Environmental Conservation Graduate Program

*Forest Resources and Arboriculture Concentration*

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**A. Concentration Description**

This concentration leads to both Master of Science (MS) and Doctor of Philosophy (PhD) degrees in Environmental Conservation (ECo) and is designed for students who want scientific training in the multi-disciplinary fields of forestry and arboriculture. The focus of this concentration is broadly on forests and trees in urban, rural, and wildland ecosystems, and encompasses specialized training in fields such as forest ecology and management, urban forestry and arboriculture, and forest policy and land conservation.

Faculty affiliated with this concentration (see below) have expertise in management of forests for watershed protection, wildlife habitat, timber production, and carbon sequestration; landscape and ecosystem ecology; forest policy and the social and economic aspects of forest ownership; development of urban forestry programs; control of non-native insect and disease infestations in trees in urban areas; forest ecology related to climate change; geographic information systems and remote sensing; and the control of invasive plant species. A major strength of our program is the unique convergence of Universities, federal and state agencies in Amherst, unmatched in the Northeast. A series of cooperative agreements and other collaborations provide a strong base of research funding. These agreements also provide important teaching and research relationships between our program and

ECo students often conduct field research on forest ecology and management issues, such as this study on old-growth forest in Massachusetts.

ECo students often conduct studies on urban forestry issues, such as this study on the impacts of the Asian longhorn beetle outbreak in Worcester Massachusetts.
governmental natural resource agencies. Much of the forest and tree research conducted in the Forestry and Arboriculture Concentration focuses on Massachusetts and the New England region, but graduate students also work in places such as Colorado, Peru, and Mexico. There are approximately 15 graduate students in the Forest Resources and Arboriculture Concentration. Through their research projects, graduate students often employ or provide volunteer opportunities for interested undergraduates (about 40 undergraduates are in the Forest Ecology and Conservation and Urban Forestry and Arboriculture concentrations within the Natural Resources Conservation major). Graduate students are encouraged to participate in projects and activities of their colleagues to broaden their experience and to provide and receive ideas and suggestions for improvements.

At the MS level, students have the option of pursuing either a professional degree or thesis degree. The thesis/dissertation degree leads to the MS or PhD degree and centers around the completion of a major independent research project in addition to a modest coursework requirement. The professional degree leads to the MS degree and centers around a professional paper based on an internship/practicum in addition to a more substantial coursework requirement. Both degree options provide students a strong foundation in three core topic areas: environmental science (biology, ecology, conservation and environmental building systems), 2) quantitative science (statistics, GIS and modeling), and 3) human dimensions (environmental policies, economics, politics, administration, management and values). The MS thesis degree is intended to prepare students for the option of pursuing a PhD or a career in conservation science. The MS professional degree is meant to be a terminal degree for students seeking graduate-level training in a particular field of study and a career as a professional conservation scientist. Overall, the academic requirements of this concentration in combination with the research/practicum experience provide students the professional training for conservation science positions within academia, state and federal resource management agencies, non-governmental conservation organizations, and private industry (e.g., environmental consulting firms). In addition, MS thesis degree students completing this program are well prepared to meet the challenges of any PhD program.
B. The MS Professional Degree

Prerequisites

Candidates for an MS professional degree in this concentration will be admitted on the basis of their academic training, work experience, and letters of recommendation. The field of forestry and arboriculture is so broad that graduate students come from a wide range of undergraduate programs and employment positions. Prospective students should contact a faculty member in this concentration to discuss their backgrounds and interests.

Candidates will be expected to possess a Bachelor’s degree in:

- a natural resources, environmental sciences, or biological sciences field; or
- any field with a strong background in mathematics and biological, physical, or social sciences, and experience working in natural resources.

Note, prerequisites exist for many of the required courses. Students are expected to have satisfied these prerequisites prior to commencing the program or in addition to the curriculum requirements outlined below.

