diving Methods (Fall) (NS)

LEC: (3 crs.) Underwater methods used to assess biological, physical, chemical, and geological characteristics of estuarine and coastal environments are presented and used to investigate seasonal changes in these parameters in the Narragansett Bay environment. (Lec. 2, Lab. 3) Pre: scuba certification and permission of instructor.

AFS 481: Shellfish Aquaculture Laboratory (Fall-alternate years) (NS)

LAB: (2 crs.) Detailed study of hatchery, nursery, and grow-out techniques for the production of bivalve mollusks. Culture of phytoplankton, conditioning of broodstock, spawning, larviculture, settlement, metamorphosis, nursery and grow-out methods. (Lab. 6) Pre: AFS 201 or permission of instructor. Offered in fall of odd-numbered years.

AFS 486: Fish Physiology (Fall) (NS)

LEC: (3 crs.) Study of how fish function in the changing aquatic environment from the molecular to the organismal level. The major organ systems, regulation of physiological and biochemical functions, and interactions will be explored. (Lec. 3) Pre: BIO 201 or 242, or AVS 331, or permission of instructor.

AFS 500: Diseases of Aquatic Organisms (Spring-alternate years) (NS)

LEC: (3 crs.) Nature, causes, diagnosis, and spread of diseases limiting piscine freshwater and marine aquaculture projects. Emphasis on prevention, control, and treatment of more common diseases affecting hatchery management. (Lec. 3) Pre: AFS 102; BIO 201 or AVS 331.

AFS 531: Fisheries Stock Assessment (Fall-alternate years) (Q)

LEC: (3 crs.) A quantitative approach to describing the processes of fish growth and mortality, the estimation of stock size, the prediction of stock yield, and management practices. Spreadsheets and other microcomputer applications will be used for analysis and modeling. (Lec. 2, Lab. 3) Pre: AFS 415, STA 409 or permission of instructor.

AFS 532: Experimental Design (Fall) (Q)

LEC: (3 crs.) Cross-listed as (STA), PSY, AFS 532. Application of statistical methods to biological and psychological research and experimentation. Experimental situations for which various ANOVA and ANCOVA designs are most suitable. (Lec. 3) Pre: STA 409 or equivalent.

AFS 560: Ecosystem Based Fisheries Science & Management (Spring) (NS or SS)

LEC: (3 crs.) Cross-listed as (AFS), OCG 560. The scientific components of ecosystem-based fisheries management: climate variation, trophic interactions, habitat, bycatch, and human dimensions. Classes emphasize problem-solving through case studies of domestic and international fisheries. (Lec. 3) Pre: Graduate standing or instructor permission.

AFS 581: Current Topics in Molluscan Aquaculture (Fall-alternate years) (NS)

LEC: (3 crs.) Review and critical analysis of recent literature within the field of molluscan biology with emphasis on application to mariculture techniques. Student presentation of selected topics and field trips to state-of-the-art mariculture facilities. (Lec. 3) Pre: graduate standing or senior standing with permission of instructor.

AFS 584: Advanced Aquaculture Systems (Spring-alternate years) (NS)

LEC: (3 crs.) Development of design criteria, operational analysis, and management of selected species in water reuse systems. (Lec. 2, Lab. 2) In alternate years.

AFS 591: Special Projects (Spring or Fall)

IND: (1-3 crs.) Research projects in animal pathology, virology, and aquaculture. (Independent Study) Pre: graduate standing or permission of chairperson.

AFS 592: Special Projects Spring or Fall)

IND: (1-3 crs.) Research projects in animal pathology, virology, and aquaculture. (Independent Study) Pre: graduate standing or permission of chairperson.

Biological & Environmental Studies (BES) BES

BES 500: Advanced Science Ethics (Fall) (SS)

LEC: (1 cr.) This course focuses on the ethics of scientific research using case studies to inform discussion on common ethical issues in science. (Lec. 1) Pre: graduate standing or permission from the instructor.

BES 501: Advanced Scientific Communication (Fall) (SS)

LEC: (2 crs.) This course focuses on the process of writing and reviewing scientific manuscripts and grant proposals. (Lec. 1, Sem. 1) Pre: graduate standing or permission from the instructor.

BES 532: Advanced Conservation Biology (NS)

SEM: (3 crs.) Cross-listed as (BES), EEC 542. Examination of different components of conservation of biological diversity. Topics include minimum viable populations, ecology and economics of reserve design, reintroductions, causes of extinction, and the ecosystem conservation strategies. (Seminar) Pre: permission of instructor.

BES 533: Using Multimedia to Communicate Science (SS)

LEC: (3 crs.) An advanced course that provides training to students of the sciences in multimodal--radio, tv, and print--storytelling focusing on science related issues. (Lec. 3) Pre: Graduate standing or permission of instructor.

BES 550: Advanced Ecology (Fall) (NS)

LEC: (4 crs.) This course provides a survey of physiological, population, and community ecology. It encourages thinking and learning about key ecological concepts through primary literature, discussion, analytical writing, and problem sets. (Lec. 4) Pre: graduate standing; must have completed introductory biology and ecology or courses that included significant introduction to ecology.

BES 551: Ecosystem Science and Sustainability (NS)

LEC: (3 crs.) Fundamental principles of systems ecology linking natural and human infrastructure, processes, ecosystem dynamics with focus on global change; creating innovative methods to frame the complexity of designing more sustainable systems. (Lec. 3) Pre: Graduate standing or permission of instructor.