Requirements

Students in this concentration are expected to meet all of the requirements for an MS degree in ECo, as outlined in the student handbook, including the following:

1. A minimum of 35 credits is required, 21 of which must be in the major (defined broadly), 8 of which must be at the 600 level or above, and 6 of which must be an internship/practicum specific to this concentration and approved by the student’s advisory committee; up to 6 graduate credits can be transferred from previous course work from UMass or another university;
2. Successful completion of a comprehensive exam based upon the student’s academic training in environmental conservation, encompassing three “core” topic areas (environmental science, quantitative science, and human dimensions) in addition to the required ECo core courses; and
3. Successful final defense of a publishable-quality professional paper resulting from the internship/practicum.

Curriculum

Note, all courses ending in 97 have an additional letter designation (e.g., 697A) not specified below because it is subject to change; check SPIRE online for the current course number listing.

1. Required Core Courses (8 credits) (take all of the following)
2. Core Topic Areas (21 credits) (including a minimum of one 500-level or above 3-4 credit course in each core topic area below, plus a minimum of three additional courses, as approved by student's committee; note, students may take courses other than those listed here to fulfill the core topic area requirements if they are approved by the students advisory committee and the Graduate Concentration Coordinator; course numbers are subject to change)

a. Environmental Science (take one or more of the following)

- NRC 521 Timber harvesting (spr even yrs, 3)
- NRC 526 Silviculture (fall even yrs, 4)
- NRC 528 Forest & wetland hydrology (fall odd yrs, 3cr)
- NRC 540 Forest resource management (spr even yrs, 4 cr)
- NRC 564 Wildlife habitat management (fall, 4cr)
- NRC 571 Fisheries science & management (fall even yrs, 4cr)
- NRC 597 Aquatic ecology (spr odd yrs, 3cr)
- NRC 597 Conservation genetics (fall, 4 cr)
- ECO 604 Forest stand dynamics (spr odd yrs, 3 cr)
- ECO 621 Landscape ecology (spr even yrs, 4cr)
- ECO 697 Conservation biology (fall odd yrs, 3cr)
- ECO 697 Urban ecology (fall, 4cr)
- ECO 697 Applied conservation genetics (fall even yrs, 4cr)
- ENTOMOL 572 Insects & diseases of forests & shade trees (spr odd yrs, 3cr)
- PLSOIL 505 General plant pathology (fall, 4cr)
- PLSOIL 510 Management & ecology of plant diseases (spr, 3cr)
- PLSOIL 555 Urban plant biology (fall, 3cr)
- PLSOIL 566 Soil formation, classification, & land use (spr odd yrs, 3 cr)
- PLSOIL 590A Plant stress physiology (fall, 3cr)
- LANDARCH 592A Plants in the Landscape (fall, 4 cr)

b. Quantitative Science (take one or more of the following)

- BCT 530 Mechanics of building materials (spr, 3 cr)
- NRC 577 Ecosystem modeling & simulation (fall odd yrs, 3cr)
- NRC 587 Digital remote sensing (spr odd yrs, 3cr)
- NRC 592 GIS for natural resource management (both, 3cr)
- ECO 697 Multivariate statistics for environmental cons. (spr odd yrs, 4cr)
- ECO 697 Advanced topics in GIS (fall odd yrs, 3cr)
- ECO 697 Intermediate statistics for environmental cons. (spr, 4cr)
- ECO 697 Advanced statistics for environmental cons. (fall even yrs, 4cr)
- ECO 697 Analysis of environmental data - lab (fall, 2cr)
ECO 777  Advanced systems ecology (spr even yrs, 3 cr)
GEO-SCI 595A  Advanced GIS (spr, 3 cr)
PLSOIL 661  Intermediate biometry (fall, 3 cr)

c. Human Dimensions (take one or more of the following courses)

NRC 697  Water resources management & policy (fall even yrs, 3 cr)
ECO 697  Federal environmental law & regulation (spr even yrs, 3 cr)
ECO 697  Human dimensions of natural res. cons. (tbd, 3 cr)
ECO 697  Natural resources policy & administration (tbd, 3 cr)
REGIONPL 553  Resource policy & planning (spr even yrs, 3 cr)
REGIONPL 575  Environmental law & resource management (tbd, 3 cr)
RES-ECON 720  Environmental & resource economics (fall even yrs, 3 cr)
RES-ECON 721  Advanced natural resource economics (fall, 3 cr)
GEO-SCI 666  Water resource policy (tbd, 3 cr)
POLSCI 784  Environmental policy (tbd, 3 cr)
ENVDES 574  City planning (fall, 3 cr)
LANDARCH 691E  People & the environment (fall, 2-3 cr)