BES 593: Internship in Science Writing (Spring) (SS)

PRA: (3 crs.) Internship with agency or organization in which student develops and disseminates written pieces on science-related topics to non-scientific audiences. (Practicum) Pre: Previous completion of WRT 533, NRS 543, and permission of instructor.

Biological Sciences (BIO)**BIO 412 Evolution and Diversity of Fishes (Spring) (NS)****BIO 455: Marine Ecology (Spring) (NS)**

LEC: (3 crs.) Investigation of the structure and dynamics of various marine ecosystems. Includes mineral cycling, energy flow, community and population organization, and behavioral ecology in selected marine environments. (Lec. 3) Pre: 262 or permission of instructor.

BIO 457: Marine Ecology Lab (Spring) (NS)

LAB: (1 cr.) Field and laboratory work on community relationships of dominant organisms in Rhode Island marine environments. (Lab. 3) Pre: concurrent enrollment in 455. Limited to 15 students.

BIO 475: Coral Reef Ecology (Fall) (NS)

(5 crs.) Structure and function of coral reef ecosystems with emphasis on the biology of corals. Laboratory sessions focus on field surveys and research techniques. (Practicum, Lab 8) Taught in Bermuda. Pre: BIO 262 and junior standing; SCUBA certification required.

BIO 539: Big Data Analysis (Spring) (Q)

LEC: (3 crs.) Cross-listed as (BIO) DSP 539. Learn about big data and gain sufficient programming skills to analyze data efficiently and accurately for research. (Lec. 3) Pre: graduate standing

BIO 544: Insect Ecology (Spring alternate years) (NS)

LEC: (3 crs.) Cross-listed as (ENT), BIO 544. Ecology of insects and other terrestrial arthropods at the physiological, individual, population, community, and ecosystem levels. Pre: permission of instructor. In alternate years.

BIO 572: Advanced Evolutionary Biology (Spring) (NS)

LEC: (3 crs.) Cross-listed as (BIO), GEO 572. A survey of modern evolutionary biology, including classic evolutionary theory, phylogenetics, evolution and development, adaptation, mass extinction and genomic evolution. (Lec./Sem. 3) Pre: BIO/GEO 272, graduate standing, or permission of instructor.

BIO 580: Community Ecology (Spring alternate years) (NS)

LEC: (3 crs.) Explores community ecology, with an emphasis on interspecific interactions (competition, predation, mutualism), species diversity, succession, niche theory, and island biogeography. Format includes lecture, case studies, and discussion. (Lec. 3) Pre: BIO 262 or permission of instructor.

BIO 585: Salt Marsh Ecology (Fall) (NS)

(4 crs.) Cross-listed as (BIO), NRS 585. Structure and function of salt marsh ecosystems, including biogeochemistry, in the context of global change. Seminar-style discussions, weekly assignments, written and oral presentations of independent proposal and research project. (Lec. 2, Lab. 4) Pre: permission of instructor. Prior undergraduate coursework equivalent to a course in ecology and 2 semesters of chemistry is expected.

Communication Studies (COM)**COM 520: Seminar in Media Studies (Varies) (SS)**

SEM: (3 crs.) In-depth examination of a topic in mass or electronic media, or new information technologies. Students review and discuss appropriate literature and author a major research paper. May be repeated under a different topic. (Seminar) Pre: graduate standing or permission of instructor (Note that the topic varies for this course, but occasionally focuses on environmental communication topics relevant to MESM.)

Community Planning (CPL)

CPL 410: Fundamentals of Community Planning Practice (Fall) (SS)

(3 crs.) Survey of the planning profession and its different functional areas: land use, environment, urban design, transportation, housing, economic development, and growth management. (Lec. 3) Pre: junior, senior, or graduate standing, or permission of instructor.

CPL 434: Introduction to Environmental Law (Fall) (SS)

LEC: (3 crs.) Cross-listed as (CPL), LAR 434. Surveys issues arising out of laws designed to protect the environment and manage resources: right to a decent environment, government regulation versus private property rights, citizen participation in planning environmental controls. (Lec. 3) Pre: sophomore standing (45 credits completed) and above.

CPL 450: Urban Design (Spring) (SS)

LEC: (3 crs.) Concepts of contemporary urban landscapes, ranging from entire cities to specific building sites. Includes private development, public spaces, transportation systems, aesthetics, and sprawl. Emphasis on urban design processes and standards. (Lec. 3) Pre: junior, senior, or graduate standing, or permission of instructor.

CPL 483: Land Development (Fall) (SS)

LEC: (3 crs.) Study of land development including land acquisition, development and project effectiveness. Techniques focus on land suitability and project viability, as well as environmental considerations. Focus on coastal development. (Lec. 3) Pre: junior, senior, or graduate standing, or permission of instructor.

CPL 485: Environmental Planning (Spring) (SS)

LEC: (3 crs.) Theories, methodologies, and substantive concerns of environmental resource analysis with attention given to coastal environmental issues. Focus on land, soils, watersheds, water quality, vegetation, air quality, wildlife, noise pollution. (Lec. 3) Pre: junior, senior, or graduate standing, or permission of instructor.