3. Practicum (6 credits)

ECO 698  Practicum

All students in the MS professional degree option are required to complete at least a 3-month long professional internship or equivalent. There are numerous internship opportunities with state and federal resource management agencies (e.g., MA Department of Conservation and Recreation, MA Division of Fisheries and Wildlife, U.S. Forest Service), nonprofit organizations (e.g. The Nature Conservancy and land trusts), and many other organizations. The advisory committee and the concentration coordinator may exempt some students with prior professional experience from this internship requirement. Each student will develop a publishable professional paper (based on the practicum) and defend it to their examination committee.

C. The MS Thesis Degree

Prerequisites

Candidates for an MS thesis degree in this concentration will be admitted on the basis of their academic training, work experience, and letters of recommendation. The field of forestry and arboriculture is so broad that graduate students come from a wide range of undergraduate programs and employment positions. Prospective students should contact a faculty member in this concentration to discuss their backgrounds and interests.

Candidates will be expected to possess a Bachelor’s degree in:
• a natural resources, environmental sciences, or biological sciences field; or
• any field with strong background in mathematics and the biological and physical sciences, and experience working in natural resources.

Note, prerequisites exist for many of the required courses. Students are expected to have satisfied these prerequisites prior to commencing the program or in addition to the curriculum requirements outlined below.

Requirements

Students in this concentration are expected to meet all of the requirements for an MS degree in ECo, as outlined in the student handbook, including the following:

1) A minimum of 35 credits is required, 21 of which must be in the major (defined broadly), 8 of which must be at the 600 level or above, and 12 of which must be a thesis specific to this concentration and approved by the student's advisory committee; up to 6 graduate credits can be transferred from previous course work from UMass or another university;

2) Successful completion of a comprehensive exam based upon the student’s academic training in environmental conservation, encompassing three “core” topic areas (environmental science, quantitative science, and human dimensions) in addition to the required ECo core courses;

3) Successful final defense of the thesis; and

4) A minimum of one publishable-quality scientific paper resulting from the thesis research project.

Curriculum

Note, all courses ending in 97 have an additional letter designation (e.g., 697A) not specified below because it is subject to change; check SPIRE online for the current course number listing.

1. Required Core Courses (8 credits) (take all of the following)

   ECO 601 Research concepts (fall, 3cr)
   ECO 697 Analysis of environmental data - lecture (fall, 3cr)
   ECO 791A Communicating science (spr, 1cr)
   ECO 691A Current research in environmental conservation (both, 1cr)