CPL 501: Introduction to Community Planning Practice (Spring) (SS)

LEC: (3 crs.) The development of community planning in the United States, history of governmental planning and evaluation of the planning profession, and the elements of planning practice. (Lec. 3)

CPL 516: Seminar On the Urban Waterfront (Fall-alternate years) (SS)

SEM: (3 crs.) Cross-listed as (MAF), CPL 516. The urban environment and its evolution, structure, and function as it pertains to metropolitan waterfronts and small recreational harbors. Emphasis on the permitting process, public participation, marine recreation, and management issues. Field trip and student project required. (Seminar).

CPL 537 Land Resource Economics (Q or SS)

LEC: (3 crs.) Cross-listed as (CPL), EEC 532. The study of economic relationships of human and scarce natural and human-made resources. Supply and demand, rent theory, resources conservation, and the impact of public policy and law. (Lec. 3)

CPL 538 Site Planning (Fall) (NS)

(3 crs.) Site analysis, planning, and design processes. Principles and techniques addressing residential, commercial, and mixed-use developments. Presents techniques to review site plans and evaluate post-development impacts. (Lec. 3) Pre: graduate standing or permission of instructor.

CPL 539: Environmental Law (SS)

LEC: (3 crs.) Analysis of specific environmental issues and policies including facility siting, land use and constitutional issues, comprehensive planning, public trust doctrine, concurrence and state impact assessments. Independent research and presentation required. (Lec. 3)

Environmental Economics (EEC)**EEC 430: Water Resource Economics (Fall) (SS or Q)**

LEC: (3 crs.) This course will analyze the economics of valuation, management, and distribution of water resources using economic theory and case studies to evaluate water policies and their effect on society. (Lec. 3) Pre: EEC 105 or ECN 201 or permission of instructor.

EEC 432: Environmental and Resource Economics and Policy (Spring) (SS)

LEC: (3 crs.) Economic analysis of policies that address environmental and natural resource problems. Topics include pollution-control policies, economic incentives, and the optimal use of renewable and nonrenewable natural resources. (Lec. 3) Pre: EEC 205 or ECN 201.

EEC 440: Benefit-Cost Analysis (Fall) (SS or Q)

LEC: (3 crs.) Basic concepts in benefit-cost analysis. Measurement, comparison of benefits and costs over time, and criteria for evaluation of projects and public policies. Problems and case studies in evaluation of current natural resources issues. (Lec. 3) Pre: EEC 105 or permission of instructor.

EEC 502: Research Methodology in Environmental and Natural Resource Economics

(Fall) (Q) (3 crs.) Practice and methods of applied research in environmental and natural resource economics. Topics include philosophical foundations, research project design, reporting research results, and criticism of proposals and research papers. (Lec. 3) Pre: EEC 528 and 576 or permission of instructor.

EEC 514 Economics of Marine Resources (Spring) (SS)

(3 crs.) Role of economics in management of estuarine and marine resources. Particular attention to resource valuation, environmental issues, and management of renewable and nonrenewable resources. (Lec. 3) Not for graduate credit in resource economics.

EEC 534: Economics of Natural Resources (Spring) (SS)

LEC: (4 crs.) Microeconomic theory applied to problems of natural resource allocation. The rationale for government intervention in the market's provision of natural resources and alternative techniques for optimally allocated natural resources are investigated. (Lec. 4) Pre: EEC 528 or permission of instructor.

EEC 535 Environmental Economics (Spring)(SS)

EEC: (3 crs.) Theory of externalities; incentive-based and regulatory policy instruments for addressing market failure; theory and methods for valuing natural resource and environmental services; other environmental topics. (Lec. 3) Pre: EEC 528 or equivalent.

EEC 634: Advanced Economics of Natural and Environmental Resources (Spring-alternate years) (SS)

LEC: (4 crs.) Concepts of economic efficiency applied to natural resources with emphasis on intertemporal allocation of nonrenewable and renewable resources. Application of welfare and institutional economics to resource management and development; analysis of optimum allocation among users. (Lec. 4) Pre: EEC 534 and 624 or permission of instructor.

Environmental Sciences (EVS)**EVS 501: Development of Learning Outcomes for MESM (Fall) (SEM)**

SEM: (1 cr.) Formulate learning outcomes and develop professional internships for new MESM students through interaction with URI faculty involved in the MESM tracks, develop skills in environmental communication, leadership, and ethics. (Seminar) Pre: enrollment in MESM graduate program.

EVS 502: Seminar in Environmental Science and Management (Spring) (SEM)

SEM: (1 cr.) Presentation of proposed, ongoing and completed major projects by MESM graduate students. Discussion among graduate students, faculty, and other mentors on project design, methods, analysis, and presentation. (Seminar) Pre: enrollment in MESM graduate program.

EVS 505: Environmental Leadership in Practice (Culminating Experience) (Spring) (SS)

LEC: (3 crs.) Explores theory and practice of leadership in the context of environmental problems and natural resources management. Emphasis on effective leadership and communication approaches across environmental organizations. (Lec. 3) Pre: Graduate student in the MESM Program or permission of instructor

EVS 510X: Field Practicum in Coastal Resilience (Summer) (NS or SS)

The Field Practicum in Coastal Resiliency course is designed to expose students to the science, management, and policy challenges of achieving resilient coastal environments and communities in the face of a changing climate. Students will learn directly from coastal scientists, managers and regulators from the local, state and federal level about the complexity of resiliency planning and the best available science and tools that are used to guide management and policy decisions in the face of uncertainty.