2. Core Topic Areas (15 credits) (including a minimum of one 500-level or above 3-4 credit course in each core topic area below, as approved by the students advisory committee; note, students may take courses other than those listed here to fulfill the core topic area requirements if they are approved by the students advisory committee and the Graduate Concentration Coordinator; course numbers are subject to change)
## a. Environmental Science (take one or more of the following)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Term</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRC 521</td>
<td>Timber harvesting</td>
<td>spr even yrs</td>
<td>3</td>
</tr>
<tr>
<td>NRC 526</td>
<td>Silviculture</td>
<td>fall even yrs</td>
<td>4</td>
</tr>
<tr>
<td>NRC 528</td>
<td>Forest &amp; wetland hydrology</td>
<td>fall odd yrs</td>
<td>3 cr</td>
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<tr>
<td>NRC 540</td>
<td>Forest resource management</td>
<td>spr even yrs</td>
<td>4 cr</td>
</tr>
<tr>
<td>NRC 564</td>
<td>Wildlife habitat management</td>
<td>fall</td>
<td>4 cr</td>
</tr>
<tr>
<td>NRC 571</td>
<td>Fisheries science &amp; management</td>
<td>fall even yrs</td>
<td>4 cr</td>
</tr>
<tr>
<td>NRC 597</td>
<td>Aquatic ecology</td>
<td>spr odd yrs</td>
<td>3 cr</td>
</tr>
<tr>
<td>NRC 597</td>
<td>Conservation genetics</td>
<td>fall</td>
<td>4 cr</td>
</tr>
<tr>
<td>ECO 604</td>
<td>Forest stand dynamics</td>
<td>spr odd yrs</td>
<td>3 cr</td>
</tr>
<tr>
<td>ECO 621</td>
<td>Landscape ecology</td>
<td>spr even yrs</td>
<td>4 cr</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Conservation biology</td>
<td>fall odd yrs</td>
<td>3 cr</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Urban ecology</td>
<td>fall</td>
<td>4 cr</td>
</tr>
<tr>
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<td>4 cr</td>
</tr>
<tr>
<td>ENTOMOL 572</td>
<td>Insects &amp; diseases of forests &amp; shade trees</td>
<td>spr yrs</td>
<td>3 cr</td>
</tr>
<tr>
<td>PLSOIL 505</td>
<td>General plant pathology</td>
<td>fall</td>
<td>4 cr</td>
</tr>
<tr>
<td>PLSOIL 510</td>
<td>Management &amp; ecology of plant diseases</td>
<td>spr</td>
<td>3 cr</td>
</tr>
<tr>
<td>PLSOIL 555</td>
<td>Urban environment &amp; plant growth</td>
<td>fall</td>
<td>3 cr</td>
</tr>
<tr>
<td>PLSOIL 566</td>
<td>Soil formation, classification, &amp; land use</td>
<td>spr odd yrs</td>
<td>3 cr</td>
</tr>
<tr>
<td>PLSOIL 590A</td>
<td>Plant stress physiology</td>
<td>fall</td>
<td>3 cr</td>
</tr>
<tr>
<td>LANDARCH 592A</td>
<td>Plants in the landscape</td>
<td>fall</td>
<td>4 cr</td>
</tr>
</tbody>
</table>

## b. Quantitative Science (take one or more of the following)

<table>
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</thead>
<tbody>
<tr>
<td>BCT 530</td>
<td>Mechanics of building materials</td>
<td>spr</td>
<td>3 cr</td>
</tr>
<tr>
<td>NRC 577</td>
<td>Ecosystem modeling &amp; simulation</td>
<td>fall odd yrs</td>
<td>3 cr</td>
</tr>
<tr>
<td>NRC 587</td>
<td>Digital remote sensing</td>
<td>spr odd yrs</td>
<td>3 cr</td>
</tr>
<tr>
<td>NRC 592</td>
<td>GIS for natural resource management</td>
<td>both</td>
<td>3 cr</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Multivariate statistics for environmental cons.</td>
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<td>4 cr</td>
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<tr>
<td>ECO 697</td>
<td>Advanced topics in GIS</td>
<td>fall odd yrs</td>
<td>3 cr</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Intermediate statistics for environmental cons.</td>
<td>spr</td>
<td>4 cr</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Advanced statistics for environmental cons.</td>
<td>fall even yrs</td>
<td>4 cr</td>
</tr>
<tr>
<td>ECO 777</td>
<td>Analysis of environmental data - lab</td>
<td>fall</td>
<td>2 cr</td>
</tr>
<tr>
<td>GEO-SCI 595A</td>
<td>Advanced systems ecology</td>
<td>spr even yrs</td>
<td>3 cr</td>
</tr>
<tr>
<td>PLSOIL 661</td>
<td>Intermediate biometry</td>
<td>fall</td>
<td>3 cr</td>
</tr>
</tbody>
</table>

## c. Human Dimensions (take one or more of the following courses)

<table>
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<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRC 597</td>
<td>Water resources management &amp; policy</td>
<td>fall even yrs</td>
<td>3 cr</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Federal environmental law &amp; regulation</td>
<td>spr even yrs</td>
<td>3 cr</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Human dimensions of natural res. cons. (tbd, 3 cr)</td>
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</tr>
<tr>
<td>ECO 697</td>
<td>Natural resources policy &amp; administration</td>
<td>tbd</td>
<td>3 cr</td>
</tr>
<tr>
<td>REGIONPL 553</td>
<td>Resource policy &amp; planning</td>
<td>spr even yrs</td>
<td>3 cr</td>
</tr>
</tbody>
</table>
REGIONPL 575  Environmental law & resource management (tbd, 3 cr)
RES-ECON 720  Environmental & resource economics (fall even yrs, 3 cr)
RES-ECON 721  Advanced natural resource economics (fall, 3 cr)
GEO-SCI 666  Water resource policy (tbd, 3 cr)
POLSCI 784  Environmental policy (tbd, 3 cr)
ENVDES 574  City planning (fall, 3cr)
LANDARCH 691E  People & the environment (fall, 2-3cr)