EVS 582: Innovative Subsurface Remediation Technologies (Spring-alternate years) (NS)

LEC: (4 crs.) Cross-listed as (GEO), EVS 582, NRS 583. Innovative remediation technologies for treating contaminated groundwater and sediments: theory, applications, and limitations of selected methods. Discussion of case studies. Offered alternate years (Lec. 4) Pre: permission of instructor.

EVS 584: Environmental Hydrogeology (Spring) (NS)

(4 crs.) Cross-listed as (GEO), EVS, NRS 584. Develop an understanding of the physico-chemical principles and fundamental relationships that describe the fate and transport of contaminants in the hydrologic system. (Lec. 3, Lab 2) Pre: GEO 483 or CVE 588 or NRS 510 or permission of instructor.

EVS 587: Environmental Hazards, Risks, Response, and Safety (Spring) (SS)

(3 crs.) Environmental, health, and safety regulations and requirements for working with hazardous materials and at hazardous waste site-related work sites. Emphasis on application of knowledge and skills needed to anticipate, recognize, evaluate, and determine controls for various hazards and risks that may be encountered at site investigations, at waste sites, and in the industrial workplace. Includes opportunity to earn OSHA 40-hour certification. (Lec. 3) Pre: Permission of instructor. Respirator clearance required prior to start of classes.

EVS 589: Environmental Hazards, Risks, Response, and Safety: Refresher (SS)

LEC: (1 cr.) Review of the environmental, health, and safety requirements for working with hazardous materials and at hazardous waste site-related work activities. Includes opportunity to earn OSHA 8-hour refresher certification. (Lec. 1) Pre: GEO or EVS 587 or permission of instructor (current OSHA 40-hour HAZWOPER certificate required). May be repeated, but not for program credit.

EVS 597: Professional Internship in Environmental Science and Management (Spring/Fall) (NS, SS, or CE)

PRA: (1-3 crs.) 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 program. (Practicum) Pre: enrollment in MESM degree program.

EVS 598: Professional Master's Research (Culminating Experience Option) (Spring/Fall) (CE)

IND: (3 crs.) Independent investigation to satisfy the research requirement for the Master of Environmental Science and Management degree. Substantial paper required. (Independent Study) Pre: enrollment in MESM degree program.

Geosciences (GEO)**GEO 404: Environmental Data Acquisition and Analysis (Fall) (Q)**

LEC: (3 crs.) Cross-listed as (OCG), NRS, GEO 404. Introduction to instrument prototyping and measurements in environmental science. Hands-on with data collection: programming microcontrollers, interfacing hardware and software, wireless sensor networks. Data analysis in Python. (Lec. 2, Lab. 1) Pre: MTH 131 or MTH 141.

GEO 483: Hydrogeology (Fall) (NS)

LEC: (4 crs.) Study and interpretation of groundwater flow systems and the interaction between groundwater and the geologic framework, including: groundwater flow, aqueous geochemistry, groundwater resource evaluation, and groundwater in geologic processes. (Lec. 3, Lab. 2) Pre: GEO 103, 210, and MTH 131 or 141, or permission of instructor.

GEO 535: Geospatial Watershed Modeling (Spring) (NS)

LEC: (3 crs.) Cross-listed with (GEO) NRS, CVE 535. Tools to simulate the water quantity and quality of a complex watershed; development of models for examining the water quantity and quality issues that are associated with watershed management. (Lec. 2, Lab. 2) Pre: NRS 461 or GEO 483 or CVE 475 or equivalent, or graduate standing, or permission of instructor.

GEO 582: Innovative Subsurface Remediation Technologies (Spring odd years) (NS)

LEC: (4 crs.) Cross-listed as (GEO), EVS 582, NRS 583. Innovative remediation technologies for treating contaminated groundwater and sediments: theory, applications, and limitations of selected methods. Discussion of case studies. Offered alternate years (Lec. 4) Pre: permission of instructor.

GEO 583: Groundwater Modeling (Fall) (NS or Q)

LEC: (3 crs.) Numerical modeling of ground-water flow and solute transport. Numerical methods, model conceptualization, assumptions, boundary conditions, and complex aquifer systems. Modeling exercises including full-scale modeling project using MODFLOW. (Lec. 2, Lab. 3) Pre: GEO 483, or NRS 461 or CVE 588, or permission of instructor. Offered in odd-numbered years.

GEO 584: Environmental Hydrogeology (Spring) (NS)

LEC: (4 crs.) Cross-listed as (GEO), NRS, EVS, CVE 484. Physico-chemical principles and fundamental relationships that describe the fate and transport of contaminants in the hydrologic system. (Lec. 3, Lab. 2) Pre: GEO 483 or CVE 588 or NRS 510, or permission of instructor. Not for graduate credit. Offered every other year.

GEO 586: Readings in Hydrogeology (NS)

SEM: (1-3 crs.) Seminar in hydrogeology with readings drawn from the current professional literature. (Seminar) Pre: permission of instructor. S/U credit.

GEO 587: Environmental Hazards, Risks, Response, and Safety (Spring) (SS)

LEC: (3 crs.) Environmental, health, and safety regulations and requirements for working with hazardous materials and at hazardous waste site-related work sites. Emphasis on application of knowledge and skills needed to anticipate, recognize, evaluate, and determine controls for various hazards and risks that may be encountered at site investigations, at waste sites, and in the industrial workplace. Includes opportunity to earn OSHA 40-hour certification. (Lec. 3) Pre: Permission of instructor. Respirator clearance required prior to start of classes.

Marine Affairs (MAF)

MAF 413: Peoples of the Sea (Fall) (SS)

LEC: (3 crs.) Cross-listed as (APG), MAF 413. Examination of human sociocultural adaptation to the seas. (Lec. 3) Pre: APG 203 or MAF 100 or graduate status. Open only to juniors, seniors, and graduate students.

MAF 461: Coastal Zone Management (Spring) (SS)

LEC: (3 crs.) Examination of activities and management efforts in the coastal zone of both developed and developing countries and their impacts on the environment. Resolution of use conflicts. (Lec. 3)

MAF 465: GIS Applications in Coastal and Marine Management (Spring/Fall) (NS)

LEC: (3 crs.) The use of geographical information systems (GIS) technology in coastal and marine settings. Database acquisition and management are emphasized. Case application in coastal zone management, artificial habitat, and fisheries management. (Lec. 3)

MAF 471: Critical Island Studies (Spring) (SS)

LEC: (3 crs.) An ecosystem approach to the sustainable development and environmental management of mid-oceanic islands in the Caribbean and the Pacific Ocean. Topics include tourism, reef fishery, cultural heritage and marine conservation. Simulation game on island-wide management process. (Lec. 3)

MAF 472: Critical Studies of Tourism and Ecotourism (Fall) (SS)

SEM: (3 crs.) Cross listed as (MAF), APG 472. Analysis of domestic and international case studies emphasizing concepts and critical thinking around issues pertaining to coastal tourism, recreation, ecotourism, the history of tourism, and consumption. (Seminar)

MAF 475: Human Responses to Coastal Hazards and Disasters (Spring/Fall) (SS)

LEC: (3 crs.) Examines the impact of hazards and disasters on human population inhabiting the coastal zone. Sets human adaptations to coastal hazards and disasters in an historical context. Extracts lessons learned for comparative analysis. (Lec. 3)

MAF 482: Quantitative Methods in Marine Affairs (Spring/Fall even years) (Q)

LEC: (3 crs.) Introduction to descriptive and inferential statistics in geography and marine affairs. Emphasis on the spatial application of statistical tests with particular utility to the geographer and marine affairs students. (Lec. 3) Pre: STA 220 or equivalent for undergraduate students.

MAF 494: Cases in Marine Policy (Spring) (SS)

SEM: (3 crs.) A single, current problem drawn from areas such as coastal management, ports, or fisheries is examined through detailed analysis of alternatives and decision processes. (Seminar) Pre: permission of instructor or chairperson.

MAF 500: Social Studies of Science (Fall) (SS)

SEM: (3 crs.) Applies social science tools to the study of the practice of science (including ecology and marine science) as cultural phenomena. (Seminar) Pre: graduate standing.

MAF 502: Research Methods in Marine Affairs (Spring) (Q)

LEC: (3 crs.) Emphasis on the application of alternative research methods utilized in a typical interdisciplinary study. Development of specific research projects. (Lec. 3) Pre: MAF 482 or permission of instructor.

MAF 511: Ocean Uses and Marine Sciences (Fall) (SS)

LEC: (3 crs.) Introduction to selected ocean uses focusing on the interplay of public policy and marine science. Emphasis on policy implications of uses such as resource and energy extraction. (Lec. 3)

MAF 515: Marine Pollution Policy (Spring odd years) (SS)

LEC: (3 crs.) Introduction to management techniques for marine pollutants (biodegradable materials, nutrients, petroleum, metals, synthetic organics, radioactive materials, plastics, heat, and dredge spoils) with emphasis on strategies to limit environmental impacts. (Lec. 3) Pre: graduate standing only.

MAF 516: Seminar on the Urban Waterfront (Fall) (SS)

SEM: (3 crs.) Cross-listed as (MAF), CPL 516. The urban environment and its evolution, structure, and function as it pertains to metropolitan waterfronts and small recreational harbors. Emphasis on the permitting process, public participation, marine recreation, and management issues. Field trip and student project required. (Seminar)

MAF 521: Coastal Zone Law (Spring) (SS)

LEC: (3 crs.) Examination of the authority of different levels and agencies of government to make decisions affecting coastal regions. Survey of existing and proposed state and national legislation affecting coastal regions. (Lec. 3)

MAF 523: Fisheries Law and Management (Fall) (SS)

LEC: (3 crs.) Examination of the relationship between law and fisheries policy on the international and national levels, law relating to fisheries, jurisdictional levels, function of law in implementing fisheries management policy. (Lec. 3)

MAF 526: Management of Marine Protected Areas (Spring odd years) (SS)

LEC: (3 crs.) Examination of ecological, political, legal and social factors in establishing and managing marine protected areas. Case studies of MPA efforts highlight interrelationships among interest groups, institutions, and legislation. (Lec. 3)

MAF 530: Marine Environmental History (spring) (SS)

SEM: (3 crs.) Cross-listed with (MAF) HIS 530. Provides background on the history of human interactions with the marine environment with insight into historical methodologies. (Seminar) Pre: Graduate standing or permission of instructor.