3. Thesis (12 credits)
    ECO 699  Thesis

D. The PhD Degree

Prerequisites

Candidates for a PhD degree in this concentration will be admitted on the basis of their academic training, work experience, and letters of recommendation.

Candidates will be expected to possess a Master’s degree in:

- a natural resources field or environmental sciences; or
- the biological sciences with an emphasis in ecology; or
- any field with strong background in mathematics and the biological and physical sciences, and professional experience working as a natural resources professional.

*Note, students wishing to pursue a PhD with only a BS degree must enroll in the MS degree program and successfully complete the requirements of the MS degree before being admitted into the PhD program.

Requirements

Students in this concentration are expected to meet all of the requirements for a PhD degree in ECo, as outlined in the student handbook, including the following:

1) A minimum of 18 dissertation credits is required, based on a research project specific to this concentration and approved by the student’s advisory committee; no other course credits are required other than those determined by the student’s advisory committee;
2) Successful completion of a comprehensive exam based upon the student’s academic training in environmental conservation, encompassing three “core” topic areas (environmental science, quantitative science, and human dimensions);
3) Successful final defense of the dissertation; and
4) A minimum of three publishable-quality scientific papers resulting from the dissertation research project.
E. Resources & Facilities

Two University forests (totaling 2,000 acres), the 800-acre Swift River Wildlife Management Area of the Massachusetts Division of Fisheries and Wildlife, and the 81,000-acre Quabbin Reservation of the Massachusetts Department of Conservation and Recreation offer unique field study areas close to campus. A research group of the U.S. Forest Service (the Center for Research on Ecosystem Change) is located in Holdsworth Hall and is actively involved in this concentration. In addition, the departmental facilities include research laboratories with state-of-the-art equipment for testing wood performance. Further, concentration faculty conduct research in a variety of sites outside Massachusetts, including overseas.

F. Matriculation & Financial Aid

This program typically takes a full-time MS professional degree student 3-4 semesters to complete, a full-time MS thesis degree student 4-5 semesters to complete, and a full-time PhD student 8-10 semesters to complete, including the completion of a practicum/thesis/dissertation. However, some students may be able to complete the degree in less time and some take longer depending on their academic preparedness and the dictates of the practicum or thesis/dissertation research project.

Funding opportunities are limited, yet financial assistance is provided to virtually all of our MS thesis and PhD students through teaching or research assistantships (at Graduate Employee Organization bargained wage rates), University fellowships, or hourly wages. Tuition is waived during semesters in which at least a 10-hour assistantship or fellowship is awarded, but the student is responsible for most fees. Research assistantships are available through faculty members who have grant-supported research, and many faculty only accept students if they are able to provide grant-supported assistantships. Limited University fellowships are awarded by the Graduate School in open competition for those (including foreign applicants) who are endorsed by the Department.

Funding opportunities are more limited for students in the MS professional degree option. Some teaching assistantships and University fellowships may be available, or internship institutions may be able to provide some assistance, but most professional degree students are self-
funded. Again, tuition is waived during semesters in which at least a 10-hour assistantship or fellowship is awarded (or the equivalent from an internship employer), but the student is responsible for most fees.

G. Concentration Coordinator & Faculty Affiliates

The following on-campus faculty (both regular and adjuncts) and professional staff, including the Graduate Concentration Coordinator, are principally affiliated with this concentration and regularly serve in the role of the student’s advisory committee chair or member and instructor for core courses; other faculty and staff are occasionally involved in this concentration. See Departmental website for information about the faculty and staff (http://eco.umass.edu/index.php/people/).

**Graduate Concentration Coordinator:**

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