MAF 531X: Environmental Justice (Fall) (SS)

Exploration of how race, class, gender, nationality, and ethnicity shape environmental inequalities. Topics include occupational health hazards, environmental social movements, public health concerns, and contested use of natural resources. (Sem. 3) Pre: graduate standing or permission of instructor. Enrollment Requirements: Pre: Graduate standing or permission of instructor (3 crs).

MAF 545: Environmental Thought and Behavior (Fall) (SS)

LEC: (3 crs.) Introduction to environmental behavior, including factors such as values, knowledge, risk perceptions, and social pressure. Attention is given to the role of attitudes and values in coastal and marine management. (Lec. 3) Pre: Graduate standing or permission of instructor.

MAF 564: Port Planning and Policy (Spring) (SS)

LEC: (3 crs.) Examination of U.S. and international port issues. Special emphasis on port stakeholders, role of ports in society, and climate change challenges. Field trips and guest speakers. (Lec. 3)

MAF 577: International Ocean Law (Fall) (SS)

LEC: (3 crs.) Cross-listed as (MAF), PSC 577. Principles of international law as they relate to ocean management problems. Jurisdiction in zones, such as territorial seas, exclusive economic zones, and the high seas will be examined, as well as the problems posed by zonal approaches to ocean-use management.

MAF 582: Coastal Ecosystem Governance (Spring) (SS)

SEM: (3 crs.) This course links human impacts on coastal environments with existing or proposed governance solutions. Management regimes for individual sectors, coastal regions, and land/estuarine ecosystems are introduced and compared. (Seminar)

Natural Resources Science (NRS)**NRS 402: Quantitative Wildlife Management (Spring) (Q)**

(3 crs.) Overview of statistical design and analysis of ecological field measurements with an emphasis on probabilistic models used in wildlife population research and conservation. Capstone. (Lec. 2, Lab. 3) Pre: BIO 262 or NRS 223, and STA 308 or 409, or permission of instructor.

NRS 404: Environmental Data Acquisition and Analysis (Fall) (Q)

(3 crs.) Cross-listed as (OCG), NRS, GEO 404. Introduction to instrument prototyping and measurements in environmental science. Hands-on with data collection: programming microcontrollers, interfacing hardware and software, wireless sensor networks. Data analysis in Python. (Lec. 2, Lab. 1) Pre: MTH 131 or MTH 141.

NRS 406: Wetland Wildlife Management (Spring) (NS)

LEC: (4 crs.) Introduction to management of wetland wildlife. Emphasis on management techniques used for major wetland types, waterfowl, furbearers and nongame wildlife. (Lec. 2, Lab 4) Pre: NRS 223 and permission of instructor.

NRS 407: Endangered Species Conservation (Spring) (SS or NS)

LEC: (3 crs.) Programs for the protection of species under the Endangered Species Act and global approaches to conservation of biodiversity in human-dominated landscapes. (Lec. 3) Pre: BIO 101 and NRS 100.

NRS 410: Fundamentals of GIS (Fall) (NS)

LAB: (3 crs.) Emphasis on using a geographic information system (GIS) to create a geographically referenced spatial database, spatial topology, data visualization, computer-assisted map making, and spatial data query and analysis. (Lab. 3, Online 2)

Pre: past or concurrent enrollment in NRS 409 or 509.

NRS 412: Soil-Water Chemistry (Spring) (NS)

LEC: (3 crs.) Biogeochemistry of soil-water interactions. Soil composition, the exchange and sorption of elements, trace element behavior, redox reactions and control of these factors on availability and loss. (Lec. 3) Pre: NRS 212 and CHM 124 and 126 or permission of instructor. In alternate years.

NRS 415: Remote Sensing of the Environment (Fall) (NS)

LEC: (3 crs.) Introduction to fundamentals of airborne and space-borne remote sensing. Emphasis on remote sensing applications in terrestrial environmental and natural resources studies. (Lec. 2, Lab. 2)

NRS 423: Wetland Ecology (Fall) (NS)

LEC: (4 crs.) Formation, development, and distinguishing features of inland and coastal wetlands. Topics include classification, geology, hydrology, soils, plant ecology, vegetation dynamics. Primary emphasis on wetlands of the glaciated Northeast. Capstone. (Lec. 2, Lab. 4) Pre: BIO 262, GEO 103, NRS 223, concurrent enrollment in NRS 425 or 525, and permission of instructor.

NRS 426: Soil Microbiology (Fall odd years) (NS)

LEC: (3 crs.) Occurrence, metabolism and ecology of soil microorganisms, with emphasis on nutrient cycling, soil pathogens, transformation of organic and inorganic pollutants, and soil biotechnology. (Lec 3) Pre: NRS 212 or permission of instructor.

NRS 450G: Soil Conservation and Land Use (Spring) (NS or SS)

LEC: (3 crs.) Application of soil survey interpretation as a tool in soil and water conservation and land use planning. Implications of soil properties and problems for land use considered with emphasis on urbanizing situations. Capstone. (Lec. 3) Pre: NRS 212 or permission of instructor.

NRS 452G: Soil, Water, and Land Use Investigations (Spring) (NS)

PRA: (1 cr.) Independent field and laboratory study of soil and water topics related to land use issues. (Practicum) Capstone. Pre: concurrent enrollment in NRS 450.

NRS 545: Invasive Species Research, Management, and Policy (SS)

LEC: (4 crs.) Overview of the major invasive alien species issues in the research, management, and policy arenas. Includes weekly field/lab sessions. (Lec. 3, Lab. 3) Pre: BIO 262 or NRS 223, or permission of instructor.

NRS 461: Watershed Hydrology and Management (Fall) (NS)

LEC: (4 crs.) Detailed study of the watershed processes that govern the hydrology and quality of surface water. Emphasis on methods and analyses employed for watershed management. (Lec. 3, Lab. 3) Pre: NRS 212, STA 308 or 409 or permission of instructor.

NRS 471: Soil Morphology and Mapping (Fall) (NS)

LEC: (4 crs.) A detailed study of the morphological properties of soils and their distribution on the landscape. Practical experience in describing soil profiles and preparing soil maps. (Lec. 2, Lab. 4)

NRS 501: Foundations of Restoration Ecology (Fall odd years) (NS)

LEC: (4 crs.) Overview of factors involved with implementing an ecological restoration. Will synthesize the physical, biological and human factors that determine restoration success. Includes weekly field/lab sessions. (Lec. 3/Lab. 3) Pre: NRS 223 or BIO 262, or permission of instructor.

NRS 505: Biology and Management of Migratory Birds (Spring even yrs) (NS)

SEM: (2 crs.) Current programs, problems, and techniques for managing migratory game and nongame birds. Emphasis on basic biology of the species, habitat management, and harvest management. (Seminar) Pre: NRS 305 or permission of instructor. In alternate years.

NRS 509: Concepts of GIS and Remote Sensing in Environmental Science (Fall) (NS)

LEC: (4 crs.) Unique properties of geospatial data, accessing existing GIS and remote sensing data, and applications of GIS and remote sensing in the environmental sciences. Uses in ecology, conservation, soil science, geohydrology, and conservation biology. (Lec. 3, Rec. 1) Pre: graduate standing or permission of instructor.

NRS 516: Remote Sensing in Natural Resources Mapping (Spring) (NS)

LEC: (3 crs.) Digital remote sensing in environmental and natural resource studies. Emphasis on satellite remote sensing image rectification, georeferencing, classification, and integration with GIS. (Lec. 2, Lab. 2) Pre: NRS 415 or permission of instructor.

NRS 517: Herpetology (Spring) (NS)

LEC: (4 crs.) Cross-listed as (NRS), BIO 517. This course provides an in-depth background on the biology, ecology, conservation, and management of reptiles and amphibians, including field methods for studying amphibians and reptiles of northeastern North America. (Lec. 2, Lab. 4) Pre: graduate student in biological and environmental sciences and permission of instructor.

NRS 518: Ecohydrology (Spring) (NS)

LEC: (3 crs.) Relationships between hydrology and the diversity, structure, and function of ecosystems. Topics include methods of study; interaction of watershed dynamics and flow regimes upon wetlands and fluvial systems. (Lec. 3) Pre: NRS 361 or NRS 461 or permission of instructor.

NRS 519: Field Experience in Herpetology (Spring) (NS)

Field: (1 cr.) Cross-listed as (NRS), BIO 419. Capstone field trip in herpetology to region with higher amphibian and reptile diversity, such as Appalachia, to hone skills in identification, broaden understanding of ecology, and apply field research methods. (Practicum) Pre: concurrent enrollment in or credit for NRS/BIO 417, and permission of instructor. S/U only. Not for graduate credit.

NRS 522: Advanced GIS Analysis of Environmental Data (Spring) (NS)

LEC: (3 crs.) Discussion and application of terrain modeling, spatial statistics, proximity analysis, remote sensing/GIS linkages, and environmental data integration. Emphasis on ecological data at watershed/landscape scales. Capstone. (Lec. 1, Lab. 6) Pre: NRS 410 or permission of instructor.

NRS 524: Application of Advanced Spatial Analysis (Spring even yrs) (NS)

PRA: (1 cr.) Independent application of spatial data analysis to derive solutions to environmental problems, with emphasis on GIS data integration, vector and raster modeling, and visualization of analytical and quantitative results. Capstone. (Practicum) Pre: concurrent enrollment in NRS 522.

NRS 533: Landscape Pattern and Change (Fall) (Q)

LEC: (3 crs.) Remote sensing perspective of landscape characterization; landscape dynamics; spatiotemporal land-use and land-cover change; modeling and analysis of landscape by integration of remote sensing, GIS, GPS, and in situ data. (Lec. 2, Lab. 2) Pre: NRS 415 or permission of instructor.

NRS 534: Ecology of Fragmented Landscapes (Spring) (NS)

LEC: (2 crs.) Presentation of the concepts of landscape ecology with emphasis on populations of plants and animals in fragmented habitats. Topics discussed include habitat corridors, fluxes of energy and species along habitat edges, shape analysis, and stability of populations in habitat patches. (Lec. 2) Pre: BIO 262 or permission of instructor. In alternate years.

NRS 535: Geospatial Watershed Modeling (Spring) (NS)

LEC: (3 crs.) Cross-listed with (GEO) NRS, CVE 535. Tools to simulate the water quantity and quality of a complex watershed; development of models for examining the water quantity and quality issues that are associated with watershed management. (Lec. 2, Lab. 2) Pre: NRS 461 or GEO 483 or CVE 475 or equivalent, or graduate standing, or permission of instructor.

NRS 542: Environmental Crisis Communication (Fall) (SS)

LEC: (3 crs.) Effective communication requires strategy, clarity, and an audience-centric approach. Using case studies, this course explores crisis communication theory and practice through the lens of recent environmental disasters. (Lec. 3)

NRS 543: Public Engagement with Science (Spring) (SS)

LEC: (3 crs.) Theoretical and practical aspects of public engagement with science, policy, and management, with an emphasis on communication. (Lec. 3) Pre: Graduate Standing or permission of instructor.

NRS 555: Applied Coastal Ecology (Spring odd yrs) (NS or SS)

LEC: (2 crs.) Resource management problems in coastal national parks. Topics include air and water pollution, barrier island erosion, deer overpopulation, Lyme disease, and ecosystem restoration. Examples of conflicting land-management mandates and research needs discussed. Optional field trips. (Lec. 2) Pre: advanced course work or experience in topical fields or permission of instructor. Offered in even- numbered years.

NRS 568: Visualizing Environmental Rhetoric (Spring) (SS)

LEC: (3 crs.) Visual media played a pivotal role in the emergence of the American environmental movements of the 1970s and 80s. Photographs of the earth from space, images of the surface of the earth, and visualizations of the ozone hole all helped catalyze a public environmental imagination. Today, visualizations are central to public engagement

with science and they offer important ways to make environmental issues visible to the public.

NRS 657: Soil Genesis and Classification (Spring odd years) (NS)

(3 crs.) Development of soils as influenced by physical, chemical, biological, and climatic factors. Processes of soil formation presented relative to soil taxonomy and geographic distribution. (Lec. 3) Pre: NRS 471 or permission of instructor.

NRS 591: Special Problems (Spring or Fall) (SS or NS)

IND: (1-3 crs.) Advanced independent research projects supervised by members of the research staff and unrelated to Master's or Doctoral research. Projects developed to meet individual needs. (Independent Study) Pre: permission of chairperson.

NRS 592: Special Problems (Spring or Fall) (SS or NS)

IND: (1-3 crs.) Advanced independent research projects supervised by members of the research staff and unrelated to Master's or Doctoral research. Projects developed to meet individual needs. (Independent Study) Pre: permission of chairperson.

Oceanography (OCG)

OCG 512: Ocean Waves and Storm Surge Modeling (Spring even yrs) (NS)

(3 crs.) Cross-listed as (OCG), OCE 512. Wind wave generation, evolution, and dissipation. Statistical description of surface waves. Interaction between waves and currents. Wave prediction models. Observational methods of waves. Storm surge models and prediction. (Lec. 3) Pre: OCE 408 or equivalent, or permission of instructor. Enrollment Requirements: OCE 408 or equivalent, or permission of instructor.

OCG 513: Ocean Renewable Energy (Fall) (NS)

LEC: (3 crs.) Cross-listed as (OCE), OCG 513. Introductory topics related to global ocean renewable energy, including fundamentals of hydrokinetic, tidal, and wave energy, leading energy devices, and more advanced topics including resource assessment and environmental interactions. (Lec. 3) Pre: MCE 354 or permission of instructor.

OCG 533 Graduate Writing in Marine and Environmental Sciences (Fall) (SS)

LEC: (3 crs.) Graduate writing in marine and environmental sciences; writing and editing journal articles and abstracts; principles and practice in scientific writing. Pre: graduate standing and WRT 104 or 106, or permission of instructor.

Statistics (STA)

STA 409: Statistical Methods in Research I (Spring/Fall) (Q)

(3 crs.) Same as STA 308, but is for students who have better mathematical preparation. (Lec. 3) Pre: MTH 131 or 141. Not open to students with credit in STA 307 or 308.

STA 412: Statistical Methods in Research II (Spring/Fall) (Q)

(3 crs.) Multiple linear regression and correlation analysis, curvilinear regression. Analysis of variance and covariance. Analysis of enumerative data. Some nonparametric methods. (Lec. 3) Pre: STA 307 or 308 or 409.

STA 532: Experimental Design (Fall) (Q)

LEC: (3 crs.) Cross-listed as (STA), PSY, AFS 532. Application of statistical methods to biological and psychological research and experimentation. Experimental situations for which various ANOVA and ANCOVA designs are most suitable. (Lec. 3) Pre: STA 409 or equivalent.

STA 550: Ecological Statistics (Fall-alternate years) (Q)

LEC: (3 crs.) Application of statistical methodology to the following topics: population growth, interactions of populations, sampling and modeling of ecological populations, spatial patterns, species abundance relations, and ecological diversity and measurement. (Lec. 3) Pre: STA 409 or permission of instructor.

Sustainability (SUS)**SUS 460: Environmental Communication: Local & Global (Fall) (SS)**

LEC: (3 crs.) Cross-listed as (COM) SUS 460. Address local and global environmental issues through communication. Target key audiences and move them towards sustainable change and active involvement, improved environmental conditions and quality of life. (Lec. 1, Seminar 2) Pre: junior standing. (C1) (B4)

Writing (WRT)**WRT 533: Seminar in Graduate Writing in the Life Sciences (Fall) (SS)**

(3 crs.) Seminar in graduate writing in life sciences; analyzing and writing journal articles, proposals, popular press; rhetorical analysis of scientific writing. (Seminar) Pre: WRT 104 or 106 or equivalent, or permission of instructor; graduate standing or senior status. Enrollment Requirements: WRT 104 or 106 or equivalent, or permission of instructor; graduate standing or senior status.